15 MHz Dual trace oscilloscope
PM 3206

Service Manual

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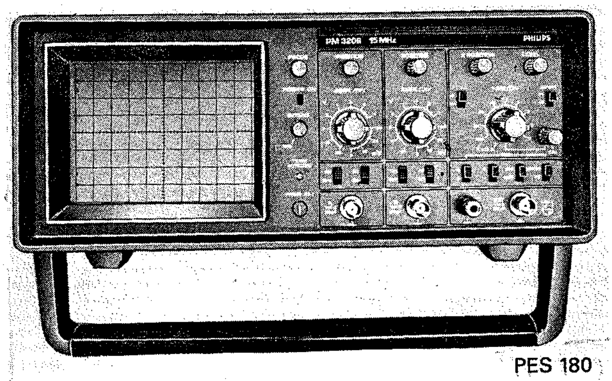
860101/1/02



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IMPORTANT

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

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

PHILIPS' EXPORT B.V. - EINDHOVEN - THE NETHERLANDS 1986

CONTENTS

LIST OF FIGURES

1. GENERAL INFORMATION

Read these pages carefully before installation and use of the instrument.

The following clauses contain information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.
Adjustment, maintenance and repair of the instrument shall be carried out only by qualified personnel.

1.1. Safety Precautions

For the correct and safe use of this instrument it is essential that both operating and servicing personnel follow generally-accepted safety procedures in addition to the safety precautions specified in this manual.
Specific warning and caution statements, where they apply, will be found throughout the manual.
Where necessary, the warning and caution statements and/or symbols are marked on the apparatus.

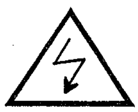
1.2. Caution and Warning Statements

CAUTION : *is used to indicate correct operating or maintenance procedures in order to prevent damage to or destruction of the equipment or other property.*

WARNING : calls attention to a potential danger that requires correct procedures or practices in order to prevent personal injury.

1.3. Symbols

High voltage 1000 V (red)



Live part (black/yellow)

Read the operating instructions (black/yellow)

Protective earth (grounding) terminal (black)

1.4. Impaired Safety-Protection

Whenever it is likely that safety-protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation. The matter should then be referred to qualified technicians.
Safety protection is likely to be impaired if, for example, the instrument fails to perform the intended measurements or shows visible damage.

1.5. General Clauses

1.5.1. **WARNING : The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to life.**

1.5.2. The instrument shall be diconnected from all voltage sources before it is opened.

1.5.3. Bear in mind that capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

1.5.4. **WARNING : Any interruption of the protective earth conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

1.6. CHARACTERISTICS

A. Performance Characteristics

- Properties expressed in numerical values with stated tolerance are guaranteed by PHILIPS. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.

  This specification is valid after the instrument has warmed up for 15 minutes (reference temperature 23°C).

B. Safety Characteristics

This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, and has been supplied in a safe condition.

C. Initial Characteristics

- Overall dimensions:
  - Height : 142 mm
  - Width (including handle) : 378 mm
  - Depth : 348 mm
- Maximum weight (Mass) : 5 kg
- Operation position
  - a) horizontally on bottom feet
  - b) vertically on rear feet
  - c) one fixed tilted position between a) and b)

1.6.1 C.R.T.

Type	:	150 BTB 31 rectangular tube with 2KV accelerating voltage
Screen type	:	P 31 phosphor standard
Useful screen area	:	8 x 10 div of 1 cm
Graticule	:	Internal graticule with Centimeter division and 2 mm divisions along the central axes.

1.6.2. VERTICAL OR Y-AXIS

Response	:	DC : 0 Hz ... 15 MHz (-3dB) AC : 10 Hz ... 15 MHz (-3dB)
Risetime	:	23 ns approximately
Deflection coefficient	:	5 mV ... 20V/div. calibrated steps, 1-2-5 sequence.
Accuracy	:	± 5%
Display modes	:	A B A & B in chopped or alternate mode
Input impedance	:	1 M Ω // 35 pF
Input coupling	:	AC, DC
Maximum rated input voltage	:	400 V (dc + ac peak) test voltage 570V(rms) 50 Hz during 1 min according to IEC 348

1.6.3. HORIZONTAL OR X-AXIS

Horizontal display modes	:	- Time base - X-Y operation with X deflection via A-input

1.6.4. HORIZONTAL AMPLIFIER

Response	:	DC : 0 Hz ... 1 MHz (-3dB)
Deflection coefficients	:	See Y-axes
Phase error	:	3° at 10 kHz

1.6.5. TIME BASE

Time coefficients	:	0.2s/div. 0.5µs/div.in 2 x 9 calibrated steps in 1-2-5 sequence. Variable sweep rate facility at any time/div setting. X 5 magnifier extends max. sweep rate to 100ns/div
Accurancy	:	± 5% Additional error for magnifier: ± 2%

1.6.6. TRIGERRING

Trigger source	:	Internal : A or B External
Trigger coupling	:	Normal (AC Coupled) TV
Slope	:	+ or -
Trigger sensitivity	:	Internal : 1 div. at 100 kHz External : 0.75V at 100 kHz
Trigger level range	:	± 8 div.
External trigger input impedence	:	1 M Ω // 35pF
Max. rated input voltage	:	400V (dc + ac peak) test voltage 570 V(rms) 50 Hz during 1 min according to IEC348

1.6.7. Z-MOD INPUT

Trace blanking	:	TTL High blanks trace. OV or not connected no trace blanking.
Max. rated input voltage	:	+ 25V and - 10V.

1.6.8. CALIBRATION

Signal available for probe adjustment

1.6.9. POWER

Line voltage (ac) and freq	:	: 108...132V, 45...66Hz 198...242V, 45...66 Hz 216...264V, 45...66 Hz
Power consumption	:	28VA maximum. The insulation between PM 3206 and line fulfills the safety requirements of IEC 348 for Class I instruments.

1.6.10. ENVIRONMENTAL CAPABILITIES

The environmental data are valid only if the instrument is checked in accordance with official checking procedure. Details on these procedures and failures criteria are supplied on request by PHILIPS Organisation in your country or by PHILIPS, scientific & Industrial Equipment Division, Eindhoven, The Netherlands.

Ambient temperature	:	Rated range of use : 5°C...+40°C Limits for operating: -10°C...+55°C Storage and transport: -40°C...+70°C
Altitude	:	Operating: to 5000m (15000 ft) Non-operating: to 15000m (45000 ft)
Humidity	:	In accordance with IEC 68 Db
Shock	:	300m/s^2(30g): half sine wave shock of 11ms. duration: 3 shocks per direction for a total of 12 shocks.
Vibration	:	30m/s^2(3g)vibrations in three directions with a maximum of 15 min. per direction; 10 mins. with a frequency of 15-25 Hz and a peak-peak altitude of 1 mm. Unit mounted on vibration table without shock absorbing material.
Recovery time	:	Operates within 60 min. coming from - 10°C soak, going into 60% relative humidity at +20°C room conditions.

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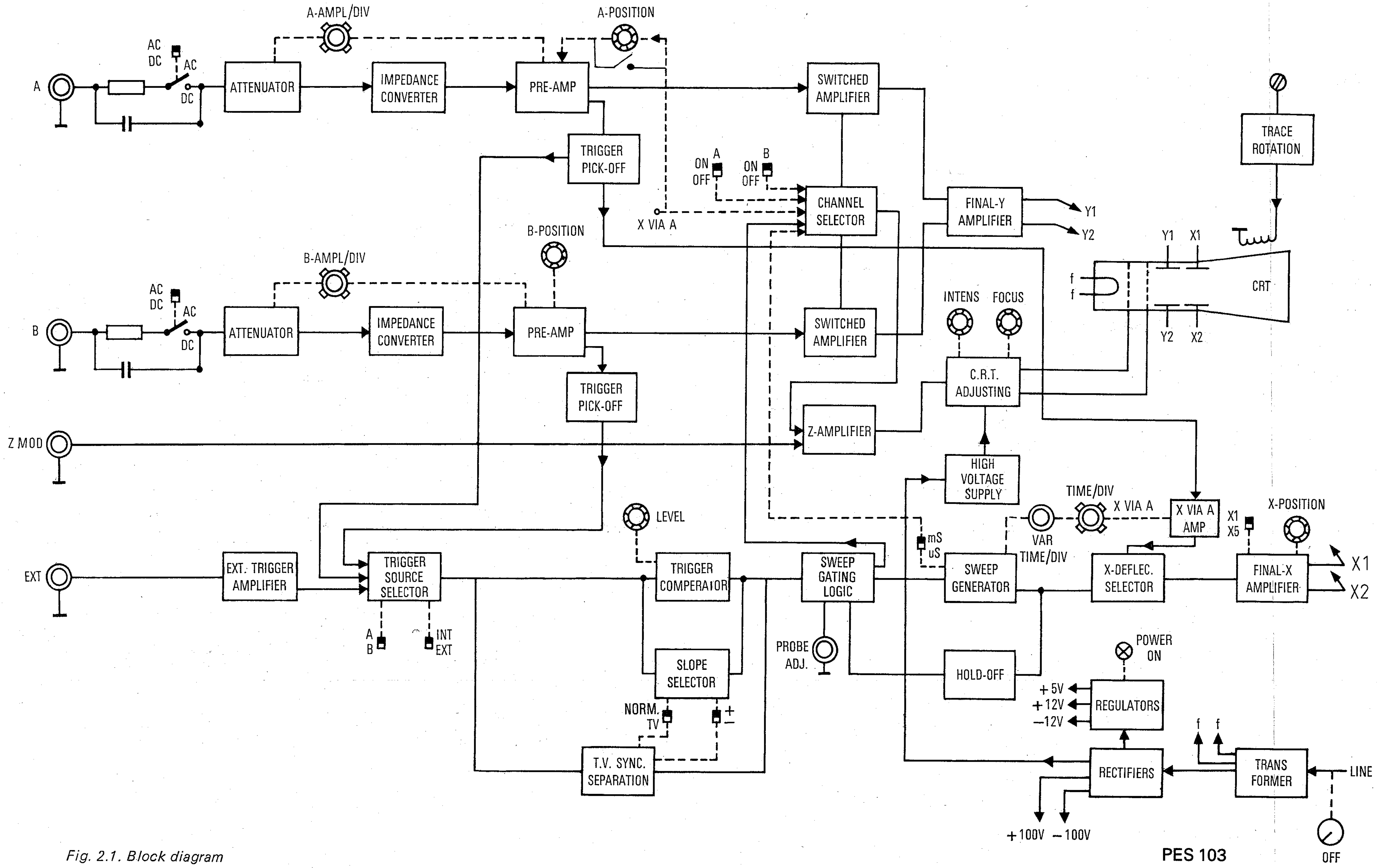
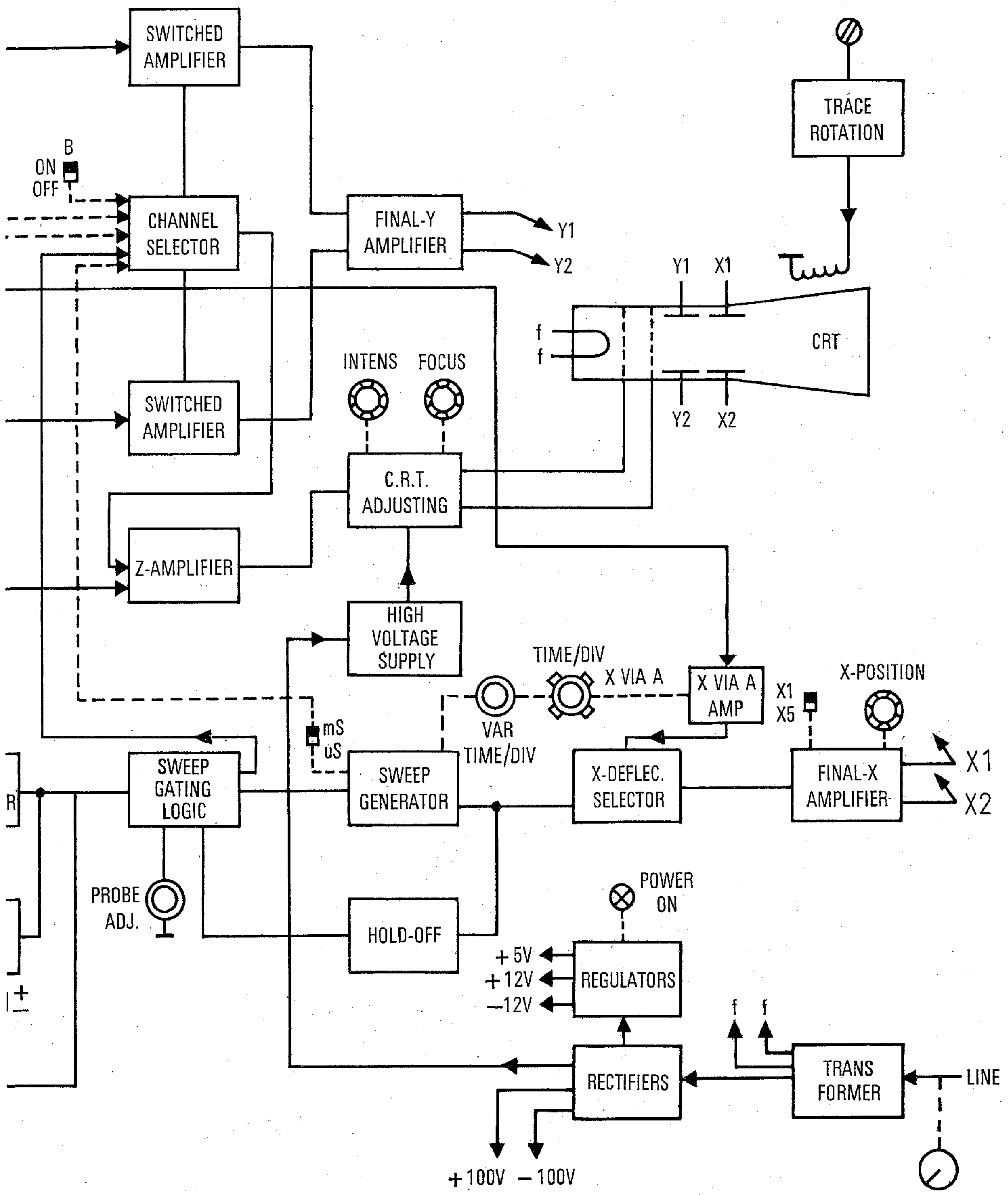


Fig. 2.1. Block diagram

2.1.2



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2. CIRCUIT DESCRIPTIONS

In Chapter 2.1 the block diagram description is given and in the Chapters 2.2 - 2.5, the detailed circuit information is described

2.1. Block Diagram Description

The circuit is located on printed circuit boards and is subdivided into the following parts :

- vertical amplifier channels A and B
- final vertical amplifier and Z amplifier
- time base and horizontal amplifier
- c.r.t. circuits
- power supply unit

The block diagram of the PM 3206 is given in Fig. 2.1. The subdivisions of the diagram do not necessarily relate to the circuit areas of the printed circuit boards.

2.1.1 Vertical Deflection

As the A and B channels are almost identical, only channel A is described. The signal at the input socket is applied either directly or via a d.c. blocking capacitor, depending upon the position of the AC/DC coupling switch to the high-impedance A ATTENUATOR stage. This stage incorporates the 1, 10, 100 and 1000 times attenuator coefficients, which are selected by the A AMPL/DIV switch. The A attenuator is followed by an IMPEDANCE CONVERTER and PREAMPLIFIER, which provides the following functions:

- the 1-2-5 attenuator sequence in conjunction with the basic attenuation coefficients
- an adjustment of DC balance
- Y position control for channel A. This control is disabled inthe X via A mode.

The PREAMPLIFIER in channel A has two outputs, one of which feeds the TRIGGER PICK-OFF amplifier and the other the SWITCHED AMPLIFIER. The CH. A TRIGGER PICKOFF Amplifier feeds the trigger source selector and the X via A Amplifier.

Depending on the command signal from the CHANNEL SELECTOR, the SWITCHED AMPLIFIER routes the PREAMPLIFIER signal to the FINAL Y AMPLIFIER. The FINAL Y AMPLIFIER feeds the Y1 and Y2 vertical deflection plates of the CATHODE RAY TUBE (C.R.T). The CHANNEL SELECTOR signals are generated by a multivibrator controlled by logic gates from the front-panel channel selection switches A ON-OFF, B ON-OFF, µs/ms (ALT./CHOP.), X VIA A. For the µs (ALT) mode, an input signal derived from the time-base is used for switching purposes. The following modes are possible:

- Single Channel Operation : One channel is permanently to the final Y amplifier while the other channel is blocked.
- Dual Channel Operation in µs (ALT) mode : the final Y channel input is switched from one channel to the other at the end of each time-base sweep.
- Dual Channel Operation in ms (CHOP) mode : the final Y amplifier input is switched from one channel to the other at a frequency of approx. 60 KHZ.
- X via A mode : the channel B is switched through to the final Y amplifier.

2.1.2 Triggering and Horizontal Deflection

The signal source required for time-base triggering is selected by the TRIGGER SOURCE SELECTOR under the command of the front panel trigger selector switches. The trigger sources are available from the following :

- The channel A or B TRIGGER PICK-OFF amplifiers which are activated by the A and B switches.
- The EXTERNAL TRIGGER AMPLIFIER in order to trigger on a signal applied to the external input X5 activated by the EXT switch.

The TRIGGER SOURCE SELECTOR output is applied to the TRIGGER COMPARATOR, where it is compared with the input from the LEVEL control. This enables the selected level to be compared with the incoming trigger signal to determine the level at which the time-base starts. With switch NORM/TV in TV position the TRIGGER SOURCE SELECTOR output is also fed to the TV SYNC SEPARATION stage. In case of positive video signal the +/- switch should be in + position.

The TV SYNC SEPARATOR stage allows triggering on TV frame pulses (ms position of ms/µs switch) or TV line pulses (µs position of ms/µs switch). The output of the TRIGGER COMPARATOR feeds the SWEEPGATING LOGIC. Depending on the position of the +/- switch the SWEEP GENERATOR starts the positive or negative going slope of the input signal. With the NORM/TV switch in TV position the TV SYNC SEPARATOR output is applied to the SWEEP GATING LOGIC and the TRIGGER COMPARATOR output is blocked. The HOLD-OFF circuit prevents the SWEEP GENERATOR from responding to a trigger command before the time base capacitors are fully discharged.

The SWEEP GATING logic, in addition to feeding the SWEEP GENERATOR, also feeds the CHANNEL SELECTOR in order to control the ALTERNATE vertical display mode switching. An output also controls the Z AMPLIFIER in order to blank the trace during the flyback of the time-base.

The SWEEP GENERATOR produces the sawtooth waveform that is used for horizontal deflection. The time-base sweep period can be adjusted by the step control TIME/DIV. The VAR. TIME/DIV control provides the variable sweep facility.
The X DEFLECTION SELECTOR enables the input to the FINAL X AMPLIFIER to be selected by diode switching networks. Normally, the internal time-base produced by the SWEEP GENERATOR is routed to the FINAL X AMPLIFIER, but in the X via A mode, an output signal from the X via A AMPLIFIER is selected.

The FINAL X AMPLIFIER, which drives the X1 and X2 horizontal deflection plates of the C.R.T has a X POSITION control potentiometer. In addition the stage has x5 magnifier switch facility, which increases the horizontal gain by a factor of 5.

2.1.3 CRT Display Section

The Z AMPLIFIER receives an input blanking pulse which originates in the channel selector multivibrator and the sweep gating logic. There is also another input to this amplifier from the Z-MOD input socket. Normally, blanking of the trace takes place during flyback of the time-base and also in the chopped mode during switching from one channel to the other. The INTENS control determines the d.c. level fed to the cathode of the CRT. The output of the Z AMPLIFIER is capacitively coupled to the CRT control electrodes.

A HIGH VOLTAGE multiplier provides the final anode potential (-2kV) of the CRT. The TRACE ROTATION circuit, operated by a front panel control, enables adjustment of the sense and strength of current through the trace rotation coil of the CRT. This allows alignment of the trace with the horizontal graticule lines.

2.1.4 Power Supply

The mains supply is transformed by means of a TRANSFORMER and rectified to give d.c. supplies of +100V and -100V.

VOLTAGE REGULATOR stages provides low voltage d.c. outputs of +5V, +12V and feed the various circuits of the oscilloscope.

A 6.3V a.c. secondary winding of the mains transformer supplies the filament of the CRT.

2.2 DESCRIPTION OF THE VERTICAL SECTION

As channels A and B are identical, only channel A is described.

2.2.1. Input coupling stage

In the DC position (switch S9 closed), the signal applied to input socket XI is fed to the high impedance attenuator via R20 and R21.

In the AC position (switch S9 open), the signal applied to input socket XI is fed to the high impedance attenuator via R21 and d.c. blocking capacitor C20.

Resistor R20 discharges C20 when switch S9 is changed from the AC to the DC position.

2.2.2. High impedance attenuator

This section of the circuit comprises of the 1,10,100 and 1000 times attentuator.

The 1000 times attenuator is active in the 5,10 and 20V/div attenuator switch (S4) positions ; i.e. the output signal from the coupling stage is applied via K21 to the attenuator section comprising of R32, R33, R35 and parallel capacitors. The signal, reduced by an attenuation factor of 1000 is fed via K25 contact to the PREAMPLIFIER.

The 100 times attenuator is active in the 0.5,1 and 2V/div attenuator switch (S4) positions; i.e. the output signal from the coupling stage is applied via K21 to the attenuator section comprising R28, R30, R31 and parallel capacitors. The signal, reduced by an attenuation factor of 100 is fed via K23 contact to the PREAMPLIFIER.

The 10 times attenuator is active in the 50mv, 0.1V and 0.2V/div attenuator switch (S4) positions i.e. the output signal from the coupling stage is applied via K21 to the attenuator section comprising R25, R26, R27 and parallel capacitors. The signal, reduced by an attenuation factor of 10 is fed via K22 contact to the PREAMPLIFIER.

The 1 x attenuator is active in the 5mV, 10mV and 20mV/div positions of S4 i.e. the output signal from the coupling stage is applied via K20 to the attenuator section comprising of R22, R23 and parallel capacitors. In conjunction with these four basic attenuator coefficients switched by reed relays K20 (5mV-20mV), K22 (50mV-0.2V), K23 (0.5V-2V) and K25 (5V-20V), the 1-2-5 attenuator sequence of adjacent ranges is provided by gain switching of PREAMPLIFIER by relays K26 and K27.

2.2.3. Preamplifier

The output of the HIGH IMPEDANCE ATTENUATOR is connected via resistor R36 to the input of a symmetrical impedance converter consisting of two matched FET's V21 in source follower configuration.

Diode V20 protects the FET input against excessive negative voltages. The output of the Impedance Converter is fed to a transistor array D20 which uses series feedback in the emitter for gain control. The current source for this circuit is obtained with a transistor biased by resistors R50, R51 and R52. Resistors R47 and R48, with K26 and K27 released, determine the gain of the stage in the attenuator switch (S4) positions 20mV, 0.2V, 2V and 20V/div.

- When contact K26 closes, R56 is switched into circuit and the gain of the stage increases 2x. This occurs in the attenuator switch positions 10mV, 0.1V, 1V and 10V/div.

- When contact K27 closes, R57 is switched into circuit and the gain of the stage increases 4x. This occurs in the attenuator switch positions 5mV, 50mV, 0.5V and 5V/div.

Resistor R55 in this preamplifier stage is used to calibrate the gain in 5mV/div range. D.C. balance control potentiometer R60 adjusts the D.C. balance for the 20mV/div switch position. Potentiometer R40 is used to adjust the D.C. balance for 5mV/div switch position.

The final stage of the preamplifier circuit uses two transistors V22 and V23 with shunt feedback resistors R61 and R62. The Y position control circuit is implemented here using transistors V25 and V26.

Resistor R2 is used for Y position control. The collector current drawn by the transistor array D20 is fixed and is dependent on the current source feeding the emitters of D20. The collectors of V25 and V26 are also connected to the collectors of D20. The change in the collector currents of V25 and V26 due to variation of R2 will now be reflected in the collector voltages of V22 and V23 which are the output voltages of the preamplifier circuit. Relay K28 (operated in X via A mode) shorts the Y position control R2 in the X via A mode only. The outputs of the preamplifier stage are d.c. coupled to the trigger amplifier circuit via resistors R75 and R76.

2.2.4. Switched amplifier

The output of the preamplifier stage goes to the series stage of the output amplifier consisting of transistors V30, V31 with series feedback resistors R80, R81, R82. R83 is used for gain adjustment in the 20mV/div attenuator switch position. In this stage itself channel switching is incorporated with the help of a switching current source (V32). When the output Q of the flipflop D200 in the CHANNEL SWITCHING circuit goes high, the current source (V32) conducts and switches channel A 'ON', while output $\overline{Q}$ of the same flipflop switches channel B 'OFF'.

The output of this stage goes to the final Y amplifier circuit via resistors R91 and R92.

2.2.5. Channel flipflop and logic circuits

The logic circuits used in this unit can have two logic output levels :

A low level or logic 0 between 0V and 0.8V and a high level or logic 1 between 2V and 5V. The unit has two outputs (pins 9 & 8 of D200) which are the Q and $\overline{Q}$ outputs of a D flipflop. A logic 1 in the Q and $\overline{Q}$ of this flipflop switches channel A and channel B respectively. The various switching modes that control these outputs are CH. A ON/OFF, CH. B ON/OFF, the ms/µs (for selecting ALT/CHOP mode of operation) and X via A modes.

CH. A ON
When channel A switch S8 is ON, input 3 of NOR gate D202 is at logic 0. Unless the X via A mode is used, the other input 2 of this gate is also at logic 0. Hence the output of this gate is at logic 1.

If channel B switch S10 is OFF, then input 1 of NAND gate D201 is at logic 1 and hence the output 3 of D201 is at logic 0. This causes the D flipflop D200 to be set and its Q output 9 goes high switching ON channel A.

CH. B ON
When channel B switch S10 is ON, input 1 of NAND gate D201 is at logic 0. If channel A switch S8 is OFF, then input 3 of NOR gate D202 is at logic 1 and its output 1 is at logic 0. This means that reset input 13 of flipflop D200 is at logic 0 and hence its $\overline{Q}$ output goes high, switching channel B ON.

CH. A ON, CH. B ON and switch S1 in µs position (ALT mode). Here the +12V on S1 is fed via resistors R231 and R232 to provide a logic 1 at input 5 of NOR gate D202. This makes the output of this gate go to logic 0 which blocks the CHOP oscillator D201/13, 12, 11 and the output D201-11 is at logic 1.

Output 5 of flipflop D303, connected to input 4 of flipflop D200 is at logic 0 during the time base sweep and at logic 1 during the hold-off period. Thus input 9 of NAND gate D201 is at logic 1 during the time base sweep and at logic 0 during the hold-off period. Therefore, the CLOCK input (pin 11) of flipflop D200 goes from logic 0 to logic 1 at the end of every sweep and changes the state of the flipflop. In this way the display switches alternately between the channels.

CH. A ON, CH. B ON and switch S1 in ms position (CHOP mode).
Here the input 5 of NOR gate D202 is at logic 0 since switch S1 is in 'ms' position. Since both inputs 2 and 3 of NOR gate D202 is at logic 0, its output 1 is at logic 1. Since channel B is ON, input 1 of NAND gate D201 is at logic 0. Hence output 3 of the same gate is at logic 1. Since inputs 4 and 5 of NAND gate D201 is at logic 1, therefore its output 6 is at logic 0. Hence output 4 of NOR gate D202 is at logic 1. This enables the CHOP oscillator D201/13, 12, 11. This oscillator is a NAND - schmitt trigger with a RC feedback loop, which produces a 120 KHZ square wave signal on its output pin 11. This is at logic 1 if the oscillator is switched off in single channel or ALT mode.

The oscillator output is fed to input 10 of NAND gate D201.

During the time base sweep the other input (pin 9) of D201 is at logic 1; therefore the inverted chopper pulses are fed to the CLOCK input (pin 11) of flipflop D200. As both the clear and Preset inputs of the flipflop are at logic 1 (switches S8 and S10 ON) they are inactive. Therefore, due to the feedback connection between output pin 8 and pin 12, the flipflop changes state at every clock pulse. In this way the display switches between the A and B channels at a frequency of 60 KHZ.

The CLOCK input 11 of flipflop D200, which gets the inverted chopper pulses, is also taken to the Z amplifier to blank the display when switching over between the A and B channels.

	D201/3	D202/1	D201/11	D200/10 PRESET	D200/13 CLEAR	D200/9 Q	D200/8 Q
AON/BOFF	0	1	-	0	1	1	0
BON/AOFF	1	0	-	1	0	0	1
A & B ON	1	1	1	1	1	1/0	0/1
- in ALT mode (us)				(state changes at end of every sweep)			
- in CHOP mode (ms)	1	1	1/0	1	1	1/0	0/1
				(state changes at chopper frequency)			

2.2.6 Final Amplifier

The final Y amplifier consists of V200, V202, V207, V210 which drive the Y1 deflection plate and are balanced by transistors V201, V203, V208, V211 which drive deflection plate Y2.
In order to increase stability, the deflection plates are driven via resistors R220 and R221.

In the Y1 plate drive section, V207 & V210 function as a current source. Transistors V200 and V202 form a shunt feedback stage. Two transistors are used in each case so as not to exceed the maximum permissible current and voltage limits of the transistors. In the Y2 plate drive section, V208 and V211 are the current source and V201 and V203 for the shunt feedback stage.

2.3 HORIZONTAL DEFLECTION AND TIME BASE

2.3.1 CH. A trigger pick off

The trigger signal picked off from the output stage of the CH. A PRE-AMPLIFIER is fed via resistors R75 and R76 to the trigger amplifier consisting of V300 and V301 for which V302 forms a current source. When channel A triggering is selected (S12 to A and S14 to INT), then the collector of V300 is applied via diode V308 in the trigger source select to the base of transistor V315. The channel B pick off and EXT trigger input are inhibited by the -12V switched supply that switches off diods V311 and V310.

The channel A trigger amplifier has another output from the collector of V301 that is used to drive the horizontal amplifier, via the shunt feedback stage using V418, in the X via A mode.

2.3.2 CH. B trigger pick off

The trigger signal picked off from the channel B pre-amplifier is fed to the trigger amplifier consisting of V303 and V305 for which V306 forms the current source. The collector signal from V303 is routed via diode V311 in the trigger source selector to the base of transistor V315.
The A channel pick off and the EXT trigger input are inhibited by the -12V switched supply that switches off diodes V308 and V307.

2.3.3 External trigger amplifier

The signal applied to the external trigger input socket (X5) is attenuated by a voltage divider network R342/C302, R343/C303 in the base circuit of emitter followers V326 and V327 connected in cascade. Capacitor C305 serves for d.c. blocking and diode V325 protects transistor V326 against excessive positive input voltage swings.

The emitter of V327 is coupled via C306 to the series feedback stage V328/V330. The collector current of V328 is connected via diode V312 to the base of transistor V315. The A and B internal pick offs are inhibited in the EXT position of S14 by the -12V switched supply via diodes V310 and V307 that blocks V311 and V308 respectively.

2.3.4. Trigger source selector amplifier

The diode networks referred to in the foregoing descriptions of the trigger pick offs and the external trigger amplifier are all associated with the trigger source selector switches S12 and S14, and the method of selecting each trigger source has been described under these headings. The selected trigger signal to the base of transistor V315 is amplified and fed to emitter follower V318. Electrolytic capacitor C300 connects this signal to the comparator circuit which follows.

2.3.5. Level control

The level voltage control R5 permits variation of the trigger level of the signal.

2.3.6. Comparator and sweep gating logic

The trigger level selected by the LEVEL control is applied to the base of V320, which together with V321 forms a differential amplifier comparator circuit, for which V322 acts as a current source. The trigger signal from the emitter follower V318 is fed directly to the base of V321. When this trigger signal exceeds the reference set by the LEVEL control, V320 conducts less and the collector current decreases so the voltage of the shunt feedback stage V323 increases.

This signal is applied to input 9 of NAND schmitt - trigger D300 in the sweep gating logic, and if S15 is in NORM position the inverted signal appears at D300. With the +/- switch S13 in "+" position, output 8 of D301 is logic 1 and the EX-OR D301 (output 6) inverts the signal applied to input 5, so triggering is effected on the positive slope. If switch S13 is in "-" position the EX-OR D301 input 4 is at logic 0 so the signal applied to input 5 appears at pin 6. Now triggering is effected on the negative slope.

2.3.7. T.V. Slope selector

The output signal from the trigger source selector is fed to the base of transistor V331 which is balanced by transistor V332.

In the negative slope position of S13 the signal on collector of V332 is routed via diode V336 to the base of transistor V338 and the inverted signal on collector of V331 is inhibited by the switched +12V supply which blocks diode V337.

In the positive slope position of S13 the signal on collector of V332 is routed via diode V337 to the base of transistor V338 and the inverted signal on collector of V332 is inhibited as diode V336 is now blocked.

In the NORM position of S15 diodes V333 and V335 conduct and V337 and V336 are blocked.

2.3.8. T.V. SYNC Separator

The line and frame TV trigger pulses from the slope selector stage are passed via V338 to V340 to a low-pass filter for the frame pulses. The low cut-off frequency is selected in the ms position of S1, which connects capacitor C310 across the output, and triggering on TV frame pulses is possible.

In the μs position of S1, this capacitor is disconnected and triggering on TV line pulses is now possible.

The output on the collector of V343 applies a logic signal to pin 4 of NAND gate D300.

With TV selected (D300 input 12 at logic 0) the other input (pin 5) of D300 is at logic 1 and therefore output pin 6 is the inverted logic signal.

This signal is inverted again and appears at pin 6 of D301.

2.3.9. Time-Base and Hold-Off Circuit

These two functional blocks are not described separately here because they function interdependently.

The time-base is built around the timing capacitor C402, which is always in circuit, and C401 which is switched into circuit via transistor V402 at the low sweep speeds by the +12V on switch S1 (ms position) via V400 and R402.

A constant current from current source V405 charges the capacitor(s) in order to produce a time-base voltage that is linear with respect to time; i.e. a linear sawtooth. The TIME/DIV control (S6) is incorporated in the emitter circuit of the current source transistor V405.

The TIME/DIV controls, R411 (µs range) and R416 (ms range), adjust the base voltage of V405 in diodes V407 and V406 respectively. A variable time/div control is obtained with a potentiometer R7 (which can be shorted by switch S7) which is connected to the base circuit of V405 via R406 and controls the base voltage in calibrated time base mode.

The appropriate base control circuit for V405 is selected by the position of the S1 switch, which provides the +12V to either the µs or ms position.

The time base capacitors are charged during the time-base sweep.

During this charging time, switching transistor V401, which is controlled by the sweep gating logic, is not conductive. This transistor, which starts to conduct at the end of the sweep, discharges the timing capacitor(s) and takes over the current from V405.

Switching transistor V401 cuts off when the time base is ready to start again.

The sawtooth time base voltage on the timing capacitor is picked-off by a Darlington stage (V408 and V410) and is applied to the X-deflection selector. The output signal from V410 is also applied via R421 to emitter follower V411, which feeds the hold off capacitors C403 and C405. Capacitor C405 is always in circuit and, capacitor C403 is switched into circuit by V403 in ms position of S1. The sawtooth on the hold-off capacitor(s) is applied to the input of NAND gate D300/1,2,3. This gate is effectively a schmitt-trigger with a hysteresis of approximately 0.8V. The output of the gate becomes logic 0 if the positive going slope of the input sawtooth reaches a level of 1V approximately.

The two D flipflops D303 operate in parallel. The non inverting output of one flipflop (pin 5) feeds the switching transistor V401 via R400 and the Z-amplifier.

The non-inverting output of the other flip-flop (pin 9) is used as probe adjust signal.

Integrated circuit D302 is a retriggerable monostable multivibrator controlled by the trigger pulses from the trigger comparator. When a trigger pulse is received on pin 3, output pin 8 is at logic 1 for 150 ms. This time constant is determined by C312.

The trigger pulses are also routed to the clock inputs (pin 3 and pin 11 of the D303 flipflops).

Free-Run Mode (Without Trigger Pulses)
If no trigger pulses are available at retriggerable monostable input D302-3, then output pin 8 is low and a preset command is given to the D303 flipflops (pins 1 and 13).

The D flipflops now function as inverters and the clear inputs (pins 4 and 10) receive a pulse from the hold-off circuit after the time base sweep, which is inverted to give outputs on pins 5 and 9.

The output pulse on D303-5 causes the switching transistor V401 to conduct at the end of the time-base sweep and during the hold-off period the time base capacitors C401 and C402 are discharged.

In this way, the time base capacitors are alternately discharged and then charged; i.e. the time-base is free-running.

X via A mode
When X via A is selected, the +12V that is available on H performs four functions :
- Via diode V317 it inhibits the trigger source input to V318
- Via diode V215 a logic 1 is applied to input pin 2 of gate D202, which causes a logic 0 on input 13 of flipflop D200. This results in channel B being switched through for Y deflection

purposes and the output of channel A being blocked.
Channel A output from vertical preamplifier is routed via V418 to provide the X-deflection signal.
- The +12V applied via R441 to the base of V417 switches off this transistor.
  The pulses from the internal time base via emitter of V410 are now blocked by diodes V412 and V413.
- The +12V applied via R442 allows switching diodes V415 and V416 to conduct so that the output on collector of transistor V418 is routed to the final X amplifier.

2.3.10. X-Deflection selector

The selection of the X via A mode has previously been described. When the internal time-base mode is selected, V417 conducts because of the bias current applied to its base via R440 and R441. The positive voltage on the collector of V417 causes switching diodes V412, V413 to conduct, which allows the time base output on emitter of V410 to be applied to the input of the X-amplifier. In this mode , switching diodes V416 and V415 are blocked by the negative potential applied via R440 and R442.

2.3.11. Final X Amplifier

The output signal from the X deflection selector is applied to the base of V421 in the series feedback stage, which consists of V421 balanced by V423. The base circuit of V423 incorporates the horizontal position control (X-POS) R4. Transistor V422 is the constant current source for this series feedback stage. In the x5 magnifier position of S2, resistor R456 shunts the emitter resistors R455, R453 to give a 5 times increase of horizontal gain.

The collectors of V423 and V421 are coupled to the output stage. This output stage consists of the shunt feedback stage V426, V428 and current source V433 that feed the X plate via R478, balanced by an identical stage comprising V427, V430 and V435.

Two transistors are employed in each of the shunt feedback stages so that the maximum current and voltage limits of the individual transistors are not exceeded, and to reduce stray capacitances.

Resistors R478 and R480 connecting the outputs to the X-plates of the CRT are inserted to increase stability.

2.4. CRT DISPLAY SECTION

2.4.1. Z Amplifier

The input to the Z amplifier is via R522 to the base of transistor V517 and receives signals from :
- the sweep gating logic in order to blank the display during the time-base hold-off period.
- the channel multivibrator in order to blank the display in the chopped mode during the switching from one channel to the other.

The Z amplifier consists of a shunt feedback stage coupled to the Wehnelt cylinder via C518. Diode V511 and resistor R512 provide D.C. restoration.

2.4.2. High voltage supply

The high voltage power supply consists of a quadruple voltage multiplier a voltage divider that produces cathode, control grid and focus potentials for the CRT and a compensation circuit (V505, V506, V504, V507) to compensate h.t voltage ripple and variations. The voltage quadrupler circuit consists of diodes V500, V501, V502, V503, and capacitors C500, C501, C502, C503. Resistors R6 and R1 control the cathode and grid g3 voltages respectively and in turn provide the intensity and focus controls.

2.4.3. Trace rotation

The emitter followers V521 and V522 and preset potentiometer R8 determine the sense and strength of the current in the trace rotation coil.

Only one emitter follower conducts at any given time, depending on the position of R8.

2.5. POWER SUPPLY

The mains voltage is applied via double-pole switch S3 to the primary winding of transformer T500, protected by a replaceable thermal fuse F500 and a replaceable cartridge fuse F501.

Provision is made to wire the primary for a nominal voltage of 120V or 220V or 240V. Two full wave bridge rectifiers V512 and V516 across the secondary winding of T500 provide the d.c. voltages for the +12V, -12V, +100V and -100V supplies respectively.

The low voltage supplies +12V and -12V are regulated by two integrated circuits D500 and D501 and smoothed by electrolytic capacitors C511 and C515. The +5V supply is obtained from the +12V supply with the help of a series pass transistor with Zener reference.

3. DISMANTLING THE INSTRUMENT

3.1. General information

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened. If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazard involved. Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

ATTENTION: This section provides the dismantling procedures required for the removal of components during repair operations. All circuit boards removed from the oscilloscope should be adequately protected against damage, and all normal precautions regarding the use of tools must be observed.
During dismantling procedures, a careful note must be made of all disconnected leads that they may be reconnected to their correct terminals during assembly. Damage may result if the instrument is switched on when a circuit board has been removed, or if a circuit board is removed within one minute after switching off the instrument.

***NOTE:** All screws which have to be remounted directly in the housing-parts must be fixed with a torque of maximum 1 Nm (10 kg cm).*

3.2. Removing the top and bottom covers

To adjust the instrument it is necessary to remove the top-cover.
- Remove the two carrying-handle mounting screws (Fig. 3.1.).
- Bend the handle outwards and remove it (Fig. 3.1.).
- Remove the two cabinet mounting-screws (Fig. 3.1.).
- Press the two buttons at the rear side until the click. (Fig. 3.2.)
- The top-cover will lift now about 2 mm (Fig. 3.2.).
- Now lift vertically the top-cover out of the front-and rear-cover (Fig. 3.3.).
- The bottom cover can now be removed.

***NOTE:** Take care of the handle gears.*

3.2.1. Remounting the top-cover

- Place the top-cover between the front and rear-cover.
- Take care that the side snaps of the top and bottom-cover fix together.
- Press the upper rear side firmly down until the click (Fig. 3.2.).
- Remount cabinet mounting-screws and the handle.

3.3 ACCESS TO PARTS FOR CHECKING AND ADJUSTING PROCEDURE

The adjusting elements are accessible after removing the top-cover.
To remove the top-cover see section 3.2.

***NOTE:** For adjustments always use an insulated adjustment tool.*

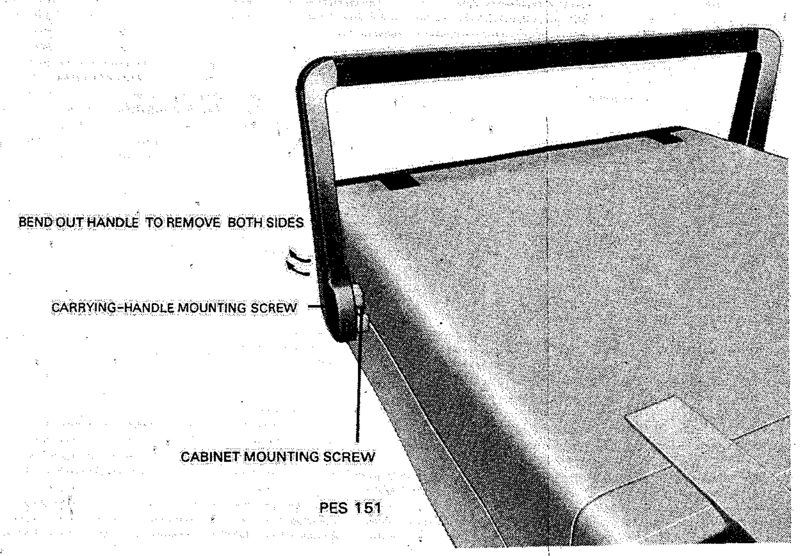


Fig. 3.1 Removing the top Cover

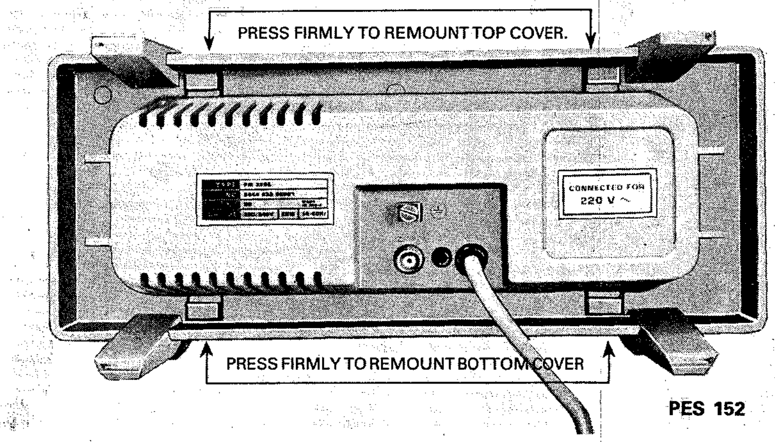


Fig. 3.2 Remounting the top cover

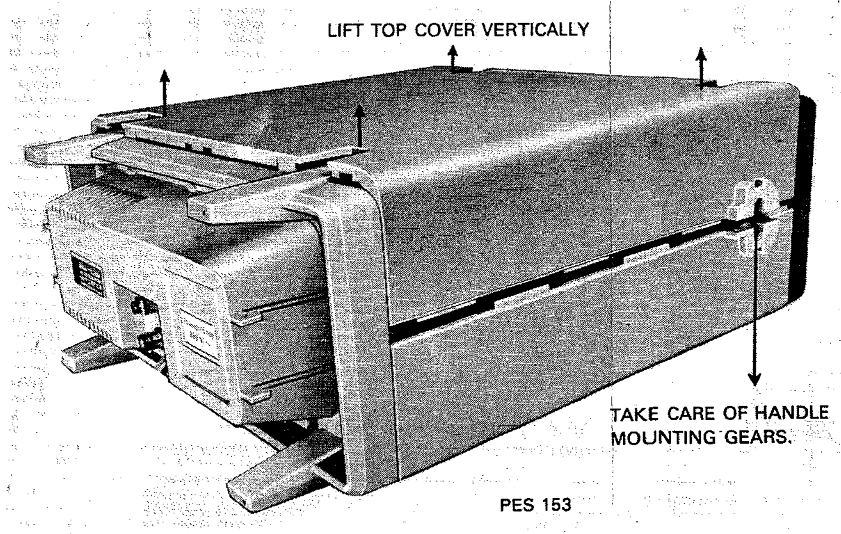


Fig. 3.3 Lifting the top cover.

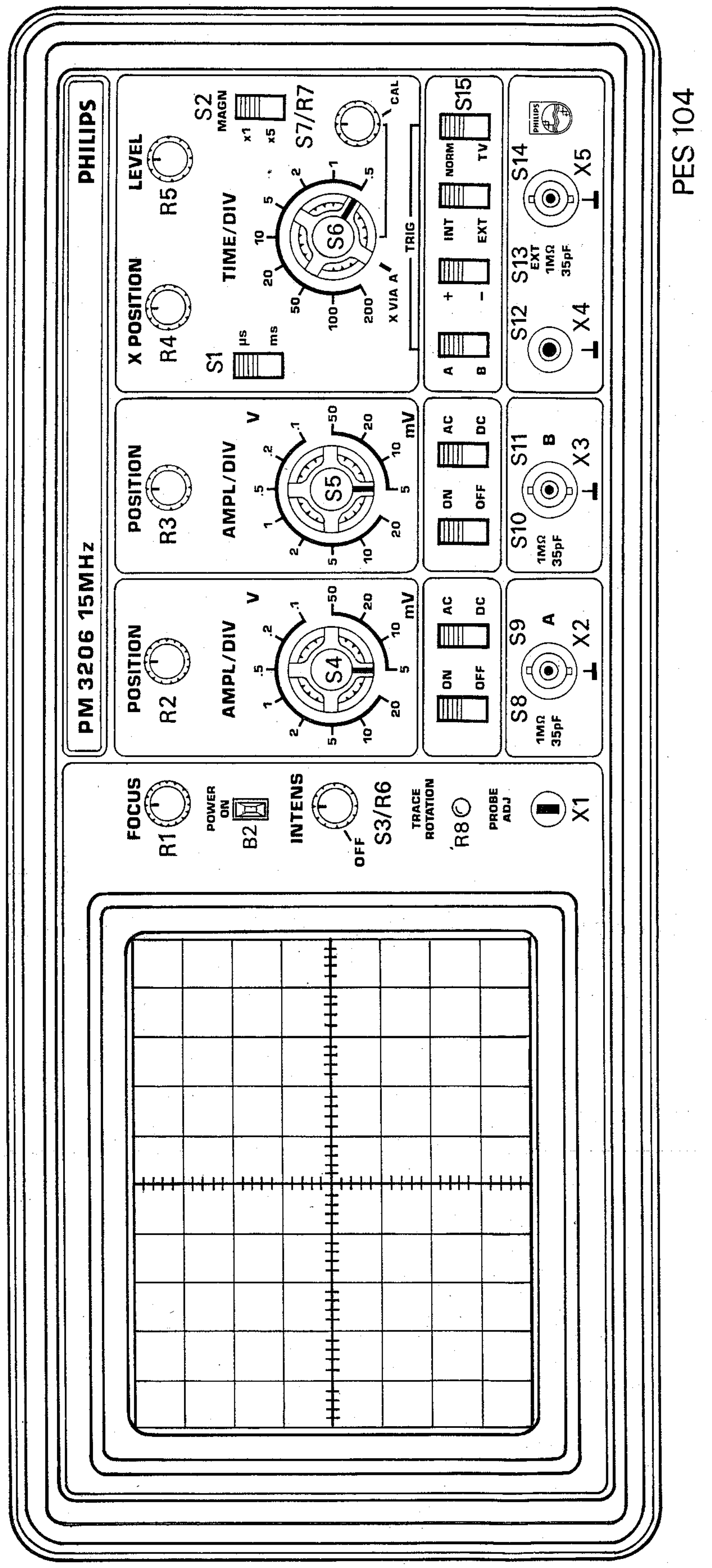


Fig. 4.1 Preliminary Settings of the controls

4. PERFORMANCE CHECK

4.1. General information

WARNING: Before switching on, ensure that the oscilloscope has been installed in accordance with the instruction outlined in Chapter 4, Directions for use of the Operating Manual.

This procedure is intended to check the instruments specifications. It can be used for incoming inspection to determine the acceptability of newly purchased or recently recalibrated instruments, or to check the necessity of recalibration after a certain operating period. It does not check every facet of the instruments calibration; rather it is concerned primarily with those portions of the instrument which are essential to measurement accuracy and correct operation. Removing the instruments covers is not necessary to perform this procedure. All checks are made from the front panel.

If this test is started a few minutes after switching on, bear in mind that test steps may be out of specification, due to insufficient warming-up time. To avoid this situation, allow the specified warming-up time.
Numerical values without tolerances are typical and represent the characteristics of an average instrument.

The performance checks are made with a stable, well-focussed, low-intensity display. Unless otherwise noted, adjust the intensity, focus and trigger-level controls as needed.

NOTE 1: *At the start of every objective, the controls always occupy the preliminary settings; unless otherwise stated.*

NOTE 2: *The input voltage has to be supplied to the A-input; unless otherwise stated.*

NOTE 3: *Set the TIME/DIV switch to a suitable position; unless otherwise stated.*

4.2. Preliminary settings of the controls

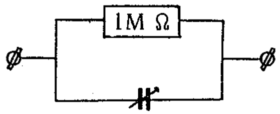
- Start this check procedure with NO input signals connected.
- Set the controls as indicated in fig. 4.1.

4.3. Recommended test equipment

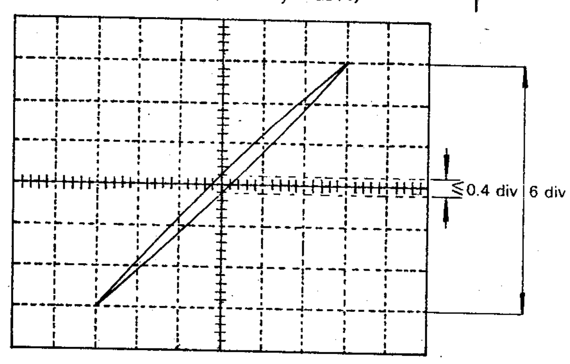
Type of instrument	Required specification
Constant amplitude	Freq.: 1 Hz ... 15 MHz
Sine-wave generator	Constant ampl. of 10 mV p.p. - 30 V p.p.
Square-wave generator	Freq.: 2 Hz ... 1 MHz Ampl.: 10 mV ... 12 V Rise-time 3 nsec. Duty cycle 50%
Time-marker generator	Repetition rate: 200 msec. ... 100 nsec.
Dummy probe 2 : 1	1 MΩ ± 0.1 % // 40 pF.

CHECKING PROCEDURE

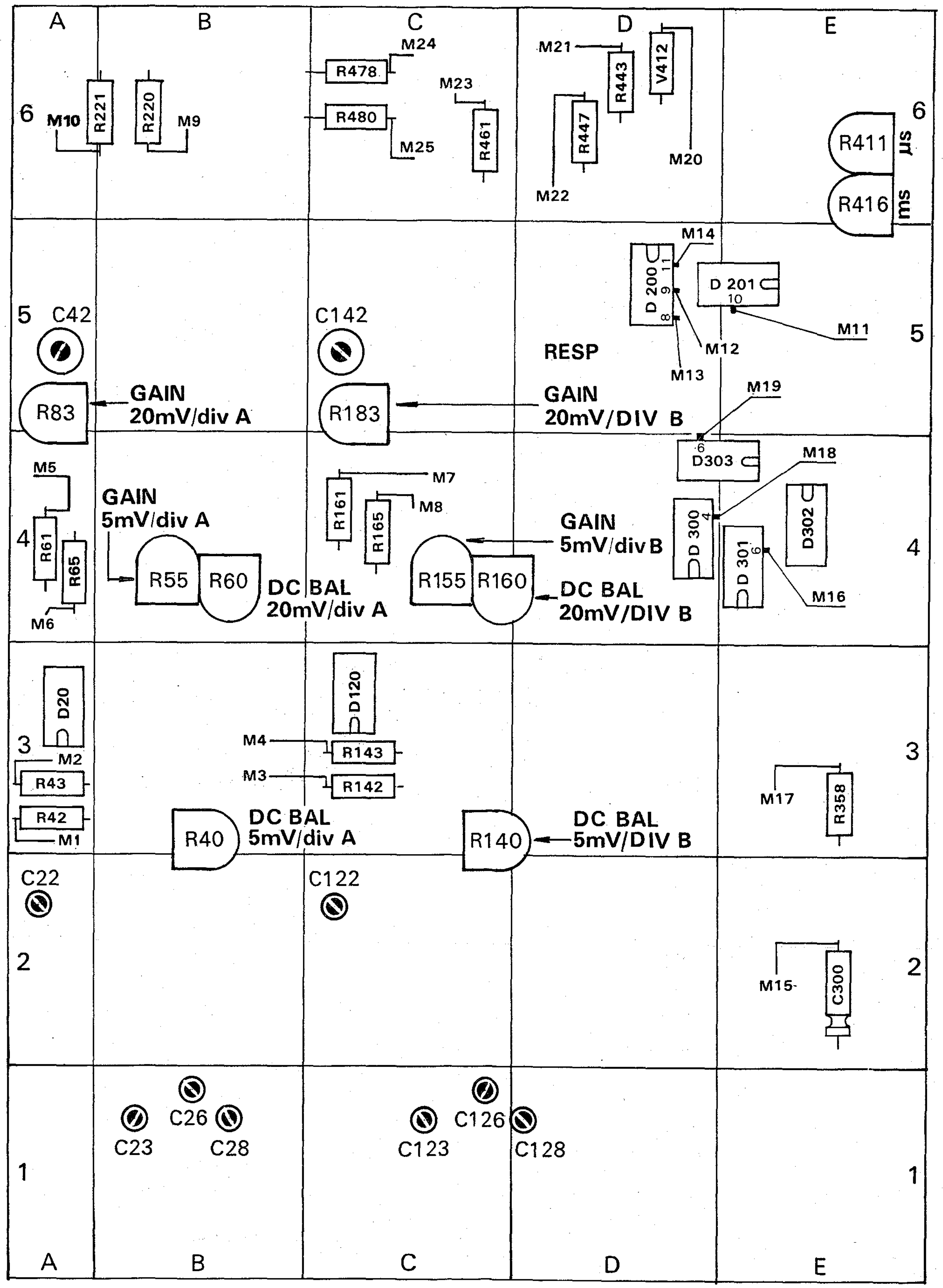
STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
4.4.1	**POWER ON**				
4.4.1.1	Start power on		- Turn Switch S3 ON	- Starts at selected mains voltage ± 10% and mains frequency 45-66 Hz. - Pilot Lamp POWER ON lights up.	
4.4.1.2	Power Consumption			- 28 VA	
4.4.2	**CRT SECTION**				
4.4.2.1	Intens		- INTENS Control R6 ↶↷	- Normal intensity adjustments	
4.4.2.2	Focus		- Focus Control R1 ↶↷	- Normal focus adjustments	
4.4.2.3	Trace Rotation		- Screwdriver adjustment TRACE ROT R8.	- Trace must coincide with central horizontal graticule line; if necessary, readjust potentiometer TRACE ROT R8.	
4.4.3	**VERTICAL AXIS**				
4.4.3.1	Display modes	Sine-wave signal, 300 mVpp, 1 kHz to A & B input	- Position control R2, R3. - Switch S10 to OFF CH.A.AMPL/DIV. to O.IV/DIV. - Switch S8 to OFF. CH. B AMPL/DIV to 0.IV/DIV.	- Traces of channel A and channel B in middle of the screen. - Signal of 3 div. visible on the screen. - Signal of 3 div. visible on the screen.	

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
4.4.3.2	Input Coupling	Sine wave signal 1kHz +DC offset to A(B) input	- Switches S9 and S11 to DC	- Signal is visible on the screen, centre of sinewave is on DC offset level.	
4.4.3.3	Vertical deflection coefficients	Square wave signal, 1kHz to A(B) input Amplitude : 30 mVpp 60 mVpp 120 mVpp 300 mVpp 600 mVpp 1.2 Vpp 3 Vpp 6 Vpp 12 Vpp 30 Vpp 60 Vpp 120 Vpp	- Switch S12 to A(B) - AMPL/DIV. switch position of S4(S5) 5 mV 10 mV 20 mV 50 mV 0.1 V 0.2 V 0.5 V 1 V 2 V 5 V 10 V 20 V	- Trace height: 6 div. ± 5%(±1.5 sub-div.)	
4.4.3.4	Input Impedance	Square wave signal, 1.2 Vpp - 1kHz to A(B) input via dummy  40pF. PES121	- AMPL/DIV switch position of S4(S5) to 0.IV	- Trace height 6 div.	
4.4.3.5	Square Wave Response	Square wave signal, 600 mVpp,100 kHz, rise time ⩽ 5 n secs. to A(B) input.	- Switch S1 to μ secs. - Switch S2 to x5 position	- Rise time ⩽ 23 n secs. - Pulse ringing ±5% (±1.5 sub-div.)	

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
4.4.3.6	Band Width	Sine wave signal to A(B) input	- Switch S1 to us.		
		Frequency : 100 kHz		- Adjust the sine wave amplitude for a trace height of 6 div.	
		10 Hz - 15 MHz	- Switch S1 to ms or µs.	- Trace height ⩾4.2 div.	
		0 Hz - 15 MHz	- Switch S9(S11) to DC		
			- Switch S1 to ms or us	- Trace height ⩾4.2 div.	
4.4.4	**HORIZONTAL AXIS**				
4.4.4.1	Time Coefficients	Marker pulse signal to A input	- Var. TIME/DIV.control S7/R7 to CAL.		
			- Switch S10 OFF		
			- Switch S1 to µs		
		Repetition time	- TIME/DIV. Switch position :	- Coefficient error ±5%(c.1±0.5 div. over 10 div. screen width)	
		0.5 µs	0.5		
		1 µs	1		
		2 µs	2		
		5 µs	5		
		10 µs	10		
		20 µs	20		
		50 µs	50		
		100 µs	100		
		200 µs	200		
			- Switch S1 to ms		
		500 µs	0.5		
		1 ms	1		
		2 ms	2		
		5 ms	10		
		20 ms	20		

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
		Repetition time (cont.) 50 ms 100 ms 200 ms	- TIME/DIV Switch position (cont.) 50 100 200		
4.4.4.2	X Magnifier	Marker pulse signal to A input repetition time 200 µs. Repetition time 100 n sec.	- Switch S10 to OFF - Switch S1 to ms - TIME/DIV to 1 - Switch S2 to X5. - Switch S1 to µs - TIME/DIV. to 0.5	- Coefficient error ± 7%(c.i±0.7 div) over 10 div. screen width - Coefficient error ±7%(c.i±0.7 div over 10 div. screen width)	
4.4.5	**HORIZONTAL AMPLIFIER**				
4.4.5.1	X via A	Sine wave signal, 600 mVpp,1kHz to A and B input	- Switch S6 to X via A - Switches S9 and S11 to DC	- A line is visible with an angle of 45° with respect to the horizontal graticule line	
4.4.5.2	Phase shift	as 4.4.5.1. Frequency 10kHz	- as 4.5.1	- adjust the input voltage for a deflection of 6 div. - Phase shift 3° (c.i. 0,4 div.)  PES 105	
4.4.5.3	Bandwidth	Sine wave signal	- Switch S10 to OFF	- Adjust input voltage for a trace	

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
4.4.6	**TRIGGERING**				
4.4.6.1	Trigger source A & B	Sine wave signal, 1kHz to A input and square wave signal 800 Hz to B input	- S10 to OFF - Switch S12 to A - Adjust the input signals for a trace height of 6 div. - Switch S12 to B	- Well triggered display of channel A - Well triggered display of channel B	
4.4.6.2	Trigger source EXT	Sine wave signal, 600mV, 1kHz to A input and EXT input.	- Switch S14 to EXT. -	- Well triggered display	
4.4.6.3	Slope	Sine wave signal, 600mv, 1kHz to A input	- Switch S13 to"+" - Switch S13 to "-"	- Signal triggers on positive going edge - Signal triggers on negative going edge	
4.4.6.4	TV triggering	TV signal to A input, syne pulse 1 div.	- Switch S15 to TV	- Well triggered display	
4.4.6.5	Sensitivity int.	Sine wave signal 100 kHz to A input		- Signal triggers at 0.75 div.	
4.4.6.6	Sensitivity EXT	Sine wave signal, 100 kHz to A input and EXT input	- Switch S14 to EXT	- Signal triggers at 0.75 vpp.	
4.4.6.7	Level range	Sine wave signal, 4V freq.1kHz to A input	- AMPL/DIV to IV - AMPL/DIV to 50mV - LEVEL control R5 ↔	- Signal of 4 div. visible on the screen. - Signal triggers in the most extreme positions of R5.	
4.4.7.	**CALIBRATION**			- Signal available for probe adjustments.	



PES 106

Fig. 5.1 Adjusting elements amplifier unit.

5. CHECKING AND ADJUSTING

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
The instrument shall be disconnected from all voltage sources before any adjustment, replacement of maintenance and repair during which the instrument will be opened.
If afterwards, any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazard involved.
Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

5.1. General information

The following information provides the complete checking and adjusting procedure for the oscilloscope.
As various control functions are interdependent, a certain order of adjustment is often necessary. The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature.

- Where possible, instrument performance is checked before and adjustment is made.
- Warming-up time under average conditions is 15 minutes.
- All limits and tolerances given in this section are calibration guides and should not be interpreted as instrument specifications unless they are also published in chapter 1.6 characteristics.
- Tolerances given are for the instrument under test and do not include test equipment error.
- The most accurate display adjustments are made with a stable, well-focused, low-intensity display. Unless otherwise noted, adjust the Intensity, Focus and Trigger Level controls as needed.

5.2. Recommended test equipment

As indicated in chapter 4.3.
Additional equipment for the checking and adjusting procedure:
Digital multimeter e.g. PM
Trimming tool set e.g. Philips 800 NTX.

5.3. Preliminary settings of the controls

As indicated in chapter 4.2.

No.	Adjustments	Preparation			Voltages to apply to X2 (channel A) and X3 (channel B)	Adjusting element		Adjusting Data
		Controls	Description	Position		Number	Location	
1.	Intensity	S2 S8 S4 S10 S5 S6 R6 R3 R4	X1/X5 CH. A ON/OFF AMPL/DIV. A CH. B ON/OFF AMPL/DIV. B TIME/DIV. INTENS POSITION B] POSITION X]	X1 ON 50 mV/div. ON 50 mV/div. X via A anti-clockwise Adjust spot to centre of screen.	---	R501	Power Supply Unit	The spot just vanishes
2.	Trace Rotation	S8 S10 S1 S2 S6 R2 R4	CH. A ON/OFF CH. B ON/OFF µs/ms X1/X5 TIME/DIV. POSITION A] POSITION X]	ON OFF ms X1 .5 Adjust trace to centre of screen	---	R8	Front panel TRACE ROT	Trace in parallel with horizontal graticule line.
3.	DC Balance Channel A (channel B in brackets)	S9 (S11) X2 (X3) S8 (S10) S4 (S5)	AC/DC BNC Channel A(B) ON/OFF AMPL/DIV. A(B)	DC Short-circuited ON 5mV < = > 10mV alternately		R40 (R140)	B2/3 (C2/3)	Trace jump 1/2 div.
3a.	DC Balance Adjustments for 20mV/div.	S9 (S11) X2 (X3) S8 (S10) S4 (S5)	AC/DC BNC CH. A(B) ON/OFF AMPL/DIV. A(B)	Same as in 4 above 20mV < = > 50mV alternately	---	R60 (R160)	B4(C/4)	Trace jump 1/2 div.
4.	Gain CH. A(B) 20 mV/div.	S8 (S10) S10 (S8) S1 S6 S12 S14 S15 S4 (S5)	CH. A(B) ON/OFF CH. B(A) ON/OFF µs/ms TIME/DIV. A/B INT/EXT NORM/TV AMPL/DIV. A(B)	ON OFF µs 200 A(B) INT NORM 20mV/div.	120 mVpp 2 kHz	R83 (R183)	A5(C5)	Amplitude 6 div.
4a.	Gain CH. A(B) 5mV/div.	S4 (S5)	All settings, same as above except S4 (S5) AMPL/DIV. A(B)	5mV/div.	30 mVpp - 2kHz	R55 (R155)	B4(C4)	Amplitude 6 div.
5.	Square wave response A (for channel B in brackets)	S1 S2 S6 S9 (S11) S12 S13 S14 S15 S10 (S8)	µs/ms X1/X5 TIME/DIV. AC/DC A/B +/- INT/EXT NORM/TV CH. B(A) ON/OFF	µs X1 200 DC A(B) + INT NORM OFF	Position 2kHz Square wave S4(S5) on X2(X3) 10 mV - 60 mV 0.1 V - 0.6 V 1 V - 6 V 10 V - 60 V	C22 (C122) C23 (C123) C26 (C126) C28 (C128)	A2(C2) B1(C1) B1(C1) B1(C1)	Topside of square wave in parallel with graticule line.
6.	HF response channel A (channel B in brackets)	S1 S4 (S5) S6 S12	µs/ms AMPL/DIV. TIME/DIV. A/B	µs 10mV 0.5 A(B)	120 mV - 1MHz square wave Rise time ⩽ 5ns.	C42 (C142)	A5(C5)	Pulse drop ⩽ 3% Ringing ⩽ 5%
7.	Time Coefficient ms	S1 S2 S6 S7/R7	µs/ms X1/X5 TIME/DIV. VAR TIME/DIV.	ms X1 2 CAL	Apply pulse marks of 2 ms	R416	E6	8 pulses per 8 div.
7a.	Time Coefficient µs	S1 S6 S7/R7 S2	µs/ms TIME/DIV. VAR TIME/DIV. X1/X5	µs 2 CAL. X1	Apply pulse marks of 2µs	R411	E6	8 pulses per 8 div.

to apply hannel A) :channel B)	Adjusting element		Adjusting Data
	Number	**Location**	
	R501	Power Supply Unit	The spot just vanishes
		Front panel TRACE ROT	Trace in parallel with horizontal graticule line.
	R8		
	R40 (R140)	B2/3 (C2/3)	Trace jump 1/2 div.
	R60 (R160)	B4(C/4)	Trace jump 1/2 div.
›p	R83 (R183)	A5(C5)	Amplitude 6 div.
› - 2kHz	R55 (R155)	B4(C4)	Amplitude 6 div.
uare wave n X2(X3)			Topside of square wave in parallel with graticule line.
60 mV	C22 (C122)	A2(C2)	
0.6 V	C23 (C123)	B1(C1)	
V	C26 (C126)	B1(C1)	
,0 V	C28 (C128)	B1(C1)	
- 1MHz vave ıe ⩽ 5ns.	C42 (C142)	A5(C5)	Pulse drop ⩽ 3% Ringing ⩽ 5%
ılse marks of	R416	E6	8 pulses per 8 div.
ılse marks of	R411	E6	8 pulses per 8 div.

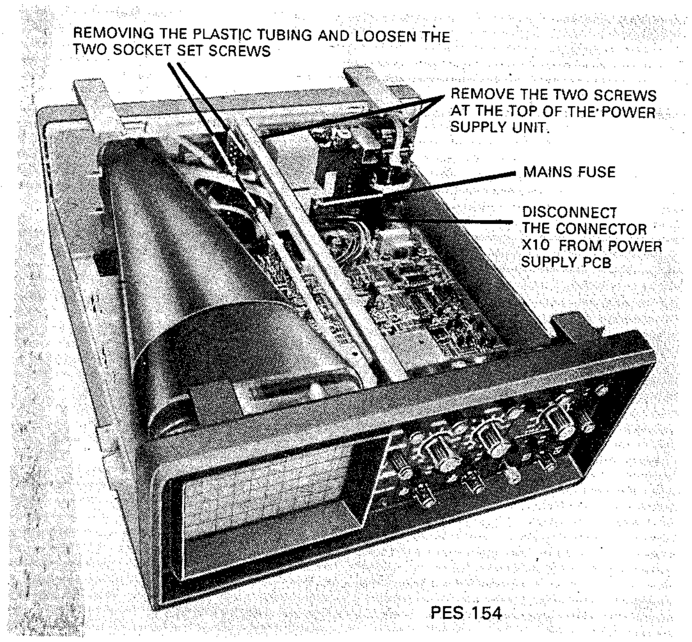


Fig. 6.1 Removing the power supply unit

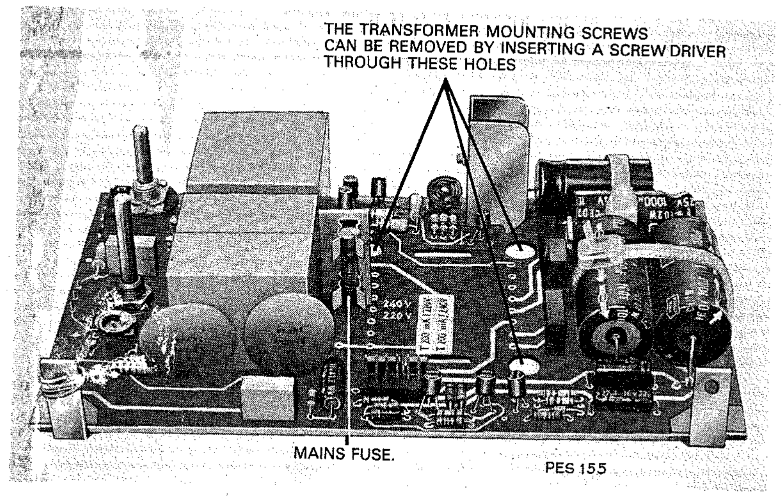


Fig. 6.2 Power supply board

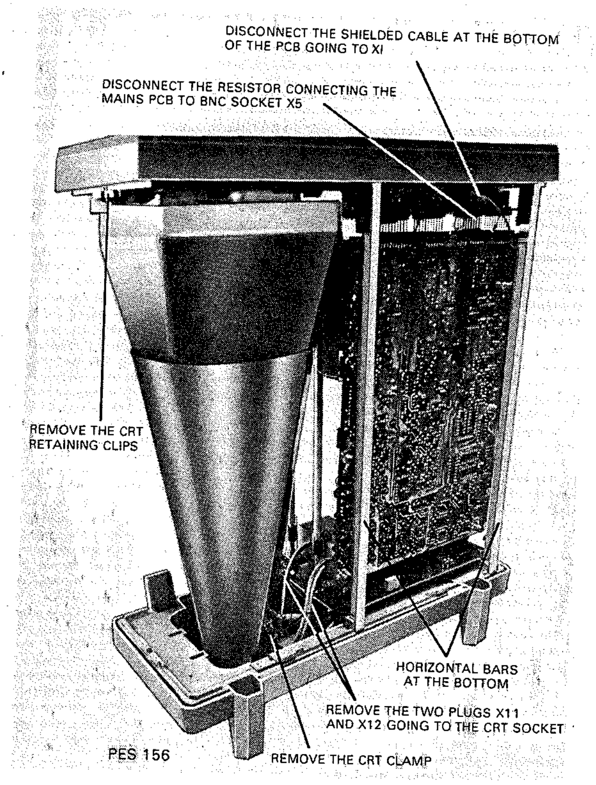


Fig. 6.3 Removing the main PCB and CRT.

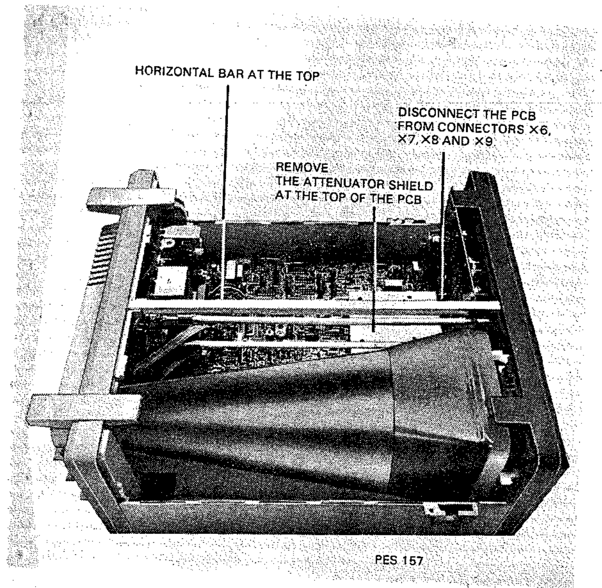


Fig. 6.4 Removing the main PCB unit.

6.

6.1

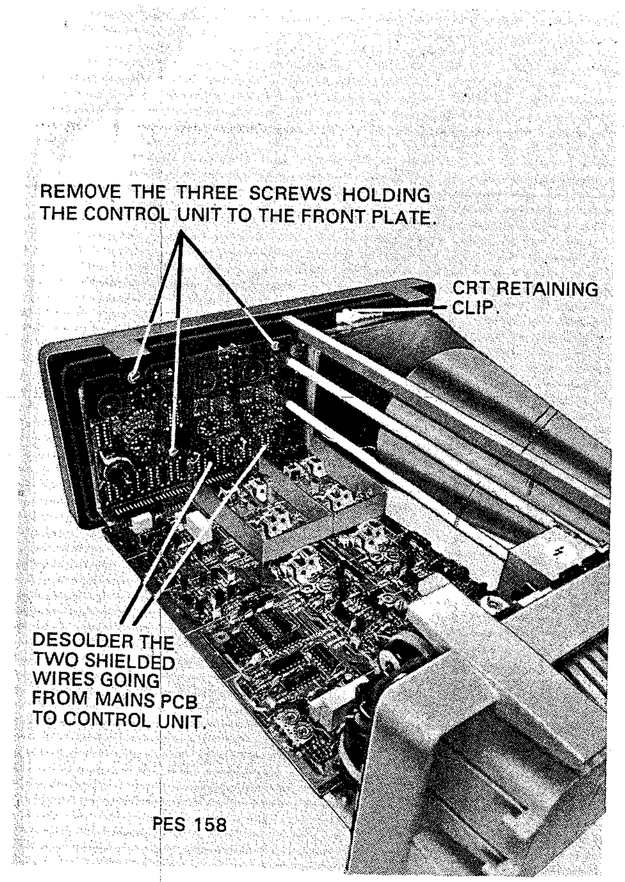


Fig. 6.5 Removing the control unit and CRT.

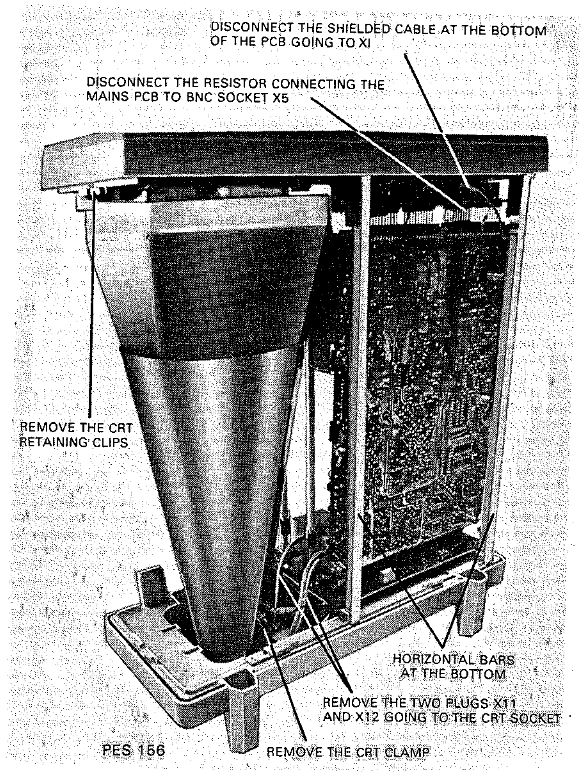


Fig. 6.3 Removing the main PCB and CRT.

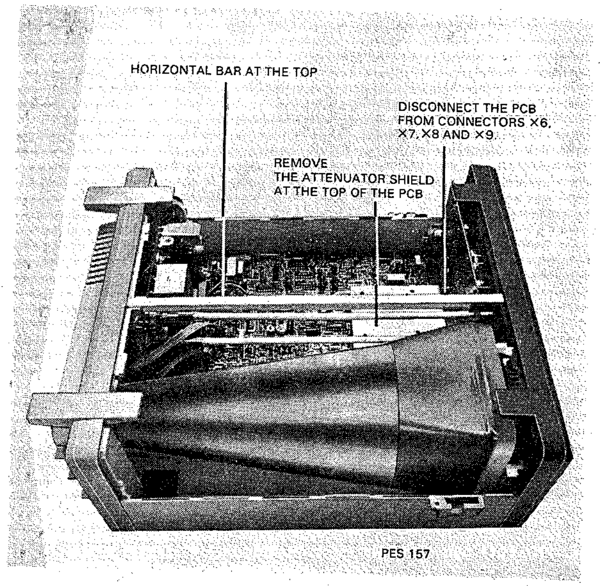


Fig. 6.4 Removing the main PCB unit.

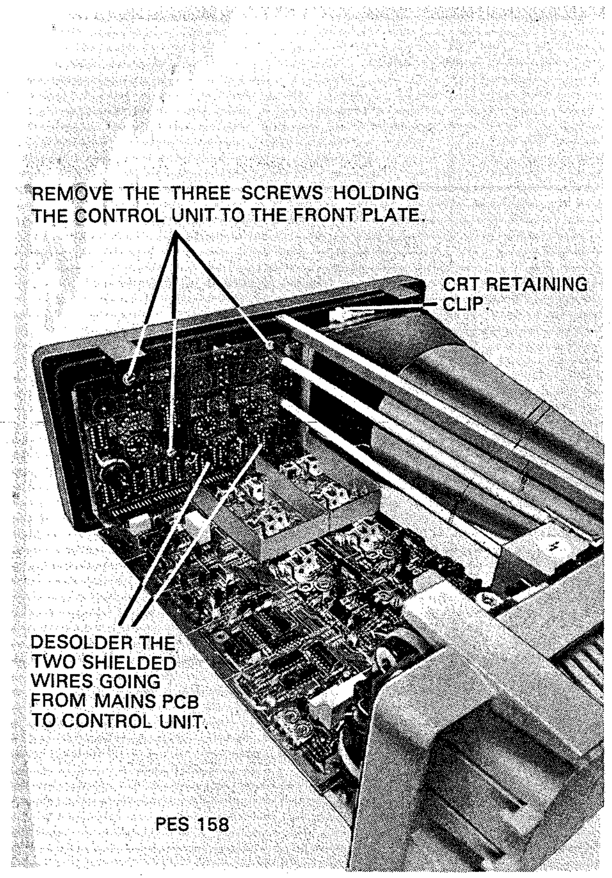


Fig. 6.5 Removing the control unit and CRT.

6. CORRECTIVE MAINTENANCE

6.1 REPLACEMENTS

⚠ **WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.**
The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be open.
If afterward any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazard involved. Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

Standard parts

Electrical and mechanical replacement parts can be obtained through your local Philips organisation or representative. However, many of the standard electronic components can be obtained from other local suppliers.
Before purchasing or ordering replacement parts, check the parts list for value tolerance, rating and description.

NOTE: *Physical size and shape of a component may affect instrument performance, particularly at high frequences. Always use direct-replacement components, unless it is known that a substitute will not degrade instrument performance.*

Special parts

In addition to the standard electronic components, some special components are used.
These components are manufactured or selected by Philips to meet specific performance requirements.

Transistors and integrated circuits

Transistors and I.C.'s (integrated circuits) should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance return them to their original sockets. Unnecessary replacement or switching of semiconductor devices may affect the calibration of the instrument. When a transistor is replaced, check the operation of the part of the instrument that may be affected.

⚠ **WARNING: Handle silicone grease with care. Avoid getting silicone grease in the eyes. Wash hands thoroughly after use.**

Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the sockets and cut the leads to the same length as on the component being replaced.

6.1.1. **Replacing the mains fuse**

To replace the mains fuse F501 which is located on the power supply board, the top cover should first be removed as described under Sec. 3.2. The mains fuse which is a slow blow fuse, can be removed from its holder, and replaced, if necessary. (See fig. 6.2.).

6.1.2. **Replacing Mains Cord or Transformer**

- Unlock the "INTENS" and "FOCUS" extension shafts on the power supply side as follows :-

  Remove the plastic tubing which covers the coupling between the shaft and the potentiometer. (See fig. 6.1.)
  Loosen the two socket set screws on the coupling with an allen key (M3) of 1.5mm across flats.

WARNING: **The intensity and focus potentiometers and their shafts are at 2000V with respect to earth. So a protective plastic tubing covers these shafts. While unlocking the "INTENS" and "FOCUS" extension shafts, the instrument has to be disconnected from voltage sources.**

- Remove the four transformer mounting screws. (See fig. 6.2.).
- Remove the two screws at the top of the power supply unit holding it to the rear cover (See fig. 6.1.)
- Remove the two screws at the bottom of the power supply unit holding it to the horizontal bars.
- Now the power supply unit is free and the back side of this unit is now accessible. The transformer can now be desoldered and replaced if necessary. Before replacing the transformer the thermal fuse on the transformer can be checked.
- To replace the mains cord, desolder the two wires of the mains cord from switch S3/R6 and also the safety earth terminal.
- Remove the grommet at the rear.
- Solder the mains cord and fix the grommet.

6.1.3. **Removing and replacing components on the main PCB**

To remove and replace components on the main PCB, the top and bottom cover should first be removed as described in Sec. 3.2.

- All components on the main PCB can now be accessed.

To replace the main PCB, the following procedure should now be adopted :-

- Remove the screw holding the attenuator shield at the top of the PCB and remove the shield (See fig. 6.4.)
- Remove the attenuator shield at the bottom of the PCB by removing the screw which holds it to the PCB.
- Remove the six screws holding this PCB to the horizontal bars.
- Remove the two plugs X11 and X12 going to the CRT socket.
- Disconnect the connector X10 from the power supply PCB (Fig. 6.1.)
- Disconnect the resistor connecting the main PCB to BNC socket X5. (Fig. 6.3.)
- Disconnect the shielded cable at the bottom of the PCB going to X1 (Fig. 6.3.)
- Desolder the two shielded wires going from the main PCB to the control unit (Fig. 6.5.)
- Slide the PCB towards the rear of the instrument and thus disconnect this PCB from connectors X6, X7, X8 and X9. (See fig. 6.4.)
- The main amplifier board can now be lifted and replaced.

6.1.4. **Removing and replacing components on the control unit.**

- To remove or replace components on the control unit, first remove the main PCB as described in Sec. 6.1.3.
- Remove the three screws holding the control unit to the front plate. (Fig. 6.5.)
- Remove all the knobs on the front panel.

- Unlock the "INTENS" and "FOCUS" extension shafts as mentioned in Sec. 6.1.2.
- Desolder the two wires (red and yellow) which go to the trace rotation coil of the CRT.
- The control unit is now free and any component can be replaced.

6.1.5. **Replacing the CRT.**

To replace the CRT, the main PCB is first removed following the procedure described in Sec. 6.1.3.

- Desolder the two wires (red and yellow) which go to the trace rotation coil of the CRT from the control unit.
  Remove the two screws connecting the front plate assembly to the horizontal bars at the bottom. **Care should be taken while removing the screws as it may damage connector X9.** (Fig. 6.3.). Also remove the screw connecting the front plate assembly to the horizontal bar at the top. (Fig. 6.4.).
- Push the front plate assembly forward.
- The two CRT retaining clips holding the CRT to the front plate will come out (Fig. 6.5.).
- Loosen the CRT clamp at the rear of the instrument. (Fig. 6.3.).
- Push the CRT with its metal shield forward and disconnect the CRT from its socket. The CRT is now free.
- Remove the tape holding the trace rotation coil to the neck of the CRT. The trace rotation coil can now be removed.
- The trace rotation coil can now be inserted around the neck of the new CRT and fixed firmly with tape.
- Insert the CRT with the metal shield into its socket and put the CRT in its place.
- Now put the bottom cover.
- Bring the front plate forward, plug it to the bottom cover and tighten the screws holding it to the horizontal bars.
- Position the CRT properly with the retaining clips. Tighten the CRT clamp. Solder the trace rotation coil back.
- Fix the main PCB in its place and tighten the six screws holding it to the horizontal bars. Resolder all the wires that were removed at the time of removing the PCB.
- Fix the top cover.

NOTE: *Take care of the CRT retaining clips and the CRT filter.*

WARNING: Handle the CRT carefully. Rough handling or scratching can cause the CRT to implode.

6.1.6. **Removing and replacing components on power supply board.**

Refer section 6.1.2.

6.2 SPECIAL TOOLS

6.2.1. Trimming Tool Kit (Type 800/NTX)

This useful kit contains 3 twin-coloured holders, 2 extension holders and 21 interchangeable trimming pins. The wide variety of pin allows almost every type of trimming function to be carried out in instruments to be calibrated (e.g. measuring instruments, radio and T.V. sets).
Ordering number 4822 310 50015.
(A spare set containing the 8 most commonly used pins is available under the ordering number 4822 310 50016).

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Fig. 6.6 Trimming Tool kit.

6.3. RECALIBRATION AFTER REPAIR

After any electrical component has been replaced the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuit.
Since the power supply affects all circuits, calibration of the entire instrument should be checked if work has been done in the power supply or if the transformer has been replaced.

6.4. INSTRUMENT REPACKAGING

If the instrument is to be shipped to a Service Centre for service or repair, attach a tag showing owner (with address) and the name of an individual at your firm that can be contacted. The Service Centre needs the complete instrument serial number and a fault description.

Save and re-use the packing in which your instrument was shipped. If the original packing is unfit for use or not available, repack the instrument in such a way that no damage during transport occurs.

6.5. TROUBLE-SHOOTING

6.5.1. Introduction

The following information is provided to facilite trouble shooting. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is helpful in locating troubles, particularly where integrated circuits are used. Refer to the Circuit Description section for this information.

6.5.2. Trouble-Shooting hints

If a fault appears, the following test sequences can be used to find the defective circuit part:

- Check if the settings of the controls of the oscilloscope are correct. Consult the operating instructions in the Operating manual.
- Check the equipment to which the oscilloscope is connected and the interconnection cables.
- Check if the oscilloscope is well-calibrated. If not refer to section 5 (checking and adjusting).
- Visually check the part of the oscilloscope in which the fault is suspected. In this way, it is possible to find faults such as bad soldering connections, bad interconnection plugs and wires, damaged components or transistors and IC's that are not correctly plugged into their sockets.
- Location of the circuit part in which the fault is suspected: the symptom often indicates this part of the circuit. If the power supply is defective the symptom will appear in several circuit parts.

After having carried out the previous steps, individual components in the suspected circuit parts must be examined:

- Transistors and diodes. Check the voltage between base and emitter (0.7 Volt approx. in conductive state) and the voltage between collector and emitter (0.2 Volt approx. in saturation) with a voltmeter or oscilloscope. When removed from the p.c.b. it is possible to test the transistor with an ohmmeter since the base/emitter and base/collector junctions can be regarded as diodes. Like a normal diode, the resistance is very high in one direction and low in the other direction. When measuring take care that the current from the ohmmeter does not damage the component under test.
  Replace the suspected component by a new one if you are sure that the circuit is not in such a condition that the new one will be damaged.
- Integrated circuit. In circuit testing can be done with an oscilloscope or voltmeter. A good knowledge of the circuit part under-test is essential. Therefore first read the circuit description in section 2.
- Capacitors. Leakage can be traced with an ohmmeter adjusted to the highest resistance range. When testing take care of polarity and maximum allowed voltage. An open capacitor can be checked if the response for AC signals is observed. Also a capacitance meter can be used: compare the measured value with value and tolerance indicated in the parts list.

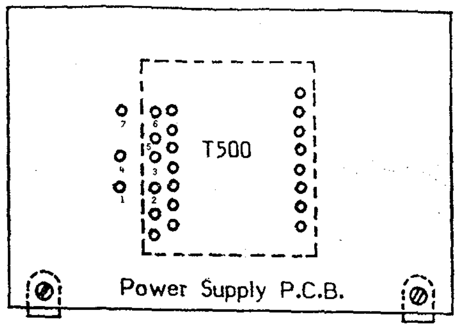
- Resistors. Can be checked with an ohmmeter after having unsoldered one side of the resistor from the p.c.b. Compare the measured value with value and tolerance indicated in the parts list.
- Coils and transformers. An ohmmeter can be used for tracing an open circuit. Shorted or partially shorted windings can be found by checking the wave-form response when HF signals are passed through the circuit. Also an inductance meter can be used.

NOTE: *If a component must be replaced always use a direct-replacement. If not available use an equivalent after carefully checking that it does not degrade the instrument's performance. See also section 6.1. (replacement).*
After replacement of a component the calibration of the instrument may be affected due to component tolerances. If necessary do the required adjustments.

6.6. ADAPTION OF MAINS (LINE) VOLTAGE

Before opening any part of the instrument it must be disconnected from all voltage sources.
Access to the power supply unit:
- Remove the two handle mounting screws.
- Bend the handle brackets outwards and remove it.
- Remove the two cabinet mounting screws which become visible now.
- Press firmly the two buttons of the rear cover until the click (the top cover will lift for approx. 2 mm).
- Now lift vertically the top cover out of the front and rear-cover.
- The power supply board is accessible now to adapt the mains voltage.

- Connections should be changed as follows :



NOTE : FOR 240V CONNECT 3-4 & 6-7
FOR 220V CONNECT 3-4 & 5-6
FOR 120V CONNECT 2-3, 6-7 & 1-4

6.7. SAFETY INSPECTION AND TESTS AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT.

6.7.1 General directives

- Take care that the creepage distances and clearances have not been reduced.
- Before soldering, the wires should be bent through the holes of solder tags, or wrapped around the tag in the form of an open U, or, wiring shall be rigidly maintained by cable clamps or cable lacing.
- Replacing all insulating guards and plates.

6.7.2 Safety components

Components in the primary circuit may only be renewed by components selected by Philips.

6.7.3 Checking the protective earth connection

The correct connection and condition is checked by visual control and by measuring the resistance between the protective lead connection at the plug and the cabinet/frame. The resistance shall not be more than 0.1Ω. During measurement the mains cable should be removed.
Resistance variations indicate a defect.

6.7.4 Checking the insulation resistance

Measure the insulation resistance at U = 500 V dc between the mains connections and the protective lead connections. For this purpose set the mains switch to ON. The insulation resistance shall not be less than 2 M Ω.

NOTE: 2 MΩ a minimum requirement at 40°C and 95% Relative Humidity. Under normal conditions the insulation resistance should be much higher (10...20 M Ω).

6.7.5 Checking the leakage current

The leakage current shall be measured between each pole of the mains supply in turn, and all accessible conductive parts connected together (including the measuring earth terminal).
The leakage current is not excessive if the measured currents from the mentioned parts is ⩽ 3,5 mA rms.

6.7.6 Voltage test

The instrument shall withstand, without electrical breakdown, the application of a test voltage between the supply sircuit and accessible conductive parts that are likely to become energized.
The test potential shall be 1500 V rms at supply-circuit frequency, applied for one second.
The test shall be conducted when the instrument is fully assembled, and with the primary switch in the ON position.
During the test, both sides of the primary circuit of the instrument are connected together and to one terminal of the voltage test equipment; the other voltage test equipment terminal is to be connected to the accessible conductive parts.

6.8. SURVEY OF MEASURING POINTS

- To make fault finding easy, test points M1 to M26 are given below. These test points can be located on the PCB with the help of fig. 6.8 and fig. 6.9.
- Apply a sine wave signal of 120 mV peak to peak to Y A(Y B) input.
- Set AMPL/DIV in 20 mV position.

Measuring point	Location	Values to be measured	Remarks
M1	A3	100 mV p.p. superimposed on 1.5 V DC approx.	Signal on Channel A.
M2	A3	1.5 V DC approx.	
M3	C3	100 mV p.p. superimposed on 1.5 V DC approx.	Signal on Channel B.
M4	C3	1.5 V DC approx.	
M5/M6	A4	1 V p.p. superimposed on 8.1 V DC approx.	Signal on Channel A.
M7/M8	C4	1 V p.p. superimposed on 8.1 V DC approx.	Signal on Channel B.
M9	B6	36 V p.p. on 0 VDC with trace at the centre	Signal on Channel A.
M10	A/B6	36 V p.p. on 0 VDC with trace at the centre	Signal on Channel B.
M11	E5	4 V DC (TTL high voltage) when CH A and CH B is ON and switch S1 in µs position. In ms position of S1, the Chopper frequency of 120 KHZ will be visible.	
M12	D5	TTL high voltage when CH.A is ON and CH.B is OFF	
M13	D5	TTL high voltage when CH.A is OFF and CH.B is ON	
M14	D5	Blanking pulse varying with TIME/DIV position.	
M15	E2	1.2 V p.p. square wave	
M16	E4	4.5 V p.p. square wave	
M17	E3	1.2 V p.p. square wave with NORM/TV switch in TV position	
M18	D4	With switch S1 in µs position needle like pulses and in ms position, no signal	
M19	D/E4	No trigger signal : square wave depending on TIME/DIV position Trigger Signal : Square wave depending on TIME/DIV position and trigger signal.	
M20	D6	Sweep voltage (sawtooth) - 1 V up to + 4.2 V	

Measuring point	Location	Values to be measured	Remarks
M21	D6	Sawtooth	
M22	D6	2.5 V p.p. square wave	
M23	C6	Position control voltage - 1.5 V DC up to + 4.5 V DC	
M24/M25	C6	Sawtooth 100 V p.p. (in X via A position - 60 V up to + 40 V)	
M26	Power Supply (R 528)	Blanking pulse to CRT - 32 V p.p. square wave superimposed on 35 V DC approx.	

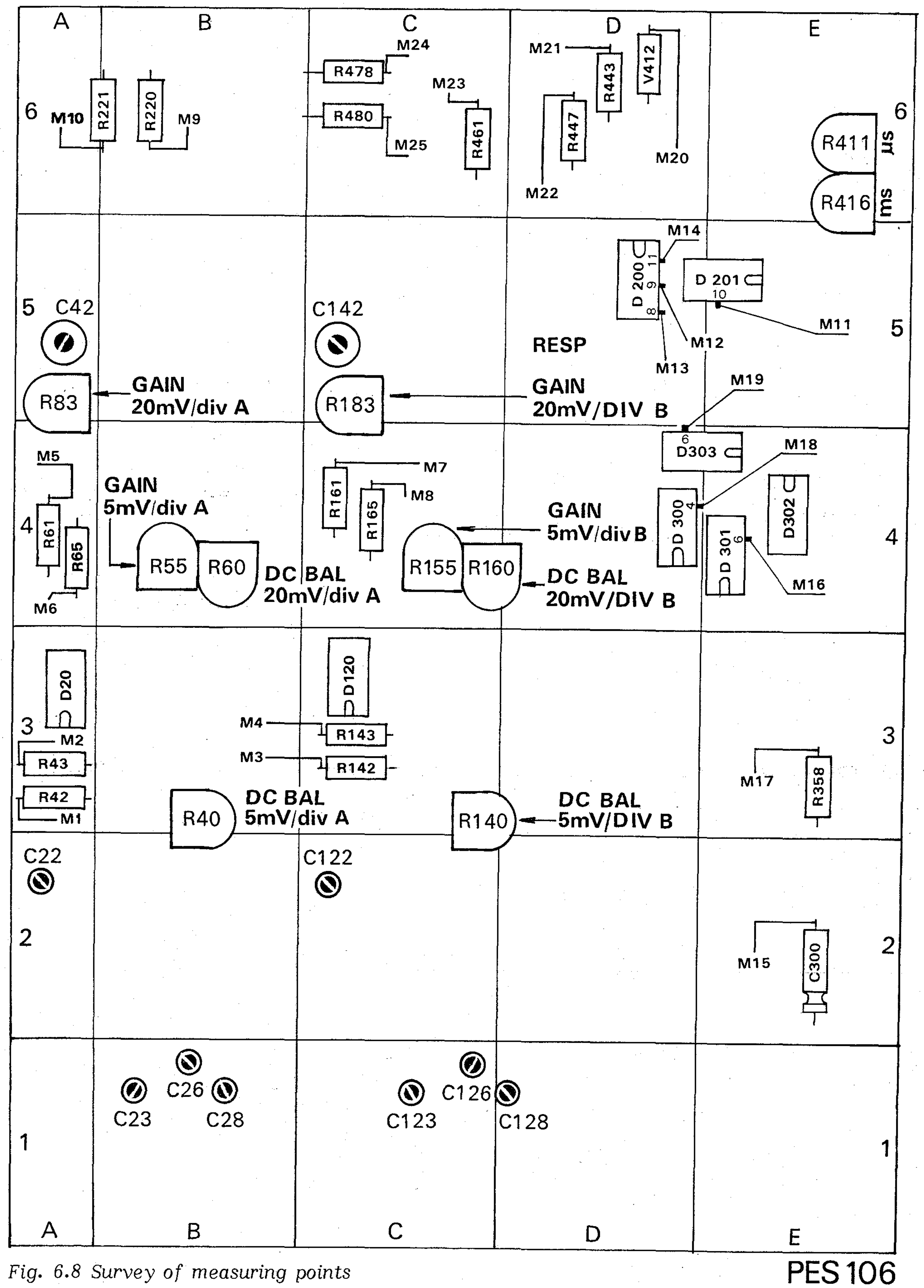


Fig. 6.8 Survey of measuring points

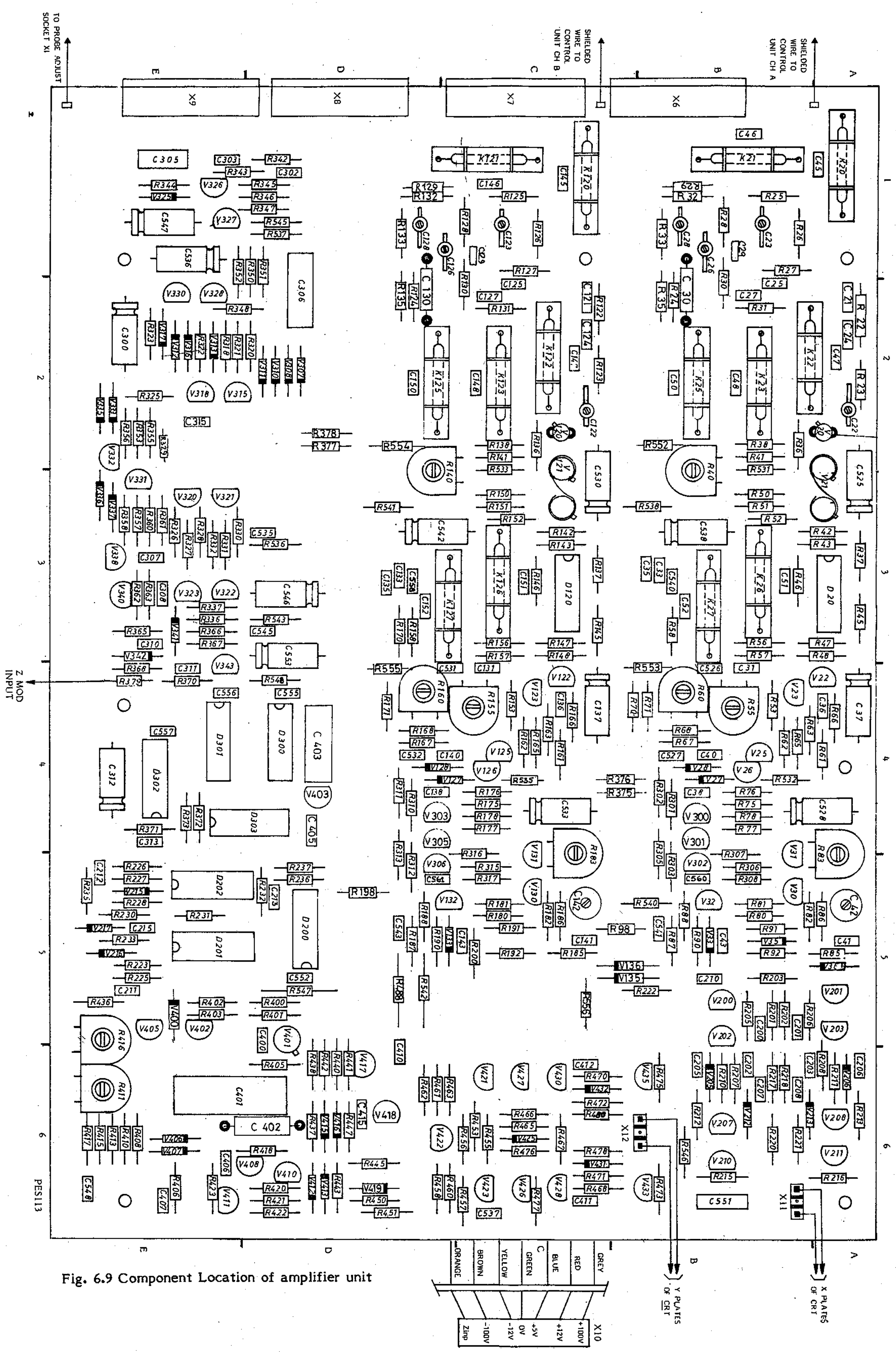


Fig. 6.9 Component Location of amplifier unit

6.9 PIN CONNECTIONS (Refer to Fig. 8.1.)

	1. AMPLIFIER UNIT	CONNECTOR NO./ PIN NO.	CONTROL UNIT
6.9.1	Coil K20, C45	X6-1	V37,V40,S4-3
	Coil K21, C46	X6-2	V57,V58,V60
	Coil K22, C47	X6-3	V42,V45,V60,S4-6
	Coil K25, C50	X6-4	V52,V55,V57,S4-12
	Coil K23, C48	X6-5	V47,V50,V58,S4-9
	Coil K27, C52	X6-6	V38,V43,V48,V53
	R70, C33	X6-7	R2
	R71, C35	X6-8	R2
	Coil K26, C51	X6-9	V41,V46,V51,V56
	+12V	X6-10	+12V
	-12V	X6-11	-12V
	Coil K120, C145	X7-1	V137,V140,S5-3
	Coil K121, C146	X7-2	V157,V158,V160
	Coil K122, C147	X7-3	V142,V145,V160, S5-6
	Coil K125, C150	X7-4	V152,V155,V157,S5-12
	Coil K123, C148	X7-5	V147,V150,V158, S5-9
	Coil K127, C132	X7-6	V138,V143,V148,V153
	C133	X7-7	R3
	R171, C135	X7-8	R3
	Coil K126, C151	X7-9	V141,V143,V151,V156
	D301-9	X7-10	S13-13
	D300-2.12	X7-11	S15-2
		X8-1	
	V321, R329	X8-2	R5
		X8-3	
	V307, V310	X8-4	S14-10
	V300, V307, V308	X8-5	S12-10
	V303, V310, V311	X8-6	S12-12
	R463	X8-7	R4
	V421, R453	X8-8	S2-8
	R456	S8-9	S2-7
	R441,R440,R442,V215	X8-10	S6-10, K28
	V330	X8-11	S14-12
	V331, V333, V337	X9-1	S13-1
	V332, V335, V336	X9-2	S13-3
	V342, R367	X9-3	S1-10
	OV	X9-4	OV
	V333, V335	X9-5	S15-5
	R410, R411	X9-6	S1-1
	R226, C212	X9-7	S8-6
	R415, R416, R417	X9-8	S1-3
	R436	X9-9	R425-R435
	R223, C211	X9-10	S10-6
		X9-11	
6.9.2	POWER SUPPLY UNIT (Refer to Fig. 8.6.)		
	+100V	X10-1	+100V
	+12V	X10-2	+12V
	+5V	X10-3	+5V
	OV	K10-4	OV
	-12V	X10-5	-12V
	-100V	X10-6	-100V
	Z input (D202-13)	X10-7	R522
6.9.3	CRT SOCKET		
	R220	X11-1	CRT Pin 7
	R221	X11-2	CRT Pin 9
	R478	X12-1	CRT Pin 11
	R480	X12-2	CRT Pin 12

7. PARTS LISTS (SUBJECT TO ALTERATION WITHOUT NOTICE).

7.1. Mechanical Parts (See fig. 7.1 & 7.2)

Item	Qty.	Ordering Code	Description
1.	2	5322 447 90604	Top and bottom cover.
2.	1	5322 462 50314	CRT shield.
3.	4	5322 462 40643	Foot.
4.	2	5322 535 91665	Extension shaft
5.	1	5322 255 40541	CRT socket.
6.	1	5322 498 50157	Handle Assembly.
7.	2	5322 522 31739	Handle gear.
8.	1	5322 466 70513	CRT filter.
9.	2	5322 462 44398	Retaining clip.
10.	1	5322 290 40191	CRT clamp assembly.
11.	1	5322 325 50101	Grommet.
12.	1	5322 535 80692	Earth stud with threaded end.
13.	1	5322 506 41004	Knurled nut.
14.	3	5322 414 30063	Switch knob. Dia. 18.7 mm.
15.	3	5322 447 90385	Brown cover for the knob. Dia. 18.7 mm.
16.	5	5322 414 30064	Control knob. Dia. 10 mm.
17.	5	5322 414 70036	Brown cover with line for control knob of dia. 10 mm.
18.	1	5322 447 90602	Front Plate Assembly
19.	1	5322 447 90384	Rear Plate Assembly

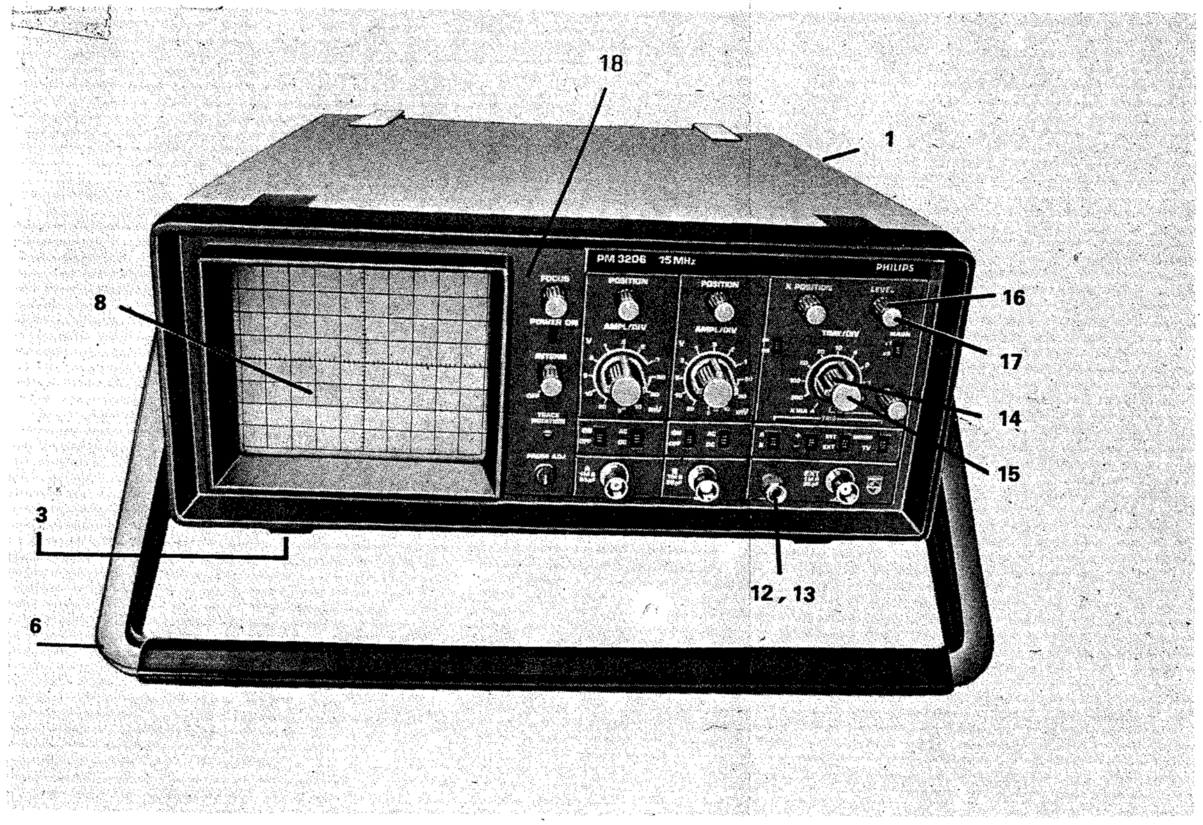


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Fig. 7.1 Mechanical parts, front view.

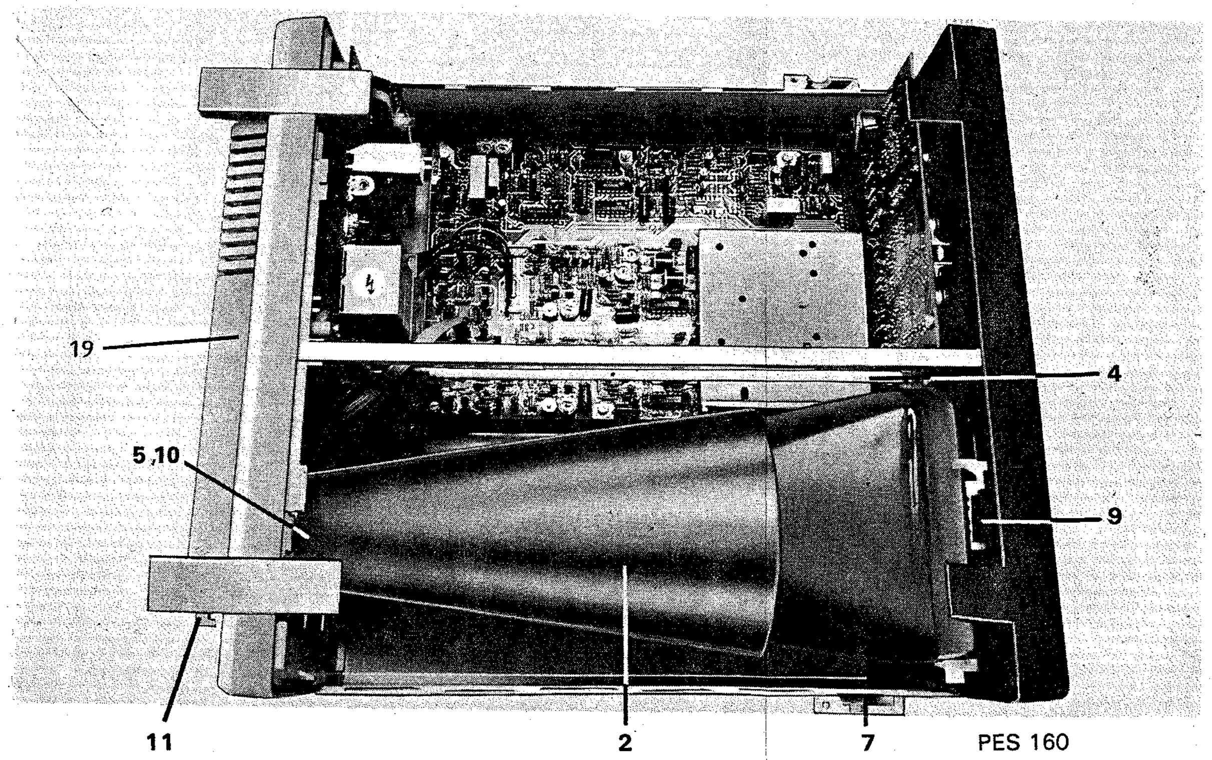


Fig. 7.2 Internal view, top cover removed

7.2 ELECTRICAL PARTS

POSNR	DESCRIPTION				ORDERING CODE
	CAPACITORS				
C 20	CAPACITOR, POLYCAP	27N	10%	400V	4822 121 42066
C 21	CAPACITOR, CERCAP	56P	2%	500V	5322 122 32791
C 22	CAPACITOR, TRIMCAP	5P5		400V	5322 125 54027
C 23	CAPACITOR, TRIMCAP	5P5		400V	5322 125 54027
C 24	CAPACITOR, CERCAP	3P9		500V	5322 122 32789
C 25	CAPACITOR, CERCAP	18P	2%	100V	4822 122 31061
C 26	CAPACITOR, TRIMCAP	5P5		400V	5322 125 54027
C 27	CAPACITOR, CERCAP	330PF	2%	100V	4822 122 31353
C 28	CAPACITOR, TRIMCAP	5P5		400V	5322 125 54027
C 29	CAPACITOR, CERCAP	1P5		100V	5322 122 32101
C 30	CAPACITOR,,POLYCAP	3N3	2%	63V	5322 121 54049
C 31	CAPACITOR, CERCAP	56P	2%	100V	4822 122 32027
C 33	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 35	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 36	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 37	CAPACITOR, ELCAP	33UF		16V	322 124 21431
C 38	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 40	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 41	CAPACITOR, CERCAP	680P	10%	100V	4822 122 30053
C 42	CAPACITOR, TRIMCAP	22P		250V	4822 125 50045
C 43	CAPACITOR, CERCAP	22P	2%	100V	5322 122 32242
C 45	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 46	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 47	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 48	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 50	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 51	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 53	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 120	CAPACITOR, POLYCAP	27N	10%	400V	4822 121 42066
C 121	CAPACITOR CERCAP	56P	2%	500V	5322 122 32791
C 122	CAPACITOR TRIMCAP	5P5		400V	5322 125 54027
C 123	CAPACITOR, TRIMCAP	5P5		400V	5322 125 54027
C 124	CAPACITOR, CERCAP	3P9		500V	5322 122 32789
C 125	CAPACITOR, CERCAP	18P	2%	100V	4822 122 31061
C 126	CAPACITOR TRIMCAP	5P5		400V	5322 125 54027
C 127	CAPACITOR, CERCAP	330PF	2%	100V	4822 122 31353
C 128	CAPACITOR, TRIMCAP	5P5		400V	5322 125 54027
C 129	CAPACITOR, CERCAP	1P5		100V	5322 122 32101
C 130	CAPACITOR, POLYCAP	3N3	2%	63V	5322 121 54049
C 131	CAPACITOR, CERCAP	56P	2%	100V	4822 122 32027
C 133	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 135	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 136	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 137	CAPACITOR, ELCAP	33UF		16V	5322 124 21431
C 138	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 140	CAPACITOR, CERCAP	22N		63V	4822 122 30103
C 141	CAPACITOR, CERCAP	680PF		100V	4822 122 30053
C 142	CAPACITOR, TRIMCAP	22PF		250V	4822 125 50045
C 143	CAPACITOR, CERCAP	22PF	2%	100V	5322 122 32242
C 145	CAPACITOR, CERCAP	22N		63V	4822 122 30103

POSNR		DESCRIPTION					ORDERING CODE		
C	146	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	147	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	148	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	150	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	151	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	152	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	200	CAPACITOR	CERCAP	1P5		100V	5322	122	32101
C	201	CAPACITOR	CERCAP	1P5		100V	5322	122	32101
C	202	CAPACITOR	CERCAP	1P5		100V	5322	122	32101
C	203	CAPACITOR	CERCAP	1P5		100V	5322	122	32101
C	205	CAPACITOR	CERCAP	100P	2%	500V	5322	122	32265
C	206	CAPACITOR	CERCAP	100P	2%	500V	5322	122	32265
C	207	CAPACITOR	CERCAP	10N		100V	4822	122	31414
C	208	CAPACITOR	CERCAP	10N		100V	4822	122	31414
C	210	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	211	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	212	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	213	CAPACITOR	CERCAP	01N	10%	100V	4822	122	30027
C	215	CAPACITOR	CERCAP	3N3	10%	100V	4822	122	30099
C	300	CAPACITOR	ELCAP	22NF		16V	5322	124	21429
C	301	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	302	CAPACITOR	CERCAP	39PF	2%	500V	5322	122	32788
C	303	CAPACITOR	CERCAP	180P	2%	500V	5322	122	32792
C	304	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	305	CAPACITOR	POLYCAP	220N	10%	100V	4822	121	40232
C	306	CAPACITOR	POLYCAP	1UF	10%	100V	5322	121	40197
C	307	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	308	CAPACITOR	CERCAP	4N7	10%	100V	4822	122	30128
C	310	CAPACITOR	CERCAP	4N7	10%	100V	4822	122	30128
C	311	CAPACITOR	CERCAP	3N9	10%	100V	4822	122	30098
C	312	CAPACITOR	ELCAP	33U		16V	5322	124	21431
C	313	CAPACITOR	CERCAP	100P	10%	100V	4822	122	32024
C	315	CAPACITOR	CERCAP	100P	10%	100V	4822	122	32024
C	400	CAPACITOR	CERCAP	150P	2%	100V	4822	122	31413
C	401	CAPACITOR	POLYCAP	2U2	2%	100V	5322	121	44246
C	402	CAPACITOR	POLYCAP	2U2	1%	63V	4822	121	50415
C	403	CAPACITOR	POLYCAP	330N	5%	100V	5322	121	50905
C	405	CAPACITOR	CERCAP	1NF	10%	100V	4822	122	30027
C	406	CAPACITOR	CERCAP	1NF	10%	100V	4822	122	30027
C	407	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	411	CAPACITOR	CERCAP	0P68		500V	4822	122	31213
C	412	CAPACITOR	CERCAP	0P68		500V	4822	122	31213
C	500	CAPACITOR	POLYCAP	150N	10%	1.5KV	5322	121	44329
C	501	CAPACITOR	POLYCAP	150N	10%	1.5KV	5322	121	44329
C	502	CAPACITOR	POLYCAP	150N	10	1.5KV	5322	121	44329
C	503	CAPACITOR	POLYCAP	300N		630V	4822	121	40344
C	505	CAPACITOR	CERCAP	22N		63V	4822	122	30103
C	506	CAPACITOR	POLYCAP	10N		2KV	5322	121	41603
C	507	CAPACITOR	POLYCAP	0.22U	10%	100V	4822	121	40232
C	508	CAPACITOR	POLYCAP	100N	10%	100V	5322	121	40323

POSNR		DESCRIPTION				ORDERING CODE		
C	510	CAPACITOR ELCAP	1000U		25V	5322	124	21428
C	511	CAPACITOR ELCAP	33U		16V	5322	124	21428
C	512	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	513	CAPACITOR ELCAP	1000U		25V	5322	124	21428
C	515	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	516	CAPACITOR ELCAP	100U		160V	5322	124	24221
C	517	CAPACITOR ELCAP	100U		160V	5322	124	24221
C	518	CAPACITOR LCCCAP	10N		3KV	5322	122	54009
C	520	CAPACITOR METCAP	047U		250V	4822	121	40239
C	521	CAPACITOR CERCAP	22PF		100V	4822	122	31063
C	550	CAPACITOR POLYCAP	68N		250V	4822	121	41156
C	535	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	526	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	527	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	528	CAPACITOR ELCAP	33U		16V	5322	124	21431
c	530	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	531	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	532	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	533	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	535	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	536	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	537	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	538	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	540	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	541	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	542	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	543	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	545	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	546	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	547	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	548	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	551	CAPACITOR POLYCAP	68N	10%	250V	4822	121	41156
C	552	CAPACITOR POLYCAP	0.1U	20%	50V	4822	121	42456
C	553	CAPACITOR ELCAP	33U		16V	5322	124	21431
C	555	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	556	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	557	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	558	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	560	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	561	CAPACITOR CERCAP	22N		63V	4822	122	30103
C	410	CAPACITOR CERCAP	22N		63V	4822	122	30103

POSNR		DESCRIPTION			ORDERING CODE		
		RESISTORS					
R	1	CARB.TRACK POTMETER	2M2		5322	101	20735
R	2	CARB. TRACK POTMETER	LIN 220E		5322	101	24159
R	3	CARB. TRACK POTMETER	LIN 220E		5322	101	24159
R	4	CARB. TRACK POTMETER	LIN 10K		5322	101	24164
R	5	CARB. TRACK POTMETER	LIN 10K		5322	101	24164
R	6	CARB. 220K POT + DPST SW			5322	101	40132
R	7	CARB. TRACK LIN 10K + SPST SW			5322	101	40126
R	8	CARB. TRACK POTMETER	LIN 10K		5322	101	24122
R	20	RESISTOR METAL FILM	1K	1%	4822	116	51235
R	21	RESISTOR METAL FILM	100E	1%	5322	116	55549
R	22	RESISTOR METAL FILM	196K	1%	5322	116	50576
R	23	RESISTOR METAL FILM	806K	1%	5322	116	51369
R	24	RESISTOR METAL FILM	2E7A	1%	5322	116	52571
R	25	RESISTOR STD. FILM	2M43	1%	5322	116	53467
R	26	RESISTOR METAL FILM	348K	1%	5322	116	55499
R	27	RESISTOR METAL FILM	348K	1%	5322	116	55499
R	28	RESISTOR STD. FILM	2M43	1%	5322	116	53467
R	29	RESISTOR METAL FILM	1K	1%	4822	116	51235
R	30	RESISTOR METAL FILM	412K	1%	5322	116	55424
R	31	RESISTOR METAL FILM	23K7	1%	5322	116	54646
R	32	RESISTOR STD. FILM	2M43	1%	5322	116	53467
R	33	RESISTOR METAL FILM	576K	1%	5322	116	53466
R	35	RESISTOR METAL FILM	2K43	1%	5322	116	54004
R	36	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	37	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	38	RESISTOR METAL FILM	12K1	1%	5322	116	50572
R	40	POTMETER TRIMMER	1K		4822	100	10037
R	41	RESISTOR METAL FILM	12K1	1%	5322	116	50572
R	42	RESISTOR STD. FILM	10E	5%	4822	116	52332
R	43	RESISTOR STD. FILM	10E	5%	4822	116	52332
R	45	RESISTOR STD. FILM	1K5	5%	4822	116	52399
R	47	RESISTOR METAL FILM	191E	1%	5322	116	54495
R	48	RESISTOR METAL FILM	191E	1%	5322	116	54495
R	50	RESISTOR METAL FILM	6K49	1%	5322	116	54603
R	51	RESISTOR METAL FILM	5K11	1%	5322	116	54595
R	52	RESISTOR METAL FILM	1K21	1%	5322	116	54557
R	53	RESISTOR METAL FILM	51E1	1%	5322	116	54442
R	55	POTMETER TRIMMER	100E		5322	101	14011
R	56	RESISTOR METAL FILM	274E	1%	5322	116	54504
R	57	RESISTOR METAL FILM	51E1	1%	5322	116	54442
R	58	RESISTOR STD. FILM	110K	5%	4822	116	52455
R	60	POTMETER TRIMMER	100K		4822	100	10052
R	61	RESISTOR METAL FILM	3K74	1%	5322	116	54588
R	62	RESISTOR METAL FILM	3K74	1%	5322	116	54588
R	63	RESISTOR METAL FILM	750E	1%	4822	116	51234
R	65	RESISTOR METAL FILM	750E	1%	4822	116	51234
R	66	RESISTOR STD. FILM	560E	5%	4822	110	73101
R	67	RESISTOR STD. FILM	4K3	5%	4822	116	52424
R	68	RESISTOR STD. FILM	3K6	5%	4822	116	52419
R	70	RESISTOR STD. FILM	430E	5%	4822	116	52423

POSNR		DESCRIPTION			ORDERING CODE		
R	71	RESISTOR STD. FILM	430E	5%	4822	116	52423
R	73	RESISTOR METAL FILM	2K61	1%	5322	116	50671
R	75	RESISTOR STD. FILM	1K2	5%	4822	110	73109
R	76	RESISTOR STD. FILM	1K2		4822	110	73109
R	77	RESISTOR STD. FILM	10E	5%	4822	116	52332
R	78	RESISTOR STD. FILM	10E	5%	4822	116	52332
R	80	RESISTOR METAL FILM	453E	1%	5322	116	54523
R	81	RESISTOR METAL FILM	453E	1%	5322	116	54523
R	82	RESISTOR METAL FILM	634E	1%	5322	116	54531
R	83	POTMETER TRIMMER	470E		5322	101	14047
R	85	RESISTOR METAL FILM	33K2	1%	4822	116	51259
R	86	RESISTOR METAL FILM	15E	1%	4822	116	51221
R	87	RESISTOR METAL FILM	90E9	1%	5322	116	54466
R	88	RESISTOR METAL FILM	8K25	1%	5322	116	51498
R	90	RESISTOR METAL FILM	110K	1%	5322	116	54701
R	91	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	92	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	98	RESISTOR STD. FILM	1E0	5%	4822	116	52385
R	120	RESISTOR METAL FILM	1K	1%	4822	116	51235
R	121	RESISTOR METAL FILM	100E	1%	5322	115	55549
R	122	RESISTOR METAL FILM	196K	1%	5322	116	50576
R	123	RESISTOR METAL FILM	806K	1%	5322	116	51369
R	124	RESISTOR METAL FILM	2E74	1%	5322	116	52571
R	125	RESISTOR STD. FILM	2M43	1%	5322	116	53467
R	126	RESISTOR METAL FILM	348K	1%	5322	116	55499
R	127	RESISTOR METAL FILM	348K	1%	5322	116	55499
R	128	RESISTOR STD. FILM	2M43	1%	5322	116	53467
R	129	RESISTOR METAL FILM	1K0	1%	4822	116	51235
R	130	RESISTOR METAL FILM	412K	1%	5322	116	55424
R	131	RESISTOR METAL FILM	23K7	1%	5322	116	54646
R	132	RESISTOR METAL FILM	2M43	1%	5322	116	53467
R	133	RESISTOR METAL FILM	576K	1%	5322	166	53466
R	135	RESISTOR METAL FILM	2K43	1%	5322	116	54004
R	136	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	137	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	138	RESISTOR METAL FILM	12K1	1%	5322	116	50572
R	140	POTMETER TRIMMER	1K		4822	100	10037
R	141	RESISTOR METAL FILM	12K1	1%	5322	116	50572
R	142	RESISTOR STD. FILM	10E	5%	4822	116	52332
R	143	RESISTOR STD. FILM	10E	5%	4822	116	52332
R	145	RESISTOR STD. FILM	1K5	5%	4822	116	52399
R	146	RESISTOR STD. FILM	1K5	5%	4822	116	52399
R	147	RESISTOR METAL FILM	191E	1%	5322	116	54495
R	148	RESISTOR METAL FILM	191E	1%	5322	116	54495
R	150	RESISTOR METAL FILM	6K49	1%	5322	116	54603
R	151	RESISTOR METAL FILM	5K11	1%	5322	116	54595
R	152	RESISTOR METAL FILM	1K21	1%	5322	116	54557
R	153	RESISTOR METAL FILM	51E1	1%	5322	116	54442
R	155	POTMETER TRIMMER	100E		5322	101	14011
R	156	RESISTOR METAL FILM	274E	1%	5322	116	54504

POSNR		DESCRIPTION			ORDERING CODE		
R	157	RESISTOR METAL FILM	51E1	1%	5322	116	54442
R	158	RESISTOR STD. FILM	110K	5%	4822	116	52455
R	160	POTMETER TRIMMER	100K		4822	100	10052
R	161	RESISTOR METAL FILM	3K74	1%	5322	116	54588
R	162	RESISTOR METAL FILM	3K74	1%	5322	116	54588
R	163	RESISTOR METAL FILM	750E	1%	4822	116	51234
R	165	RESISTOR METAL FILM	750E	1%	4822	116	51234
R	166	RESISTOR STD. FILM	560E	5%	4822	110	73101
R	167	RESISTOR STD. FILM	4K3	5%	4822	116	52424
R	168	RESISTOR STD. FILM	3K6	5%	4822	116	52419
R	170	RESISTOR STD. FILM	430E	5%	4822	116	52423
R	171	RESISTOR STD. FILM	430E	5%	4822	116	52423
R	173	RESISTOR METAL FILM	2K61	1%	5322	116	50671
R	175	RESISTOR STD. FILM	1K2	5%	4822	110	73109
R	176	RESISTOR STD. FILM	1K2	5%	4822	110	73109
R	177	RESISTOR STD. FILM	10E	5%	4822	116	52332
R	178	RESISTOR STD. FILM	10E	5%	4822	116	52332
R	180	RESISTOR METAL FILM	453E	1%	5322	116	54523
R	181	RESISTOR METAL FILM	453E	1%	5322	116	54523
R	182	RESISTOR METAL FILM	643E	1%	5322	116	54531
R	183	POTMETER TRIMMER	470E		5322	101	14047
R	185	RESISTOR METAL FILM	33K2	1%	4822	116	51259
R	186	RESISTOR METAL FILM	15E	1%	4822	116	51221
R	187	RESISTOR METAL FILM	90E9	1%	5322	116	54466
R	188	RESISTOR METAL FILM	8K25	1%	5322	116	51498
R	190	RESISTOR METAL FILM	110K	1%	5322	116	54701
R	191	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	192	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	198	RESISTOR STD. FILM	1E0	5%	4822	116	52385
R	200	RESISTOR METAL FILM	1K40	1%	5322	116	55569
R	201	RESISTOR METAL FILM	61K9	1%	4822	116	51265
R	202	RESISTOR METAL FILM	61K9	1%	4822	116	51265
R	203	RESISTOR STD. FILM	1K	5%	4822	116	52391
R	205	RESISTOR METAL FILM	5K62	1%	4822	116	51281
R	206	RESISTOR METAL FILM	5K62		4822	116	51281
R	207	RESISTOR METAL FILM	5K62	1%	4822	116	51281
R	208	RESISTOR METAL FILM	5K62	1%	4822	116	51281
R	210	RESISTANCE METAL FILM	121E	1%	5322	116	54426
R	211	RESISTOR METAL FILM	121E	1%	5322	116	54426
R	212	RESISTOR METAL FILM	5K62	1%	4822	116	51281
R	213	RESISTOR METAL FILM	5K62	1%	4822	116	51281
R	215	RESISTOR METAL FILM	5K62	1%	4822	116	51281
R	216	RESISTOR METAL FILM	5K62	1%	4822	116	51281
R	218	RESISTOR STD. FILM	110K	5%	4822	116	52455
R	220	RESISTOR STD. FILM	120E	5%	4822	110	73083
R	221	RESISTOR STD. FILM	120E	5%	4822	110	73083
R	222	RESISTOR STD. FILM	200E	5%	4822	116	52405
R	223	RESISTOR STD. FILM	3K6	5%	4822	116	52419
R	225	RESISTOR STD. FILM	1K	5%	4822	116	52391
R	226	RESISTOR STD. FILM	3K6	5%	4822	116	52419

POSNR		DESCRIPTION			ORDERING CODE		
R	228	RESISTOR STD. FILM	3K6	5%	4822	116	52419
R	230	RESISTOR STD. FILM	1K	5%	4822	116	52391
R	231	RESISTOR STD. FILM	3K6	5%	4822	116	52419
R	232	RESISTOR STD. FILM	1K	5%	4822	116	52391
R	233	RESISTOR METAL FILM	7K15	1%	5322	116	54606
R	235	RESISTOR METAL FILM	7K15	1%	5322	116	54606
R	236	RESISTOR METAL FILM	2K43	1%	5322	116	54004
R	237	RESISTOR METAL FILM	2K43	1%	5322	116	54004
R	301	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	302	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	303	RESISTOR METAL FILM	634E	1%	5322	116	54531
R	305	RESISTOR METAL FILM	634E	1%	5322	116	54531
R	306	RESISTOR METAL FILM	909E	1%	5322	116	55278
R	307	RESISTOR METAL FILM	4K64	1%	5322	116	50484
R	308	RESISTOR METAL FILM	7K32	1%	5322	116	55372
R	310	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	311	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	312	RESISTOR METAL FILM	634E	1%	5322	116	54531
R	313	RESISTOR METAL FILM	634E	1%	5322	116	54531
R	315	RESISTOR METAL FILM	909E	1%	5322	116	55278
R	316	RESISTOR METAL FILM	4K64	1%	5211	116	50484
R	317	RESISTOR METAL FILM	7K32	1%	5322	116	55372
R	318	RESISTOR METAL FILM	825E	1%	5322	116	54541
R	319	RESISTOR METAL FILM	825E	1%	5322	116	54541
R	320	RESISTOR METAL FILM	1K05	1%	4822	116	52898
R	321	RESISTOR METAL FILM	909E	1%	5322	116	55278
R	322	RESISTOR STD. FILM	2K	5%	4822	116	52406
R	323	RESISTOR STD. FILM	1K	5%	4822	116	52391
R	324	RESISTOR METAL FILM	825E	1%	5322	116	54541
R	325	RESISTOR METAL FILM	3K65	1%	5322	116	54587
R							
R	326	RESISTOR METAL FILM	36E5	1%	5322	116	50409
R	327	RESISTOR METAL FILM	36E5	1%	5322	116	50409
R	328	RESISTOR METAL FILM	100E	1%	5322	116	50581
R	329	RESISTOR STD. FILM	100E	5%	4822	116	52389
R	330	RESISTOR STD. FILM	5K1	5%	4822	110	70126
R	331	RESISTOR STD. FILM	5K1	5%	4822	110	70126
R	332	RESISTOR METAL FILM	2K15	1%	5322	116	50767
R	333	RESISTOR METAL FILM	2K49	1%	5322	116	50581
R	335	RESISTOR METAL FILM	2K49	1%	5322	116	50581
R	336	RESISTOR METAL FILM	1K54	1%	5322	116	50586
R	337	RESISTOR METAL FILM	1K3	1%	4822	116	51238
R	338	RESISTOR STD. FILM	6K8	5%	4822	110	73129
R	340	RESISTOR STD. FILM	4K7	5%	4822	116	52426
R	342	RESISTOR METAL FILM	845K	1%	5322	116	52107
R	343	RESISTOR METAL FILM	402K	1%	5322	116	55283
R	344	RESISTOR METAL FILM	301K	1%	5322	116	53743
R	345	RESISTOR METAL FILM	5K6	5%	4822	110	73127
R	346	RESISTOR METAL FILM	26E1	1%	5322	116	50876
R	347	RESISTOR STD. FILM	5K6	5%	4822	110	73127
R	348	RESISTOR STD. FILM	30K	5%	4822	116	52466

POSNR		DESCRIPTION			ORDERING CODE		
R	350	RESISTOR METAL FILM	523E	1%	5322	116	54526
R	351	RESISTOR METAL FILM	523E	1%	5322	116	54526
R	352	RESISTOR METAL FILM	2K32	1%	5322	116	54575
R	353	RESISTOR METAL FILM	1K	1%	4822	116	51235
R	355	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	356	RESISTOR METAL FILM	1K	1%	4822	116	51235
R	357	RESISTOR METAL FILM	3K83	1%	5322	116	54589
R	358	RESISTOR METAL FILM	2K87	1%	5322	116	55279
R	360	RESISTOR METAL FILM	4K02	1%	5322	116	55448
R	361	RESISTOR STD. FILM	1M	5%	4822	116	52493
R	362	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	363	RESISTOR METAL FILM	3K16	1%	5322	116	50579
R	365	RESISTOR METAL FILM	10K	1%	4822	116	51253
R	366	RESISTOR STD. FILM	1M	5%	4822	116	52493
R	367	RESISTOR METAL FILM	196K	1%	5322	116	55364
R	368	RESISTOR METAL FILM	10K	1%	4822	116	51253
R	370	RESISTOR STD. FILM	2K	5%	4822	116	52406
R	371	RESISTOR STD. FILM	5K1	5%	4822	110	70126
R	272	RESISTOR STD. FILM	1K	5%	4822	116	52391
R	373	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	375	RESISTOR STD. FILM	1E0	5%	4822	116	52385
R	376	RESISTOR STD. FILM	1E0	5%	4822	116	52385
R	377	RESISTOR STD. FILM	1E0	5%	4822	116	52385
R	378	RESISTOR STD. FILM	1E0	5%	4822	116	52385
R	379	RESISTOR STD. FILM	200E	5%	4822	116	52405
R	380	RESISTOR STD. FILM	2K	5%	4822	116	52406
R	400	RESISTOR METAL FILM	1K	1%	4822	116	51235
R	401	RESISTOR METAL FILM	10K	1%	4822	116	51253
R	402	RESISTOR STD. FILM	5K6	5%	4822	116	73127
R	403	RESISTOR METAL FILM	11K	1%	5322	116	54623
R	404	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	405	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	406	RESISTOR STD. FILM	51K	5%	4822	116	52473
R	408	RESISTOR METAL FILM	16K9	1%	5322	116	54635
R	410	RESISTOR METAL FILM	3K16	1%	5322	116	50579
R	411	POTMETER TRIMMER	22K		5322	101	14069
R	413	RESISTOR METAL FILM	16K9	1%	5322	116	54635
R	415	RESISTOR METAL FILM	3K16	1%	5322	116	50579
R	416	POTMETER TRIMMER	22K		5322	101	14069
R	417	RESISTOR METAL FILM	1K15	1%	5322	116	54606
R	418	RESISTOR STD. FILM	51E	5%	4822	116	52369
R	420	RESISTOR METAL FILM	30K1	1%	5322	116	54655
R	421	RESISTOR METAL FILM	316E	1%	5322	116	54511
R	422	RESISTOR METAL FILM	2K05	1%	5322	116	50664
R	423	RESISTOR METAL FILM	51K1	1%	5322	116	50672
R	425	RESISTOR METAL FILM	768K	1%	5322	116	52106
R	426	RESISTOR METAL FILM	383K	1%	5322	116	55335
R	427	RESISTOR METAL FILM	191K	1%	5322	116	55363
R	428	RESISTOR METAL FILM	76K8	1%	5322	116	54687
R	430	RESISTOR METAL FILM	38K3	1%	5322	116	55369

POSNR		DESCRIPTION			ORDERING CODE		
R	431	RESISTOR METAL FILM	18K7	1%	5322	116	55362
R	432	RESISTOR METAL FILM	7K32	1%	5322	116	55372
R	433	RESISTOR METAL FILM	3K48	1%	5322	116	55367
R	435	RESISTOR METAL FILM	1K58	1%	5322	116	50622
R	436	RESISTOR METAL FILM	274E	1%	5322	116	54504
R	437	RESISTOR STD. FILM	5K1	5%	4822	110	70126
R	438	RESISTOR METAL FILM	100K	1%	4822	116	51268
R	440	RESISTOR METAL FILM	20K5	1%	5322	116	55419
R	441	RESISTOR METAL FILM	51K1	1%	5322	116	50672
R	442	RESISTOR METAL FILM	5K11	1%	5322	116	54595
R	443	RESISTOR METAL FILM	20K5	1%	5322	116	55419
R	445	RESISTOR METAL FILM	1K27	1%	5322	116	50555
R	447	RESISTOR METAL FILM	7K5	1%	5322	116	54608
R	450	RESISTOR METAL FILM	6K65	1%	5322	116	54604
R	451	RESISTOR METAL FILM	4K99	1%	5322	116	50523
R	453	RESISTOR METAL FILM	1K78	1%	5322	116	50515
R	455	RESISTOR METAL FILM	1K78	1%	5322	116	50515
R	456	RESISTOR METAL FILM	806E	1%	5322	116	54539
R	457	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	458	RESISTOR STD. FILM	2K	5%	4822	116	52406
R	460	RESISTOR STD. FILM	750E	5%	4822	116	52432
R	461	RESISTOR METAL FILM	2K87	1%	5322	116	55279
R	462	RESISTOR METAL FILM	2K	1%	5322	116	54572
R	463	RESISTOR METAL FILM	4K64	1%	5322	116	50484
R	465	RESISTOR METAL FILM	3K16	1%	5322	116	50579
R	466	RESISTOR METAL FILM	3K16	1%	5322	116	50579
R	467	RESISTOR METAL FILM	3K16	1%	5322	116	50579
R	468	RESISTOR METAL FILM	82K5	1%	5322	116	55374
R	470	RESISTOR METAL FILM	82K5	1%	5322	116	55374
R	471	RESISTOR METAL FILM	348E	1%	5322	116	54515
R	472	RESISTOR METAL FILM	348E	1%	5322	116	54515
R	473	RESISTOR METAL FILM	82K5	1%	5322	116	55374
R	475	RESISTOR METAL FILM	82K5	1%	5322	116	55374
R	476	RESISTOR STD. FILM	16K	5%	4822	116	52459
R	477	RESISTOR STD. FILM	100K	5%	4822	116	52543
R	478	RESISTOR STD. FILM	510E	5%	4822	110	70099
R	480	RESISTOR STD. FILM	510E	5%	4822	110	70099
R	488	RESISTOR STD. FILM	1E0	5%	4822	116	52385
R	500	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	501	POTMETER TRIMMER	220K		4822	100	10088
R	502	RES. HI-TENSION	1M2	5%	4822	110	72189
R	503	RES. HI-TENSION	8M2	5%	4822	110	42212
R	504	RES. HI-TENSION	2M7	5%	4822	110	72198
R	505	RESISTOR STD. FILM	82K	5%	4822	116	52478
R	506	RESISTOR STD. FILM	120K	5%	4822	116	52496
R	508	RESISTOR STD. FILM	27K	5%	4822	116	52465
R	509	RESISTOR METAL FILM	3M	5%	5322	116	51836
R	510	RESISTOR HI-TENSION	2M7	5%	4822	110	72198
R	511	RESISTOR HI-TENSION	2M7	5%	4822	110	72198
R	512	RESISTOR HI-TENSION	22M	5%	4822	110	42223

POSNR		DESCRIPTION			ORDERING CODE		
R	513	RESISTOR STD. FILM	10K	5%	4822	116	52452
R	515	RESISTOR STD. FILM	75E	5%	4822	116	52377
R	516	RESISTOR STD. FILM	110K	5%	4822	116	52455
R	517	RESISTOR STD. FILM	1K	5%	4822	116	52391
R	519	RESISTOR STD. FILM	5K1	5%	4822	110	70126
R	520	RESISTOR STD. FILM	110K	5%	4822	116	52455
R	521	RESISTOR STD. FILM	1K5	5%	4822	116	52399
R	522	RESISTOR METAL FILM	1K78	1%	5322	116	50515
R	523	RESISTOR METAL FILM	4K64	1%	5322	116	50484
R	525	RESISTOR METAL FILM	23K7	1%	5322	1[illegible]	54646
R	526	RESISTOR METAL FILM	20K5	1%	5322	116	55419
R	527	RESISTOR METAL FILM	274E	1%	5322	116	54504
R	528	RESISTOR METAL FILM	511E	1%	4822	116	51282
R	530	RESISTOR METAL FILM	1K50	1%	4822	116	51239
R	531	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	532	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	533	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	535	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	536	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	537	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	538	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	540	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	541	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	542	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	543	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	545	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	546	RESISTOR STD. FILM	22E	5%	4822	116	52349
R	547	RESISTOR STD. FILM	1E	5%	4822	116	52385
R	548	RESISTOR STD. FILM	1E	5%	4822	116	52385
R	552	RESISTOR STD. FILM	1E	5%	4822	116	52385
R	553	RESISTOR STD. FILM	1E	5%	4822	116	52385
R	554	RESISTOR STD. FILM	1E	5%	4822	116	52385
R	555	RESISTOR STD. FILM	1E	5%	4822	116	52385
R	556	RESISTOR STD. FILM	1E	5%	4822	116	52385
R	341	RESISTOR STD. FILM	360E	5%	4822	116	52418

POSNR		DESCRIPTION		ORDERING CODE		
		SEMI CONDUCTORS				
V	20	DIODE	BAV45	5322	130	34037
V	21	TRANSISTOR,\FET	BFS21A	5322	130	40709
V	22	TRANSISTOR	BF199	4822	130	44154
V	23	TRANSISTOR	BF199	4822	130	44154
V	25	TRANSISTOR	BC558B	4822	130	44197
V	26	TRANSISTOR		4822	130	44197
V	27	DIODE, REFERENCE ZENER	BZX75C3V6	4822	130	30765
V	28	DIODE, REFERENCE ZENER	BZX75C3V6	4822	130	30765
V	30	TRANSISTOR	BF199	4822	130	44154
V	31	TRANSISTOR	BF199	4822	130	44154
V	32	TRANSISTOR	BF199	4822	130	44154
V	33	DIODE	1N4148	4822	130	30621
V	35	DIODE	1N4148	4822	130	30621
V	36	DIODE	1N4148	4822	130	30621
V	37	DIODE	1N4148	4822	130	30621
V	38	DIODE	1N4148	4822	130	30621
V	40	DIODE	1N4148	4822	130	30621
V	41	DIODE	1N4148	4822	130	30621
V	42	DIODE	1N4148	4822	130	30621
V	43	DIODE	1N4148	4822	130	30621
V	45	DIODE	1N4148	4822	130	30621
V	46	DIODE	1N4148	4822	130	30621
V	47	DIODE	1N4148	4822	130	30621
V	48	DIODE	1N4148	4822	130	30621
V	50	DIODE	1N4148	4822	130	30621
V	51	DIODE	1N4148	4822	130	30621
V	52	DIODE	1N4148	4822	130	30621
V	53	DIODE	1N4148	4822	130	30621
V	55	DIODE	1N4148	4822	130	30621
V	56	DIODE	1N4148	4822	130	30621
V	57	DIODE	1N4148	4822	130	30621
V	58	DIODE	1N4148	4822	130	30621
V	60	DIODE	1N4148	4822	130	30621
V	120	DIODE	BAV45	5322	130	34037
V	121	TRANSISTOR,FET	BFS21A	5322	130	40709
V	122	TRANSISTOR	BF199	4822	130	44154
V	123	TRANSISTOR	BF199	4822	130	44154
V	126	TRANSISTOR	BC558B	4822	130	44197
V	127	DIODE,REFERENCE ZENER	BZX75C3V6	4822	130	30765
V	128	DIODE,REFERENCE ZENER	BZX75C3V6	4822	130	30765
V	130	TRANSISTOR	BF199	4822	130	44154
V	131	TRANSISTOR	BF199	4822	130	44154
V	132	TRANSISTOR	BF199	4822	130	44154
V	133	DIODE	1N4148	4822	130	30621
V	135	DIODE	1N4148	4822	130	30621
V	136	DIODE	1N4148	4822	130	30621
V	125	TRANSISTOR	BC558B	4822	130	44197
V	138	DIODE	1N4148	4822	130	30621
V	140	DIODE	1N4148	4822	130	30621
V	142	DIODE	1N4148	4822	130	30621

POSNR		DESCRIPTION		ORDERING CODE		
V	143	DIODE	1N4148	4822	130	30621
V	145	DIODE	1N4148	4822	130	30621
V	146	DIODE	1N4148	4822	130	30621
V	147	DIODE	1N4148	4822	130	30621
V	148	DIODE	1N4148	4822	130	30621
V	150	DIODE	1N4148	4822	130	30621
V	151	DIODE	1N4148	4822	130	30621
V	152	DIODE	1N4148	4822	130	30621
V	153	DIODE	1N4148	4822	130	30621
V	155	DIODE	1N4148	4822	130	30621
V	156	DIODE	1N4148	4822	130	30621
V	157	DIODE	1N4148	4822	130	30621
V	158	DIODE	1N4148	4822	130	30621
V	160	DIODE	1N4148	4822	130	30621
V	200	TRANSISTOR	BF199	4822	130	44154
V	201	TRANSISTOR	BF199	4822	130	44154
V	202	TRANSISTOR	BF199	4822	130	44154
V	203	TRANSISTOR	BF199	4822	130	44154
C	205	DIODE,REFERENCE ZENER	BZX75C1V4	4822	130	34047
V	206	DIODE,REFERENCE ZENER	BZX75C1V4	4822	130	34047
V	207	TRANSISTOR	BF199	4822	130	44154
V	208	TRANSISTOR	BF199	4822	130	44154
V	210	TRANSISTOR	BF199	4822	130	44154
V	211	TRANSISTOR	BF199	4822	130	44154
V	212	DIODE,REFERENCE ZENER	BZX79C56	4822	130	34258
V	213	DIODE,REFERENCE ZENER	BZX79C56	4822	130	43258
V	215	DIODE	1N4148	4822	130	30621
V	216	DIODE	1N4148	4822	130	30621
V	217	DIODE	1N4148	4822	130	30621
V	300	TRANSISTOR	BF450	4822	130	44237
V	301	TRANSISTOR	BF450	4822	130	44237
V	302	TRANSISTOR	BC558B	4822	130	44197
V	303	TRANSISTOR	BF450	4822	130	44237
V	305	TRANSISTOR	BF450	4822	130	44237
V	306	TRANSISTOR	BC558B	4822	130	44197
V	307	DIODE	1N4148	4822	130	30621
V	308	DIODE	1N4148	4822	130	30621
V	310	DIODE	1N4148	4822	130	30621
V	311	DIODE	1N4148	4822	130	30621
V	312	DIODE	1N4148	4822	130	30621
V	313	DIODE,REFERENCE ZENER	BZX79C5V6	4822	130	34173
V	315	TRANSISTOR	BF199	4822	130	44154
V	316	DIODE,REFERENCE ZENER	BZX79C6V2	4822	130	34167
V	317	DIODE	1N4148	4822	130	30621
V	318	TRANSISTOR	BC548C	4822	130	44196
V	320	TRANSISTOR	BF199	4822	130	44154
V	321	TRANSISTOR	BF199	4822	130	44154
V	322	TRANSISTOR	BF199	4822	130	44154
V	323	TRANSISTOR	BC558B	4822	130	44197
V	325	DIODE	1N4148	4822	130	30621

POSNR	DESCRIPTION		ORDERING CODE
V 326	TRANSISTOR	BC558B	4822 130 44197
V 327	TRANSISTOR	BC558B	4822 130 44197
V 328	TRANSISTOR	BC558B	4822 130 44197
V 330	TRANSISTOR	BC558B	4822 130 44197
V 331	TRANSISTOR	BC548C	4822 130 44196
V 332	TRANSISTOR	BC548C	4822 130 44196
V 333	DIODE	1N4148	4822 130 30621
V 335	DIODE	1N4148	4822 130 30621
V 336	DIODE	1N4148	4822 130 30621
V 337	DIODE	1N4148	4822 130 30621
V 338	TRANSISTOR	BC558B	4822 130 44197
V 340	TRANSISTOR	BC548C	4822 130 44196
V 341	DIODE	1N4148	4822 130 30621
V 342	DIODE	1N4148	4822 130 30621
V 343	TRANSISTOR	BC558B	4822 130 44197
V 400	DIODE	1N4148	4422 130 30621
V 401	TRANSISTOR	BSX20	4822 130 41705
V 402	TRANSISTOR	BC548C	4822 130 44196
V 403	TRANSISTOR	BC548C	4822 130 44196
V 405	TRANSISTOR	BC558B	4822 130 44197
V 406	DIODE	1N4148	4822 130 30621
V 407	DIODE	1N4148	4822 130 30621
V 408	TRANSISTOR	BC548C	4822 130 44196
V 410	TRANSISTOR	BC548C	4822 130 44196
V 411	TRANSISTOR	BC548C	4822 130 44196
V 412	DIODE	1N4148	4822 130 30621
V 413	DIODE	1N4148	4822 130 30621
V 415	DIODE	1N4148	4822 130 30621
V 416	DIODE	1N4148	4822 130 30621
V 417	TRANSISTOR	BC558B	4822 130 44197
V 418	TRANSISTOR	BC548C	4822 130 44196
V 419	DIODE	1N4148	4822 130 30621
V 421	TRANSISTOR	BF423	4822 130 41646
V 422	TRANSISTOR	BC558B	4822 130 44197
V 423	TRANSISTOR	BF423	4822 130 41646
V 425	DIODE, REFERENCE ZENER	BZX79C6V2	4822 130 34167
V 426	TRANSISTOR	BC548C	4822 130 44196
V 427	TRANSISTOR	BC548C	4822 130 44196
V 428	TRANSISTOR	BF422	4822 130 41782
V 430	TRANSISTOR	BF422	4822 130 41782
V 431	DIODE, REFERENCE ZENER	BZX75C2V1	4822 130 34049
V 432	DIODE, REFERENCE ZENER	BZX75C2V1	4822 130 34049
V 433	TRANSISTOR	BF422	4822 130 41782
V 435	TRANSISTOR	BF422	4822 130 41782
V 500	DIODE	BY548	5322 130 32274
V 501	DIODE	BY548	5322 130 32274
V 502	DIODE	BY548	5322 130 32274
V 503	DIODE	BY548	5322 130 32274
V 504	TRANSISTOR	BF422	4822 130 41782
V 505	TRANSISTOR	BF422	4822 130 41782

POSNR	DESCRIPTION		ORDERING CODE
V 506	TRANSISTOR	BF422	4822 130 41782
V 507	TRANSISTOR	BC548C	4822 130 44196
V 508	DIODE	1N4148	4822 130 30621
V 510	DIODE	BY509	4822 130 41485
V 511	DIODE	BAV21	
V 512	BRIDGE RECT.	SKB2-08/L5A	4822 130 32031
V 513	TRANSISTOR	BC338/16	4822 130 44121
V 515	DIODE,REFERENCE ZENER	BZX79B5V6	4822 130 34173
V 516	BRIDGE RECT.	SKB2-08/L5A	5322 130 32031
V 517	TRANSISTOR	BF422	4822 130 41782
V 518	DIODE, REFERENCE ZENER	BZX75C1V4	4822 130 34047
V 520	TRANSISTOR	BF422	4822 130 41782
V 521	TRANSISTOR	BC548C	4822 130 44196
V 522	TRANSISTOR	BC558B	4822 130 44197

INTEGRATED CIRCUITS

D 20	INTEGR. CIRCUIT	SG3823	5322 209 84862
D 120	INTEGR. CIRCUIT	SG3823	5322 209 84862
D 200	INTEGR. CIRCUIT	74LS74	4822 209 80782
D 201	INTEGR. CIRCUIT	74LS132N	5322 209 85201
D 202	INTEGR. CIRCUIT	74LS02N	5322 209 85312
D 300	INTEGR. CIRCUIT	74LS132N	5322 209 85201
D 301	INTEGR. CIRCUIT	74LS86N	5322 209 84997
D 302	INTEGR. CIRCUIT	74122	5322 209 84231
D 303	INTEGR. CIRCUIT	74LS74	4822 209 80782
D 500	INTEGR. CIRCUIT	7812	4822 209 81016
D 501	INTEGR. CIRCUIT	7912T	5322 209 81856

MISCELLANEOUS

POSNR		DESCRIPTION	ORDERING CODE
		BNC CONNECTOR	5322 267 10004
		SOLDER TAG	5322 290 30204
		HEX NUT (M4)	5322 506 14005
		CONTROL UNIT	5322 216 51112
		POWER SUPPLY UNIT	5322 216 51111
		TEXT STRIP	5322 455 81015
		SCREW 3, 9x13-BLACK	5322 502 14159
		MAINS CORD (EUR-TYPE)	5322 321 14071
		MOLEX CONNECTOR 11 PINS MA	5322 265 40506
		MOLEX CONNECTOR 11 PINS FEM	5322 267 50638
		MOLEX CONNECTOR 7 PINS MA	5322 265 40505
		MOLEX CONNECTOR 7 PINS FEM	5322 267 50439
		REED RELAY CONTACT	5322 280 24126
		CATHODE RAY TUBE 150 BT B31	5322 131 20106
		POWER ON LED	4822 130 31911
F	500	THERMAL FUSE	5322 252 20114
F	501	MAINS FUSE 125 mA SLOW BLOW	4822 253 30007
F	501	MAINS FUSE 250 mA SLOW BLOW	4822 253 30013
K	20	REED RELAY ASSEMBLY	5322 280 20126
K	21	REED RELAY ASSY	5322 280 20126
K	22	REED RELAY ASSY	5322 280 20126
K	23	REED RELAY ASSY	5322 280 20126
K	25	REED RELAY ASSY	5322 280 20126
K	26	REED RELAY ASSY	5322 280 20126
K	27	REED RELAY ASSY	5322 280 20126
K	28	REED RELAY ASSY	5327 280 20126
K	120	REED RELAY ASSY	5322 280 20126
K	121	REED RELAY ASSY	5322 280 20126
K	122	REED RELAY ASSY	5322 280 20126
K	123	FEED RELAY ASSY	5322 280 20126
K	125	REED RELAY ASSY	5322 280 20126
K	126	REED RELAY ASSY	5322 280 20126
K	127	REED RELAY ASSY	5322 280 20126
S	1	SLIDE SWITCH	5322 277 24077
S	2	SLIDE SWITCH	5322 277 24077
S	4	ROTARY AMPL/DIV SWITCH	5322 273 34121
S	5	ROTARY AMPL/DIV SWITCH	5322 273 34121
S	6	ROTARY TIME/DIV SWITCH	5322 273 34119
S	8	SLIDE SWITCH	5322 277 24077
S	9	SLIDE SWITCH	5322 277 24077
S	10	SLIDE SWITCH	5322 277 24077
S	11	SLIDE SWITCH	5322 277 24077
S	12	SLIDE SWITCH	5322 277 24077
S	13	SLIDE SWITCH	5322 277 24077
S	14	SLIDE SWITCH	5322 277 24077
S	15	SLIDE SWITCH	5322 277 24077
T	500	MAINS TRANSFORMER	5322 146 40385

8. CIRCUIT DIAGRAMS and PCB LAY-OUTS.

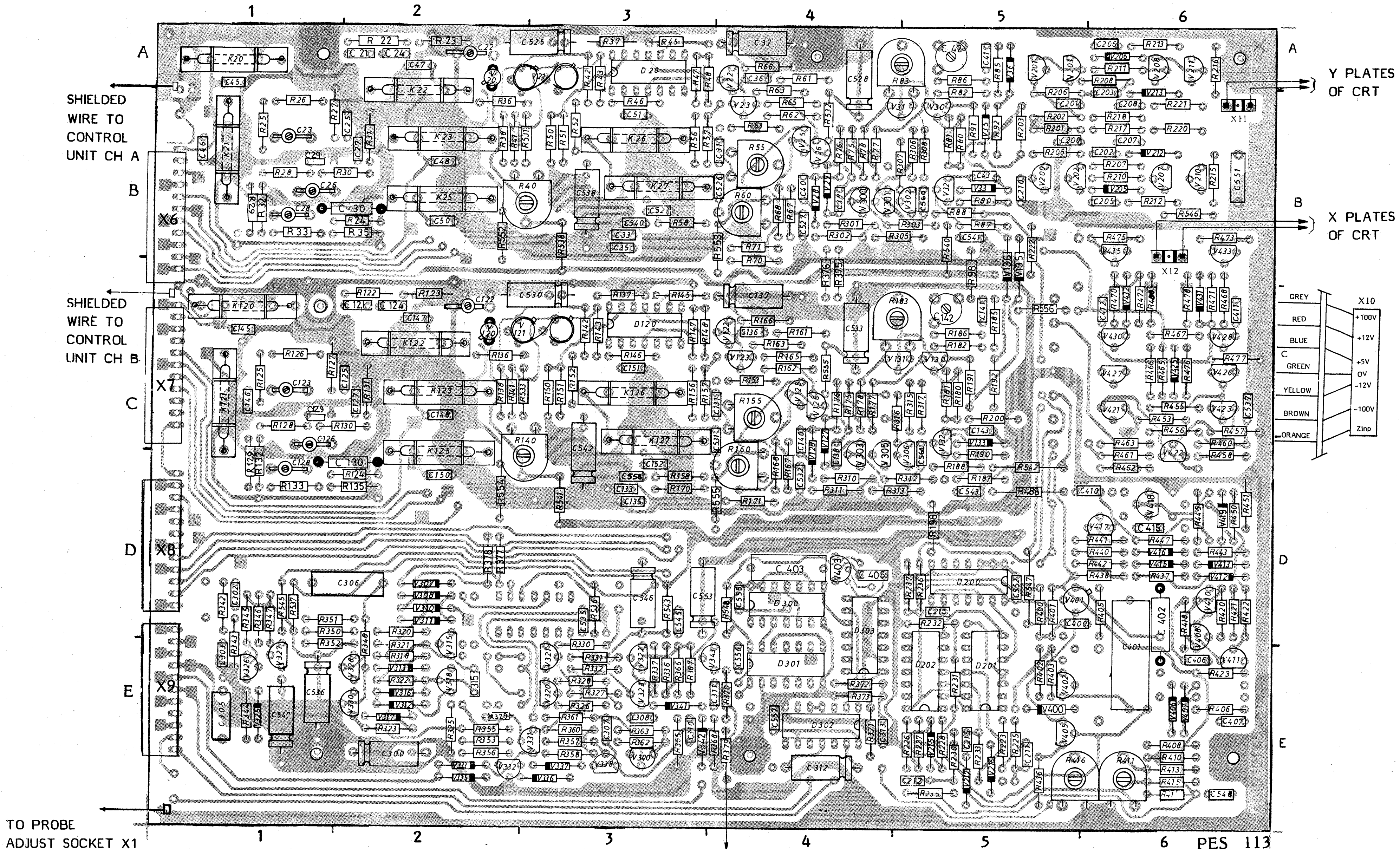


Fig. 8.1 PCB of amplifier unit

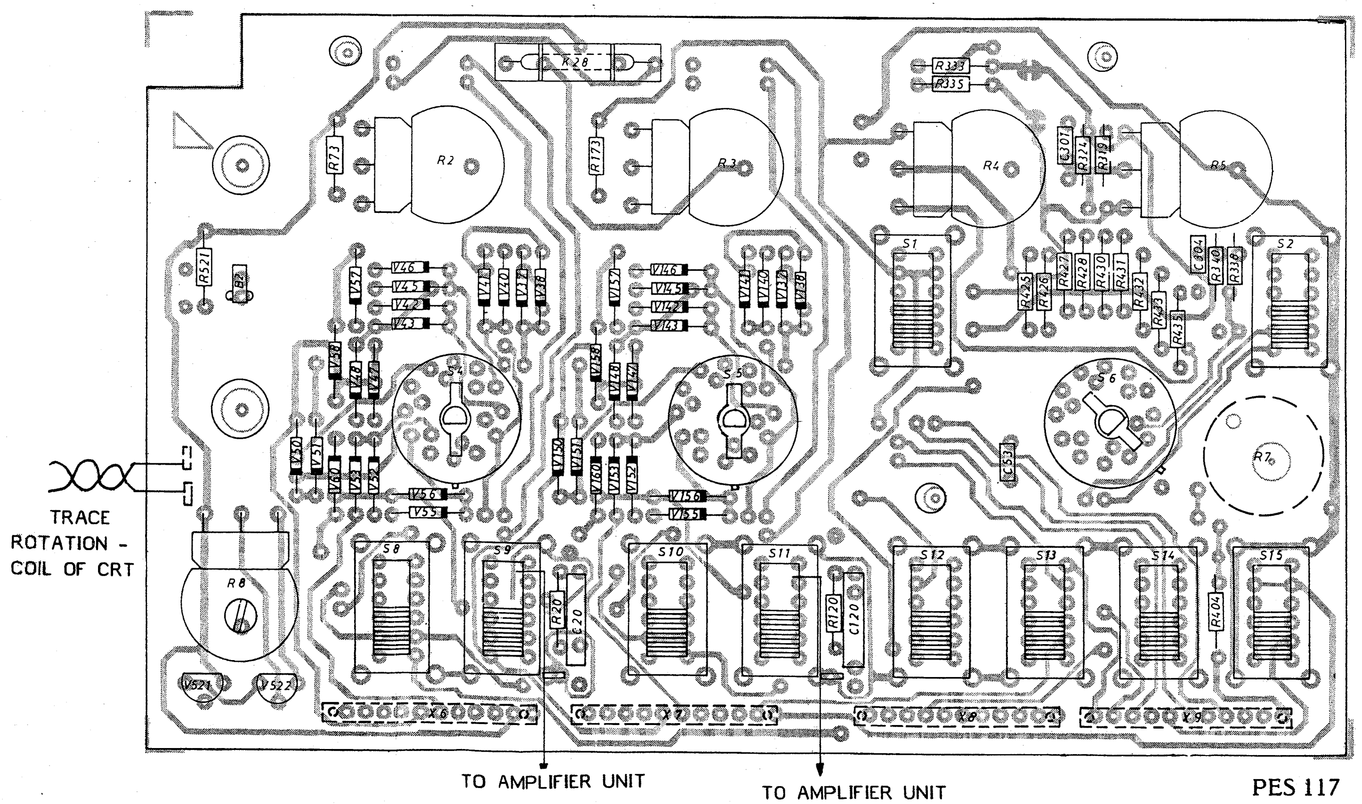


FIG. 8.2 PCB OF CONTROL UNIT

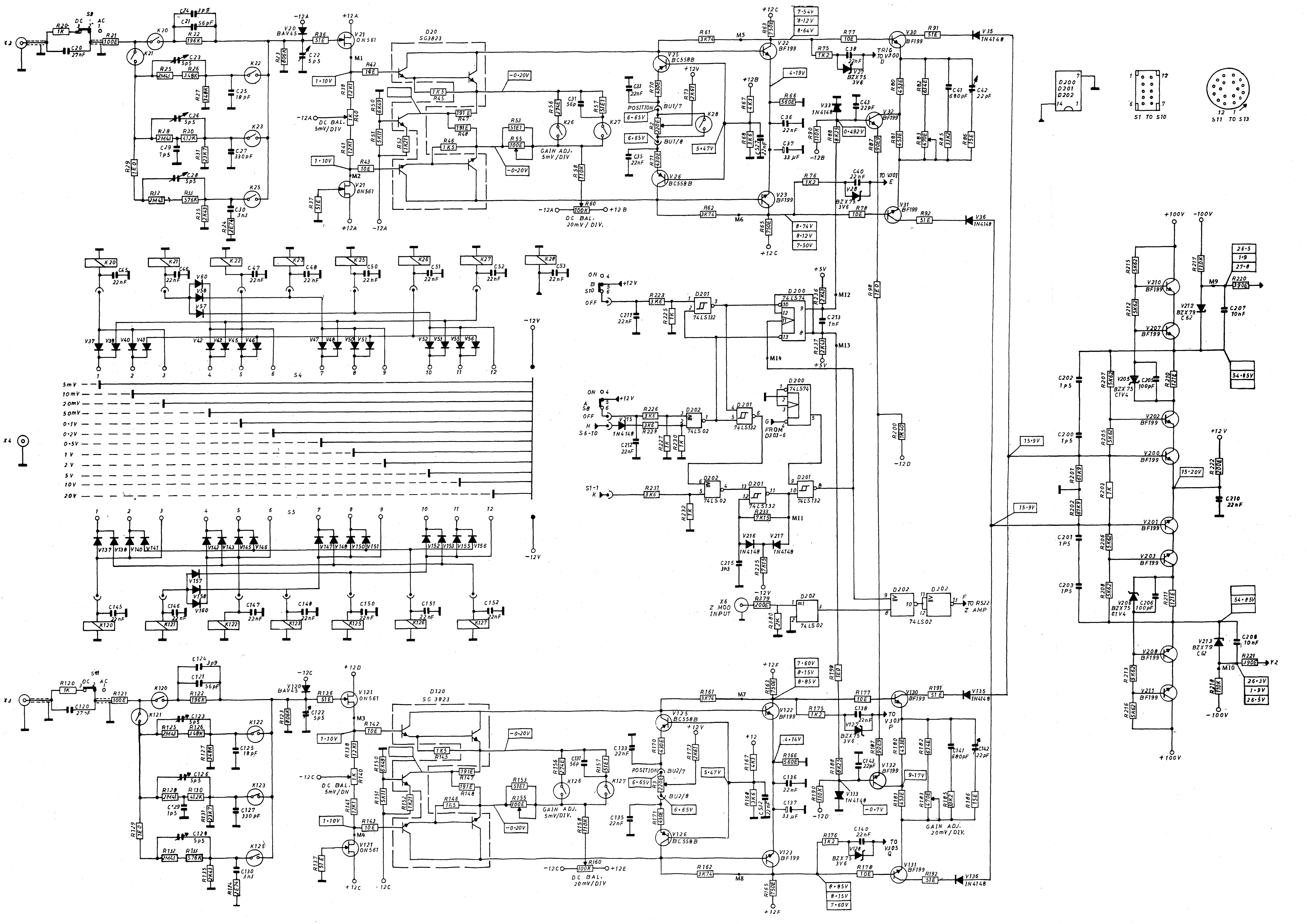
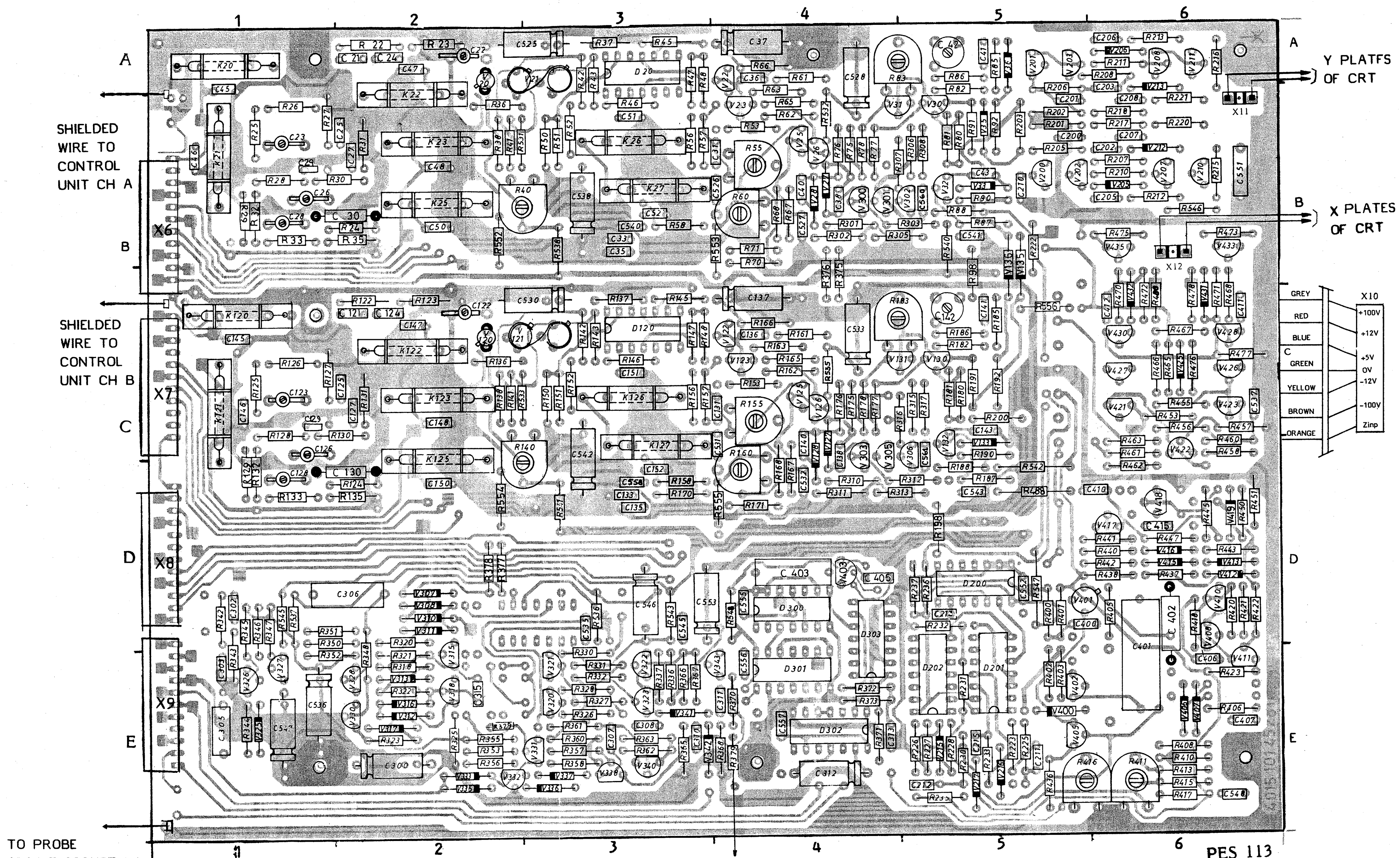


Fig. 8.3 Circuit diagram vertical channel.



TO PROBE ADJUST SOCKET X1

Z MOD INPUT

FIG. 8.4 PCB OF AMPLIFIER UNIT

PES 113

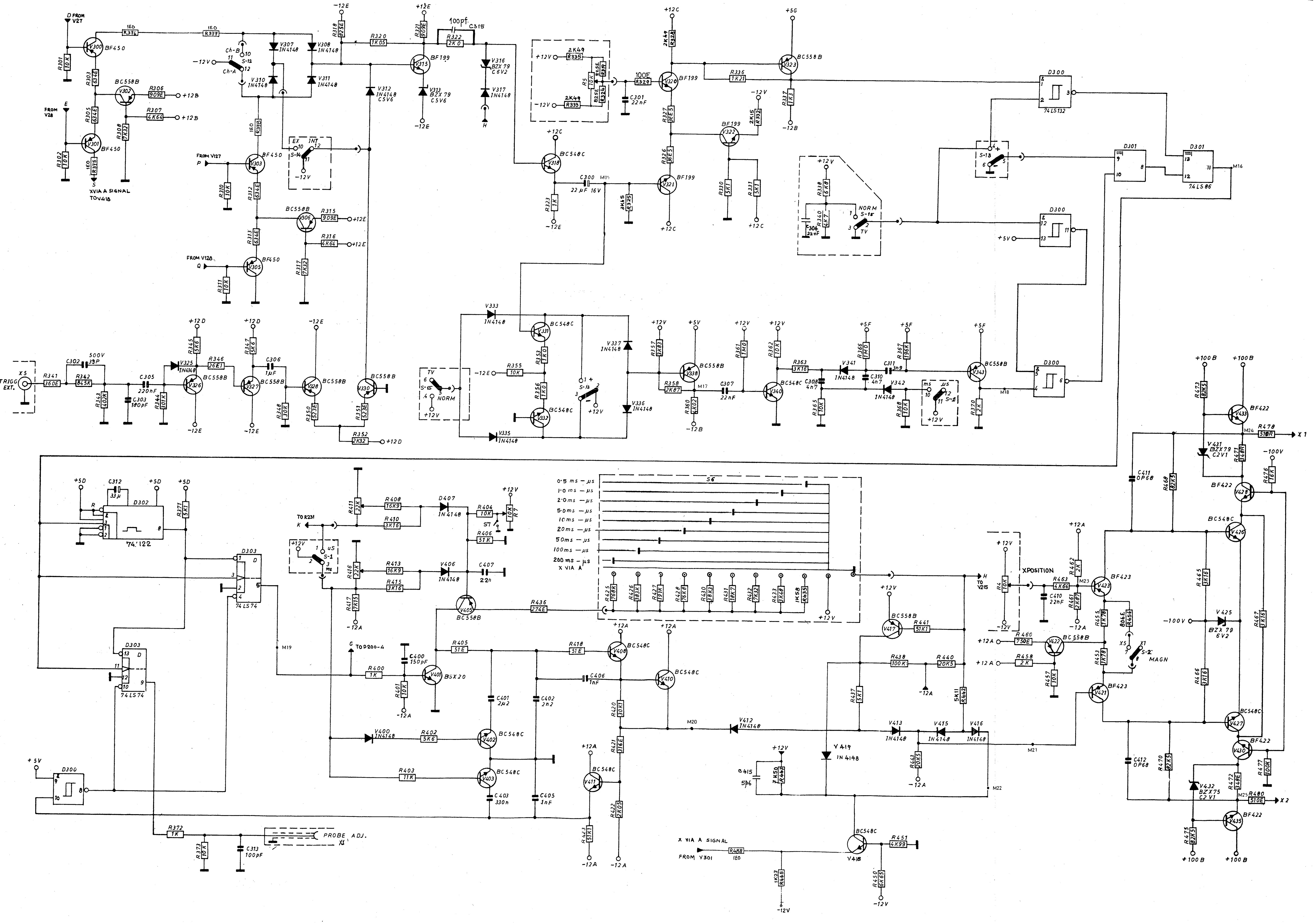


Fig. 8.5 Circuit diagram x-channel and time base.

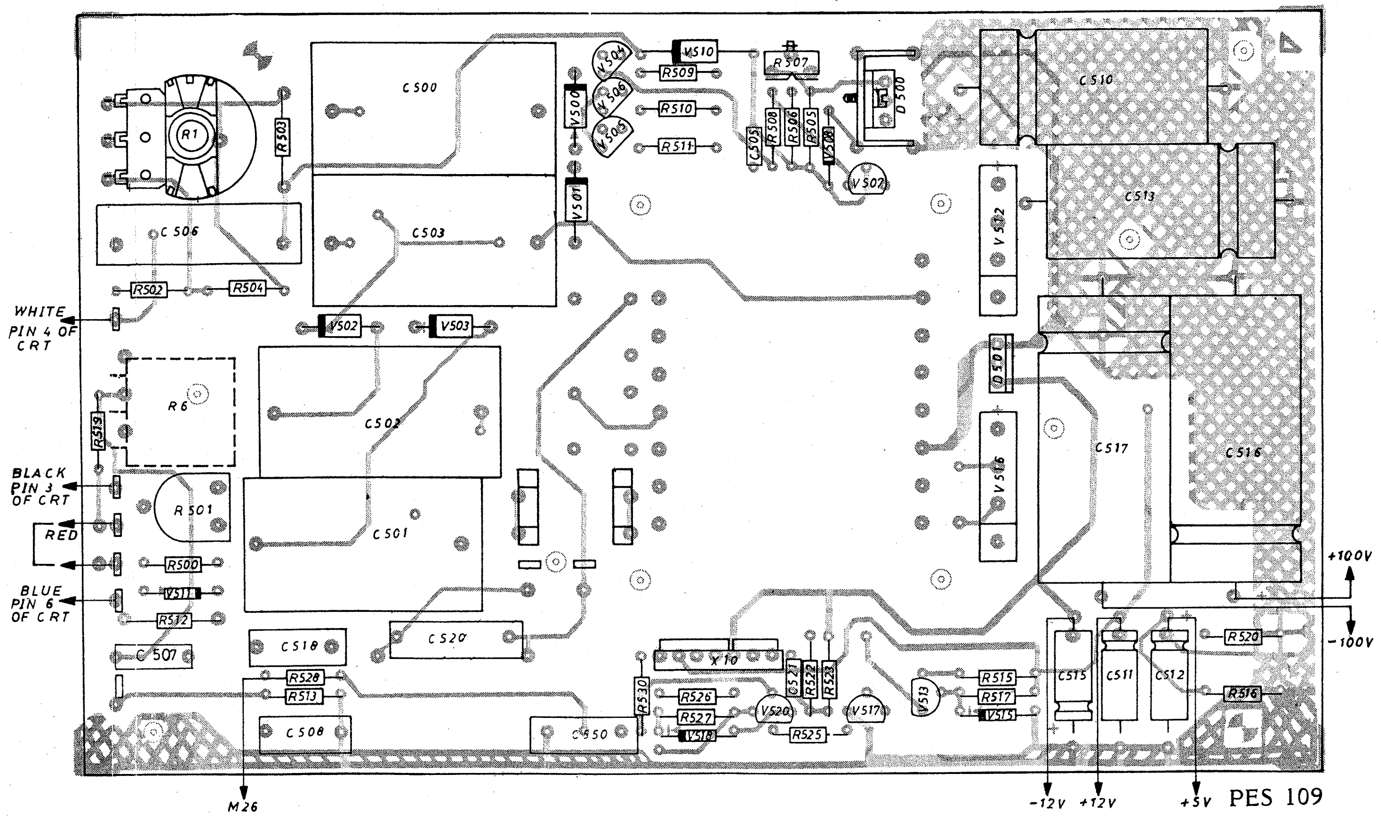


FIG. 8.6 PCB OF POWER SUPPLY UNIT

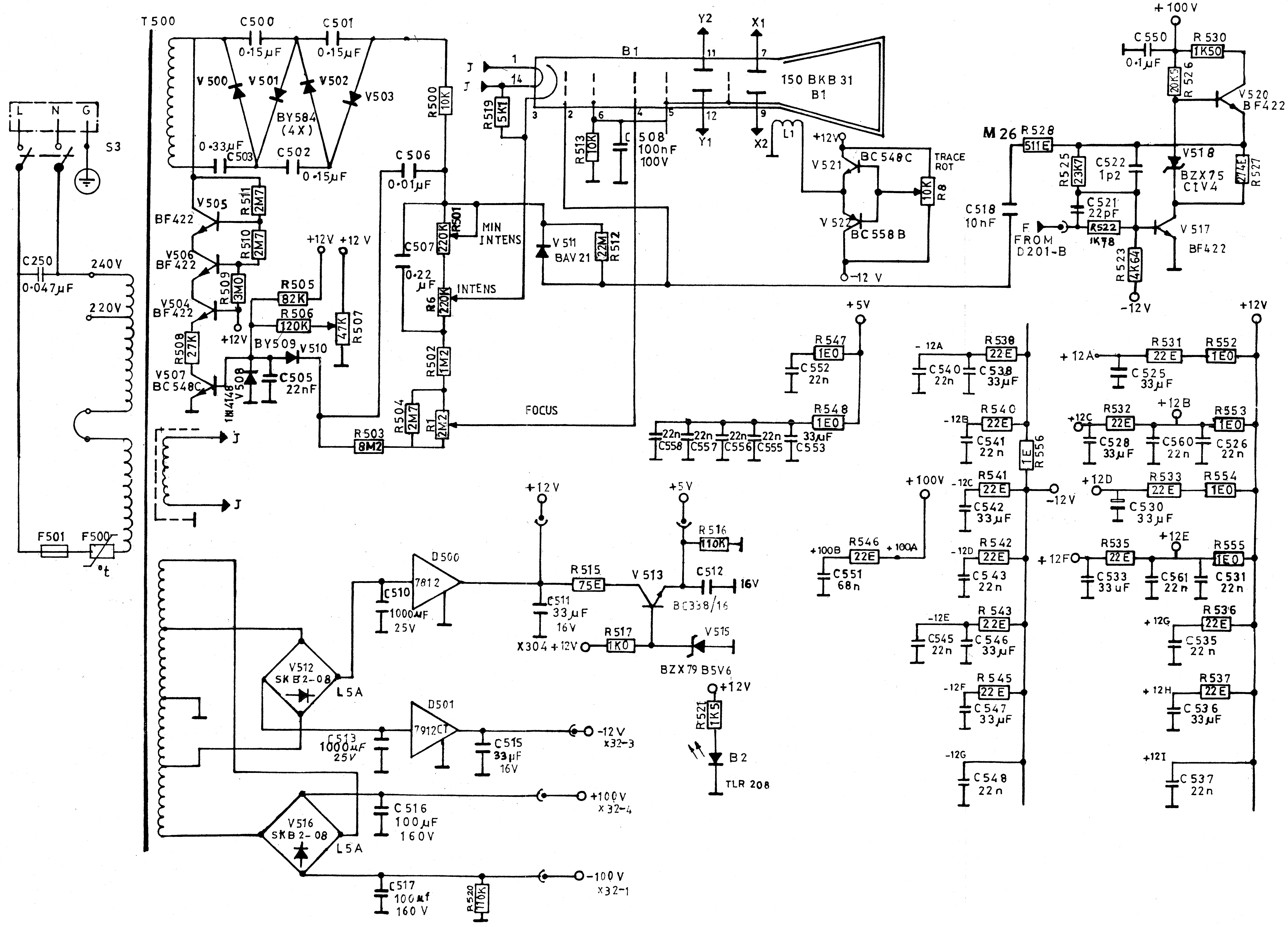


Fig. 8.7 Circuit diagram of power supply unit

9. MODIFICATIONS

(1) V213, V212 has been changed to BZX79 C62 (4822 130 34384)

(2) R29, R129 has been changed to 1E (4822 116 52385)

(3) R220, R221 has been changed to 390E (5322 116 54518)

(4) Read V21 & V121 as BFS21A in Fig. 8.3

All these changes are incorporated from the very first version of PM3206/02. Hence no change needs to be done in the field.

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

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

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

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

CODED FAILURE DESCRIPTION ⑥

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

⑦ *Job completed* ☒

⑧ *Working time* [ ][ ][1][2] Hrs

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

① Country: [3][2] = Switzerland

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

③ Type number/Version [0][P][M][3][2][6][0][0][2] = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in frônt of the serial no)

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

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

⑥ Coded failure description

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 occupiés 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.)
990008 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

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

⑧ Working time: Enter the total number of working hours spent in conneciion 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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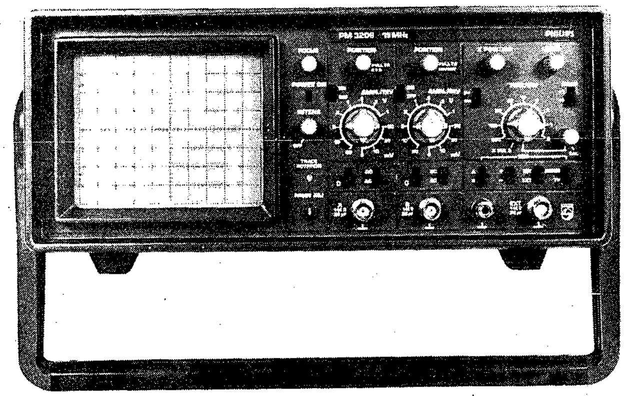
T&M/860101

MODIFICATIONS

15 MHz Dual trace oscilloscope
PM3206

Service Manual

4822 872 05316
870601/1/03



SCS 001

PHILIPS

CONTENTS

LIST OF FIGURES **Page**

1. GENERAL INFORMATION

Read these pages carefully before installation and use of the instrument.

The following clauses contain information, cautions and warnings which must be followed to ensure safe operation and to retain the instrument in a safe condition.
Adjustment, maintenance and repair of the instrument shall be carried out only by qualified personnel.

1.1. Safety Precautions

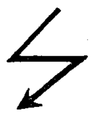
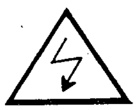
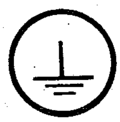
For the correct and safe use of this instrument it is essential that both operating and servicing personnel follow generally-accepted safety procedures in addition to the safety precautions specified in this manual.
Specific warning and caution statements, where they apply, will be found throughout the manual. Where necessary, the warning and caution statements and/or symbols are marked on the apparatus.

1.2. Caution and Warning Statements

__CAUTION__ : is used to indicate correct operating or maintenance procedures in order to prevent damage to or destruction of the equipment or other property.

__WARNING__ : calls attention to a potential danger that requires correct procedures or practices in order to prevent personal injury.

1.3. Symbols

	High voltage	1000 V	(red)
	Live part		(black/yellow)
	Read the operating instructions		(black/yellow)
	Protective earth (grounding) terminal		(black)

1.4. Impaired Safety-Protection

Whenever it is likely that safety-protection has been impaired, the instrument __must__ be made inoperative and be secured against any unintended operation. The matter should then be referred to qualified technicians.
Safety protection is likely to be impaired if, for example, the instrument fails to perform the intended measurements or shows visible damage.

1.5. General Clauses

1.5.1. **__WARNING__ : The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts and accessible terminals which can be dangerous to life.**

1.5.2. The instrument shall be disconnected from all voltage sources before it is opened.

1.5.3. Bear in mind that capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

1.5.4. <u>WARNING</u> : **Any interruption of the protective earth conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous. Intentional interruption is prohibited.**

1.6. CHARACTERISTICS

A. Performance Characteristics

- Properties expressed in numerical values with stated tolerance are guaranteed by PHILIPS. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.

  This specification is valid after the instrument has warmed up for 15 minutes (reference temperature 23°C).

B. Safety Characteristics

This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, and has been supplied in a safe condition.

C. Initial Characteristics

- Overall dimensions :

Height	:	142 mm
Width (including handle)	:	378 mm
Depth	:	348 mm

- Maximum weight (Mass) : 5 Kg
- Operation position
  - a) horizontally on bottom feet
  - b) vertically on rear feet
  - c) one fixed tilted position between a) and b)

1.6.1 C.R.T.

Type	:	150 BTB 31 rectangular tube with 2KV accelerating voltage
Screen type	:	P 31 phosphor standard
Useful screen area	:	8 x 10 div of 1 cm
Graticule	:	Internal graticule with Centimeter division and 2 mm divisions along the central axes.

1.6.2 VERTICAL OR Y-AXIS

Response	:	DC : 0 Hz ... 15 MHz (-3dB) AC : 10 Hz ... 15 MHz (-3dB)
Risetime	:	23 ns approximately
Deflection coefficient	:	5 mV ... 20V/div. calibrated steps, 1-2-5 sequence.
Accuracy	:	± 5%
Display modes	:	A B A & B in chopped or alternate mode A ± B
Input impedance	:	1 MΩ// 35 pF
Input coupling	:	AC,DC,O : In 'Zero' input signal is disrupted and amplifier is grounded.
Maximum rated input voltage	:	400 V (dc + ac peak) test voltage 570V (rms) 50 Hz during 1 min according to IEC 348

1.6.3 HORIZONTAL OR X-AXIS

Horizontal display modes	:	- Time base - X-Y operation with X deflection via A-input

1.6.4 HORIZONTAL AMPLIFIER

Response	:	DC : 0 Hz ... 1 MHz (-3dB)
Deflection coefficients	:	See Y-axes
Phase error	:	3° at 10 kHz

1.6.5 TIME BASE

Time coefficients	:	0.2s/div. 0.5us/div. in 2 x 9 calibrated steps in 1-2-5 sequence. Variable sweep rate facility at any time/div setting. X 5 magnifier extends max. sweep rate to 100 ns/div
Accuracy	:	± 5% Additional error for magnifier : ± 2%

1.6.6 TRIGERRING

Trigger source	:	Internal : A or B External
Trigger coupling	:	Normal (AC Coupled) TV
Slope :	:	+ or -
Trigger sensitivity	:	Internal : 1 div. at 100 kHz External : 0.75V at 100 kHz
Trigger level range	:	± 8 div.
External trigger input impedance	:	1 MΩ // 35 pF
Max. rated input voltage	:	400 V (dc + ac peak) test voltage 570 V(rms) 50 Hz during 1 min according to IEC348

1.6.7 Z-MOD INPUT

Trace blanking	:	TTL High blanks trace. OV or not connected no trace blanking
Max. rated input voltage	:	+25V and -10V.

1.6.8 CALIBRATION

Signal available for probe adjustment. Probe to be adjusted in 0.5 ms/div setting of TIME/DIV and 0.2V/DIV setting of AMPL/DIV switches.

1.6.9 POWER

Nominal Line voltage (ac) and freq	:	120V±10%, 50 - 60 Hz 220V±10%, 50 - 60 Hz 240V±10%, 50 - 60 Hz
Power consumption	:	30W maximum. The insulation between PM 3206 and line fulfills the safety requirements of IEC 348 for Class I instruments.

1.6.10. ENVIRONMENTAL CAPABILITIES

The environmental data are valid only if the instrument is checked in accordance with official checking procedure. Details on these procedures and failures criteria are supplied on request by PHILIPS Organisation in your country or by PHILIPS, Industrial & Electro-acoustic Systems Division, Eindhoven, The Netherlands.

Ambient temperature	:	Rated range of use : 5°C...+40°C Limits for operating: -10°C...+55°C Storage and transport: -40°C...+70°C
Altitude	:	Operating: to 5000m (15000 ft) Non-operating: to 15000m (45000 ft)
Humidity	:	In accordance with IEC 68 Db
Shock	:	300 m/s^2(30g): half sine wave shock of 11ms. duration: 3 shocks per direction for a total of 12 shocks.
Vibration	:	30 m/s^2(3g) vibrations in three directions with a maximum of 15 min. per direction; 10 mins. with a frequency of 15-25 Hz and a peak-peak altitude of 1 mm. Unit mounted on vibration table without shock absorbing material.
Recovery time	:	Operates within 60 min. coming from - 10°C soak, going into 60% relative humidity at +20°C room conditions.

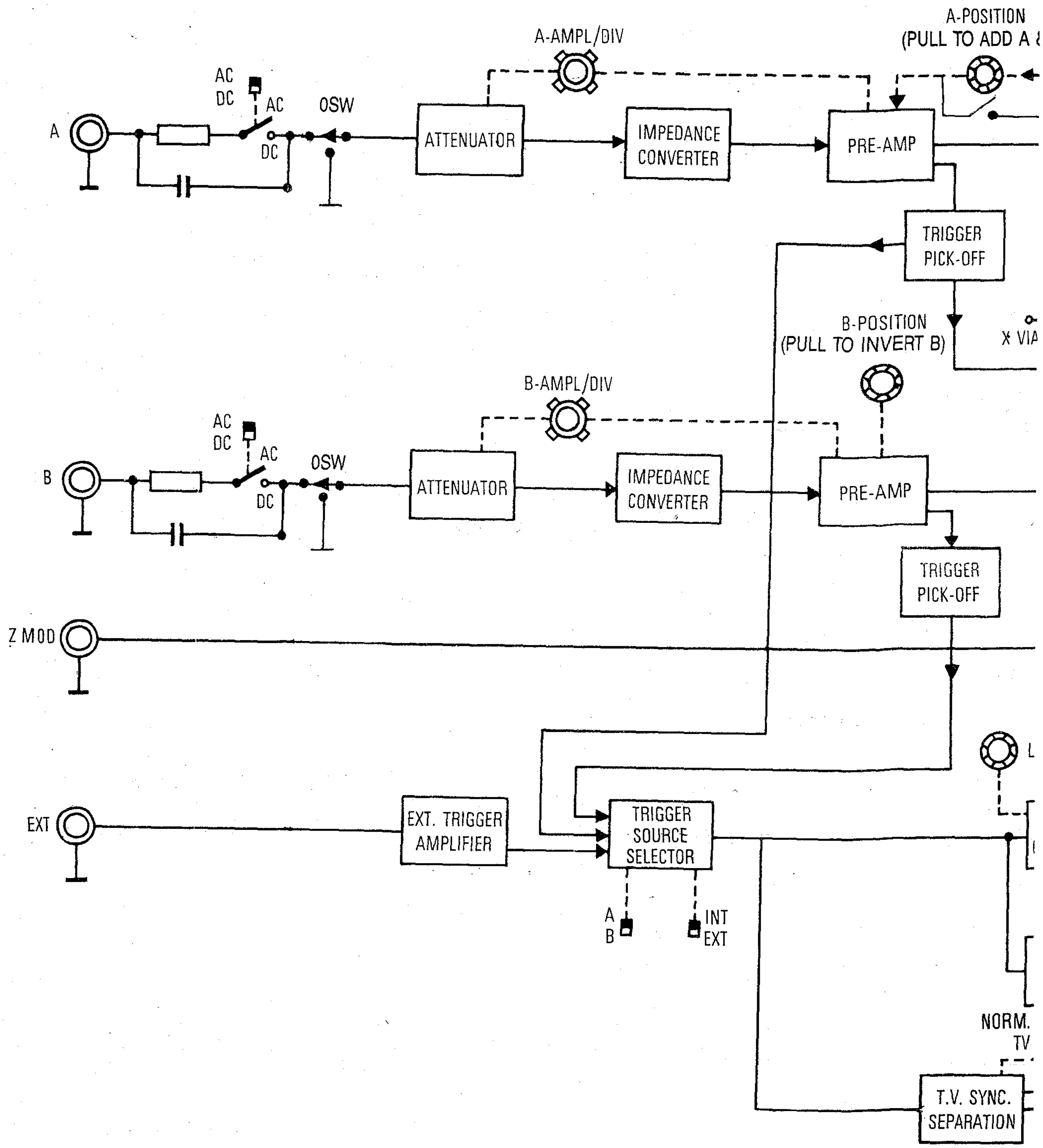


Fig. 2.1. Block diagram

- The channel A or B TRIGGER PICK-OFF amplifiers which are activated by the A and B switches.
- The EXTERNAL TRIGGER AMPLIFIER in order to trigger on a signal applied to the external input X5 activated by the EXT switch.

The TRIGGER SOURCE SELECTOR output is applied to the TRIGGER COMPARATOR, where it is compared with the input from the LEVEL control. This enables the selected level to be compared with the incoming trigger signal to determine the level at which the time-base starts. With switch NORM/TV in TV position the TRIGGER SOURCE SELECTOR output is also fed to the TV SYNC SEPARATION stage. In case of positive video signal the +/- switch should be in + position.

The TV SYNC SEPARATOR stage allows triggering on TV frame pulses (ms position of ms/us switch) or TV line pulses (us position of ms/us switch). The output of the TRIGGER COMPARATOR feeds the SWEEP GATING LOGIC. Depending on the position of the +/- switch the SWEEP GENERATOR starts the positive or negative going slope of the input signal. With the NORM/TV switch in TV position the TV SYNC SEPARATOR output is applied to the SWEEP GATING LOGIC and the TRIGGER COMPARATOR output is blocked. The HOLD-OFF circuit prevents the SWEEP GENERATOR from responding to a trigger command before the time base capacitors are fully discharged.

The SWEEP GATING logic, in addition to feeding the SWEEP GENERATOR, also feeds the CHANNEL SELECTOR in order to control the ALTERNATE vertical display mode switching. An output also controls the Z AMPLIFIER in order to blank the trace during the flyback of the time-base.

The SWEEP GENERATOR produces the sawtooth waveform that is used for horizontal deflection. The time-base sweep period can be adjusted by the step control TIME/DIV. The VAR. TIME/DIV control provides the variable sweep facility.
The X DEFLECTION SELECTOR enables the input to the FINAL X AMPLIFIER to be selected by diode switching networks. Normally, the internal time-base produced by the SWEEP GENERATOR is routed to the FINAL X AMPLIFIER, but in the X via A mode, an output signal from the X via A AMPLIFIER is selected.

The FINAL X AMPLIFIER, which drives the X1 and X2 horizontal deflection plates of the C.R.T. has a X POSITION control potentiometer. In addition the stage has X5 magnifier switch facility, which increases the horizontal gain by a factor of 5.

2.1.3. CRT Display Section

The Z AMPLIFIER receives an input blanking pulse which originates in the channel selector multivibrator and the sweep gating logic. There is also another input to this amplifier from the Z-MOD input socket. Normally, blanking of the trace takes place during flyback of the time-base and also in the chopped mode during switching from one channel to the other. The INTENS control determines the d.c. level fed to the cathode of the CRT. The output of the Z AMPLIFIER is capacitively coupled to the CRT control electrodes.

A HIGH VOLTAGE multiplier provides the final anode potential (-2kV) of the CRT. The TRACE ROTATION circuit, operated by a front panel control, enables adjustment of the sense and strength of current through the trace rotation coil of the CRT. This allows alignment of the trace with the horizontal graticule lines.

2.1.4. Power Supply

The mains supply is transformed by means of a TRANSFORMER and rectified to give d.c. supplies of +100V and -100V.

VOLTAGE REGULATOR stages provides low voltage d.c. outputs of +5V, +12V and feed the various circuits of the oscilloscope.

A 6.3V a.c. secondary winding of the mains transformer supplies the filament of the CRT.

*
Channel B is almost identical to channel A except that the signal before being applied to the final Y amplifier can be inverted in channel B, if required.

2.2 DESCRIPTION OF THE VERTICAL SECTION

*

As channels A and B are almost identical, only channel A is described.

2.2.1. Input coupling stage

In the DC position (switch S13 closed) and in the other than 'O' position of the 'O' switch (S12) the signal applied to input socket XI is fed to the high impedance attenuator via R20 and R21.

In the AC position (switch S13 open) and in the other than 'O' position of the 'O' switch (S12), the signal applied to input socket XI is fed to the high impedance attenuator via R21 and d.c. blocking capacitor C20.

Resistor R20 discharges C20 when switch S13 is changed from the AC to the DC position.

In 'O' position of the 'O' switch the input of high impedance attenuator is grounded and signal applied at XI to the high impedance attenuator is disconnected.

2.2.2 High impedance attenuator

This section of the circuit comprises of the 1,10,100 and 1000 times attenuator.

The 1000 times attenuator is active in the 5,10 and 20V/div attenuator switch (S8) positions; i.e. the output signal from the coupling stage is applied via K21 to the attenuator section comprising of R32, R33, R35 and parallel capacitors. The signal, reduced by an attenuation factor of 1000 is fed via K25 contact to the PREAMPLIFIER.

The 100 times attenuator is active in the 0.5,1 and 2V/div attenuator switch (S8) positions; i.e. the output signal from the coupling stage is applied via K21 to the attenuator section comprising R28, R30, R31 and parallel capacitors. The signal, reduced by an attenuation factor of 100 is fed via K23 contact to the PREAMPLIFIER.

The 10 times attenuator is active in the 50mv, 0.1V and 0.2V/div attenuator switch (S8) positions; i.e. the output signal from the coupling stage is applied via K21 to the attenuator section comprising R25, R26, R27 and parallel capacitors. The signal, reduced by an attenuation factor of 10 is fed via K22 contact to the PREAMPLIFIER.

The 1 x attenuator is active in the 5mV, 10mV and 20mV/div positions of S8 i.e. the output signal from the coupling stage is applied via K20 to the attenuator section comprising of R22, R23 and parallel capacitors. In conjunction with these four basic attenuator coefficients switched by reed relays K20 (5mV-20mV), K22 (50mV-0.2V), K23 (0.5V-2V) and K25 (5V-20V), the 1-2-5 attenuator sequence of adjacent ranges is provided by gain switching of PREAMPLIFIER by relays K26 and K27.

2.2.3. Preamplifier

The output of the HIGH IMPEDANCE ATTENUATOR is connected via resistor R38 to the input of a symmetrical impedance converter consisting of two matched FET's V21 in source follower configuration.

Diode V20 protects the FET input against excessive negative voltages. The output of the Impedance Converter is fed to a transistor array D20 which uses series feedback in the emitter for gain control. The current source for this circuit is obtained with a transistor biased by resistors R45, R46 and R48. Resistors R50 and R51, with K26 and K27 released, determine the gain of the stage in the attenuator switch (S8) positions 20mV, 0.2V, 2V and 20V/div.

- When contact K26 closes, R55 is switched into circuit and the gain of the stage increases 2x.

This occurs in the attenuator switch positions 10mV, 0.1V, 1V and 10V/div.

- When contact K27 closes, R56 is switched into circuit and the gain of the stage increases 4x.

This occurs in the attenuator switch positions 5mV, 50mV, 0.5V and 5V/div.

Resistor R52 in this preamplifier stage is used to calibrate the gain in 5mV/div range. D.C.

balance control potentiometer R57 adjusts the D.C. balance for the 20mV/div switch position. Potentiometer R41 is used to adjust the D.C. balance for 5mV/div switch position.

The final pre-amplifier output stage uses two transistors which are in-built in D20 having their emitters common and uses R62 and R63 as shunt feedback resistors. The Y position control circuit is implemented here using transistors V22 and V23.

Resistor R2 is used for Y position control. The collector current drawn by the transistor array D20 is fixed and is dependent on the current source feeding the emitters of D20. The collectors of V22 and V23 are also connected to the collectors of the series feedback stage in D20. The change in the collector currents of V22 and V23 due to variation of R2 will now be reflected in the collector voltages of shunt feedback stage transistors of D20, which are the output voltages of the preamplifier circuit. Relay K28 (operated in X via A mode) shorts the Y position control R2 in the X via A mode only. The outputs of the preamplifier stage are d.c. coupled to the trigger amplifier circuit via resistors R76 and R77.

2.2.4. Switched amplifier

The output of the preamplifier stage goes to the series stage of the output amplifier consisting of transistors V32, V31 with series feedback resistors R86, R85, R87, R88 is used for gain adjustment in the 20mV/div attenuator switch position. In this stage itself channel switching is incorporated with the help of a switching current source (V30). When the output Q of the flipflop D252 in the CHANNEL SWITCHING circuit goes high, the current source (V32) conducts and switches channel A 'ON', while output $\overline{Q}$ of the same flipflop switches channel B 'OFF'.

The output of this stage is passed through a common base stage V35, V33 only to ensure symmetry of Channels A and B, since Channel B uses similar common base stage to invert the input signal before it is applied to final Y amplifier in Normal/Invert mode.

2.2.5. Channel flipflop and logic circuits

The logic circuits used in this unit can have two logic output levels :

A low level or logic 0 between 0V and 0.8V and a high level or logic 1 between 2V and 5V. The unit has two outputs (pins 9 & 8 of D252) which are the Q and $\overline{Q}$ outputs of a D flipflop. A logic 1 in the Q and $\overline{Q}$ of this flipflop switches channel A and channel B respectively. The various switching modes that control these outputs are CH. A ON/OFF CH. B ON/OFF, ADD, the ms/us (for selecting ALT/CHOP mode of operation) and X via A modes.

CH. A ON
When channel A switch S3 is ON, input 3 of NOR gate D251 is at logic 0. Unless the X via A mode is used, the other input 2 of this gate is also at logic 0. Hence the output of this gate is at logic 1.

If channel B switch S4 is OFF, then input 5 of NAND gate D250 is at logic 1 and hence the output 6 of D250 is at logic 0. This causes the D flipflop D252 to be set and its Q output 9 goes high switching ON channel A.

CH. B ON
When channel B switch S4 is ON, input 5 of NAND gate D250 is at logic 0. If channel A switch S3 is OFF, then input 3 of NOR gate D251 is at logic 1 and its output 1 is at logic 0. This means that reset input 13 of flipflop D252 is at logic 0 and hence its $\overline{Q}$ output goes high, switching channel B ON.

CH. A ON, CH. B ON and switch S5 in us position (ALT mode). Here the +12V on S5 is fed via resistors R256 and R258 to provide a logic 1 at input 6 of NOR gate D251. This makes the output of this gate go to logic 0 which blocks the CHOP oscillator D250/10,9,8 and the output D250-8 is at logic 1.

Output 9 of flipflop D303, connected to input 4 of flipflop D252 is at logic 0 during the time base sweep and at logic 1 during the hold-off period. Thus input 13 of NAND gate D250 is at logic 1 during the time base sweep and at logic 0 during the hold-off period. Therefore, the CLOCK input (pin 11) of flipflop D252 goes from logic 0 to logic 1 at the end of every sweep and changes the state of the flipflop. In this way the display switches alternately between the channels.

CH. A ON, CH. B ON and switch S5 in ms position (CHOP mode).
Here the input 6 of NOR gate D251 is at logic 0 since switch S5 is in 'ms' position. Since both inputs 2 and 3 of NOR gate D251 is at logic 0, its output 1 is at logic 1. Since channel B is ON, input 5 of NAND gate D250 is at logic 0. Hence output 6 of the same gate is at logic 1. Since inputs 1 and 2 of NAND gate D250 is at logic 1, therefore its output 3 is at logic 0. Hence output 4 of NOR gate D251 is at logic 1. This enables the CHOP oscillator D250/10,9,8. This oscillator is NAND - schmitt trigger with a RC feedback loop, which produces a 120 KHZ square wave signal on its output pin 8. This is at logic 1 if the oscillator is switched off in single channel or ALT mode.

The oscillator output is fed to input 12 of NAND gate D250.

During the time base sweep the other input (pin 13) of D250 is at logic 1; therefore the inverted chopper pulses are fed to the CLOCK input (pin 11) of flipflop D252. As both the Clear and Preset inputs of the flipflop are at logic 1 (switches S4 and S3 ON) they are inactive. Therefore, due to the feedback connection between output pin 8 and pin 12, the flipflop changes state at every clock pulse. In this way the display switches between the A and B channels at a frequency of 60 KHZ.

The CLOCK input 11 of flipflop D250, which gets the inverted chopper pulses, is also taken to the Z amplifier to blank the display when switching over between the A and B channels.

Add A & B (Channel A & B ON and switch S1 in Add position i.e. pulled).
In this mode of operation input 4 of D301 is at logic 1 unless S10 is in X via A mode. (When switch S10 is in X via A position then V421 conducts and input 4 of D301 is at logic 0, so that 'Add' is not selected). The other input 5 of D301 is at logic 1. Therefore, output 6 of D301 is at logic 0. This will take input 10 & 13 of D252 to logic 0 through diodes V252 & V253. Thus output 9 & 8 of D252 are at logic 1. This will switch ON channel A & B both at the same time. Hence the 2 signals in channel A & B respectively are added and then applied to the final Y amplifier.

In add mode since both the channels are switched on and selected there is a demand for double the current as compared to when either is selected. This extra current is supplied by R210, R211, R212 and V210.

	D250/6	D251/1	D250/8	D252/10	D252/13	D252/9	D252/8
				PRESET	CLEAR	Q	$\bar{Q}$
AON/BOFF	0	1	-	0	1	1	0
BON/AOFF	1	0	-	1	0	0	1
A & B ON							
- in ALT mode (us)	1	1	1	1	1	1/0	0/1
				(state changes at end of every sweep)			
- in CHOP mode (ms)	1	1	1/0	1	1	1/0	0/1
				(state changes at chopper frequency)			
ADD	-	-	-	0	0	1	1

2.2.6 Final Amplifier

The final Y amplifier consists of V217, V216, V215, V213 which drive the Y1 deflection plate and are balanced by transistors V218, V220, V221, V222 which drive deflection plate Y2. In order to increase stability, the deflection plates are driven via resistors R233 and R235.

In the Y1 plate driven section, V215 & V213 function as a current source. Transistors V217 and V216 form a shunt feedback stage. Two transistors are used in each case so as not to exceed the maximum permissible current and voltage limits of the transistors. In the Y2 plate drive section, V221 and V222 are the current source and V218 and V220 for the shunt feedback stage.

2.3 HORIZONTAL DEFLECTION AND TIME BASE

2.3.1 CH.A trigger pick off

The trigger signal picked off from the output stage of the CH. A PRE-AMPLIFIER is fed via resistors R77 and R76 to the trigger amplifier consisting of V300 and V301 for which V302 forms a current source. When channel A triggering is selected (S16 to A and S18 to INT), then the collector of V300 is applied via diode V310 in the trigger source select to the base of transistor V313. The channel B pick off and EXT trigger input are inhibited by the -12V switched supply that switches off diodes V311 and V307.

The channel A trigger amplifier has another output from the collector of V301 that is used to drive the horizontal amplifier, via the shunt feedback stage using V415, in the X via A mode.

2.3.2 CH. B trigger pick off

The trigger signal picked off from the channel B pre-amplifier is fed to the trigger amplifier consisting of V303 and V305 for which V308 forms the current source. The collector signal from V303 is routed via diode V311 in the trigger source selector to the base of transistor V313. The A channel pick off and the EXT trigger input are inhibited by the -12V switched supply that switches off diodes V310 and V306.

2.3.3 External trigger amplifier

The signal applied to the external trigger input socket (X5) is attenuated by a voltage divider network R351/C340, R352/C341 in the base circuit of emitter followers V351 and V352 connected in cascade. Capacitor C342 serves for d.c. blocking and diode V350 protects transistor V351 against excessive positive input voltage swings.

The emitter of V352 is coupled via C343 to the series feedback stage V353/V355. The collector current of V353 is connected via diode V312 to the base of transistor V313. The A and B internal pick offs are inhibited in the EXT position of S18 by the -12V switched supply via diodes V307 and V306 that blocks V311 and V310 respectively.

2.3.4. Trigger source selector amplifier

The diode networks referred to in the foregoing descriptions of the trigger pick offs and the external trigger amplifier are all associated with the trigger source selector switches S16 and S18, and the method of selecting each trigger source has been described under these headings. The selected trigger signal to the base of transistor V313 is amplified and fed to emitter follower V318. Electrolytic capacitor C302 connects this signal to the comparator circuit which follows.

2.3.5 Level control

The level voltage control R5 permits variation of the trigger level of the signal.

2.3.6. Comparator and sweep gating logic

The trigger level selected by the LEVEL control is applied to the base of V320, which together with V321 forms a differential amplifier comparator circuit, for which V322 acts as a current source. The trigger signal from the emitter follower V318 is fed directly to the base of V321. When this trigger signal exceeds the reference set by the LEVEL control, V320 conducts less and the collector current decreases so the voltage of the shunt feedback stage V323 increases.

This signal is applied to input 13 of NAND schmitt - trigger D300 in the sweep gating logic, and if S19 is in NORM position the inverted signal appears at output 11 of D300. With the +/- switch S17 in "+" position, output 11 of D301 is logic 1 and the EX-OR D301 (output 8) inverts the signal applied to input 10, so triggering is effected on the positive slope. If switch S17 is in "-" position the EX-OR D301 input 9 is at logic 0, so the signal applied to input 10 appears at pin 8. Now triggering is effected on the negative slope.

2.3.7. T.V. Slope selector

→ The output signal from the trigger source selector is fed to the base of transistor V358 which is balanced by transistor V360.

In the positive slope position of S17 the signal on collector of V360 is routed via diode V362 to the base of transistor V363 and the inverted signal on collector of V358 is inhibited by the switched +12V supply which blocks diode V361.

In the negative slope position of S17 the inverted signal on collector of V358 is routed via diode V361 to the base of transistor V363 and the signal on collector of V360 is inhibited as diode V362 is now blocked.

In the NORM position of S19 diodes V356 and V357 conduct and V361 and V362 are blocked.

2.3.8. T.V. SYNC Separator

The line and frame TV trigger pulses from the slope selector stage are passed via V363 to V365 to a low-pass filter for the frame pulses. The low cut-off frequency is selected in the ms position of S5, which connects capacitor C347 across the output, and triggering on TV frame pulses is possible.

In the us position of S5, this capacitor is disconnected and triggering on TV line pulses is now possible.

The output on the collector of V368 applies a logic signal to pin 4 of NAND gate D300.

With TV selected (D300 input 9 at logic 0) the other input (pin 10) of D300 is at logic 1 and therefore output pin 8 is the inverted logic signal.

This signal is inverted again and appears at pin 8 of D301.

2.3.9. Time-Base and Hold-Off Circuit

These two functional blocks are not described separately here because they function inter-dependently.

The time-base is built around the timing capacitor C405, which is always in circuit, and C402 which is switched into circuit via transistor V406 at the low sweep speeds by the +12V on switch S5 (ms position) via V400 and R411.

A constant current from current source V405 charges the capacitor(s) in order to produce a time-base voltage that is linear with respect to time; i.e. a linear sawtooth. The TIME/DIV control (S10) is incorporated in the emitter circuit of the current source transistor V405.

The TIME/DIV controls, R400 (us range) and R401 (ms range), adjust the base voltage of V405 in diodes V401 and V402 respectively. A variable time/div control is obtained with a potentiometer R7 (which can be shorted by switch S11) which is connected to the base circuit of V405 via R415 and controls the base voltage in calibrated time base mode.

The appropriate base control circuit for V405 is selected by the position of the S5 switch, which provides the +12V to either the us or ms position.

The time base capacitors are charged during the time-base sweep.

During this charging time, switching transistor V403, which is controlled by the sweep gating logic, is not conductive. This transistor, which starts to conduct at the end of the sweep, discharges the timing capacitor(s) and takes over the current from V405.

Switching transistor V403 cuts off when the time base is ready to start again.

The sawtooth time base voltage on the timing capacitor is picked-off by a Darlington stage (V410 and V411) and is applied to the X-deflection selector. The output signal from V411 is also applied via R422 to emitter follower V408, which feeds the hold off capacitors C406 and C403. Capacitor C406 is always in circuit and capacitor C403 is switched into circuit by V407 in ms position of S5. The sawtooth on the hold-off capacitor(s) is applied to the input of NAND gate D300/1,2,3. This gate is effectively a schmitt-trigger with a hysteresis of approximately 0.8V. The output of the gate becomes logic 0 if the positive going slope of the input sawtooth reaches a level of 1V approximately.

The two D flipflops D303 operate in parallel. The non inverting output of one flipflop (pin 9) feeds the switching transistor V403 via R403 and the Z-amplifier.

The non-inverting output of the other flip-flop (pin 5) is used as probe adjust signal.

Integrated circuit D302 is a retriggerable monostable multivibrator controlled by the trigger pulses from the trigger comparator. When a trigger pulse is received on pin 3, output pin 8 is at logic 1 for 150 ms. This time constant is determined by C350.

The trigger pulses are also routed to the clock inputs (pin 3 & pin 11 of the D303 flipflops).

Free-Run Mode (Without Trigger Pulses)
If no trigger pulses are available at retriggerable monostable input D302-3, then output pin 8 is low and a preset command is given to the D303 flipflops (pins 1 and 13).

The D flipflops now function as inverters and the clear inputs (pins 4 and 10) receive a pulse from the hold-off circuit after the time base sweep, which is inverted to give outputs on pins 5 and 9.

The output pulse on D303-9 causes the switching transistor V403 to conduct at the end of the time-base sweep and during the hold-off period the time base capacitors C402 and C405 are discharged.

In this way, the time base capacitors are alternately discharged and then charged; i.e. the time-base is free-running.

X via A mode
When X via A is selected, the +12V that is available via S10 performs four functions :

- Via diode V317 it inhibits the trigger source input to V318
- Via diode V250 a logic 1 is applied to input pin 2 of gate D251, which causes a logic 0 on input 13 of flipflop D252. This results in channel B being switched through for Y deflection purposes and the output of channel A being blocked.
  Channel A output from vertical preamplifier is routed via V415 to provide the X-deflection signal.
- The +12V applied via R452 to the base of V416 switches off this transistor.
  The pulses from the internal time base via emitter of V411 are now blocked by diodes V412 and V417.
- The +12V applied via R457 allows switching diodes V418 and V420 to conduct so that the output on collector of transistor V415 is routed to the final X amplifier.

2.3.10. X-Deflection Selector

The selection of the X via A mode has previously been described. When the internal time-base mode is selected, V416 conducts because of the bias current applied to its base via R455 and R452. The positive voltage on the collector of V416 causes switching diodes V412, V417 to conduct, which allows the time base output on emitter of V411 to be applied to the input of the X-amplifier. In this mode, switching diodes V418 and V420 are blocked by the negative potential applied via R455 and R457.

2.3.11. Final X Amplifier

The output signal from the X deflection selector is applied to the base of V462 in the series feedback stage, which consists of V462 balanced by V461. The base circuit of V461 incorporates the horizontal position control (X-POS) R4. The Transistor V460 is the constant current source for this series feedback stage. In the x5 magnifier position of S6, resistor R470 shunts the emitter resistors R467, R468 to give a 5 times increase of horizontal gain.

The collectors of V461 and V462 are coupled to the output stage. This output stage consists of the shunt feedback stage V470, V468 and current source V467 that feed the X plate via R481, balanced by an identical stage comprising V471, V472 and V473.

Two transistors are employed in each of the shunt feedback stages so that the maximum current and voltage limits of the individual transistors are not exceeded, and to reduce stray capacitances.

Resistors R481 and R486 connecting the outputs to the X-plates of the CRT are inserted to increase stability.

2.4. CRT DISPLAY SECTION

2.4.1. Z Amplifier

The input to the Z amplifier is via R530 to the base of transistor V526 and receives signals from :

- the sweep gating logic in order to blank the display during the time-base hold-off period.
- the channel multivibrator in order to blank the display in the chopped mode during the switching from one channel to the other.

The Z amplifier consists of a shunt feedback stage coupled to the Wehnelt cylinder via C520. Diode V522 and resistor R526 provide D.C. restoration.

2.4.2. High Voltage Supply

The high voltage power supply consists of a quadruple voltage multiplier, a voltage divider that produces cathode, control grid and focus potentials for the CRT and a compensation circuit (V515, V516, V517, V518) to compensate h.t. voltage ripple and variations. The voltage quadrupler circuit consists of diodes V510, V511, V512, V513 and capacitors C510, C511, C512, C513. Resistors R6 and R1 control the cathode and grid g3 voltages respectively and in turn provide the intensity and focus controls.

2.4.3. Trace Rotation

The emitter followers V540 and V541 and preset potentiometer R8 determine the sense and strength of the current in the trace rotation coil.

Only one emitter follower conducts at any given time, depending on the position of R8.

2.5. POWER SUPPLY

The mains voltage is applied via double-pole switch S3 to the primary winding of transformer T500, protected by a replaceable thermal fuse F500 and a replaceable cartridge fuse F501.

Provision is made to wire the primary for a nominal voltage of 120V or 220V or 240V. Two full wave bridge rectifiers V501 and V502 across the secondary winding of T500 provide the d.c. voltages for the +12V, -12V, +100V and -100V supplies respectively.

The low voltage supplies +12V and -12V are regulated by two integrated circuits D500 and D501 and smoothed by electrolytic capacitors C502 and C506. The +5V supply is obtained from the +12V supply with the help of a series pass transistor with Zener reference.

*

Channel A and Channel B are almost identical except Normal/Invert function is applicable to Channel B. When switch S2 is in Normal position R203 one end is open and +12V is applied to base of V133 and V135 through R196 and R195. The signal from switching amplifier is then applied to the final Y amplifier without inversion.

When S2 is in 'Invert' position R202 one end is open and +12V is applied to base of V137 and V136 through R200 & R198. The inverted signal output from collectors of V137 & V136 is then applied to the final Y amplifier.

3. DISMANTLING THE INSTRUMENT

3.1. General Information

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be opened. If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazard involved. Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

ATTENTION This section provides the dismantling procedures required for the removal of components during repair operations. All circuit boards removed from the oscilloscope should be adequately protected against damage, and all normal precautions regarding the use of tools must be observed.
During dismantling procedures, a careful note must be made of all disconnected leads that they may be reconnected to their correct terminals during assembly. Damage may result if the instrument is switched on when a circuit board has been removed, or if a circuit board is removed within one minute after switching off the instrument.

NOTE : *All screws which have to be remounted directly in the housing-parts must be fixed with a torque of maximum 1 Nm (10 kg cm).*

3.2. Removing the top and bottom covers

To adjust the instrument it is necessary to remove the top-cover.
- Remove the two carrying-handle mounting screws (Fig. 3.1.).
- Bend the handle outwards and remove it (Fig. 3.1.).
- Remove the two cabinet mounting-screws (Fig. 3.1.).
- Press the two buttons at the rear side until the click. (Fig. 3.2.).
- The top-cover will lift now about 2 mm (Fig. 3.2.).
- Now lift vertically the top-cover out of the front and rear-cover (Fig. 3.3.).
- The bottom cover can now be removed.

NOTE : *Take care of the handle gears.*

3.2.1. Remounting the top-cover

- Place the top-cover between the front and rear-cover.
- Take care that the side snaps of the top and bottom-cover fix together.
- Press the upper rear side firmly down until the click (Fig. 3.2.).
- Remount cabinet mounting-screws and the handle.

3.3. ACCESS TO PARTS FOR CHECKING AND ADJUSTING PROCEDURE

The adjusting elements are accessible after removing the top-cover.
To remove the top-cover see section 3.2.

NOTE : *For adjustments always use an insulated adjustment tool.*

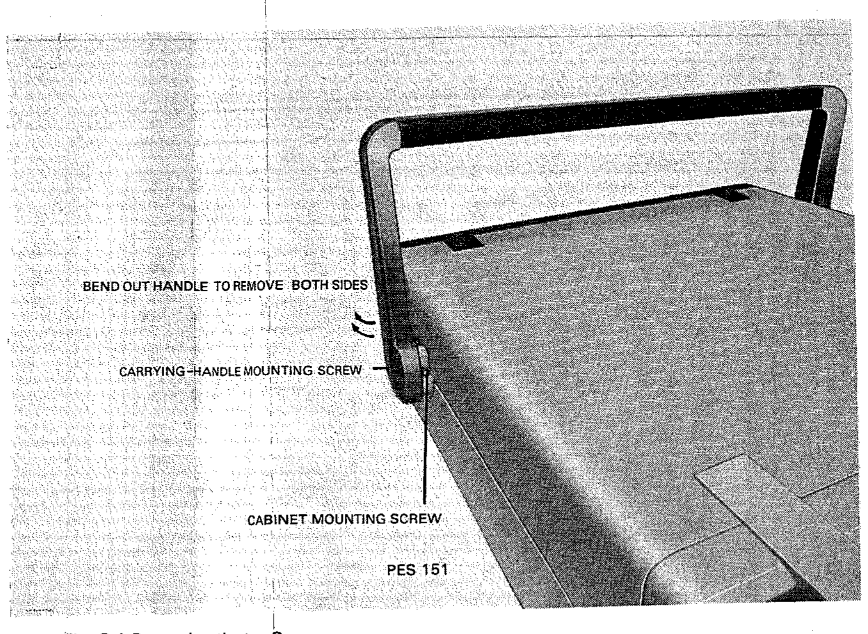


Fig. 3.1 Removing the top Cover

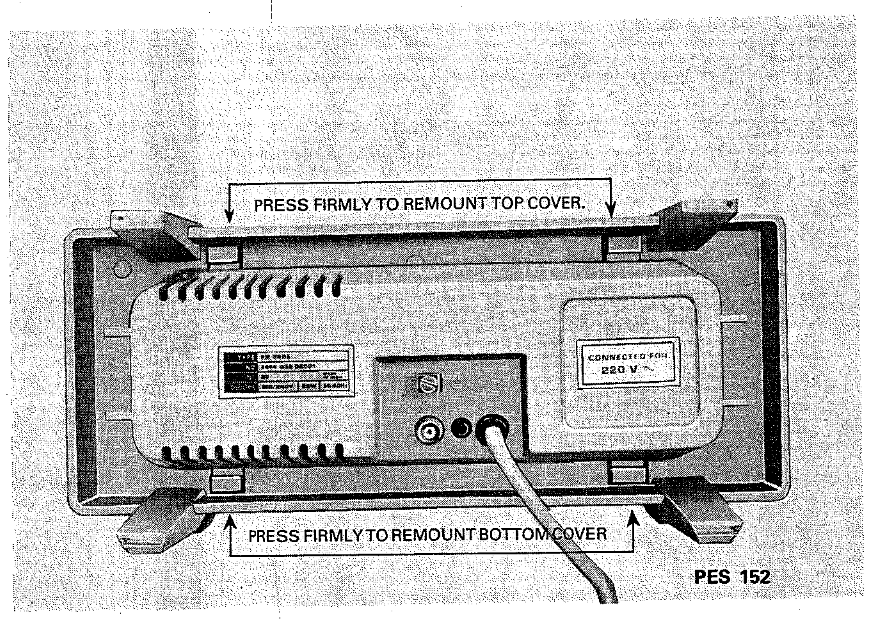


Fig. 3.2 Remounting the top cover

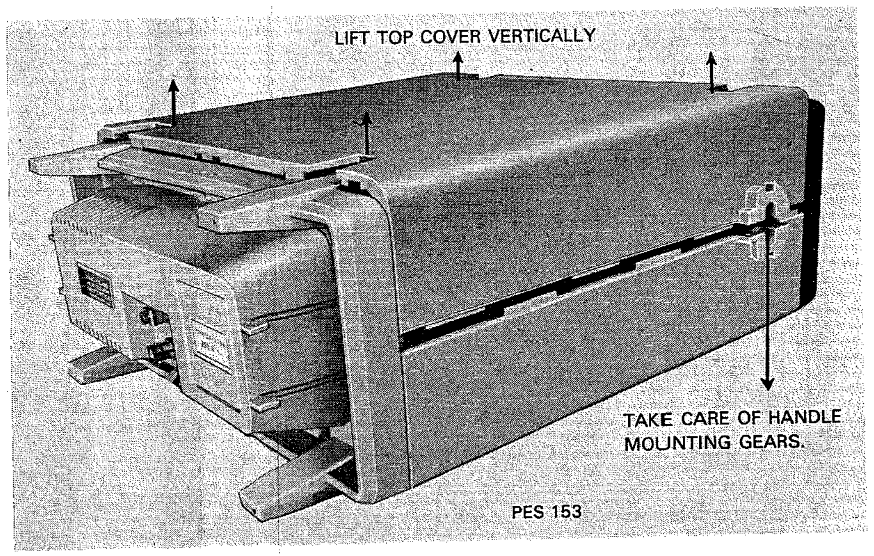


Fig. 3.3 Lifting the top cover.

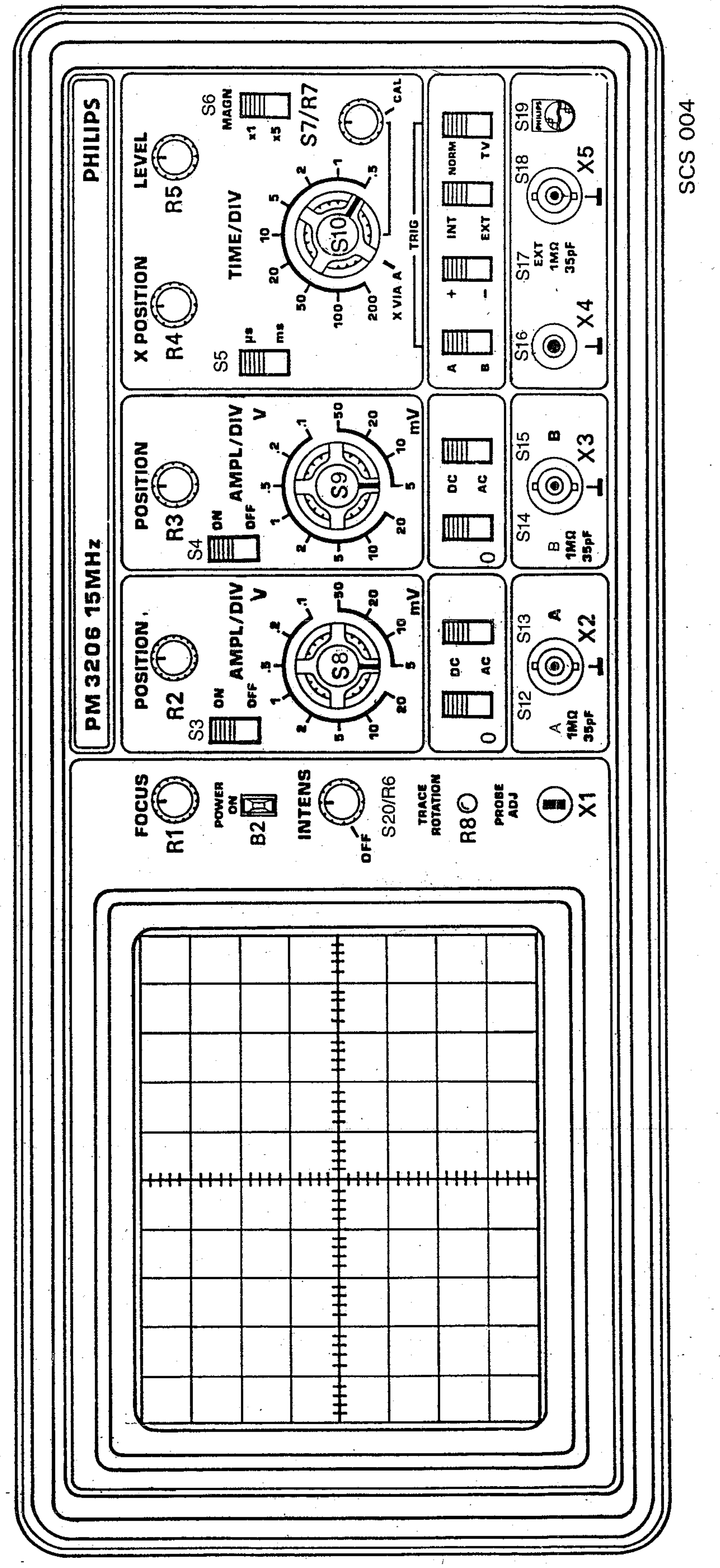


Fig. 4.1 Preliminary Settings of the controls

4. PERFORMANCE CHECK

4.1. General Information

WARNING: Before switching on, ensure that the oscilloscope has been installed in accordance with the instruction outlined in Chapter 4, Directions for use of the Operating Manual.

This procedure is intended to check the instruments specifications. It can be used for incoming inspection to determine the acceptability of newly purchased or recently recalibrated instruments, or to check the necessity of recalibration after a certain operating period. It does not check every facet of the instruments calibration; rather it is concerned primarily with those portions of the instrument which are essential to measurement accuracy and correct operation. Removing the instruments covers is not necessary to perform this procedure. All checks are made from the front panel.

If this test is started a few minutes after switching on, bear in mind that test steps may be out of specification, due to insufficient warming-up time. To avoid this situation, allow the specified warming-up time.
Numerical values without tolerances are typical and represent the characteristics of an average instrument.

The performance checks are made with a stable, well-focussed. low-intensity display. Unless otherwise noted, adjust the intensity, focus and trigger-level controls as needed.

NOTE 1 : *At the start of every objective, the controls always occupy the preliminary settings; unless otherwise stated.*

NOTE 2 : *The input voltage has to be supplied to the A-input; unless otherwise stated.*

NOTE 3 : *Set the TIME/DIV switch to a suitable position; unless otherwise stated.*

4.2. Preliminary settings of the controls

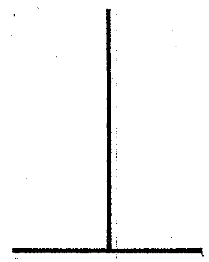
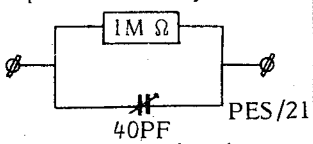
- Start this check procedure with NO input signals connected.
- Set the controls as indicated in Fig. 4.1.

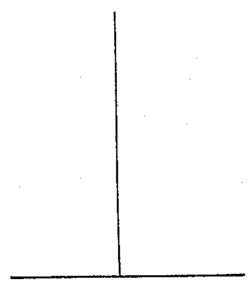
4.3. Recommended test equipment

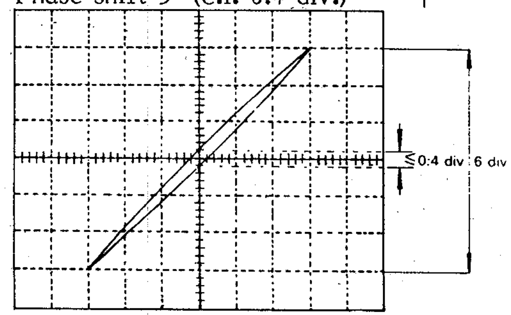
Type of Instrument	Required Specification
Constant amplitude	Freq.: 1 Hz ... 15 MHz
Sine-wave generator	Constant ampl. of 10 mV p.p. - 30 V p.p.
Square-wave generator	Freq.: 2 Hz ... 1 MHz Ampl.: 10 mV ... 12 V Rise-time 3 nsec. Duty cycle 50%
Time-marker generator	Repetition rate: 200 msec. ... 100 nsec.
Dummy probe 2 : 1	1 M Ω ± 0.1% // 40 pF.

CHECKING PROCEDURE

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
4.4.1	**POWER ON**				
4.4.1.1	Start power on		- Turn Switch S20 ON	- Starts at selected mains voltage ±10% & mains frequency 45-66 Hz. - Pilot Lamp POWER ON lights up.	
4.4.1.2	Power Consumption			- 28 VA	
4.4.2	**CRT SECTION**				
4.4.2.1	Intens		- INTENS Control R6 ↷	- Normal intensity adjustments	
4.4.2.2	Focus		- Focus Control R1 ↷	- Normal focus adjustments	
4.4.2.3	Trace Rotation		- Screwdriver adjustment TRACE ROT R8.	- Trace must coincide with central horizontal graticule line; if necessary, readjust potentiometer TRACE ROT R8.	
4.4.3	**VERTICAL AXIS**				
4.4.3.1	Display modes		- Position control R2, R3.	- Traces of channel A and channel B in middle of the screen.	
		Sine-wave signal, 300 mVpp, 1 kHz to A & B input	- Switch S4 to OFF - Switch S16 to 'A' position CH.A.AMPL/DIV. (S8) to O.1V/DIV.	- Signal of 3 div. visible on the screen.	
			- Switch S12 to 'O' position	- Trace in middle of the screen.	
			- Switch S3 to OFF & S4 to ON. —Switch S16 to 'B' position. CH. B AMPL/DIV (S9) to 0.1V/DIV.	- Signal of 3 div. visible on the screen.	
			- Pull R3 to invert 'B'.	- Inverted signal of 3 div. visible on the screen.	
			- Press R3 to get Normal B - Switch S3 to ON - Switch S12 to other than 'O' position.		
			- Pull R2 to Add A & B.	- Signal of 6 div. visible on the screen.	

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
4.4.3.2	Input Coupling	Sine wave signal 1 kHz +DC offset to A(B) input	- Switches S13 and S15 to DC	- Signal is visible on the screen, centre of sinewave is on DC offset level.	
4.4.3.3	Vertical deflection coefficients	Square wave signal, 1 kHz to A(B) input	- Switch S16 to A(B) - AMPL/DIV. switch position of S8(S9).	- Trace height :	
		Amplitude :			
		30 mVpp	5 mV	6 div. ± 5% (±1.5 sub-div.)	
		60 mVpp	10 mV		
		120 mVpp	20 mV		
		300 mVpp	50 mV		
		600 mVpp	0.1 V		
		1.2 Vpp	0.2 V		
		3 Vpp	0.5 V		
		6 Vpp	1 V		
		12 Vpp	2 V		
		30 Vpp	5 V		
		60 Vpp	10 V		
		120 Vpp	20 V		
4.4.3.4	Input Impedance	Square wave signal. 1.2 Vpp - 1 kHz to A(B) input via dummy.  	- AMPL/DIV switch position of S8(S9) to 0.1V	- Trace height 6 div.	
4.4.3.5	Square Wave Response	Square wave signal, 600 mVpp, 100 kHz, rise time ⩽ 5 nsecs. to A(B) input.	- Switch S5 to μ secs. - Switch S6 to x5 position	- Rise time ⩽ 23 nsecs. - Pulse ringing ±5% (±1.5 sub-div.)	

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
4.4.3.6	Band Width	Sine wave signal to A(B) input Frequency : 100 kHz	- Switch S5 to us.	- Adjust the sine wave amplitude for a trace height of 6 div.	
		10 Hz - 15 MHz	- Switch S5 to ms or µs.	- Trace height ⩾ 4.2 div.	
		0 Hz - 15 MHz	- Switch S13(S15) to DC. - Switch S5 to ms or us.	- Trace height ⩾ 4.2 div.	
4.4.4	**HORIZONTAL AXIS**				
4.4.4.1	Time Coefficients	Marker pulse signal to A input	- Var. TIME/DIV. control S7/R7 to CAL. - Switch S4 OFF - Switch S5 to us.		
		Repetition time	- TIME/DIV. Switch position:	- Coefficient error ±5%(c.i.±0.5 div. over 10 div. screen width)	
		0.5 µs 1 µs 2 µs 5 µs 10 µs 20 µs 50 µs 100 µs 200 µs	0.5 1 2 5 10 20 50 100 200		
		500 µs 1 ms 2 ms 5 ms 20 ms	- Switch S5 to ms 0.5 1 2 10 20		

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
		Repetition time (cont.) 50 ms 100 ms 200 ms	- TIME/DIV Switch position (cont.) 50 100 200		
4.4.4.2	X Magnifier	Marker pulse signal to A input repetition time 200 µs. Repetition time 100 ηsec.	- Switch S4 to OFF - Switch S5 to ms - TIME/DIV to 1 - Switch S6 to X5. - Switch S5 to µs - TIME/DIV. to 0.5	- Coefficient error ±7%(c.i±0.7 div) over 10 div. screen width - Coefficient error ±7%(c.i±0.7 div) over 10 div. screen width)	
4.4.5	**HORIZONTAL AMPLIFIER**				
4.4.5.1	X via A	Sine wave signal, 600 mVpp, 1 kHz to A and B input.	- Switch S10 to X via A - Switches S13 & S15 to DC	- A line is visible with an angle of 45° with respect to the horizontal graticule line	
4.4.5.2	Phase shift	As 4.4.5.1. Frequency 10 kHz	- As 4.5.1.	- Adjust the input voltage for a deflection of 6 div. - Phase shift 3° (c.i. 0.4 div.) 	
4.4.5.3	Bandwidth	Sine wave signal 1 kHz to A input Frequency 0 Hz - 1 MHz	- Switch S4 to OFF - Switch S10 to X via A - Switch S13 to DC	- Adjust input voltage for a trace width of 8 div. - Trace width ≥ 5.6 div.	

STEP	OBJECTIVE	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	MEASURING RESULTS
4.4.6	**TRIGGERING**				
4.4.6.1	Trigger source A & B	Sine wave signal, 1kHz to A input and square wave signal 800 Hz to B input	- S4 to OFF - Switch S16 to A - Adjust the input signals for a trace height of 6 div. - Switch S16 to B	- Well triggered display of channel A - Well triggered display of channel B	
4.4.6.2	Trigger source EXT	Sine wave signal, 600mV, 1kHz to A input and EXT input.	- Switch S18 to EXT.	- Well triggered display	
4.4.6.3	Slope	Sine wave signal, 600mV, 1 kHz to A input.	- Switch S17 to "+" - Switch S17 to "-"	- Signal triggers on positive going edge. - Signal triggers on negative going edge.	
4.4.6.4	TV triggering	TV signal to A input, sync. pulse 1 div.	- Switch S19 to TV.	- Well triggerd display.	
4.4.6.5	Sensitivity int.	Sine wave signal 100 kHz to A input		- Signal triggers at 0.75 div.	
4.4.6.6	Sensitivity EXT	Sine wave signal, 100kHz to A input and EXT input	- Switch S18 to EXT	- Signal triggers at 0.75 vpp.	
4.4.6.7	Level range	Sine wave signal, 4V freq. 1kHz to A input	- AMPL/DIV to 1V - AMPL/DIV to 50 mV - LEVEL control R5 ↶↷	- Signal of 4 div. visible on the screen. - Signal triggers in the most extreme positions of R5.	
4.4.7	**CALIBRATION**			- Signal available for probe adjustments.	

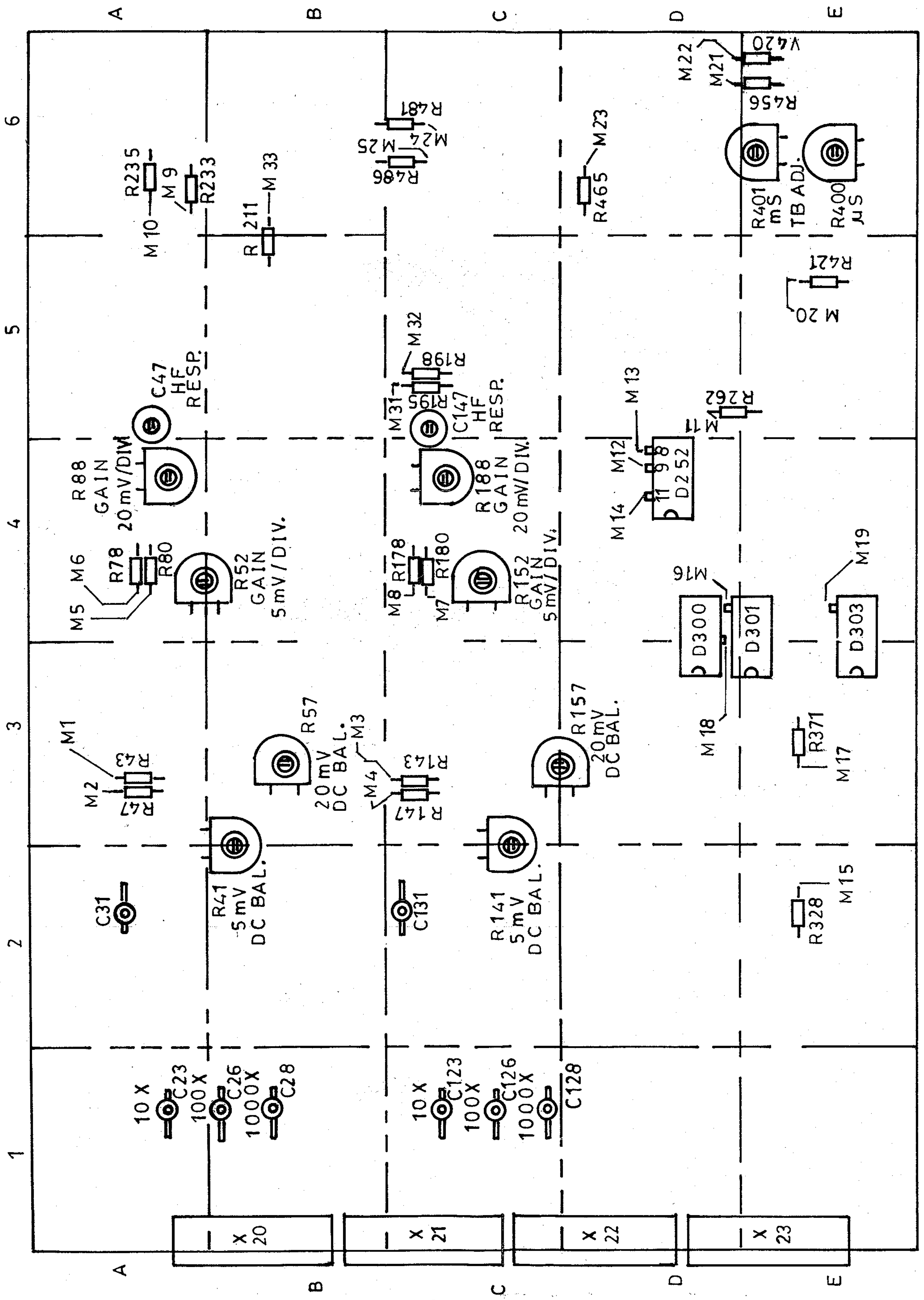


Fig. 5.1 Adjusting elements amplifier unit.

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5. CHECKING AND ADJUSTING

WARNING: **The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.**
The instrument shall be disconnected from all voltage sources before any adjustment, replacement of maintenance and repair during which the instrument will be opened. If afterwards, any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazard involved.
Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

5.1. General Information

The following information provides the complete checking and adjusting procedure for the oscilloscope.
As various control functions are interdependent, a certain order of adjustment is often necessary. The procedure is, therefore, presented in a sequence which is best suited to this order, cross-reference being made to any circuit which may affect a particular adjustment.
Before any check or adjustment, the instrument must attain its normal operating temperature.

- Where possible, instrument performance is checked before and adjustment is made.
- Warming-up time under average conditions is 15 minutes.
- All limits and tolerances given in this section are calibration guides and should not be interpreted as instrument specifications unless they are also published in chapter 1.6 characteristics.
- Tolerances given are for the instrument under test and do not include test equipment error.
- The most accurate display adjustments are made with a stable, well-focussed, low-intensity display. Unless otherwise noted, adjust the Intensity, Focus and Trigger Level controls as needed.

5.2. Recommended test equipment

As indicated in chapter 4.3.
Additional equipment for the checking and adjusting procedure :
Digital multimeter e.g. PM 2518X.
Trimming tool set e.g. Philips 800 NTX.

5.3. Preliminary settings of the controls

As indicated in chapter 4.2.

5.4 TABLE OF ADJUSTMENTS

No.	Adjustments	Preparation			Voltages to apply to X2 (channel A) and X3 (channel B)	Adjusting Element		Adjusting Data
		Controls	Description	Position		Number	Location	
1.	Intensity	S6 S3 S8 S4 S9 S10 R6 R3 R4	X1/X5 CH. A ON/OFF AMPL/DIV. A CH. B ON/OFF AMPL/DIV. B TIME/DIV. INTENS POSITION B] POSITION X]	X1 ON 50 mV/div. ON 50 mV/div. X via A anti-clockwise Adjust spot to centre of screen.	----	R522	Power Supply Unit	The spot just vanishes
2.	Trace Rotation	S3 S4 S5 S6 S10 R2 R4	CH. A ON/OFF CH. B ON/OFF us/ms X1/X5 TIME/DIV. POSITION A] POSITION X]	ON OFF ms X1 .5 Adjust trace to centre of screen	----	R8	Front panel TRACE ROT	Trace in parallel with horizontal graticule line.
3.	DC Balance Channel A (channel B in brackets)	S13 (S15) X2 (X3) S3 (S4) S3 (S4) S8 (S9)	AC/DC BNC Channel A(B) ON/OFF AMPL/DIV. A(B)	DC Short-circuited ON 5mV < = > 10 mV alternately		R41 (R141)	B2/3 (C2/3)	Trace jump 1/2 div.
3a.	DC Balance Adjustments for 20m V/div.	S13 (S15) X2 (X3) S3 (S4) S8 (S9)	AC/DC BNC CH. A(B) ON/OFF AMPL/DIV. A(B)	 Same as in 3 above 20mV < = > 50mV alternately	----	R57 (R157)	B3 (C3/D3)	Trace jump 1/2 div.
4.	Gain CH. A(B) 20 mV/div.	S3 (S4) S4 (S3) S5 S10 S16 S18 S19 S8 (S9)	CH. A(B) ON/OFF CH. B(A) ON/OFF us/ms TIME/DIV. A/B INT/EXT NORM/TV AMPL/DIV. A(B)	ON OFF us 200 A(B) INT NORM 200 mV/div.	120 mVpp 2 kHz	R88 (R188)	A4 (C4)	Amplitude 6 div.
4a.	Gain CH. A(B) 5 mV/div.	 S8 (S9)	All settings, same as above except S8 (S9) AMPL/DIV. A(B)	 5mV/div.	30 mVpp - 2 kHz	R52 (R152)	A4/B4 (C4)	Amplitude 6 div.
5.	Square wave response A (for channel B in brackets)	S5 S6 S10 S13 (S15) S16 S17 S18 S19 S4 (S3)	us/ms X1/X5 TIME/DIV. AC/DC A/B +/- INT/EXT NORM/TV CH. B(A) ON/OFF	us X1/X5 200 DC A(B) + INT NORM OFF	Position 2 kHz Square wave S8 (S9) S8 (S9) on X2(X3) 10 mV - 60 mV 0.1 V - 0.6 V 1 V - 6 V 10 V - 60 V	 C31 (C131) C23 (C123) C26 (C126) C28 (C128)	 A2 (C2) A1 (C1) B1 (C1) B1 (C1)	Topside of square wave in parallel with graticule line.
6.	HF response channel A (channel B in brackets)	S5 S8 (S9) S10 S16	us/ms AMPL/DIV. TIME/DIV. A/B	us 10mV 0.5 A(B)	120 mV - 1 MHz square wave Rise time $\leq$ 5 ns.	C47 (C147)	A5 (C5)	Pulse drop $\leq$ 3% Ringing $\leq$5%
7.	Time Coefficient ms	S5 S6 S10 S7/R7	us/ms X1/X5 TIME/DIV. VAR TIME/DIV.	ms X1 2 CAL	Apply pulse marks of 2 ms	R401	E6	8 pulses per 8 div.
7a.	Time Coefficient us	S5 S10 S7/R7 S6	us/ms TIME/DIV. VAR TIME/DIV. X1/X5	us 2 CAL X1	Apply pulse marks of 2 us	R400	E6	8 pulses per 8 div.

	Adjusting Element		Adjusting Data
	Number	Location	
	R522	Power Supply Unit	The spot just vanishes
	R8	Front panel TRACE ROT	Trace in parallel with horizontal graticule line.
	R41 (R141)	B2/3 (C2/3)	Trace jump 1/2 div.
	R57 (R157)	B3 (C3/D3)	Trace jump 1/2 div.
	R88 (R188)	A4 (C4)	Amplitude 6 div.
	R52 (R152)	A4/B4 (C4)	Amplitude 6 div.
	C31 (C131) C23 (C123) C26 (C126) C28 (C128)	A2 (C2) A1 (C1) B1 (C1) B1 (C1)	Topside of square wave in parallel with graticule line.
	C47 (C147)	A5 (C5)	Pulse drop ≤ 3% Ringing ≤5%
f	R401	E6	8 pulses per 8 div.
f	R400	E6	8 pulses per 8 div.

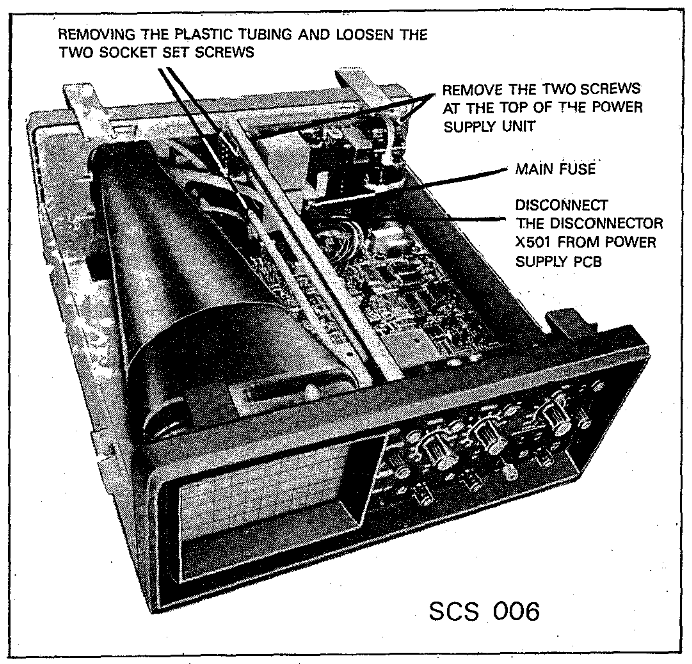

Fig. 6.1 Removing the power supply unit

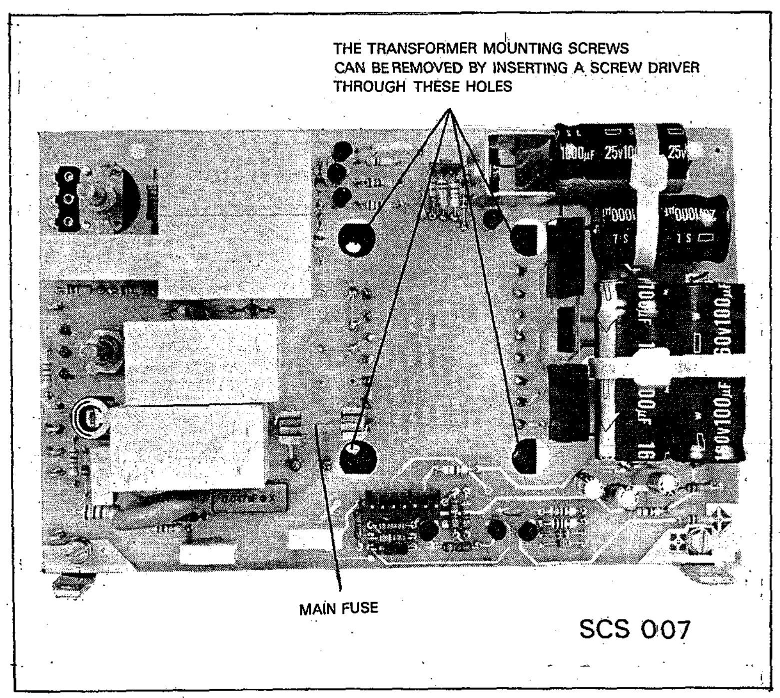

Fig. 6.2 Power supply board

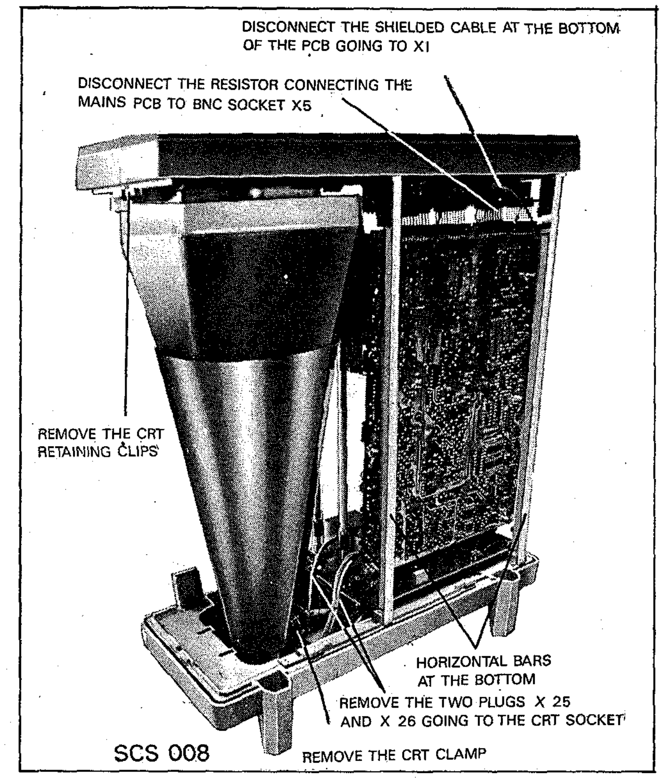

Fig. 6.3 Removing the main PCB and CRT.

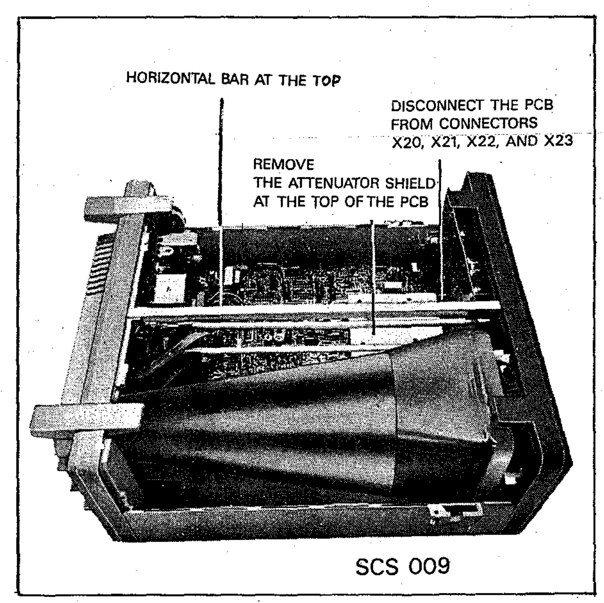

Fig. 6.4 Removing the main PCB unit.

6.

6.1.

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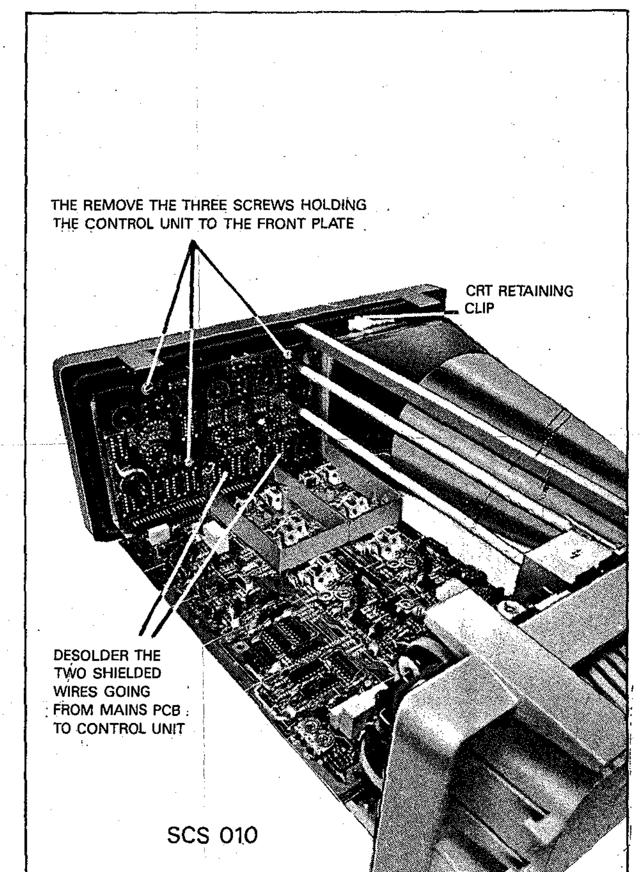

Fig. 6.5 Removing the control unit and CRT.

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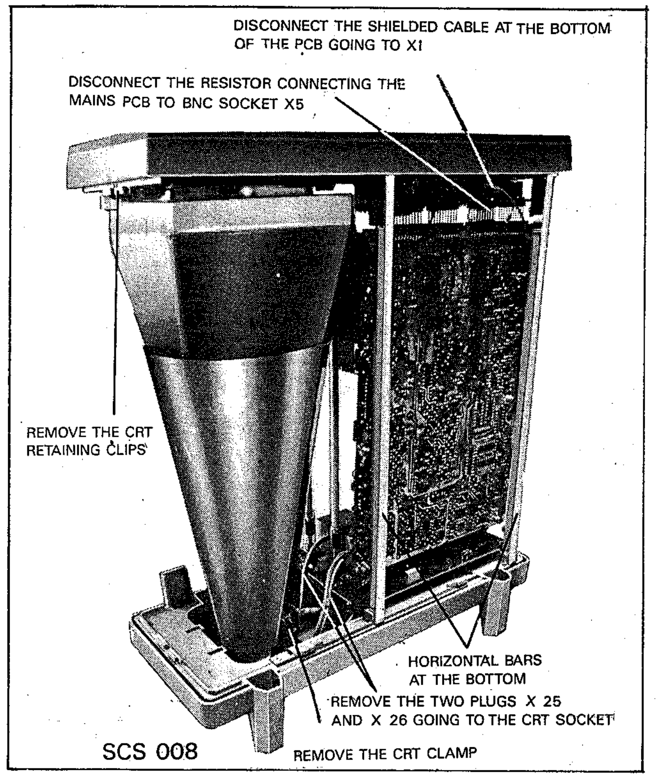


Fig. 6.3 Removing the main PCB and CRT.

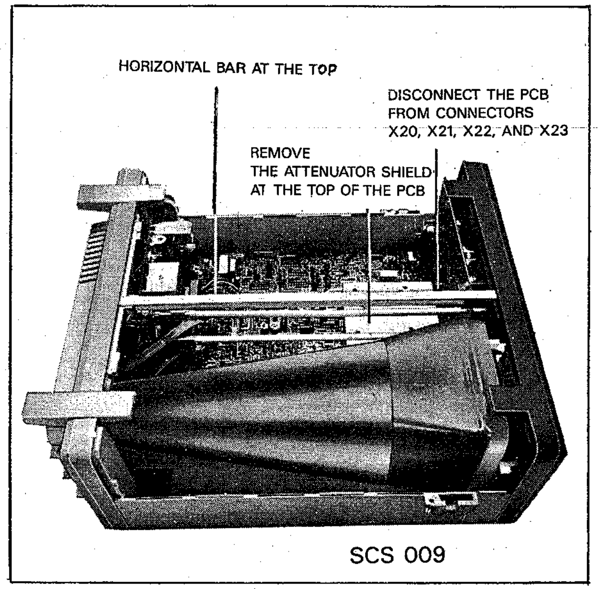


Fig. 6.4 Removing the main PCB unit.

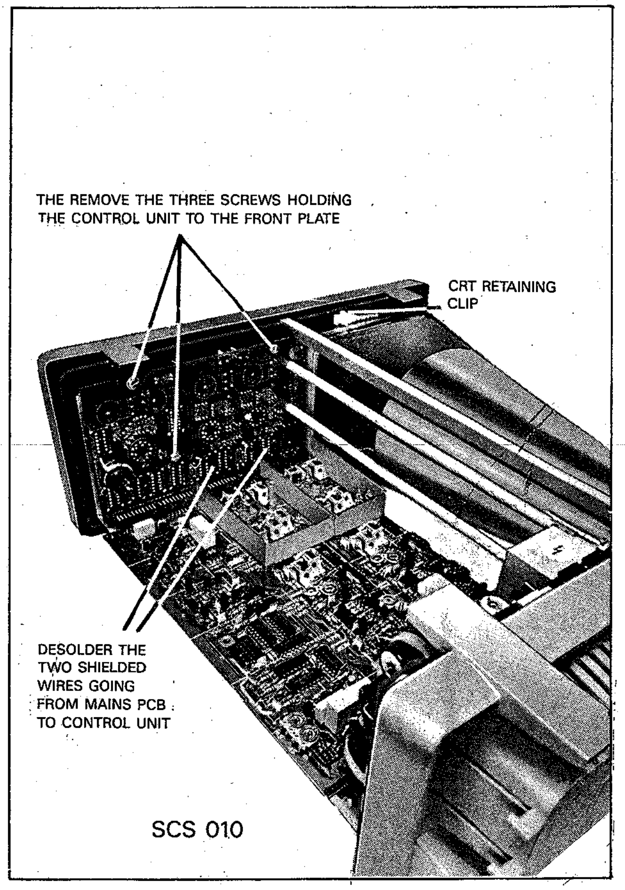


Fig. 6.5 Removing the control unit and CRT.

6. CORRECTIVE MAINTENANCE

6.1. REPLACEMENTS

WARNING: The opening of covers or removal of parts, except those to which access can be gained by hand, is likely to expose live parts, and also accessible terminals may be live.
The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair during which the instrument will be open.
If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazard involved. Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

Standard parts

Electrical and mechanical replacement parts can be obtained through your local Philips organisation or representative. However, many of the standard electronic components can be obtained from other local suppliers.
Before purchasing or ordering replacement parts, check the parts list for value tolerance, rating and description.

NOTE : *Physical size and shape of a component may affect instrument performance, particularly at high frequences. Always use direct-replacement components, unless it is known that a substitute will not degrade instrument performance.*

Special parts

In addition to the standard electronic components, some special components are used. These components are manufactured or selected by Philips to meet specific performance requirements.

Transistors and integrated circuits

Transistors and I.C.'s (integrated circuits) should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance return them to their original sockets. Unnecessary replacement or switching of semiconductor devices may affect the calibration of the instrument. When a transistor is replaced, check the operation of the part of the instrument that may be affected.

WARNING: Handle silicone grease with care. Avoid getting silicone grease in the eyes. Wash hands thoroughly after use.

Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the sockets and cut the leads to the same length as on the component being replaced.

6.1.1. Replacing the mains fuse

To replace the mains fuse F501 which is located on the power supply board, the top cover should first be removed as described under Sec. 3.2. The mains fuse which is a slow blow fuse, can be removed from its holder, and replaced, if necessary. (See fig. 6.2).

6.1.2. Replacing Mains Cord or Transformer

- Unlock the "INTENS" and "FOCUS" extension shafts on the power supply side as follows:

  Remove the plastic tubing which covers the coupling between the shaft and the potentiometer. (See fig. 6.1.)
  Loosen the two socket set screws on the coupling with an allen key (M3) of 1.5 mm across flats.

WARNING: The intensity and focus potentiometers and their shafts are at 2000V with respect to earth. So a protective plastic tubing covers these shafts. While unlocking the "INTENS" and "FOCUS" extension shafts, the instrument has to be disconnected from voltage sources.

- Remove the four transformer mounting screws. (See fig. 6.2.).
- Remove the two screws at the top of the power supply unit holding it to the rear cover (See fig. 6.1.).
- Remove the two screws at the bottom of the power supply unit holding it to the horizontal bars.
- Now the power supply unit is free and the back side of this unit is now accessible. The transformer can now be desoldered and replaced if necessary. Before replacing the transformer the thermal fuse on the transformer can be checked.
- To replace the mains cord, desolder the two wires of the mains cord from switch S20/R6 and also the safety earth terminal.
- Remove the grommet at the rear.
- Solder the mains cord and fix the grommet.

6.1.3. Removing and replacing components on the main PCB

To remove and replace components on the main PCB, the top and bottom cover should first be removed as described in Sec. 3.2.

- All components on the main PCB can now be accessed.

To replace the main PCB, the following procedure should now be adopted :

- Remove the screw holding the attenuator shield at the top of the PCB and remove the shield (See fig. 6.4.).
- Remove the six screws holding this PCB to the horizontal bars.
- Remove the attenuator shield at the bottom of the PCB by removing the screw which holds it to the PCB.
- Remove the two plugs X25 and X26 going to the CRT socket.
- Disconnect the connector X501 from the power supply PCB (Fig. 6.1.).
- Disconnect the wire connecting the main PCB to BNC socket X5. (Fig. 6.3.).
- Disconnect the shielded cable at the bottom of the PCB going to X1 (Fig. 6.3.).
- Desolder the two shielded wires going from the main PCB to the control unit (Fig. 6.5.).
- Slide the PCB towards the rear of the instrument and thus disconnect this PCB from connectors X20, X21, X22 and X23 (See fig. 6.4.).
- The main amplifier board can now be lifted and replaced.

6.1.4. Removing and replacing components on the control unit

- To remove or replace components on the control unit, first remove the main PCB as described in Sec. 6.1.3.
- Remove the three screws holding the control unit to the front plate. (Fig. 6.5.).
- Remove all the knobs on the front panel.

6.3. RECALIBRATION AFTER REPAIR

After any electrical component has been replaced the calibration of that particular circuit should be checked, as well as the calibration of other closely related circuit. Since the power supply affects all circuits, calibration of the entire instrument should be checked if work has been done in the power supply or if the transformer has been replaced.

6.4. INSTRUMENT REPACKAGING

If the instrument is to be shipped to a Service Centre for service or repair, attach a tag showing owner (with address) and the name of an individual at your firm that can be contacted. The Service Centre needs the complete instrument serial number and a fault description.

Save and re-use the packing in which your instrument was shipped. If the original packing is unfit for use or not available, repack the instrument in such a way that no damage during transport occurs.

6.5. TROUBLE-SHOOTING

6.5.1. Introduction

The following information is provided to facilitate trouble shooting. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is helpful in locating troubles, particularly where integrated circuits are used. Refer to the Circuit Description section for this information.

6.5.2. Trouble-Shooting Hints

If a fault appears, the following test sequences can be used to find the defective circuit part :

- Check if the settings of the controls of the oscilloscope are correct. Consult the operating instructions in the Operating Manual.
- Check the equipment to which the oscilloscope is connected and the interconnection cables.
- Check if the oscilloscope is well-calibrated. If not refer to section 5 (checking and adjusting).
- Visually check the part of the oscilloscope in which the fault is suspected. In this way, it is possible to find faults such as bad soldering connections, bad interconnection plugs and wires, damaged components or transistors and IC's that are not correctly plugged into their sockets.
- Location of the circuit part in which the fault is suspected: the symptom often indicates this part of the circuit. If the power supply is defective the symptom will appear in several circuit parts.

After having carried out the previous steps, individual components in the suspected circuit parts must be examined :

- Transistors and diodes. Check the voltage between base and emitter (0.7 Volt approx. in conductive state) and the voltage between collector and emitter (0.2 Volt approx. in saturation) with a voltmeter or oscilloscope. When removed from the p.c.b. it is possible to test the transistor with an ohmmeter since the base/emitter and base/collector junctions can be regarded as diodes. Like a normal diode, the resistance is very high in one direction and low in the other direction. When measuring take care that the current from the ohmmeter does not damage the component under test. Replace the suspected component by a new one if you are sure that the circuit is not in such a condition that the new one will be damaged.
- Integrated circuit. In circuit testing can be done with an oscilloscope or voltmeter. A good knowledge of the circuit part under-test is essential. Therefore, first read the circuit description in Section 2.
- Capacitors. Leakage can be traced with an ohmmeter adjusted to the highest resistance range. When testing take care of polarity and maximum allowed voltage. An open capacitor can be checked if the response for AC signals is observed. Also a capacitance meter can be used: compare the measured value with value and tolerance indicated in the parts list.

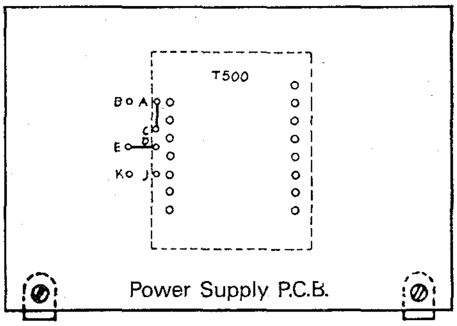
- Resistors. Can be checked with an ohmmeter after having unsoldered one side of the resistor from the p.c.b. Compare the measured value with value and tolerance indicated in the parts list.
- Coils and transformers. An ohmmeter can be used for tracing an open circuit. Shorted or partially shorted windings can be found by checking the wave-form response when HF signals are passed through the circuit. Also an inductance meter can be used.

NOTE: *If a component must be replaced always use a direct-replacement. If not available use an equivalent after carefully checking that it does not degrade the instrument's performance. See also section 6.1. (replacement).*
After replacement of a component the calibration of the instrument may be affected due to component tolerances. If necessary do the required adjustments.

6.6. ADAPTION OF MAINS (LINE) VOLTAGE

Before opening any part of the instrument it must be disconnected from all voltage sources. Access to the power supply unit :

- Remove the two handle mounting screws.
- Bend the handle brackets outwards and remove it.
- Remove the two cabinet mounting screws which become visible now.
- Press firmly the two buttons of the rear cover until the click (the top cover will lift for approx. 2 mm).
- Now lift vertically the top cover out of the front and rear-cover.
- The power supply board is accessible now to adapt the mains voltage.
- Connections should be changed as follows :



NOTE :- FOR 240 V~ CONNECT A-B & D-E
FOR 220 V~ CONNECT A-C & D-E
FOR 120 V~ CONNECT A-B, D-J & E-K

6.7. SAFETY INSPECTION AND TESTS AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT

6.7.1. General directives

- Take care that the creepage distances and clearances have not been reduced.
- Before soldering, the wires should be bent through the holes of solder tags, or wrapped around the tag in the form of an open U, or, wiring shall be rigidly maintained by cable clamps or cable lacing.
- Replacing all insulating guards and plates.

6.7.2. Safety components

Components in the primary circuit may only be renewed by components selected by Philips.

6.7.3. Checking the protective earth connection

The correct connection and condition is checked by visual control and by measuring the resistance between the protective lead connection at the plug and the cabinet/frame. The resistance shall not be more than 0.1 Ω . During measurement the mains cable should be removed. Resistance variations indicate a defect.

6.7.4. Checking the insulation resistance

Measure the insulation resistance at U = 500 V dc between the mains connections and the protective lead connections. For this purpose set the mains switch to **ON.** The insulation resistance shall not be less than 2 M.Ω.

NOTE: 2 M Ω a minimum requirement at 40°C and 95% Relative Humidity. Under normal conditions the insulation resistance should be much higher (10...20 M.Ω).

6.7.5. Checking the leakage current

The leakage current shall be measured between each pole of the mains supply in turn, and all accessible conductive parts connected together (including the measuring earth terminal). The leakage current is not excessive if the measured currents from the mentioned parts is ⩽ 3.5 mA rms.

6.7.6. Voltage test

The instrument shall withstand, without electrical breakdown, the application of a test voltage between the supply circuit and accessible conductive parts that are likely to become energized. The test potential shall be 1500 V rms at supply-circuit frequency, applied for one second. The test shall be conducted when the instrument is fully assembled, and with the primary switch in the ON position.
During the test, both sides of the primary circuit of the instrument are connected together and to one terminal of the voltage test equipment; the other voltage test equipment terminal is to be connected to the accessible conductive parts.

6.8. SURVEY OF MEASURING POINTS

- To make fault finding easy, test points M1 to M26 are given below. These test points can be located on the PCB with the help of fig. 6.8 and fig. 6.9.
- Apply a sine wave signal of 120 mV peak to peak to Y A(Y B) input.
- Set AMPL/DIV in 20 mV position.

Measuring point	Location	Values to be measured	Remarks
M1	A3	100 mV p.p. superimposed on 1 V DC approx.	Signal on Channel A.
M2	A3	1 V DC approx.	
M3	C3	100 mV p.p. superimposed on 1 V DC approx.	Signal on Channel B.
M4	C3	1 V DC approx.	
M5/M6	A4	400 mV p.p. superimposed on 8.1 V DC approx.	Signal on Channel A.
M7/M8	C4	400 mV p.p. superimposed on 8.1 V DC approx.	Signal on Channel B.
M9	A6	36 V p.p. on 0 VDC with trace at the centre	Signal on Channel A.
M10	A6	36 V p.p. on 0 VDC with trace at the centre	Signal on Channel B.
M11	D5	4 V DC (TTL high voltage) when CH A and CH B is ON and switch S1 in µs position. In ms position of S1, the Chopper frequency of 120 KHZ will be visible.	
M12	D4	TTL high voltage when CH.A is ON and CH.B is OFF	
M13	D4	TTL high voltage when CH.A is OFF and CH.B is ON	
M14	D4	Blanking pulse varying with TIME/DIV position.	
M15	E2	1.2 V p.p. square wave	
M16	D4	4.5 V p.p. square wave	
M17	E3	1.2 V p.p. square wave with NORM/TV switch in TV position	
M18	D3/D4	With switch S1 in µs position needle like pulses and in ms position, no signal	
M19	E4	No trigger signal : square wave depending on TIME/DIV position Trigger Signal : Square wave depending on TIME/DIV position and trigger signal.	
M20	E5	Sweep voltage (sawtooth) - 1 V up to + 1.2 V	

Measuring point	Location	Values to be measured	Remarks
M21	D6	Sawtooth	
M22	D6	2.5 V p.p. square wave	
M23	D6	Position control voltage - 1.5 V DC up to +4.5 V DC	
M24/M25	C6	Sawtooth 100 V p.p. (in X via A position - 60 V up to + 40 V)	
M26	Power Supply	Blanking pulse to CRT - 32 V p.p. square wave superimposed on 35 VDC approx.	
M31	C5	12 VDC in Normal 8 VDC in Invert	
M32	C5	8 VDC in Normal 12 VDC in Invert	
M33	B6	18 VDC with Add not selected 22 VDC with Add Selected.	

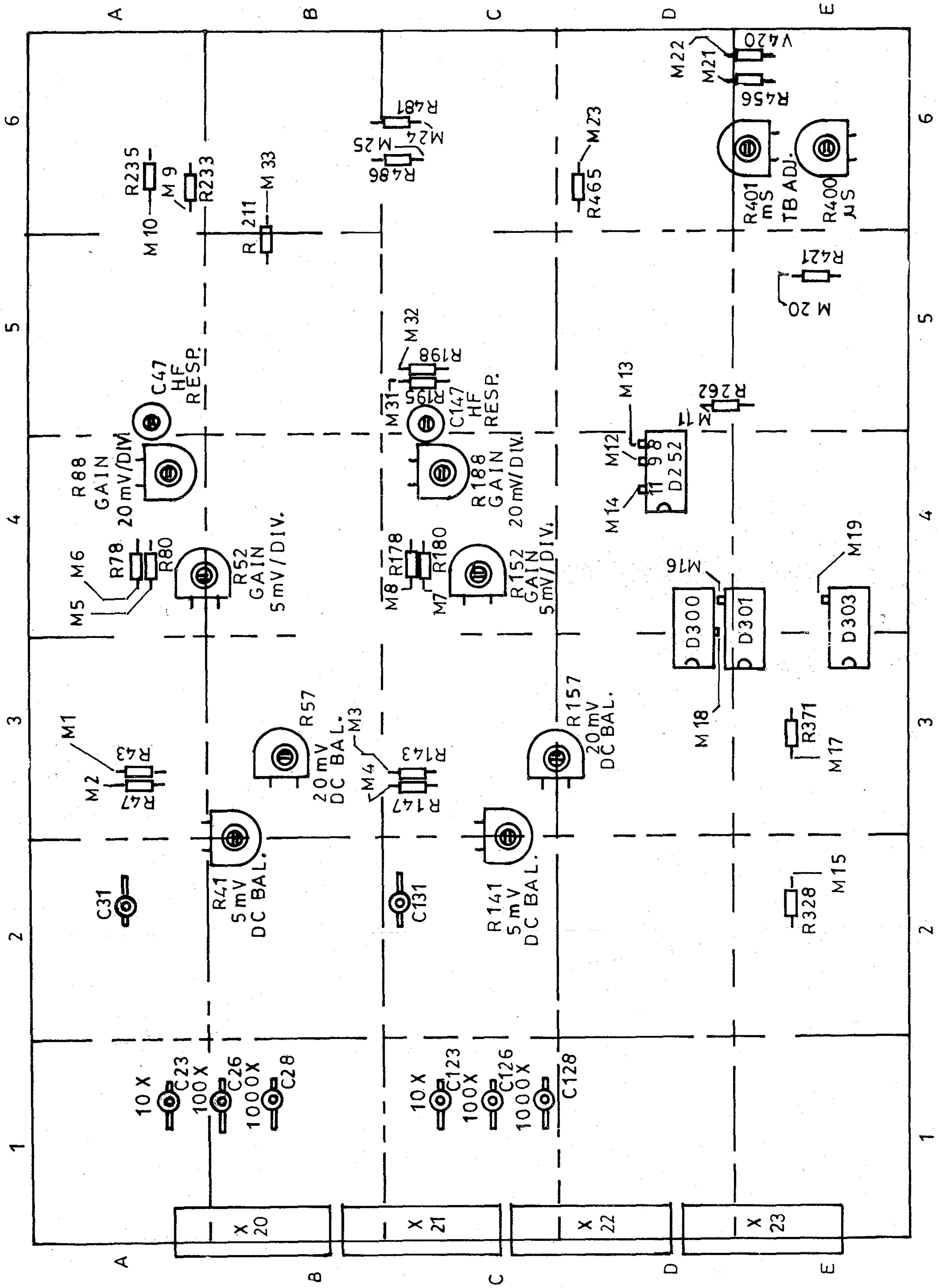
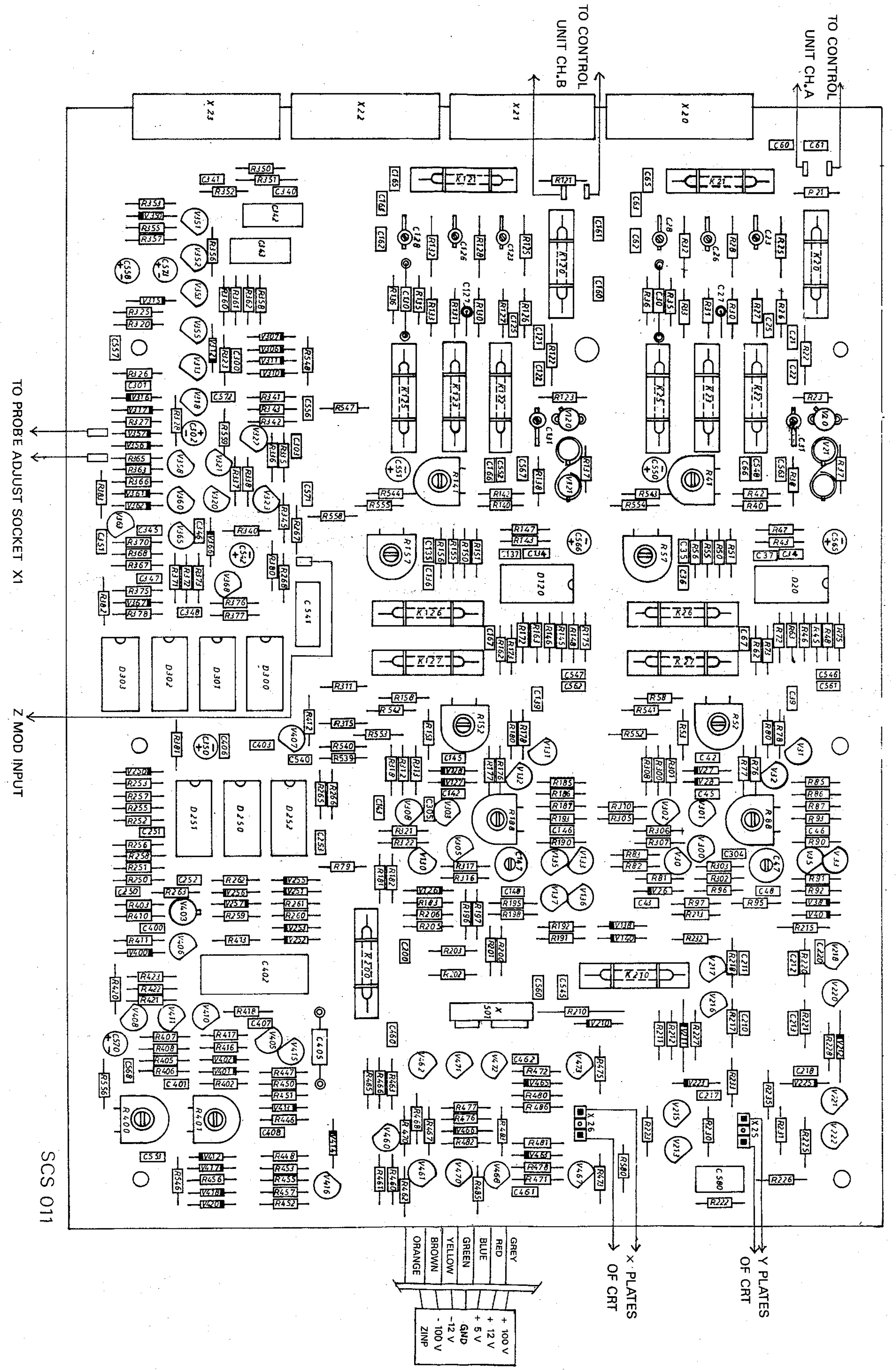


Fig. 6.8 Survey of measuring points

SCS 005



6.9. PIN CONNECTIONS (Refer to Fig. 8.1)

1. AMPLIFIER UNIT	CONNECTOR NO./ PIN NO.	CONTROL UNIT
6.9.1		
Coil K20, C60	X20-1	V50,V52,S8-3
Coil K21, C61	X20-2	V70,V71,V72
Coil K22, C62	X20-3	V55,V57,V70,S8-6
Coil K23, C63	X20-4	V60,V62,V71,S8-9
Coil K25, C65	X20-5	V65,V67,V72,S8-12
Coil K26, C66	X20-6	V53,V58,V63,V68
Coil K27, C67	X20-7	V51,V56,V61,V66
D20 pins 2 & 11, R63,C39	X20-8	R67,V22
D20 pins 4 & 8, R62,C34	X20-9	R68,V23
+ 12V	X20-10	+ 12V
- 12V	X20-11	- 12V
Coil K120, C160	X20-12	V150,V152,S9-3
Coil K121, C161	X21-1	V170,V171,V172
Coil K122, C162	X21-2	V155,V157,V170,S9-6
Coil K123, C163	X21-3	V160,V162,V171,S9-9
Coil K125, C165	X21-4	V165,V167,V172,S9-12
Coil K126, C166	X21-5	V153,V158,V163,V168
Coil K127, C167	X21-6	V151,V156,V161,V166
D120 pins 4 & 8, R162	X21-7	R168,V123
D120 pins 2 & 11, R163	X21-8	R167,V122
K200, K210	X21-9	R207
V414	X21-10	S1-1
R203	X21-11	S2-1
R202	X21-12	S2-2
+ 5.7V	X22:1	+ 5.7V
R252, C251	X22:2	S3-10
R250, C250	X22:3	S3-5
R463, C460	X22:4	R4
V462, R468	X22:5	S6-6
R470	X22:6	S6-5
D301 pin 4	X22:7	R270, S1-3
D300 pin 12	X22:8	S17-1, S19-5
D301 pin 13	X22:9	S17-2,11
R335, C303	X22:10	R332, R333
V312, V353	X22:11	S18-12
V306, V307	X22:12	S18-10
R315, V307, V311	X23:1	S16-1
R311, V306, V310	X23:2	S16-3
V362, V360, V357	X23:3	S17-6
V356, V358, V361	X23:4	S17-4
V356, V357	X23:5	S19-8
V317, R452, R455	X23:6	R425/R271
V367, R378	X23:7	S5-6
GND	X23:8	GND
C401,V405,V401,R416,V402	X23:9	R415
R401,R402,V400,R412	X23:10	S5-7
R406, R400, R256	X23:11	S5-9
R417	X23:12	R430-R433, R435-R438, R440

6.9.2 POWER SUPPLY UNIT (Refer to Fig. 8.6)

+100V	X501-1	+100V
+12V	X501-2	+12V
+5V	X501-3	+5V
OV	X501-4	OV
-12V	X501-5	-12V
-100V	X501-6	-100V
Z input (D202-10)	X501-7	R530

6.9.3 CRT SOCKET

R481	X26-1	CRT Pin 7
R486	X26-2	CRT Pin 9
R235	X25-2	CRT Pin 11
R233	X25-1	CRT Pin 12

POSNR		DESCRIPTION				ORDERING CODE		
C	140	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	141	CAPACITOR ELECTROLYTE	33UF	–	16V	5322	124	21431
C	142	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	143	CAPACITOR CERAMIC	22PF	2%	100V	5322	122	34196
C	145	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	348	CAPACITOR CERAMIC	3.9NF	10%	100V	4822	122	30098
C	350	CAPACITOR ELECTROLYTE	33UF	–	16V	5322	124	21431
C	351	CAPACITOR CERAMIC	10NF	50%	100V	4822	122	31414
C	400	CAPACITOR CERAMIC	150PF	2%	100V	4822	122	31085
C	401	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	402	CAPACITOR FOIL	2.2UF	5%	100V	5322	121	44246
C	403	CAPACITOR FOIL	0.33UF	10%	63V	5322	121	42661
C	405	CAPACITOR FOIL	2.2NF	5%	63V	4822	121	50415
C	406	CAPACITOR CERAMIC	1NF	10%	100V	4822	122	30027
C	407	CAPACITOR CERAMIC	1NF	10%	100V	4822	122	30027
C	408	CAPACITOR CERAMIC	5.6PF	5%	100V	4822	122	32148
C	460	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	461	CAPACITOR CERAMIC	0.68PF	0.25PF	500V	4822	122	31213
C	462	CAPACITOR CERAMIC	0.68PF	0,25PF	500V	4822	122	31213
C	500	CAPACITOR FOIL	47NF	10%	400V	4822	121	40239
C	501	CAPACITOR ELECTROLYTE	1000UF	50%	25V	4822	124	20786
C	502	CAPACITOR ELECTROLYTE	33UF	–	16V	5322	124	21431
C	503	CAPACITOR ELECTROLYTE	33UF	–	16V	5322	124	21431
C	506	CAPACITOR ELECTROLYTE	33UF	–	16V	5322	124	21431
C	505	CAPACITOR ELECTROLYTE	1000UF	50%	25V	4822	124	20786
C	507	CAPACITOR ELECTROLYTE	100UF	50%	160V	5322	124	24221
C	508	CAPACITOR ELECTROLYTE	100UF	50%	160V	5322	124	24221
C	510	CAPACITOR FOIL	150N	10%	1.5KV	5322	121	44329
C	511	CAPACITOR FOIL	150N	10%	1.5KV	5322	121	44329
C	512	CAPACITOR FOIL	150N	10%	1.5KV	5322	121	44329
C	513	CAPACITOR FOIL	330NF	10%	250V	4822	121	40344
C	516	CAPACITOR FOIL	10N	5%	2KV	5322	121	41603
C	517	CAPACITOR FOIL	220NF	10%	100V	4822	121	40232
C	518	CAPACITOR FOIL	100NF	10%	100V	5322	121	40323
C	520	CAPACITOR CERAMIC	10NF	50%	3000V	5322	122	50091
C	522	CAPACITOR FOIL	68N	10%	250V	4822	121	41156
C	541	CAPACITOR FOIL	100NF	10%	100V	5322	121	40323
C	542	CAPACITOR ELECTROLYTE	33UF	–	16V	5322	124	21431
C	515	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	523	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	540	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	545	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	546	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	547	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	548	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	552	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	553	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	556	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	557	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103
C	560	CAPACITOR CERAMIC	0.022UF	80%	63V	4822	122	30103

POSNR		DESCRIPTION			ORDERING CODE		
R	221	RESISTOR METAL FILM	5K62	1%	5322	116	53495
R	222	RESISTOR METAL FILM	5K62	1%	5322	116	53495
R	223	RESISTOR METAL FILM	5K62	1%	5322	116	53495
R	225	RESISTOR METAL FILM	5K62	1%	5322	116	53495
R	226	RESISTOR METAL FILM	5K62	1%	5322	116	53495
R	227	RESISTOR METAL FILM	121E	1%	4822	116	52955
R	228	RESISTOR METAL FILM	121E	1%	4822	116	52955
R	230	RESISTOR METAL FILM	110K	5%	4822	116	52455
R	231	RESISTOR METAL FILM	110K	5%	4822	116	52455
R	232	RESISTOR METAL FILM	200E	5%	4822	116	52405
R	233	RESISTOR METAL FILM	205R	1%	5322	116	53633
R	235	RESISTOR METAL FILM	205R	1%	5322	116	53633
R	250	RESISTOR METAL FILM	3K6	5%	4822	116	52419
R	252	RESISTOR METAL FILM	3K6	5%	4822	116	52419
R	253	RESISTOR METAL FILM	3K6	5%	4822	116	52419
R	256	RESISTOR METAL FILM	3K6	5%	4822	116	52419
R	251	RESISTOR METAL FILM	1K	5%	4822	116	52391
R	255	RESISTOR METAL FILM	1K	5%	4822	116	52391
R	257	RESISTOR METAL FILM	1K	5%	4822	116	52391
R	258	RESISTOR METAL FILM	1K	5%	4822	116	52391
R	259	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	260	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	261	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	262	RESISTOR METAL FILM	7K15	1%	5322	116	80125
R	263	RESISTOR METAL FILM	7K15	1%	5322	116	80125
R	265	RESISTOR METAL FILM	2K43	1%	5322	116	80109
R	266	RESISTOR METAL FILM	2K43	1%	5322	116	80109
R	267	RESISTOR METAL FILM	200E	5%	4822	116	52405
R	268	RESISTOR METAL FILM	2K	5%	4822	116	52406
R	270	RESISTOR METAL FILM	1K	5%	4822	116	52391
R	300	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	301	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	302	RESISTOR METAL FILM	249R	1%	5322	116	53573
R	303	RESISTOR METAL FILM	249R	1%	5322	116	53573
R	305	RESISTOR METAL FILM	1E	5%	4822	116	52385
R	306	RESISTOR METAL FILM	909R	1%	4822	116	53533
R	307	RESISTOR METAL FILM	4K64	1%	5322	116	53212
R	308	RESISTOR METAL FILM	7K32	1%	4822	116	53187
R	310	RESISTOR METAL FILM	1E	5%	4822	116	52385
R	311	RESISTOR METAL FILM	1E	5%	4822	116	52385
R	312	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	313	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	315	RESISTOR METAL FILM	1E	5%	4822	116	52385
R	316	RESISTOR METAL FILM	249R	1%	5322	116	53573
R	312	RESISTOR METAL FILM	249R	1%	5322	116	53573
R	318	RESISTOR METAL FILM	7K32	1%	5322	116	55372
R	320	RESISTOR METAL FILM	825R	1%	5322	116	53541
R	321	RESISTOR METAL FILM	909R	1%	4822	116	53533
R	322	RESISTOR METAL FILM	4K64	1%	5322	116	53212

POSNR		DESCRIPTION			ORDERING CODE		
R	323	RESISTOR METAL FILM	1K05	1%	4822	116	52898
R	325	RESISTOR METAL FILM	909R	1%	4822	116	53533
R	326	RESISTOR METAL FILM	2K	5%	4822	116	52406
R	327	RESISTOR METAL FILM	1K	5%	4822	116	52391
R	328	RESISTOR METAL FILM	1K62	1%	5322	116	53257
R	332	RESISTOR METAL FILM	11K5	1%	5322	116	53319
R	333	RESISTOR METAL FILM	1K47	1%	5322	116	53185
R	335	RESISTOR METAL FILM	140R	1%	5322	116	53542
R	336	RESISTOR METAL FILM	2K49	1%	5322	116	50581
R	337	RESISTOR METAL FILM	36R5	1%	5322	116	80116
R	338	RESISTOR METAL FILM	36R5	1%	5322	116	80116
R	340	RESISTOR METAL FILM	1K54	1%	5322	116	53571
R	341	RESISTOR METAL FILM	5K1	5%	4822	110	70126
R	342	RESISTOR METAL FILM	2K15	1%	5322	116	53239
R	343	RESISTOR METAL FILM	5K1	5%	4822	110	70126
R	345	RESISTOR METAL FILM	1K3	1%	5322	116	80102
R	346	RESISTOR METAL FILM	6K8	5%	4822	110	73129
R	347	RESISTOR METAL FILM	4K7	5%	4822	116	52426
R	350	RESISTOR METAL FILM	360E	5%	4822	116	52418
R	351	RESISTOR METAL FILM	845K	1%	5322	116	80172
R	352	RESISTOR METAL FILM	402K	1%	5322	116	80118
R	353	RESISTOR METAL FILM	301K	1%	5322	116	53328
R	355	RESISTOR METAL FILM	5K6	5%	4822	110	73127
R	356	RESISTOR METAL FILM	26R1	1%	5322	116	53723
R	357	RESISTOR METAL FILM	5K6	5%	4822	110	73127
R	358	RESISTOR METAL FILM	30K	5%	4822	116	52466
R	360	RESISTOR METAL FILM	523R	1%	5322	116	80122
R	361	RESISTOR METAL FILM	523R	1%	5322	116	80122
R	362	RESISTOR METAL FILM	2K32	1%	5322	116	80108
R	363	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	365	RESISTOR METAL FILM	1K	1%	4822	116	53108
R	366	RESISTOR METAL FILM	1K	1%	4822	116	53108
R	367	RESISTOR METAL FILM	3K83	1%	4822	116	53079
R	368	RESISTOR METAL FILM	2K87	1%	5322	116	55279
R	370	RESISTOR METAL FILM	4K02	1%	5322	116	53558
R	371	RESISTOR METAL FILM	1M	5%	4822	116	52493
R	372	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	373	RESISTOR METAL FILM	3K16	1%	4822	116	53021
R	375	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	376	RESISTOR METAL FILM	1M	5%	4822	116	52493
R	377	RESISTOR METAL FILM	196K	1%	5322	116	53661
R	378	RESISTOR METAL FILM	10K	1%	4822	116	53022
R	380	RESISTOR METAL FILM	2K	5%	4822	116	52406
R	381	RESISTOR METAL FILM	5K1	5%	4822	110	70126
R	382	RESISTOR METAL FILM	1K	5%	4822	116	52391
R	383	RESISTOR METAL FILM	10K	5%	4822	116	52452
R	400	POTMETER TRIMMER	22K	10%	5322	100	10979
R	401	POTMETER TRIMMER	22K	10%	5322	100	10979
R	402	RESISTOR METAL FILM	7K15	1%	5322	116	54606
R	403	RESISTOR METAL FILM	1K	1%	4822	116	53108

POSNR		DESCRIPTION		ORDERING CODE		
V	138	DIODE	IN4148	4822	130	30621
V	140	DIODE	IN4148	4822	130	30621
V	150	DIODE	IN4148	4822	130	30621
V	151	DIODE	IN4148	4822	130	30621
V	152	DIODE	IN4148	4822	130	30621
V	153	DIODE	IN4148	4822	130	30621
V	155	DIODE	IN4148	4822	130	30621
V	156	DIODE	IN4148	4822	130	30621
V	157	DIODE	IN4148	4822	130	30621
V	158	DIODE	IN4148	4822	130	30621
V	160	DIODE	IN4148	4822	130	30621
V	161	DIODE	IN4148	4822	130	30621
V	162	DIODE	IN4148	4822	130	30621
V	163	DIODE	IN4148	4822	130	30621
V	165	DIODE	IN4148	4822	130	30621
V	166	DIODE	IN4148	4822	130	30621
V	167	DIODE	IN4148	4822	130	30621
V	168	DIODE	IN4148	4822	130	30621
V	170	DIODE	IN4148	4822	130	30621
V	171	DIODE	IN4148	4822	130	30621
V	172	DIODE	IN4148	4822	130	30621
V	210	DIODE, REFERENCE ZENER	BZX79C22V	4822	130	34441
V	211	DIODE, REFERENCE ZENER	BZX75C1V4	4822	130	34047
V	212	DIODE, REFERENCE ZENER	BZX75C1V4	4822	130	34047
V	213	TRANSISTOR	BF199	4822	130	44154
V	215	TRANSISTOR	BF199	4822	130	44154
V	216	TRANSISTOR	BF199	4822	130	44154
V	217	TRANSISTOR	BF199	4822	130	44154
V	218	TRANSISTOR	BF199	4822	130	44154
V	220	TRANSISTOR	BF199	4822	130	44154
V	221	TRANSISTOR	BF199	4822	130	44154
V	222	TRANSISTOR	BF199	4822	130	44154
V	223	DIODE, REFERENCE ZENER	BZX79C56V	4822	130	34258
V	225	DIODE, REFERENCE ZENER	BZX79C56V	4822	130	34258
V	250	DIODE	IN4148	4822	130	30621
V	251	DIODE	IN4148	4822	130	30621
V	252	DIODE	IN4148	4822	130	30621
V	253	DIODE	IN4148	4822	130	30621
V	255	DIODE	IN4148	4822	130	30621
V	256	DIODE	IN4148	4822	130	30621
V	257	DIODE	IN4148	4822	130	30621
V	300	TRANSISTOR	BF450	4822	130	44237
V	301	TRANSISTOR	BF450	4822	130	44237
V	302	TRANSISTOR	BC558B	4822	130	44197
V	303	TRANSISTOR	BF450	4822	130	44237
V	305	TRANSISTOR	BF450	4822	130	44237
V	306	DIODE	IN4148	4822	130	30621
V	307	DIODE	IN4148	4822	130	30621
V	308	TRANSISTOR	BC558B	4822	130	44197
V	310	DIODE	IN4148	4822	130	30621

POSNR		DESCRIPTION		ORDERING CODE		
V	311	DIODE	IN4148	4822	130	30621
V	312	DIODE	IN4148	4822	130	30621
V	313	TRANSISTOR	BF199	4822	130	44154
V	315	DIODE, REFERENCE ZENER	BZX79C5V6	4822	130	34173
V	316	DIODE, REFERENCE ZENER	BZX79C6V2	4822	130	34167
V	317	DIODE	IN4148	4822	130	30621
V	318	TRANSISTOR	BC548C	4822	130	44196
V	320	TRANSISTOR	BF199	4822	130	44154
V	321	TRANSISTOR	BF199	4822	130	44154
V	322	TRANSISTOR	BF199	4822	130	44154
V	323	TRANSISTOR	BC558B	4822	130	44197
V	350	DIODE	IN4148	4822	130	30621
V	351	TRANSISTOR	BC558B	4822	130	44197
V	352	TRANSISTOR	BC558B	4822	130	44197
V	353	TRANSISTOR	BC558B	4822	130	44197
V	355	TRANSISTOR	BC558B	4822	130	44197
V	356	DIODE	IN4148	4822	130	30621
V	357	DIODE	IN4148	4822	130	30621
V	358	TRANSISTOR	BC548C	4822	130	44196
V	360	TRANSISTOR	BC548C	4822	130	44196
V	361	DIODE	IN4148	4822	130	30621
V	362	DIODE	IN4148	4822	130	30621
V	363	TRANSISTOR	BC558B	4822	130	44197
V	365	TRANSISTOR	BC558C	4822	130	44196
V	366	DIODE	IN4148	4822	130	30621
V	367	DIODE	IN4148	4822	130	30621
V	368	TRANSISTOR	BC558B	4822	130	44197
V	400	DIODE	IN4148	4822	130	30621
V	401	DIODE	IN4148	4822	130	30621
V	402	DIODE	IN4148	4822	130	30621
V	403	TRANSISTOR	BSX20	4822	130	41705
V	405	TRANSISTOR	BC558B	4822	130	44197
V	406	TRANSISTOR	BC548C	4822	130	44196
V	407	TRANSISTOR	BC548C	4822	130	44196
V	408	TRANSISTOR	BC548C	4822	130	44196
V	410	TRANSISTOR	BC548C	4822	130	44196
V	411	TRANSISTOR	BC548C	4822	130	44196
V	412	DIODE	IN4148	4822	130	30621
V	413	DIODE	IN4148	4822	130	30621
V	414	DIODE	IN4148	4822	130	30621
V	415	TRANSISTOR	BC548C	4822	130	44196
V	416	TRANSISTOR	BC548B	4822	130	44197
V	417	DIODE	IN4148	4822	130	30621
V	418	DIODE	IN4148	4822	130	30621
V	420	DIODE	IN4148	4822	130	30621
V	421	TRANSISTOR	BC548C	4822	130	44196
V	460	TRANSISTOR	BC548B	4822	130	44197
V	461	TRANSISTOR	BF423	4822	130	44196
V	462	TRANSISTOR	BF423	4822	130	44196
V	463	DIODE, REFERENCE ZENER	BZX75C2V1	4822	130	34049

POSNR		DESCRIPTION		ORDERING CODE		
V	465	DIODE, REFERENCE ZENER	BZX75C2V1	4822	130	34049
V	466	DIODE, REFERENCE ZENER	BZX79C6V2	4822	130	34167
V	467	TRANSISTOR	BF422	4822	130	41782
V	468	TRANSISTOR	BF422	4822	130	41782
V	470	TRANSISTOR	BC548C	4822	130	44196
V	471	TRANSISTOR	BC548C	4822	130	44196
V	472	TRANSISTOR	BF422	4822	130	41782
V	473	TRANSISTOR	BF422	4822	130	41782
V	501	DIODE, BRIDGE	SKB2-08/LSA	5322	130	32031
V	502	DIODE, BRIDGE	SKB-08/LSA	5322	130	32031
V	503	TRANSISTOR	BC338/16	4822	130	44121
V	504	DIODE	IN4148	4822	130	30621
V	505	DIODE, REFERENCE ZENER	BZX79-B5V6	4822	130	34173
V	510	DIODE	BY584	5322	130	32274
V	511	DIODE	BY584	5322	130	32274
V	512	DIODE	BY584	5322	130	32274
V	513	DIODE	BY584	5322	130	32274
V	517	TRANSISTOR	BF422	4822	130	41782
V	518	TRANSISTOR	BC548C	4822	130	44196
V	520	DIODE	IN4148	4822	130	30621
V	521	DIODE	BY509	4822	130	41485
V	522	DIODE	BAV21	4822	130	34189
V	523	TRANSISTOR	BF422	4822	130	41782
V	525	DIODE, REFERENCE ZENER	BZX75C1V4	4822	130	34047
V	526	TRANSISTOR	BF422	4822	130	41782
V	540	TRANSISTOR	BC548C	4822	130	44196
V	541	TRANSISTOR	BC548C	4822	130	44196

INTEGRATED CIRCUITS

D	250	INTEGR. CIRCUIT	74LS132N	5322	209	85201
D	251	INTEGR. CIRCUIT	74LS02N	5322	209	85312
D	252	INTEGR. CIRCUIT	74LS74	4822	209	80782
D	300	INTEGR. CIRCUIT	74LS132N	5322	209	85201
D	301	INTEGR. CIRCUIT	74LS86N	5322	209	84997
D	302	INTEGR. CIRCUIT	74122N	5322	209	84231
D	303	INTEGR. CIRCUIT	74LS74	4822	209	80782
D	500	INTEGR. CIRCUIT	7812	4822	209	81016
D	501	INTEGR. CIRCUIT	7912T	5322	209	81856

MISCELLANEOUS

POSNR		DESCRIPTION	ORDERING CODE		
		BNC CONNECTOR	5322	267	10004
		SOLDER TAG	5322	290	30204
		HEX. NUT	5322	506	14005
		CONTROL UNIT	5322	216	51147
		POWER SUPPLY UNIT	5322	216	51146
X	20	MOLEX CONNECTOR 12 PINS FEM	5322	266	40147
X	20	MOLEX CONNECTOR 12 PINS MA	5322	265	40624
X	21	MOLEX CONNECTOR 12 PINS FEM	5322	266	40147
X	21	MOLEX CONNECTOR 12 PINS MA	5322	265	40624
X	22	MOLEX CONNECTOR 12 PINS FEM	5322	266	40147
X	22	MOLEX CONNECTOR 12 PINS MA	5322	265	40624
X	23	MOLEX CONNECTOR 12 PINS FEM	5322	266	40147
X	23	MOLEX CONNECTOR 12 PINS MA	5322	265	40624
X	25	MOLEX CONNECTOR HOUSING 2 PINS FEM	5322	265	61106
X	25	MOLEX CONNECTOR PINS	5322	265	40623
X	25	MOLEX CONNECTOR 2 PINS MA	5322	265	61107
X	26	MOLEX CONNECTOR HOUSING 2 PINS FEM	5322	265	61106
X	26	MOLEX CONNECTOR PINS	5322	265	40623
X	26	MOLEX CONNECTOR 2 PINS MA	5322	265	61107
X	501	MOLEX CONNECTOR WITH CABLE	5322	321	22263
X	501	MOLEX CONNECTOR 7 PINS MA	5322	265	40237
		REED RELAY CONTACT	5322	280	24126
		CATHODE RAY TUBE 150 BT31	5322	131	20106
		POWER ON LED	4822	130	31911
		THERMAL FUSE	5322	252	20114
F	500	MAINS FUSE	4822	253	30009
K	20	REED RELAY ASSLY	5322	280	20276
K	21	REED RELAY ASSLY	5322	280	20276
K	22	REED RELAY ASSLY	5322	280	20276
K	23	REED RELAY ASSLY	5322	280	20276
K	25	REED RELAY ASSLY	5322	280	20276
K	26	REED RELAY ASSLY	5322	280	20276
K	27	REED RELAY ASSLY	5322	280	20276
K	28	REED RELAY ASSLY	5322	280	20276
K	120	REED RELAY ASSLY	5322	280	20276
K	121	REED RELAY ASSLY	5322	280	20276

POSNR		DESCRIPTION	ORDERING CODE		
K	122	REED RELAY ASSLY	5322	280	20276
K	123	REED RELAY ASSLY	5322	280	20276
K	125	REED RELAY ASSLY	5322	280	20276
K	126	REED RELAY ASSLY	5322	280	20276
K	127	REED RELAY ASSLY	5322	280	20276
S	3	SLIDE SWITCH	5322	277	24077
S	4	SLIDE SWITCH	5322	277	24077
S	5	SLIDE SWITCH	5322	277	24077
S	6	SLIDE SWITCH	5322	277	24077
S	7	DPST SWITCH	5322	101	40132
S	8	ROTARY AMPL/DIV SWITCH	5322	273	34121
S	9	ROTARY AMPL/DIV SWITCH	5322	273	34121
S	10	ROTARY TIME/DIV SWITCH	5322	273	34119
S	12	SLIDE SWITCH	5322	277	24077
S	13	SLIDE SWITCH	5322	277	24077
S	14	SLIDE SWITCH	5322	277	24077
S	15	SLIDE SWITCH	5322	277	24077
S	16	SLIDE SWITCH	5322	277	24077
S	17	SLIDE SWITCH	5322	277	24077
S	18	SLIDE SWITCH	5322	277	24077
S	19	SLIDE SWITCH	5322	277	24077
T	500	MAINS TRANSFORMER	5322	146	40385

8. CIRCUIT DIAGRAMS and PCB LAY-OUTS.

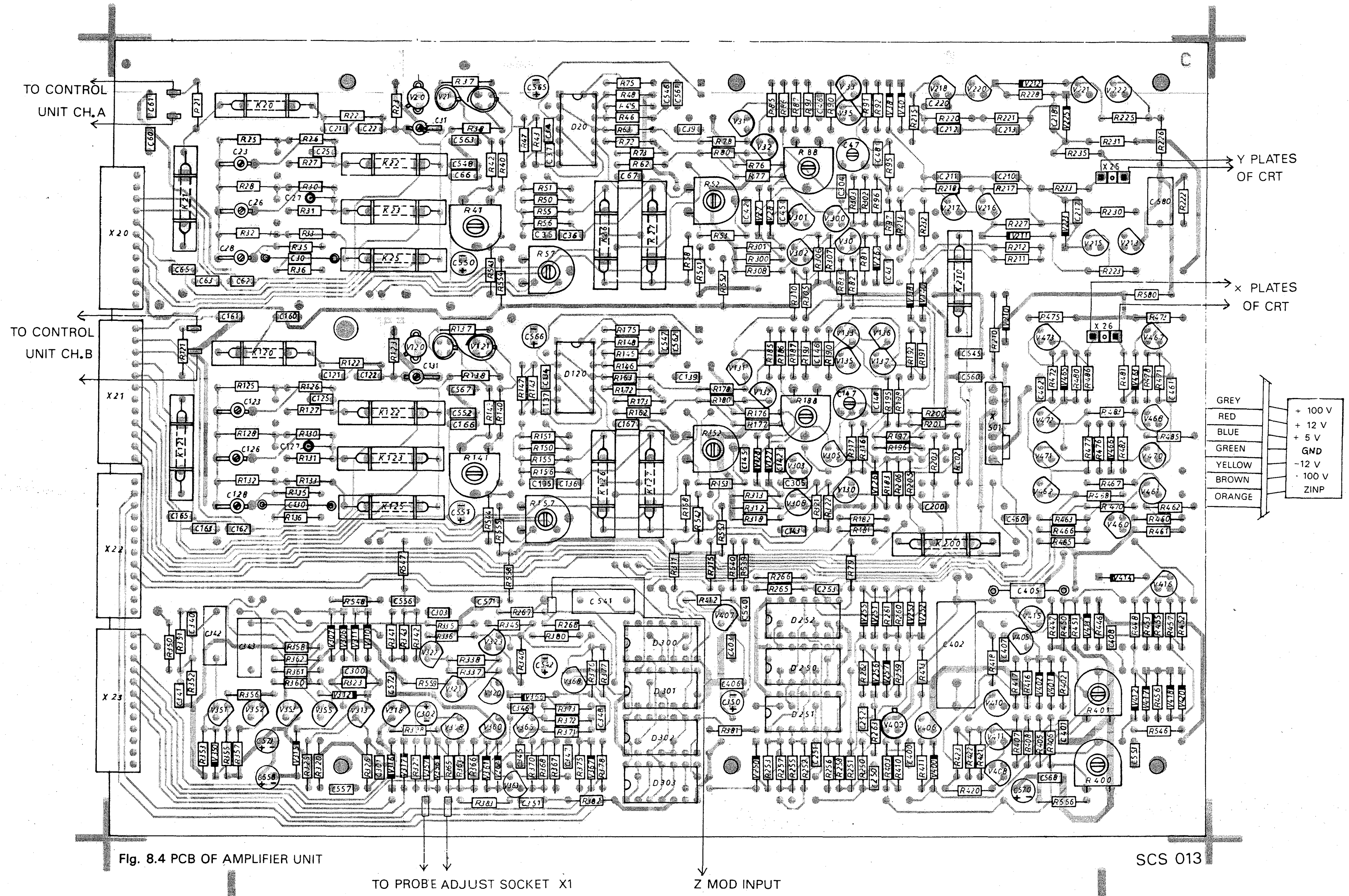


Fig. 8.4 PCB OF AMPLIFIER UNIT

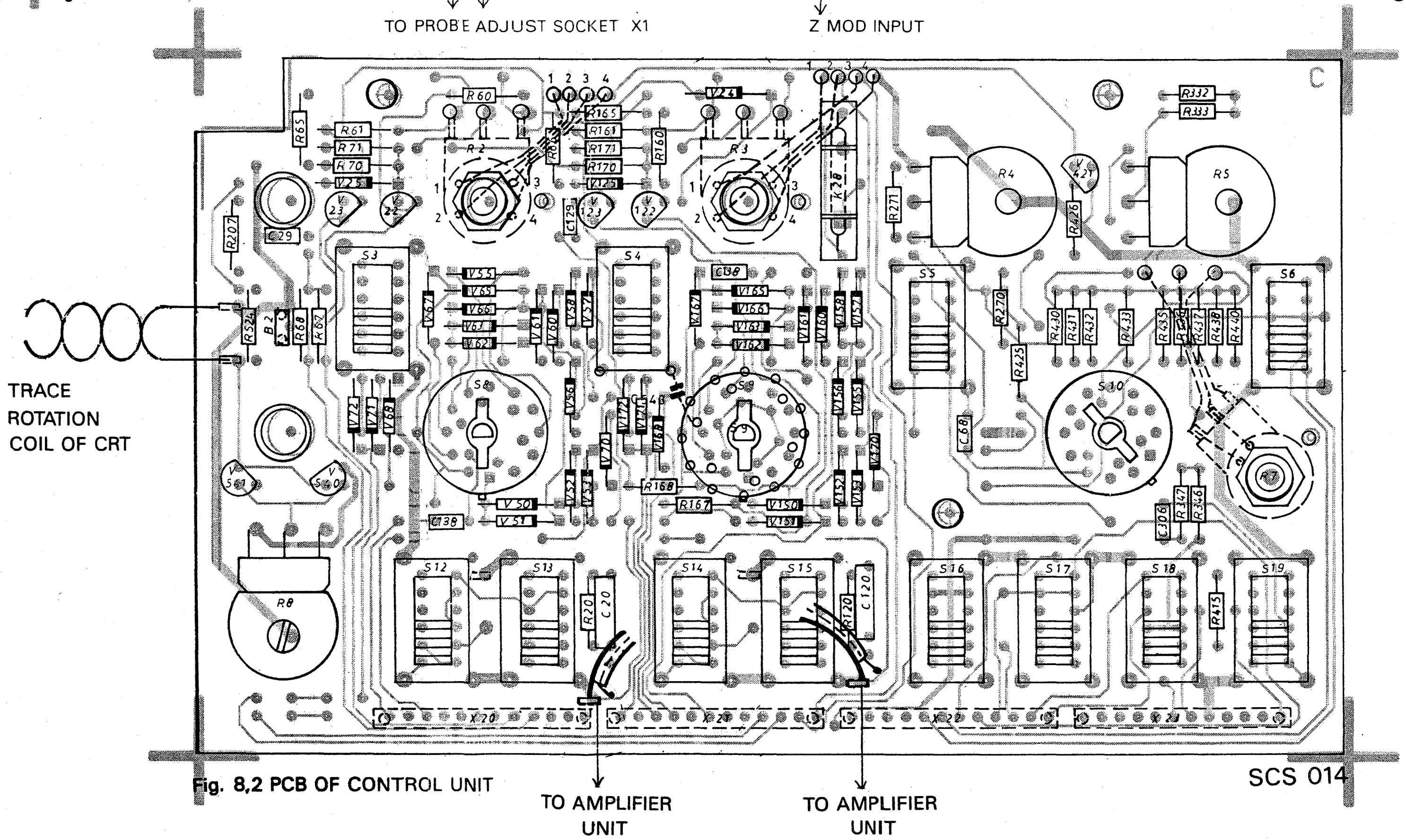


Fig. 8,2 PCB OF CONTROL UNIT

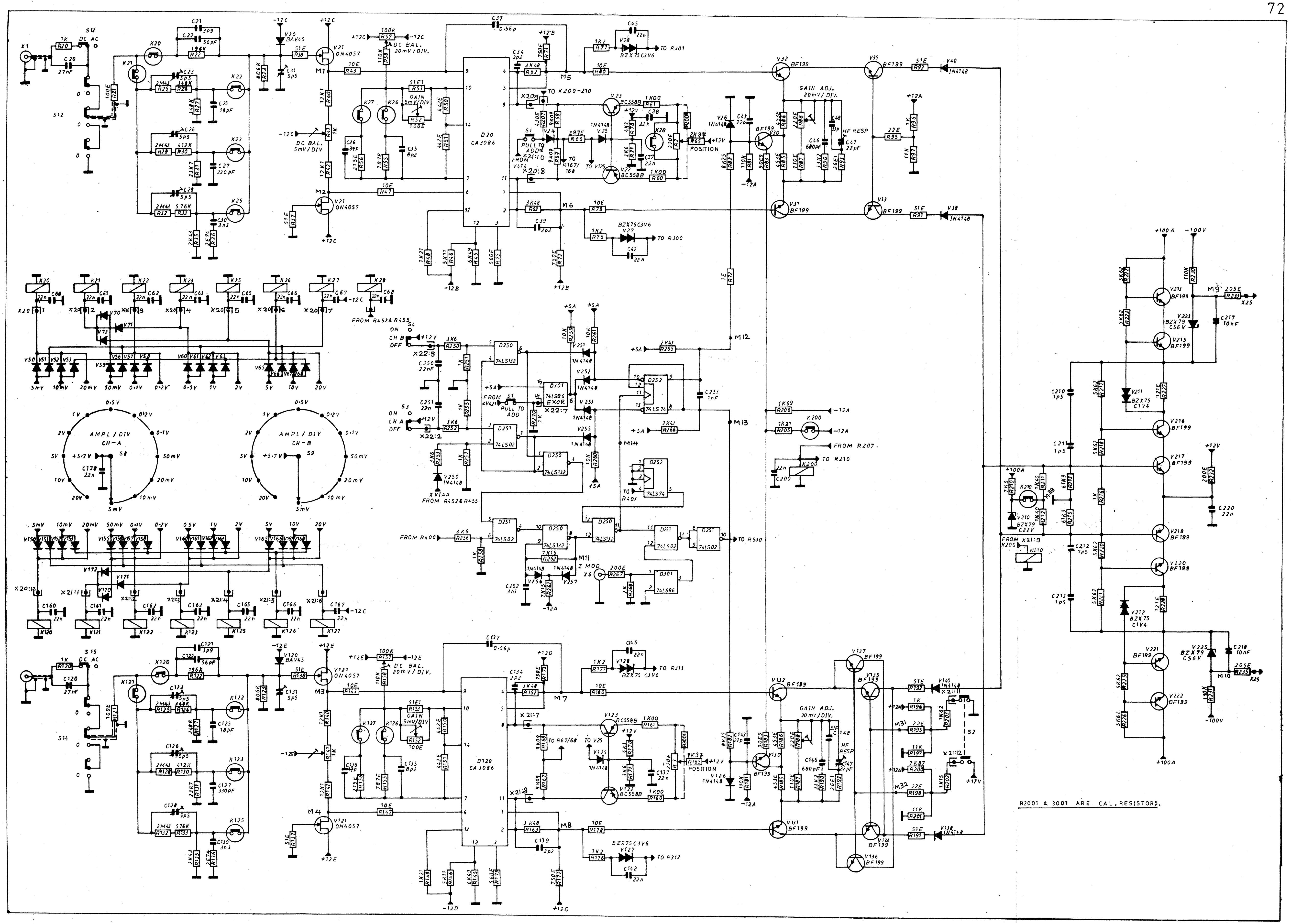


Fig. 8.3 CIRCUIT DIAGRAM VERTICAL CHANNEL

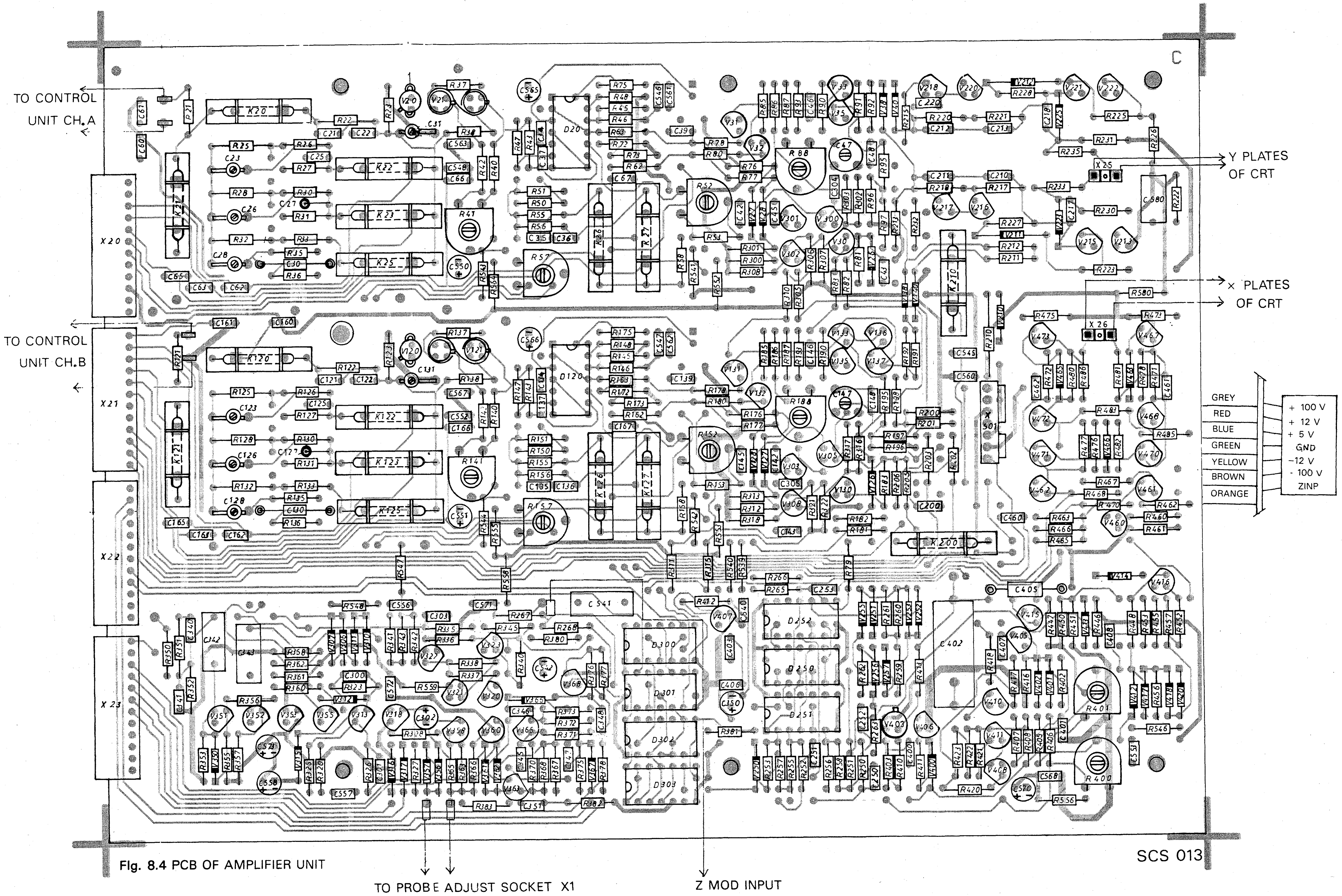


Fig. 8.4 PCB OF AMPLIFIER UNIT

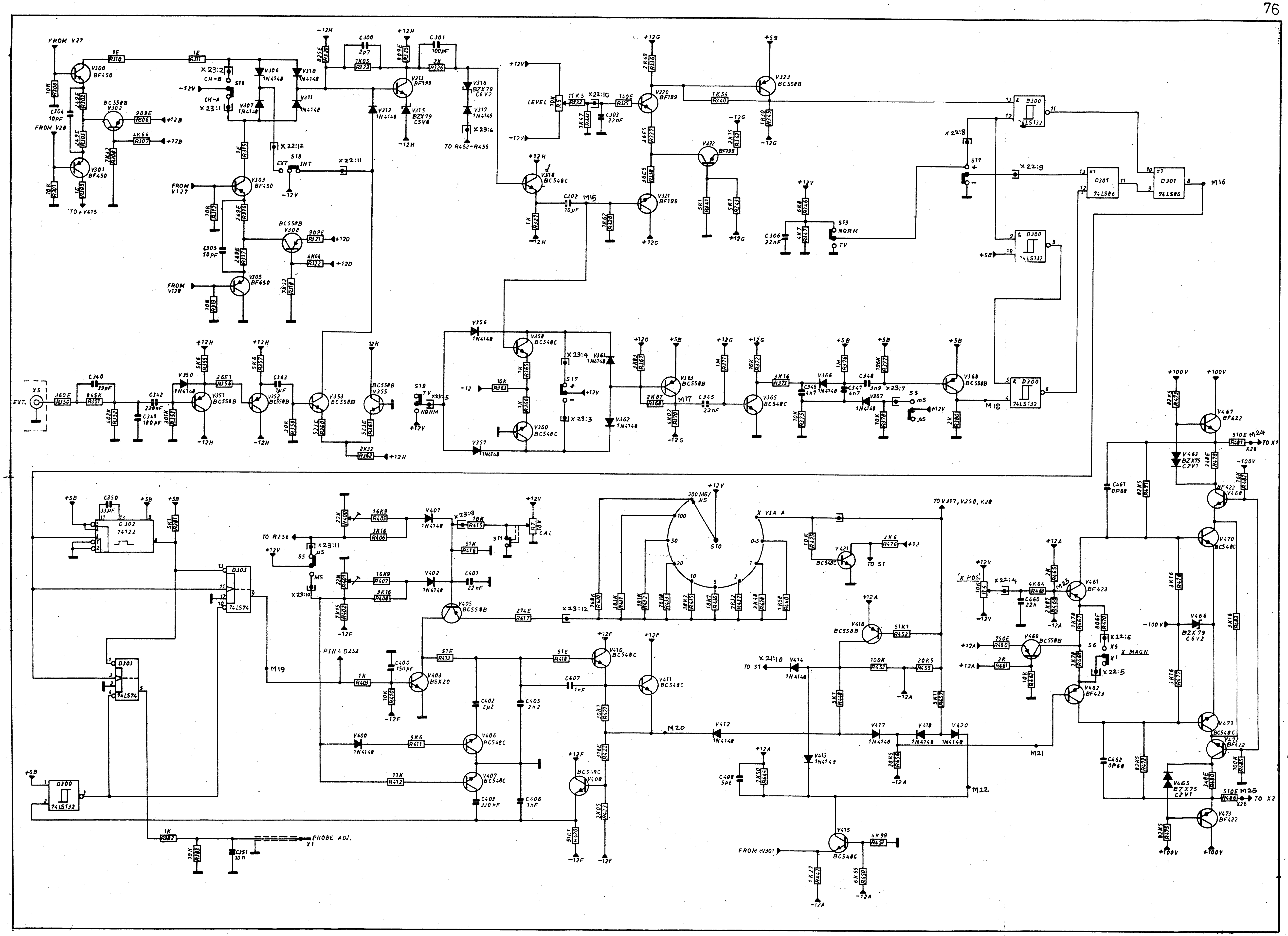


Fig. 8.5 CIRCUIT DIAGRAM X CHANNEL AND TIME BASE

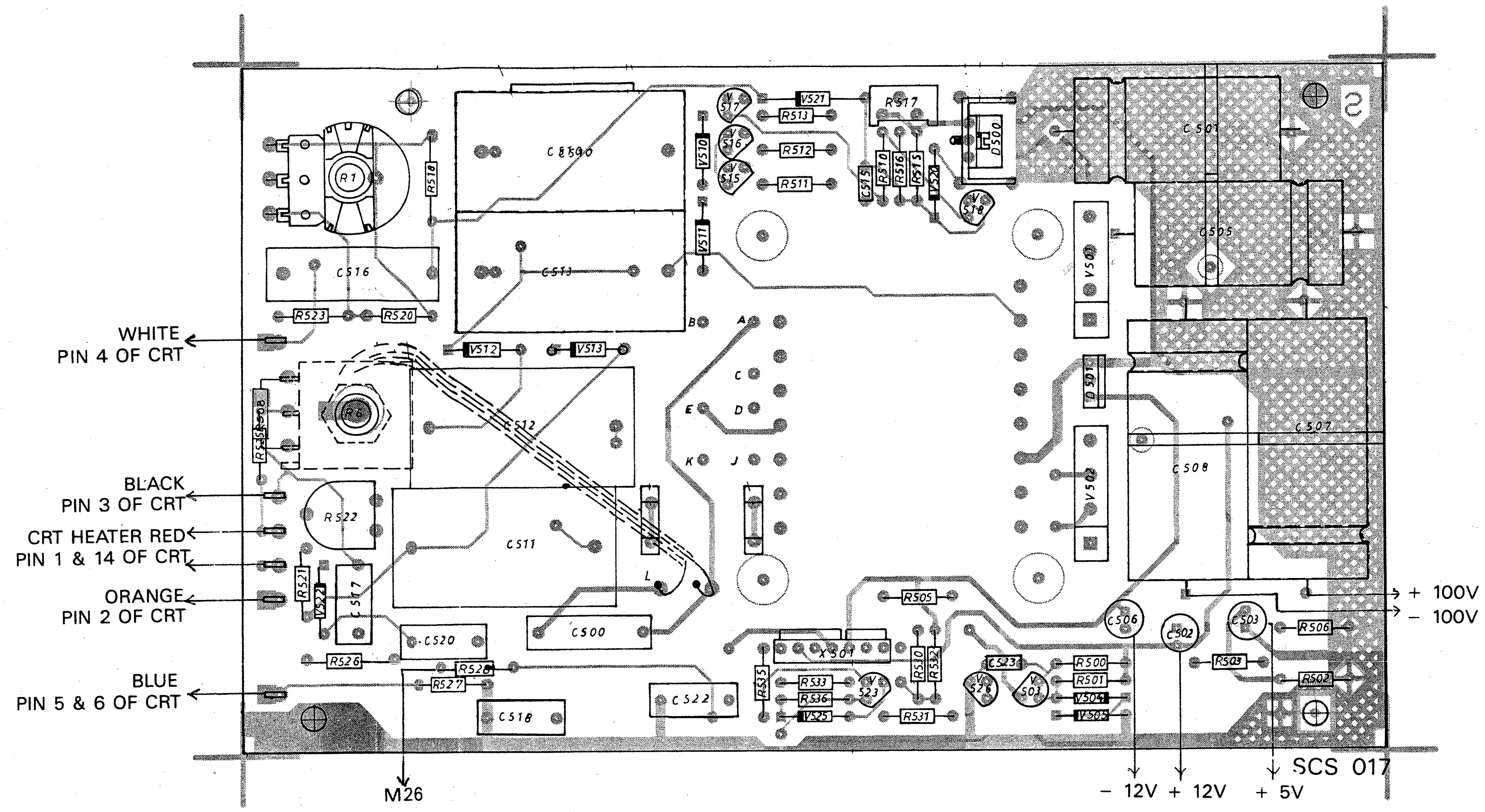
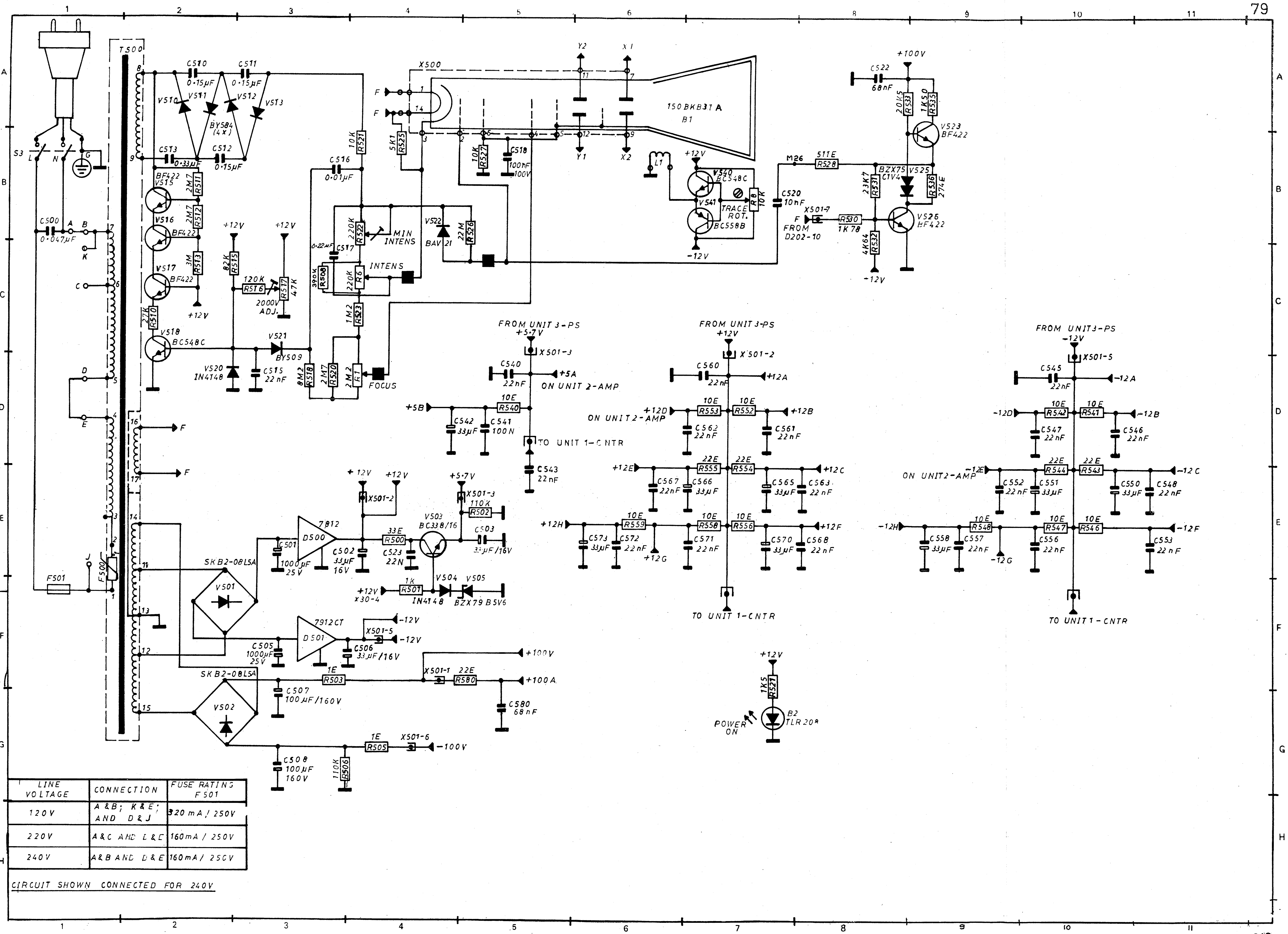


Fig. 8.6 PCB OF POWER SUPPLY UNIT



LINE VOLTAGE	CONNECTION	FUSE RATING F501
120V	A&B; K&E; AND D&J	320 mA / 250V
220V	A&C AND D&E	160mA / 250V
240V	A&B AND D&E	160mA / 250V

CIRCUIT SHOWN CONNECTED FOR 240V

Fig. 8.7 CIRCUIT DIAGRAM OF POWER SUPPLY UNIT

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 [O P M 3 2 6 0 0 2] = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

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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Deutschland (Bundesrepublik): Philips GmbH,
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