1. General information

1.1. INTRODUCTION

The PM 3211 oscilloscope is a compact, lightweight instrument featuring ergonomic design and extensive measurement capabilities. It has a wide range of use which includes servicing, research and educational applications.

The instrument has a high sensitivity of 2 mV/DIV, a bandwidth of 15 MHz and a large 8 x 10 cm screen with a high intensity trace.
There is a wide choice of display possibilities enabling the choice of one channel, two channels in the alternate or chopped mode or both channels added. Channel B can be displayed in the normal or inverted mode.

The instrument has several trigger modes including TV triggering.

A double-insulated power supply allows the frame ground to be directly connected to floating ground circuits privided this ground does not carry live potentials.
Interference by ground currents, as is frequently experienced with grounded oscilloscopes is also substantially reduced.

The PM 3211Q is the USA-version of the basic PM 3211. In addition to the basic instrument the PM 3211Q is supplied with two 10:1 probes PM 9326/40.

Warning: The frame ground (and the probe's ground lead) must not be connected to live potentials.

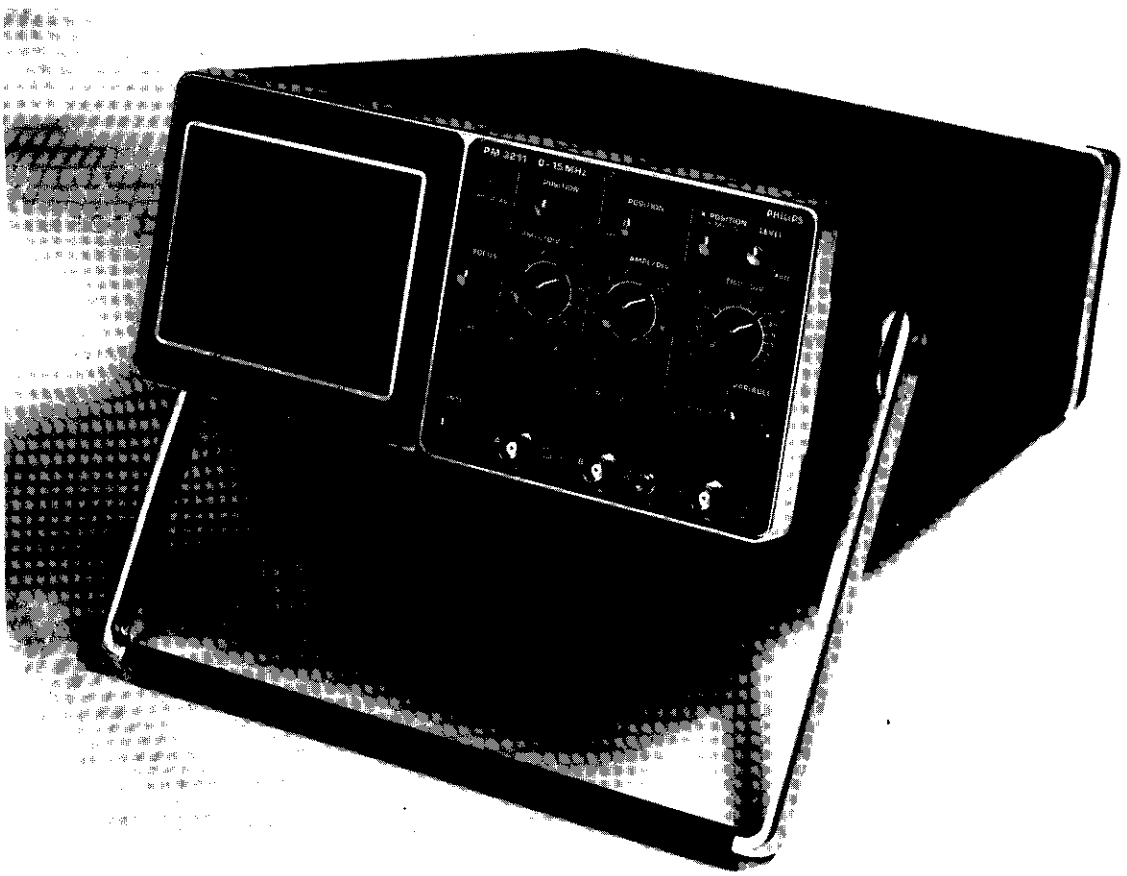


Fig. 1.1. 15 MHz dual-channel oscilloscope PM 3211

1.2. CHARACTERISTICS

This instrument has been designed and tested according to IEC Publication 348 for Class II instruments and has been supplied in a safe condition. The present Instruction Manual contains information and warnings which shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition. Properties expressed in numerical values with stated tolerances are guaranteed for ambient temperatures of +5 °C ... +40 °C unless stated otherwise. Numerical values without tolerances are typical and represent the characteristics of an average instrument.

Designation	*Specification*	*Additional Information*
1.2.1. C.R.T.		
Type	D14-260GH	
Measuring area	8 x 10 divisions	1 div. equals 1 cm
Screen type	P31 (GH) standard	P7 (GM) optional
Total acceleration voltage	4 kV	
Graticule	External	
1.2.2. Vertical amplifier		
Display modes	Channel A only Channel B only A and B chopped A and B alternated A and B added	
Input coupling	AC, DC, 0	
Channel B polarity	Normal or inverted	
Response:		
Frequency range	DC: 0 ... 15 MHz (–3 dB) AC: 10 Hz ... 15 MHz (–3 dB)	Measured at 6 div. amplitude
Pulse aberrations	$\leqslant \pm 3$ %	Measured at 6 div. amplitude, applied rise time $\geqslant 3$ ns
Deflection coefficients	2 mV/DIV ... 10 V/DIV	Calibrated steps, 1-2-5 sequence
Deflection accuracy	± 3 %	
Input impedance	1 MΩ/25 pF	
Input RC time	22 ms	Coupling switch to AC
Maximum permissible input voltage	400 V, DC + AC peak	
Chopping frequency	250 kHz approx.	
Vertical positioning range	± 8 DIV	
Maximal deflection	24 DIV	For sinewave signals with frequencies up to 5 MHz
C.M.R.R. in A-B mode	100:1 at 1 MHz	A-B mode with 8 DIV of common-mode signal
Cross-talk between channels	–50 dB or better at 15 MHz	
Instability of the spot position:		
Trace jump	$< 0{,}3$ DIV	When switching between any of the attenuator positions or operating other switches.
DC stability	< 1 DIV/hour	Over total temp. range

1.2.3. Time-base

Designation	*Specification*	*Additional Information*
Time coefficients	0,2 s/DIV ... 0,5 µs/DIV	1-2-5 sequence
Continuous control range	1:⩾ 2,5	Uncalibrated continuous control between the 1-2-5 steps
Coefficient error	± 3 %	
Magnification	5x	
Additional error for magnifier	± 2 %	

1.2.4. Triggering

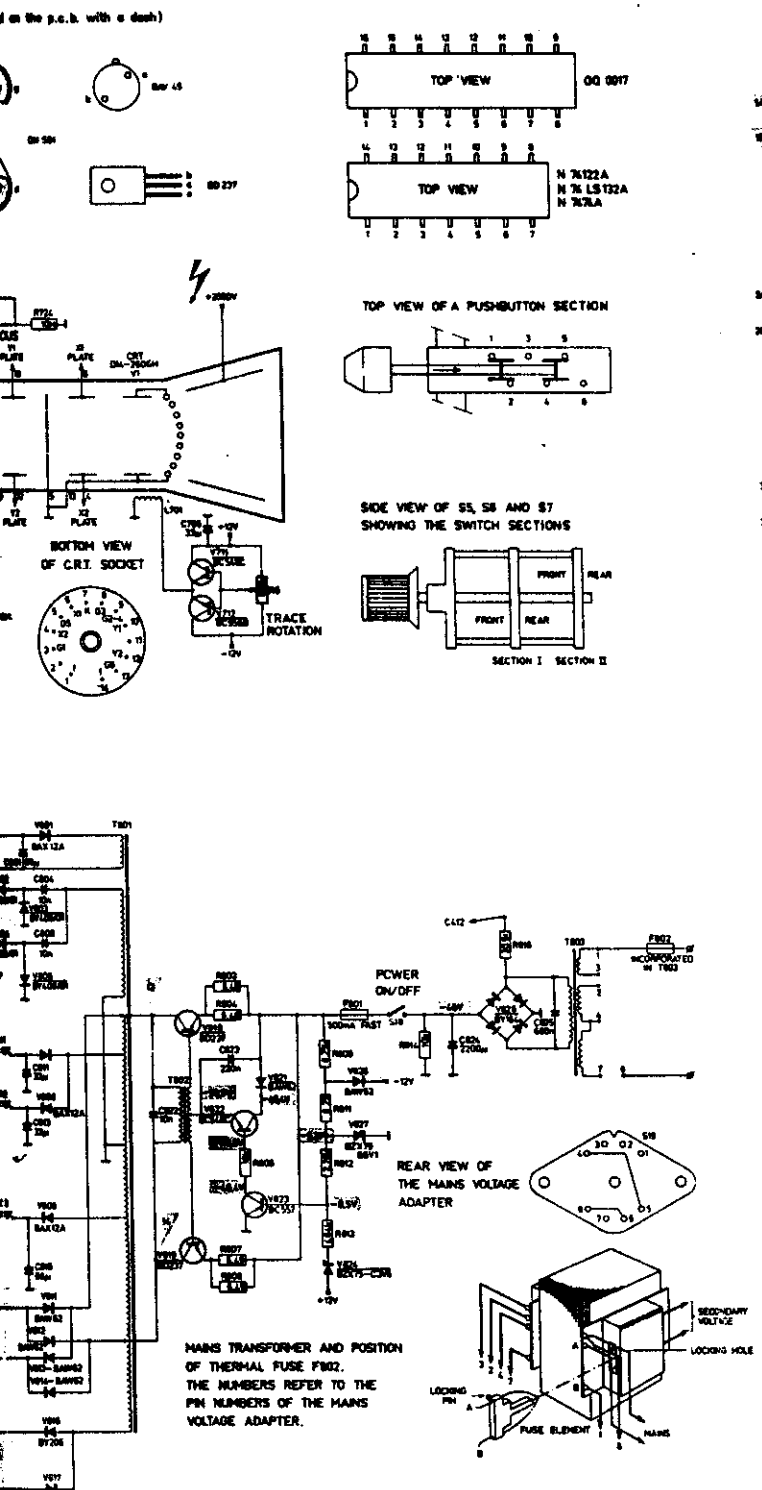
Source	Ch. A, Ch. B, External input and line/mains	
Coupling	AC	
Trigger mode	Automatic or Normal	Automatic mode combined with top level mode
Trigger sensitivity	Internal: 0,75 DIV 1,5 DIV External: 0,8 V	Signals ⩽ 5 MHz Signals ⩽ 15 MHz Signals ⩽ 15 MHz
Triggering frequency range	20 Hz ... 15 MHz 10 Hz ... 15 MHz	Automatic free run Normal
Level range	Internal: ± 12 DIV External: ± 6 V	From centre of screen From centre of screen
Triggering slope	+ or −	
Input impedance	1 MΩ//25 pF	Equivalent to input impedance of vertical inputs
Maximum permissible input voltage	400 V, DC + AC peak	
TV triggering	Triggering on Frame pulses (TVF) or Line pulses (TVL)	TIME/DIV 0.28 ... 0.5 ms/DIV: TVF TIME/DIV 0.2 ms ... 0.5 µs/DIV: TVL When the TV filter is switched on, the time base functions in the AUTO mode.
TV trigger sensitivity	internal 0.75 DIV external 0.8 V	sync pulse amplitude sync pulse amplitude

1.2.5. X Deflection

Source	Time-base X via Y_B operation	If TIME/DIV switch is in position X via B
Deflection coefficients	Ch. B: as selected by AMPL/DIV	
Deflection accuracy	± 15 %	Via Ch. B.
Frequency range	DC: 0 ... 1 MHz (−3 dB)	
Phase shift	3^o at 50 kHz	
Dynamic range	24 divisions	For frequencies ⩽ 100 kHz

1.2.6. Probe adjust

Output voltage sufficient for adjusting pulse response of attenuator probes



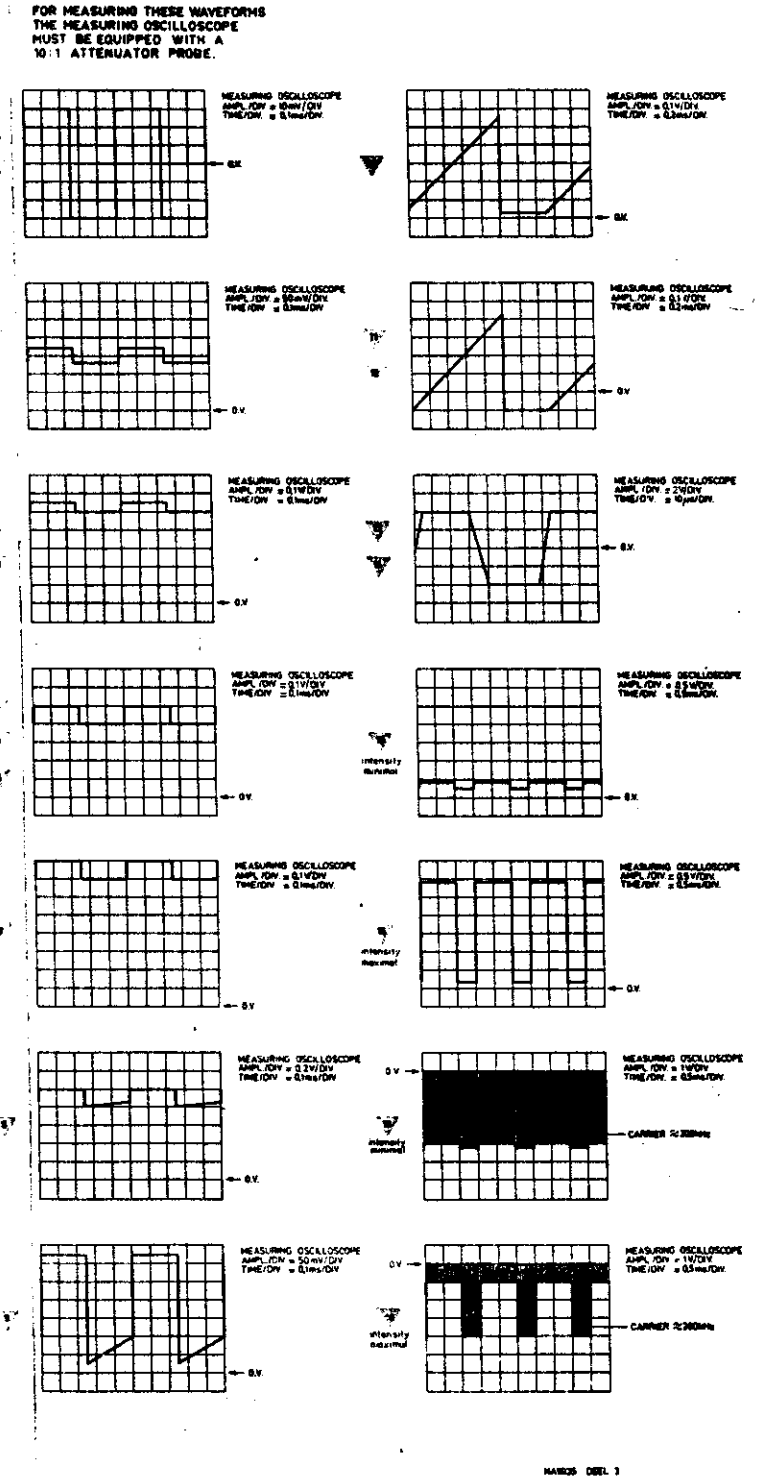
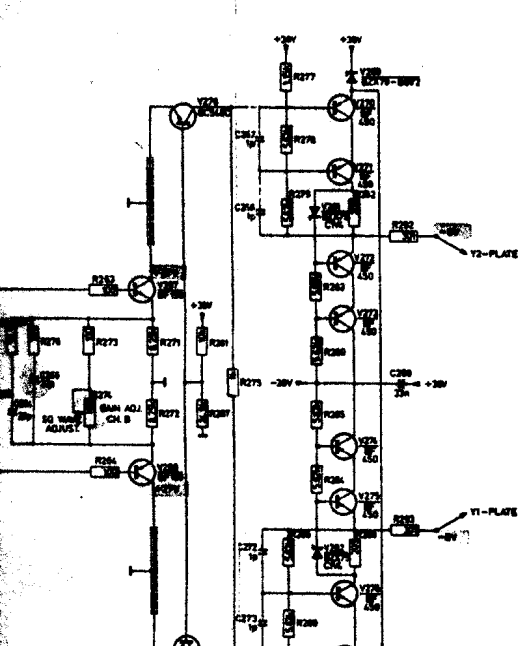
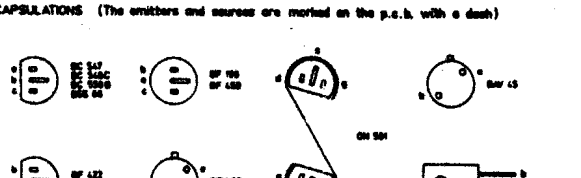
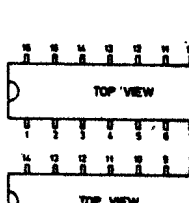


Fig. 3.19. PM 3211/PM 3211Q circuit diagram

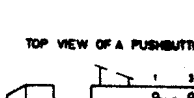


ENCAPSULATIONS (The emitters and sources are marked on the p.c.b. with a dash)

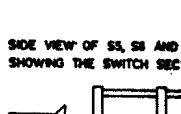


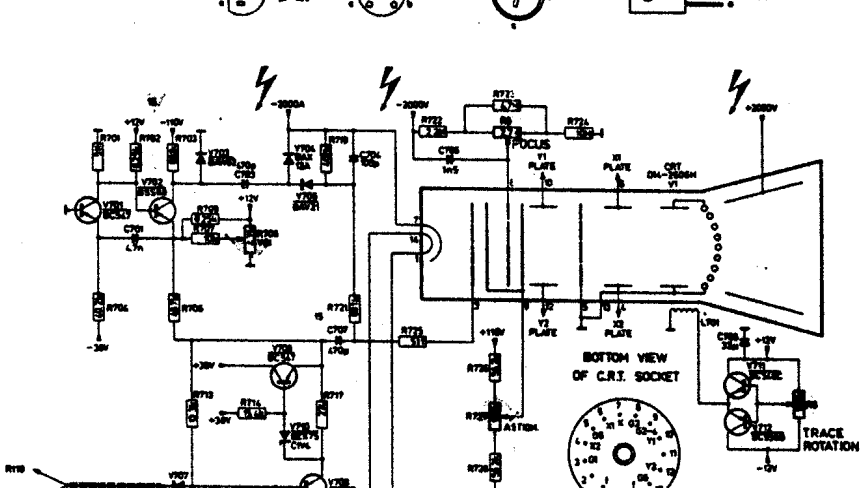


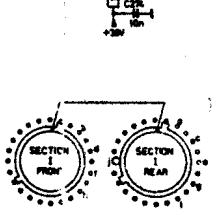
TOP VIEW OF A PUSHBUTTON



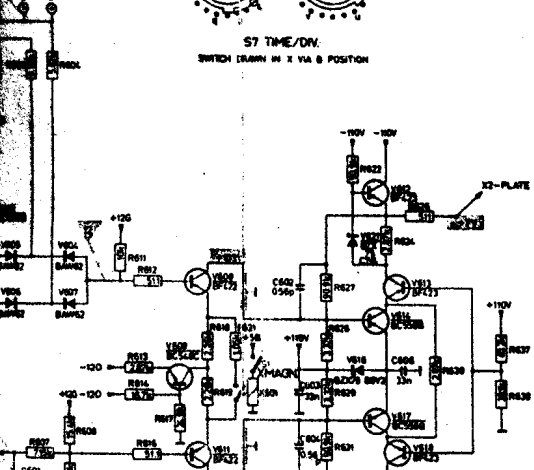
SIDE VIEW OF S5, S6 AND S7 SHOWING THE SWITCH SECTIONS

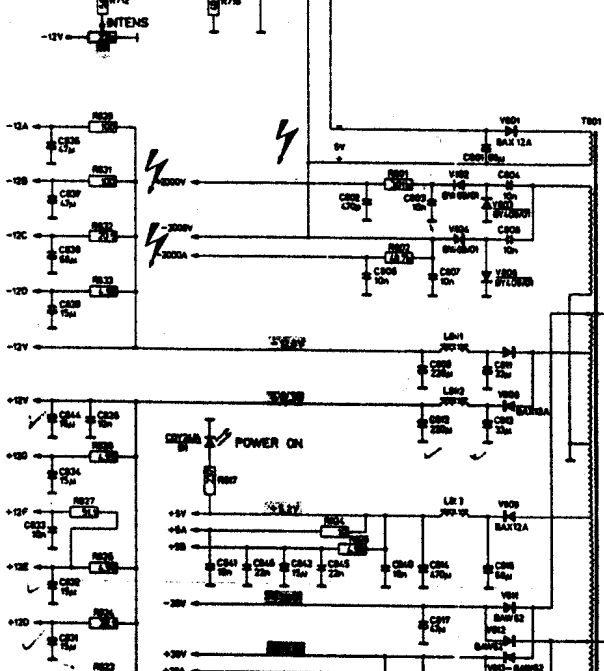


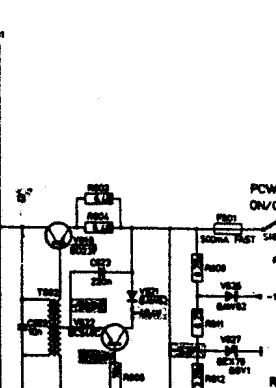




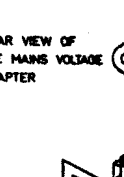
S7 TIME/DIV.
SWITCH DRAWN IN X VIA B POSITION



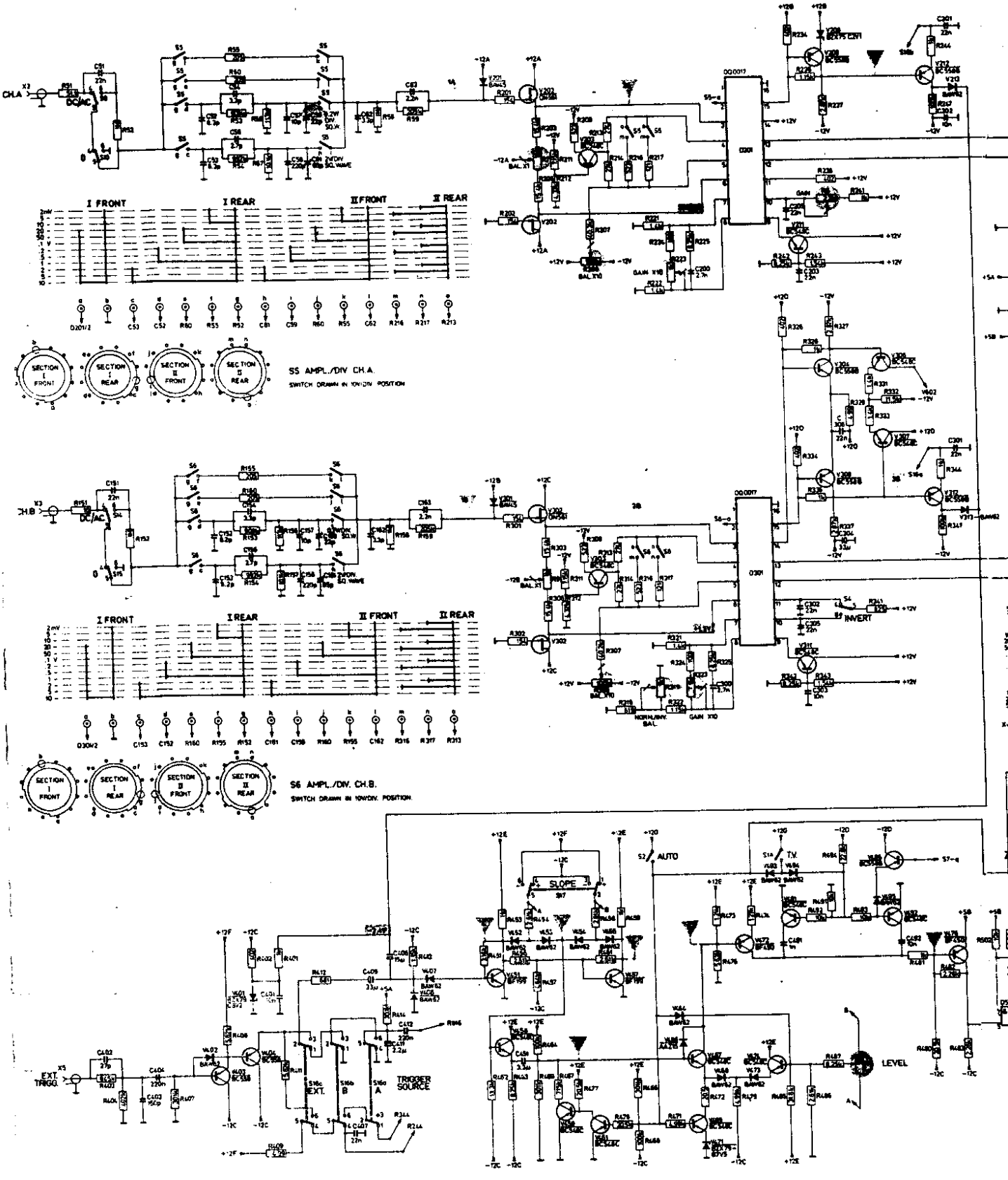




REAR VIEW OF THE MAINS VOLTAGE ADAPTER



MAINS TRANSFORMER AND POSITION OF THERMAL FUSE F802. THE NUMBERS REFER TO THE PIN NUMBERS OF THE MAINS VOLTAGE ADAPTER.


I FRONT
I REAR
II FRONT
II REAR
SECTION I FRONT
SECTION I REAR
SECTION II FRONT
SECTION II REAR
S5 AMPL./DIV CH.A.
SWITCH DRAWN IN 10MV/DIV POSITION
S6 AMPL./DIV. CH.B.
SWITCH DRAWN IN 10MV/DIV. POSITION
DC/AC
INVERT
SLOPE
AUTO
T.V.
LEVEL
TRIGGER SOURCE
EXT. TRIGG.

DEEL 1

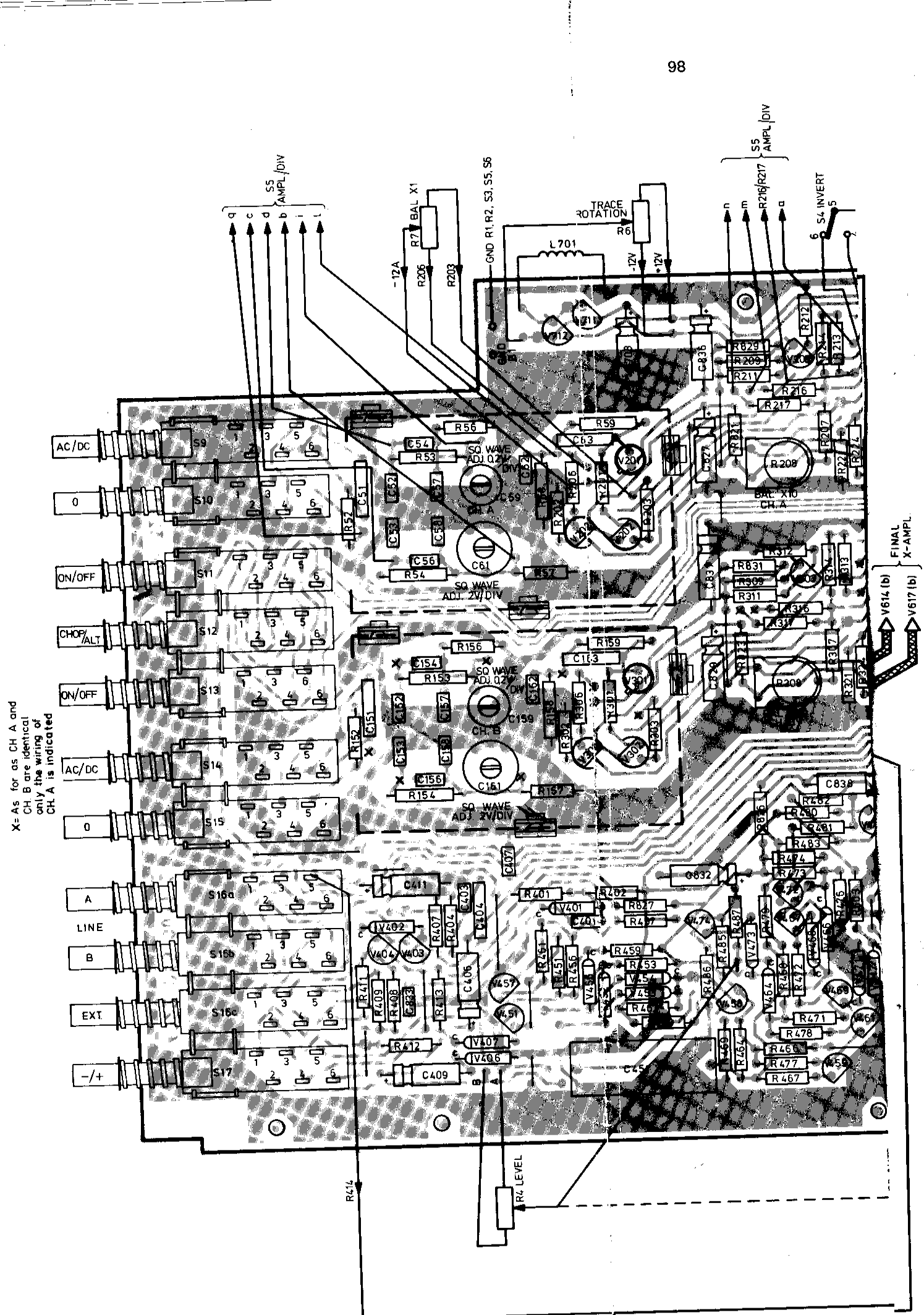
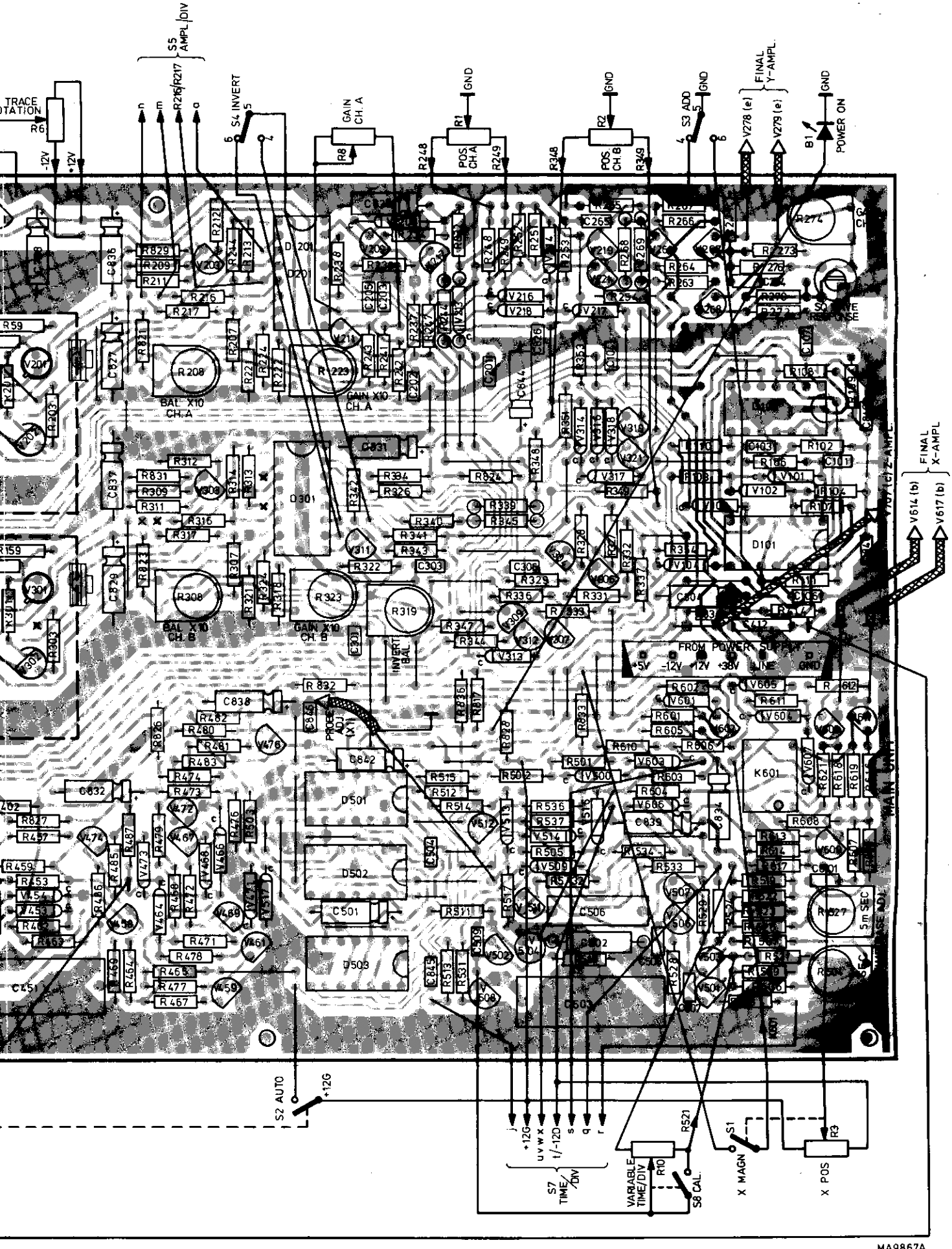


Fig. 3.18. Main unit, compo7A



MA9867A

Fig. 3.18. Main unit, components lay-out

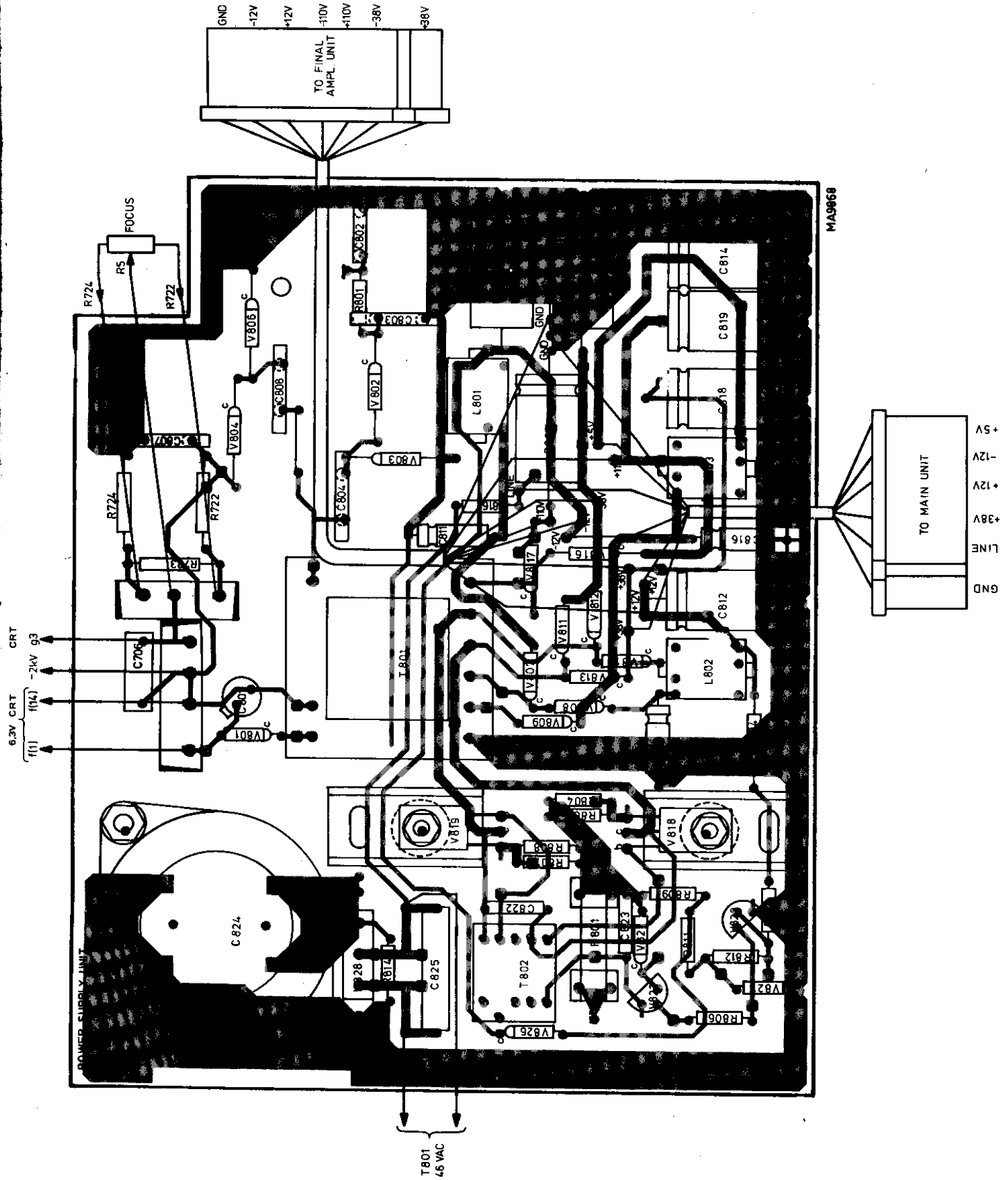


Fig. 3.15. Power supply unit, components lay-out

FINAL X-AMPLIFIER (V608, V609, V611, V612, V613, V614, V617, V618, V619)

The output signal from the X-deflection selector reaches the base of series feedback stage V608.
This stage is balanced by V611. The base circuit of this transistor incorporates the horizontal position control R3.
V608 and V611 receive their emitter-circuit from constant current source V609, via R618 and R619.
R618 and R619 are shunted by R621 in the X-magnifier X5 position so that a horizontal gain increase of 5 times is obtained.
The collector signal from V608 and V611 is fed via two coaxial cables to the output stage. This output stage consists of shunt feedback stage V614/V613 and current source V612, that drive the horizontal deflection plate X2.
The horizontal deflection plate X1 is driven by shunt feedback stage V617/V618 and current source V619.
In the shunt feedback stages V614/V613 and V617/V618 two transistors are used per stage because of maximum permissible current and voltage on each transistor and to reduce stray capacitances.
The horizontal deflection plates X1 and X2 are connected with the output stage via respectively R636 and R626 in order to increase stability.
Note that the horizontal output stage has a higher supply voltage than the vertical output stage.
This is because the horizontal deflection sensitivity is less (19 Volt/DIV) than the vertical sensitivity (9,5 Volt/DIV). Therefore the horizontal output stage must deliver a higher amplitude to the CRT for a certain deflection than the vertical output stage.

3.3.3. C.R.T. display section

Z-AMPLIFIER (V708, V709)

The input of the Z-amplifier is the cathode of V707 and receives signal 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 intensity potentiometer R11 that influences the amount of current fed into the Z-amplifier.

The Z-amplifier is a shunt-feedback stage with V709 and V708.
The HF component in the output signal is fed via the 2 kV blocking capacitor C707 to the Wehnelt cylinder of the CRT.

MODULATOR (V701, V702)

The DC and LF components at the output of the Z-amplifier are fed to the modulator as a current to the emitter of V702. V701 and V702 form a 200 kHz multivibrator. The AC voltage on the collector of V702 has a peak to peak value which depends on the current fed to the emitter of V702.
The collector voltage of V702 is fed via the 2 kV blocking capacitor C703 to the demodulator.

DEMODULATOR (V704, V706)

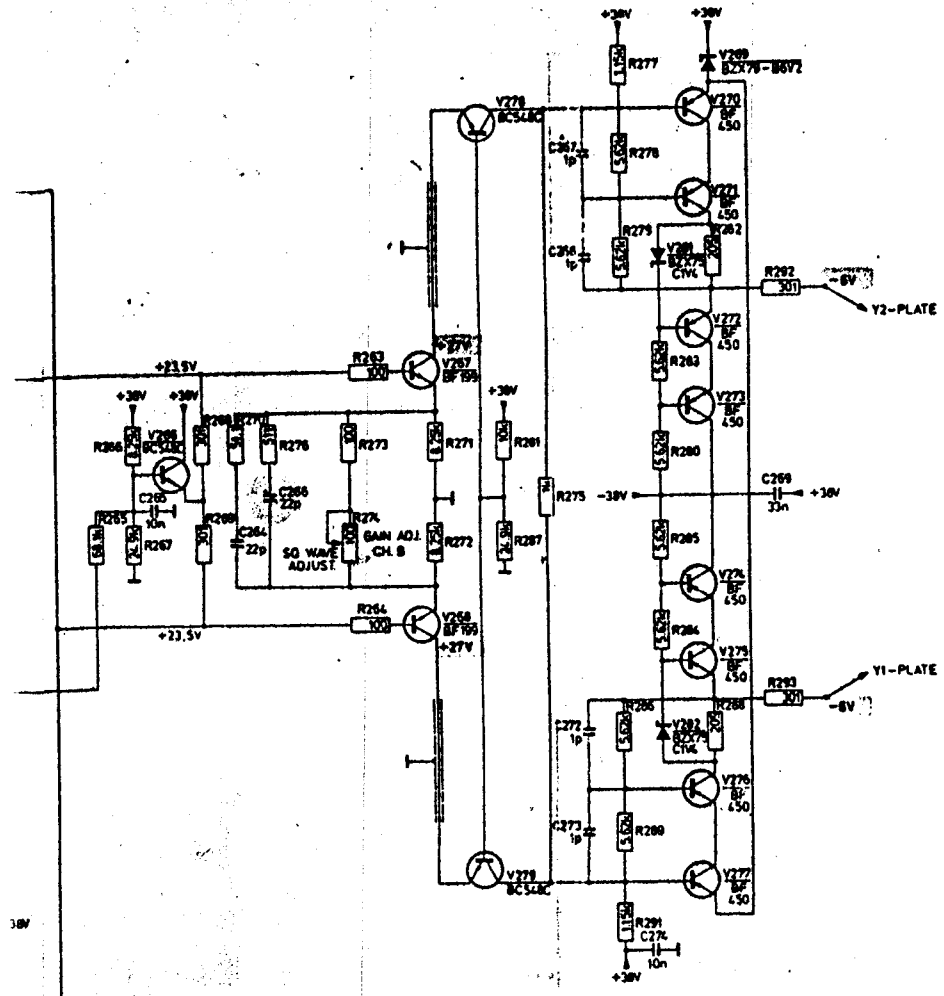
The modulated LF and DC components in the Z-amplifier output are demodulated by the rectifier diodes V704 and V706 and smoothed by C704. The voltage on C704 is added to the cathode-voltage and after that added to the HF component and fed to the Wehnelt cylinder.

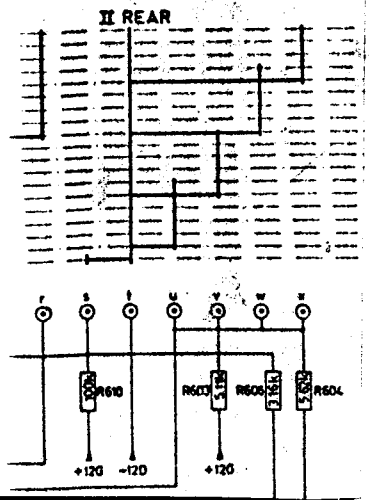
TRACE ROTATION (V711, V712)

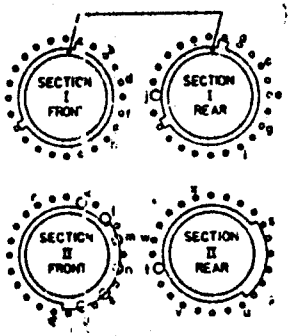
The emitter followers V711 and V712 and preset potentiometer R6 determine the strength and sense of the current in the trace rotation coil L701.
Only one emitter follower is conductive at a time. Which emitter follower is determined by the position of R11.

3.3.4. POWER SUPPLY (V818, V819, V822, V823)

The mains voltage is transformed, rectified and smoothed to 46 Volt DC. The mains transformer is double insulated and equipped with a thermal fuse to protect the insulation against excessive temperatures.
The 46 Volt DC is applied to a regulated DC to AC balance converter. This converter incorporates the power transistors V818 and V819 with series feedback stabilisation. These transistors drive the power transformer T801 with a square wave signal of approximately 16 kHz. The base of the power transistors is driven by driver transformer T802 that works with a saturated core.
The regulator circuit incorporates V823 and V822 of which the collector is connected to the centre tap of T802.







S7 TIME/DIV.
SWITCH DRAWN IN X VIA B POSITION

ENCAPSULATIONS (The emitters and sources are marked on the p.c.b. with a dash)