

Portable four-trace oscilloscope

PM3264

Instruction Manual/Gerätehandbuch/Notice d'emploi et entretien

9499 443 02502
840209/06/..

S&I

Scientific & Industrial Equipment Division



**Scientific &
Industrial Equipment**

PHILIPS



PHILIPS

SERVICE

Scientific & Analytical Equipment
Test & Measuring Instruments
Industrial Automation
Advanced Automation Systems
Welding

Scientific &
Industrial
Equipment
Division

1-2-84

TEST AND MEASURING EQUIPMENT

OSC174

OSCILLOSCOPE PM 3264/04, 05, 06

Already published: OSC 72, 83, 101, 102, 110, 166.

- Subjects:
1. Repair of attenuator unit.
 2. Service ordering codes for cabinet parts in new brown colour.
 3. Electrical modifications for improved performance.
 4. Component changes due to inavailability of the former component.

Note: this service information must be used together with instruction manual
9499 443 02502.

1. REPAIR OF ATTENUATOR UNIT.

This concerns the attenuator unit with ordering code 5322 219 84137.

The above mentioned unit is repaired in the supply centre in Enschede via the Concern Service repair procedure. In order to shorten repair times (this avoids backorders and waiting times!) the following must be borne in mind:

- when you send a faulty unit to Concern Service always attach a label to it with a clear description of the fault.
- never use contact spray on the inner or outer contacts of the unit. Contact spray only works for a short period; after this period the contact problem is worse than it has ever been!
- never try to lubricate the mechanical parts of the unit because lubrication can disturb the switch contacts.

2. CABINET PARTS IN NEW BROWN COLOUR.

Starting with the /06 production series the colour of the instrument has been changed from grey into brown. Therefore the following ordering codes on page 222, 223, 224 and 225 of the instruction manual have been changed as follows:

page 222:

Item	Quantity	Ordering number	Description
2	8	5322 414 30044	Knob, dia 10mm, shaft dia 4mm
2	8	5322 414 70016	Cover, brown with dash
3	1	5322 414 30047	Knob, dia 7...10mm, shaft dia 4mm
4	2	5322 414 30066	Knob, dia 24mm, shaft dia 6mm
4	2	5322 414 30062	Knob, dia 14mm, shaft dia 4mm

9499 448 25611

PRINTED IN THE NETHERLANDS

4	2	5322 414 70037	Cover, blue with dash
5	4	5322 414 30045	Knob, dia 19mm, shaft dia 6mm
5	4	5322 414 30046	Knob, dia 10mm, shaft dia 4mm
5	4	5322 414 70018	Cover, blue with dash
6	3	5322 414 30046	Knob, dia 10mm
6	3	5322 414 70016	Cover, brown with dash
7	25	5322 414 20036	Knob for pushbutton
11	1	5322 459 20269	Screen bezel
13a	1	5322 466 91401	Grip strip, plastic
14	1	5322 455 11006	Text strip PM3264
15	1	5322 455 11005	Text plate PM3264
--	1	5322 447 90416	Front cover, complete
page 223:			
22	1	5322 447 90414	Rear cabinet plate
page 224:			
18	1	5322 447 90412	Upper cabinet plate, complete
19	1	5322 447 90413	Lower cabinet plate, complete
page 225 (completion of parts list):			
--	4	4822 530 70119	Fixing spring, part 4. See fig. 8.4. in manual.

3. ELECTRICAL MODIFICATIONS FOR IMPROVED PERFORMANCE.

ATTENUATOR PROBE PM 8935/40.

R5 has been changed from 82,5 into 75 Ohm (5322 116 54459).

Reason: this modification brings the adjustment of the HF square wave response in conjunction with the changed cable-capacitance.

FINAL Y AMPLIFIER (UNIT 13).

(05): remove adjustment capacitor C613 (capacitance range 82...120 pF) and replace it by a fixed capacitor of 2,7 nF (4822 122 30057).

Reason: these adjustable capacitors are not necessary.

INTERMEDIATE AMPLIFIER (UNIT 12).

(05): the adjustment capacitors C205, C233, C305, C333, C2205, C2233, C2305, C2333 can be removed. The adjustment capacitors C229, C329, C2229, C2329 can be replaced by a fixed capacitor of 560 pF (4822 122 30126).

The adjustment capacitor C404A, B, C, D can be replaced by a fixed value of 4,7 nF (4822 122 30128).

Reason: adjustment capacitors are not necessary.

(05): change R272, R372, R2272, R2372 from 46,4 into 38,3 k.Ohm (5322 116 50483).

Reason: this improves the Y shift range.

TRIGGER SOURCE UNIT (UNIT 16).

(05): change the type of V704 from BC264A into BF410A (5322 130 44905).

Change R708 from 1,78 into 3,16 k.Ohm (5322 116 50579).

Reason: this modification makes all tolerances of D701 usable.

(04): remove C709 (10nF).

Reason: this avoids oscillations in the input stage.

TRIGGER AMPLIFIER (UNIT 9).

(05): add a capacitor C1223 in parallel with R1253. Value of this capacitor 330 pF/100 V (4822 122 30055).

the DTB in absence of a signal.

Reason: this avoids triggering of

(06): change R801 from 1 k.Ohm into 100 Ohm (5322 116 55549).

Reason: correction of parts list.

TIME BASE (UNIT 8).

(05): remove C904. Replace C1320 by an electrolytic capacitor of 33 uF (4822 124 20688).

The negative pole of this capacitor must be connected to earth and the positive pole to +5,2 Volt at R1311.

Reason: this avoids 500 kHz sinewave distortion in the X-direction.

Z AMPLIFIER (UNIT 11).

(04): change V2015 from BZX79-C5V6 into BZX79-B5V6 (4822 130 34173).

Reason: this gives a smoother intensity response at the highest time base sweep speeds.

POWER SUPPLY (UNIT 5).

(05): change R1839 from a resistor 1 Ohm/CR25 into a resistor 3,48 Ohm/MR25 (5322 116 51476).

Reason: this avoids 1 kHz oscillations on the supply voltages.

(05): change R1809 from 24,9 into 249 k.Ohm (5322 116 54734).

Reason: correction of parts list.

(04): change R1813 from 22,6 into 10 Ohm (5322 116 50452).

Add C1810 (22nF, 4822 122 30103) in parallel with R1823.

Reason: avoids oscillations at 260 VAC and improves starting-up at 90 VAC.

(04): change R1848 from 61,9 into 14,7 Ohm (5322 116 50412).

Reason: improvement of trigger sensitivity with a distorted 50/60 Hz sinewave.

(04): change C1810 into 22nF (4822 122 30103).

Change R1839 from 3,48 into 100 Ohm (5322 116 55549).

Reason: this avoids 1kHz oscillations on the power supply output voltages.

FRONT SIDE UNIT.

(05): replace the level potentiometers R2 and R4 by new types with a resistance value of 1 k.Ohm (5322 101 40122).

Reason: this modification gives a better reliability.

4. COMPONENT CHANGES DUE TO INAVAILABILITY OF THE FORMER COMPONENT TYPE.

Because the old component type is not any longer available and has been succeeded by a new type, the following has been altered.

The production series in which the modification is introduced is given between brackets. In some cases the new component has the same ordering code as the former one. This means that after the stock of the old component is exhausted, it will be succeeded by the new one.

UNIT 2:

(02): D101, D151: LM208H (5322 209 85475).

(04): V102, V152: BFT46 (5322 130 44797).

(04): C124, C127, C174, C177: 6,8uF/16V (5322 124 10398)

UNIT 5:

(04): R1854: 1 M.Ohm/MR25 (5322 116 55535)

V1808, V1809, V1811: BYV96E (5322 130 34979).

V1816, V1817, V1818, V1819, V1827, V1828, V1836, V1837, V1838,

V1839: BYV96D (4822 130 31348).

C1802, C1803: 220uF/385V (4822 124 70344)

(03): V1807: BAX12A (5322 130 34605).

R1817, R1818: 10 M.Ohm/VR25 (4822 110 72214).

(04): V1826, V1831, V1832, V1833, V1834: BYV96D (4822 130 31348).

(02): V1806: BUY89 (5322 130 41954).

UNIT 7:

(04): C2033: 470 nF/100 V (5322 121 40175).
V2018, V2019: BY509 (4822 130 41485).
C2038, C2039: 1nF/4kV (5322 122 50077).

UNIT 8:

(04): C921, C1318: 6,8 uF/63 V (4822 124 20727).
R926: 487 Ohm/MPR 24 (5322 116 55451).
R 1336: 887 Ohm/MPR 24 (5322 116 51483).
(03): D1303: CA3086RCA (5322 209 86236).
(04): D903, D904, D1301, D1302: LM208H (5322 209 85475).
D901: GXB10231P (5322 209 86003).

UNIT 106:

MTB switch (04)

R1001

R1002

R1003

R1004

R1006

R1007

R1008

R1009

R1011

R1012

R1013

UNIT 107:

DTB switch (04)

-

-

R1401

R1402

R1403

R1404

R1406

R1407

R1408

R1409

R1411

402 Ohm/MPR24 (5322 116 52095)
876 k.Ohm/MR54E (5322 116 54902)
887 k.Ohm/MR54E (5322 116 54901)
354 k.Ohm/MPR34 (5322 116 52102)
176 k.Ohm/MPR34 (5322 116 52101)
87,6 k.Ohm/MPR24 (5322 116 52099)
34,6 k.Ohm/MPR24 (5322 116 52098)
16,8 k.Ohm/MPR24 (5322 116 51813)
7,96 k.Ohm/MPR24 (5322 116 52097)
2,67 k.Ohm/MPR24 (5322 116 52096)
887 Ohm/MPR24 (5322 116 51483)

UNIT 9:

(04): C834: 100nF/100V (4822 121 40522)
D801, D1201, D1304: LM208H (5322 209 85475)

UNIT 11:

(03): V2021, V2022: BZT03-C180 (5322 130 31908)
(04): V2027: BYV96D (4822 130 31348)
(05): V2032, V2038, V2039, V2041, V2042: BAV21 (4822 130 30842).

UNIT 15:

This is a completely sealed unit; the components on this unit are not interchangeable and therefore removed from the parts list. These components are V1851, V1852, V1853, V1854, V1856, V1857, V1858, V1859 and V1861.

UNIT 16:

(03): R707: 10 M.Ohm/VR25 (4822 110 72214)
(04): D702: LM208H (5322 209 85475)

UNIT 17:

(04): D1901: UA709HC (5322 209 84452)

FRONT SIDE UNIT:

(04): E1, E2 (graticule illumination lamps): 28V/80mA (5322 134 40534)



PHILIPS

SERVICE

Scientific & Analytical Equipment
Test & Measuring Instruments
Industrial Automation
Advanced Automation Systems
Welding

**Scientific &
Industrial
Equipment
Division**

10-05-82.

TEST AND MEASURING EQUIPMENT

OSC 110.

Already published OSC : 72, 83, 102.

Subject : Modifications introduced during the /03 and following production series.

Note : This service information must be used in combination with manual 9499 443 02502.

Note : The production series in which a certain modification is introduced, is indicated with every modification.

For instance if a modification is introduced starting with the /03 series this is written as /03 AFS. AFS means : and following (production) series. The production series is indicated at the identification plate at the rear of the instrument.

1. GENERAL

1.1. SAFETY

Add two toothed rings (4822 530 80083) between the rear plate and the rear profile of the instrument. The toothed rings must be fixed with the fixing screws of the rear plate.

Due to this modification the earthing of the rear plate is assured. This is necessary to meet the safety regulations.

1.2. COMPLETION OF PARTS LIST

Ratchet block of carrying handle. 5322 528 34113

1.3. CORRECTION OF PARTS LIST

Special nut for attenuator switch. 5322 505 10659.

2. VERTICAL DEFLECTION

2.1. UNIT 12 (INTERMEDIATE AMPLIFIER): /04 AFS

Remove C 1652 (10 nF).

Reason : correction of manual.

3. TIME BASES AND X DEFLECTION

3.1. UNIT 8 (TIME BASE): /03 AFS.

Add a capacitor C 1504 of 22 nF (4822 122 30103) between earth and the junction of R 1543 and the screening of the coax cable connected to V 1529/V 1528.

This reduces ringing on the trigger view signal.

3.2. UNIT 8 : /03 AFS.

Remove C 907 and C 1316 from the unit.

This avoids oscillations on the + 11,4 Volt Supply.

3.3. UNIT 8 : /03 AFS.

- Change R 980 from 10 kohm into 5,11 kohm (5322 116 54595).
- Remove zener diode V 935 (BZX 79 - C 4V7).

This avoids oscillations in the time base auto-circuit.

3.4. UNIT 26 : /04 AFS.

Remove R 1736, R 1741 and 1737.

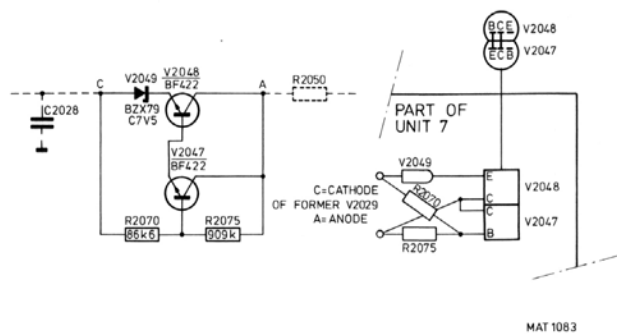
Reason : The orthogonality adjustment, for which these resistors were in circuit, is not necessary.

4. Z AMPLIFIER AND FOCUSING

4.1. UNIT 7 (FOCUS UNIT) : /04 AFS.

Replace neon stabilisation tube V 2029 by an electronic circuit consisting of 2 transistors V 2047, V 2048 (BF 422, 4822 130 44108), 1 zener diode BZX 79 C 7V5 (4822 130 30861) and 2 resistors 909 kohm (5322 116 54408) and 86,6 kohm (5322 116 54692).

For circuit diagram and lay-out of this circuit see figure below.



MAT 1083

This modification is necessary because the neon stabilisation tube will soon not be available.
The modification can also be used in older instruments where V 2029 needs to be replaced.

WWW.JETECNET.COM

PM 3264 OSCILLOSCOPE WITH EXTRA: MAIN TIME BASE (MTB) GATE OUT.
MAIN TIME BASE SWEEP OUT.
DELAYED TIME BASE (DTB) GATE OUT.
DELAYED TIME BASE SWEEP OUT.

PROJECT NR.: 9444 932 64167.

NOTE: this information sheet must be used together with PM 3264 Instruction manual 9499 443 02502.

CHARACTERISTICS:

Output voltage MTB (DTB) gate out: +5 Volt during MTB (DTB) sweep. Otherwise 0 Volt. Output impedance 1 k.Ohm.

Output voltage MTB (DTB) sweep out: the MTB (DTB) sawtooth voltage. Top voltage level: +2,5 Volt into 50 Ohm;
+5 Volt into 1 M.Ohm.
Bottom voltage level: +0,1 Volt into 50 Ohm; +0,2 Volt into 1 M.Ohm.

TECHNICAL INFORMATION.

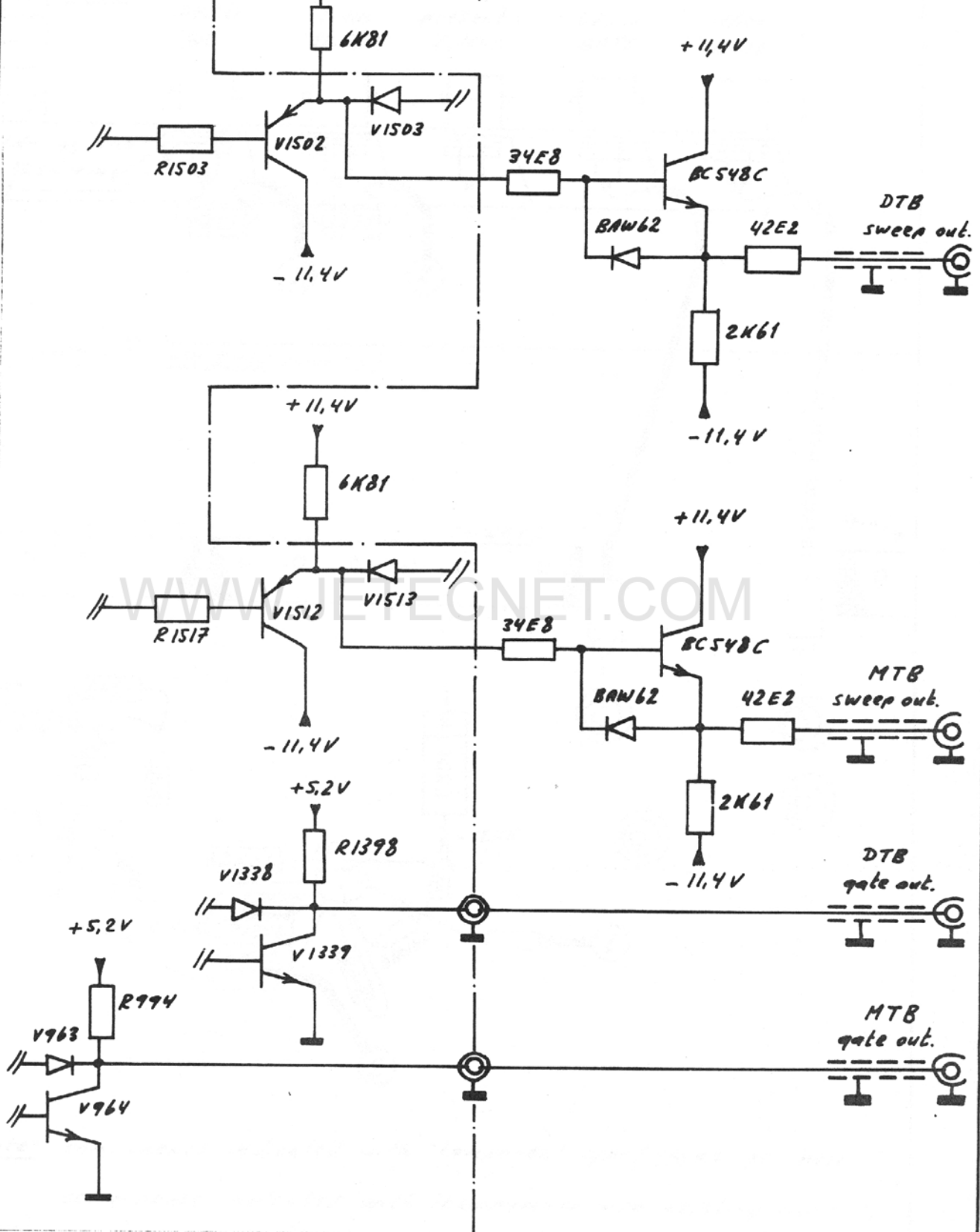
The figures that are added in this information sheet show the circuit diagram and the lay out of the circuitry. In the figures the additional circuitry and the belonging circuitry already present on the time base unit (unit 8) are shown.

The following additional components have been used (service ordering code mentioned between brackets):

2 resistors 34,8 Ohm	(5322 116 54027)
2 resistors 42,2 Ohm	(5322 116 51052)
2 resistors 2,61 k.Ohm	(5322 116 50671)
2 resistors 6,81 k.Ohm	(5322 116 54012)
2 diodes BAW62	(4822 130 30613)
2 transistors BC548C	(4822 130 44196)

Already present
on unit 8.

+11.4V Additional
circuitry



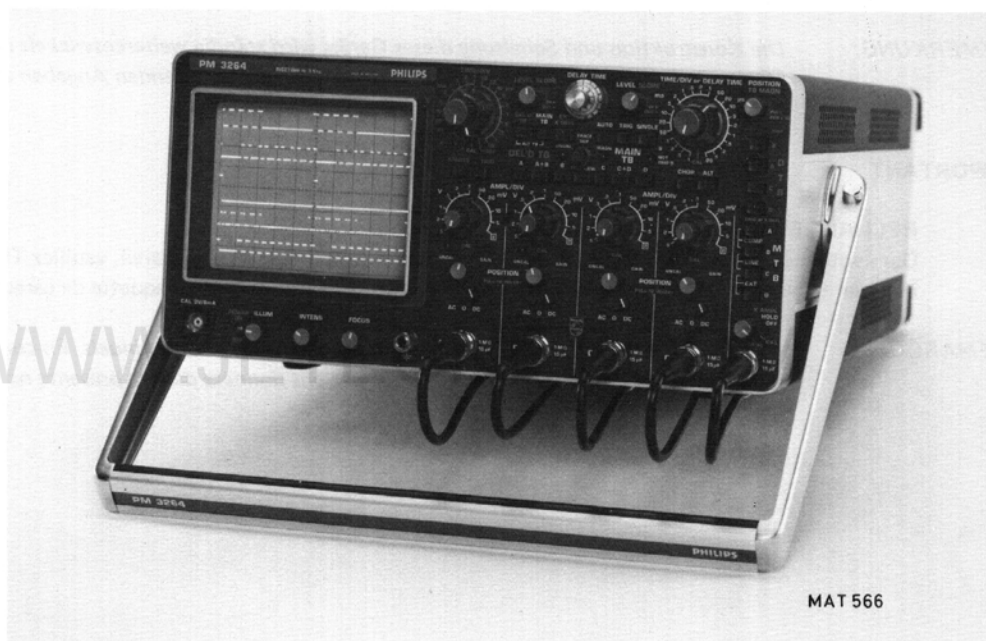
CIRCUIT DIAGRAM.

Portable four-trace oscilloscope PM3264

Instruction Manual/Gerätehandbuch/Notice d'emploi et entretien

9499 443 02502

840209/06/..



PHILIPS

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.*

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

BEMERKUNG: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

IMPORTANT**RECHANGE DES PIECES DETACHEES (Réparation)**

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

REMARKES: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

CONTENTS

Page

1. GENERAL INFORMATION	1
1.1. Introduction	1
1.2. Characteristics	2
1.2.1. CRT, Cathode ray tube	2
1.2.2. Vertical or Y-axis	2
1.2.3. Horizontal or X-axis	4
1.2.4. Main time base	5
1.2.5. Delayed time base	5
1.2.6. X-deflection	6
1.2.7. Triggering of main time base	7
1.2.8. Triggering of delayed time base	7
1.2.9. Calibration unit	8
1.2.10. Additional input and outputs	8
1.2.11. Power supply	8
1.2.12. Environmental characteristics	8
1.2.13. Mechanical data	9
1.3. Accessories delivered with the instrument	12
1.4. Information concerning the 10:1 probes delivered with the instrument	12
1.4.1. Characteristics	12
1.4.2. Adjustments	13
1.4.3. Dismantling	14
1.4.4. Replacing parts	14
1.4.5. Parts list	15
1.5. Block diagram description	21
2. INSTALLATION INSTRUCTIONS	23
2.1. Important safety instructions	23
2.2. Removing and fitting the front cover	23
2.3. Position of the instrument	23
2.4. Earthing	24
2.5. Mains voltage settings and fuse	24

3. OPERATING INSTRUCTIONS	30
3.1. General information	30
3.2. Switching on	30
3.3. Explanation of controls and sockets	31
3.3.1. C.R.T. display section	31
3.3.2. Vertical deflection	31
3.3.3. Horizontal deflection	32
3.4. Preliminary settings	34
3.4.1. Adjusting the gain	34
3.4.2. Use of probes	34
3.5. Inputs A, B, C and D and their possibilities	35
3.5.1. Y/T measurements	35
3.5.2. Y/X measurements	36
3.5.3. Input coupling switch AC/0/DC	36
3.6. Triggering	37
3.6.1. Trigger coupling	37
3.6.2. Trigger source selector and level control	37
3.6.3. Auto mode triggering	38
3.6.4. Single shot triggering	38
3.7. Time base magnifier	38
3.8. Use of the delayed time base	38
3.9. Use of the trigger view channel	39
3.9.1. External and internal trigger view	39
3.9.2. Single shot measurements	39
4. PERFORMANCE CHECK	40
4.1. General information	40
4.2. Starting positions of the controls	40
4.3. C.R.T. display section	40
4.4. Vertical channels	41
4.5. Time base and triggering	41
5. PREVENTIVE MAINTENANCE	43
5.1. General information	43
5.2. Cleaning the nextel suede coating	43
5.3. Recalibration	43

LIST OF FIGURES

Page

1.1.	Portable four channel 100MHz oscilloscope PM3264	1
1.2.	Derating of the maximum permissible input voltage as a function of frequency	10
1.3.	Typical internal trigger sensitivity as a function of frequency	10
1.4.	Typical external trigger sensitivity as a function of frequency	11
1.5.	Rise time measurement	11
1.6.	Input resistance (R_p) and reactance (X_p) as a function of frequency	12
1.7.	Maximum AC component of input voltage as a function of frequency	12
1.8.	Adjustment of the square-wave response of the 10:1 attenuator probe	13
1.9.	Adjustment of the HF step response of the 10:1 attenuator probe	13
1.10.	Dismantling the probe	14
1.11.	Mechanical parts of the probe	15
1.12.	Electrical parts and p.c.b. lay-out of the probe	20
1.13.	PM3264 block diagram	18
2.1.	Removing the front cover	25
2.2.	Rear view of the instrument	25
3.1.	Front view showing controls and sockets	28
3.2.	Adjustment of attenuator probes	35
3.3.	Suppression of common mode signals	36
3.4.	Scanning the waveform by means of the level potentiometer	37

WWW.JETECNET.COM

1. GENERAL INFORMATION

1.1. INTRODUCTION

The PM 3264 portable high frequency oscilloscope enables the measurement of signals at a sensitivity of 5 mV/DIV over an extensive bandwidth of 100 MHz (35 MHz at 2 mV/DIV). It offers a wide choice of display possibilities; for example up to four channels displayed alternately or chopped. All four channels can be displayed in the normal or inverted mode.

It is also possible to add the first two channels and the last two channels. An additional facility of the PM 3264 is a fifth channel trigger view. This trigger view channel enables the display of the main time base trigger signal.

The instrument features a main time base and a delayed time base. The alternate time base facility offers the user a simultaneous display of the vertical input signal on the main and delayed time base scales.

The PM 3264 has a highly efficient switched-mode power supply that covers the supply voltage ranges 100...127 Volt and 220...240 Volt. These voltage ranges can be selected by a rear panel slider switch.

The oscilloscope is equipped with numerous integrated circuits, which guarantee very stable operation and reduce the number of adjusting points. As an aid to checking and adjusting, test points have been included at appropriate positions in the circuit.

All these features make the oscilloscope suitable for a wide range of applications.

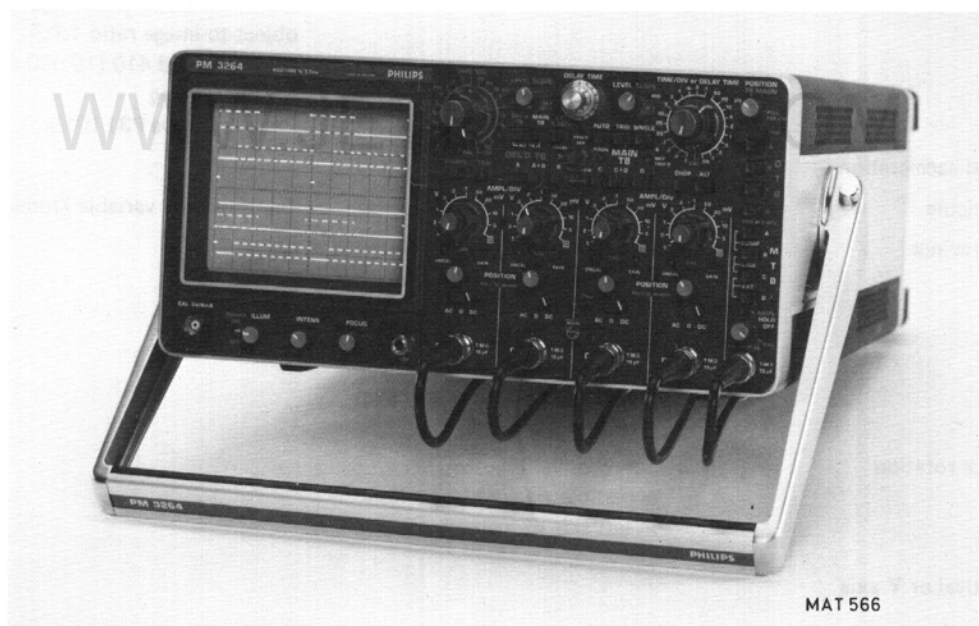


Fig. 1.1. Portable four channel 100 MHz oscilloscope PM 3264.

1.2. CHARACTERISTICS

This instrument has been designed and tested in accordance with IEC Publication 348 for Class 1 instruments and has been applied in a safe condition. The present Instruction Manual contains information and warnings that shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition.

- This specification is valid after the instrument has warmed up for 30 minutes (reference temperature 23°C).
 - Properties expressed in numerical values with tolerance stated, are guaranteed by the manufacturer.
- Numerical values without tolerances are typical and represent the characteristics of an average instrument.
- Inaccuracies (absolute or in %) relate to the indicated reference value.

<i>Designation</i>	<i>Specification</i>	<i>Additional Information</i>
1.2.1. CRT, Cathode Ray Tube		
Type	PHILIPS D14-302GH/95	Rectangular tube face, domed mesh type, post-accelerator, metal-backed phosphor
Measuring area	80 x 100 mm	
Screen type	P31 (GH) phosphor	P7 (GM) or P11 (BE) phosphor optional
Photographic writing speed	> 1500 cm/μs	Typically 2000 cm/μs Measured with Steinheil Oscillophot M5 camera; aperture 1:1,2 object-to-image ratio 1:0,5 film: Polaroid 410 (10.000 ASA) No pre-fogging Phosphor type P31 (GH)
Total acceleration	17 kV	
Graticule	Internal	Continuously variable illumination
Engravings	Centimetre divisions with sub-divisions of 2 mm along the central axes. Dotted lines at 1,5 and 6,5 div. from top of display provide a measuring lattice for checking rise-time.	
Trace rotation	Screw-driver adjustment accessible via ventilation hole in left side of instrument.	

1.2.2. Vertical or Y axis

1.2.2.1. Display modes

- Channel + or — A only
- Channel + or — B only
- Channel + or — C only
- Channel + or — D only
- Channels $\pm A \pm B$ added
- Channels $\pm C \pm D$ added
- Trigger view only
- Any possible combination of the seven channels that are mentioned above can be selected in the chopped or alternate mode

<i>Designation</i>	<i>Specification</i>	<i>Additional Information</i>
1.2.2.2. Response		
Frequency range	DC 0 ... 100 MHz AC 7 ... 100 MHz	—3 dB bandwidth, DC coupled —3 dB bandwidth, AC coupled Frequency range includes 10:1 probe over 20-30 °C
	35 MHz at 2 mV	For 2 mV spec. sec. 1.2.2.13.
Rise-time	3,5 ns	See fig. 1.5.
Pulse aberrations	± 4 % peak-peak	Over 6 divisions, 5 ... 40 °C
1.2.2.3. Deflection coefficient	2 mV/DIV ... 5 V/DIV	(for 2 mV spec. refer to Section 1.2.2.13) Eleven calibrated positions in 1-2-5 sequence. Uncalibrated continuous control 1:2,5. Uncal, lamp signalling.
Error limit	± 3 %	Except linearity of CRT
Maximum permissible input voltage	± 400 V DC + AC peak	Derating at frequencies above 500 kHz. See Fig. 1.2.
Maximum undistorted deflection	24 divisions	Up to 35 MHz
Shift range	16 divisions	8 divisions each in upward and downward direction from the central horizontal line of graticule
1.2.2.4. Input impedance	1 MΩ ± 2 %//15 pF approx.	
Input RC time	22 ms	Coupling to AC
1.2.2.5. Instability		(for 2 mV/DIV setting refer to 1.2.2.13) 20 ... 40 °C temperature range.
Instability of trace	0.1 DIV/Hour	
Trace jump	0.2 DIV	When switching between any of the attenuator positions.
Trace jump	0.5 DIV	When operating the NORM/INVERT switch.
Trace shift	0.2 DIV	When rotating the continuous attenuator. 0.4 DIV in 5 mV/DIV position.
Trace jump	0.5 DIV	When switching to the ADDED position. 1 DIV in 5 mV/DIV position. Increasing when rotating the continuous attenuator.
1.2.2.6. Temperature drift	4 × 10 ⁻³ DIV/K	Typical value
1.2.2.7. Visible signal delay	15 ns approx.	Typical value
1.2.2.8. Display time per channel in chopped mode	≈ 700ns	
1.2.2.9. Cross-talk between channels	1:500	With 8 divisions of signal amplitude on one channel, cross talk on other channel within line width, up to 35 MHz. Both attenuators in the same setting.

<i>Designation</i>	<i>Specification</i>	<i>Additional information</i>
1.2.2.10. <i>Common mode rejection factor</i>	Better than 100 up to 2 MHz 20 at 50 MHz	Measured with +A and -B added. Max. common-mode signal 8 divisions.
1.2.2.11. <i>Trigger view display</i>	External or internal trigger signal	
Deflection coefficients	Same as vertical, error $\pm 10\%$	
External	100 mV/DIV $\pm 3\%$	
1.2.2.12. <i>Trigger point (threshold)</i>	Screen centre $\pm 0,3$ div DC-coupling	
Aberrations	$\pm 10\%$ peak-to-peak	
Time delay between vertical input and external input	2 ns ± 1 ns	
Bandwidth	80 MHz	Typical value
1.2.2.13. <i>Specification of 2 mV/div setting</i>		
a. Deflection coeff.	2 mV/DIV	
Error limit	$\pm 5\%$	
b. Response		
Frequency range	DC 0 ... 35 MHz AC 7 Hz ... 35 MHz	-3 dB bandwidth, DC coupled -3 dB bandwidth, AC coupled
Rise time	10 ns	
Pulse aberration	$\pm 5\%$ peak-to-peak	
Common mode rejection factor	Better than 100 up to 2 MHz	
c. Instability		
Instability of trace	0.25 DIV/hour	20 ... 40 °C temperature range
Trace jump	2 DIV	When switching from 5 mV to 2 mV attenuator position
Trace jump	2 DIV	When operating the Normal/Invert switch
Trace shift	1 DIV	When rotating the continuous attenuator
Trace jump	2 DIV	When switching to ADDED position
1.2.3. <i>Horizontal or X Axis</i>		
1.2.3.1. <i>Display modes</i>	- Main time-base - Main time-base intensified by delayed time-base - Delayed time-base - Main TB intensified and delayed TB alternately displayed - X-Y operation	With possibility of trace separation of 4 divisions. Not functioning if TRIG VIEW is selected. X deflection by: - channel A signal - channel B signal - channel C signal - channel D signal - signal applied to EXT connector of main time base - line voltage

<i>Designation</i>	<i>Specification</i>	<i>Additional information</i>
1.2.3.2. <i>Horizontal position drift in X1 position</i>	0,2 DIV/hour	The horizontal position drift with the magnifier in the X1 position, shall not exceed 0.1 DIV/hour over 20 ... 40 °C temperature range. The same stability requirement applies to the start of the sweep during variation of the sweep speed setting, with exception of the highest sweep ranges 50 and 100 ns/DIV.
1.2.3.3. <i>Horizontal position control</i>	± 5,2 DIV from screen centre	The horizontal shift control combines coarse and fine adjustment.
1.2.4. Main time-base		
1.2.4.1. <i>Operation</i>	Automatic	Automatic free running in the absence of triggering signals, after less than 100 ms.
	Triggered single shot	NOT TRIG'D lamp lights after reset and extinguishes at the end of the sweep
1.2.4.2. <i>Time coefficient</i>	1s/DIV ... 50ns/DIV	23 calibrated positions in a 1-2-5 sequence. Uncalibrated continuous control 1 : > 2,5 between the steps. One UNCAL lamp for both time bases.
1.2.4.3. <i>Coefficient error</i>	± 2 % ± 3 %	+20 °C ... +30 °C + 5 °C ... +40 °C The sweep accuracy over any two divisions of the sweep is ± 5%.
1.2.4.4. <i>Expansion</i>		
Magnification	10x	Switched, calibrated. The display, when coinciding with the central horizontal graticule line, shall not shift more than one DIV when the horizontal magnifier is changed from x10 to x1.
Coefficient error	± 1 % additional	Excluded the first and last 50 ns of the 5 ns/DIV, 10 ns/DIV, 20 ns/DIV and 50 ns/DIV magnified sweep rates.
Max. effective time coefficient	5 ns/DIV	
1.2.4.5. <i>Variable hold-off time</i>	The sweep hold-off time can be increased by a factor of 10.	
1.2.5. Delayed time base		
1.2.5.1. <i>Operation</i>	STARTS:DEL'D TB starts immediately after the selected delay time. TRIG:DEL'D TB is triggered after the delay time.	

<i>Designation</i>	<i>Specification</i>	<i>Additional information</i>
1.2.5.2. Comparator long-term stability	< 2 DIV at 1000 times magnification	When MAIN TB at 1 ms/DIV and DEL'D TB at 1 μ s/DIV a selected signal detail in the DEL'D TB mode shall not move more than two divisions after warming-up.
1.2.5.3. Time coefficient	0.5 s/DIV ... 50 ns/DIV	22 calibrated positions in 1-2-5 sequence Uncalibrated continuous control 1:2,5 between the steps. One uncal. lamp for both MAIN TB and DEL'D TB.
1.2.5.4. Coefficient error	$\pm 2 \%$ $\pm 3 \%$	+20 $^{\circ}$ C ... +30 $^{\circ}$ C + 5 $^{\circ}$ C ... +40 $^{\circ}$ C The sweep accuracy over any two divisions of the sweep is $\pm 5 \%$.
1.2.5.5. Delay-time	Continuously variable between 0,5x and 10x the time coefficient of the MAIN TB.	Calibrated ten turn knob. Range delay-time multiplier 0 ... 10 Incremental accuracy 0.5 %, typically 0.2 %.
1.2.5.6. Delay-time jitter	Better than 1:30.000	When MAIN TB at 1ms/DIV and DEL'D TB at 1 μ /DIV a selected detail in the DEL'D TB mode shall not move more than one third of a division after warming up.
1.2.6. X Deflection X deflection via channel Y _A , Y _B , Y _C or Y _D	2 mV/DIV ... 5 V/DIV	Uncalibrated continuous control 1:2,5 via Y gain potentiometer.
1.2.6.1. Coefficient error	$\pm 5 \%$	
1.2.6.2. Bandwidth	0 - 2 MHz	-3dB bandwidth over 4 divisions in horizontal screen centre.
1.2.6.3. Maximum undistorted deflection	20 divisions	up to 100 kHz
1.2.6.4. Phase difference with respect to Y display	3 $^{\circ}$ at 100 kHz	
External X-deflection via EXT socket		
1.2.6.5. Deflection coefficient External	50 mV/DIV	Uncalibrated continuous control 1:3
1.2.6.6. Accuracy External	$\pm 3 \%$	
1.2.6.7. Bandwidth	0 ... 2 MHz 7 Hz ... 2 MHz	With DC trigger coupling With AC trigger coupling
1.2.6.8. Input characteristics	Identical to Y channels	

<i>Designation</i>	<i>Specification</i>	<i>Additional information</i>
1.2.6.9. <i>Phase difference with respect to Y-channels</i>	3° at 100 kHz	
1.2.6.10. <i>Linearity</i>	1.5 %	
1.2.6.11. <i>Drift</i>	0.2 DIV/hour	
1.2.7. Triggering of the main time-base		
1.2.7.1. <i>Trigger source</i>	Internal from channel A Internal from channel B Internal from channel C Internal from channel D Composite (COMP): any combination of the channels A, B, C or D Internal from mains (LINE) External source (EXT)	In alternate mode only.
1.2.7.2. <i>Slope</i>	Positive or negative	
1.2.7.3. <i>Trigger sensitivity</i>	Internal: better than 0.5 DIV up to 30 MHz. 1.5 DIV up to 100 MHz External: 50 mV up to 30 MHz. 150 mV up to 100 MHz	Typical sensitivity as a function of frequency: see fig. 1.3. Typical sensitivity as a function of frequency: see fig. 1.4.
1.2.7.4. <i>Trigger modes and coupling</i>	DC: 0 — full bandwidth AC: 100 Hz — full bandwidth	Both internal and external —3 dB
1.2.7.5. <i>Level range</i>		
Internal trigg.	24 DIV	
External trigg.	+1,2 V to —1,2 V	
1.2.7.6. <i>Input characteristics</i>	1 M Ω $\pm$ 2 %//15 pF approx.	
1.2.7.7. <i>Trigger jitter</i>	Less than 0,5 ns	
1.2.8. Triggering of the delayed time-base		
1.2.8.1. <i>Trigger source</i>	Internal from channel A Internal from channel B Internal from channel C Internal from channel D	

Other characteristics are identical to
those of MTB triggering; see
section 1.2.7.

<i>Designation</i>	<i>Specification</i>	<i>Additional information</i>
1.2.9. Calibration unit		
Output voltage	3 V _{p-p} ± 1 %	Square wave voltage and current.
Output current	6 mA ± 1 %	
Frequency	2 kHz ± 2 %	
Protection	The output is protected against continuous short-circuiting.	
1.2.10. Additional input and outputs		
1.2.10.1. Z-modulation	DC coupled. TTL compatible. High level blanks display. Response time 35 ns. Input impedance 10 kΩ. Max. input voltage 50 V.	
1.2.10.2. MAIN gate	+5 V during MAIN TB sweep Otherwise 0 Volt Output impedance 1 kΩ	Optional
1.2.10.3. DEL'D gate	+5 V during DEL'D TB sweep. Otherwise 0 Volt. Output impedance 1 kΩ	Optional
1.2.11. Power supply		
Line voltage	100 ... 127 VAC, ± 10 % 220 ... 240 VAC, ± 10 % 250 ... 350 VDC	Automatically protected against incorrect setting of the mains voltage selector switch
Line frequency	46 ... 440 Hz	
Power consumption	50 Watt	
Power transients	Damage to the oscilloscope shall not occur under voltage and frequency transient conditions specified in MIL-T-28800.	
1.2.12. Environmental characteristics		
<i>Note:</i>		
<i>The characteristics are valid only if the instrument is checked in accordance with the official checking procedure. Details on these procedures and failure criteria are supplied on request by the PHILIPS-organisation in your country, or by N.V. PHILIPS' GLOEILAMPENFABRIEKEN, TEST AND MEASURING DEPARTMENT, EINDHOVEN, THE NETHERLANDS.</i>		
<i>Temperature tests</i>		
In accordance with IEC 68 Ab and Bb.		
Operation within specification: +5 °C to +40 °C. Exceptions on tolerances to be indicated per spec. point.		
Operation: -15 °C to +55 °C.		
Storage: -55 °C to +75 °C.		

Altitude

In accordance with IEC 68-2-13 test M.

Operation: to 5000 m (15.000 feet)

Derating: 1K/300 m (1000 feet) for the max. operating temperature

Storage: to 17.000 m (50.000 feet)

Humidity

21 days cyclic damp heat 25 °C — 40 °C at 95 % relative humidity.

Shock

Operating: 30 g, half-sine, 11 ms duration, 2 shocks per axis per direction for a total of 12 shocks.

Vibration

Operating: 15 minutes along each of 3 axes.

635 μ m p-p displacement (4 g at 55 Hz) with frequency varied from 10 Hz to 55 Hz and back to 10 Hz in one minute cycles.

Recovery

Operates within 30 minutes coming from -10 °C soak, going into room condition of 60 % relative humidity at 20 °C.

Magnetic shielding

In accordance with IEC 351 - 22.3.1.

A maximum deviation of 1 DIV.

Interference

VDE 0871 and 0875, Grenzwert Klasse B.

Safety

Safety class I according to IEC 348

1.2.13. Mechanical data*Dimensions*

Length 460 mm (18 1/8 inch)

Excluding controls, cover and feet

Width 316 mm (12 1/4 inch)

Height 154 mm (6 1/8 inch)

Mass

11 kg (24 lbs)

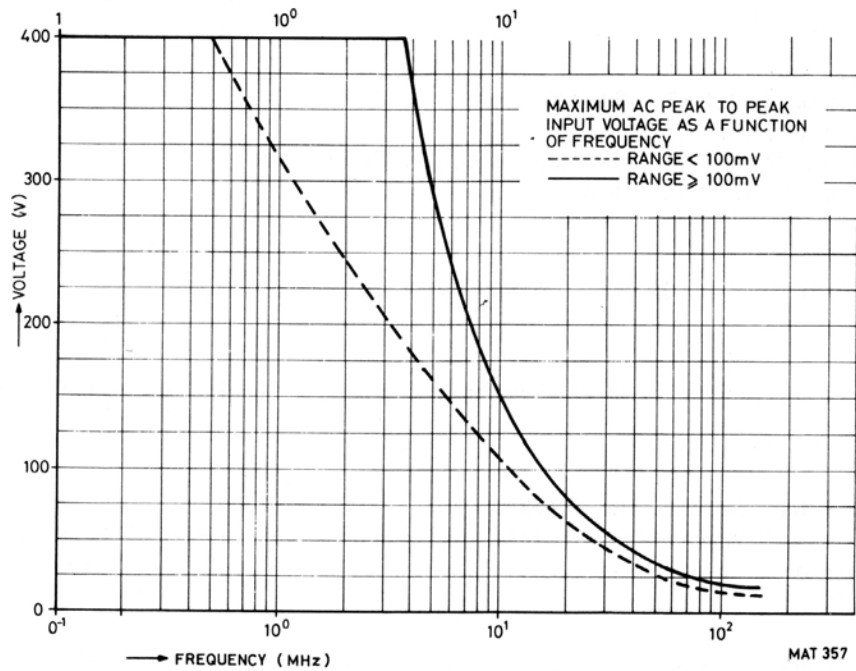


Fig. 1.2. Derating of the maximum permissible input voltage as a function of frequency

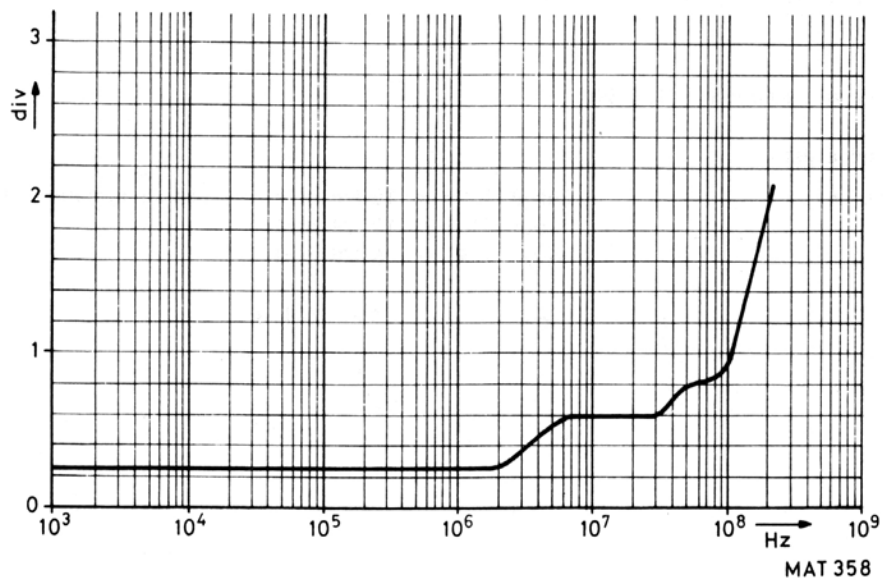


Fig. 1.3. Typical internal trigger sensitivity as a function of frequency

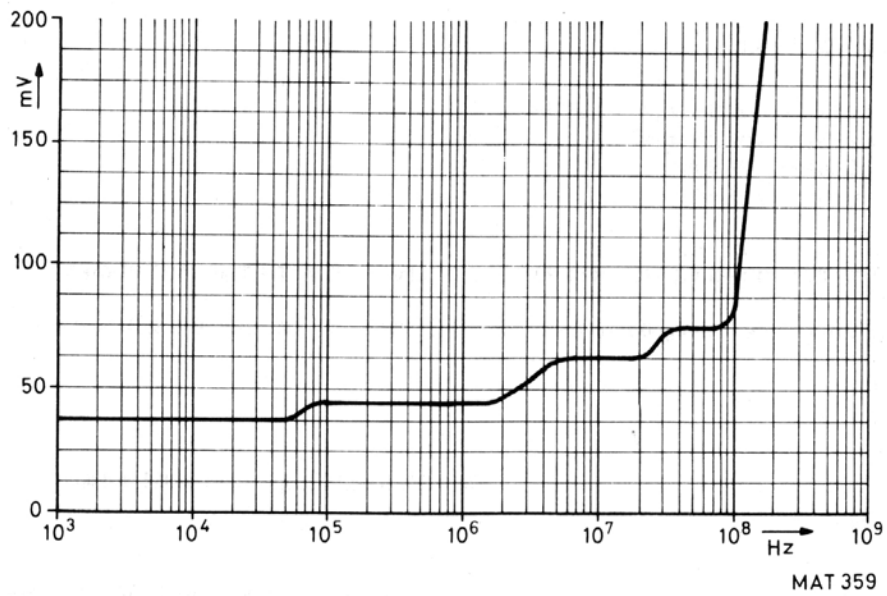


Fig. 1.4. Typical external trigger sensitivity as a function of frequency

WWW.JETECNET.COM

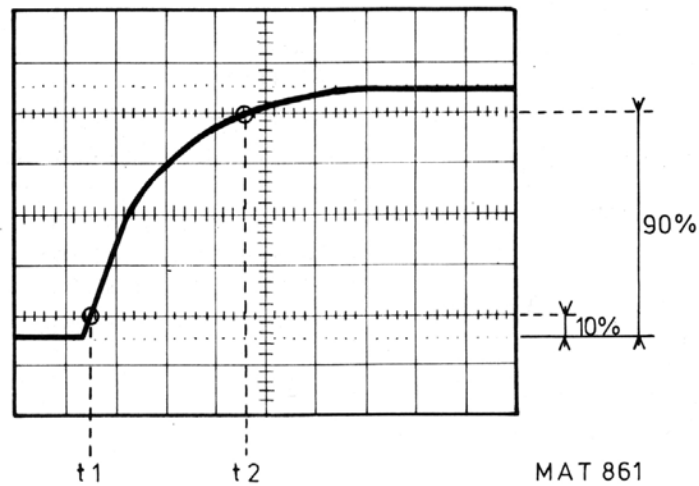


Fig. 1.5. Rise time measurement $t_R = t_2 (90\%) - t_1 (10\%)$

1.3. ACCESSORIES DELIVERED WITH THE INSTRUMENT

- Four passive 10 : 1 probes
- Contrast filter
- Front cover with storage space for e.g. probes
- Collapsible viewing hood PM 9366
- Banana/BNC adapter PM 9051
- Adaptor CAL terminal/BNC
- Manual

1.4. INFORMATION CONCERNING THE 10:1 PROBES DELIVERED WITH THE INSTRUMENT

This 10x attenuator probe is designed for the oscilloscopes PM 3262, PM 3263, PM 3264 and PM 3266.

1.4.1. Characteristics

Electrical

Attenuation

$10x \pm 2\%$ (Oscilloscope input $1M\Omega \pm 1\%$)

Input resistance d.c.
a.c.

$10M\Omega \pm 2\%$ (Oscilloscope input $1M\Omega \pm 5\%$)
See curve Fig. 1.6.

Input capacitance d.c. and l.f.

$11pF \pm 1pF$ (Oscilloscope input $1M\Omega \pm 5\%$ paralleled by $13pF \pm 3pF$)

Input reactance h.f.
bandwidth

See curve Fig. 1.6.

Probe has negligible effect on oscilloscope bandwidth

Max. input voltage

500V d.c. + a.c. peak, derating with frequency. See Fig. 1.7.
Oscilloscope input $1M\Omega$ and voltage applied between probe tip and earthed part of probe body. Test voltage 1500V_{d.c.} during 1s. at a temperature between 15 and 25°C, a rel. hum. of 80% at maximum and at sea level.

Check-zero button probe shell

Same function as 0 position of input coupling switch on oscilloscope.

Environmental

Probe operates within specifications over the following ranges:

Temperature

-25°C to +70°C

Altitude

Up to 5000 metres (15000 feet)

Other environmental data

Same as for any PHILIPS oscilloscope the probe is used with

Mechanical

Dimensions

Probe body 103mm x 10mm dia (max.)

Cable length 1500mm or 2500mm

Correction box 55 x 30 x 15mm incl. BNC

Incl. standard accessories 125 g.

Mass

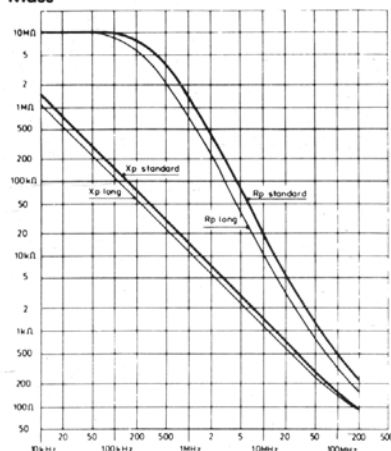


Fig. 1.6. Input resistance (R_p) and reactance (X_p) as a function of frequency

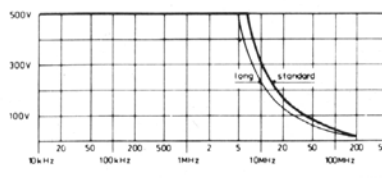


Fig. 1.7. Maximum AC component of input voltage as a function of frequency

1.4.2. Adjustments

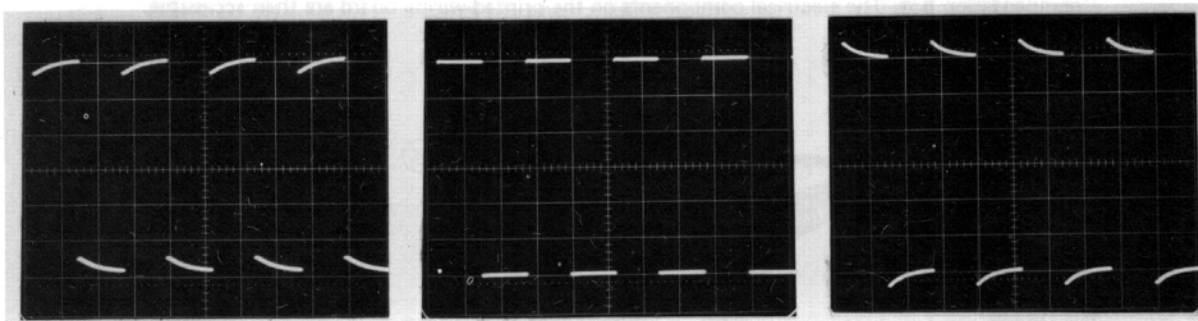
Matching the probe to your oscilloscope

The measuring probe has been adjusted and checked by the manufacturer. However, to match the probe to your oscilloscope, the following manipulation is necessary.

Connect the measuring pin to the CAL socket of the oscilloscope.

A trimmer C2, can be adjusted through a hole in the compensation box to obtain optimum square-wave response.

See Fig. 1.8.b.



*Fig. 1.8.a. Over-compensation
(adjustment C2)*

*Fig. 1.8.b. Correct compensation
(adjustment C2)*

*Fig. 1.8.c. Under-compensation
(adjustment C2)*

Adjusting the h.f. step response

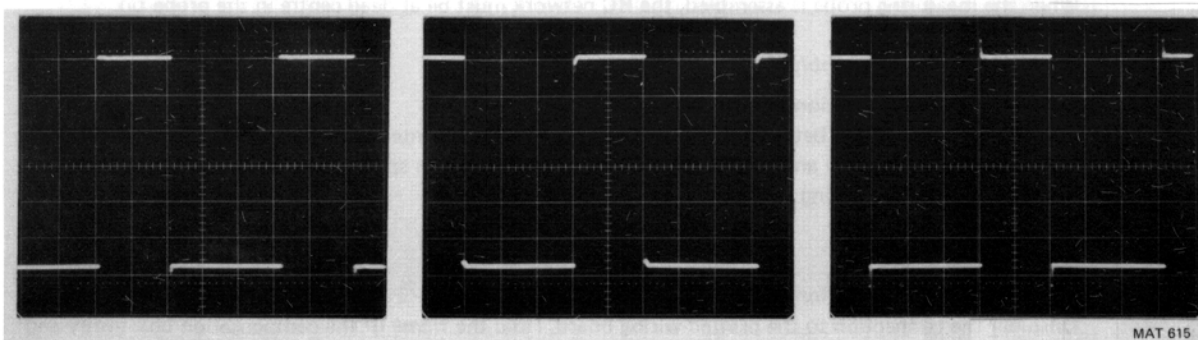
The h.f. step response correction network has been adjusted by the manufacturer to match the oscilloscope input, so that adjustment of the h.f. response is normally not necessary.

Later readjustment is only necessary if the probe is to be used with a different type of oscilloscope, or after replacement of an electrical component.

For the adjustment, proceed as follows:

Connect the probe to a fast pulse generator (rise-time not exceeding 1 ns) which is terminated by its characteristic impedance. Dismantle the compensation box. Set the generator to 100kHz. Adjust R3 to obtain a display as shown in Fig. 1.9.a.

It is important that the leading edge is as steep, and the top is as flat, as possible. Incorrect setting of R3 gives rise to pulse distortions as shown in Fig. 1.9.b. and 1.9.c.



*Fig. 1.9.a. Preset potentiometers
correctly adjusted*

*Fig. 1.9.b. Rounding due to incorrectly
adjusted potentiometers*

*Fig. 1.9.c. Overshoot due to
incorrectly adjusted
potentiometers*

For the location of adjustment point R3 on the p.c.b. in the compensation box, refer to fig. 1.12.

1.4.3. Dismantling

Dismantling the probe (see Fig. 1.10.).

The front part 11 of the probe can be screwed from the rear part 13. Item 11 can then be slid from 12 and 13.

The RC combination 12 is soldered to 13. For replacement of 12 refer to the next section.

Dismantling the compensation box (see Fig. 1.10.).

Unscrew the ribbed collar of the compensation box to the cable. The case 14 can then be slide sideways off the compensation box. The electrical components on the printed-wiring board are then accessible.

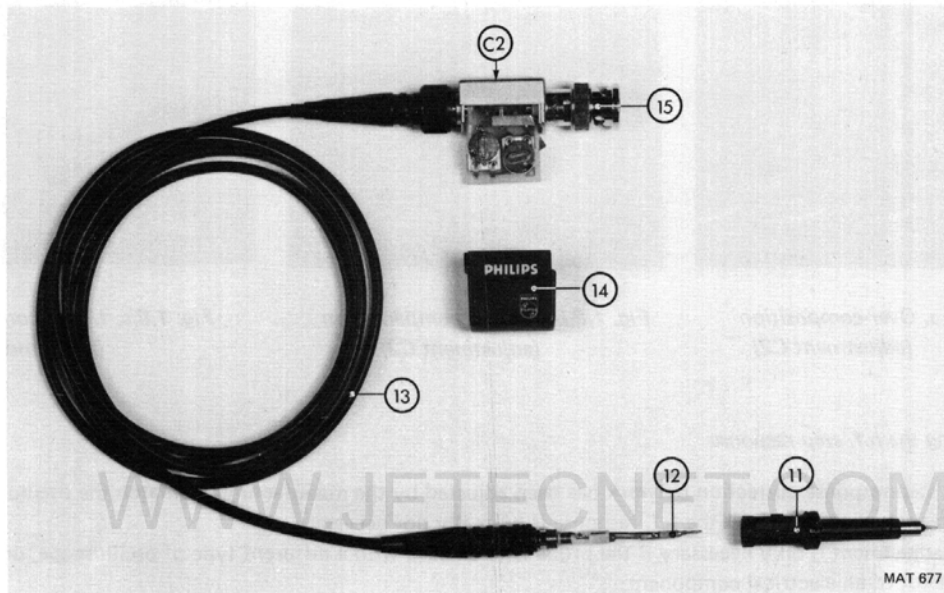


Fig. 1.10. Dismantling the probe

1.4.4. Replacing parts

Assembling the probe

A new RC network is slid over the cable nipple, after which the cable core is soldered on to the resistor wire. When the measuring probe is assembled, the RC network must be at dead centre in the probe tip.

Replacing the cable assembly

Dismantle the compensation box.

Unsolder the connection between the inner conductor and the printed-wiring board. Keep the frame of the compensation box steady and loosen the cable nipple with a 5 mm spanner on the hexagonal part. Replace the cable and fit it, working in the reverse order.

Replacing the BNC

Dismantle the compensation box.

Unsolder the connection to the printed-wiring board. Hold the frame of the compensation box firmly and loosen the BNC with a 3/8 inch spanner. Replace the BNC and fit it, working in the reverse order.

Replacing the probe tip

The damaged tip can be pulled out by means of a pair of pliers. A new tip must be firmly pushed in.

1.4.5. Parts list

1.4.5.1. Mechanical parts (see Fig. 1.10. and 1.11.).

Items 1 to 10 are standard accessories supplied with the probe.

Item	Order number	Qty	Description
1	5322 321 20223	1	Earth cable
2	5322 256 94136	1	Probe holder
3	5322 255 44026	5	Soldering terminals which may be incorporated in circuits as routine test points
4	5322 532 64223	2	Marking ring red
5	5322 532 64224	2	Marking ring white
	5322 532 64225	2	Marking ring blue (not shown)
6	5322 268 14017	2	Probe tip
7	5322 462 44319	1	Insulating cap to cover metal part of probe during measurements in densely wired circuits
8	5322 462 44318	2	Cap facilitating measurements on dual-in-line integrated circuits
9	5322 264 24018	1	Wrap pin adaptor
10	5322 264 24019	1	Spring-loaded test clip
11	5322 264 24021	1	Probe shell with check-zero button
12	5322 216 54152	1	RC network
13	5322 320 14063	1	Cable assembly
14	5322 447 64015	1	Cap
15	5322 268 44019	1	BNC connector

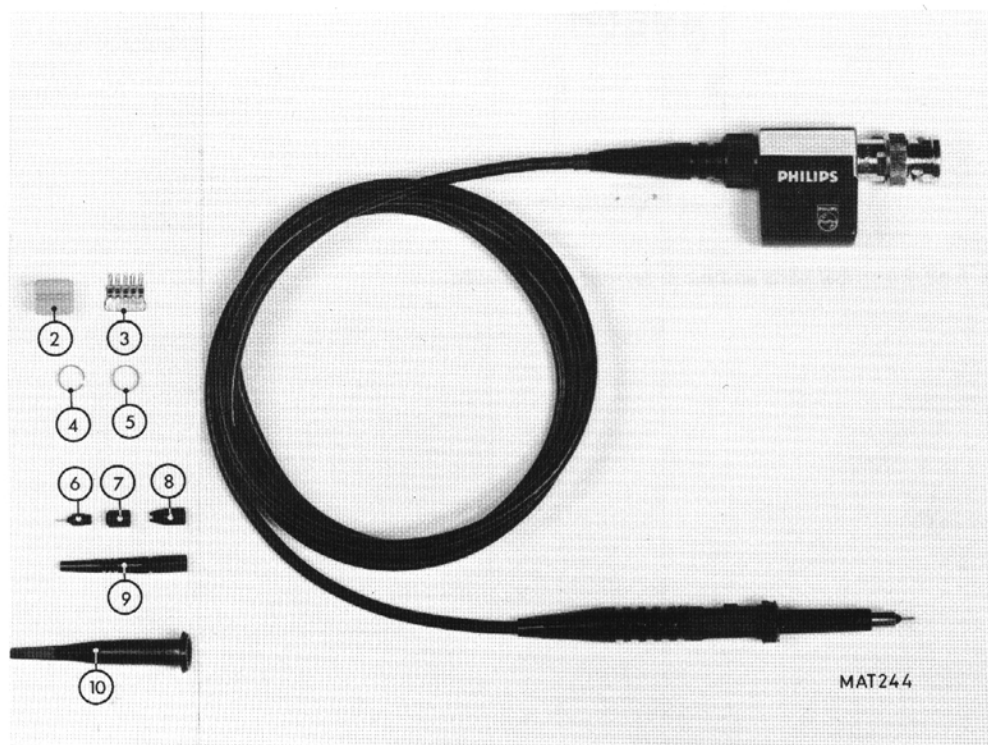


Fig. 1.11. Mechanical parts of the probe

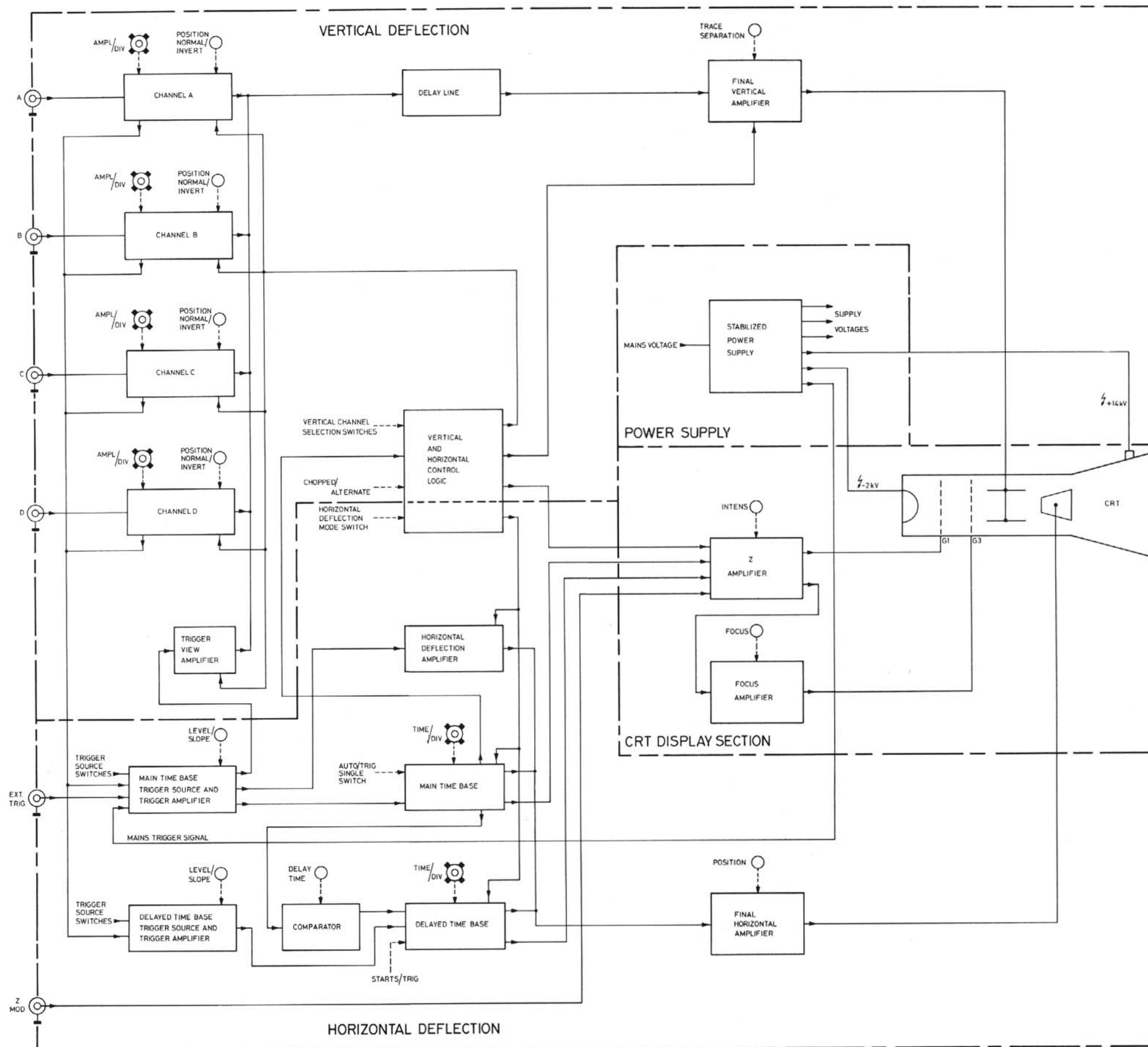


Fig. 1.13 PM3264 block diagram
 Abb. 1.13 PM3264 Blockschaltbild
 Fig. 1.13 PM3264 Schéma synoptique

1.4.5.2. Electrical parts (see Fig. 1.12).

Item	Ordering Number	Description
C1	—	Part of RC-network (not supplied separately).
C2	5322 125 54003	Trimmer 60pF/300 V.
C3	4822 122 31038	Capacitor 2,7pF.
L1	—	Coil 5,5 windings, wire 0,4mm. diameter
R1	—	Part of RC-network (not supplied separately).
R2	5322 116 50536	Metal film resistor 464 Ω , 1%, MR25
R3	5322 101 14047	Potmeter 470 Ω , 20%
R4	5322 116 50536	Metal film resistor 464 Ω , 1%, MR25
R5	5322 116 54462	Metal film resistor 82,5 Ω , 1%, MR25

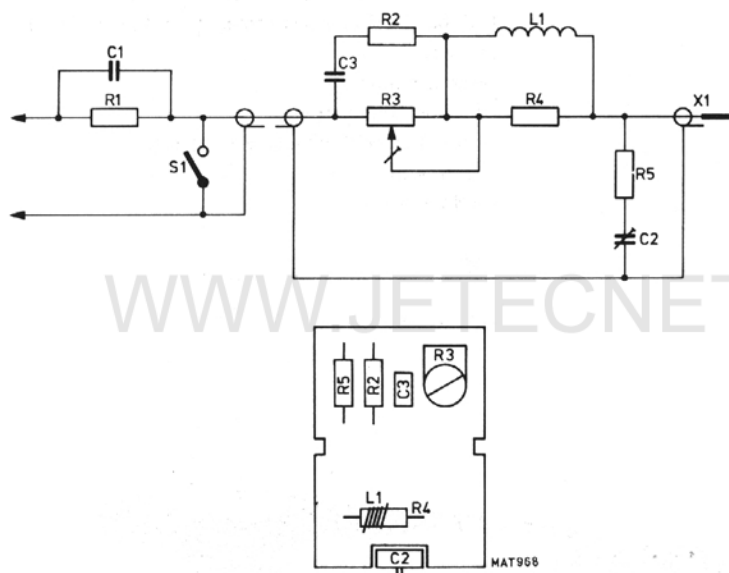


Fig. 1.12. Electrical parts and p.c.b. lay-out of the probe

1.5. BLOCK DIAGRAM DESCRIPTION

1.5.1. Vertical deflection

The PM 3264 oscilloscope has four identical vertical channels, A, B, C and D, each providing signal control and amplification for one Y input. For simplicity, only CHANNEL A is described. CHANNEL A incorporates the AMPL/DIV control, for adjusting the signal amplification to give the desired vertical trace, and the POSITION control which also combines the NORMAL/INVERT function. The POSITION potentiometer provides continuous rotary control of the vertical shift of the signal on the screen; the push-pull control action enables the signal to be displayed either in the NORMAL polarity mode or INVERTED.

Channel triggering

An output signal from CHANNEL A, via the TRIGGER SOURCE SWITCHES of the HORIZONTAL DEFLECTION section, enables the user to trigger the time-base(s) on the channel A signal, if desired.

Channel switching logic

On a command signal from the VERTICAL CONTROL LOGIC, the CHANNEL A output signal is switched via the DELAY LINE to the FINAL VERTICAL AMPLIFIER.

The logic also controls the B, C and D channels. If A and B or C and D are switched through simultaneously, the signals of the relevant channels are added and the sum is displayed on the screen.

If the logic switching connects the output signal from the TRIGGER VIEW AMPLIFIER, the signal on which the MAIN TIME-BASE is triggered is displayed.

The logic is controlled by the VERTICAL CHANNEL SELECTION SWITCHES. If more than one channel is selected, the display will function in the chopped or alternate display mode, depending on the position of the CHOPPED/ALTERNATE switch. A signal derived from the MAIN TIME-BASE is used for alternate display switching.

Delay line and vertical output

The DELAY LINE gives sufficient signal delay to enable the leading edge of a fast signal phenomenon to be displayed on the screen.

The FINAL VERTICAL AMPLIFIER drives the vertical deflection plates of the CRT. In the alternate time-base mode the TRACE SEPARATION control enables an adjustable vertical trace shift between main and delayed time-base signals to facilitate viewing.

1.5.2. Horizontal deflection

Input source

Choice of input source for the FINAL HORIZONTAL AMPLIFIER can be selected from the MAIN TIME-BASE, the DELAYED TIME-BASE and the HORIZONTAL DEFLECTION AMPLIFIER. Source selection depends on the setting of the HORIZONTAL DEFLECTION MODE SWITCH.

Time-bases and triggering

Each time-base produces a time-linear sawtooth voltage, the sweep time of which is adjustable by a TIME/DIV control.

MAIN TIME-BASE TRIGGER SOURCE AND TRIGGER AMPLIFIER: the MAIN TIME-BASE can be triggered by one of the four vertical channels, by a mains-voltage related signal or by a signal applied to the external trigger input (EXT). The trigger source is selected by the trigger source switches. The level and the slope at which the time-base is started can be determined by the LEVEL/SLOPE control. The selected MAIN TIME-BASE trigger source can also be used for horizontal deflection via the HORIZONTAL DEFLECTION AMPLIFIER and for trigger view via the TRIGGER VIEW AMPLIFIER.

DELAYED TIME-BASE TRIGGER SOURCE AND TRIGGER AMPLIFIER: the DELAYED TIME-BASE can be triggered by one of the four vertical channels, the level and slope being adjustable. The COMPARATOR block compares the main time-base sawtooth waveform with an adjustable d.c. reference voltage derived from the DELAY TIME potentiometer. At the moment that the sawtooth corresponds to the adjusted d.c. level, the COMPARATOR sends a signal to the DELAYED TIME-BASE. Depending on the position of the STARTS/TRIG pushbutton, the DELAYED TIME-BASE now starts immediately, or it starts upon the receipt of a trigger pulse from the DELAYED TIME-BASE TRIGGER SOURCE and TRIGGER AMPLIFIER.

1.5.3. CRT Display Section

The Z AMPLIFIER produces an output signal that is applied to the Wehnelt Cylinder G1 of the CRT in order to control the intensity of the trace on the screen.

The signals that control spot intensity are:

- the setting of the INTENS control
- a blanking signal for the chopped mode derived from the VERTICAL AND HORIZONTAL CONTROL LOGIC
- an alternate mode blanking signal generated by the MAIN TIME-BASE
- a signal generated by the DELAYED TIME-BASE for the intensified part of the DELAYED TIME-BASE on the MAIN TIME-BASE signal
- a signal that can be applied to the external Z modulation input (Z MOD).

Via the FOCUS AMPLIFIER, the FOCUS control is applied to G3 of the CRT.

1.5.4. Power supply

The mains power supply output is stabilised and produces the d.c. supply voltages for the electronic circuits in the instrument, a mains-voltage related trigger signal and the high voltages required by the cathode and final accelerator of the CRT.

WWW.JETECNET.COM

2. INSTALLATION INSTRUCTIONS

2.1. IMPORTANT SAFETY INSTRUCTIONS (IN ACCORDANCE WITH IEC 348)

Before connecting the instrument to the mains (line), visually check the cabinet, controls and connectors etc. to ascertain whether any damage has occurred in transit. If any defects are apparent, **do not** connect the instrument to the mains (line).

CLAIMS: In the event of obvious damage or shortages, or if the safety of the instrument is suspect, a claim should be filed with the carrier immediately. A Philips Sales or Service organisation should also be notified in order to facilitate the repair procedure.

Before any other connection is made, the protective earth terminal shall be connected to a protective conductor (see section 2.4. EARTHING).

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.

The instrument shall be disconnected from all voltage sources before any adjustment, replacement or maintenance and repair is effected with the instrument open. If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a skilled person who is aware of the hazards involved. Bear in mind that the capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

2.2. REMOVING AND FITTING THE FRONT COVER (see fig. 2.1.)

Removing:

- Push and rotate the knob in the centre of the cover a quarter-turn anti-clockwise to the UNLOCKED position.
- Remove the cover.

Fitting:

- Push and rotate the knob to the UNLOCKED position.
- Fit the cover over the front of the oscilloscope.
- Press and rotate the knob a quarter-turn clockwise to the LOCKED position.

2.3. POSITION OF THE INSTRUMENT

The instrument may be used in any desired position. With the handle folded down the instrument may be used in sloping position. The electrical characteristics in accordance with chapter 1.2. are guaranteed for any position of the instrument. (Ensure that the ventilation holes in the top and bottom covers are free). Do not position the instrument on any surface which produces or radiates heat, or in direct sunlight.

The carrying handle can be rotated if the push-buttons on its bearings are depressed.

2.4. EARTHING

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

- via the protective earth terminal
- via the three-core mains cable. The mains plug shall only be inserted into a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension cord without protective conductor.

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

When an instrument is brought from a cold into a warm environment, condensation may cause a hazardous condition. Therefore, make sure that the earthing requirements are strictly adhered to.

2.5. MAINS VOLTAGE SETTING AND FUSE

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

The instrument can operate on two mains voltage ranges: 100 ... 127 VAC ($\pm 10\%$) and 220 ... 240 VAC ($\pm 10\%$). The latter voltage range is also used when the instrument is operated by a DC voltage between 250 and 350 Volt. Either of the two voltage ranges can be selected by means of the slider switch that is located behind the window in the rear plate of the instrument. The selected voltage range is visible through this window, see figure 2.2.

Disconnect the instrument from all voltage sources before attempting to gain access to the voltage selector switch.

The switch is accessible if the rear plate of the instrument is removed (unscrew two screws).

The instrument is protected against incorrect setting of the mains voltage selector.

The fuse-holder mounted on the rear panel carries a 2A delayed-action fuse.

When replacing a fuse make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders must be avoided. The instrument must be disconnected from all voltage sources when a fuse is to be replaced or when the instrument is to be adapted to a different mains voltage.



Fig. 2.1. Removing the front cover

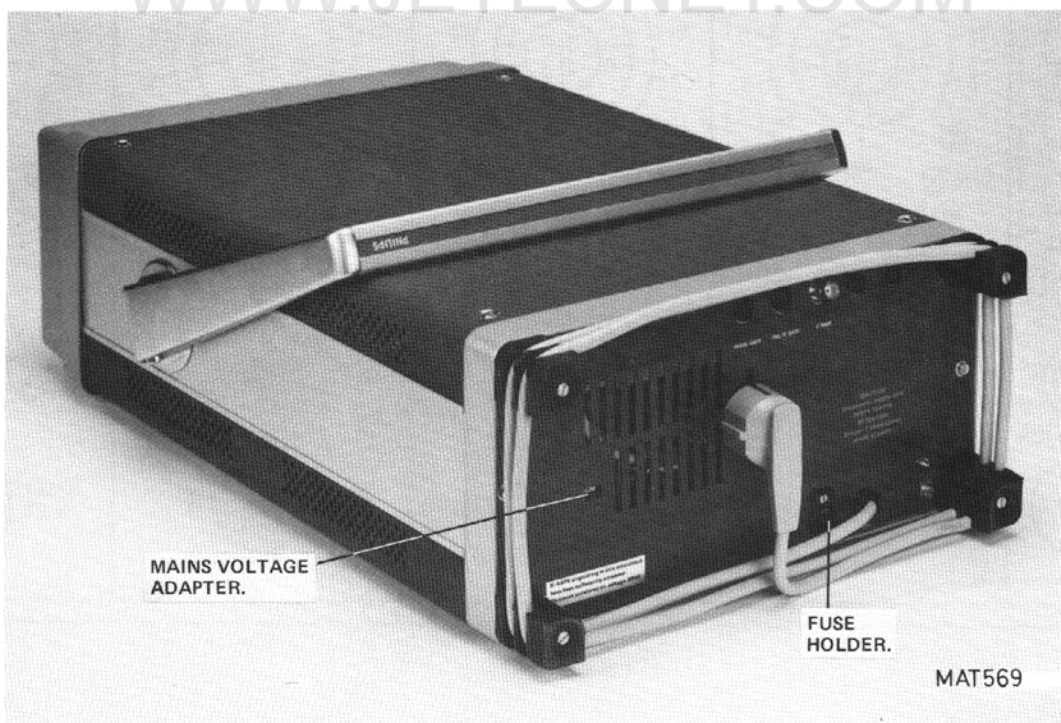


Fig. 2.2. Rear view of the instrument

Fig. 3.1. Front view showing controls and sockets
Abb. 3.1. Vorderansicht mit Bedienungsorganen und Buchsen
Fig. 3.1. Vue avant montrant les commandes et douilles

3. OPERATING INSTRUCTIONS

3.1. GENERAL INFORMATION

This section outlines the procedures and precautions necessary for operation. It identifies and briefly describes the functions of the front and rear panel controls and indicators, and explains the practical aspects of operation to enable an operator to evaluate quickly the instrument's main functions.

3.2. SWITCHING ON

After the oscilloscope has been connected to the mains(line) voltage in accordance with chapters 2.4. and 2.5., it can be switched on with the POWER switch. This switch is incorporated in the graticule ILLUM control on the front-panel, immediately below the screen bezel. The associated POWER ON/OFF indicator lamp is adjacent to the ILLUM control. When switching on the oscilloscope, it is immediately ready for use. With normal installation, according to section 2, and after a warming-up time of 30 minutes, the characteristics according to chapter 1.2. are valid.

WARNING: The oscilloscope must never be switched on whilst any circuit board is removed. Never remove a circuit board until the oscilloscope has been switched-off for at least one minute.

WWW.JETECNET.COM

3.3 EXPLANATION OF CONTROLS AND SOCKETS

3.3.1. C.R.T. display section

ILLUM, POWER ON (R21/S31)	Continuously variable control of the CRT screen graticule illumination. This control also operates the mains on/off switch. The pilot lamp lights up when the instrument is switched on.
INTENS (R22)	Continuously variable control of the brilliance of the trace on the C.R.T. screen.
FOCUS (R23)	Continuously variable control of the focusing of the electron beam in the C.R.T.
TRACE ROTATION (R26)	Screw driver control for aligning the trace with the graticule lines. The control is accessible via one of the ventilation holes in the left side of the instrument.
CAL 6 V/3 mA (X1/X2)	Output socket providing a 2 kHz square wave voltage of 3 V peak to peak and a current of 6 mA for calibration purposes.
 (X7)	Measuring earth socket.
Z MOD (X9)	BNC input socket at the rear of the instrument for external Z-modulation.

3.3.2. Vertical deflection

A, A+B, B, TRIG VIEW, C, C+D, D (S27)	Vertical display mode switch with seven independent pushbuttons. With this switch any combination of seven display possibilities can be selected for vertical deflection. The seven possibilities are: channels A, B, C and D channel A and B added channel C and D added channel TRIG VIEW (trigger view) The TRIG VIEW channel enables the display of the MAIN TB trigger signal. If no, pushbutton is depressed channel A is displayed.
CHOP/ALT (S28)	This switch is only operative if two or more channels are chosen for vertical deflection. If the ALT pushbutton is depressed the instrument functions in the alternate mode: in this mode the display is switched over from one channel to the other at the end of every main time base sweep. If the CHOP pushbutton is depressed the instrument functions in the chopped mode: in this mode the display is switched over from one channel to the other at a fixed switching frequency. If not any pushbutton is depressed the instrument functions in alternate mode.
A, B, C, D 1 M Ω //15 pF (X3, X4, X5, X6)	BNC input sockets for channels A, B, C and D respectively.
AC, 0, DC (S17, S18, S19, S20)	Input signal coupling switches for channels A, B, C and D with three positions. In the DC position the complete input signal is connected through to the vertical deflection system.

	In the AC position, only the AC component is passed through, the DC component being blocked by a capacitor. In the 0 position the input signal is interrupted and the amplifier input is earthed to establish a zero reference.
POSITION (R14, R15, R18, R19)	Continuously variable controls giving vertical shift for channels A, B, C and D.
PULL TO INVERT (S21, S22, S23, S24)	Push-pull switches combined with the position controls of channel A, B, C and D. If the control is pulled, the signal of the relevant channel is inverted.
AMPL/DIV (S9, S11, S13, S15)	Switches with eleven positions giving eleven deflection coefficients for each channel.
CAL (AMPL/DIV) (R8/S10, R9/S12, R10/S14, R11/S16)	Continuously variable controls for the vertical deflection coefficients of channels A, B, C and D. In the CAL position the selected position of the AMPL/DIV switches is calibrated. A pilot lamp marked UNCAL lights up if the control does not occupy the CAL position.
GAIN (R12, R13, R16, R17)	Continuously variable preset controls (screwdriver operated) of the overall gain of channels A, B, C and D.
3.3.3. Horizontal deflection	
DEL'D TB, MAIN TB EXT X DEFL, ALT TB (S8)	Horizontal display mode selection by means of 3 pushbuttons.
DEL'D TB	If this pushbutton is depressed, the horizontal deflection voltage is supplied by the delayed time base. If the TIME/DIV switch is in the OFF position the MAIN TB will supply the horizontal deflection voltage.
EXT X DEFL	If this pushbutton is depressed, the horizontal deflection is achieved by the signal that is selected on the main time base trigger source selector.
MAIN TB	If this pushbutton is depressed the horizontal deflection voltage is supplied by the main time base. This function is also operative if no pushbutton is depressed. A part of the trace is intensified if the DEL'D TB is switched on.
ALT TB	This function is operative if the DEL'D TB and MAIN TB pushbuttons are depressed together. The horizontal deflection is switched over from one time base to the other at the end of every time base sweep. This function is not operative if the DEL'D TB is switched to OFF.
POSITION, TB MAGN (R6/R7/S7)	This control gives a horizontal shift of the display. In the pull position the incorporated push-pull switch gives an increase of the horizontal deflection coefficient by a factor of 10 (PULL FOR X10). A pilot lamp marked MAGN indicates that the X10 function is operative.
X AMPL, HOLD OFF (R25/R24/S32)	Continuously variable control of the horizontal gain when using the external X deflection mode. In the case of time base operation, this control determines the HOLD OFF time between the MAIN TB sweeps. During the HOLD OFF time the MAIN TB does not respond to trigger pulses, which gives the opportunity to suppress certain trigger pulses.
TRACE SET (R20)	If the ALT TB mode is operative this control determines the vertical space between the two time base displays.

Main time base

LEVEL, SLOPE (R4/S4)	Control for selecting the level of the triggering signal at which the time base starts. The incorporated push-pull switch enables choice of triggering on the positive-going slope (push) or on the negative-going slope (pull). The pilot lamp NOT TRIG'D (V8) indicates that the time base generator is not triggered.
AUTO, TRIG, SINGLE (S25)	Trigger mode selection by means of a three pushbutton switch.
AUTO	If this pushbutton is depressed the main TB becomes free-running 100 ms after the last trigger pulse so that a trace remains visible on the screen.
TRIG	The time base must be triggered in the normal way if this pushbutton is depressed.
SINGLE	After depressing this pushbutton, the time base runs only once upon receipt of a trigger pulse. This function is also operative if no pushbutton is depressed.
TIME/DIV or DELAY TIME (S5)	Time coefficient control by means of a 23-position rotary switch.
CAL (TIME/DIV) (R5/S6)	Continuously variable control of the MAIN TB coefficient. In the CAL position the TIME/DIV switch position is calibrated. The pilot lamp UNCAL indicates that the control is not in the calibrated position. This lamp also indicates that the DEL'D TB is out of the calibrated position.
PULL FOR AC (S32)	This push-pull switch is incorporated in the X AMPL/HOLD OFF control. If the control is pushed, the trigger signal is DC coupled. If the control is pulled the trigger signal is AC coupled. Low frequencies are cut off in this position.
A, B, C, D, COMP, LINE, EXT (S30)	Trigger source selector switch with four pushbuttons. In the EXT X DEFL mode this switch determines the X deflection source.
A, B, C or D	Internal triggering or X deflection by a signal derived from channels A, B, C, or D respectively.
COMP	Pushbutton A and B depressed together. Now the composite trigger mode is switched on, this mode only functions correctly in the alternate mode. In the composite trigger mode the time base will trigger on the channel that is in turn to be displayed. In this way two or more channels that have no time relation can both give a steady display.
LINE	Pushbutton B and C are depressed together. Internal triggering or X deflection is achieved by a signal derived from the mains voltage.
EXT	Pushbutton C and D are depressed together. Triggering or X deflection is achieved by a signal applied to the external trigger input.
1 M Ω //15 pF (X8)	BNC input socket to which the external MAIN TB trigger signal can be applied.
MAIN GATE (optional)	BNC output socket on the rear panel of instrument, giving +5 Volt during MAIN TB sweep and 0 Volt for the other conditions.

Delayed time base

DELAY TIME (R3)	Calibrated ten turn dial knob to adjust the delay time after which the delayed time base becomes operative. This delay time is the product of the DELAY TIME dial setting and the MAIN TB TIME/DIV coefficient.
STARTS, TRIG (S26)	If the STARTS pushbutton is depressed, the DEL'D TB starts immediately after the adjusted delay time. If the TRIG pushbutton is depressed, the DEL'D TB starts after the adjusted delay time upon receipt of the first coming trigger pulse. If not any pushbutton is depressed the STARTS mode is operative.
LEVEL, SLOPE (R2/S3)	This control has the same functions as the corresponding MAIN TB control.
TIME/DIV (S1)	Time coefficient control by means of a 23-position rotary switch. In the OFF position the DEL'D TB is switched off.
CAL (TIME/DIV) (R1/S2)	This control has the same function as in the MAIN TB.
A, B, C, D (S29)	Trigger source selector switch with a choice of four different sources. These sources are explained in detail in the MAIN TB description.
PULL FOR AC (S32)	This push-pull switch is incorporated in the X AMPL/HOLD OFF control. Its function, which is outlined in the main time base description, is also operative for the DEL'D TB.
DEL'D GATE (optional)	BNC output socket at rear panel of instrument. Output voltage is +5 Volt during DEL'D TB sweep and 0 Volt for the other conditions.

3.4. PRELIMINARY SETTINGS

As the following settings are identical for the four vertical channels, only the procedure for channel A has been indicated. Unless otherwise stated, the controls occupy the same position as in the previous adjusting procedure.

3.4.1. Adjusting the GAIN

- Depress pushbutton A of the vertical display mode switch.
- Depress pushbutton A of the MAIN TB trigger source selector switch.
- Depress pushbutton AUTO of the trigger mode switch.
- Depress pushbutton MAIN TB of the horizontal deflection selector switch.
- Set the trace to the centre of the screen by means of the channel A POSITION control.
- Adjust the INTENS and FOCUS controls for a sharp well-defined trace.
- Put the channel A input coupling switch in the DC position.
- Set the channel A AMPL/DIV switch to 0.5 V/DIV and set the continuous control in the CAL position.
- Put the DEL'D TB TIME/DIV switch in the OFF position.
- The controls not mentioned may occupy any position.
- Connect the output voltage from the CAL output to the channel A input socket.
- Check that the trace height is exactly 6 divisions. If not, readjust the screw-driver operated GAIN control located on the front panel, immediately under the AMPL/DIV switch.

3.4.2. Use of probes

1:1 passive probes should only be used for DC and low frequency signals. The capacitive loading of these probes attenuates high frequencies or increases the rise-time of signals to be measured (dependent on the source impedance).

10:1 passive probes have less capacitive loading, usually about 10 pF to 20 pF.

FET probes are superior, especially when measurements are to be taken from high impedance test points at the upper frequency limit of the oscilloscope bandwidth.

10:1 passive probes must be properly compensated before use. Incorrect compensation leads to pulse distortion or amplitude errors at high frequencies. For correct adjustment connect the probe tip to the CAL socket and adjust the adjustment point in the probe compensation box to optimum square-wave response on the CRT screen (see fig. 3.2.).

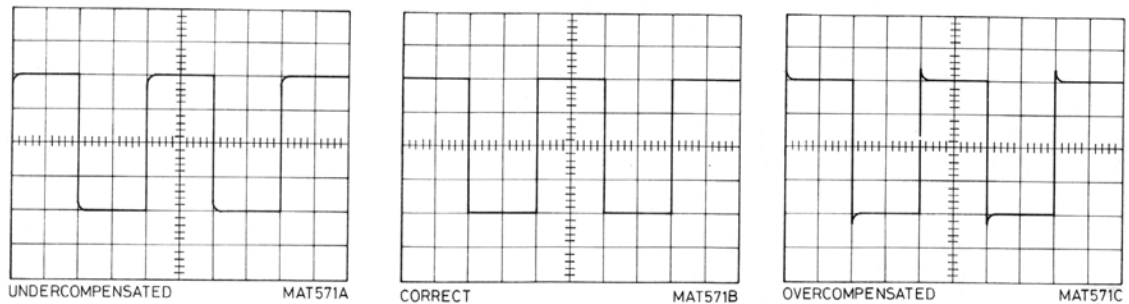


Fig. 3.2. Adjustment of attenuator probes

3.5. INPUTS A, B, C AND D AND THEIR POSSIBILITIES.

The oscilloscope has been provided with four identical channels, each of which can be used for either Y/T measurements in combination with one or both time base generators, or X/Y measurements in combination with the external horizontal channel.

3.5.1. Y/T measurements

If one signal must be displayed, one of the four vertical channels can be selected by depressing either pushbutton A, B, C or D of the vertical display mode selector.

If two or more signals must be displayed, they can be displayed in the chopped mode (CHOP pushbutton depressed) or in the alternate mode (ALT pushbutton depressed).

In the alternate mode, the display is switched over from one channel to another during the flyback of the main time base. In general the alternate mode is not used at low sweep speeds of the time base generator(s) because during these long sweep times the alternate display of the input signals is clearly visible to the eye.

In the chopped mode, the display is switched over from one channel to another at a fixed frequency.

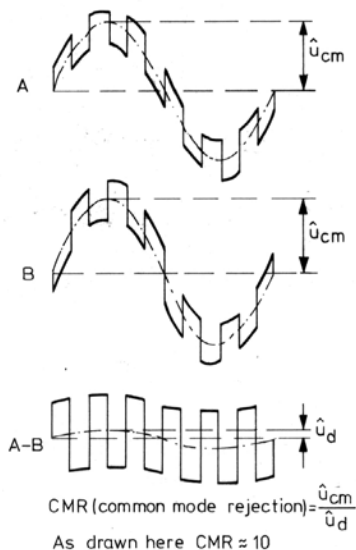
The chopped mode is mostly used at low sweep speeds of the time base generator(s).

If pushbutton A+B of the display mode selector is depressed, the signals of vertical channel A and B are added.

If pushbutton C+D of the display mode selector is depressed, the signals of vertical channel C and D are added.

Depending on the position of the polarity switches (PULL TO INVERT), either the sum or the difference of two input signals is displayed.

The A+B or C+D modes also enable differential measurements. With these measurements advantage is taken of the common mode rejection (CMR). When the polarity switches of two channels (A+B or C+D) are set in opposite positions, the common mode portions of the signals on both input sockets will undergo a very slight amplification only, with respect to the differential mode portions: See also fig. 3.3. In this mode the GAIN of channel A and B (or C and D) must be completely equal for optimum results.



MAT574

Fig. 3.3. Suppression of common mode signals.

3.5.2. Y/X measurements

If pushbutton EXT X DEFL of the horizontal display mode selector is depressed the time base generator(s) are switched off and the selected MAIN TB trigger source is used for horizontal deflection. In this mode the chopped display mode is automatically switched on.

If, for instance, pushbutton A of the MAIN TB trigger source selector is depressed, a signal applied to the A input socket can be used for horizontal deflection. The AC/0/DC function and the AMPL/DIV controls remain operative. The X POSITION control remains operative, but the TB MAGN function is switched off.

Also a signal applied to the external trigger input socket can be used for horizontal deflection. To achieve this, depress simultaneously pushbutton A and B (= EXT) of the MAIN TB trigger selector switch. The horizontal gain can be adjusted with the X AMPL/HOLD control. In the CAL position of this control the horizontal sensitivity is calibrated.

The external signal can be either AC coupled (X AMPL/HOLD OFF control pulled; PULL FOR AC) or DC coupled (control pushed).

3.5.3. Input coupling switch AC/0/DC

In the DC position of the coupling switch the full bandwidth of the instrument is available and DC components are displayed as trace shifts.

This may be inconvenient if small AC components are superimposed on high DC voltages. Any attenuation of the signal results in an attenuation of the small AC component.

The solution for the problem mentioned above is to use the AC position of the coupling switch. Now the DC component of the signal is inhibited by a blocking capacitor. This capacitor also suppresses low frequencies so that some pulse droop will occur when low frequency square wave signals are displayed.

The 0-position of the coupling switch interrupts the input signal and earths the amplifier input so that the 0 Volt level of a trace can be quickly determined.

3.6. TRIGGERING

If a signal is to be displayed, the horizontal deflection must always be started on one fixed point of the signal in order to obtain a stationary display. The time-base generator is, therefore, started by narrow trigger pulses formed in the trigger unit and controlled by a signal originating from one of the vertical input signals, an internal voltage at mains frequency or an external source.

3.6.1. Trigger coupling

The two-position trigger coupling switch is combined with the X AMPL/HOLD OFF control. If the control is pulled the trigger signal is AC coupled (PULL FOR AC) via a capacitor. This position can be used to reduce low frequency interference (e.g. hum) on the trigger signal.

If the control is pushed the trigger signal is DC coupled and passes through unchanged.

3.6.2. Trigger source selector and level control

The trigger signal is obtained from channel A, B, C or D depending whether trigger source pushbutton A, B, C or D is depressed.

The above-mentioned trigger sources are selectable for both MAIN and DEL'D TB.

Additional trigger sources for the MAIN TB are COMP (composite triggering), LINE (pushbutton B and C simultaneously depressed) and a signal applied to the external input socket (pushbutton C and D simultaneously depressed).

If the A and B pushbuttons are simultaneously depressed (COMP) the composite trigger mode is chosen.

In this mode the time base is triggered by the channel that (in the alternate mode) is in turn to be displayed.

This has the result that two or more signals that have no time relation each give a steady display.

In the LINE position the MAIN TB is triggered by a mains voltage related signal derived via an opto-coupler from the power supply.

The trigger signal is fed to the input of a differential amplifier. The voltage on the other input of this amplifier is determined by the position of the LEVEL control. If the trigger signal has reached the voltage level of the LEVEL potentiometer a trigger pulse is generated and the time base starts. See also fig. 3.4.

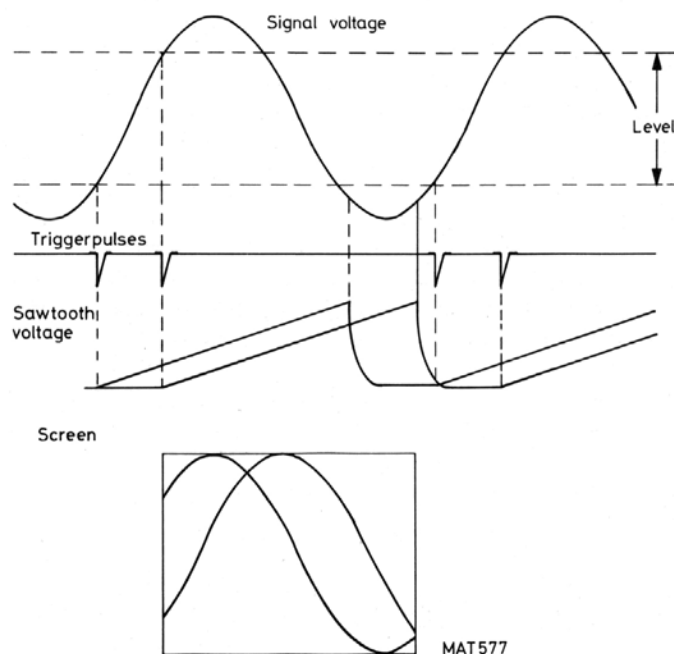


Fig. 3.4. Scanning the waveform by means of the LEVEL potentiometer

The time base is thus started at a fixed point of the trigger signal which means that with the aid of the LEVEL control, it is possible to scan the shape of the waveform.

The LEVEL potentiometer is also equipped with a push-pull switch +/— SLOPE which allows selection of the trigger slope. If the switch is depressed the time base starts on the positive-going slope as indicated in fig. 3.4. If the switch is pulled the time base starts on the negative-going slope of the trigger signal.

The LEVEL and SLOPE are adjustable for both MAIN TB and DEL'D TB.

3.6.3. AUTO mode triggering

When the AUTO pushbutton of the trigger mode selector is depressed and no trigger pulses are available, the MAIN TB becomes free running 100 ms after the last trigger pulse. Therefore the trace always remains visible. As soon as trigger pulses are available the free running state of the MAIN TB is terminated and it is triggered in the normal way as described in section 3.6.2.

The AUTO mode cannot be used for signals with a frequency lower than 10 Hz or for pulse trains with a repetition rate of 100 ms or more.

3.6.4. SINGLE shot triggering

When effects which only occur once have to be observed it is often desirable to ensure that only one sawtooth is generated, even though several trigger pulses might be produced after the phenomena of interest.

To this end the SINGLE pushbutton of the trigger mode selector must be depressed. The first trigger pulse that appears after the SINGLE button has been depressed will start the MAIN TB. After this the MAIN TB does not respond to trigger pulses until the SINGLE button is again depressed. The NOT TRIG'D pilot lamp will light up as soon as the SINGLE pushbutton is depressed and extinguishes at the end of the main time base sweep.

Displays in the SINGLE shot mode are often photographed.

For additional information see section 3.9.2.

3.7. TIME BASE MAGNIFIER

The time-base magnifier (TB MAGN) is operated by a push pull switch incorporated in the horizontal POSITION control. If this switch is pulled (PULL FOR X10), the sweep speed on the screen is ten times the TIME/DIV setting of the selected time base. Now the portion of the signal displayed over a width equal to one division in the centre of the screen in the X1 position (TB MAGN depressed), will occupy the full width of the screen in the X10 position (TB MAGN pulled).

Any portion of the trace can be brought on to the screen by the horizontal POSITION control for scrutiny. In the X10 position, the time coefficient is determined by dividing the TIME/DIV value by 10. The magnifier function is not operative if the EXT X DEFL pushbutton is depressed.

3.8. USE OF THE DELAYED TIME BASE

The delayed time base (DEL'D TB) can be used for the accurate study of complex signals.

When the pushbutton MAIN TB is depressed and the DEL'D TIME/DIV switch is not in the OFF position the DEL'D TB is on. Now a part of the MAIN TB trace is intensified if the DEL'D TB is triggered or if the STARTS pushbutton is depressed. This intensified part indicates the time during which the DEL'D TB is running.

The ten-turn DELAY TIME control enables the intensified portion to be shifted along the time axis. The length of the intensified portion can be controlled in steps and continuously by means of the DEL'D TB TIME/DIV controls.

When the DEL'D TB pushbutton of the horizontal deflection selector is depressed the intensified portion occupies the full width of the screen.

If the STARTS pushbutton is depressed the DEL'D TB starts immediately after the adjusted delay time. This delay time can be found by multiplying the setting of the MAIN TB TIME/DIV control and the setting of the ten turn DELAY TIME knob.

If the TRIG pushbutton is depressed the DEL'D TB starts after the adjusted delay time upon receipt of the first trigger pulse. The TRIG mode can be used when time jitter would otherwise give a blurred image of the detail under observation. This time jitter could be part of the signal being investigated or, at extreme magnification, originate from the time base circuits.

The instrument functions in the so called alternate time base mode (ALT TB) when the pushbuttons DEL'D TB and MAIN TB of the horizontal deflection mode selector are simultaneously depressed. In this mode the MAIN and DEL'D TB signals are alternately displayed on the CRT screen, so that the user can immediately correlate the signal detail with the overall signal without the necessity of switching between MAIN and DEL'D TB.

In the ALT TB mode the input of the horizontal amplifier is switched from one time base to the other at the end of every MAIN TB sweep.

The vertical shift between the two time base displays is continuously variable with the trace separation control (TRACE SEP).

In the alternate time-base mode is combined with more than one channel, for instance channel A and B, the display sequence is as follows:

- Channel A with MAIN TB intensified by DEL'D TB.
- Channel A with DEL'D TB.
- Channel B with MAIN TB intensified by DEL'D TB.
- Channel B with DEL'D TB.
- And again channel A with MAIN TB intensified by DEL'D TB.

If the alternate time-base mode is combined with trigger view the display only shows the TRIG VIEW channel with MAIN TB intensified by DEL'D TB.

The indicator UNCAL beneath the horizontal deflection selector indicates that at least one TIME/DIV switch is out of the CAL position. This indicator is used for the MAIN and DEL'D TB switch.

3.9. USE OF THE TRIGGER VIEW CHANNEL

3.9.1. External and internal trigger view

If the TRIG VIEW pushbutton is depressed the trigger view channel is switched on and the signal becomes visible on which the MAIN TB is triggered. If the external input is used for triggering an extra vertical channel becomes available.

The sensitivity of the TRIG VIEW channel via the external trigger input is 100 mV/DIV.

When using a 10:1 attenuator probe the sensitivity can be decreased to 1 V/DIV.

Also internal trigger sources can be displayed via the TRIG VIEW channel. If the TRIG VIEW channel is selected together with composite triggering, trigger view only shows the channel A trigger signal.

In the TRIG VIEW mode it can be observed at which level of the triggering signal the MAIN TB sweep is started. This level is of course adjustable with the LEVEL/SLOPE control.

3.9.2. Single shot measurements

With the LEVEL/SLOPE control the trigger level can be set at a predetermined value without the need of an input signal. This is of importance when the signal to be measured is not available in advance as when single events are to be observed. When input signals, which exceed a known trigger level, have to be displayed the trigger level can be set in advance and an input signal of sufficient amplitude will initiate the time base sweep.

The procedure is as follows: depress the TRIG VIEW pushbutton. Position the trace of the TRIG VIEW channel in such a direction (in relation to the central horizontal graticule line) as the required trigger level.

4. PERFORMANCE CHECK

4.1. GENERAL INFORMATION

This check is intended to check the oscilloscopes main function with a minimum of test steps and actions required. It is assumed that the operator doing this test is familiar with the oscilloscope and its characteristics.

WARNING: Before switching on, ensure that the oscilloscope has been installed in accordance with the instructions mentioned in chapter 2.

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 be sure that this will not happen, allow the full indicated warming-up time. The test should be done at an environmental temperature of 20 ... 30°C.

The measuring values that must be checked are indicated without tolerance and represent the characteristics of an average instrument: for tolerances see chapter 1.2. "Characteristics". The checks are carried out with the use of the instruments internal calibration voltage generator.

4.2. STARTING POSITIONS OF THE CONTROLS

- Depress pushbutton AUTO of S25.
- Depress pushbutton ALT of S28.
- Depress pushbutton A, B, C and D of S27.
- Put the channel A, B, C and D AMPL/DIV switches S9, S11, S13 and S15 in the 0.5V position and their verniers in the CAL position.
- Put the channel A, B, C, D POSITION controls R14/S21, R15/S22, R18/S23 and R19/S24 in their mid position and depress them.
- Put the channel A, B, C and D AC/0/DC signal coupling controls S17, S18, S19 and S20 in the 0-position.
- Put the main time-base TIME/DIV switch S5 in the 0.1ms/DIV and its vernier control R5/S6 in the CAL position.
- Put the delayed time-base TIME/DIV control S1 in the OFF position and its vernier control R1/S2 in the CAL position.
- Depress pushbutton MAIN TB of the horizontal display mode selector S8.
- Put the horizontal POSITION control R6/R7/S7 in its mid position and depress it.
- Depress the MAIN TB and DEL'D TB trigger coupling switch S32 (PULL FOR AC).

4.3. C.R.T. DISPLAY SECTION

- Adjust the INTENS and FOCUS controls R22 and R23 for a well-defined display. When carrying out these checks it may be necessary to readjust the controls.
- Centre the channel A, B, C and D time-base lines using the POSITION position potentiometers.
- Check if the time-base lines run exactly in parallel with the horizontal graticule lines. If not readjust the TRACE ROTATION control R26. This screw driver operated control is attainable via a ventilation hole in the left side panel of the instrument.

4.4. VERTICAL CHANNELS

- The checking of channel A, B, C and D is identical. The knobs, sockets and adjusting elements of channel B, C and D are shown in brackets behind those of channel A.
- Put the main time-base TIME/DIV switch in the 50ms/DIV position and check if channel A, B, C and D alternately displayed.
- Depress pushbutton CHOP of the vertical display mode selector and check that it looks like channel A, B, C and D are displayed simultaneously.
- Put the main time-base TIME/DIV switch in the 0,1ms/DIV position.
- Depress pushbutton A, (B, C, D) of the vertical display mode selector (other pushbuttons not depressed): now only the channel A, (B, C, D) time-base line is visible.
- Depress pushbutton A, (B, C, D) of the main time-base trigger source selector S30.
- Apply the output voltage from the CAL socket X1/X2 to the channel A (B, C, D) input socket X3 (X4, X5, X6).
- Put the channel A (B, C, D) signal coupling switch in the DC-position: the output signal from the CAL socket now becomes visible on the screen.
- Adjust the main time-base LEVEL so that a stable waveform is written. The vertical deflection must be 6 divisions. If not readjust screw driver operated front panel adjustment point R12 (R13, R16, R17).
- Also check the trigger SLOPE selection S4 that is incorporated in LEVEL control R4. If the control R4/S4 is pulled the trace starts at negative going slope of the signal and if it is depressed the trace starts at the positive going slope of the signal.
- The signal that is displayed now is a square-wave with a bottom level of 0Volt and a top level of 3Volt. The signal contains a DC component of 1,5Volt. With the AC/0/DC coupling switch in the AC position the DC component is blocked and the signal now is situated symmetrical around the 0Volt level on the screen. Now check the AC position.
- Check if the channel A (B, C, D) signal on the screen is inverted if the PULL TO INVERT function is switched on by pulling the A (B, C, D) POSITION control R14/S21 (R15/S22, R18/S23, R19/S24).
- Depress the channel A (B, C, D) POSITION control again.
- Depress pushbutton EXT X DEFL of the horizontal deflection mode selector S8.
- Depress the A (B, C, D) pushbutton of the main time-base trigger source selector.
- Apply the output voltage of the CAL socket to the channel A (B, C, D) input socket.
- Depress the B (C, D, A) pushbutton of the vertical deflection mode selector.
- Check that two points are displayed that have a horizontal distance of 6 divisions.
- Depress pushbutton TRIG VIEW of the vertical deflection mode selector.
- Depress pushbutton A (B, C, D) of the main time-base trigger source selector.
- Apply the output voltage of the CAL socket to the channel A (B, C, D) input socket.
- Depress pushbutton MAIN TB of the horizontal deflection mode selector.
- Check that a square-wave signal of 6 divisions is displayed on the screen. This signal is shifted a vertical sense if the main time-base LEVEL control is operated.

4.5. TIME BASES AND TRIGGERING

- Depress pushbutton A (B, C, D) of the vertical display mode selector.
- Apply the output signal of the CAL socket to the channel A (B, C, D) input socket.
- Depress pushbutton A (B, C, D) of the main time-base trigger source selector.
- Put the main time-base TIME/DIV switch in the 0,1ms/DIV position.
- Depress pushbutton MAIN TB of the horizontal display mode selector.
- Adjust the main time-base LEVEL control for a triggered display.
- Pull the TB MAGN knob R6/R7/S7 that is incorporated in the horizontal POSITION control and check that the horizontal deflection is magnified by a factor of ten times.
- Depress TB MAGN knob again.
- Depress the SINGLE pushbutton of the trigger mode selector S25. Check if the main time-base runs only once after release of this pushbutton.
- Depress the AUTO pushbutton of the trigger mode selector again.
- Put the delayed time-base TIME/DIV control S1 in the 20 μ s/DIV position and its vernier R1/S2 in the CAL position.

- Depress pushbutton STARTS of the delayed time-base trigger selector S26.
- Check that an intensified part becomes visible on the main time-base signal and that this part can be shifted along the main time-base line by means of the DELAY TIME control R3.
If necessary readjust the INTENS control for a better intensity ratio between the main time-base signal and the intensified part.
- Depress pushbutton DELD TB of the horizontal display mode selector and check if the intensified part now covers the entire horizontal screen width.
- Depress pushbutton ALT TB of the horizontal display mode selector. Now both the main time-base signal with intensified part and the intensified part displayed over the entire horizontal screen width must be displayed. The vertical shift between both displays must be adjustable by means of the TRACE SEparation control R20.
- Depress pushbutton MAIN TB of the horizontal display mode selector.
- Depress pushbutton A (B, C, D) of the delayed time-base trigger source selector and TRIG of S26.
- Adjust the delayed time-base LEVEL control R2 in such a way that the intensified part is visible on the main time-base signal. Check also the trigger SLOPE function S3 that is incorporated in the LEVEL control.

WWW.JETECNET.COM

5. PREVENTIVE MAINTENANCE

5.1. GENERAL INFORMATION

This instrument generally requires no maintenance, as the instrument contains no components that are subject to wear.

However, to ensure reliable and troublefree operation, the instrument should not be exposed to moisture, heat, corrosive elements or excessive dust.

5.2. CLEANING THE NEXTEL SUEDE COATING

WARNING: The Nextel suède coating is ethanol-resistant, but is susceptible to methylated spirit, which will attack the surface (due to one of the de-naturing substances).

The bright appearance of the cabinet, lacquered with Nextel suède coating will deteriorate after some time as the surface becomes soiled. Cleaning with a cloth soaked in water, ethanol or a common household cleansing agent does not always restore this lustre and leaves dirt in the holes and the pores.

The 3M Company have developed a new cleansing pad (White Cleansing Pad, Catalogue No. 8440) which when soaked in water, ethanol or a common household cleansing agent will also penetrate holes and pores.

This method is similar to that of abrasive cleaning pads but lacks their abrasive action. Abrasive cleaning pads should not be used, otherwise surface scratches will result.

5.3. RECALIBRATION

From experience it is expected that the oscilloscope operates within its specification for a period of at least 1000 hours or for six months if used infrequently.

In addition, replacement of components may necessitate recalibration of the affected circuits. The checking & adjusting procedure can also be helpful in localising certain troubles in the instrument.

In some cases, minor troubles may be revealed and/or corrected by recalibration. Complete checking & adjusting instructions are given in the Checking & Adjusting Section.

Contents

SERVICE MANUAL

3.	CIRCUIT DESCRIPTIONS	129
3.1.	Block diagram description	129
3.2.	Vertical deflection system	130
3.3.	Main time base triggering and sweep generator	135
3.4.	Delayed time base triggering and sweep generator	138
3.5.	X-deflection selector and final X amplifier	141
3.6.	Display mode logic	143
3.7.	CRT display section	148
3.8.	Power supply	150
4.	DISMANTLING THE INSTRUMENT	152
4.1.	Warning	152
4.2.	Removing the covers	152
4.3.	Access to parts necessary for the checking and adjusting procedure	152
5.	CHECKING AND ADJUSTING	153
5.1.	General information	153
5.2.	Survey of adjusting elements	159
5.3.	Checking and adjusting procedure	164
5.3.1.	Power supply	164
5.3.2.	Calibration voltage	165
5.3.3.	C.R.T. circuit	165
5.3.4.	Balance adjustments	167
5.3.5.	Time base generators	170
5.3.6.	LF corrections and sensitivities	172
5.3.7.	Vertical channels, square wave response	176
5.3.8.	Triggering	186
5.3.9.	Checking the delay time jitter	191
5.3.10.	Horizontal amplifier	191
5.3.11.	Periodic and random deviations	192
5.3.12.	Mains voltage variations	192
5.4.	Performance check	193
6.	CORRECTIVE MAINTENANCE	209
6.1.	Important notes	209
6.2.	Replacements	209
6.2.1.	Standard parts	209
6.2.2.	Special parts	210
6.2.3.	Transistors and IC's	210
6.2.4.	Knobs	210
6.2.5.	Carrying handle	211
6.2.6.	CRT	211
6.2.7.	Printed circuit boards	211
6.2.8.	Soldering techniques	215
6.2.9.	Special tools	216
6.2.10.	Replacing a pushbutton switch	217
6.2.11.	Recalibration after repair	218

6.2.12.	Instrument repacking	218
6.3.13.	Trouble shooting hints	218
7.	PARTS LIST	122
7.1.	Mechanical parts	122
7.2.	Electrical parts	228
8.	CIRCUIT DIAGRAMS AND PRINTED CIRCUIT BOARD LAY-OUTS	267

FIGURES

3.1.	Detailed block diagram PM 3264	126
5.1.	Adjusting elements, top view	156
5.2.	Adjusting elements, bottom view	157
5.3.	Orthogonality check	166
5.4.	Geometry check	166
5.5.	Position of intens potentiometer, when adjusting intensity ratio	167
5.6.	Diagram of 2:1 dummy probe	177
5.7.	Phase difference in X-Y mode	191
6.1.	Removing the knobs	210
6.2.	Dimensional drawing of micro-miniature semiconductor in SOT 23 encapsulation	215
6.3.	Tool for attenuator unit, dimensional drawing	216
6.4.	Tool for position potentiometer, dimensional drawing	216
6.5.	Pushbutton set clamping device	217
6.6.	Replacing a switch-segment of a pushbutton set	217
7.1.	Front view with item numbers	221
7.2.	Rear view with item numbers	221
7.3.	Rear panel view with item numbers	225
7.4.	Internal view of bottom side of instrument, showing the item numbers of the units	226
7.5.	Internal view of top side of instrument, showing the item numbers of the units and CRT-shield	226
8.1.	Input attenuators, circuit diagram	271
8.2.	Attenuator unit, printed circuit board lay-out, component side	268
8.3.	Attenuator unit, printed circuit board lay-out, conductor side	268
8.4.	Attenuator unit, mechanical lay-out	267
8.5.	Intermediate amplifier, circuit diagram	272
8.6.	Intermediate amplifier, printed circuit board lay-out	285
8.7.	Trigger pick-off unit, printed circuit board lay-out	283
8.8.	Final Y-amplifier, printed circuit board lay-out	286
8.9.	Logic unit, printed circuit board lay-out	288
8.10.	Final Y-amplifier and logic, circuit diagram	292
8.11.	Trigger source and trigger amplifier, circuit diagram	296
8.12.	Trigger source, printed circuit board lay-out	297
8.13.	Trigger amplifier, printed circuit board lay-out	298
8.14.	Time base and final X-amplifier, circuit diagram	304
8.15.	Time base unit, printed circuit board lay-out	299
8.16.	Final X-amplifier, printed circuit board lay-out	300
8.17.	Power supply, circuit diagram	308
8.18.	Power supply, printed circuit board lay-out	311
8.19.	Z-amplifier, focus unit and auxiliary unit, circuit diagram	314

8.20.	Z-amplifier, printed circuit board lay-out	315
8.21.	Focus unit, printed circuit board lay-out	316
8.22.	CRT-socket, wiring lay-out	317
8.23.	Auxiliary unit, printed circuit board lay-out	317
8.24.	Wiring lay-out of PM 3264	320

WWW.JETECNET.COM

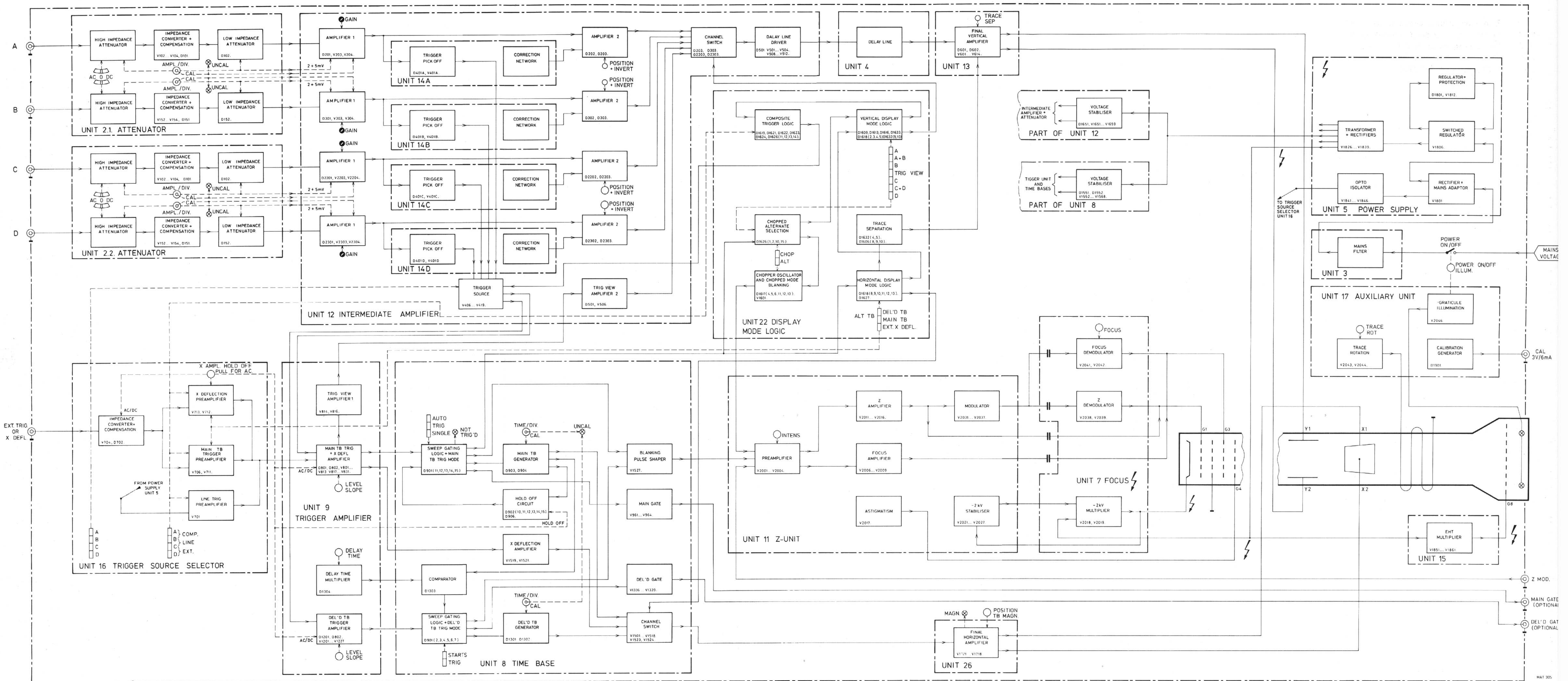


Fig. 3.1. Detailed block diagram PM 3264

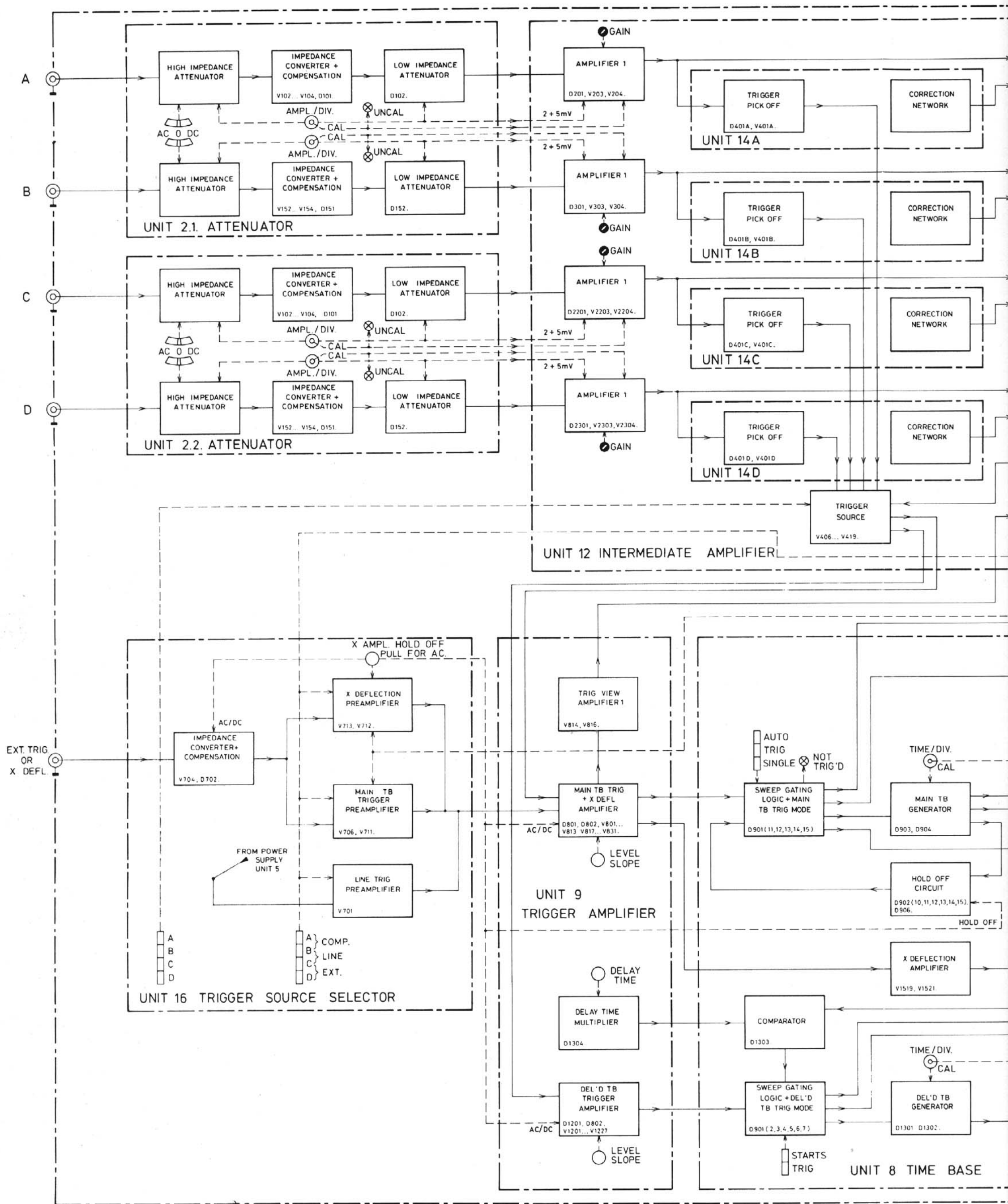
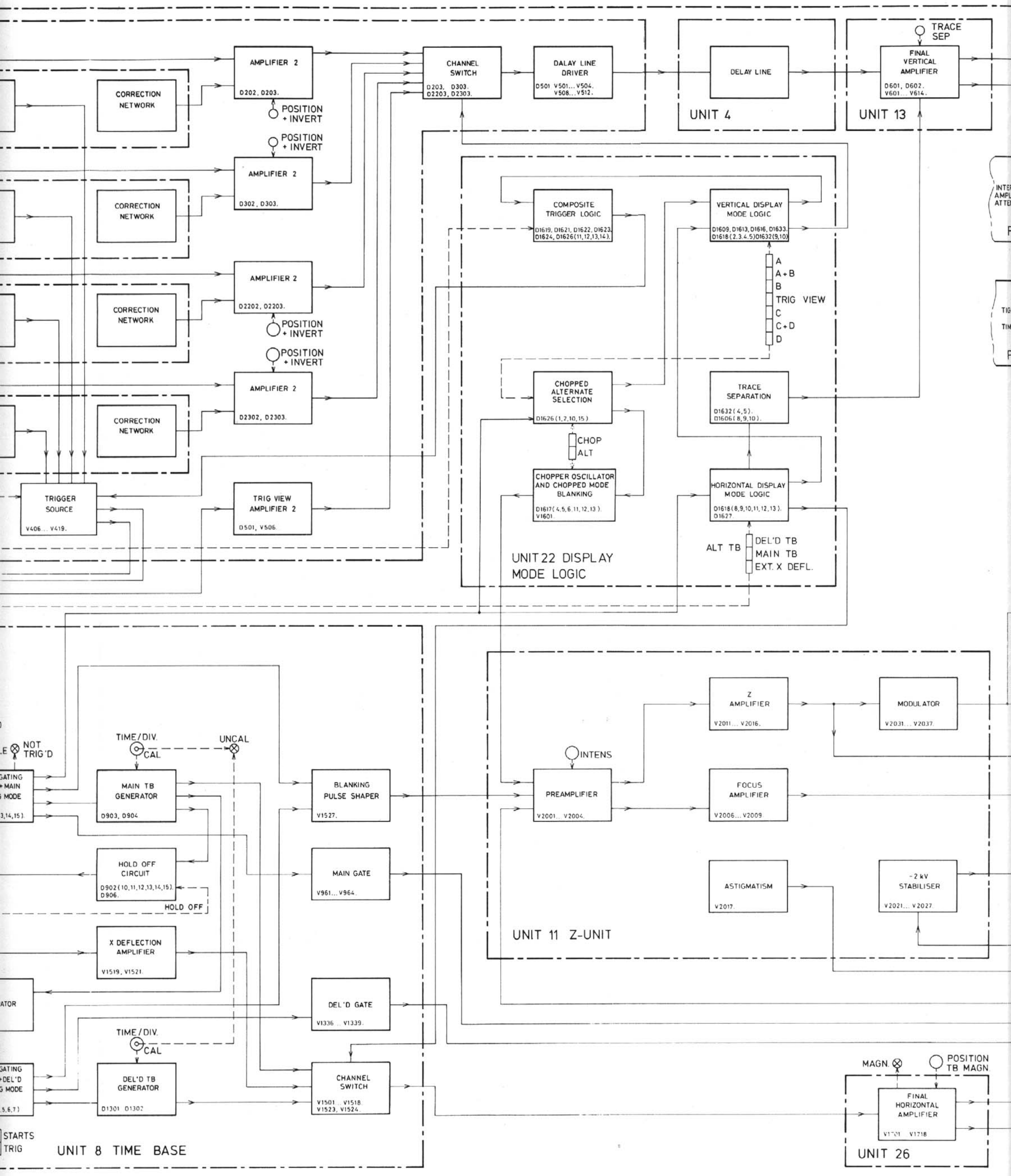
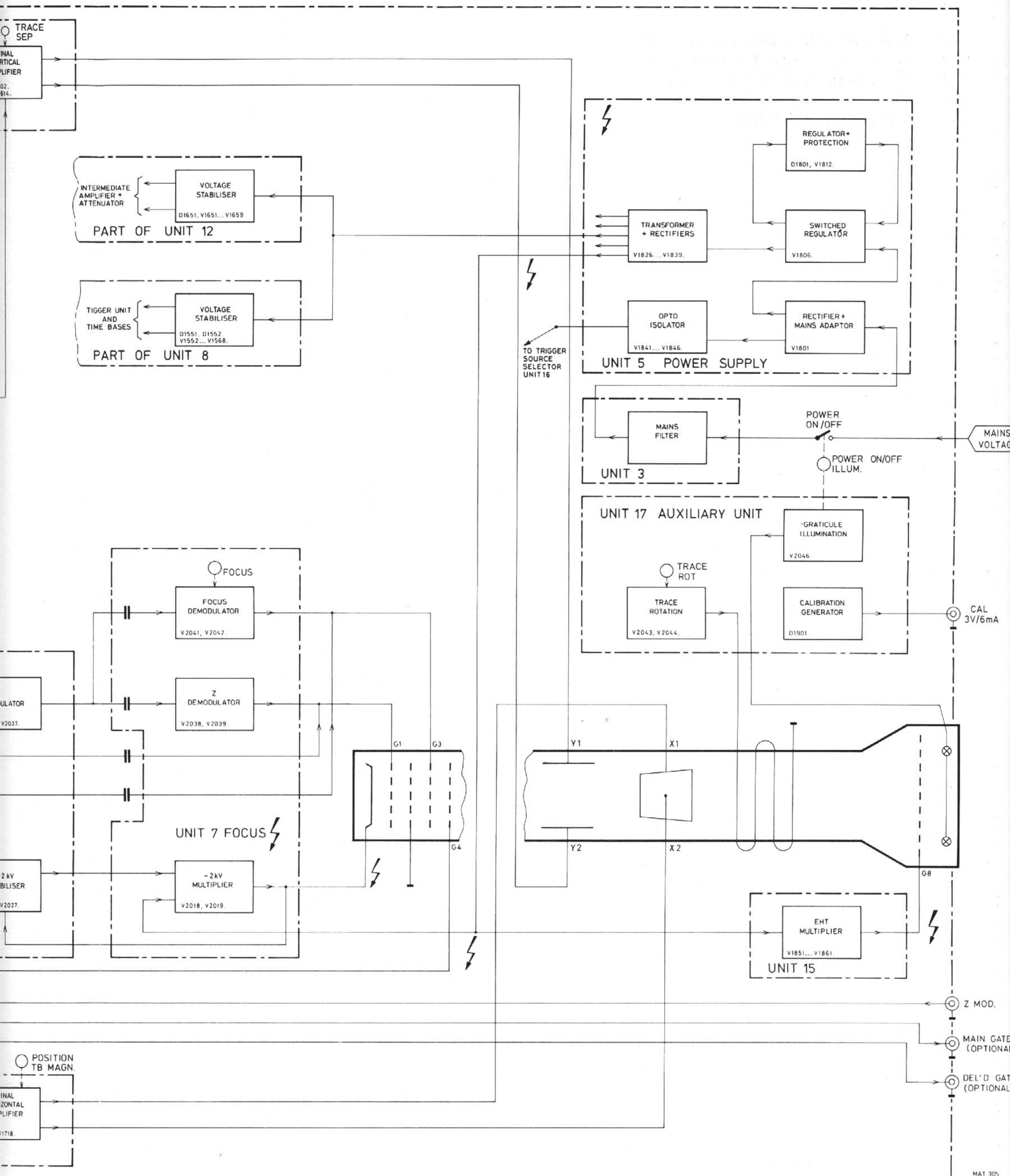


Fig. 3.1. Detailed block diagram PM 3264





3. Circuit description

3.1. BLOCK DIAGRAM DESCRIPTION

3.1.1. Vertical deflection

The instrument has four identical channels A, B, C and D of which for simplicity only CHANNEL A is described. CHANNEL A comprises the control AMPL/DIV for adjustment of the amplification of this channel and the control POSITION combined with a NORMAL/INVERT function. If this control is turned the result is a vertical shift of the signal on the screen. With the push-pull function of the control the signal can be displayed either in the normal way or in the inverted way.

CHANNEL A supplies an output signal to the section HORIZONTAL DEFLECTION in order to give the user the opportunity to trigger the time base(s) on the channel A signal.

Depending on a command signal from the VERTICAL CONTROL LOGIC the CHANNEL A output signal is switched through or not to DELAY LINE and FINAL VERTICAL AMPLIFIER.

The logic also controls the B, C and D channels; if A and B or C and D are switched through at a time the signals of the relevant channels are added and the sum is displayed on the screen.

If the logic switches through the output signal from the TRIGGER VIEW AMPLIFIER the signal on which the MAIN TIME BASE is triggered is displayed.

The logic is controlled by the VERTICAL CHANNEL SELECTION SWITCHES. If more than one channel is selected the display can function in the chopped or alternate display mode, depending on the position of the CHOPPED/ALTERNATE switch. For the alternate display switching a signal originating from the MAIN TIME BASE is used.

The DELAY LINE gives such a signal delay that also the leading edge of a fast phenomena can be displayed on the screen.

The FINAL VERTICAL AMPLIFIER drives the vertical deflection plates of the CRT. The control TRACE SEPARATION enables in the alternate time base mode an adjustable vertical trace shift between main and delayed time base signals.

3.1.2. Horizontal deflection

As an input source for the FINAL HORIZONTAL AMPLIFIER can be selected the MAIN TIME BASE, the DELAYED TIME BASE and the HORIZONTAL DEFLECTION AMPLIFIER. The source that is selected depends on the setting of the HORIZONTAL DEFLECTION MODE SWITCH.

Every time base produces a time-linear sawtooth voltage of which the sweep time is adjustable with a TIME/DIV control.

MAIN TIME BASE TRIGGER SOURCE AND TRIGGER AMPLIFIER: the MAIN TIME BASE can be triggered by one of the four vertical channels, by a mains-voltage related signal or by a signal applied to the external trigger input (EXT). The trigger source is selected with the trigger source switches. The level and the slope of the signal at which the time base is started can be adjusted with the LEVEL/SLOPE control. The selected MAIN TIME BASE trigger source can also be used for horizontal deflection via the HORIZONTAL DEFLECTION AMPLIFIER and for trigger view via the TRIGGER VIEW AMPLIFIER.

DELAYED TIME BASE TRIGGER SOURCE AND TRIGGER AMPLIFIER: the DELAYED TIME BASE can be triggered by one of the four vertical channels and the LEVEL and SLOPE are adjustable. The COMPARATOR block compares the main time base sawtooth with an adjustable DC voltage originating from the DELAY TIME potentiometer. At the moment that the level of the sawtooth reaches the adjusted DC level the COMPARATOR sends a signal to the DELAYED TIME BASE. Depending on the position of the STARTS/TRIG pushbutton the DELAYED TIME BASE now directly starts or it starts upon receipt of a trigger pulse from DELAYED TIME BASE TRIGGER SOURCE AND TRIGGER AMPLIFIER.

3.1.3. CRT display section

The Z-AMPLIFIER produces an output signal that is applied to the Wehnelt Cylinder G1 of the CRT in order to control the intensity of the spot on the screen.

The signals that control the intensity of the spot are:

- the setting of the INTENS control
- A blanking signal for the chopped mode coming from the VERTICAL AND HORIZONTAL CONTROL LOGIC
- An alternate mode blanking signal coming from the MAIN TIME BASE
- A signal coming from the DELAYED TIME BASE for the intensified part of the DELAYED TIME BASE on the MAIN TIME BASE signal.
- A signal that can be applied to the external Z-modulation input (Z-MOD).

3.1.4. Power supply

The power supply is stabilised and produces the output voltages for the electronic circuits in the instrument and the high voltages applied to cathode and final accelerator of the CRT.

3.2. VERTICAL DEFLECTION SYSTEM

3.2.1. Introduction

The oscilloscope contains four vertical channels A, B, C and D and the TRIGGER VIEW channel.

The vertical channels are identical, each comprising an input coupling switch, an input step attenuator, an impedance converter and a preamplifier with trigger pick-off.

A channel switch, controlled by the display mode logic, switches either channel A, B, C, D or TRIGGER VIEW channel to the final Y-amplifier via the delay line driver and the delay line. The final Y-amplifier feeds the Y-deflection plates of the cathode-ray tube.

The individual stages of the vertical deflection system are now described in detail.

As the channel paths for channel A, B, C and D are basically identical, only the channel A signal path is described.

3.2.2. Input coupling

Input coupling switch S17 (AC-0-DC) forms a part of the input attenuator unit (Unit 2.1.). Input signals connected to the A input socket X3 can be AC coupled, DC coupled or internally disconnected.

In the AC position of S17, there is a capacitor (C102) in the signal path. This capacitor prevents the DC component of the input signal from being applied to the amplifier and so reduces the lower frequency limit to 7 Hz.

In position DC of switch S17, the input signal is coupled directly to the step attenuator and at the same time, blocking capacitor C102 is discharged via R101, to prevent damage to the circuit under test by a possible high charge.

Selection of the 0 position of S17 isolates the channel A input signal and earths the channel input for reference purposes; e.g. for calibration or centering the trace.

3.2.3. Input attenuator and impedance converter

The input stage comprises four identical attenuator circuits which are combined on two units (unit 2.1 and 2.2.). For convenience, only the channel A attenuator is described.

The input attenuator consists of a triple high-ohmic voltage divider and an impedance converter in conjunction with a drift-correction circuit. The impedance converter provides an output at zero level, which can be adjusted by potentiometer R129, followed by a low-ohmic attenuator with attenuation factors of 1, 2 and 5.

The overall attenuation of the input stage is determined by the combination of the selected sections of two voltage dividers. The various combinations are selected by the eleven positions of the front panel AMPL/DIV attenuator switch S9.

The high-ohmic voltage divider sections attenuate by a factor of X1, X10 and X100. The low-ohmic divider D102 following the impedance converter, V102, V103, V104 gives attenuations of X1, X2 and X5 at the output. With the overall combinations of attenuation, eleven Y-deflection coefficients are realised from 2 mV/DIV to 5 V/DIV in a 1-2-5 sequence. Only for the most sensitive positions, 2 mV/DIV and 5 mV/DIV of the AMPL/DIV switch S9, the gain of the intermediate amplifier increased.

Constant input capacitance for the various attenuator positions is achieved by trimmers C101, C104 and C109. The high-ohmic voltage divider sections are made independent of the input frequency (i.e. the capacitive attenuation for AC signals is adjusted to the resistive attenuation for DC signals) by means of trimmers C107 and C112.

A diode clipper V101, in the gate circuit of FET-transistor V102 protects the input source follower of the impedance converter from excessive voltage swings.

The high frequency path of the input signal consists of capacitor C114 and FET-transistor V102 connected in a source-follower configuration. The low frequency path of the input signal consists of error amplifier D101, which samples the input and output signals of the impedance converter over a frequency range from d.c. to 1 kHz. The error amplifier generates a correction signal on pin 6 which is fed to the impedance converter to replace the missing low frequency components of the high frequency path.

The gain of the low frequency path is set by adjusting the resistor divider ratio from which the output is sampled. Preset R132 (L.F. corr) is adjusted so that the ratio of the network R134/R132 is the same as the ratio of network R122/R123. The offset voltage of the error amplifier is corrected by preset R124.

After low-ohmic attenuator switching, the output from the impedance converter provides a correct impedance match from the coaxial cable to the intermediate amplifier.

3.2.4. Intermediate amplifier

The intermediate amplifier comprises two main stages.

The first stage comprises the gain adjustments, vernier and continuous control, balance adjustments and sensitivity increase for the 2 mV and 5 mV/ DIV attenuator switch positions.

The second stage comprises a series-shunt feedback amplifier circuit formed by D202 input transistors and transistors V502, V504 on the delay-line driver circuit and D203. Interposed in this stage are the normal/invert, shift and electronic switch facilities.

Both stages have overall gains of approximately 3.

To improve temperature control and stability, the intermediate amplifier mainly comprises integrated circuits. The signal paths for channel A, B, C and D are identical in the input stages, consequently, only the channel A input circuit is described.

The Y-signal from the channel A attenuator is applied to a coaxial input socket on the intermediate amplifier, to pin 3 of integrated circuit D201. The asymmetrical input is converted to a symmetrical output in a transistor balance amplifier within the integrated circuit.

Potentiometer R211 provides a continuous balance control to correct for line shift.

Four diode-connected transistors across the base circuits of the D201 cascode transistors provide control of attenuation by means of GAIN control R12 and CONT. control R8, which vary the dynamic resistance of the diodes. Control R8 gives a 3 to 1 attenuation, which is sufficient to give the desired overlap between the input attenuator steps. When the currents through the diode bridge are equal, there is no gain and the transistors are cut off. When current flows in one diode and not in the other, the gain is maximum.

The cascode transistors V204 and V203 that follow integrated circuit D201 provide additional gain for the most sensitive ranges by the selection of load resistors. By switching this additional gain at intermediate amplifier level a reduction in noise is achieved.

The different loads of V203, V204 are selected by switching diodes under the control of the front-panel AMPL switch positions.

In the 10 mV-5 V positions the -5.2 V supply from AMPL/DIV switch S9 contact 14 is applied to the junction of R241, stabistor V208 and diode V211. The stabistor V208 conducts and applies the negative potential via switching diode V206 to load resistors R233 and R237 of V204 and V203 respectively. Diode V211 also conducts and blocks V213, thus causing transistor V214 to switch off and disconnect the load resistors R236 and R239.

In the 5 mV position, the -5.2 V supply from AMPL/DIV switch S9 contact 20 is applied to the junction of R242, and diodes V209, V212. Diode V212 conducts and applies the negative potential via switching diode V207 to the load resistors R234 in series with R233 and R238 in series with R237 of V204 and V203 respectively. Diode V212 also conducts and blocks V213, thus causing transistor V214 to switch off and disconnect the remaining load resistors. To compensate for the reduction of bandwidth in the 5 mV position because of the higher value of the load resistor, an additional capacitor, C202, is switched into the emitter circuit via R212 diodes V201 and V202 and resistor R200.

In the 2 mV position, transistor V214 conducts because of the 0 V applied to its base via R243 and V213. The resulting negative potential on its collector is applied to the total load resistors R237, R238, R239 and R233, R234, R236 of V204 and V203 respectively. In this position, switching diodes V206 and V207 are blocked. The 2 mV position is an extra facility, the bandwidth being degraded to 35 MHz.

To compensate for any shift of the trace that may occur when switching between the 5 mV and 10 mV positions, preset R216 is provided. It permits the emitter current of V204 to be adjusted, as required.

Emitter potentials for V203 and V204 are routed via feed resistors R219 and R222 respectively. The RC networks R219, C212 and R222, C214 provide damping. Series RC networks R208, C206 and R221, C214 on points 1 and 8 of the cascode circuit of D201 prevent any tendency for parasitic oscillation.

The second stage of the intermediate amplifier is a voltage-to-current amplifier that incorporates the trigger pick-off point, the NORMAL/INVERT switching facility, and the channel selection switching. The stage basically comprises two integrated circuits D202 and D203.

Emitter points 4 and 5 (D202) of the input transistors provide the trigger pick-off points that are routed to resistors R418 and R419 on the trigger circuit. A number of RC networks across the common emitter circuit provide for bandwidth compensation over the frequency range. Preset components are located on the trigger pick-off unit (unit 14A) and have the item numbers R244A, R253A, R254A and R257A.

The NORMAL/INVERT function is performed by a diode-gate switching circuit under the control of the PULL TO INVERT switch S21. In the NORMAL position, i.e. S21 is open, transistor V216 conducts because of the negative base potential applied via R271. Point 11 of D202 is therefore at 0 V and this is applied to the bases of two transistors, which conduct and pass the signal through D202 without inversion (points 1-14, 8-12).

The negative potential via R269 is passed to point 9 of D202 on the appropriate side of the diode gate network. This negative potential is applied to block the bases of the other pair of transistors in the signal path.

In the INVERT position, i.e. S21 is closed, V216 is cut off because of the 0 V potential applied via R271.

Point 11 of D202 now becomes negative via R268 and this switches off the two transistors that were previously conducting. The signal path is now inverted through the integrated circuit (points 1-13, 8-15) by the 0 V signal applied via S21, R267 to point 9 of D202.

Any trace shift due to inversion can be corrected by preset R259.

The output signals are fed to pins 1 and 8 of integrated circuit block D203, the emitters of the electronic switching transistors. Channel selection is achieved by means of a network, controlled from the display mode logic on unit 22 (see section 3.6.).

Front-panel POSITION control R14 applies a variable potential to the base of one of the input transistors to provide a means of shifting the trace.

3.2.5. Trigger pick-off via channels A (B, C or D)

The trigger pick-off circuit is present on the trigger pick-off units, located above the intermediate amplifier. The pick-off units are: unit 14A for channel A, unit 14B for channel B, unit 14C for channel C and unit 14D for channel D. For simplicity only channel A is discussed.

Diode switches are used for the switching of the desired trigger source. The outputs on which the selected trigger signal is present are asymmetrical and are taken via two coaxial cables to the main time base trigger amplifier and the delayed time base trigger amplifier.

The trigger signal from channel A is applied via R418A and R419A to the base of the input transistors of D401A (pin 3 and 6). Transistor V401A provides a constant current for these transistors. One of the collector outputs (pin 7) is coupled to the emitter of the output transistors in D401A (pin 8) via R422A and C414A.

The output transistors provide a high gain output on pin 13 that can be used for main time-base triggering and on pin 15 an identical signal for delayed time-base triggering.

The desired trigger source is coupled through via switching diodes.

If DEL'D TB triggering by means of channel A is selected, an earth potential from trigger source selector switch S29A/pin 2 is applied to the anode of diode V402A, which blocks. As a result the trigger signal available on D401A/pin 15 is coupled to the delayed time base trigger amplifier via diode V414 (unit 12) and a coaxial cable.

If another channel is selected +5.2 Volt originating from S29A/pin 2 is applied to the anode of diode V402A, which conducts.

As a result the trigger signal on D401A/pin 15 leaks away via V402A and C418A. Triggering via channel A is now blocked.

The main time-base trigger signal is switched by means of diode V403A. This diode switches in the same manner as diode V402A for the delayed time base trigger signal. However, diode V403A is not controlled directly by a switch contact, but by the display mode logic via transistor V416 which is directly controlled by an output of the display mode logic (unit 22).

A low logic level on the base of V416 results in a low level on the anode of switching diode V403A: this diode now blocks and main time-base triggering on channel A is possible.

When another channel is selected, a high logic level on the base of V416 makes diode V403A conductive and the main time-base trigger signal from channel A leaks away via this diode.

For the description of the display mode logic, see section 3.6.

3.2.6. Delay-line driver

The signal collector outputs from D203 (points 12 and 14) are diode coupled to the bases of the output transistors V502, V504 of the shunt-series feedback amplifier and each normally draws 10 mA from the current source of V501, V503.

When the channel is switched off by the display mode logic, the signal transistors in D203 are blocked and the alternative transistors in D203 are switched on so that they now draw 20 mA current from the +11.4 V rail via resistors R502, R501, R508, R507.

Similarly, the collector outputs from D303 for channel B, D2203 for channel C, D2303 for channel D and D501 for TRIG VIEW channel are coupled to the bases of V502, V504.

By the use of alternative transistors in the various switching modes, the current demands of delay-line driver stage are constant irrespective of the switching. The instrument has five channels and the current demand per channel is 20 mA. Thus V501 and V503 have to supply a total of 100 mA.

The collector outputs of transistors V502 and V504 are coupled via V511 and V512 respectively to the bases of the output transistors of the delay-line stage (points 3 and 6 respectively of integrated circuit D501). The collector outputs on points 2 and 7 of D501 feed the combined output resistor R552, the value of which, 120 ohms, matches the characteristic input impedance of the delay line.

A cable-type delay line is used with a characteristic output impedance of 75 ohms. From the delay line, the signals are routed to the vertical output amplifier stage, via input resistors R602 and R609, which terminate the delay line in 75 ohms. Transistors V601 and V602 in common-base configuration provide the first stage of the vertical output amplifier.

3.2.7. Final Y-amplifier

The voltage signals present on R604 and R613 are applied to the bases of transistors (point 3 and point 6) of integrated circuit D601.

The emitters of these transistors (points 4 and 5) are fed from a constant-current source, V606, via transistors V607 and V603. The base of V607 is controlled via V608 from the TRACE SEP; potentiometer R6 on the time-base circuit.

This potentiometer varies the current on the side of the balanced amplifier to give trace separation in the ALTERNATE TB mode.

The networks R634, C613, R636, C614 and C616 provide delay-line correction at different frequencies.

High frequency compensation for this stage is achieved by V609, C617 and V611, C618 adjusted by preset R646. The NTC resistor temperature-controls the vari-cap capacitance and compensates for increase in temperature.

Integrated circuit D601 and thin-film circuit D602 form a shunt-series feedback circuit, followed by a cascode amplifier with voltage output developed across the load resistors inside D603.

The Y-plates of the c.r.t. are fed via series chokes L601 and L602 damped by the parallel resistors R662 and R664.

Together with the capacitance of the c.r.t. plates, this forms a series resonant circuit to lift the gain at the high frequency end of the bandwidth. Preset R654 provides a measure of gain adjustment (20% approx.) to allow for different c.r.t. sensitivities.

It controls the quiescent current of the diodes and thus the gain of the D601 amplifier stage.

Any unbalance in the c.r.t. deflection plates can be corrected for by the line centring preset R658, which provides a compensating current for one side of the balanced output stage.

3.3. MAIN TIME- BASE TRIGGERING AND SWEEP GENERATOR

3.3.1. Main time-base triggering, introduction

The trigger source switches for triggering the main time-base generator, can select any of the following input sources.:

- an internal signal from the vertical A channel
- an internal signal from the vertical B channel
- an internal signal from the vertical C channel
- an internal signal from the vertical D channel
- an internal composite signal of channel A, B, C and D
- a signal derived from the mains supply
- an external source.

3.3.2. Main time-base trigger source selector and preamplifier

The signal used for external triggering or X-deflection can be applied to input socket X8. If DC coupling is selected by means of switch S32 (incorporated in the hold off/X-ampl. control) a DC path is supplied via R703 and R704 to D702/pin 3. In the AC mode (S32 pulled) this DC path is interrupted. The LF component of the X8 input signal is fed via capacitor C706 to D702/pin 3, and the HF component is fed via capacitor C703 to the gate of V704. The combined output signal from V704 and D702 is then applied to the bases of the transistor V706 and V713 to produce a trigger signal via diodes V711 and V712.

If one of the S30 switch positions A, B, C, D, COMP or LINE is selected the following occurs: D701/pin 6 becomes high, transistor V702 conducts and connects junction R718/R719 to earth potential. Transistors V703 and V708 now conduct and the signal paths via the switching diodes V711 and V712 are blocked.

If the trigger mode EXT is selected on S30 V702 is not conductive. As a result only one of the transistors V703 or V708 is conductive at a time. The transistor that is conductive depends on a signal originating from V1602/collector on the display mode logic (unit 22, see section 3.6.). This signal is applied to the junction of R714 and R716. Transistor V707 functions as an inverter for this signal.

If one of the time bases is selected for X-deflection by means of S8 the result is as follows: transistor V708 conducts and diode V712 is therefore blocked, V703 is blocked by the signal from V1602 and the collector current of V706 can thus reach the trigger amplifier (unit 9) via diode V711.

If the signal applied to input socket X8 is selected for X-deflection by means of S8 the result is as follows: V703 conducts and diode V711 is blocked, V708 is not conducting and the collector current of V713 can thus reach the trigger amplifier (unit 9) via diode V712. The potentiometer X AMPL (R25) is incorporated in the emitter of V713.

If LINE triggering is selected on S30 the result is as follows: D701/pin 3 is low, diode V701 becomes non-conducting and is not able to short-circuit the line trigger signal (derived from the power supply) applied to R723.

Because diode V709 is now conductive the line trigger signal can reach the trigger amplifier (unit 9). The value of the current coming from the trigger amplifier and flowing into either diode V709, V711 or V712 is 5 mA approx.

3.3.3. Main time-base trigger amplifier

The main time-base trigger amplifier consists of an input stage, coupling filters and a final amplifier. In this trigger amplifier, there is an output taken off for trigger view.

The signal current from the intermediate amplifier (channel A, B, C, D, or composite) is fed via the trigger source selector circuit to the emitter of V803. The output from the trigger source (EXT or LINE i.e. mains frequency) is also fed to the emitter of V803.

This transistor, connected in common-base configuration, is coupled to the shunt feedback stage V804, V806. The output of this stage is diode-coupled to the filters for the AC and DC coupling modes.

By means of these filters, the input frequency range of the trigger circuit can be set.

The desired filter is switched in by biasing the appropriate switching diodes in the forward direction via two resistors. For example the DC position, selected by switch S32, is switched in by the $-11,4$ V which causes diodes V809 and V812 to conduct. The AC mode is selected in a similar way.

In the AC mode (S32 pulled, PULL FOR AC) the DC filter section is not supplied with the $-11,4$ V.

The filter section is coupled to an emitter-follower V813, which compensates for the temperature drift of transistor V804.

On the trigger amplifier, the trigger view signal and the trigger signal proper are split up by means of two amplifier stages.

The two transistors V816 and V817 accept the trigger signal. The transistors V814 and V818 accept the trigger level voltage. The LEVEL voltage control R4 permits variation of the trigger level of the signal.

The trigger view gain can be varied by means of preset potentiometer R842 in the emitter circuit of transistors V814 and V816.

The collectors of transistors V814 and V816 provide the trigger view output and the collector currents of transistors V817 and V818 are fed to the shunt feedback stage V821 and V822 respectively, thus providing the trigger signal.

In the negative position of the $\pm$ SLOPE switch S4, the trigger signal is taken from one of the collectors V822 via transistors V824 and V827 and in the positive position from V821 collector via transistor V823 and V826. The $\pm$ SLOPE switch S4 determines the polarity of the trigger signal. In the closed position a 0 V signal causes V827 to conduct the negative trigger, and also switches off V829. In the open position, V829 is switched on and the positive trigger is routed via V826 and V827 is blocked by $+5,2$ V via R888.

In this way, the appropriate trigger signal appears at the combined emitters of transistors V826 and V827. This trigger signal is routed via a Schmitt-trigger formed by D802 (2-4-5), R894 and R895 to the flip-flop D901 in the main time-base sweep gating logic.

3.3.4. Main time-base generator

The main time-base generator comprises a sweep gating logic, a sweep generator, a hold-off circuit and an auto sweep circuit.

The operation of the main time-base generator is based on the principle that a capacitor charges linearly when a constant-current source is applied, and can be periodically discharged rapidly by means of an electronic switch. In this way, a linear saw-tooth waveform is generated.

The constant-current source consists of transistors V913, V914 and integrated circuit D903. The emitter voltage of V914 has the same potential as point 3 of D903, therefore a constant voltage exists across the series circuit of R926 and the charging resistors on switch TIME/DIV S5. This voltage, and thus the charging current may be varied by means of potentiometer R5 and the preset potentiometers R911 and R913, which compensate for the tolerances of the timing capacitors.

In the TRIG. position V931 is switched off because of the $+5,2$ V applied to its base by switch S25 (AUTO). If point 14 of the master slave flip-flop D901 is logic "high" due to a trigger pulse, V929 will also be switched off.

Consequently, its collector will be negative and switching transistors V906, V907 will be turned off (discharge switch open) and the timing capacitors C916 and C917 in parallel (and C912, C913 or C914

as selected) will be charged. This charging voltage is applied via the buffer stage consisting of the Darlington pair emitter-follower V922, V923 (HF path) and via the operational amplifier D904 together with V924 (LF path) to point 12 of the R; S; flip-flop D902. This flip-flop reaches its switching voltage when the time-base saw-tooth voltage rises to approximately +4,3 V. Output 14 will then be "high" and output 15 will be "low". Since the collector of V937 is positive (see operation of AUTO circuit), diodes V927 and V926 will conduct and the "high" output on point 14 of D902 will be applied to point 12 (S input) of flip-flop D901. This results in a "low" output on point 14 of D901 irrespective of the state of the other inputs. The "low" output causes V929 to start conducting and its collector becomes less negative. Consequently, switching transistors V906, V907 conduct (discharge switches closed), the timing capacitance is discharged and point 12 of D902 drops below the switching level. Transistor V944, the base of which was turned on by the "high" output (point 14) of D902, is now switched off. In turn, transistor V956 (discharge switch for the hold-off circuit) is switched off and allows the hold-off capacitance (C928 and C926, C927 as selected) to be charged by current source V954, D906. The voltage on point 3 of D906 is derived from a resistor that carries the charging current of the time-base generator. Therefore, the charging current for the hold-off capacitance is proportional to that for the time-base capacitance, thus giving a constant relationship between time-base length and the hold-off time. Potentiometer R24 (HOLD-OFF) allows the length of the hold-off period to be increased by a factor of 10. When the voltage across the hold-off capacitance has risen to a value of approximately 4,3 V the flip-flop D902 will be switched to its original state (outputs 14 low, 15 high), via buffer stage V949, V948. The "low" state on the base of V944 causes it to conduct and turn on V956 to discharge the hold-off capacitance. As a result, point 10 of D902 drops below its switching level. The S input of D901 will also be low again, whereupon the clock input (point 11) will be effective. The D input (point 10) is coupled with the clock pulse. Due to this pulse the flip-flop is switched over, resulting in a low level on point 15 and a high level on point 14 to permit the new time-base sweep.

3.3.5. Free run AUTO-circuit

If as a result of a trigger pulse, the Q output (point 15 of D901) is low, V934 and V936 start conducting and provide a discharge path for capacitor C923. Resistor R957 has been selected so that the current through R958 is insufficient to bring the base-emitter voltage of V936 to 0,7 V; therefore, both transistors are cut off as soon as C923 has discharged, provided that the Q output has switched to "high" in the meantime. The voltage on the negative side of C923 is then approximately +3,5 V and V937 is turned off, as a result of which diodes V926 and V927 are able to transfer the pulse on D902 output 14 to input 12 of D901.

Transistor V931 is turned off because its base is held at +5,2 V via R959, R960 and R962 (switch S25/AUTO is interrupted in the AUTO position). Thus, with a trigger signal input the time-base operates in the same way as in the TRIG position.

However, in the absence of a trigger signal, when D901 output 15 is "high", capacitor C923 will be slowly charged to approximately -6 V. If before this charging time (0.1 s approx.), point 15 turns to "low" (due to a trigger signal), C923 is discharged again before V937 starts conducting. As a result, V937 remains switched off and the instrument is still triggered.

If the voltage across C923 is permitted to charge to -6 V (i.e. no trigger signals appear), V937 starts to conduct and the resulting negative on its collector blocks diodes V926 and V927. At the same time, the base voltage of V931 drops. Consequently, the pulse on output 14 of D902 is no longer transferred to input 12 of D901, but is fed direct to the switching transistors V906, V907 via diode V932 and transistors V931 and V929.

In this way, the time-base generator runs automatically without the intervention of a trigger pulse. Transistor V937 is conductive when the time-base generator is not triggered. The base of V939 is then low, as a result of which the transistor conducts and the NOT TRIG'D lamp (V8) lights.

3.3.6. SINGLE SHOT mode

In the trigger position SINGLE, the time-base hold-off capacitors are short-circuited by diode V953 and switch contacts S25 (AUTO) and S25 (TRIGG).

The flip-flop D902 must then be reset manually by the RESET button S25 (SINGLE), which applies

+5,2 V via R975, V946 to input 10. After input 10 has been brought to a high level and the RESET button released, triggering can occur, but on one event only as the flip-flop is not reset automatically. In the SINGLE mode, V937 is permanently turned off via R965 by S25 (AUTO) and S25 (SINGLE). Since diodes V941 and V942 are now conductive, the pulse on output 14 of D902 will be transferred to the base of V939.

Consequently, the NOT TRIG'D lamp will light during the period when output 14 of D902 is low, i.e. from the moment the RESET button is pressed until the end of the time-base sweep initiated by the incoming trigger pulse of the event under observation.

3.4. DELAYED TIME-BASE TRIGGERING AND SWEEP GENERATOR

3.4.1. Delayed time-base triggering, introduction

The trigger source switches for triggering the delayed time-base generator can select any of the following input sources.

- an internal signal from the vertical A channel
- an internal signal from the vertical B channel
- an internal signal from the vertical C channel
- an internal signal from the vertical D channel
- an internal signal derived from the main time-base to start the delayed time-base immediately after the selected delay time

Source selection is done by means of a trigger selector switch S29.

3.4.2. Delayed time-base trigger amplifier

The delayed time-base trigger amplifier consists of an input stage, coupling filters and a final amplifier.

The signal current from the intermediate amplifier (channel A, B, C or D) is fed via the trigger source selector circuit to the emitter of V1203.

This transistor connected in common-base configuration, is coupled to the shunt feed-back stage V1204, V1206.

The output of this stage is diode-coupled to the filters for the AC and DC coupling modes.

By means of these filters, the input frequency range of the trigger circuit can be set.

The desired filter is switched in by biasing the appropriate switching diodes in the forward direction via two resistors. For example, the DC position, selected by switch S26, is switched in by the $-11,4$ V which causes diodes V1208 and V1209 to conduct. The AC mode is selected in a similar way.

The pushbutton switch TRIG/STARTS (S26) and the control PULL FOR AC (S32) are interconnected in such a way that the filters function as follows:

- in the STARTS mode, when no delayed time-base trigger signal is necessary both the DC and AC filter are not supplied with the $-11,4$ V.
- in the AC mode (S32 pulled) the DC filter is not supplied with the $-11,4$ V.

The filter section is coupled to an emitter-follower V1212, which compensates for the temperature drift of transistor V1204.

The two transistors V1213 and V1214 accept the trigger signal and the trigger LEVEL voltage respectively.

The LEVEL voltage control R2 permits variation of the trigger level of the signal.

The collector currents of V1213 and V1214 are fed to the shunt feedback stage V1217 and V1218 respectively, thus providing the trigger signal.

In the negative position of the $\pm$ SLOPE switch S3, the trigger signal is taken from one of the collectors via V1222 and transistor V1223, and the positive position via V1219 and V1221.

$\pm$ SLOPE switch S3 determines the polarity of the trigger signal. In the closed position a 0 V signal causes V1223 to conduct the negative trigger and also switches off V1227. In the open position, V1227 is switched on and the positive trigger is routed via V1221 and V1223 is blocked. In this way the appropriate trigger signal is supplied to the time-base.

3.4.3. Delayed time-base generator

The delayed time-base generator comprises a sweep gating logic, a sweep generator, a comparator and an end-of-the-sweep detector.

Before considering these stages in detail, the general principle is briefly described.

Basically, the sweep gating logic, under the control of trigger signals from the trigger circuit and also feedback pulses from the end-of-the-sweep detector circuit, supplies square-wave pulses to the switching transistors V1309 and V1311 of the sawtooth generator. The time-base capacitors (effectively in parallel with the switching transistor) are charged linearly through a constant-current source to provide the forward sweep, and are discharged rapidly by the switching transistor to provide the flyback period. The resulting sawtooth is fed via the X-deflection selector to the X-final amplifier.

The sweep speed or time coefficient is determined by the value of the time-base capacitance in circuit, and also by the magnitude of the charging resistor selected.

The time-base capacitors C1311, C1312 are always in circuit, the capacitors C1307, C1308 and C1309 are selected by the transistors V1319, V1322 and V1323 respectively. These transistors operate as electronic switches and are either fully cut-off or fully-conducting. They are switched on by the application of a positive voltage on their bases from the TIME/DIV switch S1. According to the position of S1, the transistors switch in one of the capacitors in parallel with C1311 and C1312.

As mentioned, the sweep speed is also dependent upon the magnitude of the accurate constant-current supplied by transistors V1317 and V1318. This current can be adjusted in steps by selecting the emitter resistance of V1318 by means of the TIME/DIV switch S1.

Continuous control of the charging current can be effected by varying the drive to point 3 of integrated circuit D1301 with the continuous sweep control, TIME/DIV potentiometer R1.

Potentiometer R1326 enables the sweep speeds of the delayed time-base generator to be equalized to those of the main time-base generator.

Together with C1307 and C1309, transistors V1314 and V1312 are switched into the circuit by a +5,2 V voltage from the TIME/DIV switch S1. In these positions, potentiometers R1318 and R1321 provides a fine adjustment for the timing circuit.

The discharge circuit for the time-base capacitors consists of transistor V1311, which is driven by the sweep gating logic.

The resulting sawtooth voltage is fed via an LF path and an HF path to the X-deflection selector. The LF path consists of integrated circuit D1302 and transistor V1328 and the HF path consists of transistors V1326 and V1327.

3.4.4. Delayed time-base end of the sweep detection circuit

This circuit prevents the sweep gating logic from responding to trigger pulses before the time-base capacitor has fully discharged. The sawtooth output is applied to point 7 of SR flip-flop D902.

At the end of the time-base sweep, output 2 of the SR flip-flop D902 will be "high" and output 3 will be "low". These logic levels are transferred to pins 5 and 4 respectively of D901 irrespective of the state of the comparator D1303. As a result, the $\bar{Q}$ output becomes "low" and the timing capacitors are discharged via V1311, since the flip-flop D902 is not reset until the end of the main time-base sweep (D902-15 on MTB connected via a differential network to D902-5 on DTB). This situation will persist until the next sweep of the main time-base. If the main time-base sweep is completed before the end of the delayed time-base, the R and S inputs (5 and 4) of D901 are switched over and the delayed time-base capacitors are discharged. The system can now be triggered again.

3.4.5. Delay time function

The function of the DELAY TIME potentiometer R3 is to provide an adjustable DC voltage for comparison with the sweep voltage of the main time-base generator. This comparison is then used to start the delayed time-base generator at a pre-determined time during the sweep of the main time-base. The DELAY-TIME potentiometer R3 is a 10-turn front-panel control.

3.4.6. Comparator circuit and sweep gating logic

The comparator consists of an integrated circuit D1303. Transistor (points 6-7-8) is a constant-current source for the transistors (points 1-2-3 and points 3-4-5) of a differential amplifier. The DC voltage set by the DELAY TIME potentiometer R3 is fed to the base of transistor (points 3-4-5). The sawtooth voltage of the main time-base generator is fed to the base of the other transistor. As soon as the amplitude of the sawtooth exceeds the set d.c. voltage, a high level is passed from D1303, pin 5, to input 4 of master-slave flip-flop D901 (R input), and a low level from D1303, pin 1 to S input 5 of D901.

The $\bar{Q}$ output on point 3 will then be high, with a result that V1304 and the time-base capacitor discharge switches V1309 and V1311 will be turned off. This is the situation if the STARTS pushbutton of S26 has been depressed.

If pushbutton TRIG of S26 is depressed, point 4 of D901 is always low. The delayed time-base then starts first upon receipt of trigger pulses on clock input 6, after the S input has dropped to the low level.

3.5. X-DEFLECTION SELECTOR AND FINAL X-AMPLIFIER

3.5.1. X-deflection selector

Depending on the selected position of X-deflection source selector switch S8, the circuit provides for X-deflection by the main time-base signal, the delayed time-base signal, a signal from an external source or X-deflection by one of the internal signals derived from channel A, B, C, D or the mains voltage. There is also the possibility to select, the main and delayed time base alternately.

The different horizontal display possibilities are as follows:

- MAIN TB** — When horizontal deflection by the main time-base is selected, D1632/pin 2 on the display mode logic (unit 22, see section 3.6.) is high. D1632/pin 2 drives the base of V1509 in the X-deflection selector. In the MAIN TB position of switch S8, transistor V1509, and consequently transistor V1511, conduct. Diode gate V1513, V1514 is therefore opened and the main time-base output is applied via transistor V1512 to the X-amplifier, via these diodes and R1703. In this mode, only the main time-base sawtooth signal is fed to the final X-amplifier.
- DEL'D TB** — When horizontal deflection by the delayed time-base is selected, D1632/pin 15 on the display mode logic (unit 22, see section 3.6.) is high. D1632/pin 15 drives the base of V1501 in the X-deflection selector. In the DEL'D TB position of switch S8 transistor V1501 and consequently transistor V1506 conduct. Diodes V1503 and V1504 conduct and provide a signal path for the output sawtooth signal of the delayed time-base to the final X-amplifier. In this mode the main time-base signal and the X-deflection signal are blocked.
- ALT TB** — When the ALT TB function is depressed the instrument functions in the alternate time-base mode and main and delayed time-bases are selected alternately. This selection is of course controlled by the display mode logic: refer to section 3.6. for more details.
- EXT X DEFL** — In the EXT X DEFL mode a high logic level is applied to the base of V1516 with the result that the base of V1517 exceeds +5,2 V and this transistor is turned off. Transistor V1524 then starts to conduct via R1528 and zenerdiode V1523 and the external X-deflection signal from amplifier V1519/V1521 is routed via diode gate V1522/V1526 to the input of the final X-amplifier. When EXT X DEFL mode is switched off, transistor V1516 is turned off and V1517 conducts via R1522. The collector of V1517 is therefore at +5,2 V, and as the voltage across zenerdiode V1523 is less than 8,2 V this diode is blocked and V1524 is turned off. In this position the X MAGN X10 reed relay K1701 may be switched on.

3.5.2. Final X-amplifier

The final X-amplifier consists of two identical amplifier stages in parallel (one for each deflection plate). One stage consists of transistors V1706, V1707, V1708 and V1709 and the other consists of transistors V1714, V1716, V1717 and V1718.

The final stage is supplied from the +60 V and -60 V because the X-plates of the C.R.T. are mechanically displaced such that they are less sensitive than the Y-plates.

The amplifier stages are controlled via the transistors V1701 and V1702.

With the X POSITION potentiometer R6/R7 the bias of transistor V1702 can be varied via transistor V1704.

Potentiometer R6/R7 consists of a tandem potentiometer with back-lash, giving a good vernier control. Variation of the bias causes the balance of the amplifier to be disturbed, which results in a horizontal trace shift on the screen.

The X-amplifier allows choice of X- deflection by the time-base signals or one of the sources, channel A, B, C, D, line or an external signal. The X-deflection source is selected by X-deflection mode selector S8 and by S30 when X-deflection is selected by means of a main time-base trigger source. The selected X-deflection signal is applied via R1703 to the base of transistor V1701.

The X-amplifier offers the possibility of using either the nominal gain (X1 position of X MAGN switch S7), or the gain increased by a factor of 10 (X10 position of the X MAGN switch S7). When the front-panel X MAGN switch S7 is operated for X10 magnification, the emitter resistance of V1701 and V1702 is shunted by resistors R1704, R1706 and R1707 via relay K1701, reducing the value by a factor of 10. Consequently, the gain of the stage is increased by the same factor.

The X1 gain can be set by potentiometer R1709 and the gain X10 by potentiometer R1706. The gain X10 is not operative when EXT X DEFL is selected.

Both outputs of the X final amplifier are connected to the X-deflection plates of the C.R.T.

For correct orthogonality adjustment a signal from the orthogonality potentiometer R1737 is applied to R661 in the final Y-amplifier.

3.6. DISPLAY MODE LOGIC

3.6.1. Introduction

The logic circuits are all located on the logic unit (unit 22). The type of logic used is "LOCMOS" characterised by its very low power consumption.

The word LOCMOS is the abbreviation for Local Oxidation Complementary Metal Oxide Semiconductor, which indicates that field-effect transistors with an insulated gate are used in this type of logic. Although these field-effect transistors have input and output protection diodes, this type of logic is sensitive to electrostatic charges.

Therefore the following must be carefully read before starting to handle unit 22.

To safeguard against any possible damage to the LOCMOS circuits, the following rules must be observed:

- a. Store and transport the circuits in their original packing, which short-circuits the leads or insulates them from external influences.
- b. Electrically connect together to the same potential: testing or handling personnel, measuring equipment, soldering iron and circuit board with the LOCMOS circuits being handled. This potential can, of course, be earth.
- c. After the LOCMOS circuits have been mounted on the board, proper handling precautions should still be observed. Until the sub-assemblies are inserted into a complete system in which the proper voltages are applied, the board is no more than an extension of the leads of the device mounted on the board. To prevent any static discharges from being transmitted through the board wiring to the device, it is recommended that conductive clips or conductive tape be put in the circuit-board terminals.
- d. Handling personnel should be dressed in clothing of non-electrostatic material (i.e. no wool, silk or synthetic fibres).
- e. To prevent permanent damage due to transient voltages, do not insert or remove LOCMOS devices, or printed circuit boards containing LOCMOS devices, from test sockets or systems with power on.

The supply voltage for the logic is +5 V.

The logic levels are defined as follows:

- a high logic level (H) lies between 3,5 V and 5 V
- a low logic level (L) lies between 0 V and 1,5 V.

For a better understanding of the circuit description the functioning of most IC types used on unit 22 is explained briefly:

- output buffers (D1632, 1633): in these devices the output simply follows the input. In contrast to a normal LOCMOS device, the output of a buffer is able to drive TTL logic or high capacitive loads
- AND gates (D1602, 1604, 1606): the output is only H if all the inputs are H
- NAND gates (D1601, 1608, 1612, 1614, 1617, 1619, 1621, 1623, 1628): the output is only L if all the inputs are H
- OR gates (D1603, D1607): the output is H if at least one input is H
- NOR gates (D1629, 1631): the output is L if at least one input is H
- Inverter (D1622): the output is the opposite of the input
- Triple electronic change-over switches (D1624, 1626): depending on the control input (pin 9, 10 or 11) voltage level the switch occupies one of the two possible positions. The switches are drawn in the diagram in the position initiated by a L control input. With the control input H the switches occupy the other switch position. The functions stated above are only valid if the enable input (pin 6) is L. If it is H, all the switches are in the off state.
- Dual D-type flip-flops (D1609, 1613, 1616, 1618): The flip-flop has an output (pin 1 or 13) and an inverted output (pin 2 or 12). If the reset input (pin 4 or 10) is made H it is activated and the flip-flop is forced to the reset condition: output is L and inverted output H. The set input (pin 6 or 8) is active when H and forces the flip-flop in the set condition: output is H and inverted output is L. If the reset and set are L the condition of the data input (pin 5 or 9) and the clock input (pin 3 or 11) are important. Data is accepted on the data input if the clock input is L. Data is clocked into the flip-flop if the clock input goes from L to H and then becomes available on the output.

The logic circuits can be subdivided into the following functions:

- Vertical display mode logic: switches the vertical channels A, B, C, D and TRIG VIEW on and off at the required instant. It is controlled by the vertical display mode switch S27 and the chopped/alternate switch S28. In the chopped mode a blanking pulse is applied to the Z-amplifier
- Main time-base composite trigger logic: switches the main time-base triggering via vertical channels A, B, C and D depending on the position of the trigger source switch S30.
- Horizontal display mode logic: switches the input signals for the final X-amplifier depending on the position of S8 (horizontal display mode) and S1 ("DTB OFF" contact of delayed time-base TIME/DIV switch). This part of the logic also produces the trace separation signal applied to the final Y-amplifier in the alternate time-base mode.

Test hint

When troubleshooting it may be easier in some cases to observe the change of the logic levels on certain gates and flip-flops after each clockpulse.

This can be done by using the instrument in the alternate display mode combined with single shot mode. Every time the single-shot pushbutton is operated and the time-base is triggered a clockpulse is generated at the end of the main time base sweep. The mains trigger signal may be used to trigger the main time-base.

3.6.2. Vertical display mode logic

The heart of the logic is formed by a row of seven D-flip-flops designated flip-flop A, A + B, B, TRIG VIEW, C, C + D and D. Each flip-flop is able to switch the associated related channel(s) on in the set condition; i.e. its output (pin 1 or 13) is H and its inverted output (pin 2 or 12) is L.

The channels A, B, C, D, TRIG VIEW, A + B, C + D can be selected by means of the display mode switch S27 that has seven independent pushbuttons.

The switching of the vertical channels happens as follows:

- If channel A is selected resulting in L output on NAND gate D1617/10 the channel A flip-flop D1609 is set and pin 2 is L. This low level is applied to pin 2 of NAND gate D1623, which gives a logic H on output 3 of D1623 is H. This high level is applied to the A channel switch on the intermediate amplifier via output buffer D1633/9, 10. As a result the channel A signal is applied to the delayline driver
- If function A + B is selected the A + B flip-flop D1609 is set and pin 12 is L. This low level is applied to the inputs 1 and 6 of NAND gate D1623. The result of input pin 1 being low is that D1623/3 is high and channel A is switched on via buffer D1633/9, 10 as previously explained. The result of input pin 6 being low is that D1623/4 is high and channel B is switched on via output buffer D1633/14, 15. As a result channel A and B are switched through to the delay line driver at the same time and addition takes place
- The working principle for the channels/functions B, TRIG VIEW, C, C + D and D is identical to the functions described above.

If a channel is not selected the reset input of the associated flip-flop receives a high level, derived from the +5 Volt supply via a resistor in resistor array R1601 if the related contact of the channel selection switch S27 is not closed.

With the reset input at logic high, the flip-flop is forced in the reset condition; which means that its output is L and its inverted output is H.

The situation described above is valid for channel A + B, B, TRIG VIEW, C, C + D and D. For channel A the situation is different because of the provision that channel A must also appear on the screen if no switch of S27 is depressed (see operating section). If none of the channels is selected all the inputs of NAND gate D1601 are at logic high and as a result output 13 is then low. This low level is applied to the reset input of flip-flop channel A via the NAND gates D1608/1, 2, 3 and D1617/8, 9, 10. As a result the reset input of the A-flip-flop is L (not activated), although the channel A contact of S27 is open, producing a high level to input 2 of D1608. This high level can only reach the reset input of flip-flop A if one of the other channels is selected thus causing output pin 13 of D1601 to become H. In this way, channel A is always switched into circuit unless one of the other channels is selected.

In the foregoing description, there is no explanation of what is happening if more than one channel is selected.

The detection of the multi-channel is achieved by means of inverter D1622/5, 6 combined with voltage divider R1611 and the resistors R1612.... R1619 that are switched in the circuit by means of contacts of S27. With more than one channel selected the level on input 5 of D1622 is detected as being L. With one channel or no channel selected the detected level is H.

If more than one channel is selected output 10 of OR gate D1607 is H. This high level is applied to pin 13 of AND gate D1606. Together with a high level on pin 12 of D1606, this produces a high level on output pin 11 to switch on the chopper oscillator. This oscillator consists of D1617/12, 13, 11, D1617/5, 6, 4 and the associated RC feedback loops. The high level on pin 12 of D1606 is derived from OR gate D1607/12, 13, 11 if either the chopped mode is selected by means of S28 or the external X deflection mode is selected by means of S8. In the external X-deflection mode the display always functions in the chopped mode if more than one channel is selected.

The output square-wave signal of the chopper oscillator is available on pin 4 of D1617 and is routed via pin 1 and 15 of electronic switch D1626 to the clock inputs of the flip-flops that switch the vertical channels.

The display blanking is achieved by the circuit consisting of transistor V1601 and its associated components. The chopper blanking pulses are applied by means of a coaxial cable to R2002 on the Z-amplifier (unit 11).

If the alternate mode is selected by means of S28, the alternate pulse, which is present on D1628, pin 1, is routed via pins 2 and 15 of electronic switch D1626 to the clock inputs of the channel flip-flops. The alternate pulse originates from the horizontal display mode logic that will be explained later on.

If for example channel A, B, C and D are selected by means of S27 the following sequence occurs: flip-flop A is already set and all the other flip-flops are reset. Thus channel A is switched on. In multi-channel operation clock pulses are applied to the clock inputs (pin 3 or 11) of the vertical channel flip-flops.

At the positive-going slope of the first clock pulse the set condition "jumps" from flip-flop A to flip-flop B. This occurs because the information on the output of the A flip-flop (D1609/2) is routed via D1608/12, 13, 11, D1608/5, 6, 4 and D1612/1, 2, 3 to the data input of the B flip-flop (D1613/5). Note that flip-flop A + B is skipped, because the A + B function was not selected. The row of 12 NAND gates D1608, D1612, D1614 and D1617, indicated as "flip-flop interconnection" provides the interconnection between the channel flip-flops depending on the selected channels on S27.

At the positive-going slope of the second clock-pulse the set condition "jumps" from flip-flop B to flip-flop C via NAND gates of the "flip-flop interconnection". Similarly at the positive-going slope of the third clock-pulse the set condition jumps from flip-flop C to flip-flop D via NAND gates of the "flip-flop interconnection".

After this the set condition must "jump" from flip-flop D to flip-flop A so that the cycle can start again. This function is not achieved by the "flip-flop interconnection" circuit but by the gates that form the so-called "watchdog" circuit.

The "watchdog" output (D1602/4) applies a low level to the D-input of the A-flip-flop or if A is not selected, to the D-input of the first selected flip-flop in the row) as long as a certain channel is on, and following its associated channel flip-flop, other channels are selected on S27.

As soon as the last selected flip-flop in the row is set a high level becomes present on the output of the "watchdog" circuit, so that the first selected flip-flop in the row can assume its set condition.

Normally only one flip-flop in the row is set at a time and the other are reset. However if for instance due to interference more flip-flops in the row are set at a time this fault condition must be eliminated. The characteristics of the watchdog are such that this type of error is corrected (at the end of a cycle). Also the error condition whereby no flip-flop is set is eliminated by the "watchdog" circuit.

If in the row of flip-flops no flip-flop is set then all the channels are switched off. This has the result that the inputs of NOR gate D1631 are all L; thus its output is H. This high level is applied to input 8 of D1607 and as a result the clock-pulses for the channel flip-flops are switched on. These clock-pulses can be alternate or chopped pulses, depending on the position of S28, and they are also present if only

one channel is selected. The clockpulses are necessary to get the desired flip-flop into the set condition. If this flip-flop is set the relevant channel is switched on and an input of NOR gate D1631 is made H. Therefore output 13 becomes L and thus input 8 of D1607 becomes L. The clock-pulses can now only occur if more than one channel is selected by means of a high level on pin 9 of D1607.

3.6.3. Main time base composite trigger logic

The desired trigger function can be selected by means of front-panel pushbutton switch S30. The positions of S30 are decoded in NAND gate D701 on the trigger source (unit 16). In contrast to the LOCMOS devices on unit 22 D701 is a TTL device. The detected S30 positions are applied to the logic on unit 22.

If one of the vertical channels A, B, C or D is selected as a trigger source a high logic level from D701/11 on unit 16 is applied to the control inputs of the electronic switches; so D1626/11 and D1624/9, 10, 11 are H and the switches are in the opposite state to that shown in the diagram.

If channel A is selected or if not any pushbutton on S30 is depressed a high level is routed via pin 13 and 14 of electronic switch D1626.

If pin 9 of D1623 is H the H level on output pin 14 of D1626 is inverted; consequently a low level is available on D1623/10. This low level is applied to the main time-base trigger control via channel A on unit 12 and permits triggering on channel A.

If the external trigger input or line triggering is selected triggering on channel A is prevented by a L level on D1623/9. This L level is initiated by D701/9, 10, 8 and inverter D1622/3, 4.

If channel B, C or D is selected a H level from the related S30 switch section is routed to the associated electronic switch in D1624. Because of inversion a L level switches via an output buffer channel B, C or D as main time-base trigger source.

If the external trigger input or line triggering is selected a H level from D701/8 on unit 16 is routed to D1624/6 (the control input) to block the triggering on channel B, C or D.

In the composite trigger mode the electronic switches occupy the positions drawn in the diagram because of a L level on the control inputs.

If channel A or TRIG VIEW or A + B is on, one of the inputs of NAND gate D1619/1, 2, 8, 9 is L and as a result the output (pin 9) is H.

This H level is routed via pins 12 and 14 of D1626, D1623/8, 9, 10 (inversion) and output buffer D1633/7, 6 and switches through channel A as trigger source. Thus in composite mode triggering on channel A occurs if channel A or function A + B or TRIG VIEW is switched on by the vertical logic.

If channel B is switched on pin 2 of electronic switch D1624 is L. This signal is routed via pin 15 to buffer D1633/5, 4 and channel B is switched through as trigger source.

If channel C or function C + D is switched on one of the inputs of NAND gate D1621/8, 9, 10 is L and as a result the output (pin 10) is H.

This H level is routed via pin 12 and 14 of D1624, D1621/13, 11 (inversion) and output buffer D1632/7, 6 to switch channel B on as a trigger source. Thus in composite trigger mode triggering on channel C occurs if channel C or function C + D is switched on by the vertical logic.

If channel D is switched on pin 5 of electronic switch D1624 is L. In this way channel D is switched on as a trigger source via buffer D1632/11, 12.

3.6.4. Horizontal display mode logic

The horizontal display mode logic circuit basically comprises:

- the 10 to 1 decoder D1627, which detects the horizontal display function selected by front-panel switches S8 and S1 (DTB off), and routes the information via various logic gates to,

- the flip-flop D1618, which switches the main time-base via output (pin 13) and the delayed time-base via inverted output (pin 12) to,
- output buffers D1632 for MTB, DTB and trace separation outputs.
- electronic switches D1626, which route the alternate pulses from the time-bases to the vertical display mode logic.
- transistor V1602, which switches EXT X DEFL signals to the X-amplifier.

The logic states are now described for the various horizontal display function possibilities.

Delayed time-base: output 14 of the 10 to 1 decoder is at logic H. Reset input (pin 10) of D1618 is H and via NOR gate D1629/5, 6, 4 the set input (pin 8) of D1618 is L.

The result is that the flip-flop occupies the reset condition: inverting output pin 12 is H, which switches the delayed time-base sawtooth via output buffer D1632/14, 15 to the final X-amplifier input.

The output pin 13 of D1618 is L, which blocks the main time-base sawtooth via output buffer D1632/3, 2, R1512 on unit 8.

Main time-base: output 14 of the 10 to 1 decoder is L. Reset input (pin 10) of D1618 is L and via NOR gate D1629/5, 6, 4 the set input (pin 8) of D1618 is H. The flip-flop now occupies the set position with the result that the high output on pin 13 via output buffer D1632/3, 2 and R1512 allows the main time-base sawtooth to switch to the input of the final X-amplifier. The delayed time-base sawtooth is blocked (output 12 of D1618 is low).

Both in the delayed time-base and main time-base mode the alternate pulses derived from V903 on the time-base (unit 8) are routed via D1626 pin 5 and 4 to the vertical display mode logic.

For ease of operation, if the delayed time-base is selected and the delayed time-base TIME/DIV switch occupies the "off" position (contact S1 closed) the logic automatically ensures that the main time-base operates.

Alternate time-base: in this mode, both the set input (pin 8) and the reset input (pin 10) are L and not active. Now the data input (pin 9) and the clock input (pin 11) are significant. The data input receives via D1629/12, 13, 11 alternate pulses from V903 on the time base.

The data input of D1618 is connected with the inverting output (pin 12): the result is that D1618 functions as a divide-by-two-stage for the alternate pulses so that main and delayed time-base are alternately initiating the X-deflection.

The trace separation control signal is derived from D1618/12 and applied to R632 on the time-base unit via AND gate D1606/8, 9, 10 and output buffer D1632/5, 4. This control signal is H if the delayed time-base is initiating the X-deflection.

In the alternate time-base mode, electronic switch D1626/3, 5, 9, 4 occupies the opposite position to the one drawn in the diagram. The alternate pulses are divided by two by D1618 and are then applied via pin 3 and 4 of D1626 to the vertical logic.

If TRIG VIEW is selected the alternate time-base mode is interrupted and only the main time-base initiates the X-deflection. This happens because the selection of TRIG VIEW makes D1628/13 L.

If the EXT X DEFL pushbutton of S30 is selected the 10 to 1 decoder makes pin 10 of D1628 H. The X-deflection signal is switched to the X-amplifier input because transistor V1602 is conductive now. This transistor also switches the stage on the trigger source (unit 16) that gives variable horizontal gain in the external X-deflection mode.

The H level on pin 10 of D1628 starts the chopper oscillator.

3.7. CATHODE-RAY TUBE CIRCUIT

3.7.1. Introduction and survey of CRT controls

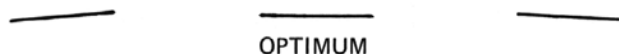
The cathode-ray tube circuit comprises the C.R.T. itself and the brightness, focus, astigmatism, geometry and trace rotation controls and the beam blanking amplifier.

By means of the INTENS potentiometer R22, the brightness of the display can be continuously controlled. The display can be focused by means of the FOCUS potentiometer R23. Both INTENS and FOCUS controls are front panel controls.

Furthermore the C.R.T. circuit comprises preset potentiometers for trace rotation, astigmatism and geometry.

The FOCUS control R23 forms a part of a voltage divider network across the 2 kV output of the power supply.

TRACE ROTATION is achieved by means of the trace rotation coil. This coil mounted inside the mu-metal screen, provides a magnetic field for rotational control of the entire scan. The degree and direction of rotation is determined by the setting of the screw-driver adjustment point R26, that is accessible via a ventilation hole in the left-hand side of the instrument. The slider of R26 is connected to the bases of the complementary transistors V2043 and V2044. The trace rotation coil is supplied by these transistors.



With the ASTIGMATISM control R2037, the form of the spot can be adjusted by influencing the voltage on grid G4.

With the GEOMETRY control R2039 the barrel and pin-cushion distortion is corrected by influencing the voltage on the grid G6.



3.7.2. Z unit and Focus unit

In these units, the controls for the following c.r.t. grids are located:

- G1 Wehnelt cylinder controlled between -2200 V and -2300 V
- G2 Screen grid at earth potential
- G3 Focusing grid, at approximately -1000 V ... -1100 V
- G4 Astigmatism grid at $\pm 30\text{ V}$ (adjustable from -60 V to $+60\text{ V}$).

Focus and modulation

To maintain a well-focused spot, independent of the beam current, the voltage pulse is applied to the focusing grid G3. This pulse is in antiphase with, and has an amplitude of approximately 60% of the Z pulse on G1. The phase shift is achieved by differential stage V2006, V2011. This stage is followed by individual driver stages for G1 and G3.

The AC pulse is applied to grids G1 and G3 via capacitors C2017 and C2018 respectively.

The DC transfer is obtained by means of a modulator comprising V2033, V2034 and V2036, driven via R2064 and R2067, and a demodulator working at e.h.t. level. The oscillator pulses are transferred via C2038 and C2039 to be demodulated by diodes V2038 and V2039 (positive components) and by diodes V2041 and V2042 (negative components). The AC and DC paths of G3 are equalised by the voltage divider R2083, R2084.

Z-unit

The Z-amplifier has the following inputs:

- via the INTENS potentiometer R22.
- the external input socket X9 (Z MOD).
- two signals originating in the main and delayed time-base are supplied to the amplifier to unblank the trace during the sweeps.
- the chopper blanking pulse to blank the trace during switching from channel to channel in the chopped mode.

The bright-up pulse of the main and delayed time-base is obtained in a similar way. In the main time-base, the pulse that switches V907 is also used for switching on and off transistor V903 and diode V904. Diode V904 is conductive when the time-base is running and in that case consumes about 3 mA from the switching unit. When V904 is blocked (during the hold-off time) a current (Z-pulse) flows via V902 to R1542 in the Z-unit. This current is consumed by V904 when this diode is conductive.

The same conditions apply to the delayed time-base. When the position DEL'D TB is selected, transistor V1527 on the switching unit is turned off and resistor R1539 feeds 3 mA into the Z-amplifier unit, which during the delayed time-base sweep is consumed via R1534 by V1307.

The sequence is as follows:

- start MTB, start DTB; less than 3 mA = half intensity.
- then start DTB; end of DTB; 0 mA = brilliance (bright-up pulse)
- then end DTB, end MTB; less than 3 mA = half intensity.
- end MTB, start MTB; more than 3 mA = blanked pulse.

During the hold-off period, 3 mA is applied via V1528. The trace is then blanked regardless of any other control signals. This applies to the chopper blanking circuit, which supplies current pulses of 3 mA, via R1608/R1609 on the logic unit into R2002 on the Z-amplifier. Resistor R2001 also supplies 3 mA, which can be bypassed by transistor V2003 as determined by the position of the INTENS potentiometer R22. This provides a continuous control of the trace brilliance. Finally, the external input pulse may take over the current of transistor V2003 via V2002, independent of the set brilliance. As a result of the current flowing through R2001, the c.r.t. is blanked. The sensitivity of the external Z-input is adapted to suit TTL logic. Logic "1" provides blanking; logic "0" is ineffective.

CRT cathode regulation

To prevent sensitivity variations of the c.r.t., the cathode voltage is regulated. Variations of the a.c. supply voltage are applied via C2028 to an amplifier consisting of V2026, V2024 and V2023; d.c. variations are applied via R2051. The collector voltage of V2023 compensates for the voltage variations of the power supply and the rectifier. Consequently, the cathode voltage remains independent of the cathode current.

3.7.3. Graticule illumination circuit

The graticule of the C.R.T. can be illuminated by means of the bulbs E1 and E2. The intensity can be varied with the aid of ILLUM potentiometer R21 which controls the collector current (i.e. the current through the bulbs) of transistor V2046. The illumination circuit is not short-circuit proof.

3.7.4. Calibration voltage and current generator

The calibration unit is a square-wave generator consisting of an operational amplifier D1901 with feedback. The oscillator frequency is determined by resistor R1909 and capacitor C1903. Capacitor C1902 keeps point 3 of the IC constantly equal to the average output voltage. Consequently, the generator is independent of fluctuations in the supply voltage. The square-wave amplitude is determined by zener diode V1901.

Potentiometer R1906 allows accurate adjustment of the output voltage and output current.

This output voltage is fed to socket X1 and the output current flows through current loop X2. This is the front panel CAL terminal.

The calibrator output signal can be used for probe compensation and/or checking the vertical deflection accuracy.

3.8. POWER SUPPLY

3.8.1. Input circuit

The power supply input circuit is matched to the 115V or 230 V range with selector-switch S33 which is located at the power supply unit at the rear side.

The mains voltage is rectified with the diode bridge V1801 and C1802, C1803, which form a voltage doubler in the 115V position of S33, and a standard bridge rectifier circuit in the 230V position of S1801.

The voltage across the series circuit of C1802 and C1803 is 250V to 400V for both mains voltage ranges.

3.8.2. Switching circuit

The unregulated DC voltage is applied in the form of pulses to a resonance circuit consisting of the primary coil of the convertor transformer T1801, combined with C1807 and C1808, via switching transistor V1806. The sine-wave voltage (approx. 800Vp-p) across the primary coil of T1801 is kept constant by regulating the duty cycle of the base current of V1806.

The primary coil of L1806 which is in series with the switching transistor, limits the current through this transistor.

The energy stored in L1806 is fed-back to the mains rectifier circuit, during the cut-off time of V1806, via diode V1811.

V1808 and V1809 eliminate the dissipation during the switching period from transistor V1806; instead of this, these losses are dissipated in R1814 and R1816.

V1807 improves the base drive for V1806.

3.8.3. Regulator circuit

The regulator circuit itself consists of integrated circuit D1801 (type TDA 1060), the output (p. 15) of which supplies a square wave current with variable duty-cycle to the base of V1812.

The collector signal of V1812 is applied to the switching transistor via transformer L1803.

The regulator circuit is controlled by:

- Feed back voltage (p. 3)
This is the regulator control voltage and is taken from the rectifier circuit in the feedback winding of T1801.
This control voltage depends on the setting of R1826 (V out).
- Over-voltage protection (p. 13)
This voltage is also derived from the mains voltage and inhibits the regulator output at too high mains voltages (the trip-level on p. 13 is 600 mV).
- Current limit (p. 11)
The voltage drop across the current-sense resistor R1811 controls the regulator circuit in case of overload.
- Frequency (p. 7)
The resistance between p. 7 and ground determines the convertor frequency.
R1827 (Freq.) has been adjusted to obtain a frequency of 20 kHz.
The resonance frequency of C1807, 1808 and the primary coil of T1801 is wide enough to tolerate this.

Under normal working conditions the power supply voltages for the regulator circuit are delivered by the rectifier connected to the feedback winding of T1801.

V1804 is then conducting so that V1803 does not deliver current.

3.8.4. Switching-on and switching-on protection

When switching on the instrument, no supply voltages are available in the regulator circuit, from T1801. At this moment V1804 is not conducting, so that V1803 is fully conducting, and the regulator circuit gets current via R1804 and R1806.

As soon as the converter circuit is working V1804 becomes conducting and V1803 goes non-conducting.

If the instrument is switched-on and no convertor voltage would appear (due to possible defect) the PTC resistor R1806 will warm up, reducing the current through V1803 to a safe low value.

3.8.5. Output circuits

The output rectifiers are of the coil-input types delivering the mean value of the sine-wave transformer voltage across the output capacitor. Apart from the d.c. voltage the converter transformer delivers also:

- 6,3 V for the c.r.t. heater
- 0–1 kV –1,5 kV for the focus and high tension circuits
- 120 V for the additional power supply unit (not used in the PM3264).

3.8.6. Photocoupler circuit

This circuit delivers a sine-wave voltage (derived from the mains voltage) used for mains triggering or mains deflection.

The photo-coupler V1842 which provides isolation between the mains voltage and the oscilloscope circuits drives the V1843-circuit in saturation, so that the square-wave voltage at the collector of V1843 has the same value for all mains voltages.

With an integration network R1851, 1852, 1853 and C1836, 1837, 1838 the original sine-wave is obtained. Via V1844 and V1846 this signal is applied to the trigger selector (R730) via capacitor C1839.

4. Dismantling the instrument

4.1. WARNING

The opening of covers or removal of parts, except those of 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 skilled 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.

4.2. REMOVING THE COVERS AND SCREEN BEZEL

Both upper and lower cabinet plate can be removed after slackening one or two turns the four quick-release fasteners at the corners of each plate. Do not slacken the fasteners more than two turns, otherwise they may come apart.

The screen bezel can be detached by pressing the longer edges and pulling it out the front panel.

4.3. ACCESS TO PARTS NECESSARY FOR CHECKING AND ADJUSTING

Most of the adjustment points can be reached after removal of the top and bottom covers of the instrument (see section 4.2.).

However at the bottom side the Z-amplifier (unit 11), focus unit (unit 7) and EHT multiplier (unit 15) are covered by a black metal screening plate. This plate is provided with holes that align with adjustment points on the Z-amplifier and the output voltage adjustment point of the power supply (R1826/unit 5).

For adjustment, always use an *insulated adjustment tool*.

If it is necessary to reach resistors on the Z-amplifier for measuring or adjustment purposes, the screening plate can be removed after slackening four screws.

Warning: note that after removal of this cover parts are accessible that carry dangerously high voltages.

5. Checking and adjusting

NOTE: Before starting with the "adjusting procedure" check the specification of the instrument by means of the "performance check" on page 193

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 skilled 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

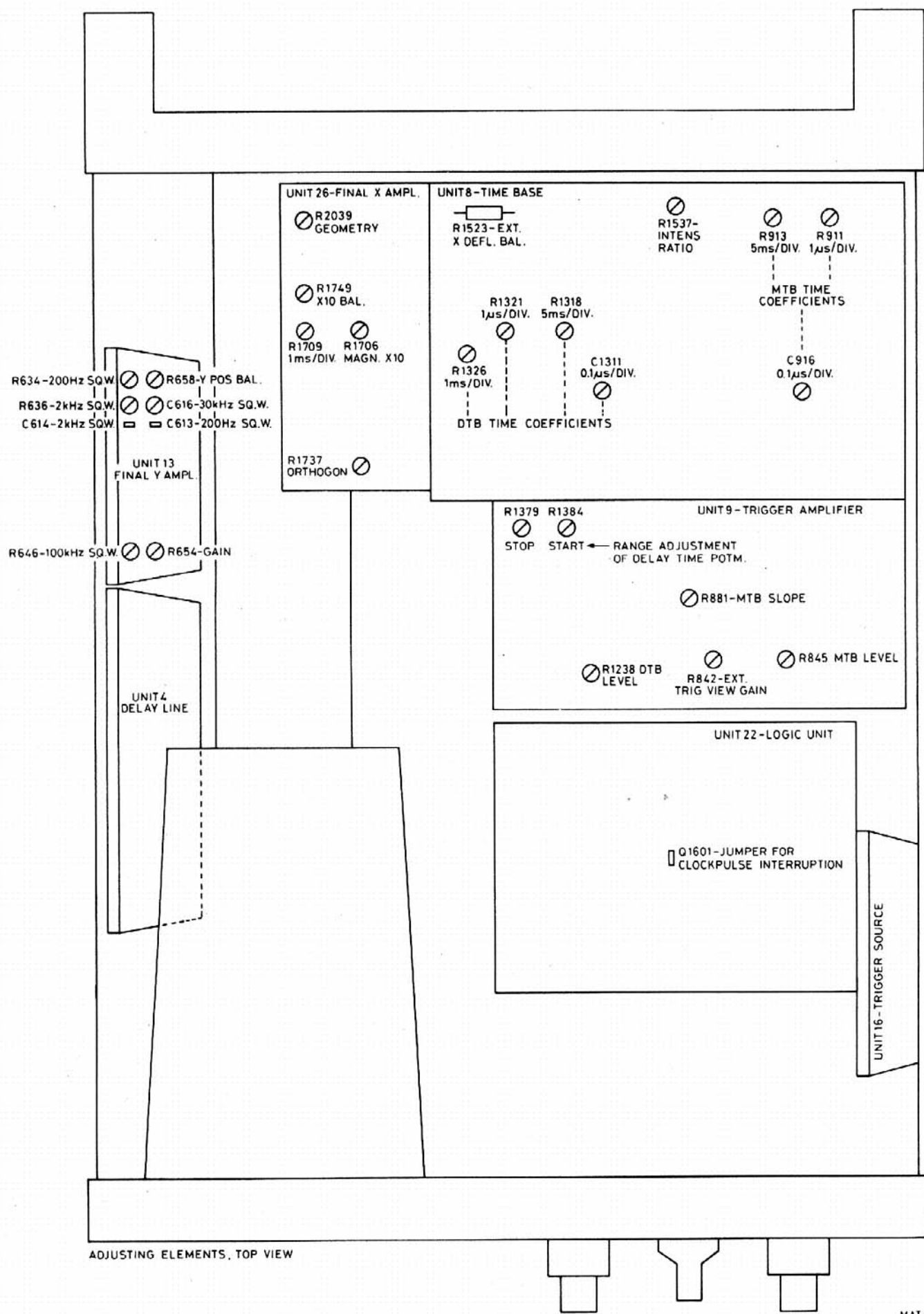
5.1.1. Introduction

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 that is best suited to this order.

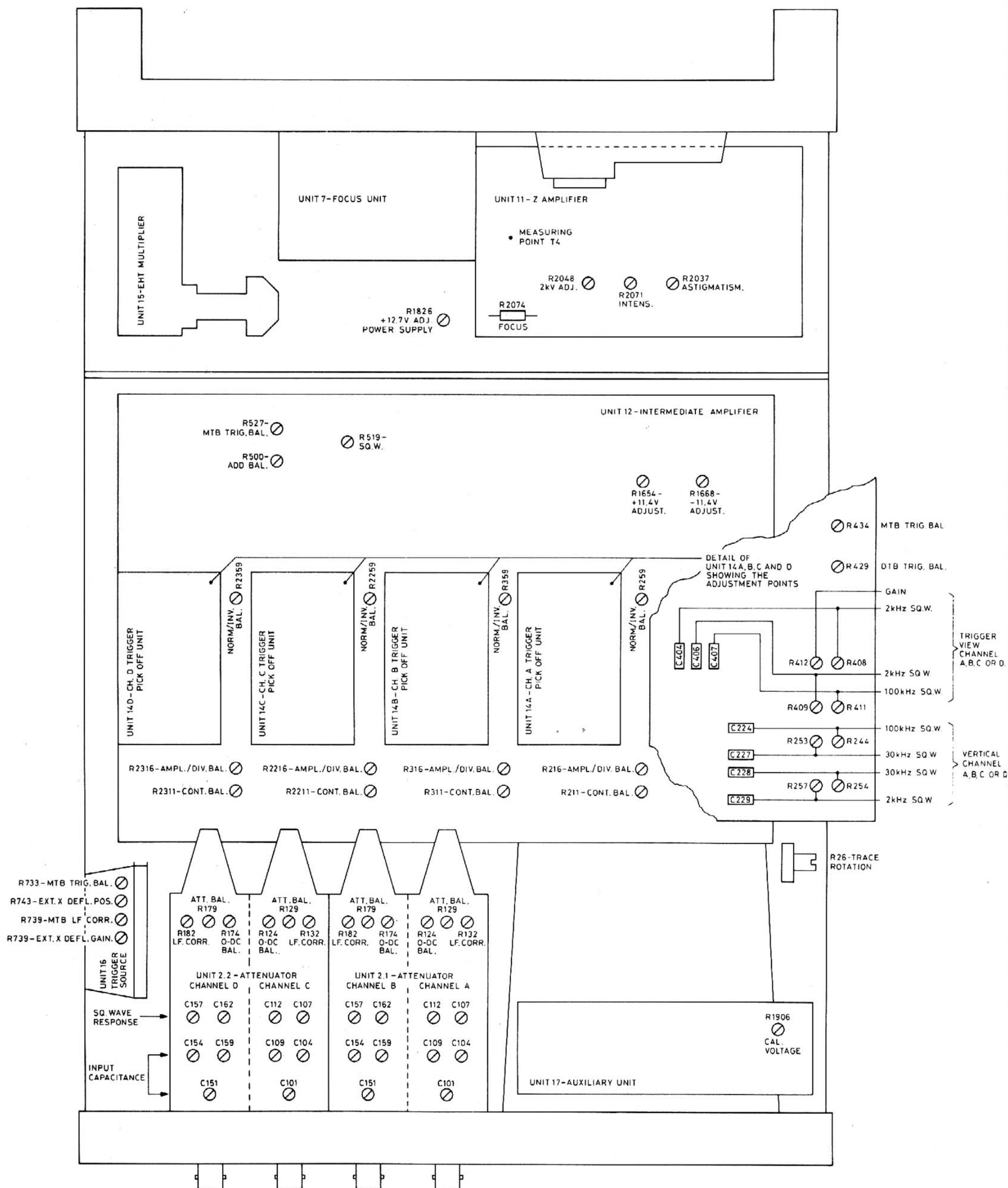
Before any check or adjustment, the instrument must attain its normal operating temperature.

- Where possible, instrument performance is checked before an adjustment is made.
- Warming-up time under average conditions is 30 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 section 1.2. 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, Astigmatism, Focus, and Trigger Level controls as needed.



ADJUSTING ELEMENTS, TOP VIEW

Figure 5.1. Adjusting elements, top view



ADJUSTING ELEMENTS, BOTTOM VIEW.

MAT 683

Figure 5.2. Adjusting elements, bottom view

5.1.2. Recommended test equipment

Required instrument	Specification	Example of required instrument
Function generator	Freq.: 1Hz ... 10MHz, 0 ... 30V p.p. DC offset 0 ... $\pm 10V$. Sine-wave and square-wave. Rise-time < 30ns. Duty cycle 50%	Philips PM5167
Constant amplitude sine-wave generator	Freq.: 50kHz + 250kHz ... 100MHz, 10mV ... 3Vp.p.	Tektronix SG503
Square-wave calibration generator	Freq.: 100Hz ... 1MHz Ampl.: 10mV ... 50Vp.p. Rise-time < 1ns. Duty cycle 50%	Tektronix PG506
Time marker generator	Repetition rate 1 sec ... 0,0 μ s	Tektronix TG501.
Variable mains transformer	90 ... 264VAC. Isolated output voltage. Output power ≥ 60 Watt.	Philips ordering number 2422 529 00005
Wattmeter	≥ 60 Watt.	—
Dummy probe 2 : 1	1M Ω $\pm 0,1\%$ // 15pF.	See fig. 5.6.
Cables, T-piece, termination resistors for the generators.	Good quality BNC types	—
Low capacitance trimming tools	—	Philips 800NTX
Digital multimeter	Wide voltage current and resistance ranges.	Philips PM2527
Oscilloscope	100MHz	Philips PM3262.

5.1.3. Preliminary settings of all the controls

All preset potentiometers and trimming capacitors are indicated on the drawings of the printed-wiring board, see the figures

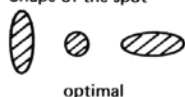
- Push the Y POSITION controls to the depressed position
- Set the switches of the channel A, B, C and D signal coupling controls to DC
- Set the DELAY TIME control (R3) to 0 (fully anti-clockwise)
- Depress push-button MAIN TB of the X-deflection controls (S8)
- Push the TB MAGN control to position X1.
- Depress push-button AUTO of the trigger mode controls
- Set the MAIN TIME/DIV switch to 1 ms
- Set the DEL'D TIME/DIV switch to OFF
- Set the TIME/DIV vernier controls to CAL
- Depress push-buttons A of the trigger-source controls (S29, S30)
- Select the DC trigger coupling mode (R25/R24/S32 depressed)

TRIGGER
VIEW
CHANNEL
A, B, C OR D

VERTICAL
CHANNEL
A, B, C OR D

5.2. SURVEY OF ADJUSTING ELEMENTS AND AUXILIARY EQUIPMENT

The adjusting elements are indicated in fig. 5.1. and 5.2. for respectively top and bottom view of the instrument

Adjustment and adjustment sequence	Adjusting element	Measuring values and explanation	Measuring instrument	Chapter	Figures
Power supply					
Power consumption	—	50 Watt	Moving-iron meter	5.3.1.1.	—
+12,7 V supply voltage	R1826/unit 5	+12,7 V $\pm$ 100 mV	Digital multimeter	5.3.1.2.	5.2
Oscillator frequency	R1827/unit 5	+12,7 V $\pm$ 100 mV	Digital multimeter	5.3.1.3.	5.2
Supply voltages unit 12	R1654/unit 12	+11,4 V $\pm$ 50 mV	Digital multimeter	5.3.1.4.	5.2
	R1668/unit 12	-11,4 V $\pm$ 50 mV	Digital multimeter	5.3.1.4.	5.2
Cathode voltage	R2048/unit 11	150 V $\pm$ 3 V	Digital multimeter	5.3.1.5.	5.2
Calibration voltage/current					
CAL voltage	R1906/unit 17	3 V $\pm$ 1%	Oscilloscope	5.3.2.	5.2
CAL frequency	—	2 kHz $\pm$ 2%	Oscilloscope	5.3.2.	5.2
CRT circuit					
Astigmatism	R2037/unit 11	Shape of the spot 	—	5.3.3.1	5.2
Focus	R2074/unit 11	Mid position of focus potentiometer.	Sine-wave generator	5.3.3.1	5.2
Trace rotation	R26/left side panel	Horizontal trace 	—	5.3.3.2.	5.2
Orthogonality	R1737/unit 26	Barrel and pin cushion distortion 	Sine-wave generator	5.3.3.3.	5.1/5.3
Geometry	R2039/unit 26		Sine-wave generator	5.3.3.4.	5.1/5.4
Intensity	R2071/unit 11	Barely visible dot at the beginning of the trace	—	5.3.3.5.	5.2.
	R2012/unit 11	20 mV across R2087	Digital voltmeter	5.3.3.5.	5.2.
Intensity ratio	R1537/unit 8	Barely visible MTB trace and DTB intensified part more brilliant	Sine-wave generator	5.3.3.6.	5.1./5.5.
Balance adjustments					
0-DC balance	R124/Ch.A/unit 2.1 R174/Ch.B/unit 2.1 R124/Ch.C/unit 2.2 R174/Ch.D/unit 2.2	Minimum trace jump when switching 0-DC	—	5.3.4.2.	5.2.
Attenuator AMPL/DIV balance	R129/Ch.A/unit 2.1 R179/Ch.B/unit 2.1 R129/Ch.C/unit 2.2 R179/Ch.D/unit 2.2	Minimum trace jump when switching between 5 V/DIV 5 mV/DIV	—	5.3.4.3.	5.2.
Continue balance	R211/Ch.A/unit 12 R311/Ch.B/unit 12 R2211/Ch.C/unit 12 R2311/Ch.D/unit 12	Minimum trace shift when rotating the continuous control	—	5.3.4.4.	5.2.
Balance AMPL/DIV 2 mV/5 mV	R216/Ch.A/unit 12 R316/Ch.B/unit 12 R2216/Ch.C/unit 12 R2316/Ch.D/unit 12	Minimum trace jump when switching between 5 mV/DIV 2 mV/DIV	—	5.3.4.5.	5.2.
Normal/invert balance	R259/Ch.A/unit 12 R359/Ch.B/unit 12 R2259/Ch.C/unit 12 R2359/Ch.D/unit 12	Minimum trace jump when switching normal/invert	—	5.3.4.6.	5.2.

Adjustment and adjustment sequence	Adjusting element	Measuring values and explanation	Measuring instrument	Chapter	Figures
Trigger balance MTB	R733/unit 16 R434A/Ch.A/unit 14A R434B/Ch.B/unit 14B R434C/Ch.C/unit 14C R434D/Ch.D/unit 14D R527/unit 12	Trigger view trace must remain in the screen centre	—	5.3.4.7.	5.2.
Trigger balance DTB	R1238/unit 9 R429A/Ch.A/unit 14A R429B/Ch.B/unit 14B R429C/Ch.C/unit 14C R429D/Ch.D/unit 14D	DTB level adjustment	Sine-wave generator	5.3.4.7.	5.2.
Y-position correction	R658/unit 13	Trace exactly in centre of screen	—	5.3.4.8.	5.1.
	R500/unit 12	Trace exactly in centre of screen	—	5.3.4.9.	5.2.
	R500/unit 12	Minimum trace jump when switching from ALT to A+B	—	5.3.4.9.	5.2.
Time-base MAGN X10 balance	R1749/unit 26	No movement of starting point of trace when switching between X1 and X10	—	5.3.4.10	5.1.
Time base generators					
MTB time-coefficients	R1709/unit 26 R913/unit 8 R911/unit 8 R1706/unit 26 C916/unit 8	1 ms/DIV range 5 ms/DIV range 1 μ s/DIV range time base magnifier 0,1 μ s/DIV range	Time marker generator	5.3.5.1.	5.1.
DTB time-coefficients	R1326/unit 8 R1318/unit 8 R1321/unit 8 C1311/unit 8	1 ms/DIV range 5 ms/DIV range 1 μ s/DIV range 0,1 μ s/DIV range	Time marker generator	5.3.5.2.	5.1.
Delay time	R1384/unit 9 R1379/unit 9	start stop	Time marker generator	5.3.5.3.	5.1.
Alternate t.b. and trace sep.	R20/front panel	R20 fully counter-clockwise: distance between traces 0 DIV R20 fully clockwise: distance between traces 4 DIV	—	5.3.5.4.	—
LF corrections and sensitivities					
LF correction attenuator	R132/Ch.A/unit 2.1. R182/Ch.B/unit 2.1. R132/Ch.C/unit 2.2. R182/Ch.D/unit 2.2.	Check that the pulse top is straight	Sine-wave generator	5.3.6.1.	5.2.
LF correction MTB ext. input	R739/unit 16	Check that the pulse top is straight	Sine-wave generator	5.3.6.2.	5.2.
Gain Y _A VIA Y	R654/unit 13	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.3.	5.1.
Gain Y _B VIA Y	R13/front panel	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.4.	—
Gain Y _C VIA Y	R16/front panel	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.5.	—
Gain Y _D VIA Y	R17/front panel	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.6.	—
Gain at ext. X-deflection	R737/unit 16	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.7.	5.2.
Gain ext. trig. with trig. view	R842/unit 9	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.8.	5.1.
Gain Ch.A. trig. with trig. view	R412A/unit 14A	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.9.	5.2.
Gain Ch.B trig. with trig. view	R412B/unit 14B	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.10.	5.2.
Gain Ch.C. trig. with trig. view	R412C/unit 14C	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.11.	5.2.
Gain Ch.D trig. with trig. view	R412D/unit 14D	Adjust for 6 DIV trace height	Square-wave generator	5.3.6.12.	5.2.
Gain Y _A VIA X check	—	Check for 6 DIV ($\pm 0,6$ DIV) trace height	Square-wave generator	5.3.6.13.	—
Gain Y _B VIA X check	—	Check for 6 DIV ($\pm 0,6$ DIV) trace height	Square-wave generator	5.3.6.14	—

Adjustment and adjustment sequence	Adjusting element	Measuring values and explanation	Measuring instrument	Chapter	Figures
Gain Y_C VIA X check	—	Check for 6 DIV ($\pm 0,6$ DIV) trace height	Square-wave generator	5.3.6.15	—
Gain Y_D VIA X check	—	Check for 6 DIV ($\pm 0,6$ DIV) trace height	Square-wave generator	5.3.6.16.	—
Vertical channels					
Square-wave response attenuator units	C107/Ch.A/unit 2.1 C157/Ch.B/unit 2.1 C112/Ch.A/unit 2.1 C162/Ch.B/unit 2.1 C107/Ch.C/unit 2.2 C157/Ch.D/unit 2.2 C112/Ch.C/unit 2.2 C162/Ch.D/unit 2.2	Adjust for optimal square-wave response	Square-wave generator	5.3.7.1.	5.2.
Input capacitance attenuator units	C101/Ch.A/unit 2.1 C151/Ch.B/unit 2.1 C104/Ch.A/unit 2.1 C154/Ch.B/unit 2.1 C109/Ch.A/unit 2.1 C159/Ch.B/unit 2.1 C101/Ch.C/unit 2.2 C151/Ch.D/unit 2.2 C104/Ch.C/unit 2.2 C154/Ch.D/unit 2.2 C109/Ch.C/unit 2.2 C159/Ch.D/unit 2.2	Adjust for optimal square-wave response	Square-wave generator and 2:1 dummy probe	5.3.7.2.	5.2./5.6.
Square wave response final Y-amplifier	R634/unit 13 C613/unit 13 R636/unit 13 C614/unit 13	Adjust for optimal square-wave response	Square-wave generator	5.3.7.3.	5.1.
Square-wave response channel A and final Y-amplifier	R257A/unit 14A C229A/unit 14A C231A/unit 14A R254A/unit 14A R253A/unit 14A C228A/unit 14A C227A/unit 14A C224A/unit 14A R244A/unit 14A C233/unit 12 C616/unit 13 R646/unit 13	Adjust for optimal square-wave response	Square-wave generator	5.3.7.4.	5.1./5.2.
Square-wave response channel B	R257B/unit 14B C229B/unit 14B C231B/unit 14B R254B/unit 14B R253B/unit 14B C228B/unit 14B C227B/unit 14B C224B/unit 14B R244B/unit 14B C333/unit 12	Adjust for optimal square-wave response	Square-wave generator	5.3.7.5.	5.2.
Square-wave response channel C	R257C/unit 14C C229C/unit 14C C231C/unit 14C R254C/unit 14C R253C/unit 14C C228C/unit 14C C227C/unit 14C C224C/unit 14C R244C/unit 14C C2233/unit 12	Adjust for optimal square-wave response	Square-wave generator	5.3.7.6.	5.2.

Adjustment and adjustment sequence	Adjusting element	Measuring values and explanation	Measuring instrument	Chapter	Figures
Square-wave response channel D	R257D/unit 14D C229D/unit 14D C231D/unit 14D R254D/unit 14D R253D/unit 14D C228D/unit 14D C227D/unit 14D C224D/unit 14D R244D/unit 14D C233D/unit 12	Adjust for optimal square-wave response	Square-wave generator	5.3.7.7.	5.2.
Bandwidth check ch. A,B,C,D	—	35 MHz at 2 mV/DIV and 100 Mhz at other AMPL/DIV positions	Sine-wave generator	5.3.7.8.	—
Common mode rejection A+B and C+D	—	Check according to table	Sine-wave generator	5.3.7.9./ 5.3.7.10.	—
Dynamic range and position range	—	Check for distortion	Sine-wave generator	5.3.7.11	—
Chopped display mode check	—	Check chopped function	—	5.3.7.12.	—
Alternate display mode	—	Check alternate function	—	5.3.7.13.	—
Square-wave response trig. view via external trigger input	C818/C819 (unit 9)	Adjust for optimal square-wave response	Square-wave generator	5.3.7.14.	5.1.
Square-wave response trig. view via channel A	R408A/C404A/unit 14A R409A/C406A/unit 14A R411A/C407A/unit 14A	Adjust for optimal square-wave response	Square-wave generator	5.3.7.15.	5.2.
Square-wave response trig. view via channel B	R408B/C404B/unit 14B R409B/C406B/unit 14B R411B/C407B/unit 14B	Adjust for optimal square-wave response	Square-wave generator	5.3.7.16.	5.2.
Square-wave response trig. view via channel C	R408C/C404C/unit 14C R409C/C406C/unit 14C R411C/C407C/unit 14C	Adjust for optimal square-wave response	Square-wave generator	5.3.7.17.	5.2.
Square-wave response trig. view via channel D	R408D/C404D/unit 14D R409D/C406D/unit 14D R411D/C407D/unit 14D	Adjust for optimal square-wave response	Square-wave generator	5.3.7.18.	5.2.
Bandwidth check trigger view via channel A(B,C,D)	—	Check the bandwidth	Sine-wave generator	5.3.7.19.	—
Bandwidth check trigger view via external trigger input	—	Check the bandwidth	Sine-wave generator	5.3.7.20.	—
Triggering					
Trigger slope and level of main time base	R881/unit 9	Starting point of the trace may not change when operating the SLOPE switch	Sine-wave generator	5.3.8.1.	5.1.
	R845/unit 9	Check the LEVEL function	Sine-wave generator	5.3.8.1.	5.1.
Trigger sensitivities of main time-base	—	Check according to table	Sine-wave generator	5.3.8.2.	—
Single sweep operation check	—	Check single sweep function	Sine-wave generator	5.3.8.3.	—
Mains frequency triggering check	—	Check for a stable display	—	5.3.8.4.	—
Trigger slope and level of delayed time-base	—	Starting point of trace may not change when operating SLOPE switch	Sine-wave generator	5.3.8.5.	—
	R1238/unit 9	Check the LEVEL function	Sine-wave generator	5.3.8.5.	5.1.
Trigger sensitivities of delayed time-base	—	Check according to table	Sine-wave generator	5.3.8.6.	—

Adjustment and adjustment sequence	Adjusting element	Measuring values and explanation	Measuring instrument	Chapter	Figures
Delay time jitter	—	Check for a jitter free display	Square-wave generator	5.3.9.	—
Horizontal amplifier					
Bandwidth	—	Check bandwidth	Sine-wave generator	5.3.10.1.	—
Phase difference	—	Phase difference less than 3 degrees	Sine-wave generator	5.3.10.2.	5.7.
Periodic and random deviations					
		Check ripple	—	5.3.11.	—
		Check noise	—	5.3.11.	—
		Check microphony	—	5.3.11.	—
		Check for power supply converter interference	—	5.3.11.	—
		Check trace instability	—	5.3.11.	—
		Check parasitic Z-modulation	—	5.3.11.	—
Effect of mains voltage variations					
		Check instrument performance when varying mains voltage	Variable transformer	5.3.12.	—

WWW.JETECNET.COM

5.3. ADJUSTING PROCEDURE

The adjusting elements are indicated in fig. 5.1. and fig. 5.2. for respectively top and bottom of the instrument.

5.3.1. Power supply

5.3.1.1. Power consumption

- Check that the voltage has been set to the local mains voltage and connect the instrument to such a voltage
- Switch the oscilloscope on and check that the pilot lamp on the front panel lights up
- Check that the power consumption does not exceed 50W (measured with a moving-iron meter)

WARNING: Use an isolated adjustment tool when carrying out adjustments on the power supply.

5.3.1.2. +12,7V supply voltage

- Check at nominal mains voltage that the voltage on the positive pole of C1831 is $+12,7V \pm 100mV$; if necessary, readjust potentiometer R1826 on the power supply board.
- Check that this voltage does not vary more than $\pm 50mV$ when the mains voltage is varied between -10% and $+20\%$.

5.3.1.3. Pre-set potentiometer R1827 (FREQ.)

This potentiometer is a factory adjustment control. THE SETTING OF THIS POTENTIOMETER MUST NOT BE DISTURBED UNLESS IT IS ABSOLUTELY IMPOSSIBLE TO SET THE $+12,7V$ WITH THE AID OF POTENTIOMETER R1826.

Adjusting procedure:

- Set the mains input voltage to 220V
- Turn potentiometer R1827 fully anti-clockwise
- Check that the voltage on the positive pole of C1831 is $+12,7V \pm 100mV$; if necessary; readjust potentiometer R1826 on the power supply board.
- Set the mains input voltage to 170V
- Check that the voltage on the positive pole of C1831 is $+12,7V \pm 100mV$; if necessary readjust potentiometer R1827 on the power supply board.

5.3.1.4. Output voltages from additional stabilisation circuit on intermediate amplifier (unit 12) and time base (unit 8)

- Adjust potentiometer R1654 on unit 12 for a correct $+11,4V (\pm 50mV)$ across C1653.
- Adjust potentiometer R1668 on unit 12 for a correct $-11,4V (\pm 50mV)$ across C1664.
- Adjust potentiometer R1549 on unit 8 for a correct $+5,2V (\pm 100mV)$ across V1562/emitter.

5.3.1.5. Cathode voltage (unit 11)

- Check that the voltage on test point T4 (V2033/collector) on the **Z-amplifier board** is $150V \pm 3V$ with the INTENS control (R22) fully counterclockwise.
- If necessary readjust potentiometer **R2048** on the Z-amplifier board.
- The voltage on T4 must be adjustable between 0 and 300 Volt.

5.3.2. Calibration socket

If necessary, check the supply voltages first, refer to section 5.3.1.

- Check the calibration square wave on irregularities.
- Check that the amplitude of the CAL voltage is $3V \pm 1\%$; if necessary, readjust potentiometer **R1906** on the auxiliary unit (unit 17).
- Check that the frequency of the CAL voltage is $2\text{kHz} \pm 2\%$.
- Check that the CAL current is $6\text{mA} \pm 1\%$.

5.3.3. Cathode-ray tube circuit

5.3.3.1. Focus and astigmatism (unit 11)

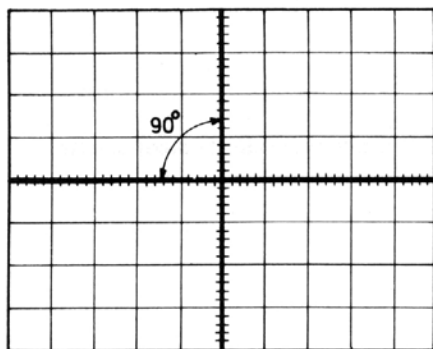
- Check that the controls occupy the positions indicated in section 5.1.3.
- Depress push-button A of the display-mode controls (S27).
- Apply a sine-wave signal at a frequency of 100 kHz to input A.
- Adjust the trace height to 6 DIV, using the AMPL switch and vernier.
- Set the MAIN TIME/DIV switch and the LEVEL control to such a position that several complete cycles are displayed.
- Set the INTENS potentiometer to normal brightness.
- Check that an evenly sharp trace can be obtained with the aid of the FOCUS potentiometer. If necessary, readjust potentiometer **R2037** on the **Z amplifier unit**. After this adjustment, the FOCUS potentiometer must be approximately in mid-position. If necessary, this may be corrected by selecting a different value for resistor **R2074** on the Z-amplifier unit.
- Increase the trace brightness using the INTENS potentiometer.
- Check that still a sharp trace may be obtained with the aid of the FOCUS potentiometer. If necessary, optimize with the aid of **R2037**.
- Remove the input signal.

5.3.3.2. Trace rotation

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X-deflection controls (S8).
- Centre the time-base line using the POSITION control
- Check that the time-base line runs exactly in parallel with the horizontal graticule lines; if necessary, readjust the TRACE ROT control R26, accessible via one of the ventilation holes in the left side of the instrument.

5.3.3.3. Orthogonality (unit 26)

- Select channel A and B on S27 and depress pushbutton ALT of S28.
- Depress pushbutton MAIN TB of the X-deflection controls (S8)
- Set the switch of the channel A signal-coupling control to 0.
- Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TB switch to $5\mu\text{s}$.
- Set the channel B AMPL switch to 5 mV/DIV and its vernier control to CAL.
- Apply a sine-wave voltage of 120mV, frequency 100kHz, to input B.
- Depress pushbutton B of the DTB trigger source controls (S29).
- Adjust the DTB LEVEL control for the triggering of the DTB.
- Centre the intensified part of the trace, using the DELAY TIME control (R3).
- Centre the channel A time-base line, using the channel A POSITION potentiometer.
- Check that the angle between the horizontal and vertical line is 90° , see fig. 5.3. If necessary, readjust **R1737** on the final X-amplifier unit.



MA 8858

Fig. 5.3. Orthogonality check.

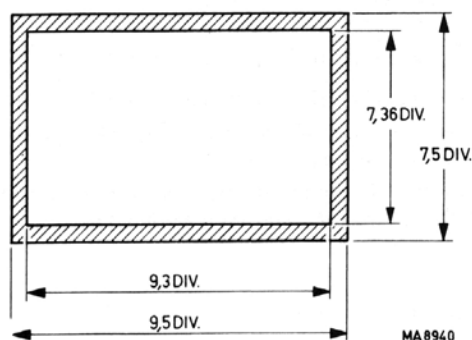


Fig. 5.4. Geometry check.

5.3.3.4. Geometry (= barrel and pin cushion distortion) (unit 26)

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X-deflection controls (S8).
- Apply a sine-wave voltage at a frequency of approx. 100kHz to the channel A input socket.
- Set the channel A signal coupling control to DC.
- Set the AMPL./DIV. control of channel A for a trace height of 7,4 DIV.
- Apply a sine-wave voltage at a frequency of approx. 50Hz to the channel B input socket.
- Depress pushbutton EXT X DEFL of the X-deflection controls (S8).
- Depress pushbutton B of the main time-base trigger-source controls (S30).
- Set the channel B AMPL switch and vernier control to obtain a display width of 9,4 DIV.
- Check that the edges of the display lie within the hatched area shown in fig. 5.4., if necessary, readjust potentiometer R2039 on the final X-amplifier unit.
- Remove the input signals.

5.3.3.5. Intensity (unit 11)

- Depress pushbutton A of the display-mode controls (S27).
 - Depress pushbutton DEL'D TB of the X-deflection controls (S8).
 - Turn the INTENS potentiometer clockwise (R22).
 - Set the MAIN TIME/DIV switch to 1 ms and the DEL'D TIME/DIV switch to 1 μ s.
 - Set the switch of the signal-coupling control of channel A to O.
 - Depress pushbutton STARTS of the delayed time-base trigger mode switch (S26).
 - Check that there is a barely visible dot at the beginning of the trace. If necessary, readjust potentiometer R2071 on the Z-amplifier board.
 - Resistor R2012 will be a "select in test" resistor of 7k 15 15k.
- Adjust the intensity (beam current) in such a way that the voltage across R2087 lies, between 10 μ V and 20 μ V. Adjust if possible for 20 μ V across R2087. In case that the dead angle of R22 will be too great (more than 120°), a different value for R2012 must be selected. Repeat this procedure after replacement of a C.R.T.

5.3.3.6. Intensity ratio (unit 8)

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X-deflection controls (S8).
- Turn the DELAY TIME control (R3) to 5.0 (mid-position).
- Set the MAIN TIME/DIV switch to .2 ms and the DEL'D TIME/DIV switch to 50 μ s.
- Set the switch of the channel A signal-coupling control to AC.

- Apply a sine-wave signal at a frequency of 100 kHz to the channel A input socket.
- Set the display-height to 6 DIV.
- Set the INTENS potentiometer to a position 90° from the anti clockwise stop; see Fig. 5.5.
- Check that the trace of the main time-base generator is barely visible over the entire screen and that the part determined by the delayed time-base generator is more brilliant. If necessary, readjust potentiometer **R1537** on the **time-base board**.

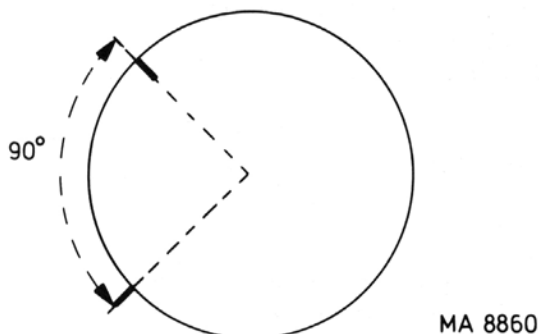


Fig. 5.5. Position of the INTENS potentiometer, when adjusting the intensity ratio.

5.3.4. Balance adjustments

5.3.4.1. Introduction

The adjustments of the vertical channels A, B, C and D are identical. The knobs, sockets and adjusting elements of channel B, C and D are shown in brackets behind those of channel A. **The balance adjustments influence one another and must, therefore, be readjusted in the order in which they are described.**

5.3.4.2. O-DC balance (Attenuator units, unit 2.1 and 2.2.)

- Depress pushbutton A (B, C, D) of the display mode control S27.
- Set the channel A (B, C, D) AMPL/DIV switch to 5mV/DIV and the continuous control to CAL.
- Set the channel A (B, C, D) signal coupling switch from O to DC.
- Check that the trace does not jump. If necessary adjust potentiometer R124 (channel A/unit 2.1, channel C unit 2.2.) and potentiometer R174 (channel B/unit 2.1., channel D/unit 2.2.).

5.3.4.3. Attenuator AMPL/DIV balance (Attenuator units).

- Depress pushbutton A (B, C, D) of the display mode control S27.
- Set the channel A (B, C, D) signal coupling switch to O.
- Centre the time base line using the vertical position control R14 (R15, R18, R19).
- Rotate the AMPL/DIV switch S9 (S11, S13, S15) between the positions 5V/DIV . . . 5mV/DIV.
- Check that the trace does not jump more than 0,2 DIV. If necessary adjust potentiometer R129 (channel A/unit 2.1., channel C/unit 2.2.) and potentiometer R179 (channel B/unit 2.1., channel D/unit 2.2.).

5.3.4.4. Continuous balance (Intermediate amplifier, unit 12).

- Depress pushbutton A (B, C, D) of the display mode control S27.
- Set the channel A (B, C, D) signal coupling switch to O.
- Rotate the channel A (B, C, D) continuous vernier control R8 (R9, R10, R11) between minimum and maximum.
- Check that the trace does not move more than 1 DIV in 2mV/DIV position, 0,4 DIV in 5mV/DIV, 0,2 DIV in the other AMPL/DIV positions.
- If necessary adjust potentiometer R211 (R311, R2211, R2311.).

5.3.4.5. Balance AMPL/DIV position 2mV/5mV (Intermediate amplifier).

- Depress pushbutton A (B, C, D) of the display mode control S27.
- Set the channel A (B, C, D) signal coupling switch to O.
- Centre the time base line, using the vertical position control R14 (R15, R18, R19).
- Check that the trace does not jump more than 2 DIV when switching between 5mV/DIV and 2mV/DIV.
- If necessary adjust potentiometer R216 (R316, R2216, R2316).

5.3.4.6. Normal/ invert balance (Intermediate amplifier, unit 12).

- Depress pushbutton A (B, C, D) of the display mode control S27.
- Set the channel A (B, C, D) signal coupling switch to O.
- Centre the time base line, using the vertical position control R14 (R15, R18, R19).
- Set the channel A (B, C, D) AMPL/DIV switch to 10mV/DIV.
- Check that the trace does not jump more than 0,3 DIV when switching from normal position to INVERT.
- If necessary adjust potentiometer R259 (R359, R2259, R2359).
- Set the channel A (B, C, D) AMPL/DIV switch to 2mV/DIV.
- Check that the trace does not jump more than 2 DIV when switching from normal position to INVERT.
- If necessary readjust potentiometer R259 (R359, R2259, R2359).

5.3.4.7. Trigger balance main time base (unit 9 and 16).

- Select trigger source EXT for the main time base by means of S30.
- Depress pushbutton TRIG VIEW of the display mode control S27.
- Select AC trigger coupling by means of S32.
- Put the main time base level control (R4) in the mid position.
- Centre the trigger view line with potentiometer R845 on the trigger amplifier (unit 9).
- Select DC trigger coupling by means of S32.
- Check that the trigger view line remains in the screen centre.
If necessary adjust potentiometer R733 on the trigger source (unit 16).
- Depress pushbutton A of the main time base trigger source selector (S30).
- Check that the trigger view line remains in the screen centre. If necessary adjust potentiometer R434 A on the channel A pick off unit (unit 14 A).
- Do this also for channel B (R434 B on unit 14 B), for channel C (R434 C on unit 14 C) and for channel D (R434 D on unit 14 D).
- Select trigger source EXT for the main time base by means of S30.
- Apply a sine-wave signal of 30mV/2kHz to the external trigger input socket.

- Adjust the main time base level potentiometer R4 for a triggered display.
- Check that the trigger view line is written across the centre of the screen. If necessary adjust potentiometer R527 on the intermediate amplifier (unit 12).
- Remove the input signal.

5.3.4.8. *Trigger balance delayed time-base*

- Depress pushbutton DEL'D TB of the X deflection controls (S8)
- Set the MAIN TIME/DIV switch to $.5 \mu\text{s}$ and its vernier to CAL.
- Set the DEL'D TIME/DIV switch to $.2 \mu\text{s}$ and its vernier to CAL.
- Select AC trigger coupling by means of S32.
- Depress pushbutton A of the display-mode controls (S27).
- Set the channel A AMPL switch to 20 mV/DIV and its vernier to CAL
- Depress pushbutton A of the d.t.b. trigger-source selector switch (S29).
- Apply a sine-wave voltage of 120 mV, frequency 1 MHz, to input A.
- Set the d.t.b. LEVEL potentiometer in its mid position.
- Adjust R1238 on the trigger amplifier (unit 9) for a triggered display.
- Centre the display, using the channel A POSITION control.
- Shift the starting point of the sine-wave to the central horizontal graticule line, using the d.t.b. LEVEL potentiometer.
- Select DC trigger coupling by means of S32.
- Check that the starting point of the sine-wave remains in the centre of the screen; if necessary, readjust potentiometer R429 A on the channel A pick off unit (unit 14 A).
- Now repeat this procedure for channel B, C and D and adjust potentiometer R429 B/pick off (unit 14 B), R429 C/pick off (unit 14 C) and R429 D/pick off (unit 14 D).
- Remove the input signal.

5.3.4.9. *Y Position correction and ADD balance adjustment. (Unit 12 and 13)*

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X-deflection controls (S8).
- Set the vertical POSITION potentiometer to its mid-position.
- Short-circuit the input of the delay-line on the intermediate amplifier board (Unit 12).
- Check that the time-base line is displayed exactly in the centre of the screen; if necessary, readjust potentiometer R658 on the final Y-amplifier board. (Unit 13).
- Remove the short-circuit on the intermediate amplifier board.
- Depress pushbutton ALT of the display-mode controls S28 and push button A and B of S27
- Shift the A and B traces in equal opposite directions from the screen centre, by means of the POSITION controls. (R14 and R15).
- Depress pushbutton A+B of the display-mode controls (S27) and release A and B of S27.
- Readjust potentiometer R500 on the intermediate amplifier so that the trace appears in the centre of the screen.
- Depress pushbutton A and B of S27 and release A+B of S27.
- Shift both traces to the centre of the screen with the POSITION controls (R14 and R15).
- Depress pushbutton A+B of the display-mode controls (S27) and release A and B of S27.
- Readjust potentiometer R500 for minimum trace jump.
- If necessary, repeat this procedure.

5.3.4.10. *TB MAGN balance (unit 26).*

- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Depress pushbutton A of the display-mode controls (S27).
- Move the starting point of the time-base line to the centre of the screen, using the X POSITION control.
- Check that the starting point does not move when the TB MAGN control is operated; if necessary, readjust potentiometer R1749 on the final X amplifier (unit 26).

5.3.5. Time-base generators

5.3.5.1. Main time-base time coefficients (unit 8 and 26).

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Depress pushbutton AUTO of the trigger-mode controls (S25).
- Set the d.t.b. TIME/DIV switch to OFF and its vernier to CAL.
- Select DC trigger coupling by means of S32.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Set the channel A AMPL switch to .1 V/DIV and its vernier to CAL.
- Set the switch of the channel A signal-coupling control to DC.
- Apply a time-marker signal of 600mV, pulse repetition rate 1 ms, to the channel A input.
- Push the TB MAGN switch to x1.
- Set the m.t.b. TIME/DIV switch to 1 ms and its vernier to CAL.
- Adjust the m.t.b. LEVEL potentiometer for a stable display.
- Check that the pilot lamps MAGN and time-base UNCAL are off.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1709** on the final X amplifier (unit 26).
- Set the m.t.b. TIME/DIV switch to 5 ms.
- Change the repetition rate of the input signal to 5 ms.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R913** on the time-base board.
- Set the m.t.b. TIME/DIV switch to 1 μ s.
- Change the repetition rate of the input signal to 1 μ s.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R911** on the time-base board.
- Pull the TB MAGN switch to x10.
- Check that the pilot lamp MAGN lights up.
- Change the repetition rate of the input voltage to .1 μ s.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1706** on the final X amplifier (unit 26).
- Push the TB MAGN switch to x1.
- Set the m.t.b. TIME/DIV switch to .1 μ s.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust trimmer capacitor **C916** on the time-base board.
- Check that the other positions of the m.t.b. TIME/DIV switch, using the appropriate input signals; tolerance $\pm 2\%$ at an ambient temperature of 20 to 30°C
- Check that the control range of the m.t.b. TIME/DIV vernier control lies between 1:2,6 and 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of its CAL position.

5.3.5.2. Delayed time-base time coefficients (unit 8)

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton DEL'D TB of the X deflection controls (S8).
- Depress pushbutton AUTO of the trigger-mode controls (S25).
- Select DC trigger coupling by means of S32.
- Rotate the DELAY TIME control (R3) fully anti-clockwise (minimum delay time).
- Push the TB MAGN switch to x1.
- Depress pushbutton A of the d.t.b. trigger-source controls (S29).
- Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL.
- Set the d.t.b. TIME/DIV switch to 1 ms and its vernier to CAL.
- Check that the time-base UNCAL lamp is off.

- Apply a time-marker signal of 600mV, repetition rate 1 ms, to the channel A input.
- Set the channel A AMPL switch to .1 V/DIV and its vernier to CAL.
- Adjust the d.t.b. LEVEL control for a stationary display.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1326** on the time-base board.
- Set the m.t.b. TIME/DIV switch to 10 ms.
- Set the d.t.b. TIME/DIV switch to 5 ms.
- Change the repetition rate of the input signal to 5 ms.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1318** on the time-base board.
- Set the m.t.b. TIME/DIV switch to 2 μ s.
- Set the d.t.b. TIME/DIV switch to 1 μ s.
- Change the repetition rate of the input signal to 1 μ s.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust potentiometer **R1321** on the time-base board.
- Set the m.t.b. TIME/DIV switch to .2 μ s.
- Set the d.t.b. TIME/DIV switch to .1 μ s.
- Change the repetition rate of the input signal to .1 μ s.
- Check that the centre 8 cycles have a total width of 8 DIV; if necessary, readjust trimmer capacitor **C1311** on the time-base board.
- Check the sweep times in all other positions of the d.t.b. TIME/DIV switch; tolerance $\pm 2\%$ in temperature range +20... +30°C. Keep during this check the DELAY TIME control fully anti-clockwise and the m.t.b. TIME/DIV switch one position slower than the d.t.b. TIME/DIV switch.
- Check that the control range of the d.t.b. TIME/DIV vernier control lies between 1:2,6 and 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of its CAL position.

5.3.5.3. Delay time (unit 9)

- Depress pushbutton A of the display-mode controls (S27).
- Set the switch of the channel A signal-coupling control to DC.
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Depress pushbutton AUTO of the trigger-mode controls (S25).
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Depress pushbutton STARTS of the delayed time base trigger mode switch (S26).
- Push the TB MAGN switch to position x1.
- Set the AMPL/DIV of channel A to 0,1V/DIV and its vernier to CAL.
- Set the m.t.b. TIME/DIV switch to .1 ms and its vernier to CAL.
- Set the d.t.b. TIME/DIV switch to .05 μ s and its vernier to CAL.
- Set the DELAY TIME control (R3) to 1.00.
- Apply a time marker voltage with a repetition rate of 0,1 ms to the channel A input.
- Check that the intensified spot on the trace coincides with the starting point of the second time marker pulse; if necessary, readjust potentiometer **R1384** on the trigger amplifier board.
- Set the DELAY TIME control (R3) to 9.00.
- Check that the intensified spot on the trace coincides with the starting point of the tenth time marker pulse; if necessary, readjust potentiometer **R1379** on the trigger amplifier board.
- Remove the input signal.

As both adjustments are slightly interdependent, they must be repeated until both conditions are fulfilled.

5.3.5.4. Alternate time-base and trace separation

- Depress pushbutton A of the display-mode controls (S27).
- Select ALT TB with the X deflection controls (S8).
- Set the m.t.b. TIME/DIV switch to $.5 \mu\text{s}$ and its vernier to CAL.
- Set the d.t.b. TIME/DIV switch to $.5 \mu\text{s}$ and its vernier to CAL.
- Set the switch of the channel A signal-coupling control to 0 (S17).
- Check that the distance between the two traces is 0 DIV with the TRACE SEP control (R20) turned anti-clockwise and approximately 4 DIV with this control turned clockwise.

5.3.6. L.F. correction and sensitivities

Before checking the sensitivities, check the balances in accordance with section 5.3.4. Balance adjustments.

5.3.6.1. L.F. correction (Attenuator units, unit 2.1. and 2.2.)

- Depress pushbutton A (B, C, D) of the display mode control S27.
- Depress pushbutton MAIN TB of the X deflection selector S8.
- Depress the Y-position control to the position normal.
- Set the channel A (B, C, D) signal coupling control to DC.
- Depress pushbutton A (B, C, D) of the main time base trigger-source selector S30.
- Adjust the channel A (B, C, D) AMPL/DIV switch to 10 mV/DIV and the vernier control to CAL.
- Adjust the main time base TIME/DIV control to 2 ms/DIV and the vernier control to CAL.
- Adjust the delayed time base TIME/DIV control to OFF.
- Apply a square-wave of 60 mV/200 Hz to the channel A (B, C, D) input socket.
- Check that the pulse top is straight. If not readjust potentiometer R132 (Channel A/unit 2.1., channel C/unit 2.2.) or potentiometer R182 (Channel B/unit 2.1., channel D/unit 2.2.).

5.3.6.2. L.F. correction main time base external input (unit 16).

- Depress pushbutton TRIG VIEW of the display mode selector S27.
- Depress pushbutton MAIN TB of the horizontal deflection selector S8.
- Depress pushbutton EXT of the MTB trigger-source selector S30.
- Select DC trigger coupling by means of S32.
- Set MTB TIME/DIV switch in the 1 ms/DIV position.
- Set the DTB TIME/DIV switch in the OFF position.
- Apply a 200 Hz/600 mV square-wave signal to the MTB external input socket X8.
- Position the wave form on the screen by means of the MTB level control R4.
- Check that the pulse top is straight; if not adjust R739 on the trigger source unit (unit 16).
- Remove the input signal.

5.3.6.3. Gain (sensitivity) Y_A VIA Y (final Y amplifier, unit 13).

- Set front panel GAIN potentiometer R12 in its mid position.
- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Push the Y POSITION controls to position NORMAL.
- Set the channel A signal-coupling control to AC.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Set the m.t.b. TIME/DIV to 0.2ms/DIV.
- Set the d.t.b. TIME/DIV switch to OFF.

- Set the channel A AMPL switch to .5V/DIV and its vernier to CAL.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel A input.
- Check that the trace-height is 6 DIV; if necessary, readjust potentiometer R654 on the final Y amplifier board.
- Check that the control range of the channel A AMPL vernier control lies between 1:2,6 and 1 : 3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of the CAL position.

5.3.6.4. Gain (sensitivity) Y_B VIA Y (R13, front panel).

- Depress pushbutton B of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Push the Y POSITION controls to position NORMAL.
- Set the channel B signal-coupling control to AC.
- Depress pushbutton B of the m.t.b. trigger-source controls.
- Set the d.t.b. TIME/DIV switch to OFF.
- Set the channel B AMPL switch to .5V/DIV and its vernier to CAL.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel B input.
- Check that the trace height is 6 DIV; if necessary, readjust GAIN potentiometer R13 on the front panel.
- Check that R13 does not touch its end position after adjustment.
- Check that the control range of the channel B AMPL vernier control lies between 1:2,6 and 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of the CAL position.

5.3.6.5. Gain (sensitivity) Y_C VIA Y (R16, front panel).

- Depress pushbutton C of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Push the Y POSITION controls to position NORMAL.
- Set the channel C signal-coupling control to AC.
- Depress pushbutton C of the m.t.b. trigger-source controls.
- Set the d.t.b. TIME/DIV switch to OFF.
- Set the channel C AMPL switch to .5V/DIV and its vernier to CAL.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel C input.
- Check that the trace height is 6 DIV; if necessary, readjust GAIN potentiometer R16 on the front panel.
- Check that R16 does not touch its end position after adjustment.
- Check that the control range of the channel C AMPL vernier control lies between 1:2,6 and 1 : 3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of the CAL position.

5.3.6.6. Gain (sensitivity) Y_D VIA Y (R17, front panel).

- Depress pushbutton D of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Push the Y POSITION controls to position NORMAL.
- Set the channel D signal-coupling control to AC.
- Depress pushbutton D of the m.t.b. trigger-source controls.
- Set the d.t.b. TIME/DIV switch to OFF.
- Set the channel D AMPL switch to .5V/DIV and its vernier to CAL.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel D input.
- Check that the trace height is 6 DIV; if necessary, readjust GAIN potentiometer R17 on the front panel.
- Check that R17 does not touch its end position after adjustment.
- Check that the control range of the channel D AMPL vernier control lies between 1:2,6 and 1:3,5 and that the pilot lamp UNCAL lights up as soon as the vernier is out of the CAL position.

5.3.6.7. Gain (sensitivity) at external X deflection (external trigger input, unit 16).

- Depress pushbutton EXT X DEFL of the X deflection controls (S8).
- Select function EXT of the m.t.b. trigger-source controls (S30).
- Set the X AMPL-HOLD OFF control to CAL (R24/R25).
- Apply a 300mV square-wave voltage, frequency 2kHz, to the m.t.b. EXT input.
- Adjust the X POSITION potentiometer R6/7 so that there are two points displayed on the screen.
- Check that the trace width is 6 DIV; if necessary, readjust potentiometer **R737** on unit 16.
- Check that the control range of the X AMPL-HOLD OFF is 1:3,5 or better.
- Set the X AMPL-HOLD OFF control to CAL.

5.3.6.8. Gain (sensitivity) external triggering combined with trigger view (trigger unit, unit 9).

- Depress pushbutton TRIG VIEW of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Select function EXT of the m.t.b. trigger-source controls (S30).
- Set the m.t.b. TIME/DIV, switch to 0,2m sec.
- Position the waveform in the middle of the screen by means of the m.t.b. LEVEL potentiometer.
- Apply a 600mV square-wave voltage, frequency 2kHz, to the m.t.b. external trigger input.
- Check that the trace height is 6 DIV; if necessary, readjust potentiometer **R842** on unit 9.
- Remove the input signal.

5.3.6.9. Gain (sensitivity) triggering on channel A combined with trigger view (trigger pick off unit, unit 14 A).

- Depress pushbutton TRIG VIEW of the display-mode controls (S27).
- Set the channel A AMPL/DIV switch to .5V/DIV and its vernier to CAL.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel A input.
- Set the channel A POSITION control fully anticlockwise.
- Centre the trigger view waveform by means of the m.t.b. LEVEL control R4.
- Check that the trace height is 6 DIV; if necessary readjust potentiometer **R412 A** on trigger pick off unit 14 A.

5.3.6.10. Gain (sensitivity) triggering on channel B combined with trigger view (trigger pick off unit, unit 14 B).

- Depress pushbutton TRIG VIEW of the display-mode controls (S27).
- Set the channel B AMPL/DIV switch to .5V/DIV and its vernier to CAL.
- Depress pushbutton B (S30) of the m.t.b. trigger-source controls.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel B input.
- Set the channel B POSITION control fully anticlockwise.
- Centre the trigger view waveform by means of the m.t.b. LEVEL control R4.
- Check that the trace height is 6 DIV; if necessary readjust potentiometer **R412 B** on trigger pick off unit 14 B.

5.3.6.11. Gain (sensitivity) triggering on channel C combined with trigger view (trigger pick off unit, unit 14 C).

- Depress pushbutton TRIG VIEW of the display-mode controls (S27).
- Set the channel C AMPL/DIV switch to .5V/DIV and its vernier to CAL.
- Depress pushbutton C (S30) of the m.t.b. trigger-source controls.

- Apply a 3V square-wave voltage, frequency 2kHz, to the channel C input.
- Set the channel C POSITION control fully anticlockwise.
- Centre the trigger view waveform by means of the m.t.b. LEVEL control R4.
- Check that the trace height is 6 DIV; if necessary readjust potentiometer **R412 C** on trigger pick off unit 14 C.

5.3.6.12. Gain (sensitivity) triggering on channel D combined with trigger view (trigger pick off unit, unit 14 D.

- Depress pushbutton TRIG VIEW of the display-mode controls (S27).
- Set the channel D AMPL/DIV switch to .5V/DIV and its vernier to CAL.
- Depress pushbutton D (S30) of the m.t.b. trigger-source controls.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel D input.
- Set the channel D POSITION controls fully anticlockwise.
- Centre the trigger view waveform by means of the m.t.b. LEVEL control R4.
- Check that the trace height is 6 DIV; if necessary readjust potentiometer **R412 D** on trigger pick off unit 14 D.

5.3.6.13. Gain (sensitivity) Y_A VIA X mode check.

- Depress pushbutton B of the display-mode controls (S27).
- Depress pushbutton EXT X DEFL of the X deflection controls (S8).
- Push the Y POSITION controls to position NORMAL.
- Set the channel A signal-coupling control to AC.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Set the d.t.b. TIME/DIV switch to OFF.
- Set the channel A AMPL switch to .5V/DIV and its vernier to CAL.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel A input.
- Adjust the X POSITION potentiometer R6/R7 so that there are two points displayed on the screen.
- Position these two points on the middle of the screen by means of the channel B POSITION control
- Check that the trace width is $6 \text{ DIV} \pm 0,3 \text{ DIV}$.

5.3.6.14. Gain (sensitivity) Y_B VIA X mode check

- Depress pushbutton C of the display-mode controls (S27).
- Depress pushbutton EXT X DEFL of the X deflection controls (S8).
- Push the Y POSITION controls to position NORMAL
- Set the channel B signal-coupling control to AC.
- Depress pushbutton B of the m.t.b. trigger-source controls (S30).
- Set the d.t.b. TIME/DIV switch to OFF.
- Set the channel B AMPL switch to .5V/DIV and its vernier to CAL.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel B input.
- Adjust the X POSITION potentiometer R6/R7 so that there are two points displayed on the screen.
- Position these two points on the middle of the screen by means of the channel C POSITION control.
- Check that the trace width is $6 \text{ DIV} \pm 0,3 \text{ DIV}$.

5.3.6.15. Gain (sensitivity) Y_C VIA X mode check

- Depress pushbutton D of the display-mode controls (S27).
- Depress pushbutton EXT X DEFL of the X deflection controls (S8).
- Push the Y POSITION controls to position NORMAL.
- Set the channel C signal-coupling control to AC.
- Depress pushbutton C of the m.t.b. trigger-source controls (S30).
- Set the d.t.b. TIME/DIV switch to OFF.
- Set the channel C AMPL switch to .5V/DIV and its vernier to CAL.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel C input.
- Adjust the X POSITION potentiometer R6/R7 so that there are two points displayed on the screen.
- Position these two points on the middle of the screen by means of the channel D POSITION control.
- Check that the trace width is $6 \text{ DIV} \pm 0,3 \text{ DIV}$.

5.3.6.16. Gain (sensitivity) Y_D VIA X mode check

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton EXT X DEFL of the X deflection controls (S8).
- Push the Y POSITION controls to position NORMAL.
- Set the channel D signal-coupling control to AC.
- Depress pushbutton D of the m.t.b. trigger-source controls (S30).
- Set the d.t.b. TIME/DIV switch to OFF.
- Set the channel D AMPL switch to .5V/DIV and its vernier to CAL.
- Apply a 3V square-wave voltage, frequency 2kHz, to the channel D input.
- Adjust the X POSITION potentiometer R6/R7 so that there are two points displayed on the screen.
- Position these two points on the middle of the screen by means of the channel A POSITION control.
- Check that the trace width is $6 \text{ DIV} \pm 0,3 \text{ DIV}$.

5.3.7. Vertical channels, square-wave response adjustments

The adjustments of the vertical channels A, B, C and D are identical. The itemnumbers of knobs, sockets and adjusting elements of channel B, C and D are shown between brackets behind those of channel A. Before performing the following checking and adjusting procedure the balances and sensitivities must be checked in accordance with section 5.3.4. and 5.3.6.

5.3.7.1. Square-wave response (Attenuator units, unit 2.1. and 2.2.).

- Depress pushbutton A (B, C, D) of the display-mode switch S27.
- Push the Y POSITION controls out of the INVERT position.
- Put the channel A (B, C, D) input coupling switches in the DC position.
- Depress pushbutton A (B, C, D) of the main time base trigger source selector (S30).
- Depress pushbutton MAIN TB of the X deflection selector (S8).
- Put the main time base TIME/DIV switch in the 0.1 ms/DIV position and its vernier to CAL.
- Put the delayed time base TIME/DIV switch in the OFF position.
- Apply a square-wave voltage (frequency 2kHz/risetime $\leq 200 \text{ ns}$), to the channel A (B, C, D) input. The peak to peak value is indicated in the table below.
- Check that the pulse top errors do not exceed $\pm 3\%$. If necessary adjust the relevant trimmers.

Ch. A (B, C, D) AMPL/DIV	Ch. A (B, C, D) input signal	Adjusting element
2 mV/DIV	12 mV p-p	—
5 mV/DIV	30 mV p-p	—
10 mV/DIV	60 mV p-p	—
20 mV/DIV	120 mV p-p	—
50 mV/DIV	300 mV p-p	—
0,1 V/DIV	0,6 V p-p	C107/Ch. A/unit 2.1., C157/Ch. B/unit 2.1. C107/Ch. C/unit 2.2., C157/Ch. D/unit 2.2.
0,2 V/DIV	1,2 V p-p	—
0,5 V/DIV	3 V p-p	—
1 V/DIV	6 V p-p	C112/Ch. A/unit 2.1., C162/Ch. B/unit 2.1. C112/Ch. C/unit 2.2., C162/Ch. D/unit 2.2.
2 V/DIV	12 V p-p	—
5 V/DIV	30 V p-p	—

— Remove the input signal.

5.3.7.2. Input capacitance (Attenuator units, unit 2.1. and 2.2.).

- Depress pushbutton A (B, C, D) of the display-mode switch S27.
- Push the Y POSITION controls out of the INVERT position.
- Put the channel A (B, C, D) input coupling switches in the DC position.
- Depress pushbutton A (B, C, D) of the main time base trigger source selector (S30).
- Depress pushbutton MAIN TB of the X deflection selector (S8).
- Put the main time base TIME/DIV switch in the 0,1 ms/DIV position and its vernier to CAL.
- Put the delayed time base TIME/DIV switch in the OFF position.
- Apply a square-wave voltage (frequency 2kHz/risetime ≤ 200 ns) to the channel A (B, C, D) input via the dummy probe indicated in figure 5.6. (1 Mohm $\pm 1\%$ // 15pF).
- Check according to the following table that the pulse top errors do not exceed $\pm 3\%$. Thus the trace height must be 3 DIV / $\pm 3\%$. If necessary adjust the relevant trimmers.

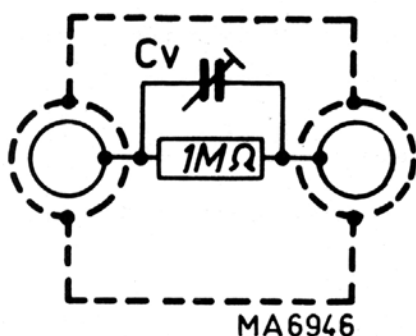


Fig. 5.6. Diagram of 2 : 1 dummy probe.

Ch. A (B, C, D) AMPL/DIV	Ch. A (B, C, D) input signal	Adjusting element
2 mV/DIV	12 mV p-p	C101/Ch. A/unit 2.1., C151/Ch. B/unit 2.1. C101/Ch. C/unit 2.2., C151/Ch. D/unit 2.2.
5 mV/DIV	30 mV p-p	—
10 mV/DIV	60 mV p-p	—
20 mV/DIV	120 mV p-p	—
50 mV/DIV	300 mV p-p	—
0,1 V/DIV	600 mV p-p	C104/Ch. A/unit 2.1, C154/Ch. B/unit 2.1., C104/Ch. C/unit 2.2., C154/Ch. D/unit 2.2.
0,2 V/DIV	1,2 V p-p	—
0,5 V/DIV	6 V p-p	—
1 V/DIV	6 V p-p	C109/Ch. A/unit 2.1., C159/Ch. B/unit 2.1., C109/Ch. C/unit 2.2., C159/Ch. D/unit 2.2.
2 V/DIV	12 V p-p	—
5 V/DIV	30 V p-p	—

- Remove the input signal.

5.3.7.3. Square-wave response final Y-amplifier (unit 13).

- Depress pushbutton A and B of the display-mode switch S27.
- Depress pushbutton CHOP of display-mode switch S28.
- Depress pushbutton A of the main time base trigger source selector (S30).
- Shift by means of R15 the channel B time base line in the vertical middle of the screen.
- Apply to the ch. A input socket (X3) a 200 Hz square-wave signal giving a vertical deflection of a 6 DIV.
- Adjust the main time base controls for a suitable, triggered display.
- Put potentiometer R634 in its mid position.
- Select for C613 a capacitance value in the range 82...120 pF in order to obtain a Ch. B time base line that is as straight as possible.
- Adjust R634 to optimal straightness of the time base line.
- Increase the frequency of the Ch. A input signal to 2kHz.
- Adjust the main time base controls for a suitable, triggered display.
- Put potentiometer R636 in its mid position.
- Select for C614 a capacitance value in the range 27...47pF in order to obtain a Ch. B time base line that is as straight as possible.
- Adjust R636 to optimal straightness of the time base line.

5.3.7.4. Square-wave response channel A and final Y amplifier (unit 14A, 13, 12).

- The adjustment points are located on unit 14A, unless otherwise noted
- Depress pushbutton A of the display-mode controls (S27).
- Push the Y POSITION controls to the normal position.
- Set the switch of the channel A signal-coupling control to DC.
- Set the channel A AMPL/DIV switch to 10 mV/DIV and its vernier to CAL.
- Set the X Magnifier in the X1 position.
- Depress pushbutton MTB of the X deflection controls (S8).
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Set the m.t.b. TIME/DIV switch to a suitable value.
- Set the d.t.b. TIME/DIV switch to OFF.
- Apply a/square-wave voltage of 60 mV, rise time 1 ns, repetition rate 2 kHz, to the channel A input.

- Check that the pulse top is straight within 2% and the rise time is as short as possible; if necessary readjust potentiometer **R257 A** or select a different value for capacitor **C229 A** and if necessary **C231 A**.
- Increase the repetition rate of the input signal to 30 kHz.
- Put the instrument in the Magnifier X10 mode for better wave form analysis.
- Check that the pulse top is straight within 2% and that the rise time is as short as possible. If necessary, readjust potentiometers **R254 A** and **R253 A** or select a different value for capacitors **C228 A** and **C227 A**.
- Increase the repetition rate of the input signal to 100 kHz.
- Check that the pulse is straight within 2% and that the rise time is as short as possible; if necessary, select capacitor **C224 A** and readjust potentiometer **R244 A** for an optimal result.
- Select **C233** on the intermediate amplifier (unit 12) to such a value that the square wave response is optimal.
- Set the generator frequency to 30 kHz.
- Set the m.t.b. controls to obtain a suitable, triggered display.[
- Check that the top of the displayed pulse is straight within 2%; if necessary, readjust trimming capacitor **C616** on the Y amplifier board (unit 13).
- Set the generator frequency to 100 kHz.
- Set the m.t.b. controls to obtain a suitable, triggered display.
- Check that the top of the displayed pulse is straight within 2%; if necessary, adjust potentiometer **R646** on the final Y amplifier board.
- Check the square-wave response in positions 5 mV/DIV and 2 mV/DIV of the AMPL/DIV switch at input voltages of 30 mV and 12 mV. The pulse top aberrations must not exceed 2%.
- Pull the channel A Y POSITION control to INVERT.
- Repeat the checks described above; the response must be the same and the pulse top aberrations must remain within the specified value.
- Depress pushbutton B of the display-mode controls (S27).
- Set the switch of the channel B signal-coupling control to 0.
- Set the channel B time base line in the middle of the screen with the POSITION control.
- Depress pushbutton A of the display-mode controls (S27).
- Set the switch of the channel A signal-coupling control to 0.
- Set the channel A time base line in the middle of the screen with the POSITION control.
- Set the switch of the channel A signal-coupling control to DC.
- Check that the response does not change.
- Check that the pulse top aberrations remain within the specified value.
- Release pushbuttons A and B of S27 and depress pushbutton A+B of S27.
- Remove the input signal.

5.3.7.5. Square-wave response channel B (unit 14B, 12).

- The adjustment points are located on unit 14B, unless otherwise noted.
- Depress pushbutton B of the display-mode controls (S27).
- Push the channel Y POSITION control to NORM position.
- Set the switch of the channel B signal-coupling control to DC.
- Set the channel B AMPL/DIV switch to 10 mV/DIV and its vernier to CAL.
- Set the X Magnifier in the X1 position.
- Depress pushbutton MTB of the X deflection controls (S8).
- Depress pushbutton B of the m.t.b. trigger source-controls (S30).
- Set the m.t.b. TIME/DIV switch to a suitable value.
- Set the d.t.b. TIME/DIV switch OFF.
- Apply a square-wave voltage of 60 mV, rise time 1 ns, repetition rate 2kHz, to channel B input.
- Check that the pulse top is straight within 2% and the rise time is as short as possible; if necessary readjust potentiometer **R257 B** or select a different value for capacitor **C229 B** and if necessary **C231 B**.

- Increase the repetition rate of the input signal to 30 kHz.
- Put the instrument in the Magn X10 mode for better waveform analysis.
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary readjust potentiometer **R254 B** and **R243 B** or select a different value for capacitors **C228 B** and **C227 B**.
- Increase the repetition rate of the input signal to 100 kHz.
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, select capacitor **C224 B** and readjust potentiometer **R244 B** for an optimal result.
- Select **C333** on the intermediate amplifier (unit 12) to such a value that the square-wave is optimal.
- Check the square-wave response in position 5 mV/DIV and 2 mV/DIV of the AMPL/DIV switch at input voltages of 30 mV and 12 mV. The pulse top aberrations must not exceed 2%.
- Pull the channel B POSITION control to INVERT.
- Repeat the checks described above; the response must be the same and the pulse top aberrations must remain within the specified value.
- Depress pushbutton A of the display-mode control (S27).
- Set the switch of the channel A signal-coupling control to 0.
- Set the channel A time base line in the middle of the screen with the POSITION control.
- Depress pushbutton B of the display-mode controls (S27).
- Set the switch of the channel B signal-coupling to 0.
- Set the channel B time base line in the middle of the screen with the POSITION control.
- Set the switch of the channel B signal-coupling control to DC.
- Release pushbuttons A and B of S27 and depress pushbutton A+B of S27. Check that the response does not change.
- Check that the pulse top aberrations remain within the specified value.
- Remove the input signal.

5.3.7.6. Square-wave response channel C (unit 14C, 12).

- The adjustment points are located on unit 14C, unless otherwise noted.
- Depress pushbutton C of the display-mode controls (S27).
- Push the channel Y POSITION control to NORM position.
- Set the switch of the channel C signal-coupling control to DC.
- Set the channel C AMPL/DIV switch to 10 mV/DIV and its vernier to CAL.
- Set the X Magnifier in the X1 position.
- Depress pushbutton MTB of the X deflection controls (S8).
- Depress pushbutton C of the m.t.b. trigger source-controls (S30).
- Set the m.t.b. TIME/DIV switch to a suitable value.
- Set the d.t.b. TIME/DIV switch to OFF.
- Apply a square-wave voltage of 60 mV, rise time 1 ns, repetition rate 2 kHz, to channel C input.
- Check that the pulse top is straight within 2% and the rise time is as short as possible; if necessary readjust potentiometer **R257 C** or select a different value for capacitor **C229 C** and if necessary **C231 C**.
- Increase the repetition rate of the input signal to 30 kHz.
- Put the instrument in the Magn X10 mode for better waveform analysis.
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, readjust potentiometers **R254 C** and **R253 C** or select a different value for capacitors **C228 C** and **C227 C**.

- Increase the repetition rate of the input signal to 100 kHz.
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; if necessary, select capacitor C224 C and readjust potentiometer R244 C for an optimal result.
- Select C2233 on the intermediate amplifier (unit 12) to such a value that the square-wave response is optimal.
- Check the square-wave response in position 5 mV/DIV and 2 mV/DIV of the AMPL switch at input voltages of 30 mV and 12 mV. The pulse top aberrations must not exceed 2%.
- Pull the channel C POSITION control to INVERT.
- Repeat the checks described above; the response must be the same and the pulse top aberrations must remain within the specified value.
- Depress bushbutton D of the display-mode control (S27).
- Set the switch of the channel D signal-coupling control to 0.
- Set the channel D time base line in the middle of the screen with the POSITION control.
- Depress pushbutton C of the display-mode controls (S27).
- Set the switch of the channel C signal-coupling control to 0.
- Set the channel C time base line in the middle of the screen with the POSITION control.
- Set the switch of the channel C signal-coupling control to DC.
- Release pushbuttons C and D of S27 and depress pushbutton C + D of S27. Check that the response does not change.
- Check that the pulse top aberrations remain within the specified value.
- Remove the input signal.

5.3.7.7. Square-wave response channel D (unit 14D, 12)

- The adjustment points are located on unit 14D, unless otherwise noted.
- Depress pushbutton D of the display-mode controls (S27).
- Push the channel Y POSITION control to NORM position.
- Set the switch of the channel D signal-coupling control to DC.
- Set the channel D AMPL/DIV switch to 10 mV/DIV and its vernier to CAL.
- Set the X Magnifier in the X1 position.
- Depress pushbutton MTB of the X deflection controls (S8).
- Depress pushbutton D of the m.t.b. trigger source-controls (S30).
- Set the m.t.b. TIME/DIV switch to a suitable value.
- Set the d.t.b. TIME/DIV switch to OFF.
- Apply a square-wave voltage of 60 mV, rise time 1 ns, repetition rate 2 kHz, to channel D input.
- Check that the pulse top is straight within 2%, and the rise time is as short as possible; if necessary, readjust potentiometer R257 D or select a different value for capacitor C229 D and if necessary C231 D.
- Increase the repetition rate of the input signal to 30 kHz.
- Put the instrument in the Magn X10 mode for better waveform analysis.
- Check that the pulse top is straight within 2% and that the rise time is as short as possible; If necessary, readjust potentiometers R254 D and R253 D or select a different value for capacitors C228 D and C227 D.
- Increase the repetition rate of the input signal to 100 kHz.
- Check that the pulse top is straight within 2% and the rise time is as short as possible; if necessary, select capacitor C224 D and readjust potentiometer R244 D.
- Select C2333 on the intermediate amplifier (unit 12) to such a value that the square-wave response is optimal.
- Check the square-wave response in position 5 mV/DIV and 2 mV/DIV of the AMPL switch at input voltages of 30 mV and 12 m V. The pulse top aberrations must not exceed 2%.

- Pull the channel D POSITION control to INVERT.
- Repeat the checks described above; the response must be the same and the pulse top aberrations must remain within the specified value.
- Depress pushbutton C of the display-mode control (S27).
- Set the switch of the channel C signal-coupling control to 0.
- Set the channel C time base line in the middle of the screen with the POSITION control.
- Depress pushbutton D of the display-mode controls (S27).
- Set the switch of the channel D signal-coupling control to 0.
- Set the channel D time base line in the middle of the screen with the POSITION control.
- Set the switch of the channel D signal-coupling control to DC.
- Release pushbuttons C and D of S27 and depress pushbutton C+D of S27. Check that the response does not change.
- Check that the pulse top aberrations remain within the specified value.
- Remove the input signal.

5.3.7.8. Bandwidth check channel A (B, C, D).

- Depress pushbutton A (B, C, D) of the display-mode controls (S27).
- Push the Y POSITION controls to the NORM position.
- Set the channel A (B, C, D) AMPL switch to 2 mV/DIV and its vernier to CAL.
- Set the switch of the signal coupling control to AC.
- Depress pushbutton MTB of the X deflection controls (S8).
- Push the TB MAGN switch to x1.
- Depress pushbutton AUTO of the trigger-mode controls.
- Select DC trigger coupling.
- Depress pushbutton A (B, C, D) of the trigger-source controls (S30).
- Set the m.t.b. TIME/DIV switch to 2 μ s and its vernier to CAL.
- Set the d.t.b. TIME/DIV switch to OFF.
- Apply a sine-wave voltage of 16 mV_{p-p}, frequency 2 MHz, to the channel A (B, C, D) input.
- Check that the trace height is 8 DIV.
- Check that the trace height is at least 5.6 DIV.
- Increase the frequency of the input signal to 35 MHz.
- Check for at least 5.6 DIV.
- Set the channel A (B, C, D) AMPL/DIV switch to 5 mV/DIV and its vernier to CAL.
- Increase the input voltage to 40 mV_{p-p}, frequency 2 MHz.
- Check that the trace height is 8 DIV.
- Increase the frequency of the input voltage to 100 MHz.
- Check that the trace height is at least 5.6 DIV. If not readjust the square-wave response of the involved channel.
- Remove the input signal.

5.3.7.9. Common mode rejection check channel A and B

- Depress pushbutton A of the display-mode controls (S27).
 - Set the channel A time base line in the middle of the screen with the POSITION control.
 - Depress pushbutton B of the display-mode controls (S27).
 - Set the channel B time base line in the middle of the screen with the POSITION control.
 - Set the channel A and B signal-coupling switches to DC.
 - Push the channel A POSITION control to NORM.
 - Pull the channel B POSITION control to INVERT.
 - Set both AMPL controls to 10 mV/DIV and their verniers to CAL.
 - Apply a sine-wave voltage of 240 mV_{p-p} simultaneously to the channel A and B inputs.
 - Release pushbuttons A and B of S27 and depress pushbutton A+B of S27.
 - Check the rejection in accordance with the following table.
 - Set the m.t.b. TIME/DIV switch to a suitable value.
- Note:** Adjust the channel A or B AMPL vernier control for minimum trace height.

Input voltage	Frequency	Max. trace height	Rejection factor
240 mV	100 kHz	0,24 DIV	> 100
240 mV	2 MHz	0,24 DIV	> 100
240 mV	50 MHz	1,2 DIV	> 20

- Push the channel B POSITION control to NORM.
- Remove the input signal.

5.3.7.10. Common mode rejection check channel C and D

- Depress pushbutton C of the display-mode controls (S27).
- Set the channel C time base line in the middle of the screen with the POSITION control.
- Depress pushbutton D of the display-mode controls (S27).
- Set the channel D time base line in the middle of the screen with the POSITION control.
- Set the channel C and D signal-coupling switches to DC.
- Push the channel C POSITION control to NORM.
- Pull the channel D POSITION control to INVERT.
- Set both AMPL controls to 10 mV/DIV and their verniers to CAL.
- Apply a sine-wave voltage of 240 mV_{p-p} simultaneously to the channel C and D inputs.
- Release pushbuttons C and D of S27 and depress pushbutton C+D of S27.
- Check the rejection in accordance with the following table.
- Set the m.t.b. TIME/DIV switch to a suitable value.

Note: Adjust the channel C or D AMPL vernier control for minimum trace height.

Input voltage	Frequency	Max. trace height	Rejection factor
240 mV	100 kHz	0,24 DIV	> 100
240 mV	2 MHz	0,24 DIV	> 100
240 mV	50 MHz	1,2 DIV	> 20

- Push the channel D POSITION control to NORM.
- Remove the input signal.

5.3.7.11. Dynamic range and position range check for ch. A, B, C and D

- Depress pushbutton A (B, C, D) of the display-mode controls (S27).
- Set both AMPL switches to 5 mV/DIV and their vernier to CAL.
- Depress pushbutton A (B, C, D) of the m.t.b. trigger-source controls (S30).
- Apply a sine-wave signal of 120 mV_{p-p}, frequency 10 kHz, to the channel A (B, C, D) input.
- Check that the top and bottom parts of the sine-wave signal can be displayed, reasonably undistorted, within the measuring graticule, using the channel A (B, C, D) POSITION control.
- Remove the input signal.

5.3.7.12. Chopped display-mode check

- Depress pushbutton CHOP of the display-mode control S28.
- Depress pushbuttons A, B, C and D of the display-mode control S27.
- Put the main time base in the 2 μ s/DIV position.
- Check that four time base lines are displayed, which can be shifted in relation to each other and that these lines are sharp and well defined.

5.3.7.13. Alternate display mode check

- Depress pushbutton ALT of the display-mode control S28.
- Depress pushbuttons A, B, C and D of the display-mode control S27.
- Put the main time base in the 10 μ s/DIV position.
- Check that four time base lines are displayed, which can be shifted in relation to each other.
- Put the main time base in the 0,1 s/DIV position.
- Check that the channels are switched over after every sweep of the main time base.

5.3.7.14. Square-wave response trigger view via external input (unit 9)

- Depress pushbutton TRIG VIEW of the display-mode control.
- Put the trigger coupling switch (PULL FOR AC) in the DC-coupled position.
- Depress pushbutton MAIN TB of the X deflection control.
- Adjust the main time base TIME/DIV switch to a suitable position.
- Put the delayed time base TIME/DIV switch in the OFF position.
- Apply a square-wave voltage 600 mV_{p-p}/100 kHz.
- Adjust the square-wave response with C818 and C819.
- Remove the input signal.

5.3.7.15. Square-wave response trig view via channel A (unit 14A)

- Depress pushbutton TRIG VIEW of the display-mode control.
- Push the Y POSITION controls to the non-inverted position.
- Set the channel A, B, C and D signal coupling switches to the DC position.
- Set the AMPL/DIV switches to 10 mV/DIV and their verniers to CAL.
- Depress pushbutton MAIN TB of the X deflection control.
- Depress pushbutton A of the main time base trigger-source control.
- Adjust the main time base TIME/DIV switch to a suitable position.
- Put the delayed time base TIME/DIV switch in the OFF position.
- Select DC signal coupling for the triggering.
- Apply a square-wave voltage of 60 mV/2 kHz, rise time ≤ 1 ns to the channel A input.
- Check that the pulse top of the trigger view signal is straight and the rise time is as short as possible.
- Increase the repetition rate of the input signal to 30 kHz.
- Check that the pulse top is straight within 10% and that the rise time is as short as possible. If necessary readjust potentiometer R408 A and R409 A or select a different value for the capacitors C404 A and C406 A.
- Increase the repetition rate of the input signal to 100 kHz.
- Check that the pulse top is straight within 10% and that the rise time is as short as possible. If necessary readjust potentiometer R411 A or select a different value for the capacitor C407 A.
- Remove the input signal.

5.3.7.16. Square-wave response trigger view via channel B (unit 14B)

- Depress pushbutton TRIG VIEW of the display-mode control.
- Push the Y POSITION controls to the non-inverted position.
- Set the channel A, B, C and D signal coupling switches to the DC position.
- Set the AMPL/DIV switches to 10 mV/DIV and their verniers to CAL.
- Depress pushbutton MAIN TB of the X deflection control,
- Depress pushbutton B of the main time base trigger-source control.
- Adjust the main time base TIME/DIV switch to a suitable position.

- Put the delayed time base TIME/DIV switch in the OFF position.
- Select DC signal coupling for the triggering.
- Apply a square-wave voltage of 60 mV/2 kHz, rise time ≤ 1 ns to the channel B input.
- Check that the pulse top of the trigger view signal is straight and that the rise time is as short as possible.
- Increase the repetition rate of the input signal to 30 kHz.
- Check that the pulse top is straight within 10% and that the rise time is as short as possible
- If necessary readjust potentiometer **R408 B** and **R409 B** or select a different value for the capacitors C404 B and C406 B.
- Increase the repetition rate of the input signal to 100 kHz.
- Check that the pulse top is straight within 10% and that the rise time is as short as possible. If necessary readjust potentiometer **R411 B** or select a different value for the capacitor C407 B.
- Remove the input signal.

5.3.7.17. Square-wave response trig view via channel C (unit 14C)

- Depress pushbutton TRIG VIEW of the display-mode control.
- Push the Y POSITION controls to the non-inverted position.
- Set the channel A, B, C and D signal coupling switches to the DC position.
- Set the AMPL/DIV switches to 10 mV/DIV and their verniers to CAL.
- Depress pushbutton MAIN TB of the X deflection control.
- Depress pushbutton C of the main time base trigger-source control.
- Adjust the main time base TIME/DIV switch to a suitable position.
- Put the delayed time base TIME/DIV switch in the OFF position.
- Select DC signal coupling for the triggering.
- Apply a square-wave voltage of 60 mV/2 kHz, rise time ≤ 1 ns to the channel C input.
- Check that the pulse top of the trigger view signal is straight and that the rise time is as short as possible.
- Increase the repetition rate of the input signal to 30 kHz.
- Check that the pulse top is straight within 10% and that the rise time is as short as possible. If necessary readjust potentiometer **R408 C** and **R409 C** or select a different value for the capacitors C404 C and C406 C.
- Increase the repetition rate of the input signal to 100 kHz.
- Check that the pulse top is straight within 10% and that the rise time is as short as possible. If necessary readjust potentiometer **R411 C** or select a different value for the capacitor C407 C.
- Remove the input signal.

5.3.7.18 Square-wave response trig view via channel D (unit 14 D)

- Depress pushbutton TRIG VIEW of the display-mode control.
- Push the Y POSITION controls to the non-inverted position.
- Set the channel A, B, C and D signal coupling switches to the DC position.
- Set the AMPL/DIV switches to 10 mV/DIV and their verniers to CAL.
- Depress pushbutton MAIN TB of the X deflection control.
- Depress pushbutton D of the main time base trigger source control.
- Adjust the main time base TIME/DIV switch to a suitable position.
- Put the delayed time base TIME/DIV switch in the OFF position.
- Select DC signal coupling for the triggering.
- Apply a square-wave voltage of 60 mV/2 kHz, rise time ≤ 1 ns to the channel D input.
- Check that the pulse top of the trigger view signal is straight and that the rise time is as short as possible.
- Increase the repetition rate of the input signal to 30 kHz.
- Check that the pulse top is straight within 10% and that the rise time is as short as possible. If necessary readjust potentiometer **R408 D** and **R409 D** or select a different value for the capacitors C404 D and C406 D.

- Increase the repetition rate of the input signal to 100 kHz.
- Check that the pulse top is straight within 10% and that the rise time is as short as possible.
If necessary readjust potentiometer **R411 D** or select a different value for the capacitor **C407 D**.
- Remove the input signal.

5.3.7.19 Bandwidth check trigger view via channel A (B, C, D)

- Depress pushbutton TRIG VIEW of the display-mode control.
- Put the AMPL/DIV switches in the 10 mV/DIV position and their verniers to CAL.
- Put the input signal coupling switches in the AC position.
- Depress pushbutton MAIN TB of the X deflection selector.
- Depress pushbutton A (B, C, D) of the main time base trigger-source selector.
- Put the main time base TIME/DIV switch in the 2 ms/DIV position and its vernier to CAL.
- Apply a sine-wave voltage of 60 mV_{p-p}/2 MHz to the channel A (B, C, D) input socket.
- Centre the trigger view signal by means of the main time base level control.
- Check that the trace height of signal is exactly 6 DIV.
- Increase the frequency of the input signal up to 80 MHz and check that the trace height remains at least 4,2 DIV.
- Remove the input signal.

5.3.7.20 Bandwidth check trigger view via external trigger input

- Depress pushbutton TRIG VIEW of the display-mode control.
- Put the signal coupling switch (PULL FOR AC) in the DC position.
- Depress pushbutton MAIN TB of the X deflection selector.
- Select the external trigger input (EXT) for main time base triggering.
- Put the main time base TIME/DIV switch in the 2 ms/DIV position and its vernier to CAL.
- Apply a sine-wave of 600 mV_{p-p}/2 MHz to the external trigger input socket.
- Check that the trace height is 6 DIV.
- Increase the frequency of the input signal up to 80 MHz and check that the trace height remains at least 4,2 DIV.
- Remove the input signal.

5.3.8. Triggering

5.3.8.1. Trigger slope and level of main time base (unit 9)

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Select DC trigger coupling.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Set the switch of the channel A input-coupling control to DC.
- Push the channel A Y POSITION control to the non-inverted position.
- Set the channel A AMPL/DIV switch to 20 mV and its vernier to CAL.
- Set the m.t.b. TIME/DIV switch to 10 μ s and its vernier to CAL.
- Set the d.t.b. TIME/DIV switch to OFF.
- Apply a sine-wave voltage of 120 mV_{p-p}, frequency 30 kHz, to the channel A input.
- Centre the display, using the POSITION control.
- Centre the starting point of the sine-wave, using the m.t.b. LEVEL control.
- Check that the starting point of the signal does not move when the SLOPE switch is set from + to —; if necessary readjust potentiometer **R881** on the trigger-amplifier board.

- Push the SLOPE switch to its + position.
- Check that the time base generator starts on the positive-going edge of the sine-wave and moves upwards when the LEVEL potentiometer is turned clockwise.
- Pull the SLOPE switch to its – position.
- Check that the time base generator starts on the negative-going edge of the sine-wave.
- Set the channel A AMPL/DIV switch to 5 mV/DIV.
- Rotate the m.t.b. LEVEL control fully clockwise and fully anti-clockwise.
- Check that in both extreme positions the time base generator cuts out and that the NOT TRIG'D lamp lights up, if necessary readjust potentiometer R845 on the trigger amplifier.
- Increase the amplitude of the input signal to 160 mV_{p-p}
- Rotate the m.t.b. LEVEL control fully clockwise and anti-clockwise.
- Check that in both extreme positions the trace remains triggered and that the NOT TRIG'D lamp does not light up.
- Remove the input signal.

5.3.8.2. *Trigger sensitivities check for main time base*

- Depress pushbutton MAIN TB of the X deflection selector (S8).
- Adjust the main time base LEVEL for a well triggered display.
- Put the input coupling switches in the DC position.
- Adjust the MAIN TB TIME/DIV switch to such a position that a reasonable number of sine-waves is written on the screen.
- Put the DEL'D TB TIME/DIV switch in the OFF position.
- Check the trigger sensitivities in accordance with the table below.

WWW.JETECNET.COM

Input socket	Vertical display mode	Frequency of sine-wave	Trigger coupling	Trigger mode	Trigger source	Trace height /amplitude
A	Ch. A	20 Hz	DC	Auto	A	0,5 div.
A	Ch. A	30 MHz	DC	Auto	A	0,5 div.
A	Ch. A	100 MHz	DC	Auto	A	1,5 div.
A	Ch. A	20 Hz	DC	Trigg.	A	0,5 div.
A	Ch. A	30 MHz	DC	Trigg.	A	0,5 div.
A	Ch. A	100 MHz	DC	Trigg.	A	1,5 div.
A	Ch. A	100 Hz	AC	Trigg.	A	0,5 div.
A	Ch. A	20 kHz	AC	Trigg.	A	0,5 div.
A	Ch. A	100 MHz	AC	Trigg.	A	1,5 div.
B	Ch. B	20 Hz	DC	Trigg.	B	0,5 div.
B	Ch. B	30 MHz	DC	Trigg.	B	0,5 div.
B	Ch. B	100 MHz	DC	Trigg.	B	1,5 div.
A and B	Ch. A and B/ALT	30 MHz	AC	Trigg.	Comp.	0,5 div.
C	Ch. C	20 Hz	DC	Trigg.	C	0,5 div.
C	Ch. C	30 MHz	DC	Trigg.	C	0,5 div.
C	Ch. C	100 MHz	DC	Trigg.	C	1,5 div.
D	Ch. D	20 Hz	DC	Trigg.	D	0,5 div.
D	Ch. D	30 MHz	DC	Trigg.	D	0,5 div.
D	Ch. D	100 MHz	DC	Trigg.	D	1,5 div.
external	Ch. A	20 Hz	DC	Trigg.	Ext.	50 mV
external	Ch. A	30 MHz	DC	Trigg.	Ext.	50 mV
external	Ch. A	100 MHz	DC	Trigg.	Ext.	150 mV

5.3.8.3. Single sweep operation check

- Depress pushbutton A of the display-mode controls (S27).
- Set the channel A AMPL/DIV switch to .2 V/DIV and its vernier to CAL.
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Set the m.t.b. LEVEL control to mid-range.
- Set the m.t.b. TIME/DIV switch to .1 s and the vernier to CAL.
- Set the d.t.b. TIME/DIV switch to OFF.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Depress pushbutton AUTO of the m.t.b. trigger-mode control (S25).
- Apply a sine-wave signal of 5 Hz to the channel A input.
- Adjust the trace-height to approximately 6 DIV
- Set the switch of the channel A signal-coupling control to 0.
- Push the SINGLE button of the m.t.b. trigger-mode controls (S25).
- Check that the NOT TRIG'D lamp lights up.
- Set the switch of the channel A signal-coupling control to AC.
- Check that the trace is written once and that the NOT TRIG'D lamp is extinguished at the end of the sweep.
- Remove the input signal.

5.3.8.4. Mains frequency triggering check

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Depress pushbutton AUTO of the trigger-mode controls.
- Select DC trigger coupling.
- Set the m.t.b. TIME/DIV switch to 5 ms and its vernier to CAL.
- Select external main time base triggering (EXT, S30).
- Apply a mains voltage derived signal to the channel A input.
- Adjust the trace height to approx. 3 DIV; the trace must be running.
- Select main time base triggering by a mains voltage derived signal (LINE, S30).
- Check that a stable display can be obtained, using the m.t.b. LEVEL control.
- Remove the input signal.

5.3.8.5. Trigger slope and level check of the delayed time base

- Depress pushbutton A of the display-mode controls (S27).
- Depress pushbutton DEL'D TB of the X deflection controls (S8).
- Depress pushbutton A of the d.t.b. trigger-source controls (S29).
- Select DC trigger coupling.
- Push the channel A Y POSITION control to the non-inverted position.
- Set the channel A AMPL/DIV switch to 20 mV/DIV and its vernier to CAL.
- Turn the DELAY TIME (R3) control fully anti-clockwise.
- Set the m.t.b. TIME/DIV switch to 20 μ s and its vernier to CAL.
- Set the d.t.b. TIME/DIV switch to 10 μ s and its vernier to CAL.
- Apply a sine-wave voltage of 120 mV_{p-p}, frequency 30 kHz, to the channel A input.
- Centre the display, using the POSITION controls.
- Centre the starting point of the sine-wave, using the d.t.b. LEVEL control.
- Check that the starting point of the signal does not move when the SLOPE switch is set from + to –.
- Push the SLOPE switch to its + position.
- Check that the time base generator starts on the positive-going part of the sine-wave and moves upwards when the d.t.b. LEVEL potentiometer is turned clockwise.

- Pull the SLOPE switch to – position.
- Check that the time base generator starts on the negative-going part of the sine-wave.
- Set the channel A AMPL switch to 5 mV/DIV and its vernier to CAL.
- Rotate the d.t.b. LEVEL control fully clockwise and anti-clockwise.
- Check that in both extreme positions the time base generator cuts out; if not readjust potentiometer **R1238** on the trigger amplifier (unit 9).
- Increase the amplitude of the input signal to 160 mV_{p-p}.
- Rotate the d.t.b. LEVEL control fully clockwise and anti-clockwise.
- Check that in both extreme positions the trace remains triggered.
- Remove the input signal.

5.3.8.6. Trigger sensitivities check for delayed time base

- Depress pushbutton DEL'D TB of the X deflection controls (S8).
- Adjust the d.t.b. LEVEL control for a stationary display.
- Depress pushbutton AUTO of the m.t.b. trigger-mode controls.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Select DC trigger coupling.
- Set the m.t.b. TIME/DIV switch one position lower (longer sweep time) than the d.t.b. TIME/DIV switch.
- Set the d.t.b. TIME/DIV switch to such a position that a reasonable number of sine-waves is written (except for 20 Hz).
- Check the trigger sensitivity in accordance with the table below.

Input socket	Vertical display mode	Frequency of sine-wave	Trigger coupling	Trigger mode	Trigger source	Trace height /amplitude
A	Ch. A	20 Hz	DC	—	Starts	0,5 div.
A	Ch. A	30 MHz	DC	—	Starts	0,5 div.
A	Ch. A	100 MHz	DC	—	Starts	1,5 div.
A	Ch. A	20 Hz	DC	A	Trigg.	0,5 div.
A	Ch. A	30 MHz	DC	A	Trigg.	0,5 div.
A	Ch. A	100 MHz	DC	A	Trigg.	1,5 div.
A	Ch. A	100 Hz	AC	A	Trigg.	0,5 div.
A	Ch. A	20 kHz	AC	A	Trigg.	0,5 div.
A	Ch. A	100 MHz	AC	A	Trigg.	1,5 div.
B	Ch. B	20 Hz	DC	B	Trigg.	0,5 div.
B	Ch. B	30 MHz	DC	B	Trigg.	0,5 div.
B	Ch. B	100 MHz	DC	B	Trigg.	1,5 div.
C	Ch. C	20 Hz	DC	C	Trigg.	0,5 div.
C	Ch. C	30 MHz	DC	C	Trigg.	0,5 div.
C	Ch. C	100 MHz	DC	C	Trigg.	1,5 div.
D	Ch. D	20 Hz	DC	D	Trigg.	0,5 div.
D	Ch. D	30 MHz	DC	D	Trigg.	0,5 div.
D	Ch. D	100 MHz	DC	D	Trigg.	1,5 div.

5.3.9. Checking the delay-time jitter

- Depress pushbutton A of the display-mode controls (S27).
- Set the DELAY TIME (R3) control to 9.00.
- Push the TB MAGN switch to position x1.
- Depress pushbutton DEL'D TB of the X deflection controls (S8).
- Set the d.t.b. TIME/DIV switch to $2\mu\text{s}$ and its vernier to CAL.
- Set the m.t.b. TIME/DIV switch to 1 ms and its vernier to CAL.
- Depress pushbutton AUTO of trigger-mode controls.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Depress pushbutton STARTS of the d.t.b. trigger-mode switch.
- Apply a square-wave voltage for a trace height of 4 DIV, repetition rate $20\mu\text{s}$, to the channel A input.
- Adjust the m.t.b. LEVEL control for a stable, triggered display.
- Check that the time jitter does not exceed 0,3 DIV.
- Depress pushbutton A of the d.t.b. trigger-source controls (S29).
- Check that a jitter-free display can be obtained, setting the d.t.b. LEVEL control.
- Remove the input signal.

5.3.10. Horizontal amplifier

5.3.10.1. Bandwidth check

- Depress pushbutton B of the display-mode controls (S27).
- Depress pushbutton EXT X DEFL of the X deflection controls (S8).
- Push the TB MAGN switch to x1.
- Depress pushbutton A of the m.t.b. trigger-source controls (S30).
- Apply a sine-wave voltage of $3\text{ V}_{\text{p-p}}$, frequency 2 kHz, to the channel A input.
- Check that the trace width is 6 DIV.
- Increase the frequency of the input signal to 2 MHz.
- Check that the trace width is at least 4,2 DIV.
- Remove the channel A input signal.

5.3.10.2. Checking the phase difference between horizontal and vertical channels

- Depress pushbutton A (B, C, D) of the display-mode controls (S27).
- Push the Y POSITION controls to non-inverted position.
- Set both AMPL/DIV switches to 5 mV/DIV and their verniers to CAL.
- Set the switches of the signal-coupling controls of channel A, B, C and D to DC.
- Depress pushbutton EXT X DEFL of the X deflection controls (S8).
- Depress pushbutton A (B, C, D) of the m.t.b. trigger-source controls (S30).
- Apply a sine-wave voltage of $30\text{ mV}_{\text{p-p}}$, frequency 100 kHz, to the channel A (B, C, D) input.
- Check that the phase difference does not exceed 3° (see Fig. 5.7.) in which $\frac{B}{A}$ equals the sine of the phase error angle.

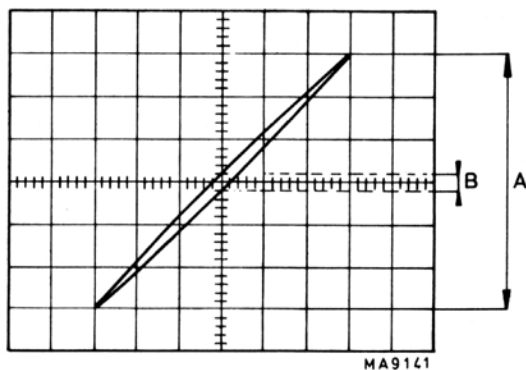


Fig. 5.7. Phase difference in X - Y mode.

5.3.11. Checking periodic and random deviations

- The cabinet plates must be fitted for the measurement.
- The channel A, B, C and D inputs must be open.
- Put the AMPL/DIV switches in the 2 mV/DIV position.
- Select AC signal coupling for channel A, B, C and D.
- Select channel A, B, C and D on the vertical display-mode switch S27.
- Select alternate display-mode (ALT, S30).
- Put the delayed time base TIME/DIV switch in the OFF position.
- Depress pushbutton MAIN TB of the X deflection selector (S8).
- Depress pushbutton AUTO of the trigger-mode switch S25.
- Measure the periodic and random deviations in accordance with the following table.

Ripple	1/20 DIV
Noise	1/20 DIV
Microphony	1/20 DIV
Power supply converter interference	1/20 DIV
Instability of the trace	1/20 DIV
Parasitic Z modulation	not visible

5.3.12. Checking the effect of mains voltage variations

- Depress pushbutton CHOP of the display-mode controls (S28).
- Depress pushbutton MAIN TB of the X deflection controls (S8).
- Pull the TB MAGN switch to x10.
- Set the m.t.b. TIME/DIV switch to 2 ms and its vernier to CAL.
- Set the d.t.b. TIME/DIV switch to OFF.
- Depress pushbutton AUTO of the trigger-mode controls.
- Set both AMPL/DIV switches to 0.5 V/DIV and their verniers to CAL.
- Set the switches of the signal-coupling controls of channel A and B to AC.
- Interconnect the CAL socket and inputs A and B.
- Vary the mains voltage by + and – 10%.
- Check that neither trace height nor trace width changes and that the brilliance remains the same.
- Remove the input signal of channel A and B.

5.4. PERFORMANCE CHECK

5.4.1. General information

This procedure is intended to be used for incoming inspection to determine the acceptability of newly purchased or recently recalibrated instruments.

If 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.

- The specifications are valid after the instrument has warmed up for 30 minutes (reference temperature 23°C).
- Properties expressed in numerical values with tolerance stated, are guaranteed by the manufacturer. Numerical values without tolerances are typical and represent the characteristics of an average instrument.
- Inaccuracies (absolute or in %) relate to the indicated reference value.
- The performance checks are made with a stable, well-focused, low-intensity display. Unless otherwise noted, adjust the intensity position and trigger-level controls as needed:

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

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

NOTE 3: Set the TIME/DIV switches of MAIN TIME BASE (S5) and of DELAYED TIME BASE (S1) to a suitable position; unless otherwise stated.

NOTE 4: The required test equipment is indicated in the table in chapter 5.1.2. Only the trimming tools, the digital multimeter and the measuring oscilloscope from this list are not necessary.

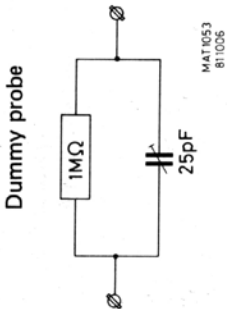
5.4.2. Preliminary settings of the controls.

NOTE: The itemnumbers of controls and sockets are indicated in fig. 3.1. of the operating manual.

- Switch the instrument on with S31.
- Depress pushbutton A of S27 (other pushbuttons of S27 released).
- Depress pushbutton MAIN TB of S8.
- Depress pushbutton AUTO of S25.
- Depress the POSITION and LEVEL controls R14/S21, R15/S22, R18/S23, R19/S24, R6/R7/S7, R2/S3 and R4/S4.
- Put the input coupling switches AC/0/DC of channel A, B, C, D (S17, S18, S19, S20) in the DC position.
- Put the time-base coupling switch S32 (PULL FOR AC) in the DC position by depressing it.
- Depress pushbutton A of the MTB trigger source selector S30.
- Depress pushbutton STARTS of S26.
- Put the continuous controls of the vertical channels and time-bases R8/S10, R9/S12, R10/S14, R11/S16, R1/S2 and R5/S6 in the CAL position
- Turn the DELAY TIME control R3 fully anti-clockwise.

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
5.4.3. Performance check				
5.4.3.1. Power supply				
— Mains voltage ranges	90 ... 140VAC 200 ... 264VAC	from variable mains transformer	Display a sine-wave of 100kHz/6 Div. on screen	Check that X and Y deflection and intensity do not change within mains voltage range.
— Power consumption	Mains voltage	—		Check that power consumption is 50Watt approximately.
5.4.3.2. CRT display				
— Graticule illumination	—	Operate ILLUM control R21	Check proper functioning and adjust to desired illumination.	
— Intensity	—	Operate INTENS control R22.	Check proper functioning and adjust to normal intensity.	
— Focus	—	Operate FOCUS control R23.	Check proper functioning and adjust to a sharp trace.	
— Trace rotation	—	Operate screw-driver adjustment R26.	Adjust, if necessary, so that trace is in parallel with horizontal graticule lines.	
5.4.3.3. Vertical deflection				
— Display modes	Square-wave signal 10kHz/120mV p.p. applied to A, B, C, D input	Put AMPL/DIV switches to 20mV. — Depress A of S27 — Depress B of S27. — Depress C of S27. — Depress D of S27. — Depress TRIG VIEW of S27. — Depress CHOP of S28 and A, B, C, D and TRIG VIEW of S27.	— Check for approx. 6 Div. deflection — Check for approx. 6 Div. deflection — Check for approx. 6 Div. deflection. — Check for approx. 6 Div. deflection. — Check for approx. 6 Div. deflection. — Check for deflection (6 Div. approx.) from channel A, B, C, D and TRIG VIEW.	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
			Depress ALT of S28 and A, B, C, D and TRIG VIEW of S27.	Check for deflection (6 Div. approx.) from chann. A, B, C, D and TRIG VIEW.
	Square-wave signal 10kHz/200mV p.p. applied to A, B, C and D input.	- Put the A, B, C and D AMPL/DIV switches to 50mV. - Depress A + B of S27.	Check for approx. 8 Div. deflection.	
		Depress C + D of S27.	Check for approx. 8 Div. deflection.	
Channel A, B, C, D INVERT	Square-wave signal 10kHz/200mV p.p. applied to A, B, C and D input.	- Depress A, B, C, D of S27 and ALT of S28. - Put the A, B, C and D AMPL/DIV switches to 50mV. - Pull switch PULL to INVERT of channel A, B, C and D.	Check that the signal from channel A, B, C and D is inverted.	
Vertical deflection accuracy	Square-wave signal 1kHz from a calibration generator to input A (B, C, D) ampli: 10mV p.p. 20mV p.p. 50mV p.p. 0,1V p.p. 0,2V p.p. 0,5V p.p. 1V p.p. 2V p.p. 5V p.p. 10V p.p. 20V p.p.	- Depress pushbutton A (B, C, D) of S27. - A (B) AMPL/DIV in position:	- Check for 5 Div. ($\pm 5\%$) deflection - Check for 4 Div. ($\pm 3\%$) deflection - Check for 5 Div. ($\pm 3\%$) deflection - Check for 5 Div. ($\pm 3\%$) deflection - Check for 4 Div. ($\pm 3\%$) deflection - Check for 5 Div. ($\pm 3\%$) deflection - Check for 4 Div. ($\pm 3\%$) deflection - Check for 5 Div. ($\pm 3\%$) deflection - Check for 4 Div. ($\pm 3\%$) deflection - Check for 5 Div. ($\pm 3\%$) deflection - Check for 4 Div. ($\pm 3\%$) deflection	
Continuous gain control	Square-wave signal 10kHz/120mV p.p. to input A (B, C, D).	Turn continuous control R8(R9, R10, R11) counterclockwise and AMPL/DIV to 20mV.	- Check that UNCAL LED V4 (V5, V6, V7) lights up. - Check that the vertical deflection can be decreased by a factor of 2,5 times at least.	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
— Input capacitance  Dummy probe	Apply square-wave signal 1kHz from a calibration generator to A (B, C, D) via dummy probe: ampl: 20mV p.p. 50mV p.p. 0,1V p.p. 0,2V p.p. 0,5V p.p. 1V p.p. 2V p.p. 5V p.p. 10V p.p. 20V p.p. 50V p.p.	AMPL/DIV switch S9 (S11, S13, S15) in position: 2mV 5mV 10mV 20mV 50mV 0,1V 0,2V 0,5V 1 V 2 V 5 V	Check for 5 Div. ($\pm 5\%$) deflection Check for 5 Div. ($\pm 3\%$) deflection	
— Input coupling AC-0-DC	Sine-wave signal 10kHz/120mV p.p. on positive DC offset voltage so that bottom level is 0 Volt applied to A, B, C and D.	— AMPL/DIV switch S9 (S11, S13, S15) in 20mV. — Select 0 of S17 (S18, S19, S20) — Put trace in vertical mid of screen by R14 (R15, R18, R19). — Select AC of S17 (S18, S19, S20). — Select DC of S17 (S18, S19, S20)	Check for 5 Div. ($\pm 3\%$) deflection	Signal must be visible in vertical centre of screen. Signal must be shifted upwards from vertical centre of screen.
— Common mode rejection.	Apply a sine-wave 2MHz/0,8V p.p. to channel A and B input.	— AMPL/DIV switches of channel A, B in position 0,1V. — Pull R15/S22 (PULL TO INVERT) of channel B. — Adjust R8 and R9 for minimum difference in channel A and B deflection. — Depress A + B of S27.	Check that vertical deflection is 0,08 Div. or less. Check that vertical deflection is 0,4 Div. or less.	
	Increase frequency to 50MHz.	— Readjust R8 and R9 if necessary		

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
	Apply a sine-wave 2MHz/ 0,8V p.p. to channel C, D input.	– AMPL/DIV switches of channel C, D in position 0,1V. – Pull R19/S24 (PULL TO INVERT) of channel D. – Adjust R10 and R11 for minimum difference in channel C and D deflection. – Depress C + D of S27. – Depress C of S30. – Readjust R10 and R11 if necessary.	Check that vertical deflection is 0,08 Div. or less.	
	Increase frequency to 50MHz		Check that vertical deflection is 0,4 Div. or less.	
– Dynamic range	Apply a sine-wave signal of 35MHz/2,4V p.p. to channel A (B, C, D).	– Depress AC of S17 (S18, S19, S20) – Put the AMPL/DIV switches in position 0,1V. – Shift the trace, with control R14 (R15, R18, R19). – Put the AMPL/DIV switches in 20mV. – Switch S28 to CHOP and depress A and B of S27. – Put the AMPL/DIV switches in 20mV. – Switch S28 to CHOP and depress C and D of S27. – Put the AMPL/DIV switches to 2mV.	Check that top and bottom of the signal can be made visible when operating R14 (R15, R18, R19).	
– Cross-talk	Apply a sine-wave to the A (B) input 35MHz/100mV p.p. Apply a sine-wave to the C (D) input of 35MHz/160mV p.p.		Check that the deflection of channel B (A) is invisible (within time base line width).	
– Pulse aberrations and rise-time	Apply a square-wave signal 1MHz/10mV p.p. /rise-time ≤ 1 ns from a calibration generator to channel A (B, C, D).		Check that the deflection of channel B (A) is invisible (within time base line width). – Check that the aberrations on top of the positive signal edge do not exceed $\pm 5\%$ p.p. – Check that the rise-time does not exceed 10ns. This is the time necessary for the signal edge to come from 10% to 90% of the signal amplitude.	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
	Increase the calibration generator amplitude to 100mV	Put the AMPL/DIV switches to 20mV.	- Check that the aberrations do not exceed $\pm 4\%$ p.p. - Check that the rise-time does not exceed 3,5ns. This is the time necessary for the signal edge to come from 10% to 90% of the signal amplitude.	
Visible signal delay.	Apply a square-wave signal 1MHz/100mV p.p./rise-time ≤ 1 ns. from a calibration generator to channel A.	- Put the A AMPL/DIV switch to 20mV. - Pull the TB MAGN control. - Put the TIME/DIV switch in 0,05μs.	Check that MAGN LED V3 lights up. Check that the visible signal delay is at least 15ns.	
Trace jump attenuator A (B, C, D)	—	- Put S17 (S18, S19, S20) in the "0" position. - Depress pushbutton A (B, C, D) of S27. - Put the trace in the vertical screen centre. - Switch the AMPL/DIV between 2 and 5mV - Switch the AMPL/DIV between 5mV and 5V.	Check that the trace jump ≤ 2 Div. Check that the trace jump $\leq 0,2$ Div.	
Trace jump normal/invert A (B, C, D)	—	- Put S17 (S18, S19, S20) in the "0" position. - Depress pushbutton A (B, C, D) of S27. - Put the trace in the vertical screen centre. - Pull and push switch PULL TO INVERT. - AMPL/DIV in position 20mV. - AMPL/DIV in position 2mV.	Check that the trace jump $\leq 0,5$ Div. Check that the trace jump ≤ 2 Div.	
Trace jump continuous control	—	- Put S17 (S18, S19, S20) in the "0" position. - Depress pushbutton A (B, C, D) of S27. - Put the trace in the vertical screen centre. - Operate the continuous control R8 (R9, R10 R11). - AMPL/DIV in position 20mV. - AMPL/DIV in position 5mV. - AMPL/DIV in position 2mV.	Check that the trace jump $\leq 0,2$ Div. Check that the trace jump $\leq 0,4$ Div. Check that the trace jump ≤ 1 Div.	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
- Trace jump added A + B - Trace jump added C + D.	-	- Put S17 and S18 in the "0" position. - Depress pushbutton A and B of S27. - Put the traces in the vertical screen centre. - Depress A + B of S27. - A and B AMPL/DIV in position 20mV	Check that the trace has a distance from the vertical screen centre $\leq 0,5$ Div. Check for a distance ≤ 1 Div. Check for a distance ≤ 2 Div.	
		- A and B AMPL/DIV in position 5mV. - A and B AMPL/DIV in position 2mV. - Put S19 and S20 in the "0" position. - Depress pushbutton C and D of S27. - Put the C and D traces in the vertical screen centre. - Depress C + D of S27. - C and D AMPL/DIV in position 20mV.	Check that the trace has a distance from the vertical screen centre $\leq 0,5$ Div. Check for a distance ≤ 1 Div. Check for a distance ≤ 2 Div.	
Bandwidth A (B, C, D).	Sine-wave signal 50kHz/ 120mV p.p. applied to input A (B, C, D). Increase the frequency up to 100MHz.	- C and D AMPL/DIV in position 5mV. - C and D AMPL/DIV in position 2mV. - Put the AMPL/DIV in position 20mV. - Put the TIME/DIV in position 50 μ s/DIV.	Check for 6 Div. vertical deflection. If necessary correct generator output to 6 Div. deflection.	
		- Put the AMPL/DIV in position 2mV. - Put the TIME/DIV in position 50 μ s/DIV.	Check for a vertical deflection $\geq 4,2$ Div. over the whole bandwidth.	
- Bandwidth A (B, C, D) in 2mV/Div.	Sine-wave signal 50kHz/ 12mV p.p. applied to input A (B, C, D). Increase generator frequency to 35MHz.		Check for 6 Div. vertical deflection. If necessary correct generator output to 6 Div. deflection.	
			Check for a vertical deflection $\geq 4,2$ Div. over the whole bandwidth.	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
5.4.3.4. Trigger view				
— Vertical deflection accuracy via channel A (B, C, D).	Square-wave signal 1kHz from a calibration generator applied to input A (B, C, D).	- Depress A (B, C, D) of S30. - Depress TRIG VIEW of S27. - AMPL/DIV switch S9 (S11, S13, S15) in position:	- Check for 5 Div. ($\pm 10\%$) deflection - Check for 4 Div. ($\pm 10\%$) deflection - Check for 5 Div. ($\pm 10\%$) deflection - Check for 5 Div. ($\pm 10\%$) deflection - Check for 4 Div. ($\pm 10\%$) deflection - Check for 5 Div. ($\pm 10\%$) deflection - Check for 5 Div. ($\pm 10\%$) deflection - Check for 4 Div. ($\pm 10\%$) deflection - Check for 5 Div. ($\pm 10\%$) deflection - Check for 5 Div. ($\pm 10\%$) deflection - Check for 4 Div. ($\pm 10\%$) deflection - Check for 5 Div. ($\pm 10\%$) deflection	
	ampl.: 10mV 20mV 50mV 0,1V 0,2V 0,5V 1 V 2 V 5 V 10 V 20 V	2mV 5mV 10mV 20mV 50mV 0,1V 0,2V 0,5V 1 V 2 V 5 V		
— Vertical deflection accuracy via EXT trig. input.	Square-wave signal 1kHz/500mV p.p. from calibration generator applied to ext. trig. input X8.	- Depress EXT of S30 - Depress TRIG VIEW of S27.	Check for 5 Div. ($\pm 3\%$) deflection	
— Pulse aberrations	Square-wave signal 1MHz/100mV p.p./rise-time $\leq 1\text{ns}$ from calibration generator to input A (B, C, D).	- Put the A (B, C, D) AMPL/DIV in position 20mV. - Depress TRIG VIEW of S27. - Depress A (B, C, D) of S30. - Depress TRIG VIEW of S27. - Depress EXT of S30.	Check that the aberrations on top of the positive signal edge do not exceed $\pm 10\%$ p.p.	
	Square-wave signal 1MHz/500mV p.p./rise-time $\leq 1\text{ns}$ from calibration generator to EXT input X8.		Check that the aberrations on top of the positive signal edge do not exceed $\pm 10\%$ p.p.	
— Time delay between channel A (B, C, D) and EXT trig. input via TRIG VIEW.	Square-wave signal 1MHz/500mV p.p./rise-time $\leq 1\text{ns}$ from a calibration generator applied to input A (B, C, D) and input EXT (X8).	- AMPL/DIV A (B, C, D) in position 0,1V. - Depress A (B, C, D) and TRIG VIEW of S27 and ALT of S28. - Put the TIME/DIV switch S15 in 0,05μs position. - Pull the TB MAGN control. - Depress EXT of S30.	Check that the time delay between the positive going slopes of A (B) signal and TRIG VIEW signal is $\leq 2\text{ns}$ ($\pm 1\text{ns}$).	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
Bandwidth internal TRIG VIEW via channel A (B, C, D).	Apply sine-wave 50kHz/120mV p.p. to input A (B, C, D).	- Depress TRIG VIEW of S27. - Put A (B, C, D) AMPL/DIV in position 20mV.	Check for 6 Div. vertical deflection If necessary correct generator output to 6 Div. deflection.	
	Increase the frequency up to 80MHz.		Check for a vertical deflection $\geq 4,2$ Div. over the whole bandwidth.	
Bandwidth external TRIG VIEW	Apply sine-wave 50kHz/600mV p.p. to input EXT (X8).	- Depress TRIG VIEW of S27. - Depress EXT of S30.	Check for 6 Div. vertical deflection. If necessary correct generator output to 6 Div. deflection.	
	Increase the frequency up to 80MHz.		Check for a vertical deflection $\geq 4,2$ Div. over the whole bandwidth.	
5.4.3.5. Horizontal deflection				
Display modes and trace separation	Square-wave signal 2kHz/120mV p.p. applied to input A.	- Channel A AMPL/DIV in position 50mV. - MTB TIME/DIV (S5) in position 0,2ms. - Depress MAIN TB of S8. - DTB TIME DIV (S1) in position 50μs. - Depress DELD TB of S8. - Depress ALT TB of S8.	Check for 2,4 Div. square-wave on MTB time scale.	
			Check that intensified part (=DTB sweep) is visible on MTB trace.	
			Intensified part must be visible over horizontal screen width.	
			Both the MTB and DTB are present.	
			Check that the vertical shift between both signals is adjustable by means of TRACE SEP control (R20) over ≥ 4 Div.	
5.4.3.6. Triggering of main time base				
Trigger source and trigger coupling.	Square-wave signal 100Hz/120mV p.p. applied to input A.	Channel A AMPL/DIV switch in position 20mV.	Triggered display	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
		- Depress TRIG VIEW of S27. - Pull control R24/R25/S32 (PULL FOR AC).	Check for a differentiated square-wave signal: only the rising and falling slopes are undistorted.	
	Square-wave signal 2kHz/600mV p.p. applied to input B (C, D) and EXT. (X8).	- Depress B (C, D) of S27. - Channel B (C, D) AMPL/DIV in position 0,1V. - Depress control PULL FOR AC. - Depress B of S30. - Depress EXT of S30.	Triggered display. Triggered display.	
	- Sine-wave 10kHz/120mV p.p. to channel A and B input and CAL voltage (X1/X2) to channel C and D input. - Signals have no time relation	- A, B AMPL/DIV in position 20mV. - C, D AMPL/DIV in position 0,5V. - Depress A and B (COMP) of S30. - Depress ALT of S28 and A, B, C, D of S27.	Check for triggered display of the channel A, B, C and D signals.	
		- Depress B and C (LINE) of S30. - Depress TRIG VIEW of S27. - MTB TIME/DIV in position 5ms.	Check for a signal at mains frequency.	
Trigger sensitivity internal via channel A (B, C, D).	Sine-wave signal 30MHz/50mV p.p. to input A (B, C, D).	- AMPL/DIV A (B, C, D) in position 0,1V. - Depress A (B, C, D) of S30. - Depress A (B, C, D) of S27.	Check that the signal on the screen (amplitude 0,5 Div.) can be triggered.	
	Sine-wave signal 100MHz/150mV p.p. to input A (B, C, D).	- AMPL/DIV A (B, C, D) in position 0,1V. - Depress A (B, C, D) of S30. - Depress A (B) of S27.	Check that the signal on the screen (amplitude 1,5 Div.) can be triggered.	
Trigger sensitivity external.	Sine-wave signal 30MHz/50mV p.p. applied to input A and EXT (X8).	- AMPL/DIV A in position 20mV. - Depress EXT of S30.	Check that the signal on the screen can be triggered.	
	Sine-wave signal 100MHz/150mV p.p. applied to input A and EXT (X7).	- AMPL/DIV A in position 50mV. - Depress EXT of S30.	Check that the signal on the screen can be triggered.	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
— Level range and trigger slope.	Sine-wave signal 1kHz/480mV p.p. applied to input A.	— A AMPL/DIV in position 20mV.	Check that the signal can be triggered over the whole waveform (24 Div.) on the screen.	
		— Operate the LEVEL control R4.		
	Sine-wave signal 1kHz/2,4V p.p. applied to input A and EXT (X8).	— Operate the + / — SLOPE switch S4.	Check that the signal starts at respectively the + going or — going edge.	
		— AMPL/DIV in position 0,5V. — Depress EXT of S30.	Check that the signal can be triggered over the whole waveform on the screen.	
5.4.3.7. Main time base				
Time-coefficients	Time marker pulser with repetition rate applied to A input.	— Depress TRIG of S25.	Check that time coefficient error:	
		— A AMPL/DIV in position 0,5V. — MTB TIME/DIV switch in position:		
	0,05 μ s	0,05 μ s	$\leq 2\%$	
	0,1 μ s	0,1 μ s	"	
	0,2 μ s	0,2 μ s	"	
	0,5 μ s	0,5 μ s	"	
	1 μ s	1 μ s	"	
	2 μ s	2 μ s	"	
	5 μ s	5 μ s	"	
	10 μ s	10 μ s	"	
	20 μ s	20 μ s	"	
	50 μ s	50 μ s	"	
	0,1 ms	0,1 ms	"	
	0,2 ms	0,2 ms	"	
	0,5 ms	0,5 ms	"	
	1 ms	1 ms	"	
	2 ms	2 ms	"	
	5 ms	5 ms	"	
	10 ms	10 ms	"	
	20 ms	20 ms	"	
	50 ms	50 ms	"	
	0,1 s	0,1 s	"	
	0,2 s	0,2 s	"	
	0,5 s	0,5 s	"	
	1 s	1 s	"	

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
- Function TB MAGN	Time marker signal with repetition rate 1μs to A input	- A AMPL/DIV in position 0.5V.	- Check that MAGN LED V3 lights up.	
		- MTB TIME/DIV (S5) in position 10μs.	- Check that the trace can be shifted over 100 Div. in horizontal sense (R6/R7/S7).	
		- Pull the TB MAGN control R6/R7/S7.	- Check that the coefficient error does not exceed 3%.	
- Continuous MTB control hold off.	Time marker signal with repetition rate 1μs to A input.	- A AMPL/DIV in position 0.5V.	- Check that UNCAL LED V2 lights up.	
		- MTB TIME/DIV (S5) in position 1μs. R5/S6.	- Check that the horizontal deflection speed can be decreased by a factor of ≥ 2.5X.	
		- Turn the continuous MTB TIME/DIV control R5/S6.		
- Single shot function	Time marker signal with repetition rate 1ms to A input.	- Move the HOLD OFF control R6/R7/S7 out of the CAL position.	- Check that the intensity of the waveform on the screen decreases.	
		- A AMPL/DIV in position 0.5V.	- Depress SINGLE and check that NOT TRIG'D LED V8 lights up.	
		- MTB TIME/DIV (S5) in position 1ms. Operate pushbutton SINGLE of S25.	- Release SINGLE and check that the time base runs only once.	
5.4.3.8. Triggering of delayed time base				
- Trigger source selection via channel A (B, C, D)	Sine-wave voltage 1kHz/600mV p.p. applied to input A (B, C, D).	- A (B, C, D) AMPL/DIV in position 100mV.		
		- Depress A (B, C, D) of S30.		
		- Depress A (B, C, D) of S29.		
		- MTB TIME/DIV in position 0.2ms.		
		- DTB TIME/DIV in position 20μs.		
		- Depress A (B, C, D) of S27.		
		- Depress TRIG of S26.		
		- Adjust LEVEL control R4 for a triggered MTB trace.	- Check for a well triggered intensified DTB part on the MTB trace.	
		- Adjust LEVEL control R2 for a triggered DTB trace.		
- Trigger sensitivity via channel A (B, C, D).	Sine-wave signal 30MHz/50mV p.p. to input A (B, C, D).	- AMPL/DIV A (B, C, D) in position 0.1V.		
		- Depress A (B, C, D) of S30.		
		- Depress A (B, C, D) of S29.		
		- Depress A (B, C, D) of S27.		
		- MTB and DTB TIME/DIV in suitable positions.	Check for a well triggered intensified part on the MTB trace. If necessary readjust LEVEL controls R4 and R2.	

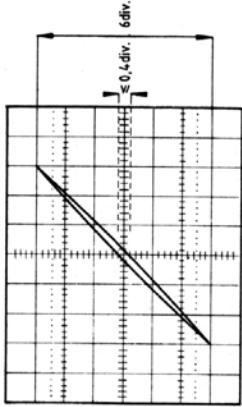
SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
— Level range and	Sine-wave signal 100MHz/150mV p.p. to input A (B, C, D).	— Same settings as above.	Check for a well triggered intensified part on the MTB trace. If necessary readjust LEVEL controls R4 and R2.	
	Sine-wave signal 1kHz/480mV applied to input A.	— Depress A of S29. — Select a triggered position for MTB LEVEL R4. — AMPL/DIV A in position 20mV p.p. — Operate the LEVEL control R2. — MTB TIME/DIV in position 0,2ms. — DTB TIME/DIV in position 20μs. — Operate the +/- SLOPE switch S3.	Check that the intensified part can be triggered over the whole waveform (24 Div.) on the screen. Check that the signal starts at respectively the + going or — going edge.	
5.4.3.9. Delayed time base				
— Time coefficients	Time marker pulses with repetition rate applied to input:	— Depress DEL'D TB of S2.	Check that time coefficient error:	≤ 2%
		— Depress TRIG of S8.		
		— TIME/DIV in position:		
		MTB (S15)		
	0,05 μs	0,1 μs		≤ 2%
	0,1 μs	0,2 μs		"
	0,2 μs	0,5 μs		"
	0,5 μs	1 μs		"
	1 μs	2 μs		"
	2 μs	5 μs		"
	5 μs	10 μs		"
	10 μs	20 μs		"
	20 μs	50 μs		"
	50 μs	0,1 ms		"
	0,1 ms	0,2 ms		"
	0,2 ms	0,5 ms		"
	0,5 ms	1 ms		"
	1 ms	2 ms		"
	2 ms	5 ms		"
	5 ms	10 ms		"
	10 ms	20 ms		"
		DTB (S13)		
		0,05 μs		"
		0,1 μs		"
		0,2 μs		"
		0,5 μs		"
		1 μs		"
		2 μs		"
		5 μs		"
		10 μs		"
		20 μs		"
		50 μs		"
		0,1 ms		"
		0,2 ms		"
		0,5 ms		"
		1 ms		"
		2 ms		"
		5 ms		"
		10 ms		"
		20 ms		"

5.4.3.9. Delayed time base

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
- Function TB MAGN	20 ms	50 ms	"	
	50 ms	0,1 s	"	
	0,1 s	0,2 s	"	
	0,2 s	0,5 s	"	
	0,5 s	1 s	"	
- Continuous DTB control	Time marker signal with a repetition rate of 0,1 μ s applied to the A input.	- A AMPL/DIV in position 0,5V.	- Check that the MAGN LED V3 lights up.	
		- MTB TIME/DIV in position 5 μ s.	- Check that the trace can be shifted over 100 Div. in horizontal sense by means of R6/R7/S7.	
		- DTB TIME/DIV in position 1 μ s.	- Check that the time coefficient error does not exceed 3%.	
		- Depress DEL'D TB of S8.	- Check that UNCAL LED V2 lights up.	
		- Pull the TB MAGN control R6/R7/S7.	- Check that the horizontal deflection speed can be decreased by a factor of $\geq 2,5X$.	
- DELAY TIME control	Square-wave signal 1MHz/120mV p.p. applied to A input.	- A AMPL/DIV in position 0,5V.		
		- MTB TIME/DIV in position 10 μ s.		
		- DTB TIME/DIV in position 1 μ s.		
		- Adjust DELAY TIME control R3 to 0,00.	- Check that the DTB trace starts at the same point as the MTB trace.	
		- Adjust the DELAY TIME control R3 to 9,00.	- Check that the DTB trace starts 9 Div. after the MTB trace.	
- Delay time jitter	Sine-wave signal 1MHz/120mV p.p. applied to A input.	- A AMPL/DIV in position 20mV.	- Check that the jitter of the DTB trace does not exceed 2/3 Div.	
		- MTB TIME/DIV in position 1ms.		
		- DTB TIME/DIV in position 0,5 μ s.		
		- Adjust the DELAY TIME control R3 to 5,00		
		- Depress DEL'D TB of S8.		

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
5.4.3.10.X/Y operation				
— Modes and deflection coefficients	Sine-wave signal 10kHz/120mV p.p. applied to input A and B (C, D).	— A and B (C, D) AMPL/DIV in position 20mV.	A line under an angle of 45° with respect to the graticule. Horizontal trace width 6 Div. (±5%)	
		— Depress A of S27. — Depress B (C, D) of S30. — Depress EXT X DEFL of S8.		
	Sine-wave signal 10kHz/120mV p.p. applied to input A and B.	— A and B AMPL/DIV in position 20mV.	A line under an angle of 45° with respect to the graticule. Horizontal trace width 6 Div. (± 5%)	
		— Depress B of S27. — Depress A of S30. — Depress EXT X DEFL of S8.		
— Horizontal band-width.	Sine-wave signal 10kHz/0.5V p.p. applied to EXT input X8.	— Depress A of S27. — Depress EXT X DEFL of S8. — Depress EXT of S30.	Check for a horizontal deflection of 10 Div. (± 3%).	
		— Depress EXT X DEFL of S8. — Depress EXT of S30.		
	Sine-wave signal 50kHz/0.2V p.p. applied to EXT input X8.	— Depress EXT X DEFL of S8. — Depress EXT of S30.	Check for 4 Div. horizontal deflection If necessary correct generator output to 4 Div. deflection and position the signal in the horizontal middle of the screen. Check for a horizontal deflection $\geq 2,8$ Div. over the whole bandwidth.	
		— Put the A AMPL/DIV switch in position — 0,1 Volt. — Depress B of S27. — Depress A of S30. — Depress EXT X DEFL of S8.		
— Dynamic range	Increase the generator frequency up to 2MHz.			
	Sine-wave signal 100kHz/2V p.p. applied to A input.			

Check for a total of 20 Div. horizontal deflection.

SUBJECT	INPUT VOLTAGE	SETTINGS	REQUIREMENTS	RESULT
— Phase shift between X and Y channel	Sine-wave signal 100kHz/ 0,6V p.p. applied to the A input.	— Put the A AMPL/DIV switch in position 0,1 Volt. — Depress A of S27. — Depress A of S30. — Depress EXT X DEFL of S8.	Check for a phase shift between X and Y channel of 3° or less. This can be checked according to the figure below.  MAT 985	

6. CORRECTIVE MAINTENANCE

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 skilled 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.

6.1. IMPORTANT NOTES

Section 6 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. The digital ICs on the logic unit (unit 22) are of the LOC MOS type and are sensitive to static discharges.

The method of handling these ICs or the complete unit 22 is outlined in section 3.6.1. 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.

Warning:

The E.H.T. cable is unbreakably connected to the C.R.T. (disconnection at E.H.T. voltage multiplier).
When the E.H.T. cable to the post-acceleration anode of the C.R.T. is disconnected at the E.H.T. unit end, the E.H.T. cable must be discharged immediately by shorting them to the instrument earth.

6.2. REPLACEMENTS

6.2.1. Standard parts

Electrical and mechanical part replacements 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 frequencies. Always use direct-replacement components, unless it is known that a substitute will not degrade instrument performance.

6.2.2. 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.

6.2.3. Transistors and integrated circuits

Transistors and IC 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.

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

Warning:

Silicone grease is used to facilitate the conduction of heat between power transistors and their heatsink (for instance V1806/unit 5). Handle silicone grease with care. Avoid getting silicone grease in the eyes. Wash hands thoroughly after use.

6.2.4. Replacing knobs

Single knobs

- Prise off cap A
- Slacken screw (or nut) B
- Pull the knob from the spindle

Double knobs

- Prise off cap A and slacken screw B
- Pull the inner knob from the spindle
- Slacken nut C and pull the outer knob from the spindle

When fitting a knob or cap, ensure that the spindle is in a position which allows reference lines to be coincident with the markings on the text plate of the oscilloscope.

Delay-time multiplier knob

- Slacken screw D using a hexagonal key and pull the knob from the spindle
- Remove the nut E and withdraw the ring from the spindle.

When fitting the vernier control, turn the spindle of the potentiometer fully anticlockwise. Place the ring on the spindle so that the reference line corresponds to the zero mark on the calibrated scale. Then lock it with nut E. Fit the inner knob so that its cam is engaged with the slot in the ring. Rotate the inner knob until its zero mark coincides with the reference line on the ring. Secure the assembly by tightening screw D.

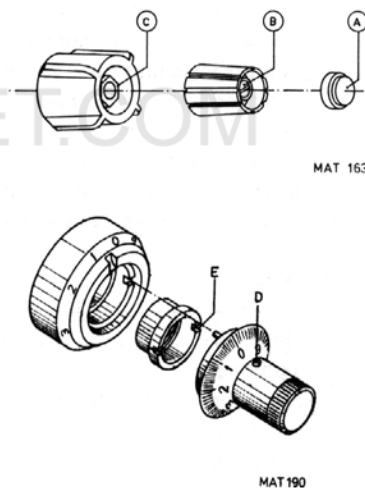


Fig. 6.1 Removing the knobs.

6.2.5. Replacing the carrying handle

1. Remove the upper and lower cabinet plates
2. Remove the plastic strip which is snapped on to the grip.
3. Remove the four screws which secure the grip to the brackets (these screws have been locked with a sealing varnish).
4. Depress the pushbuttons in the brackets and turn the carrying handle as far as possible to the upper side of the oscilloscope.
5. Keep the pushbutton of the right-hand bracket depressed and pull the bracket from its bearing ¹⁾.
6. Remove the grip from the remaining bracket.
7. Depress the pushbutton of the left-hand bracket and turn the latter as far as possible to the lower side of the instrument.
8. Keep the pushbutton depressed and pull the bracket from its bearing.
If it is impossible to remove the left-hand bracket in this way, remove also its bearing in a similar way as described in footnote ¹⁾.

¹⁾ With some instruments it may be impossible to remove the handle in the described way. This is due to an extra securing plate in the right-hand bearing. In that case, DO NOT USE FORCE, but work in accordance with the following procedure which replaces points 3, 4 and 5.

3. Remove the two screws which secure the grip to the right-hand bracket.
4. Remove the two hexagonal bolts which secure the right-hand bearing to the side strip.
5. Depress the pushbutton of the right-hand bracket and take the bearing from the bracket.

6.2.6. Replacing the cathode ray tube (CRT)

Warning:

Handle the CRT carefully. Rough handling or scratching can cause the CRT to implode. In particular be very careful with the side connections of the CRT. If these pins are bent the CRT is likely to develop a loss of vacuum.

- Remove the top, bottom and rear covers.
- Remove the black metal screening plate, that covers the Z-amplifier, focus unit and EHT-multiplier.
- Remove the screen bezel by pulling the lower edge.
- Slacken the two screws that secure the support for the graticule illumination lamps.
- Carefully remove the CRT-socket.
- Slacken the brace round the CRT-neck.
- Disconnect the EHT-cable from the EHT unit after unscrewing the swivel nut and discharge the cable to the instrument earth.
- Unsolder the screening wire of the EHT-cable.
- Disconnect the trace rotation wires from the auxiliary unit.
- Carefully unplug the side connections of the CRT.
- Carefully withdraw the CRT through the front panel of the instrument.
- If the rubber sleeve around the neck of the CRT needs to be slid over the neck of a replacement tube, the use of industrial talcum powder is strongly recommended, to prevent the rubber sleeve from sticking on the CRT neck.

6.2.7. Removing the printed circuit boards (units)

6.2.7.1. Removal and repair of the attenuator units (unit 2.1. and 2.2.)

- Remove the cabinet top and bottom plates.
- Remove the shielding plate at the bottom side of the attenuator (remove 6 screws).
- Unplug the appropriate multipole connectors and coaxial cables.

- Remove the attenuator knobs.
- Remove the two Allen-key screws, which clamp the attenuator at the bottom side to the front panel.
- Remove the two central nuts which clamp the attenuator to the front panel. Use for this use the special tool described in section 6.2.9.
- The attenuator can be removed by shifting it backwards and have it leaving the instrument via the bottom side.

Repair note:

Under the code number for the attenuator listed in the parts list the unit complete with stock connectors will be delivered. Only the coaxial cables are not included.

Due to the complexity of this unit it has been decided to put it into the **central repair procedure** of Concern Service in Eindhoven/The Netherlands. For information contact your local National Philips Organisation.

Well equipped workshops however, are able to do the following:

- measurements on the p.c.b.
- replacing components on the p.c.b.
- replacing the p.c.b. itself (5322.216.54202)
- replacing the UNCAL LED s
- replacing the plastic potentiometer axes (5322.535.94951)
- replacing the continuous control potentiometers
- replacing switch segment at the rear side of the unit (5322.273.34116)

Removal of the contact array and the GAIN potentiometers must not be carried out, as special tools are required.

6.2.7.2. Removing the delay-line (unit 4)

- Unsolder two coaxial leads from the intermediate amplifier (unit 12).
- Unsolder two coaxial leads from the final Y-amplifier (unit 13).
- Slacken two screws and take the unit out.

6.2.7.3. Removing the power supply (unit 5)

- Remove the lower cabinet plate.
- Remove the rear plate of the instrument (2 screws).
- Remove the black metal screening plate.
- Remove the two screws which secure the circuit board to the rear panel.
- Remove the two screws which secure the circuit board to the bottom side of its compartment.
- Unplug the three multipole connectors and disconnect the two single-wire connectors to the FOCUS p.c. board (unit 7).
- Disconnect the two single wire connectors to the EHT voltage multiplier (unit 15).
- Carefully withdraw the circuit board from its compartment.

6.2.7.4. Removing the focus unit (unit 7)

- Unplug the connections with Z-amplifier and power supply.
- Unsolder the wires that are attached to the CRT socket.
- Slacken two screws and take the unit out.

6.2.7.5. Removing the time base unit (unit 8)

- Remove the trigger amplifier as described in section 6.2.7.6.
- Remove the final X-amplifier as described in section 6.2.7.15.
- Unplug stocko plugs, coaxial plugs and other connections.
- Unscrew five screws and take the unit out of the instrument.

6.2.7.6. Removing the trigger amplifier unit (unit 9)

- Unplug stocko plugs, coax plugs and other connections.
- Unscrew three screws.
- Gently slide the unit out of the connector on the time base unit.

6.2.7.7. Removing the Z-amplifier (unit 11)

- Unplug the connections with the other units.
- Unsolder the wires leading to the CRT.
- Slacken two screws and remove two spacers and take the unit out.

6.2.7.8. Removing the intermediate amplifier (unit 12)

- Remove the shielding plates of both attenuator units.
- Remove the various plugs.
- Unsolder the delay line connections.
- Unscrew the screws and spacers that secure the unit to the chassis.

6.2.7.9. Removing the final Y-amplifier (unit 13)

- Remove the two screws which secure the unit to the side strip.
- Unplug the multipole connector.
- Remove the delay line connections.
- Carefully disconnect the wires from the CRT-pins and gently lift out the circuit board.

6.2.7.10. Removing the pick-off units (unit 14A, 14B, 14C and 14D)

- Remove the coaxial cables from the intermediate amplifier (unit 12).
- Slacken two screws and one spacer.
- Carefully take the unit out of the connectors that make the connection with the intermediate amplifier.

Note:

If a pick-off unit has been removed the signal path of the related channel is not interrupted. Only the HF compensation and trigger pick-off are not functioning. Because the pick-off units contain the HF adjustment they must not be interchanged with each other!

6.2.7.11. Removing the EHT multiplier (unit 15)

- Remove the black metal screening plate.
- Unplug the two single-wire connectors to the power supply board (unit 5).
- Disconnect the EHT connector after unscrewing the swivel nut and discharge the cable to the instrument earth.
- To extract the EHT unit, swivel out by applying slight pressure to one side of this unit.
- Before screwing the EHT cable on to a replacement EHT unit, the EHT connector should be greased with Silicon Dielectric Compound. Order no. 4822 390 20023.

6.2.7.12. Removing the trigger source unit (unit 16)

Bottom side of instrument:

- Slacken the screw that attaches the switch unit to the mounting bracket.
- Unsolder the coaxial cable coming from the external trigger input.
- Unplug the CIS-connector and coaxial cable.

Note:

When reinstalling the unit ensure that the unit fits in the slot in the chassis plate of the intermediate amplifier.

Top side of instrument:

- Remove the X position potentiometer unit by slackening the screw that attaches the mounting bracket of this unit to the side profile. Also remove the knob. Remove the special nut that is now visible.
- Slacken the two screws in the trigger source unit.
- Slacken four screws in the logic unit (unit 22).
- Slide the logic unit out of the connector of the trigger source unit.

Note:

For measuring purposes it is possible to operate the unit out of the instrument. For this proceed as follows;

- Attach the logic unit temporarily with two screws. Use the screw situated close to IC D1617 to mount the X position potentiometer unit temporarily.
- It is now possible to connect the trigger source in upside down position to the logic unit. This is possible because of a double-sided CIS connector on the trigger-source unit. When carrying out this, two extension shafts must be removed from the trigger-source unit.
- For testing under working conditions it is necessary to use an extension cable for the five pole CIS connector. This extension cable can be composed with the CIS connectors listed in the parts list.

6.2.7.13. Removing the auxiliary unit (unit 17)

- Pull off the FOCUS and INTENS knobs.
- Remove the lower cabinet plate.
- Unplug the two multipole connectors.
- Disconnect the single wire connectors.
- Unsolder the two LED wires.
- Remove the two screws that secure the board to the front panel.
- Unscrew the two screws which secure the board to the side strip.
- Carefully lift the unit out of the oscilloscope.

6.2.7.14. Removing the logic unit (unit 22)

- Unplug the multipole and coaxial connectors.
- Slacken four screws.
- Gently take the unit out of the connector in the trigger-source unit.

6.2.7.15. Removing the final X-amplifier (unit 26)

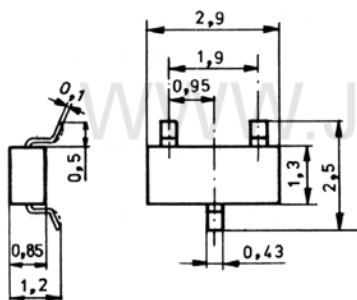
- Unplug stocko plugs and other connections.
- Unplug very carefully the CRT side connections.
- Unscrew two screws and gently slide the unit out of the connector on the time base unit.

6.2.8. Soldering techniques

6.2.8.1. General

Ordinary 60/40 solder and 35– to 40-watt pencil-type soldering iron can be used for the majority of the soldering. If a higher wattage-rating soldering iron is used on the etched circuit boards, excessive heat can cause the etched circuit wiring to separate from the board base material.

6.2.8.2. Micro-miniature semi-conductors



SOT-23

MA9154

Fig. 6.2. Dimensional drawing SOT-23 encapsulation.

Because of the small dimensions of these SOT semi-conductors and the lack of space between the components on the printed-circuit board, it is necessary to use a miniature soldering iron with a pin-point tip (max. dia 1 mm) to solder a SOT on to a printed-circuit board.

Working method:

- Carefully unsolder one after the other the soldering tags of the semi-conductor.
- Remove all superfluous soldering material. Use a sucking iron or sucking copper litze wire.
- Check that the tags of the replacement part are clean and pre-tinned on the soldering places.
- Locate the replacement semi-conductor exactly in place, and solder each tag to the relevant printed conductor on the circuit board.

Note:

Bear in mind that the maximum permissible soldering time is 10 seconds during which the temperature of the tags must not exceed 250 deg C. The use of a solder with a low melting point is therefore recommended.

Take care not to damage the plastic encapsulation of the SOT during the soldering procedure (softening point of the plastic is 150°C).

Attention:

When soldering inside the instrument it is essential to use a low-voltage soldering iron, the tip of which must be earthed to the mass of the oscilloscope.

Suitable soldering irons are:

- ORYX micro-miniature soldering instrument, type 6A, voltage 6 V, in combination with PLATO pin-point tip type 0-569.
- ERSA miniature soldering iron, type minor 040 B, voltage 6 V.
- Low Voltage Mini Soldering Iron, Type 800/12 W - 6 V, power 12 W, voltage 6 V, order no. 4822 395 10004, in combination with 1 mm-pin-point tip, order no. 4822 395 10012.

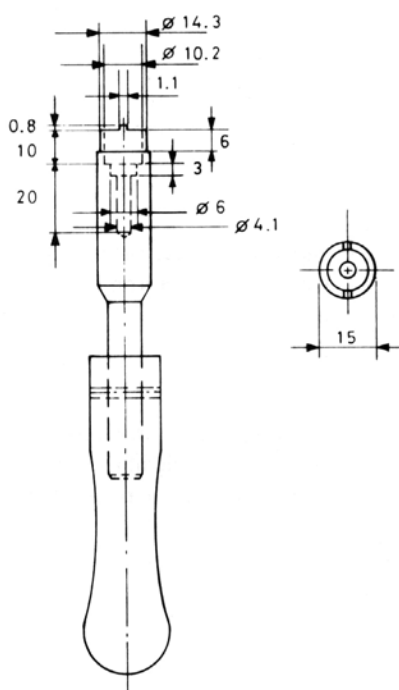
6.2.9. Special tools

Special tool for the slotted nut of attenuator switches A, B, C and D, order no. 5322 395 54023

For those who want to make such a tool, a sketch is given with the dimensions in mm in Fig. 6.3. The material is silver steel N094, tempered 40-45 Rc.

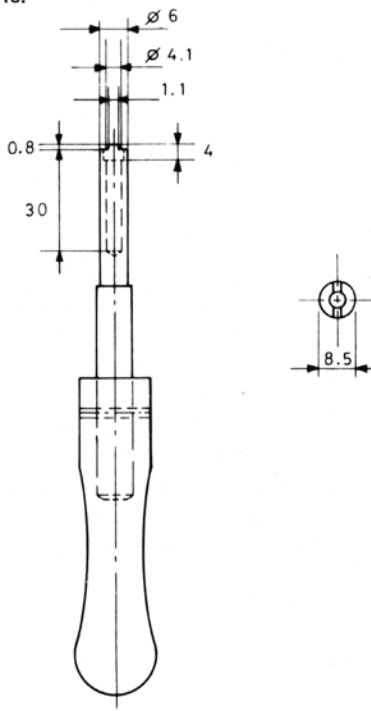
Special tool for the slotted nut of the POSITION and LEVEL/SLOPE potentiometers, order no. 5322 395 54024

For those who want to make such a tool, a sketch is given with the dimensions in mm in Fig. 6.4. The material is silver steel N094, tempered 40-45 Rc.



MAT 138

Fig. 6.3. Tool for attenuator unit.



MAT 139

Fig. 6.4. Tool for position potentiometer.

6.2.10. Replacing a pushbutton switch

Each of the pushbutton sets is fitted to the front panel by means of two clamping devices secured by hexagon screws, see Fig. 6.5.

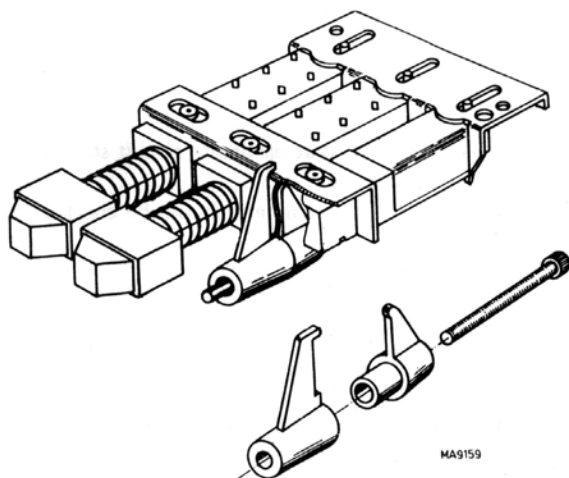


Fig. 6.5. Push-button set clamping device.

To remove a pushbutton switch, the hexagon screws that secure it to the front panel must be removed. To replace one switch-section of a pushbutton set, refer to Fig. 6.6.

To remove a pushbutton switch which is mounted on a p.c. board:

- Remove the printed-circuit board for replacing a switch in this unit.
- Straighten the 4 retaining lugs of the relevant switch as shown in Fig. 6.6.
- Break the body of the relevant switch by means of a pair of pliers and remove the pieces. The soldering pins are then accessible.
- Remove the soldering pins and clean the holes in the printed-wiring board (e.g. with a suction soldering iron).
- Solder the new switch onto the printed-circuit board.
- Bend the 4 retaining lugs back to their original positions.

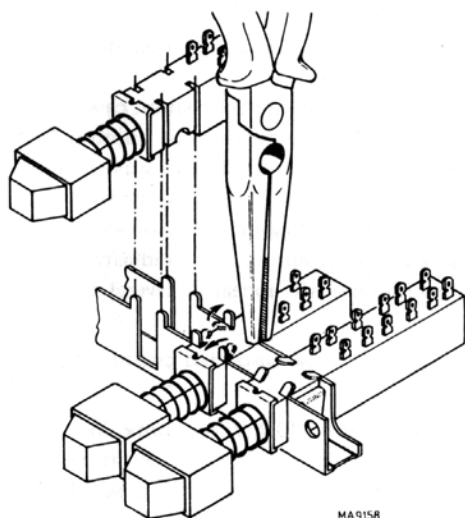


Fig. 6.6. Replacing a switch-segment of a push-button set.

Note:

Before a pushbutton switch is refitted to the front panel, it is advisable to stick the two parts of the clamping device together by means of adhesive tape or non-hardening glue, in order to facilitate replacement, refer to Fig. 6.5.

6.2.11. 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 circuits.

Since the power supply affects all circuits, calibration of the entire instrument should be checked if work has been done on the power supply.

6.2.12. Instrument repacking

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 who 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 occurs during transport.

6.3.13. Trouble-shooting**6.3.13.1. 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.

6.3.13.2. Trouble-shooting hints

If a fault appears, the following test sequence 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 this manual (Section 2.2.).
- 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 ICs 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 circuits. 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 3.
- 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 6.2. (replacement).

After replacement of a component the calibration of the instrument may be affected due to component tolerances. If necessary do the required adjustments.

WWW.JETECNET.COM

7. PARTS LIST

7.1. MECHANICAL PARTS

Item	Qty.	Ordering number	Description	Used for:
1	1	5322 414 34147	Knob with dial	Delay time: R3 Position/TB Magn.: R6/R7/S7 Level/Slope: R2/S3, R4/S4 Position/Pull to invert: R14/S21, R15/S22, R18/S23, R19/S24 X-ampl./Hold off: R24/R25/S32
2	8	5322 414 34091	Knob dia 10 mm, shaft dia 4 mm	
2	8	5322 414 74015	Cover grey with dash	
3	1	5322 414 34217	Knob dia 7 10 mm, shaft dia 4 mm	Trace separation: R20 Time/div: R5/S6/S5, R1/S2/S1
3	1	5322 492 64337	Clamping spring	
4	2	5322 414 34081	Knob dia 24 mm, shaft dia 6 mm	
4	2	5322 414 34119	Knob dia 14 mm, shaft dia 4 mm	Ampl./div.: S9/R8/S10, S11/R9/S12, S13/R10/S14, S15/R11/S16
4	2	5322 414 74016	Cover blue with dash	
5	4	5322 414 34079	Knob dia 19 mm, shaft dia 6 mm	
5	4	5322 414 34134	Knob dia 10 mm, shaft dia 4 mm	
5	4	5322 414 74029	Cover blue with dash	
5	4	5322 492 64337	Clamping spring	Illum./Power on/off: R21/S31 Intens: R22 Focus: R23
6	3	5322 414 34134	Knob dia 10 mm	
6	3	5322 414 74015	Cover grey with dash	
6	3	5322 492 64337	Clamping spring	CAL socket: X1/X2
7	25	5322 414 14011	Knob for pushbutton	
8	1	5322 267 14014	CAL socket	
8	1	5322 505 14184	Plastic nut	
8	1	5322 405 94073	Current loop	
—	1	5322 263 54003	BNC adapter for CAL socket	Vertical input A, B, C and D: X3/X4/X5/X6 External trigger and X-defl. input: X8 External Z-modulation input: X9
9	6	5322 267 10004	BNC socket	
10	1	5322 535 80523	Earth socket	
10	1	5322 505 14178	Serrated nut	X7
11	1	5322 466 74059	Screen bezel	
12	1	5322 480 34046	Contrast filter, grey	
12	1	5322 480 34074	Contrast filter, blue	
13	1	5322 498 54082	Set grip and brackets	
14	1	5322 455 84089	Text strip PM 3264	
15	1	5322 455 84088	Text plate PM 3264	
—	1	5322 447 94606	Front cover, complete	

Item	Qty.	Ordering number	Description	Used for:
—	8	5322 276 14101	Dual change-over switch with spring for use with a reset bar	Pushbutton units S29 and S30 (trigger source selection)
—	2	5322 278 74007	Reset bar for maximal 6 switches. Must be sawn to the required size. When doing this take care that the distance between end of bar and last stud is exactly 4,1 mm	
—	1	5322 466 85843	Support for maximal 11 switches: must be sawn to the required size	
22	1	5322 447 94524	Rear cabinet plate	Rear side
23	4	5322 462 44154	Nylon foot complete	
24	1	5322 447 94504	Aluminium rear profile	Attaches mains cable
25	1	5322 321 14066	Mains cable	
26	1	5322 325 64061	Cable cleat	
27	1	5322 256 34081	Fuse holder	
—	1	4822 253 30025	Fuse 2A, slow blow	
28	2	5322 219 84137	Attenuator unit, unit 2	Attenuator unit
—	2	5322 216 54202	Printed circuit board	
—	4	5322 273 34116	Switch segment S9/S11/S13/S15	
—	4	5322 535 94951	Plastic shaft, vertical variable gain	
29	1	5322 121 44261	Mains filter, unit 3	Focus unit
30	1	5322 320 44039	Delay line, unit 4	
31	1	5322 216 54204	Power supply, unit 5	
32	1	5322 218 64113	Focus unit, unit 7	
—	—	5322 390 34006	Coating, Dow Corning 3140 RTV coating	
33	1	5322 216 54236	Time base, unit 8	Located on intermediate amplifier
34	1	5322 216 54252	Trigger unit, unit 9	
35	1	5322 216 54203	Z-amplifier, unit 11	
36	1	5322 216 54253	Intermediate amplifier, unit 12	
37	1	5322 216 54197	Final Y-amplifier, unit 13	
38	4	5322 216 54254	Trigger pick-off unit, unit 14	EHT-connector
39	1	5322 219 84132	E.H.T. unit, unit 15	
—	—	5322 390 20011	Grease, Dow Corning "4-compound" Silicon Dielectric, MIL.S.8660 B	Trigger source
40	1	5322 216 54255	Trigger source, unit 16	
—	8	5322 535 74594	Extension piece for pushbutton switches	For coax socket
41	1	5322 216 54256	Auxiliary unit, unit 17	
42	1	5322 216 54257	Logic unit, unit 22	
43	1	5322 216 54214	Final X-amplifier, unit 26	
—	—	5322 320 14106	Set of coaxial cables	
—	50	5322 268 24116	Coaxial socket, vertically mounted on p.c.b.	
—	50	5322 268 14141	Contact pin	
—	8	4822 266 30071	3-pole plug "Stocko"	
—	9	4822 265 30121	3-pole socket "Stocko"	
—	5	4822 266 30072	4-pole plug "Stocko"	
—	8	4822 265 30119	4-pole socket "Stocko"	
—	15	4822 266 30073	6-pole plug "Stocko"	
—	15	4822 265 30117	6-pole socket "Stocko"	
—	8	4822 266 40057	7-pole plug "Stocko"	
—	8	4822 265 40119	7-pole socket "Stocko"	
—	1	5322 265 54006	6-pole socket "CIS"	Trigger source, unit 16

Item	Qty.	Ordering number	Description	Used for:
16	1	5322 447 94604	Aluminium front profile	Attaches side profiles to front and rear profile
17	2	5322 460 64042	Aluminium side profile	
—	8	4822 502 30047	Screw for aluminium side profile	
—	15	4822 505 10029	Square nut in aluminium profile	Attaches internal parts to side profiles
—	3	5322 255 44138	LED holder	Attaches V2, V3 and V8
—	1	5322 255 44088	LED holder	Attaches V9
—	2	5322 255 24015	Lamp holder	Attaches E1 and E2
—	1	5322 381 14151	CRT support	Supports CRT-front
—	5	5322 405 94074	Male clamping piece	Pushbutton sets
—	5	5322 405 94075	Female clamping piece	
—	5	4822 502 11142	Screw M3 x 20	
—	1	5322 535 74525	Plastic spindle	R21
—	4	5322 505 10659	Special nut	Attenuator switch
—	—	5322 395 54023	Tool	For above mentioned special nut
—	3	5322 505 14186	Special nut	Level/slope and X-position
—	—	5322 395 54024	Tool	For above mentioned special nut
18	1	5322 447 94482	Upper cabinet plate, complete	Upper and lower cabinet plates
19	1	5322 447 94483	Lower cabinet plate, complete	
20	8	5322 417 24024	Quick fastener, complete	
21	4	5322 462 44297	Rubber foot	Lower cabinet plate
—	1	5322 270 14019	Main time base time/div. switch unit	Pushbutton units S8 and S25 (X-deflection selector and trigger mode)
—	1	5322 270 14021	Del'd time base time/div. switch unit	
—	5	5322 276 14101	Dual change-over switch with spring for use with a reset bar	
—	1	5322 276 14359	Dual change-over switch with spring for use with a reset bar. Release key for single shot function	
—	1	5322 278 74007	Reset bar for maximal 6 switches. Must be sawn to the required size. When doing this take care that the distance between end of bar and last stud is exactly 4,1 mm.	
—	1	5322 466 85843	Support for maximal 11 switches: must be sawn to the required size	
—	4	5322 276 14101	Dual change-over switch with spring for use with a reset bar	
—	7	5322 276 14117	Dual change-over switch of the push-on push-off type	
—	1	5322 278 74007	Reset bar for maximal 6 switches. Must be sawn to the required size. When doing this take care that the distance between end of bar and last stud is exactly 4,1 mm	
—	1	5322 405 94181	Support for maximal 13 switches	

Item	Qty.	Ordering number	Description	Used for:
—	1	5322 267 54205	18-pole socket "CIS"	Trigger source, unit 16 Logic, unit 22
—	1	4822 267 50268	18-contact pins "CIS"	
—	1	5322 267 64007	Contact block 6-pin "CIS"	
44	1	5322 447 94605	CRT-shield	CRT, V1
—	4	5322 528 20333	Coupling disc, part 1.	
—	4	4822 530 70043	Fixing spring, part 2.	Part of flexible coupling in attenuator, unit 2. For part no. see fig. 8.4.
—	4	5322 532 60758	Coupling bush, part 3.	
—	4	4822 530 70119	Fixing spring, part 4.	
—	4	5322 528 20335	Coupling disc, part 5.	

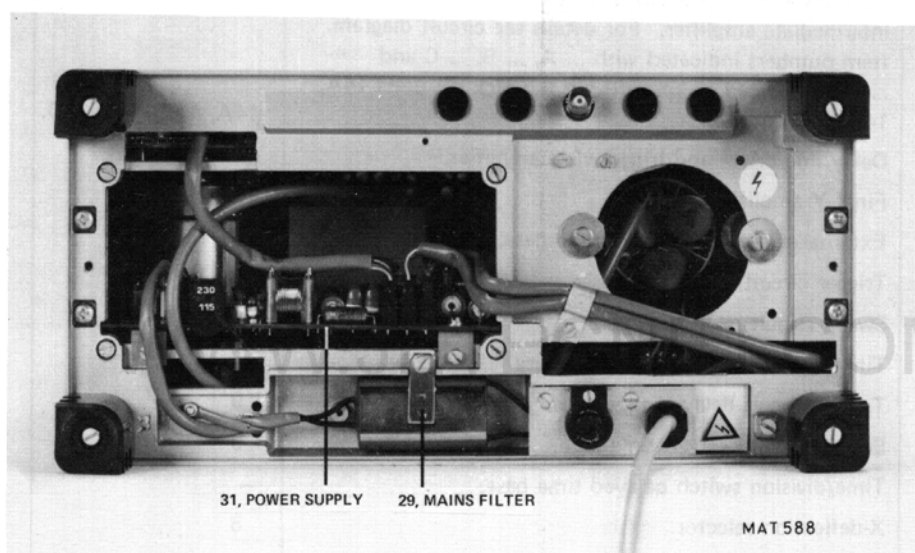


Fig. 7.3. Rear panel view with item numbers.

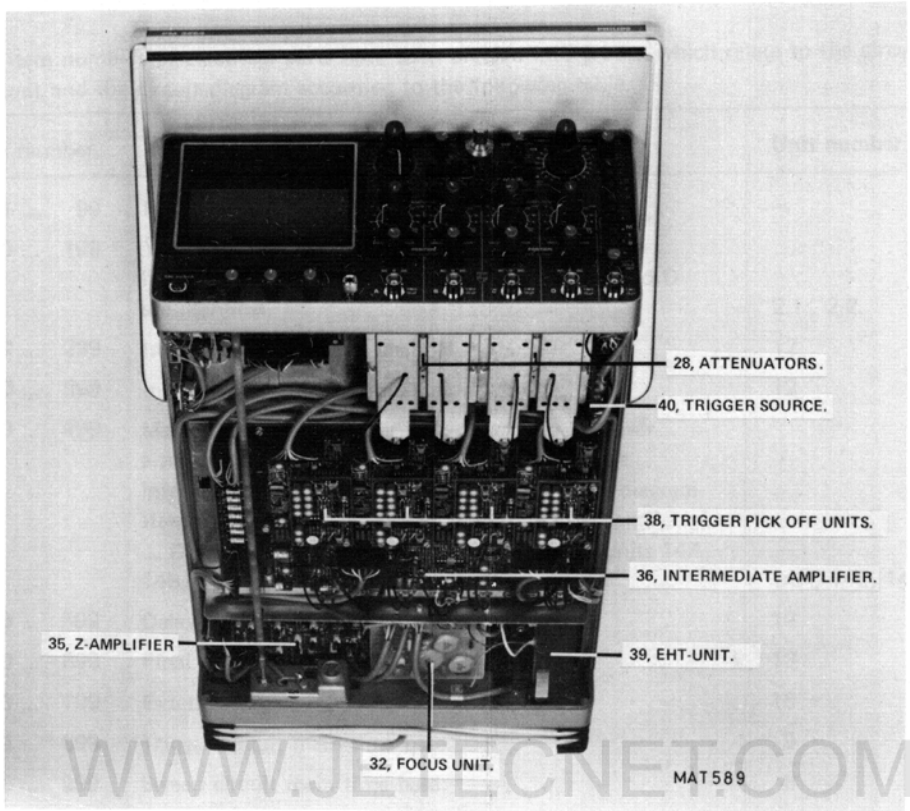


Fig. 7.4. Internal view of the bottom side of the instrument.

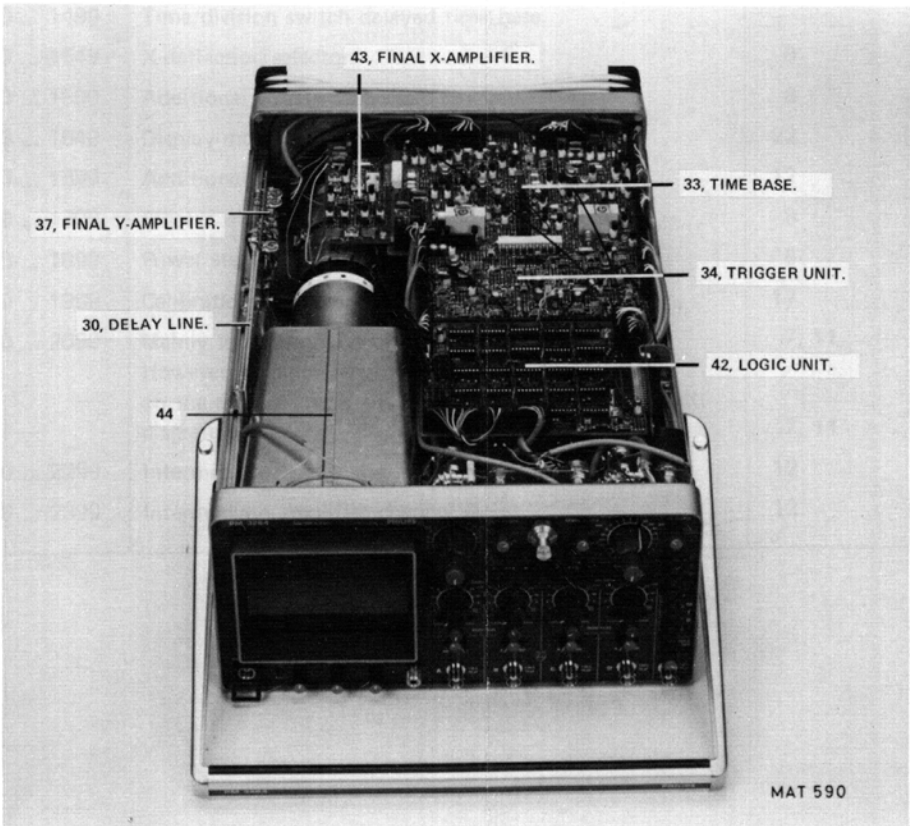


Fig. 7.5. Internal view of the top side of the instrument.

7.2. ELECTRICAL PARTS

The item numbers of electrical parts have been divided into groups which relate to the circuit, the unit and the circuit diagram according to the following table.

Item number	Location	Unit number
1 ... 99	Front or rear panel of the instrument.	—
100 ... 199	Y input attenuators channel A, B, C and D. The item numbers for channel A and C/channel B and D are identical.	2.1., 2.2.
200 ... 299	Intermediate amplifier channel A	12
300 ... 399	Intermediate amplifier channel B.	12
400 ... 499	Mainly located on trigger pick-off units. However, a minority of the components is located on the intermediate amplifier. For details see circuit diagram. Item numbers indicated with ... A, ... B, ... C and ... D are located on respectively the pick-off units 14A, 14B, 14C and 14D.	14A, 14B, 14C, 14D.
500 ... 599	Delay line driver and trigger view amplifier.	12
600 ... 699	Final Y amplifier	13
700 ... 799	External trigger input main time base.	16
800 ... 899	Trigger circuit main time base.	9
900 ... 999	Sweep circuit main time base.	8
1000 ... 1099	Time/division switch main time base	—
1200 ... 1299	Trigger circuit delayed time base.	9
1300 ... 1399	Sweep circuit delayed time base.	8
1400 ... 1499	Time/division switch delayed time base.	—
1500 ... 1549	X-deflection selector.	8
1550 ... 1599	Additional voltage stabiliser.	8
1600 ... 1649	Display-mode logic.	22
1650 ... 1699	Additional voltage stabiliser.	12
1700 ... 1799	Final X amplifier.	8
1800 ... 1899	Power supply.	5
1900 ... 1999	Calibration generator.	17
2000 ... 2099	Mainly located on Z-amplifier unit and focus unit. However, a minority of the components is located on the auxiliary unit (unit 17). For details see circuit diagram.	7, 11 7, 11
2200 ... 2299	Intermediate amplifier channel C.	12
2300 ... 2399	Intermediate amplifier channel D.	12

POSNR	DESCRIPTION	ORDERING CODE					
R 1	POTM,CARB+SW.	10K	20	0.1W	5322 101	44023	
R 100	RESISTOR,M.FILM	10	1	MR25	5322 116	50452	
R 1001	RESISTOR,M.FILM	402	0,25		5322 116	51484	
R 1002	RESISTOR,M.FILM	876K	0,25	MR54E	5322 116	54902	
R 1003	RESISTOR,M.FILM	887K	0,25	MR54E	5322 116	54901	
R 1004	RESISTOR,M.FILM	354K	0,25		5322 116	51415	
R 1006	RESISTOR,M.FILM	176K	0,25		5322 116	51485	
R 1007	RESISTOR,M.FILM	87,6K	0,25		5322 116	51479	
R 1008	RESISTOR,M.FILM	34,6K	0,25		5322 116	51414	
R 1009	RESISTOR,M.FILM	16,8K	0,25		5322 116	51413	
R 101	RESISTOR,CARBON	1,8M	5	0,125W	5322 111	44121	
R 1011	RESISTOR,M.FILM	7,96K	0,25		5322 116	51481	
R 1012	RESISTOR,M.FILM	2,67K	0,25		5322 116	51482	
R 1013	RESISTOR,M.FILM	887	0,25		5322 116	51483	
R 1014	RESISTOR,M.FILM	274	1	MR25	5322 116	54504	
R 102	RES,M.GLAZED	10	5	0.125W	5322 116	64045	
R 103	RESISTOR,M.FILM	1K	5	0.125W	4822 116	51123	
R 104	RESISTOR,M.FILM	900K	0,5	SPEC	5322 116	55152	
R 105	RESISTOR,HT	22	5	0.125W	5322 116	64108	
R 106	RESISTOR,M.FILM	111K	0,5	MR25	5322 116	55316	
R 107	RES,M.GLAZED	47	5	0.125W	5322 116	64049	
R 108	RESISTOR,M.FILM	1K	5	0.125W	4822 116	51123	
R 109	RESISTOR,M.FILM	992K	0,5	SPEC	5322 116	55153	
R 110	RESISTOR,M.FILM	71,5	1	MR16	5322 116	55409	
R 111	RESISTOR,M.FILM	10,1K	0,5	MR25	5322 116	55285	
R 112	RES,M.GLAZED	47	5	0.125W	5322 116	64049	
R 113	RES,M.GLAZED	15	5	0.125W	5322 116	64051	
R 114	RESISTOR,CARBON	100M	5	0.125W	5322 111	30376	
R 116	RES,M.GLAZED	15	5	0.125W	5322 116	64051	
R 117	RESISTOR,M.FILM	51,1	1	MR25	5322 116	54442	
R 118	RESISTOR,M.FILM	6,81K	1	MR25	4822 116	51252	
R 119	RESISTOR,M.FILM	12,1K	1	MR25	5322 116	50572	
R 12	POTM,CARBON	10K	20	0.1W	5322 101	24148	
R 1201	RESISTOR,M.FILM	3,48K	1	MR25	5322 116	54585	
R 1202	RESISTOR,M.FILM	8,25K	1	MR25	5322 116	54558	
R 1203	RESISTOR,M.FILM	332	1	MR25	4822 116	51226	
R 1204	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527	
R 1205	RESISTOR,M.FILM	4,99	1	MR25	5322 116	50568	
R 1206	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527	
R 1207	RESISTOR,M.FILM	46,4	1	MR25	5322 116	50492	
R 1208	RESISTOR,M.FILM	51,1	1	MR25	5322 116	54442	
R 121	RESISTOR,M.FILM	750	1	MR25	4822 116	51234	
R 1210	RESISTOR,M.FILM	1K	1	MR25	5322 116	54549	
R 1211	RESISTOR,M.FILM	100	1	MR25	5322 116	54469	
R 1212	RESISTOR,M.FILM	511	1	MR25	4822 116	51282	
R 1213	RESISTOR,M.FILM	750	1	MR25	4822 116	51234	
R 1214	RESISTOR,M.FILM	750	1	MR25	4822 116	51234	

POSNR	DESCRIPTION				ORDERING CODE
R 1216	RESISTOR,M.FILM	511	1	MR25	4822 116 51282
R 1217	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1218	RESISTOR,M.FILM	51,1	1	MR25	5322 116 54442
R 1219	RESISTOR,M.FILM	51,1	1	MR25	5322 116 54442
R 122	RESISTOR,M.FILM	750K	1	MR30	5322 116 54335
R 1221	RESISTOR,M.FILM	1,47K	1	MR25	5322 116 50635
R 1222	RESISTOR,M.FILM	1,47K	1	MR25	5322 116 50635
R 1223	RESISTOR,M.FILM	18,7K	1	MR25	5322 116 55362
R 1224	RESISTOR,M.FILM	18,7K	1	MR25	5322 116 55362
R 1226	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1227	RESISTOR,M.FILM	1,47K	1	MR25	5322 116 50635
R 1228	RESISTOR,M.FILM	1,47K	1	MR25	5322 116 50635
R 1229	RESISTOR,M.FILM	18,7K	1	MR25	5322 116 55362
R 123	RESISTOR,M.FILM	255K	1	MR25	5322 116 54735
R 1231	RESISTOR,M.FILM	18,7K	1	MR25	5322 116 55362
R 1232	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1233	RESISTOR,M.FILM	1,47K	1	MR25	5322 116 50635
R 1234	RESISTOR,M.FILM	1,47K	1	MR25	5322 116 50635
R 1236	RESISTOR,M.FILM	18,7K	1	MR25	5322 116 55362
R 1237	RESISTOR,M.FILM	18,7K	1	MR25	5322 116 55362
R 1238	POTM,TRIMMING	1K	20	0.75W	5322 100 10143
R 1239	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 124	POTM,TRIMMING	1K	20	0.75W	5322 100 10143
R 1241	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 1242	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1243	RESISTOR,M.FILM	750	1	MR25	4822 116 51234
R 1244	RESISTOR,M.FILM	59	1	MR25	5322 116 54448
R 1246	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 1247	RESISTOR,M.FILM	78,7	1	MR25	5322 116 50578
R 1248	RESISTOR,M.FILM	825	1	MR25	5322 116 54541
R 1249	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 1251	RESISTOR,M.FILM	261	1	MR25	5322 116 54502
R 1252	RESISTOR,M.FILM	121	1	MR25	5322 116 54426
R 1253	RESISTOR,M.FILM	121	1	MR25	5322 116 54426
R 1254	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 1256	RESISTOR,M.FILM	316	1	MR25	5322 116 54511
R 1257	RESISTOR,M.FILM	332	1	MR25	4822 116 51226
R 1258	RESISTOR,M.FILM	90,9	1	MR25	5322 116 54466
R 1259	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 126	RESISTOR,M.FILM	221K	1	MR25	4822 116 51272
R 1261	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1262	RESISTOR,M.FILM	649	1	MR25	5322 116 54532
R 1263	RESISTOR,M.FILM	649	1	MR25	5322 116 54532
R 1264	RESISTOR,M.FILM	316	1	MR25	5322 116 54511
R 1266	RESISTOR,M.FILM	332	1	MR25	4822 116 51226
R 1267	RESISTOR,M.FILM	90,9	1	MR25	5322 116 54466
R 1268	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 127	RESISTOR,HT	10M	5	VR37	4822 110 42214
R 1271	RESISTOR,M.FILM	16,2K	1	MR25	5322 116 55361
R 1272	RESISTOR,M.FILM	316	1	MR25	5322 116 54511
R 1273	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1274	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 1276	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 1277	RESISTOR,M.FILM	150	1	MR25	5322 116 54486
R 1278	RESISTOR,M.FILM	51,1	1	MR25	5322 116 54442
R 128	RESISTOR,HT	33M	5	VR37	4822 110 42227
R 1281	RESISTOR,M.FILM	274	1	MR25	5322 116 54504
R 1282	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 1283	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1284	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 1286	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1287	RESISTOR,M.FILM	16,2K	1	MR25	5322 116 55361
R 1288	RESISTOR,M.FILM	316	1	MR25	5322 116 54511
R 1289	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 129	POTM,TRIMMING	10K	20	0.75W	5322 100 10141

POSNR	DESCRIPTION			ORDERING	CODE
R 1291	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 1292	RESISTOR,M.FILM	5,11	1	MR25	5322 116 54192
R 1293	RESISTOR,M.FILM	51,1	1	MR25	5322 116 54442
R 13	POTM,CARBON	10K	20	0.1W	5322 101 24148
R 1300	RESISTOR,M.FILM	1,4K	1	MR25	5322 116 54562
R 1301	RESISTOR,M.FILM	2,26K	1	MR25	5322 116 50675
R 1303	RESISTOR,M.FILM	750	1	MR25	4822 116 51234
R 1304	RESISTOR,M.FILM	4,87K	1	MR25	5322 116 50509
R 1305	RESISTOR,M.FILM	3,01K	1	MR25	4822 116 51246
R 1306	RESISTOR,M.FILM	274	1	MR25	5322 116 54504
R 1307	RESISTOR,M.FILM	274	1	MR25	5322 116 54504
R 1308	RESISTOR,M.FILM	2,05K	1	MR25	5322 116 50664
R 1309	RESISTOR,M.FILM	464	1	MR25	5322 116 50536
R 131	RESISTOR,M.FILM	5,11K	1	MR25	5322 116 54595
R 1310	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 1311	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1312	RESISTOR,M.FILM	464	1	MR25	5322 116 50536
R 1313	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 1314	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 1315	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 1316	RESISTOR,M.FILM	4,42K	1	MR25	5322 116 50556
R 1317	RESISTOR,M.FILM	2,26K	1	MR25	5322 116 50675
R 1318	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 1319	RESISTOR,M.FILM	2,26K	1	MR25	5322 116 50675
R 132	POTM,TRIMMING	47K	20	0.75W	5322 101 14056
R 1320	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 1321	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 1322	RESISTOR,M.FILM	5,11K	1	MR25	5322 116 54595
R 1323	RESISTOR,M.FILM	750	1	MR25	4822 116 51234
R 1324	RESISTOR,M.FILM	5,11K	1	MR25	5322 116 54595
R 1326	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 1327	RESISTOR,M.FILM	3,83K	1	MR25	5322 116 54589
R 1328	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 1329	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 133	RESISTOR,M.FILM	100K	1	MR25	4822 116 51268
R 1331	RESISTOR,M.FILM	12,1K	1	MR25	5322 116 50572
R 1332	RESISTOR,M.FILM	5,9K	1	MR25	5322 116 50583
R 1333	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 1334	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 1335	RESISTOR,M.FILM	4,64K	1	MR25	5322 116 50484
R 1336	RESISTOR,M.FILM	887	0,1	MR24E	5322 116 51418
R 1337	RESISTOR,M.FILM	22,6K	1	MR25	5322 116 50481
R 1338	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 1339	RESISTOR,M.FILM	22,6K	1	MR25	5322 116 50481
R 134	RESISTOR,M.FILM	301K	1	MR25	5322 116 54743
R 1341	RESISTOR,M.FILM	464	1	MR25	5322 116 50536
R 1342	RESISTOR,M.FILM	22,6K	1	MR25	5322 116 50481
R 1343	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 1344	RESISTOR,M.FILM	38,3	1	MR25	5322 116 50954
R 1346	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 1347	RESISTOR,M.FILM	68,1	1	MR25	5322 116 54455
R 1348	RESISTOR,M.FILM	33,2K	1	MR25	4822 116 51259
R 1349	RESISTOR,M.FILM	2,49K	1	MR25	5322 116 50581
R 1350	RESISTOR,M.FILM	332	1	MR25	4822 116 51226
R 1351	RESISTOR,HT	5,6M	10	CR25	4822 110 72207

POSNR	DESCRIPTION			ORDERING CODE
R 1352	RESISTOR,M.FILM	5,11	1	MR25 5322 116 54192
R 1353	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 1354	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 1355	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 1356	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 1357	RESISTOR,M.FILM	15,4K	1	MR25 5322 116 50479
R 1358	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 1359	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 1360	RESISTOR,M.FILM	953	1	MR25 5322 116 54547
R 1361	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 1362	RESISTOR,M.FILM	953	1	MR25 5322 116 54547
R 1363	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 1364	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 1365	RESISTOR,M.FILM	787	1	MR25 5322 116 54538
R 1366	RESISTOR,M.FILM	1,33K	1	MR25 5322 116 54561
R 1367	RESISTOR,M.FILM	3,32K	1	MR25 5322 116 54005
R 1368	RESISTOR,M.FILM	3,32K	1	MR25 5322 116 54005
R 1369	RESISTOR,M.FILM	2,61K	1	MR25 5322 116 50671
R 1370	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 1371	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 1372	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 1373	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 1374	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 1376	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 1377	RESISTOR,M.FILM	3,32K	1	MR25 5322 116 54005
R 1378	RESISTOR,M.FILM	15,4K	1	MR25 5322 116 50479
R 1379	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 1381	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 1382	RESISTOR,M.FILM	5,62K	1	MR25 4822 116 51281
R 1383	RESISTOR,M.FILM	2,26K	1	MR25 5322 116 50675
R 1384	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 1386	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 1387	RESISTOR,M.FILM	590	1	MR25 5322 116 50561
R 1388	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 1389	RESISTOR,M.FILM	909	1	MR25 5322 116 55278
R 1391	RESISTOR,M.FILM	909	1	MR25 5322 116 55278
R 1392	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 1393	RESISTOR,M.FILM	750	1	MR25 4822 116 51234
R 1394	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 1396	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 1397	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 1398	RESISTOR,M.FILM	2,15K	1	MR25 5322 116 50767
R 14	POTM,CARB+SW.	10K	20	0.1W 5322 101 40097
R 1401	RESISTOR,M.FILM	887K	0,25	MR54E 5322 116 54901
R 1402	RESISTOR,M.FILM	354K	0,25	5322 116 51415
R 1403	RESISTOR,M.FILM	176K	0,25	5322 116 51485
R 1404	RESISTOR,M.FILM	87,6K	0,25	5322 116 51479
R 1406	RESISTOR,M.FILM	34,6K	0,25	5322 116 51414
R 1407	RESISTOR,M.FILM	16,8K	0,25	5322 116 51413
R 1408	RESISTOR,M.FILM	7,96K	0,25	5322 116 51481
R 1409	RESISTOR,M.FILM	2,67K	0,25	5322 116 51482
R 141	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 1411	RESISTOR,M.FILM	887	0,25	5322 116 51483
R 15	POTM,CARB+SW.	10K	20	0.1W 5322 101 40097
R 150	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 1501	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 1502	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 1503	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 1504	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 1506	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 1507	RESISTOR,M.FILM	3,32K	1	MR25 5322 116 54005
R 1508	RESISTOR,M.FILM	402	1	MR25 5322 116 54519
R 1509	RESISTOR,M.FILM	3,32K	1	MR25 5322 116 54005
R 151	RESISTOR,CARBON	1,8M	5	0,125W 5322 111 44121
R 1511	RESISTOR,M.FILM	402	1	MR25 5322 116 54519

POSNR	DESCRIPTION			ORDERING CODE
R 1512	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 1513	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 1514	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 1515	RESISTOR,M.FILM	464	1	MR25 5322 116 50536
R 1516	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 1517	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 1518	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 1519	RESISTOR,M.FILM	12,1K	1	MR25 5322 116 50572
R 152	RES,M.GLAZED	10	5	0.125W 5322 116 64045
R 1520	RESISTOR,M.FILM	6,81K	1	MR25 4822 116 51252
R 1521	RESISTOR,M.FILM	4,02K	1	MR25 5322 116 55448
R 1522	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 1525	RESISTOR,M.FILM	46,4	1	MR25 5322 116 50492
R 1526	RESISTOR,M.FILM	1,87K	1	MR25 5322 116 50728
R 1527	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 1528	RESISTOR,M.FILM	15,4K	1	MR25 5322 116 50479
R 1529	RESISTOR,M.FILM	2,26K	1	MR25 5322 116 50675
R 153	RESISTOR,M.FILM	1K	5	0.125W 4822 116 51123
R 1531	RESISTOR,M.FILM	1,4K	1	MR25 5322 116 54562
R 1532	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 1533	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 1534	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 1535	RESISTOR,M.FILM	24,9K	1	MR25 5322 116 54648
R 1536	RESISTOR,M.FILM	15,4K	1	MR25 5322 116 50479
R 1537	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 1538	RESISTOR,M.FILM	15,4K	1	MR25 5322 116 50479
R 1539	RESISTOR,M.FILM	1,21K	1	MR25 5322 116 54557
R 154	RESISTOR,M.FILM	900K	0,5	SPEC 5322 116 55152
R 1541	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 1542	RESISTOR,M.FILM	1,21K	1	MR25 5322 116 54557
R 1543	RESISTOR,M.FILM	24,9K	1	MR25 5322 116 54648
R 1549	POTM,TRIMMING	470	20	0.75W 5322 100 10135
R 155	RESISTOR,HT	22	5	0.125W 5322 116 64108
R 1550	RESISTOR,M.FILM	215	1	MR25 5322 116 55274
R 1551	RESISTOR,M.FILM	787	1	MR25 5322 116 54538
R 1552	RESISTOR,M.FILM	1,78K	1	MR25 5322 116 50515
R 1553	RESISTOR,M.FILM	1,62K	1	MR25 5322 116 55359
R 1554	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 1556	RESISTOR,M.FILM	68,1K	1	MR25 5322 116 54683
R 1557	RESISTOR,M.FILM	226	1	MR25 5322 116 54497
R 1558	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 1559	RESISTOR,M.FILM	13,7K	1	MR25 5322 116 54628
R 156	RESISTOR,M.FILM	111K	0,5	MR25 5322 116 55316
R 1561	RESISTOR,M.FILM	11,5K	1	MR25 5322 116 55358
R 1562	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 1563	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 1564	RESISTOR,M.FILM	42,2	1	MR25 5322 116 51052
R 1566	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 1567	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 1568	RESISTOR,M.FILM	2,26K	1	MR25 5322 116 50675
R 1569	RESISTOR,M.FILM	3,32K	1	MR25 5322 116 54005
R 157	RES,M.GLAZED	47	5	0.125W 5322 116 64049
R 1570	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 1571	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 1572	RESISTOR,M.FILM	68,1K	1	MR25 5322 116 54683

POSNR	DESCRIPTION				ORDERING	CODE
R 1573	RESISTOR,M.FILM	140	1	MR25	5322 116	54484
R 1574	RESISTOR,M.FILM	6,19K	1	MR25	5322 116	55426
R 1576	RESISTOR,M.FILM	5,11K	1	MR25	5322 116	54595
R 1577	RESISTOR,M.FILM	332	1	MR25	4822 116	51226
R 1578	RESISTOR,M.FILM	42,2	1	MR25	5322 116	51052
R 1579	RESISTOR,M.FILM	1,4K	1	MR25	5322 116	54562
R 158	RESISTOR,M.FILM	1K	5	0.125W	4822 116	51123
R 1581	RESISTOR,M.FILM	332	1	MR25	4822 116	51226
R 159	RESISTOR,M.FILM	992K	0,5	SPEC	5322 116	55153
R 160	RESISTOR,M.FILM	71,5	1	MR16	5322 116	55409
R 1601	RESISTOR,M.FILM	100K	5%	1W	5322 116	90095
R 1602	RESISTOR,M.FILM	100K	5%	1W	5322 116	90095
R 1603	RESISTOR,M.FILM	100K	5%	1W	5322 116	90095
R 1604	RESISTOR,M.FILM	4,42K	1	MR25	5322 116	50556
R 1605	RESISTOR,M.FILM	1K	1	MR25	5322 116	54549
R 1606	RESISTOR,M.FILM	4,42K	1	MR25	5322 116	50556
R 1607	RESISTOR,M.FILM	17,8K	1	MR25	5322 116	54637
R 1608	RESISTOR,M.FILM	1,54K	1	MR25	5322 116	50586
R 1609	RESISTOR,M.FILM	1,54K	1	MR25	5322 116	50586
R 161	RESISTOR,M.FILM	10,1K	0,5	MR25	5322 116	55285
R 1610	RESISTOR,M.FILM	2,15K	1	MR25	5322 116	50767
R 1611	RESISTOR,M.FILM	1,33K	1	MR25	5322 116	54561
R 1612	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 1613	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 1614	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 1616	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 1617	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 1618	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 1619	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 162	RES,M.GLAZED	47	5	0.125W	5322 116	64049
R 163	RES,M.GLAZED	15	5	0.125W	5322 116	64051
R 1632	RESISTOR,M.FILM	21,5K	1	MR25	5322 116	50451
R 1633	RESISTOR,M.FILM	22,6	1	MR25	5322 116	50491
R 1634	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 1636	RESISTOR,M.FILM	6,49K	1	MR25	5322 116	54603
R 1637	RESISTOR,M.FILM	2,37K	1	MR25	5322 116	54576
R 1638	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 1639	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 164	RESISTOR,CARBON	100M	5	0.125W	5322 111	30376
R 1641	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 1642	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 1643	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 1644	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 1646	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 1651	RESISTOR,M.FILM	787	1	MR25	5322 116	54538
R 1652	RESISTOR,M.FILM	1,78K	1	MR25	5322 116	50515
R 1653	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 1654	POTM,TRIMMING	4,7K	20	0.75W	5322 100	10139
R 1656	RESISTOR,M.FILM	2,61K	1	MR25	5322 116	50671
R 1657	RESISTOR,M.FILM	3,16K	1	MR25	5322 116	50579
R 1658	RESISTOR,M.FILM	3,16K	1	MR25	5322 116	50579
R 1659	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 166	RES,M.GLAZED	15	5	0.125W	5322 116	64051
R 1661	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 1662	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 1663	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 1664	RESISTOR,M.FILM	787	1	MR25	5322 116	54538
R 1666	RESISTOR,M.FILM	1,78K	1	MR25	5322 116	50515
R 1667	RESISTOR,M.FILM	14,7K	1	MR25	5322 116	54632
R 1668	POTM,TRIMMING	4,7K	20	0.75W	5322 100	10139
R 1669	RESISTOR,M.FILM	2,61K	1	MR25	5322 116	50671
R 167	RESISTOR,M.FILM	51,1	1	MR25	5322 116	54442
R 1671	RESISTOR,M.FILM	3,16K	1	MR25	5322 116	50579
R 1672	RESISTOR,M.FILM	3,16K	1	MR25	5322 116	50579
R 1673	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527

POSNR	DESCRIPTION				ORDERING	CODE
R 1674	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 1676	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 1677	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 168	RESISTOR,M.FILM	6,81K	1	MR25	4822 116	51252
R 169	RESISTOR,M.FILM	12,1K	1	MR25	5322 116	50572
R 1701	RESISTOR,M.FILM	511	1	MR25	4822 116	51282
R 1702	RESISTOR,M.FILM	590	1	MR25	5322 116	50561
R 1703	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 1704	RESISTOR,M.FILM	162	1	MR25	5322 116	50417
R 1706	POTM,TRIMMING	1K	20	0,5W	5322 100	10112
R 1707	RESISTOR,M.FILM	110	1	MR25	5322 116	54474
R 1708	RESISTOR,M.FILM	2,49K	1	MR25	5322 116	50581
R 1709	POTM,TRIMMING	10K	20	0,5W	5322 100	10113
R 171	RESISTOR,M.FILM	750	1	MR25	4822 116	51234
R 1710	RESISTOR,M.FILM	22,6K	1	MR25	5322 116	50481
R 1711	RESISTOR,M.FILM	549	1	MR25	5322 116	50732
R 1712	RESISTOR,M.FILM	549	1	MR25	5322 116	50732
R 1713	RESISTOR,M.FILM	12,1K	1	MR25	5322 116	50572
R 1714	RESISTOR,M.FILM	10K	1	MR25	4822 116	51253
R 1716	RESISTOR,M.FILM	442	1	MR25	5322 116	50592
R 1718	RESISTOR,M.FILM	12,1K	1	MR25	5322 116	50572
R 1719	RESISTOR,M.FILM	22,6	1	MR25	5322 116	50491
R 172	RESISTOR,M.FILM	750K	1	MR30	5322 116	54335
R 1721	RESISTOR,M.FILM	33,2	1	MR25	5322 116	50527
R 1722	RESISTOR,M.FILM	110K	1	MR25	5322 116	54701
R 1723	RESISTOR,M.FILM	15,4K	1	MR25	5322 116	50479
R 1724	RESISTOR,M.FILM	100K	1	MR25	4822 116	51268
R 1726	RESISTOR,M.FILM	19,6K	1	MR25	5322 116	54641
R 1727	RESISTOR,M.FILM	1,87K	1	MR25	5322 116	50728
R 1728	RESISTOR,M.FILM	649	1	MR25	5322 116	54532
R 1729	RESISTOR,M.FILM	82,5	1	MR25	5322 116	54462
R 173	RESISTOR,M.FILM	255K	1	MR25	5322 116	54735
R 1731	RESISTOR,M.FILM	10K	1	MR25	4822 116	51253
R 1732	RESISTOR,M.FILM	511	1	MR25	4822 116	51282
R 1733	RESISTOR,M.FILM	1K	1	MR25	5322 116	54549
R 1734	RESISTOR,M.FILM	402	1	MR25	5322 116	54519
R 1738	RESISTOR,M.FILM	1K	1	MR25	5322 116	54549
R 1739	RESISTOR,M.FILM	402	1	MR25	5322 116	54519
R 174	POTM,TRIMMING	1K	20	0,75W	5322 100	10143
R 1742	RESISTOR,M.FILM	511	1	MR25	4822 116	51282
R 1743	RESISTOR,M.FILM	82,5	1	MR25	5322 116	54462
R 1744	RESISTOR,M.FILM	10K	1	MR25	4822 116	51253
R 1746	RESISTOR,M.FILM	7,15K	1	MR25	5322 116	54606
R 1747	RESISTOR,M.FILM	649	1	MR25	5322 116	54532
R 1748	RESISTOR,M.FILM	10K	1	MR25	4822 116	51253
R 1749	POTM,TRIMMING	10K	20	0,5W	5322 100	10113
R 176	RESISTOR,M.FILM	221K	1	MR25	4822 116	51272
R 177	RESISTOR,HT	10M	5	VR37	4822 110	42214
R 178	RESISTOR,HT	33M	5	VR37	4822 110	42227
R 179	POTM,TRIMMING	10K	20	0,75W	5322 100	10141
R 1801	RESISTOR,M.FILM	301K	1	MR25	5322 116	54743
R 1802	RESISTOR,M.FILM	301K	1	MR25	5322 116	54743
R 1803	RESISTOR,HT	1M	5	VR37	4822 110	42187
R 1804	RESISTOR,WW.	3,3K	5	4W	4822 112	21121
R 1805	RESISTOR,HT	1M	5	VR37	4822 110	42187

POSNR	DESCRIPTION				ORDERING CODE
R 1806	RESISTOR,NTC	1K5	25%		5322 116 34051
R 1807	RESISTOR,M.FILM	82,5K	0,5	MR30	5322 116 54935
R 1808	RESISTOR,M.FILM	82,5K	0,5	MR30	5322 116 54935
R 1809	RESISTOR,M.FILM	82,5K	0,5	MR30	5322 116 54935
R 181	RESISTOR,M.FILM	5,11K	1	MR25	5322 116 54595
R 1810	RESISTOR,M.FILM	4,42K	1	MR25	5322 116 50556
R 1811	RESISTOR,M.FILM	1,62	1	MR25	5322 116 55337
R 1812	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1813	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 1814	RESISTOR,M.FILM	20	5	PR52	5322 116 54351
R 1816	RESISTOR,M.FILM	2K	5	PR52	5322 116 55205
R 1817	RESISTOR,HT	10M	10	CR25	4822 110 72214
R 1818	RESISTOR,HT	10M	10	CR25	4822 110 72214
R 1819	RESISTOR,M.FILM	24,9K	1	MR25	5322 116 54648
R 182	POTM,TRIMMING	47K	20	0.75W	5322 101 14056
R 1822	RESISTOR,M.FILM	1,74K	1	MR25	5322 116 50629
R 1823	RESISTOR,M.FILM	100K	1	MR25	4822 116 51268
R 1824	RESISTOR,M.FILM	22,6K	1	MR25	5322 116 50481
R 1826	POTM,TRIMMING	1K	20	0.75W	5322 100 10143
R 1827	POTM,TRIMMING	10K	20	0,5W	5322 100 10113
R 1828	RESISTOR,M.FILM	11K	1	MR25	5322 116 54623
R 1829	RESISTOR,M.FILM	4,64K	1	MR25	5322 116 50484
R 183	RESISTOR,M.FILM	100K	1	MR25	4822 116 51268
R 1830	RESISTOR,M.FILM	33,2K	1	MR25	4822 116 51259
R 1831	RESISTOR,M.FILM	5,9K	1	MR25	5322 116 50583
R 1832	RESISTOR,M.FILM	3,32K	1	MR25	5322 116 54005
R 1833	RESISTOR,M.FILM	6,81K	1	MR25	4822 116 51252
R 1834	RESISTOR,M.FILM	249	1	MR25	5322 116 54499
R 1836	RESISTOR,M.FILM	12,1K	1	MR25	5322 116 50572
R 1837	RESISTOR,M.FILM	249	1	MR25	5322 116 54499
R 1838	RESISTOR,M.FILM	140	1	MR25	5322 116 54484
R 1839	RESISTOR,M.FILM	1	5	CR25	4822 110 73027
R 184	RESISTOR,M.FILM	301K	1	MR25	5322 116 54743
R 1846	RESISTOR,M.FILM	121K	1	MR25	5322 116 54704
R 1847	RESISTOR,M.FILM	121K	1	MR25	5322 116 54704
R 1848	RESISTOR,HT	3,9M	5	VR25	4822 110 72203
R 1849	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 1851	RESISTOR,M.FILM	68,1K	1	MR25	5322 116 54683
R 1852	RESISTOR,M.FILM	249K	1	MR25	5322 116 54386
R 1853	RESISTOR,M.FILM	511K	1	MR25	5322 116 55258
R 1854	RESISTOR,M.FILM	1M	5	CR25	4822 110 73187
R 1856	RESISTOR,M.FILM	1,33K	1	MR25	5322 116 54561
R 1857	RESISTOR,M.FILM	1,33K	1	MR25	5322 116 54561
R 1858	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 1861	RESISTOR,HT	10M	5	VR37	4822 110 42214
R 1901	RESISTOR,M.FILM	82,5	1	MR25	5322 116 54462
R 1902	RESISTOR,M.FILM	19,6K	1	MR25	5322 116 54641
R 1903	RESISTOR,M.FILM	6,19K	1	MR25	5322 116 55426
R 1904	RESISTOR,M.FILM	316	1	MR25	5322 116 54511
R 1906	POTM,TRIMMING	10K	20	0,5W	5322 100 10113
R 1907	RESISTOR,M.FILM	750	1	MR25	4822 116 51234
R 1908	RESISTOR,M.FILM	1,33K	1	MR25	5322 116 54561
R 1909	RESISTOR,M.FILM	6,19K	1	MR25	5322 116 55426
R 191	RESISTOR,M.FILM	274	1	MR25	5322 116 54504
R 1911	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 1912	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 1913	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 2	POTM,CARB+SW.	10K	20	0.1W	5322 101 44039
R 20	POTM,CARBON	4,7K	20	0.1W	5322 101 24204
R 200	RESISTOR,M.FILM	10	1	MR25	5322 116 50452
R 2001	RESISTOR,M.FILM	1,69K	1	MR25	5322 116 54567
R 2002	RESISTOR,M.FILM	42,2	1	MR25	5322 116 51052
R 2003	RESISTOR,M.FILM	42,2	1	MR25	5322 116 51052
R 2004	RESISTOR,M.FILM	22,6	1	MR25	5322 116 50491
R 2006	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253

POSNR	DESCRIPTION			ORDERING CODE
R 2007	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 2008	RESISTOR,M.FILM	511	1	MR25 4822 116 51282
R 2009	RESISTOR,M.FILM	2,61K	1	MR25 5322 116 50671
R 201	RESISTOR,M.FILM	536	1	MR25 5322 116 50621
R 2011	RESISTOR,M.FILM	1,69K	1	MR25 5322 116 54567
R 2014	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 2016	RESISTOR,M.FILM	3,32K	1	MR25 5322 116 54005
R 2017	RESISTOR,M.FILM	464	1	MR25 5322 116 50536
R 2018	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 2019	RESISTOR,M.FILM	205	1	MR25 5322 116 50669
R 202	RESISTOR,M.FILM	30,1	1	MR25 5322 116 50904
R 2021	RESISTOR,M.FILM	12,1K	1	MR25 5322 116 50572
R 2022	RESISTOR,M.FILM	750	1	MR25 4822 116 51234
R 2023	RESISTOR,M.FILM	1,21K	1	MR25 5322 116 54557
R 2024	RESISTOR,M.FILM	5,9K	1	MR25 5322 116 50583
R 2026	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2027	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2028	RESISTOR,M.FILM	12,1K	1	MR25 5322 116 50572
R 2029	RESISTOR,M.FILM	562	1	MR25 5322 116 54009
R 203	RESISTOR,M.FILM	30,1	1	MR25 5322 116 50904
R 2030	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2031	RESISTOR,M.FILM	68,1K	1	MR25 5322 116 54683
R 2032	RESISTOR,M.FILM	4,02K	1	MR25 5322 116 55448
R 2033	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2034	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2037	POTM,TRIMMING	1M	20	0,5W 5322 101 14094
R 2038	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2039	POTM,TRIMMING	1M	20	0,5W 5322 101 14094
R 2041	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2042	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2043	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 2044	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2046	RESISTOR,M.FILM	86,6K	1	MR25 5322 116 54692
R 2047	RESISTOR,M.FILM	301K	1	MR25 5322 116 54743
R 2048	POTM,TRIMMING	100K	20	0.5W 5322 101 14071
R 2049	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 205	RESISTOR,M.FILM	90,9	1	MR25 5322 116 54466
R 2050	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 2051	RESISTOR,HT	15M	5	VR37 4822 110 42218
R 2052	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 2053	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 2054	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2056	RESISTOR,M.FILM	18,7K	1	MR25 5322 116 55362
R 2057	RESISTOR,M.FILM	59K	1	MR25 5322 116 54678
R 2058	RESISTOR,M.FILM	301K	1	MR25 5322 116 54743
R 2059	RESISTOR,M.FILM	464	1	MR25 5322 116 50536
R 206	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 2060	RESISTOR,HT	22M	5	VR37 4822 110 42223
R 2061	RESISTOR,M.FILM	1,33K	1	MR25 5322 116 54561
R 2062	RESISTOR,M.FILM	100K	1	MR25 4822 116 51268
R 2063	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2064	RESISTOR,M.FILM	68,1K	1	MR25 5322 116 54683
R 2065	RESISTOR,M.FILM	100K	1	MR25 4822 116 51268
R 2067	RESISTOR,M.FILM	12,1K	1	MR25 5322 116 50572
R 2068	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491

POSNR	DESCRIPTION			ORDERING CODE
R 2069	RESISTOR,M.FILM	59K	1	MR25 5322 116 54678
R 207	RESISTOR,M.FILM	169	1	MR25 5322 116 54489
R 2070	RESISTOR,M.FILM	86,6K	1	MR25 5322 116 54692
R 2071	POTM,TRIMMING	100K	20	0.5W 5322 101 14071
R 2072	RESISTOR,HT	10M	5	VR37 4822 110 42214
R 2073	RESISTOR,HT	15M	5	VR37 4822 110 42218
R 2075	RESISTOR,M.FILM	909K	1	MR25 5322 116 55533
R 2077	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 2078	RESISTOR,M.FILM	1M	5	CR25 4822 110 73187
R 2079	RESISTOR,M.FILM	1M	5	CR25 4822 110 73187
R 208	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2081	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2082	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2083	RESISTOR,M.FILM	301K	1	MR25 5322 116 54743
R 2084	RESISTOR,M.FILM	681K	1	MR25 5322 116 55284
R 2086	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 2087	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2088	RESISTOR,M.FILM	100K	1	MR25 4822 116 51268
R 2089	RESISTOR,M.FILM	100K	1	MR25 4822 116 51268
R 209	RESISTOR,M.FILM	5,9K	1	MR25 5322 116 50583
R 2090	RESISTOR,M.FILM	1,96	0,5	MR30 5322 116 55599
R 2091	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2092	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2093	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2094	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2095	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 2096	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2097	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 2098	RESISTOR,M.FILM	15,4K	1	MR25 5322 116 50479
R 2099	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 21	POTM,CARB+SW.	100K	20	5322 101 44037
R 210	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 2100	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 2101	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 211	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 212	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 213	RESISTOR,M.FILM	169	1	MR25 5322 116 54489
R 214	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 216	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 217	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 218	RESISTOR,M.FILM	249	1	MR25 5322 116 54499
R 219	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 22	POTM,CARBON	10K	20	0.1W 5322 101 24132
R 220	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2200	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 2201	RESISTOR,M.FILM	536	1	MR25 5322 116 50621
R 2202	RESISTOR,M.FILM	30,1	1	MR25 5322 116 50904
R 2203	RESISTOR,M.FILM	30,1	1	MR25 5322 116 50904
R 2205	RESISTOR,M.FILM	90,9	1	MR25 5322 116 54466
R 2206	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 2207	RESISTOR,M.FILM	169	1	MR25 5322 116 54489
R 2208	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2209	RESISTOR,M.FILM	5,9K	1	MR25 5322 116 50583
R 221	RESISTOR,M.FILM	249	1	MR25 5322 116 54499
R 2210	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 2211	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 2212	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 2213	RESISTOR,M.FILM	169	1	MR25 5322 116 54489
R 2214	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2216	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 2217	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 2218	RESISTOR,M.FILM	249	1	MR25 5322 116 54499
R 2219	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 222	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2220	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549

POSNR	DESCRIPTION			ORDERING CODE
R 2221	RESISTOR,M.FILM	249	1	MR25 5322 116 54499
R 2222	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2223	RESISTOR,M.FILM	562	1	MR25 5322 116 54009
R 2224	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 2226	RESISTOR,M.FILM	16,2K	1	MR25 5322 116 55361
R 2227	RESISTOR,M.FILM	10,5K	1	MR25 5322 116 50731
R 2228	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 2229	RESISTOR,M.FILM	3,48K	1	MR25 5322 116 54585
R 223	RESISTOR,M.FILM	562	1	MR25 5322 116 54009
R 2231	RESISTOR,M.FILM	5,36K	1	MR25 5322 116 54597
R 2232	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2233	RESISTOR,M.FILM	56,2	1	MR25 5322 116 54446
R 2234	RESISTOR,M.FILM	59	1	MR25 5322 116 54448
R 2235	RESISTOR,M.FILM	9,09	1	MR25 5322 116 50863
R 2236	RESISTOR,M.FILM	237	0,1	MR24E 5322 116 54995
R 2237	RESISTOR,M.FILM	56,2	1	MR25 5322 116 54446
R 2238	RESISTOR,M.FILM	59	1	MR25 5322 116 54448
R 2239	RESISTOR,M.FILM	237	0,1	MR24E 5322 116 54995
R 224	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 2240	RESISTOR,M.FILM	9,09	1	MR25 5322 116 50863
R 2241	RESISTOR,M.FILM	100K	1	MR25 4822 116 51268
R 2242	RESISTOR,M.FILM	100K	1	MR25 4822 116 51268
R 2243	RESISTOR,M.FILM	3,48K	1	MR25 5322 116 54585
R 2248	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 2249	RESISTOR,M.FILM	511	1	MR25 4822 116 51282
R 2251	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 2258	RESISTOR,M.FILM	5,9K	1	MR25 5322 116 50583
R 2259	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 226	RESISTOR,M.FILM	16,2K	1	MR25 5322 116 55361
R 2260	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2261	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2262	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 2263	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 2264	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2266	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2267	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2268	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 2269	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 227	RESISTOR,M.FILM	10,5K	1	MR25 5322 116 50731
R 2271	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2272	RESISTOR,M.FILM	46,4K	1	MR25 5322 116 50557
R 2273	RESISTOR,M.FILM	681	1	MR25 4822 116 51233
R 2274	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2276	RESISTOR,M.FILM	536	1	MR25 5322 116 50621
R 2277	RESISTOR,M.FILM	1,33K	1	MR25 5322 116 54561
R 2278	RESISTOR,M.FILM	140	1	MR25 5322 116 54484
R 2279	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 228	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 2280	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2281	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 2282	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 2283	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 2284	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 2286	RESISTOR,M.FILM	2,61K	1	MR25 5322 116 50671
R 2287	RESISTOR,M.FILM	8,66K	1	MR25 5322 116 54613

POSNR	DESCRIPTION				ORDERING CODE
R 2289	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 229	RESISTOR,M.FILM	3,48K	1	MR25	5322 116 54585
R 23	POTM,CARBON	4,7M	20	0.1W	5322 101 24133
R 2300	RESISTOR,M.FILM	10	1	MR25	5322 116 50452
R 2301	RESISTOR,M.FILM	536	1	MR25	5322 116 50621
R 2302	RESISTOR,M.FILM	30,1	1	MR25	5322 116 50904
R 2303	RESISTOR,M.FILM	30,1	1	MR25	5322 116 50904
R 2305	RESISTOR,M.FILM	90,9	1	MR25	5322 116 54466
R 2306	RESISTOR,M.FILM	51,1	1	MR25	5322 116 54442
R 2307	RESISTOR,M.FILM	169	1	MR25	5322 116 54489
R 2308	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2309	RESISTOR,M.FILM	5,9K	1	MR25	5322 116 50583
R 231	RESISTOR,M.FILM	5,36K	1	MR25	5322 116 54597
R 2310	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 2311	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 2312	RESISTOR,M.FILM	5,11K	1	MR25	5322 116 54595
R 2313	RESISTOR,M.FILM	169	1	MR25	5322 116 54489
R 2314	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2316	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 2317	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 2318	RESISTOR,M.FILM	249	1	MR25	5322 116 54499
R 2319	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 232	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2320	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 2321	RESISTOR,M.FILM	249	1	MR25	5322 116 54499
R 2322	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2323	RESISTOR,M.FILM	562	1	MR25	5322 116 54009
R 2324	RESISTOR,M.FILM	5,11K	1	MR25	5322 116 54595
R 2326	RESISTOR,M.FILM	16,2K	1	MR25	5322 116 55361
R 2327	RESISTOR,M.FILM	10,5K	1	MR25	5322 116 50731
R 2328	RESISTOR,M.FILM	1,47K	1	MR25	5322 116 50635
R 2329	RESISTOR,M.FILM	3,48K	1	MR25	5322 116 54585
R 233	RESISTOR,M.FILM	56,2	1	MR25	5322 116 54446
R 2331	RESISTOR,M.FILM	5,36K	1	MR25	5322 116 54597
R 2332	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2333	RESISTOR,M.FILM	56,2	1	MR25	5322 116 54446
R 2334	RESISTOR,M.FILM	59	1	MR25	5322 116 54448
R 2335	RESISTOR,M.FILM	9,09	1	MR25	5322 116 50863
R 2336	RESISTOR,M.FILM	237	0,1	MR24E	5322 116 54995
R 2337	RESISTOR,M.FILM	56,2	1	MR25	5322 116 54446
R 2338	RESISTOR,M.FILM	59	1	MR25	5322 116 54448
R 2339	RESISTOR,M.FILM	237	0,1	MR24E	5322 116 54995
R 234	RESISTOR,M.FILM	59	1	MR25	5322 116 54448
R 2340	RESISTOR,M.FILM	9,09	1	MR25	5322 116 50863
R 2341	RESISTOR,M.FILM	100K	1	MR25	4822 116 51268
R 2342	RESISTOR,M.FILM	100K	1	MR25	4822 116 51268
R 2343	RESISTOR,M.FILM	3,48K	1	MR25	5322 116 54585
R 2348	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 2349	RESISTOR,M.FILM	511	1	MR25	4822 116 51282
R 235	RESISTOR,M.FILM	9,09	1	MR25	5322 116 50863
R 2351	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 2358	RESISTOR,M.FILM	5,9K	1	MR25	5322 116 50583
R 2359	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 236	RESISTOR,M.FILM	237	0,1	MR24E	5322 116 54995
R 2360	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 2361	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2362	RESISTOR,M.FILM	10	1	MR25	5322 116 50452
R 2363	RESISTOR,M.FILM	10	1	MR25	5322 116 50452
R 2364	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2366	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2367	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 2368	RESISTOR,M.FILM	4,64K	1	MR25	5322 116 50484
R 2369	RESISTOR,M.FILM	4,64K	1	MR25	5322 116 50484
R 237	RESISTOR,M.FILM	56,2	1	MR25	5322 116 54446
R 2371	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549

POSNR	DESCRIPTION			ORDERING CODE
R 2372	RESISTOR,M.FILM	46,4K	1	MR25 5322 116 50557
R 2373	RESISTOR,M.FILM	681	1	MR25 4822 116 51233
R 2374	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 2376	RESISTOR,M.FILM	536	1	MR25 5322 116 50621
R 2377	RESISTOR,M.FILM	1,33K	1	MR25 5322 116 54561
R 2378	RESISTOR,M.FILM	140	1	MR25 5322 116 54484
R 2379	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 238	RESISTOR,M.FILM	59	1	MR25 5322 116 54448
R 2380	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 2381	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 2382	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 2383	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 2384	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 2386	RESISTOR,M.FILM	2,61K	1	MR25 5322 116 50671
R 2387	RESISTOR,M.FILM	8,66K	1	MR25 5322 116 54613
R 2389	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 239	RESISTOR,M.FILM	237	0,1	MR24E 5322 116 54995
R 24	POTM,TANDEM+SW.			5322 102 44019
R 240	RESISTOR,M.FILM	9,09	1	MR25 5322 116 50863
R 241	RESISTOR,M.FILM	100K	1	MR25 4822 116 51268
R 242	RESISTOR,M.FILM	100K	1	MR25 4822 116 51268
R 243	RESISTOR,M.FILM	3,48K	1	MR25 5322 116 54585
R 244	POTM,TRIMMING	470	20	0.75W 5322 100 10135
R 248	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 249	RESISTOR,M.FILM	511	1	MR25 4822 116 51282
R 251	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 253	POTM,TRIMMING	470	20	0.75W 5322 100 10135
R 254	POTM,TRIMMING	2,2K	20	0.75W 5322 100 10144
R 256	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 257	POTM,TRIMMING	4,7K	20	0.75W 5322 100 10139
R 258	RESISTOR,M.FILM	5,9K	1	MR25 5322 116 50583
R 259	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 26	POTM,CARBON	22K	20	0.1W 4822 101 20417
R 260	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 261	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 262	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 263	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 264	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 266	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 267	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 268	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 269	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 271	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 272	RESISTOR,M.FILM	46,4K	1	MR25 5322 116 50557
R 273	RESISTOR,M.FILM	681	1	MR25 4822 116 51233
R 274	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 276	RESISTOR,M.FILM	536	1	MR25 5322 116 50621
R 277	RESISTOR,M.FILM	1,33K	1	MR25 5322 116 54561
R 278	RESISTOR,M.FILM	140	1	MR25 5322 116 54484
R 279	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 280	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 281	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 282	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 283	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 284	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484

POSNR	DESCRIPTION				ORDERING CODE
R 286	RESISTOR,M.FILM	2,61K	1	MR25	5322 116 50671
R 287	RESISTOR,M.FILM	8,66K	1	MR25	5322 116 54613
R 289	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 3	POTM,TANDEM+SW.	47K +47K	LIN	0,1W	5322 103 50002
R 300	RESISTOR,M.FILM	10	1	MR25	5322 116 50452
R 301	RESISTOR,M.FILM	536	1	MR25	5322 116 50621
R 302	RESISTOR,M.FILM	30,1	1	MR25	5322 116 50904
R 303	RESISTOR,M.FILM	30,1	1	MR25	5322 116 50904
R 305	RESISTOR,M.FILM	90,9	1	MR25	5322 116 54466
R 306	RESISTOR,M.FILM	51,1	1	MR25	5322 116 54442
R 307	RESISTOR,M.FILM	169	1	MR25	5322 116 54489
R 308	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 309	RESISTOR,M.FILM	5,9K	1	MR25	5322 116 50583
R 310	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 311	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 312	RESISTOR,M.FILM	5,11K	1	MR25	5322 116 54595
R 313	RESISTOR,M.FILM	169	1	MR25	5322 116 54489
R 314	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 316	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 317	RESISTOR,M.FILM	10K	1	MR25	4822 116 51253
R 318	RESISTOR,M.FILM	249	1	MR25	5322 116 54499
R 319	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 320	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 321	RESISTOR,M.FILM	249	1	MR25	5322 116 54499
R 322	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 323	RESISTOR,M.FILM	562	1	MR25	5322 116 54009
R 324	RESISTOR,M.FILM	5,11K	1	MR25	5322 116 54595
R 326	RESISTOR,M.FILM	16,2K	1	MR25	5322 116 55361
R 327	RESISTOR,M.FILM	10,5K	1	MR25	5322 116 50731
R 328	RESISTOR,M.FILM	1,47K	1	MR25	5322 116 50635
R 329	RESISTOR,M.FILM	3,48K	1	MR25	5322 116 54585
R 331	RESISTOR,M.FILM	5,36K	1	MR25	5322 116 54597
R 332	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 333	RESISTOR,M.FILM	56,2	1	MR25	5322 116 54446
R 334	RESISTOR,M.FILM	59	1	MR25	5322 116 54448
R 335	RESISTOR,M.FILM	9,09	1	MR25	5322 116 50863
R 336	RESISTOR,M.FILM	237	0,1	MR24E	5322 116 54995
R 337	RESISTOR,M.FILM	56,2	1	MR25	5322 116 54446
R 338	RESISTOR,M.FILM	59	1	MR25	5322 116 54448
R 339	RESISTOR,M.FILM	237	0,1	MR24E	5322 116 54995
R 340	RESISTOR,M.FILM	9,09	1	MR25	5322 116 50863
R 341	RESISTOR,M.FILM	100K	1	MR25	4822 116 51268
R 342	RESISTOR,M.FILM	100K	1	MR25	4822 116 51268
R 343	RESISTOR,M.FILM	3,48K	1	MR25	5322 116 54585
R 348	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 349	RESISTOR,M.FILM	511	1	MR25	4822 116 51282
R 351	RESISTOR,M.FILM	33,2	1	MR25	5322 116 50527
R 358	RESISTOR,M.FILM	5,9K	1	MR25	5322 116 50583
R 359	POTM,TRIMMING	10K	20	0.75W	5322 100 10141
R 360	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 361	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 362	RESISTOR,M.FILM	10	1	MR25	5322 116 50452
R 363	RESISTOR,M.FILM	10	1	MR25	5322 116 50452
R 364	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 366	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 367	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 368	RESISTOR,M.FILM	4,64K	1	MR25	5322 116 50484
R 369	RESISTOR,M.FILM	4,64K	1	MR25	5322 116 50484
R 371	RESISTOR,M.FILM	1K	1	MR25	5322 116 54549
R 372	RESISTOR,M.FILM	46,4K	1	MR25	5322 116 50557
R 373	RESISTOR,M.FILM	681	1	MR25	4822 116 51233
R 374	RESISTOR,M.FILM	100	1	MR25	5322 116 54469
R 376	RESISTOR,M.FILM	536	1	MR25	5322 116 50621
R 377	RESISTOR,M.FILM	1,33K	1	MR25	5322 116 54561
R 378	RESISTOR,M.FILM	140	1	MR25	5322 116 54484

POSNR	DESCRIPTION			ORDERING CODE
R 379	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 380	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 381	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 382	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 383	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 384	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 386	RESISTOR,M.FILM	2,61K	1	MR25 5322 116 50671
R 387	RESISTOR,M.FILM	8,66K	1	MR25 5322 116 54613
R 389	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 4	POTM,CARB+SW.	10K	20	0.1W 5322 101 44039
R 401	RESISTOR,M.FILM	287	1	MR25 5322 116 54506
R 402	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 403	RESISTOR,M.FILM	4,22K	1	MR25 5322 116 50729
R 404	RESISTOR,M.FILM	4,22K	1	MR25 5322 116 50729
R 406	RESISTOR,M.FILM	30,1	1	MR25 5322 116 50904
R 407	RESISTOR,M.FILM	30,1	1	MR25 5322 116 50904
R 408	POTM,TRIMMING	4,7K	20	0.75W 5322 100 10139
R 409	POTM,TRIMMING	2,2K	20	0.75W 5322 100 10144
R 411	POTM,TRIMMING	470	20	0.75W 5322 100 10135
R 412	POTM,TRIMMING	220	20	0.75W 5322 100 10133
R 413	RESISTOR,M.FILM	53,6	1	MR25 5322 116 54444
R 414	RESISTOR,M.FILM	59	1	MR25 5322 116 54448
R 416	RESISTOR,M.FILM	442	1	MR25 5322 116 50592
R 417	RESISTOR,M.FILM	287	1	MR25 5322 116 54506
R 418	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 419	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 421	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 422	RESISTOR,M.FILM	442	1	MR25 5322 116 50592
R 423	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 424	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 426	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 427	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 428	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 429	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 432	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 433	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 434	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 435	RESISTOR,M.FILM	12,7K	1	MR25 5322 116 50443
R 436	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 437	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 438	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 439	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 441	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 5	POTM,CARB+SW.	10K	20	0.1W 5322 101 44023
R 500	POTM,TRIMMING	1K	20	0.75W 5322 100 10143
R 501	RESISTOR,M.FILM	86,6	1	MR25 5322 116 54464
R 502	RESISTOR,M.FILM	86,6	1	MR25 5322 116 54464
R 503	RESISTOR,M.FILM	48,7	1	MR25 5322 116 50511
R 504	RESISTOR,M.FILM	169	1	MR25 5322 116 54489
R 505	RESISTOR,M.FILM	1,21K	1	MR25 5322 116 54557
R 506	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 507	RESISTOR,M.FILM	86,6	1	MR25 5322 116 54464
R 508	RESISTOR,M.FILM	90,9	1	MR25 5322 116 54466
R 509	RESISTOR,M.FILM	402	1	MR25 5322 116 54519
R 510	RESISTOR,M.FILM	274	1	MR25 5322 116 54504

POSNR	DESCRIPTION			ORDERING CODE
R 511	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 512	RESISTOR,M.FILM	48,7	1	MR25 5322 116 50511
R 513	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 514	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 515	RESISTOR,M.FILM	169	1	MR25 5322 116 54489
R 516	RESISTOR,M.FILM	59	1	MR25 5322 116 54448
R 517	RESISTOR,M.FILM	3,01K	1	MR25 4822 116 51246
R 518	RESISTOR,M.FILM	2,74K	1	MR25 5322 116 50636
R 521	RESISTOR,M.FILM	536	1	MR25 5322 116 50621
R 522	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 523	RESISTOR,M.FILM	536	1	MR25 5322 116 50621
R 524	RESISTOR,M.FILM	59	1	MR25 5322 116 54448
R 526	RESISTOR,M.FILM	5,9K	1	MR25 5322 116 50583
R 527	POTM, TRIMMING	10K	20	0.75W 5322 100 10141
R 528	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 529	RESISTOR,M.FILM	348	1	MR25 5322 116 54515
R 531	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 534	RESISTOR,M.FILM	30,1	1	MR25 5322 116 50904
R 536	RESISTOR,M.FILM	442	1	MR25 5322 116 50592
R 537	RESISTOR,M.FILM	30,1	1	MR25 5322 116 50904
R 538	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 539	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 541	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 542	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 543	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 544	RESISTOR,M.FILM	348	1	MR25 5322 116 54515
R 546	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 547	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 548	RESISTOR,M.FILM	10	1	MR25 5322 116 50452
R 550	RESISTOR,M.FILM	46,4	1	MR25 5322 116 50492
R 551	RESISTOR,M.FILM	46,4	1	MR25 5322 116 50492
R 552	RESISTOR,M.FILM	121	1	MR25 5322 116 54426
R 554	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 556	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 557	RESISTOR,M.FILM	46,4	1	MR25 5322 116 50492
R 558	RESISTOR,M.FILM	46,4	1	MR25 5322 116 50492
R 6	POTM,TANDEM+SW.	47K +47K	LIN	0,1W 5322 102 40057
R 601	RESISTOR,M.FILM	715	1	MR25 5322 116 50571
R 602	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 603	RESISTOR,M.FILM	205	1	MR25 5322 116 50669
R 604	RESISTOR,M.FILM	115	1	MR25 5322 116 54476
R 606	RESISTOR,M.FILM	4,22K	1	MR25 5322 116 50729
R 607	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 608	RESISTOR,M.FILM	2,26K	1	MR25 5322 116 50675
R 609	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 610	RESISTOR,M.FILM	84,5	0,5	MR30 5322 116 54776
R 611	RESISTOR,M.FILM	715	1	MR25 5322 116 50571
R 612	RESISTOR,M.FILM	205	1	MR25 5322 116 50669
R 613	RESISTOR,M.FILM	115	1	MR25 5322 116 54476
R 614	RESISTOR,M.FILM	6,81K	1	MR25 4822 116 51252
R 616	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 617	RESISTOR,M.FILM	348	1	MR25 5322 116 54515
R 618	RESISTOR,M.FILM	140	1	MR25 5322 116 54484
R 619	RESISTOR,M.FILM	8,25K	1	MR25 5322 116 54558
R 621	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 622	RESISTOR,M.FILM	1,4K	1	MR25 5322 116 54562
R 623	RESISTOR,M.FILM	82,5	1	MR25 5322 116 54462
R 624	RESISTOR,M.FILM	140	1	MR25 5322 116 54484
R 626	RESISTOR,M.FILM	348	1	MR25 5322 116 54515
R 627	RESISTOR,M.FILM	4,64K	1	MR25 5322 116 50484
R 628	RESISTOR,M.FILM	6,81K	1	MR25 4822 116 51252
R 629	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 630	RESISTOR,M.FILM	2,61K	1	MR25 5322 116 50671
R 631	RESISTOR,M.FILM	316	1	MR25 5322 116 54511
R 632	RESISTOR,M.FILM	2,74K	1	MR25 5322 116 50636

POSNR	DESCRIPTION				ORDERING CODE
R 634	POTM, TRIMMING	10K	20	0.5W	5322 101 14066
R 636	POTM, TRIMMING	4,7K	20	0.5W	5322 101 14292
R 637	RESISTOR, M. FILM	100	1	MR25	5322 116 54469
R 638	RESISTOR, M. FILM	100	1	MR25	5322 116 54469
R 639	RESISTOR, M. FILM	10	1	MR25	5322 116 50452
R 640	RESISTOR, M. FILM	10K	1	MR25	4822 116 51253
R 641	RESISTOR, M. FILM	10	1	MR25	5322 116 50452
R 642	RESISTOR, M. FILM	10K	1	MR25	4822 116 51253
R 643	RESISTOR, M. FILM	20,5	1	MR25	5322 116 50678
R 644	RESISTOR, M. FILM	20,5	1	MR25	5322 116 50678
R 646	POTM, TRIMMING	10K	20	0.5W	5322 101 14066
R 647	RESISTOR, M. FILM	2,74K	1	MR25	5322 116 50636
R 649	RESISTOR, NTC	1,3K	10	1W	4822 116 30018
R 653	RESISTOR, M. FILM	12,1K	1	MR25	5322 116 50572
R 654	POTM, TRIMMING	10K	20	0,5W	5322 100 10113
R 655	RESISTOR, M. FILM	2,05K	1	MR25	5322 116 50664
R 656	RESISTOR, M. FILM	2,05K	1	MR25	5322 116 50664
R 657	RESISTOR, M. FILM	100	1	MR25	5322 116 54469
R 658	POTM, TRIMMING	10K	20	0,5W	5322 100 10113
R 659	RESISTOR, M. FILM	147	1	MR25	5322 116 50766
R 660	RESISTOR, M. FILM	147	1	MR25	5322 116 50766
R 661	RESISTOR, M. FILM	100	1	MR25	5322 116 54469
R 701	RESISTOR, M. FILM	301	1	MR25	5322 116 54508
R 702	RESISTOR, M. FILM	750K	1	MR30	5322 116 54335
R 703	RESISTOR, M. FILM	1K	1	MR25	5322 116 54549
R 704	RESISTOR, M. FILM	1K	1	MR25	5322 116 54549
R 705	RESISTOR, M. FILM	71,5	1	MR25	5322 116 54457
R 706	RESISTOR, M. FILM	249K	1	MR25	5322 116 54386
R 707	RESISTOR, HT	10M	10	CR25	4822 110 72214
R 708	RESISTOR, M. FILM	1,78K	1	MR25	5322 116 50515
R 709	RESISTOR, M. FILM	33,2	1	MR25	5322 116 50527
R 710	RESISTOR, M. FILM	787	1	MR25	5322 116 54538
R 711	RESISTOR, M. FILM	5,11K	1	MR25	5322 116 54595
R 712	RESISTOR, M. FILM	6,81K	1	MR25	4822 116 51252
R 713	RESISTOR, M. FILM	12,1K	1	MR25	5322 116 50572
R 714	RESISTOR, M. FILM	100K	1	MR25	4822 116 51268
R 715	RESISTOR, M. FILM	10K	1	MR25	4822 116 51253
R 716	RESISTOR, M. FILM	12,1K	1	MR25	5322 116 50572
R 717	RESISTOR, M. FILM	6,81K	1	MR25	4822 116 51252
R 718	RESISTOR, M. FILM	24,9K	1	MR25	5322 116 54648
R 719	RESISTOR, M. FILM	24,9K	1	MR25	5322 116 54648
R 720	RESISTOR, M. FILM	100	1	MR25	5322 116 54469
R 721	RESISTOR, M. FILM	6,81K	1	MR25	4822 116 51252
R 722	RESISTOR, M. FILM	12,1K	1	MR25	5322 116 50572
R 723	RESISTOR, M. FILM	383	1	MR25	5322 116 54518
R 724	RESISTOR, M. FILM	100	1	MR25	5322 116 54469
R 726	RESISTOR, M. FILM	187K	1	MR25	5322 116 54723
R 727	RESISTOR, M. FILM	6,98K	1	MR25	5322 116 54605
R 728	RESISTOR, M. FILM	1,1K	1	MR25	4822 116 51236
R 729	RESISTOR, M. FILM	19,6K	1	MR25	5322 116 54641
R 730	RESISTOR, M. FILM	100	1	MR25	5322 116 54469
R 732	RESISTOR, M. FILM	348	1	MR25	5322 116 54515
R 733	POTM, TRIMMING	10K	20	0.75W	5322 100 10141
R 734	RESISTOR, M. FILM	100	1	MR25	5322 116 54469
R 737	POTM, TRIMMING	470	20	0.75W	5322 100 10135

POSNR	DESCRIPTION			ORDERING CODE
R 738	RESISTOR,M.FILM	56,2K	1	MR25 4822 116 51264
R 739	POTM,TRIMMING	47K	20	0.75W 5322 101 14056
R 741	RESISTOR,M.FILM	2,15K	1	MR25 5322 116 50767
R 743	POTM,TRIMMING	470	20	0.75W 5322 100 10135
R 744	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 8	POTM,CARB+SW.	10K	20	0.1W 5322 101 44038
R 801	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 802	RESISTOR,M.FILM	750	1	MR25 4822 116 51234
R 803	RESISTOR,M.FILM	4,42K	1	MR25 5322 116 50556
R 804	RESISTOR,M.FILM	825	1	MR25 5322 116 54541
R 805	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 806	RESISTOR,M.FILM	511	1	MR25 4822 116 51282
R 807	RESISTOR,M.FILM	750	1	MR25 4822 116 51234
R 808	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 809	RESISTOR,M.FILM	46,4	1	MR25 5322 116 50492
R 811	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 812	RESISTOR,M.FILM	3,48K	1	MR25 5322 116 54585
R 813	RESISTOR,M.FILM	8,25K	1	MR25 5322 116 54558
R 814	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 815	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 816	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 817	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 818	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 819	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 820	RESISTOR,M.FILM	511	1	MR25 4822 116 51282
R 821	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 822	RESISTOR,M.FILM	18,7K	1	MR25 5322 116 55362
R 823	RESISTOR,M.FILM	18,7K	1	MR25 5322 116 55362
R 824	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 825	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 826	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 827	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 828	RESISTOR,M.FILM	18,7K	1	MR25 5322 116 55362
R 829	RESISTOR,M.FILM	18,7K	1	MR25 5322 116 55362
R 831	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 832	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 833	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 834	RESISTOR,M.FILM	18,7K	1	MR25 5322 116 55362
R 835	RESISTOR,M.FILM	4,99	1	MR25 5322 116 50568
R 836	RESISTOR,M.FILM	18,7K	1	MR25 5322 116 55362
R 837	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 838	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 839	RESISTOR,M.FILM	825	1	MR25 5322 116 54541
R 841	RESISTOR,M.FILM	205	1	MR25 5322 116 50669
R 842	POTM,TRIMMING	1K	20	0.75W 5322 100 10143
R 844	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 845	POTM,TRIMMING	1K	20	0.75W 5322 100 10143
R 846	RESISTOR,M.FILM	365	1	MR25 5322 116 54516
R 847	RESISTOR,M.FILM	365	1	MR25 5322 116 54516
R 848	RESISTOR,M.FILM	909	1	MR25 5322 116 55278
R 849	RESISTOR,M.FILM	147	1	MR25 5322 116 50766
R 851	RESISTOR,M.FILM	909	1	MR25 5322 116 55278
R 852	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 853	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 854	RESISTOR,M.FILM	95,3	1	MR25 5322 116 50569
R 855	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 856	RESISTOR,M.FILM	750	1	MR25 4822 116 51234
R 857	RESISTOR,M.FILM	95,3	1	MR25 5322 116 50569
R 858	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 859	RESISTOR,M.FILM	825	1	MR25 5322 116 54541
R 861	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 862	RESISTOR,M.FILM	78,7	1	MR25 5322 116 50578
R 863	RESISTOR,M.FILM	261	1	MR25 5322 116 54502
R 864	RESISTOR,M.FILM	121	1	MR25 5322 116 54426
R 865	RESISTOR,M.FILM	5,11	1	MR25 5322 116 54192

POSNR	DESCRIPTION			ORDERING CODE
R 866	RESISTOR,M.FILM	121	1	MR25 5322 116 54426
R 867	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 868	RESISTOR,M.FILM	316	1	MR25 5322 116 54511
R 869	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 870	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 871	RESISTOR,M.FILM	90,9	1	MR25 5322 116 54466
R 872	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 873	RESISTOR,M.FILM	16,2K	1	MR25 5322 116 55361
R 874	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 875	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 876	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 877	RESISTOR,M.FILM	909	1	MR25 5322 116 55278
R 878	RESISTOR,M.FILM	681	1	MR25 4822 116 51233
R 879	RESISTOR,M.FILM	1,87K	1	MR25 5322 116 50728
R 881	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 882	RESISTOR,M.FILM	150	1	MR25 5322 116 54486
R 883	RESISTOR,M.FILM	316	1	MR25 5322 116 54511
R 884	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 885	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 886	RESISTOR,M.FILM	90,9	1	MR25 5322 116 54466
R 887	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 888	RESISTOR,M.FILM	16,2K	1	MR25 5322 116 55361
R 889	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 890	RESISTOR,M.FILM	5,11	1	MR25 5322 116 54192
R 891	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 892	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 893	RESISTOR,M.FILM	316	1	MR25 5322 116 54511
R 894	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 896	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 897	RESISTOR,M.FILM	316	1	MR25 5322 116 54511
R 898	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 899	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 9	POTM,CARB+SW.	10K	20	0.1W 5322 101 44038
R 900	RESISTOR,M.FILM	1,69K	1	MR25 5322 116 54567
R 901	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 902	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 903	RESISTOR,M.FILM	825	1	MR25 5322 116 54541
R 904	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 905	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 906	RESISTOR,M.FILM	464	1	MR25 5322 116 50536
R 907	RESISTOR,M.FILM	464	1	MR25 5322 116 50536
R 908	RESISTOR,M.FILM	2,26K	1	MR25 5322 116 50675
R 909	RESISTOR,M.FILM	2,26K	1	MR25 5322 116 50675
R 910	RESISTOR,M.FILM	7,15K	1	MR25 5322 116 54606
R 911	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 912	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 913	POTM,TRIMMING	10K	20	0.75W 5322 100 10141
R 914	RESISTOR,M.FILM	750	1	MR25 4822 116 51234
R 916	RESISTOR,M.FILM	2,49K	1	MR25 5322 116 50581
R 917	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 918	RESISTOR,M.FILM	3,83K	1	MR25 5322 116 54589
R 919	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 920	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 921	RESISTOR,M.FILM	12,1K	1	MR25 5322 116 50572
R 922	RESISTOR,M.FILM	5,9K	1	MR25 5322 116 50583

POSNR	DESCRIPTION			ORDERING CODE
R 923	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 924	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 926	RESISTOR,M.FILM	487	0,1	MR24E 5322 116 54249
R 927	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 928	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 929	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 931	RESISTOR,M.FILM	464	1	MR25 5322 116 50536
R 932	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 933	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 934	RESISTOR,M.FILM	38,3	1	MR25 5322 116 50954
R 936	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 937	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 938	RESISTOR,HT	5,6M	10	CR25 4822 110 72207
R 939	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 940	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 941	RESISTOR,M.FILM	5,11	1	MR25 5322 116 54192
R 942	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 943	RESISTOR,M.FILM	68,1	1	MR25 5322 116 54455
R 944	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 945	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 946	RESISTOR,M.FILM	2,49K	1	MR25 5322 116 50581
R 947	RESISTOR,M.FILM	2,05K	1	MR25 5322 116 50664
R 948	RESISTOR,M.FILM	2,26K	1	MR25 5322 116 50675
R 949	RESISTOR,M.FILM	90,9	1	MR25 5322 116 54466
R 950	RESISTOR,M.FILM	511	1	MR25 4822 116 51282
R 951	RESISTOR,M.FILM	332	1	MR25 4822 116 51226
R 952	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 953	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 954	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 955	RESISTOR,M.FILM	5,11K	1	MR25 5322 116 54595
R 956	RESISTOR,M.FILM	750	1	MR25 4822 116 51234
R 957	RESISTOR,M.FILM	22,6	1	MR25 5322 116 50491
R 958	RESISTOR,M.FILM	750	1	MR25 4822 116 51234
R 959	RESISTOR,M.FILM	3,32K	1	MR25 5322 116 54005
R 960	RESISTOR,M.FILM	6,81K	1	MR25 4822 116 51252
R 961	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 962	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 963	RESISTOR,M.FILM	205	1	MR25 5322 116 50669
R 964	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 965	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 966	RESISTOR,M.FILM	562	1	MR25 5322 116 54009
R 967	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 968	RESISTOR,M.FILM	274	1	MR25 5322 116 54504
R 969	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 970	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 971	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 972	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 973	RESISTOR,M.FILM	464	1	MR25 5322 116 50536
R 974	RESISTOR,M.FILM	16,2K	1	MR25 5322 116 55361
R 975	RESISTOR,M.FILM	100	1	MR25 5322 116 54469
R 976	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 977	RESISTOR,M.FILM	15,4K	1	MR25 5322 116 50479
R 978	RESISTOR,M.FILM	1,47K	1	MR25 5322 116 50635
R 980	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253
R 981	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 982	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 983	RESISTOR,M.FILM	22,6K	1	MR25 5322 116 50481
R 984	RESISTOR,M.FILM	402	1	MR25 5322 116 54519
R 985	RESISTOR,M.FILM	619K	1	MR25 5322 116 55315
R 986	RESISTOR,M.FILM	33,2	1	MR25 5322 116 50527
R 987	RESISTOR,M.FILM	33,2K	1	MR25 4822 116 51259
R 992	RESISTOR,M.FILM	1,87K	1	MR25 5322 116 50728
R 993	RESISTOR,M.FILM	1K	1	MR25 5322 116 54549
R 994	RESISTOR,M.FILM	2,15K	1	MR25 5322 116 50767
R 995	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 996	RESISTOR,M.FILM	301	1	MR25 5322 116 54508
R 997	RESISTOR,M.FILM	51,1	1	MR25 5322 116 54442
R 998	RESISTOR,M.FILM	10K	1	MR25 4822 116 51253

CAPACITORS

POSNR	DESCRIPTION			ORDERING CODE
C 101	CAPACITOR, TRIMM	3PF		5322 125 54026
C 102	CAPACITOR, FOIL	22NF 10%	630V	4822 121 40278
C 103	CAPACITOR, CERAM	47PF 2	100	4822 122 31072
C 104	CAPACITOR, TRIMM	3,5PF		5322 125 50048
C 106	CAPACITOR, CERAM	5,6PF 0,25PF	500	4822 122 31191
C 107	CAPACITOR, TRIMM	18PF		5322 125 50051
C 108	CAPACITOR, CHIP	33PF 10%	50V	5322 122 34105
C 109	CAPACITOR, TRIMM	10PF		5322 125 50049
C 110	CAPACITOR, CERAM	15PF 2	100	4822 122 31058
C 111	CAPACITOR, CERAM	1PF 0,25PF	500	4822 122 31182
C 112	CAPACITOR, TRIMM	18PF		5322 125 50051
C 113	CAPACITOR, CHIP	39PF 10%	50V	5322 122 34113
C 114	CAPACITOR, CERAM	100PF 2	500	5322 122 31626
C 115	CAPACITOR, CERAM	15PF 2	100	4822 122 31058
C 117	CAPACITOR, CHIP	10NF 20%	50V	5322 122 34098
C 118	CAPACITOR, CERAM	1,5PF 0,25PF	100	4822 122 30105
C 119	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 120	CAPACITOR, CERAM	2,7PF 0,25PF	100	4822 122 31038
C 1201	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 1202	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1204	CAPACITOR, CERAM	10NF-20+50	100	4822 122 31414
C 1205	CAPACITOR, CERAM	1NF-20+80	40	4822 122 30027
C 1206	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1207	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1208	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 121	CAPACITOR, CERAM	2,2NF-20+80	40	4822 122 31116
C 1211	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 1212	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1213	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 1214	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 1216	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1217	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 1218	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1219	CAPACITOR, CERAM	12PF 2	100	4822 122 31056
C 122	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1220	CAPACITOR, CERAM	560PF 10	100	4822 122 30126
C 1221	CAPACITOR, CERAM	220PF 10	100	4822 122 30094
C 1224	CAPACITOR, CERAM	12PF 2	100	4822 122 31056
C 1226	CAPACITOR, CERAM	12PF 2	100	4822 122 31056
C 1228	CAPACITOR, CERAM	12PF 2	100	4822 122 31056
C 1229	CAPACITOR, CERAM	10PF 2	100	4822 122 31054
C 123	CAPACITOR, CERAM	5,6PF 0,25PF	100	4822 122 31047
C 1231	CAPACITOR, CERAM	12PF 2	100	4822 122 31056
C 1232	CAPACITOR, CERAM	10PF 2	100	4822 122 31054
C 1234	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1236	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1237	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1238	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1239	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 124	CAP, ELEC. TANTAL	6,8UF-20+20	16	5322 124 14069
C 126	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 127	CAP, ELEC. TANTAL	6,8UF-20+20	16	5322 124 14069
C 128	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1301	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1302	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043

POSNR	DESCRIPTION			ORDERING	CODE
C 1303	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1304	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1305	CAPACITOR,CERAM	22PF 2	100	4822 122	31063
C 1306	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1307	CAPACITOR,FOIL	4.7UF 10%	100V	5322 121	40224
C 1308	CAPACITOR,FOIL	47NF 1%	63V	5322 121	54108
C 1309	CAPACITOR,FOIL	4.3NF 1%	63V	5322 121	54062
C 1311	CAPACITOR,TRIMM	60PF		5322 125	54003
C 1312	CAPACITOR,FOIL			5322 121	54228
C 1313	CAPACITOR,FOIL	100NF 10%	250V	4822 121	41161
C 1314	CAPACITOR,CERAM	470PF 10	100	4822 122	30034
C 1315	CAPACITOR,CERAM	100PF 2	100	4822 122	31316
C 1316	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1317	CAP,ELECTROLYT.	10UF-10+50	25	4822 124	20697
C 1318	CAP,ELECTROLYT.	6,8UF-10+50	40	4822 124	20707
C 1319	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1320	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1321	CAPACITOR,CERAM	100PF 2	100	4822 122	31316
C 1322	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1323	CAP,ELECTROLYT.	10UF-10+50	25	4822 124	20697
C 1324	CAPACITOR,CERAM	10PF 2	100	5322 122	34143
C 1325	CAPACITOR,CERAM	220PF 2	100	4822 122	31222
C 1326	CAP,ELECTROLYT.	47UF-10+50	10	4822 124	20678
C 1501	CAPACITOR,CERAM	3,9PF 0,25PF	100	5322 122	34107
C 1502	CAPACITOR,CERAM	22NF-20+80	40	4822 122	30103
C 1503	CAPACITOR,CERAM	270PF 2	100	4822 122	31335
C 1505	CAPACITOR,CERAM	56PF 2	100	4822 122	31521
C 151	CAPACITOR,TRIMM	3PF		5322 125	54026
C 152	CAPACITOR,FOIL	22NF 10%	630V	4822 121	40278
C 153	CAPACITOR,CERAM	47PF 2	100	4822 122	31072
C 154	CAPACITOR,TRIMM	3,5PF		5322 125	50048
C 1550	CAPACITOR,FOIL	100NF 10%	250V	4822 121	41161
C 1551	CAPACITOR,FOIL	100NF 10%	250V	4822 121	41161
C 1552	CAPACITOR,FOIL	100NF 10%	250V	4822 121	41161
C 1553	CAPACITOR,CERAM	2,7NF 10	100	4822 122	30057
C 1554	CAPACITOR,CERAM	2,7NF 10	100	4822 122	30057
C 1557	CAPACITOR,FOIL	100NF 10%	250V	4822 121	41161
C 1559	CAPACITOR,CERAM	2,7NF 10	100	4822 122	30057
C 156	CAPACITOR,CERAM	5,6PF 0,25PF	500	4822 122	31191
C 1561	CAPACITOR,FOIL	100NF 10%	250V	4822 121	41161
C 1562	CAPACITOR,FOIL	100NF 10%	250V	4822 121	41161
C 1563	CAPACITOR,CERAM	2,7NF 10	100	4822 122	30057
C 1564	CAPACITOR,CERAM	2,7NF 10	100	4822 122	30057
C 1567	CAPACITOR,FOIL	100NF 10%	250V	4822 121	41161
C 1569	CAPACITOR,CERAM	2,7NF 10	100	4822 122	30057
C 157	CAPACITOR,TRIMM	18PF		5322 125	50051
C 158	CAPACITOR,CHIP	33PF 10%	50V	5322 122	34105
C 159	CAPACITOR,TRIMM	10PF		5322 125	50049
C 160	CAPACITOR,CERAM	15PF 2	100	4822 122	31058
C 1601	CAPACITOR,CERAM	15PF 2	100	4822 122	31058
C 1602	CAPACITOR,CERAM	56PF 2	100	4822 122	31074
C 1603	CAPACITOR,CERAM	27PF 2	100	4822 122	30045
C 1606	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1607	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1608	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1609	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 161	CAPACITOR,CERAM	1PF 0,25PF	500	4822 122	31182
C 1610	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1611	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1612	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1613	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1614	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1615	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1616	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043
C 1617	CAPACITOR,CERAM	10NF-20+80	40	4822 122	30043

POSNR	DESCRIPTION			ORDERING CODE
C 1618	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1619	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 162	CAPACITOR, TRIMM	18PF		5322 125 50051
C 1620	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1621	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1622	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1623	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1624	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1625	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1626	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1627	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1628	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1629	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 163	CAPACITOR, CHIP	39PF 10%	50V	5322 122 34113
C 1630	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1631	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 1632	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 164	CAPACITOR, CERAM	100PF 2	500	5322 122 31626
C 165	CAPACITOR, CERAM	15PF 2	100	4822 122 31058
C 1651	CAP, ELECTROLYT.	68UF-10+50	16	4822 124 20689
C 1652	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1653	CAP, ELECTROLYT.	68UF-10+50	16	4822 124 20689
C 1654	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1656	CAP, ELECTROLYT.	150UF-10+50	6,3	4822 124 20672
C 1657	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 1658	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 1659	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 1661	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 1662	CAP, ELECTROLYT.	68UF-10+50	16	4822 124 20689
C 1663	CAP, ELECTROLYT.	150UF-10+50	16	4822 124 20586
C 1664	CAP, ELECTROLYT.	68UF-10+50	16	4822 124 20689
C 1666	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1667	CAP, ELECTROLYT.	150UF-10+50	6,3	4822 124 20672
C 1668	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 1669	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 167	CAPACITOR, CHIP	10NF 20%	50V	5322 122 34098
C 1671	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 1672	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 168	CAPACITOR, CERAM	1,5PF 0,25PF	100	4822 122 30105
C 169	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 170	CAPACITOR, CERAM	2,7PF 0,25PF	100	4822 122 31038
C 1701	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1702	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 1703	CAPACITOR, CERAM	0,56PF 0,25PF	100	5322 122 34039
C 1704	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 1705	CAPACITOR, TRIMM	3,5PF		5322 125 50048
C 171	CAPACITOR, CERAM	2,2NF-20+80	40	4822 122 31116
C 172	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 173	CAPACITOR, CERAM	5,6PF 0,25PF	100	4822 122 31047
C 174	CAP, ELEC. TANTAL	6,8UF-20+20	16	5322 124 14069
C 176	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 177	CAP, ELEC. TANTAL	6,8UF-20+20	16	5322 124 14069
C 178	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 1801	CAPACITOR, PAPER	220NF 10%	250V	5322 121 44142
C 1802	CAP, ELECTROLYT.	220UF-10+50	350	5322 124 44007

POSNR	DESCRIPTION			ORDERING	CODE
C 1803	CAP, ELECTROLYT.	220UF-10+50	350	5322 124	44007
C 1804	CAPACITOR, FOIL	47NF 10%	630V	4822 121	40342
C 1806	CAPACITOR, HT	270PF 10%	2KV	5322 122	54024
C 1807	CAPACITOR, FOIL	30.1NF 2%	500V	5322 121	44248
C 1808	CAPACITOR, FOIL	30.1NF 2%	500V	5322 121	44248
C 1809	CAPACITOR, CERAM	22NF-20+80	40	4822 122	30103
C 1811	CAPACITOR, CERAM	22NF-20+80	40	4822 122	30103
C 1812	CAPACITOR, FOIL	3.3NF 1%	160V	5322 121	54049
C 1813	CAPACITOR, CERAM	22NF-20+80	40	4822 122	30103
C 1814	CAP, ELECTROLYT.	10UF-20+20	16	5322 124	24089
C 1816	CAP, ELECTROLYT.	10UF-20+20	16	5322 124	24089
C 1817	CAPACITOR, FOIL	100NF 10%	250V	4822 121	41161
C 1818	CAP, ELECTROLYT.	10UF-20+20	16	5322 124	24089
C 1819	CAP, ELECTROLYT.	22UF-20+20	25	5322 124	24099
C 1821	CAP, ELECTROLYT.	22UF-20+20	25	5322 124	24099
C 1826	CAPACITOR, CERAM	560PF 10	500	4822 122	31166
C 1828	CAP, ELECTROLYT.	220UF-20+20	6,3	5322 124	24212
C 1829	CAP, ELECTROLYT.	220UF-20+20	6,3	5322 124	24212
C 1831	CAP, ELECTROLYT.	100UF-20+20	16	5322 124	24155
C 1832	CAP, ELECTROLYT.	100UF-20+20	16	5322 124	24155
C 1833	CAPACITOR, FOIL	2,2UF 10%	100V	4822 121	40456
C 1834	CAPACITOR, FOIL	2,2UF 10%	100V	4822 121	40456
C 1836	CAPACITOR, FOIL	100NF 10%	250V	4822 121	41161
C 1837	CAPACITOR, FOIL	33NF 10%	400V	4822 121	40411
C 1838	CAPACITOR, FOIL	10NF	630V	4822 121	41134
C 1839	CAP, ELECTROLYT.	10UF-20+20	16	5322 124	24089
C 1841	CAPACITOR, FOIL	100NF 10%	250V	4822 121	41161
C 1842	CAPACITOR, CERAM	100PF 2	100	4822 122	31316
C 1851	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1852	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1853	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1854	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1856	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1857	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1858	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1859	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1861	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 1901	CAP, ELECTROLYT.	10UF-10+50	63	4822 124	20728
C 1902	CAPACITOR, FOIL	680NF 10%	100V	5322 121	40233
C 1903	CAPACITOR, FOIL	20NF 1%	63V	4822 121	50611
C 1904	CAP, ELECTROLYT.	10UF-10+50	63	4822 124	20728
C 2001	CAPACITOR, FOIL	100NF 10%	250V	4822 121	41161
C 2002	CAPACITOR, CERAM	8,2PF 0,25PF	100	4822 122	31052
C 2003	CAPACITOR, CERAM	8,2PF 0,25PF	100	4822 122	31052
C 2004	CAP, ELECTROLYT.	10UF-10+50	25	4822 124	20697
C 2007	CAPACITOR, CERAM	10NF-20+80	40	4822 122	30043
C 2009	CAPACITOR, CERAM	10PF 2	100	4822 122	31054
C 201	CAPACITOR, CERAM	10NF-20+80	40	4822 122	30043
C 2011	CAPACITOR, FOIL	100NF 10%	250V	4822 121	41161
C 2012	CAPACITOR, FOIL	100NF 10%	250V	4822 121	41161
C 2013	CAPACITOR, CERAM	10NF-20+80	40	4822 122	30043
C 2014	CAPACITOR, FOIL	100NF 10%	250V	4822 121	41161
C 2015	CAPACITOR, FOIL	100NF 10%	250V	4822 121	41161
C 2016	CAPACITOR, CERAM	4,7NF 10	100	4822 122	30128
C 2017	CAPACITOR, HT	4,7NF-20+50	3K	5322 122	50001
C 2018	CAPACITOR, HT	4,7NF-20+50	3K	5322 122	50001
C 2019	CAPACITOR, HT	4,7NF-20+50	3K	5322 122	50001
C 202	CAPACITOR, TRIMM	18PF		5322 125	50051
C 2021	CAPACITOR, HT	4,7NF-20+50	3K	5322 122	50001
C 2022	CAPACITOR, CERAM	10NF-20+80	40	4822 122	30043
C 2023	CAPACITOR, CERAM	22NF-20+80	40	4822 122	30103
C 2026	CAPACITOR, HT	10NF-20+50	3K	5322 122	30134
C 2027	CAPACITOR, CERAM	22NF-20+80	40	4822 122	30103
C 2028	CAPACITOR, HT	220PF 20%	5KV	5322 122	54007
C 2029	CAPACITOR, HT	4,7NF-20+50	3K	5322 122	50001

POSNR	DESCRIPTION			ORDERING CODE
C 203	CAPACITOR,CERAM	470PF 10	100	4822 122 30034
C 2030	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2031	CAPACITOR			5322 121 54259
C 2032	CAPACITOR,CERAM	4,7NF 10	100	4822 122 30128
C 2033	CAPACITOR,FOIL	470NF 10%	100V	5322 121 40175
C 2034	CAPACITOR,CERAM	100PF 10	500	4822 122 31211
C 2035	CAPACITOR,HT	4,7NF-20+50	3K	5322 122 50001
C 2036	CAPACITOR,FOIL	15NF 10%	1000V	4822 121 40366
C 2037	CAPACITOR,CERAM	680PF 10	500	4822 122 31178
C 2038	CAPACITOR,HT	1NF-20+50	3K	5322 122 50044
C 2039	CAPACITOR,HT	1NF-20+50	3K	5322 122 50044
C 204	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2041	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 2042	CAP,ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 2043	CAP,ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 2044	CAP,ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 2046	CAPACITOR,FOIL	100NF 20%	100V	4822 121 40522
C 2049	CAPACITOR,CERAM	4,7NF 10	100	4822 122 30128
C 206	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 207	CAPACITOR,CERAM	22NF-20+80	40	4822 122 30103
C 208	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 209	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 212	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 213	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 214	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 216	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 217	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 218	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 219	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2201	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2202	CAPACITOR,TRIMM	18PF		5322 125 50051
C 2203	CAPACITOR,CERAM	470PF 10	100	4822 122 30034
C 2204	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2206	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2207	CAPACITOR,CERAM	22NF-20+80	40	4822 122 30103
C 2208	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2209	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 221	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2212	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2213	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2214	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2216	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 2217	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2218	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2219	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 222	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2221	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2222	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2223	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2226	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 223	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2230	CAPACITOR,CERAM	100PF 2	100	4822 122 31081
C 2232	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2234	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2235	CAPACITOR,CERAM	560PF 10	100	4822 122 30126

POSNR	DESCRIPTION			ORDERING CODE
C 2236	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2237	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2239	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2240	CAPACITOR,CERAM	560PF 10	100	4822 122 30126
C 2241	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2242	CAPACITOR,CERAM	100PF 2	100	4822 122 31316
C 2243	CAPACITOR,CERAM	5,6PF 0,25PF	100	4822 122 31047
C 2245	CAPACITOR,CERAM	100PF 2	100	4822 122 31504
C 2247	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 2248	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 2249	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 2251	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 226	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 230	CAPACITOR,CERAM	100PF 2	100	4822 122 31081
C 2301	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2302	CAPACITOR,TRIMM	18PF		5322 125 50051
C 2303	CAPACITOR,CERAM	470PF 10	100	4822 122 30034
C 2304	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2306	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2307	CAPACITOR,CERAM	22NF-20+80	40	4822 122 30103
C 2308	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2309	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2312	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2313	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2314	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2316	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 2317	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2318	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2319	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 232	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2321	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2322	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2323	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2326	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2330	CAPACITOR,CERAM	100PF 2	100	4822 122 31081
C 2332	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2334	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2335	CAPACITOR,CERAM	560PF 10	100	4822 122 30126
C 2336	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2337	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2339	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 234	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 2340	CAPACITOR,CERAM	560PF 10	100	4822 122 30126
C 2341	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 2342	CAPACITOR,CERAM	100PF 2	100	4822 122 31316
C 2343	CAPACITOR,CERAM	5,6PF 0,25PF	100	4822 122 31047
C 2345	CAPACITOR,CERAM	100PF 2	100	4822 122 31504
C 2347	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 2348	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 2349	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 235	CAPACITOR,CERAM	560PF 10	100	4822 122 30126
C 2351	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 236	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 237	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 239	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 240	CAPACITOR,CERAM	560PF 10	100	4822 122 30126
C 241	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043
C 242	CAPACITOR,CERAM	100PF 2	100	4822 122 31316
C 243	CAPACITOR,CERAM	5,6PF 0,25PF	100	4822 122 31047
C 245	CAPACITOR,CERAM	100PF 2	100	4822 122 31504
C 247	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 248	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 249	CAPACITOR,FOIL	100NF 10%	250V	4822 121 41161
C 251	CAPACITOR,CERAM	22PF 2	100	4822 122 31063
C 301	CAPACITOR,CERAM	10NF-20+80	40	4822 122 30043

POSNR	DESCRIPTION			ORDERING CODE
C 302	CAPACITOR, TRIMM	18PF		5322 125 50051
C 303	CAPACITOR, CERAM	470PF 10	100	4822 122 30034
C 304	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 306	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 307	CAPACITOR, CERAM	22NF-20+80	40	4822 122 30103
C 308	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 309	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 312	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 313	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 314	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 316	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 317	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 318	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 319	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 321	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 322	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 323	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 326	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 330	CAPACITOR, CERAM	100PF 2	100	4822 122 31081
C 332	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 334	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 335	CAPACITOR, CERAM	560PF 10	100	4822 122 30126
C 336	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 337	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 339	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 340	CAPACITOR, CERAM	560PF 10	100	4822 122 30126
C 341	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 342	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 343	CAPACITOR, CERAM	5,6PF 0,25PF	100	4822 122 31047
C 345	CAPACITOR, CERAM	100PF 2	100	4822 122 31504
C 347	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 348	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 349	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 351	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 401	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 402	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 409	CAPACITOR, CERAM	33PF 2	100	4822 122 31067
C 411	CAPACITOR, CERAM	100PF 2	100	4822 122 31081
C 413	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 414	CAPACITOR, CERAM	100PF 2	100	4822 122 31081
C 416	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 417	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 418	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 419	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 421	CAPACITOR, CERAM	220PF 10	100	4822 122 30094
C 422	CAPACITOR, CERAM	220PF 10	100	4822 122 30094
C 423	CAPACITOR, CERAM	220PF 10	100	4822 122 30094
C 424	CAPACITOR, CERAM	220PF 10	100	4822 122 30094
C 502	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 503	CAPACITOR, CERAM	10PF 2	100	4822 122 31054
C 505	CAPACITOR, CERAM	5,6PF 0,25PF	100	4822 122 31047
C 506	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 507	CAPACITOR, CERAM	10PF 2	100	4822 122 31054
C 508	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 509	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043

POSNR	DESCRIPTION			ORDERING CODE
C 510	CAPACITOR, CERAM	10NF-20+50	100	4822 122 31429
C 511	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 514	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 515	CAP, ELECTROLYT.	33UF-10+50	16	4822 124 20688
C 601	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 602	CAPACITOR, CERAM	5,6PF 0,25PF	100	4822 122 31047
C 603	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 604	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 605	CAP, ELECTROLYT.	68UF-10+50	16	4822 124 20689
C 606	CAPACITOR, CERAM	5,6PF 0,25PF	100	4822 122 31047
C 608	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 609	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 611	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 615	CAPACITOR, CERAM	15PF 2	100	4822 122 31058
C 616	CAPACITOR, TRIMM	18PF	5322	125 50051
C 617	CAPACITOR, CERAM	180PF 10	100	4822 122 30113
C 618	CAPACITOR, CERAM	180PF 10	100	4822 122 30113
C 620	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 621	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 622	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 623	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 625	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 626	CAPACITOR, CERAM	4,7NF 10	100	4822 122 30128
C 628	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 629	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 702	CAPACITOR, CERAM	2,2PF 0,25PF	500	4822 122 31186
C 703	CAPACITOR, CERAM	100PF 2	500	5322 122 31626
C 704	CAPACITOR, CERAM	3,3PF 0,25PF	500	4822 122 31188
C 706	CAPACITOR, FOIL	22NF 10%	250V	4822 121 40407
C 707	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 708	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 709	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 710	CAPACITOR, CERAM	4,7PF 0,25PF	100	5322 122 34225
C 711	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 713	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 714	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 715	CAPACITOR, CERAM	6,8PF 0,25PF	100	4822 122 31049
C 716	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 717	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 718	CAPACITOR, CERAM	2,2NF 10	100	4822 122 30114
C 719	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 720	CAPACITOR, CERAM	4,7PF 0,25PF	100	5322 122 34225
C 801	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 802	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 803	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 804	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 805	CAPACITOR, CERAM	1NF-20+80	40	4822 122 30027
C 807	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 808	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 809	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 811	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 812	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 813	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 814	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 817	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 822	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 823	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 824	CAPACITOR, CERAM	12PF 2	100	4822 122 31056
C 826	CAPACITOR, CERAM	12PF 2	100	4822 122 31056
C 827	CAPACITOR, CERAM	220PF 10	100	4822 122 30094
C 829	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 830	CAPACITOR, CERAM	10NF-20+50	100	4822 122 31414
C 831	CAPACITOR, CERAM	560PF 10	100	4822 122 30126
C 832	CAPACITOR, CERAM	12PF 2	100	4822 122 31056
C 833	CAPACITOR, CERAM	12PF 2	100	4822 122 31056

POSNR	DESCRIPTION			ORDERING CODE
C 834	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 836	CAPACITOR, CERAM	10PF 2	100	4822 122 31054
C 837	CAPACITOR, CERAM	10PF 2	100	4822 122 31054
C 838	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 841	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 842	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 843	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 844	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 846	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 847	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 848	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 849	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 851	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 852	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 853	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 854	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 856	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 857	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 900	CAPACITOR, CERAM	22PF 2	100	4822 122 31063
C 901	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 903	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 904	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 907	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 908	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 909	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 911	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 912	CAPACITOR, FOIL	4.7UF 10%	100V	5322 121 40224
C 913	CAPACITOR, FOIL	47NF 1%	63V	5322 121 54108
C 914	CAPACITOR, FOIL	4.3NF 1%	63V	5322 121 54062
C 915	CAPACITOR, CERAM	100PF 2	100	4822 122 31316
C 916	CAPACITOR, TRIMM	60PF		5322 125 54003
C 917	CAPACITOR, FOIL			5322 121 54228
C 918	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 919	CAPACITOR, CERAM	470PF 10	100	4822 122 30034
C 921	CAP, ELECTROLYT.	6.8UF-10+50	40	4822 124 20707
C 922	CAP, ELECTROLYT.	10UF-10+50	25	4822 124 20697
C 923	CAP, ELECTROLYT.	68UF-10+50	16	4822 124 20689
C 924	CAPACITOR, CERAM	10NF-20+80	40	4822 122 30043
C 925	CAPACITOR, CERAM	10PF 2	100	4822 122 31054
C 926	CAPACITOR, FOIL	470NF 10%	100V	4822 121 40438
C 927	CAPACITOR, CERAM	4.7NF 10	100	4822 122 30128
C 928	CAPACITOR, CERAM	1.8NF 10	100	4822 122 30048
C 930	CAPACITOR, CERAM	220PF 10	100	4822 122 30094
C 931	CAPACITOR, FOIL	100NF 10%	250V	4822 121 41161
C 932	CAPACITOR, CERAM	4.7PF 0.25PF	500	4822 122 31189
D 101	INTEGR. CIRCUIT	LM208H	SC	5322 209 85475
D 102	COMPOSITION RES.	TF CIRCUIT		5322 116 94021
D 1201	INTEGR. CIRCUIT	LM308T	PH	5322 209 85475
D 1301	INTEGR. CIRCUIT	LM208H	NS	5322 209 85475
D 1302	INTEGR. CIRCUIT	LM208H	NS	5322 209 85475
D 1303	INTEGR. CIRCUIT	CA3086	PH	5322 209 86236
D 1304	INTEGR. CIRCUIT	LM308T	PH	5322 209 85475
D 151	INTEGR. CIRCUIT	LM208H	SC	5322 209 85475
D 152	COMPOSITION RES.	TF CIRCUIT		5322 116 94021
D 1551	INTEGR. CIRCUIT	TCA220	PH	5322 209 84386

POSNR	DESCRIPTION			ORDERING CODE
D 1552	INTEGR.CIRCUIT	TCA220	PH	5322 209 84386
D 1601	INTEGR.CIRCUIT	HEF4068BP	PH	5322 209 14117
D 1602	INTEGR.CIRCUIT	HEF4081BP	PH	5322 209 14054
D 1603	INTEGR.CIRCUIT	HEF4071BP	PH	5322 209 14053
D 1604	INTEGR.CIRCUIT	HEF4081BP	PH	5322 209 14054
D 1606	INTEGR.CIRCUIT	HEF4081BP	PH	5322 209 14054
D 1607	INTEGR.CIRCUIT	HEF4071BP	PH	5322 209 14053
D 1608	INTEGR.CIRCUIT	HEF4011BP	PH	5322 209 14046
D 1609	INTEGR.CIRCUIT	HEF4013BP	PH	5322 209 10002
D 1612	INTEGR.CIRCUIT	HEF4011BP	PH	5322 209 14046
D 1613	INTEGR.CIRCUIT	HEF4013BP	PH	5322 209 10002
D 1614	INTEGR.CIRCUIT	HEF4011BP	PH	5322 209 14046
D 1616	INTEGR.CIRCUIT	HEF4013BP	PH	5322 209 10002
D 1617	INTEGR.CIRCUIT	HEF4011BP	PH	5322 209 14046
D 1618	INTEGR.CIRCUIT	HEF4013BP	PH	5322 209 10002
D 1619	INTEGR.CIRCUIT	HEF4023BP	PH	5322 209 14065
D 1621	INTEGR.CIRCUIT	HEF4011BP	PH	5322 209 14046
D 1622	INTEGR.CIRCUIT	HEF4069UBP	PH	4822 209 10185
D 1623	INTEGR.CIRCUIT	HEF4011BP	PH	5322 209 14046
D 1624	INTEGR.CIRCUIT	HEF4053BP	PH	5322 209 14121
D 1626	INTEGR.CIRCUIT	HEF4053BP	PH	5322 209 14121
D 1627	INTEGR.CIRCUIT	HEF4028BP	PH	5322 209 14056
D 1628	INTEGR.CIRCUIT	HEF4011BP	PH	5322 209 14046
D 1629	INTEGR.CIRCUIT	HEF4001BP	PH	5322 209 14045
D 1631	INTEGR.CIRCUIT	HEF4078BP	PH	5322 209 14234
D 1632	INTEGR.CIRCUIT	HEF4050BP	PH	5322 209 14068
D 1633	INTEGR.CIRCUIT	HEF4050BP	PH	5322 209 14068
D 1651	INTEGR.CIRCUIT	LM324N	SC	4822 209 80587
D 1801	INTEGR.CIRCUIT	TDA1060	PH	5322 209 85662
D 1901	INTEGR.CIRCUIT	UA709CH	SC	5322 209 84452
D 201	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 202	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 203	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 2201	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 2202	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 2203	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 2301	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 2302	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 2303	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 301	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 302	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 303	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 401	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 501	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 601	INTEGR.CIRCUIT	OQ 0012		5322 209 85484
D 602	PRINTED CIRCUIT	OM504		5322 216 54192
D 603	HEATSINK	HIC-P5185	PH	5322 255 44246
D 701	INTEGR.CIRCUIT	N74LS00N	SC	5322 209 84823
D 702	INTEGR.CIRCUIT	LM308T	PH	5322 209 85475
D 801	INTEGR.CIRCUIT	LM308T	PH	5322 209 85475
D 802	INTEGR.CIRCUIT	GXB10104P	PH	5322 209 86012
D 901	INTEGR.CIRCUIT	GXB10231P	PH	5322 209 86003
D 902	INTEGR.CIRCUIT	GXB10102D	SC	5322 209 85955
D 903	INTEGR.CIRCUIT	LM208H	NS	5322 209 85475
D 904	INTEGR.CIRCUIT	LM208H	NS	5322 209 85475
D 906	INTEGR.CIRCUIT	UA741CN	SC	4822 209 80617
E 1	LAMP,FILAMENT			5322 134 44177
E 2	LAMP,FILAMENT			5322 134 44177
F 1	FUSE	T2A		4822 253 30025
K 1701	COIL,REED RELAY	RELAY COIL		5322 280 24076
L 1801	COIL	SPOEL		5322 156 14076
L 1802	COIL	SPOEL		5322 156 14076
L 1803	TRANSF,DRIVER			5322 142 44026
L 1804	COIL	COIL		5322 281 64154
L 1806	TRANSFORMER			5322 148 84041

POSNR	DESCRIPTION	ORDERING CODE		
L 1807	COIL,CHOKE	5322	152	24062
L 1811	COIL	4822	156	20663
L 1812	COIL	4822	156	20663
L 1813	COIL	4822	156	20663
L 1814	COIL	4822	156	20663
L 1816	COIL,CHOKE	5322	152	24067
L 1817	COIL,CHOKE	5322	152	24068
Q 1601	PLUG,ADAPTER	5322	263	64007
S 1	SWITCH,ROTARY	SEGMENT SWITCH	5322	273 44098
S 11	SWITCH,ROTARY	SEGMENT SWITCH	5322	273 34116
S 1801	SWITCH	NETSP OMSCHAK SAM	5322	277 24071
S 5	SWITCH,ROTARY	SEGMENT SWITCH	5322	273 44097
S 9	SWITCH,ROTARY	SEGMENT SWITCH	5322	273 34116
T 1801	TRANSF,AUTO		5322	148 84039
V 1	TUBE	D14-302GH/95 PH	5322	131 24089
V 101	DIODE	BAV45 PH	5322	130 34037
V 102	TRANSISTOR	BFT46 PH	5322	130 44797
V 103	TRANSISTOR	BFT25R PH	5322	130 44459
V 104	TRANSISTOR	BFR92 PH	5322	130 44178
V 1201	TRANSISTOR	BF324 PH	4822	130 41448
V 1202	DIODE	BAW56 PH	5322	130 30691
V 1203	TRANSISTOR	BFT92R PH	5322	130 44713
V 1204	TRANSISTOR	BFT92 PH	5322	130 44711
V 1206	TRANSISTOR	BFR92R PH	5322	130 44606
V 1207	DIODE	BAW62 PH	4822	130 30613
V 1208	DIODE	BAW56 PH	5322	130 30691
V 1209	DIODE	BAW56 PH	5322	130 30691
V 1211	DIODE	BAW62 PH	4822	130 30613
V 1212	TRANSISTOR	BFT92 PH	5322	130 44711
V 1213	TRANSISTOR	BFR92R PH	5322	130 44606
V 1214	TRANSISTOR	BFR92 PH	5322	130 44178
V 1216	DIODE	BAV99 PH	5322	130 34337
V 1217	TRANSISTOR	BFR92 PH	5322	130 44178
V 1218	TRANSISTOR	BFR92R PH	5322	130 44606
V 1219	TRANSISTOR	BFR92R PH	5322	130 44606
V 1221	TRANSISTOR	BFT92 PH	5322	130 44711
V 1222	TRANSISTOR	BFR92 PH	5322	130 44178
V 1223	TRANSISTOR	BFT92 PH	5322	130 44711
V 1224	DIODE	BAW62 PH	4822	130 30613
V 1226	DIODE	BAW62 PH	4822	130 30613
V 1227	TRANSISTOR	BC549C PH	4822	130 44246
V 1300	TRANSISTOR	BC559B PH	4822	130 44358
V 1301	DIODE	BAW62 PH	4822	130 30613
V 1302	DIODE	BAW62 PH	4822	130 30613
V 1303	DIODE	BAW62 PH	4822	130 30613
V 1304	TRANSISTOR	BF324 PH	4822	130 41448
V 1305	DIODE	BAW62 PH	4822	130 30613
V 1306	DIODE	BAW62 PH	4822	130 30613
V 1307	TRANSISTOR	BC549C PH	4822	130 44246
V 1308	TRANSISTOR	BSX20 PH	5322	130 40417
V 1309	TRANSISTOR	BSX20 PH	5322	130 40417
V 1310	TRANSISTOR	BC549C PH	4822	130 44246
V 1311	TRANSISTOR	BSX20 PH	5322	130 40417
V 1312	TRANSISTOR	BC549C PH	4822	130 44246
V 1313	DIODE	BAW62 PH	4822	130 30613
V 1314	TRANSISTOR	BC549C PH	4822	130 44246
V 1316	DIODE	BAW62 PH	4822	130 30613
V 1317	TRANSISTOR	BC559B PH	4822	130 44358
V 1318	TRANSISTOR	BC559B PH	4822	130 44358
V 1319	TRANSISTOR	BC549C PH	4822	130 44246

POSNR	DESCRIPTION			ORDERING CODE
V 1321	DIODE	BAW62	PH	4822 130 30613
V 1322	TRANSISTOR	BCY59	PH	5322 130 44073
V 1323	TRANSISTOR	BC549C	PH	4822 130 44246
V 1324	DIODE	BAW62	PH	4822 130 30613
V 1326	TRANSISTOR	BC549C	PH	4822 130 44246
V 1327	TRANSISTOR	BC549C	PH	4822 130 44246
V 1328	TRANSISTOR	BC559B	PH	4822 130 44358
V 1329	DIODE	BAW62	PH	4822 130 30613
V 1331	DIODE	BAW62	PH	4822 130 30613
V 1332	DIODE	BAW62	PH	4822 130 30613
V 1336	TRANSISTOR	BC559B	PH	4822 130 44358
V 1337	DIODE	BAW62	PH	4822 130 30613
V 1338	DIODE	BAW62	PH	4822 130 30613
V 1339	TRANSISTOR	BC549C	PH	4822 130 44246
V 1501	TRANSISTOR	BC549C	PH	4822 130 44246
V 1502	TRANSISTOR	BC559B	PH	4822 130 44358
V 1503	DIODE	BAW62	PH	4822 130 30613
V 1504	DIODE	BAW62	PH	4822 130 30613
V 1506	TRANSISTOR	BC559B	PH	4822 130 44358
V 1507	DIODE	BAW62	PH	4822 130 30613
V 1508	DIODE	BAW62	PH	4822 130 30613
V 1509	TRANSISTOR	BC549C	PH	4822 130 44246
V 151	DIODE	BAV45	PH	5322 130 34037
V 1511	TRANSISTOR	BC559B	PH	4822 130 44358
V 1512	TRANSISTOR	BC559B	PH	4822 130 44358
V 1513	DIODE	BAW62	PH	4822 130 30613
V 1514	DIODE	BAW62	PH	4822 130 30613
V 1515	DIODE	BAW62	PH	4822 130 30613
V 1516	TRANSISTOR	BC559B	PH	4822 130 44358
V 1517	TRANSISTOR	BC559B	PH	4822 130 44358
V 1518	DIODE	BAW62	PH	4822 130 30613
V 1519	TRANSISTOR	BC549C	PH	4822 130 44246
V 152	TRANSISTOR	BFT46	PH	5322 130 44797
V 1520	TRANSISTOR	BC549C	PH	4822 130 44246
V 1521	TRANSISTOR	BC559B	PH	4822 130 44358
V 1522	DIODE	BAW62	PH	4822 130 30613
V 1523	DIODE, REFERENCE	BZX79-C8V2	PH	4822 130 34382
V 1524	TRANSISTOR	BC559B	PH	4822 130 44358
V 1526	DIODE	BAW62	PH	4822 130 30613
V 1527	TRANSISTOR	BC559	PH	4822 130 40963
V 1528	DIODE	BAW62	PH	4822 130 30613
V 1529	DIODE	BAW62	PH	4822 130 30613
V 153	TRANSISTOR	BFT25	PH	5322 130 44458
V 154	TRANSISTOR	BFR92R	PH	5322 130 44606
V 1552	DIODE, REFERENCE	BZX79-B5V1	PH	4822 130 34233
V 1555	DIODE, REFERENCE	BZX79-C4V7	PH	4822 130 34174
V 1556	DIODE	BAW62	PH	4822 130 30613
V 1557	DIODE	BAW62	PH	4822 130 30613
V 1558	DIODE	BAW62	PH	4822 130 30613
V 1559	TRANSISTOR	BD135	PH	4822 130 40823
V 1561	TRANSISTOR	BC559B	PH	4822 130 44358
V 1562	TRANSISTOR	BD135	PH	4822 130 40823
V 1563	DIODE	BAW62	PH	4822 130 30613
V 1564	DIODE, REFERENCE	BZX79-B6V2	PH	4822 130 34167
V 1566	DIODE	BAW62	PH	4822 130 30613
V 1567	TRANSISTOR	BD136	PH	4822 130 40712
V 1568	TRANSISTOR	BD136	PH	4822 130 40712
V 1601	TRANSISTOR	BSX20	PH	5322 130 40417
V 1602	TRANSISTOR	BSX20	PH	5322 130 40417
V 1603	TRANSISTOR	BC558B	PH	4822 130 44197
V 1651	DIODE, REFERENCE	BZX91	PH	5322 130 34397
V 1652	DIODE, REFERENCE	BZX79-C12	PH	4822 130 34197
V 1653	TRANSISTOR	BD436	PH	4822 130 40995
V 1654	TRANSISTOR	BD435	PH	4822 130 40982
V 1656	DIODE, REFERENCE	BZX91	PH	5322 130 34397

POSNR	DESCRIPTION			ORDERING CODE
V 1657	DIODE,REFERENCE	BZX79-C12	PH	4822 130 34197
V 1658	TRANSISTOR	BD435	PH	4822 130 40982
V 1659	TRANSISTOR	BD436	PH	4822 130 40995
V 1701	TRANSISTOR	BC549C	PH	4822 130 44246
V 1702	TRANSISTOR	BC549C	PH	4822 130 44246
V 1703	TRANSISTOR	BC549C	PH	4822 130 44246
V 1704	TRANSISTOR	BC559B	PH	4822 130 44358
V 1706	TRANSISTOR	BF422	PH	4822 130 41782
V 1707	TRANSISTOR	BF423	PH	4822 130 41646
V 1708	TRANSISTOR	BF423	PH	4822 130 41646
V 1709	TRANSISTOR	BF422	PH	4822 130 41782
V 1711	DIODE	BAW62	PH	4822 130 30613
V 1712	DIODE,REFERENCE	BZX75-C2V1	PH	4822 130 34049
V 1713	DIODE	BAW62	PH	4822 130 30613
V 1714	TRANSISTOR	BF422	PH	4822 130 41782
V 1716	TRANSISTOR	BF423	PH	4822 130 41646
V 1717	TRANSISTOR	BF423	PH	4822 130 41646
V 1718	TRANSISTOR	BF422	PH	4822 130 41782
V 1801	DIODE	BY224-600	PH	5322 130 34761
V 1802	DIODE,REFERENCE	BZX79-C12	PH	4822 130 34197
V 1803	TRANSISTOR	BUX86	PH	5322 130 44718
V 1804	TRANSISTOR	BC549C	PH	4822 130 44246
V 1806	TRANSISTOR	BU208	PH	5322 130 44917
V 1807	DIODE	BAX12	PH	5322 130 34605
V 1808	LED	BY208-1000	PH	4822 130 31051
V 1809	LED	BY208-1000	PH	4822 130 31051
V 1811	LED	BY208-1000	PH	4822 130 31051
V 1812	TRANSISTOR	BC549C	PH	4822 130 44246
V 1813	DIODE,REFERENCE	BZX79-C12	PH	4822 130 34197
V 1814	DIODE	BAW62	PH	4822 130 30613
V 1816	DIODE	BY206	PH	4822 130 30839
V 1817	DIODE	BY206	PH	4822 130 30839
V 1818	DIODE	BY206	PH	4822 130 30839
V 1819	DIODE	BY206	PH	4822 130 30839
V 1826	DIODE	BYX55-600	PH	4822 130 30817
V 1827	DIODE	BY206	PH	4822 130 30839
V 1828	DIODE	BY206	PH	4822 130 30839
V 1829	DIODE	BYX55-600	PH	4822 130 30817
V 1831	DIODE	BYX55-600	PH	4822 130 30817
V 1832	DIODE	BYX55-600	PH	4822 130 30817
V 1833	DIODE	BYX55-600	PH	4822 130 30817
V 1834	DIODE	BYX55-600	PH	4822 130 30817
V 1836	DIODE	BY206	PH	4822 130 30839
V 1837	DIODE	BY206	PH	4822 130 30839
V 1838	DIODE	BY206	PH	4822 130 30839
V 1839	DIODE	BY206	PH	4822 130 30839
V 1841	DIODE	BAW62	PH	4822 130 30613
V 1842	SENSOR	H11A550	GE	5322 130 94015
V 1843	TRANSISTOR	BC549C	PH	4822 130 44246
V 1844	TRANSISTOR	BC549C	PH	4822 130 44246
V 1846	TRANSISTOR	BC549C	PH	4822 130 44246
V 1847	DIODE,REFERENCE	BZX75-C1V4	PH	4822 130 34047
V 1851	DIODE	BY409	PH	5322 130 34594
V 1852	DIODE	BY409	PH	5322 130 34594
V 1853	DIODE	BY409	PH	5322 130 34594

POSNR	DESCRIPTION			ORDERING CODE
V 1854	DIODE	BY409	PH	5322 130 34594
V 1856	DIODE	BY409	PH	5322 130 34594
V 1857	DIODE	BY409	PH	5322 130 34594
V 1858	DIODE	BY409	PH	5322 130 34594
V 1859	DIODE	BY409	PH	5322 130 34594
V 1861	DIODE	BY409	PH	5322 130 34594
V 1901	DIODE, REFERENCE	BZX79-C5V6	PH	4822 130 34173
V 2	LED	CQY24B-III	PH	4822 130 31144
V 2001	DIODE	BAW62	PH	4822 130 30613
V 2002	TRANSISTOR	BSX20	PH	5322 130 40417
V 2003	TRANSISTOR	BSX20	PH	5322 130 40417
V 2004	TRANSISTOR	BC559B	PH	4822 130 44358
V 2006	TRANSISTOR	BF324	PH	4822 130 41448
V 2007	DIODE, REFERENCE	BZX75-C2V1	PH	4822 130 34049
V 2008	TRANSISTOR	BSS38	PH	4822 130 40968
V 2009	TRANSISTOR	BSS38	PH	4822 130 40968
V 201	DIODE	BAW62	PH	4822 130 30613
V 2011	TRANSISTOR	BF324	PH	4822 130 41448
V 2012	TRANSISTOR	BF324	PH	4822 130 41448
V 2013	TRANSISTOR	BSS38	PH	4822 130 40968
V 2014	THYRISTOR	BSS68	PH	5322 130 44247
V 2015	DIODE, REFERENCE	BZX79-C5V6	PH	4822 130 34173
V 2016	TRANSISTOR	BSS38	PH	4822 130 40968
V 2017	TRANSISTOR	BSS38	PH	4822 130 40968
V 2018	DIODE	BY509	PH	4822 130 41485
V 2019	DIODE	BY509	PH	4822 130 41485
V 202	DIODE	BAW62	PH	4822 130 30613
V 2021	DIODE, REFERENCE	BZX61-C180	PH	5322 130 34841
V 2022	DIODE, REFERENCE	BZX61-C180	PH	5322 130 34841
V 2023	TRANSISTOR	BUX86	PH	5322 130 44718
V 2024	TRANSISTOR	BC549C	PH	4822 130 44246
V 2026	TRANSISTOR	BC559B	PH	4822 130 44358
V 2027	DIODE	BYX10	PH	4822 130 30195
V 203	TRANSISTOR	BFT92	PH	5322 130 44711
V 2031	DIODE	BAW62	PH	4822 130 30613
V 2032	DIODE	BAX17	PH	5322 130 30605
V 2033	THYRISTOR	BSS68	PH	5322 130 44247
V 2034	TRANSISTOR	BSS38	PH	4822 130 40968
V 2035	DIODE	BYW54	PH	5322 130 34919
V 2036	TRANSISTOR	BSS38	PH	4822 130 40968
V 2037	DIODE	BAW62	PH	4822 130 30613
V 2038	DIODE	BAX17	PH	5322 130 30605
V 2039	DIODE	BAX17	PH	5322 130 30605
V 204	TRANSISTOR	BFT92R	PH	5322 130 44713
V 2041	DIODE	BAX17	PH	5322 130 30605
V 2042	DIODE	BAX17	PH	5322 130 30605
V 2043	TRANSISTOR	BC549C	PH	4822 130 44246
V 2044	TRANSISTOR	BC559B	PH	4822 130 44358
V 2046	TRANSISTOR	BD680	PH	5322 130 44749
V 2047	TRANSISTOR	BF422	PH	4822 130 41782
V 2048	TRANSISTOR	BF422	PH	4822 130 41782
V 2049	DIODE, REFERENCE	BZX79-C7V5	PH	4822 130 30861
V 206	DIODE	BAV70	PH	5322 130 34331
V 207	DIODE	BAV70	PH	5322 130 34331
V 208	DIODE, REFERENCE	BZX75-C1V4	PH	4822 130 34047
V 209	DIODE	BAW62	PH	4822 130 30613
V 211	DIODE	BAW62	PH	4822 130 30613
V 212	DIODE	BAW62	PH	4822 130 30613
V 213	DIODE	BAW62	PH	4822 130 30613
V 214	TRANSISTOR	BCW33R	PH	5322 130 44342
V 216	TRANSISTOR	BCW30R	PH	5322 130 44341
V 2201	DIODE	BAW62	PH	4822 130 30613
V 2202	DIODE	BAW62	PH	4822 130 30613
V 2203	TRANSISTOR	BFT92	PH	5322 130 44711
V 2204	TRANSISTOR	BFT92R	PH	5322 130 44713

POSNR	DESCRIPTION			ORDERING CODE
V 2206	DIODE	BAV70	PH	5322 130 34331
V 2207	DIODE	BAV70	PH	5322 130 34331
V 2208	DIODE, REFERENCE	BZX75-C1V4	PH	4822 130 34047
V 2209	DIODE	BAW62	PH	4822 130 30613
V 221	DIODE	BAW62	PH	4822 130 30613
V 2211	DIODE	BAW62	PH	4822 130 30613
V 2212	DIODE	BAW62	PH	4822 130 30613
V 2213	DIODE	BAW62	PH	4822 130 30613
V 2214	TRANSISTOR	BCW33R	PH	5322 130 44342
V 2216	TRANSISTOR	BCW30R	PH	5322 130 44341
V 2221	DIODE	BAW62	PH	4822 130 30613
V 2301	DIODE	BAW62	PH	4822 130 30613
V 2302	DIODE	BAW62	PH	4822 130 30613
V 2303	TRANSISTOR	BFT92	PH	5322 130 44711
V 2304	TRANSISTOR	BFT92R	PH	5322 130 44713
V 2306	DIODE	BAV70	PH	5322 130 34331
V 2307	DIODE	BAV70	PH	5322 130 34331
V 2308	DIODE, REFERENCE	BZX75-C1V4	PH	4822 130 34047
V 2309	DIODE	BAW62	PH	4822 130 30613
V 2311	DIODE	BAW62	PH	4822 130 30613
V 2312	DIODE	BAW62	PH	4822 130 30613
V 2313	DIODE	BAW62	PH	4822 130 30613
V 2314	TRANSISTOR	BCW33R	PH	5322 130 44342
V 2316	TRANSISTOR	BCW30R	PH	5322 130 44341
V 2321	DIODE	BAW62	PH	4822 130 30613
V 3	LED	CQY24B-III	PH	4822 130 31144
V 301	DIODE	BAW62	PH	4822 130 30613
V 302	DIODE	BAW62	PH	4822 130 30613
V 303	TRANSISTOR	BFT92	PH	5322 130 44711
V 304	TRANSISTOR	BFT92R	PH	5322 130 44713
V 306	DIODE	BAV70	PH	5322 130 34331
V 307	DIODE	BAV70	PH	5322 130 34331
V 308	DIODE, REFERENCE	BZX75-C1V4	PH	4822 130 34047
V 309	DIODE	BAW62	PH	4822 130 30613
V 311	DIODE	BAW62	PH	4822 130 30613
V 312	DIODE	BAW62	PH	4822 130 30613
V 313	DIODE	BAW62	PH	4822 130 30613
V 314	TRANSISTOR	BCW33R	PH	5322 130 44342
V 316	TRANSISTOR	BCW30R	PH	5322 130 44341
V 321	DIODE	BAW62	PH	4822 130 30613
V 4	LED	CQY24B-III	PH	4822 130 31144
V 401	TRANSISTOR	BC549C	PH	4822 130 44246
V 402	DIODE	BAW62	PH	4822 130 30613
V 403	DIODE	BAW62	PH	4822 130 30613
V 406	DIODE	BAW62	PH	4822 130 30613
V 407	DIODE	BAW62	PH	4822 130 30613
V 408	DIODE	BAW62	PH	4822 130 30613
V 409	DIODE	BAW62	PH	4822 130 30613
V 411	DIODE	BAW62	PH	4822 130 30613
V 412	DIODE	BAW62	PH	4822 130 30613
V 413	DIODE	BAW62	PH	4822 130 30613
V 414	DIODE	BAW62	PH	4822 130 30613
V 416	TRANSISTOR	BCW33R	PH	5322 130 44342
V 417	TRANSISTOR	BCW33R	PH	5322 130 44342
V 418	TRANSISTOR	BCW33R	PH	5322 130 44342

POSNR	DESCRIPTION			ORDERING CODE
V 419	TRANSISTOR	BCW33R	PH	5322 130 44342
V 5	LED	CQY24B-III	PH	4822 130 31144
V 501	TRANSISTOR	BCW30	PH	5322 130 44335
V 502	TRANSISTOR	BFT92R	PH	5322 130 44713
V 503	TRANSISTOR	BCW30R	PH	5322 130 44341
V 504	TRANSISTOR	BFT92	PH	5322 130 44711
V 506	TRANSISTOR	BCW33	PH	5322 130 44337
V 507	DIODE	BAW62	PH	4822 130 30613
V 508	DIODE	BAW56	PH	5322 130 30691
V 509	DIODE	BAW56	PH	5322 130 30691
V 511	TRANSISTOR	BFT92	PH	5322 130 44711
V 512	TRANSISTOR	BFT92R	PH	5322 130 44713
V 601	TRANSISTOR	BFT92R	PH	5322 130 44713
V 602	TRANSISTOR	BFT92	PH	5322 130 44711
V 603	TRANSISTOR	BC549C	PH	4822 130 44246
V 604	DIODE	BAW62	PH	4822 130 30613
V 606	TRANSISTOR	BC549C	PH	4822 130 44246
V 607	TRANSISTOR	BC549C	PH	4822 130 44246
V 608	TRANSISTOR	BC559B	PH	4822 130 44358
V 609	DIODE	BBY31	PH	5322 130 34689
V 611	DIODE	BBY31	PH	5322 130 34689
V 612	DIODE, REFERENCE	BZX75-C3V6	PH	4822 130 30765
V 614	DIODE, REFERENCE	BZX87-C5V6	PH	5322 130 34898
V 701	DIODE	BAW62	PH	4822 130 30613
V 702	TRANSISTOR	BC549C	PH	4822 130 44246
V 703	TRANSISTOR	BC559B	PH	4822 130 44358
V 704	TRANSISTOR, FET	BC264A	PH	5322 130 44476
V 706	TRANSISTOR	BFY90	PH	4822 130 40493
V 707	TRANSISTOR	BC549C	PH	4822 130 44246
V 708	TRANSISTOR	BC559B	PH	4822 130 44358
V 709	DIODE	BAW62	PH	4822 130 30613
V 711	DIODE	BAW62	PH	4822 130 30613
V 712	DIODE	BAW62	PH	4822 130 30613
V 713	TRANSISTOR	BFY90	PH	4822 130 40493
V 8	LED	CQY24B-III	PH	4822 130 31144
V 801	TRANSISTOR	BC559B	PH	4822 130 44358
V 802	DIODE	BAW56	PH	5322 130 30691
V 803	TRANSISTOR	BFT92	PH	5322 130 44711
V 804	TRANSISTOR	BFT92R	PH	5322 130 44713
V 806	TRANSISTOR	BFR92	PH	5322 130 44178
V 807	TRANSISTOR	BF324	PH	4822 130 41448
V 808	DIODE	BAW62	PH	4822 130 30613
V 809	DIODE	BAW56	PH	5322 130 30691
V 811	DIODE	BAW62	PH	4822 130 30613
V 812	DIODE	BAW56	PH	5322 130 30691
V 813	TRANSISTOR	BFT92R	PH	5322 130 44713
V 814	TRANSISTOR	BFR92R	PH	5322 130 44606
V 815	DIODE	BAX12A	PH	5322 130 34605
V 816	TRANSISTOR	BFR92	PH	5322 130 44178
V 817	TRANSISTOR	BFR92	PH	5322 130 44178
V 818	TRANSISTOR	BFR92R	PH	5322 130 44606
V 819	DIODE	BAV99	PH	5322 130 34337
V 821	TRANSISTOR	BFR92	PH	5322 130 44178
V 822	TRANSISTOR	BFR92R	PH	5322 130 44606
V 823	TRANSISTOR	BFR92R	PH	5322 130 44606
V 824	TRANSISTOR	BFR92	PH	5322 130 44178
V 826	TRANSISTOR	BFT92R	PH	5322 130 44713
V 827	TRANSISTOR	BFT92R	PH	5322 130 44713
V 828	DIODE	BAW62	PH	4822 130 30613
V 829	TRANSISTOR	BC549C	PH	4822 130 44246
V 831	DIODE	BAW62	PH	4822 130 30613
V 9	LED	CQY24B-III	PH	4822 130 31144
V 901	DIODE	BAW62	PH	4822 130 30613
V 902	TRANSISTOR	BC549C	PH	4822 130 44246
V 903	TRANSISTOR	BSX20	PH	5322 130 40417

POSNR	DESCRIPTION			ORDERING CODE
V 904	DIODE	BAW62	PH	4822 130 30613
V 906	TRANSISTOR	BSX20	PH	5322 130 40417
V 907	TRANSISTOR	BSX20	PH	5322 130 40417
V 908	TRANSISTOR	BC549C	PH	4822 130 44246
V 909	DIODE	BAW62	PH	4822 130 30613
V 910	DIODE	BAW62	PH	4822 130 30613
V 911	TRANSISTOR	BC549C	PH	4822 130 44246
V 912	DIODE	BAW62	PH	4822 130 30613
V 913	TRANSISTOR	BC559B	PH	4822 130 44358
V 914	TRANSISTOR	BC559B	PH	4822 130 44358
V 916	TRANSISTOR	BC549C	PH	4822 130 44246
V 917	DIODE	BAW62	PH	4822 130 30613
V 918	TRANSISTOR	BCY59	PH	5322 130 44073
V 919	TRANSISTOR	BC549C	PH	4822 130 44246
V 921	DIODE	BAW62	PH	4822 130 30613
V 922	TRANSISTOR	BC549C	PH	4822 130 44246
V 923	TRANSISTOR	BC549C	PH	4822 130 44246
V 924	TRANSISTOR	BC559B	PH	4822 130 44358
V 926	DIODE	BAW62	PH	4822 130 30613
V 927	DIODE	BAW62	PH	4822 130 30613
V 928	TRANSISTOR	BSX20	PH	5322 130 40417
V 929	TRANSISTOR	BF324	PH	4822 130 41448
V 930	DIODE	BAW62	PH	4822 130 30613
V 931	TRANSISTOR	BF324	PH	4822 130 41448
V 932	DIODE	BAW62	PH	4822 130 30613
V 933	DIODE	BAW62	PH	4822 130 30613
V 934	TRANSISTOR	BC559B	PH	4822 130 44358
V 935	DIODE, REFERENCE	BZX79-C4V7	PH	4822 130 34174
V 936	TRANSISTOR	BC549C	PH	4822 130 44246
V 937	TRANSISTOR	BC549C	PH	4822 130 44246
V 938	DIODE	BAW62	PH	4822 130 30613
V 939	TRANSISTOR	BC559B	PH	4822 130 44358
V 940	DIODE	BAW62	PH	4822 130 30613
V 941	DIODE	BAW62	PH	4822 130 30613
V 942	DIODE	BAW62	PH	4822 130 30613
V 943	DIODE	BAW62	PH	4822 130 30613
V 944	TRANSISTOR	BF324	PH	4822 130 41448
V 945	TRANSISTOR	BC549C	PH	4822 130 44246
V 946	DIODE	BAW62	PH	4822 130 30613
V 948	TRANSISTOR	BC549C	PH	4822 130 44246
V 949	TRANSISTOR	BC549C	PH	4822 130 44246
V 950	DIODE	BAW62	PH	4822 130 30613
V 951	TRANSISTOR	BC549C	PH	4822 130 44246
V 952	TRANSISTOR	BC549C	PH	4822 130 44246
V 953	DIODE	BAW62	PH	4822 130 30613
V 954	TRANSISTOR	BC559B	PH	4822 130 44358
V 955	DIODE	BAW62	PH	4822 130 30613
V 956	TRANSISTOR	BC549C	PH	4822 130 44246
V 957	DIODE	BAW62	PH	4822 130 30613
V 958	DIODE	BAW62	PH	4822 130 30613
V 959	TRANSISTOR	BC559B	PH	4822 130 44358
V 960	DIODE	BAW62	PH	4822 130 30613
V 961	TRANSISTOR	BC559B	PH	4822 130 44358
V 962	DIODE	BAW62	PH	4822 130 30613
V 963	DIODE	BAW62	PH	4822 130 30613
V 964	TRANSISTOR	BC549C	PH	4822 130 44246
V 965	DIODE	BAW62	PH	4822 130 30613

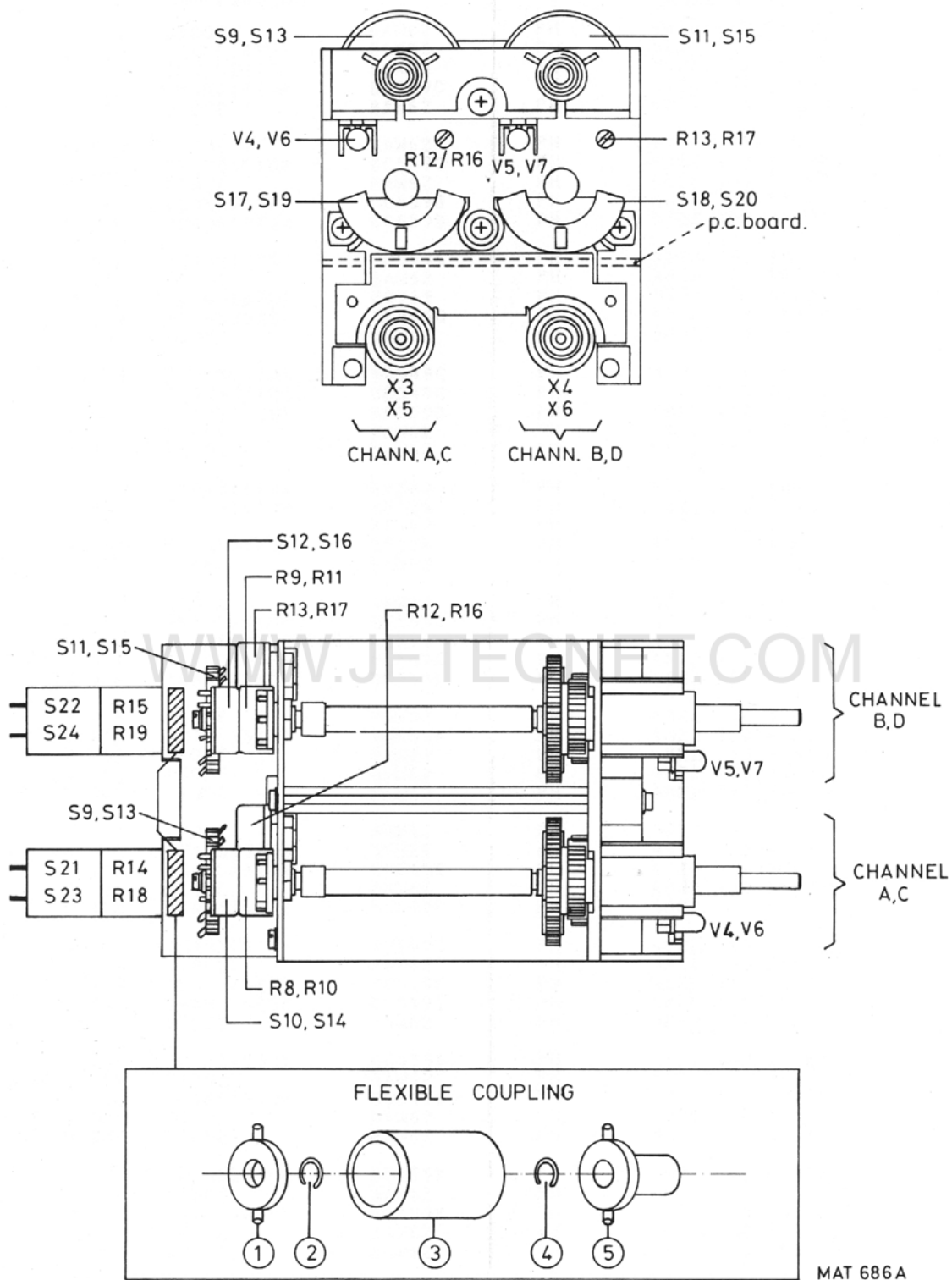


Fig. 8.4. Attenuator unit, mechanical lay-out

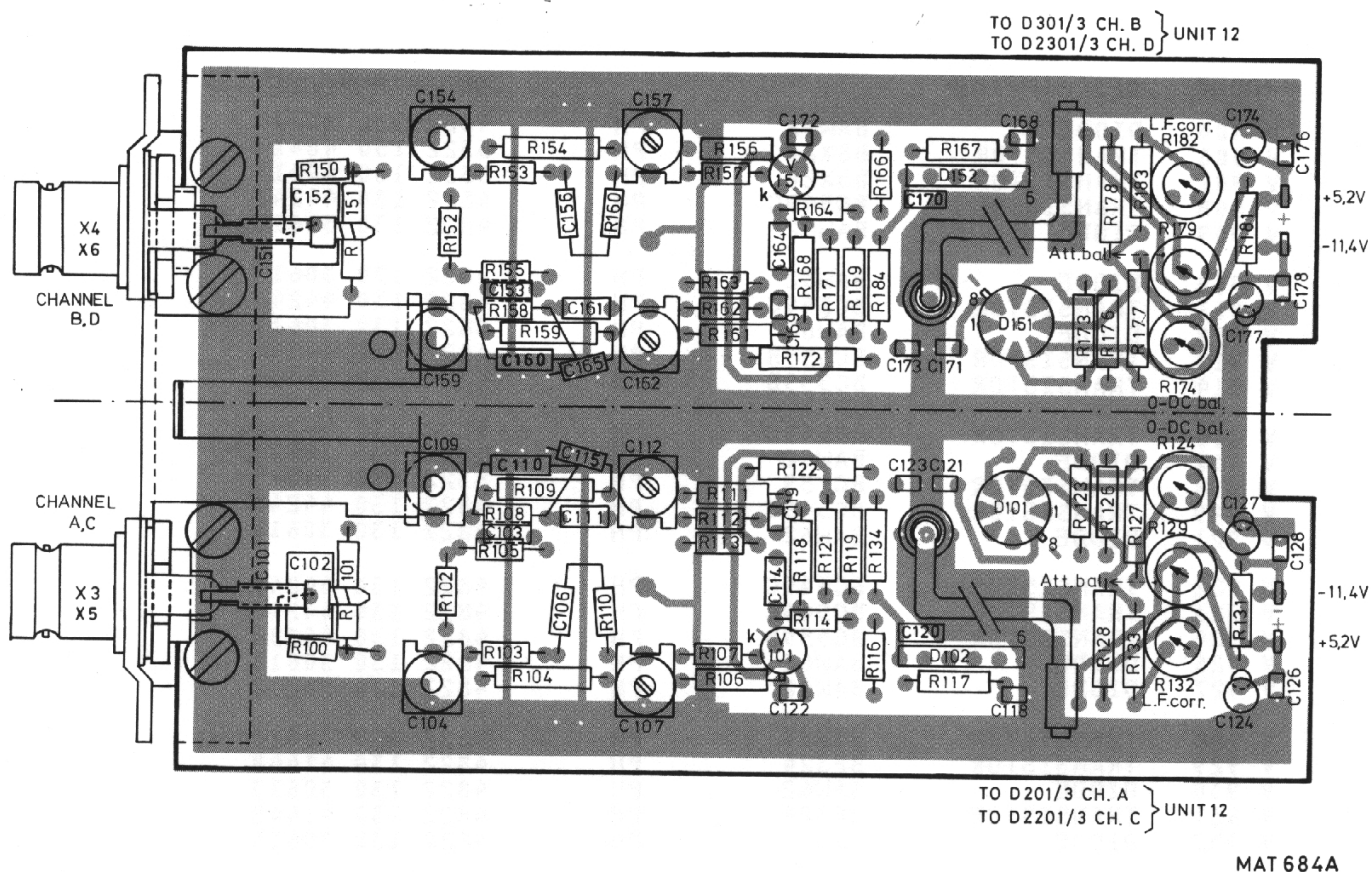


Fig. 8.2. Attenuator unit, printed circuit board lay-out, component side

WWW.JETECNET.COM

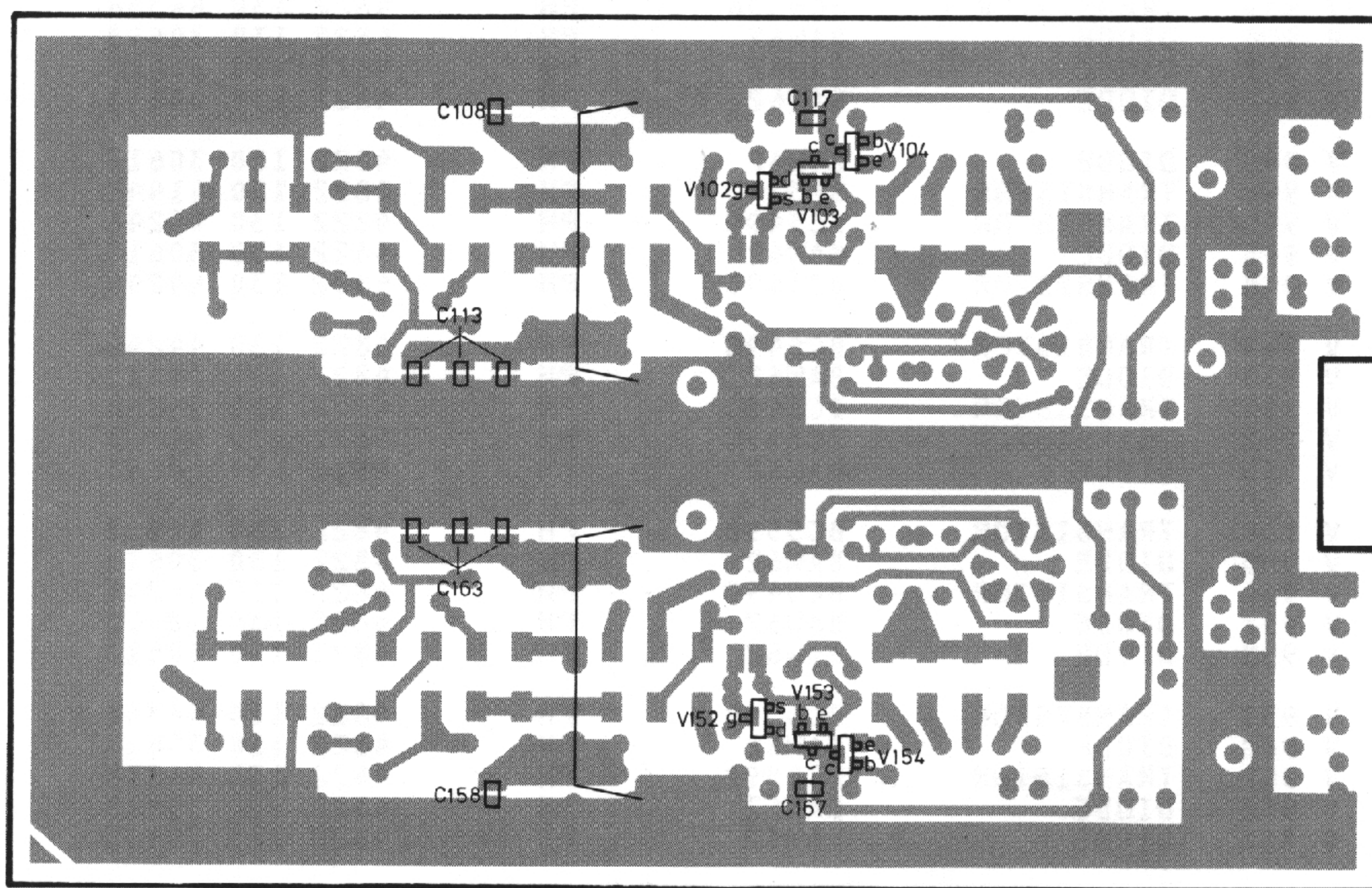
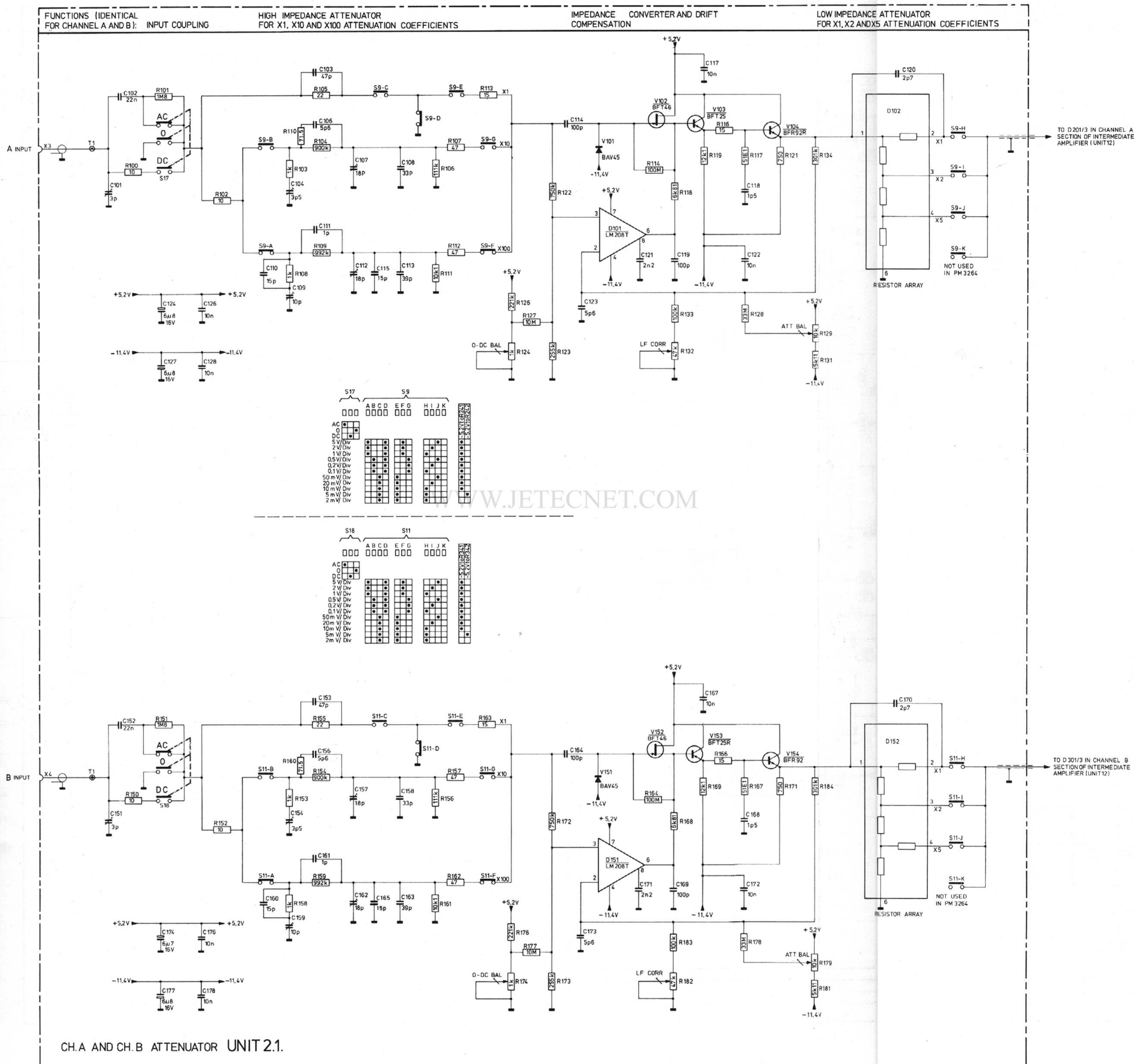


Fig. 8.3. Attenuator unit, printed circuit board lay-out, conductor side



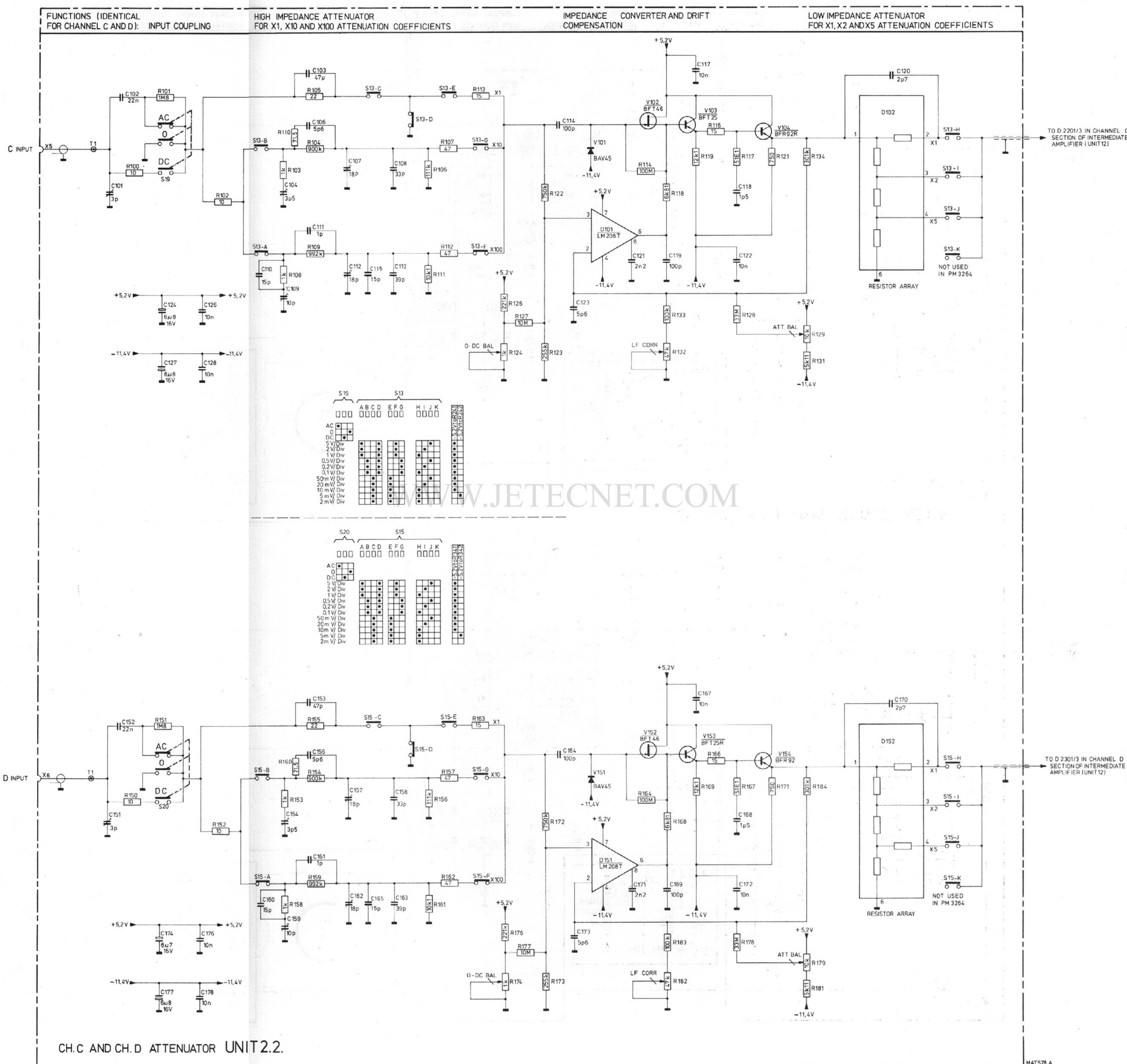


Fig. 8.1. Input attenuators, circuit diagram

LOW IMPEDANCE
FOR X1, X2 AND X5



HIGH IMPEDANCE ATTENUATOR
FOR X1, X10 AND X100 ATTENUATION COEFFICIENTS

IMPEDANCE CONVERTER AND DRIFT
COMPENSATION

LOW IMPEDANCE ATTENUATOR
FOR X1, X2 AND X5 ATTENUATION COEFFICIENTS

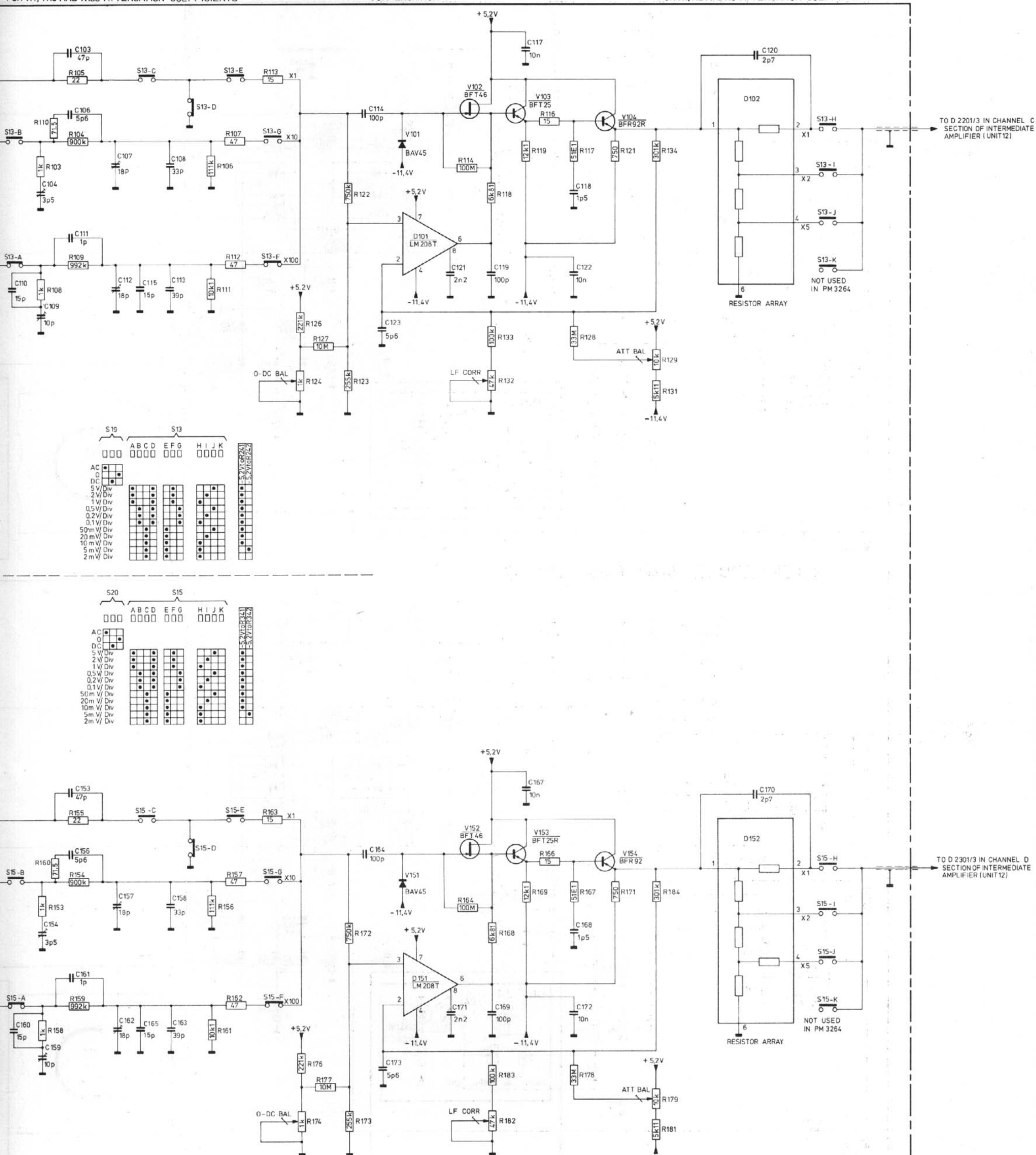
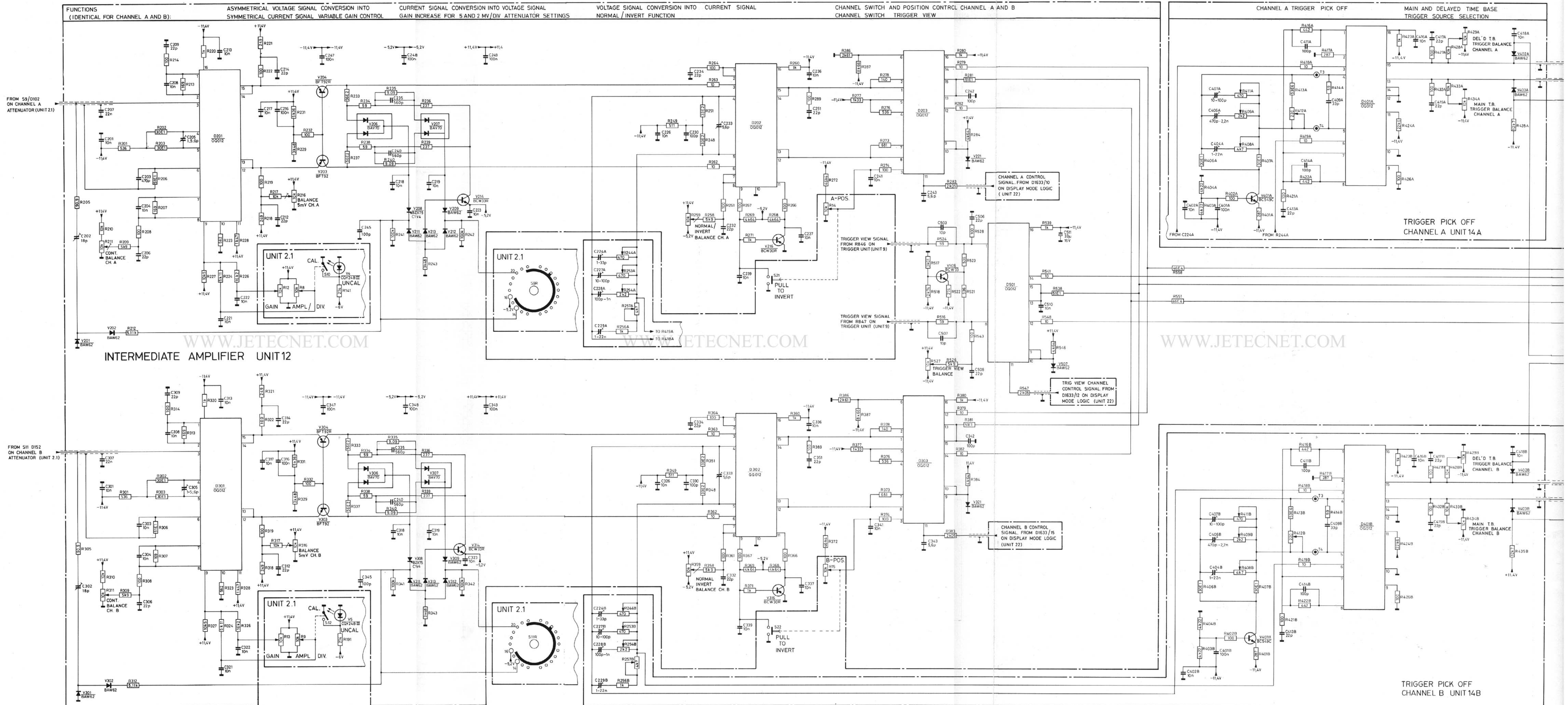
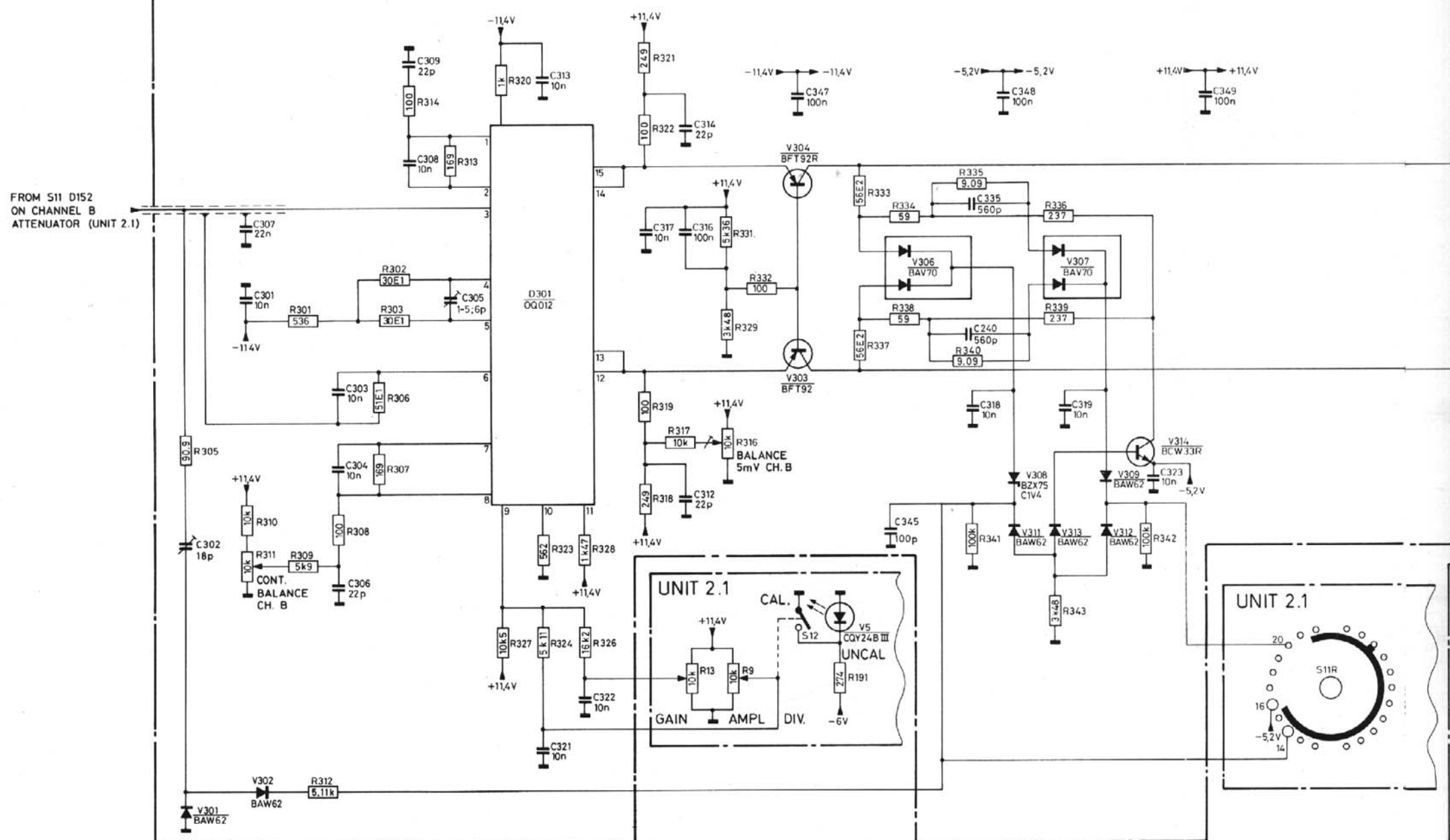


Fig. 8.1. Input attenuators, circuit diagram

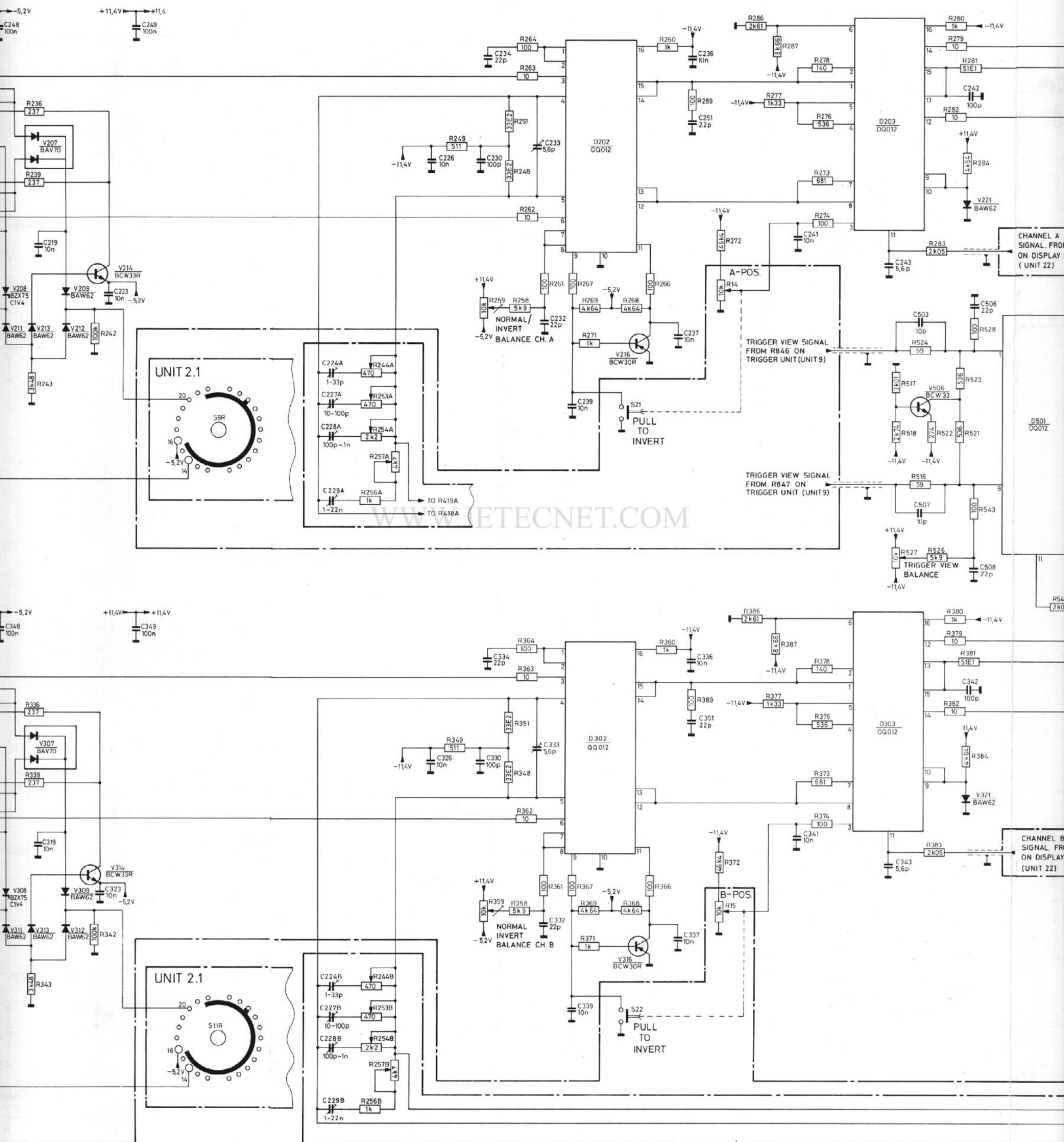


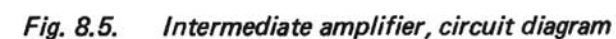


CURRENT SIGNAL CONVERSION INTO VOLTAGE SIGNAL
GAIN INCREASE FOR 5 AND 2 MV/DIV ATTENUATOR SETTINGS

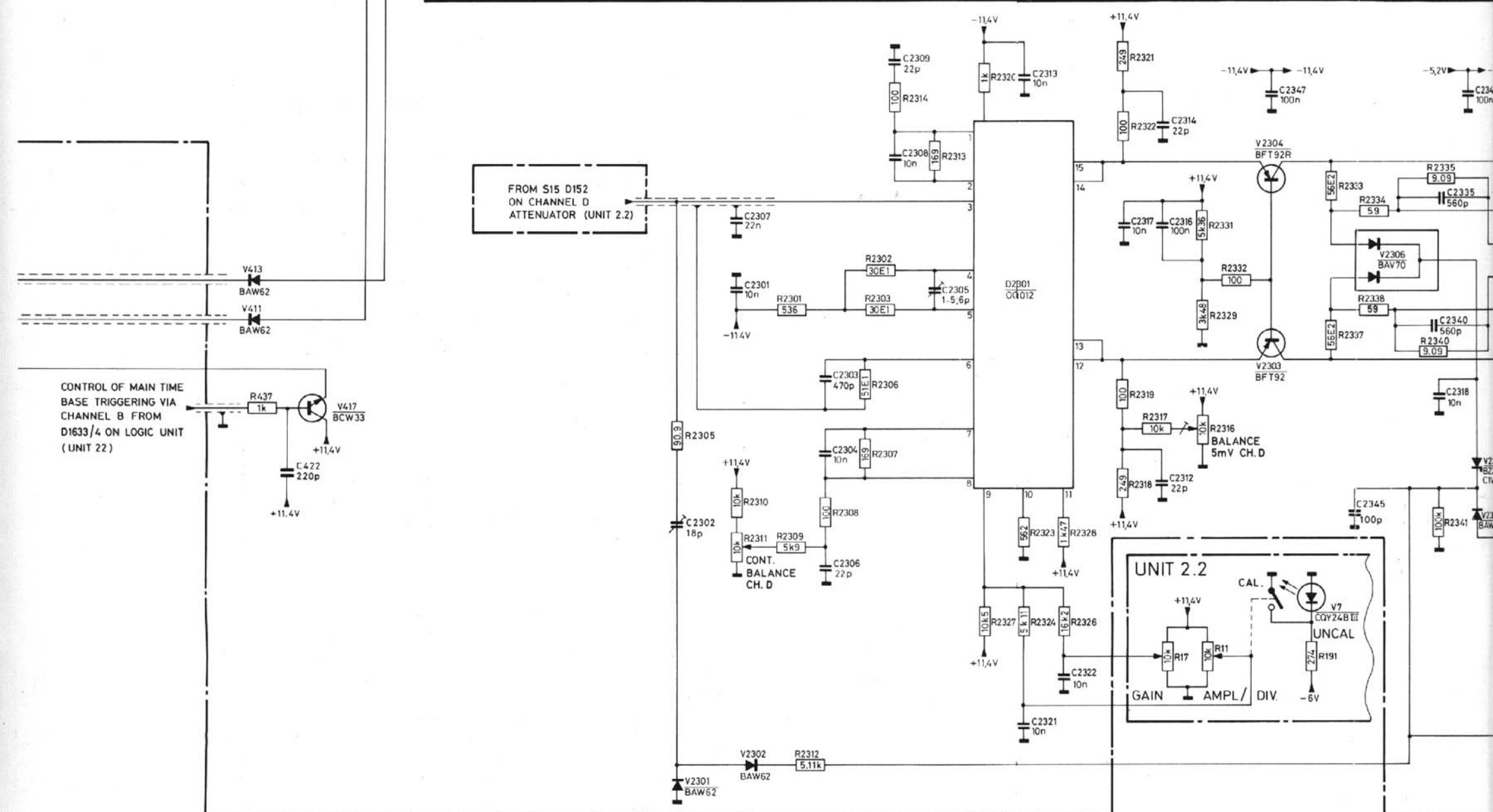
VOLTAGE SIGNAL CONVERSION INTO CURRENT SIGNAL
NORMAL / INVERT FUNCTION

CHANNEL SWITCH AND POSITION CONTROL CHANNEL A AND B
CHANNEL SWITCH TRIGGER VIEW

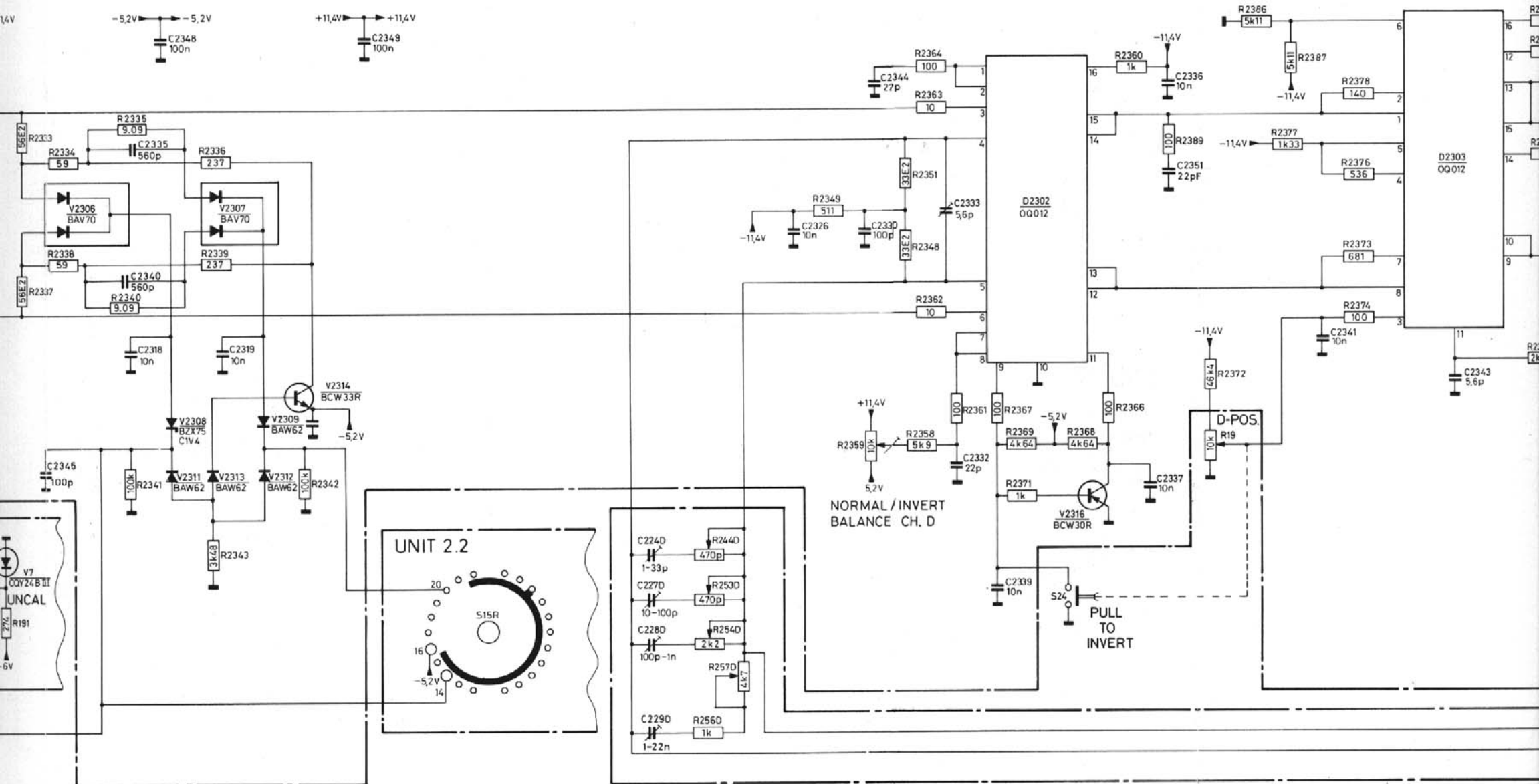




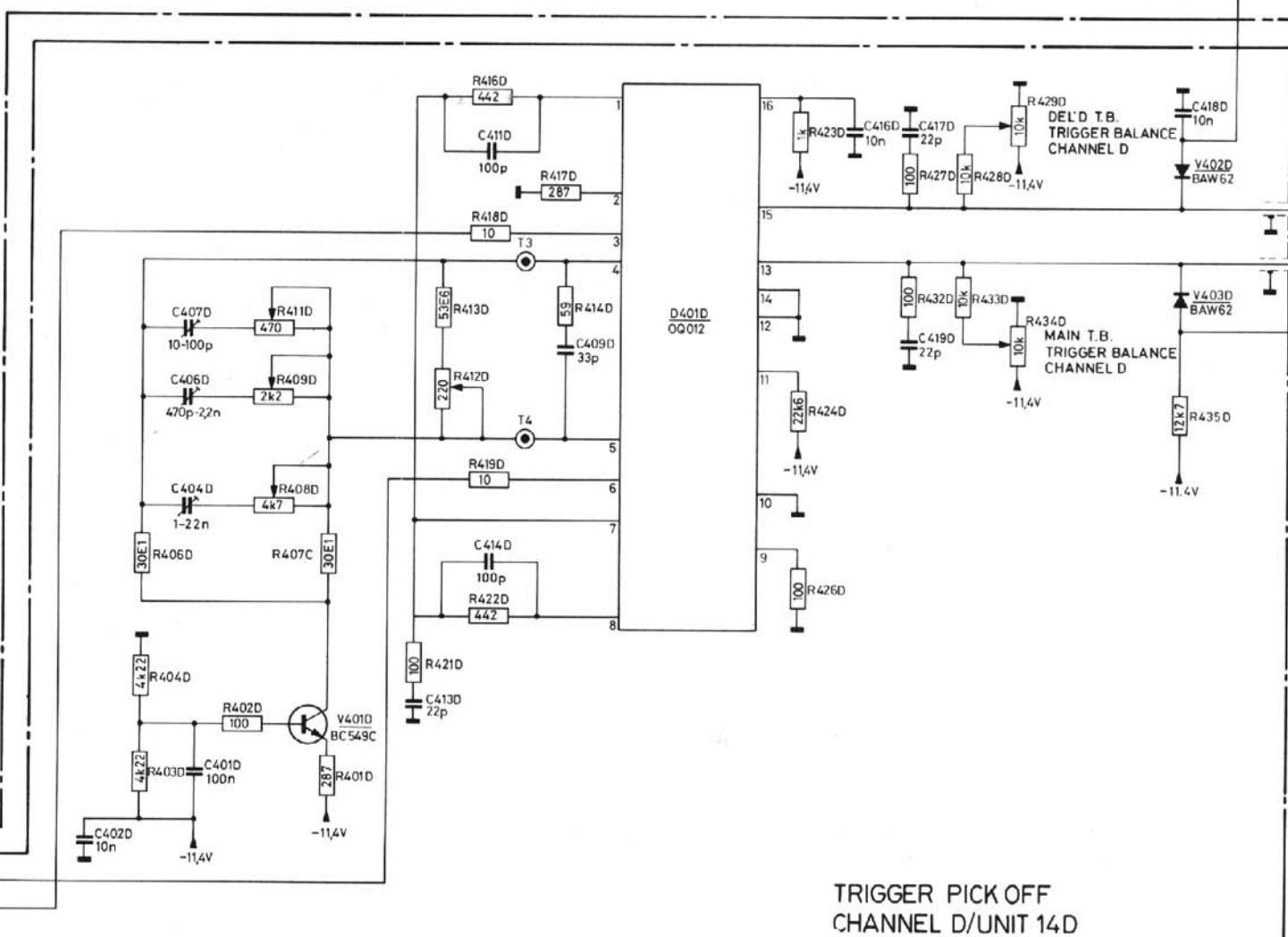
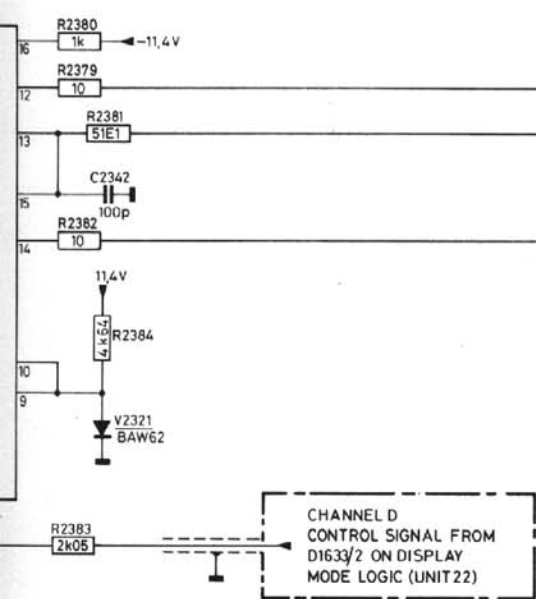
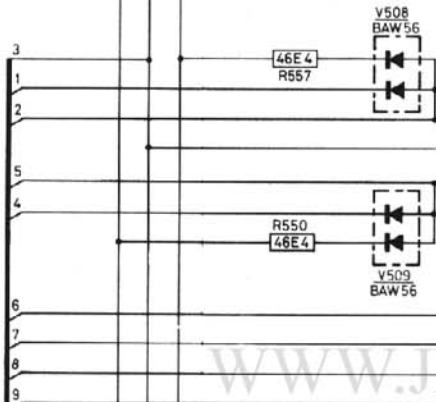
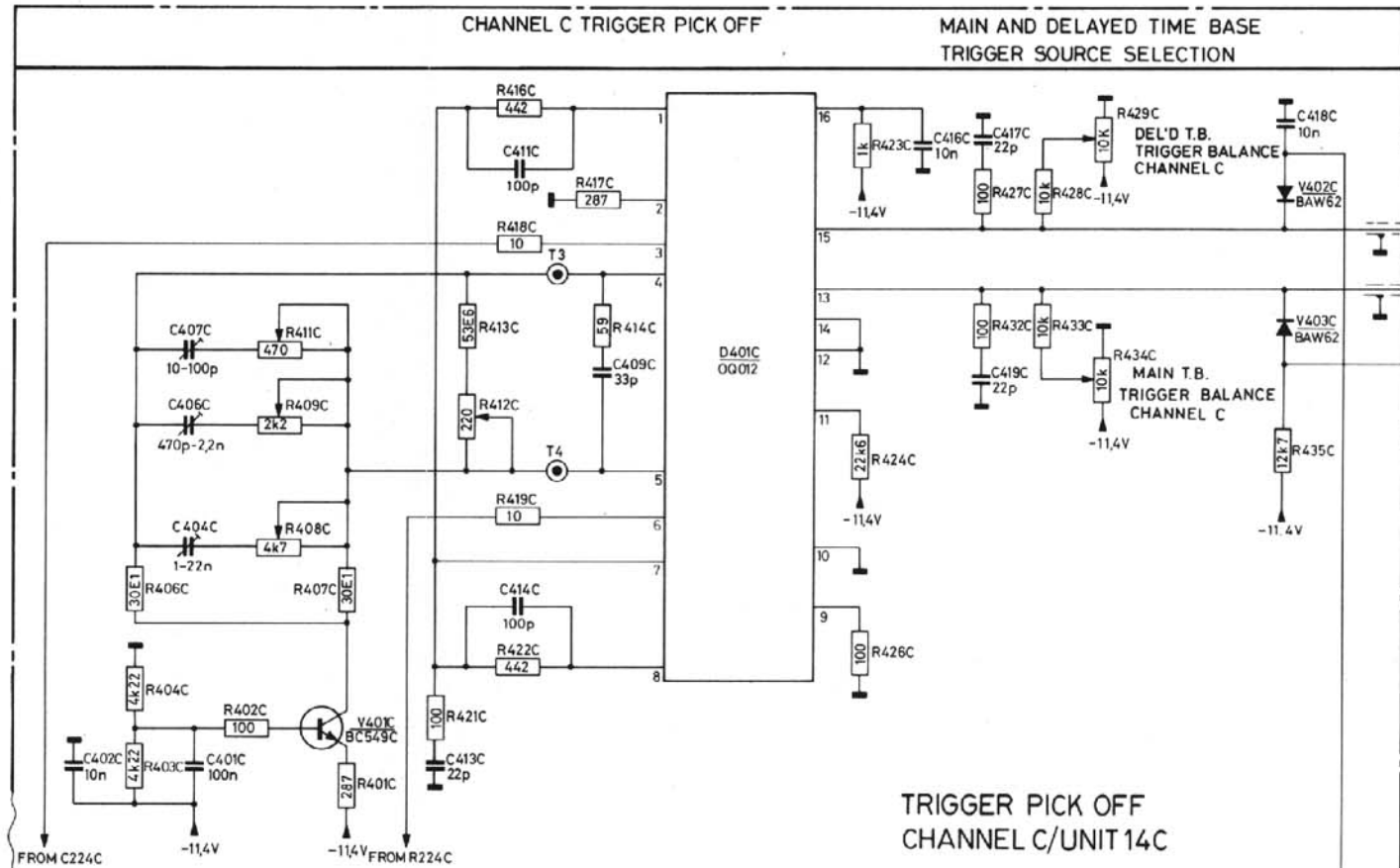
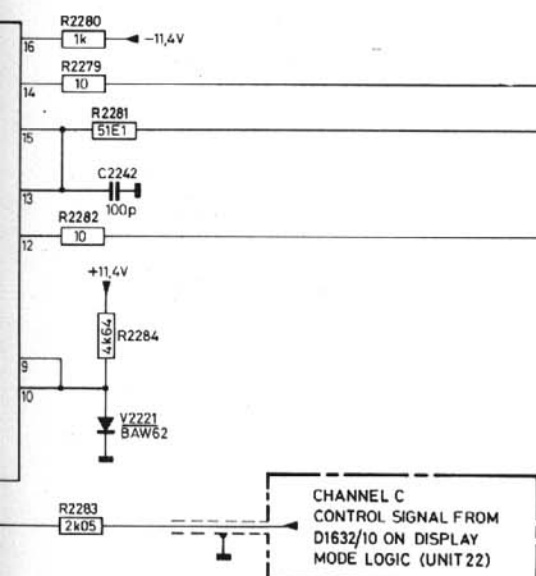
ASYMMETRICAL VOLTAGE SIGNAL CONVERSION INTO	CURR
SYMMETRICAL CURRUNT SIGNAL VARIABLE GAIN CONTROL	GAIN



CHANNEL SWITCH AND



CH AND POSITION CONTROL, CHANNEL C AND D.



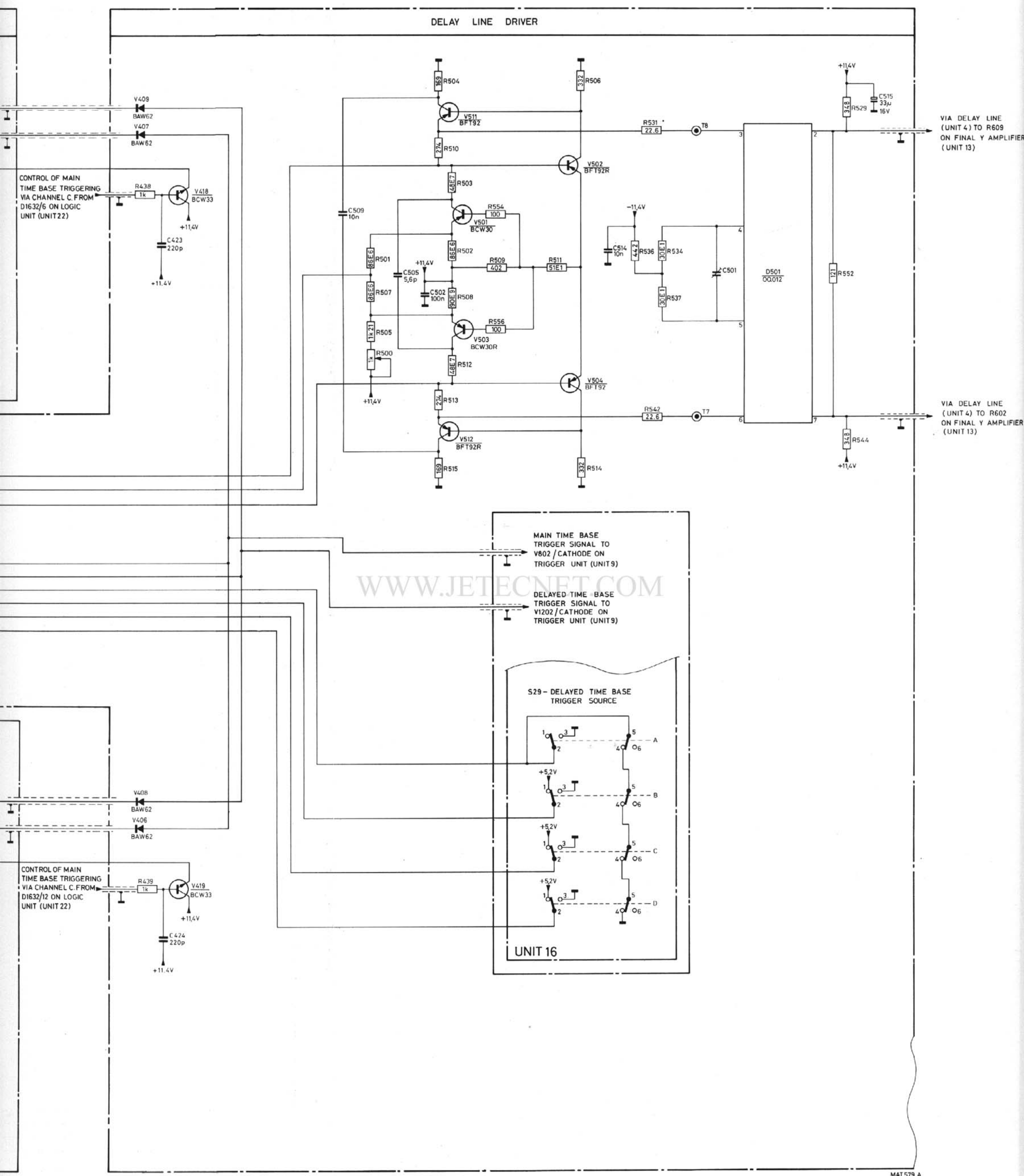
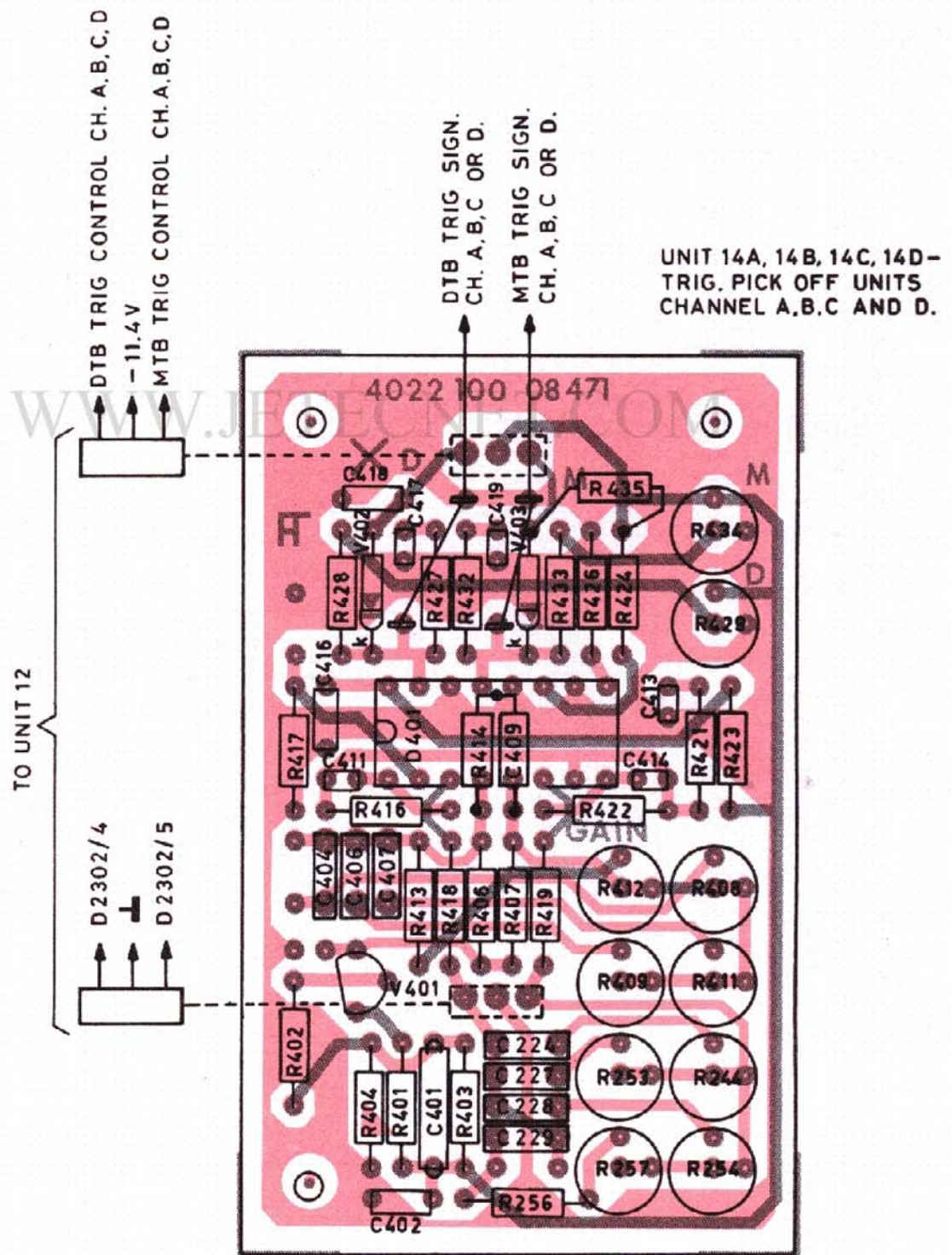


Fig. 8.5. Intermediate amplifier, circuit diagram



MAT 699

Fig. 8.6. Intermediate amplifier, printed circuit board lay-out

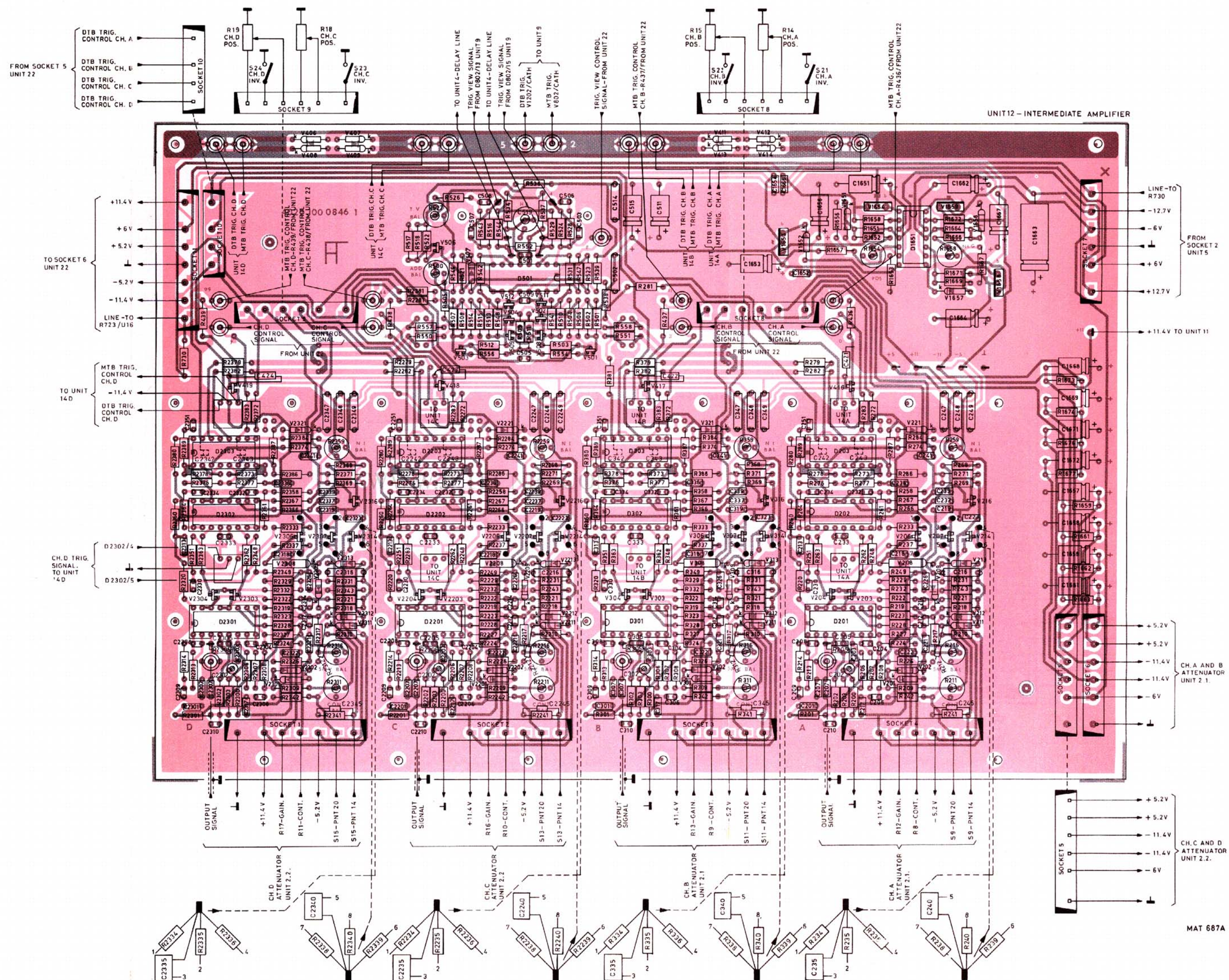


Fig. 8.7. Trigger pick-off unit, printed circuit board lay-out

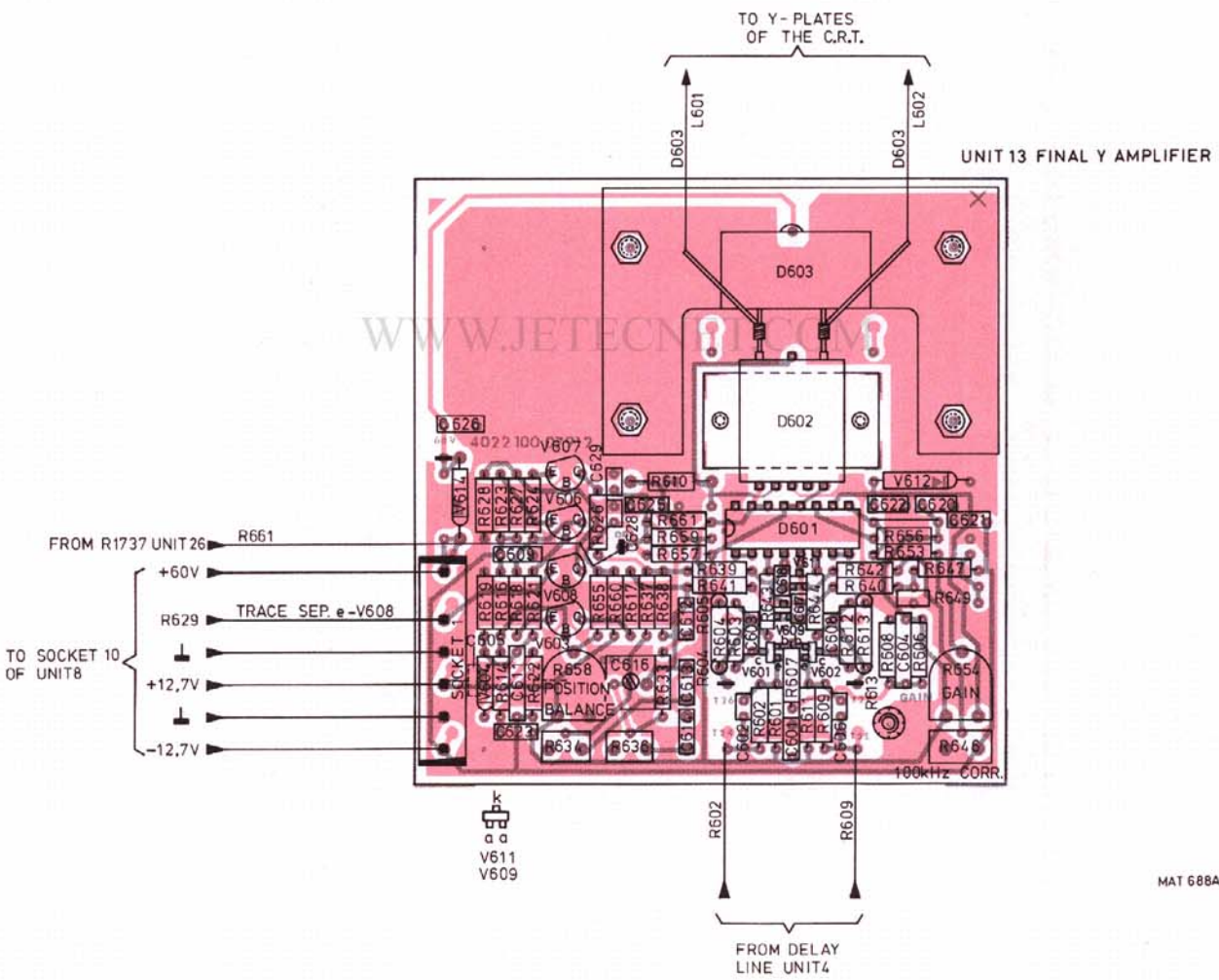


Fig. 8.8. Final Y-amplifier, printed circuit board lay-out

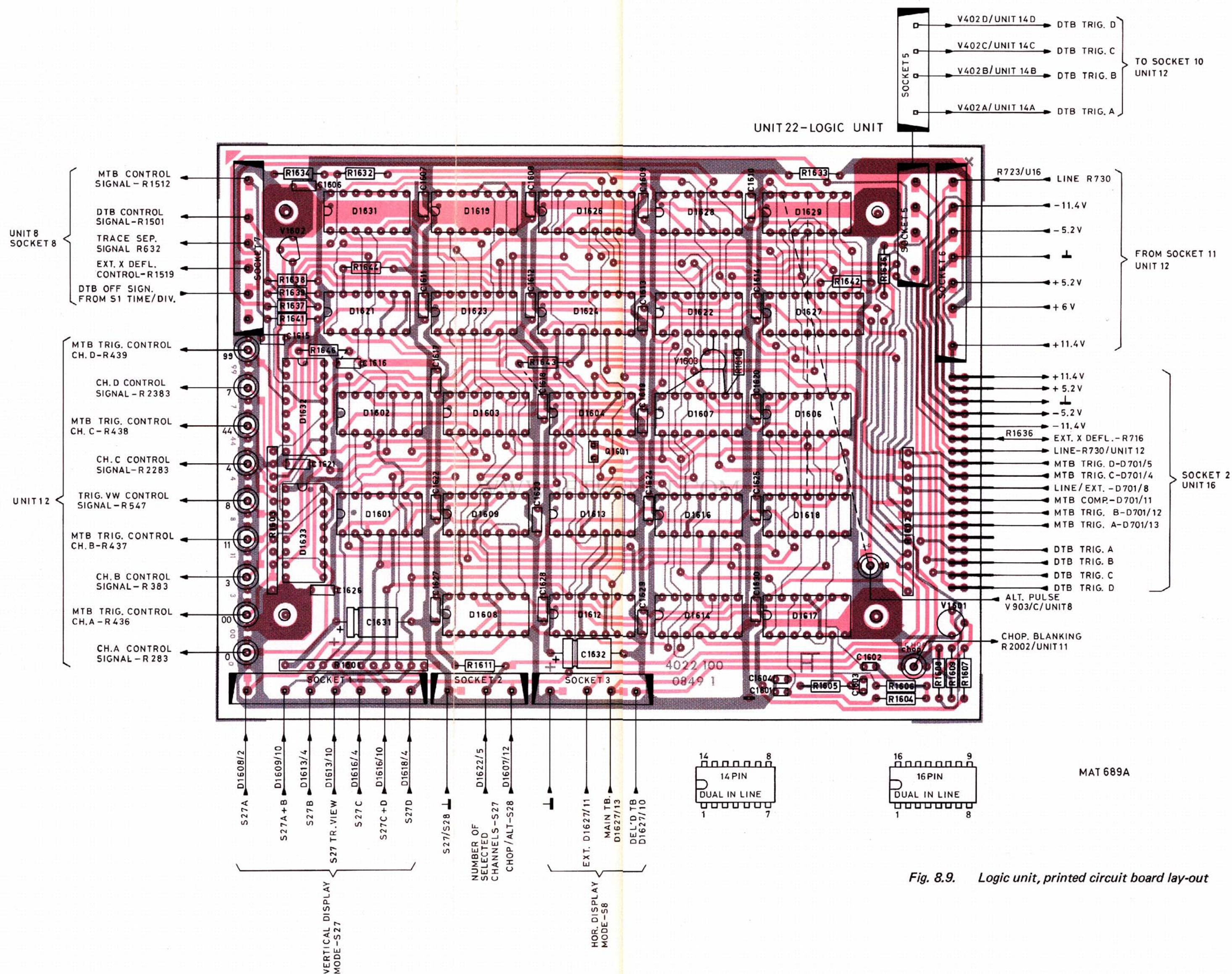


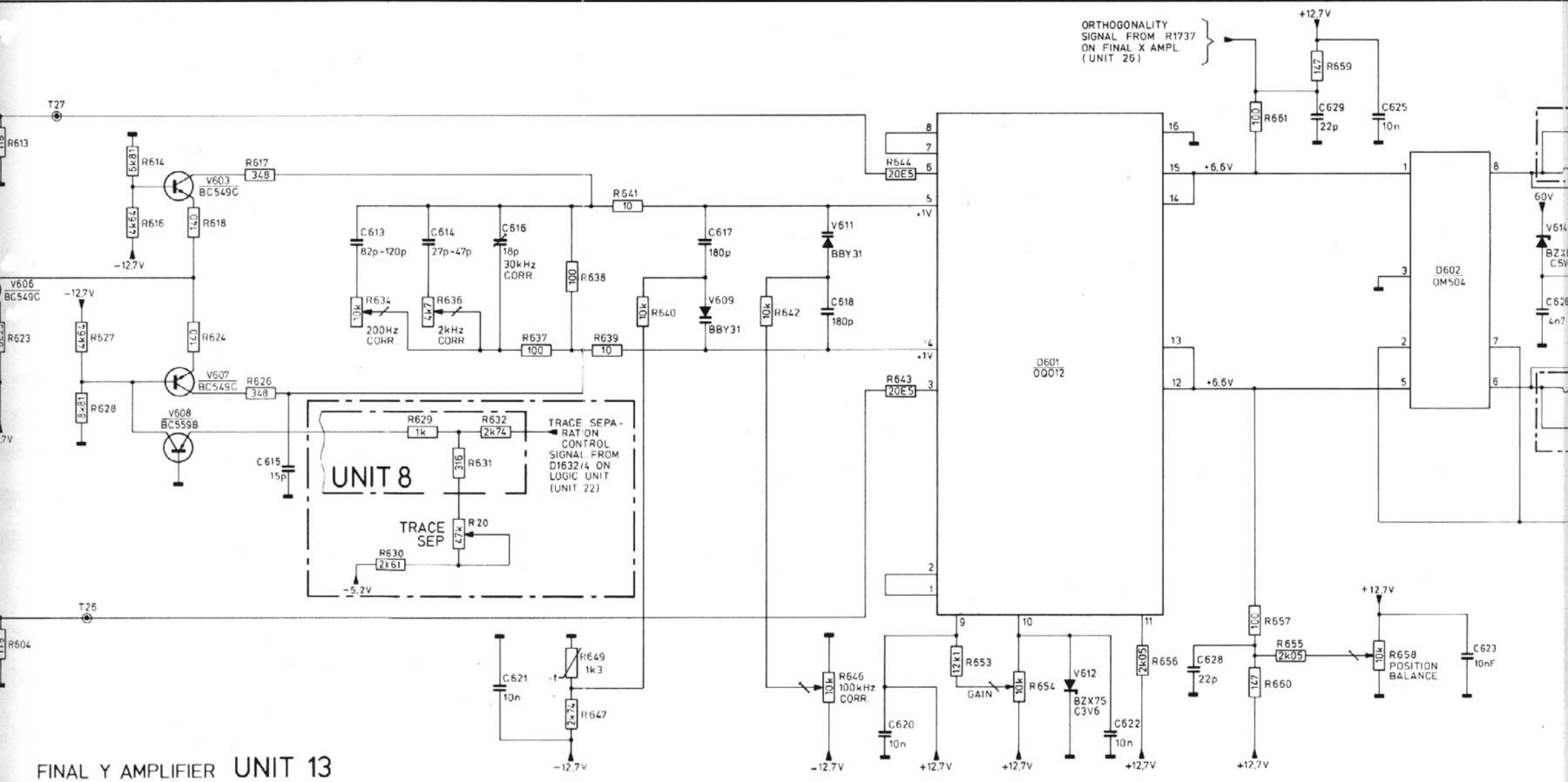
Fig. 8.9. Logic unit, printed circuit board lay-out

Fig. 8.10. Final Y-amplifier and logic, circuit diagram

CURRENT SOURCE FOR
D601 AND TRACE SEPARATION CONTROL

DELAY LINE
COMPENSATION

OUTPUT STAGE

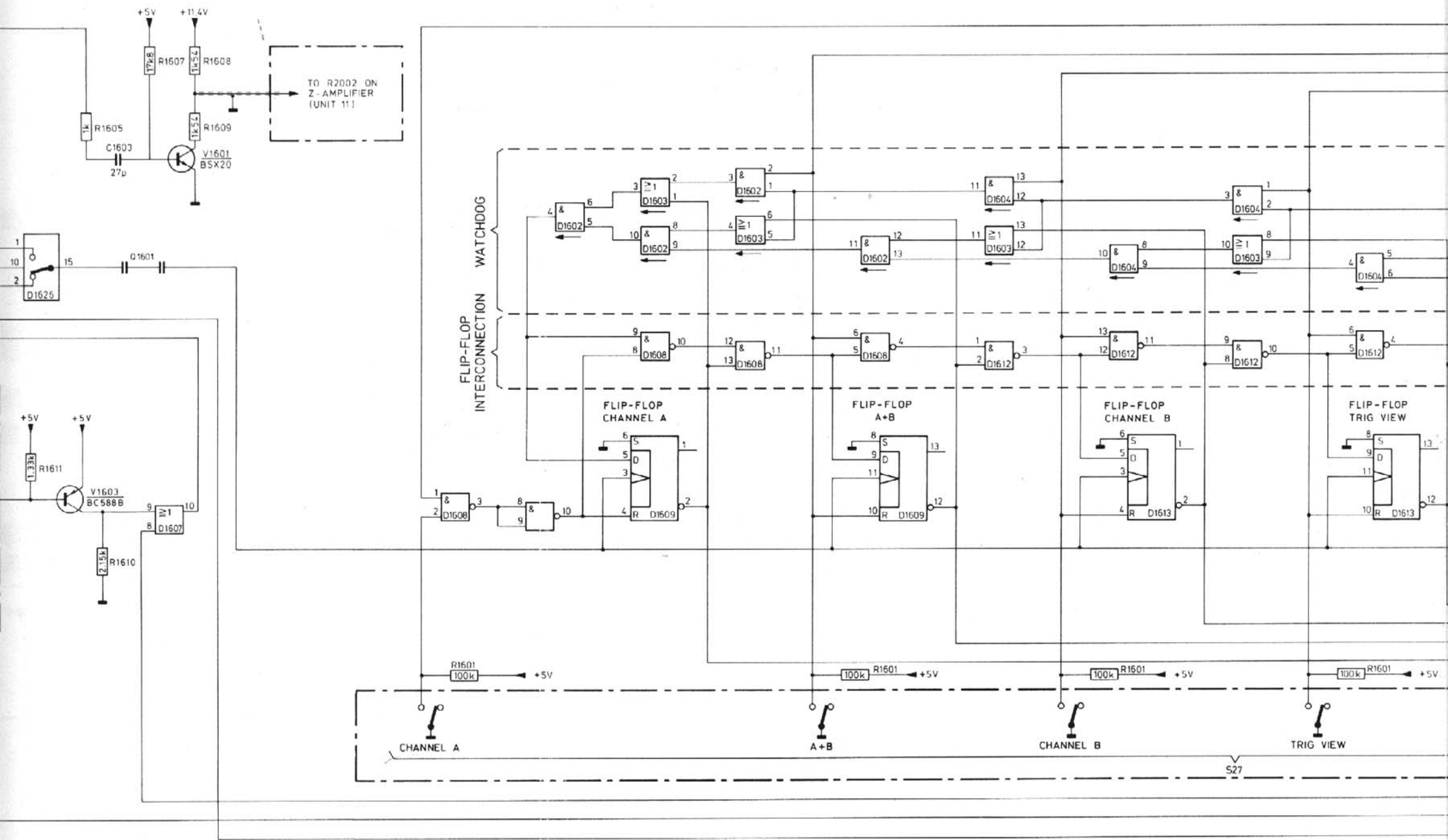


FINAL Y AMPLIFIER UNIT 13

AND DISPLAY BLANKING

WWW.JETECNET.COM

VERTICAL DISPLAY MODE LOGIC



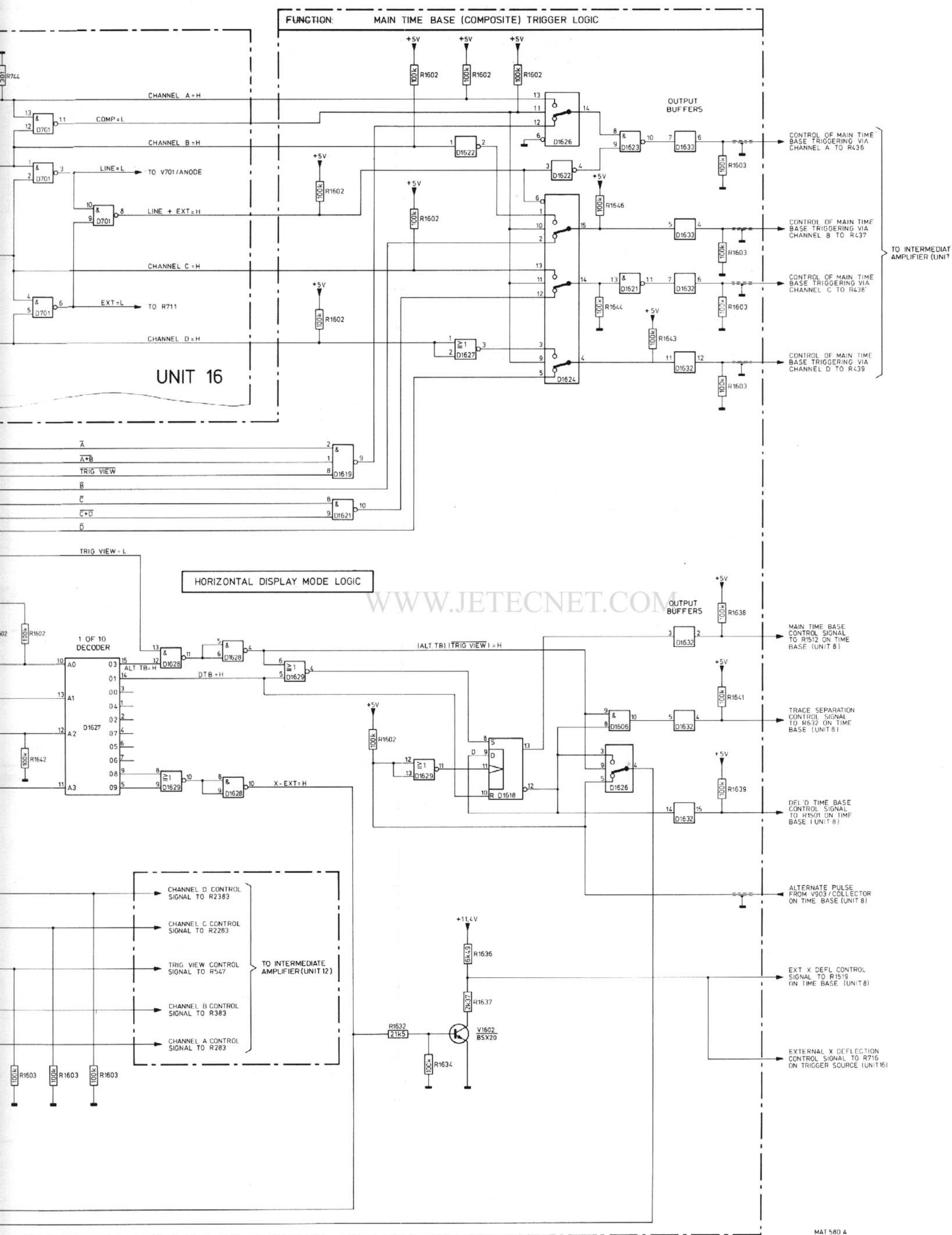


Fig. 8.10. Final Y-amplifier and logic, circuit diagram

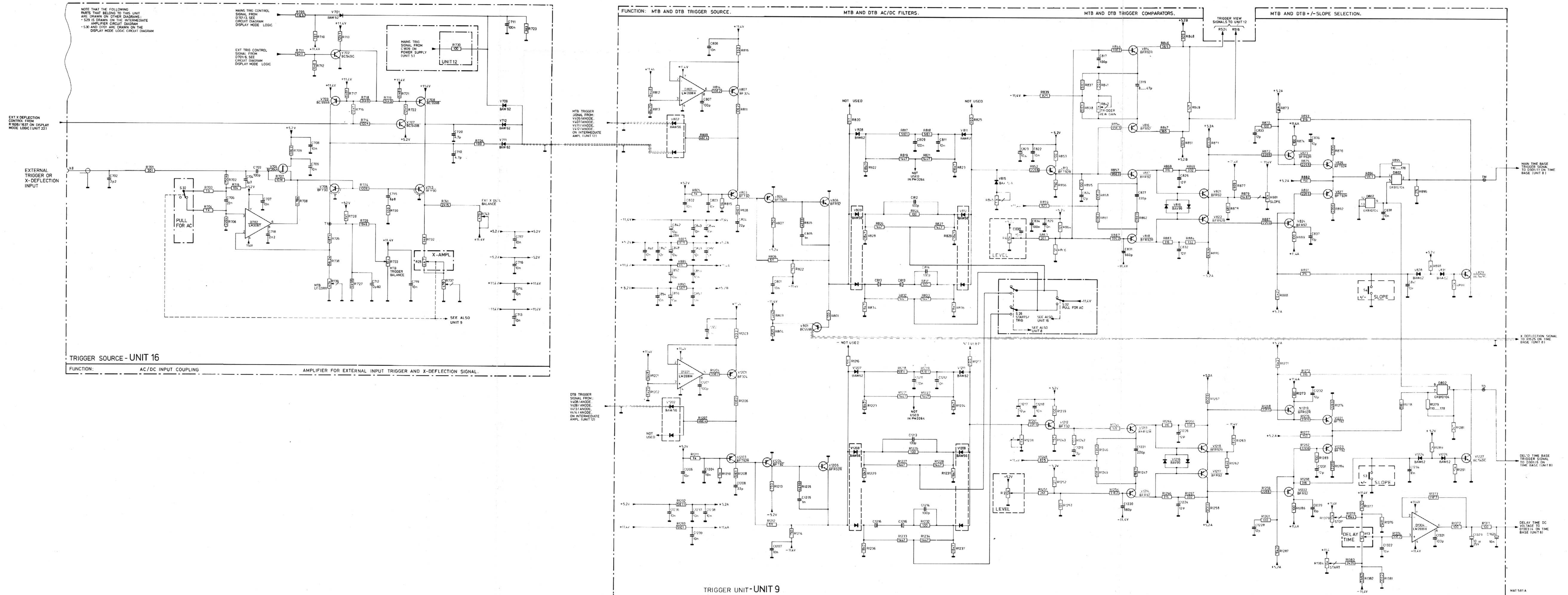
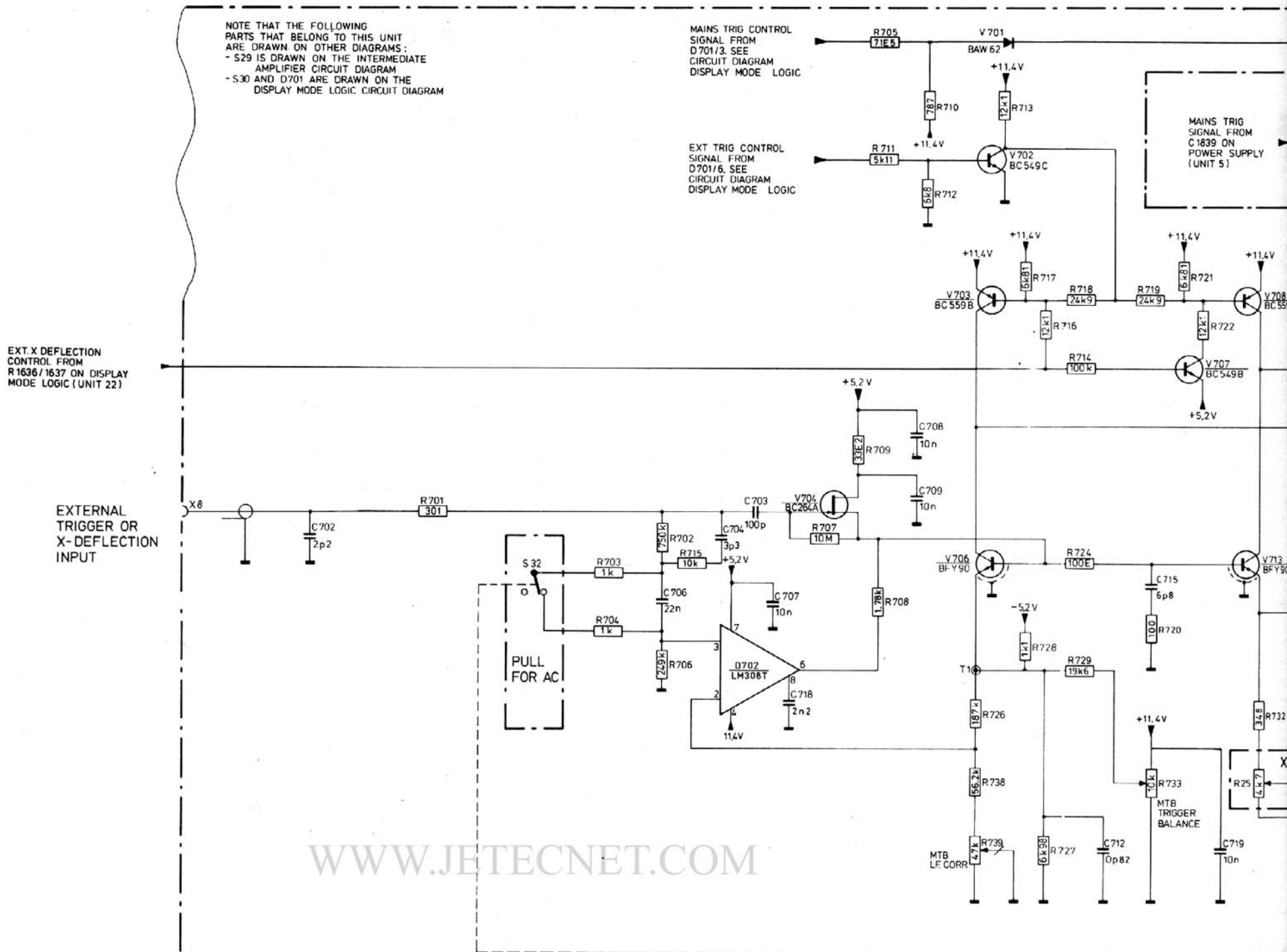


Fig. 8.11. Trigger source and trigger amplifier, circuit diagram



TRIGGER SOURCE - UNIT 16

FUNCTION: AC/DC INPUT COUPLING

AMPLIFIER FOR EXTERNAL INPUT TRIGGER AND X-DE

MAINS TRIG CONTROL
SIGNAL FROM
D701/3. SEE
CIRCUIT DIAGRAM
DISPLAY MODE LOGIC

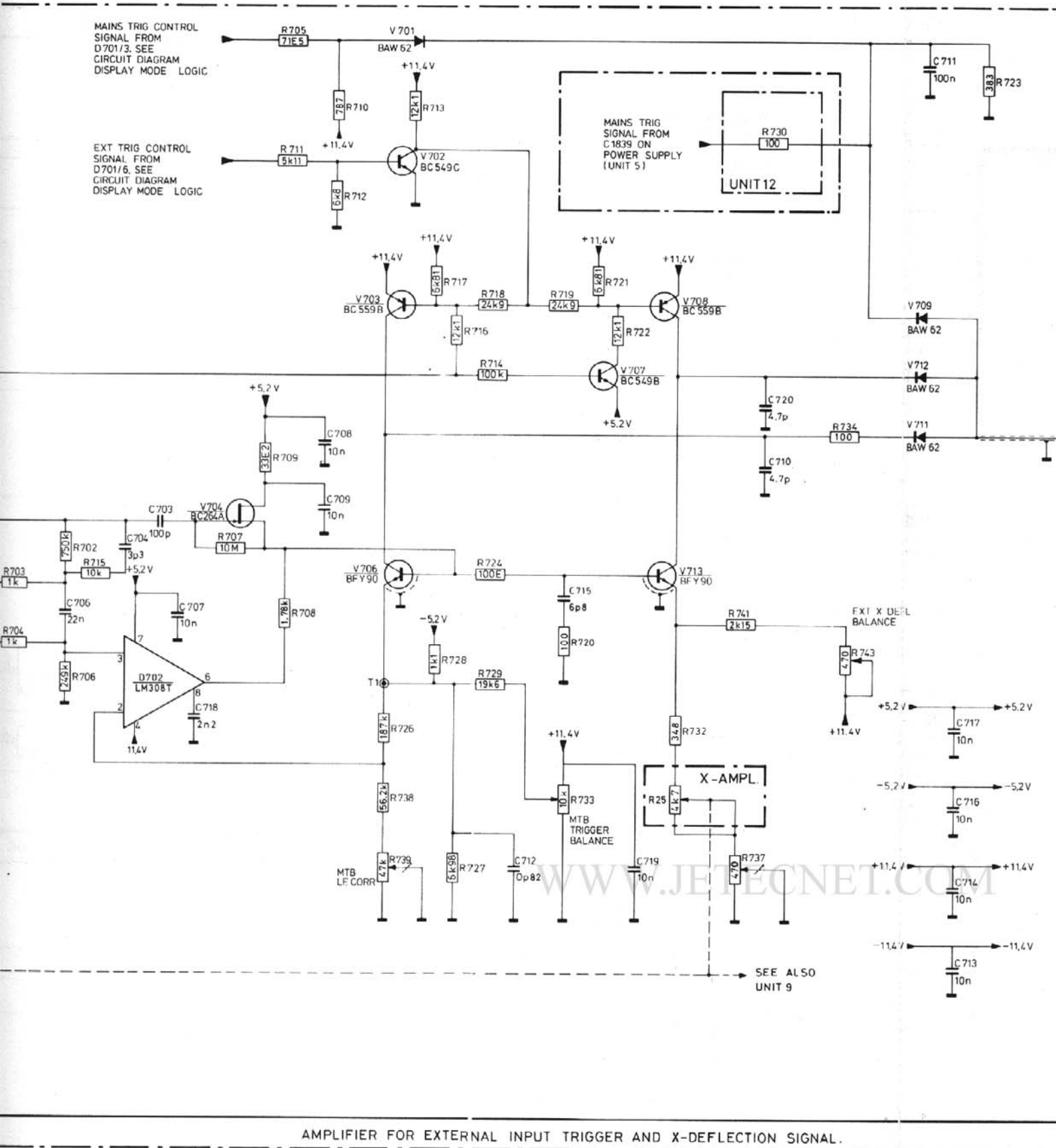
EXT TRIG CONTROL
SIGNAL FROM
D701/6. SEE
CIRCUIT DIAGRAM
DISPLAY MODE LOGIC

MAINS TRIG
SIGNAL FROM
C1839 ON
POWER SUPPLY
(UNIT 5)

UNIT 12

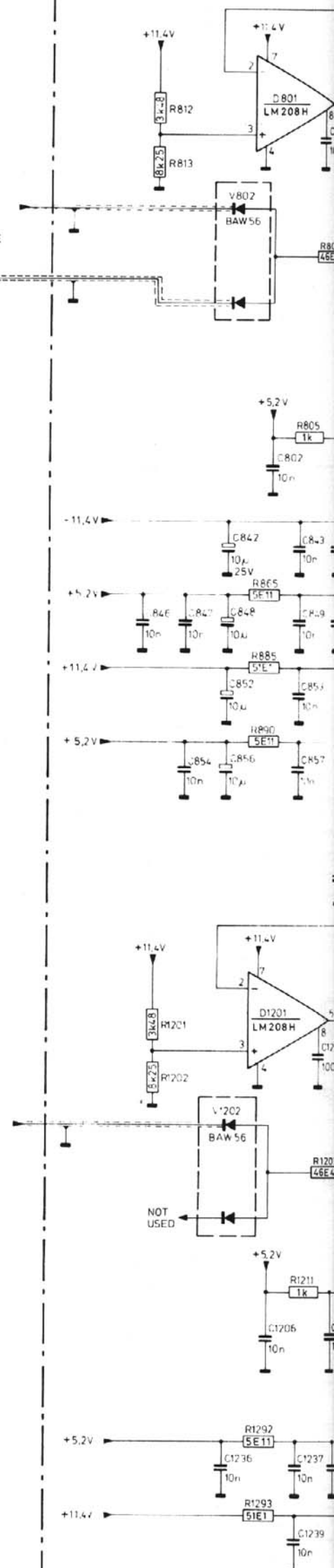
MTB TRIGGER
SIGNAL FROM:
V406/ANODE,
V407/ANODE,
V411/ANODE,
V412/ANODE,
ON INTERMEDIATE
AMPL (UNIT 12)

FUNCTION: MTB AND DTB TRIGGER



SEE ALSO
UNIT 9

DTB TRIGGER
SIGNAL FROM:
V408/ANODE,
V409/ANODE,
V413/ANODE,
V414/ANODE,
ON INTERMEDIATE
AMPL (UNIT 12)

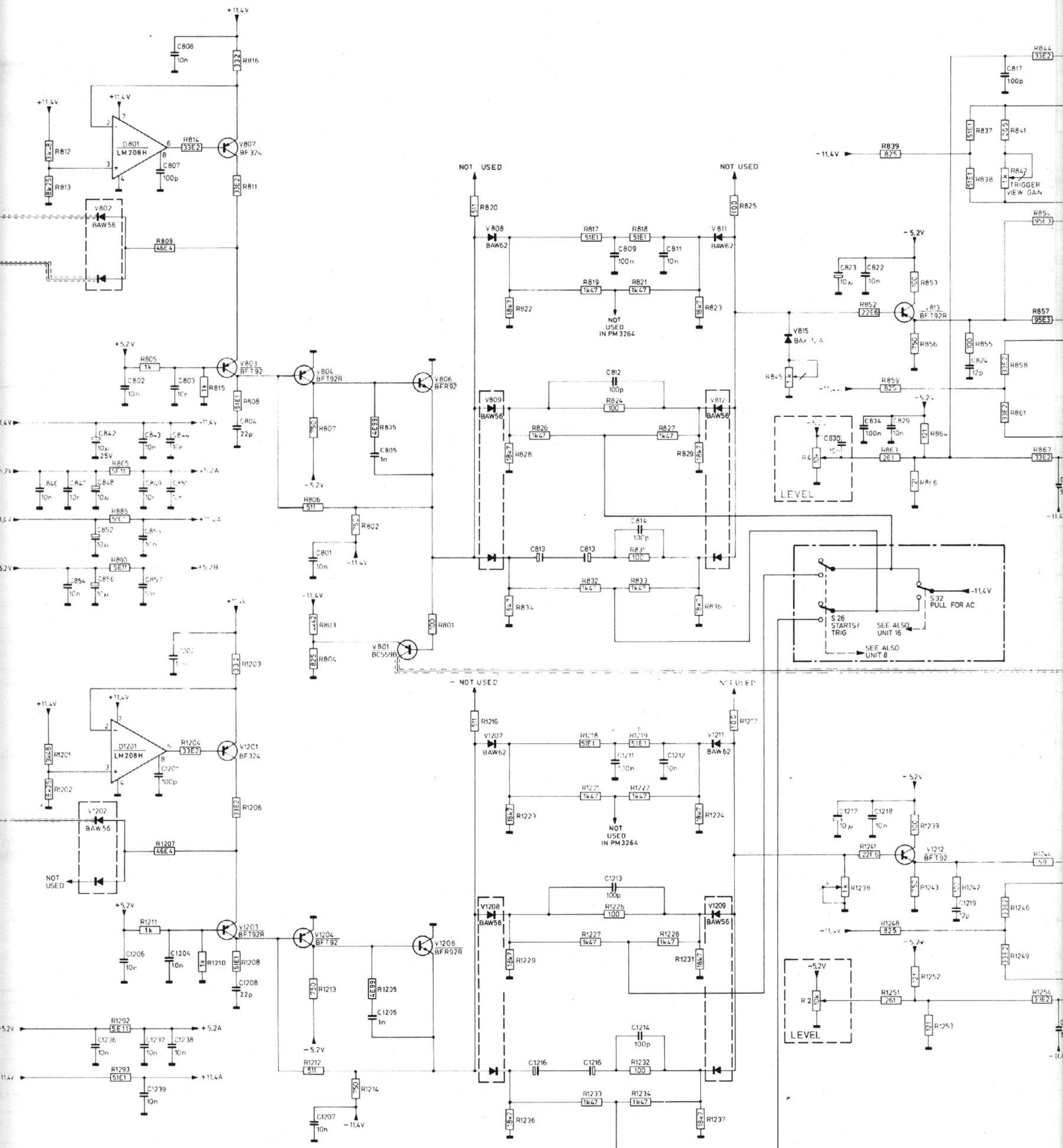


Please Note :Quality of original manual is poor

FUNCTION: MTB AND DTB TRIGGER SOURCE.

MTB AND DTB AC/DC FILTERS.

MTB AND DTB TRIG



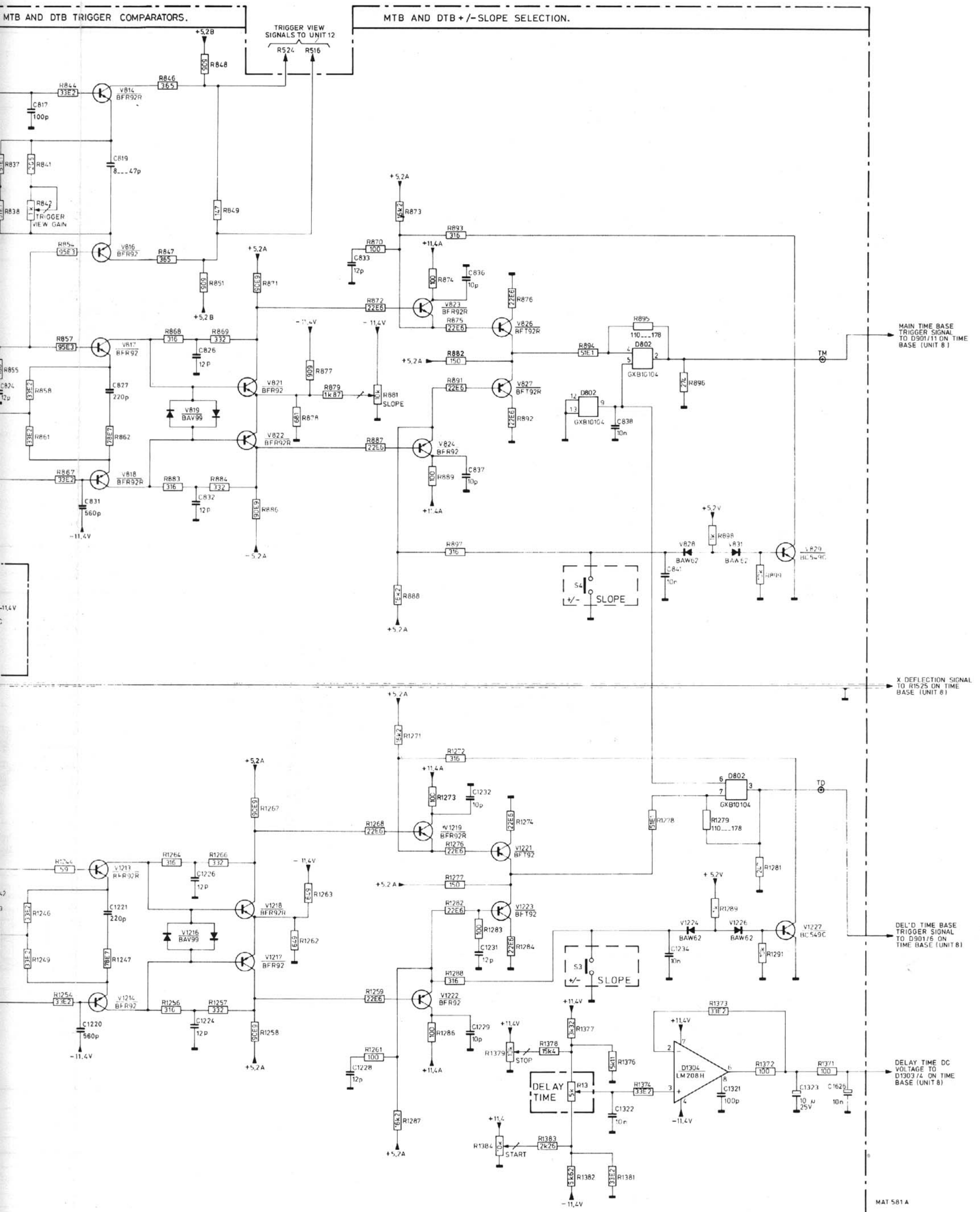
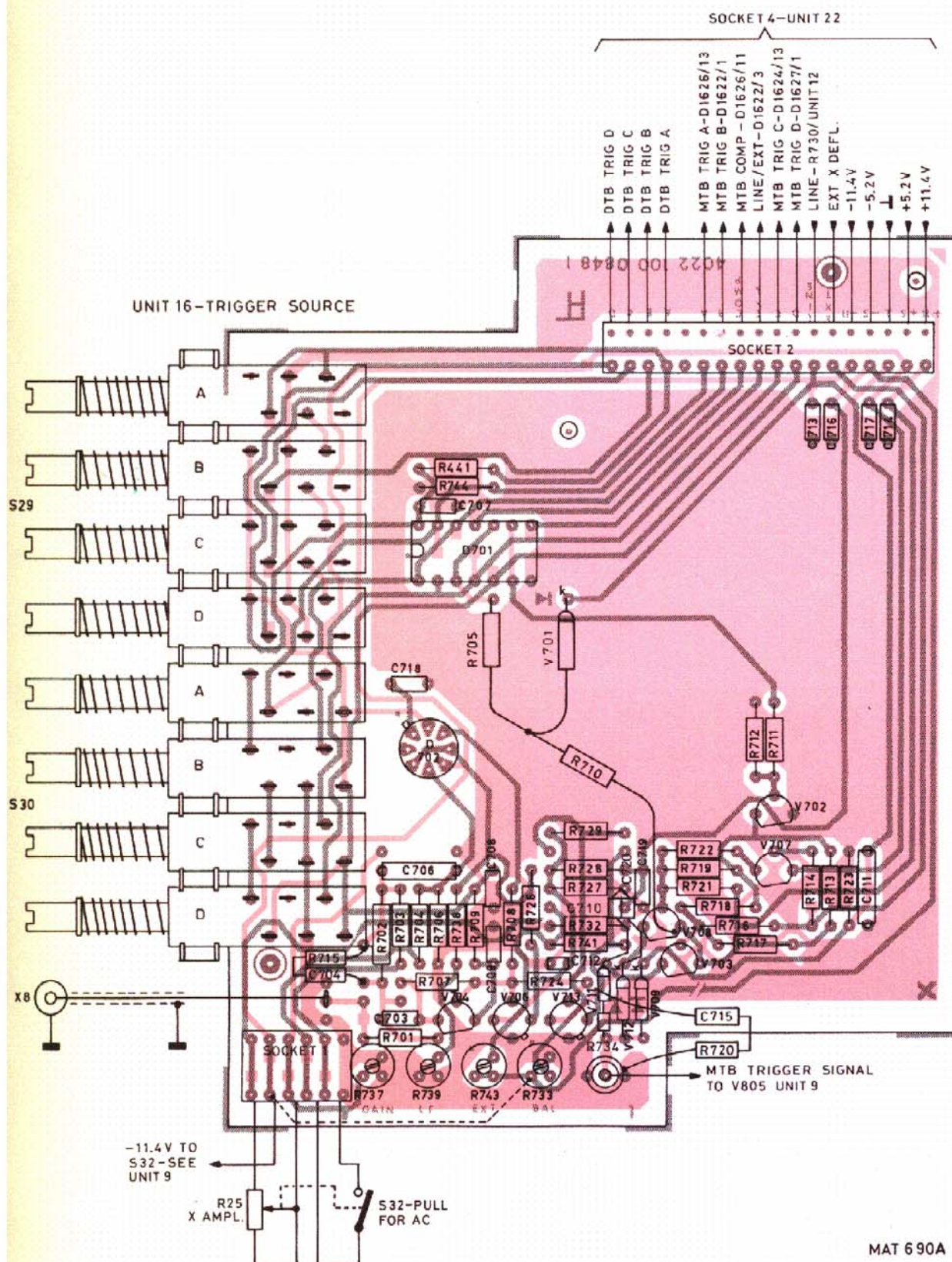


Fig. 8.11. Trigger source and trigger amplifier, circuit diagram



MAT 690A

Fig. 8.12. Trigger source, printed circuit board lay-out

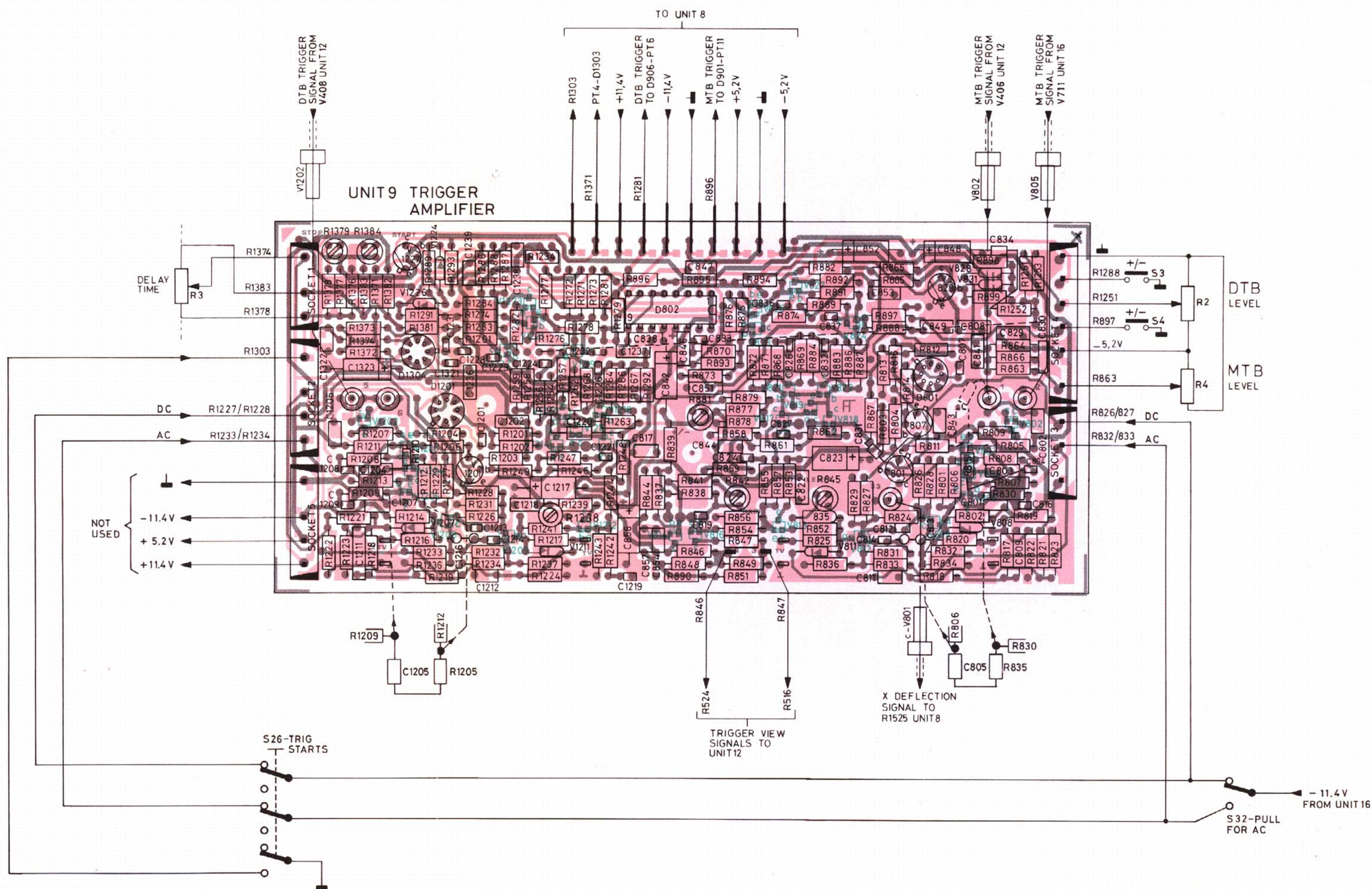


Fig. 8.13. Trigger amplifier, printed circuit board lay-out

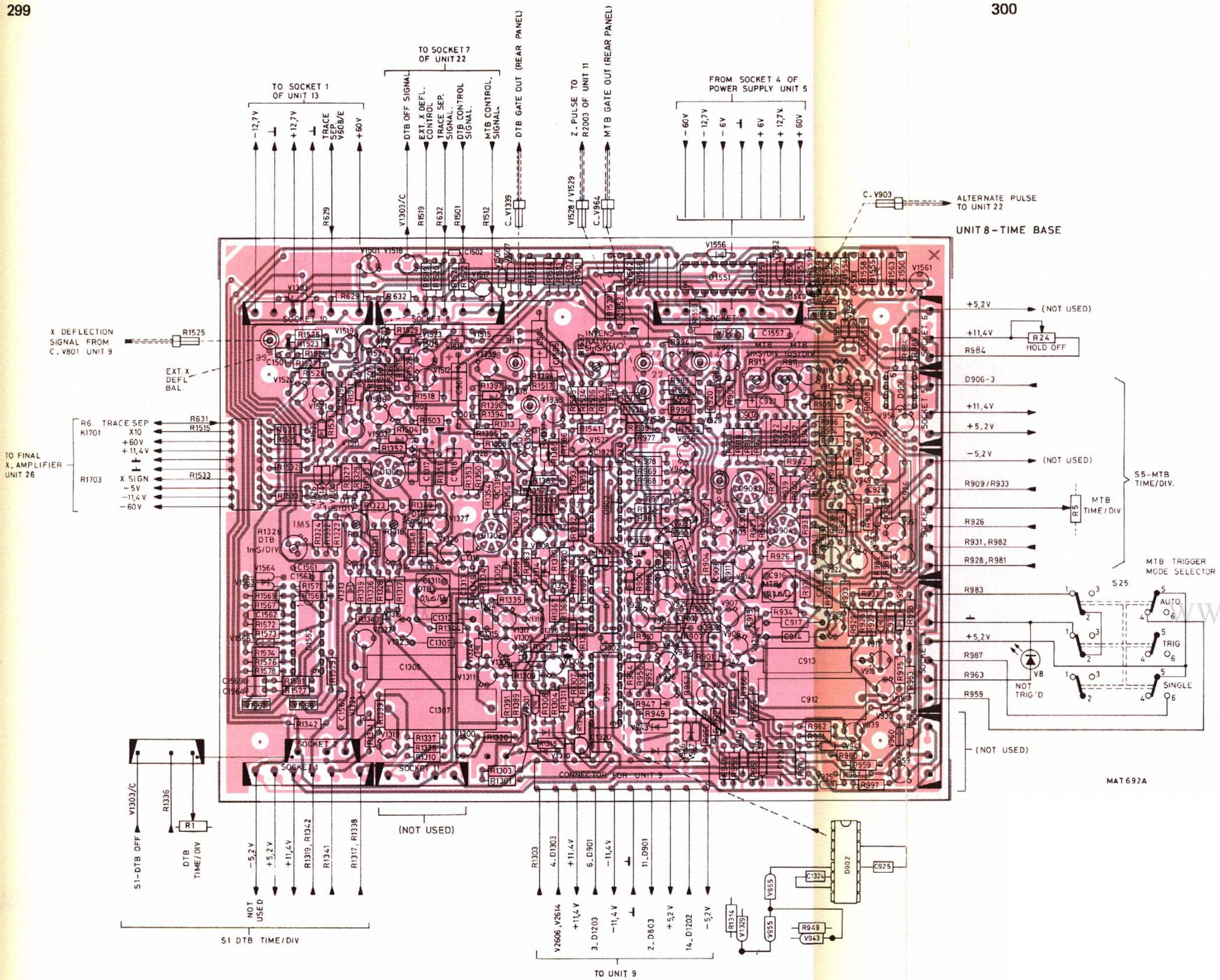


Fig. 8.15. Time base unit, printed circuit board lay-out

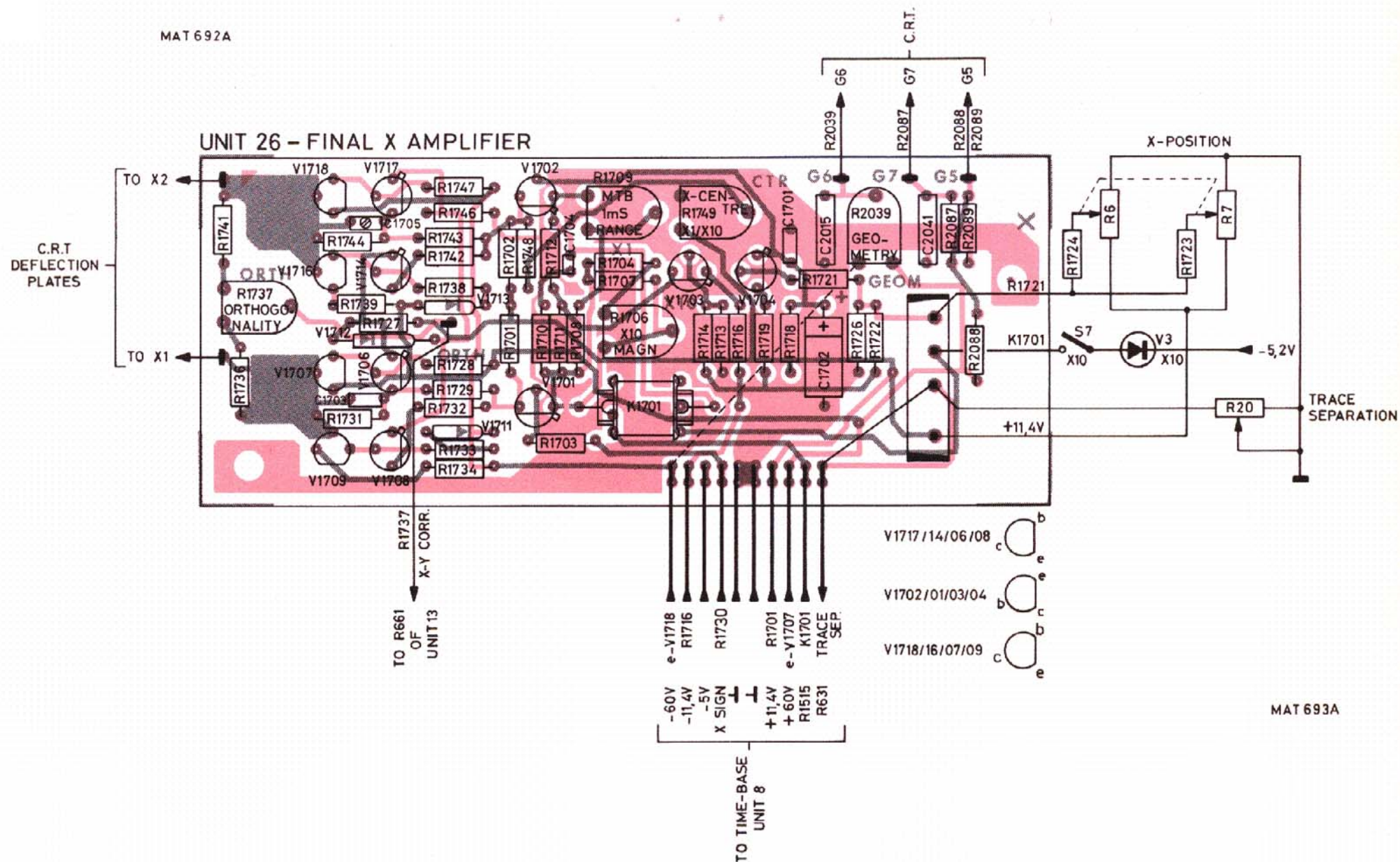


Fig. 8.14. Time base and final X-amplifier, circuit diagram

FUNCTION :

MTB AND DTB SWEEP GATING LOGIC AND TRIGGER MODE

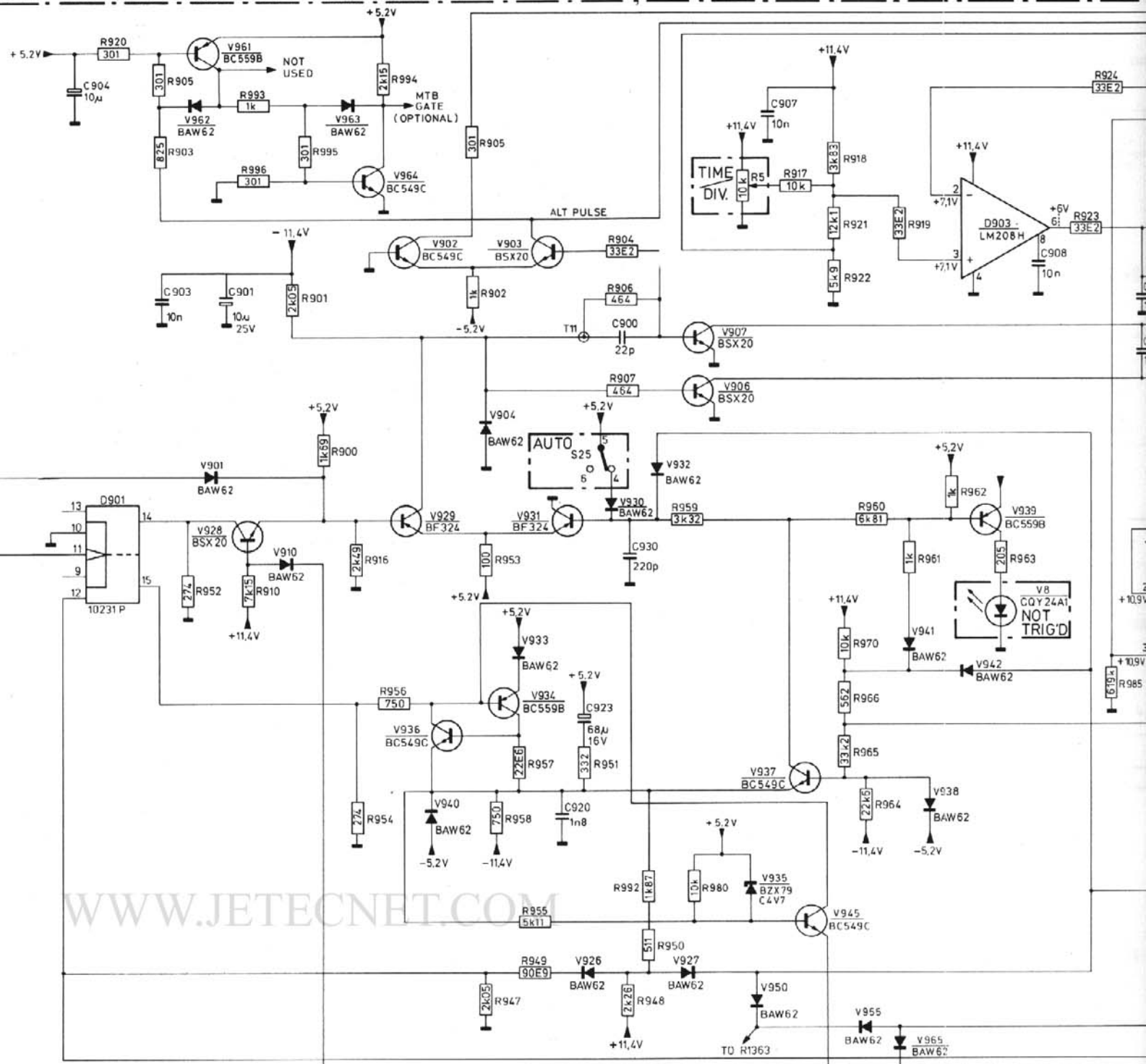
MAIN AND DELAY

MAIN TIME BASE
TRIGGER SIGNAL
FROM D802/2 ON
TRIGGER UNIT (UNIT 9)

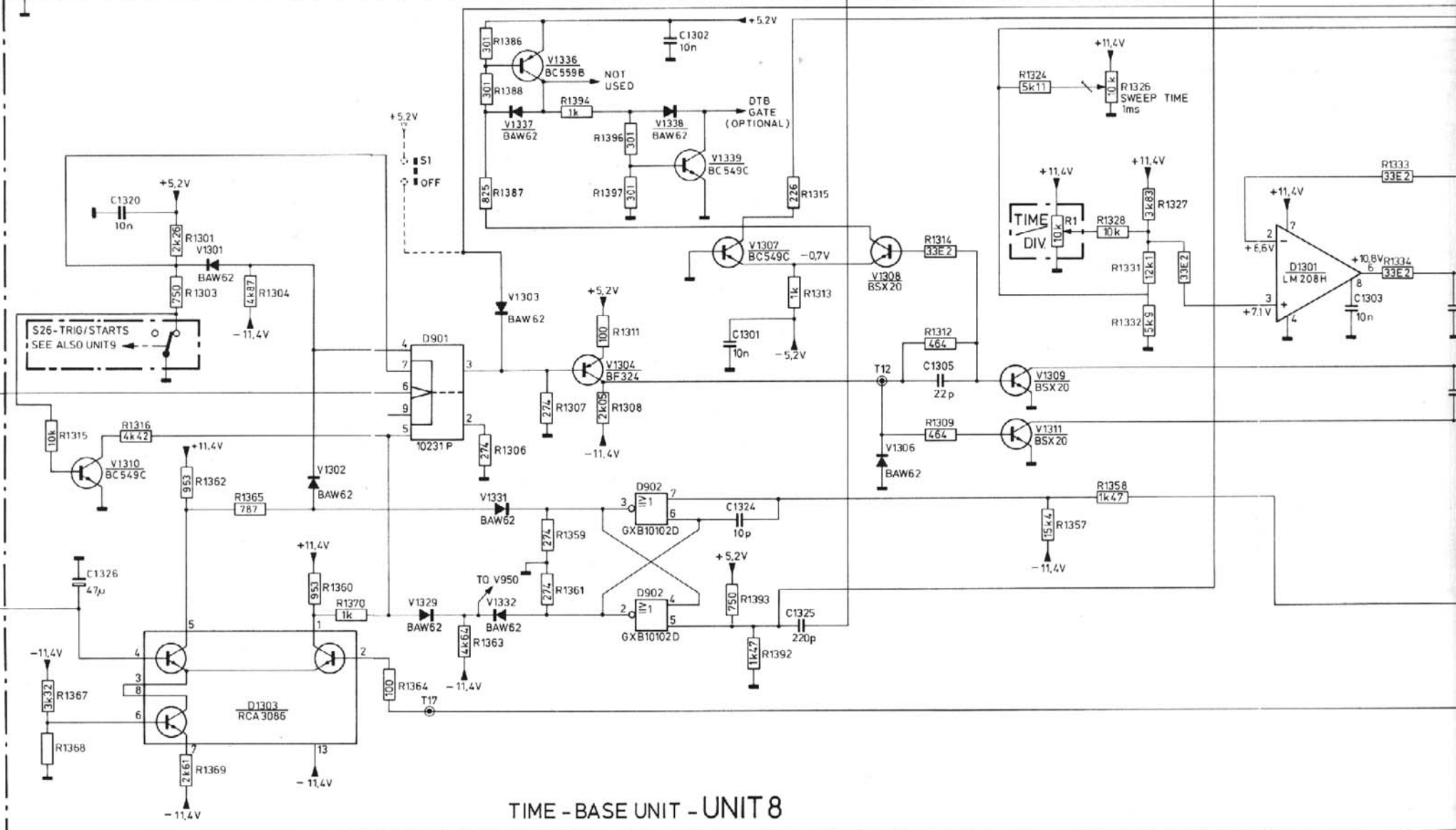
X DEFLECTION
SIGNAL FROM
V801/COLLECTOR ON
TRIGGER UNIT (UNIT 9)

DEL'D TIME BASE
TRIGGER SIGNAL
FROM D802/3 ON
TRIGGER AMPLIFIER
(UNIT 9)

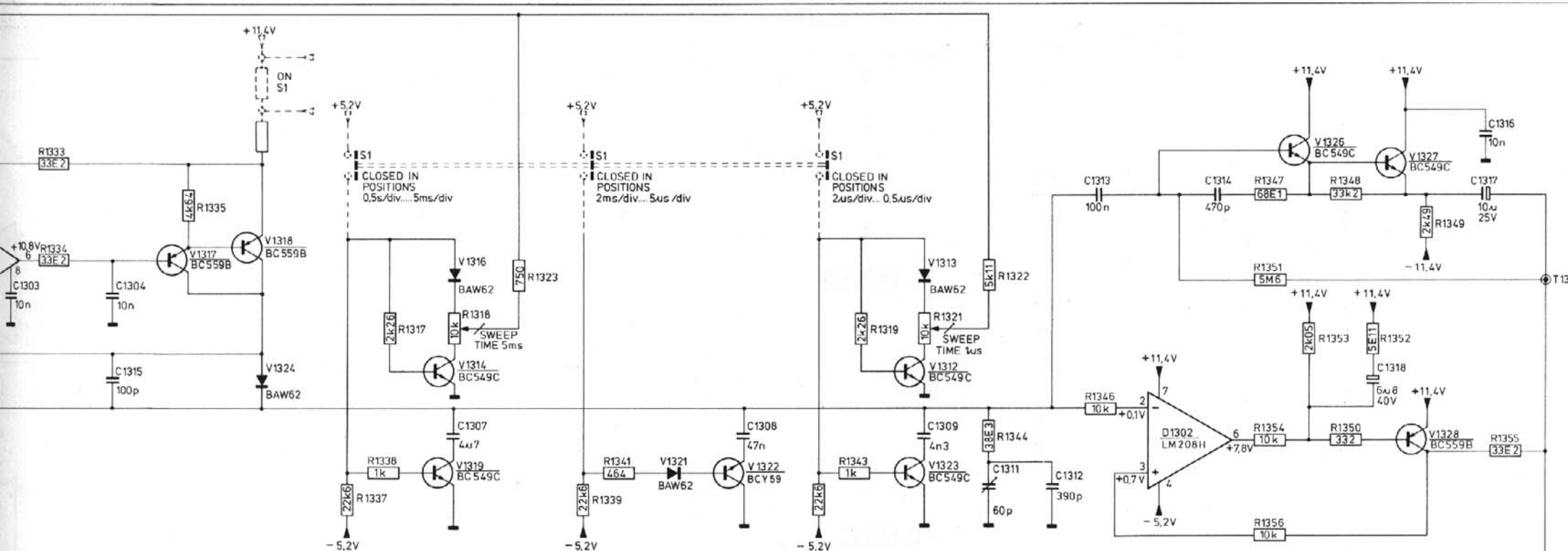
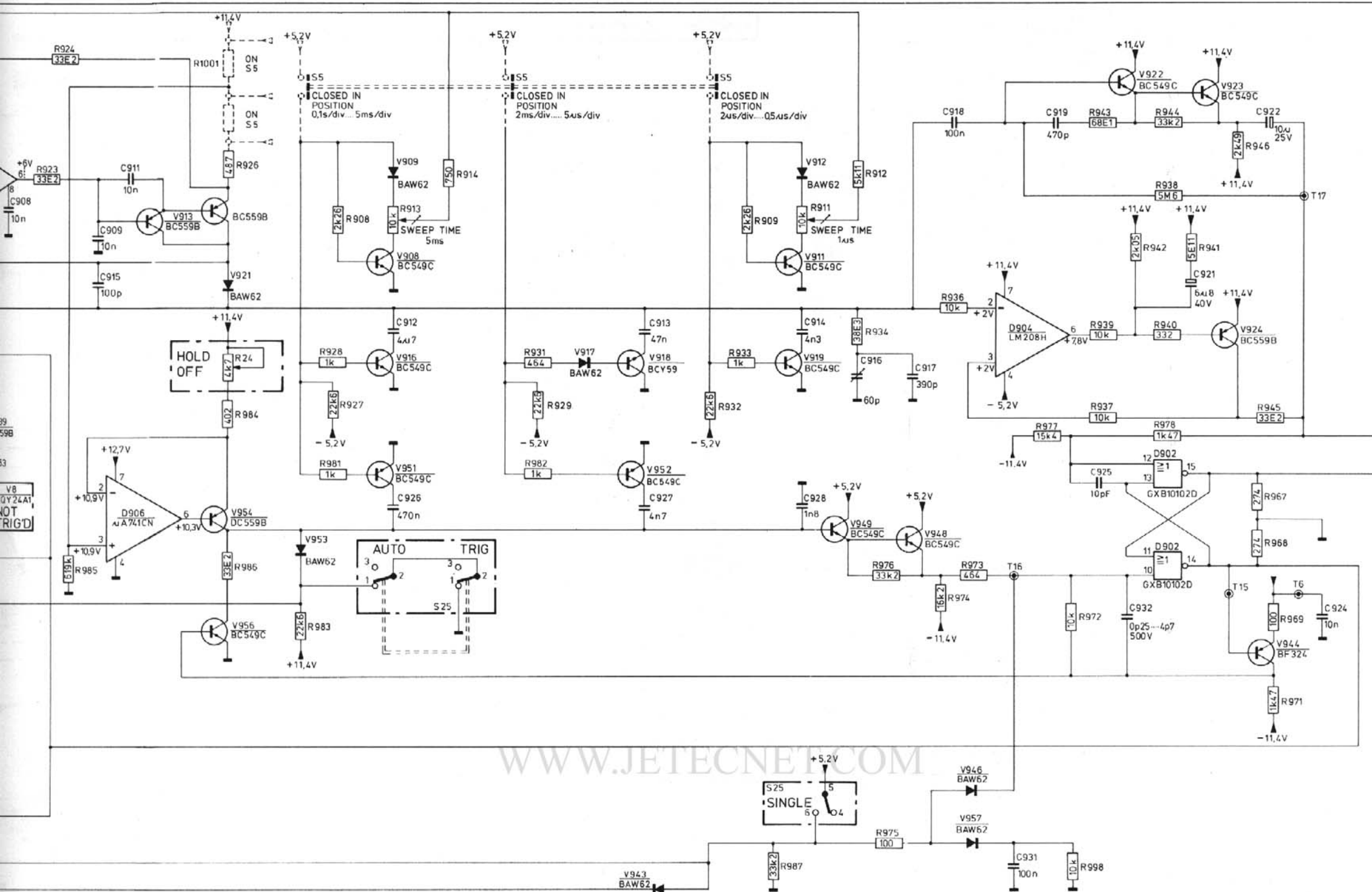
DELAY TIME DC
VOLTAGE FROM
R1371 ON TRIGGER
AMPLIFIER (UNIT 9)

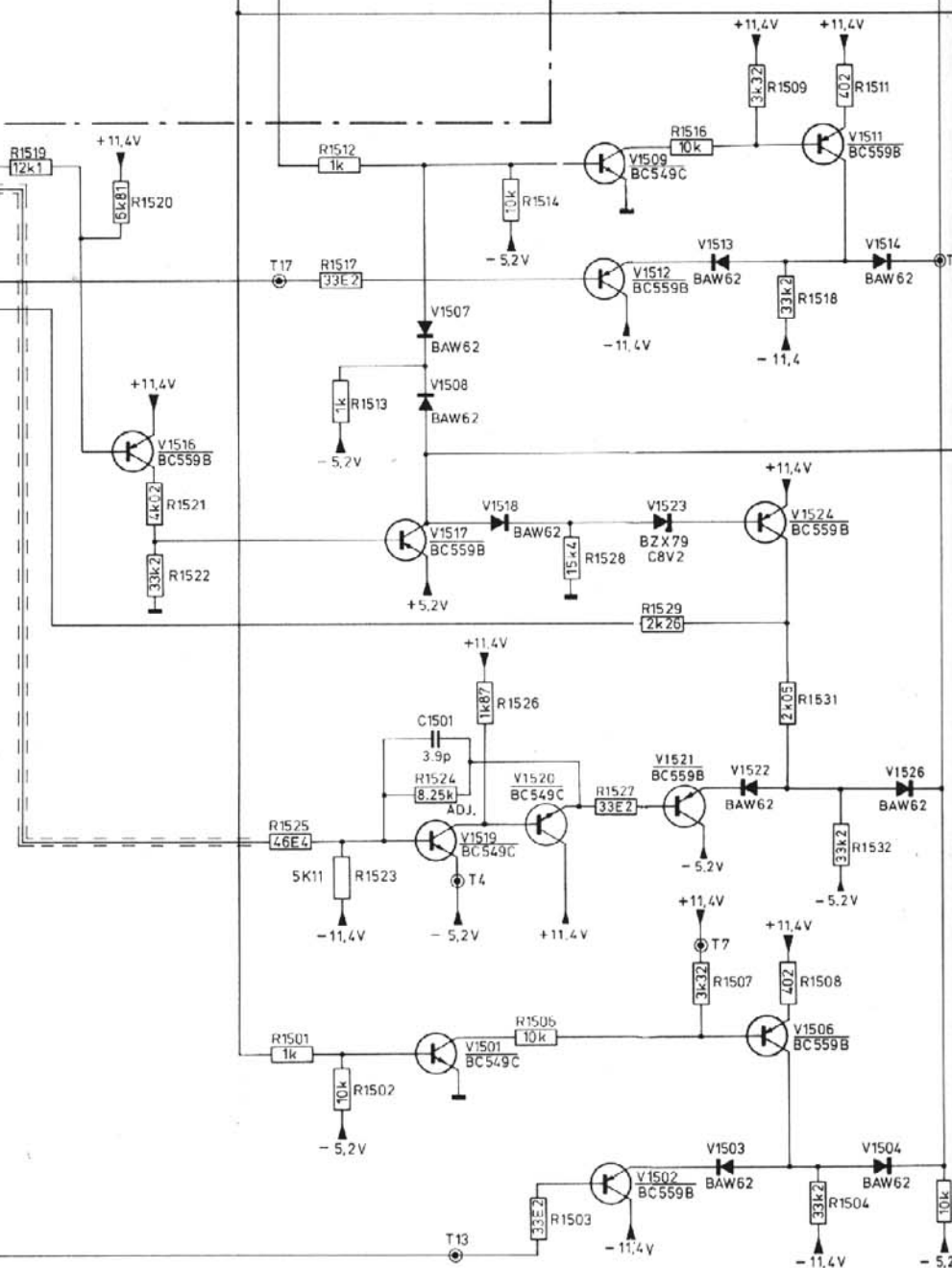
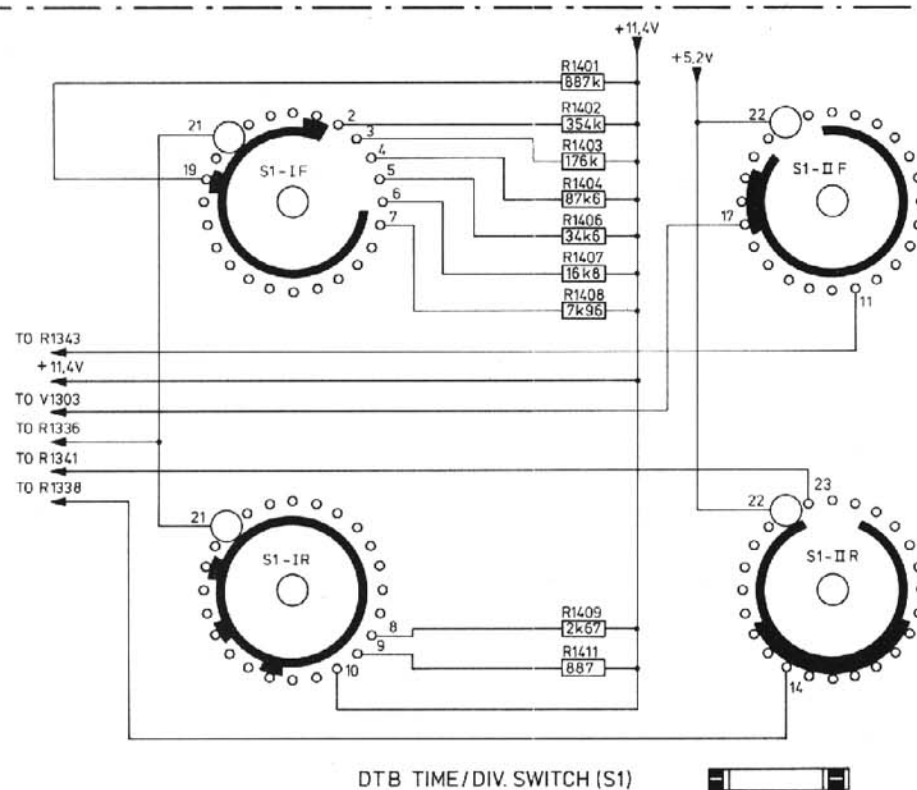
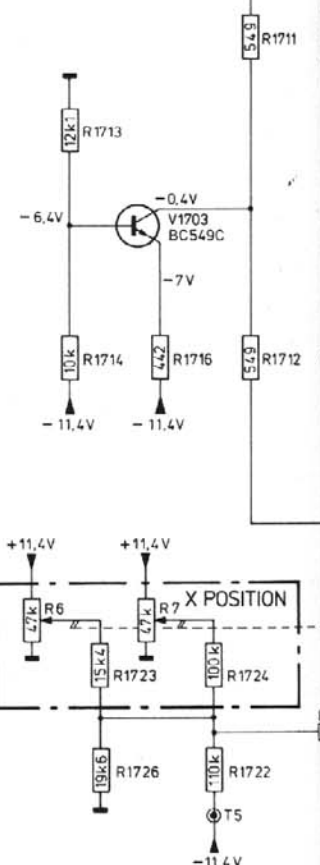
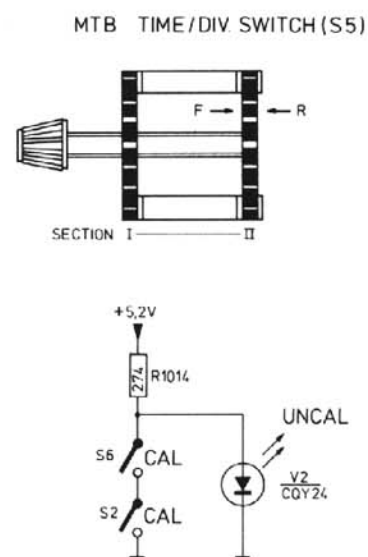


WWW.JETECNET.COM



TIME - BASE UNIT - UNIT 8





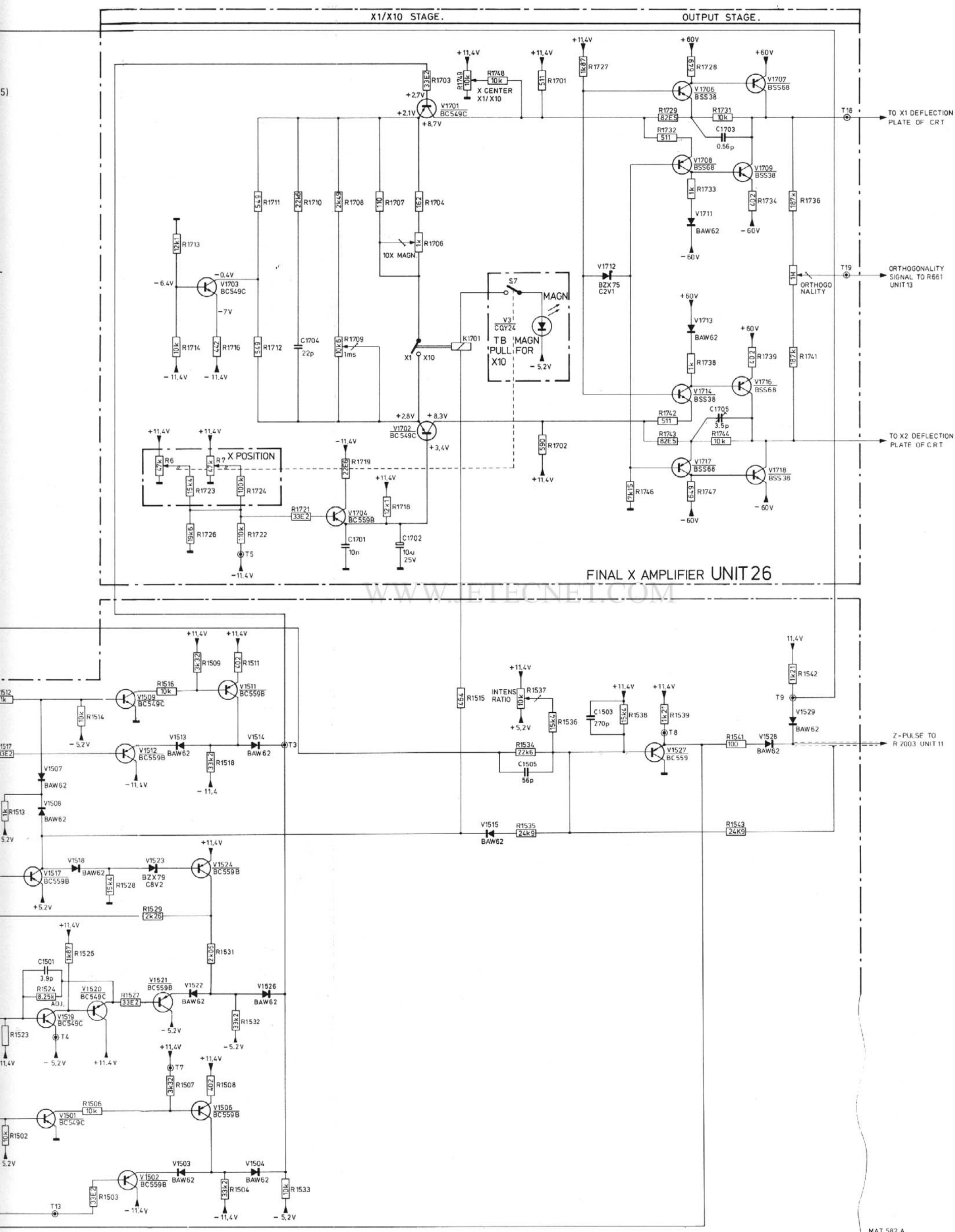


Fig. 8.14. Time base and final X-amplifier, circuit diagram

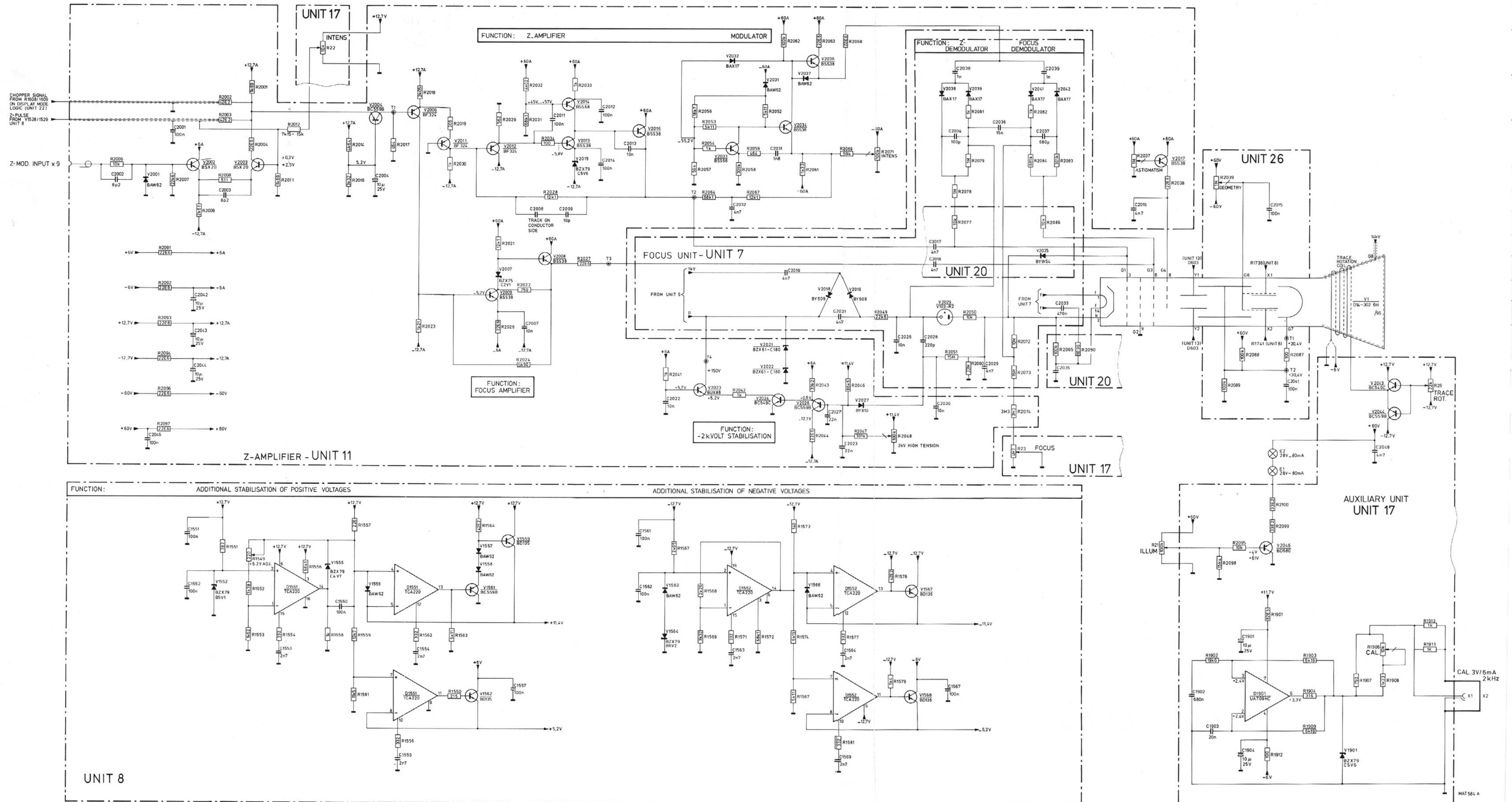


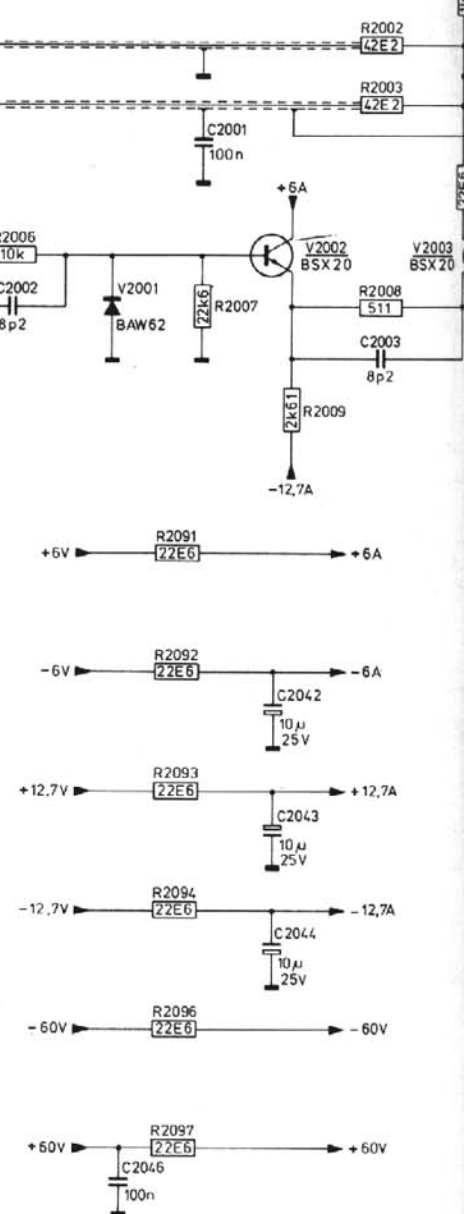
Fig. 8.17. Power supply, circuit diagram

WWW.JETECNET.COM

CHOPPER SIGNAL
FROM R1608/1609
ON DISPLAY MODE
LOGIC (UNIT 22)

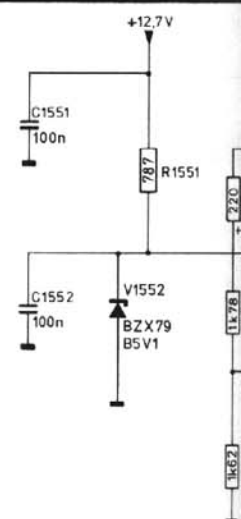
Z-PULSE
FROM V1528/1529
UNIT 8

Z-MOD. INPUT x 9



FUNCTION:

ADDITIONAL STABIL



UNIT 8

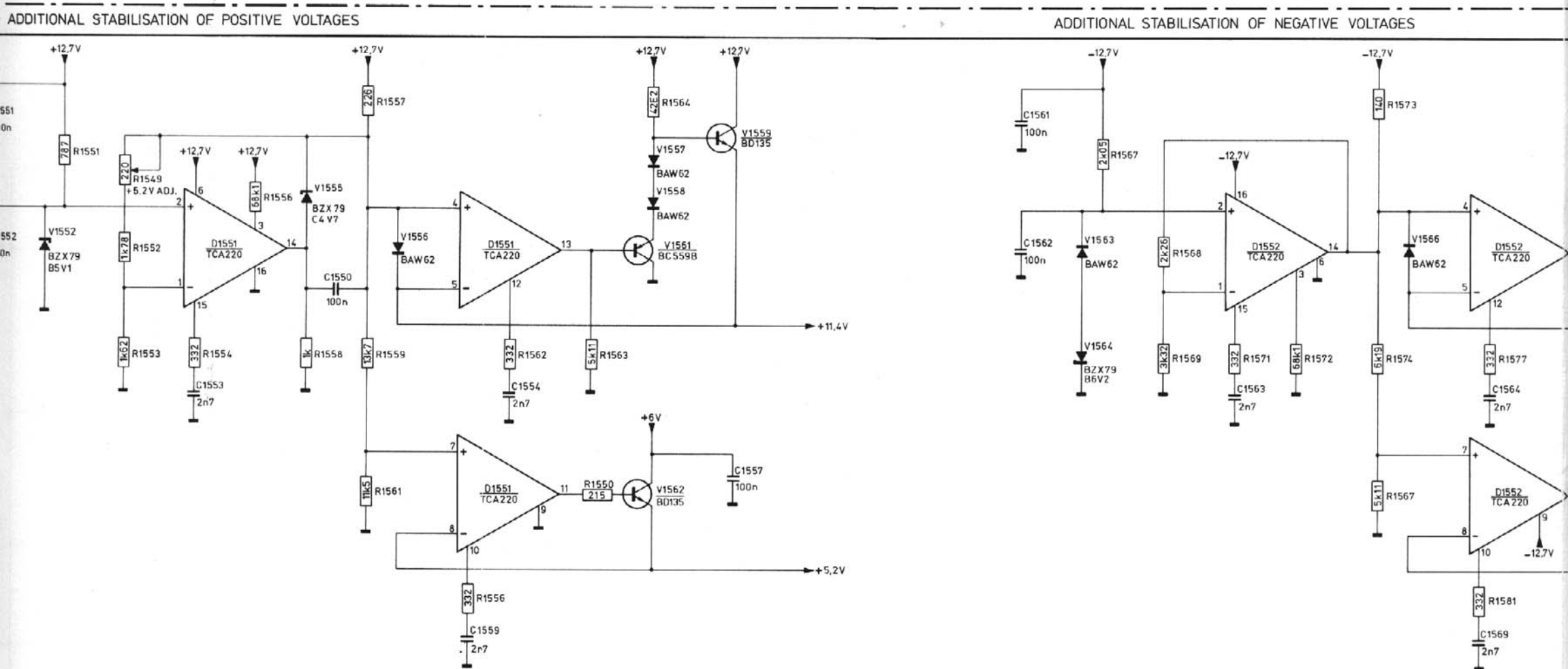
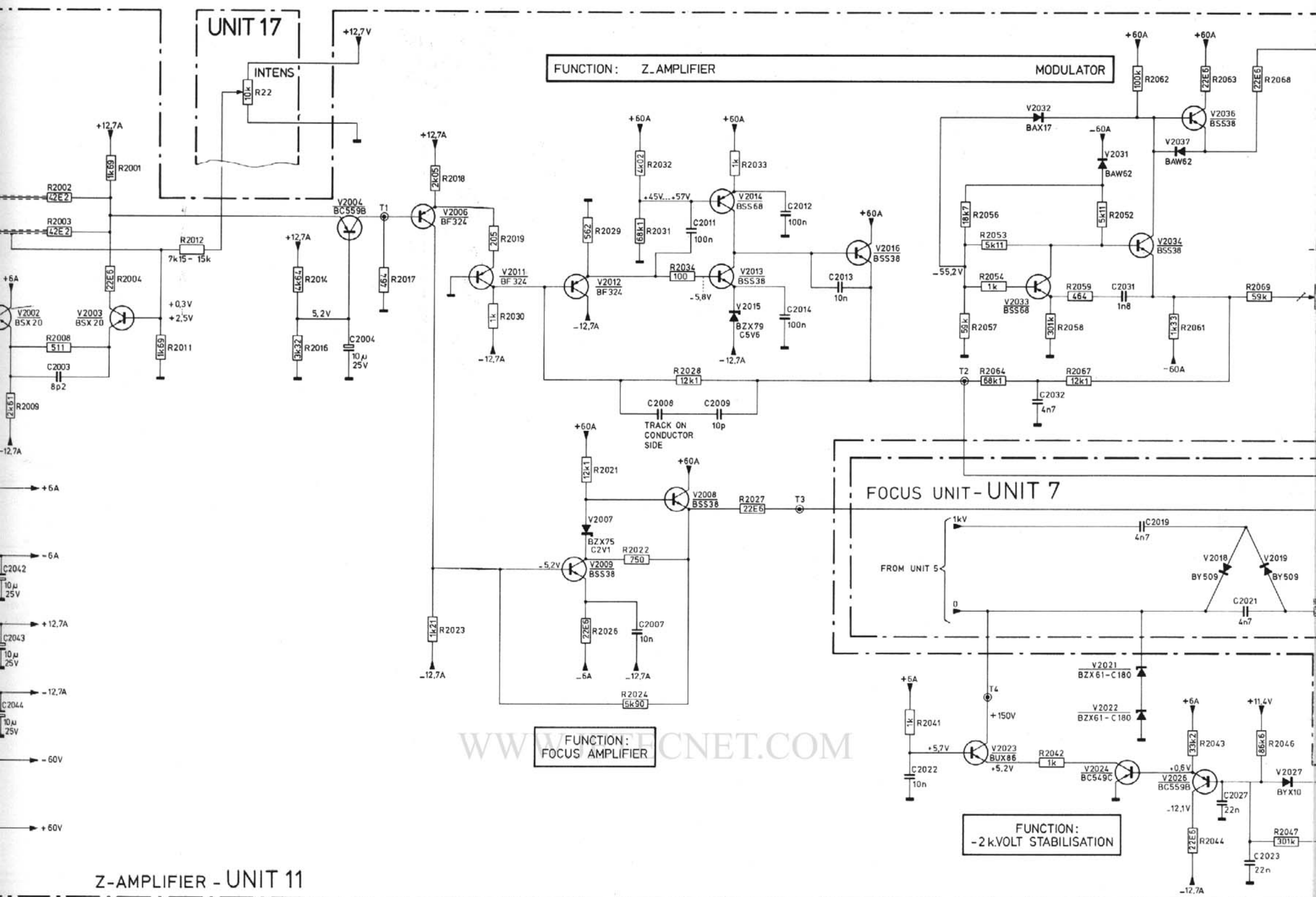
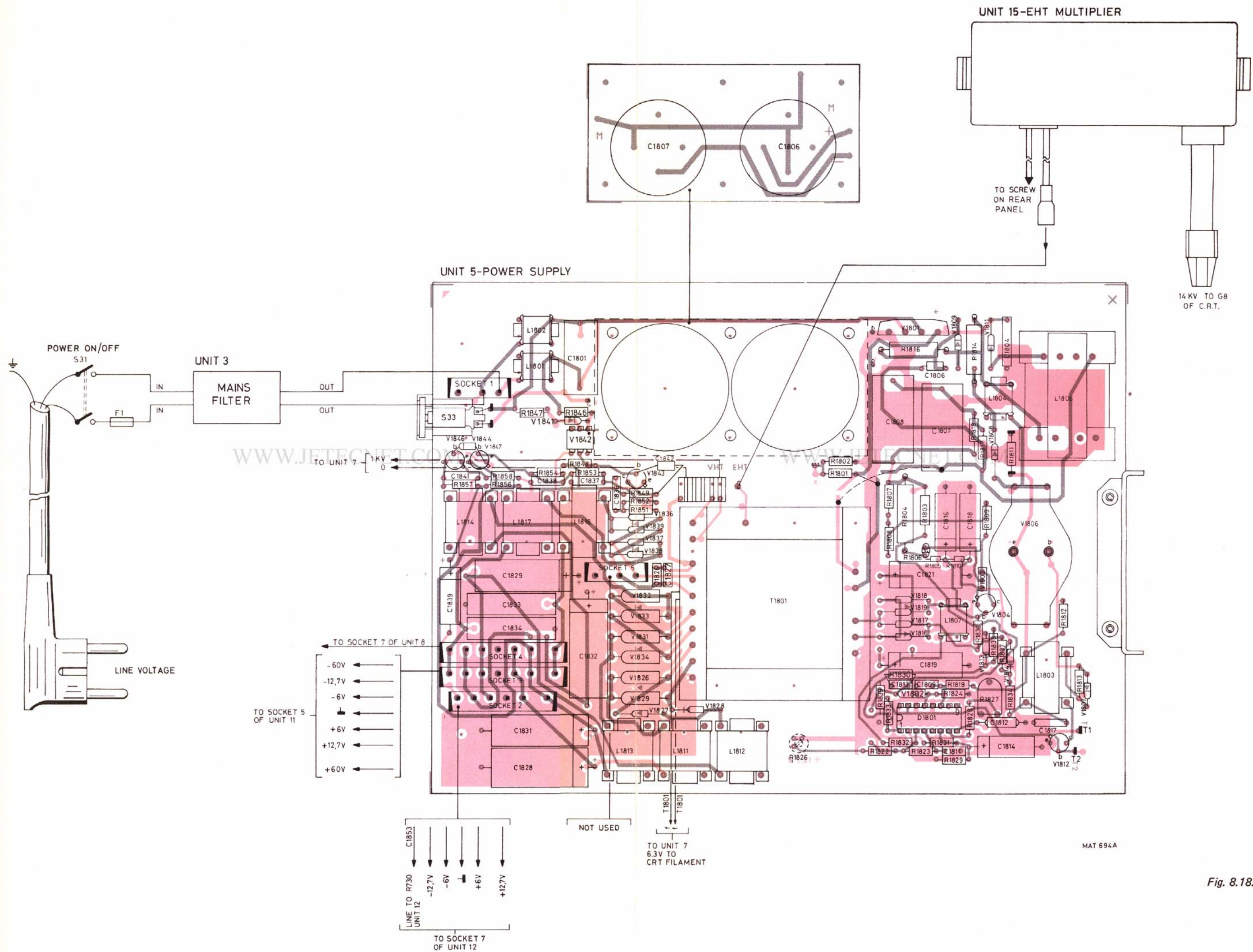
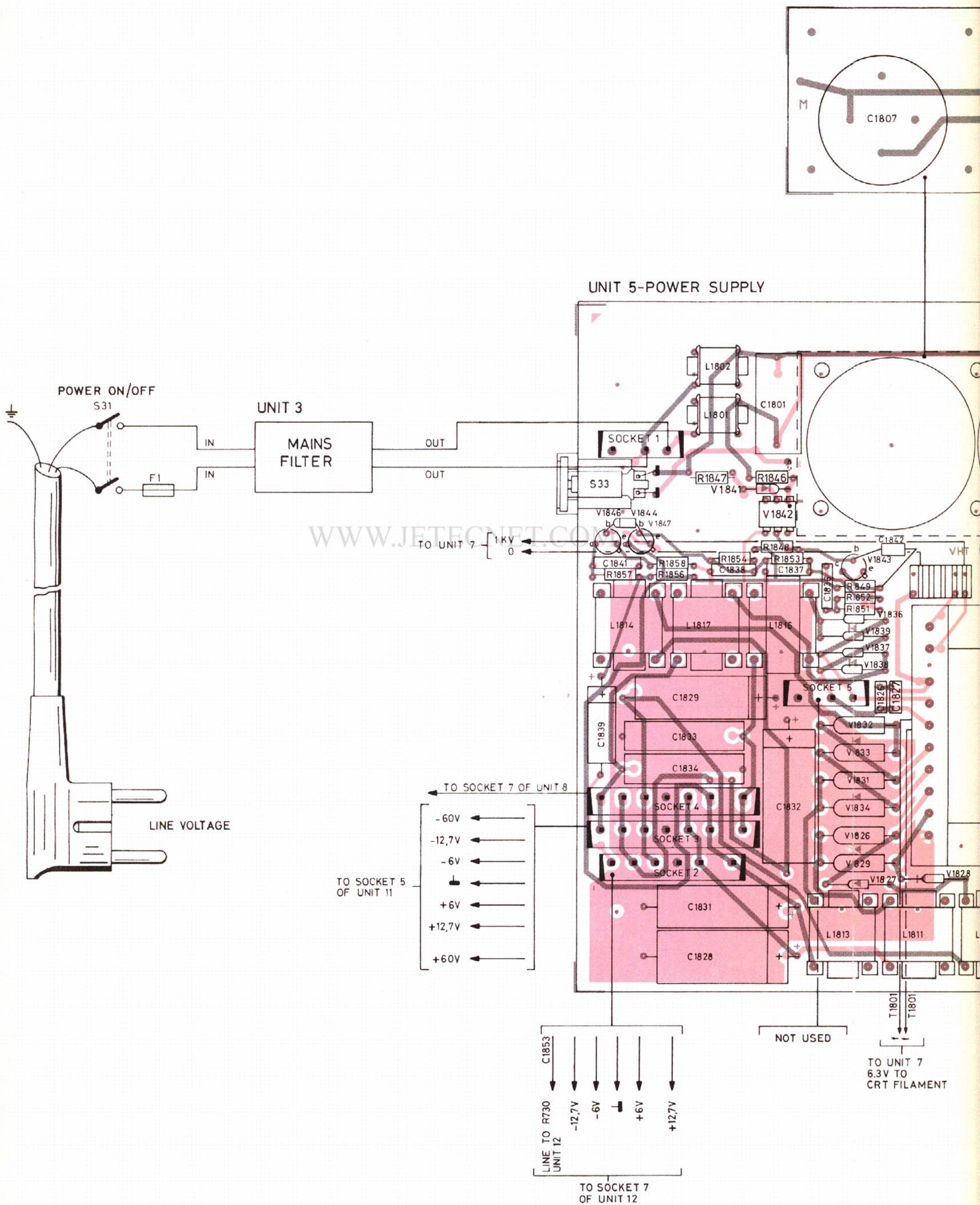




Fig. 8.17. Power supply, circuit diagram





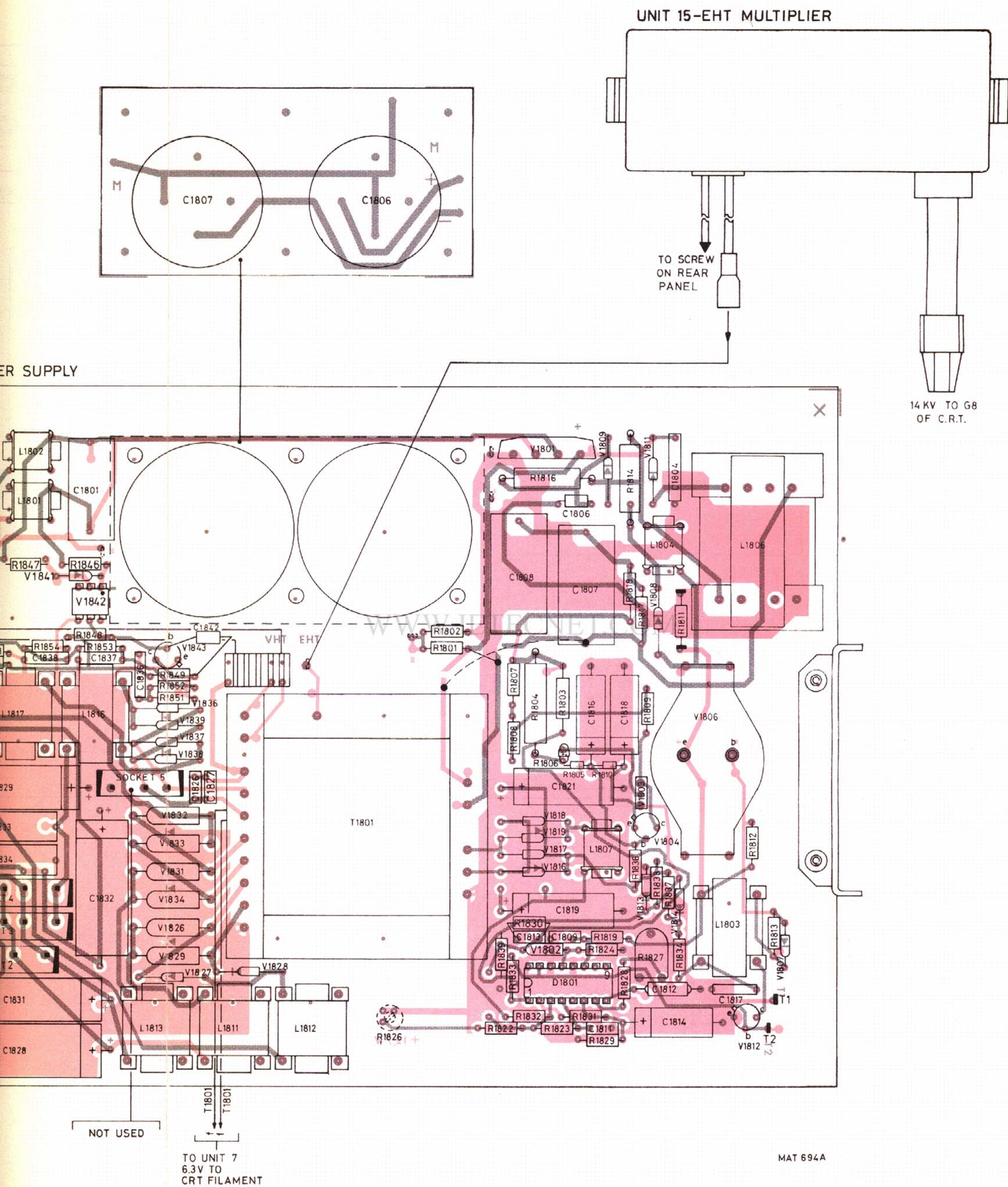
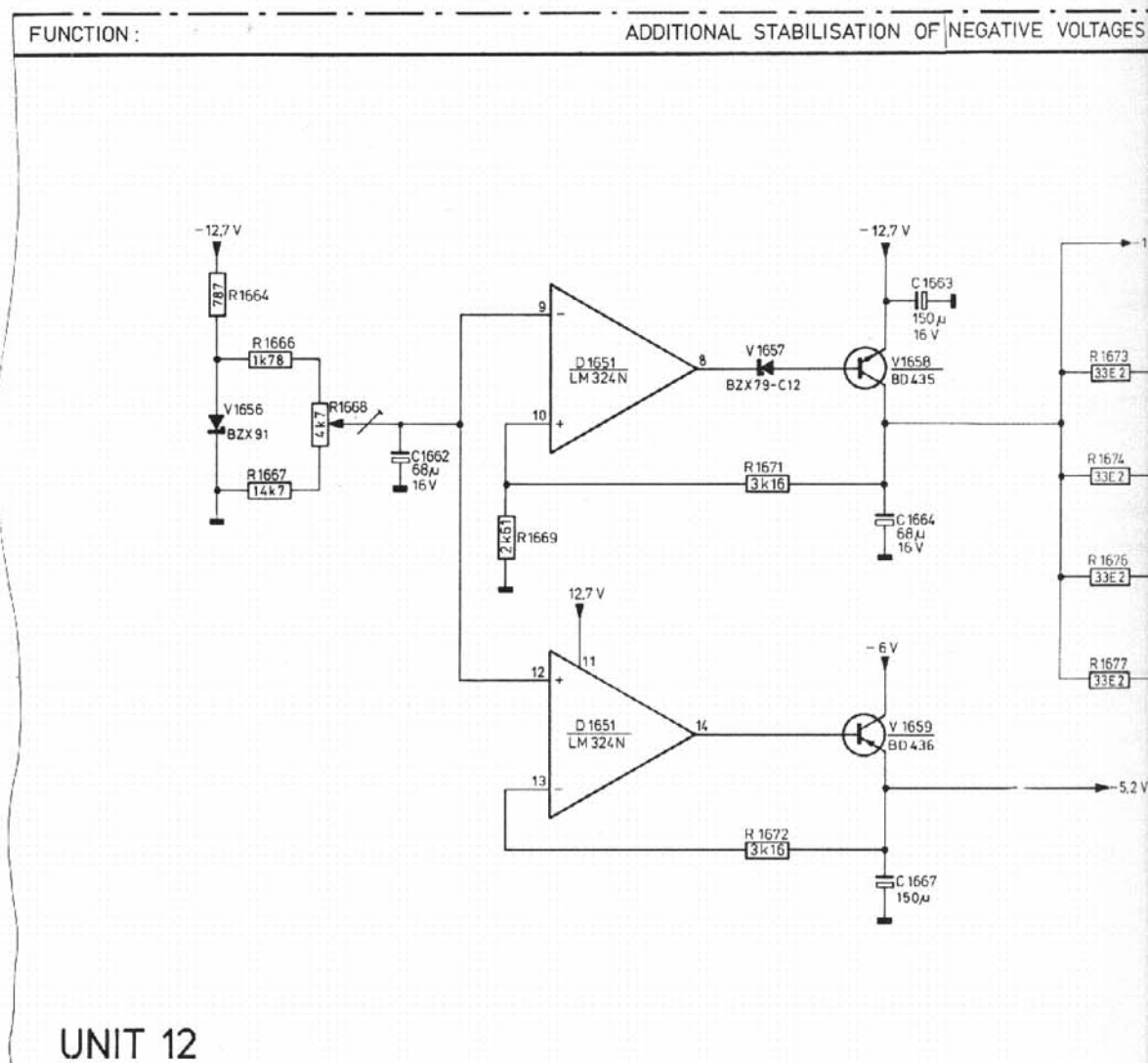
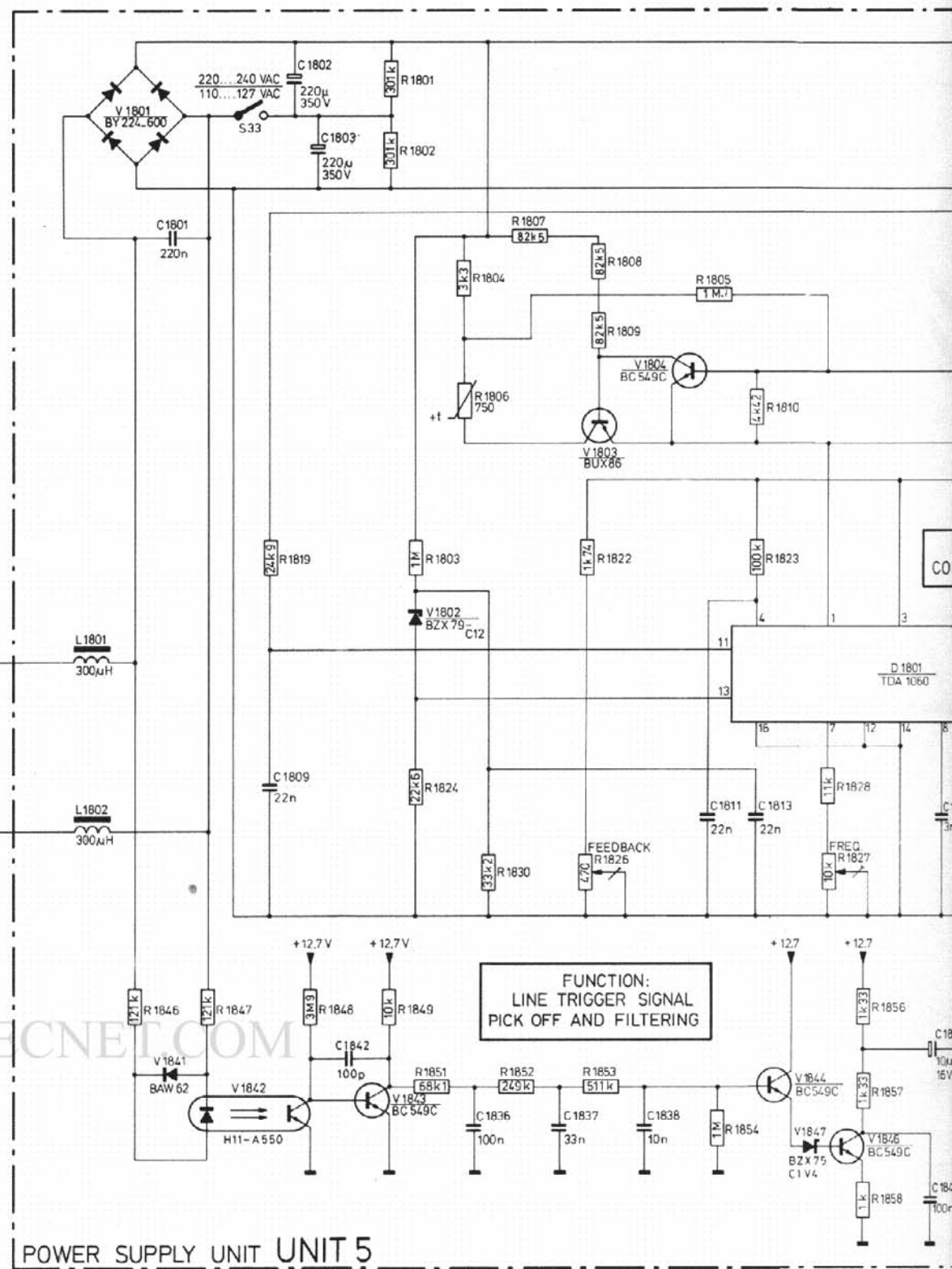
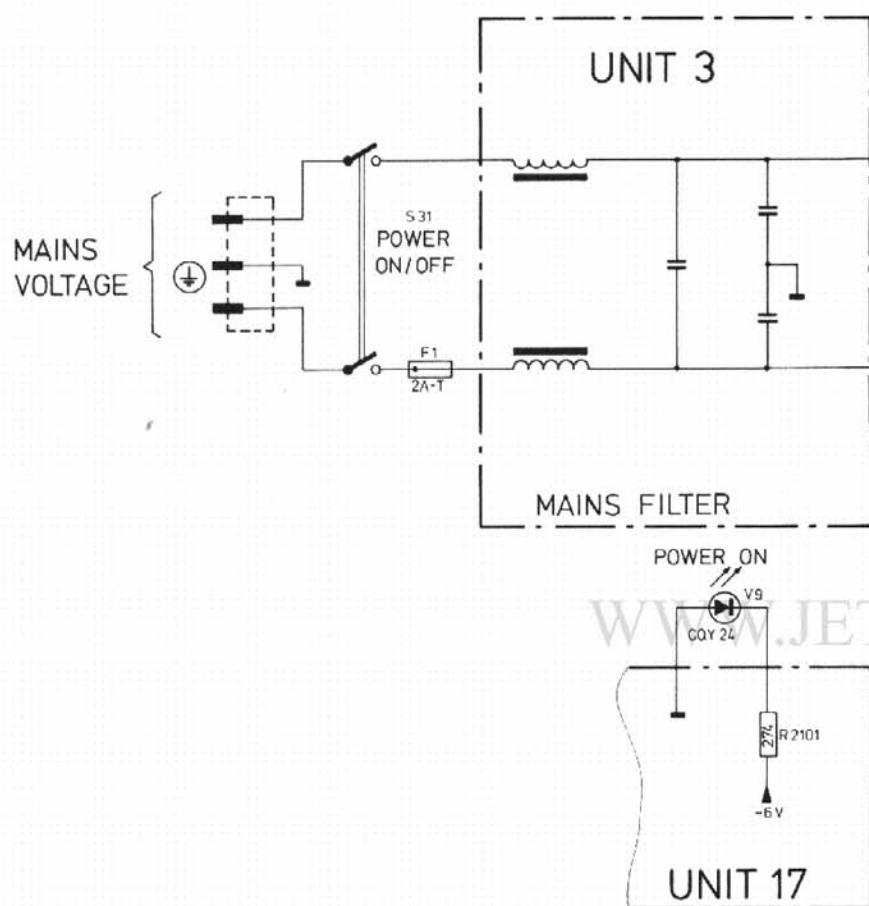


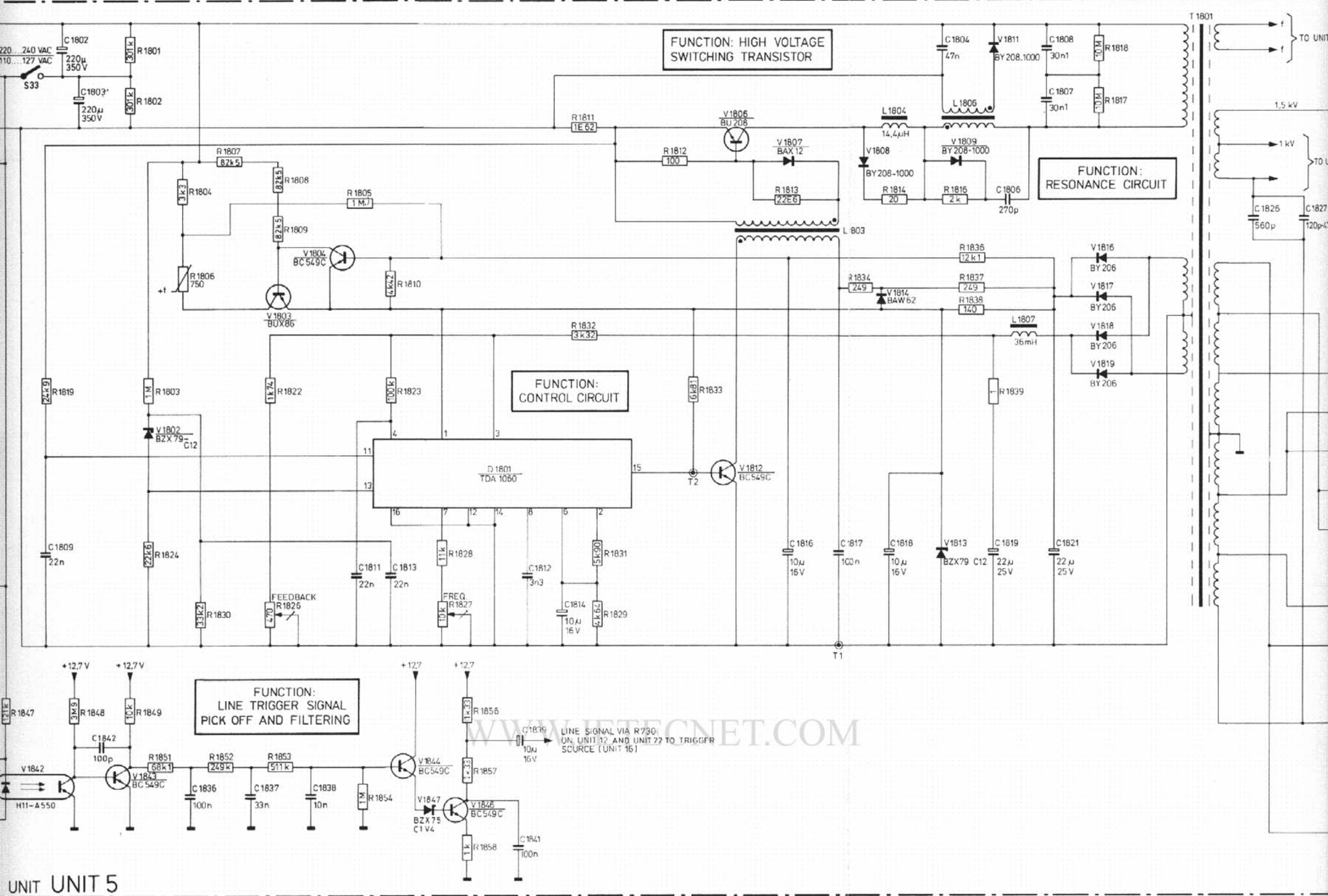
Fig. 8.18. Po



Fig. 8.19. Z-amplifier, focus unit and auxiliary unit, circuit diagram

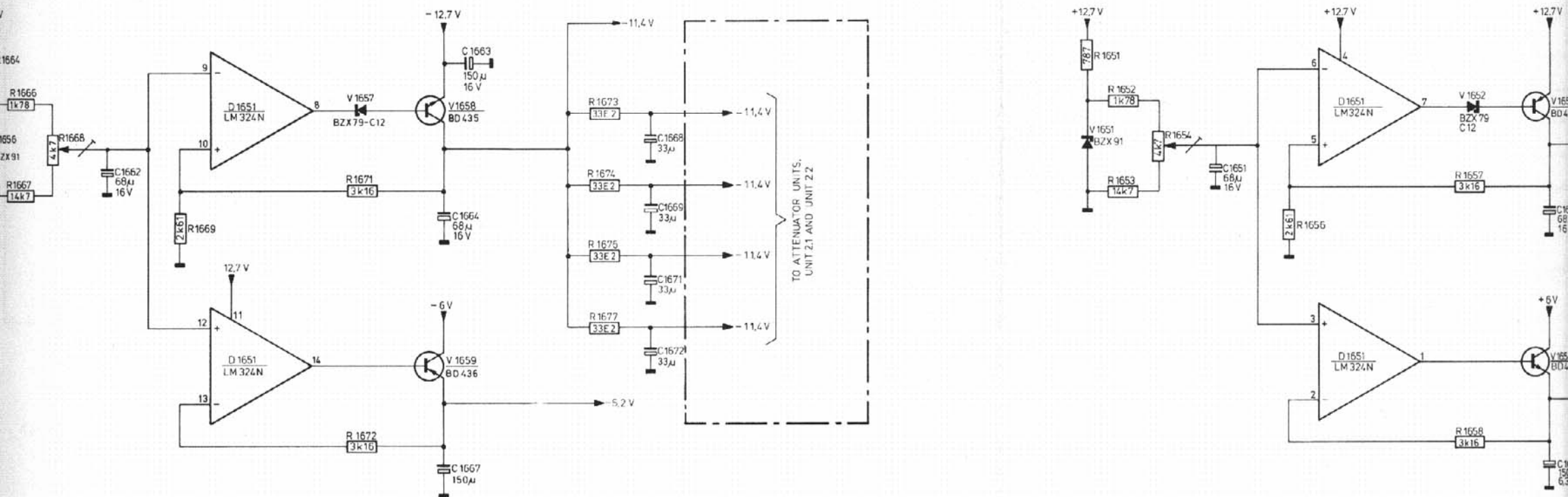


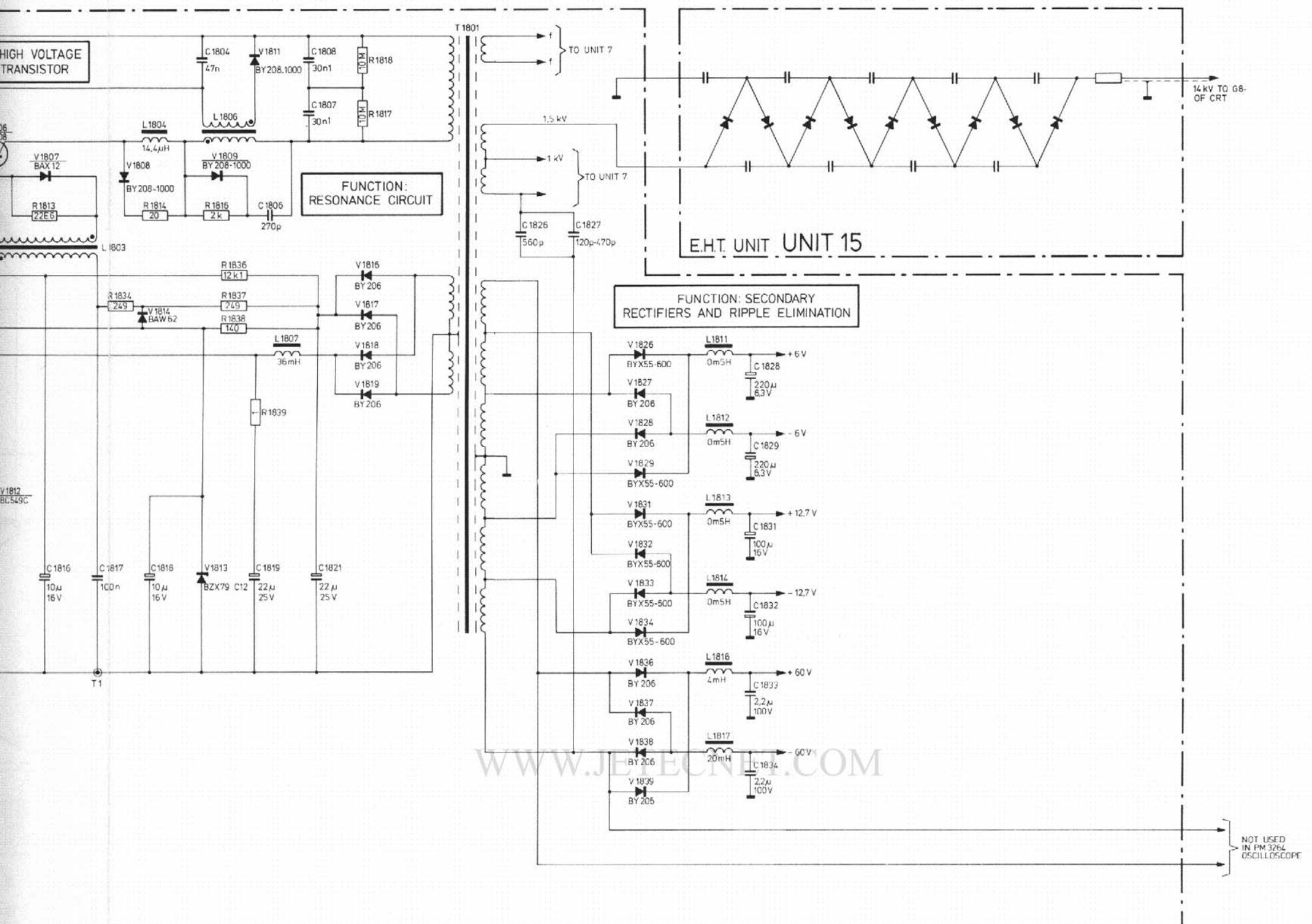
UNIT 12



ADDITIONAL STABILISATION OF NEGATIVE VOLTAGES

ADDITIONAL STABILISATION OF





ADDITIONAL STABILISATION OF POSITIVE VOLTAGES

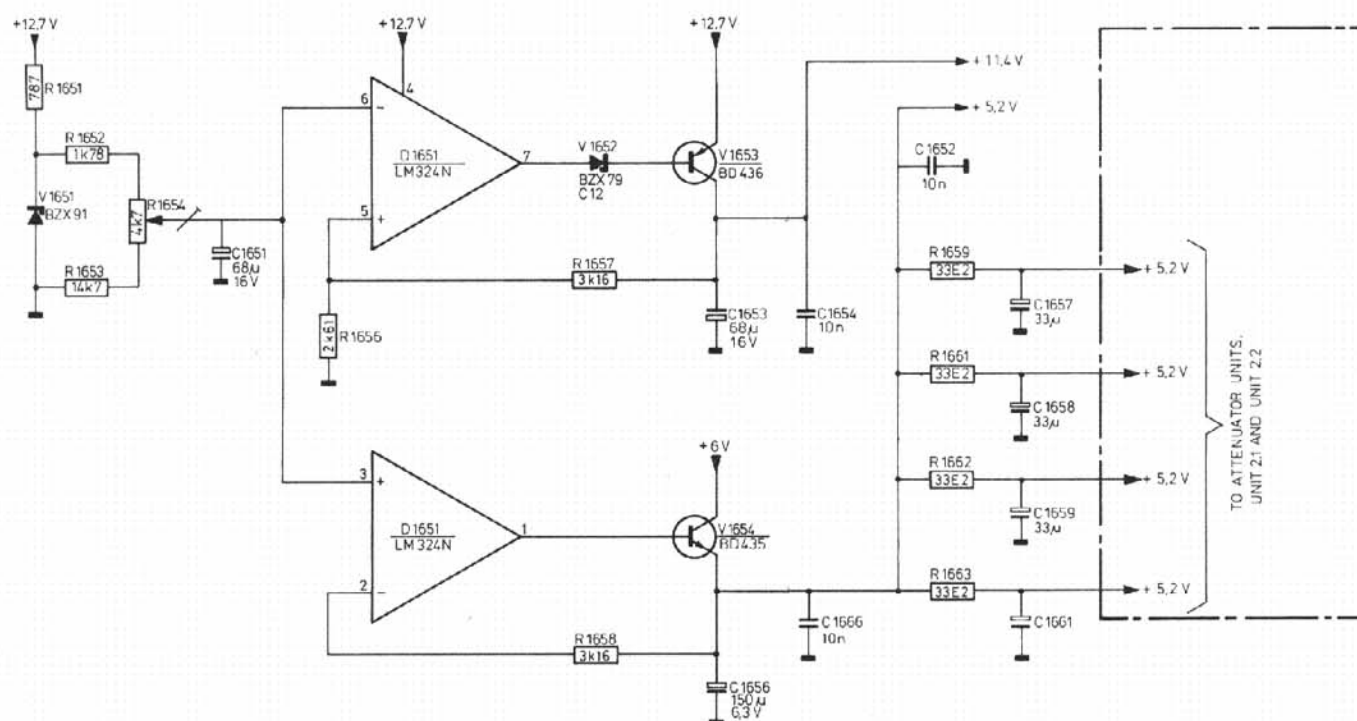


Fig. 8.19. Z-amplifier, focus unit and auxiliary unit, circuit diagram

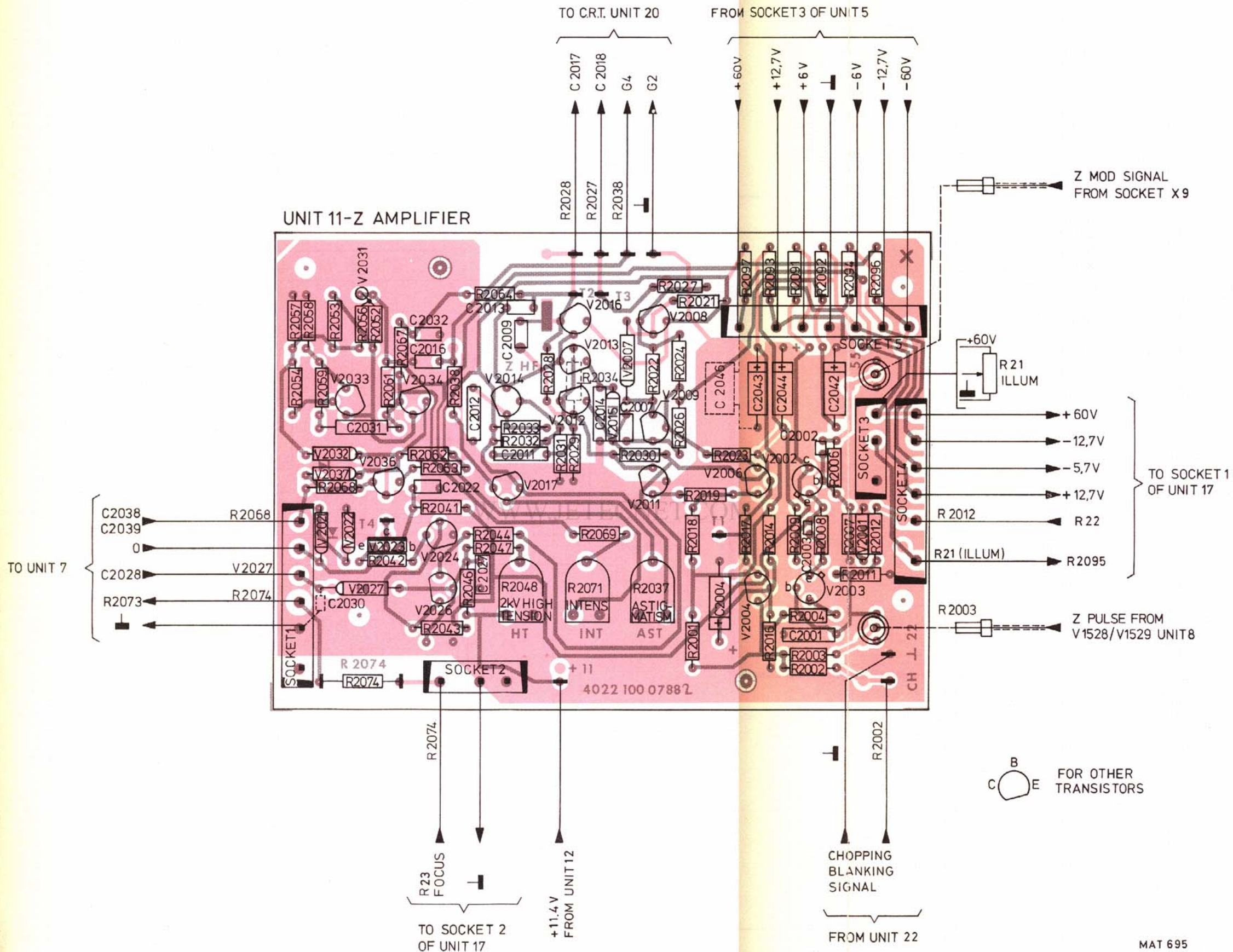


Fig. 8.20. *Z-amplifier, printed circuit board lay-out*

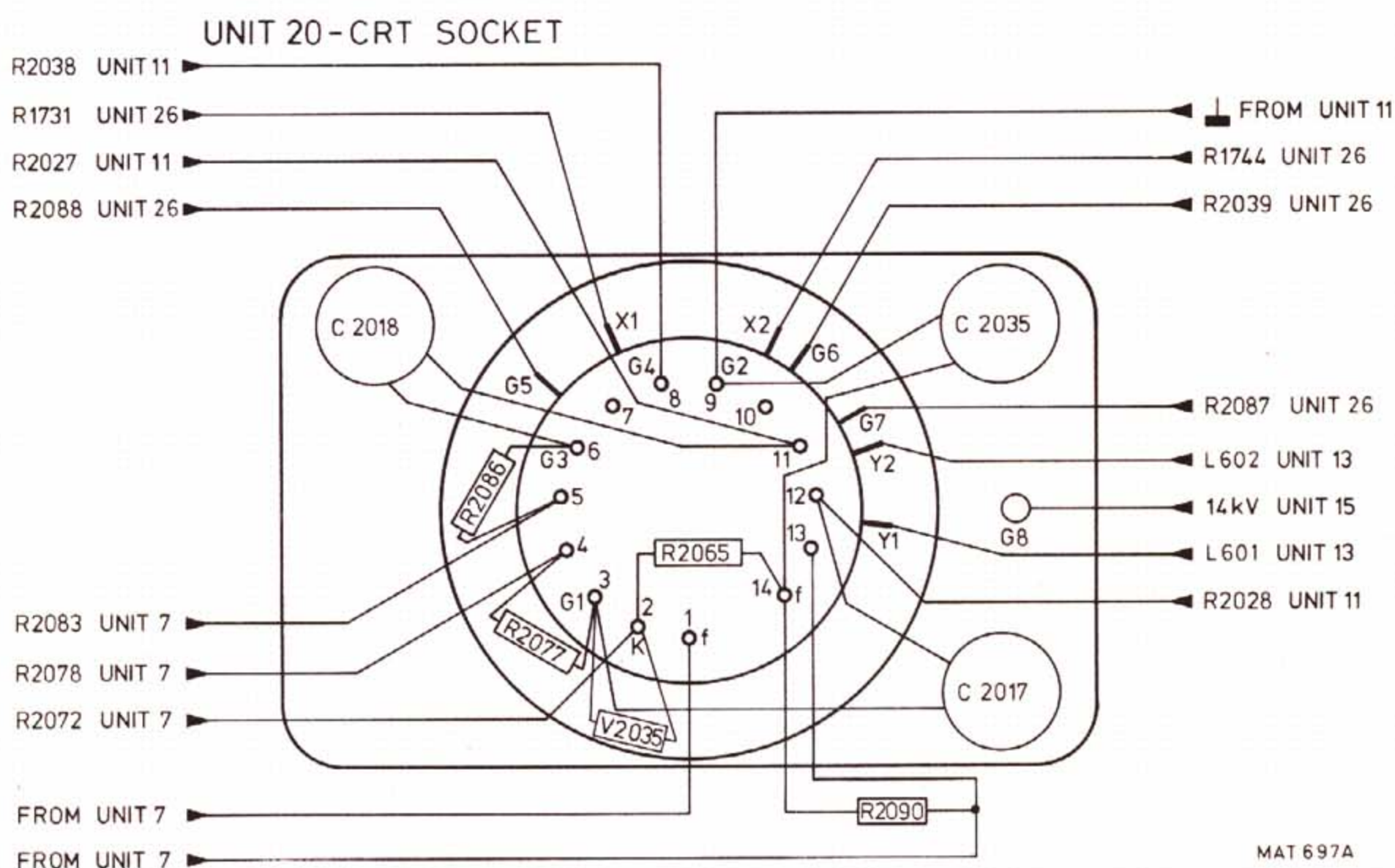


Fig. 8.22. CRT-socket, wiring lay-out

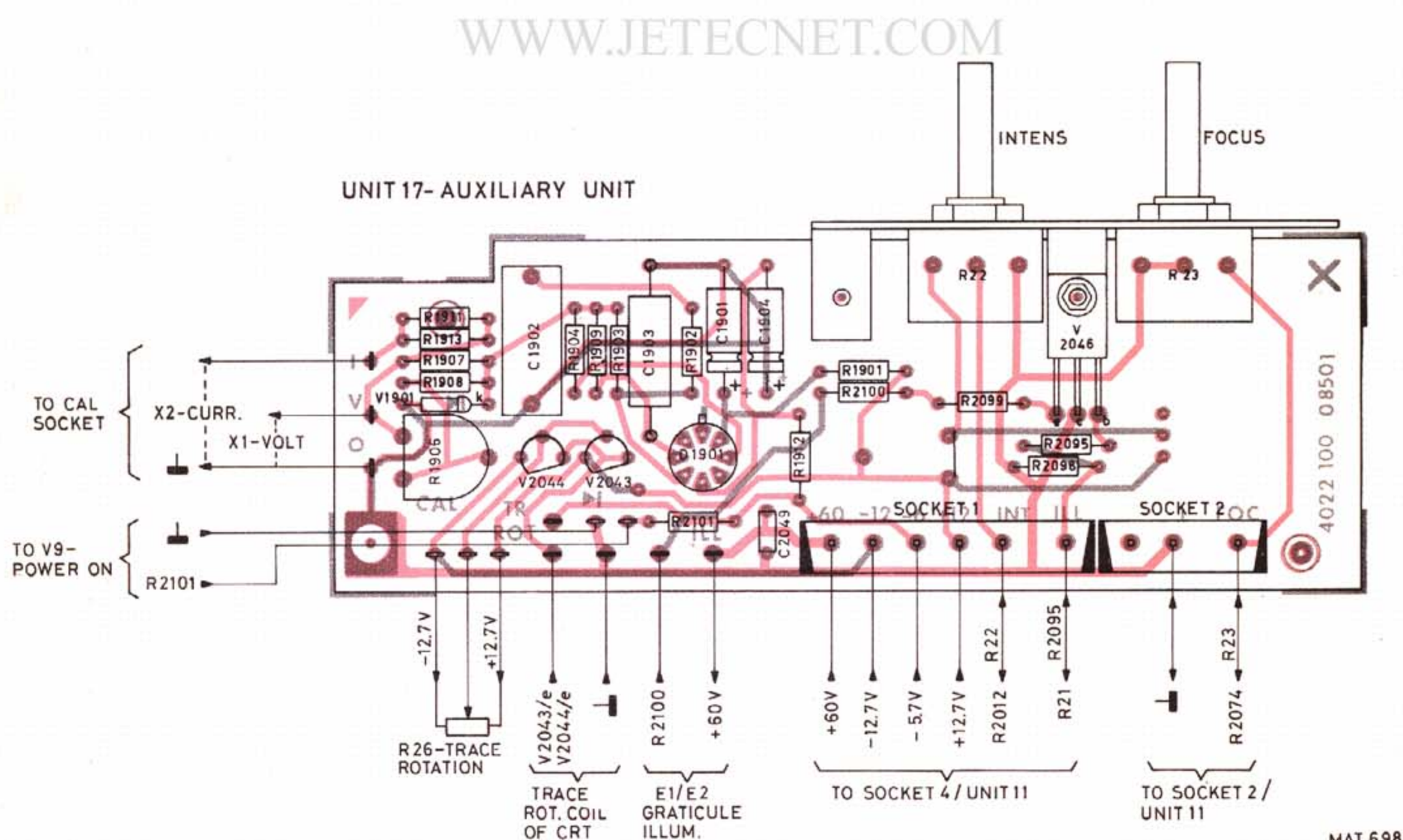


Fig. 8.23. Auxiliary unit, printed circuit board lay-out

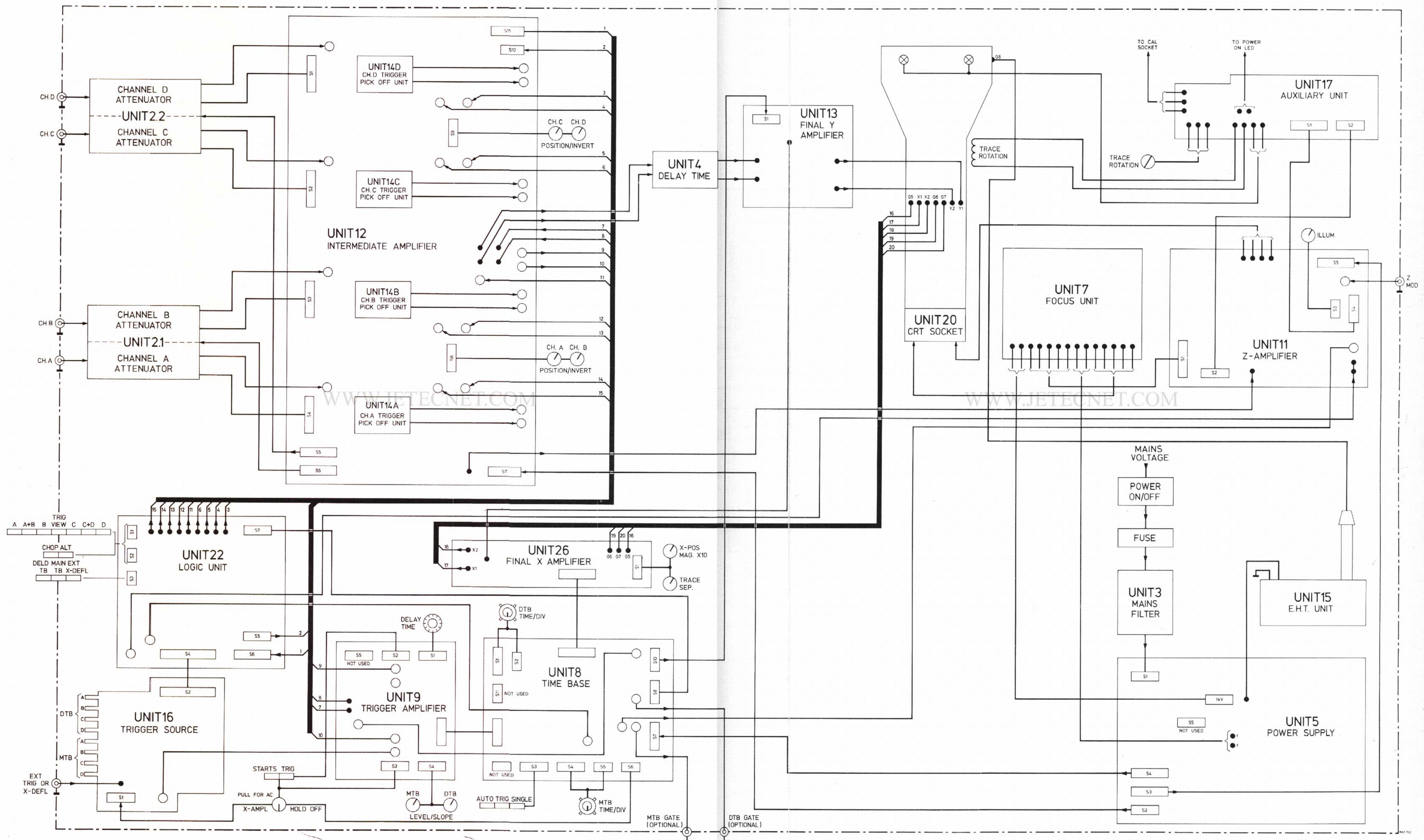
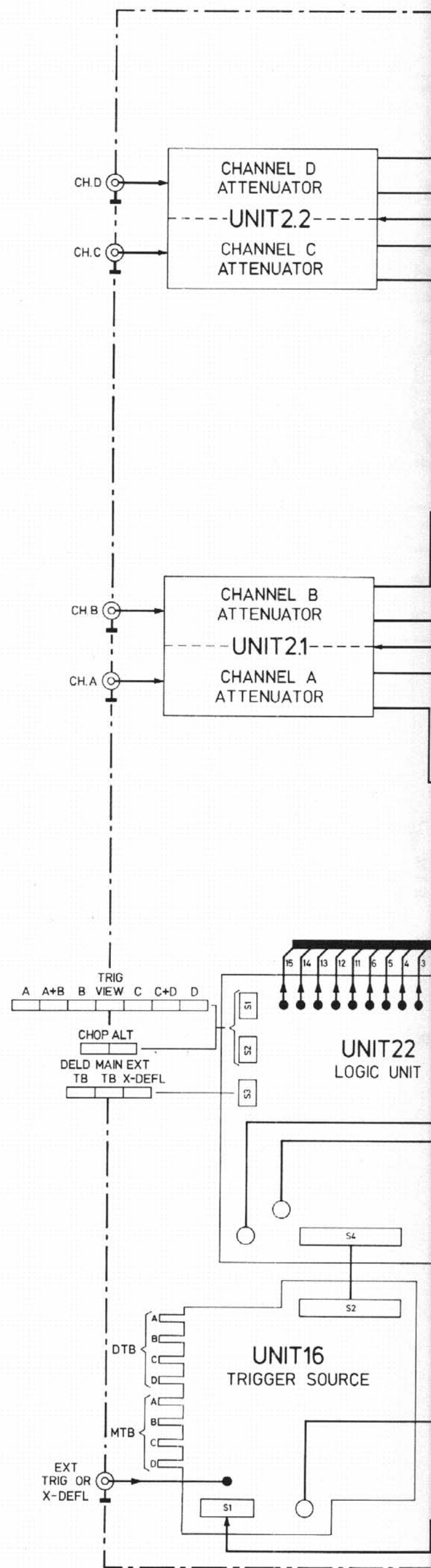
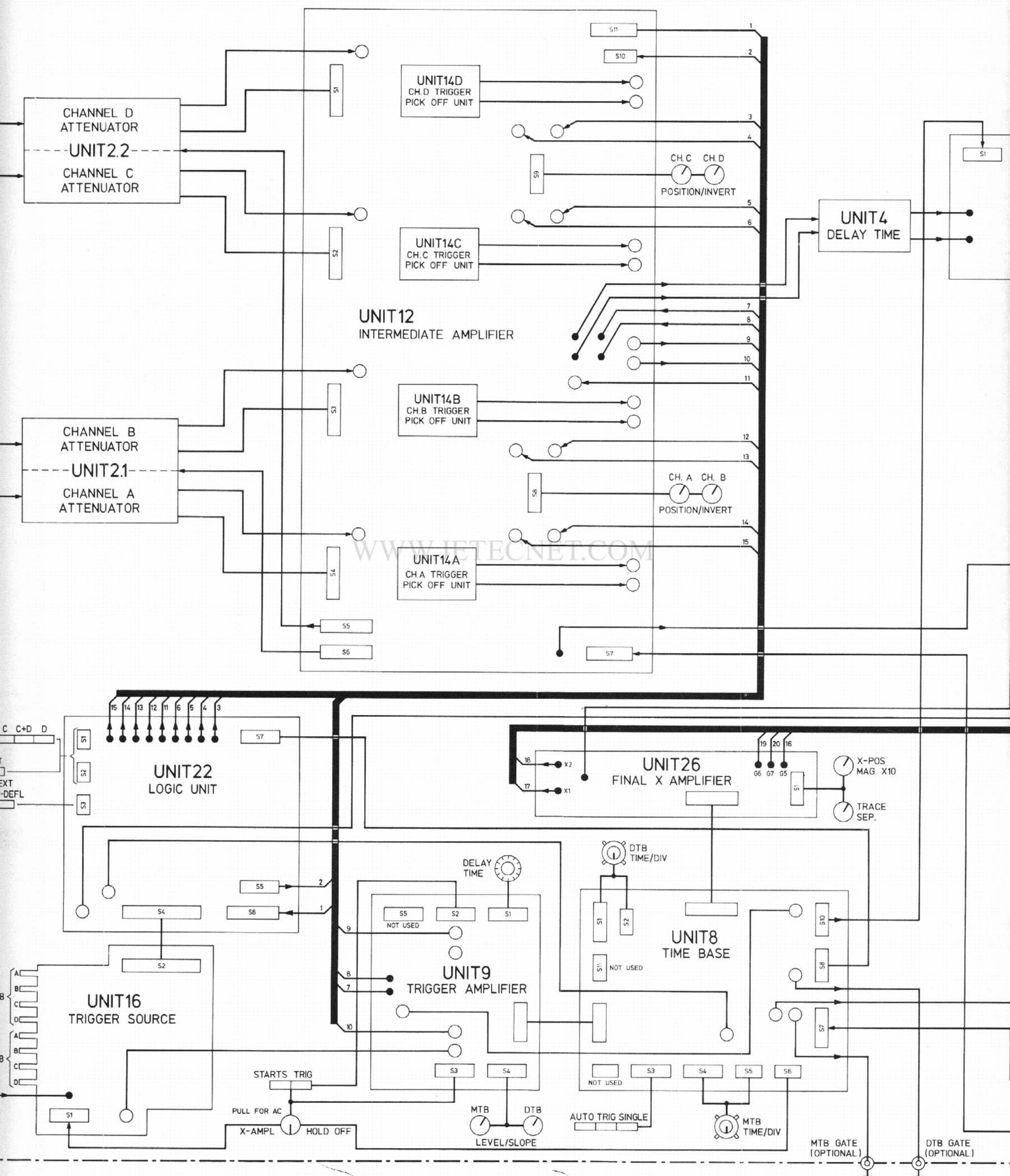


Fig. 8.24. Wiring lay-out of PM 3264

WWW.JETECNET.COM





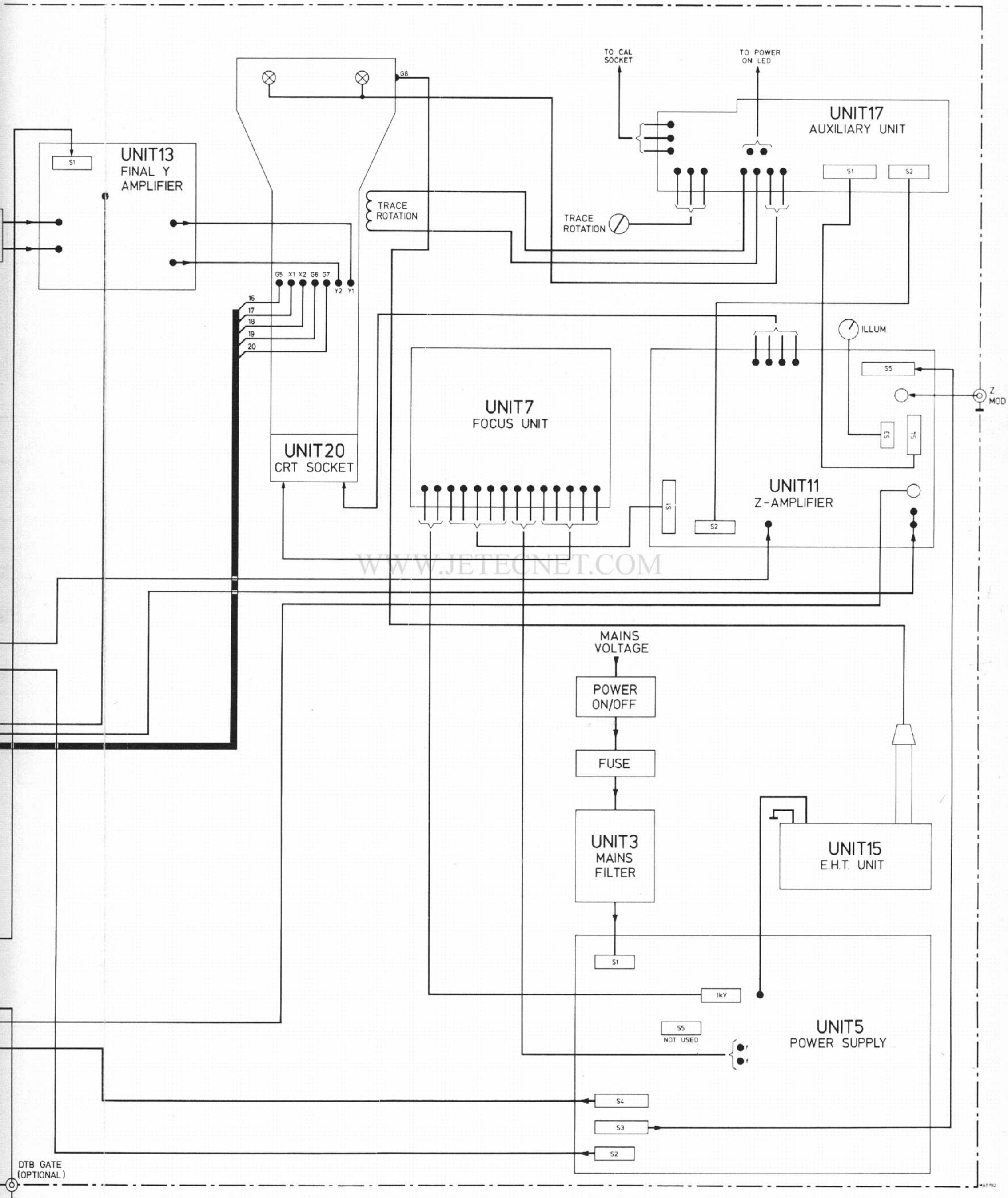


Fig. 8.24. Wiring lay-out of PM 3264