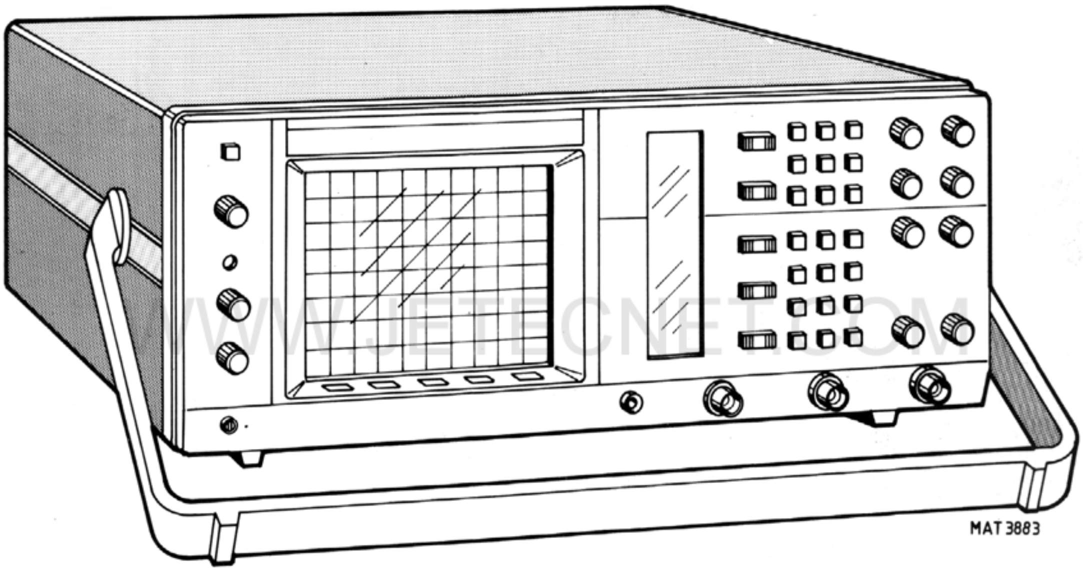
60MHz Digital Storage Oscilloscope
PM3335-PM3337

Service Manual

4822 872 05345
900910/2



Warning: These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock do <u>not</u> perform any servicing other then that specified in the Operating Instructions unless you are fully qualified to do so.

PHILIPS

PHILIPS

Table of Contents

16 CORRECTIVE MAINTENANCE

1 SAFETY INSTRUCTIONS

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

1.1 INTRODUCTION

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

1.2 SAFETY PRECAUTIONS

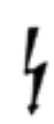
For the correct and safe use of this instrument it is essential that both operating and servicing personnel follow generally-accepted safety procedures in addition to the safety precautions specified in this manual.
Specific warning and caution statements, where they apply, will be found throughout the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

1.3 CAUTION AND WARNING STATEMENTS

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

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

1.4 SYMBOLS


High voltage ≥ 1000 V (red)


Live part (black/yellow)


Read the operating instructions


Static sensitive componnents (black/yellow)


Protective earth (grounding) terminal (black)

1.5 IMPAIRED SAFETY-PROTECTION

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

1.6 GENERAL CLAUSES

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 live.**

- The instrument shall be disconnected from all voltage sources before it is opened.
- Bear in mind that capacitors inside the instrument can hold their charge even if the instrument has been separated from all voltage sources.

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

- Components which are important for the safety of the instrument may only be renewed by components obtained through your local Philips organisation. (See also section 17).
- After repair and maintenance in the primary circuit, safety inspection and tests, as mentioned in section 17 have to be performed.

2 CHARACTERISTICS

A. Performance Characteristics

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

- This specification is valid after the instrument has warmed up for 30 minutes (reference temperature 23 °C).

- For definitions of terms, reference is made to IEC Publication 351-1.

B. Safety Characteristics

- This apparatus has been designed and tested in accordance with Safety Class I requirements of IEC Publication 348, Safety requirements for Electronic Measuring Apparatus, UL 1244 and CSA 556B and has been supplied in a safe condition.

C. Initial Characteristics

- Overall dimensions:

- Width

Including handle	: 387 mm
Excluding handle	: 350 mm

- Length

Including handle	: 518,5 mm
Excluding handle, excl. knobs	: 443,5 mm
Excluding handle, incl. knobs	: 455,5 mm

- Height

Including feet	: 146,5 mm
Excluding feet	: 134,5 mm
Excl. under-cabinet	: 132,5 mm

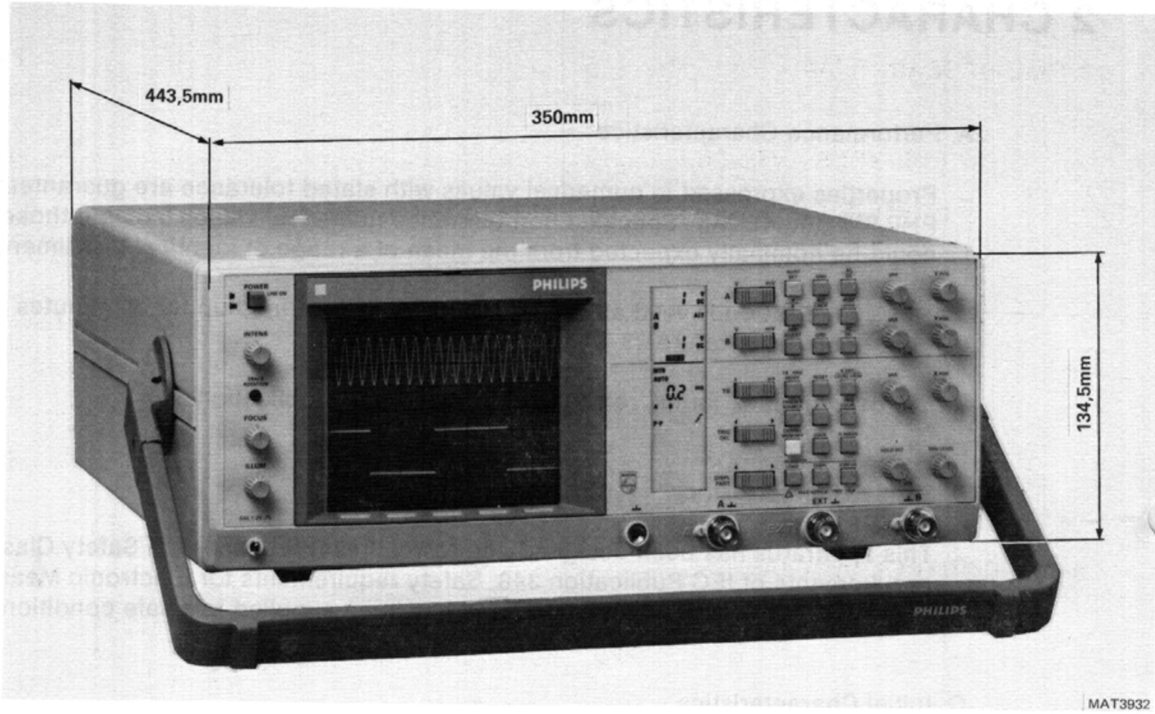


Figure 2.1 Dimensions of oscilloscope PM3335.

* Mass : 8,5 kg

* Operating positions:

a. Horizontally on bottom feet
b. Vertically on rear feet
c. On the carrying handle in two sloping positions.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.1 DISPLAY

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
– CRT		
Type No	PHILIPS D 14-372	
Measuring area (h x w)	80 x 100 mm	8 x 10 div. 1 div. = 10 mm 1 subdiv. (sd) = 2 mm
– Screen type		
Standard	GH (P 31)	Standard persistence (7 ms)
Option	GM (P 7)	Long persistence (30 ms)
– Total acceleration voltage	16 kV	
– Graticule:		
Engravings	Internal fixed	
Divisions lines	1 cm	Horizontal as well as vertical
Subdivisions	2 mm	Horizontal as well as vertical
Dotted lines	1,5 and 6,5 cm from top	Only horizontal.
Percentages	0%, 10%, 90%, 100%	Left side of screen
– Orthogonality	90° +/- 1°	Measured in zero point.
– Illumination	Continuously variable	By means of potentiometer.

2.2 VERTICAL DEFLECTION OR Y AXIS

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
– Auto set	Automatic setting according to input signal	
– Deflection modes and sources	Channel A and/or B or ADDED (A + B, A – B)	Channel B can be inverted. All combinations are possible in ALTERNATE as well as in CHOP mode
– Deflection coefficients	2 mV/div...10 V/div	In 1, 2, 5 sequence. If probe with range indicator is used, deflection coeff. is automatically calculated in display.
– Variable gain control range	1 : > 2,5	
– Error limit	+/- 3%	Only in calibrated position.
– Input impedance	1 M Ω +/- 2%	Measured below 1 MHz
Paralleled by	20 pF +/- 2pF	Measured below 1 MHz

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
– Max. input voltage	400 V (d.c. + a.c. peak)	
Max. test voltage (rms)	500 V	Max. duration 60 s.
– Bandwidth for 20 mV...10 V	> 60 MHz (-3dB, amb. 15..35 °C)	Input 6 div. sine-wave. Deviation max. 5 MHz for ambient 0 ... 50 °C
– Bandwidth for 2 mV, 5 mV and 10 mV	> 35 MHz	Input 6 div. sine-wave.
– Rise-time	Calculated from 0,35/f-3 dB	
– Noise 20 mV...10 V	< 0,5 sd	Measured visually. Pick up on open BNC excluded.
– Lower - 3 dB point	< 10 Hz	In AC position, 6 div. sine-wave
– Dynamic range		
at 1 MHz	+/- 12 div.	Vernier in CAL position.
at 50 MHz	> 8 div.	Vernier in CAL position.
– Position range	> +/- 8 div.	Vernier in CAL position.
– Cross talk between channels		Both channels same attenuator setting. Input max. 8 div. sine-wave.
at 10 MHz	1 : > 100	2,5 and 10 V are excluded.
at 50 MHz	1 : > 50	2,5 and 10 V are excluded.
– Common Mode Rejection Ratio at 1 MHz	1 : >100	Both channels same attenuator setting, vernier adjusted for best CMRR; measured with max. 8 div. (+/- 4 div.) each channel.
– Visible signal delay	> 15 ns	Max. intensity, measured from line start to trigger point.
– Base-line jump: between attenuator steps 20 mV...10 V	< 1 sd	
Additional jump between 10 mV <---> 20 mV	< 1,5 sd	
Normal Invert jump	< 1 sd	Only channel B.
ADD jump	< 0,6 div.	When A and B are positioned in screen centre (20 mV...10 V).
Variable jump	< 1 sd	Max. jump in any two positions of the VARiable control

2.3 HORIZONTAL DEFLECTION OR X AXIS

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.3.1 Time Base		
– Time coeff.	0,5 s... 50 ns	1, 2, 5 sequence (magn.off)
Error limit	+/- 3 %	Measured at -4... +4 div. from screen centre.
– Horizontal position range	Start of sweep and 10th div. must be shifted over screen centre	
– Variable control ratio	1 : > 2,5	
– Time Base magnifier	Expansion x10	Not valid in X-deflection.
Error limit	+/- 4 %	Measured at +4...-4 div. from screen centre. Excluding first 50 ns and last 50 ns.
– Horizontal magnifier balance x10 --- > x1	< 2,5 sd	Shift start of sweep in x10 in mid-screen position, then switch to x1.
– Hold-Off Minimum to maximum hold-off time ratio	1 : > 10	Minimum hold off time is related to time base setting.
2.3.2 X-deflection		
– Deflection coeff.		
Via channel A or B	2 mV/div...10 V/div	1, 2, 5 sequence.
Via EXT input	100 mV/div.	
– Error limit		
Via channel A or B	+/- 5%	
Via EXT input	+/- 5%	
– Bandwidth	DC .... > 2 MHz	DC coupled
– Phase shift between X and Y-deflection	< 3° at 100 kHz	DC coupled
– Dynamic range	> +/– 12 div. DC...100 kHz	DC coupled

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.3.3	**EXT input**		
	– Input impedance Paralleled by	1 M Ω +/- 2% 20 pF +/- 2 pF	f_o < 1 MHz f_o < 1 MHz
	– Max. input voltage Max. test voltage (rms)	400 V (d.c. + a.c. peak) 500 V	 Max. duration 60 s.
	– Lower - 3 dB point	< 10 Hz	AC coupled

2.4 TRIGGERING

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
– Trig. mode AUTO (auto free run)	Bright line in absence of trigger signal	Auto free run starts 100 ms (typ.) after no trig. pulse.
TRIGgered		Switches automatically to auto free run if one of the display channels is grounded.
SINGLE		In multi-channel mode (alternated) each channel is armed after reset; if sweep has already started, sweep is not finished. Not applicable in peak-to-peak coupling.
– Trigger source A, B, Composite (A/B), EXT, Line		Line trigger source always triggers on mains frequency. Line trigger amplitude depends on line input voltage. Approx. 6 div. at 220 VAC input voltage.
– Trigger coupling Peak-to-peak (p-p), DC, TVL, TVF, LF, HF		
– Level range Peak-to-peak:	Related to peak-to-peak value	p-p coupling is DC rejected.
DC internal DC EXTernal	> (+ or - 8 div.) > (+ or - 800 mV)	
TVL/TVF	Fixed level	
– Trigger slope	+/-	Slope sign in LCD. For TVL/TVF use + or - to chose positive or negative video

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
– Trigger sensivity		
INTERNAL		
0 - 10 MHz	> 1,0 div.	Trig. oupling DC.
at 50 MHz	> 1,0 div.	Trig. coupling DC.
at 100 MHz	> 3,0 div..	Trig. coupling DC.
EXTERNAL		
0 – 10 MHz	> 100 mV	Trig. coupling DC.
at 50 MHz	> 150 mV	Trig. coupling DC.
at 100 MHz	> 500 mV	Trig. coupling DC.
TVL/F INTERNAL	> 0,7 div.	Sync. pulse.
TVL/F EXTERNAL	> 70 mV	Sync. pulse.

2.5 SIGNAL AQUISITION

– Sampling type at 10 us/div ... 50s/div	Real time	
– Maximum sample rate:		Sample rate depends on time/div setting
single channel	20 Megasamples/s	
dual channel	20 Megasamples/s	
– Vertical (voltage) Resolution	8 bits	(= 0,4% of full range of 10 div)
– Horizontal (time) Resolution: in single channel acquisition:		
in 20 us/div...50 s/div	8192 samp./acquisition	1 Sample = 0,0125% of full record.
10 us/div	4096 samp./acquisition	1 Sample = 0,024% of full record.
in dual channel acquisition 10 us...50 s/div	4096 samp./acquisition	1 Sample = 0,024% of full record.
– Record length	20,4 x time/div	Display in unmagnified position.
– Acquisition time: real time 10 us/div...50 s/div	20,4 x time/div + 0...20 ms	excluding delay time
– Sources	Channel A	
	Channel B	Channel B can be inverted before acquisition.
– Acquisition modes	1 Channel only	Full memory available for 1 channel.
	2 Channels	Simultaneously sampled; 2 channels share memory.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.6 CHANNELS A AND B

– Frequency response: Lower transition point of BW		
Input coupling in DC position	d.c.	
Input coupling in AC position	≤ 10 Hz	
Upper transition point of BW:		
In memory on mode (Ambient: 15...35 °C)	≥ 10 MHz (-3dB)	Deviation max. 3 MHz for ambient: 0...50 °C.
In memory off mode (Ambient: 15...35 °C)	≥ 60 MHz (-3dB)	Deviation max. 5 MHz for ambient: 0...50 °C.
– Max. base line instability: Jump (Ambient: 15...35 °C)		Add 25% for ambient: 0...50 °C.
when switching to memory mode:	0,3 div	
when actuating INVertor switch	0,3 div	
between any time /div positions	0,5 div	
Drift	0,1 div/h	} Measured in 20 mV/div
Temperature coefficient	± 0,05 div/k	} position. }

2.7 TIME BASE

– Modes	Recurrent, Single shot, Multiple shot	Up to 2 shots.
– Time coefficients: in recurrent	10 us/div...50 s/div	
in single shot & multiple shot	10 us/div...50 s/div	
error limit (Ambient: 15...35 °C) in real time mode	± 1%	Add 0,5% for ambient: 0...50 °C.
up to memory	± 0,01%	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.8 TRIGGER

– Trigger delay:		
range	-20...0 div	Selectable in divisions.
accuracy	± 0,3 div	
– Trigger level view		Indication in LCD
inaccuracy	≤ 0,5 div	

2.9 MEMORY

– Memory size:		
registers	2	
register depth:		
acquisition	8K words	
register	8K words	
wordlength	8 bits	
– Functions	Clear	
	Load	Contents of acquisition are saved in register
	Lock	Memory system is locked. If lock is not active the signal is written into the acquisition memory.

2.10 DISPLAY

– Sources	Channel A Channel B Register A Register B	In any combination
– Display expansion horizontal	0,5x, 1x, 2x, 4x, 8x, 16x and 32x.	
– Number of displayed samples:		
single trace	4 K/channel	
two traces	2 K/channel	
three traces	1 K/channel	
four traces	1 K/channel	

2.11 CALCULATION FACILITIES

– Functions	Ratio, Phase, dV, dt, 1/dt	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.12 AUTO SETTING

– Setting time	3 s (typ.)	Auto set is done analog mode.

2.13 CURSORS

– Horizontal resolution:		
in single channel mode	1 : 1000	Over 10 div
in dual channel mode	1 : 1000	
– Vertical resolution	1 : 200	8 div
– Read out resolution	3 Digits	
– Voltage cursors: error limit amb. 15...35 °C	± 3%	Referred to input at BNC, error of probes etc. excluded. Add 3% for ambient 0..40 °C.
cursor range	Full range	Cursors can not pass not each other. X-position is neglected.
– Time cursors error limit	± 0,01 %	

2.14 POWER SUPPLY

– Line voltage a.c.		One range.
Nominal	100...240 V	
Limits of operation	90...250 V	
– Line frequency		
Nominal	50...400 Hz	
Limits of operation	43...445 Hz	
– Safety requirements within specification of: IEC 348 CLASS I UL 1244 VDE 0411 CSA 556 B		
– Power consumption (a.c. source)	55W nominal	At nominal source voltage

2.15 SUNDRIES

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
– Z-MODulation		TTL-compatible. Blanks display. Max. intensity Analog control ViH and ViL is possible.
ViH	> 2,0 V	
ViL	< 0,8 V	
– CAL output		To calibrate drop or tilt of probes. Rectangular output pulse.
Output voltage	1,2 V +/- 1%	
Frequency	2 kHz	
The output may be short-circuited to ground.		
– Data and settings retention:		When instrument is switched off or during mains faillure. The oscilloscope settings and traces are saved before instrument goes down.
memory back-up voltage	2 V...3,5 V	
memory back-up current drain	Typical 100 uA	at 25 °C
recommended: batteries:		According to IEC285 (=Alkaline Manganese Penlight Battery)
type	LR 6	e.g. PHILIPS LR 6
quantity	2 pcs	Delivered with the instrument.
temperature rise of batteries	20 K	After warming up period of instrument.
retention time	typical 3 years	at 25 °C, with recommended (fresh) batteries.
– Temperature range	0... +70 °C	at -40 ... 0°C settings retention is uncertain. It is advised to remove batteries from instrument when it is stored during longer (24h) period below -30 °C above 60 °C. WARNING: UNDER NO CIRCUMSTANCES BATTERIES SHOULD BE LEFT IN INSTRUMENT AT TEMPERATURES BEYOND THE RATED RANGE OF THE BATTERY SPECIFICATIONS!

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.16 ENVIRONMETAL CHARACTERISTICS

The environmetal data mentioned in this manual are based on the results of the manufacturer's checking procedures.
Details in these procedures and failure criteria are supplied on request by the PHILIPS/FLUKE organisation in your country, or by PHILIPS, INDUSTRIAL AND ELECTRO-ACOUSTIC SYSTEMS DIVISION, EINDHOVEN, THE NETHERLANDS.

– Meets environmental requirements of:	MIL-T-2800 C, type III, CLASS 5, Style D	Class 5, except for operating temperature: 0...40 °C. Style D, except for front cover.
– Temperature:		Memory back-up batteries removed from instrument, unless batteries meet temperature specifications (see also 2.15).
operating:		
min. low temperature	0 °C	Cf. MIL-T-28800 C parr. 3.9.2.3. tested cf. par. 4.5.5.1.1.
max. high temperature	+50 °C	Cf. MIL-T-28800 C parr. 3.9.2.4. tested cf. par. 4.5.5.1.1.
non-operating (storage):		
min. low temperature	- 40 °C	Cf. MIL-T-28800 C parr. 3.9.2.3. tested cf. par. 4.5.5.1.1.
max. high teperature	+75 °C	CF. MIL-T-28800 C parr. 3.9.2.4. tested cf. par. 4.5.5.1.1.
– Max. humidity operating/ non-operating	95% RH	+10...30 °C
– Max. altitude:		MIL-T-28800 C par. 3.9.3. tested, par. 4.5.5.2.
operating	4,5 km (15000 feet)	Maximum Operating Temperature derated 3 °C for each km, for each 3000 feet, above sea level.
non-operating (storage)	12 km (40 000 feet)	
– Vibration (operating)		MIL-T-28800 C par. 3.9.4.1. tested, par. 4.5.5.3.1.
Freq. 5...15 Hz		
Sweep time	7 min.	
Excursion (p-p)	1,5 mm	
Max Acceleration	7 m/s ^{2} (0,7 x g)	at 15 Hz

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
Freq. 15 ....25 Hz		
Sweep Time	3 min.	
Excursion (p-p)	1 mm	
Max Acceleration	13 m/s ^{2} (1,3 x g)	at 25 Hz
Freq. 25 ... 55 Hz		
Sweep time	5 min.	
Excursion (p-p)	0,5 mm	
Max Acceleration	30 m/s ^{2} (3 x g)	at 55 Hz
Resonance Dwell	10 min.	at each resonance freq. (or at 33 Hz if no resonance was found). Excursion, 9.7.1. to 9.7.2.
– Shock (operating)		MIL-T-28800 C par. 3.9.5.1. tested, par. 4.5.5.4.1.
Amount of shocks		
total	18	
each axis	6	3 in each direction
Shock Wave-form	Half sine-wave	
Duration	11 ms	
Peak Acceleration	300 m/s ^{2} (30 x g)	
– Bench handling		MIL-T-28800 C par. 3.9.5.3. tested cf. par. 4.5.5.4.3.
Meets requirements of	MIL-STD-810 method 516, proced. V	
– Salt Atmosphere		MIL-T-28800 C par. 3.9.8.1. tested, par. 4.5.6.2.1.
Structural parts meet requirements of	MIL-STD-810 method 509, proced. I salt solution 20%	
– EMI (Electronic Magnetic Interference) meets requirements of	MIL-STD-461 CLASS B	Applicable requirements of part 7: CE03, CS01, CS02, CS06, RE02, RS03
	VDE 0871 and VDE 0875 Grenzwert-klasse B	

2.17 SAFETY

– Meets requirements of	IEC 348 CLASS I VDE 0411	Except for power cord, unless shipped with Universal European power plug.
	UL 1244 CSA A 556 B	Except for power cord, unless shipped with North American power plug.

2.18 OPTIONAL VERSIONS

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
– General		These options can be factory installed only.
– Power cord		Length 2,1 m (82,7 inch)
	Universal European	VDE, KEMA listed (option .01)
	North American	CSA, UL listed (option .03)
	United Kingdom	BSI listed (option .04)
	Australian	SAA listed (option .08)
	Swiss	SAV listed (option .05)
– Cabinet	Rack mount	PM3337 PM3337/40. with IEEE + RS232-interface installed.
– Interface	IEEE-488/IEC-625 including RS 232-C	Option 40. Dump to plotters: PM8153/1, PM8153/6, PM8154, PM8155, HP7475A and HP7550. Dump to printers: FX80 and HP2225 Thinkjet.
	RS 232-C dump only	Option 50. Dump to plotters: PM8153/1, PM8153/6, PM8154, PM8155, HP7475A and HP7550. Dump to printers: FX80 and HP2225 Thinkjet.

3 BLOCK DIAGRAM DESCRIPTION

3.1 INTRODUCTION TO CIRCUIT DESCRIPTION

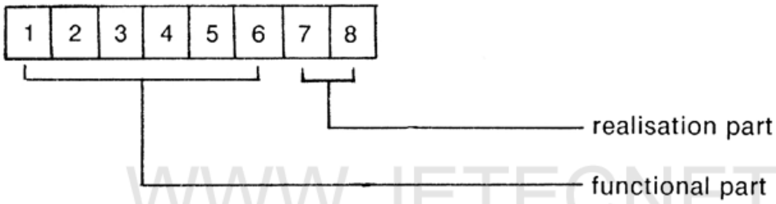
3.1.1 General

The functioning of the circuits is described per printed-circuit board (p.c.b.). For every p.c.b. (unit) a separate chapter is available containing the lay out of the p.c.b., the associated circuit diagram(s), the circuit description and a signal name list.

3.1.2 Explanation of signal name set-up

Signal names consist of two parts:

- a functional part of maximal 6 characters
- a realisation part of 2 characters



The realisation part is optional. If it is used then the functional parts should consist of 6 characters. If necessary dummies (minus sign)are used in the functional part, to make it 6 characters long.

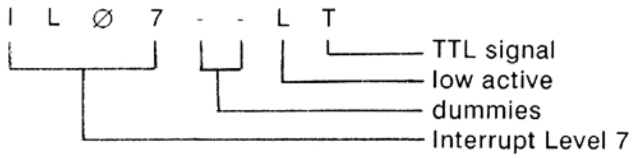
The first character of the realisation part has the following meaning:

H: active high signal
L: active low signal
X: irrelevant (e.g. counter outputs)

The second character of the realisation part is used to identify signal levels:

A: analogue
C: CMOS 12 V or 15 V
D: CMOS 5 V
E: ECL -4,5 V or -5,2 V
T: TTL 5 V or HCT

Example:



Sometimes the functional part can also be used for a serial number e.g. to indicate a buffered version of a signal.

Example: CHPT--Ø1

Figure 3.1 Block diagram, analog part

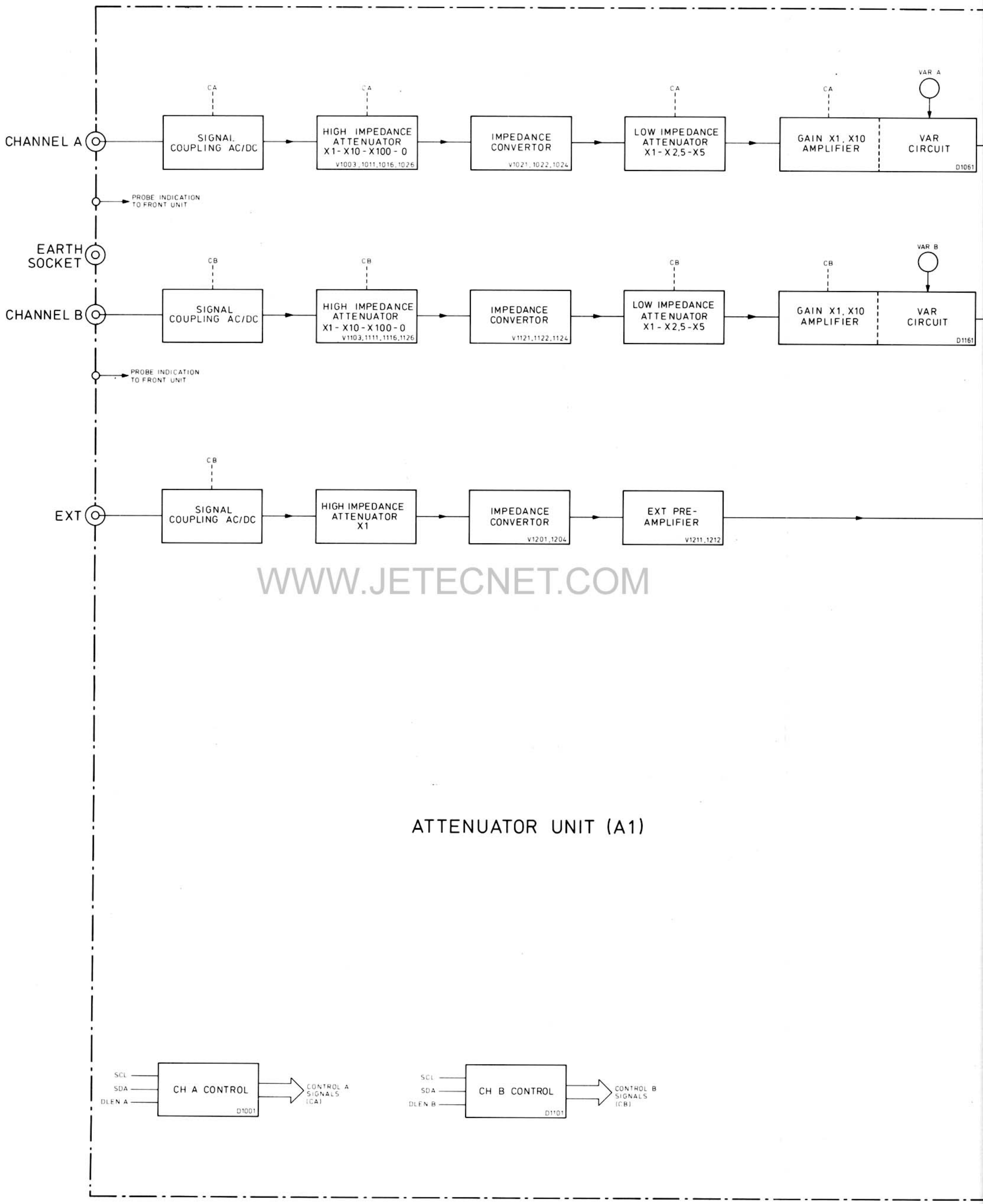
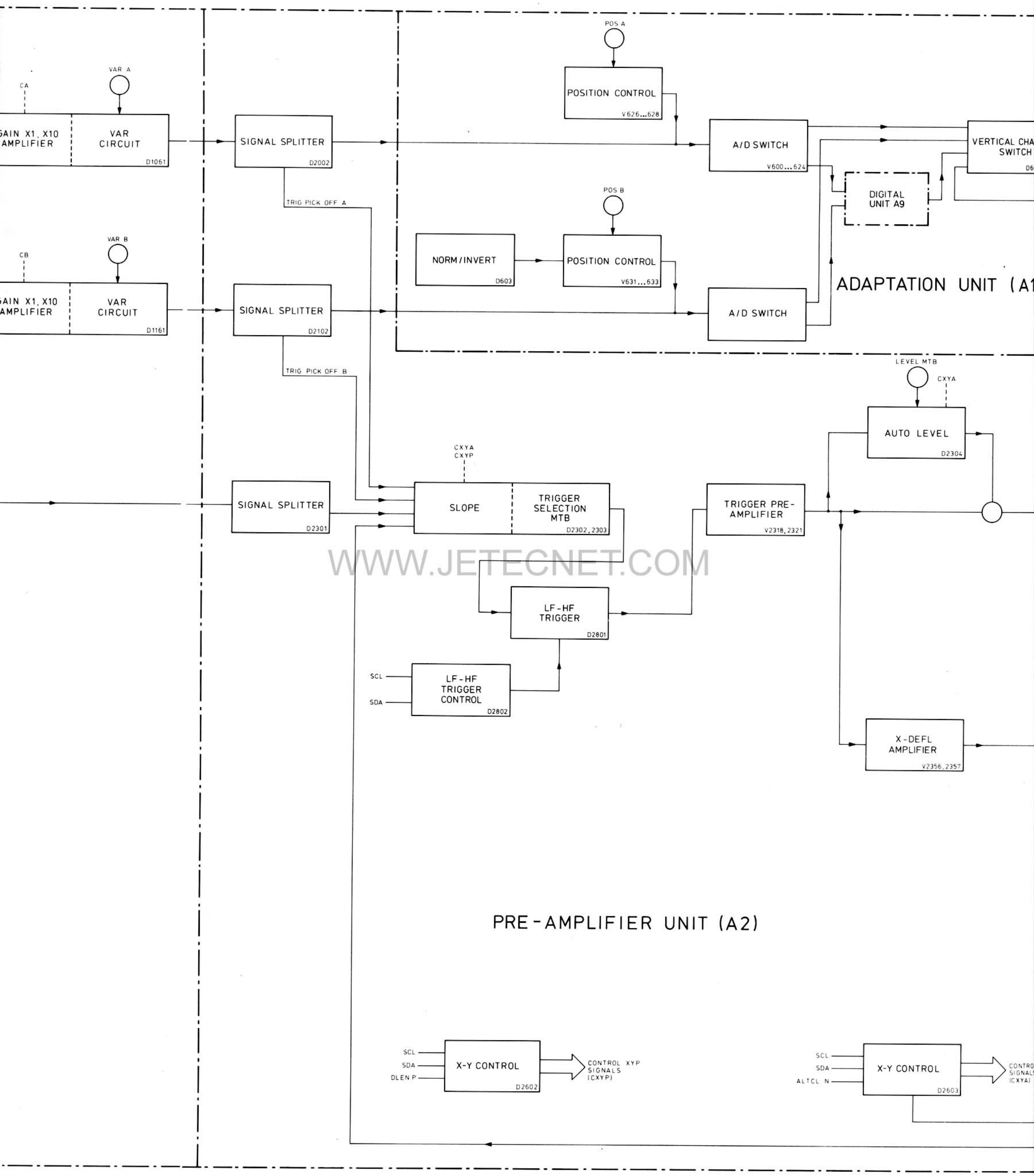
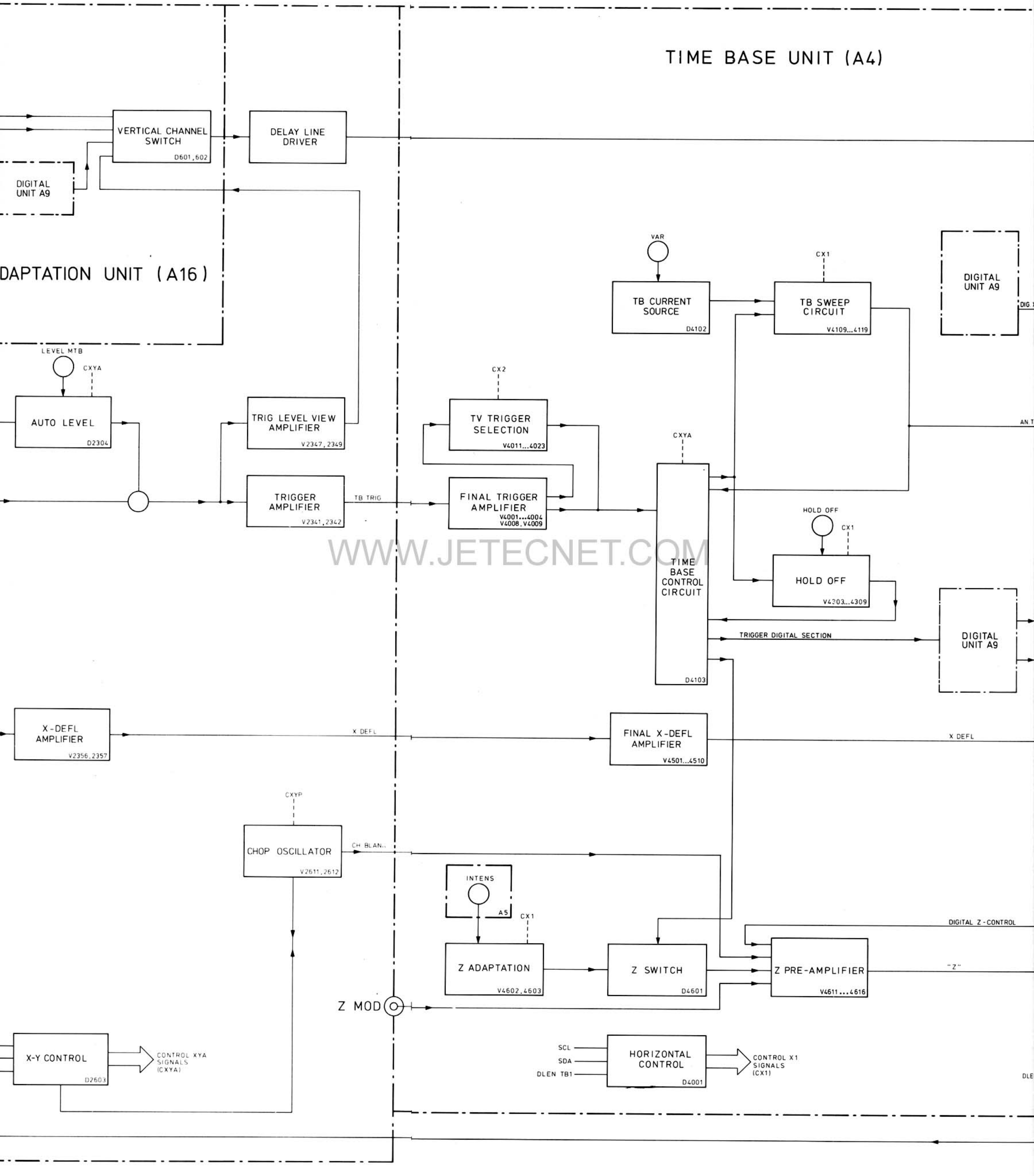
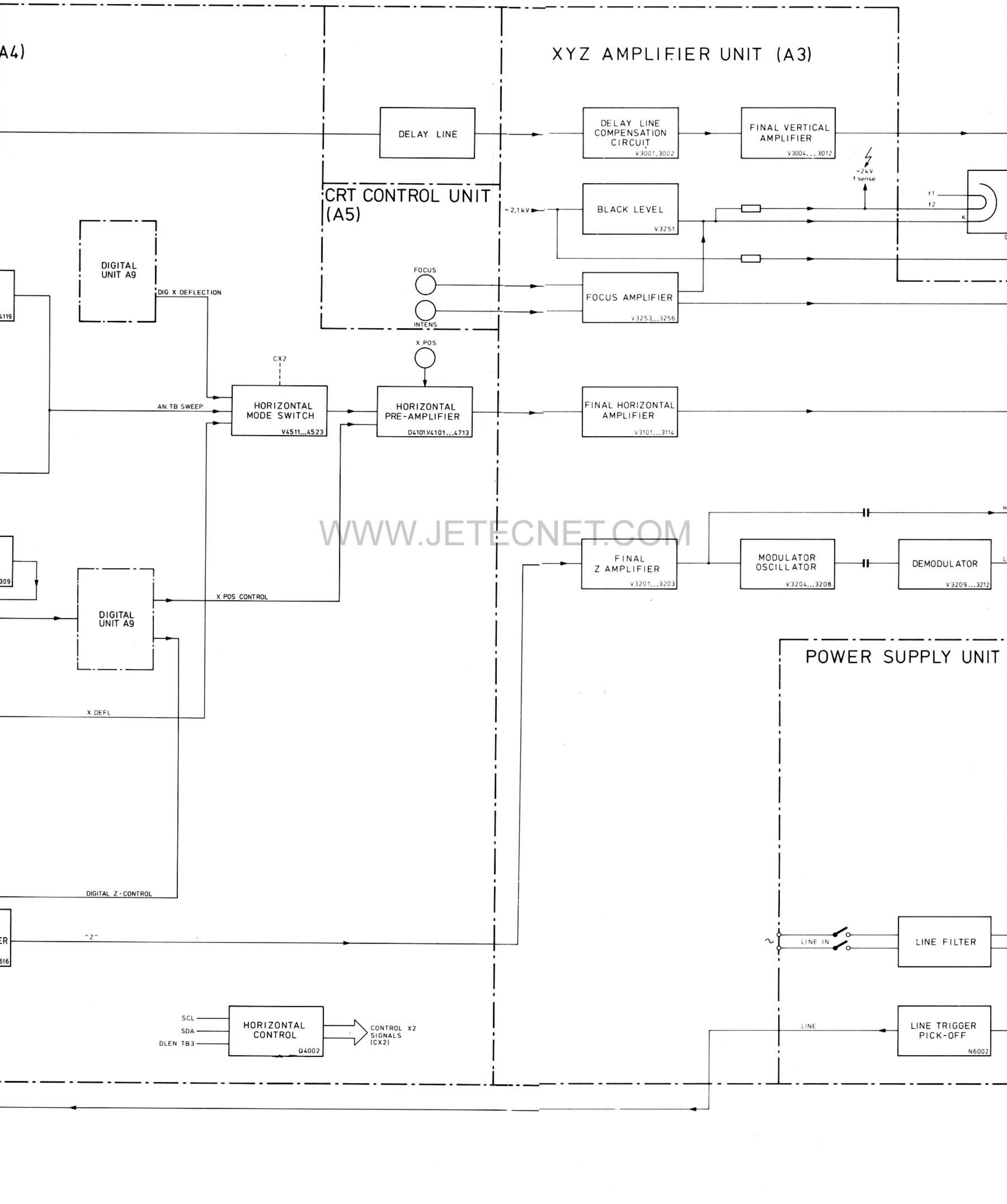


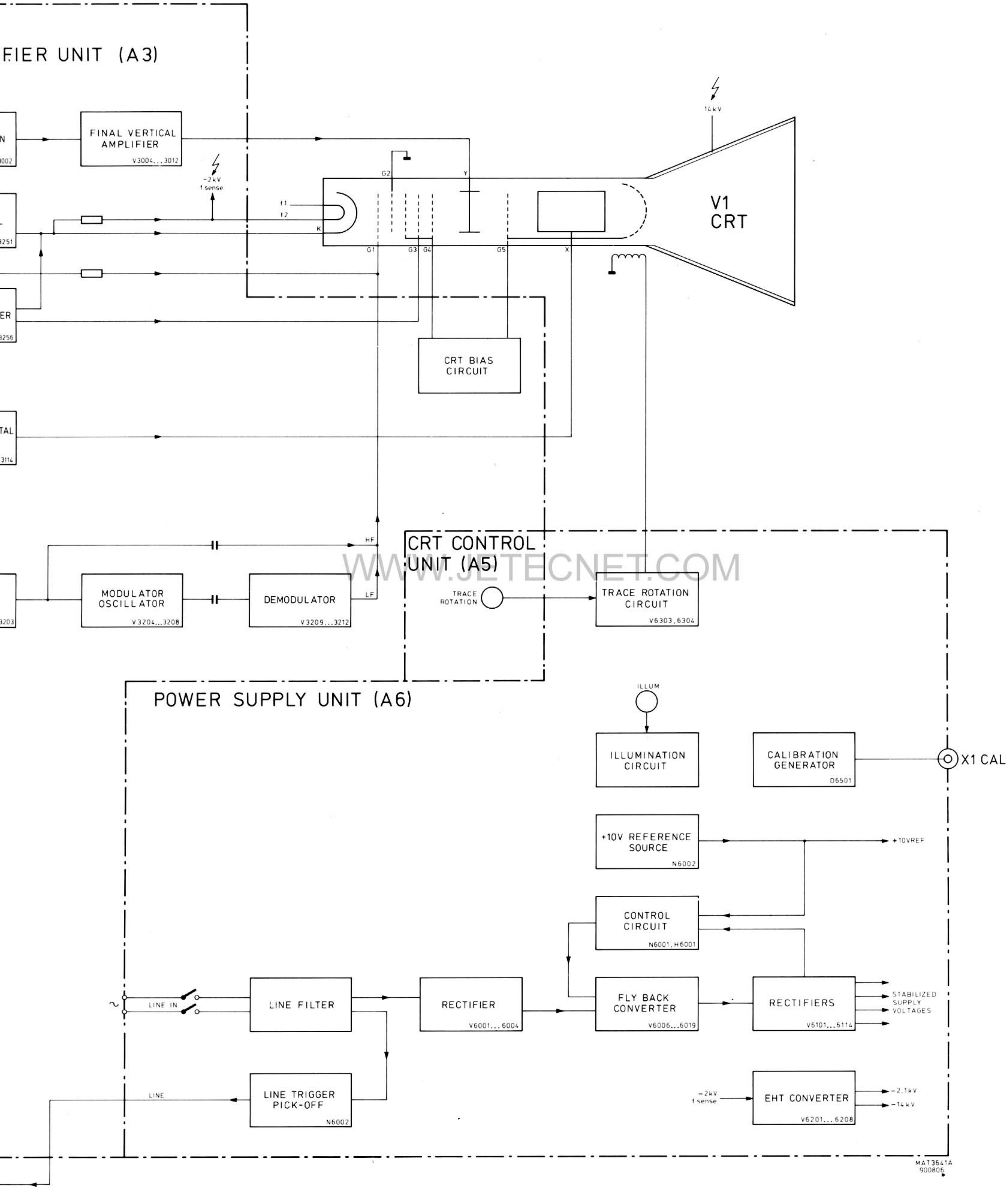
Figure 3.1 Block diagram, analog part


CA
VAR A
GAIN X1, X10 AMPLIFIER
VAR CIRCUIT
D1061
SIGNAL SPLITTER
D2002
TRIG PICK OFF A
POS A
POSITION CONTROL
V626...628
A/D SWITCH
V600...624
VERTICAL CHA SWITCH
DIGITAL UNIT A9
CB
VAR B
GAIN X1, X10 AMPLIFIER
VAR CIRCUIT
D1161
SIGNAL SPLITTER
D2102
TRIG PICK OFF B
NORM/INVERT
D603
POS B
POSITION CONTROL
V631...633
A/D SWITCH
ADAPTATION UNIT (A1
LEVEL MTB
CXYA
AUTO LEVEL
D2304
CXYA
CXYP
SIGNAL SPLITTER
D2301
SLOPE
TRIGGER SELECTION MTB
D2302, 2303
TRIGGER PRE-AMPLIFIER
V2318, 2321
LF-HF TRIGGER
D2801
SCL
SDA
LF-HF TRIGGER CONTROL
D2802
X-DEFL AMPLIFIER
V2356, 2357
PRE-AMPLIFIER UNIT (A2)
SCL
SDA
DLEN P
X-Y CONTROL
D2602
CONTROL XYP SIGNALS (CXYP)
SCL
SDA
ALTCL N
X-Y CONTROL
D2603
CONTRO SIGNALS (CXYA)


TIME BASE UNIT (A4)
DAPTATION UNIT (A16)
VERTICAL CHANNEL SWITCH
D601,602
DELAY LINE DRIVER
DIGITAL UNIT A9
VAR
TB CURRENT SOURCE
D4102
CX1
TB SWEEP CIRCUIT
V4109...4119
DIGITAL UNIT A9
LEVEL MTB
CXYA
AUTO LEVEL
D2304
TRIG LEVEL VIEW AMPLIFIER
V2347,2349
CX2
TV TRIGGER SELECTION
V4011...4023
TRIGGER AMPLIFIER
V2341,2342
TB TRIG
FINAL TRIGGER AMPLIFIER
V4001...4004
V4008,V4009
CXYA
TIME BASE CONTROL CIRCUIT
D4103
HOLD OFF
CX1
HOLD OFF
V4303...4309
TRIGGER DIGITAL SECTION
DIGITAL UNIT A9
X-DEFL AMPLIFIER
V2356,2357
X DEFL
FINAL X-DEFL AMPLIFIER
V4501...4510
X DEFL
CXYP
CHOP OSCILLATOR
V2611,2612
CH BLAN..
INTENS
A5
CX1
Z ADAPTATION
V4602,4603
Z SWITCH
D4601
DIGITAL Z-CONTROL
Z PRE-AMPLIFIER
V4611...4616
"Z"
Z MOD
X-Y CONTROL
D2603
CONTROL XYA SIGNALS (CXYA)
SCL
SDA
DLEN TB1
HORIZONTAL CONTROL
D4001
CONTROL X1 SIGNALS (CX1)
WWW.JETECNET.COM



A4)
XYZ AMPLIFIER UNIT (A3)
DELAY LINE
DELAY LINE COMPENSATION CIRCUIT
V3001, 3002
FINAL VERTICAL AMPLIFIER
V3004...3012
-2kV
f sense
CRT CONTROL UNIT (A5)
~2,1 kV
BLACK LEVEL
V3251
f1
f2
K
DIGITAL UNIT A9
FOCUS
INTENS
FOCUS AMPLIFIER
V3253...3256
DIG X DEFLECTION
4119
X POS
CX2
HORIZONTAL MODE SWITCH
V4511...4523
AN. TB SWEEP
HORIZONTAL PRE-AMPLIFIER
D4101,V4101...4713
FINAL HORIZONTAL AMPLIFIER
V3101...3114
309
DIGITAL UNIT A9
X POS CONTROL
FINAL Z AMPLIFIER
V3201...3203
MODULATOR OSCILLATOR
V3204...3208
DEMODULATOR
V3209...3212
POWER SUPPLY UNIT
X DEFL
DIGITAL Z-CONTROL
"Z"
ER
616
LINE IN
LINE FILTER
SCL
SDA
DLEN TB3
HORIZONTAL CONTROL
D4002
CONTROL X2 SIGNALS (CX2)
LINE
LINE TRIGGER PICK-OFF
N6002



FIER UNIT (A3)
FINAL VERTICAL AMPLIFIER
V3004...3012
14kV
-2kV f.sense
V1 CRT
G2 Y
f1 f2 K
G1 G3 G4 G5 X
CRT BIAS CIRCUIT
HF
LF
MODULATOR OSCILLATOR
V3204...3208
DEMODULATOR
V3209...3212
CRT CONTROL UNIT (A5)
TRACE ROTATION
TRACE ROTATION CIRCUIT
V6303, 6304
POWER SUPPLY UNIT (A6)
ILLUM
ILLUMINATION CIRCUIT
CALIBRATION GENERATOR
D6501
X1 CAL
+10V REFERENCE SOURCE
N6002
+10VREF
CONTROL CIRCUIT
N6001, H6001
LINE IN
LINE FILTER
RECTIFIER
V6001...6004
FLY BACK CONVERTER
V6006...6019
RECTIFIERS
V6101...6114
STABILIZED SUPPLY VOLTAGES
LINE
LINE TRIGGER PICK-OFF
N6002
-2kV f.sense
EHT CONVERTER
V6201...6208
-2,1kV
-14kV
MAT3541A
900806

Signal name list:

The description of the digital unit A9 contains a list with the signal names used in that unit given in alphabetical order.
After each name, a short signal description is given and also the signal source and the signal destination(s).

A number of power supply lines and ground lines are not mentioned on the signal name lists because they appear very often and because their function in obvious.

3.1.3 Location of electrical parts

The item numbers of C...., R...., V...., N...., D.... and K.... have been divided into groups which relate to the circuit and the printed- circuit board according to the following table:

Item number	Unit no.	Printed-circuit board
1000-1999	A1	Attenuator unit
2000-2999	A2	Pre-amplifier unit
3000-3999	A3	XYZ amplifier unit
4000-4999	A4	Time base unit
5000-5999	A5	CRT control unit
6000-6999	A6	Power-supply unit
7000-7999	A7	Front unit
8000-8999	A8	LCD unit
9000-9999	A9	Digital unit
600- 699	A16	Adaptation unit

3.2 BLOCK DIAGRAM DESCRIPTION (see figure 3.1 and 3.2)

3.2.1 Introduction

This block diagram description is based around all the important functional blocks and their interconnections. In order to assist in cross-reference with the circuit diagrams, the blocks include the item numbers of the active components they contain.
Furthermore, the blocks are grouped together per printed-circuit board, or parts of it. To facilitate reference, the names of the functional blocks are given in text in CAPITALS.
Signal waveforms are also indicated at block interconnections where useful.
In this instrument almost all the switches (UP-DOWN controls, softkeys and potentiometer UNCAL switches) influence the oscilloscope circuits via a microprocessor (uP) system.

3.2.2 Attenuator unit (unit A1)

The vertical channels A and B for the signals to be displayed are identical. Each channel comprises an input SIGNAL COUPLING for AC/DC, a HIGH IMPEDANCE ATTENUATOR which gives signal attenuation of x1, x10 or x100, an IMPEDANCE CONVERTER, a LOW IMPEDANCE ATTENUATOR which gives signal attenuation of x1, x2,5 or x5 and a GAIN x1 / x10 AMPLIFIER block, incorporated with the CONTINUOUS CIRCUIT. This block has a variable gain, influenced by the front-panel VAR control. The gain is also increased by x10 in order to obtain 2, 5 and 10mV/div settings.

Similar to the vertical channels, the external channel attenuator also has an input SIGNAL COUPLING, HIGH IMPEDANCE ATTENUATOR and IMPEDANCE CONVERTER in line. However, the external channel has only x1 attenuation and no LOW IMPEDANCE ATTENUATOR. The output of the external channel is fed to both MTB and DTB EXT PRE-AMPLIFIERS.

All blocks that are capable of working in different modes are controlled by the control A or control B signals. These signals are generated by the CH.A CONTROL or CH.B CONTROL blocks under influence of the SDA and SCL signals that come from the MICROPROCESSOR.

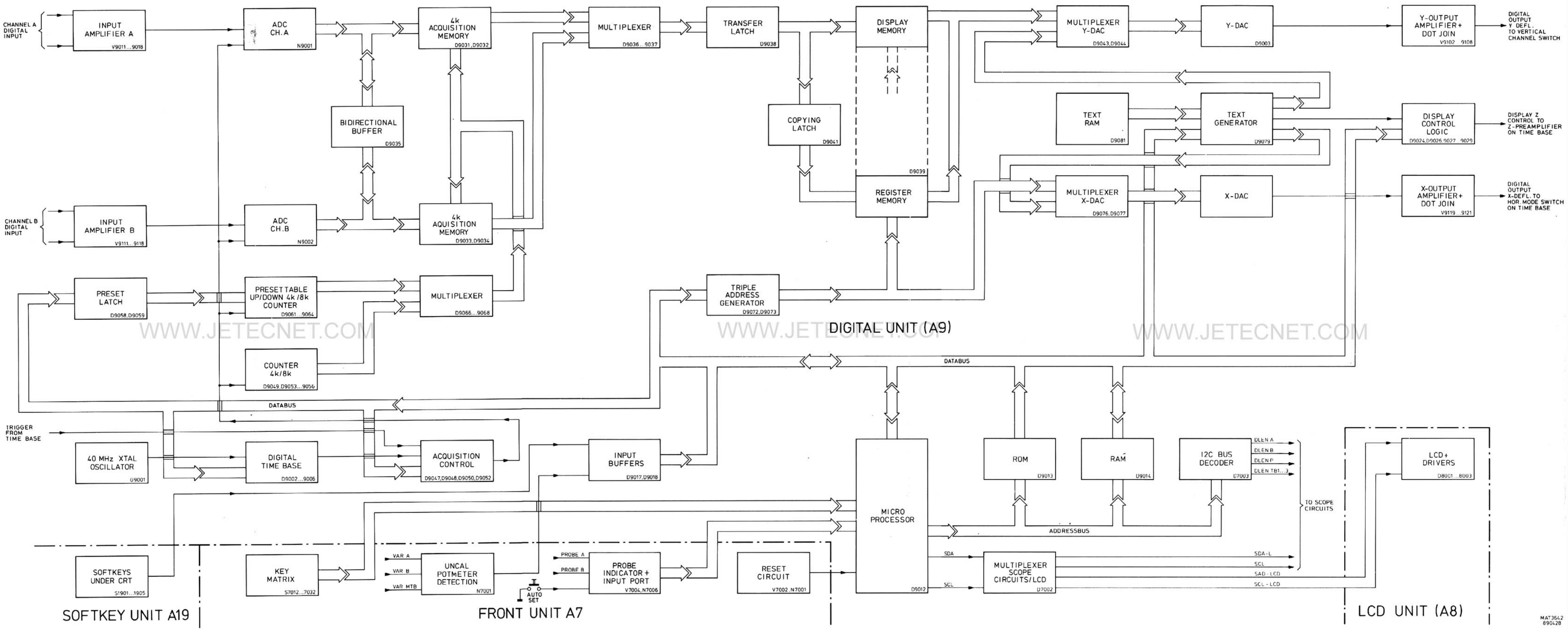


Figure 3.2 Block diagram, digital part

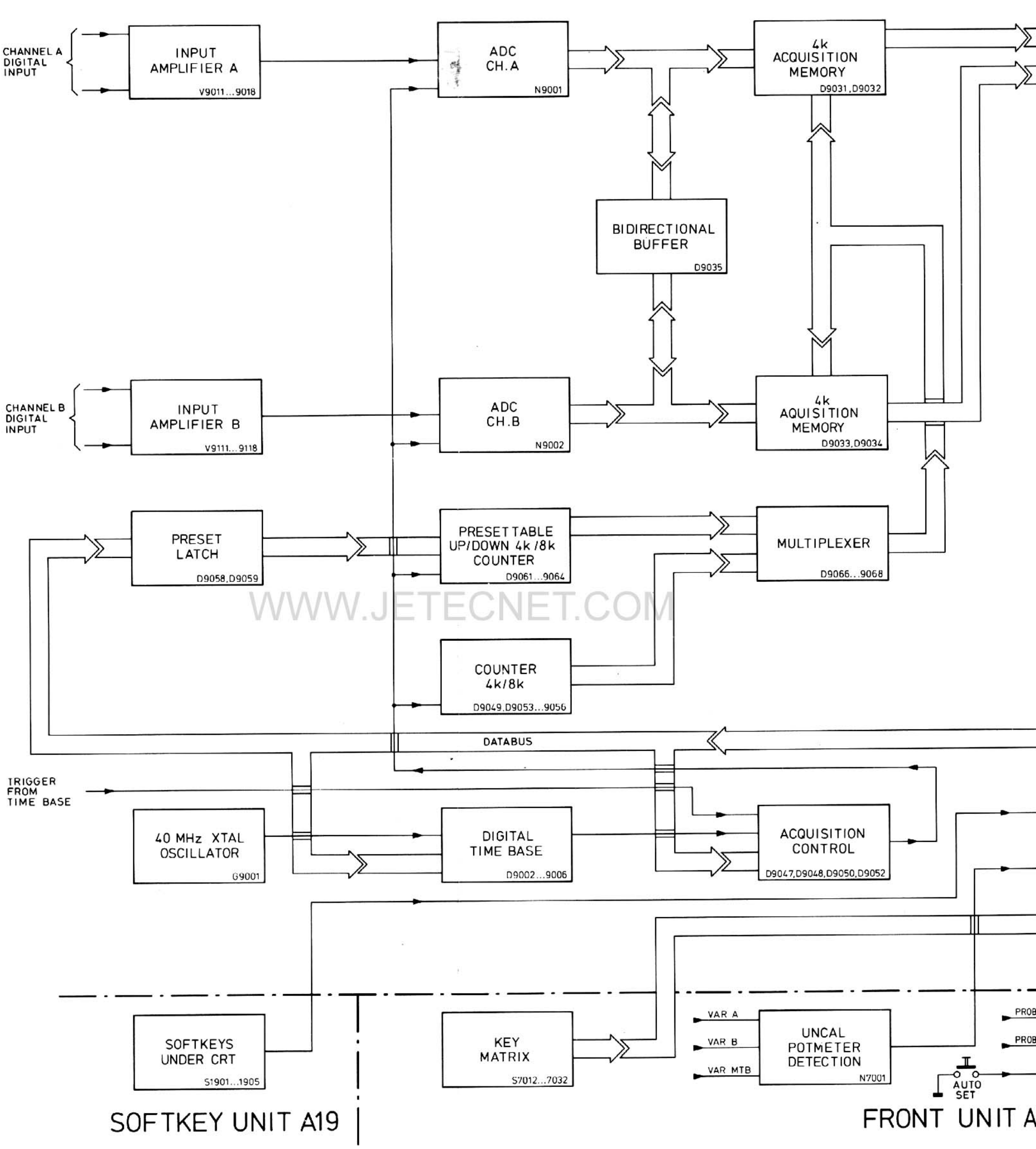
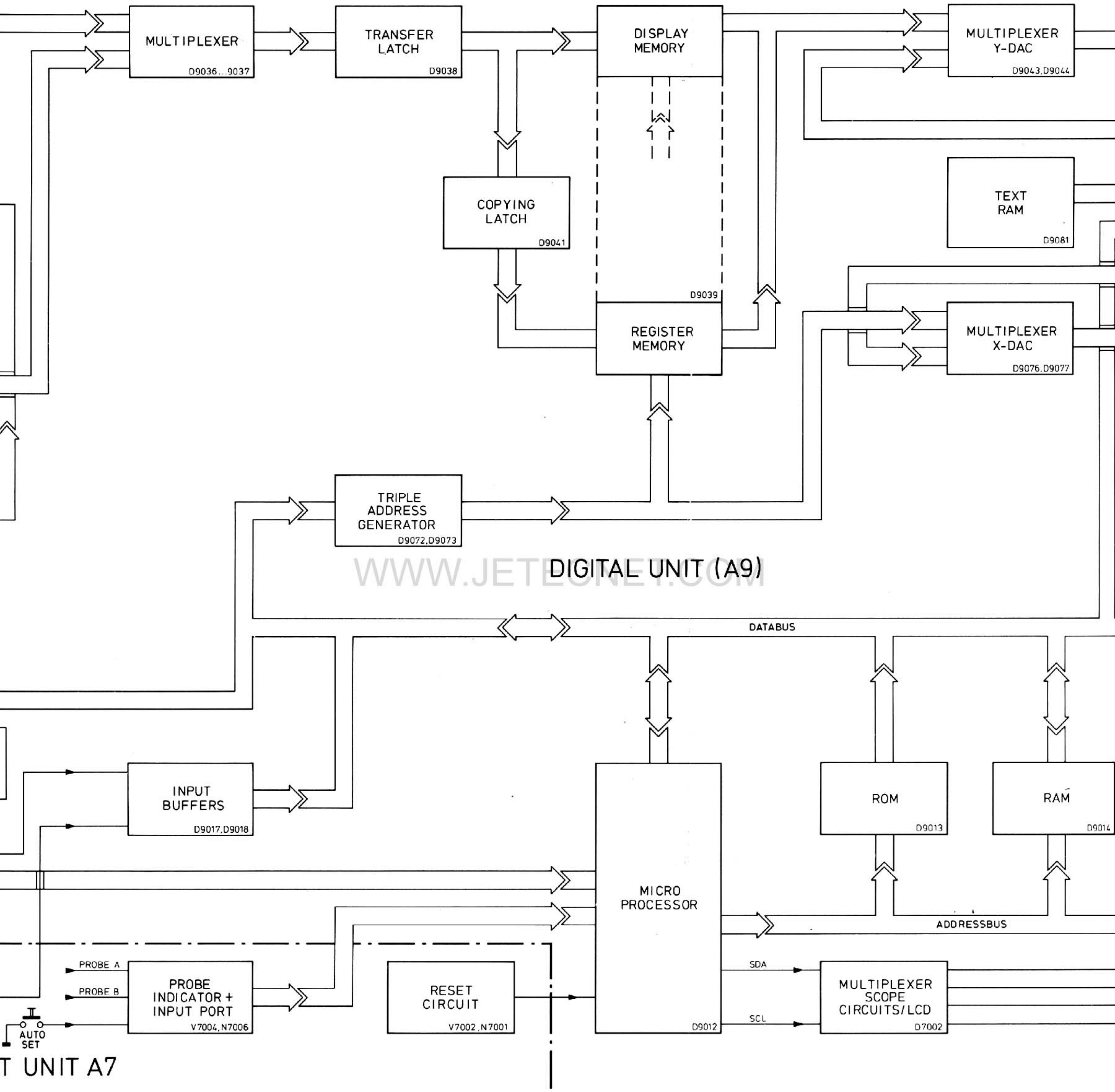
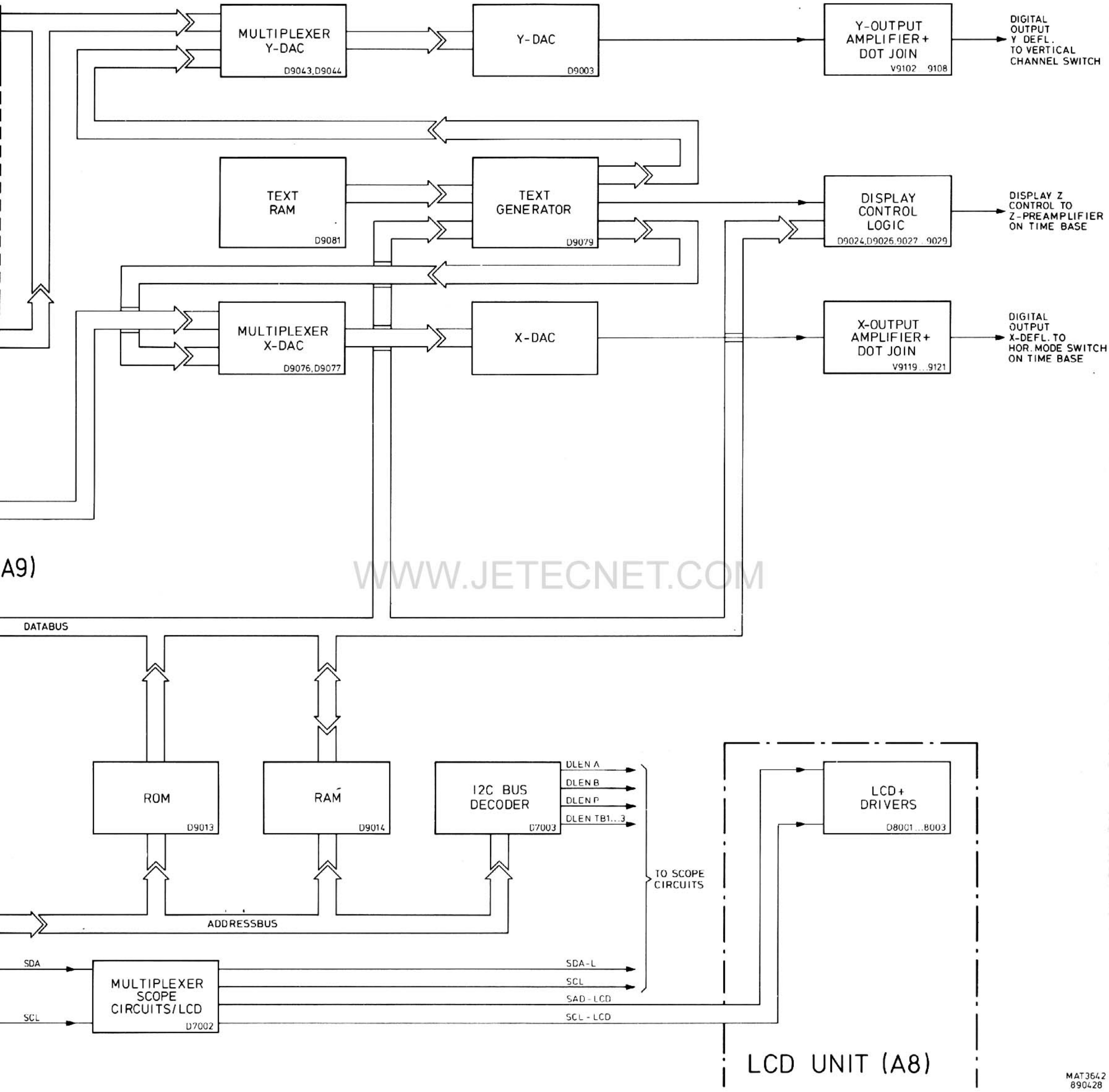


Figure 3.2 Block diagram, digital part


MULTIPLEXER
D9036...9037
TRANSFER LATCH
D9038
DISPLAY MEMORY
D9039
MULTIPLEXER Y-DAC
D9043,D9044
COPYING LATCH
D9041
TEXT RAM
D9081
REGISTER MEMORY
MULTIPLEXER X-DAC
D9076,D9077
TRIPLE ADDRESS GENERATOR
D9072,D9073
DIGITAL UNIT (A9)
DATABUS
INPUT BUFFERS
D9017,D9018
ROM
D9013
RAM
D9014
MICRO PROCESSOR
D9012
ADDRESSBUS
PROBE A
PROBE B
PROBE INDICATOR + INPUT PORT
V7004,N7006
AUTO SET
RESET CIRCUIT
V7002,N7001
SDA
SCL
MULTIPLEXER SCOPE CIRCUITS/LCD
D7002
T UNIT A7



MULTIPLEXER Y-DAC D9043,D9044
Y-DAC D9003
Y-OUTPUT AMPLIFIER+ DOT JOIN V9102...9108
DIGITAL OUTPUT Y DEFL. TO VERTICAL CHANNEL SWITCH
TEXT RAM D9081
TEXT GENERATOR D9079
DISPLAY CONTROL LOGIC D9024,D9026,9027...9029
DISPLAY Z CONTROL TO Z-PREAMPLIFIER ON TIME BASE
MULTIPLEXER X-DAC D9076,D9077
X-DAC
X-OUTPUT AMPLIFIER+ DOT JOIN V9119...9121
DIGITAL OUTPUT X-DEFL. TO HOR. MODE SWITCH ON TIME BASE
A9)
DATABUS
ROM D9013
RAM D9014
I2C BUS DECODER D7003
DLEN A
DLEN B
DLEN P
DLEN TB1...3
TO SCOPE CIRCUITS
LCD+ DRIVERS D8001...8003
ADDRESSBUS
SDA
SCL
MULTIPLEXER SCOPE CIRCUITS/LCD D7002
SDA-L
SCL
SAD-LCD
SCL-LCD
LCD UNIT (A8)
MAT3642 890428

3.2.3 Pre-amplifier unit and adaptation unit (unit A2 and A16)

The pre-amplifier unit incorporates the signal splitters for the vertical channels A and B, the trigger level view amplifier, the trigger circuits for the time base and the chopper oscillator circuit. Next the adaptation unit is mounted as a separate p.c.b. on the pre-amplifier unit. All these functions are controlled by the control XYP and XYA signals, generated by the X-Y CONTROL blocks under influence of the SDA and SCL signals from the MICROPROCESSOR.

* Vertical channels A and B:

Both channels are completely identical and receive their input signals from the ATTENUATOR UNIT. This signal is applied to the SIGNAL SPLITTER, which has two outputs:

- one output is applied to the SLOPE/TRIGGER SELECTION for the time base triggering.
- A second output is routed to the adaptation unit.

On the adaptation unit, vertical shift of the displayed signal is achieved by the front-panel POSITION control.
Switching between the analog path and the digital storage path is obtained in the A/D SWITCH block. The digital circuit is given in figure 3.2 and described separately.
Next, the output of the VERTICAL CHANNEL SWITCH is routed via the DELAY LINE DRIVER to the DELAY LINE.
The TRIGGER LEVEL VIEW channel enables display of the time base triggerlevel and can be used to determine the trigger point of the signal.

* Trigger circuit:

The SLOPE/TRIGGER SELECTION block receives a trigger signal from one of the vertical channels A or B, from the EXT SIGNAL SPLITTER or from the LINE TRIGGER PICK-OFF. Inversion of the trigger signal is controlled by the CXYA signals INVAM and INVBM to obtain the slope function.
Routed via the TRIGGER PRE-AMPLIFIER block, the signal is split up into different paths:

- after summation of the LEVEL signal, direct to the TRIGGER AMPLIFIER
- to the AUTO LEVEL block. This block contains the different trigger facilities and levelling of the trigger signal is influenced by the front-panel LEVEL control. The output of this path is routed again to the summation point to influence the direct trigger signal.
- to the X-DEFL AMPLIFIER for X-deflection facility. This block incorporates a phase correction circuit for the X-Y display.

The TRIGGER AMPLIFIER feeds the trigger signal to the time-base unit. The trigger signal from the summation point is also routed via the TRIGGER LEVEL VIEW AMPLIFIER to the vertical CHANNEL SWITCH stage to display the trigger point.

* Chopper oscillator circuit:

A square-wave signal for chopper blanking and vertical switching is generated in the CHOP OSCILLATOR. For chopper blanking the signal is routed to the Z PRE-AMPLIFIER on the time-base unit.

3.2.4 Time-base unit (unit A4)

This unit incorporates the time-base (TB), the horizontal amplifier and the Z amplifier circuit. All functions are controlled by the CX1 and CX2 signals, generated by the HORIZONTAL CONTROL CIRCUIT blocks.

* Time-base (TB):
The trigger signal can be either routed via the FINAL TRIGGER AMPLIFIER to the TIME-BASE CONTROL CIRCUIT or routed via the TV TRIGGER SELECTION for the TV trigger coupling. When in the AUTO mode, in the absence of trigger signals, the time base will be free running.

The CURRENT SOURCE applies the sawtooth charging current to the sweep circuit. This block generates the time base sawtooth signal, which is routed to the HORIZONTAL DISPLAY MODE SWITCH..

The HOLD OFF and the DIGITAL UNIT blocks are also under control of the TIME BASE CONTROL CIRCUIT. Hold off time is varied by the front-panel HOLD OFF control. The output of the HOLD OFF block is routed to the TIME-BASE CONTROL CIRCUIT again. The signal going to the DIGITAL UNIT triggers the digital signal acquisition.

The ALTCLN-pulse is applied to the PRE-AMPLIFIER UNIT.

3.2.5 XYZ unit (unit A3)

This unit comprises the final amplifiers for the vertical (Y) and horizontal (X) deflection and for the blanking (Z) circuit. In addition to this, the CRT control circuits are also incorporated in the unit.

* Final vertical amplifier:

The output signal from the pre-amplifier unit is first routed via the DELAY LINE to give sufficient delay to ensure that the steep leading edges of fast signals are displayed and then fed to the DELAY LINE COMPENSATION. This block compensates the signal for distortion originating in the DELAY LINE before it is applied to the FINAL VERTICAL AMPLIFIER. The output of the FINAL VERTICAL AMPLIFIER feeds the vertical deflection plates of the CRT.

* Final horizontal amplifier:

The horizontal deflection signal is routed to the FINAL HORIZONTAL AMPLIFIER, the output of which feeds the horizontal deflection plates of the CRT.

* Blanking circuit:

The output signal from the Z PRE-AMPLIFIER of the time-base unit, that determines trace blanking or unblanking and modulation is routed to the FINAL Z-AMPLIFIER. After amplification the blanking signal is split into two paths:

- the h.f. signals are fed via a high voltage capacitor to grid G1 of the CRT.
- the l.f. signals are used to modulate the amplitude of an oscillator wave-form, which then passes via another high voltage capacitor and is demodulated in the DEMODULATOR block to retrieve the original signal.

Note that the original h.f. and l.f. signals are again recombined on the grid G1.

* CRT control circuits:

The FOCUS AMPLIFIER block is influenced by both front-panel FOCUS and INTENS controls to provide a focus that is independent of the intensity, and drives the focusing grid G3 of the CRT.

The -100 V BLACK LEVEL block provides the correct presetting of the cathode voltage.

The CRT BIAS gives a d.c. voltage to the grids G4 and G5 to provide an optional adjustment for geometry and astigmatism.

3.2.6 Power supply unit

The mains input voltage is filtered and then applied to the RECTIFIER block to obtain a d.c. voltage source. Another output of the LINE FILTER block is routed via the LINE TRIGGER PICK-OFF and serves as a MTB LINE trigger signal. The rectified mains source is routed to the FLYBACK CONVERTER, which generates the necessary voltages for the oscilloscope circuits. Each supply voltage is rectified in the RECTIFIERS block.
The LOW-voltage supplies are stabilized by the CONTROL circuit to the converter.
The +10 V REF supply serves as a low-voltage reference and is generated in the +10 V REFERENCE source block. This reference voltage is also fed to the different circuits on the power supply or in the oscilloscope.

The EHT CONVERTER generates the -14 kV for the post-accelerator anode of the CRT and the -2 kV for the cathode circuits.

* Auxiliary circuits:

The CALIBRATION GENERATOR generates the CAL voltage, which is applied to the output socket X1. The CAL voltage has a square-wave of 1,2 V p-p level with a frequency of 2 kHz.

The ILLUMINATION CIRCUIT determines the amount of current passed to the graticule illumination lamp of the CRT, controlled by the ILLUM control on the front-panel.

The TRACE ROTATION CIRCUIT determines the strength and sense of the current passed to the trace rotation coil around the neck of the CRT. The current is influenced by the front-panel screwdriver-operated TRACE ROT control.

3.2.7 Digital memory and control circuits (unit A7, A8, A9 and A19)

Introduction.

The blockdiagram of the digital sections can roughly be split up into three main parts. These parts are:

- Signal acquisition: this section captures signal samples and places them in the acquisition memories.
- The memory and display part are used to store the signal and to display it on the CRT screen.
- The control section that is based upon a microprocessor takes care that the signal display and acquisition function correctly. Moreover it reads all the instrument's knobs and controls all analog and digital circuits.

The digital parts are mainly concentrated on the large digital unit A9. A small part is present on the front unit A7 and the LCD unit A8.
The softkey unit A19 is located under the CRT and only incorporates five softkeys.

Signal acquisition.

The channel A(B) signals that are coming from the adaptation unit A16 are applied to the INPUT AMPLIFIERS A(B). These blocks feed the analog-to-digital converters ADC CHANNEL A and ADC CHANNEL B. The digitised signals of channel A and B can be loaded into two 4K ACQUISITION MEMORY blocks. In case of dual channel mode, each channel is loaded into one 4K memory. In case of single channel operation, the full 8K memory capacity is available for one channel. The BIDIRECTIONAL BUFFER makes it possible that the ADC-output of the selected single channel can reach the input of both 4K memories.

The addresses for the two 4K ACQUISITION MEMORIES are originating from two counters. COUNTER 4K/8K is only able to count upwards and has a range of 4K or 8K addresses. The PRESETTABLE UP/DOWN COUNTER has also a range of 4K/8K. It can also count up or down and can be preset by the MICROPROCESSOR via the block PRESET LATCH. Depending on the state of the MULTIPLEXER, the address of one of the two counters is addressing the 4K ACQUISITION MEMORIES. The possible modes are explained more in depth during the circuit description; also the trigger delay mode is explained then.

The acquisition of signal samples is synchronised by the DIGITAL TIME BASE circuit. This circuit is based upon a 40MHz XTAL OSCILLATOR that is followed by the DIGITAL TIME BASE. The DIGITAL TIME BASE is put in the appropriate position via the ADDRESSBUS of the MICROPROCESSOR. The output signal of the DIGITAL TIME BASE is applied to the ACQUISITION CONTROL block. Also this block is controlled by the MICROPROCESSOR and it takes care that the ADC's take signal samples at the correct moment and that these samples are placed in the appropriate part of the ACQUISITION MEMORIES. The trigger pulse that originates from the TIME BASE is also applied to the ACQUISITION CONTROL.

Memory section and display part.

The contents of the two 4K ACQUISITION MEMORIES can be transferred to the DISPLAY MEMORY. This happens at a particular moment after a trigger. The transfer occurs via the TRANSFER LATCH. The contents of the DISPLAY MEMORY can be copied via the COPYING LATCH into the REGISTER MEMORY. This last memory can be used to store waveforms for reference purposes.

The addressing of the DISPLAY MEMORY and the REGISTER MEMORY is done by the TRIPLE ADDRESS GENERATOR. This block is controlled by the MICROPROCESSOR and contains three separate address generators.
They have the following purposes:

- The addressing of the display memory during the information transfer from ACQUISITION MEMORIES to the DISPLAY MEMORY.
- The addressing of the DISPLAY/REGISTER MEMORY during the transfer of information between these memory blocks.
- The addressing of the DISPLAY and REGISTER MEMORY during the display on the CRT screen of their contents. The contents of the addressed memory locations is applied to the vertical Y DAC and then to the Y OUTPUT AMPLIFIER. The address itself is applied to the horizontal X DAC and then to the X OUTPUT AMPLIFIER.

3.2 BLOCK DIAGRAM DESCRIPTION (see figure 3.1 and 3.2)

The X and Y OUTPUT AMPLIFIERS also incorporate a DOT JOIN facility.
This means in the DOT JOIN mode a decrease of the speed of these amplifiers because a low pass filter is added. This has the result that the move from one dot to the next one is smoothed.

The input of the Y DAC and the X DAC are connected with two-position multiplexers. They are named MULTIPLEXER Y DAC and MULTIPLEXER X DAC.
In one position of the multiplexer, the contents of the DISPLAY/REGISTER MEMORY is displayed. In the other position text and cursors are displayed: this is generated by the TEXT GENERATOR. This block is integrated in one IC. The kind of text to be generated is given by the MICROPROCESSOR. This text is stored into the TEXT RAM (Random Access Memory) that belongs to the TEXT GENERATOR.

Control section.

The heart of this part is formed by the MICROPROCESSOR with belonging ROM (Read Only Memory) and RAM (Random Access Memory). The MICROPROCESSOR reads the softkeys under the CRT via the block INPUT BUFFERS and also the UNCAL position of VARiable A, VARiable B and VARiable MTB. The MICROPROCESSOR directly reads the KEY MATRIX at the front unit A7. The RESET CIRCUIT on unit A7 initiates the MICROPROCESSOR when switching the power on.

The MICROPROCESSOR controls many circuits inside the oscilloscope.
The blocks on the digital unit that are under control of the MICROPROCESSOR are already explained. They are all connected with the databus or parts of it. Also the LCD and the analog scope circuits are under microprocessor control. For this purpose the so-called I2C bus is used. This is a bus consisting of two signal wires: the data line SDA (Serial DAta) and the synchronisation line SCL (Serial CLock). The I2C bus lines are switched to either the LCD (as SDA-LCD and SCL-LCD) or the analog scope circuits. This selection is made via the MULTIPLEXER SCOPE CIRCUITS/LCD. The analog scope circuits incorporate many control blocks that are all connected to the SDA and SCL lines of the I2C bus. The control blocks are separately addressed via the I2C BUS DECODER. If e.g. output DLEN A (Data Latch ENable A) is active, the control block of channel A on the attenuator unit accepts the data from SDA/SCL. The result is for instance that the channel A attenuator switches to another input sensitivity. Identical to this the signals DLEN B, DLEN P and DLEN TB 1...3 activate the control blocks on respectively the channel B attenuator, the preamplifier and the time base.

4 ATTENUATOR UNIT (A1)

4.1 VERTICAL ATTENUATORS

The A and B channel attenuators are identical: therefore only channel A is described.

All relay and FET switches are controlled by the microcomputer via the I^2C bus. The IC D1001 converts this serial DATA into the parallel control signals for all relay or FET switches. A list of the control lines for all attenuator settings is given in the table below.

	X1H	X10H	X100H	X1F	X10F	X100F	X1L	X2,5L	X5L	X1/X10
2mV	●			●			●			●
5mV	●			●				●		●
10mV	●			●					●	●
20mV	●			●			●			
50mV	●			●				●		
.1V	●			●					●	
.2V		●			●		●			
.5V		●			●			●		
1V		●			●				●	
2V			●			●	●			
5V			●			●		●		
10V			●			●			●	

MAT 2227

Figure 4.1 Table of attenuator settings

The channel A attenuator consists of in five stages:

Input coupling, where depending on the relay K1001 position, the input signal can either be d.c.-coupled (relay activated) or a.c.- coupled (relay not activated).

High impedance attenuator with three attenuator stages for the x1, x10 and x100 attenuation. The l.f. part of each stage is split via a resistor divider and routed via N1001 and V1019 to the output of this stage, where it is re-connected with the h.f. part of the input signal. Potentiometers R1036 (TRACE jump) serves as a offset compensation for N1001.

	RELAY	FET	TRIMMER FOR L.F. SQUARE WAVE	L.F. RESISTOR DIVIDER DIVIDER
x1	K1004	V1011	C1033	--
x10	K1003	V1006	C1029	R1007-R1011
x100	K1002	V1003	C1023	R1019-R1004

Note that, when "0" (GND-A) is selected, the output is connected to ground via FET V1016 and all other relay- and FET switches are switched off.

The impedance converter serves as an inverting buffer circuit for the high impedance attenuator. For the l.f.-feedback the output signal of this stage is routed to the l.f. summation point N1001-2.

The low impedance attenuator reduces the gain by x1, x2.5 and x5, depending on which relay is activated.

	RELAY	RESISTOR DIVIDER
x1	K1006	--
x2.5	K1007	R1053 vs R1056, R1057 and R1058
x5	K1008	R1053, R1056 and R1057 vs R1058

The continuous circuit (D1061), the differential input voltages of which are fed to pins 4 and 5.
This stage comprises the following functions:

- Continuously variable control (pin 11).
- Gain x1 (pin 2 and 3) with offset adjustment R1064 and gain adjustment R1069.
- Gain x10 (pin 6 and 7) with offset adjusting R1072 and gain adjustment R1076.
- x1/x10 control (pin 10) to select the 2, 5 and 10 mV/DIV settings.

The differential output current from pin 13 and pin 14 is routed via a common-base circuit V1063, V1064 and applied to the pre-amplifier unit.

4.2 EXTERNAL INPUT

The external input can be subdivided into four stages:

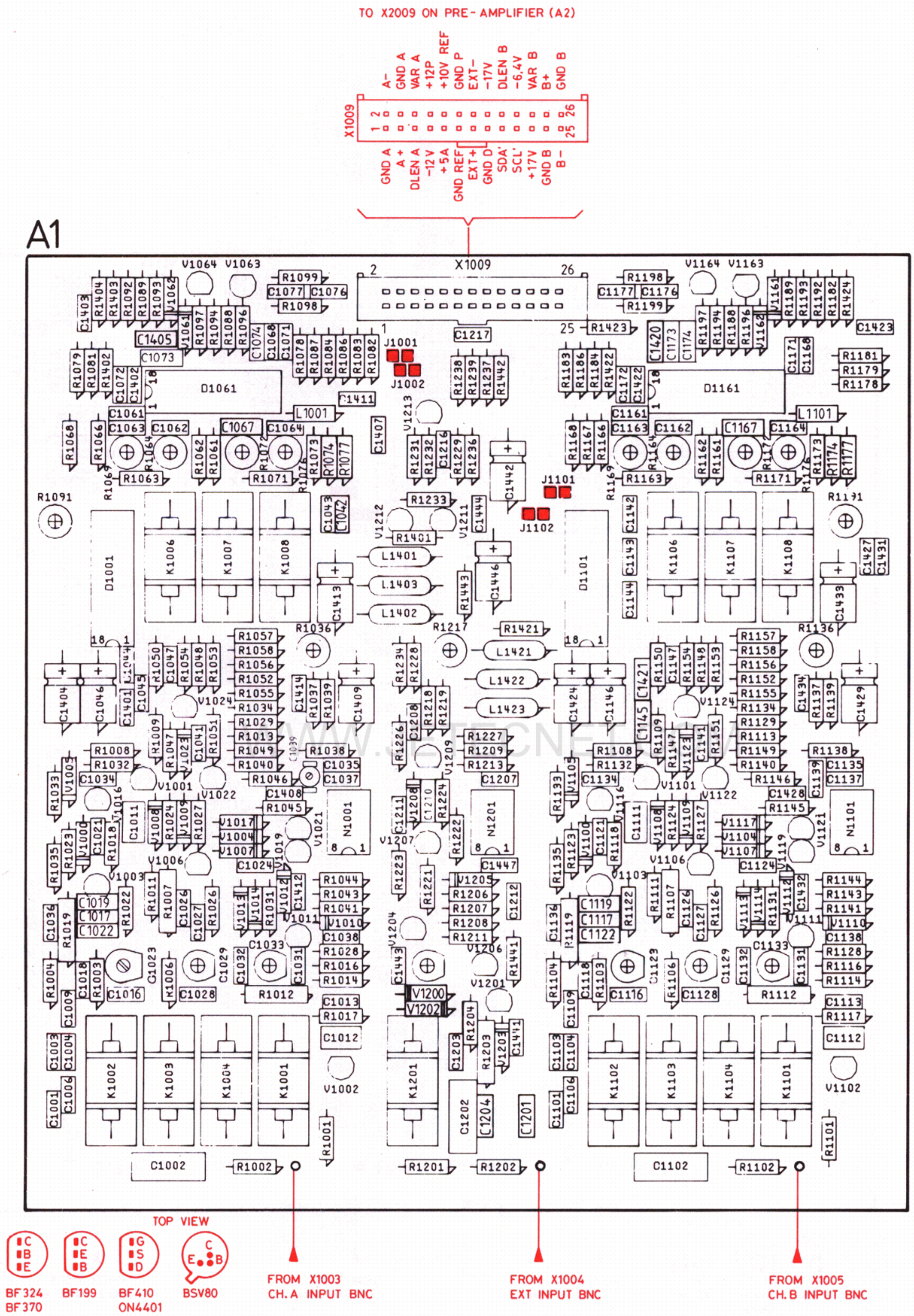
Input coupling, basically similar to the ch.A input coupling.

High impedance attenuator for the x1 attenuator only, where the l.f. square-wave can be adjusted with trimmer C1206. The l.f. part is routed to the summation point N1201-2. R1217 serves as an offset compensation for N1201. For l.f.-feedback the output of the impedance converter is also routed to this summation point.

Note that the output of this stage is also a reconstituted version of the input signal.

Impedance converter, is basically similar to the ch.A impedance converter.

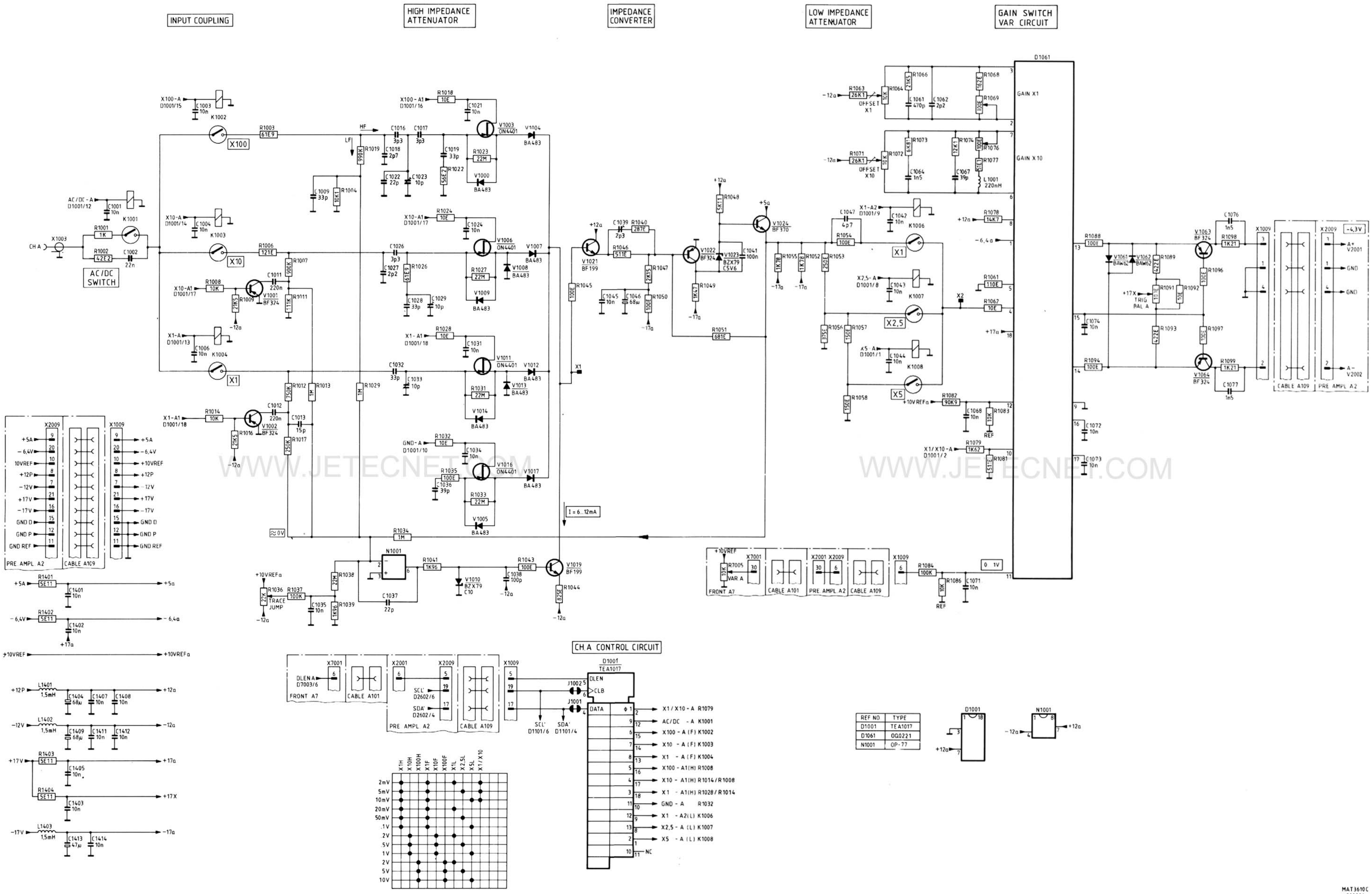
The differential amplifier V1211, V1212 converts the voltage from emitter-follower V1209 into the differential current signals EXT + and EXT-. This signal is applied to the pre-amplifier unit and serves as external trigger signal or as an external deflection signal. The current for this stage is applied from current source V1213.



SOLDERJOINTS:	
J1001	IF OPENED, SDA' TO D1061 IS INTERRUPTED
J1002	IF OPENED, SCA' TO D1061 IS INTERRUPTED
J1003	IF OPENED, SDA' TO D1161 IS INTERRUPTED
J1004	IF OPENED, SCA' TO D1161 IS INTERRUPTED
TO BE USED IN POWER-UP ROUTINE IN CASE OF FAILURE	

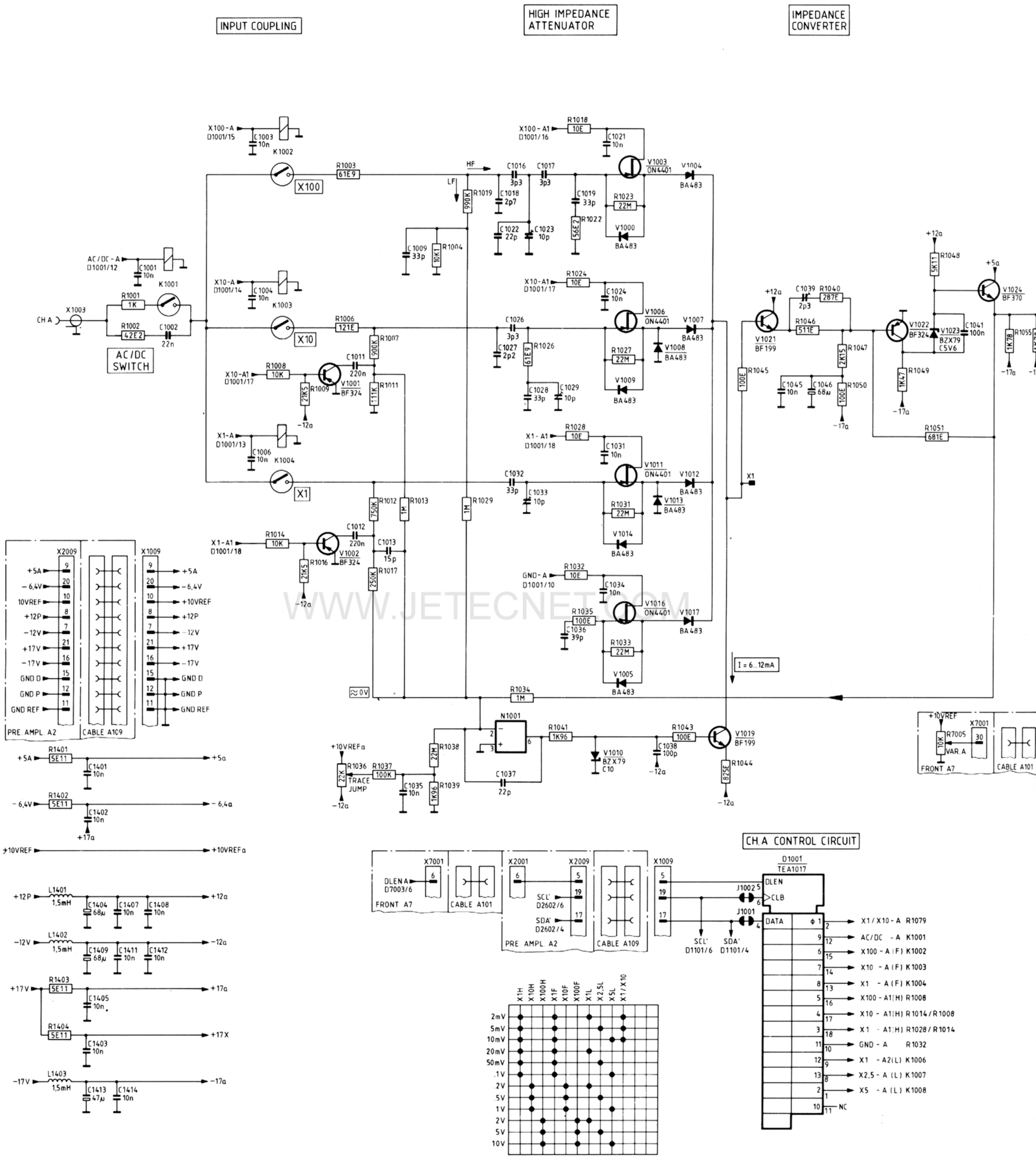
MAT3609A

Figure 4.2 Attenuator unit p.c.b.

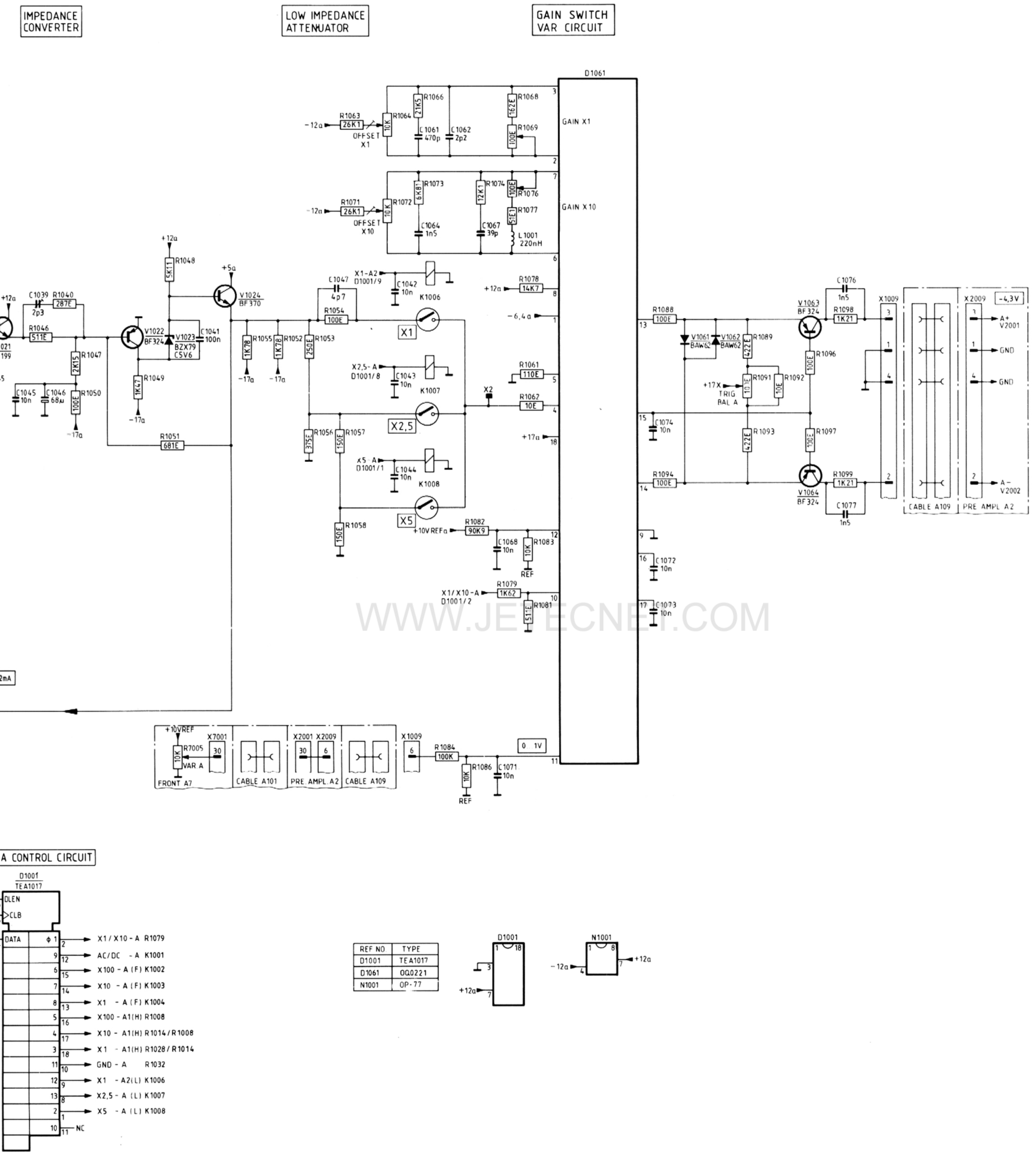


MAT3610C
900806

Figure 4.3 Circuit diagram of attenuator, ch.A

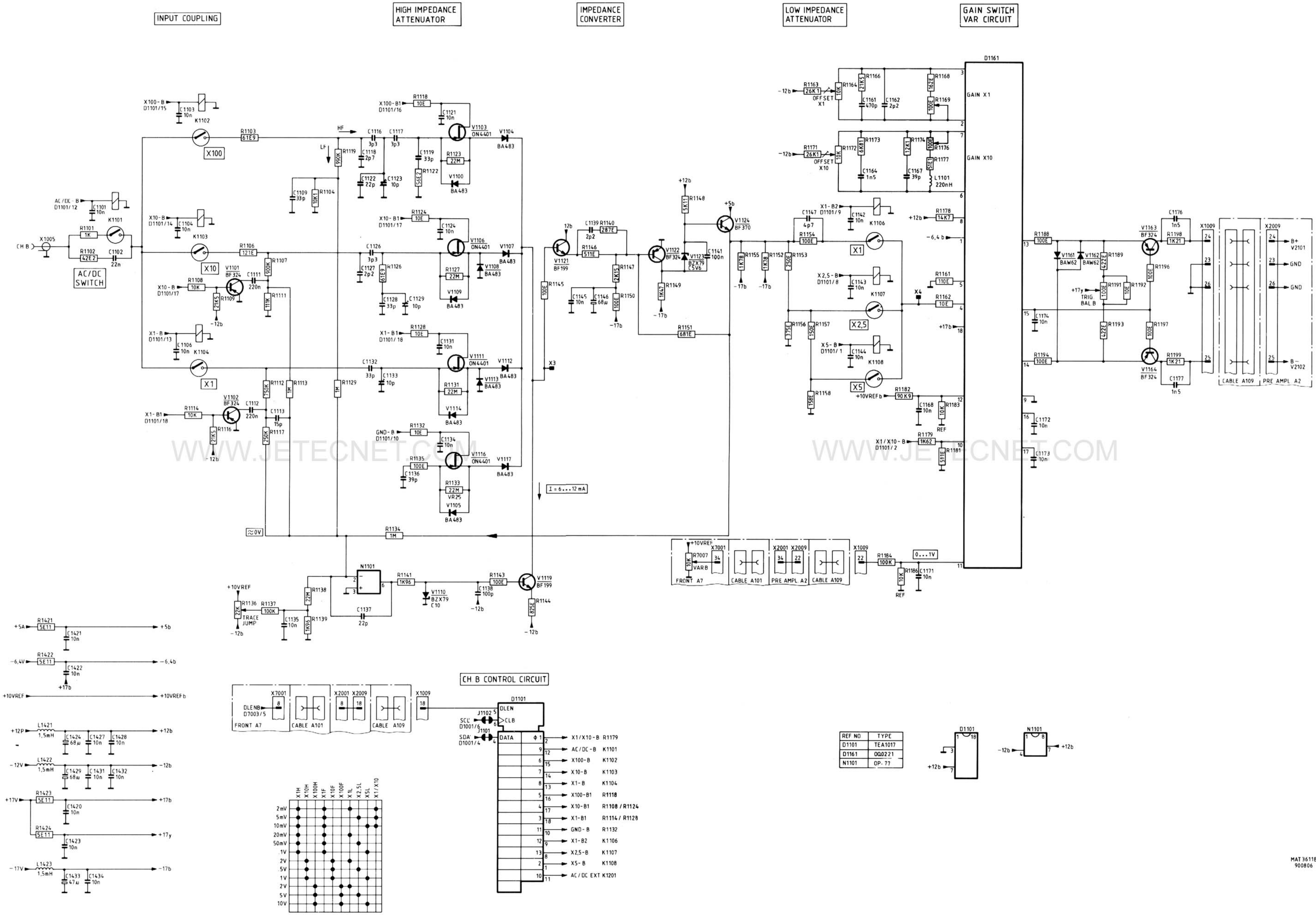


INPUT COUPLING
HIGH IMPEDANCE ATTENUATOR
IMPEDANCE CONVERTER
AC/DC SWITCH
CH A
X100
X10
X1
I = 6...12mA
PRE AMPL A2
CABLE A109
FRONT A7
CABLE A101
CH.A CONTROL CIRCUIT
D1001
TEA1017
DLEN
CLB
DATA
X1/X10 - A R1079
AC/DC - A K1001
X100 - A (F) K1002
X10 - A (F) K1003
X1 - A (F) K1004
X100 - A1(H) R1008
X10 - A1(H) R1014/R1008
X1 - A1(H) R1028/R1014
GND - A R1032
X1 - A2(L) K1006
X2,5 - A (L) K1007
X5 - A (L) K1008
NC
TRACE JUMP
VAR. A
WWW.JETECNET.COM



REF NO	TYPE
D1001	TEA1017
D1061	OQ0221
N1001	OP-77

Figure 4.3 Circuit diagram of attenuator, ch.A



REF NO	TYPE
D1101	TEA1017
D1161	OQ0221
N1101	OP-77

Figure 4.4 Circuit diagram of attenuator, ch.B

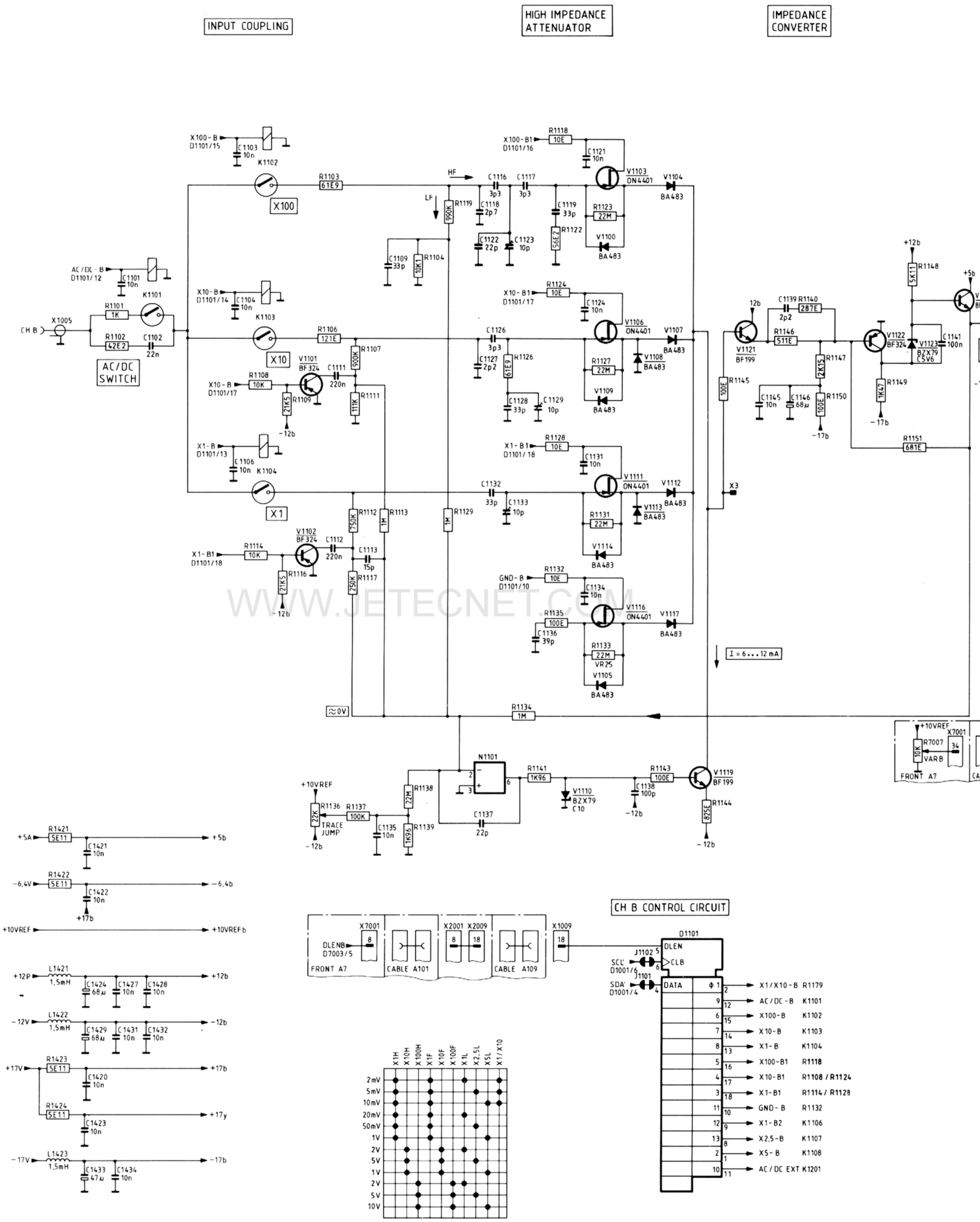
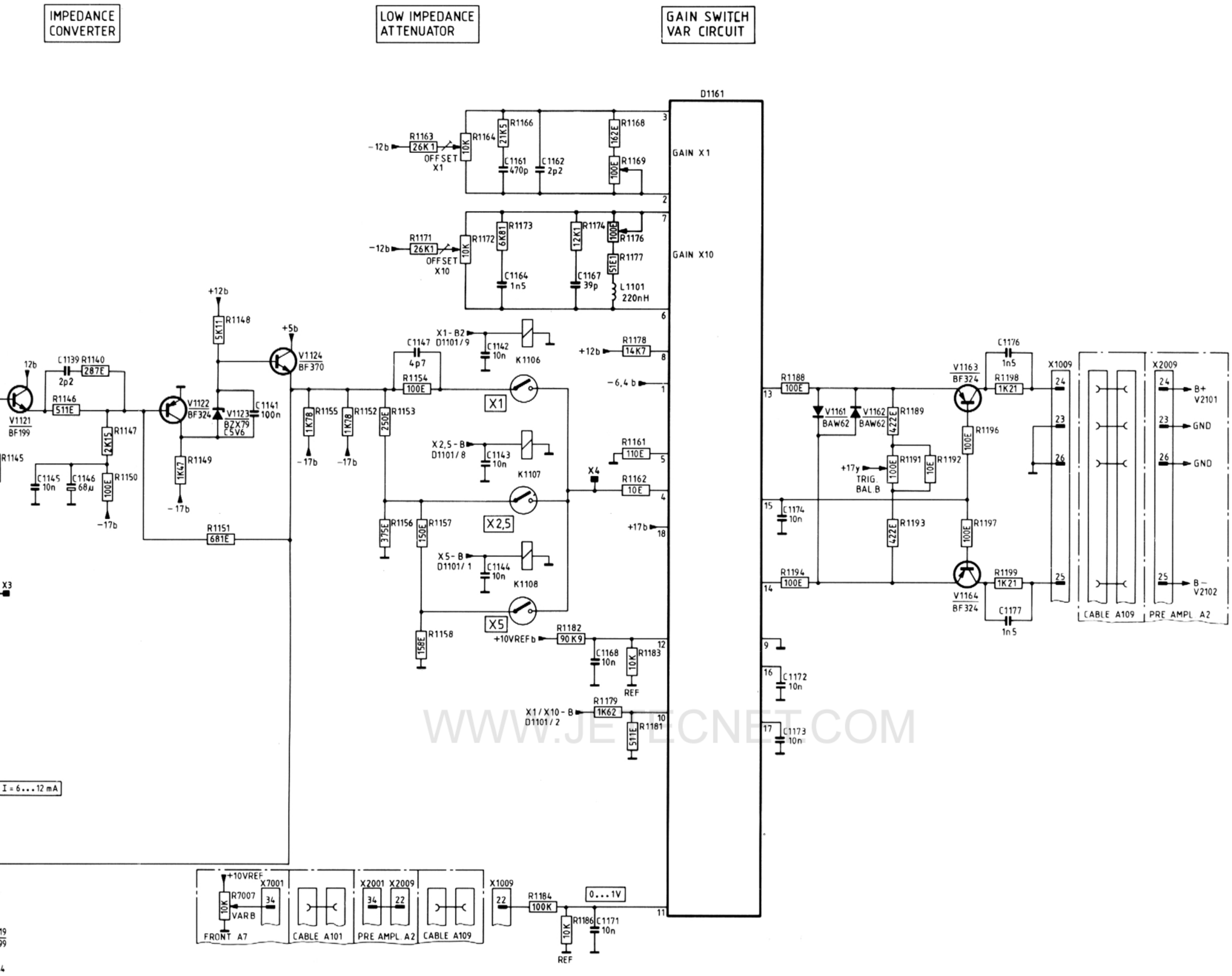
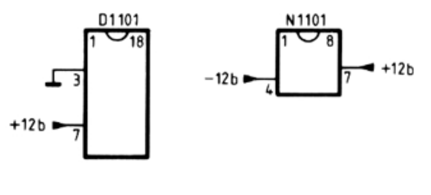


Figure 4.4 Circuit diagram of attenuator, ch.B

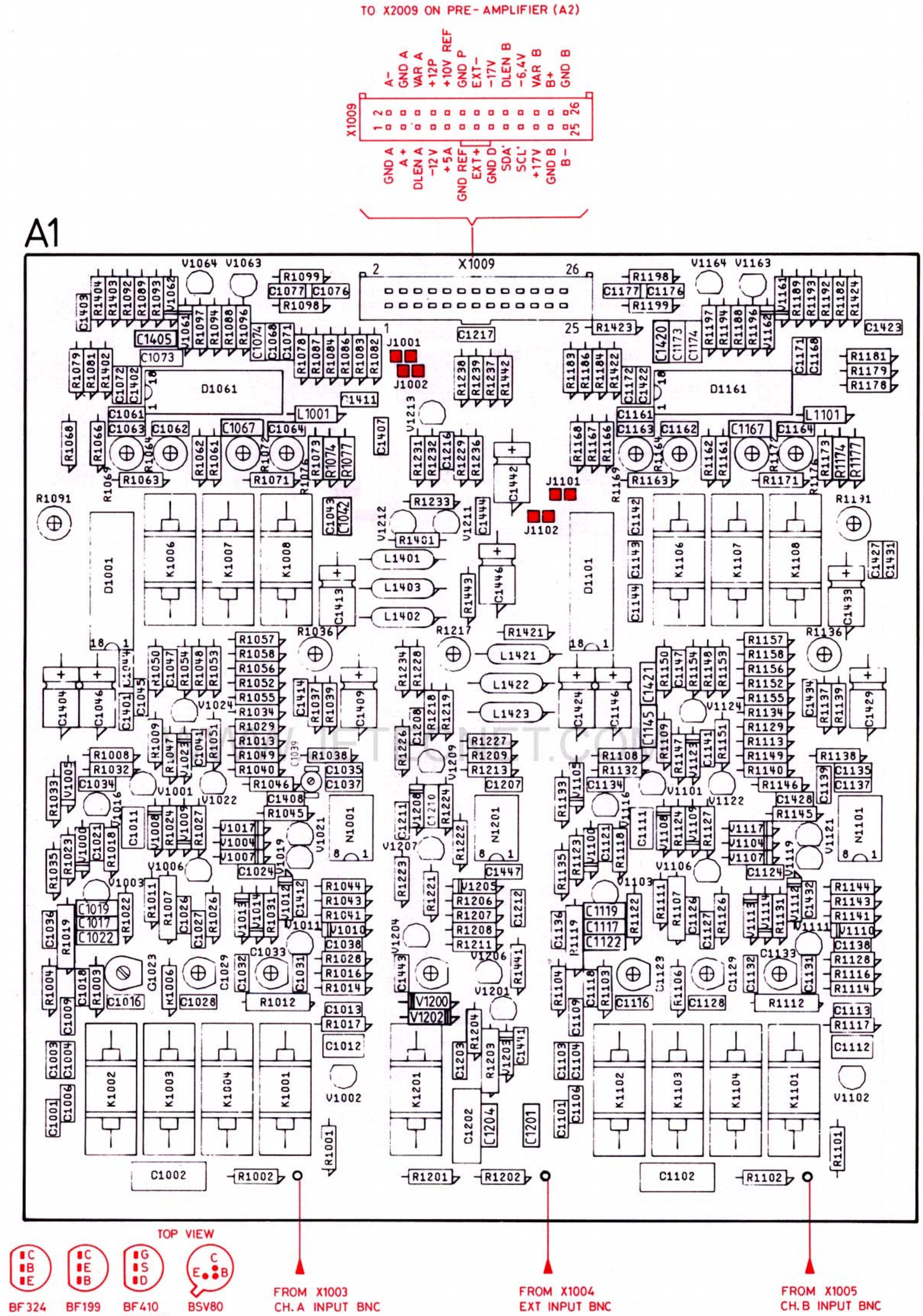


REF NO	TYPE
D1101	TEA1017
D1161	OQ0221
N1101	OP-77



X1/X10-B R1179
AC/DC-B K1101
X100-B K1102
X10-B K1103
X1-B K1104
X100-B1 R1118
X10-B1 R1108 / R1124
X1-B1 R1114 / R1128
GND-B R1132
X1-B2 K1106
X2,5-B K1107
X5-B K1108
AC/DC EXT K1201

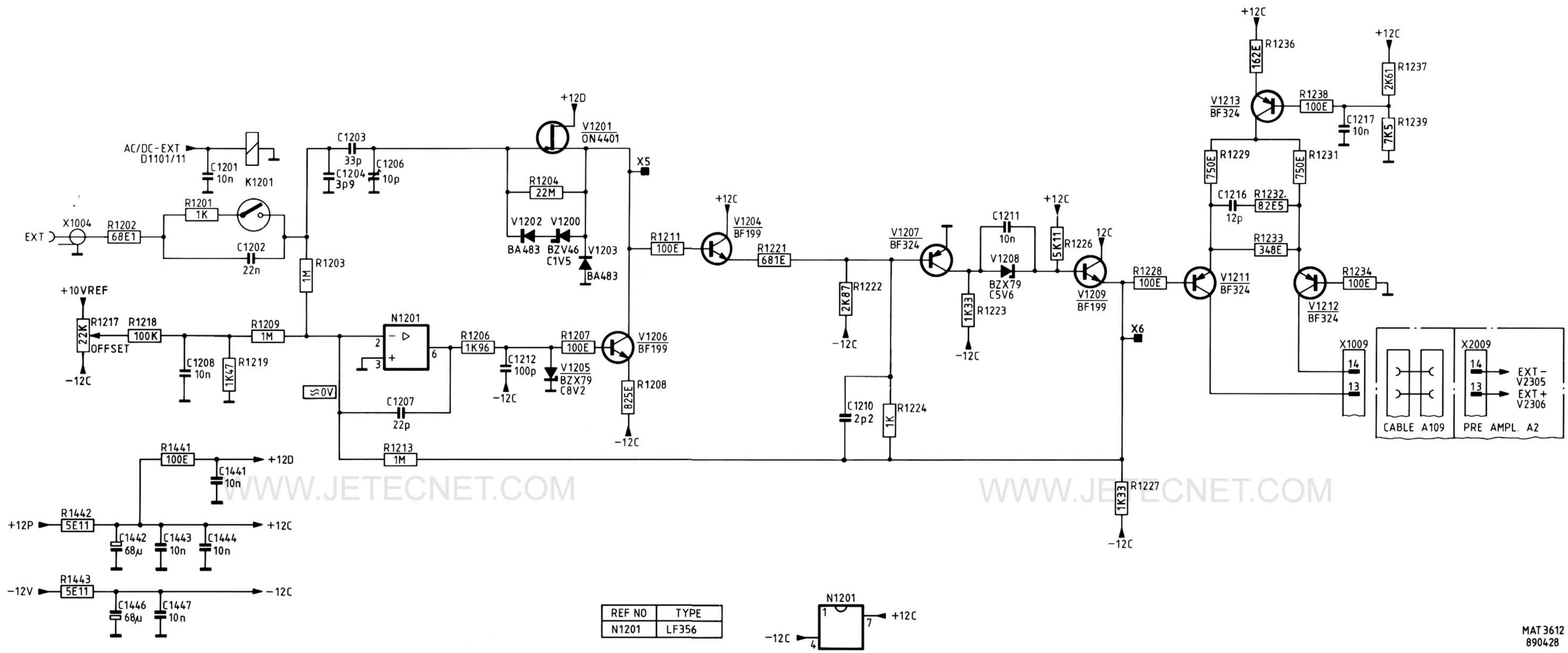
MAT 3611B
900806



SOLDERJOINTS:	
J1001	IF OPENED, SDA' TO D1061 IS INTERRUPTED
J1002	IF OPENED, SCA' TO D1061 IS INTERRUPTED
J1003	IF OPENED, SDA' TO D1161 IS INTERRUPTED
J1004	IF OPENED, SCA' TO D1161 IS INTERRUPTED
TO BE USED IN POWER-UP ROUTINE IN CASE OF FAILURE	

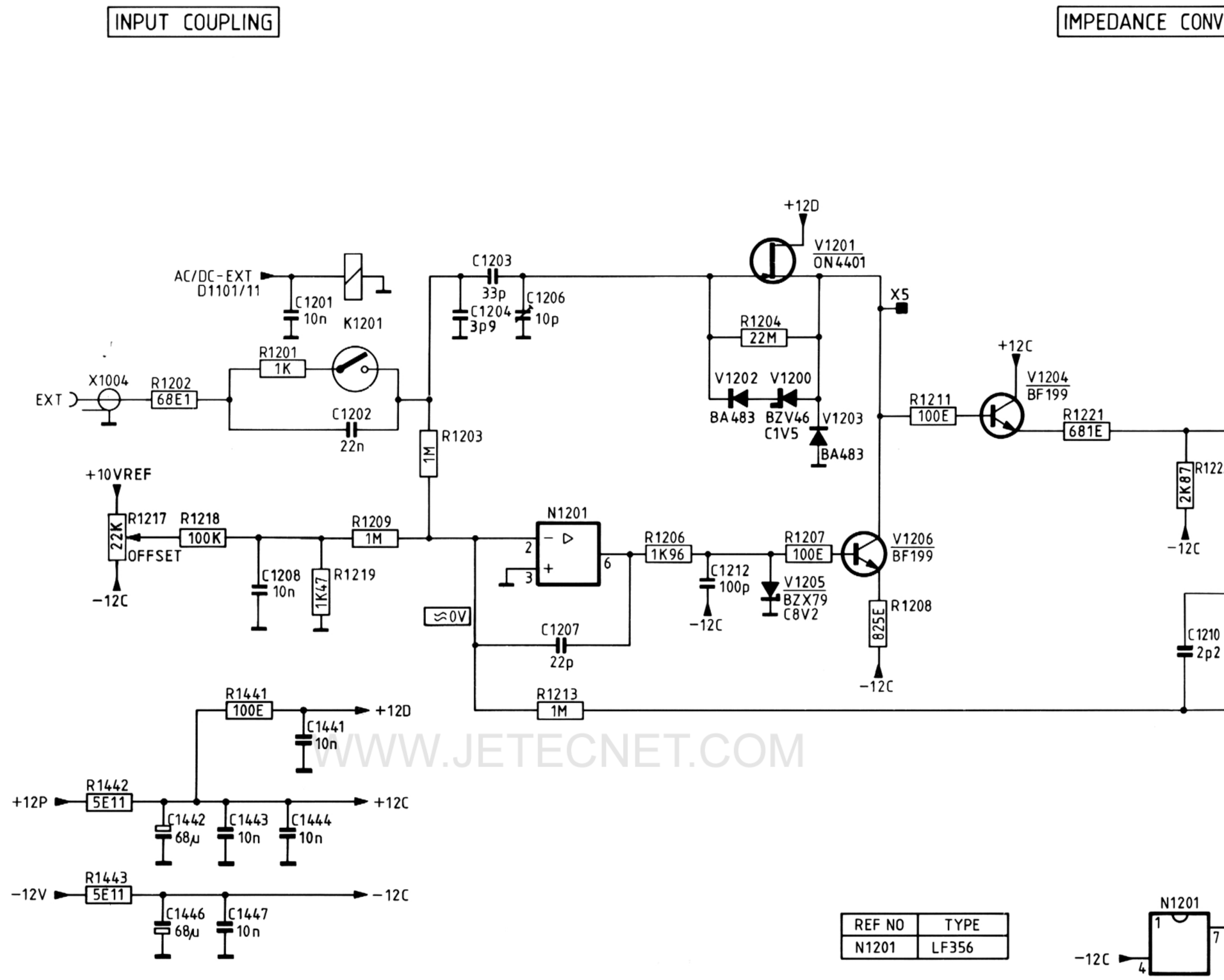
MAT3609A

Figure 4.5 Attenuator unit p.c.b.



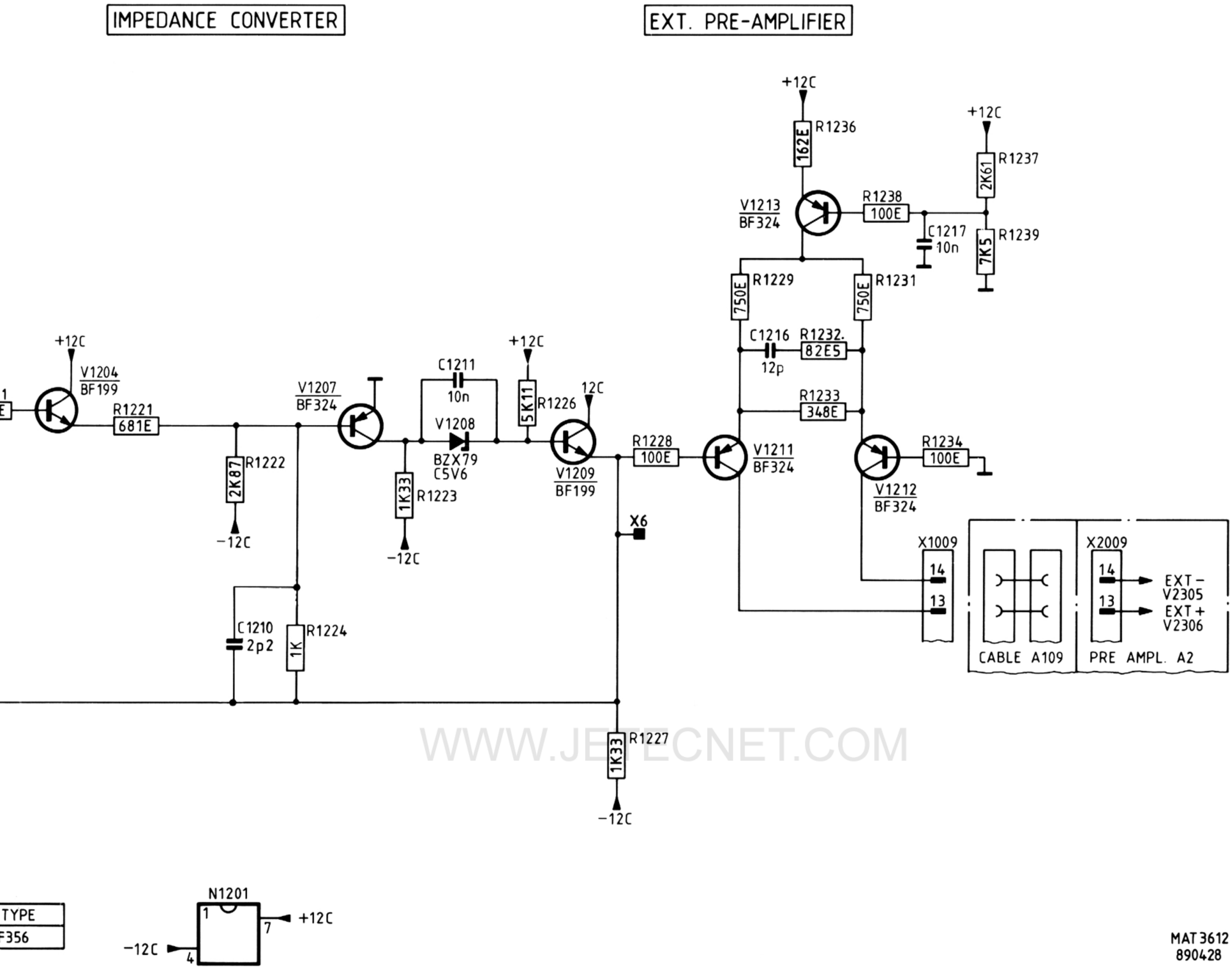
REF NO	TYPE
N1201	LF356

Figure 4.6 Circuit diagram of attenuator, EXT



REF NO	TYPE
N1201	LF356

Figure 4.6 Circuit diagram of attenuator, EXT


IMPEDANCE CONVERTER
EXT. PRE-AMPLIFIER
+12C
R1236
162E
V1213
BF324
R1238
100E
+12C
R1237
2K61
C1217
10n
R1239
7K5
R1229
750E
R1231
750E
C1216
12p
R1232.
82E5
R1233
348E
+12C
V1204
BF199
R1221
681E
V1207
BF324
R1222
2K87
-12C
C1211
10n
V1208
BZX79
C5V6
R1223
1K33
-12C
+12C
5K11
R1226
12C
V1209
BF199
R1228
100E
V1211
BF324
V1212
BF324
R1234
100E
X6
X1009
14
13
CABLE A109
X2009
14
13
EXT -
V2305
EXT +
V2306
PRE AMPL. A2
C1210
2p2
R1224
1K
R1227
1K33
-12C
TYPE
F356
N1201
1
7
+12C
-12C
4
MAT 3612
890428

5 PRE-AMPLIFIER UNIT (A2)

The pre-amplifier unit consists of:

- Vertical pre-amplifier
- Trigger pre-amplifier
- Pre-amplifier control, including CHOPPER oscillator

Next, the adaptation unit A16 is mounted on this board. This unit is described separately in chapter 12.

All control pulses for this unit are generated by the pre-amplifier control circuit, via the 1^2C bus (see Section 5.4).

5.1 VERTICAL PRE-AMPLIFIER

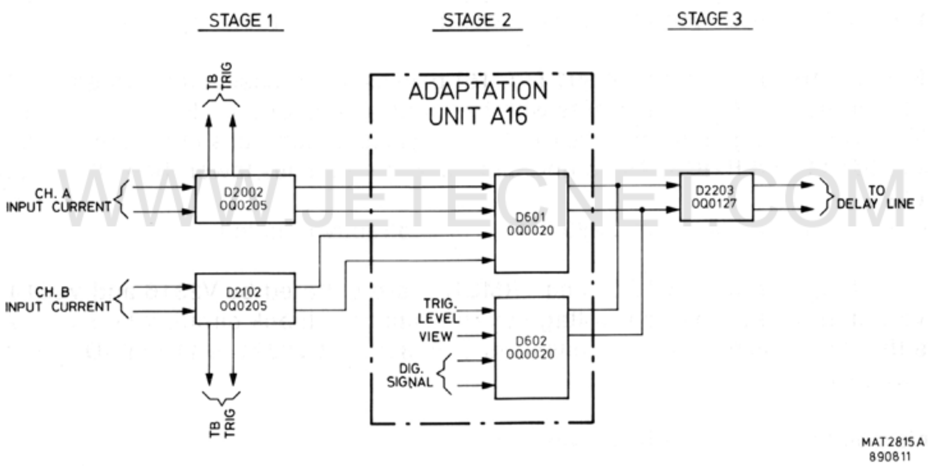


Figure 5.1 The three stages of the vertical pre-amplifier

The vertical pre-amplifier consists of three stages.

The signal splitter (Q0205) receives its input signal for channel A (B) from the attenuator unit and copies this signal into two identical differential output current signals for:

- Vertical deflection (pin 7 and 10)
- Time Base triggering (pin 5 and 12), refer to section 5.2.

The output of pin 7 and 10 is applied to the adaptation unit A16.

Stage 2 (unit A16): refer to the description of A16.

Stage 3 (D2203): serves as delay line driver where the output current of both OQ0020's is converted into voltage signal applied to the delay line. The current for this stage and for the OQ0020's D601 and D602 on adaption unit A16 is supplied via R2231 and R2246. The current regulation for the common-mode circuit is achieved by transistor D2203 (12, 13, 14).

5.2 TB TRIGGER PRE-AMPLIFIER

Trigger possibilities are:

	Signal name	Signal routed to	Selected by: name	routed to	Inverted by: name	routed to
ch. A	TRAM+,TRAM-	D2302(3,4)	AM	D2302(10)	INVAM	D2302(2)
ch. B	TRBM+,TRBM-	D2302(5,6)	BM	D2302(11)	INVBM	D2302(7)
EXT	EXT-,EXT+	D2303(3,4)	EXTM	D2303(10)	INVAM	D2303(2)
line	LINE	D2303(5)	LNM	D2303(11)	INVAM	D2303(7)

D2301 serves as a signal splitter and receives its input signal from the attenuator unit. This input current signal is copied into identical differential output current signals for EXT MTB signal (pin 6 and 11)

The symmetrical output currents from D2302 (13, 14) and D2303 (13, 14) are buffered by V2801 and V2802 and then applied to the DC-LF-HF trigger circuit D2801. This device is controlled on pin 15 for LF, pin 10 for HF and pin 9 for DC trigger coupling. A +3,2 V to one of these three inputs selects one trigger coupling mode while the other inputs are then + 1,9 V. D2802 Converts the data of the I^2C bus to these control lines.

In LF mode, the signal from D2801 (13, 16) passes a low-pass filter formed by C2801, R2809 and R2811. All components with frequencies higher then 50 kHz are then rejected.
In HF mode, the signal from D2801 (12, 17) passes a high-pass filter formed by C2802, C2803, R2811 and R2813. All components with frequencies lower then 50 kHz are now rejected.
In DC mode, the signal from D2801 (11, 18) is directly coupled.

The resulting currents TRMOD- and TRMOD+ are buffered by V2316 and V2319 and then converted into a symmetrical voltage by the shunt feedback circuit V2318 and V2321. Note that the sensitivity at the collectors of V2318 and V2321 is 110 mV/DIV (c.i. MTB- and MTB+).

At this point the signal path is divided into:

- a trigger path, fed to both V2333 and V2334, where depending on the current to the base, levelling of the trigger signal is obtained. Two separate series feedback circuits take care of voltage-to-current conversion:

  * V2341 and V2342 for time-base triggering.
    The trigger output signal, TRIGM- and TRIGM+ are fed to the time- base unit A4.
  * V2347 and V2349 for trigger level view.
    This symmetrical output can be balanced by potentiometer R2407.
    The TRIGV+ and TRIGV- signals are fed to D602/3,4 on the adaptation unit A16.

Integrated circuit D2304 serves as an auto level circuit. The following functions are possible:

a. <u>Peak-peak</u>
In this case the amplitude of the trigger signal applied to D2304 (3,7) is measured by peak-peak detectors on D2304 (2,4,6,8). The output current from D2304 (14,15) is dependent on the peak-peak level and is adjustable with the LEVEL control R7012, connected to D2304(1).

b. <u>Triggering</u>
In this case the level range is 16 div. The level is adjustable with R7012 and the current variation on D2304 (14,15) can be varied between +or- 0,6mA.

c. TV triggering
The level control is made ineffective. In TV triggering, the LEVEL must be set to a fixed value. This is done by applying a high level current to pin 1 via diode V2326.

d. Auto
In auto the signal LEVEL ZERO is high and via diode V2325 the output level D2304 (15) is asymmetrical with output level D2304 (14). Thus the maximum signal amplitude is 2 Vp-p.

An external deflection path, routed via the series feedback circuit V2356 and V2357, the X DEFL+ and X DEFL- signals are fed to the time base unit A2.
R2416, R2422 and C2350 gives phase correction for the X-Y display.

5.3 PRE-AMPLIFIER CONTROL

The pre-amplifier control converts the data from the I^2C bus (SDA and SCL), derived from the microcomputer, into the control pulses for the pre-amplifier unit. To eliminate interference the SDA and SCL lines can be switched off via D2601.

This integrated circuit serves as a digital switch, controlled by the VERT IIC line. Logic high connects the outputs D2601(4,14,15) to the input "1" contact (switched on); logic low connects the outputs to the "2" contact (switched off) and gives SDA a logic low level and SCL a logic high level.

When D2601 is switched on, the serial data information is converted into parallel control pulses via D2602 and D2603, provided that D2602 is enabled (D2602-5 is high). The control lines are active when the level of the line is high.

Output Q12-D2602(9) serves as a power up not line for D2603: when the oscilloscope is in the power-up routine, Q12 is high and resets D2603. After the power-up routine, Q12 goes low and enables D2603.

Integrated circuit D2603 relieves the microcomputer of a number of such functions as:

- trigger level view
- chop/alt
- trigger select
- time-base select (fed to time base unit A4)

Adaptation of this I.C. to the oscilloscope version is made by the AD0 and AD1 inputs D2603(15,16).
For this oscilloscope, both AD0 and AD1 must be LOW.

Timing for alternate and chopped mode is derived by the ALTCLN and CHOPCL pulses.

The chopper oscillator formed by V2611 and V2612 supplies a square wave voltage of 1,5 Vp-p with a frequency of 1 MHz.

This frequency is defined by two current loops:

- I1 is determined by: V2612(c-e), C2611, R2627 and R2625.
- I2 is determined by: V2611(c-e), C2611, R2628 and R2625.

The duty cycle (I1/I1+I2) is 12% approx.

The square wave on the collector of V2612 serves as a chopper clock pulse for D2603 and gives a 500 kHz display for 2 channels CHOP, 333 kHz display for 3 channels CHOP and 250 kHz for 4 channels CHOP (A, B, TRIG VIEW, ADD).

Note that D2603(8) serves as the chopper switch, which is high when the CHOP softkey is depressed.

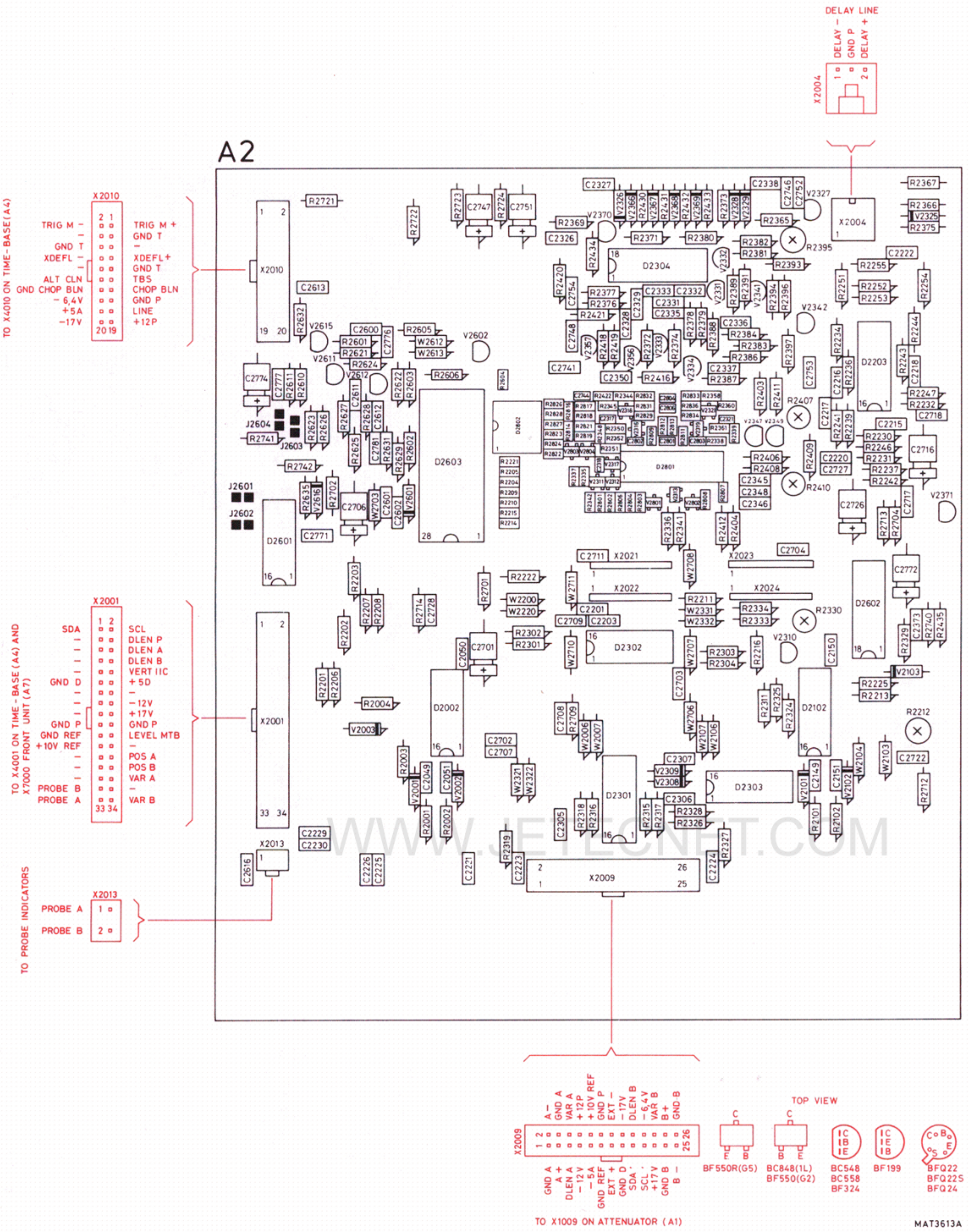
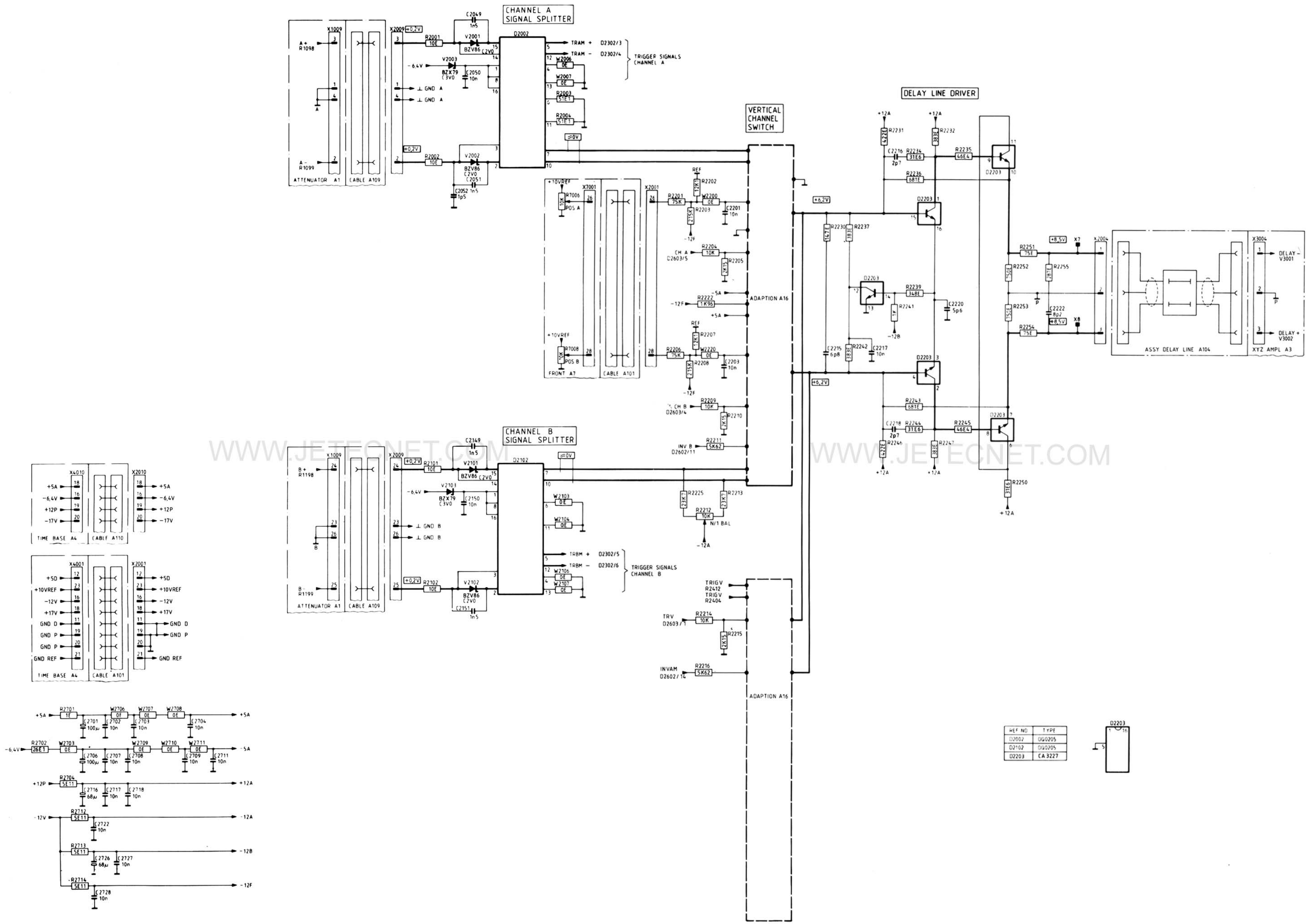
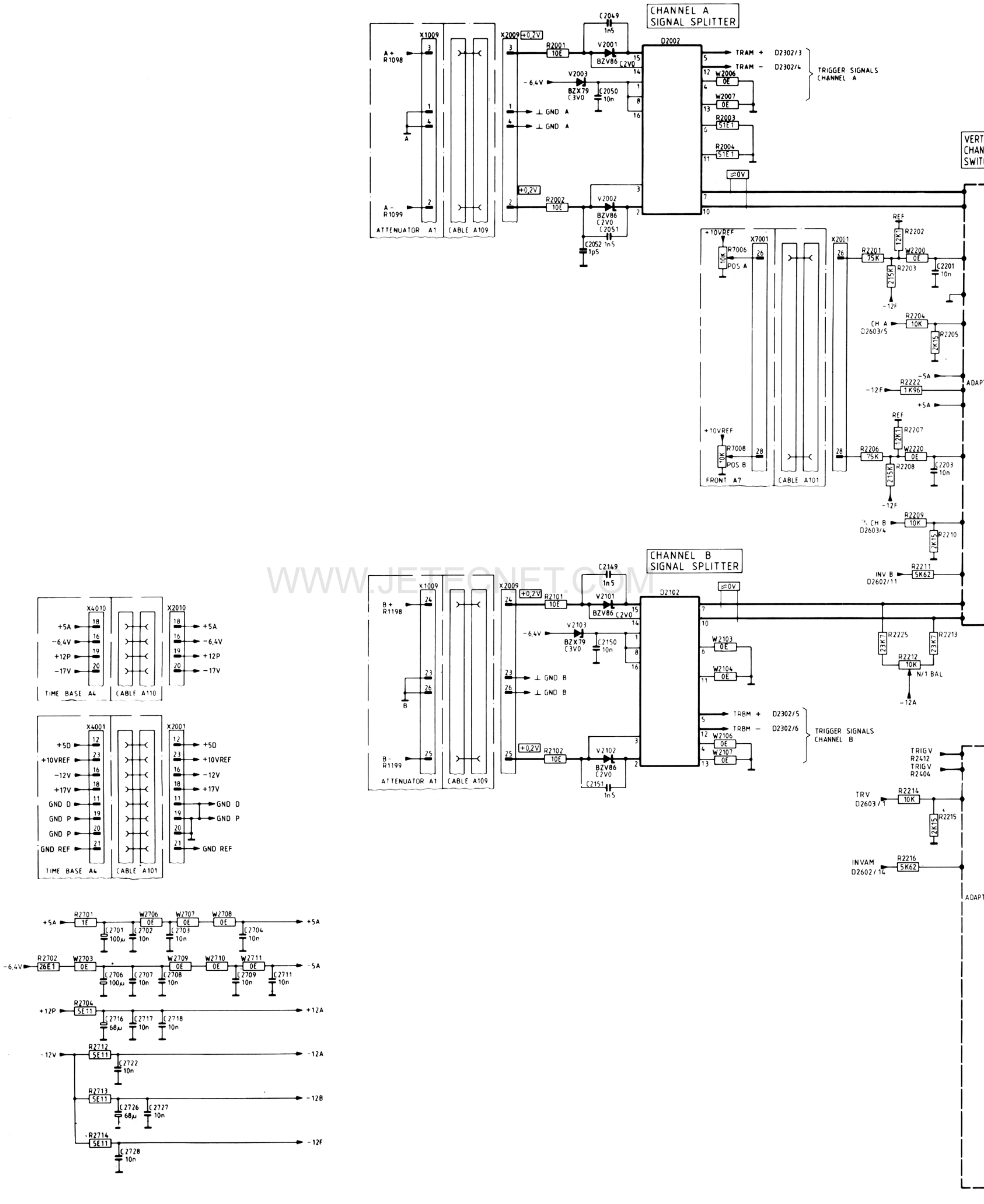


Figure 5.2 Pre-amplifier unit p.c.b.



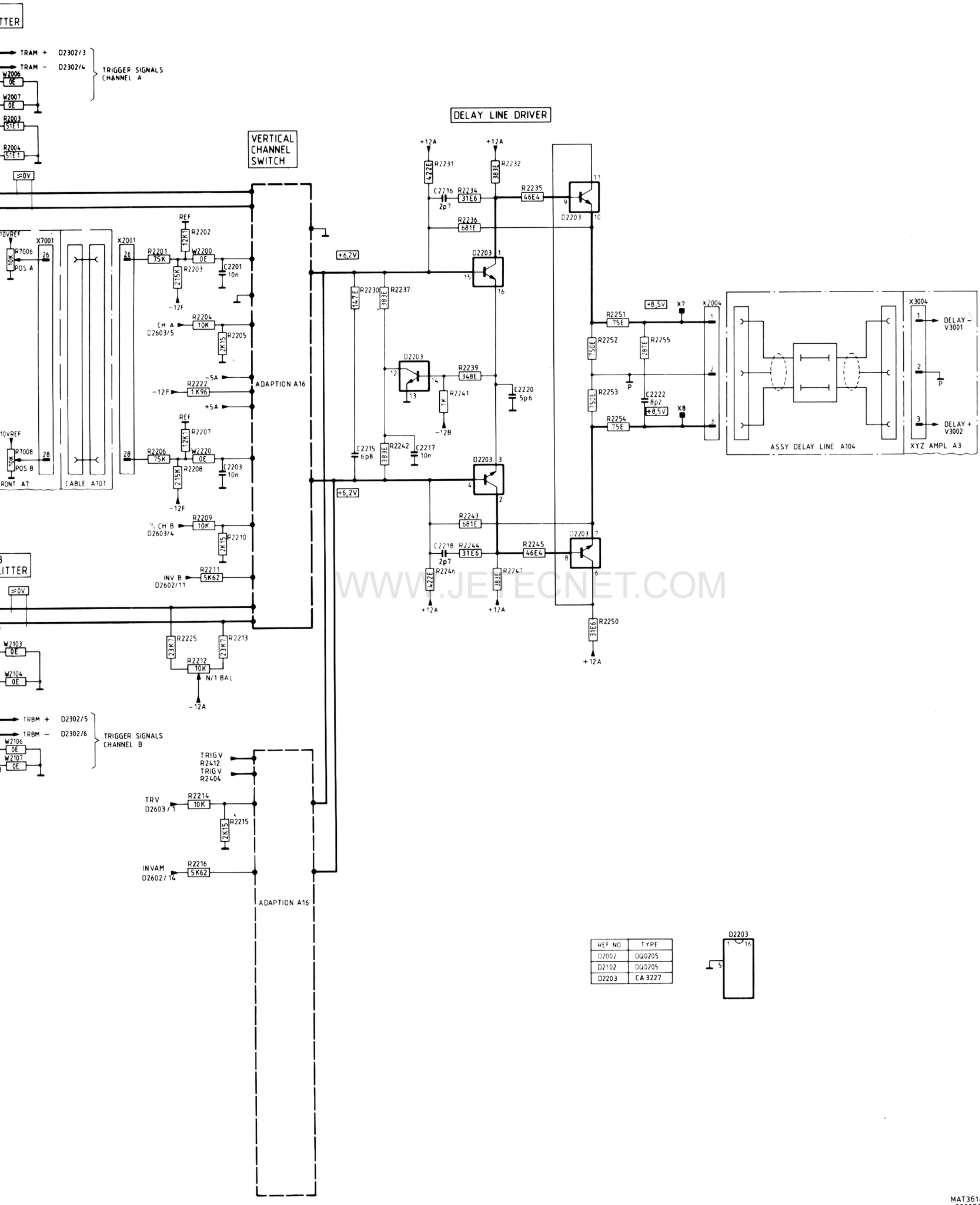
MAT3614B
900822

Figure 5.3 Circuit diagram of pre-amplifier, channel switch and delay line driver



CHANNEL A SIGNAL SPLITTER
CHANNEL B SIGNAL SPLITTER
TRIGGER SIGNALS CHANNEL A
TRIGGER SIGNALS CHANNEL B
ATTENUATOR A1
CABLE A109
FRONT A7
CABLE A101
TIME BASE A4
CABLE A110
D2002
D2102
TRAM + D2302/3
TRAM - D2302/4
TRBM + D2302/5
TRBM - D2302/6
POS A
POS B
N/1 BAL
TRIG V R2412
TRIG V R2404
TRV D2603/1
INVAM D2602/14
INV B D2602/11
CH A D2603/5
CH B D2603/4
VERT CHAN SWIT
ADAPT

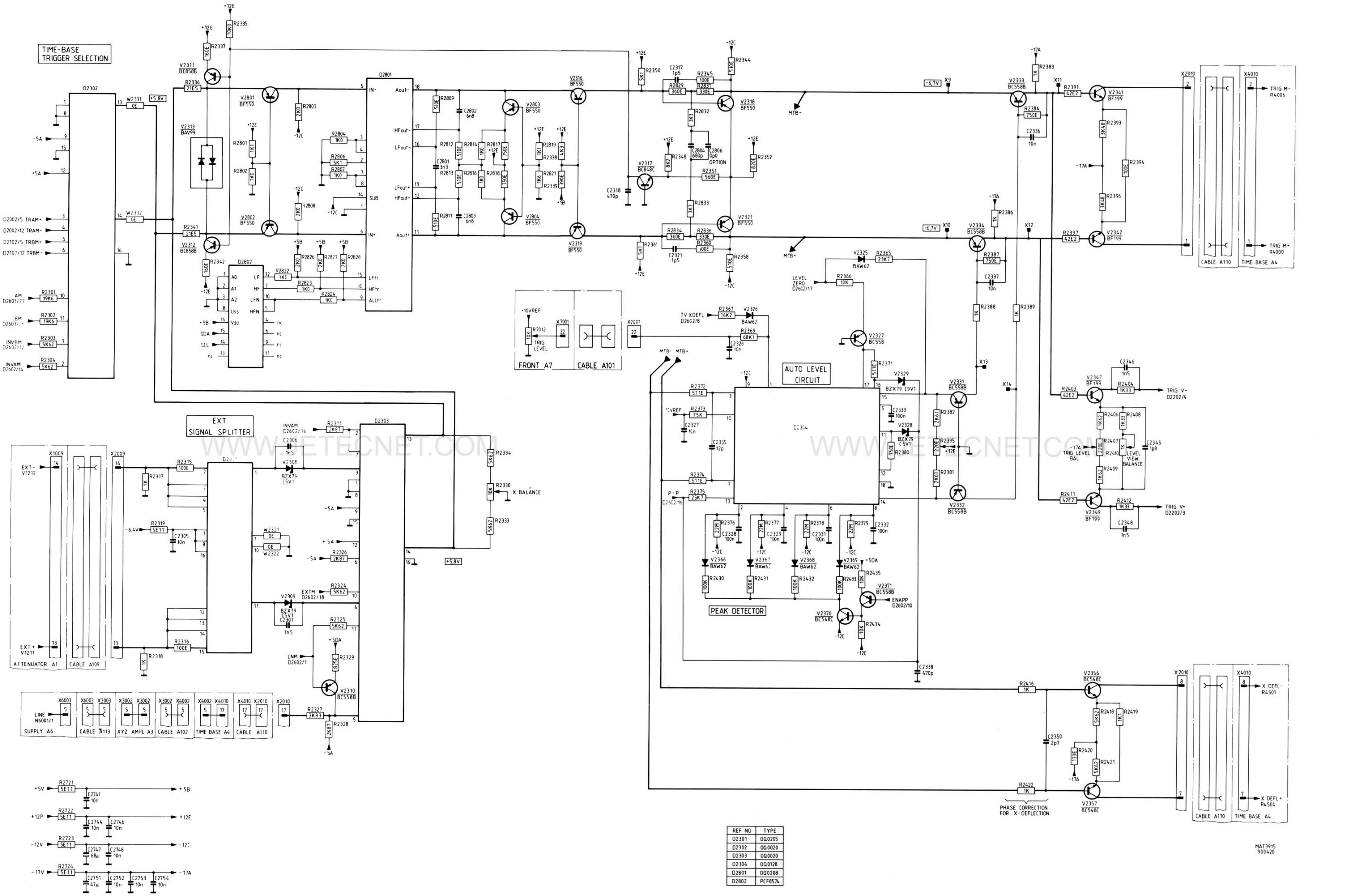
Fig



REF NO	TYPE
D2002	OQ0205
D2102	OQ0205
D2203	CA 3227

MAT3614B
900822

Figure 5.3 Circuit diagram of pre-amplifier, channel switch and delay line driver



REF NO	TYPE
D2301	OQ0205
D2302	OQ0020
D2303	OQ0020
D2304	OQ0128
D2801	OQ0208
D2802	PCF8574

Figure 5.4 Circuit diagram of pre-amplifier, trigger switch

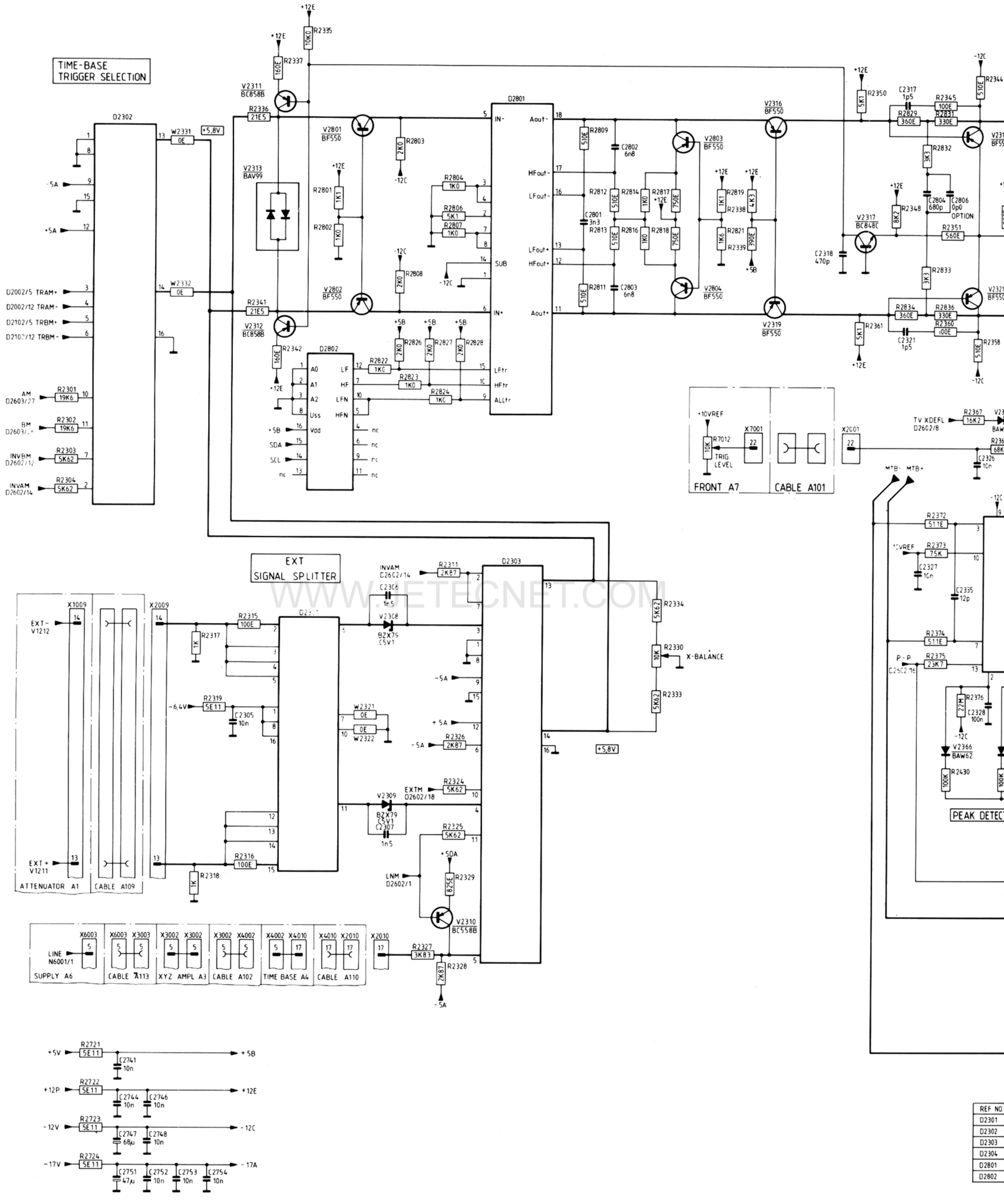
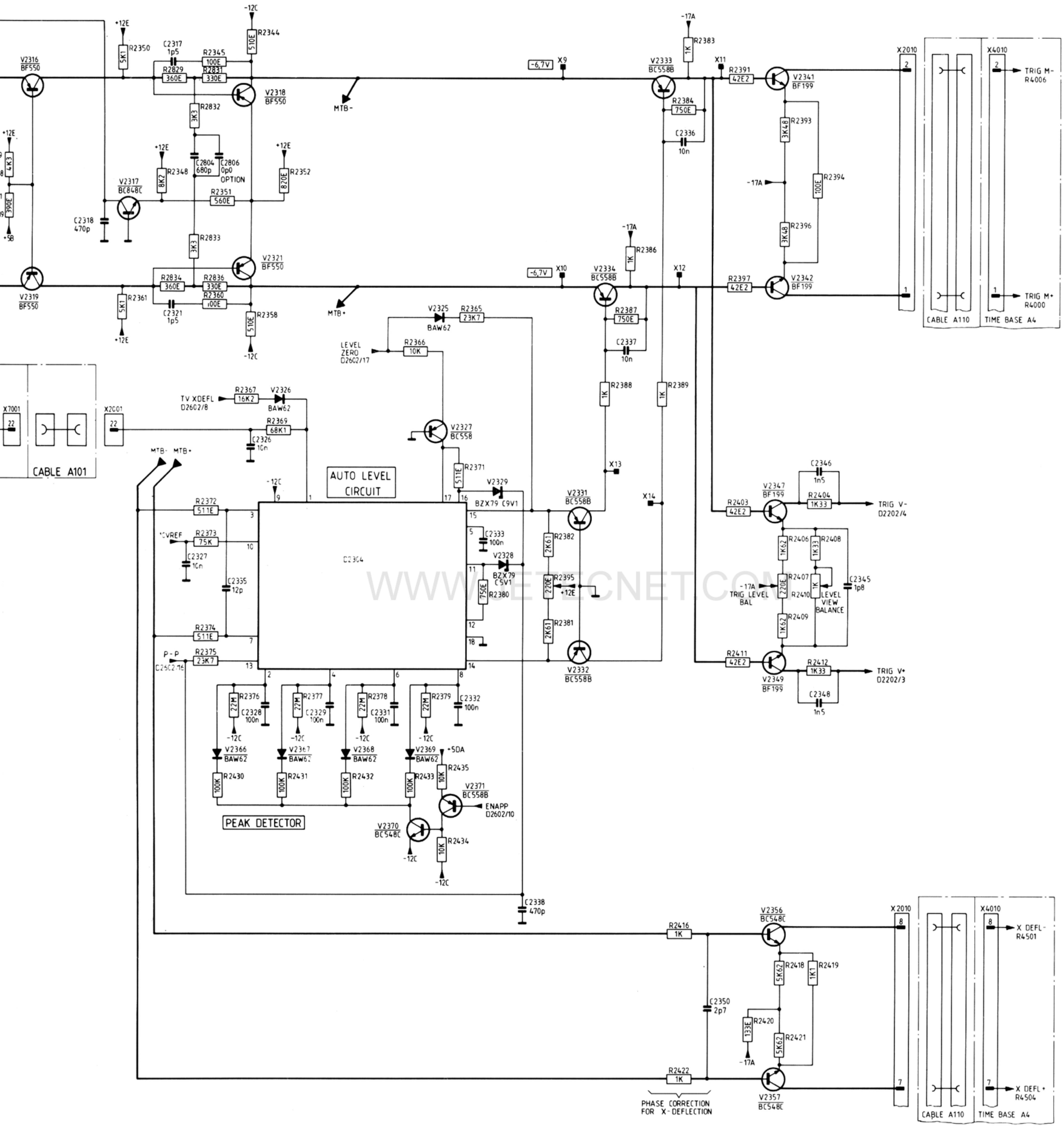


Figure 5.4 Circuit diagram of pre-amplifier, trigger switch



REF NO.	TYPE
D2301	OQ0205
D2302	OQ0020
D2303	OQ0020
D2304	OQ0128
D2801	OQ0208
D2802	PCF8574

MAT3915
900420

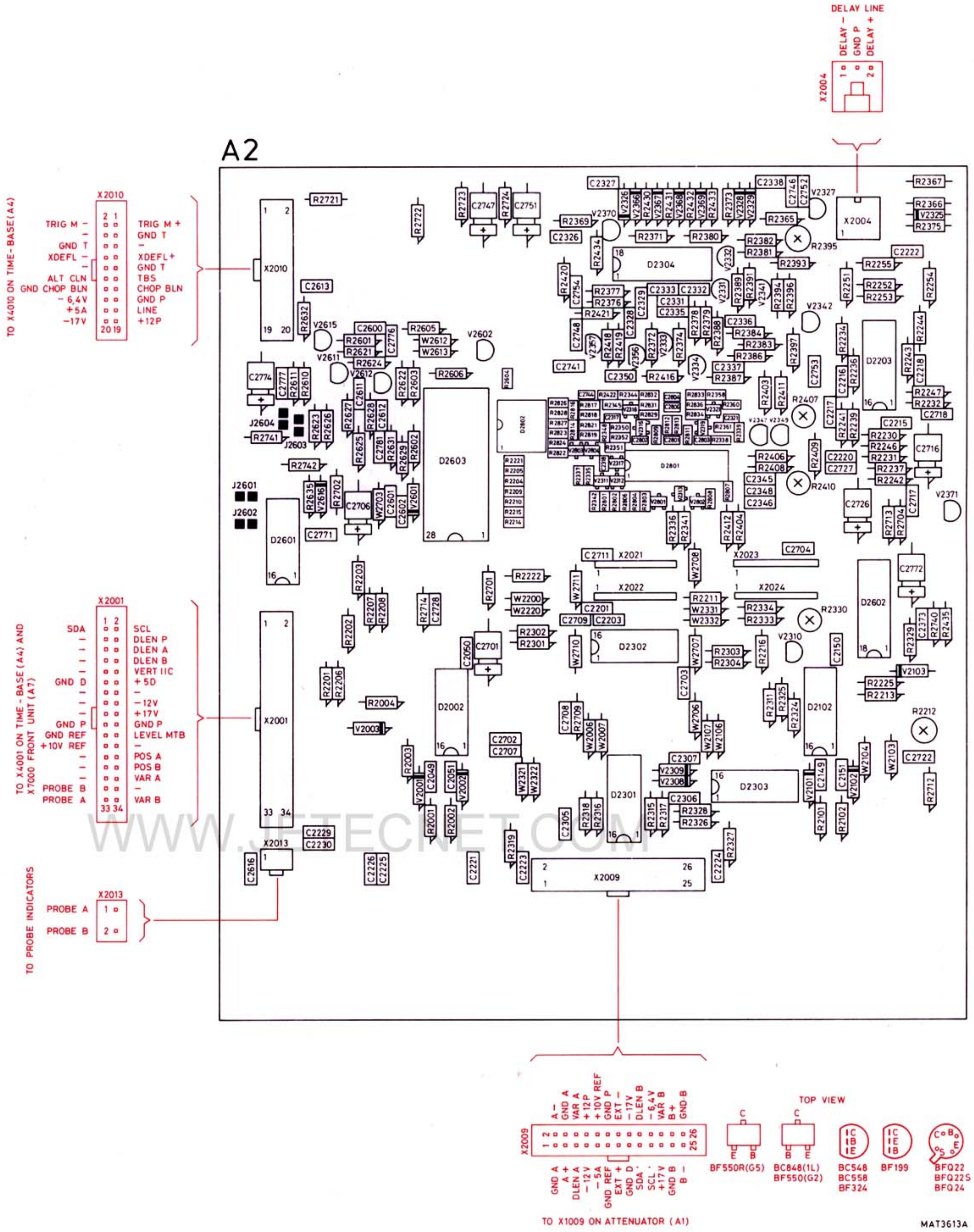
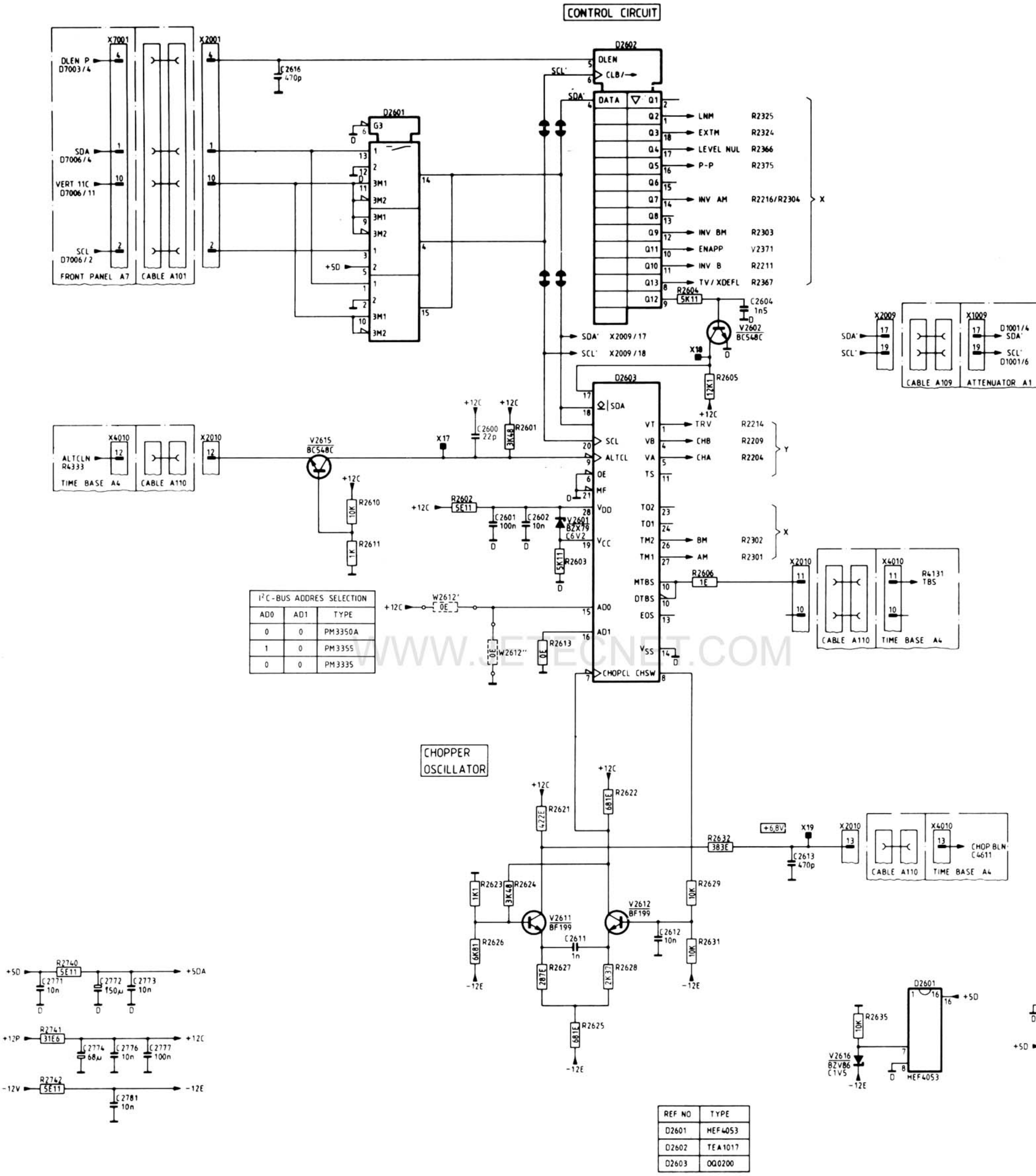


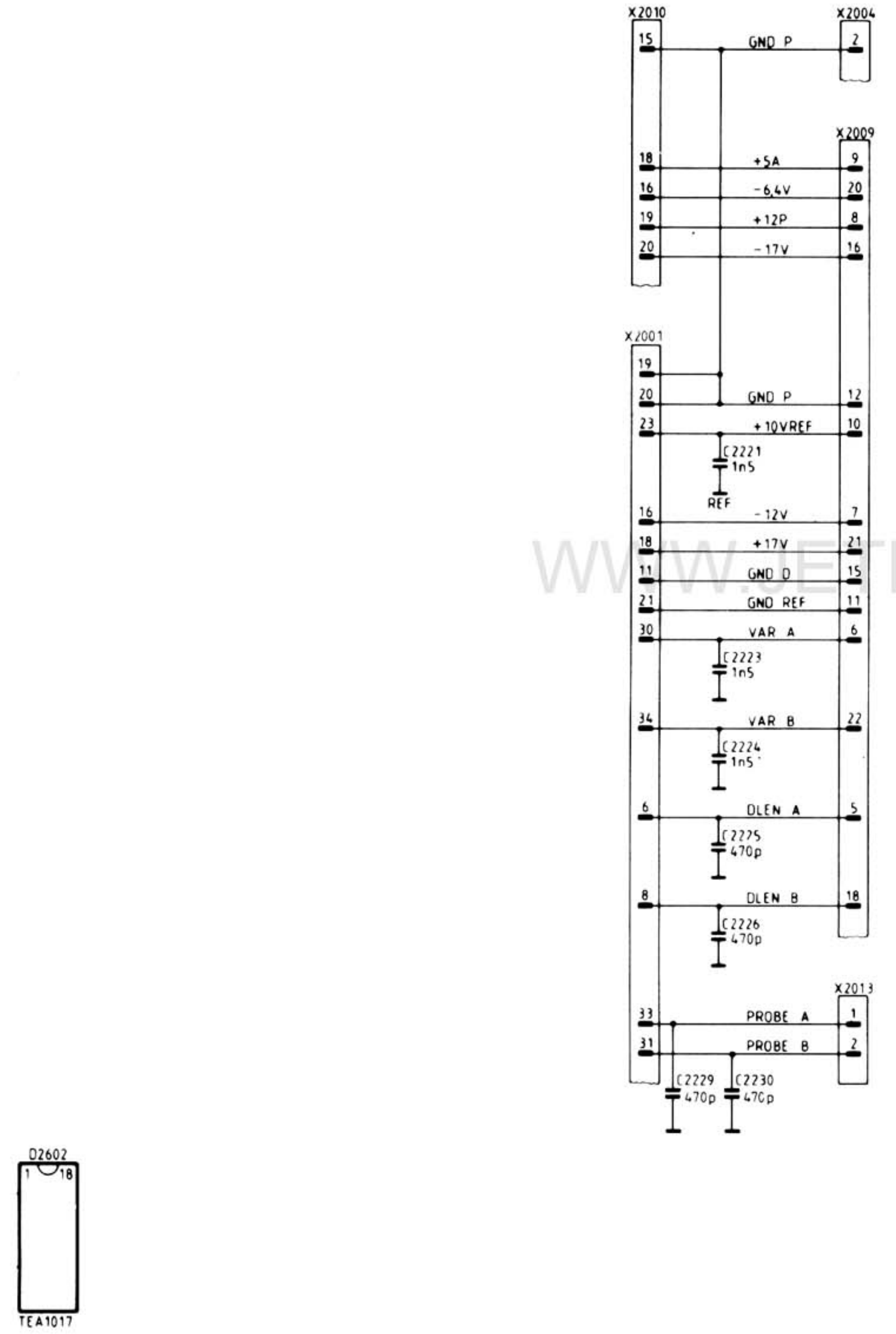
Figure 5.5 Pre-amplifier unit p.c.b.



I²C-BUS ADDRES SELECTION		
AD0	AD1	TYPE
0	0	PM3350A
1	0	PM3355
0	0	PM3335

REF NO	TYPE
D2601	HEF4053
D2602	TEA1017
D2603	OQ0200

Figure 5.6 Circuit diagram of pre-amplifier, logic control



MAT3616B
900806

6 XYZ-AMPLIFIER UNIT (A3)

6.1 INTRODUCTION

Unit A3 incorporates two separate pcb's which are connected via a flatcable. One pcb includes among other things the CRT socket and is connected at the rear of the CRT. The other pcb comprises the final X and Z amplifiers and is situated above the Cathode Ray Tube (CRT). For ease of description, unit A3 is described as one unit.

The XYZ-amplifier unit consists of:

- Final vertical (Y) amplifier.
- Final horizontal (X) amplifier.
- Final unblanking (Z) amplifier, incl. CRT.

6.2 FINAL VERTICAL (Y) AMPLIFIER

The final Y-amplifier receives its signal from the delay line and supplies the appropriate vertical signal to the Y-deflection plates of the CRT. For this the signal is processed in four stages:

- V3001, V3002 is a series feedback amplifier, including a delay line compensation network and potentiometer R3007 that controls current source V3003 for correction of any unbalance in the Y-deflection plates of the CRT. These circuits are connected between the emitters of both transistors V3001 and V3002.
  In this stage the input voltage is converted into a current signal.

- V3004, V3006 is a shunt feedback amplifier, which gives a voltage signal to the next stage.

- V3008, V3009 is a series feedback amplifier, including a final RC-correction network and potentiometer R3038 for gain adjustment to compensate the different CRT sensitivities. V3007 supplies a constant current of 60 mA, i.e. 30 mA for each half. Note that the output again supplies a current signal.

- V3011, V3012 is a common-base amplifier for buffering the final Y- amplifier to the Y-deflection plates. The maximum amplitude on each deflection plate is:
  30 mA x 655 Ω = 20 V approx.

6.3 FINAL HORIZONTAL (X) AMPLIFIER

The input current for X-deflection is obtained from the time-base unit (ref: X- and X+) and processed in three stages, with circuits in the following configurations:

- V3101, V3102 is a common-base amplifier. The current "I" on the collector of both transistors determines the voltage across R3102 and R3116. This voltage is about 1,5 V p-p and feeds the next stage.

- V3103, V3106 is a series feedback amplifier, including an RC- correction network for optimum linearity of the trace and potentiometer R3118 for x1 amplifier adjustment, mounted between the emitters of both transistors. V3104 serves as current source.

- V3112, V3114 are connected as a shunt feedback amplifier, with resistors R3126 and R3134 as the feedback resistors. The transistor source are emitter followers V3109, V3111. This circuit serves as the actual final amplifier, which converts the deflection current into the proper deflection voltage for the X-deflection plates of the CRT.Transistors V3108, V3116 supply the bias current for the circuit.

6.4 FINAL BLANKING (Z) AMPLIFIER AND CRT

The blanking current derived from the Z pre-amplifier of the time-base unit is routed via common base amplifier V3200 and emitter-follower V3201 to the shunt-feedback amplifier V3202. This stage is fed by current source V3203, which gives a constant current of 4 mA. The voltage on the collector of V3202 can vary between +5 V for unblanking and -35 V for fully blanking.
This Z-pulse may contain d.c., l.f. and h.f. components to be applied to grid G1 of the CRT. Since G1 is at a cathode potential of -2000 V, blocking capacitors are required between G1 and the Z-amplifier output. The h.f. component is directly routed via blocking capacitor C3211 to G1.
However, the d.c. and l.f. components are blocked, so these components are first modulated on a 200 kHz carrier signal by V3207 and V3208 to pass blocking capacitor C3209. Then the signal is demodulated again by V3209 and V3211. Finally, the reconstituted d.c. and l.f. components are added to the h.f. component.

Transistor V3251 forms a nominal 70 V zener circuit which provides the voltage difference between the cathode and G1 of the CRT. This bias voltage ensures blanking when there is no input signal. For adaptation to each CRT, this voltage can be varied between about 40 V and 100 V by means of R3252 (BLACK LEVEL). Resistor R3254 keeps the CRT-filament at the same potential as the cathode.

Any ripple on the cathode voltage is fed-back via transistor V3213 to the input of the Final Z-amplifier and added to the blanking signal. This means that the differential voltage between G1 and the cathode of the CRT is always fixed. Because this differential voltage determines the intensity of the spot, as a result, the intensity is almost independent of the ripple.

The amplifier stage V3253, V3254 and V3256 provides amplification for the range of the FOCUS control. The range of 0...+10 V gives a final range on G3 of the CRT of -1350 V ... -1600 V.

Resistor R3257 connects the INTENS control to the focus adjustment to maintain a sharply defined trace at varying brightness.

For optimum presetting of the GEOMETRY, the voltage on G5 of the CRT is set to a fixed level of -30 V. The ASTIGMATISM can be varied by means of potentiometer R3267.

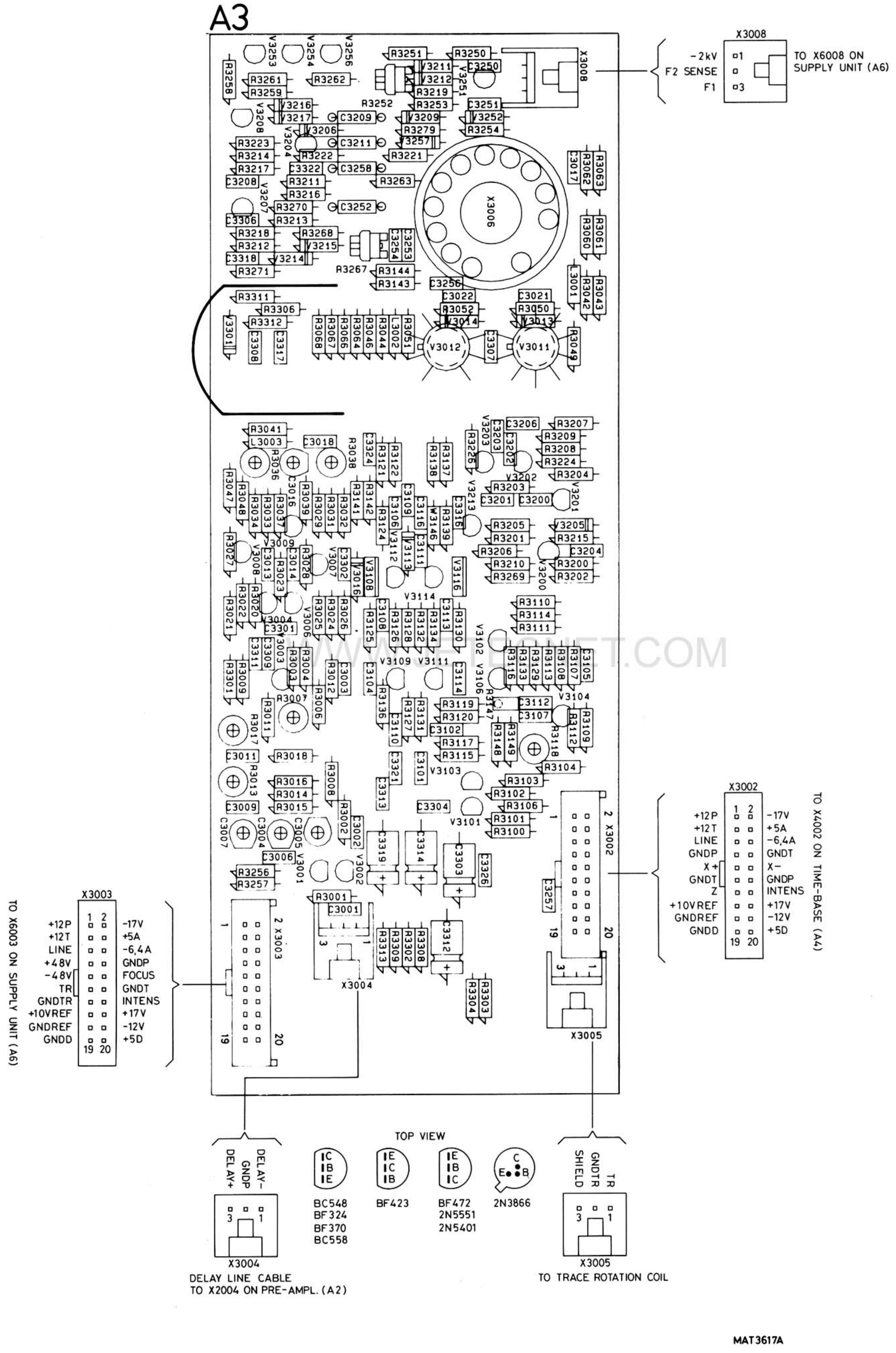
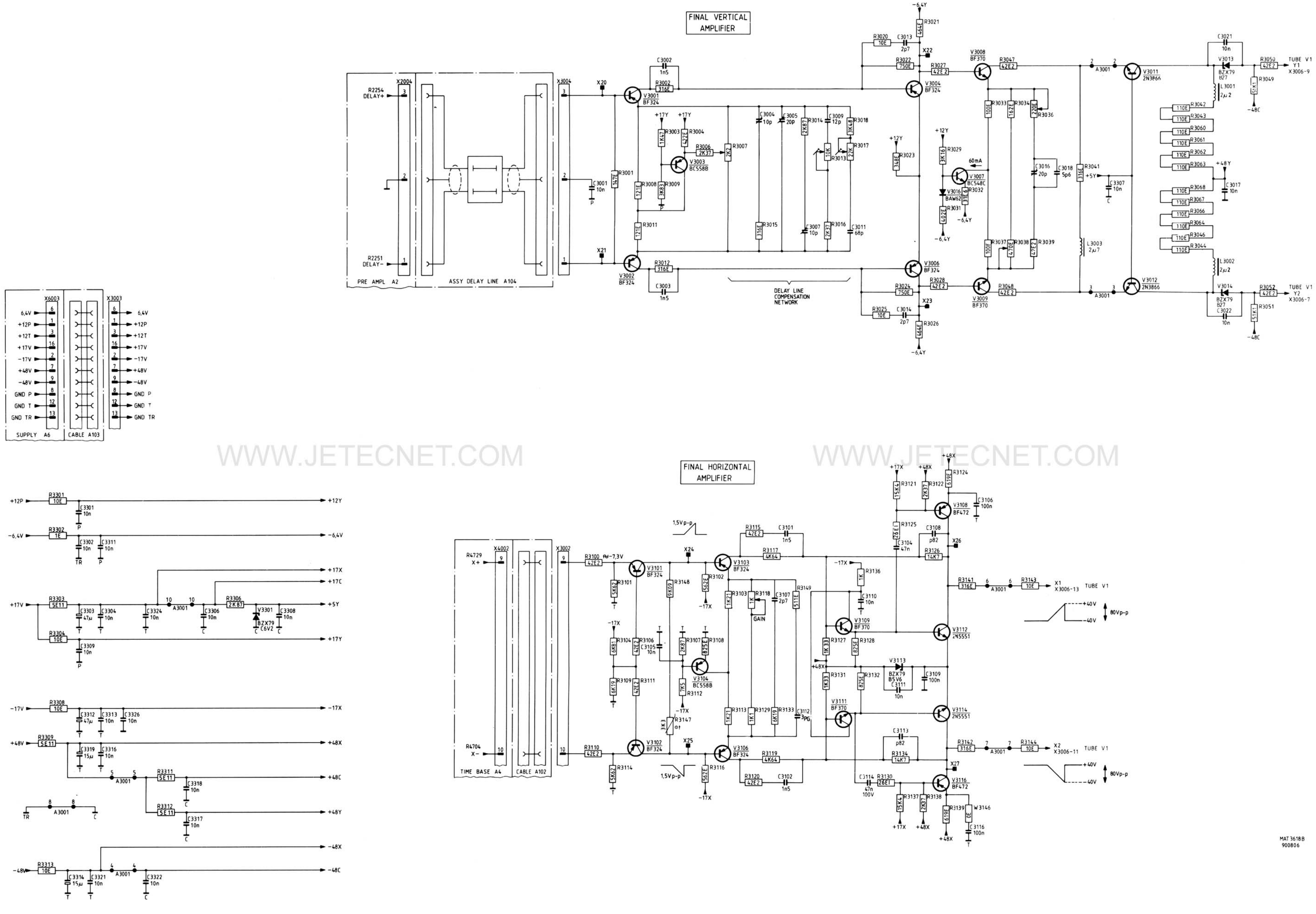


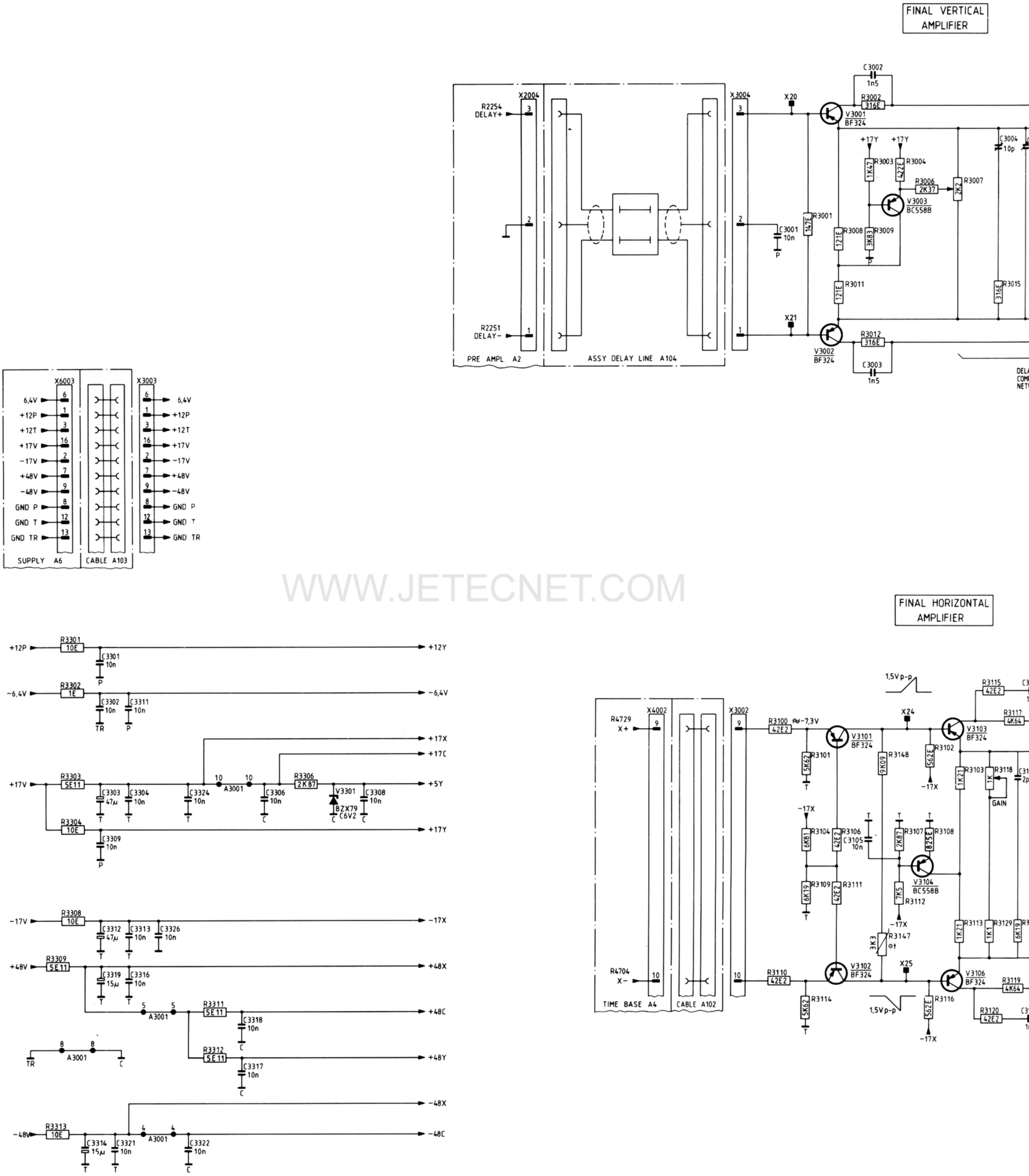
Figure 6.1 XYZ amplifier p.c.b.



WWW.JETECNET.COM

Figure 6.2 Circuit diagram of XYZ amplifiers, final X and Y amplifiers

(A6)


FINAL VERTICAL AMPLIFIER
PRE AMPL A2
ASSY DELAY LINE A104
R2254 DELAY+
R2251 DELAY−
X2004
X3004
X20
X21
C3002 1n5
R3002 316E
V3001 BF324
V3002 BF324
R3012 316E
C3003 1n5
C3001 10n
R3001 147E
R3008 121E
R3011 121E
+17Y
R3003 1K47
R3004 42E2
R3006 2K37
R3007 2K2
V3003 BC558B
R3009 3K83
C3004 10p
R3015 316E
SUPPLY A6
CABLE A103
X6003
X3003
6,4V
+12P
+12T
+17V
−17V
+48V
−48V
GND P
GND T
GND TR
R3301 10E
C3301 10n
+12Y
R3302 1E
−6,4V
C3302 10n
C3311 10n
R3303 5E11
C3303 47μ
C3304 10n
C3324 10n
A3001
C3306 10n
R3306 2K87
V3301 BZX79 C6V2
C3308 10n
+17X
+17C
+5Y
R3304 10E
C3309 10n
+17Y
R3308 10E
C3312 47μ
C3313 10n
C3326 10n
−17X
R3309 5E11
C3319 15μ
C3316 10n
+48X
R3311 5E11
C3318 10n
+48C
R3312 5E11
C3317 10n
+48Y
−48X
R3313 10E
C3314 15μ
C3321 10n
C3322 10n
−48C
FINAL HORIZONTAL AMPLIFIER
TIME BASE A4
CABLE A102
R4729 X+
R4704 X−
X4002
X3002
1,5Vp-p
R3100 42E2
≈−7,3V
V3101 BF324
V3102 BF324
R3101 5K62
R3110 42E2
R3114 5K62
X24
X25
R3148 9K09
R3102 562E
R3116 562E
R3104 6K81
R3106 42E2
C3105 10n
R3109 6K19
R3111 42E2
R3107 2K87
R3108 825E
V3104 BC558B
R3112 7K5
R3147 3K3
V3103 BF324
V3106 BF324
R3115 42E2
R3117 4K64
R3103 1K21
R3118 1K
GAIN
R3113 1K21
R3129 1K1
R3119 4K64
R3120 42E2

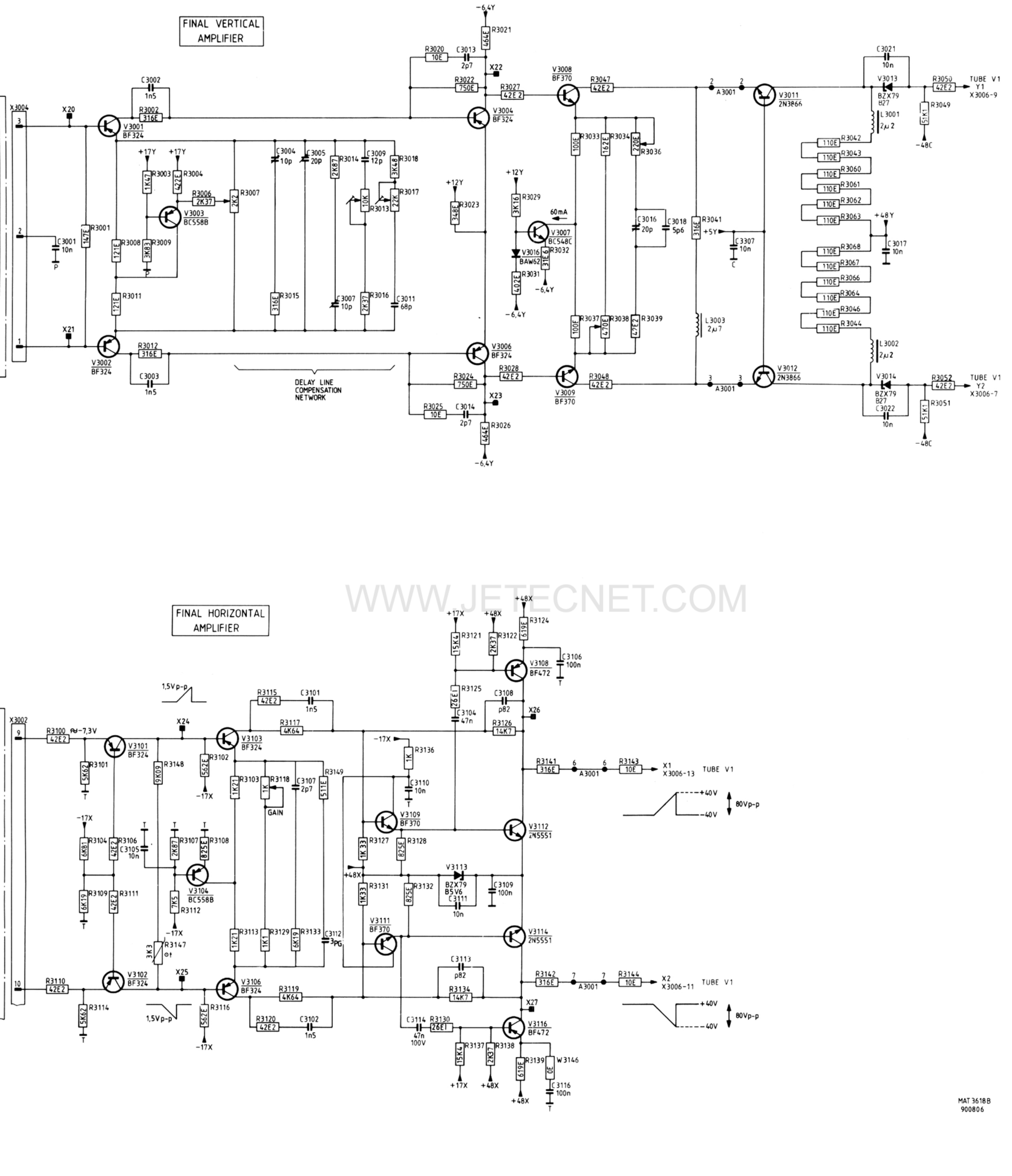


Figure 6.2 Circuit diagram of XYZ amplifiers, final X and Y amplifiers

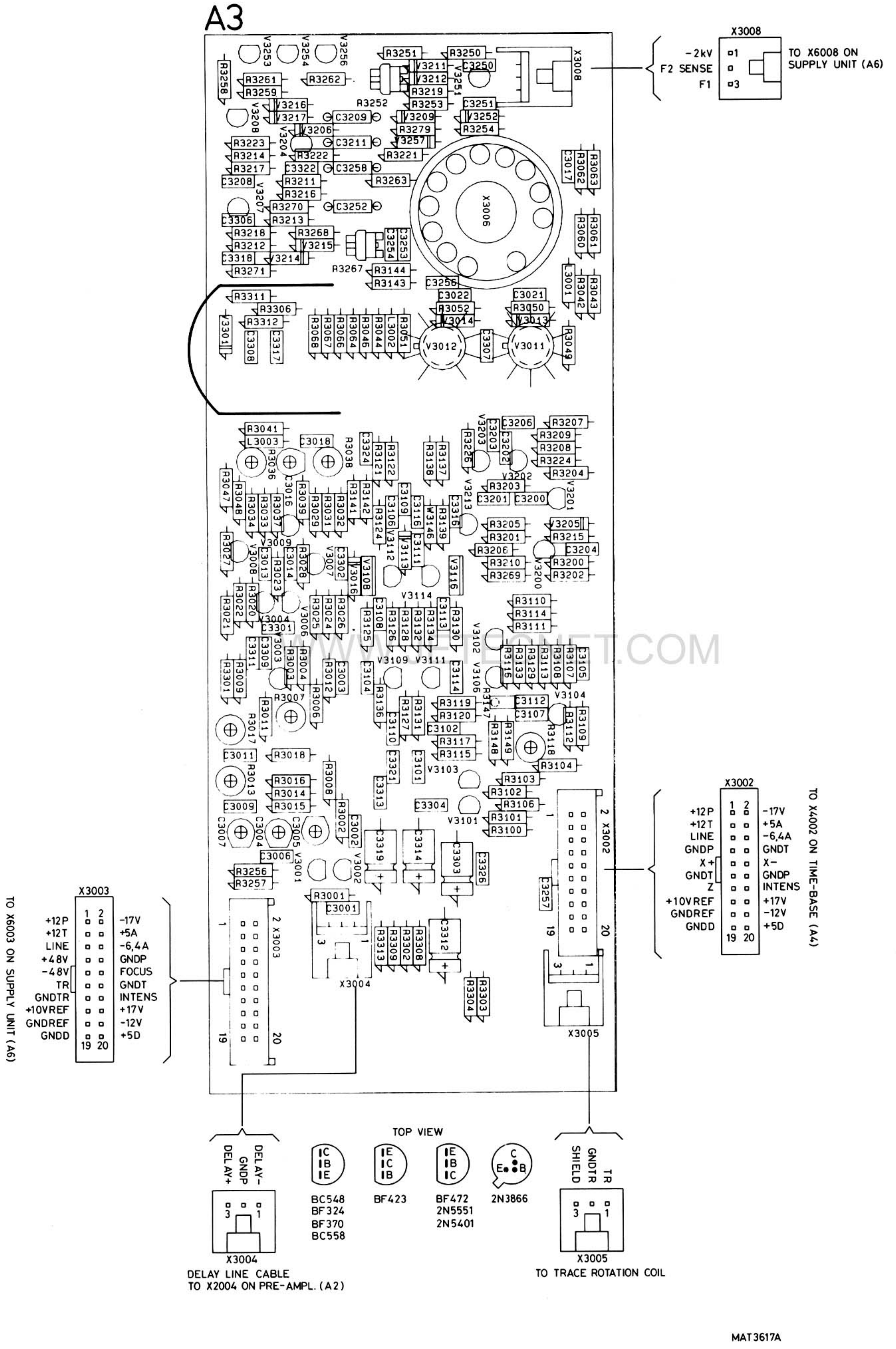


Figure 6.3 XYZ amplifier unit p.c.b.

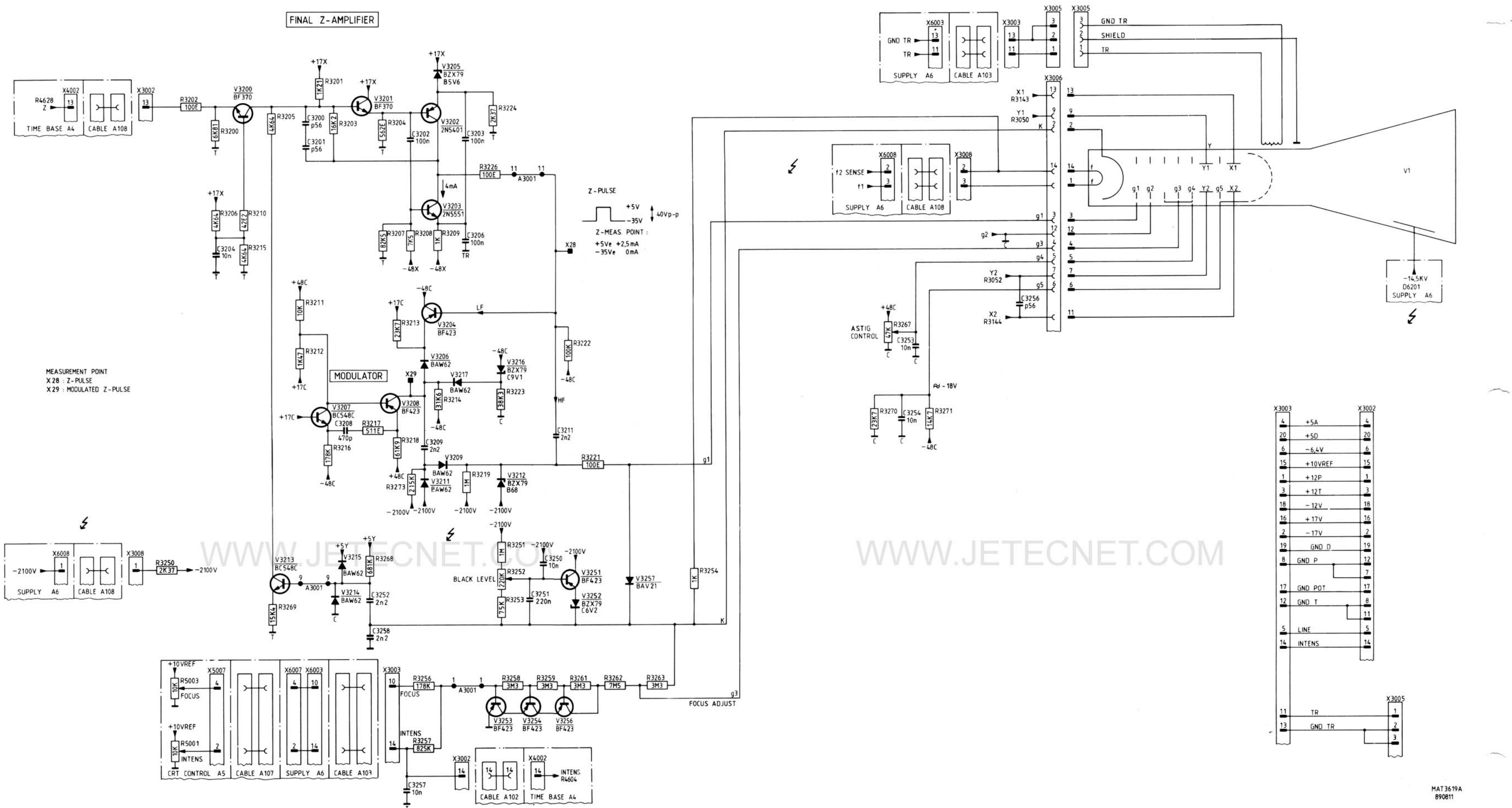


Figure 6.4 Circuit diagram of XYZ amplifiers, Z amplifier and CRT circuit

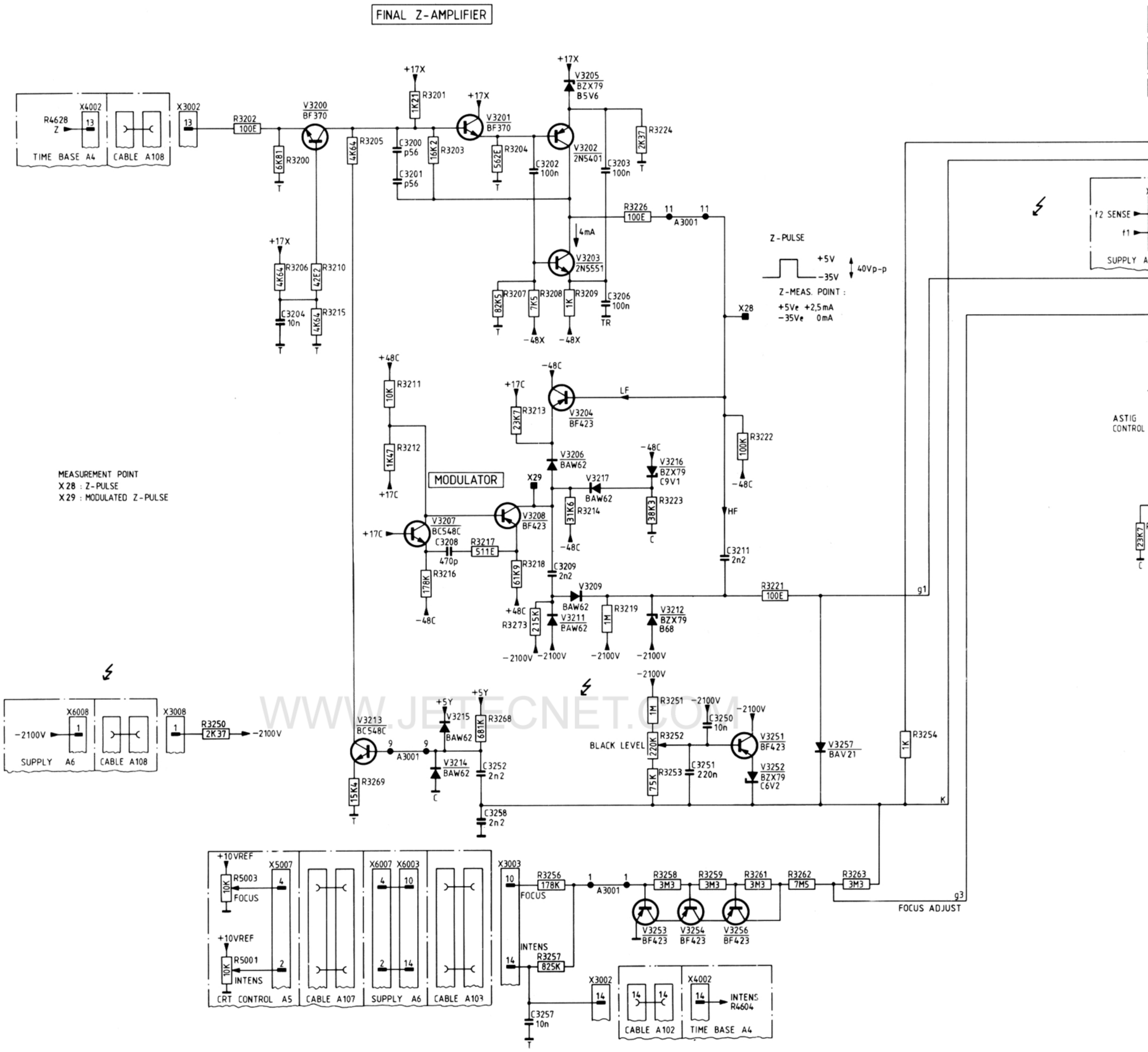


Figure 6.4 Circuit diagra

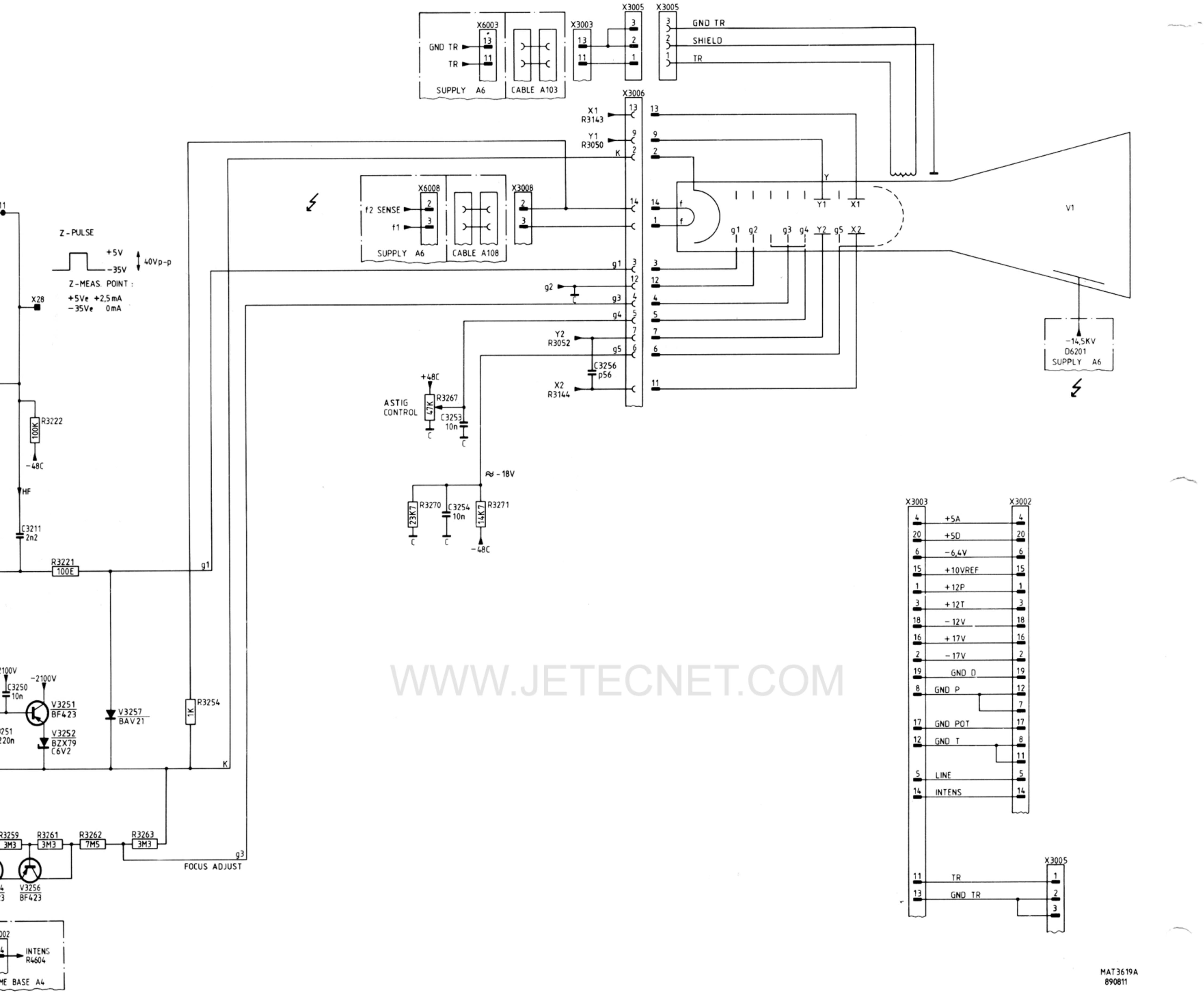


Figure 6.4 Circuit diagram of XYZ amplifiers, Z amplifier and CRT circuit

7 TIME-BASE UNIT (A4)

The time-base unit consists of:

- Trigger amplifier
- Timing circuit
- Sweep generator
- X DEFL amplifier, incl. display mode switch
- Horizontal pre-amplifier
- Z amplifier

As a supplement, the timing diagram for several conditions of the time base is given in section 7.7.

All control pulses for this unit are generated by the time-base controlcircuit, via the I^2C bus. Integrated circuits D4001 and D4002 convert this series DATA into the parallel control pulses, provided that DLEN TB1, and DLEN TB2 are HIGH.

7.1 TRIGGER AMPLIFIER

* TB triggering:

The symmetrical trigger current signals TRIGM+ and TRIGM- are derived from the pre-amplifier unit and converted into the asymmetrical triggervoltage via the summation amplifier V4004, the shunt feedback amplifier V4008 and the emitterfollower V4009. The summation amplifier adds the base signal voltage of V4004 (caused by TRIGM-) and the collector signal current of V4001 (caused by TRIGM+).

* TV triggering:

When the signal TVMTB goes LOW, the normal trigger path is blocked via V4022 and the trigger signal is routed via the TV trigger stage V4011...V4023. Transistor V4012 serves to clip the synchronisation pulse and LINE/FRAME selection is obtained by V4021. If the signal TVF/LINE is high, TV frames are detected by C4004 ... C4007. A low control signal serves line detection by C4007.

7.2 TIMING CIRCUIT (see figure 7.1)

The timing for the entire time-base circuit is obtained by D4103 together with its associated components.

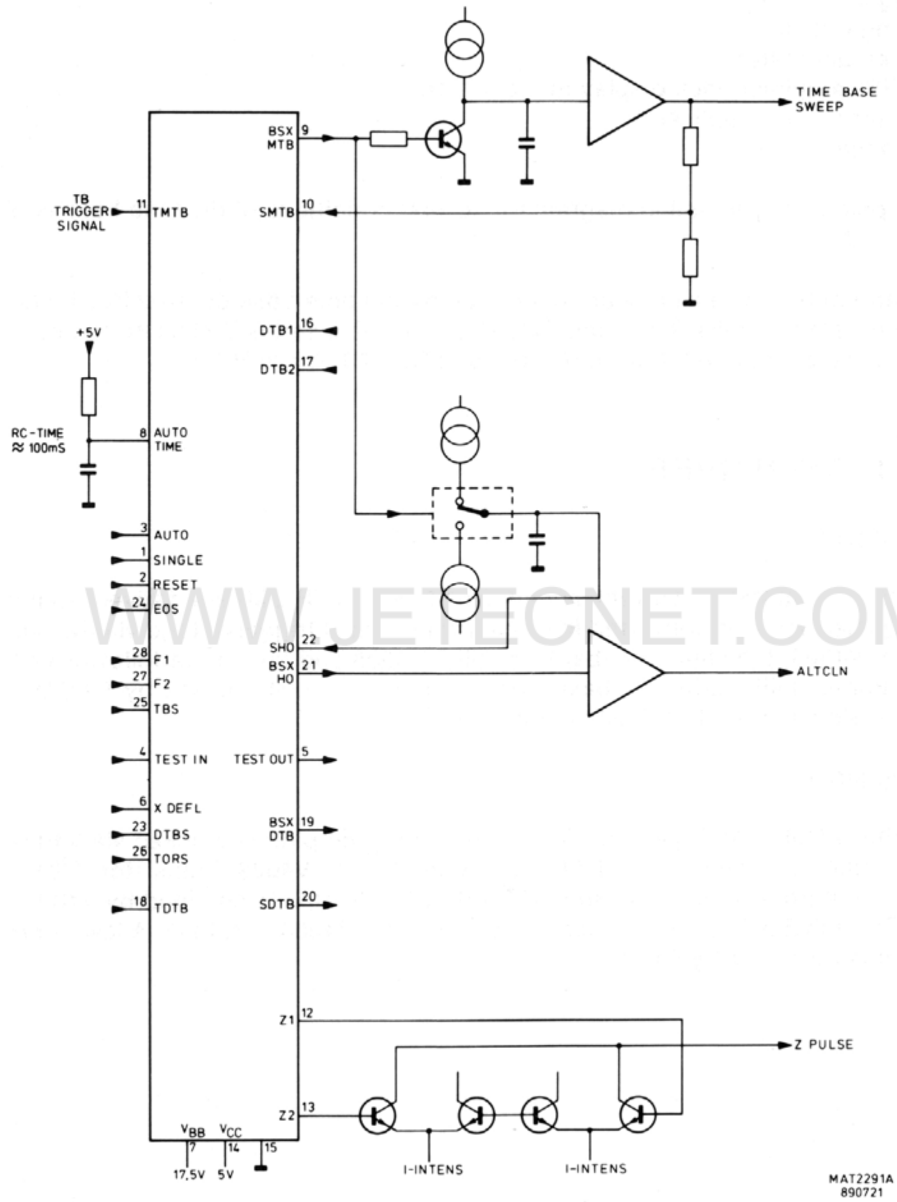


Figure 7.1 D4103 configuration

D4103 has the following relevant pin connections:

Pin	Name	INPUT-OUTPUT	Description
1	SINGLE	TTL-input	Selects the single time-base mode.
2	RESET	TTL-input	Stops the sweep and starts the hold off sweep.
3	AUTO	TTL-input	Selects the AUTO trigger mode, the time base is free-running after the last trigger pulse.
4	TESTIN	TTL-input	Selects the possibility to drive several functions (TESTOUT) in combination with SINGLE and RESET.
5	TESTOUT	TTL-output	--
6	X DEFL	TTL-input	Activates the Z1 and Z2 outputs.
7	Vbb	-	+1,5 V supply input.
8	AUTOTIME	input	RC-time determination (100 ms) for the AUTO trigger mode.
9	BSXMTB	TTL-output	Discharges the TB-sweep capacitor(s).
10	SMTB	SCHMITT-input	Determines the end of the TB-sweep.
11	TMTB	SCHMITT-input	Determines the start of the TB-sweep.
12	Z1	TTL-output	Determines the blanking of the CRT.
13	Z2	TTL-output	Determines the blanking of the CRT.
14	GND	-	Ground.
15	Vcc	-	+5 V supply input.
16	DTB1	-	Not used
17	DTB2	-	Not used, connected to ground.
18	TDTB	-	Not used, connected to ground.
19	BSXDTB	-	Not used
20	SDTB	-	Not used, connected to ground.
21	BSXHO	TTL-output	Determines the ALT clock pulse
22	SHO	SCHMITT-input	Determines the end of the Hold-off sweep.
23	DTBS	-	Not used; connected to supply +5Z.
24	EOS	-	Not used; connected to supply +5Z.
25	TBSX	TTL-input	Determines the TB-unblanking (HIGH)
26	TORS	TTL-input	Determines the STARTS condition (LOW) or TRIG'D condition (HIGH) of the DTB.
27	F1	TTL-input }	Determines the time base display
28	F2	TTL-input }	mode (both LOW).

NOTE: All SCHMITT-inputs are at +2,5 V level.

7.2 TIMING CIRCUIT (see figure 7.1)

7.3 SWEEP GENERATOR

* TB sweep generator (see figure 7.2):

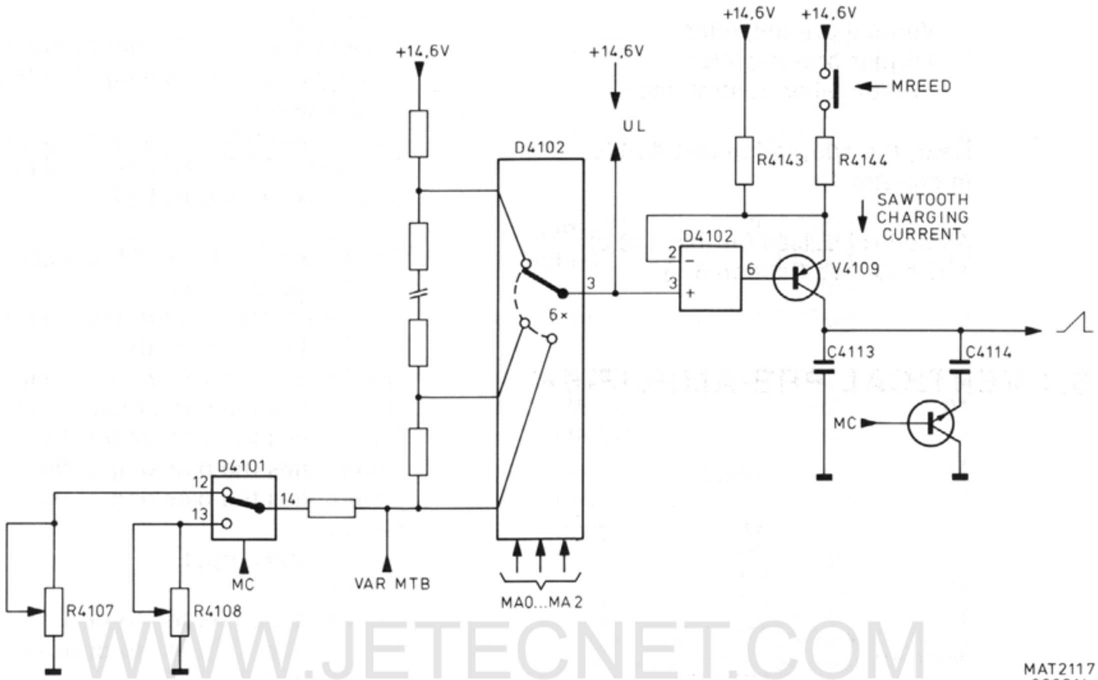


Figure 7.2 Simplified diagram of the time-base sweep generator

The sawtooth charging current $\frac{UL}{\text{R4143 (and R4144)}}$ determines the sweep speed via UL/[C4113 (+C4114)].
The circuit is controlled by the following address lines:

- MA0...MA2, for interconnection of D4102-3 to an input pin, thus giving six different voltage levels UL with respect to +14,6 V.
- MREED, for addition of R4144 to the sawtooth charging circuit.
- MC, for addition of C4114 to the sawtooth charging circuit and for switching over between calibration pot.meters R4107 (50ns...100us) and R4108 (200 us...0,5 s).

The voltage UL can be continuously varied by moving the VAR TB control R7009 from the CAL position. Thus a sweep variation of 1:2,5 can be obtained.

The function table for the sweep generator is given below:

sweep speed	MA2	MA1	MA0	MREED	MC
50 ns	1	1	1	0	0
.1 us	0	1	0	0	0
.2	0	0	1	0	0
.5	0	0	0	0	0
1	0	1	1	0	0
2	1	0	0	1	0
5	1	1	1	1	0
10	0	1	0	1	0
20	0	0	1	1	0
50	0	0	0	1	0
.1 ms	0	1	1	1	0
.2	1	0	0	0	1
.5	1	1	1	0	1
1	0	1	0	0	1
2	0	0	1	0	1
5	0	0	0	0	1
10	0	1	1	0	1
20	1	0	0	1	1
50	1	1	1	1	1
.1 s	0	1	0	1	1
.2	0	0	1	1	1
.5	0	0	0	1	1

NOTE: When MREED is low, then RELAY is switched on.

The sawtooth current is fed to the buffer circuit, where the h.f.sweep components (to 2 usec) are routed via C4116 and V4118, V4119.
The l.f. sweep components (0,5 sec...2usec) is routed via N4103.

Finally the time-base sweep voltage is applied to the horizontal display mode switch.

* Hold-off circuit:

During the time base sweep, capacitor C4304 is discharged. In the lower sweepspeeds (lower then 10us) capacitor C4302 is also discharged via V4306. After the sweep, the capacitor(s) are charged via current source V4304 until the voltage across C4304 reaches the +2,5 V level. This voltage is applied to D4103 as the SHO signal and determines if the time base can generate a new sweep.

Depending on the HOLD OFF control potentiometer R7011 adjustment, a part of the charging current leaks away via V4301 and thus continuously variation of the charging time (i.e. hold-off time) is obtained. When BSXMTB goes LOW, the time base starts to run again and at the same time C4304 (and C4302) are discharged again via V4309.

7.4 X DEFL AMPLIFIER AND DISPLAY MODE SWITCH

* X DEFL amplifier:

The circuit for converting the symmetrical X DEFL+ and X DEFL- signals into the asymmetrical voltage, applied to the display mode switch is identical to the trigger input. However, this circuit can be switched- off by diodes V4500 and V4505, provided that the X DEFL signal is HIGH.

* Horizontal display mode switch:

The three deflection signals for real time base, digital time base or X deflection are switched to the horizontal pre-amplifier via diode switches. These switches are under control of the signals X DEFL and TBS. The output of the circuit is applied to R4701 on the horizontal pre-amplifier stage. The logic table is given below:

X DEFL	TBS	Output
1	*	X DEFL signal
0	0	Digital time base
0	1	Real time base

7.5 Z-AMPLIFIER

* Z-switch:

The Z-switch N4601 is configured as two differential amplifiers with a common current output to R4625. The stage is supplied by a constant current source via pin 3 and pin 9. The inputs Z1 and Z2 are derived from the timer stage D4103 and determine the unblanking of the CRT. For this oscilloscope Z1 and Z2 must be HIGH for normal intensity of the time base signal.
The amplitude of the Z-current can be varied by the front-panel INTENS control R5001. The slider of this control potentiometer drives the base pin 2 and pin 10 of both current sources.

To prevent burn-in of the CRT in the lower sweep speeds 0,5 sec...50 usec, signal ZB is LOW and reduces the voltage to pin 2 and pin 10.

Signal ZA is a software-controlled pulse to blank the trace when the AMPL/DIV switch is used.

* Z Pre-amplifier:

In normal condition, the full current for CRT blanking derived from N4601 is routed via R4625, V4612 and R2628 to the XYZ Amplifier A3.

However, there are two conditions for additional blanking:

- In the chopped mode of the vertical channels the display is blanked during switching over between channels. This happens by connecting the CHOPBLN pulse to V4611. When this pulse is HIGH, transistor V4611 conducts and a part of the blanking current flows via V4611 emitter- collector to the +5 K (+5V supply) rail.

- If a HIGH level is applied to the external Z MOD input on the rear panel, this signal causes conducting of V4616 so that a part of the blanking current flows via V4616 emitter-collector to the +5 K rail.

7.6 HORIZONTAL PREAMPLIFIER

The horizontal preamplifier drives the final X-amplifier on unit A6.
It is a balanced amplifier that consists of V4702 and V4712. The amplifier receives the selected X-deflection signal. This signal can be the analog time base signal, the digital time base signal or the X-deflection signal. This signal is applied to the base of V4702. The base of V4712 receives a d.c. signal that determines the horizontal shift of the display on the CRT screen. The preamplifier can work with two different amplification factors:

- If X MAGN is inactive, the signal X10---LT is high. This has the result that V4706 is on and V4708 is off at the same time.
  The amplification is determined by the emitterresistors R4705 and R4718.
  V4707 serves as a constant current source.

- If X MAGN is active, the signal X10---LT is low. This has the result that V4706 is off and V4708 is on at the same time.
  The amplification is determined by the emitter resistors R4706, R4707, R4719 and R4721. This gives a 10 times gain increase compared with the other mode.

The signal that determines the horizontal shift of the signal is applied to the base of transistor V4712. This signal can be derived either from the X POS potentiometer via W4909 (during normal signal display) or via trimming potentiometer R4260 (during display of text and/or cursors). The selection is done in multiplexer D4101 under control of signal XPOSOFF-HT that is high during text display.
The signal is low during display of the signal.

7.7 TIMING DIAGRAM

The following figure gives the timing diagram for D4103 for a free running time base sweep.

SINGLE	0
RESET	0
AUTO	1
TEST IN	0
X DEFL	0
TORS	0
F1	0
F2	0
DTBS	0
EOS	1
TBS	1

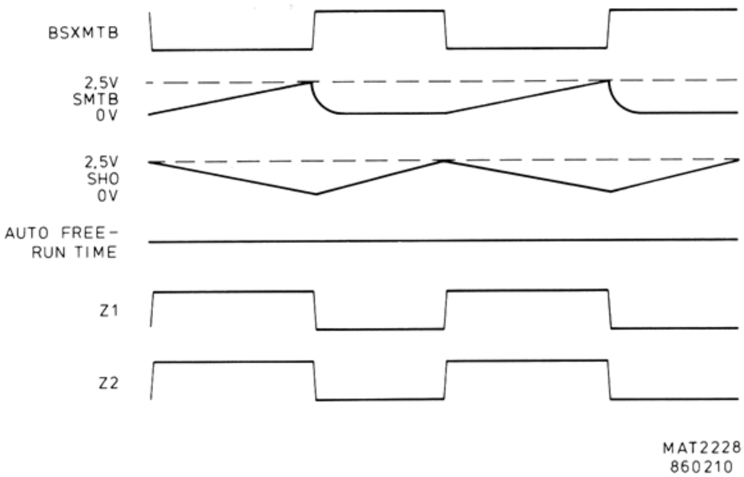
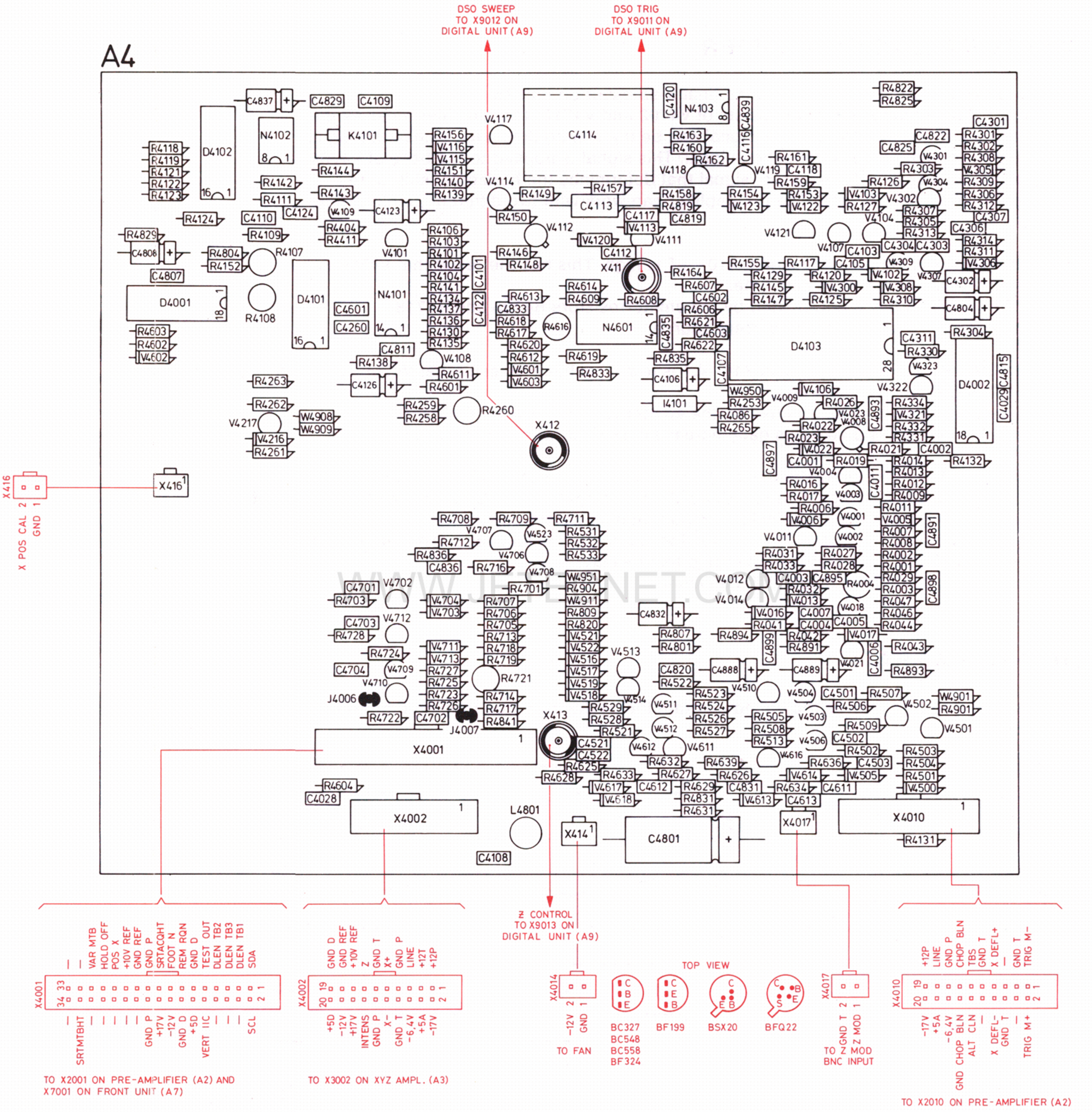
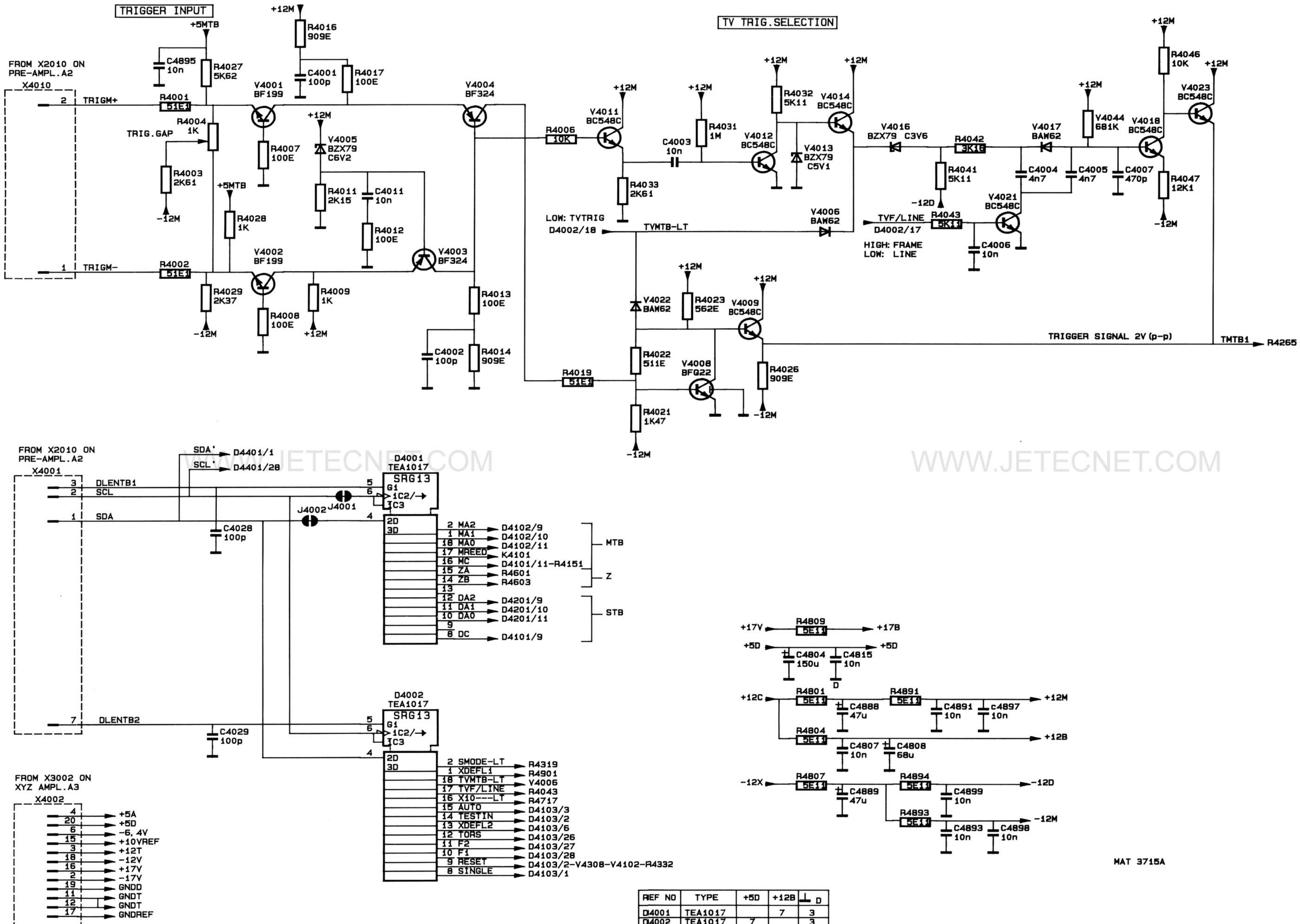


Figure 7.3 Free-running sweep-timing diagram



MAT 3968

Figure 7.4 Time-base unit p.c.b.



REF NO	TYPE	+5D	+12B	⊥ D
D4001	TEA1017		7	3
D4002	TEA1017	7		3
D4103	OQ0201			

Figure 7.5 Circuit diagram of time-base, trigger amplifier and control circuits

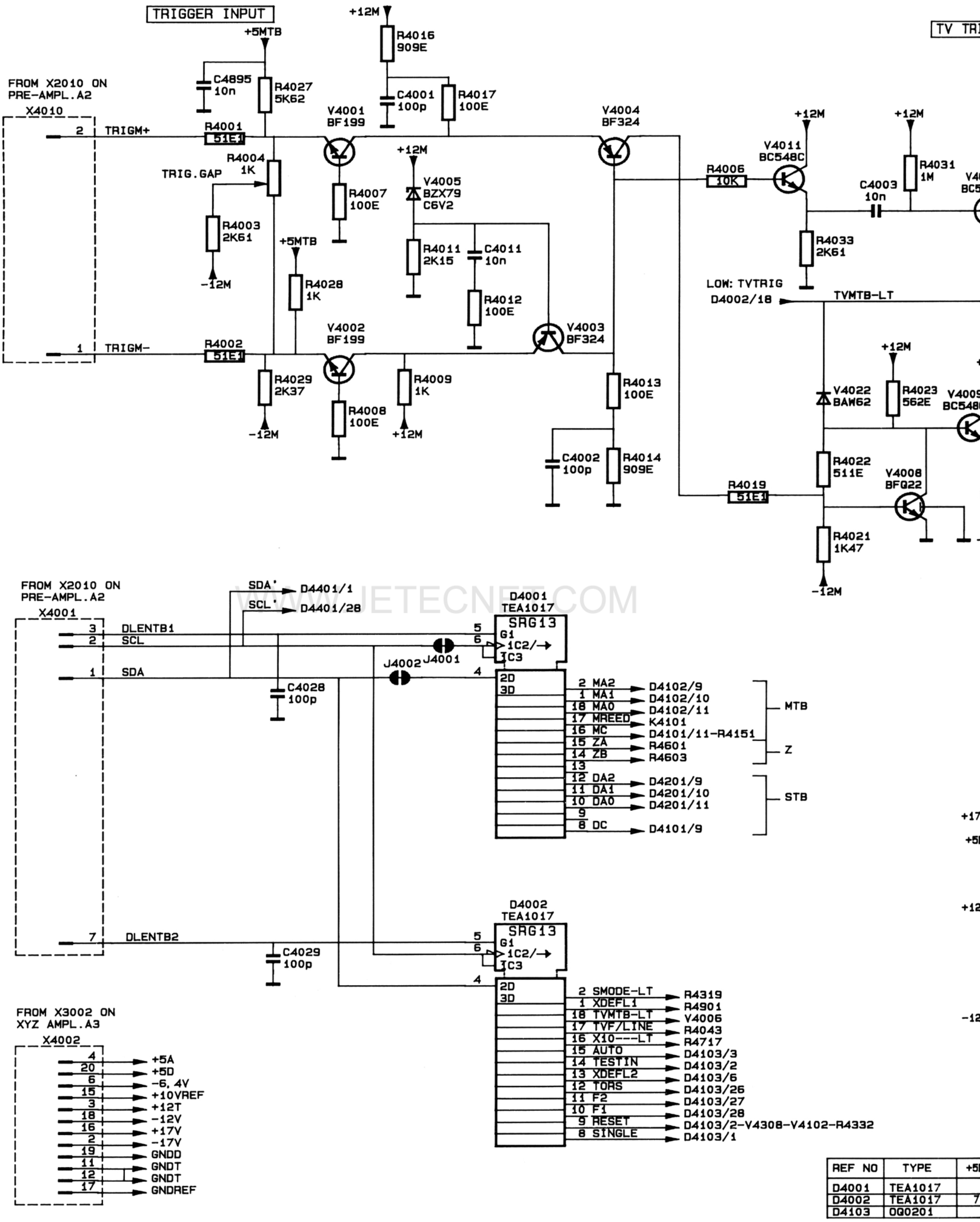
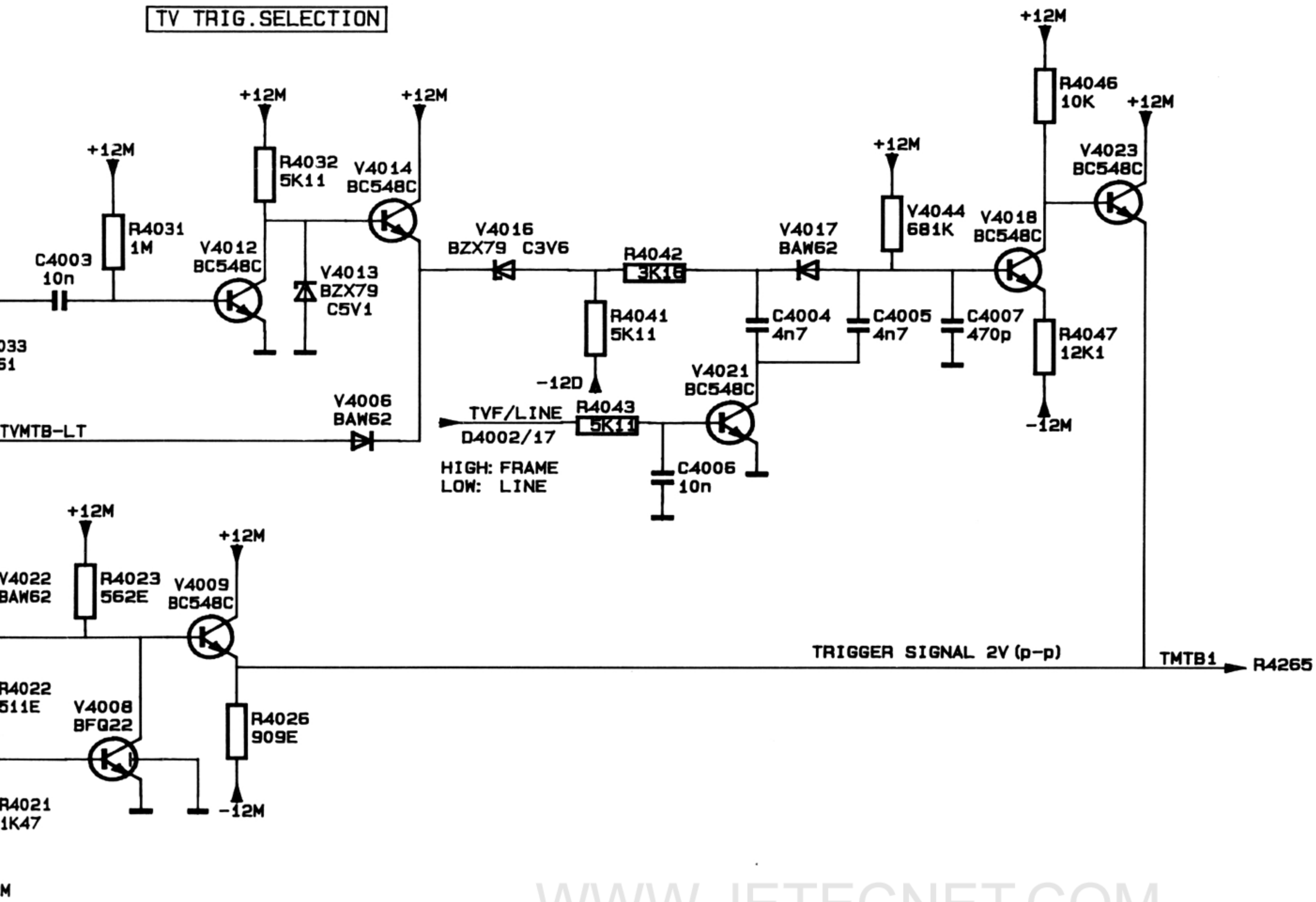
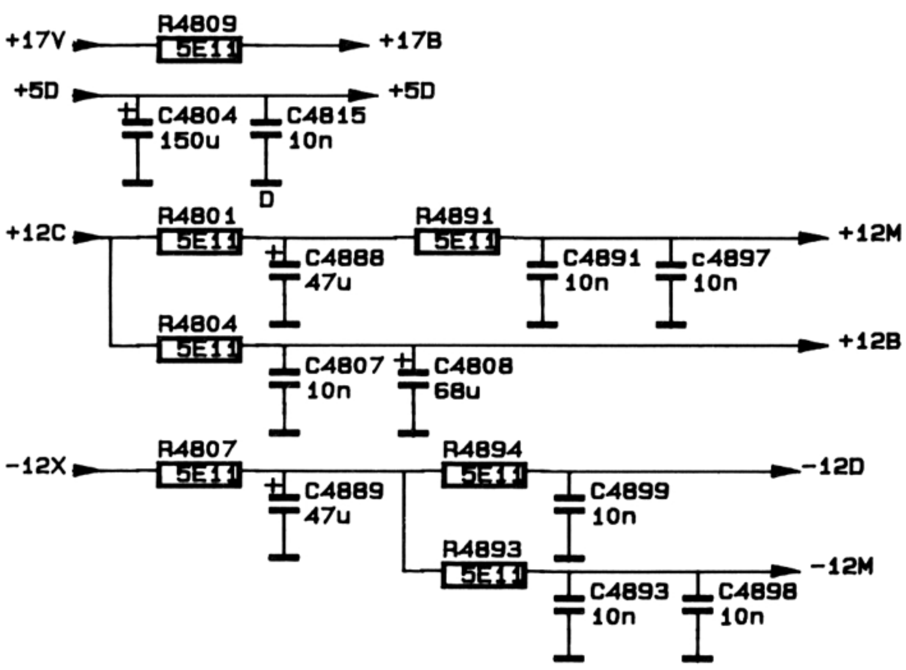


Figure 7.5 Circuit diagram of time-base, trigger amplifier and control circuits

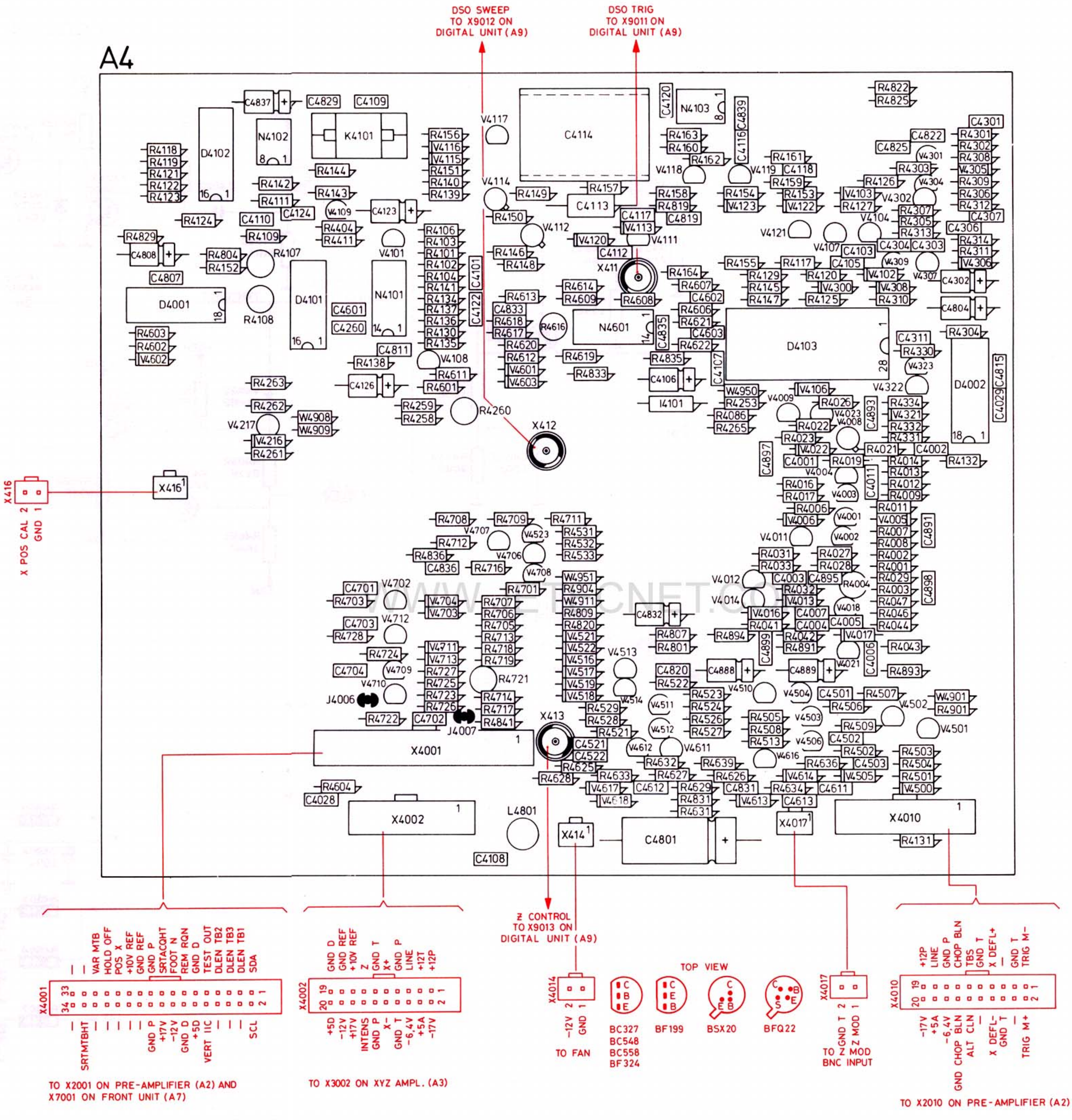




-R4332

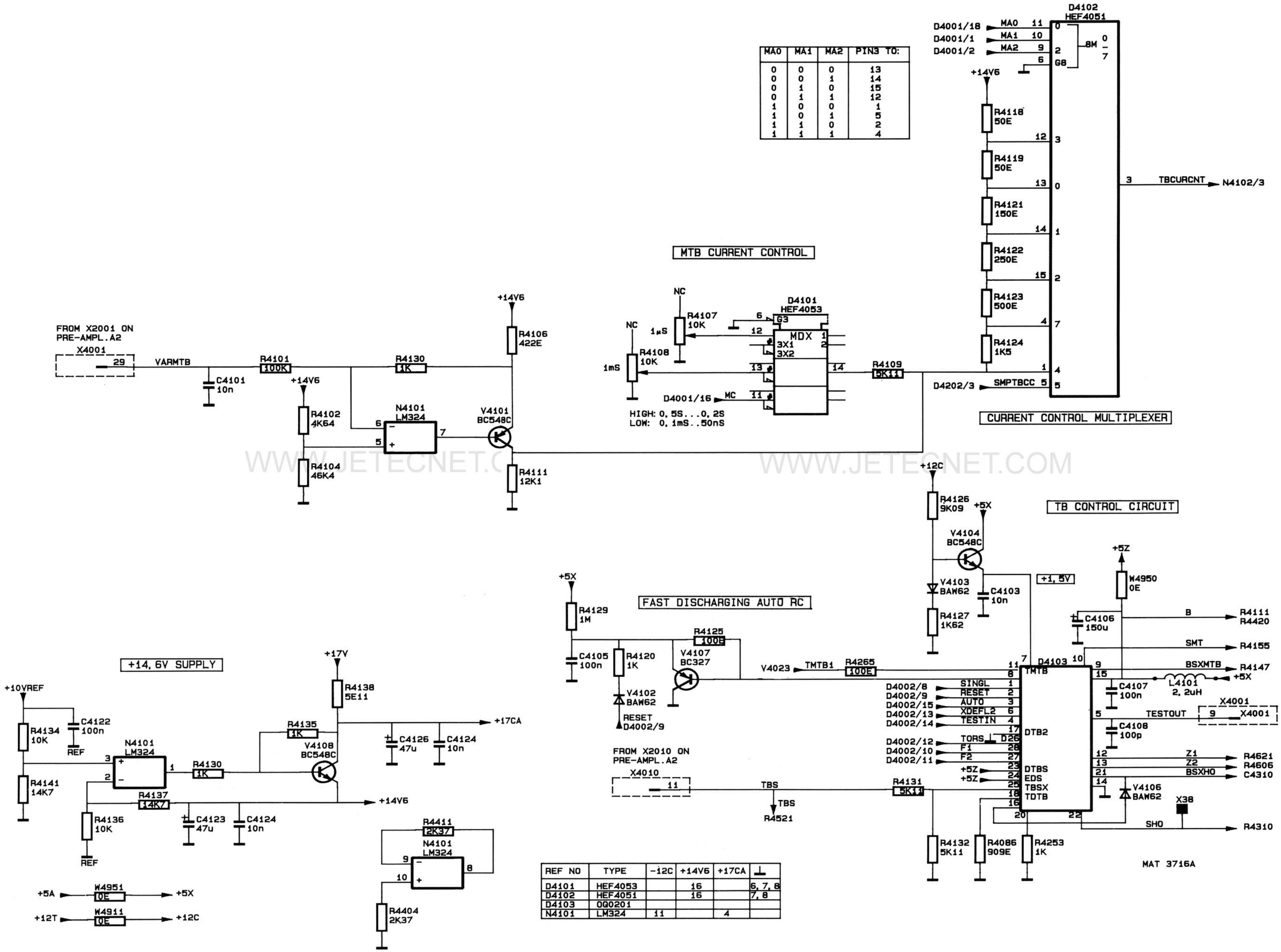
MAT 3715A

REF NO	TYPE	+5D	+12B	⊥ D
D4001	TEA1017		7	3
D4002	TEA1017	7		3
D4103	OQ0201			



MAT 3968

Figure 7.6 Time-base unit p.c.b.

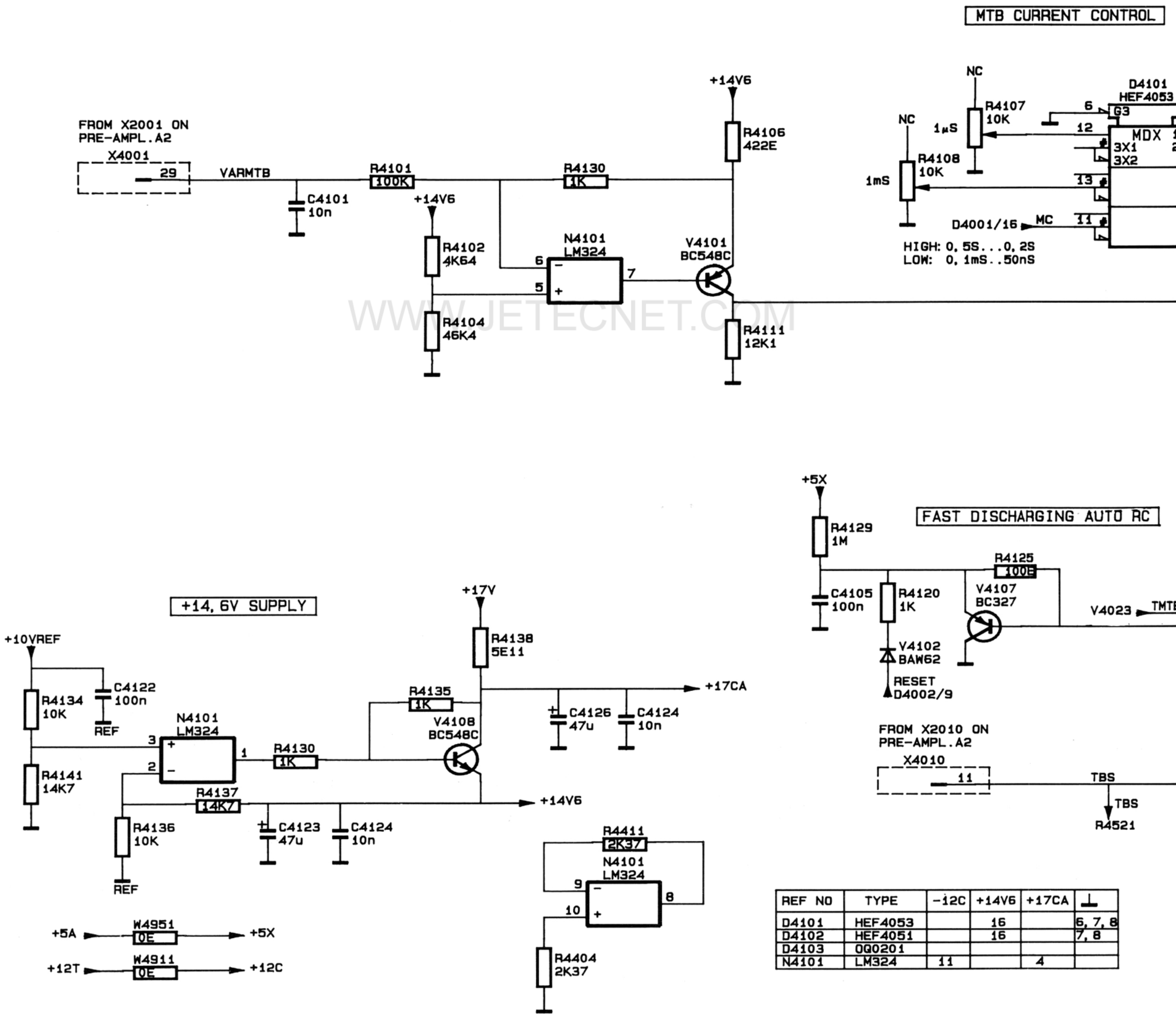


MA0	MA1	MA2	PIN3 TO:
0	0	0	13
0	0	1	14
0	1	0	15
0	1	1	12
1	0	0	1
1	0	1	5
1	1	0	2
1	1	1	4

REF NO	TYPE	-12C	+14V6	+17CA	⊥
D4101	HEF4053		16		6, 7, 8
D4102	HEF4051		16		7, 8
D4103	OQ0201				
N4101	LM324	11		4	

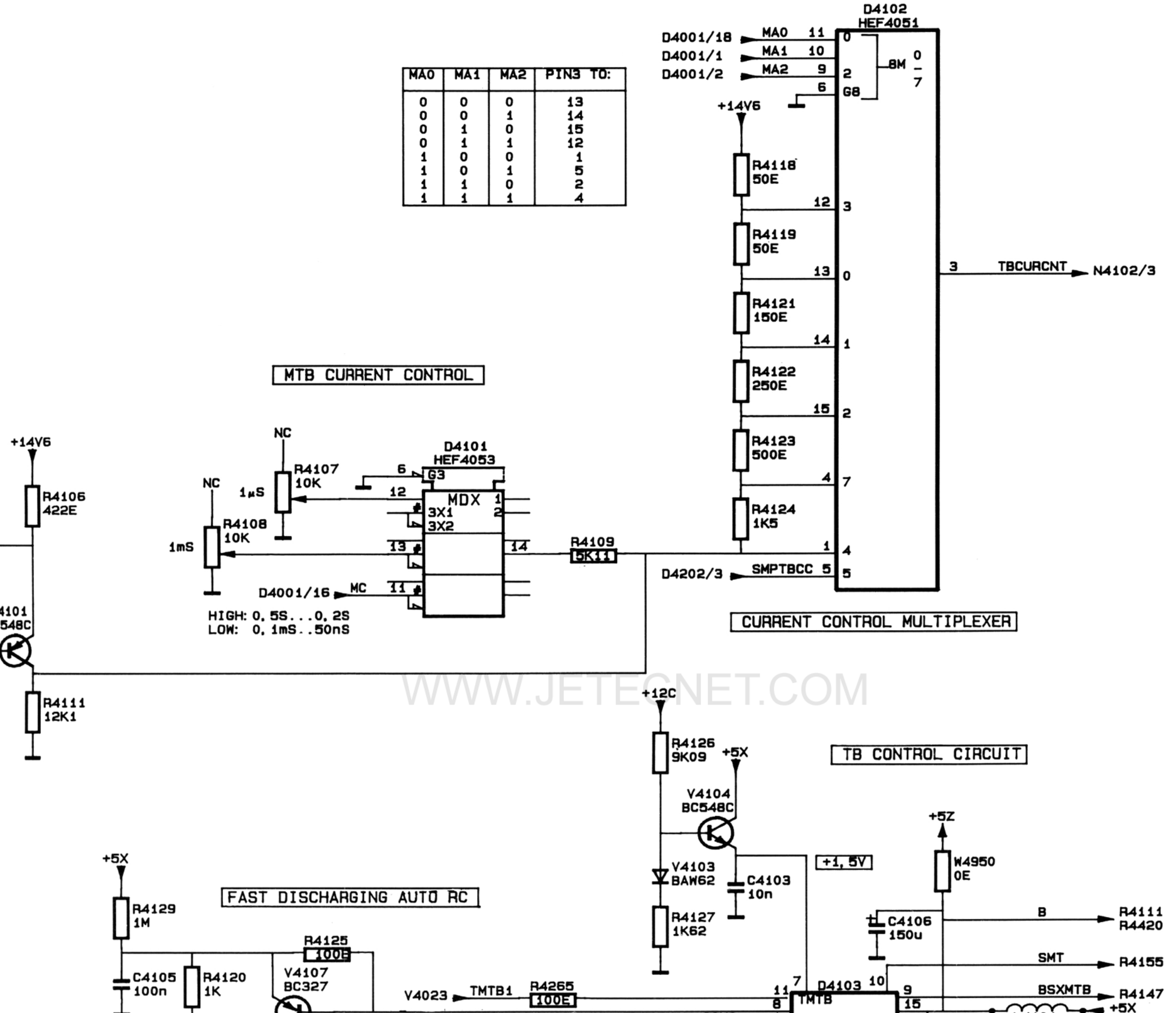
Figure 7.7 Circuit diagram of time-base, timing control and TB control

MA0	MA1
0	0
0	0
0	1
0	1
1	0
1	0
1	1
1	1



REF NO	TYPE	-12C	+14V6	+17CA	⊥
D4101	HEF4053		16		6, 7, 8
D4102	HEF4051		16		7, 8
D4103	0Q0201				
N4101	LM324	11		4	

Figure 7.7 Circuit diagram of time-base, timing control and TB control



MA0	MA1	MA2	PIN3 TO:
0	0	0	13
0	0	1	14
0	1	0	15
0	1	1	12
1	0	0	1
1	0	1	5
1	1	0	2
1	1	1	4

REF NO	TYPE	-12C	+14V6	+17CA	⊥
D4101	HEF4053		16		6, 7, 8
D4102	HEF4051		16		7, 8
D4103	OQ0201				
N4101	LM324	11		4	

trol

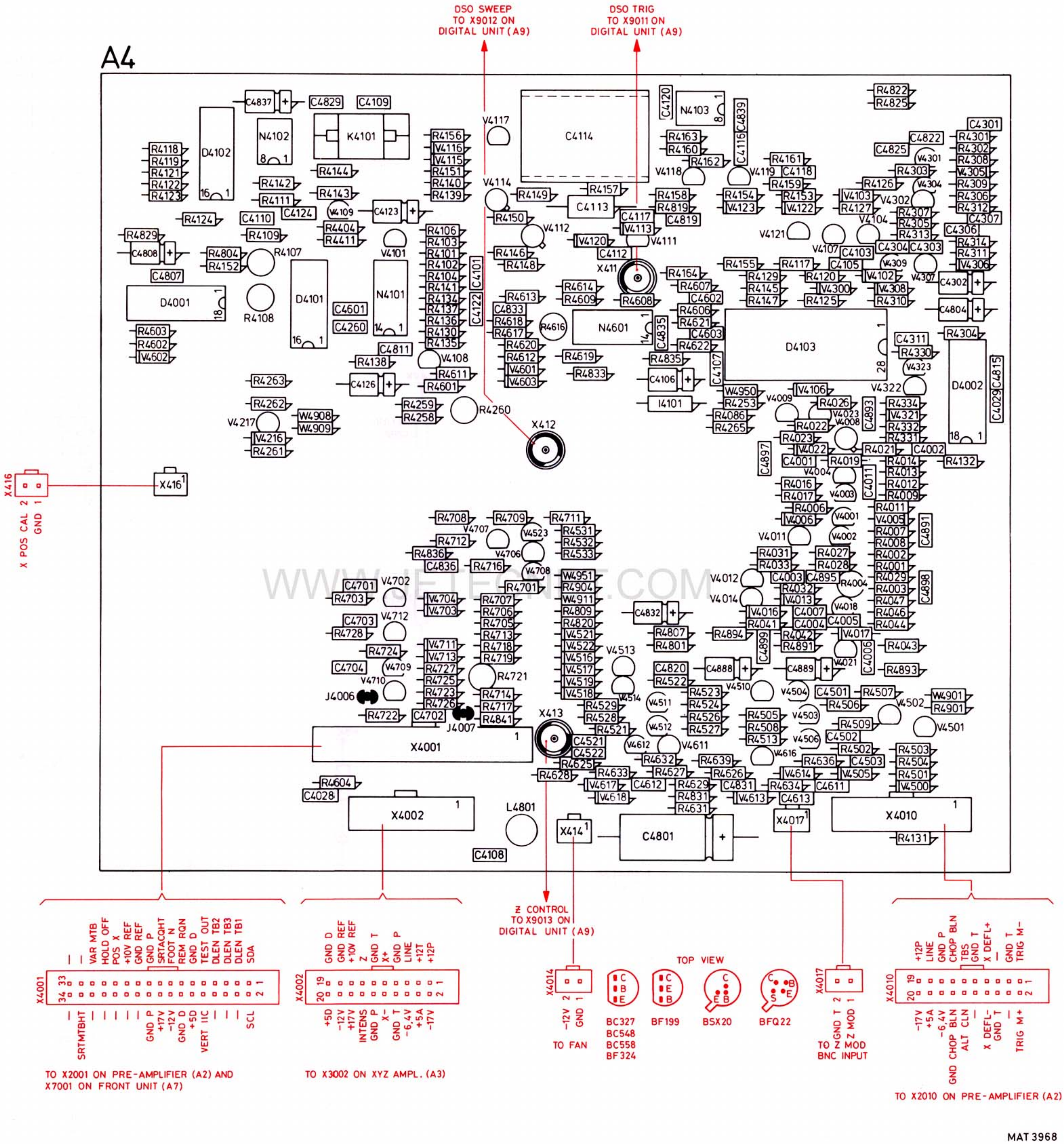
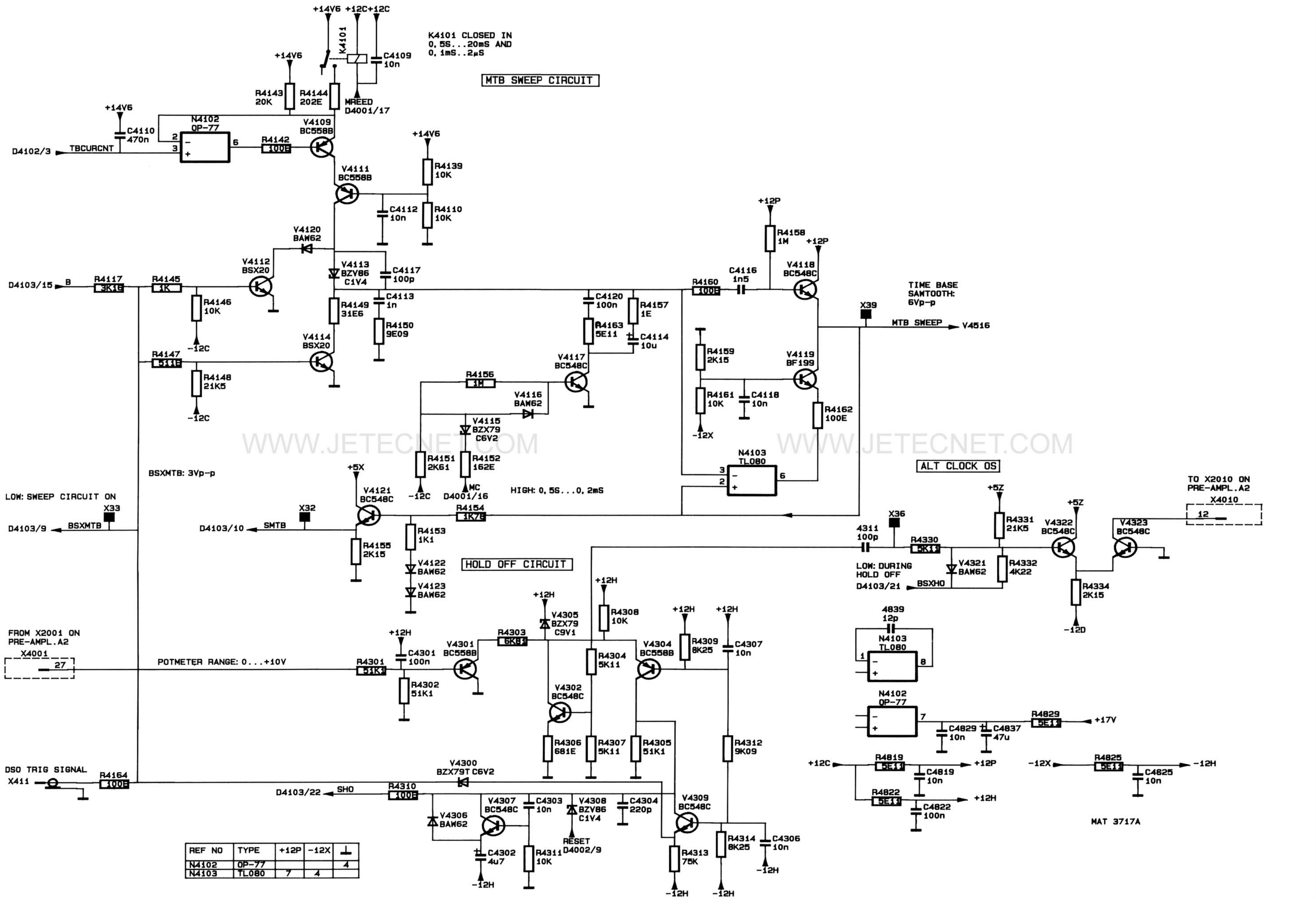
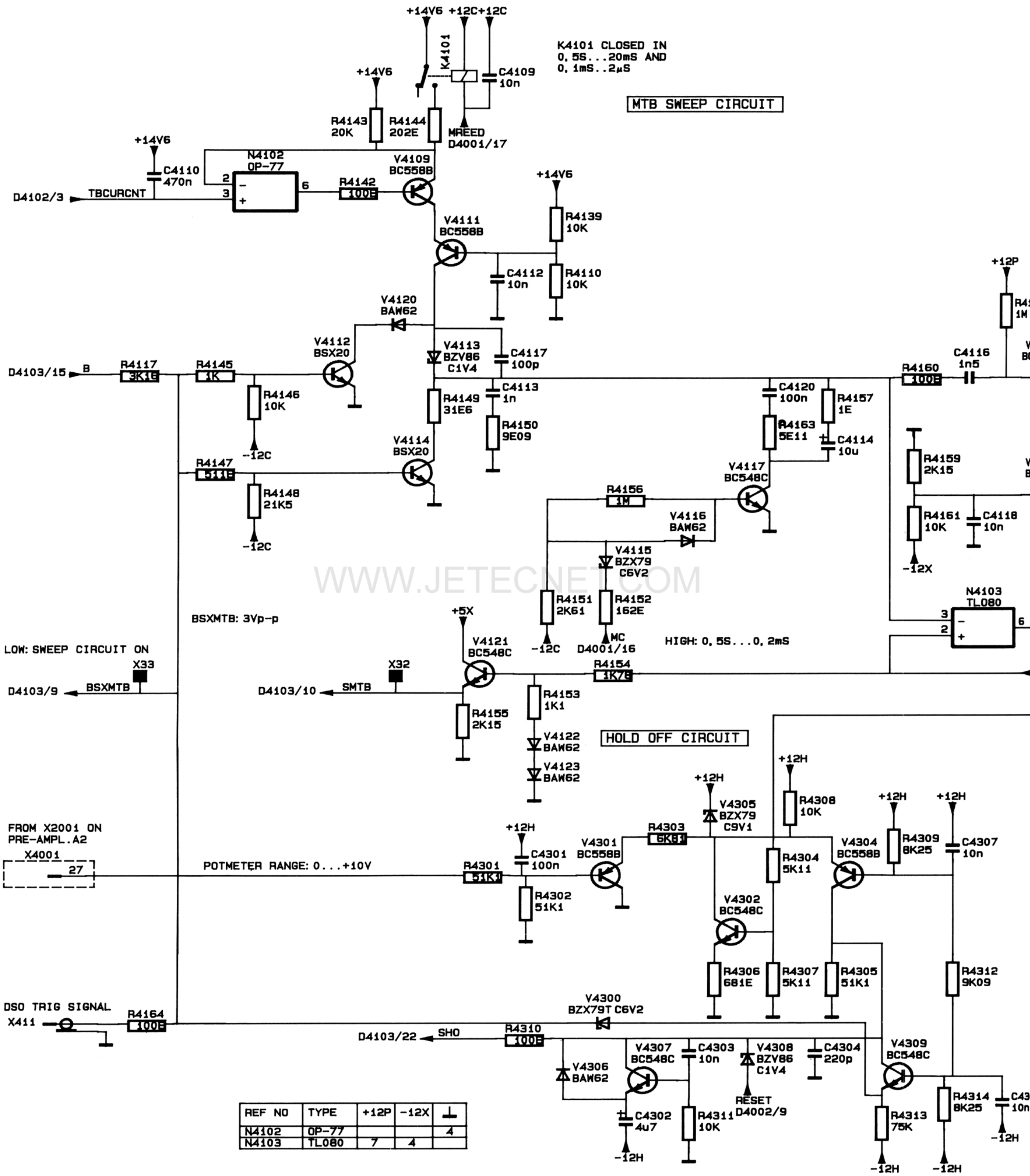


Figure 7.8 Time-base unit p.c.b.



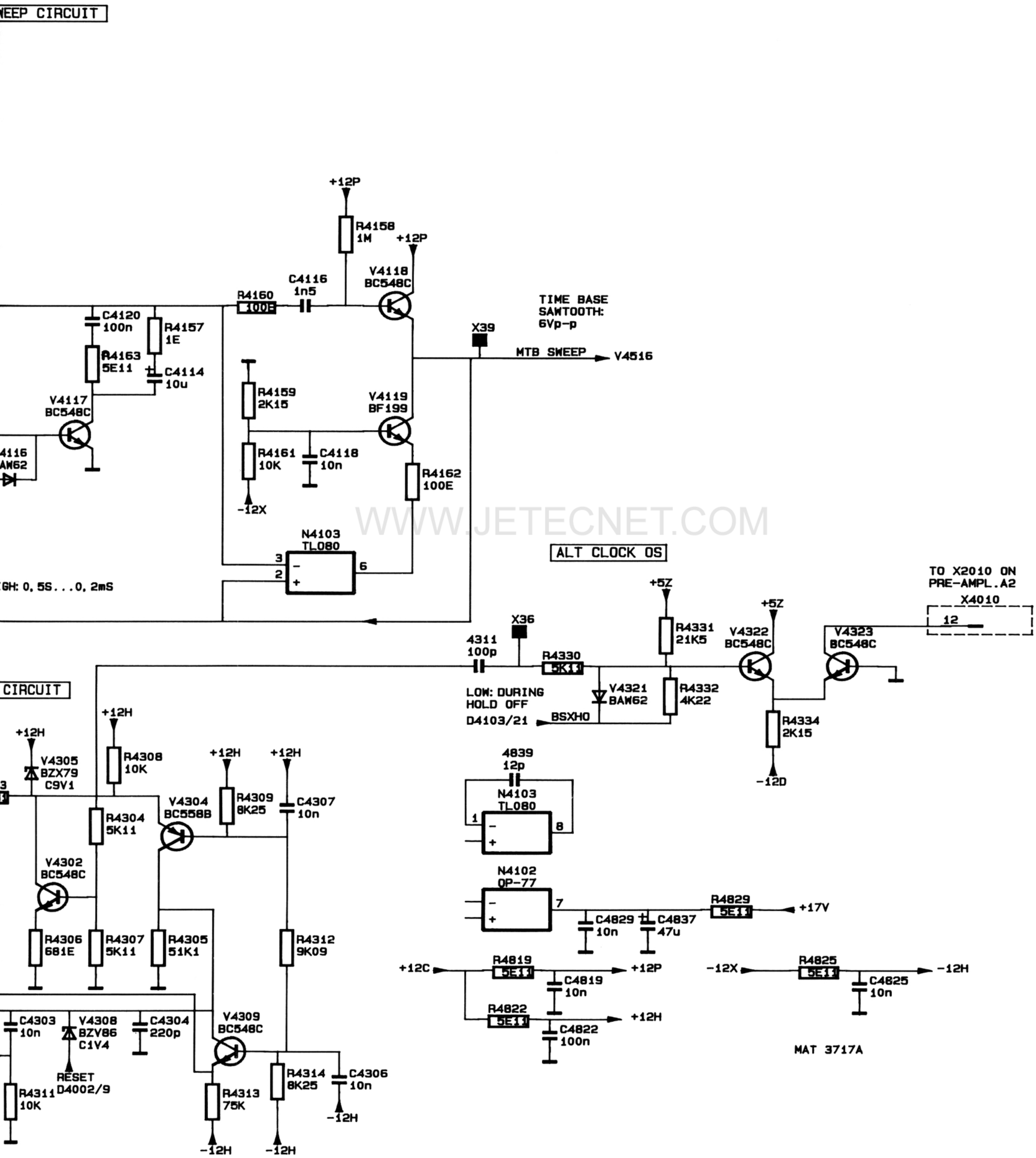
REF NO	TYPE	+12P	-12X	⊥
N4102	OP-77			4
N4103	TL080	7	4	

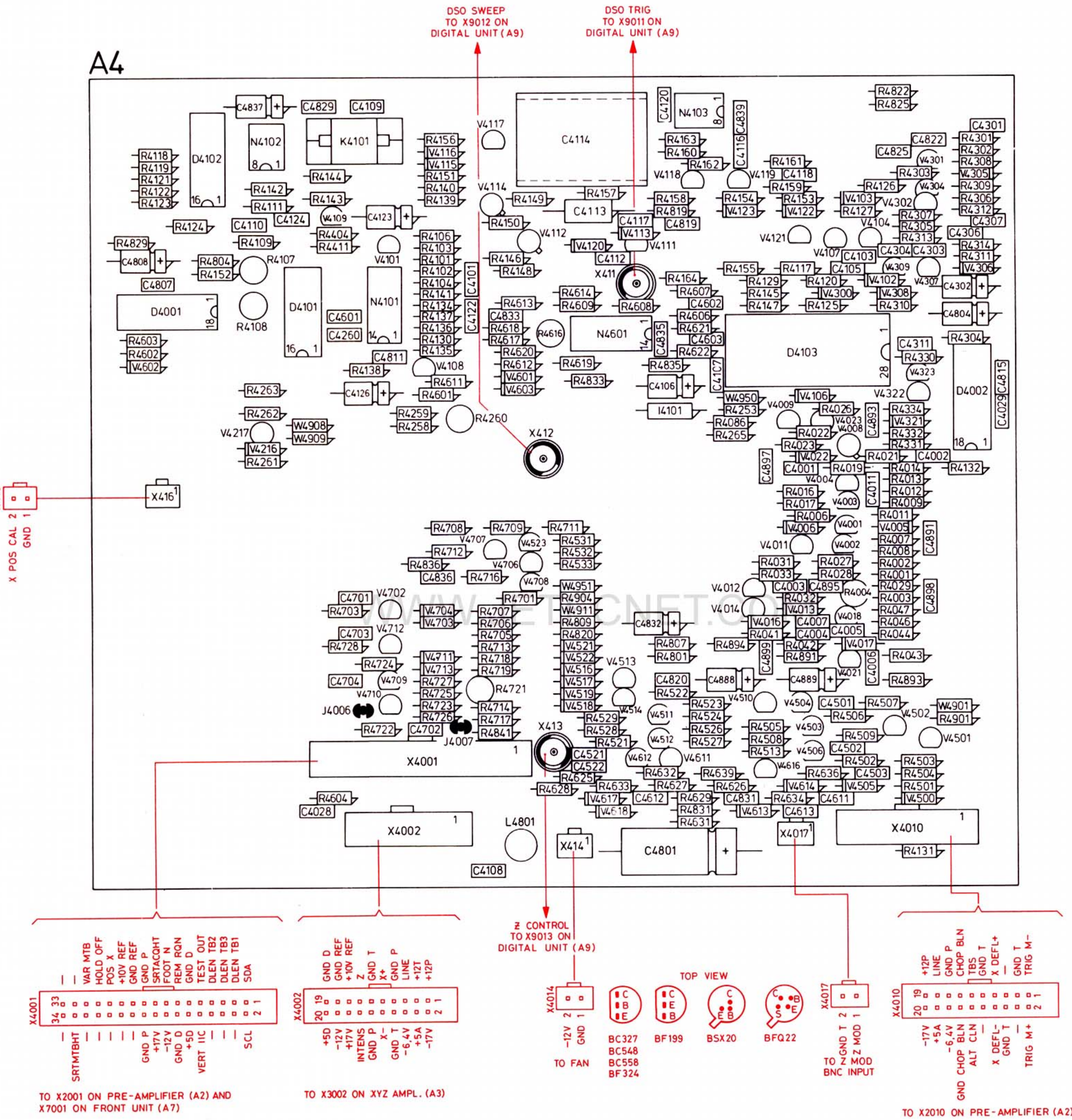
Figure 7.9 Circuit diagram of time-base, sweep generator and hold-off



REF NO	TYPE	+12P	-12X	⊥
N4102	OP-77			4
N4103	TL080	7	4	

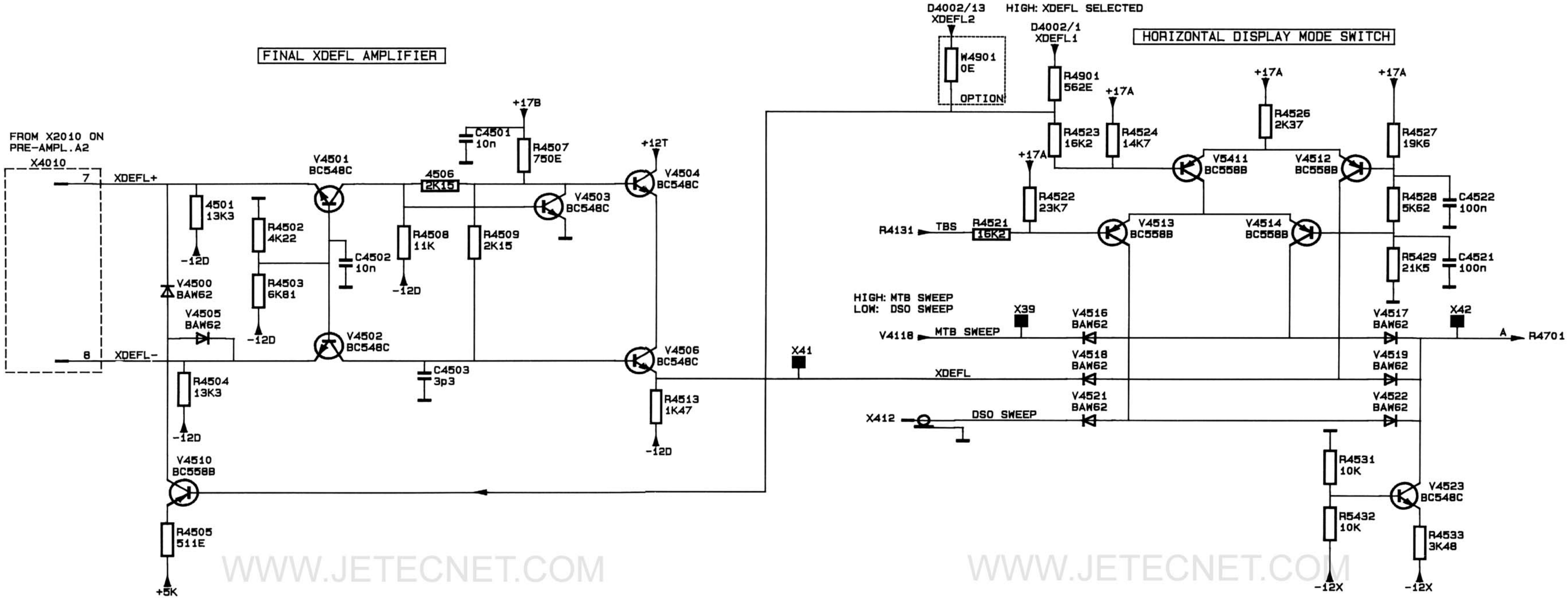
Figure 7.9 Circuit diagram of time-base, sweep generator and hold-off


EEP CIRCUIT
CIRCUIT
ALT CLOCK OS
+12P
R4158 1M
+12P
V4118 BC548C
C4116 1n5
R4160 100E
TIME BASE SAWTOOTH: 6Vp-p
X39
MTB SWEEP
V4516
C4120 100n
R4157 1E
R4163 5E11
C4114 10u
V4117 BC548C
R4159 2K15
V4119 BF199
R4161 10K
C4118 10n
R4162 100E
-12X
N4103 TL080
GH: 0,5S...0,2mS
+5Z
TO X2010 ON PRE-AMPL.A2
X4010
12
X36
4311 100p
R4330 5K11
R4331 21K5
V4322 BC548C
V4323 BC548C
V4321 BAW62
R4332 4K22
LOW: DURING HOLD OFF
D4103/21
BSXHO
R4334 2K15
-12D
+12H
V4305 BZX79 C9V1
R4308 10K
V4304 BC558B
R4309 8K25
C4307 10n
R4304 5K11
V4302 BC548C
4839 12p
N4103 TL080
N4102 OP-77
R4829 5E11
+17V
C4829 10n
C4837 47u
R4306 681E
R4307 5K11
R4305 51K1
R4312 9K09
+12C
R4819 5E11
+12P
C4819 10n
R4822 5E11
C4822 100n
-12X
R4825 5E11
-12H
C4825 10n
C4303 10n
V4308 BZV86 C1V4
C4304 220p
V4309 BC548C
RESET D4002/9
R4311 10K
R4313 75K
R4314 8K25
C4306 10n
MAT 3717A



MAT 3968

Figure 7.10 Time-base unit p.c.b.



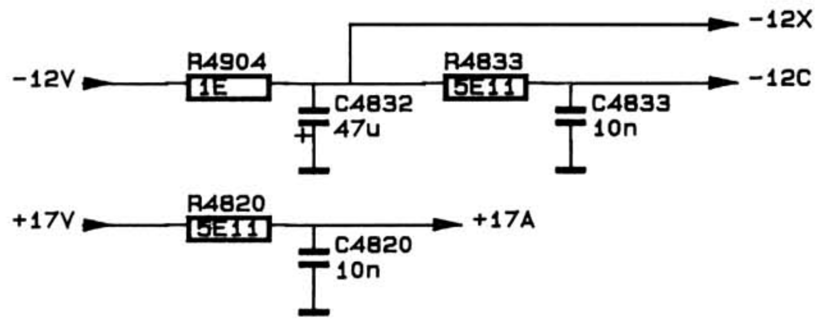


Figure 7.11 Circuit diagram of time base, X-deflection selection

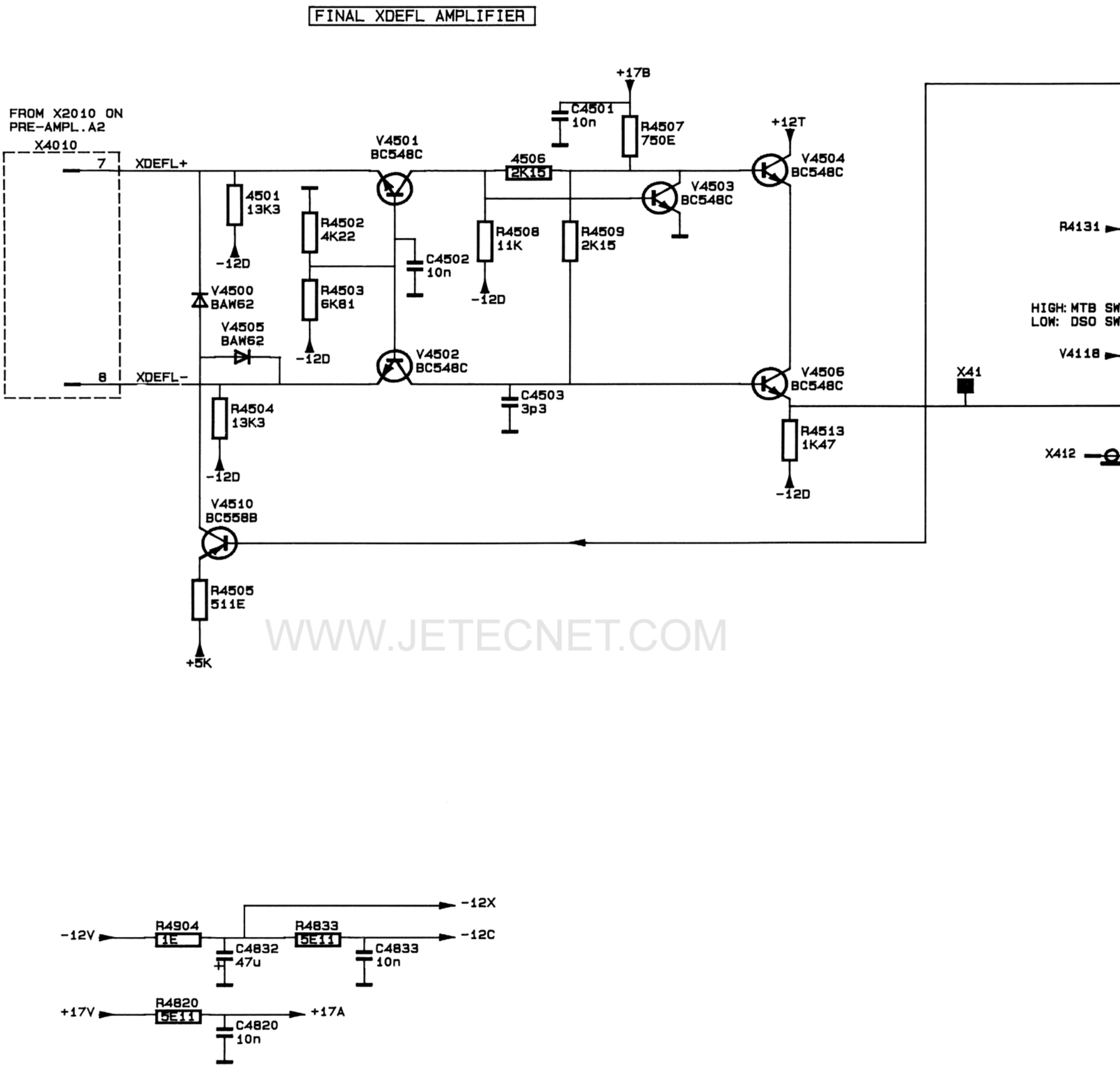
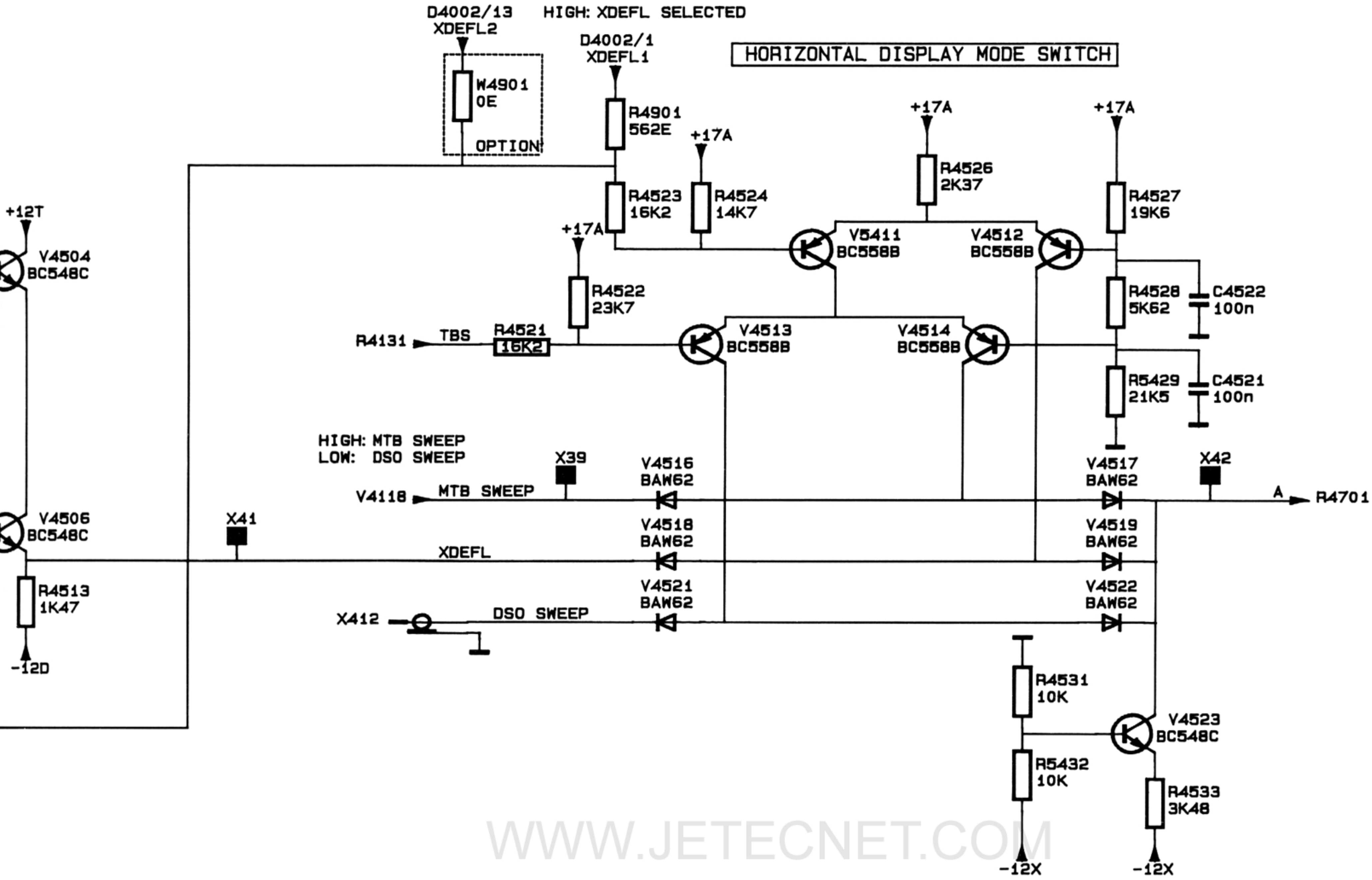


Figure 7.11 Circuit diagram of time base, X-deflection selection


HORIZONTAL DISPLAY MODE SWITCH
D4002/13
XDEFL2
HIGH: XDEFL SELECTED
D4002/1
XDEFL1
W4901
0E
OPTION
R4901
562E
+17A
R4526
2K37
R4527
19K6
R4523
16K2
R4524
14K7
+12T
V4504
BC548C
V5411
BC558B
V4512
BC558B
R4522
23K7
R4528
5K62
C4522
100n
R4131
TBS
R4521
16K2
V4513
BC558B
V4514
BC558B
R5429
21K5
C4521
100n
HIGH: MTB SWEEP
LOW: DSO SWEEP
X39
V4516
BAW62
V4517
BAW62
X42
V4118
MTB SWEEP
A
R4701
V4506
BC548C
X41
V4518
BAW62
V4519
BAW62
XDEFL
R4513
1K47
V4521
BAW62
V4522
BAW62
X412
DSO SWEEP
-12D
R4531
10K
V4523
BC548C
R5432
10K
R4533
3K48
-12X
-12X

MAT 3718A

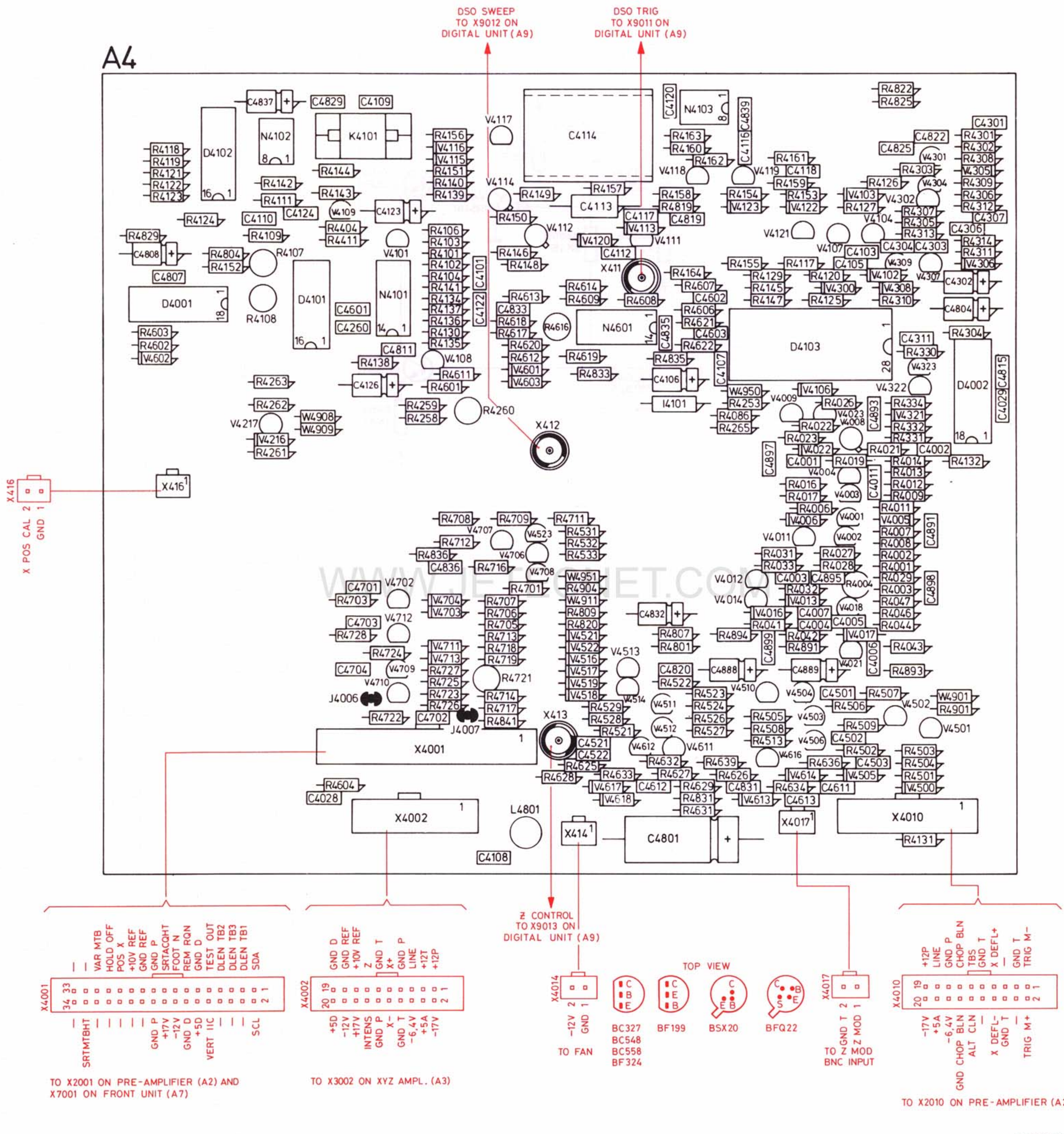
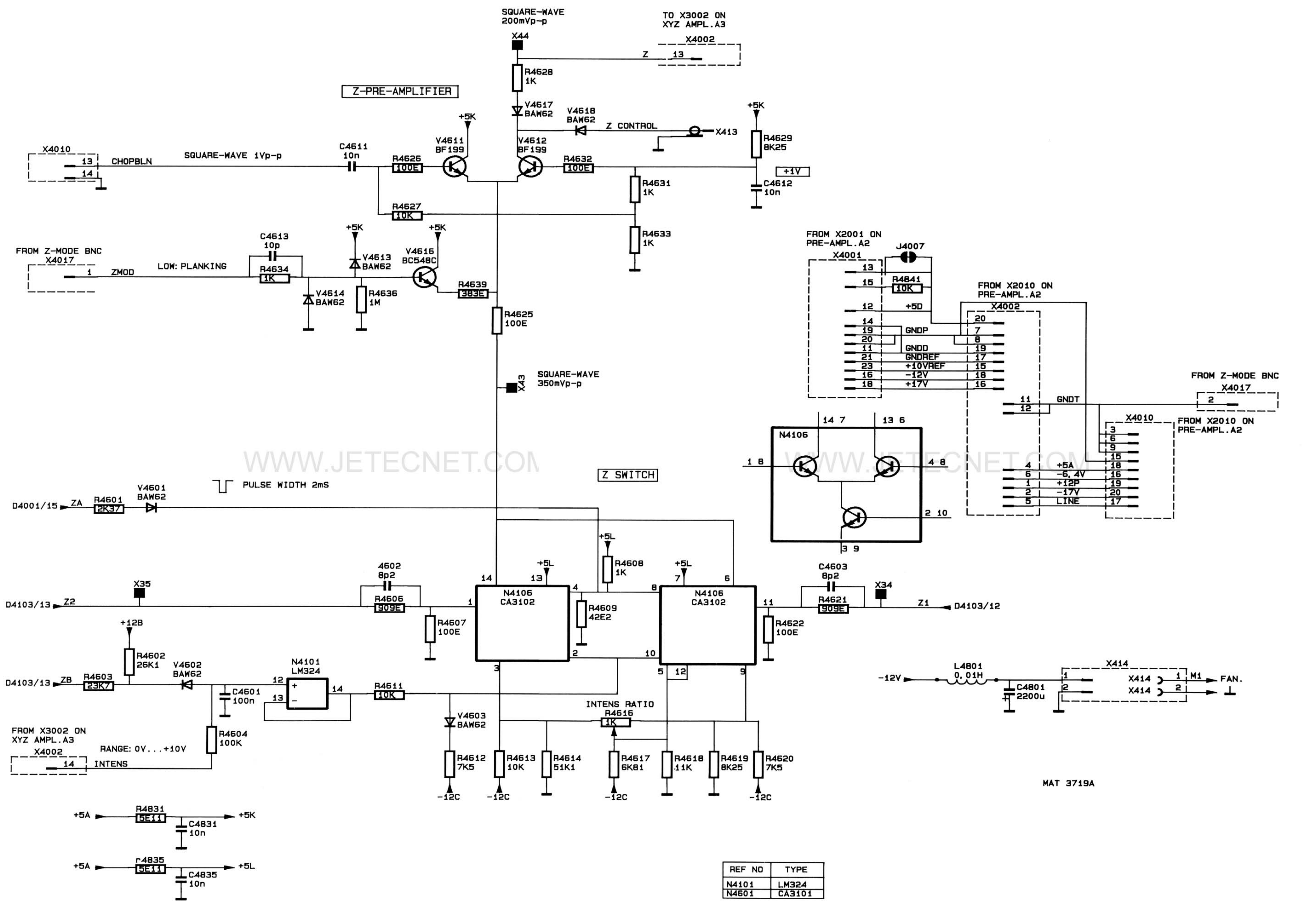


Figure 7.12 Time-base unit p.c.b.



REF NO	TYPE
N4101	LM324
N4601	CA3101

Figure 7.13 Circuit diagram of time-base, Z-preamplifier

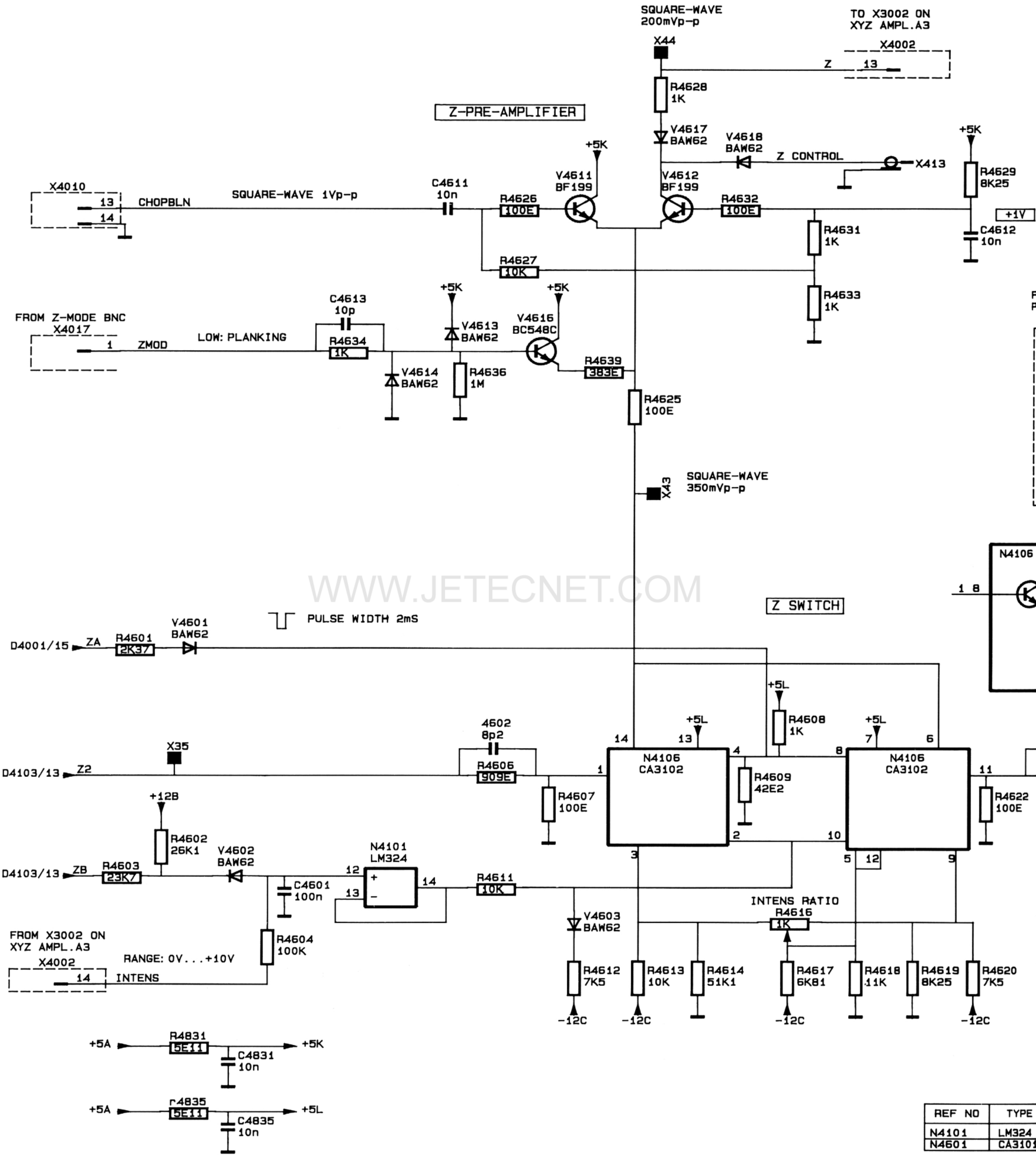
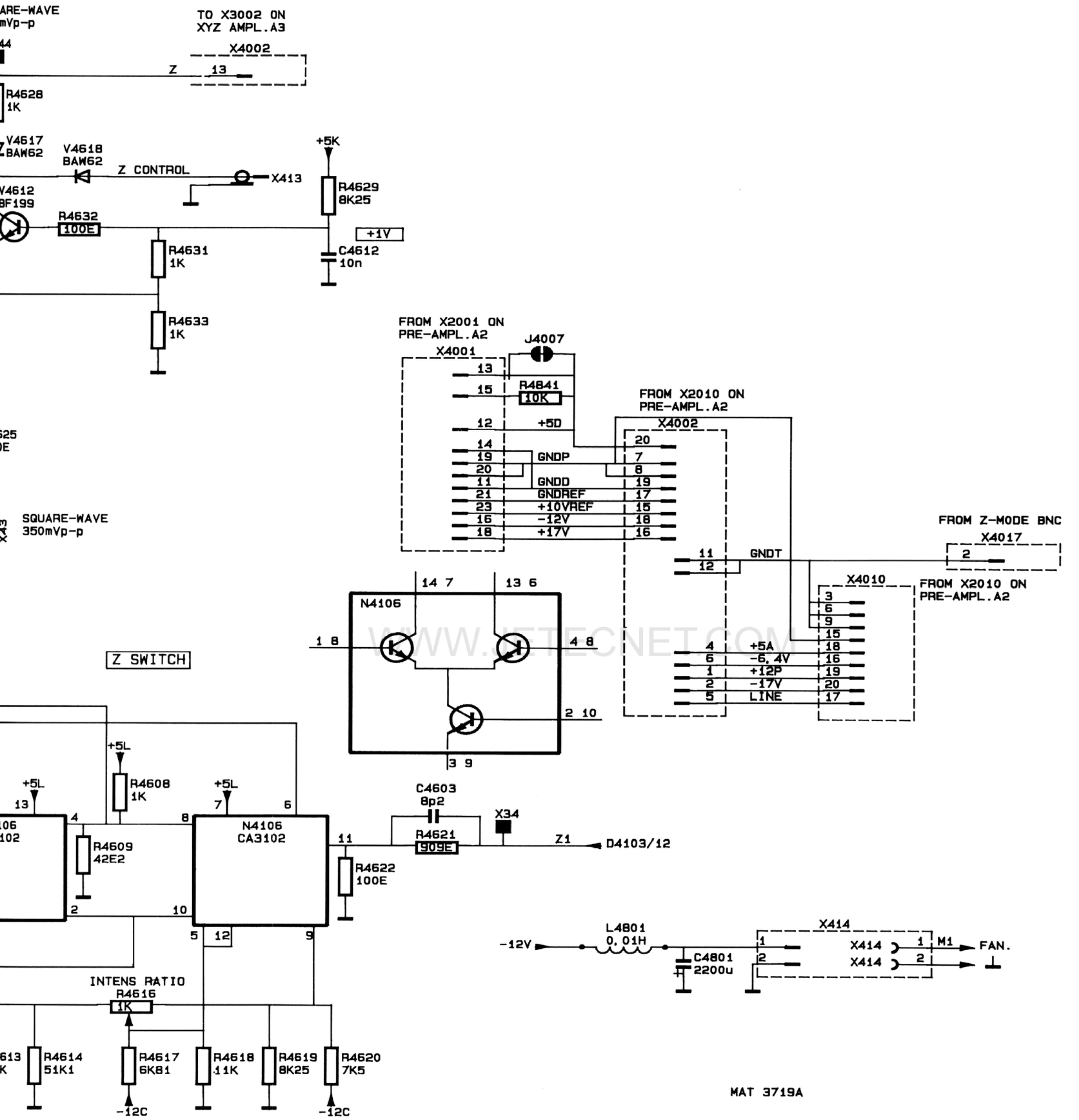


Figure 7.13 Circuit diagram of time-base, Z-preamplifier



REF NO	TYPE
N4101	LM324
N4601	CA3101

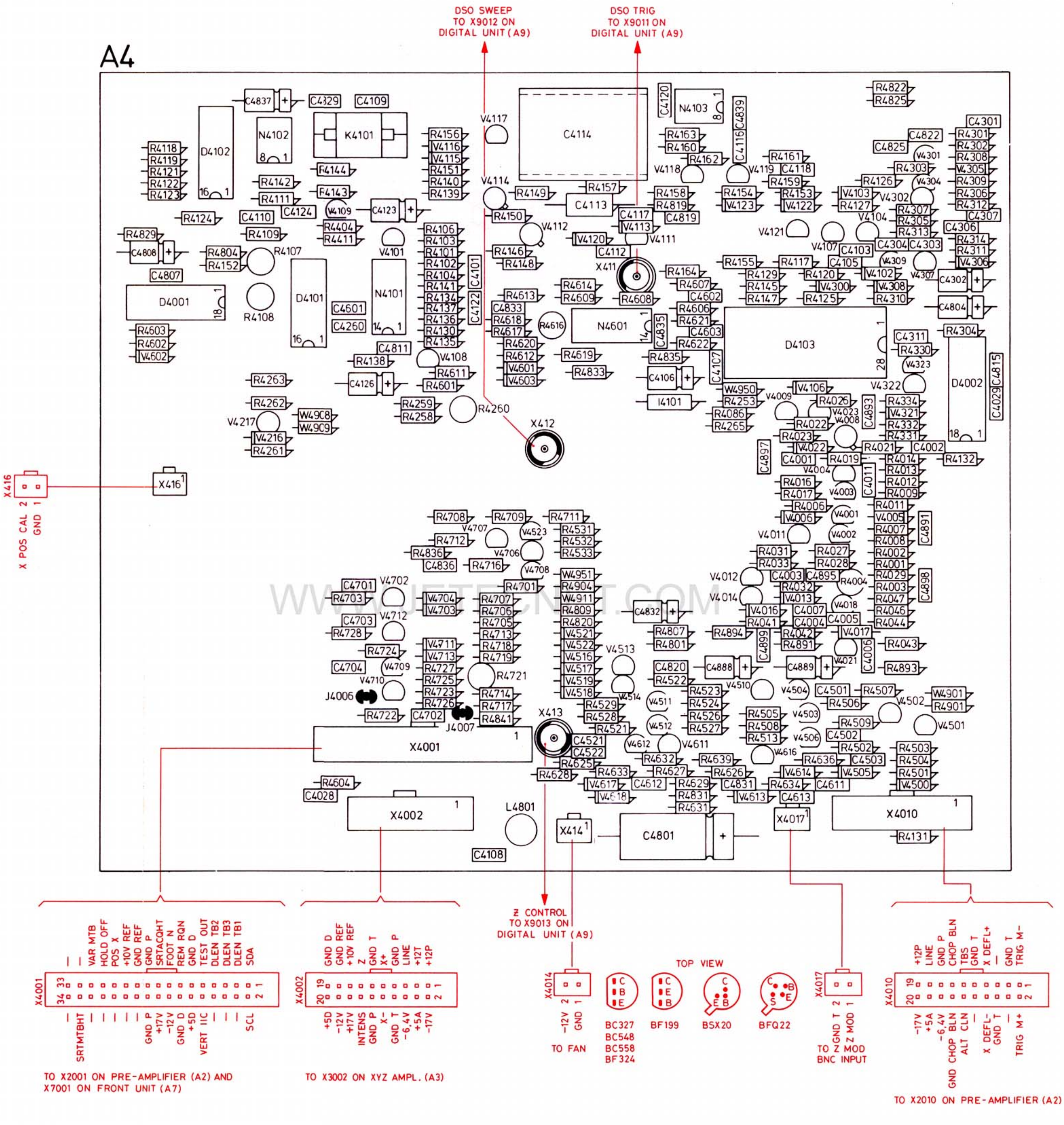


Figure 7.14 Time-base unit p.c.b.

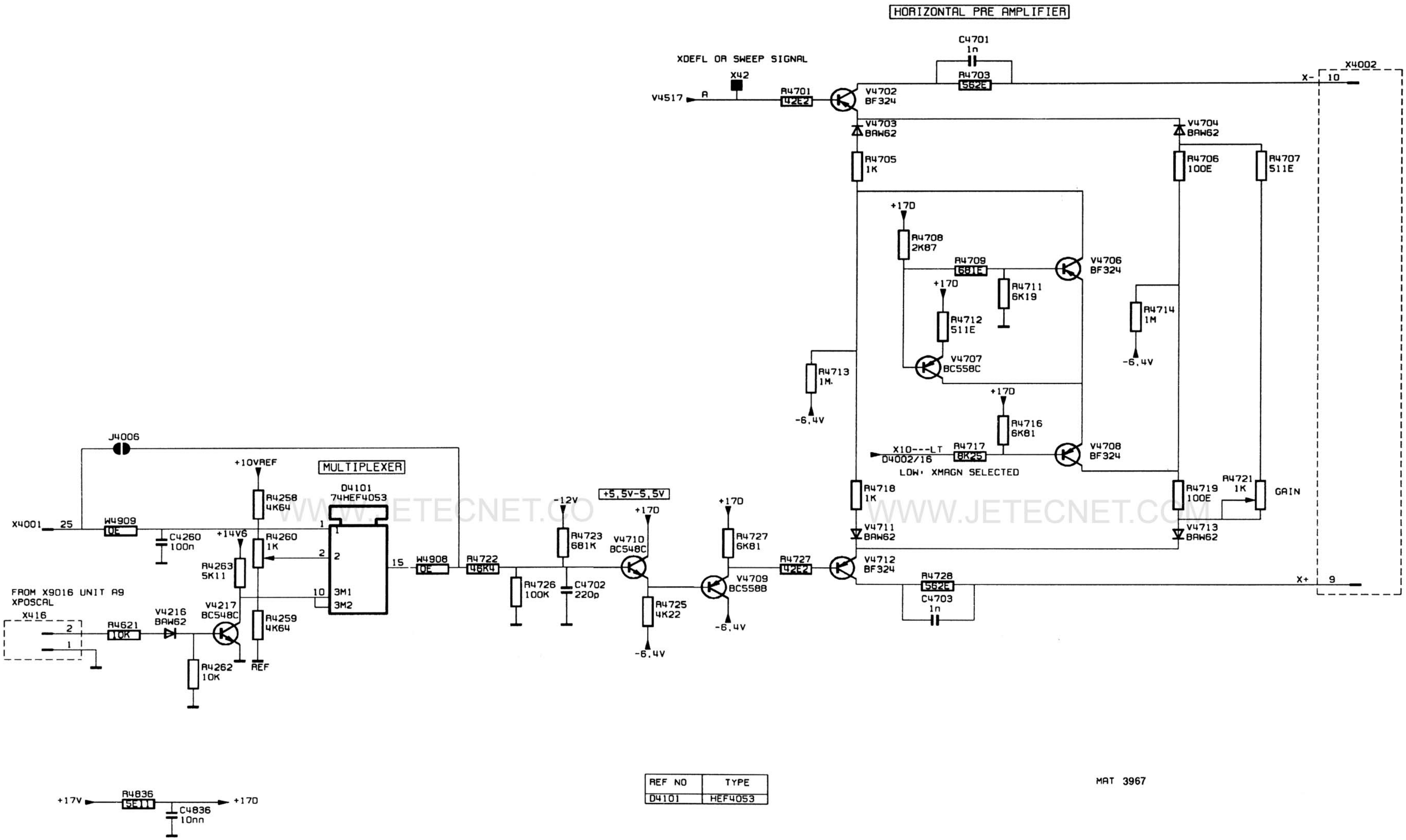
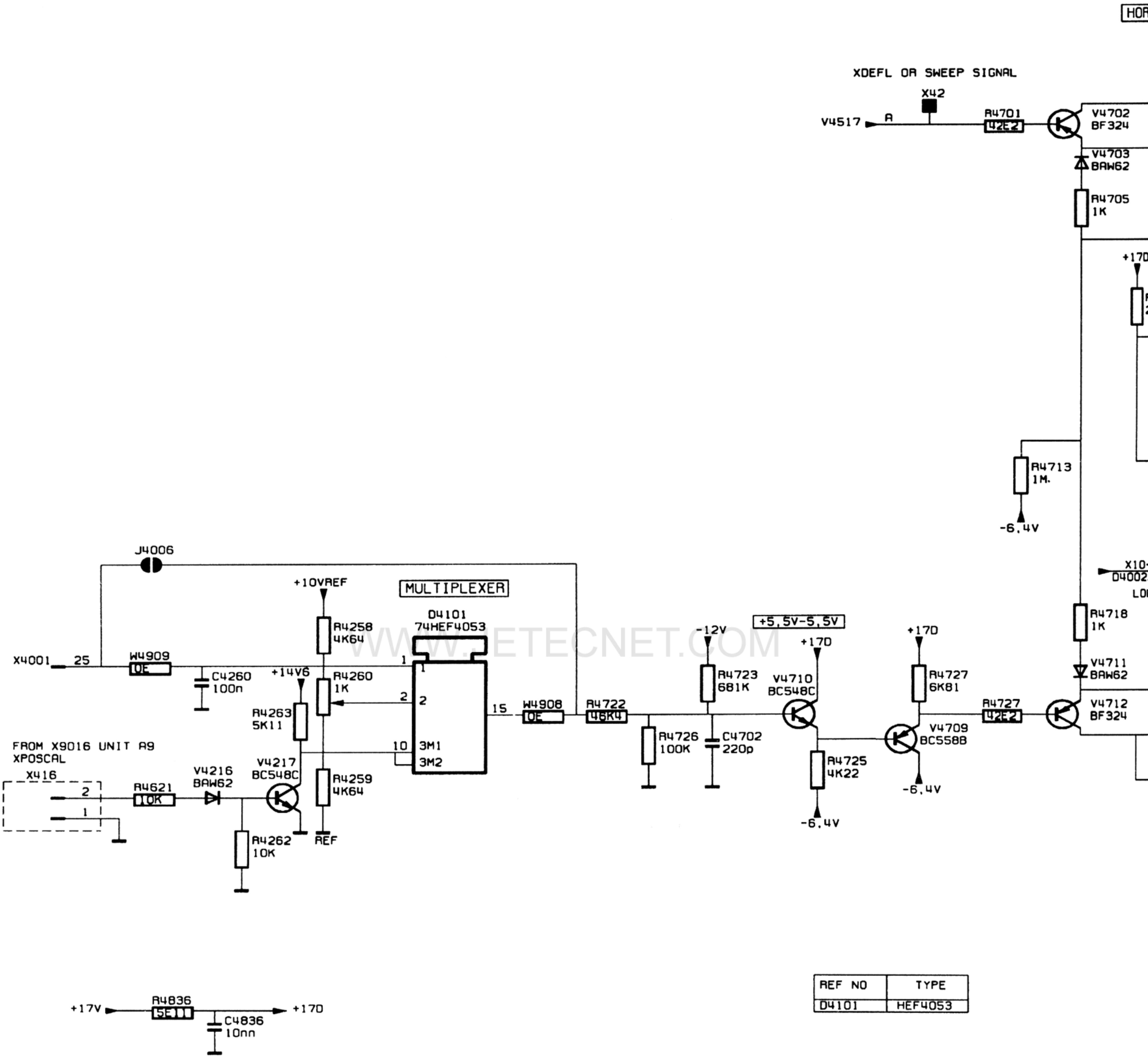
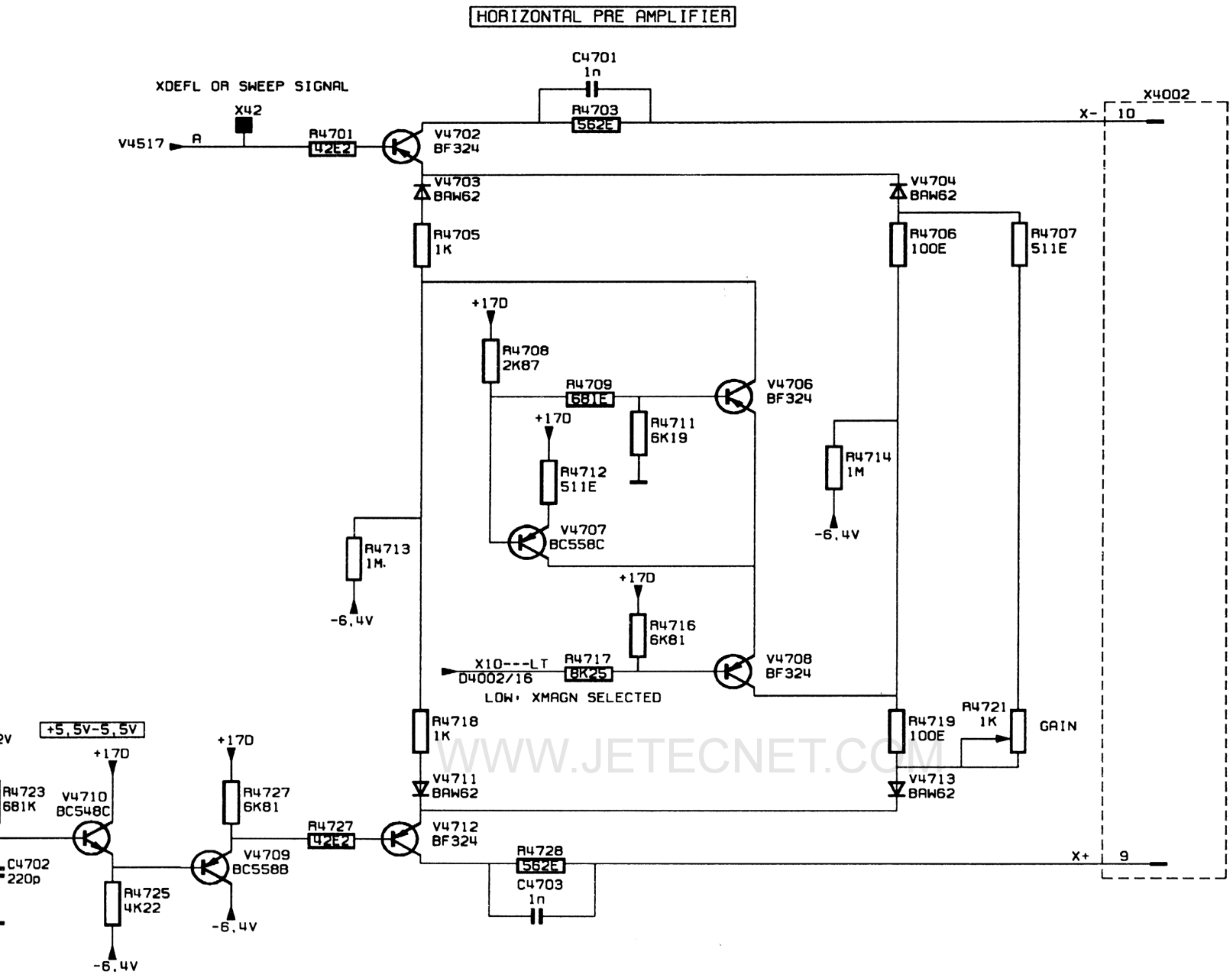


Figure 7.15 Circuit diagram of time-base, horizontal preamplifier



REF NO	TYPE
D4101	HEF4053

Figure 7.15 Circuit diagram of time-base, horizontal preamplifier



REF NO	TYPE
D4101	HEF4053

MAT 3967

8 CRT CONTROL UNIT (A5)

This unit incorporates the potentiometers that control the CRT functions. These potentiometers are INTENS (R1), screwdriver operated control TRACE ROT (R2), FOCUS (R3) and ILLUM (R4).
The range of these potentiometers is between 0 V and +10 V.
The way these potentiometers influences the associated circuit is described together with the description of the relevant circuit part.

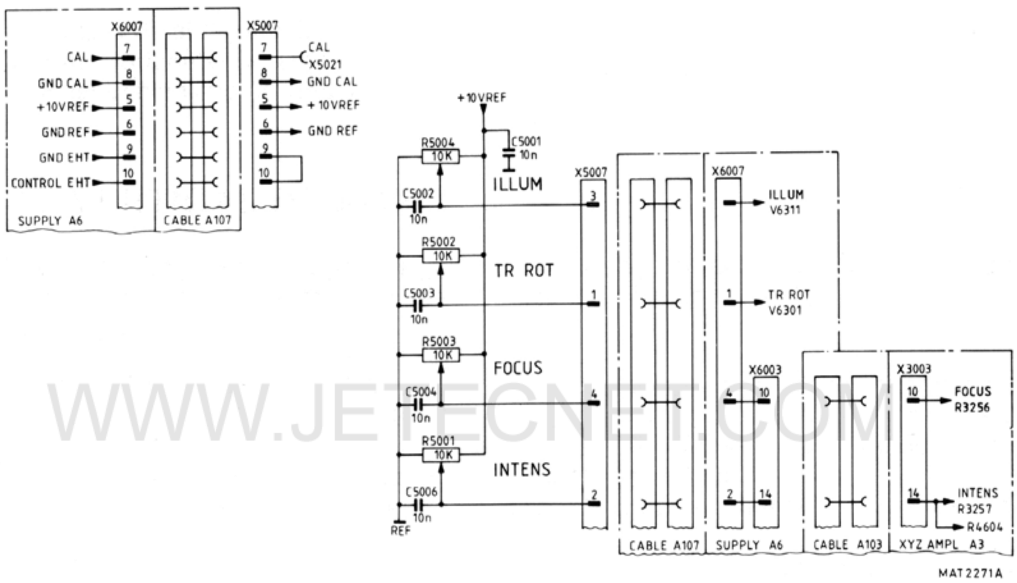


Figure 8.1 Circuit diagram of CRT control

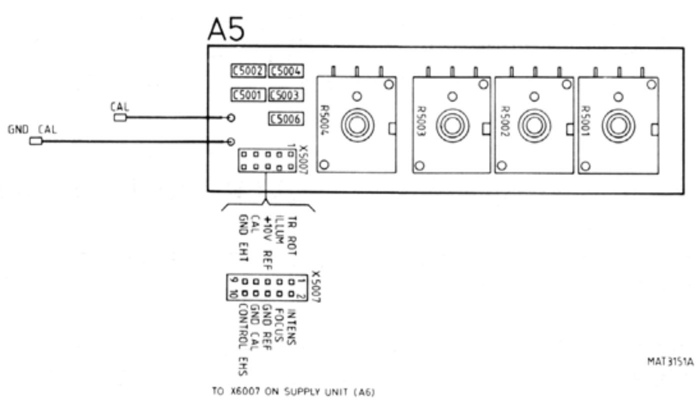


Figure 8.2 CRT control unit p.c.b.

9 POWER SUPPLY UNIT (A6)

Basically, the power supply unit consists of:

- input circuit
- converter circuit
- secondary output rectifiers
- HT supply
- CAL oscillator
- CRT control circuit

9.1 INPUT CIRCUIT

The instrument may be powered from a nominal mains voltage of 90 V...250 V (ac).
The mains voltage is primary protected by a fuse of 1,6 AT, which is located on the rear of the instrument.

After rectification by the diode bridge V6001...V6004 a d.c. voltage is applied to the converter circuit.
This voltage is smoothed by capacitors C6007, C6008 and chokes L6000, L6001 and L6002.
Depending on the mains voltage, the rectified voltage is 120 V...370 V.

NOTE: All measurements in the primary circuit should be done with a floating oscilloscope. As reference voltage can be used measuring point X48.

A fixed part of the mains voltage serves as a LINE-trigger signal.
The amplitude of the LINE trigger signal is 1/22 x MAINS.

NOTE: The LINE trigger signal is not present when a d.c. voltage serves as MAINS.

9.2 CONVERTER CIRCUIT

(see figures 9.1, 9.2 and 9.3)

In this oscilloscope a flyback converter is used to generate the required voltages out of the LINE IN voltage. The combination of the transistors V6014 and V6018 functions as a switch in this flyback converter. The converter switching frequency depends of the amplitude of the LINE IN voltage (for 110 V (ac): 30 kHz approx and for 220 V (ac): 45 kHz approx).

Transistors V6014 and V6018 conduct on the forward stroke and charge transformer T6001. Thyristor V6013 fires when the voltage on the gate reaches the firing level (0,6 V approx). Consequently V6018 blocks and V6014 blocks (flyback stroke). During this flyback stroke, the secondary windings of T6001 discharge via the diode rectifiers into smoothing capacitors. The NTC resistor R6009 provides temperature compensation for the firing point of the thyristor. During the flyback, capacitor C6009 charges again via the path T6001-1,V6012, V6009, R6001, C6009 and T6001-2.

At the end of the flyback, when C6009 has been charged, the voltage over this capacitor is stabilized by a voltage stabilizer and is used to switch on again V6014 (and V6018). The voltage stabilizer, consisting of V6009, R6006 and V6012, outputs a square-wave signal to the gate of transistor V6014 with a maximum amplitude of 15 V.

The dv/dt limiter with L6004, L6006, V6017 and V6019 serves to slow down the increase of the collector voltage of V6018 when this transistor is switched off (see figure 9.1).

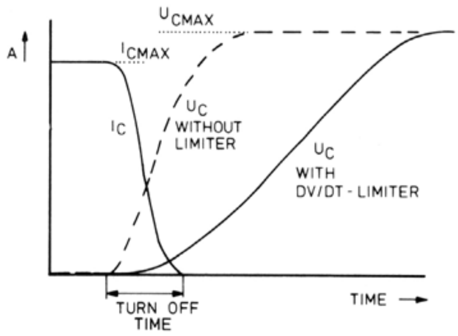


Figure 9.1 Converter-voltage and -current waveforms of V6018 (switching off).

By slowing down the increase of Uc (i.e. limiting dv/dt), the product P = Uc Ic of the collector coltage Uc and the collector current Ic, build up in the transistor while switching off, is limited.

The voltage control circuit (N6001 (5-6-7) and associated components) feed back any variation in the -12 R voltage to the gate of V6013. For example: if the -12 V voltage is too low, more current is sent into H6001. Because of the extra current, V6013 fires earlier so that the output voltage decreases.

NOTE: The only function of diode V6021 is protection of R6017, R6018 and the circuit that controls the base of V6018. If the main fuse has blown, always check V6021, too !

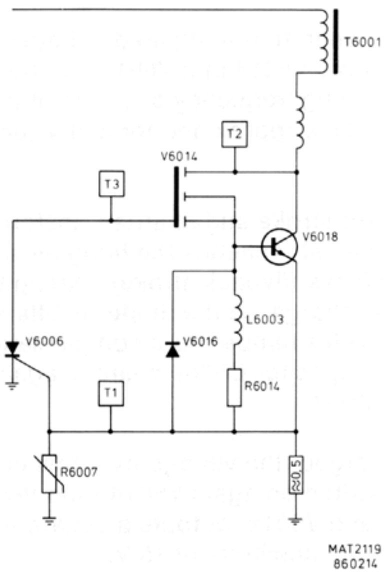


Figure 9.2 Converter circuit

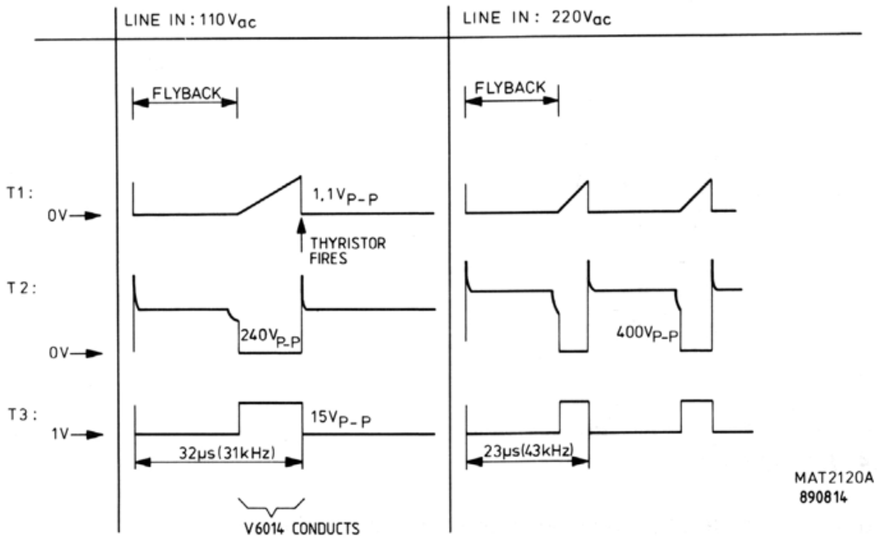


Figure 9.3 Timing diagram converter circuit

9.3 SECONDARY OUTPUT RECTIFIERS

The output voltages taken from the secondary windings of transformer T6001 are rectified by diodes and smoothed by capacitors in conventional circuits.
A "CROWBAR" circuit with transistor V6137 and V6112 protects the +5 V supply. When the +5 V level is too high, transistor V6137 (and V6112) conduct and the power supply goes into short circuit mode. (This results in a decrease of the converter switching frequency).

A voltage protection circuit using V6134, V6136 and V6112 protects against overload. When the power supply is overloaded, these components conduct and the power supply goes into in the short circuit mode.

9.4 HT SUPPLY

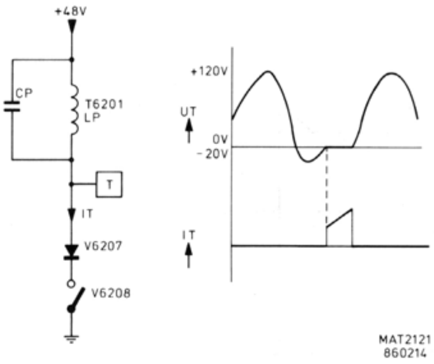


Figure 9.4 HT oscillator

The HT supply consists of an oscillator and a regulator circuit.
Transformer T6201 determines the frequency (50 kHz approx.) of the oscillator. The output signal voltage on the secondary winding of T6201 is rectified by diode V6209 and smoothed by C6211. The -2,1 kV is also converted to -14,5 kV in the HT multiplier D6201 and routed via connector X6030 to the post-acceleration anode of the CRT.

To regulate this HT voltage the -2 kV is fed to the input of OP-AMP N6002.
The output level of N6002 determines the energy to T6201, and thus the amplitude of the HT-voltage.

9.5 CALIBRATOR

The calibrator circuit consists of two analog switches D6501(8-9) and D6501(11-10) controlled by the active HIGH enable inputs 6 and 12 respectively, that are connected as a 2 kHz astable oscillator. Capacitor C6502 and resistor R6504 determine the 2 kHz frequency. The oscillator outputs, applied to enable inputs 5 and 13 of the second stage are in anti-phase with each other. Depending on the level of input 5 and 13, the CAL voltage will have a 1,2 V level or a 0 V level.

A6

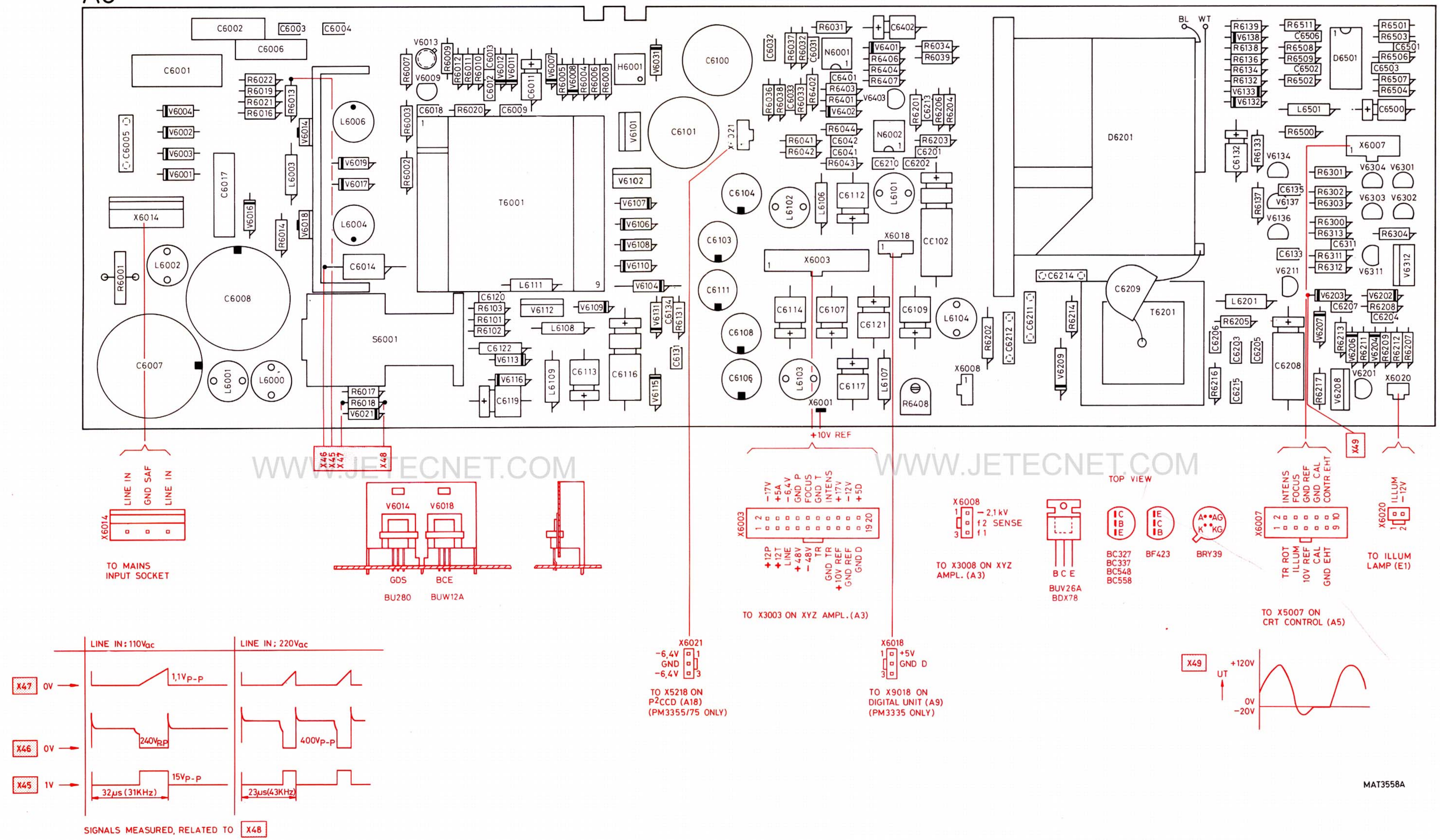


Figure 9.5 Power supply unit p.c.b.

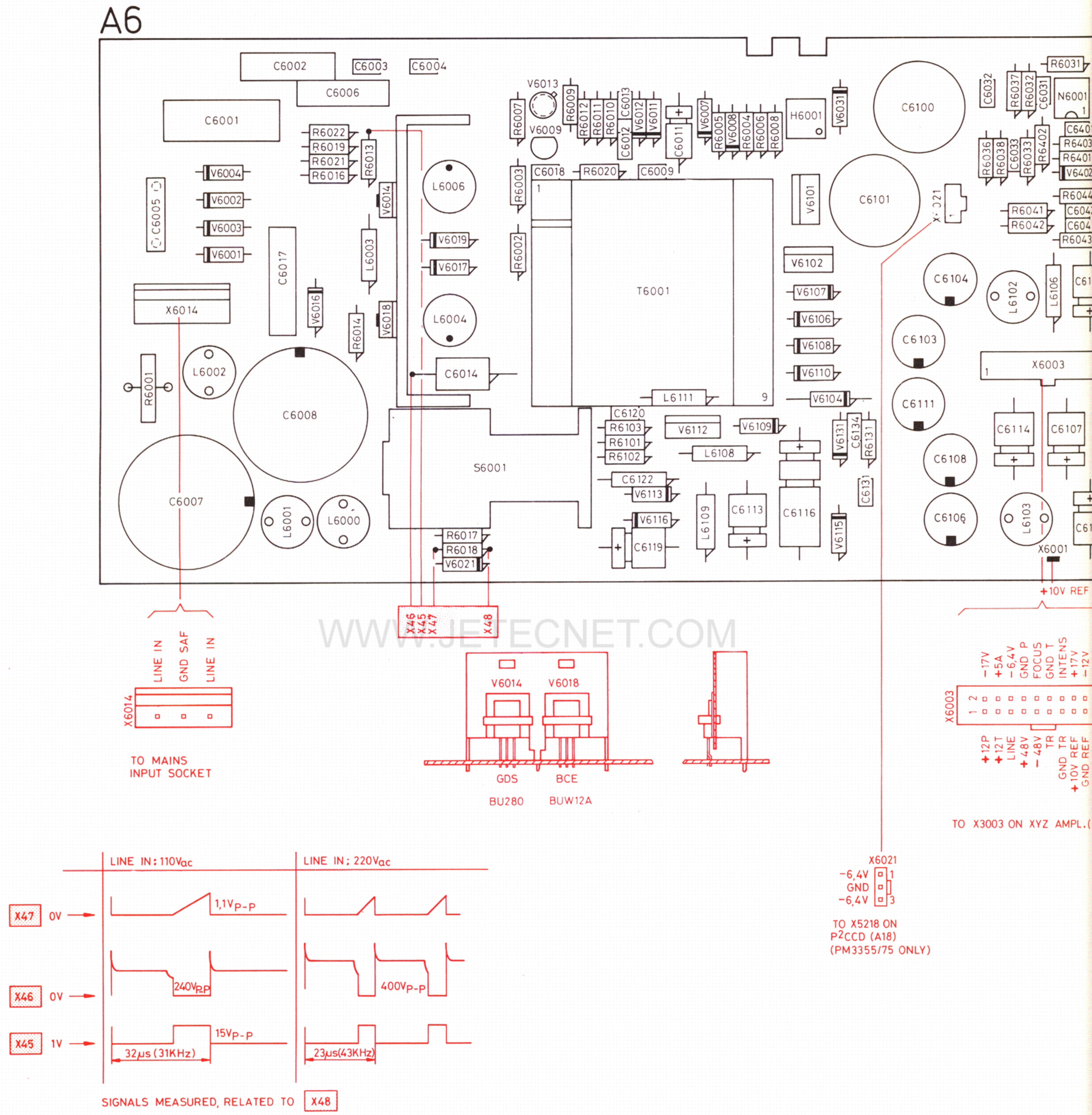
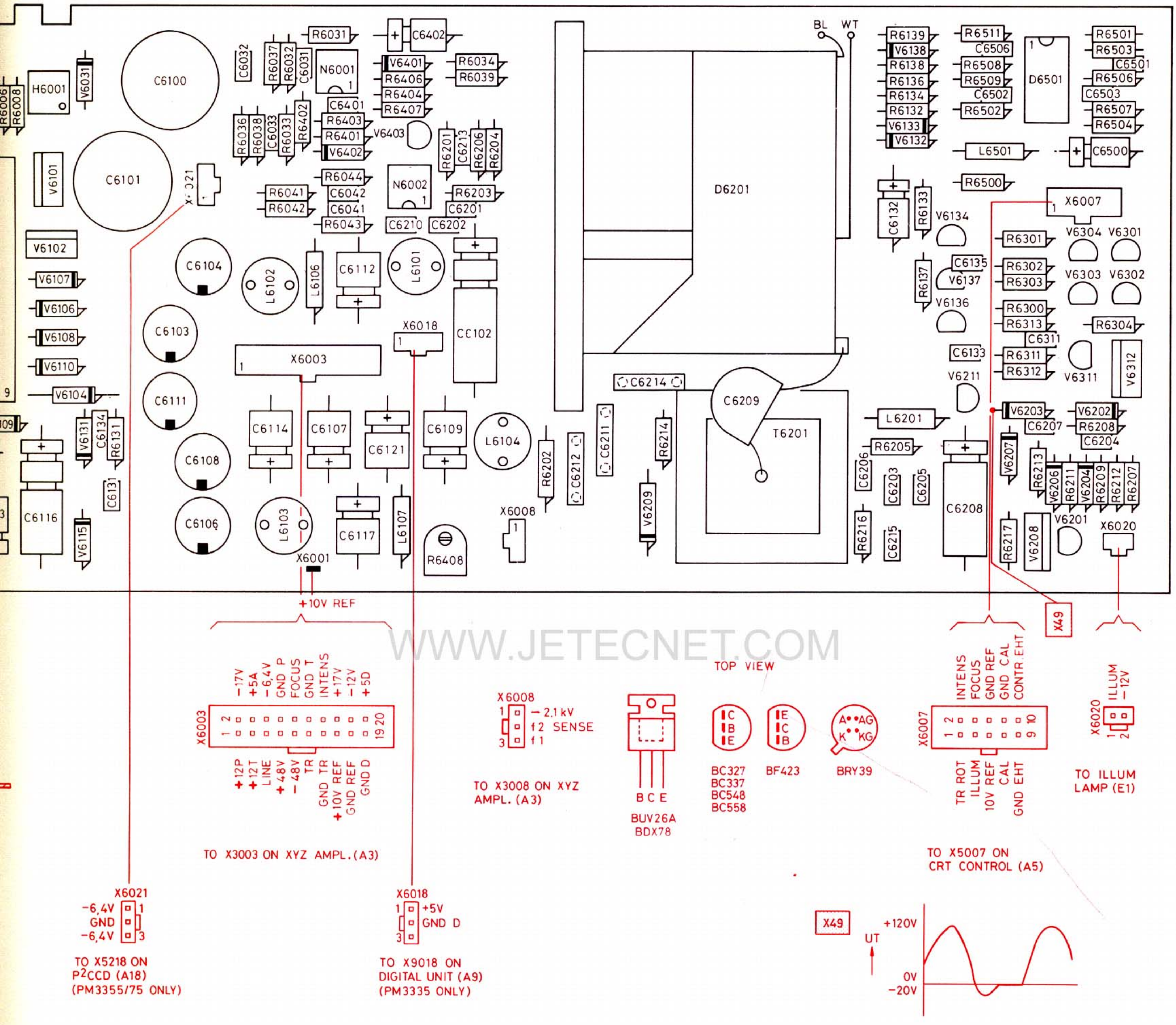
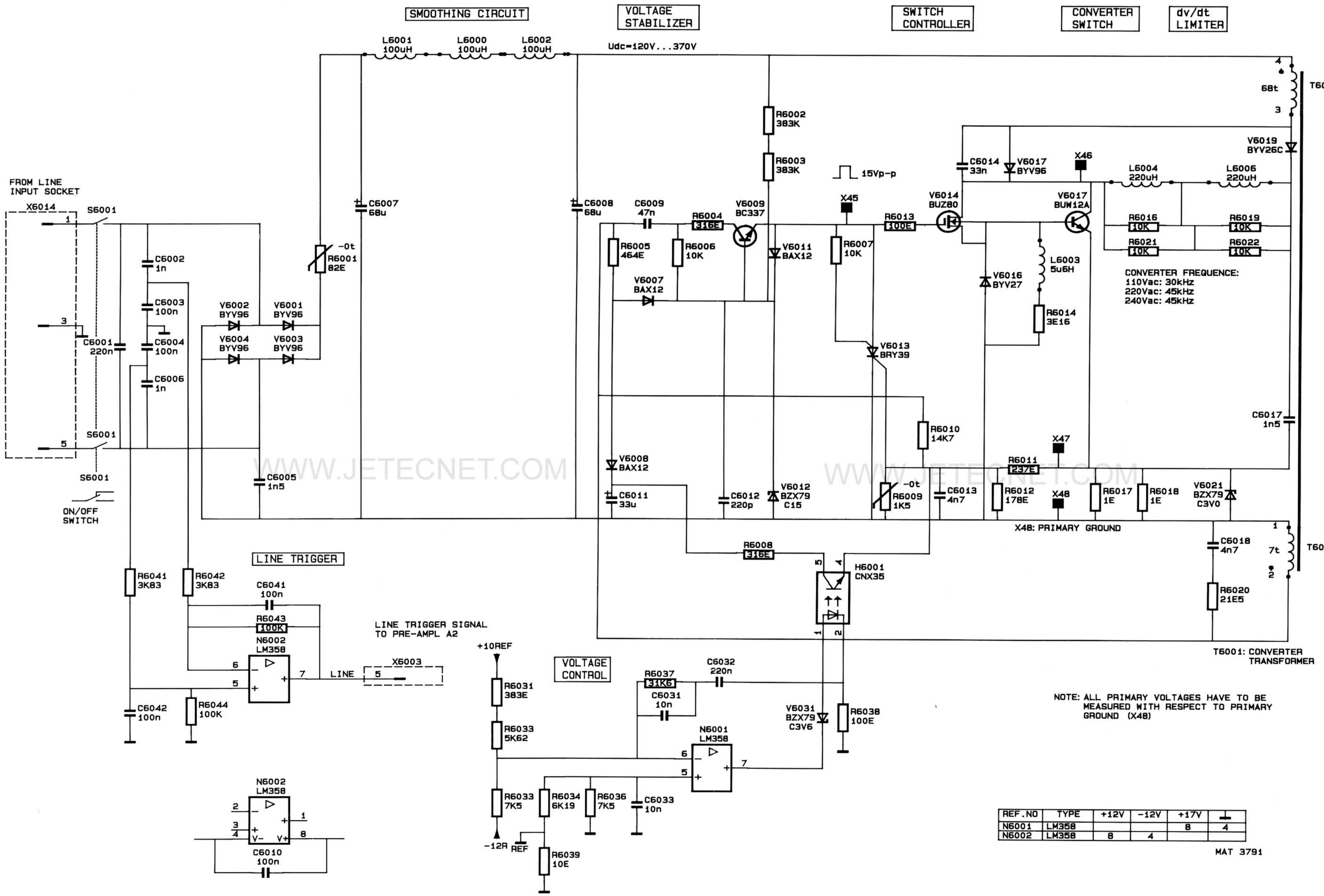


Figure 9.5 Power supply unit p.c.b.


+10V REF
X6003
-17V +5A -6,4V GND P FOCUS GND T INTENS +17V -12V +5D
+12P +12T LINE +48V -48V TR GND TR +10V REF GND REF GND D
TO X3003 ON XYZ AMPL.(A3)
X6008
-2,1kV
f2 SENSE
f1
TO X3008 ON XYZ AMPL. (A3)
TOP VIEW
B C E
BUV26A
BDX78
BC327
BC337
BC548
BC558
BF423
BRY39
X6007
INTENS FOCUS GND REF GND CAL CONTR EHT
TR ROT ILLUM 10V REF CAL GND EHT
TO X5007 ON CRT CONTROL (A5)
X6020
ILLUM -12V
TO ILLUM LAMP (E1)
X49
X6021
-6,4V
GND
-6,4V
TO X5218 ON P2CCD (A18) (PM3355/75 ONLY)
X6018
+5V
GND D
TO X9018 ON DIGITAL UNIT (A9) (PM3335 ONLY)
X49
+120V
UT
0V
-20V

MAT3558A



REF.NO	TYPE	+12V	-12V	+17V	⏚
N6001	LM358			8	4
N6002	LM358	8	4		

Figure 9.6 Circuit diagram of power supply, primary circuit

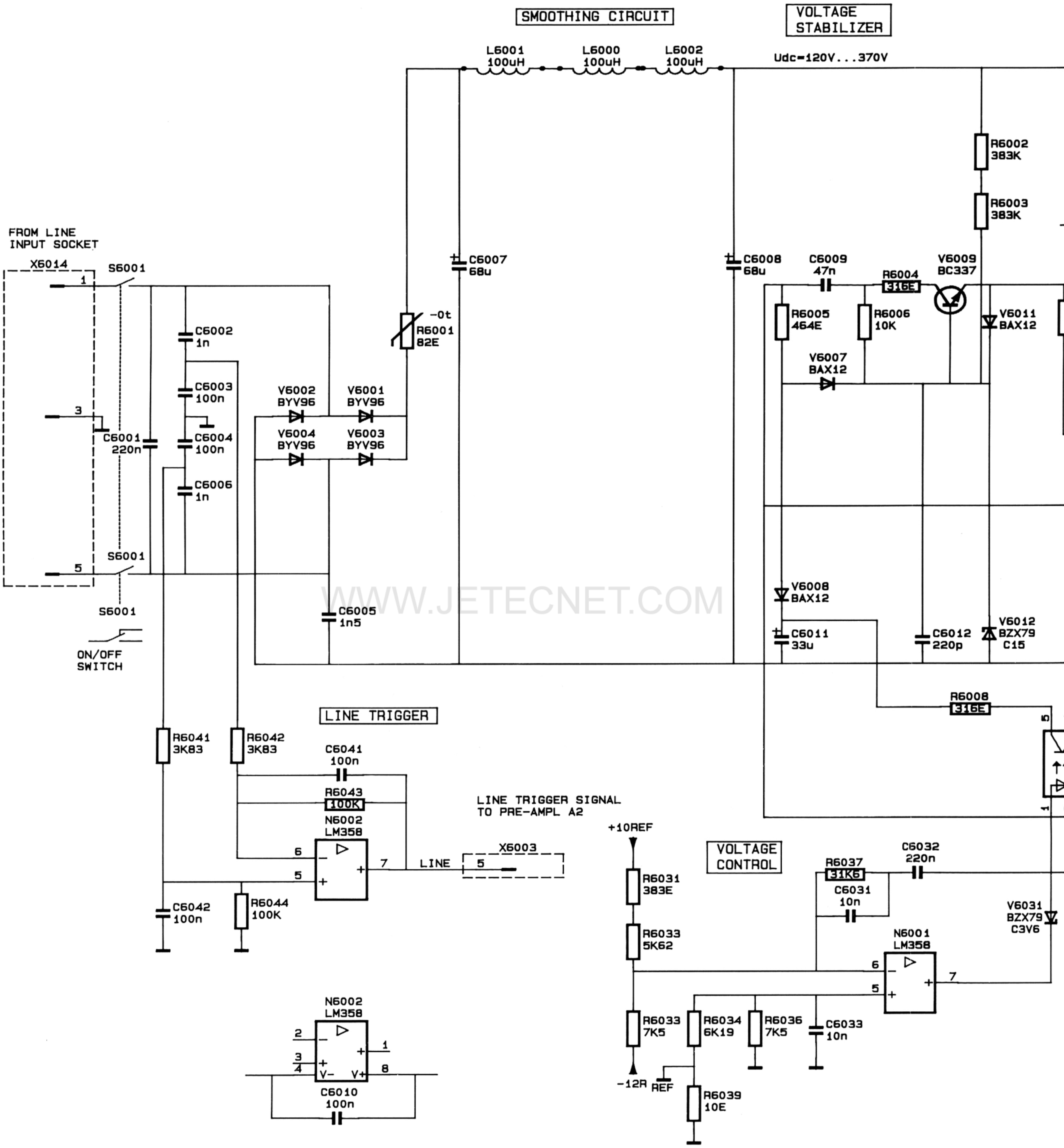
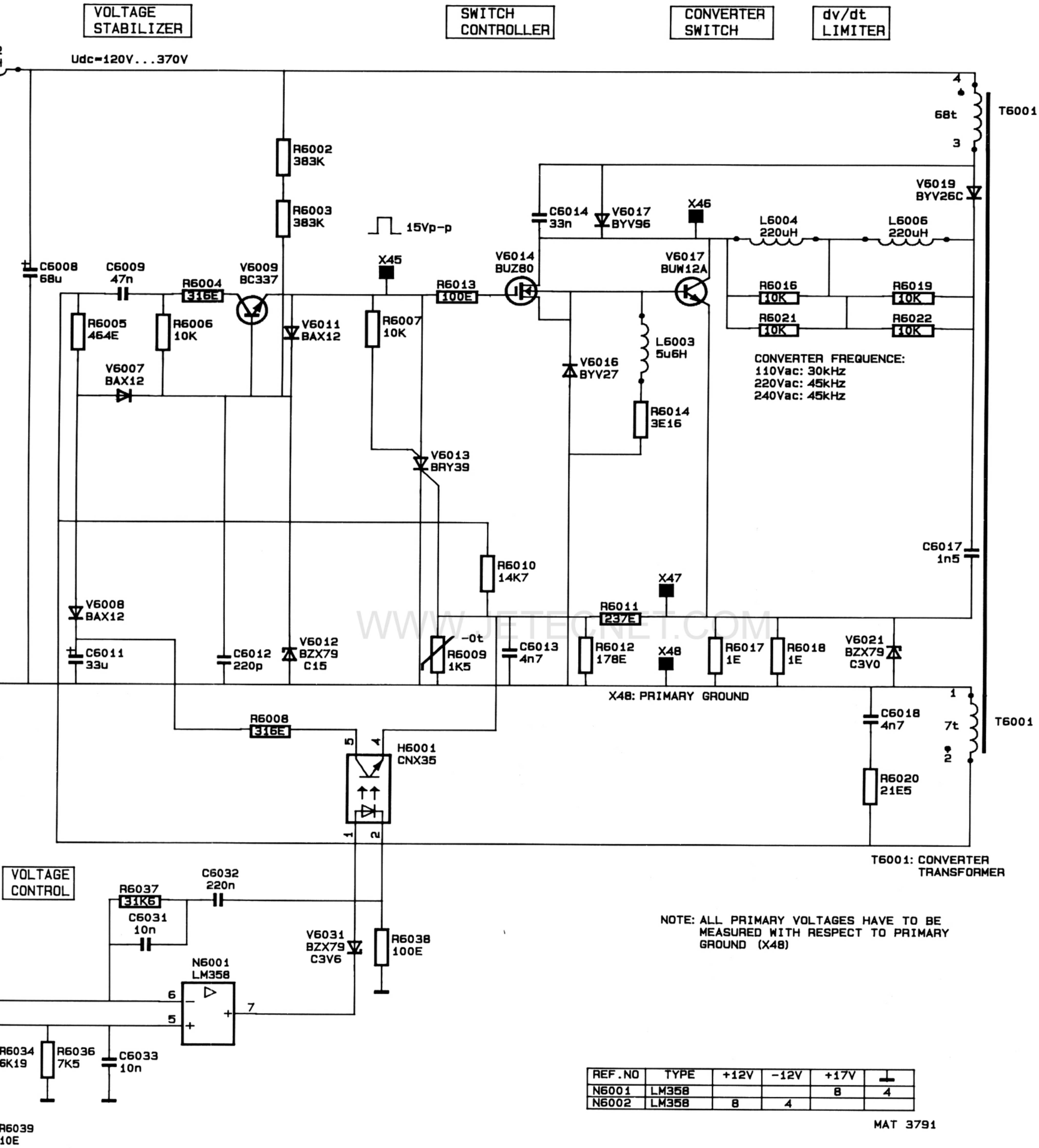


Figure 9.6 Circuit diagram of power supply, primary circuit



REF.NO	TYPE	+12V	-12V	+17V	⊥
N6001	LM358			8	4
N6002	LM358	8	4		

MAT 3791

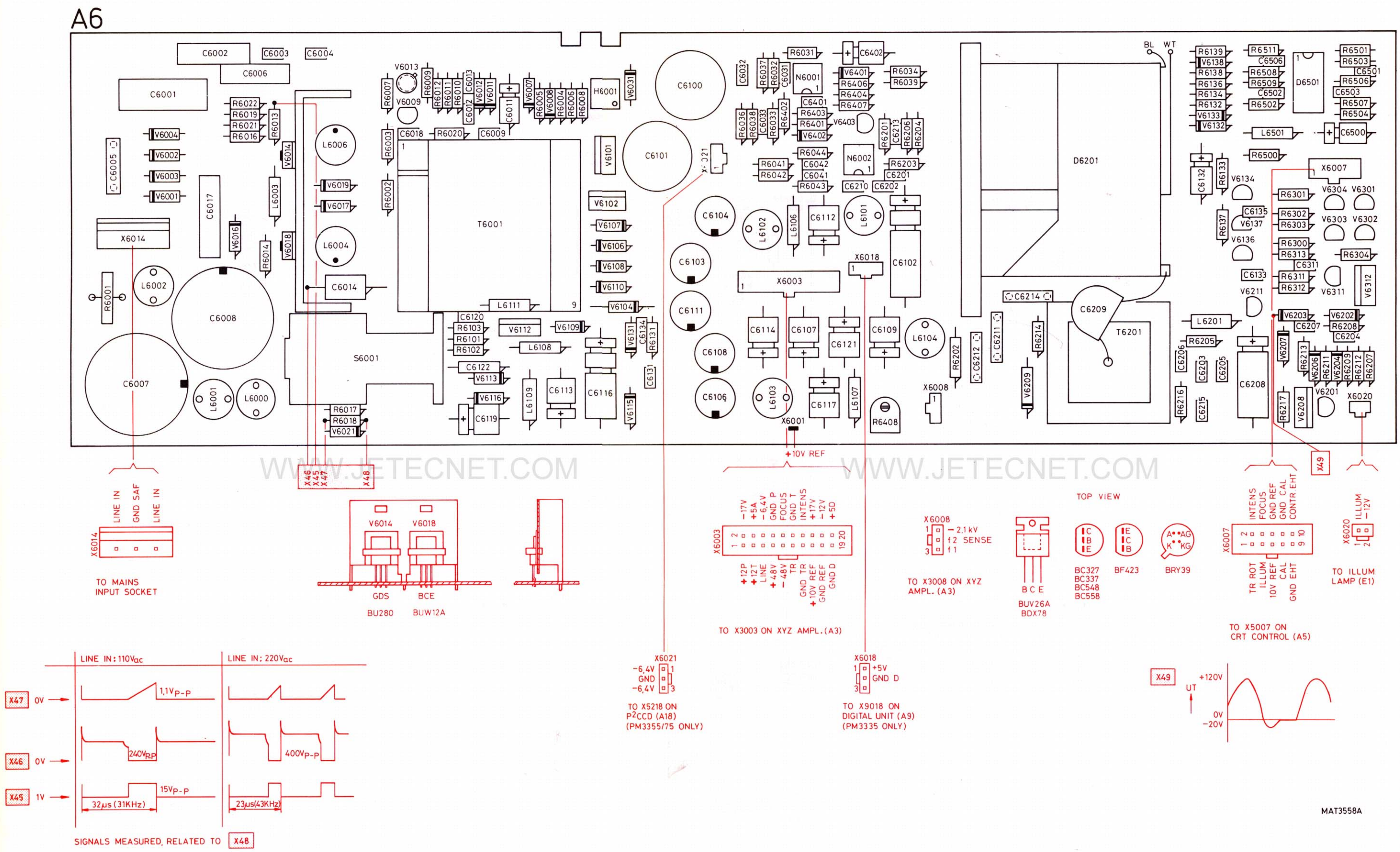


Figure 9.7 Power supply unit, p.c.b.

A6

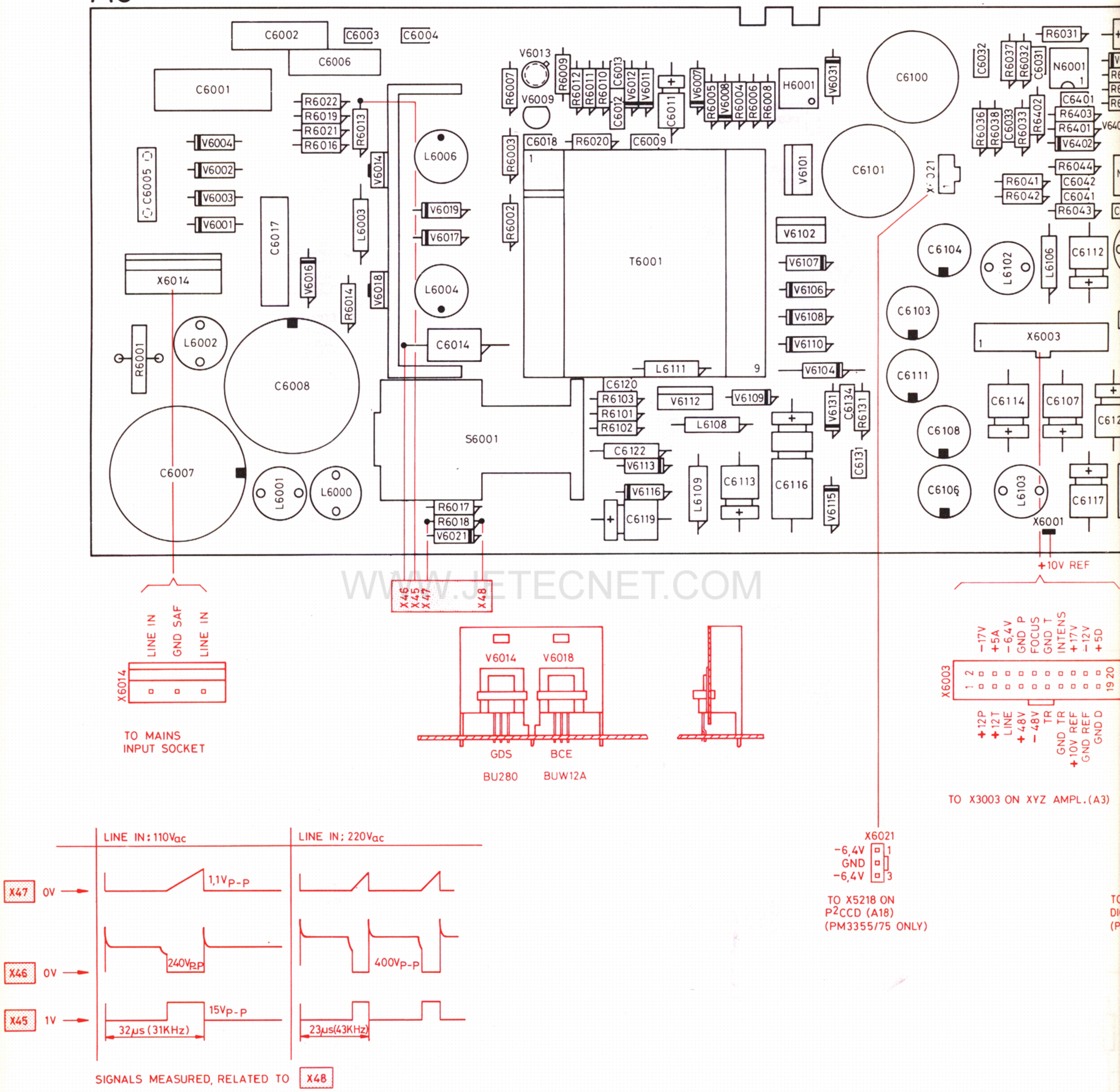


Figure 9.7 Pow

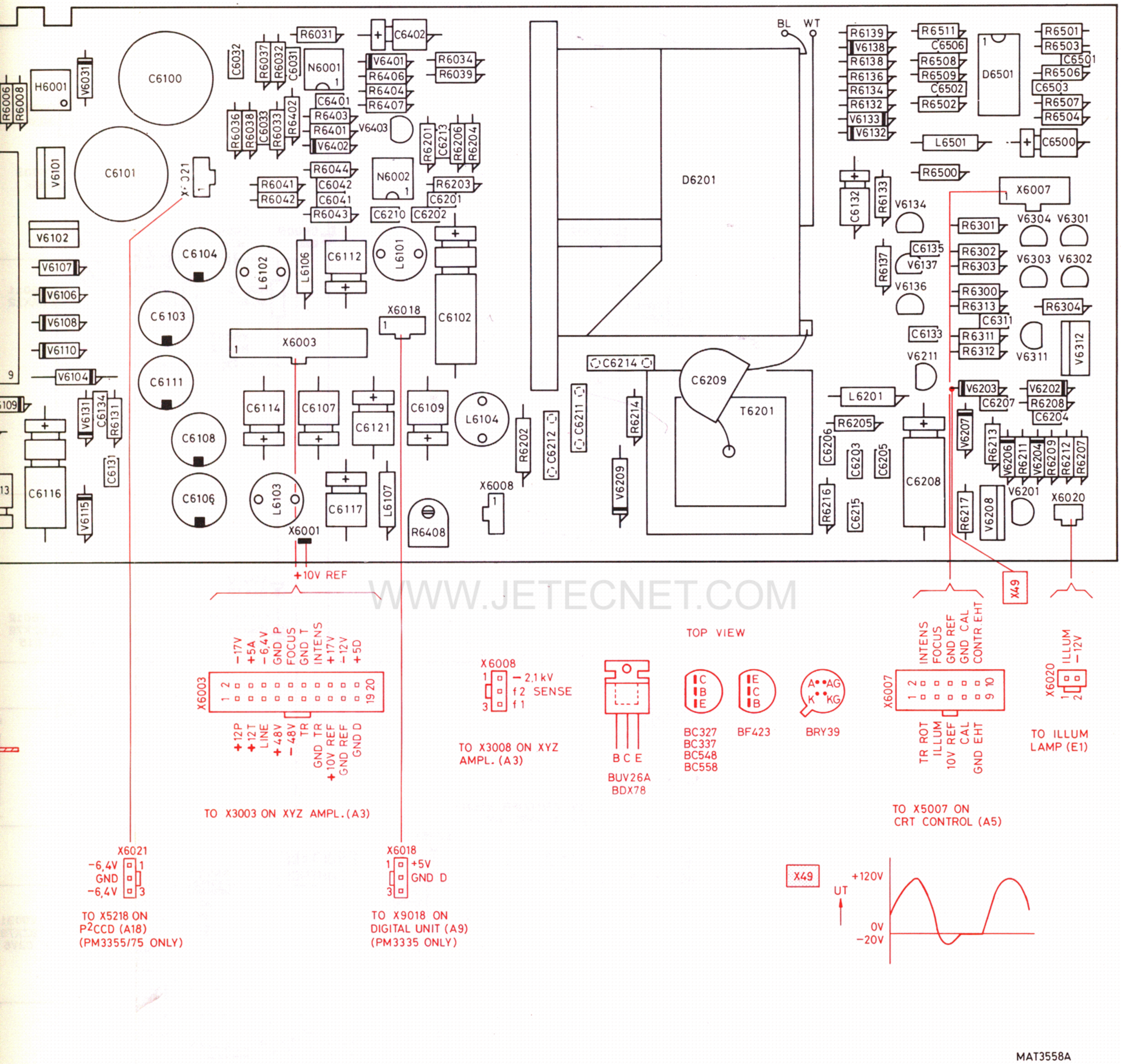


Figure 9.7 Power supply unit, p.c.b.

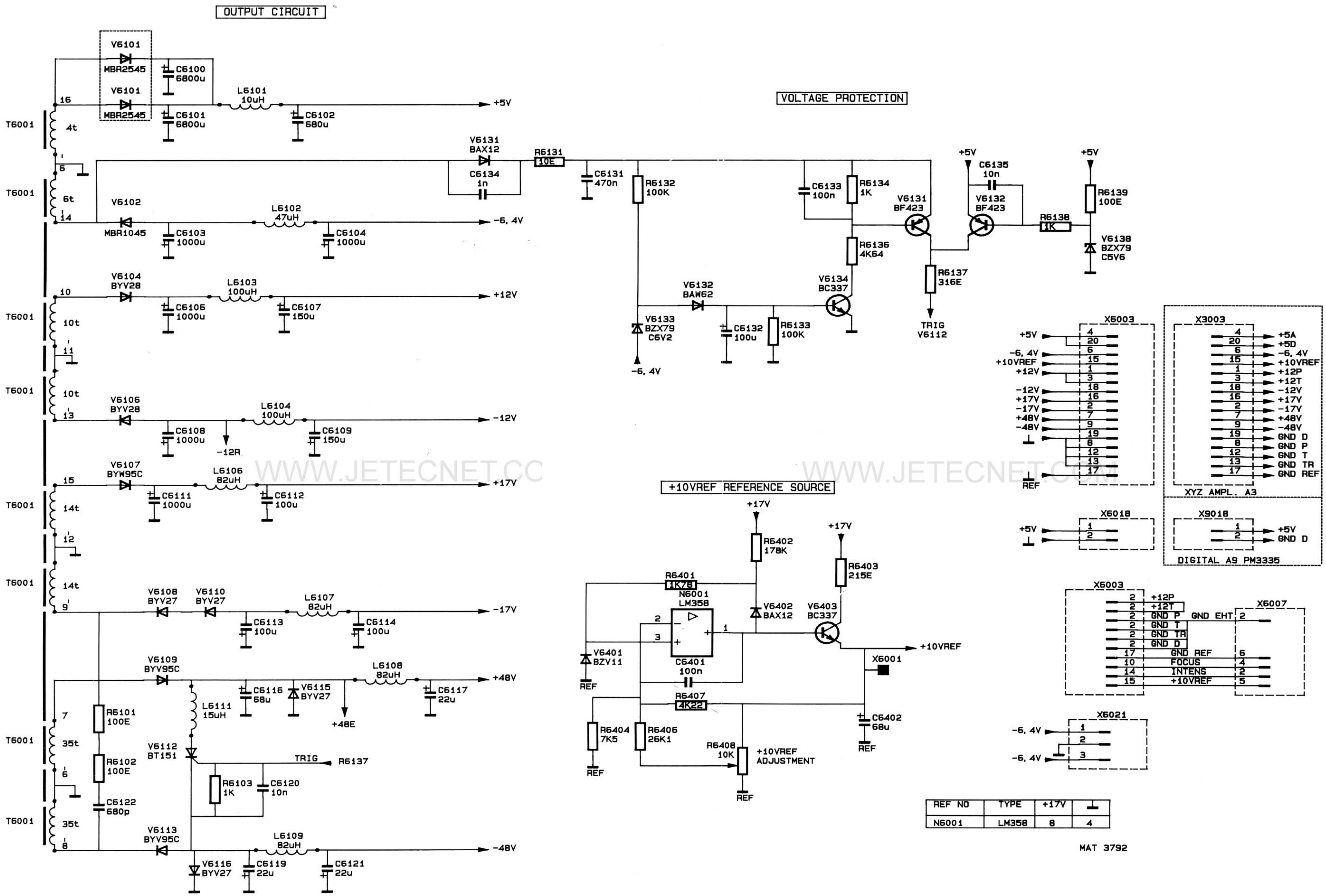


Figure 9.8 Circuit diagram of power supply, secondary circuit

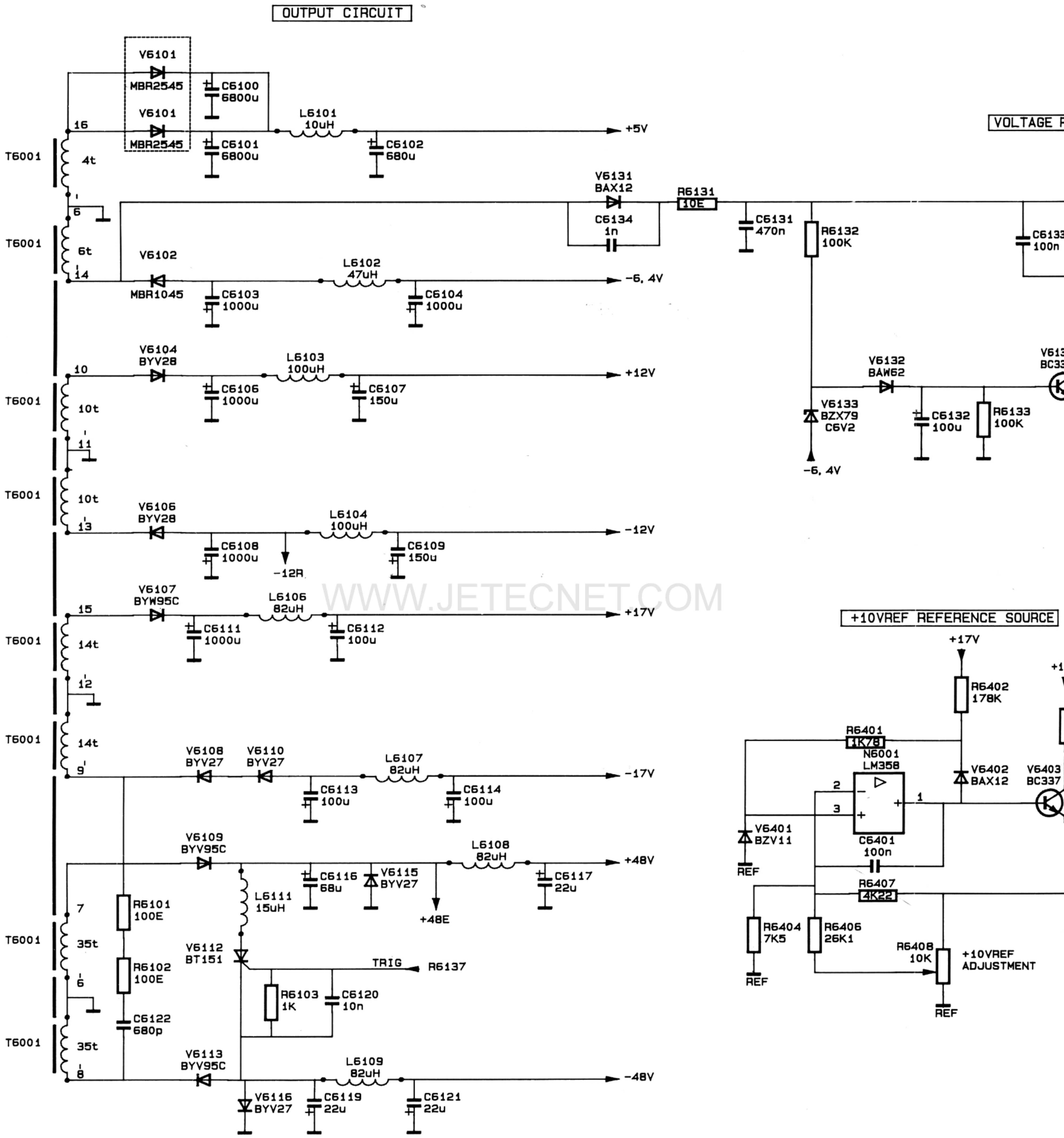
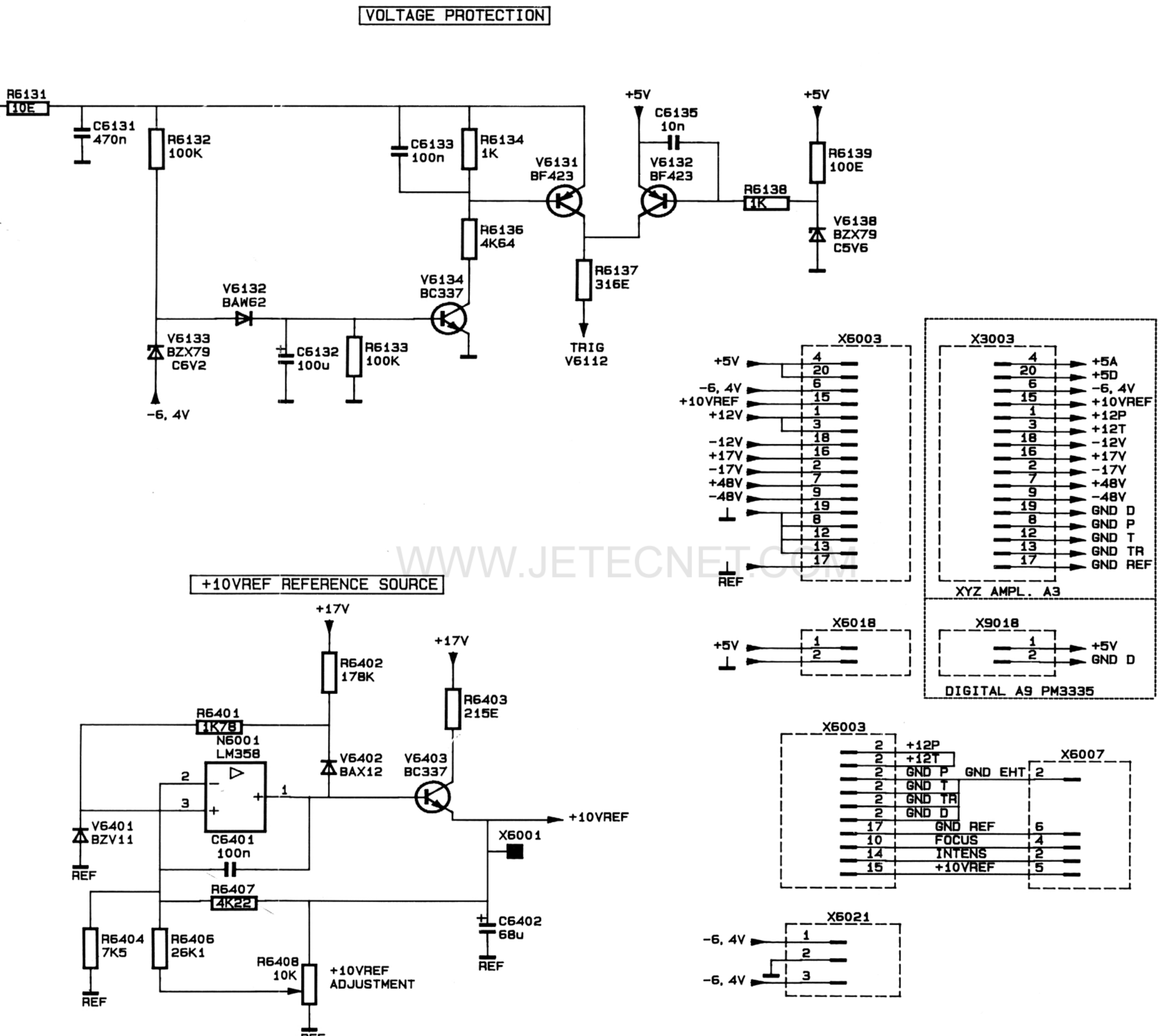
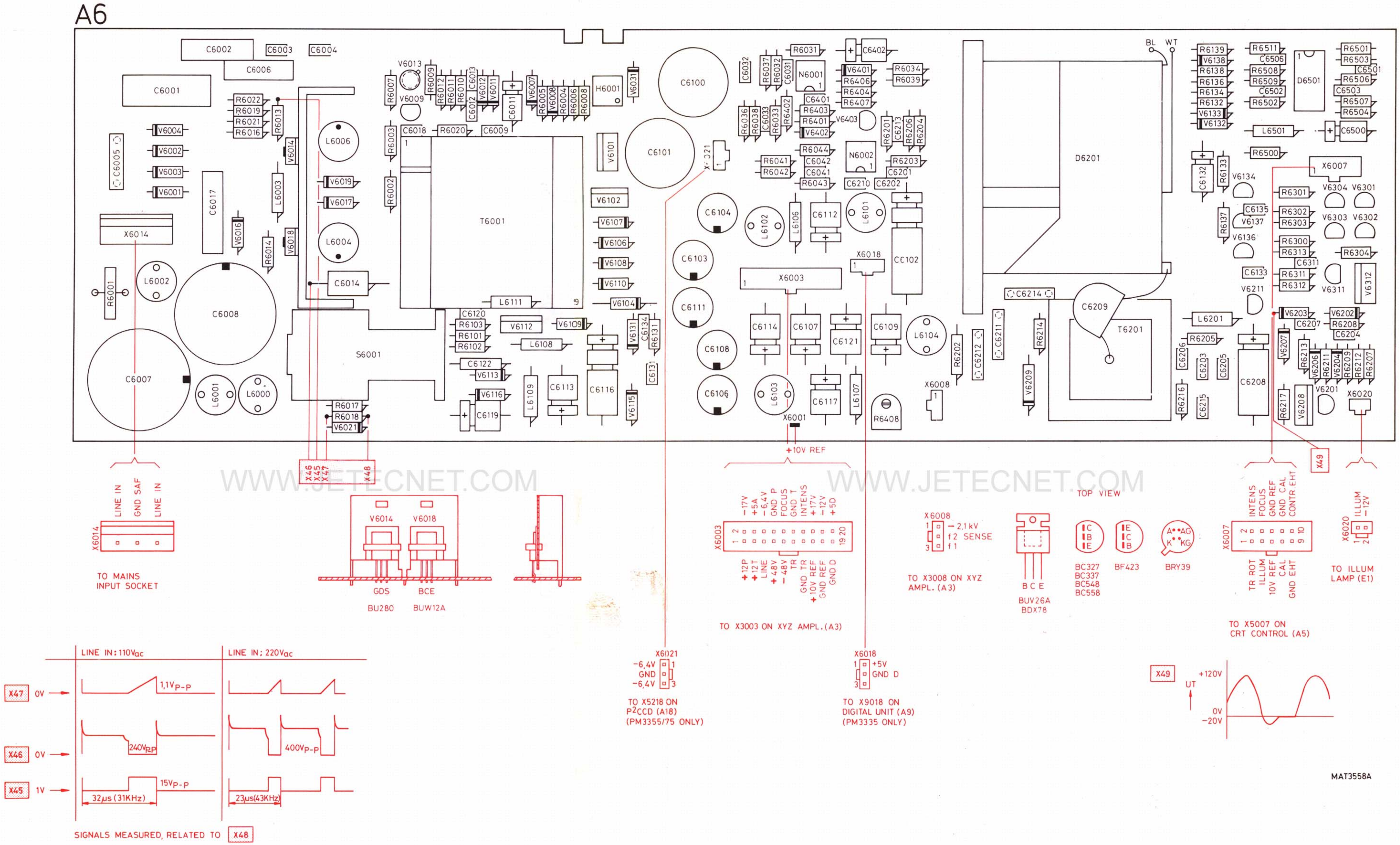


Figure 9.8 Circuit diagram of power supply, secondary circuit



REF NO	TYPE	+17V	⊥
N6001	LM358	8	4

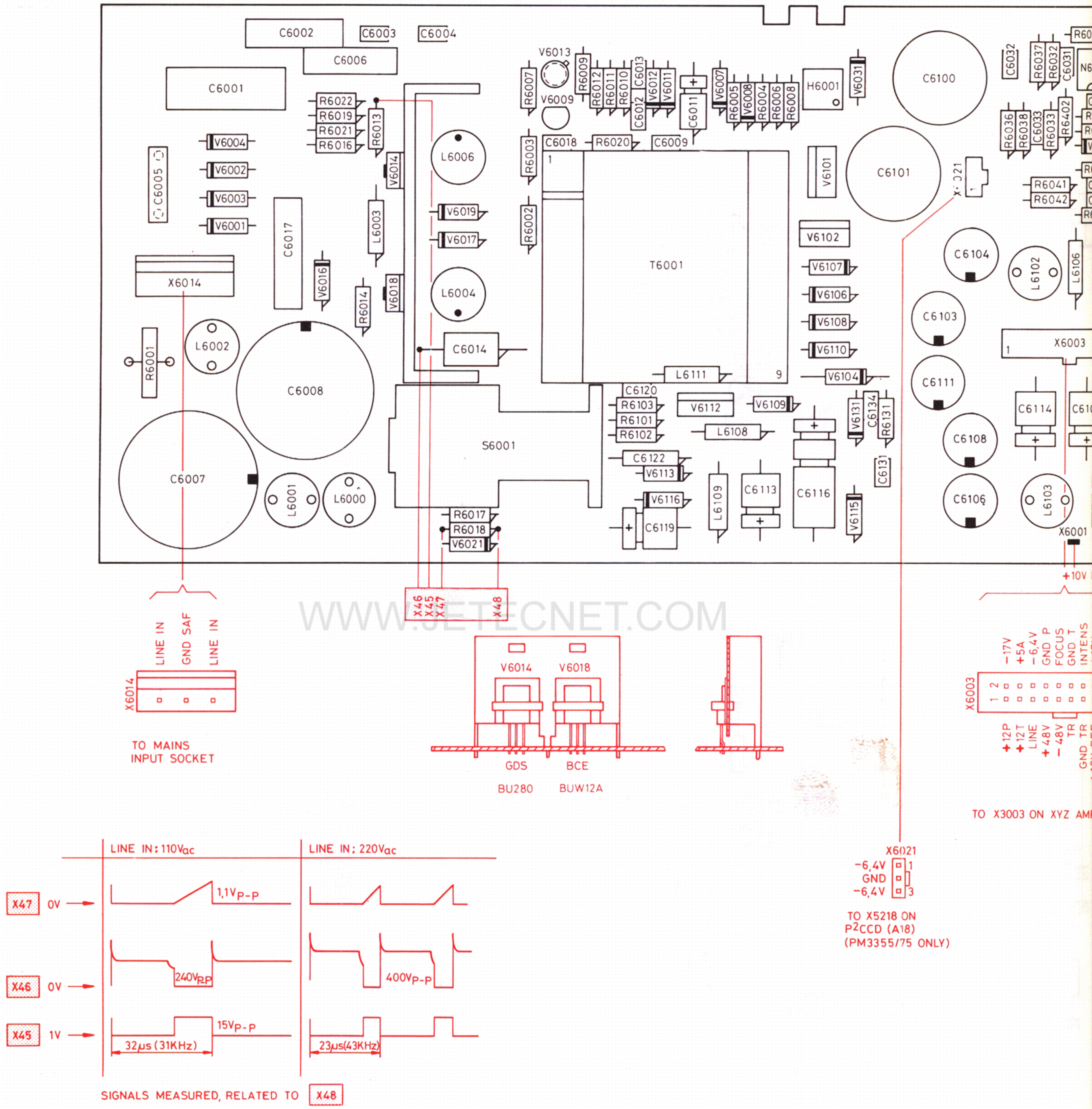
MAT 3792



WWW.JETECNET.COM

Figure 9.9 Power supply unit, p.c.b.

A6



C6001
C6002
C6003
C6004
C6005
C6006
C6007
C6008
C6014
C6017
L6000
L6001
L6002
L6003
L6004
L6006
R6001
R6013
R6014
R6016
R6017
R6018
R6019
R6021
R6022
V6001
V6002
V6003
V6004
V6014
V6016
V6017
V6018
V6019
V6021
X6014
S6001
T6001
H6001
C6100
C6101
C6103
C6104
C6106
C6108
C6111
C6113
C6114
C6116
C6119
C6120
C6122
L6102
L6103
L6106
L6108
L6109
L6111
X6001
X6003
X6021
X46
X45
X47
X48
LINE IN
GND SAF
LINE IN
X6014
TO MAINS
INPUT SOCKET
V6014
V6018
GDS
BCE
BU280
BUW12A
+10V
-17V
+5A
-6,4V
GND P
FOCUS
GND T
INTENS
X6003
+12P
+12T
LINE
+48V
-48V
TR
GND
TO X3003 ON XYZ AMP
X6021
-6,4V
GND
-6,4V
TO X5218 ON
P2CCD (A18)
(PM3355/75 ONLY)
LINE IN: 110Vac
LINE IN: 220Vac
X47
0V
1,1Vp-p
X46
0V
240Vp-p
400Vp-p
X45
1V
15Vp-p
32μs (31KHz)
23μs(43KHz)
SIGNALS MEASURED, RELATED TO X48

Figure 9.

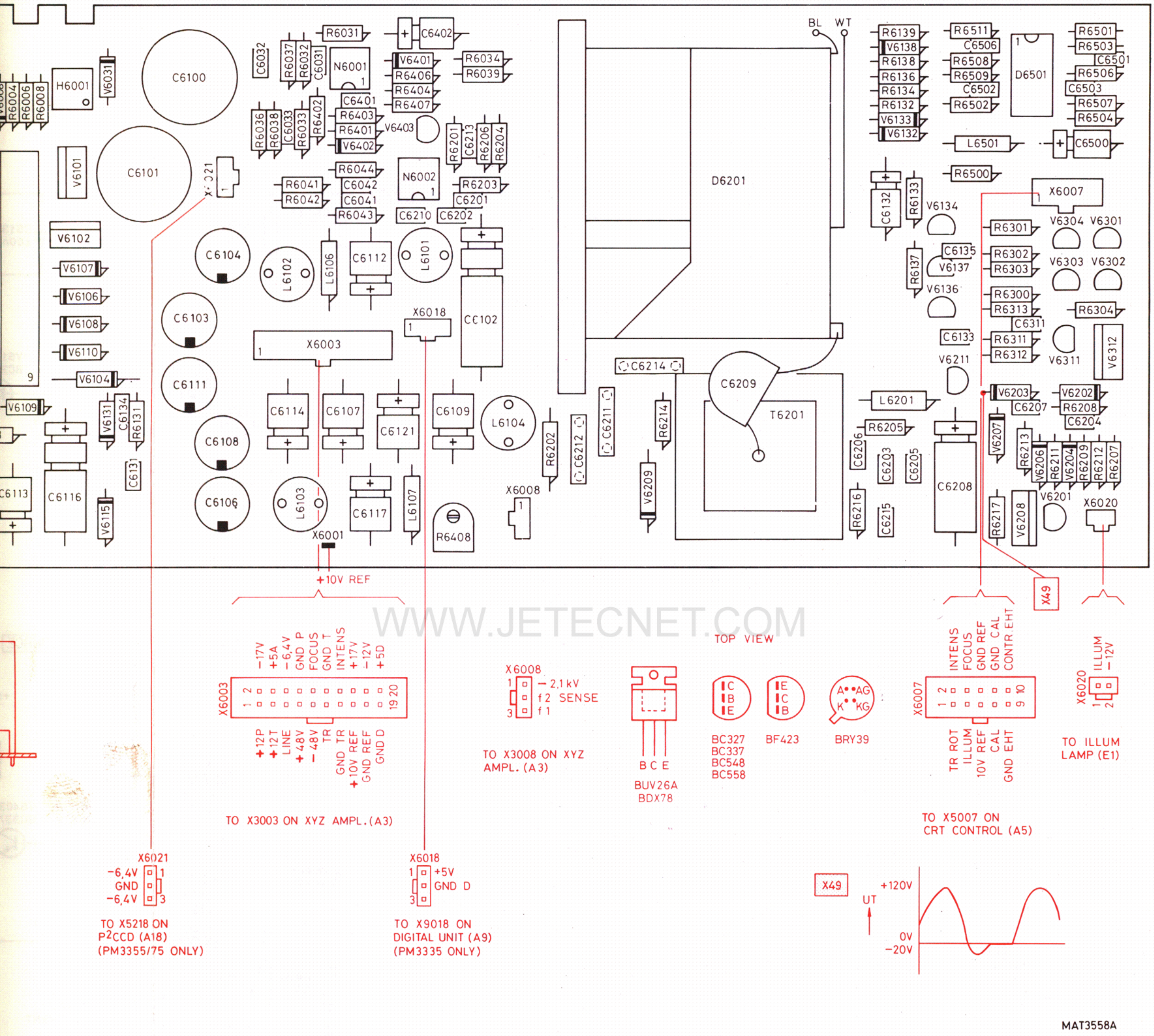
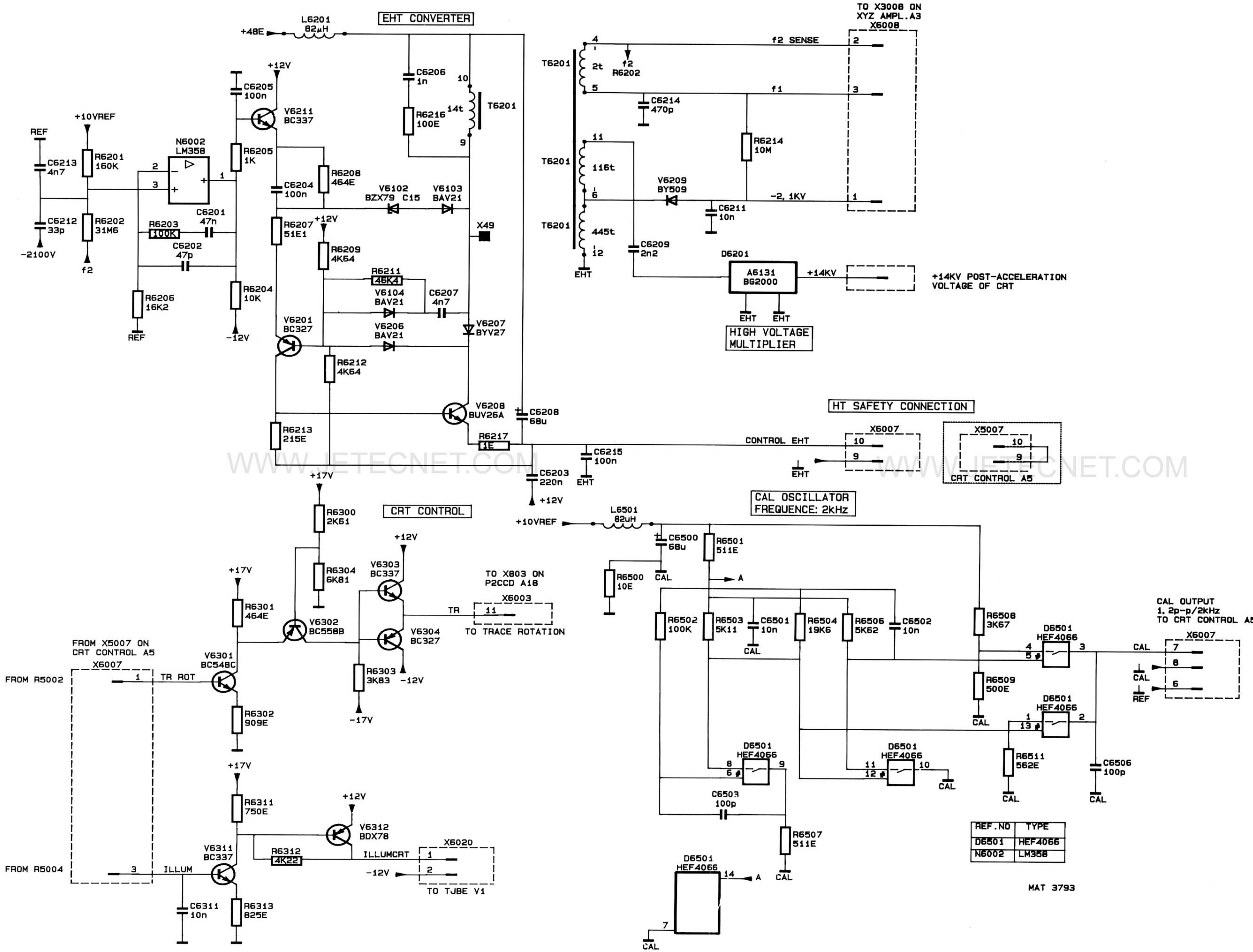


Figure 9.9 Power supply unit, p.c.b.



REF.NO	TYPE
D6501	HEF4066
N6002	LM358

Figure 9.10 Circuit diagram of power supply, EHT circuit and various

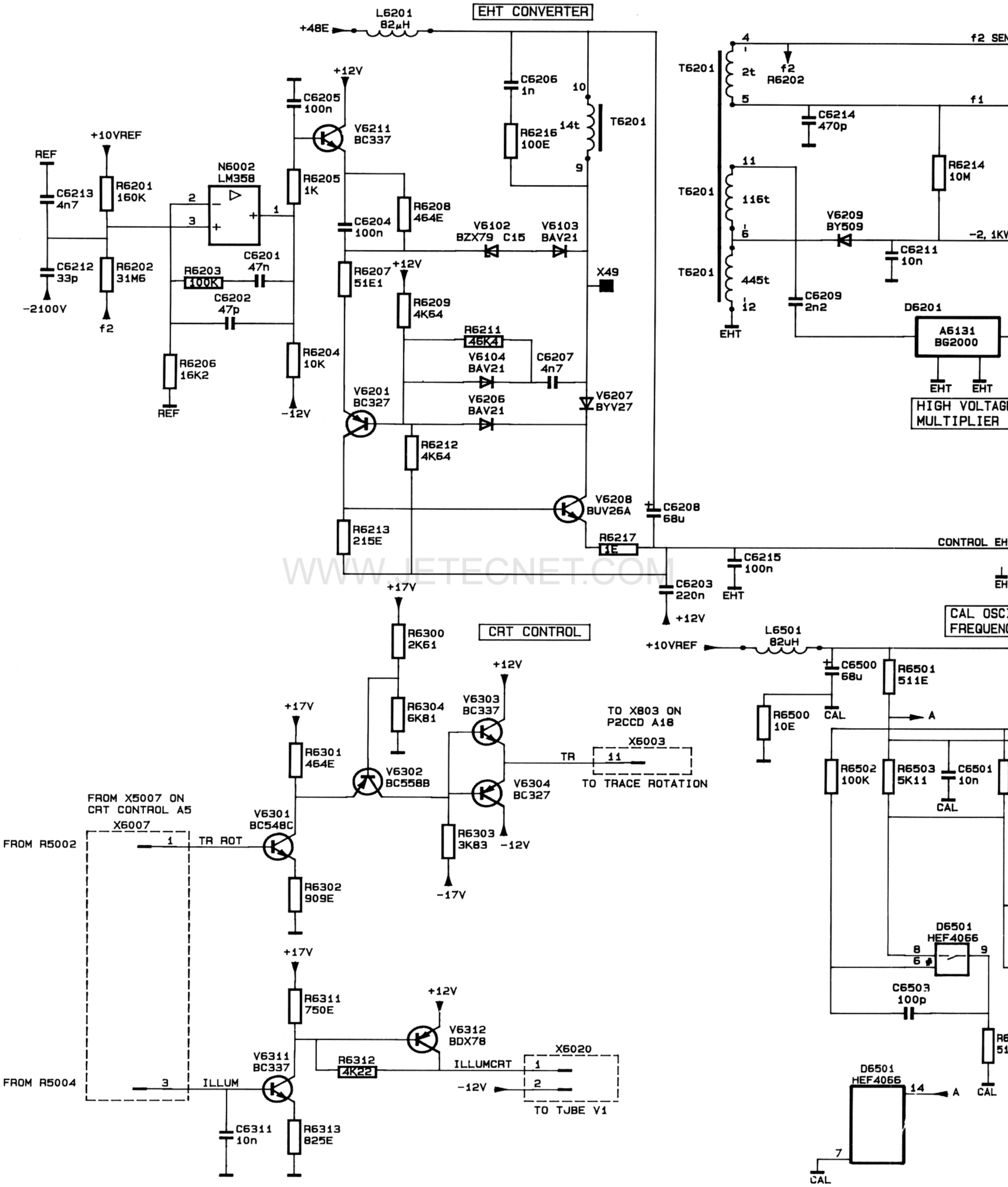
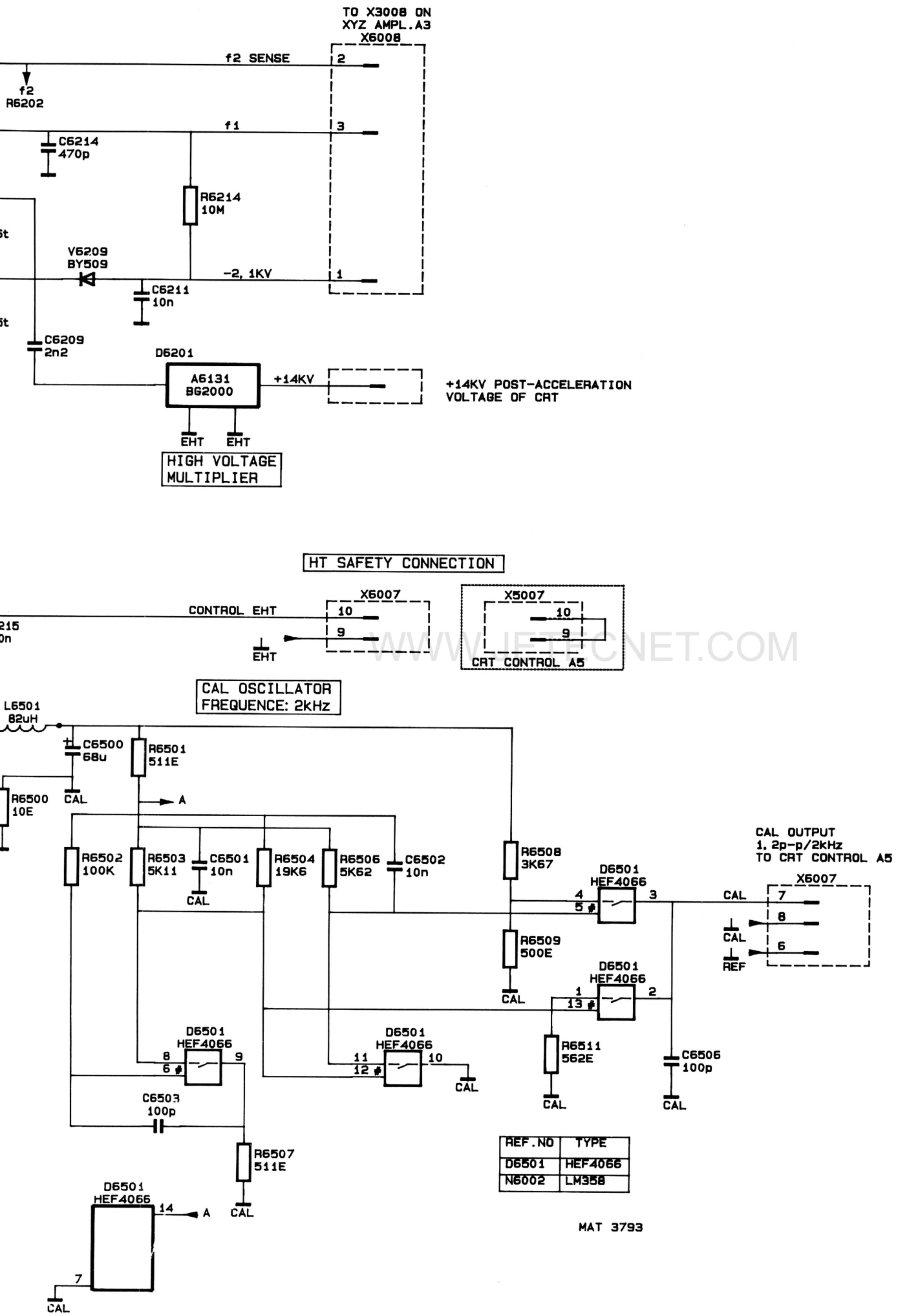


Figure 9.10 Circuit diagram of power supply, EHT circuit and various



REF.NO	TYPE
D6501	HEF4066
N6002	LM358

10 FRONT UNIT (A7-A8)

The front unit consists of:
- the key-matrix and reset circuit
- the front controls, probe indicator and auxiliary circuits
- the LCD display

The microprocessor that reads and controls this unit is located on the digital unit A9. The interconnection between both units is made by means of a 40-pole flatcable.

10.1 KEY-MATRIX AND RESET CIRCUIT

The front keys are grouped in a matrix configuration consisting of 9 lines. Every key (except the AUTO SET key) is present at the crossing point of two lines. The 9 lines are named KEY0 ... KEY8 and are directly read by the microprocessor D9012 on digital unit A9.

The reset circuit generates the signal RESET-HT. This signal is high during some time after switching-on of the instrument. This high level forces the microcomputer on unit A9 to initiate its main program.

10.2 POTENTIOMETERS AND AUXILIARY CIRCUITS

The front-panel potentiometers give voltages between 0...10 V to the various circuits. To determine the UNCAL position of VAR A, VAR B or VAR MTB, the dc voltages on the slider of the potentiometer are applied to triple comparator N7001. When the voltage level of the control is lower than 0,7 V a logic high is read. The UNCAL data is read by the microprocessor via a buffer that is present on unit A9.

Integrated circuit D7004 (OQ0044) detects the kind of probe which is connected to the oscilloscope. Depending on the resistance between the probe indication input (pin 3 for channel A and pin 16 for channel B) and ground, the V/DIV reading of the LCD automatically increases according to the table below. Depending on the type of probe (e.g. 10:1, 100:1) the indication ring incorporates a different resistance value.

Pin 3 (16)	Pin 6 (17)	Pin 7 (12)	V/DIV attenuation
2k32	0	0	x10
6k98	1	0	x100
7k68	0	1	x1
10k	1	1	x1

The 4 output signals of D7004 are read by the microprocessor via buffer D7006. This buffer also reads the AUTO SET key and the signals TEST OUT (high if scope is triggered), NOPTION (low for optional trigger facilities) and REMRQN (if low the interface option tells the micro- processor that the scope must go to remote). When the enable inputs pin 1 and 19 are made low by multiplexer D7002, the inputs of the buffer D7006 are read by the microprocessor.

D7002 is the multiplexer that makes a separation between the I2C lines that drive the LCD drivers and the I2C lines for the other circuits.
This is controlled by the SEL II C line. If this line is high, the SDA (Serial Data) and SCL (Serial clock) lines control the LCD drivers on LCD unit A8.

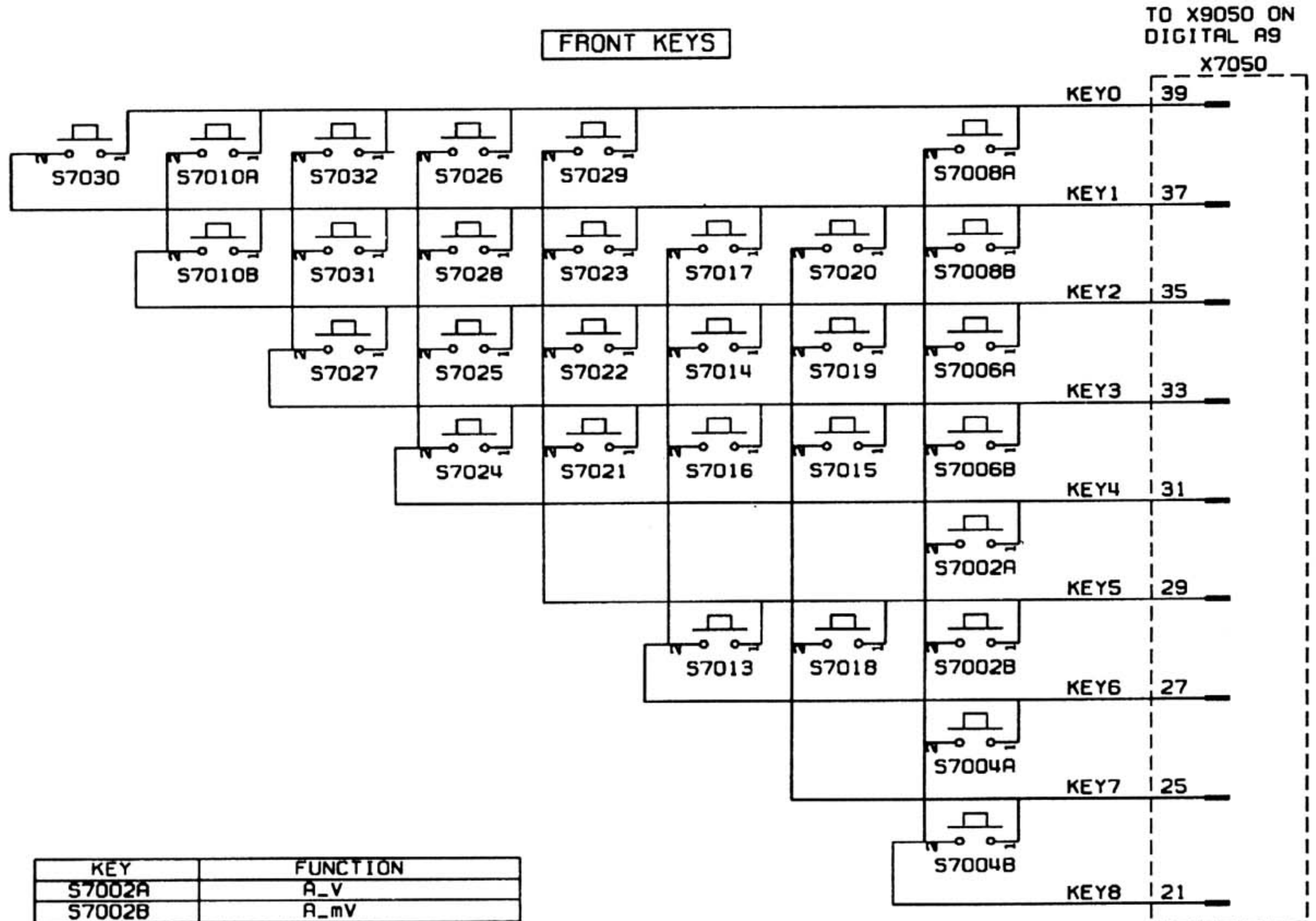
D7003 decodes the address lines A8, A9 and A11 into the DLEN (Data Latch Enable) signals that select one of the serial-parallel conversion circuits.

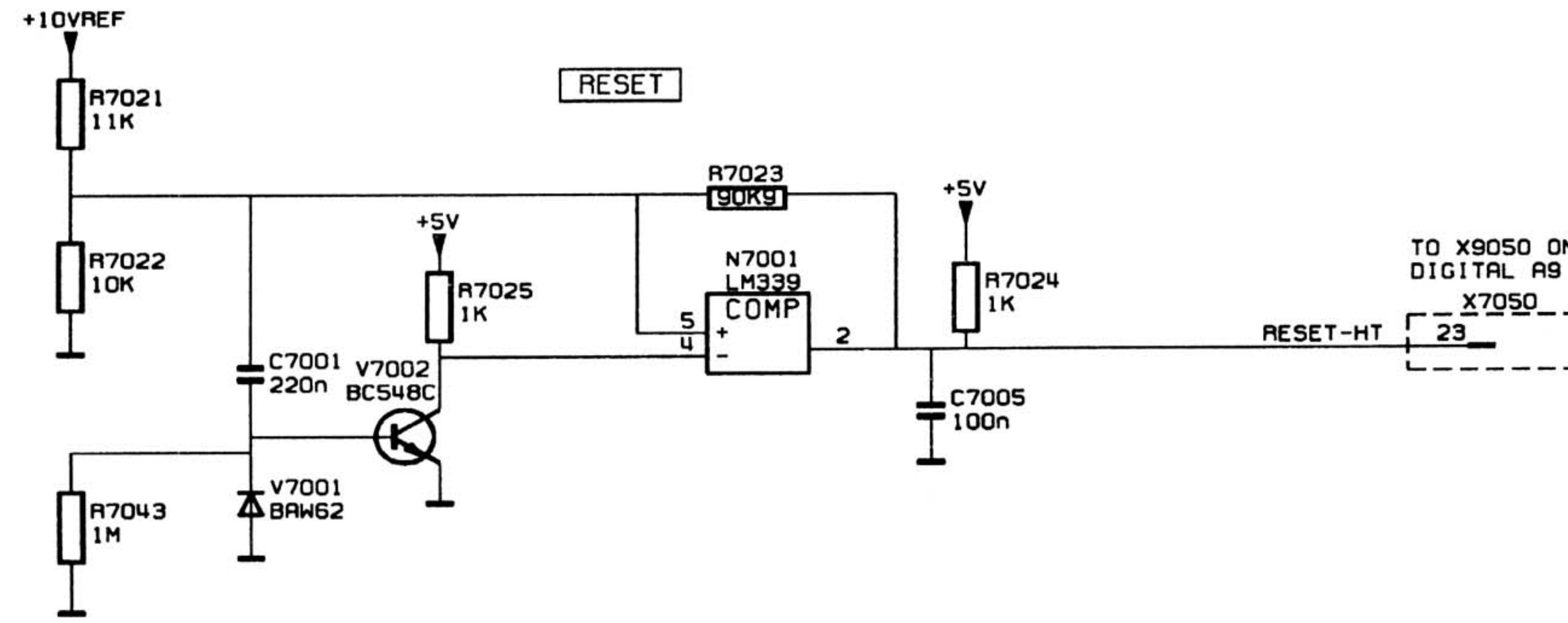
10.3 LCD DISPLAY CIRCUIT

The LCD is driven by three drivers D8001, D8002 and D8003 (PCF8577).
The temperature dependent supply voltage VCPCF is 4 V approx. at 25°C When the temperature increases, this voltage decreases. This is achieved by NTC resistor R7036. As a result the intensity of the LCD is constant over a wide temperature range.
The single-pin built-in oscillator on pin 37 of D8001 provides the modulation frequency for the LCD segment driver outputs. Capacitor C7008 and resistor R7018 are connected to this pin to form the oscillator, with a frequency of 150 Hz approx. Pin 36 and pin 37 are used to determine the LCD driver address in the I^2C bus.

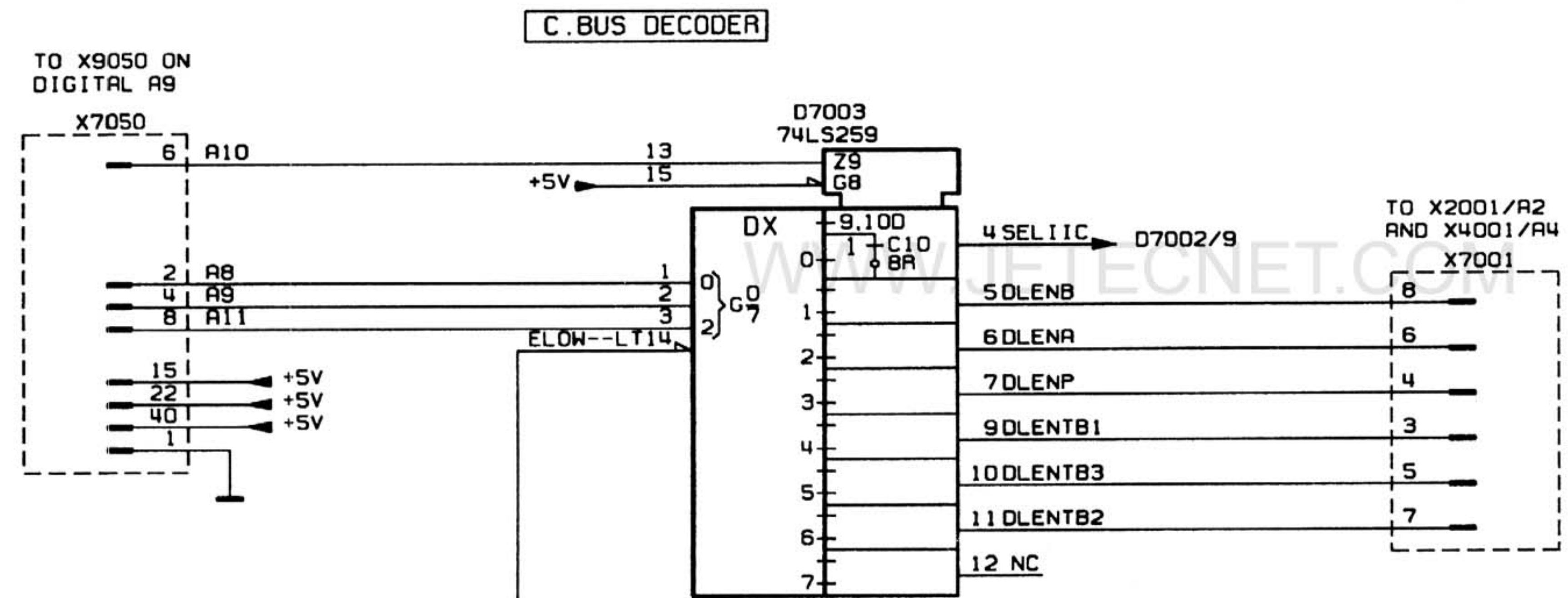
The outputs pin 1...pin 32 directly drive the LCD.

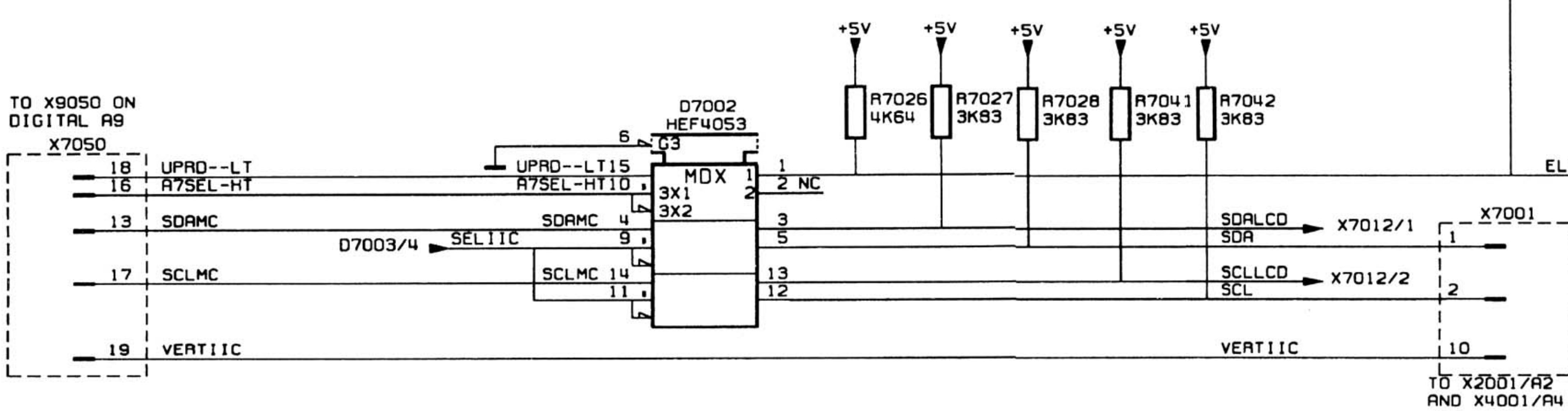
Outputs BP1 and BP2 (pin 33 and pin 34) drive the COMMON pins of the LCD.





KEY	FUNCTION
S7002A	A_V
S7002B	A_mV
S7004A	B_V
S7004B	B_mV
S7006A	TB_s
S7006B	TB_us
S7008A	TRIG DEL<--
S7008B	TRIG DEL-->
S7010A	DISPL PART<--
S7010B	DISPL PART-->
S7012	A_ AUTOSET
S7013	A_ 0
S7014	A_ AC/DC
S7015	A/B
S7016	ALT/CHOP
S7017	PLOT
S7018	B_ ADD AB/INVERT
S7019	B_ 0
S7020	B_ AC/DC
S7021	TB TRIG MODE
S7022	RESET
S7023	XDEFL/LEVEL VIEW
S7024	TB_ TRIG OR SOURCE
S7025	TB_
S7026	TB_ TRIG COUPLING
S7027	DIGITAL MEMORY
S7028	LOCK
S7029	XMAGN
S7030	LOAD
S7031	DISPL
S7032	STATUS

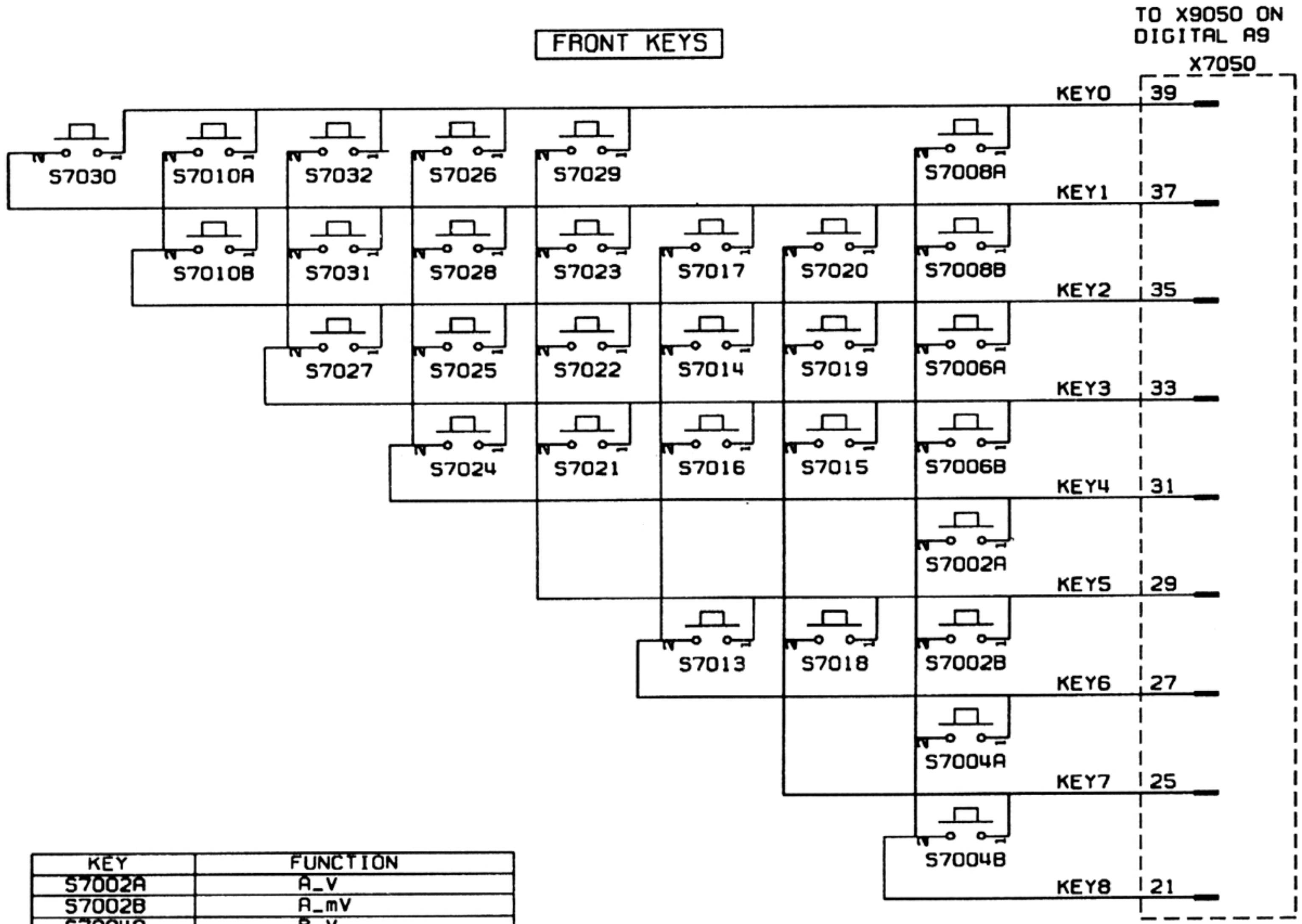


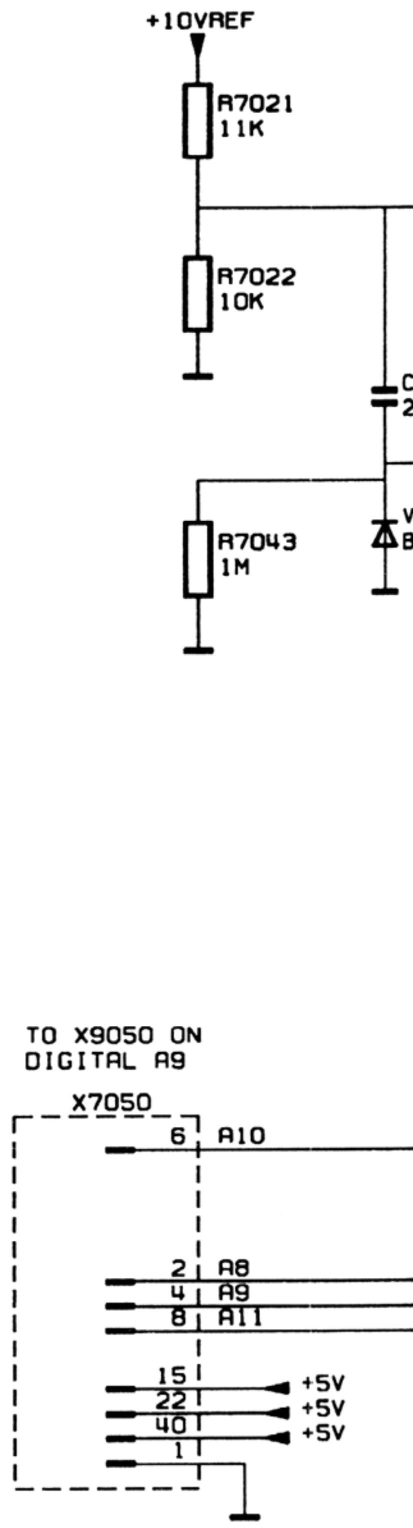


REF. NO.	TYPE	+5V	-12A	+17A	⊥
D7003	74LS259	16			8
D7002	74HCT4053	16			8
N7001	LM339			3	12

MAT 3628A

Figure 10.1 Circuit diagram of front unit, key matrix and auxiliary.





KEY	FUNCTION
S7002A	A_V
S7002B	A_mV
S7004A	B_V
S7004B	B_mV
S7006A	TB_s
S7006B	TB_us
S7008A	TRIG DEL<--
S7008B	TRIG DEL-->
S7010A	DISPL PART<--
S7010B	DISPL PART-->
S7012	A_ AUTOSET
S7013	A_ 0
S7014	A_ AC/DC
S7015	A/B
S7016	ALT/CHOP
S7017	PLOT
S7018	B_ ADD AB/INVERT
S7019	B_ 0
S7020	B_ AC/DC
S7021	TB TRIG MODE
S7022	RESET
S7023	XDEFL/LEVEL VIEW
S7024	TB_ TRIG OR SOURCE
S7025	TB_ _‾ ‾_
S7026	TB_ TRIG COUPLING
S7027	DIGITAL MEMORY
S7028	LOCK
S7029	XMAGN
S7030	LOAD
S7031	DISPL
S7032	STATUS

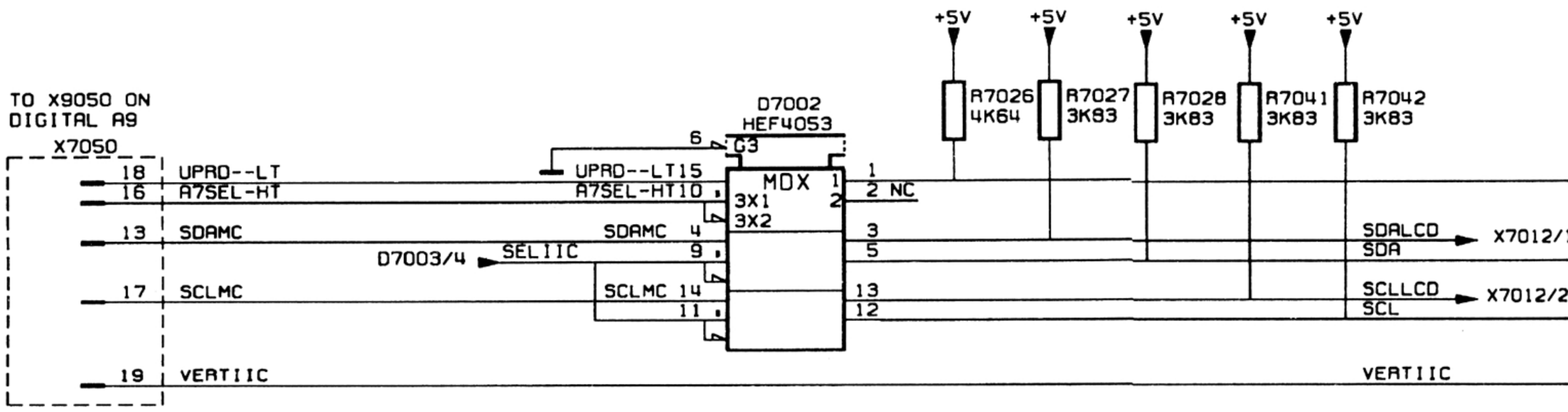
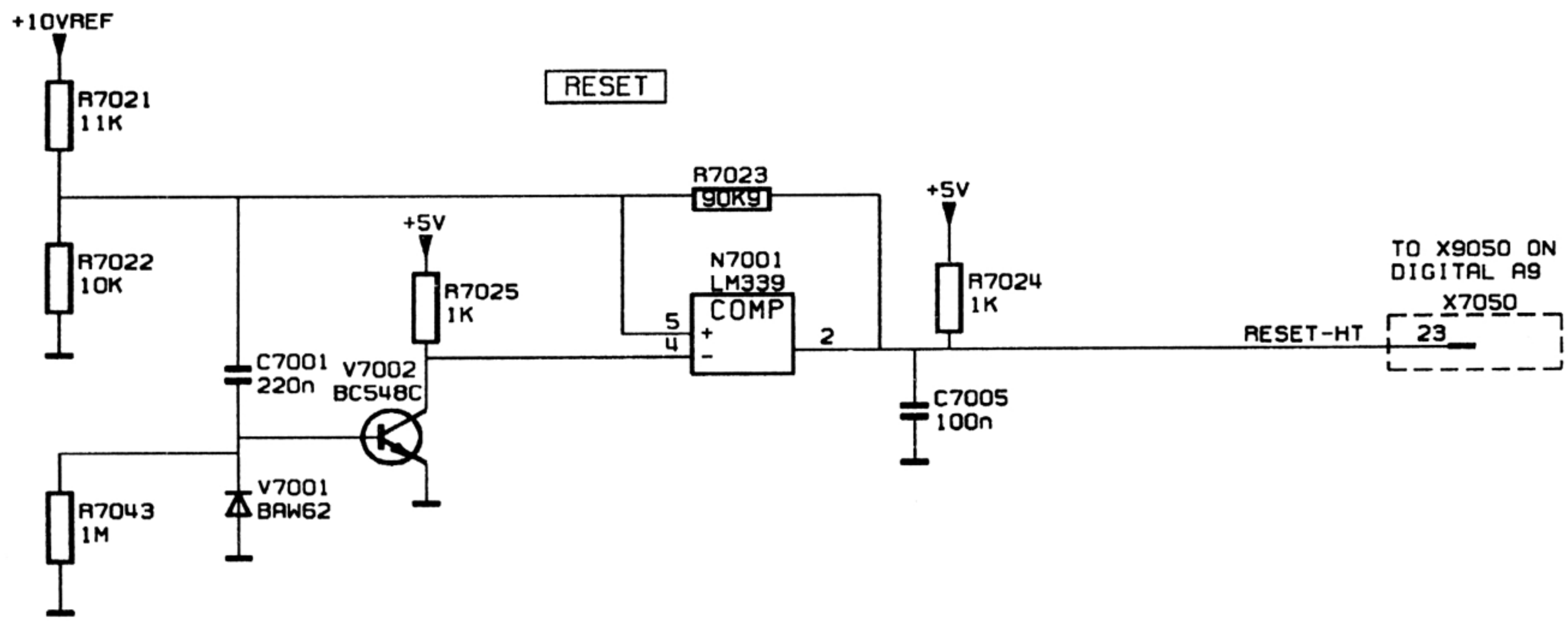
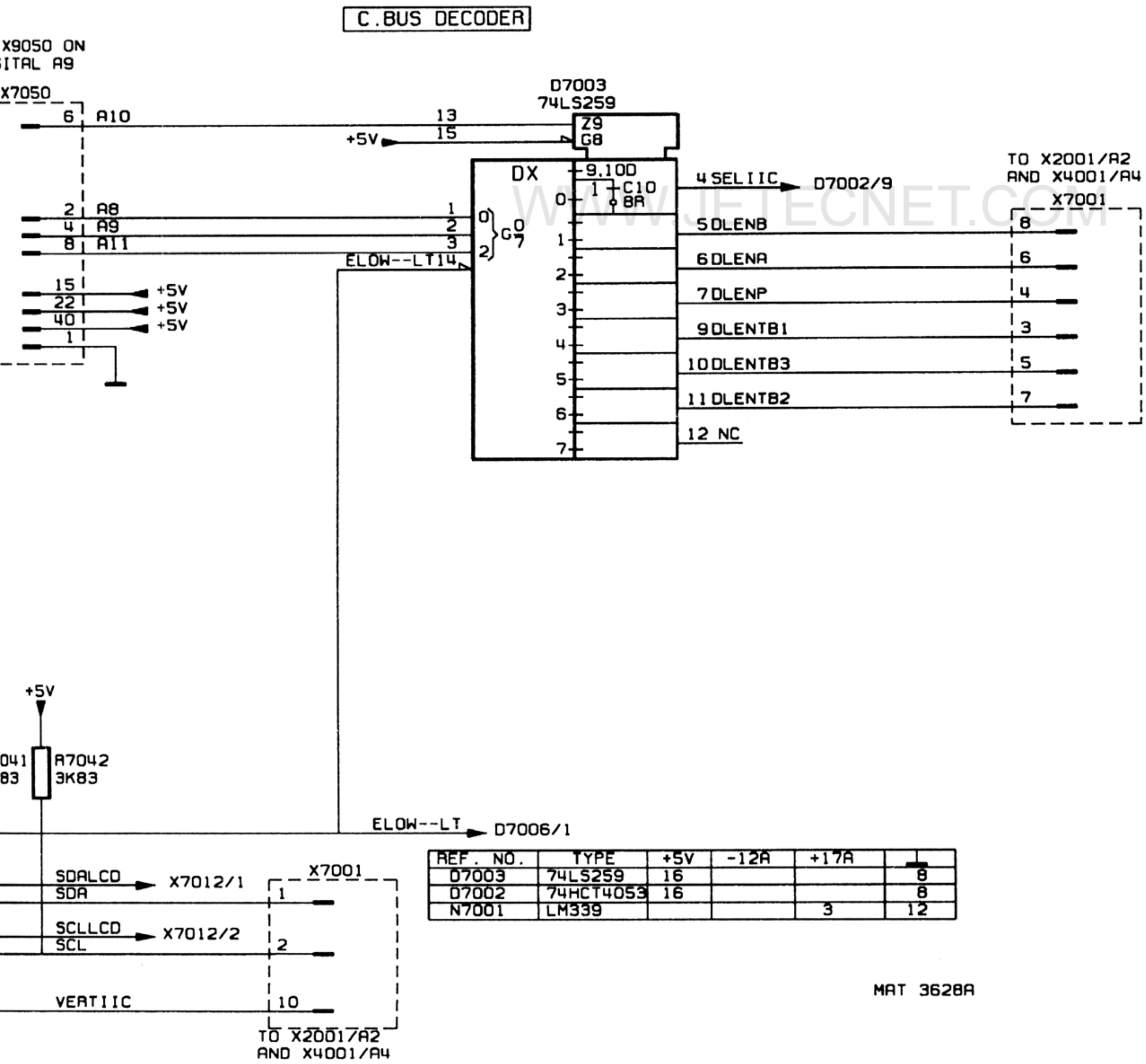


Figure 10.1 Circuit diagram of front unit, key matrix and auxiliary.





REF. NO.	TYPE	+5V	-12A	+17A	⊥
D7003	74LS259	16			8
D7002	74HCT4053	16			8
N7001	LM339			3	12

MAT 3628A

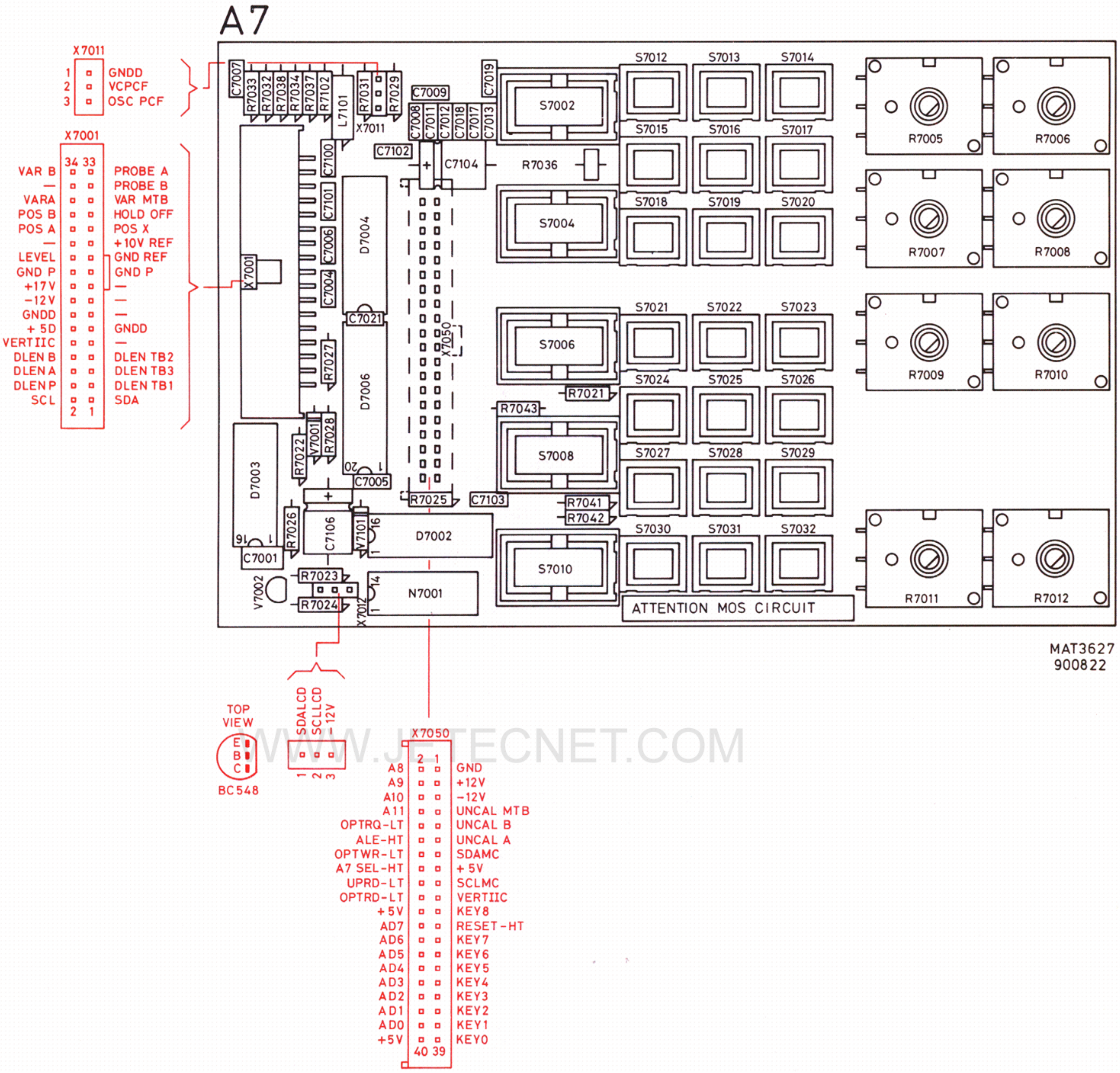
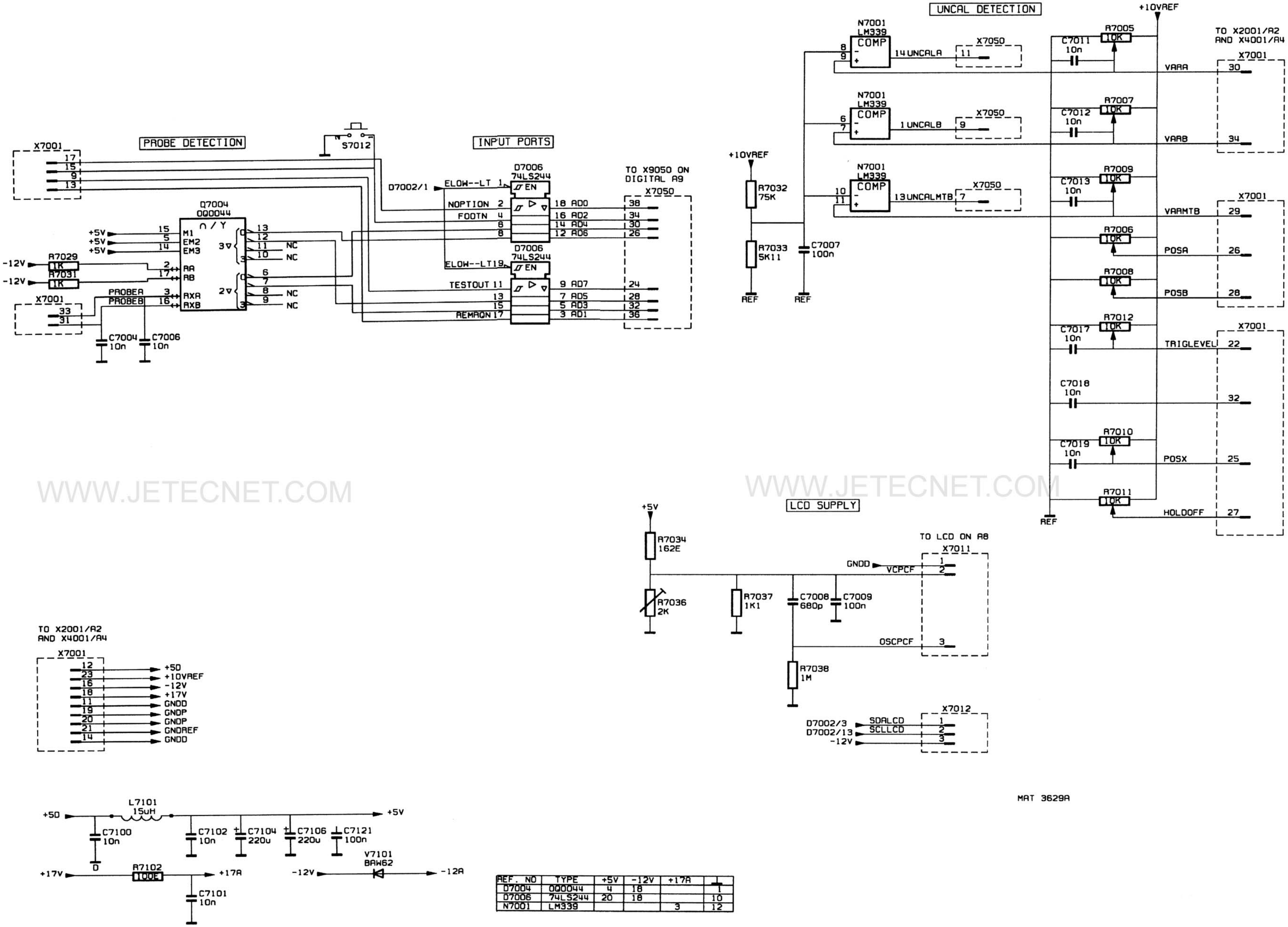
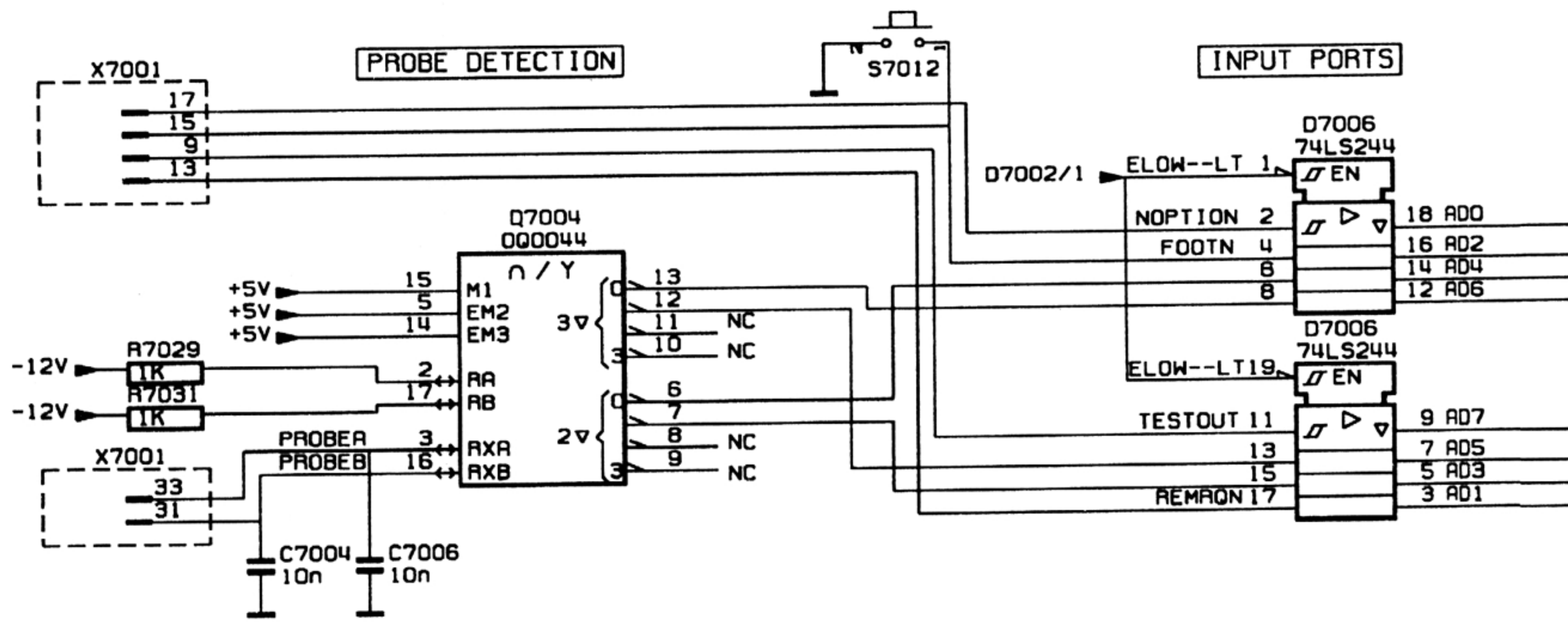


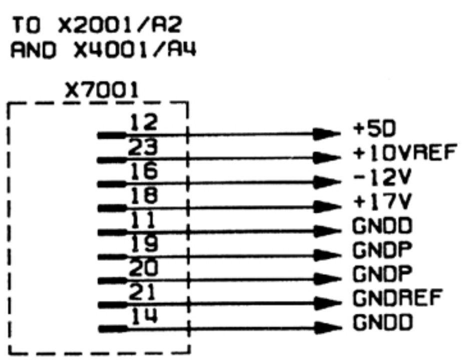
Figure 10.2 Front unit p.c.b.

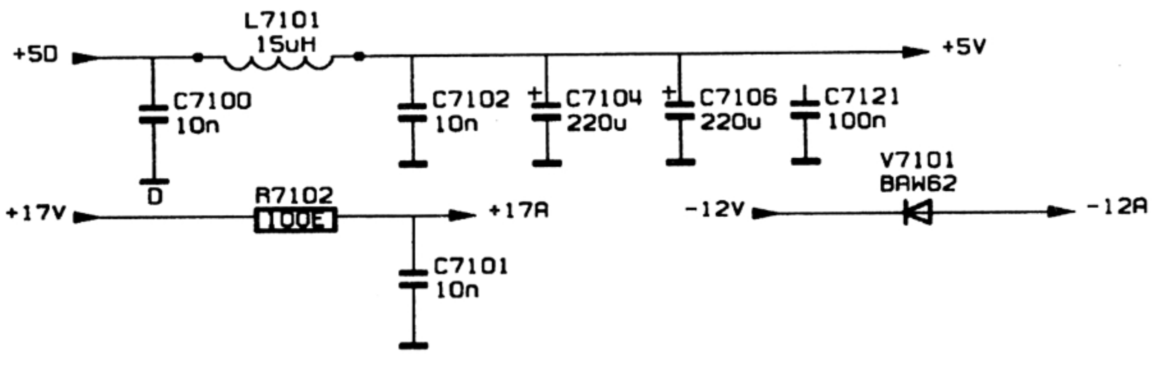


REF. NO	TYPE	+5V	-12V	+17A	⊥
D7004	0Q0044	4	18		1
D7006	74LS244	20	18		10
N7001	LM339			3	12

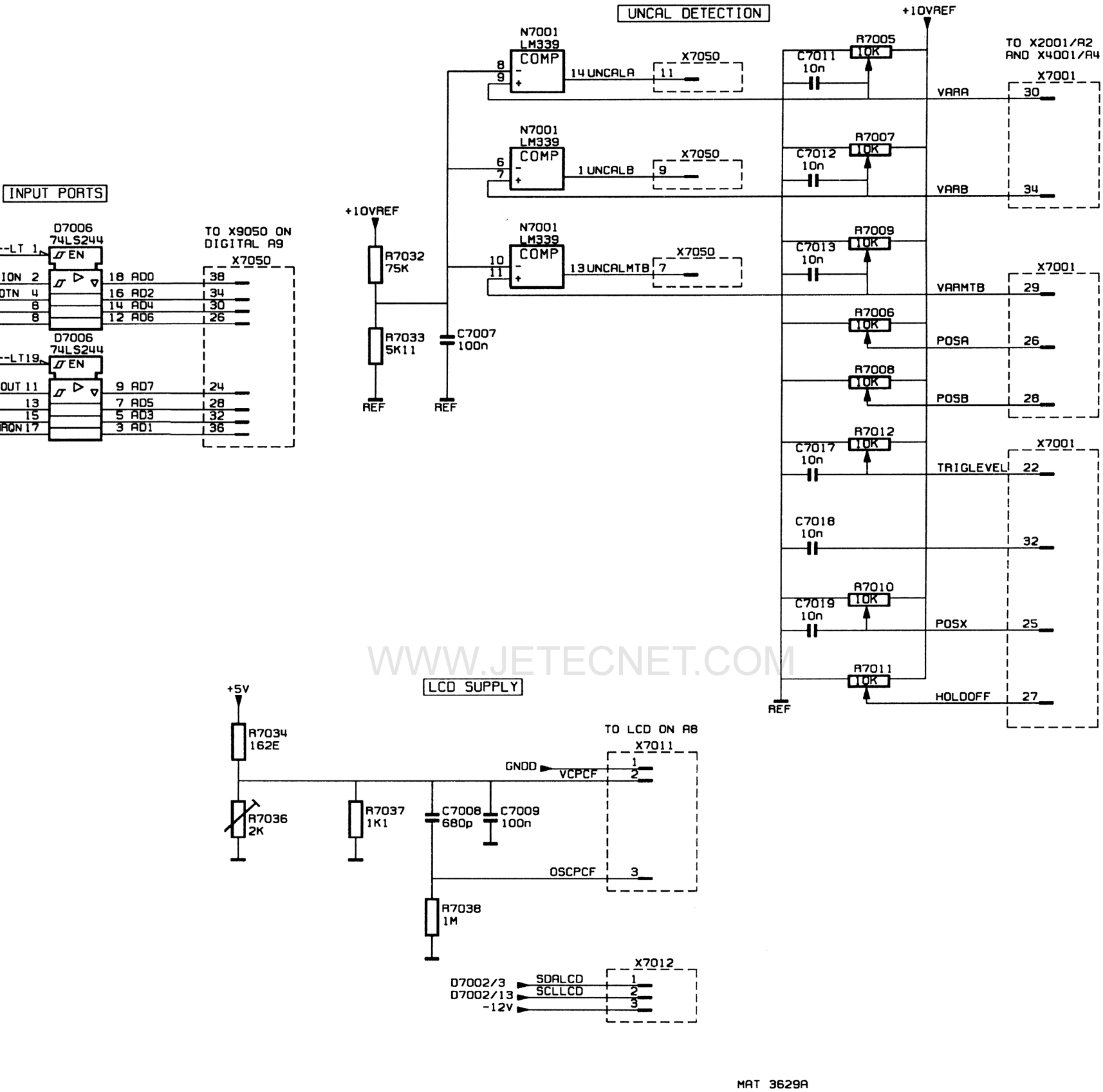
Figure 10.3 Circuit diagram of front unit, front controls and probe indication







REF. NO	TYPE	+5
D7004	OQ0044	4
D7006	74LS244	20
N7001	LM339	



REF. NO	TYPE	+5V	-12V	+17A	⊥
D7004	OQ0044	4	18		1
D7006	74LS244	20	18		10
N7001	LM339			3	12

Figure 10.3 Circuit diagram of front unit, front controls and probe indication

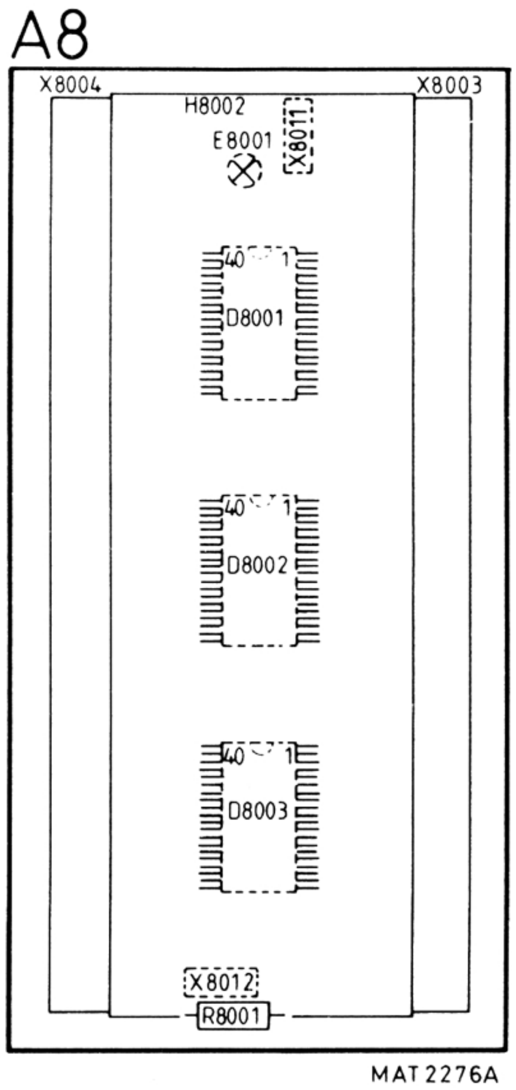
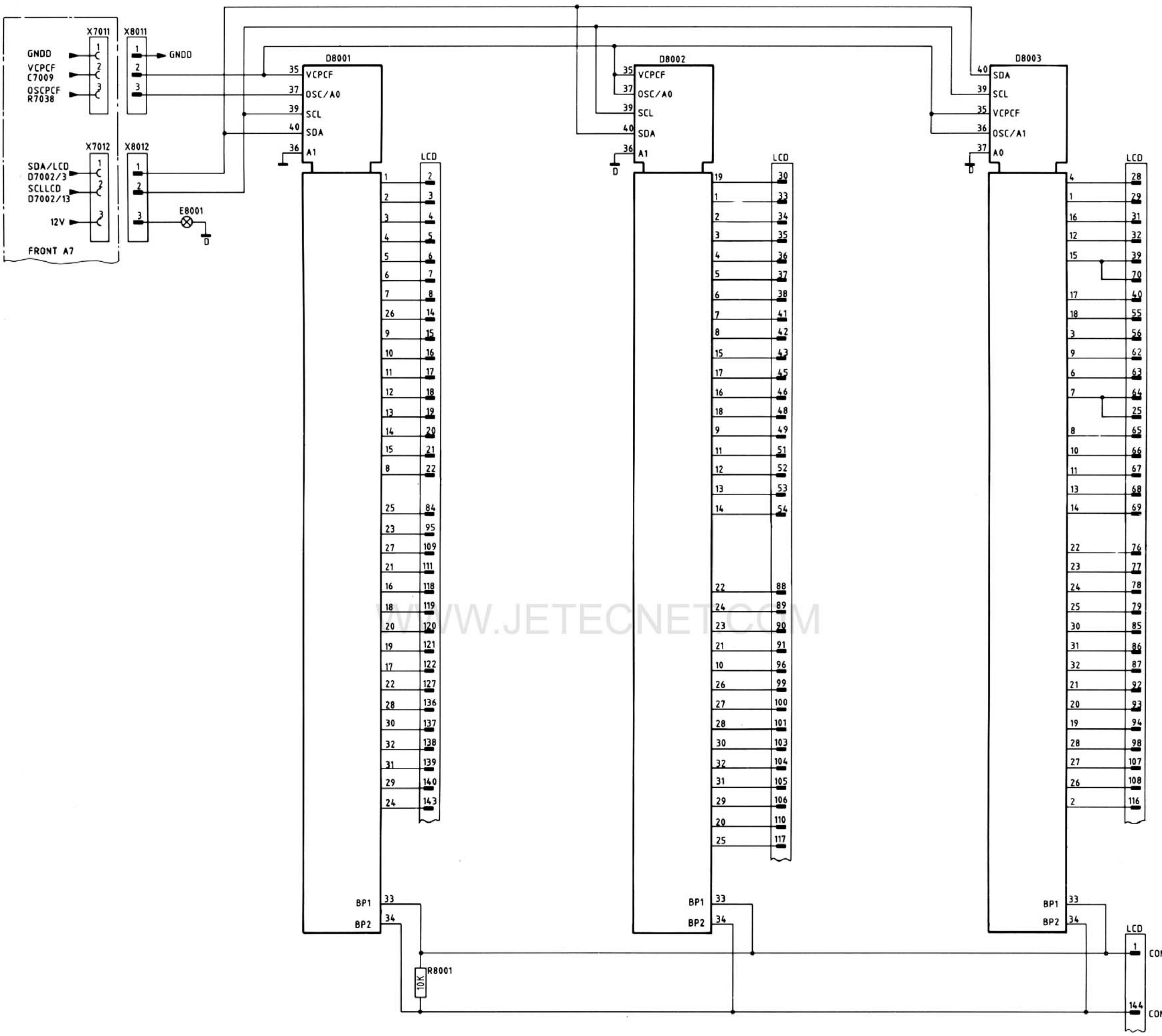


Figure 10.4 LCD unit p.c.b.



REF NO	TYPE	D
D8001	PCF8577	38
D8002	PCF8577	38
D8003	PCF8577	38

PIN	LCD COM1 DISPLAY	LCD COM1 SEGMENT	LCD COM2 DISPLAY	LCD COM2 SEGMENT
144				COM2
143		x1		INV
142	NC		NC	
141	NC		NC	
140	1	a	1	f
139	1	g	1	e
138	1	c	1	d
137	1	b		P1
136		ALT		A
135	NC		NC	
134	NC		NC	
133	NC		NC	
132	NC		NC	
131	NC		NC	
130	NC		NC	
129	NC		NC	
128	NC		NC	
127		x2		INV
126	NC		NC	
125	NC		NC	
124	NC		NC	
123	NC		NC	
122	3	a	3	f
121	3	g	3	e
120	3	c	3	d
119	3	b		P2
118		TRIG D		NOT
117				TB
116		TRIG		AUTO
115	NC		NC	
114	NC		NC	
113	NC		NC	
112	NC		NC	
111		x4		x3
110	5	g	5	e
109	5	c	5	d
108	6	g	6	e
107	6	c	6	d
106	7	g	7	e
105	7	c	7	d
104		3		MAGN
103		2		4
102	NC		NC	
101		10		8
100		EXT		A
99		DC		P-P
98		y10,TV		y9
97				y7,y8
96		y4		y5,y6
95				DIGITAL MEMORY
94		y1		y2,y3
93	8	g	8	e
92	8	c	8	d
91	9	g	9	e
90	9	c	9	d
89	9	b		P6
88	10	g	10	e
87	10	c	10	d
86	10	b		P7
85	11	c	11	d
84		LOCK		REG
83	NC		NC	
82	NC		NC	
81	NC		NC	
80	NC		NC	
79		z2		z1
78		z3		z4
77		z6		z5
76				REMOTE
75	NC		NC	
74	NC		NC	
73	NC		NC	

H8002

PIN	LCD COM1 DISPLAY	LCD COM1 SEGMENT	LCD COM2 DISPLAY	LCD COM2 SEGMENT
1		COM1		
2	2	a	2	f
3	2	b		
4	2	g	2	e
5	2	c	2	d
6		ɾ		)
7		V		•<
8		DC		AC
9	NC		NC	
10	NC		NC	
11	NC		NC	
12	NC		NC	
13	NC		NC	
14		CHOP		B
15		ADD		LEVEL VIEW
16	4	a	4	f
17	4	b		
18	4	g	4	e
19	4	c	4	d
20		ɾ		)
21		V		•<
22		DC		AC
23	NC		NC	
24	NC		NC	
25	NC		NC	
26	NC		NC	
27	NC		NC	
28		ARMED		—
29		MULTI		X-DEFL
30		SINGLE		
31	5	a	5	f
32	5	b		P3
33	6	a	6	f
34	6	b		P4
35	7	a	7	f
36	7	b		
37		)		ɾ
38		s		µ
39		s		
40		16		x9
41		x5		x8
42		x6		x7
43		LINE		DC
44	NC		NC	
45		B		AC
46		LF		HF
47	NC		NC	
48	8	a	8	f
49	8	b		P5
50	NC		NC	
51	9	a	9	f
52	10	a	10	f
53	11	a	11	f
54	11	b		
55	11	g	11	e
56		mV		DIV
57	NC		NC	
58	NC		NC	
59	NC		NC	
60	NC		NC	
61	NC		NC	
62		PLOT		ROLL
63		DOTS		STATUS
64		0,1/2,1,z17,z21		
65		z15		z16
66		z14		z13
67		z11		z12
68		z10		z9
69		z7		z8
70				MENU
71	NC		NC	
72	NC		NC	

MAT3016
871016

Figure 10.5 Circuit diagram of LCD unit

11 DIGITAL UNIT (A9)

11.1 INPUT AMPLIFIERS AND ADC CIRCUIT

This part of the circuit comprises two identical circuits (one for channel A and one for channel B) of which the channel A circuit is explained.
Every circuit incorporates an analog input amplifier followed by an analog into digital converter (ADC). The balanced current signal from V616/V617 (V621/V622 in channel B) on the adaptation unit A16 is applied to the emitters of common base circuit V9011/V9012. The signal currents in every branch are equal (0,1 mA/div) and are in antiphase. Trimming potentiometer R9064 is used for gain adjustment. The biasing currents in both branches are equal.

With no signal, the currents through V9011, V9016 and V9012, V9013, V9014 are equal and no current is running towards the base of V9017. V9017 is a shuntfeedback amplifier that converts current into voltage signal. The voltage amplitude is determined by the resistance value of R9083; C9074 limits the bandwidth of this stage. The output voltage of V9017 is applied to pin 8 of the ADC N9001 via emitterfollower V9018. The biasing voltage at the output of the emitter follower is adjusted to +2,5V with offset adjustment R9078. The input voltage range of the ADC lies between +1,6 and +3,4V.

The emitter of common base transistor V9013 is always at +0,6V which is identical to the base voltage of V9017. The transistors V9014, V9016 serve as a current mirror: if due to signal the current applied to V9011 sinks with e.g.0,1 mA the current in V9012 rises with the same amount. The current mirror on its turn adds this signal current and as a result the current in R9083 increases with 0,2 mA.

The ADC has 8 bits of output information coded AQDB00 (least significant bit)... AQDB07 (most significant bit) for channel A. For channel B the 8 bits are coded AQDB10 (least significant bit) ... AQBD17 (most significant bit). If pin22 (enable ADC) is low, the ADC can convert the analog input signal at pin 8 into digital at the moment that pin 16 (start conversion) goes from low to high level.

11.2 ACQUISITION MEMORIES

This diagram incorporates the 8K acquisition memory. The memory is loaded with the output information of the two ADC's. In dual channel mode the channel A ADC output (AQDB00 ... 07) is providing the information that is loaded into the 4K memory D9031, D9032. The channel B ADC information is loaded into the other 4K memory D9033, D9034. The information is loaded into the memory if pin 18 (Chip Select RAM) and pin 21 (write acquisition) are both low. The 12 bit memory address (necessary to address 4K) is AQAB00 (least significant bit) ... AQAB11 (most significant bit). This address is generated by an address generator that is present on the acquisition control logic. With address line AQAB11 low the memories D9031 and D9033 are enabled. Via inverter D9023/5,6 the memories D9032 and D9034 are enabled if address line AQAB11 is high.

If only one channel is selected, the full 8K memory is available for that channel. If channel A is selected, the 4K memory D9031, D9032 is loaded and then via bidirectional buffer D9035 the 4K memory D9033, D9034. If channel B is selected, the 4K memory D9033, D9034 is loaded and then via bidirectionalbuffer D9035 the 4K memory D9031, D9032. The bidirectional buffer is controlled by or gate D9030/9,10,8. The input signals for these gates are explained on the next circuit diagram where they are generated. The output signals ENAD1-LTand ENAD2-LT are the enable signals for ADC 1 and ADC 2.

The contents of the acquisition memory can be transferred to the instrument's display section via the two-position multiplexers D9036, D9037. Depending on the state of pin 1 of the multiplexers (select databus) either the information from D9031, D9032 (pin 1 low) or the information from D9033, D9034 (pin 1 high)is transferred. When reading the contents of the acquisition memories their control input pin 20 is low and pin 21 is high.

11.3 ACQUISITION CONTROL LOGIG

The acquisition control logic plays the central role in the signal acquisition:
it generates all the necessary control signals for the ADC's, the aquisition memories, two counters and the exchange of data from acquisition part to the display part of the instrument.

The diagram comprises two counters. Counter 1 consists of the 4-bit counters D9053, D9054, D9056 and D-flipflop D9049. This counter can only count upwards and can be preset to 0000 by control signal RSCN1- LT (reset counter 1) because its data inputs are connected to 0V. The clockpulse for counter 1 is CKCN1(clockpulse counter 1).

Counter 2 consists of the 4-bit counters D9061, D9062, D9063 and D9064. This counter can be preset to a certain preset value by control signal LDCN2-LT (load counter 2). This 13-bit preset value comes from the outputs of the latches D9058, D9059. These latches are loaded in advance by the instrument's microprocessor via the control signals CKPR1 (clock pretrigger) and CKPR2. Moreover counter 2 can count up or down: this is controlled by the signal UPDO (up/down). The counter counts up with UPDO being low and its counts down with UPDO high. Both counters have a range of 0 ... 4K in dual channel mode: two 4K memories for respectively channel A and B are adressed in parallel. The range in single channel mode is 8K because the two 4K memories are placed behind each other so that 8K must be adressed by the counter.
The two-position multiplexers D9066, D9067 and D9068 select the address for the acquisition memory: this can be either the outputs of counter 1 (SLAQAB/selectacquisition address bus = low) or the outputs of counter 2 (SLAQAB = high).

The acquisition system can take in information in two different modes that depend on the TIME/DIV setting of the instrument. The modes are D1 mode for 10us ... 1ms/div and D2 for 2ms ... 50s/div. The difference between the two modes is that in the D2 mode the waveform is built up on the CRT screen while the acquisition is busy taking-in signal samples.

Working principle of D1 mode (refer to timing diagram, the signals STate0 and STate1 are also given because they can serve as a reference):

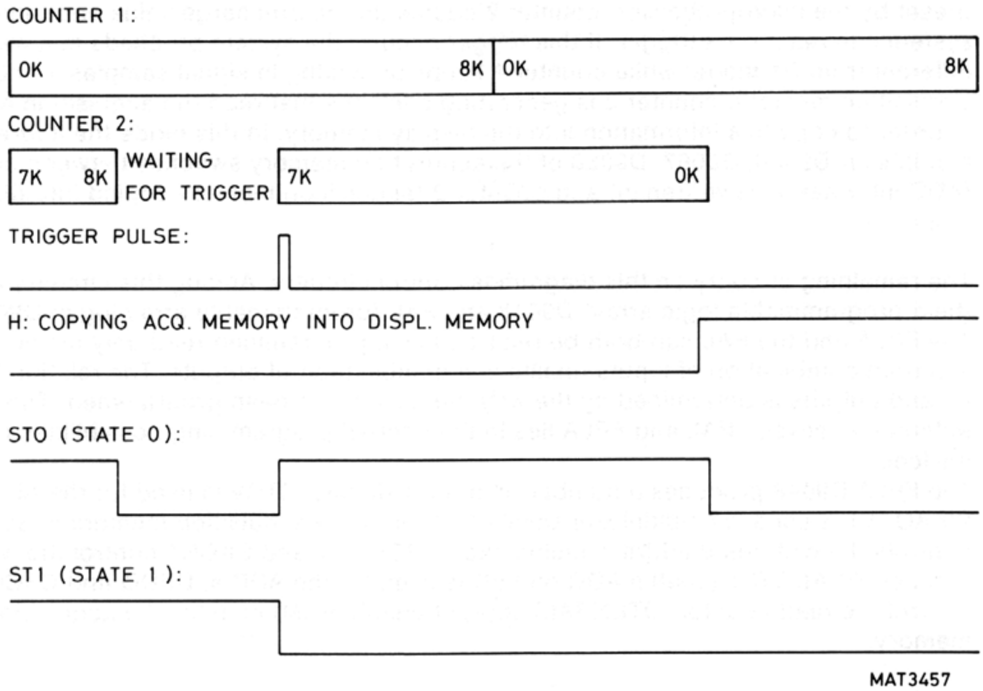


Figure 11.1 States of counter 1 and counter 2

The acquisition starts after reset of counter 1 to 0000 and after it has preset counter 2 to the so-called precharge-value. This value depends on the adjusted pretrigger value. If this value is e.g. -3 div, the precharge-value is in single channel 8192 - (3 * 400) = 6992 (7K approx) because 1 div equals 400 samples then. In dual channel the value is 4096 - (3 * 200) = 3496 because 1 div equals 200 samples then. The now following example is based upon a pretrigger value of -3 div in single channel mode:

the acquisition starts with counter 1 at 0000 and counts upwards so that the digitized signal samples from the ADC are placed in successive acquisition memory locations. At the same time counter 2 counts up from the precharge value towards 8192. The system can not trigger during this period; this assures that at least 3 div of signal are stored in memory before a trigger can occur. The clockpulse frequencies for counter 1 and 2 are equal during this mode. At the moment that counter 2 has reached 8192, it is reset to the precharge value (in this example 6992) and switched to count down mode. The system now is able to get triggered and stands waiting for a trigger pulse. This trigger pulse comes as "DSO TRIG SIGNAL" from connector X411 on the time base. It is applied to X9011 and consequently to D9050/pin13. Inbetween counter 1 goes on counting up and adressing successive acquision memory locations. Counter 2 starts to count down from 6992 ... 0000 if the trigger occurs. This goes on until the value 0000 is reached: now counter 2 and also counter 1stop. This is the moment that the acquisition memory contents are copied into the display memory. How this is done will be explained on the next diagram "display logic". However bear in mind that the copying of the acquisition memory starts at the counter 1 address succeeding to the address where the acquisition stopped. The aquisition memory contents are copied into the display memory locations starting with address 0000 and onwards. The copy action stops if the display memory has received 8K signal samples. After this a new acquisition stroke starts, and so on. However after a reset command in single (multiple) shot mode, only 1 (2) acquisition stroke is performed.

Working principle of D2 mode:
the start of the acquisition stroke is identical to the D1 mode. The various circuits are preset by the microprocessor, counter 2 counts up the precharge value and then the system can react on a trigger. If this trigger occurs, the system proceeds in a way different from D1 mode: while counter 1 keeps on writing in signal samples in the acquisition memory, counter 2 is generating adresses that read the acquisition memory in order to copy this information into the display memory. In this mode the address multiplexer D9066, D9067, D9068 of the acquisition memory switches between counter 1 (ADC information is written in) and counter 2 (acquisition memory copied into display memory).

The remaining circuitry on this diagram is control circuitry. Among this circuitry are FPLA (field programmable logic array) D9048 and PAL (programmable array logic) D9047. The FPLA and the PAL can both be regarded as a programmed read only memory where a certain combination of inputs results in a combination of outputs. The relation between in- and outputs is determined by the way the device has been programmed. The difference between PAL and FPLA lies in the internal programming possibilities of both devices.
The FPLA D9048 produces a number of control signals: STCV is used for the ADC's, WRAQ--LT is used via multiplexer D9064 to control the acquisition memories, SLAQAB controls the write/read address multiplexer, RSCN1-LT and CKCN1 control the write counter, ENADOTLT (enable ADC output) is used for the ADC's, UPDO and CKCN2 control the read counter, OTENRALT (output enable RAM) enables the acquisition memory.

The PAL D9047 produces also a number of control signals. ST0 (state 0) and ST1 represent the four different modes of the acquisition system. These modes are:
- counter 2 counting up the precharge value.
- system stands waiting for a trigger.
- counting down after the trigger until the information transfer starts.
- information transfer from acquisition memory to display memory.

Other PAL output signals are: LDCN2 (load counter 2), SLDB (select databus) used on circuit diagram "acquisition memories", CKDPL (clock display latch) used for information transfer on circuit diagram "display logic" and ST3 (state3) that controls FPLA D9048. The latches D9059, D9052 generate control signals such as: the acquisition mode signals D1 and D2, the DUAL channel mode signal, TBM00/TBM01/TBM02 for digital time base control and 1CHA/1CHB for single channel mode with channel A or B.

11.4 DISPLAY LOGIC

The heart of this diagram is formed by the 32k display memory D9039. This IC of which half the capacity is used, incorporates the 8K display memory and the 8K register memory. In single channel mode 8K is used for the trace of one channel. In dual channel mode the even addresses of 8K are used for channel A and the odd addresses for channel B. The adresses for the display memory are generated by the ASIC (application specific IC) D9072. This device incorporates 3 address counters. Every counter has 12 bits and can address 4K of memory.

There are two additional static address lines that are set by the microcomputer so that 16K can be adressed as a total. The output of one counter is available at a time at the outputs DPAD00 ... DPAD14. The counter to be active at the outputs is determined by the control signals SC00, SC10 (select counters). The outputs DPAD13, DPAD14 are static bits and not dirived from the counter outputs. The function of the three counters is now explained for the various modes that are possible. The three counters are used for (1) memory addressing during signal transfer from acquisition to display section, (2) memory addressing during the display cycle, (3) horizontal deflection during the display cycle and (4) transfer from display to register memory respectively.

Information transfer from acquisition to display memory.
The acquisition brings the signal samples one by one into latch D9038 via CKDPL (clock display latch). CKDPL is also applied to the control logic so that the display part knows that information is available. This information is taken from the latch by OTENDPLT (output enable display) and loaded into the D9039 memory addres determined by the 4K counter in D9072, divide-by-two stage D9073 (total address range 8K) and multiplexer D9074. The timing of this action is given in the diagram below where two transfers are given:

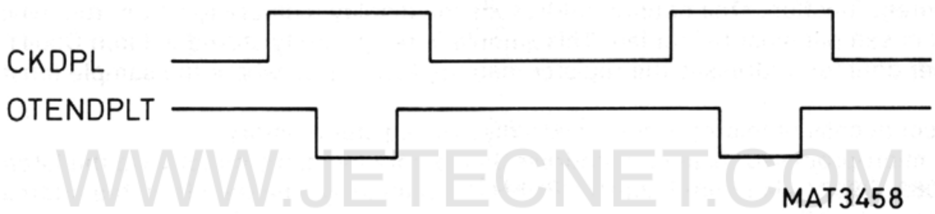


Figure 11.2 Timing diagram of signal transfer

If the display section has taken the signal sample it makes OTENDPLT high again. This is signalled to the acquisition control logic that makes CKDPL low again. Now a new signal sample can be transferred between the acquisition part and the display part. The two parts are independent and have their own systemclock (20 and 8MHz). The proces that is shown can be regarded as a handshake process.

Signal display.
The display of signal means that the contents of a certain D9039 display/register memory location is converted into vertical and horizontal deflection. The vertical deflection is initiated by 8 bits DPDB00 ... DPDB07 from a certain adressed memory location. These 8 bits are applied to the Y DAC (digital to analog converter) via the multiplexers D9043, D9044. With the multiplexers in opposite position text and cursors are displayed.

The horizontal deflection is initiated by 10 bits DPAD02 ... DPAD11 that are applied to the X DAC via multiplexers D9078, D9077, D9076. With the multiplexers in opposite position, text and cursors are displayed. There are 4K signal samples for one CRT screen and only 1K (equals 10 bits) for horizontal addressing. This means that at every horizontal position 4 signal samples are displayed. Now the role of the counters in D9072 on the display cycle:

one counter addresses 4K out of the 32K memory range. For this purpose 15 bits are necessary: 14 bits from the counter inside D9072 and 1 bit DPAD12 from Dflipflop D9049. The counter inside D9072 is presettable because of the instrument's display part function. The contents of the addressed memory location is placed in latch D9041. Now the counter inside D9072 that is responsable for the X deflection is applied to the outputs. Ten bits of information DPAD02 ... DPAD11 are applied via multiplexers to the X DAC. This counter must be able to count in steps of 1, 2, 4, 8, 16, 32 or 64. This inconnection with the instrument's X EXPAND functions. Now the contents of latch D9041 is applied to the Y DAC while counter D9072 output determines the horizontal position of the dot on the screen via the X DAC.

Copying information from display memory into register:
during this action the acquisition is stopped and there is no signal display on the instrument's screen. During this action two counters inside D9072 temporarely get a different function. One counter addresses the display memory location from where a signal sample must be copied. This sample is temporarely stored in latch D9041. The other counter addresses the register memory location to where the sample must copied.

Direct access of microprocessor into display/register memory:
the microprocessor is able to address all memory locations directly via the latches D9069, D9071 via control signal CPUEN (CPU enable). The data from the addressed memory location is accessible via bidirectional latch D9042. This makes it possible for the microprocessor to read and to write into the memory.
This is necessary if the oscilloscope is controlled via the (optional) communication interface (reading from or writing into the memory) or when the RESET key is pushed (1000 0000 is written into the memory).

11.5 DAC CIRCUITS

This diagram incorporates the (vertical) Y DAC and the (horizontal) X DAC and their output amplifiers. For the Y section a 8 bits DAC is used. It has 2 outputs delivering a balanced current output signal that is applied to an amplifier stage V9107, V9108 with gain and offset adjustments. The signal current in each output branch is 0,1 mA/div and is applied to D602/pin 5 and 6 on adaptation unit A16. The circuit with V9102 and V9106 has all transistors in conductive state in the dot join mode because signal TRAMO-HT (trace mode) is high then. The circuit switches on low pass circuits by activating the capacitors C9102 (lowpass with R9107), C9103 (low pass with R9112), C9104 (low pass with R9108) and C9106 (low pass with R9113). The low pass filters give the result that the spot on the screen between one sample and the next one moves gradually. With the low pass filters not activated, the spot moves in steps.

For the X section a 10 bits DAC is used. It has two outputs delivering a balanced current output signal of which one is not used and connected to 0V. The other output is applied to V9119 that converts current into voltage. This voltage signal (range 0 ... 6V) is applied to the time base unit A4 via emitter follower V9121. Also the X deflection circuit has a smoothing circuit for the dot join mode. This circuit comprises V9122 that switches on C9111, C9112. The working principle is identical to the corresponding circuit in the Y deflection part.

11.6 DISPLAY AND TIME BASE CONTROL

This diagram comprises the digital time base and logic for display control.
The digital time base is driven by 40MHz X-tal oscillator G9001. The 40MHz output signal is divided by two cascaded D-flipflops D9003 so that 20 and 10MHz square waves are available. Divider D9002 divides the 40MHz signal into 4 and 8 MHz signals for the the digital time base. The signals of 20, 10, 8 and 4 MHz are used for the fastest sweep speeds. They can be selected via multiplexer D9006. This multiplexer is controlled by address lines TBM00, TBM01, TBM02 that come from latch D9052 on circuit diagram "acquisition control logic". The 20MHz signal is used for 10 and 20us/div in single channel. For 20us/div dual channel 10MHz is used. 8MHz (4MHz) is used for 50us/div in single (dual) channel mode.

The 8MHz signal is also routed to a programmable divider D9004. Output pin 10 of this device is used for sweep speeds 0,5ms ... 0,5 s/div. This output signal is applied to the input (pin 15) of a second divider that makes the sweep speeds 1 ... 50 s/div. The programmable divider is controlled by the microcomputer via the data lines ABDB00 ... ABDB07 and the address lines UPAD00, UPAD01. Other control lines from the microcomputer are UPWR (microprocessor write) and CSTB (chip select time base).

The display control logic:
this part of the circuit generates the control signals for the display section.
The circuit is controlled by the microcomputer data bits ABDB00 ... ABDB06 via latch D9024. The latch is loaded with the information on the data bus via signal CKDSP-LT (clock display). Because the display system works asynchroneously from the microcomputer, the latch D9024 is followed by a second latch D9026 that is read out by the signal SC10 that is synchroneous with the 8MHz clock of the display control logic. The control signals that are generated by the two PAL's D9027, D9028 and multiplexer D9029. A PAL is a programmable array logic of which the function is already discussed during the explanation of circuit diagram of acquisition control logic. The multiplexer D9029 is enabled indigital memory mode (MEMON-LT low). The multiplexer positions are determined by TRAMO-HT (trace mode; H if signals are displayed, L if text/cursors are displayed). D9029 makes two output signals of which ZCONTR-LT is used to determine the intensity of the spot on the screen via V4618 on the time base. A low level switches the display on. This level is determined by ZCONTR (signal display) or by ZTEN0 (text/cursor display). This last signal comes from the text/cursor generator.

The other D9029 output signal XYDTCLLT switches the multiplexers D9043 ...D9076 that switch the Y and X defection in memory on between signal and cursor/text display. This signal is the 10MHz clock in case of text/cursor display and XYDTCL in case of signal display. The most important output signals that are generated in the display control logic are:

- CPUEN-LT: L enables the display RAM so that the microcomputer can read/write into it.
- STYDT-LT, RTYDT-LT, YDTCL-HT: L gives set/reset to flipflop D9049 in display RAM section. The clock is YDTCL-HT.
- SLDPRALT: L selects display RAM D9039.
- CNTCL-HT: clockpulse for transfer counter D9073.
- OTENDPLT: L transfers acquisition memory information from latch 9038 into display RAM D9039.
- DPRAWRLT: L enables display RAM D9039
- CKCPL-HT, ENCPL-LT: clock and enable pulse for copy latch D9041 for copying from display into register memory.

The most important input signals are:
- TCCPCNHT: H if terminal count occurs of counter that controls transfer from acquisition to display memory.
- LOCK: H if system is in locked mode.

The following timing signals are used:

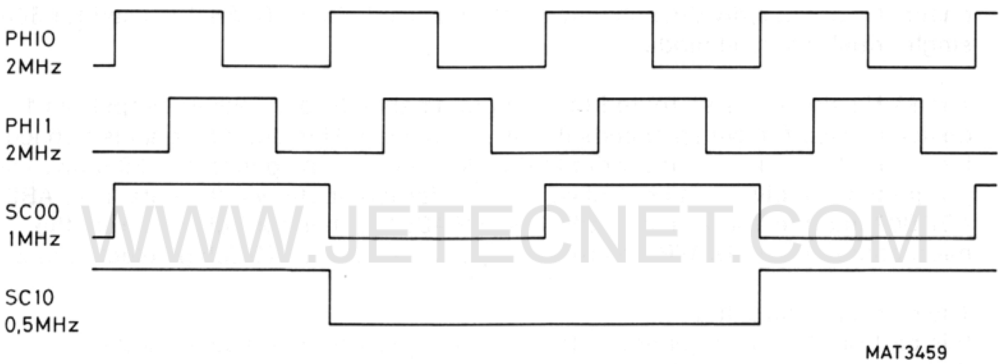


Figure 11.3 Timing diagram display and time base control

The supply voltage for the IC's D9014 (microprocessor RAM), D9046 (switch IC), D9039 (display memory/register) is coming from the +5V power supply via diode V9002 and V9003 if the line voltage is on. If the line voltage is off, the supply is coming from a back-up battery via diode V9001 (BAV0).

11.7 CPU LOGIC

This diagram comprises two main parts: the microcomputer and the textgenerator. The microcomputer consists of the 8 bit microprocessor D9012 with a read-only memory D9013 and a random access memory D9014. The address and databits UPADB00 ... UPADB07 of the microprocessor are combined and the addressinformation is separated by the latch D9016 under control of the signal ALE (address latch enable). The read-only memory is enabled by the signal PSE(program store enable) that is generated by the microcomputer. The random access memory is enabled by signal CSUPRALT (chip select microprocessor RAM) and controlled by either UPRD--LT (microprocessor read) or UPWR--LT (microprocessor write). The buffer D9018 that is enabled by signal SFTKY-LT (softkey) permits the microcomputer to read the five softkeys under the CRT and the uncal positions of the verniers of channel A, B and time base. The buffer D9017 is used as a buffer because of the maximum fan-out of the processor.

The text generator D9079 is written in by the microprocessor by the databits ABDB00 ... ABDB07 and the address bits UPAD08, UPAD09 via the commands UPWR and TXTSL-LT (text select). The text generator uses the same 10MHz clock signal as the microcomputer. Output signals of the text generator are 10 bits TXDB00 ...TXDB09 that are used for horizontal positioning of the text and 8 bits Y2 ...Y9 that are used for vertical positioning. The signal ZTEN0 determines the intensity when text is written. The text generator is functioning under control of the microprocessor in a display cycle where 9,5 ... 10 ms is reserved for writing text/cursors, then 9 ms to write signal and then text/cursors, and so on.

The remaining circuitry on this diagram consists of decoding circuitry. D9019 incorporates two demultiplexers. Depending on a two bit address, one out of the four output lines is low if the enable output is low. D9021 is a demultiplexer with 8 outputs of which one is low at a time depending on a three bit address and if two enable lines are low and one line is high. Some of the control signals that are generated in this circut are:

- CSDSP-LT (chip select display): enables the latch D9042 that gives the microcomputer direct access to the display/register memory.
- DPCNT-LT (display counter chip select): microcomputer can write data into display counter D9072.
- RSCPCNLT: reset pulse for the counter that controls the data transfer between acquisition and display memory.
- OPTWR-LT (option write): of use in case that interface option is present
- TXTSL-LT (text select): microcomputer can enable text generator via this line.
- CKMOR (clock mode register): clockpulse for latch D9052 that serves as mode register in acquisition control logic.
- CSTB--LT (chip select time base): chip select for time base IC D9004.
- CKPR1, CKPR2 (clock preset 1/2): clock pulse for latches that are loaded with the preset value for a 8K counter on the acquisition control logic.
- CKDSP-LT: clock pulse for latch D9024 on display mode control logic.

11.8 SIGNAL NAME LIST

Signal Name	Description	Signal Source	Signal Destination
1CHA	Single channel A	D9052	D9030, D9035
1CHB	Single channel B	D9052	D9030
BR	Bank read	D9064	D9047
CK08M	8 MHz clock	D9002	D9004, D9006 D9027, D9028
CK10M	10 MHz clock	D9003	D9006, D9012, D9029, D9079
CK20M	20MHz clock	D9003	D9003, D9006, D9047
CKCN1	Clock counter 1	D9048	D9053, D9054, D9056
CKCN2	Clock counter 2	D9048	D9061, D9062, D9063, D9064
CKCPL-HT	Clock copy latch	D9028	D9041
CKDPL	Clock display latch	D9047	D9027, D9038, D9048
CKDSP-LT	Clock display register	D9021	D9024
CKMOR	Clock mode register	D9021	D9052
CKPR1	Clock preset 1	D9021	D9058
CKPR2	Clock preset 2	D9021	D9059
CNTCL-HT	Count clock	D9082/8	D9072, D9073
CNTCL-LT	Count clock	D9027	D9082/9
CNTOF-HT	Count overflow	D9072	D9073, D9028, D9082/5
CPUEN-HT	CPU enable	D9026	D9023, D9027, D9028, D9072, D9074
CPUEN-LT	CPU enable	D9023	D9069, D9071
CSDSP-LT	Chip select display	D9022/3	D9022, D9042
CSTB-LT	Chip select time base	D9021	D9004
CSUPRALT	Chip select uP RAM	D9046/3	D9014, D9047

Signal Name	Description	Signal Source	Signal Destination
D1	Tb mode 20us...2ms/div	D9052	D9047, D9048
D2	Tb mode 5ms...50s/div	D9052	D9047, D9048
DPCNT-LT	Display counter chip select	D9019	D9072
DPRAWRLT	Display RAM write	D9022/11	D9039
DSPEN-HT	Display enable	D9026	D9027, D9028
DSPWR-LT	Display write	D9019	D9022/2, D9022/13
DUAL	Dual trace mode	D9052	D9030, D9047, D9048, D9051
ENAD1-LT	Enable ADC 1	D9030	N9001
ENAD2-LT	Enable ADC 2	D9030	N9002
ENADOTLT	Enable ADC output	D9048	D9030/10, 2, 4
ENCPL-LT	Enable copy latch	D9028	D9041
LDCN2-LT	Load counter 2	D9047	D9061, D9062, D9063, D9064
LOCK--HT	Lock mode of system	D9026	D9027
MEMON-HT	Memory on	D9059	D9023/13
MEMON-LT	Memory on	D9023/12	D9029
OPTRQ-LT	Option request	D9046	D9012, X9050
OPTWR-LT	Option write	D9021	X9050
OTENDPLT	Output enable display	D9027	D9038, D9050
OTENRALT	Output enable RAM	D9048	D9031, D9032, D9033, D9034
PSE---LT	Program store enable	D9012	D9013
REGEN-HT	Register enable	D9026	D9027, D9028
RESET-HT	Reset power on	X9050	D9012, D9046/8
RESET-LT	Reset power on	D9046/9	D9046/5, D9024, D9026, D9046/13, D9079, D9045
RSCN1-LT	Reset counter 1	D9048	D9049, D9053, D9054, D9056

Signal Name	Description	Signal Source	Signal Destination
RSCPCNLT	Reset CP counter	D9021	D9073
RTYDT-LT	Reset Y D-flipflop	D9026	D9049
SC00	Select counter	D9027	D9028, D9072, D9074
SC10	Select counter	D9027	D9028, D9072, D9073, D9074 D9082
SCL	Serial clock	D9012	X9050
SDA	Serial data	D9012	X9050
SFTKY-LT	Softkey select	D9019	D9018
SLAQAB	Select aquisition addr bus	D9048	D9066, D9067, D9068
SLDB	Select databus	D9047	D9036, D9037, D9048
SLDPRALT	Select display RAM	D9022/6	D9046/1
ST0	State 0	D9047	D9048
ST1	State 1	D9047	D9048
ST2	State 2	D9047	D9048
STCV	Start conversion	D9048	D9050, N9001 N9002
STYDT-LT	Set Y D-flipflop	D9026	D9049
TBCK	Time base clock	D9006	D9048
TBM00	Time base mode 00	D9052	D9006
TBM01	Time base mode 01	D9052	D9006
TBM02	Time base mode 02	D9052	D9006
TCCN1-LT	Terminal count counter 1	D9057/12	D9049
TCCN2-LT	Terminal count counter 2	D9057/6	D9050
TCCPCNHT	Term count copy counter	D9073	D9023, D9027, D9047
TCCPCNLT	Term count copy counter	D9023/8	D9012
TCD1	Terminal count D-flipflop 1	D9049/9	D9050, D9051
TCXD	Terminal count X data	D9028	D9027

Signal Name	Description	Signal Source	Signal Destination
TRAMO-HT	Trace mode (txt/signal)	D9059	D9029, D9043, D9044, D9076 D9077, D9078 V9101
TXTSL-LT	Text select	D9021	D9079
UPDO	Up /down counter 2	D9048	D9061, D9062, D9063, D9064
UPRD--LT	Microprocessor read	D9012	D9014, D9017, D9017, D9019, D9042, X9050
UPWR--LT	Microprocessor write	D9012	D9004, D9014, D9019, D9079, D9082
VERTIIC	Vertical IC	D9012	X9050
WRAQ--LT	Write acquisition	D9048	V9003, D9049
WRAQ1-LT	Write acquisition 1	D9051	D9031, D9032
WRAQ2-LT	Write acquisition 2	D9051	D9033, D9034
WRB---LT	Write buffer	D9082/3	D9072
XPOSCAL	X position calibrated	D9059	X9016
XYDTCLLT	X/Y data clock	D9029	D9043, D9044, D9076, D9077, D9078
YDTCL-HT	Y D-flipflop clock	D9023/10	D9049
ZCNTR-LT	Z control	D9029	V9004
ZTEN0	Z text enable	D9079	D9029
ABDB00//07	Buffered uP data bus	D9017	D9004, D9014, D9018, D9024, D9042, D9052, D9058, D9059, D9072, D9079
AQAB00//03	Acquisition address bus	D9066	D9031, D9032 D9033, D9034
AQAB04//07	Acquisition address bus	D9067	D9031, D9032, D9033, D9034
AQAB08//10	Acquisition address bus	D9068	D9031, D9032 D9033, D9034
AQAB11	Acquisition address bus	D9068	D9031, D9033 D9023/5

Signal Name	Description	Signal Source	Signal Destination
AQDB00//03	Acquisition data bus	N9001	D9031, D9032, D9035, D9036
AQDB04//07	Acquisition data bus	N9001	D9031, D9032, D9035, D9037
AQDB10//13	Acquisition data bus	N9002	D9033, D9034 D9035, D9036
AQDB14//17	Acquisition data bus	N9002	D9033, D9034 D9035, D9037
AQDBAB00//03	Acquisition data bus A/B	D9036	D9038
AQDBAB04//07	Acquisition data bus A/B	D9037	D9038
DPAD00,01	Display address	D9069	D9039, D9072
DPAD02,03	Display address	D9069	D9039, D9072 D9078
DPAD04//07	Display address	D9069	D9039, D9072 D9077
PAD08//11	Display address	D9071	D9039, D9072 D9076
DPAD12//14	Display address	D9071	D9039, D9072
DPDB00//03	Display data bus	D9038 D9042	D9039, D9041 D9043
DPDB04//07	Display data bus	D9038 D9042	D9039, D9041 D9044
DXDB00,01	Deflection X data bus	D9078	N9004
DXDB02//05	Deflection X data bus	D9077	D9004
DXDB06//09	Deflection X data bus	D9076	D9004
DYDB00//03	Deflection Y data bus	D9043	D9003
DYDB04//07	Deflection Y data bus	D9044	D9003
PRAB00//03	Pretrigger address bus	D9058	D9061
PRAB04//07	Pretrigger address bus	D9058	D9062
PRAB08//11	Pretrigger address bus	D9059	D9063
PRAB12	Pretrigger address bus	D9059	D9064

Signal Name	Description	Signal Source	Signal Destination
RDAB00//03	Read address bus	D9061	D9066
RDAB04//07	Read address bus	D9062	D9067
RDAB08//11	Read address bus	D9063	D9068
TXDB00,01	Text X data bus	D9079	D9078
TXDB02//05	Text X data bus	D9079	D9077
TXDB06//09	Text X data bus	D9079	D9076
TYDB02//05	Text Y data bus	D9079	D9043
TYDB06//09	Text Y data bus	D9079	D9044
UPAD00,01	Microprocessor address	D9016	D9004, D9013, D9014, D9069, D9072
UPAD02	Microprocessor address	D9016	D9013, D9014, D9069
UPAD03//07	Microprocessor address	D9016	D9013, D9014, D9069
UPAD08//11	Microprocessor address	D9012	D9013, D9014, D9071, D9079, X9050
UPAD12	Microprocessor address	D9012	D9013, D9014, D9021, D9071
UPAD13	Microprocessor address	D9012	D9013, D9021, D9071
UPADB00//07	Microproc. address/data bus	D9012	D9013, D9016, D9017, X9050
WRAB00//03	Write address bus	D9053	D9066
WRAB04//07	Write address bus	D9054	D9067
WRAB08//11	Write address bus	D9056	D9068

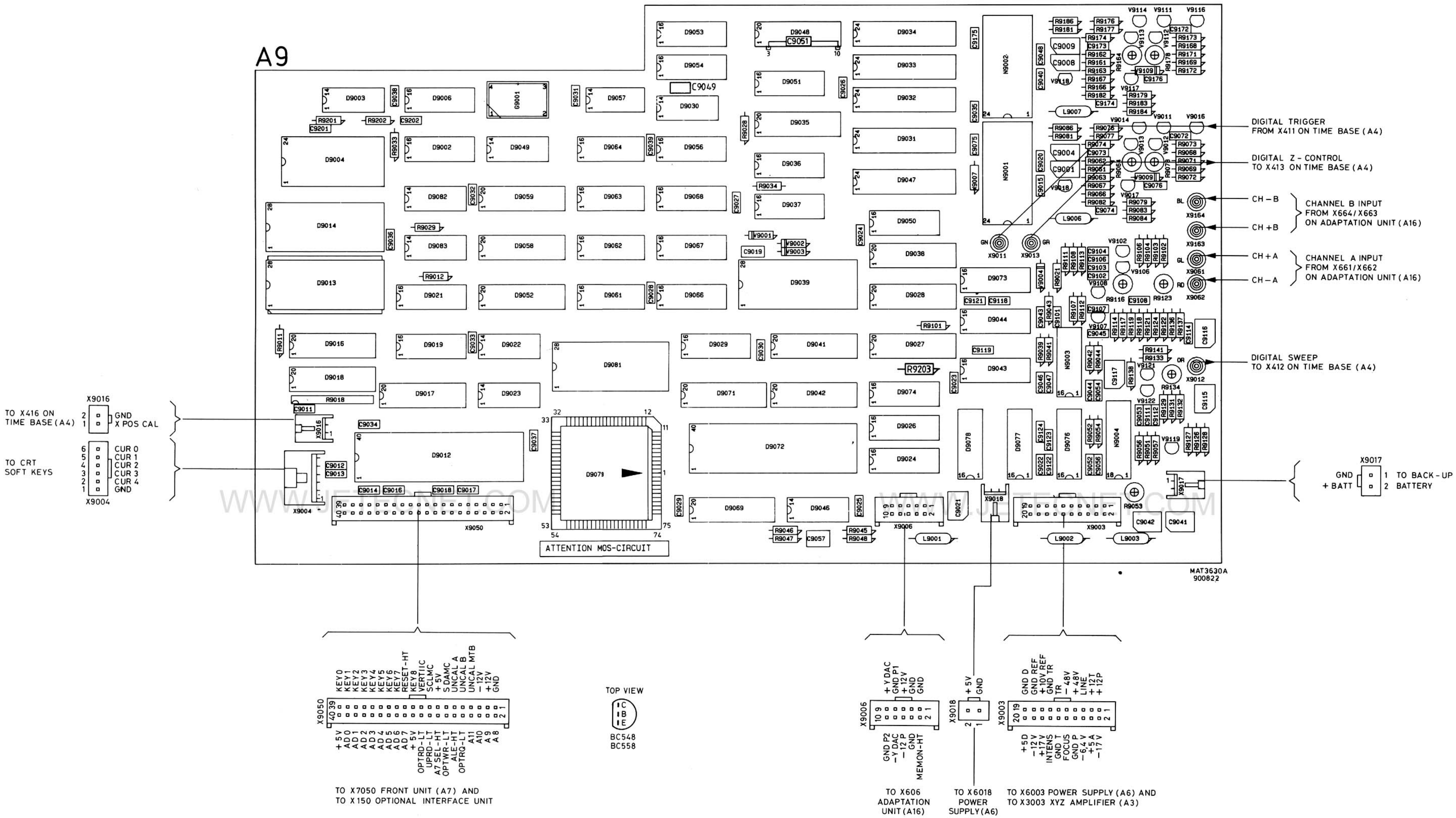
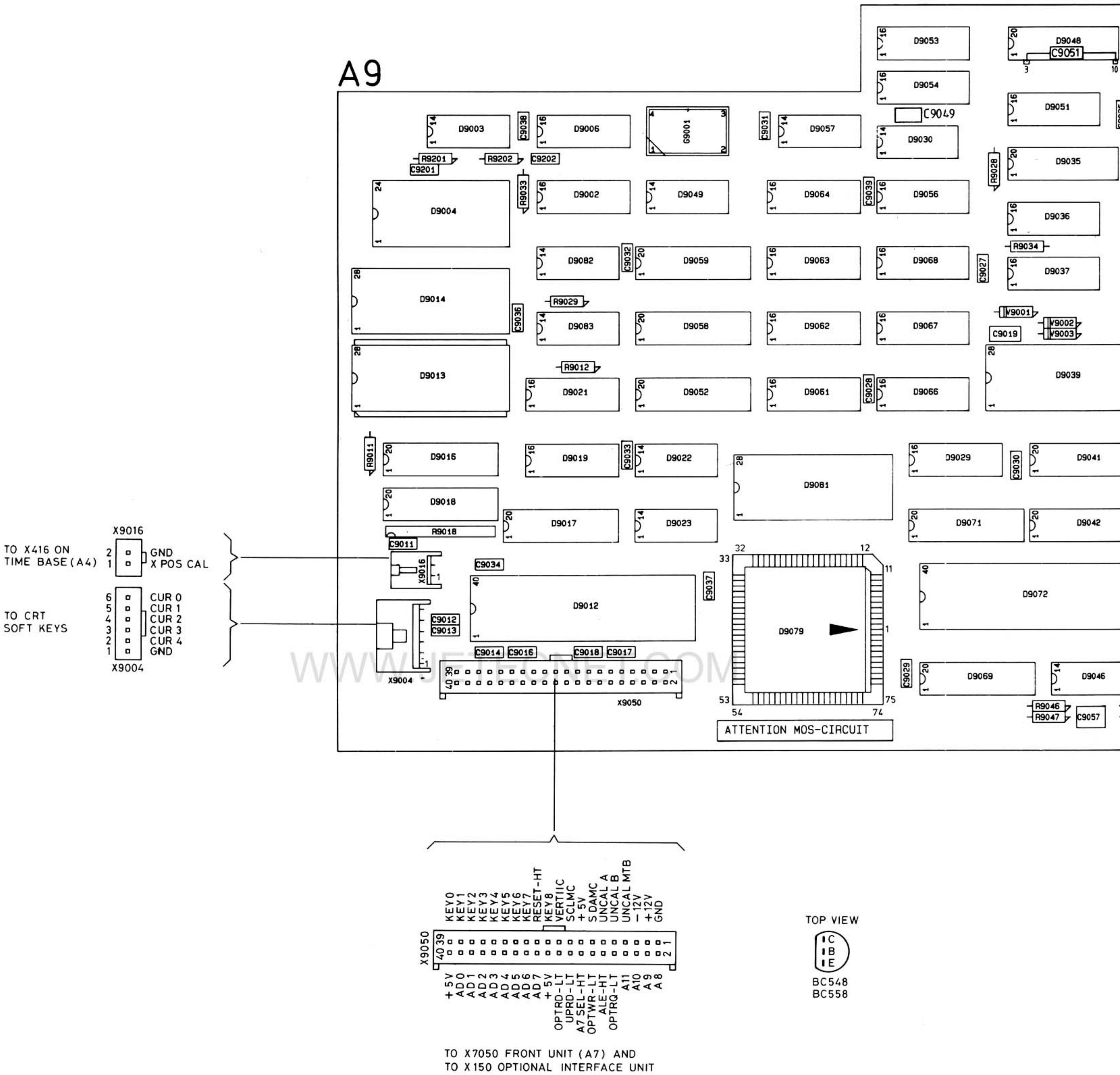


Figure 11.4 Digital unit, p.c.b. lay-out


A9
TO X416 ON
TIME BASE (A4)
X9016
2 GND
1 X POS CAL
TO CRT
SOFT KEYS
6 CUR 0
5 CUR 1
4 CUR 2
3 CUR 3
2 CUR 4
1 GND
X9004
D9053
D9048
C9051
D9054
C9049
D9051
D9003
C9038
D9006
G9001
C9031
D9057
D9030
R9201
R9202
C9202
C9201
R9028
D9035
D9004
R9033
D9002
D9049
D9064
C9039
D9056
D9036
R9034
D9082
C9032
D9059
D9063
D9068
C9027
D9037
D9014
R9029
V9001
C9036
D9083
D9058
D9062
D9067
V9002
V9003
C9019
D9013
R9012
D9039
D9021
D9052
D9061
C9028
D9066
R9011
D9016
D9019
C9033
D9022
D9081
D9029
C9030
D9041
D9018
D9017
D9023
D9071
D9042
R9018
C9011
C9034
D9012
C9037
D9079
D9072
C9012
C9013
C9014
C9016
C9018
C9017
C9029
D9069
D9046
R9046
R9047
C9057
X9050
ATTENTION MOS-CIRCUIT
KEY0
KEY1
KEY2
KEY3
KEY4
KEY5
KEY6
KEY7
RESET-HT
KEY8
VERTIIC
SCLMC
+5V
SDAMC
UNCAL A
UNCAL B
UNCAL MTB
-12V
+12V
GND
+5V
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
+5V
OPTRD-LT
UPRD-LT
A7 SEL-HT
OPTWR-LT
ALE-HT
OPTRQ-LT
A11
A10
A9
A8
TO X7050 FRONT UNIT (A7) AND
TO X150 OPTIONAL INTERFACE UNIT
TOP VIEW
C
B
E
BC548
BC558

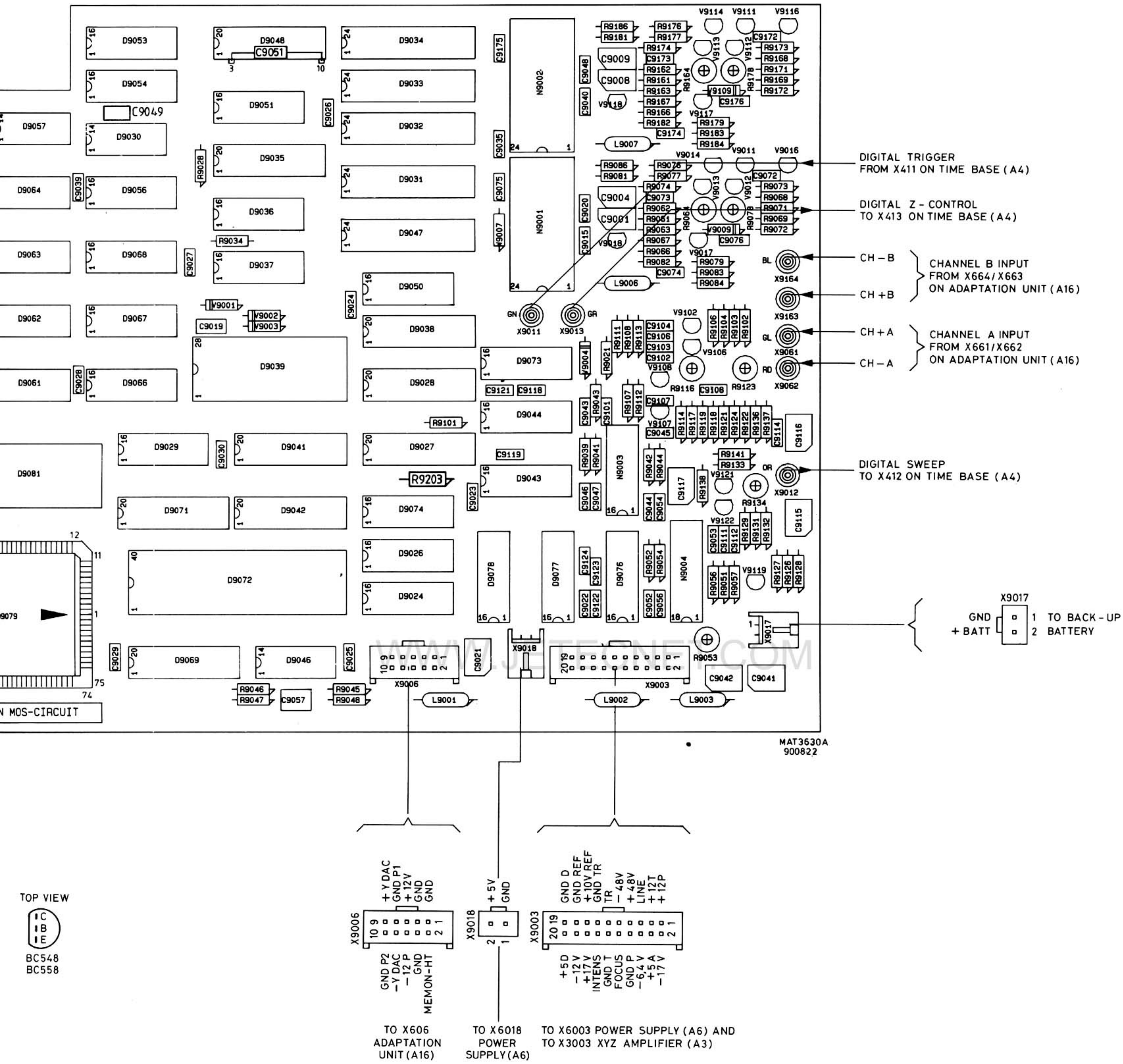
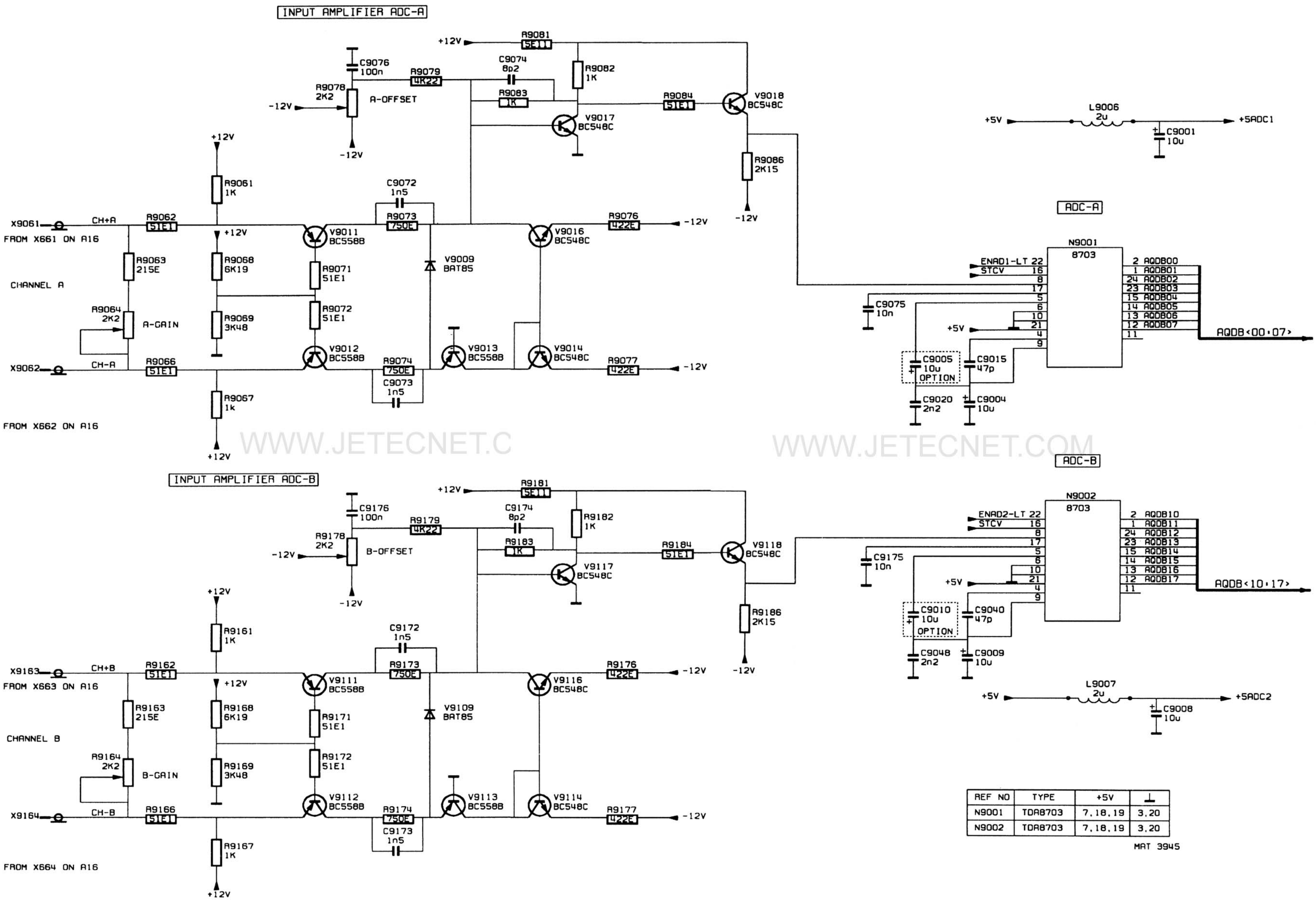


Figure 11.4 Digital unit, p.c.b. lay-out



REF NO	TYPE	+5V	⊥
N9001	TDA8703	7,18,19	3,20
N9002	TDA8703	7,18,19	3,20

Figure 11.5 Circuit diagram of input amplifiers and ADC circuit

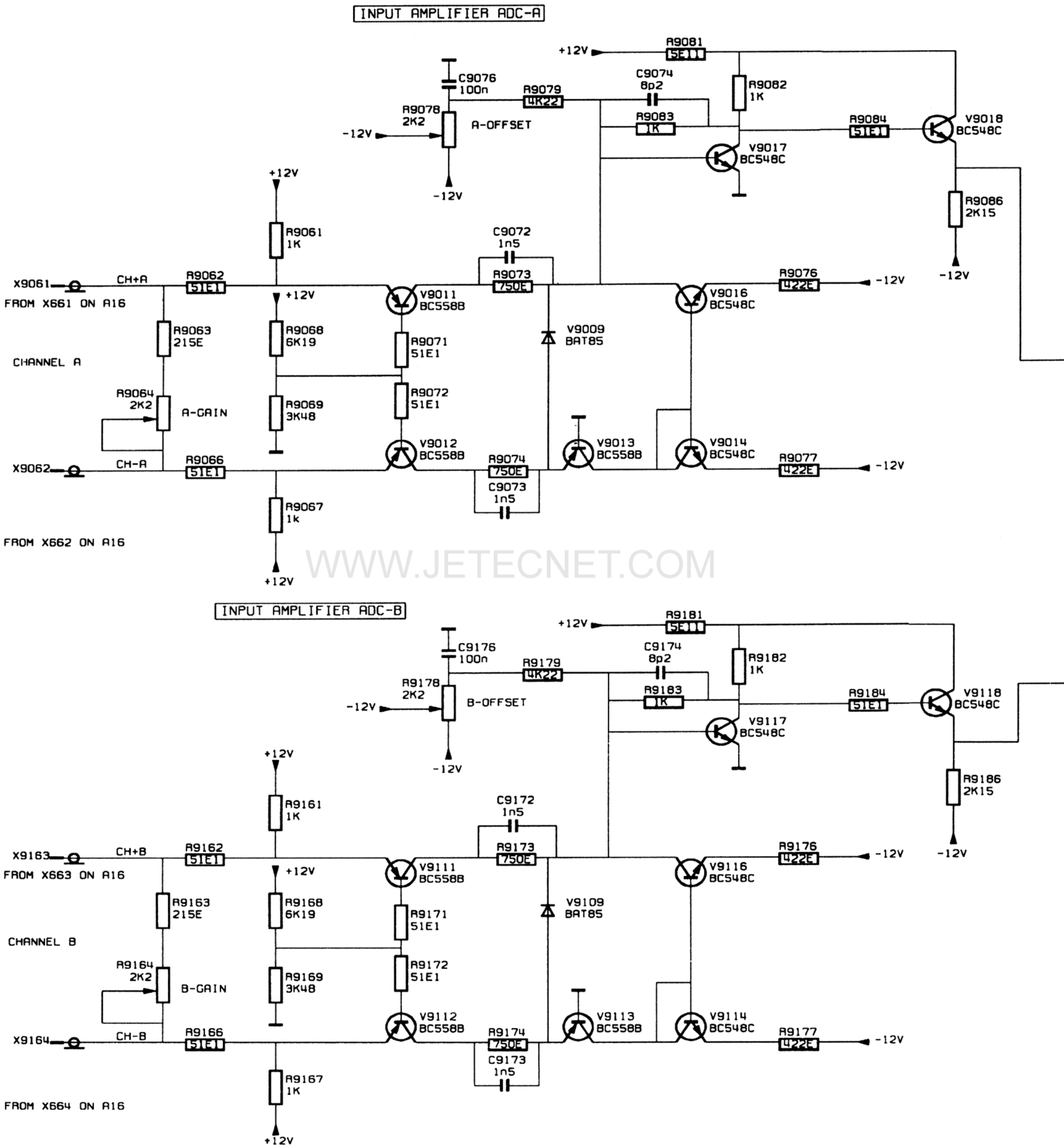
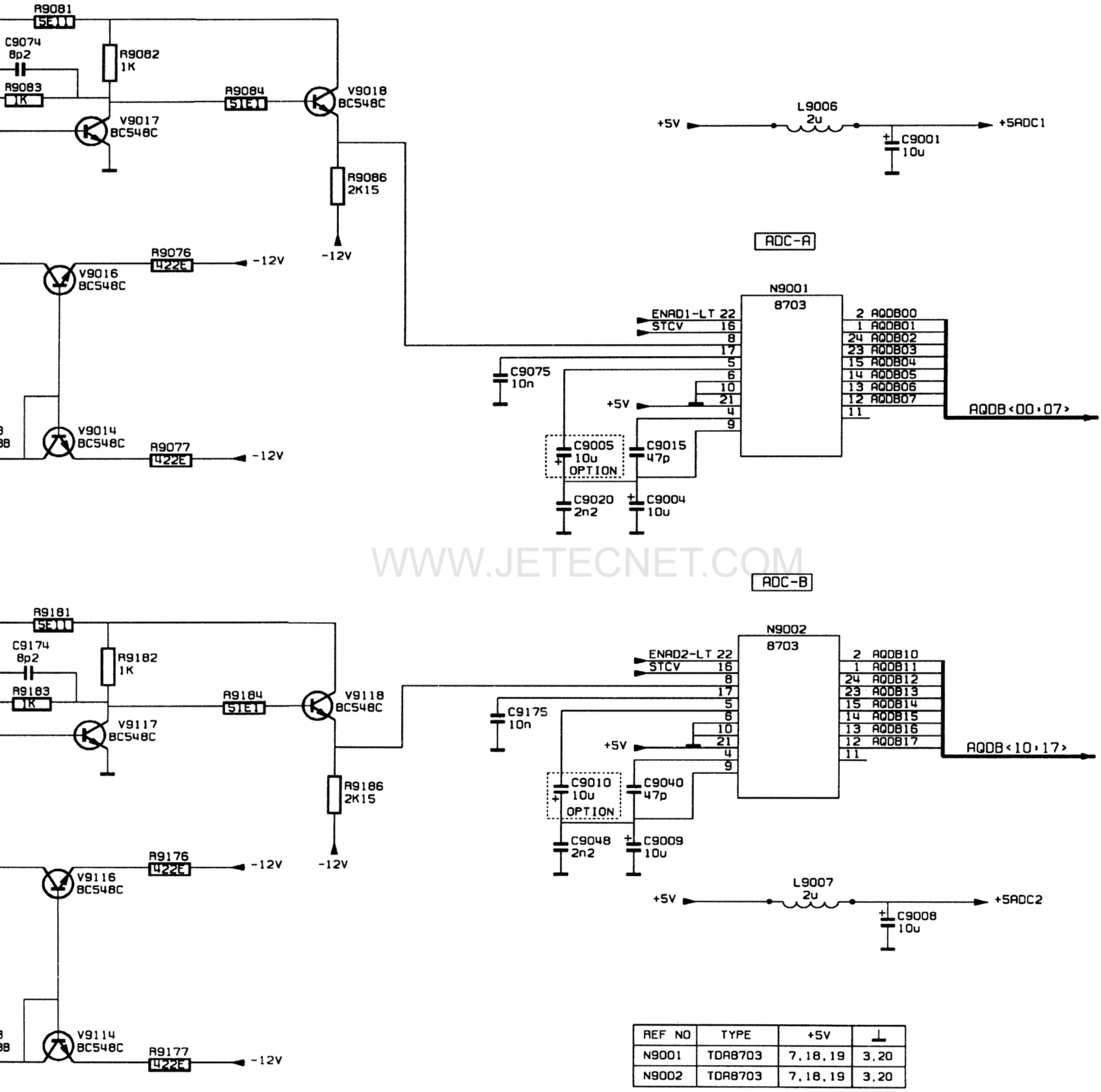


Figure 11.5 Circuit diagram of input amplifiers and ADC circuit



REF NO	TYPE	+5V	⊥
N9001	TDA8703	7,18,19	3,20
N9002	TDA8703	7,18,19	3,20

MAT 3945

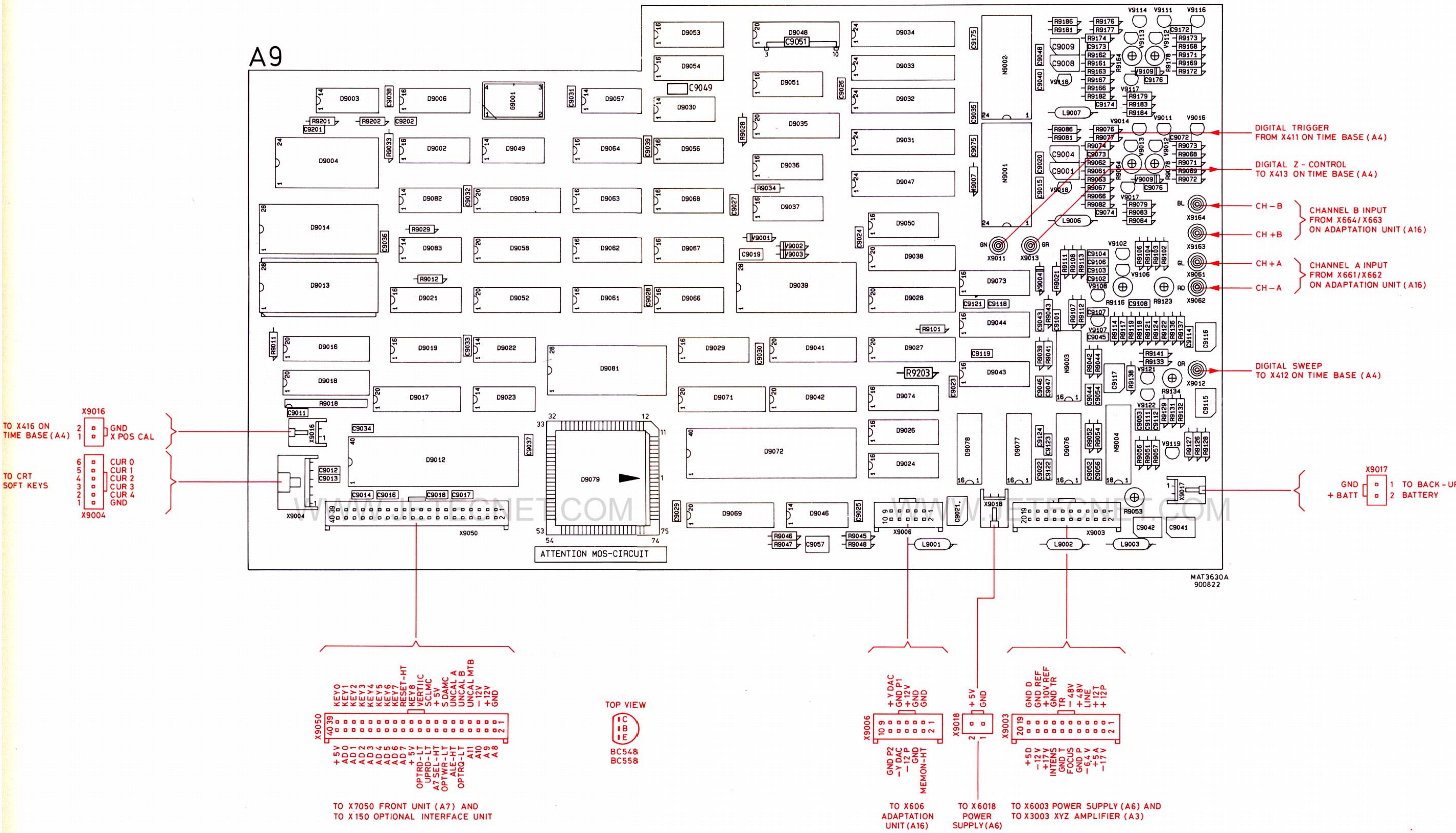


Figure 11.6 Digital unit, p.c.b. lay-out

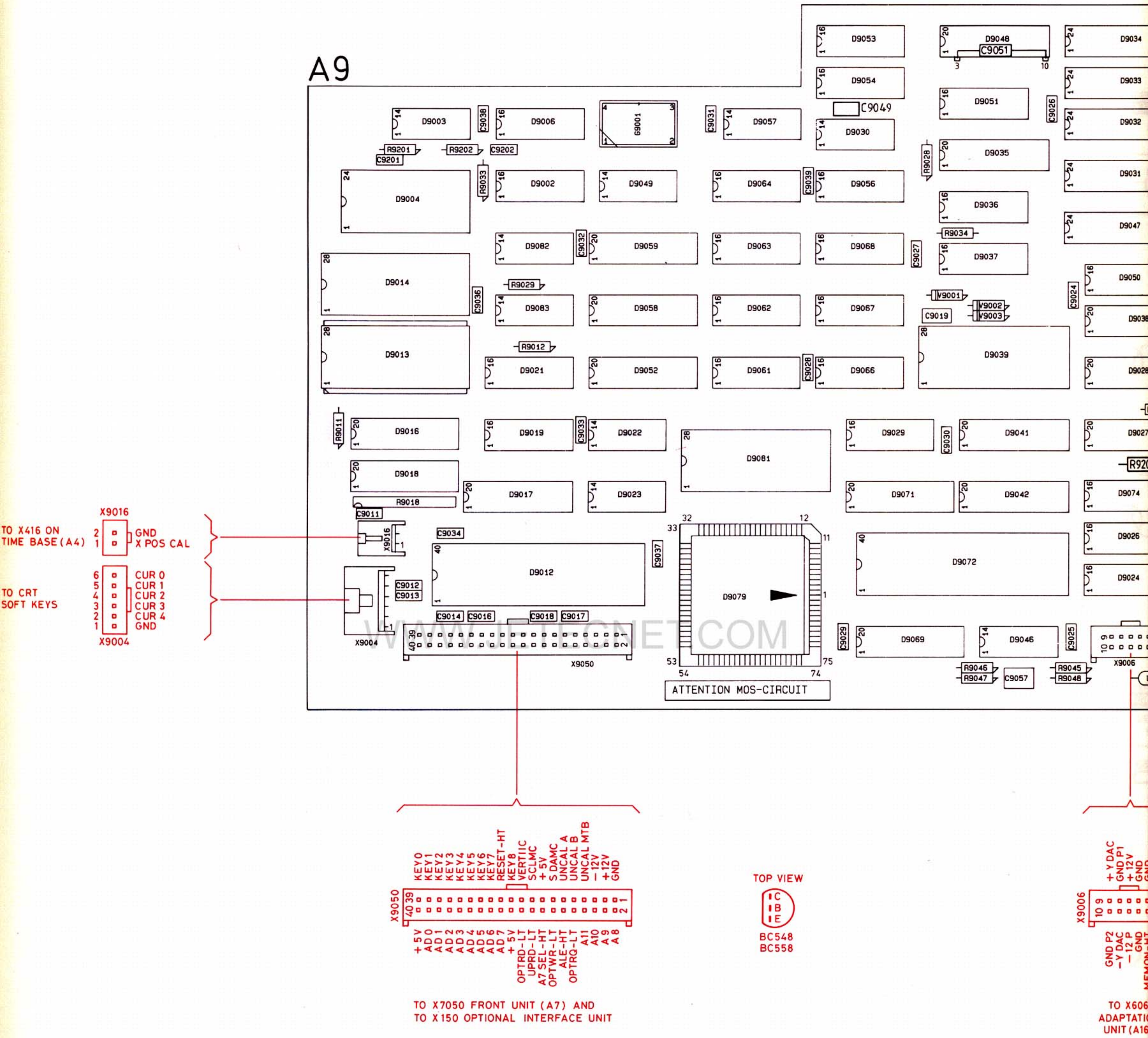


Figure 11.6 Digita

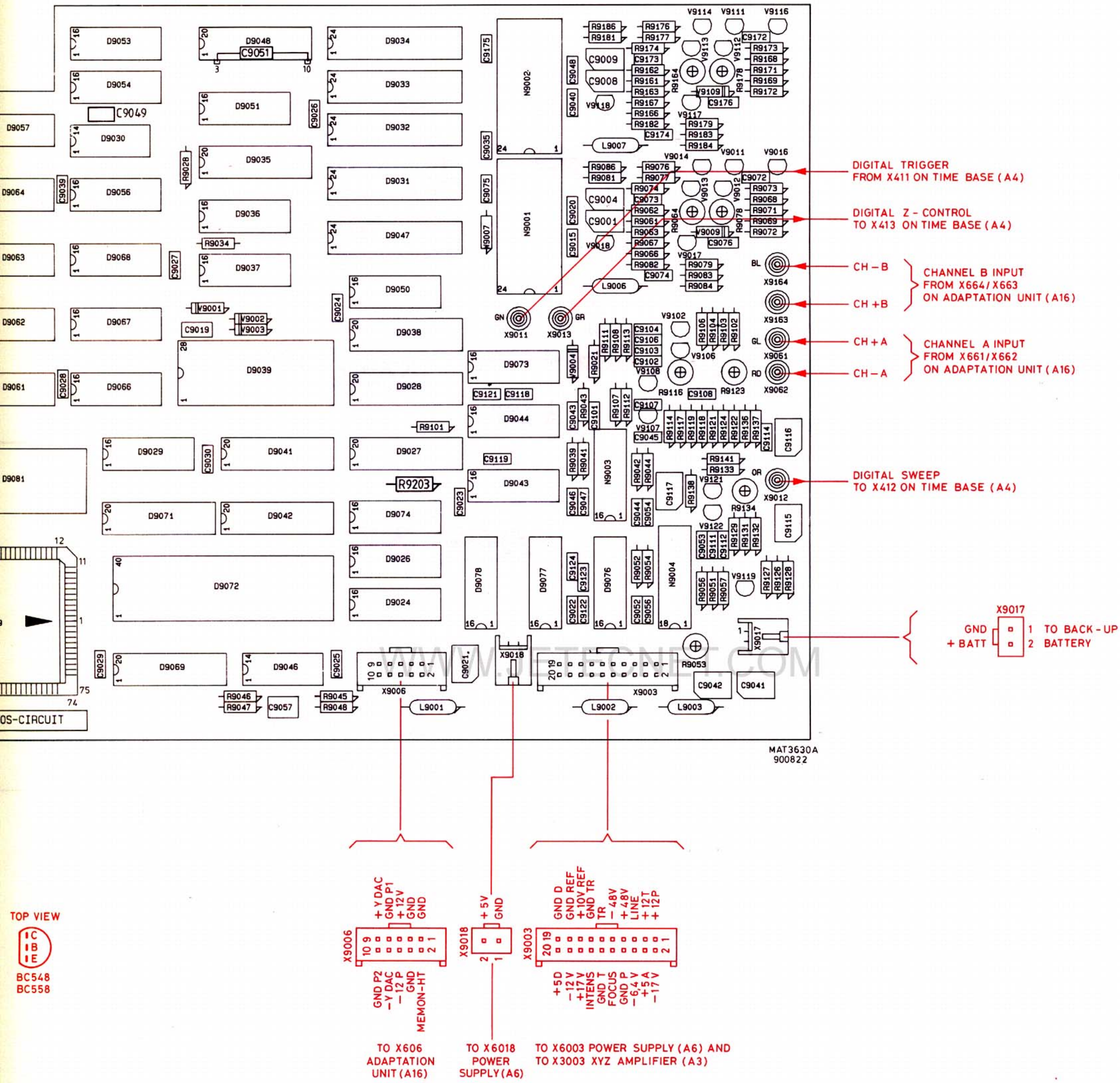
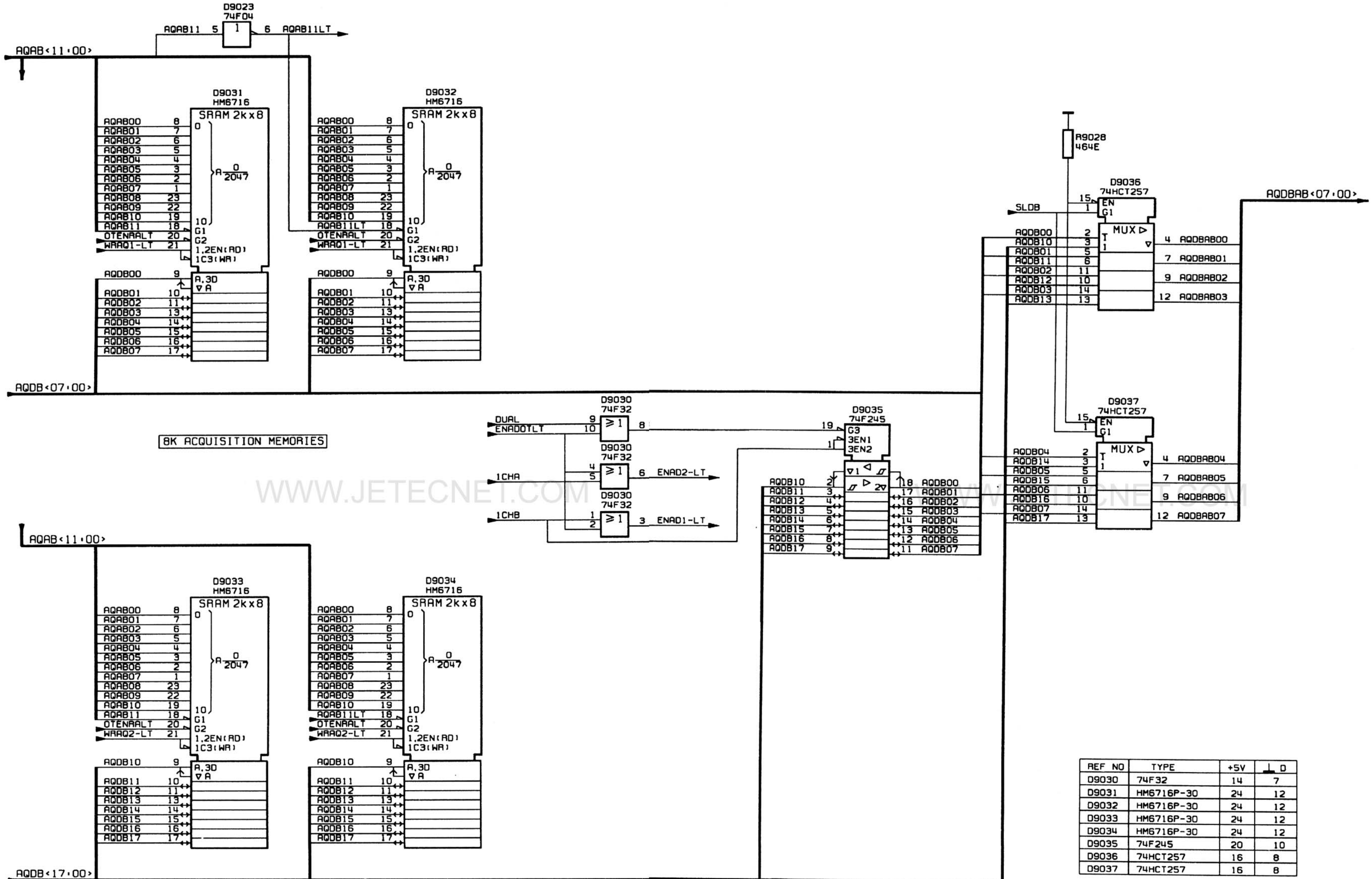


Figure 11.6 Digital unit, p.c.b. lay-out



REF NO	TYPE	+5V	⊥ D
D9030	74F32	14	7
D9031	HM6716P-30	24	12
D9032	HM6716P-30	24	12
D9033	HM6716P-30	24	12
D9034	HM6716P-30	24	12
D9035	74F245	20	10
D9036	74HCT257	16	8
D9037	74HCT257	16	8

MAT 3946

Figure 11.7 Circuit diagram of acquisition memories

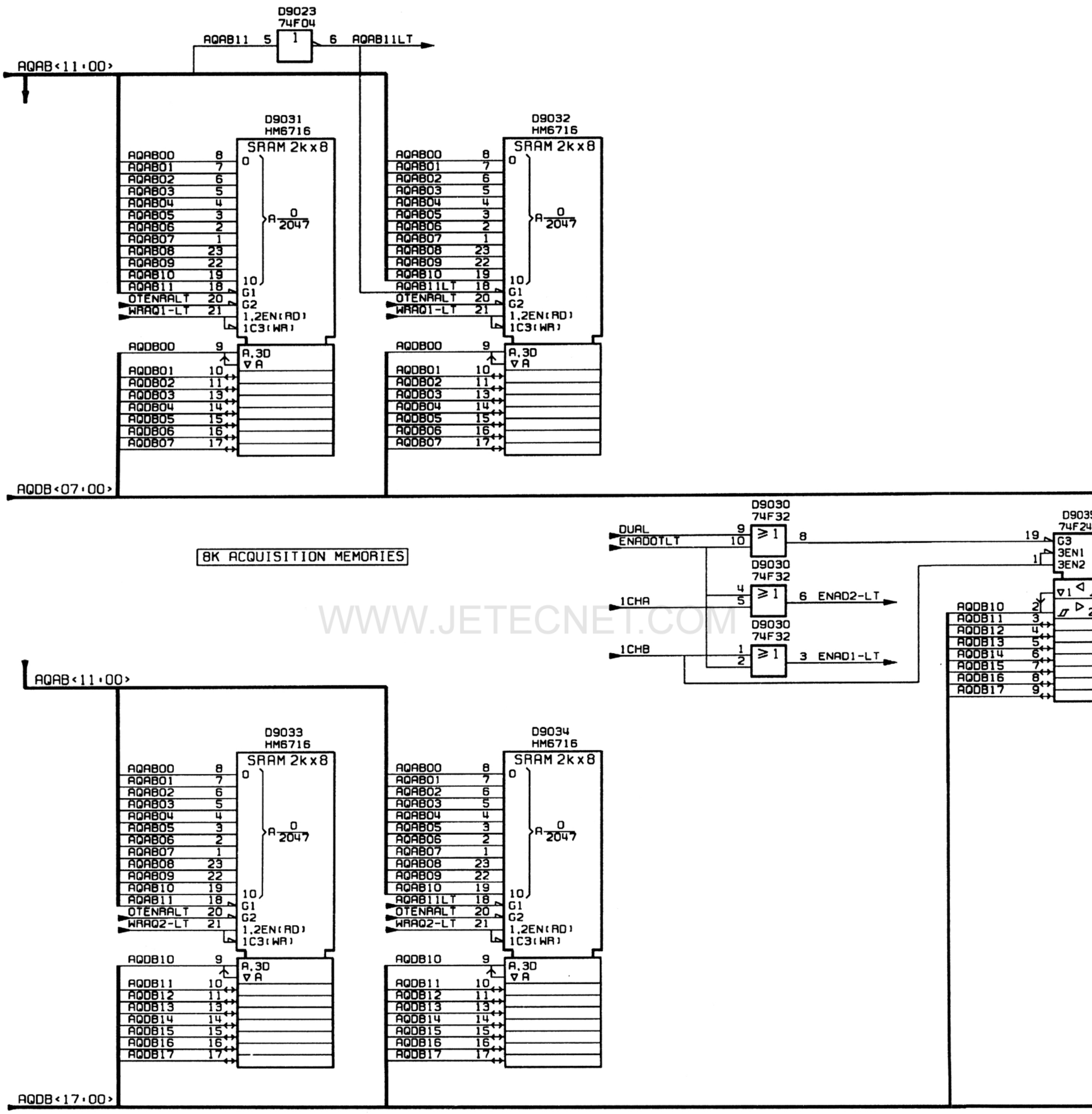
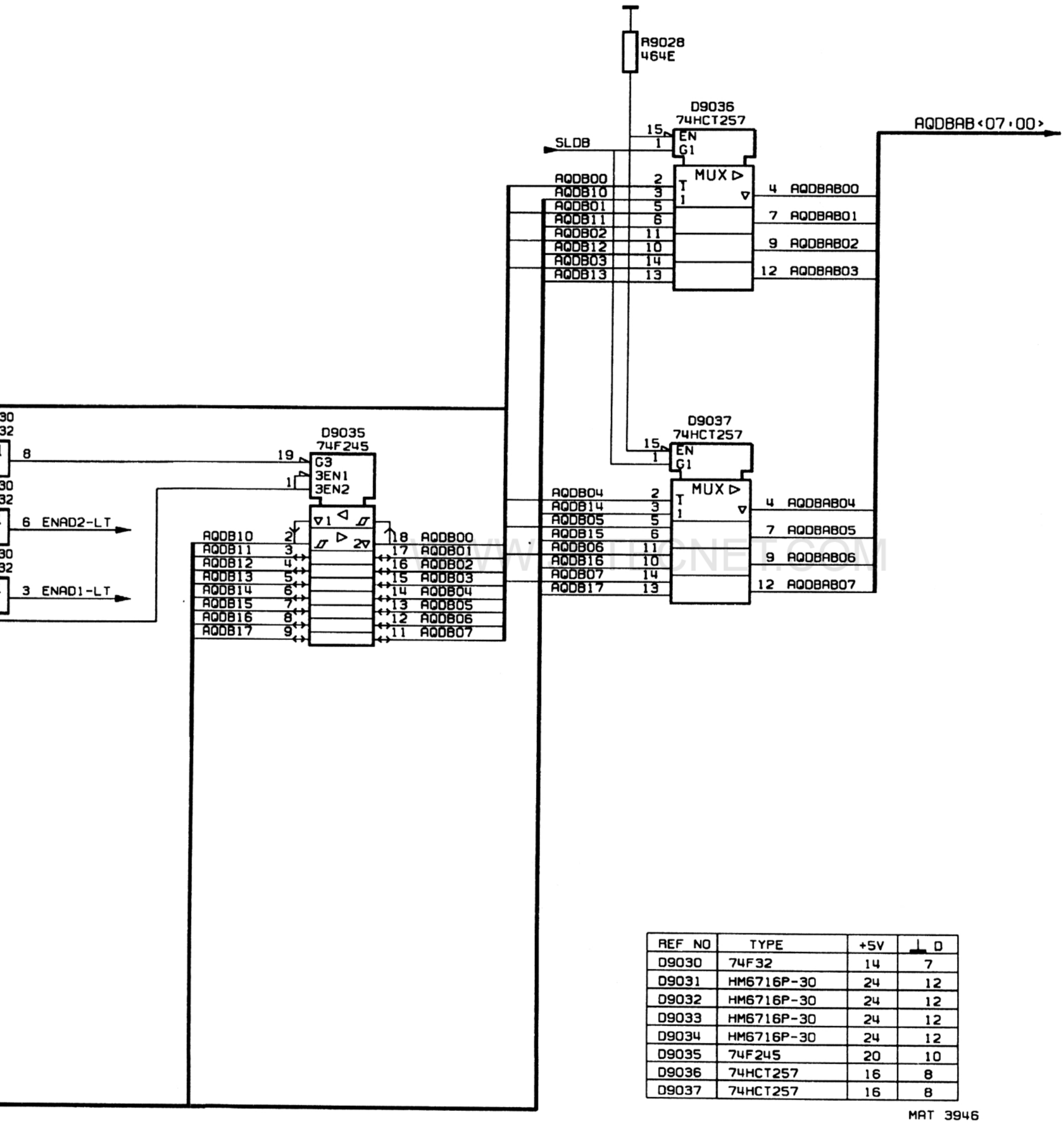


Figure 11.7 Circuit diagram of acquisition memories



REF NO	TYPE	+5V	⊥ D
D9030	74F32	14	7
D9031	HM6716P-30	24	12
D9032	HM6716P-30	24	12
D9033	HM6716P-30	24	12
D9034	HM6716P-30	24	12
D9035	74F245	20	10
D9036	74HCT257	16	8
D9037	74HCT257	16	8

MAT 3946

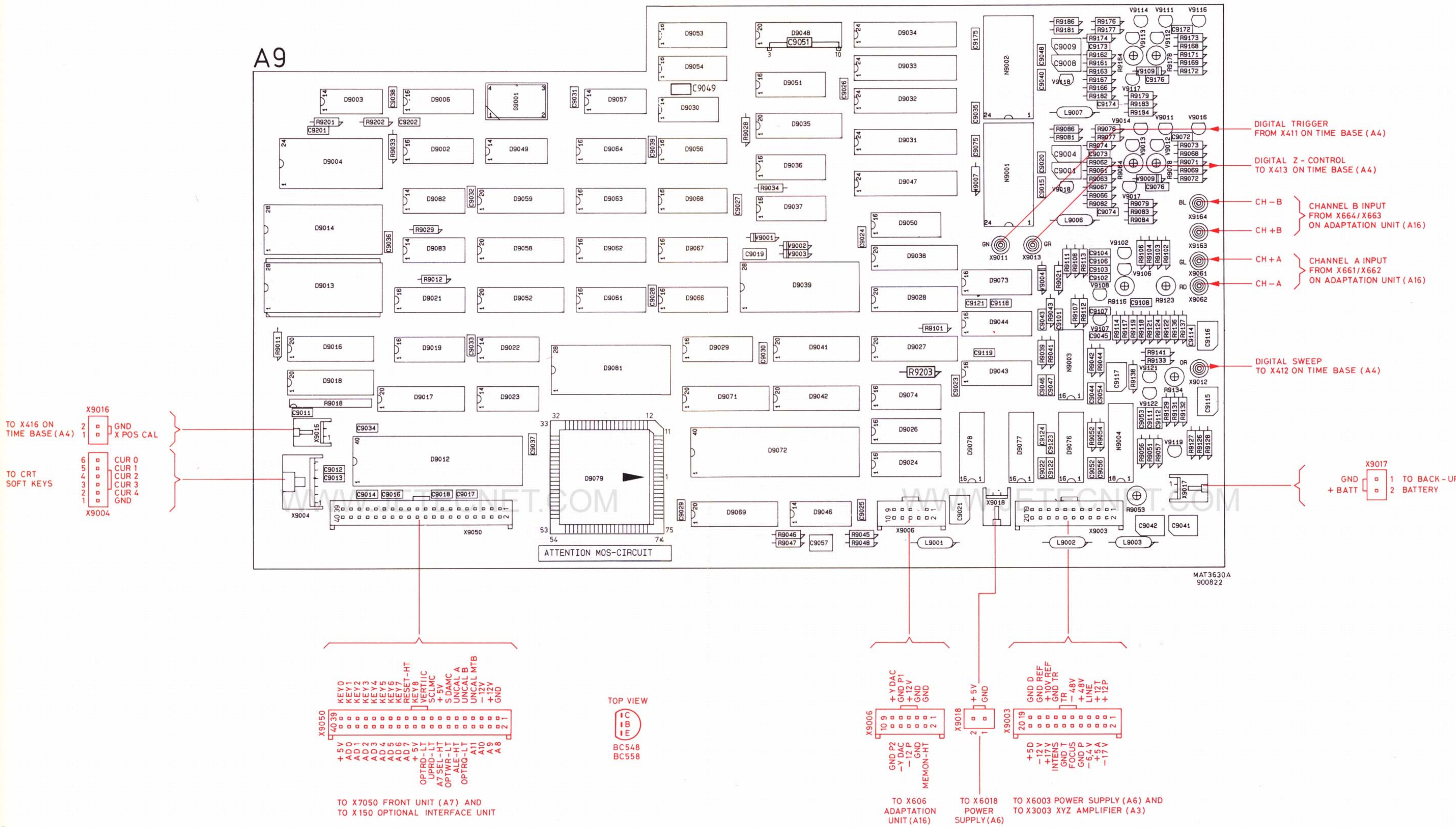


Figure 11.8 Digital unit, p.c.b. lay-out

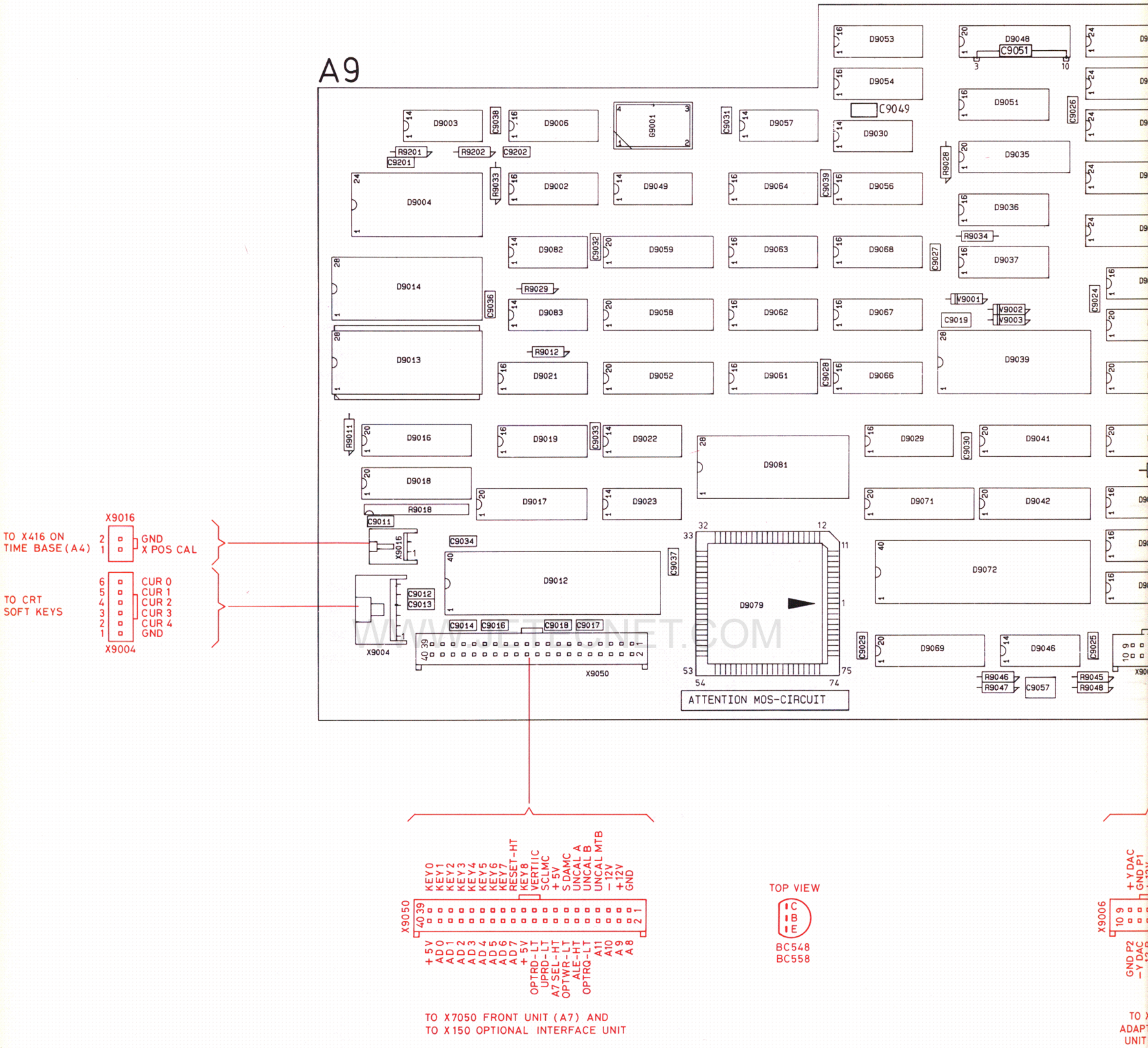


Figure 11.8 Dig

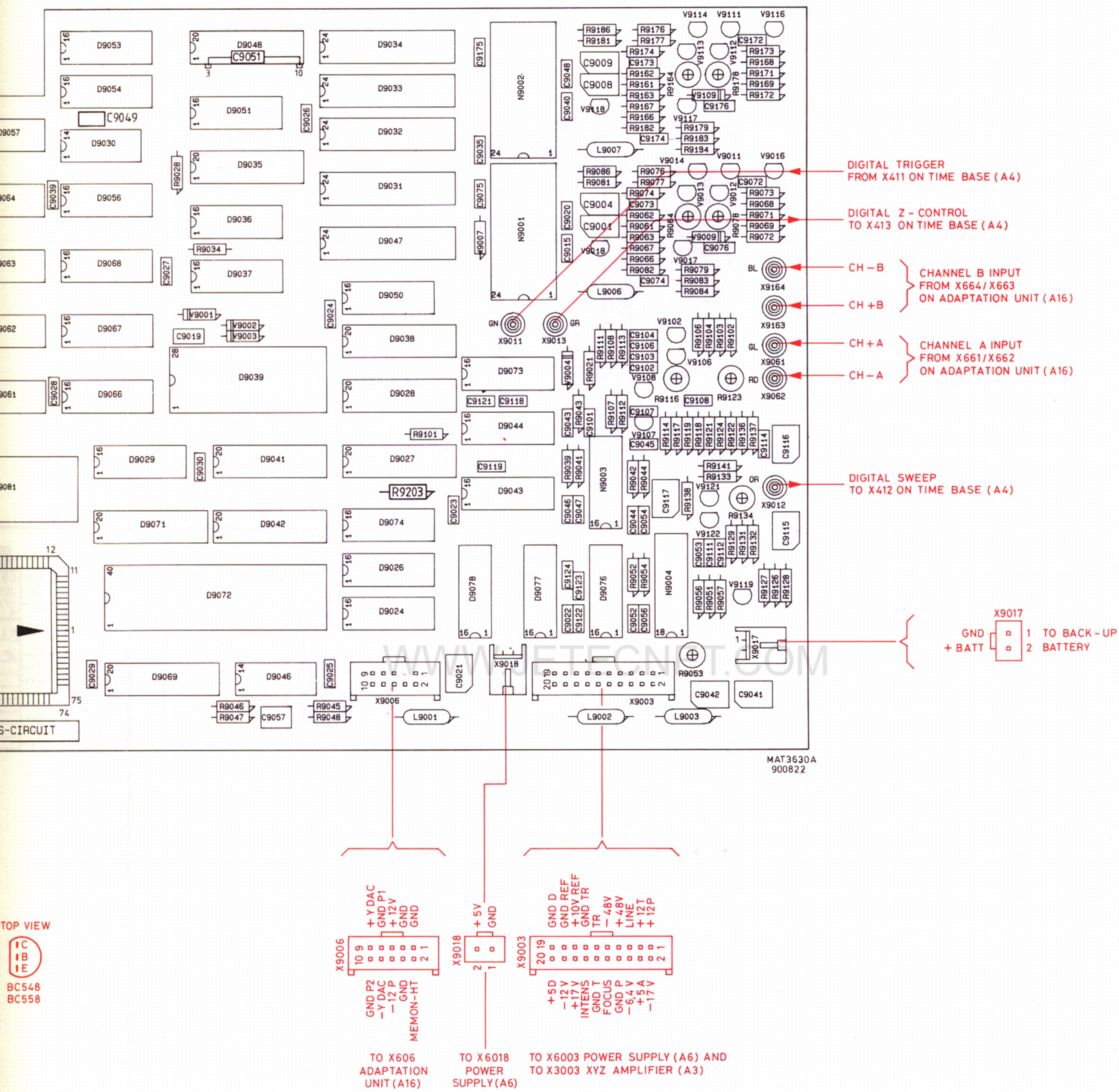
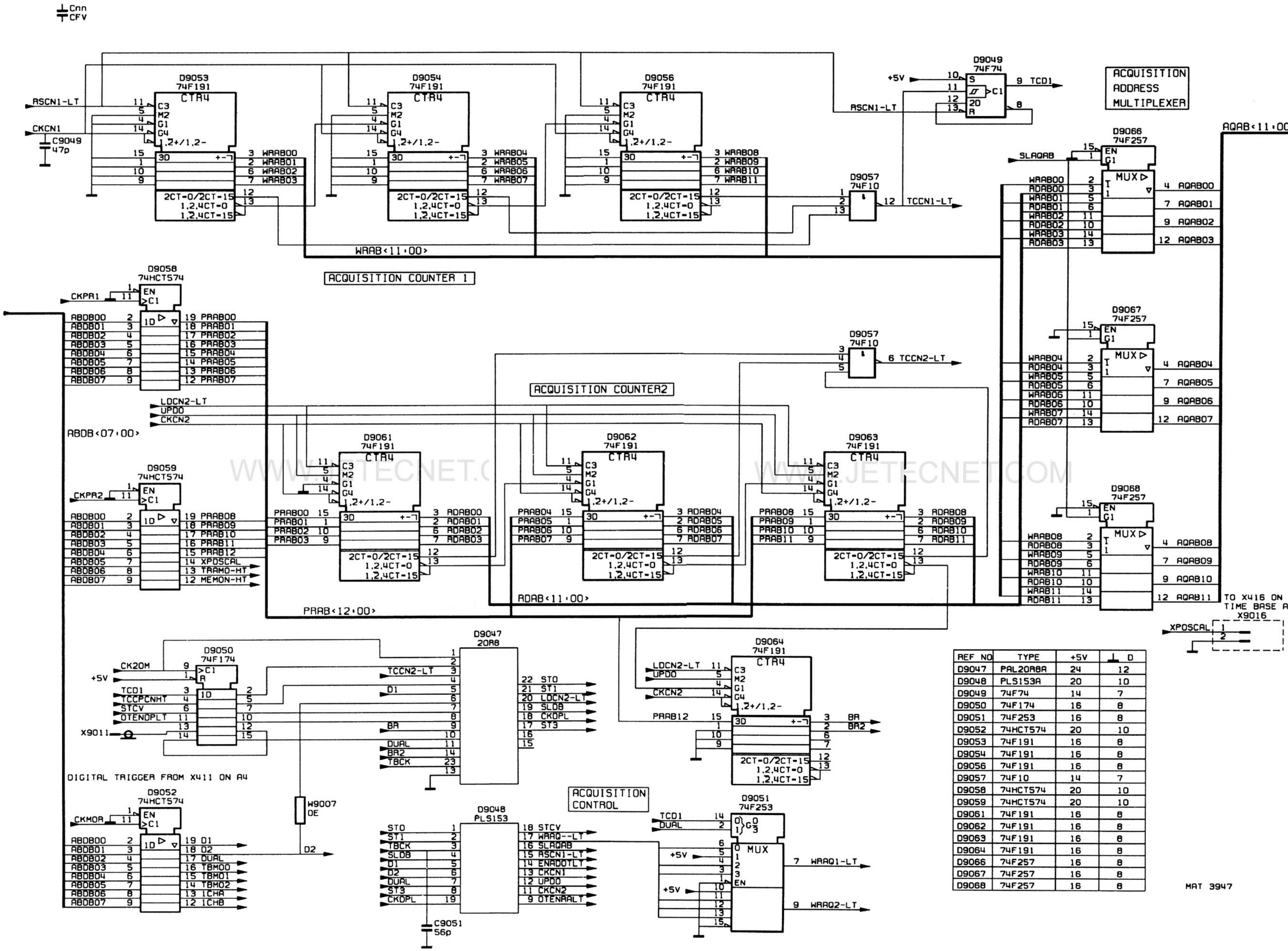


Figure 11.8 Digital unit, p.c.b. lay-out



REF NO	TYPE	+5V	⊥ D
D9047	PAL20R8A	24	12
D9048	PLS153A	20	10
D9049	74F74	14	7
D9050	74F174	16	8
D9051	74F253	16	8
D9052	74HCT574	20	10
D9053	74F191	16	8
D9054	74F191	16	8
D9056	74F191	16	8
D9057	74F10	14	7
D9058	74HCT574	20	10
D9059	74HCT574	20	10
D9061	74F191	16	8
D9062	74F191	16	8
D9063	74F191	16	8
D9064	74F191	16	8
D9066	74F257	16	8
D9067	74F257	16	8
D9068	74F257	16	8

Figure 11.9 Circuit diagram of acquisition control logic

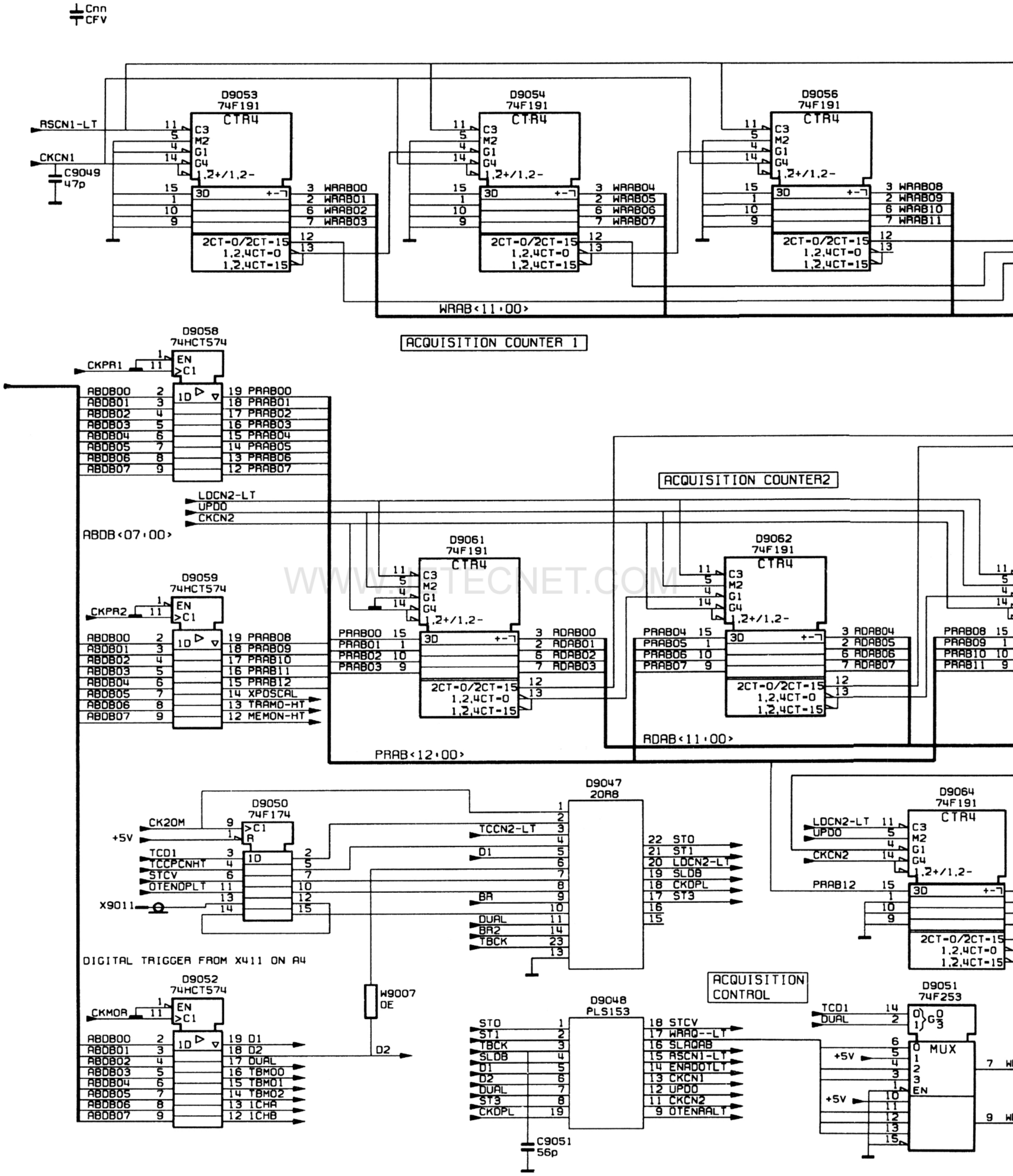
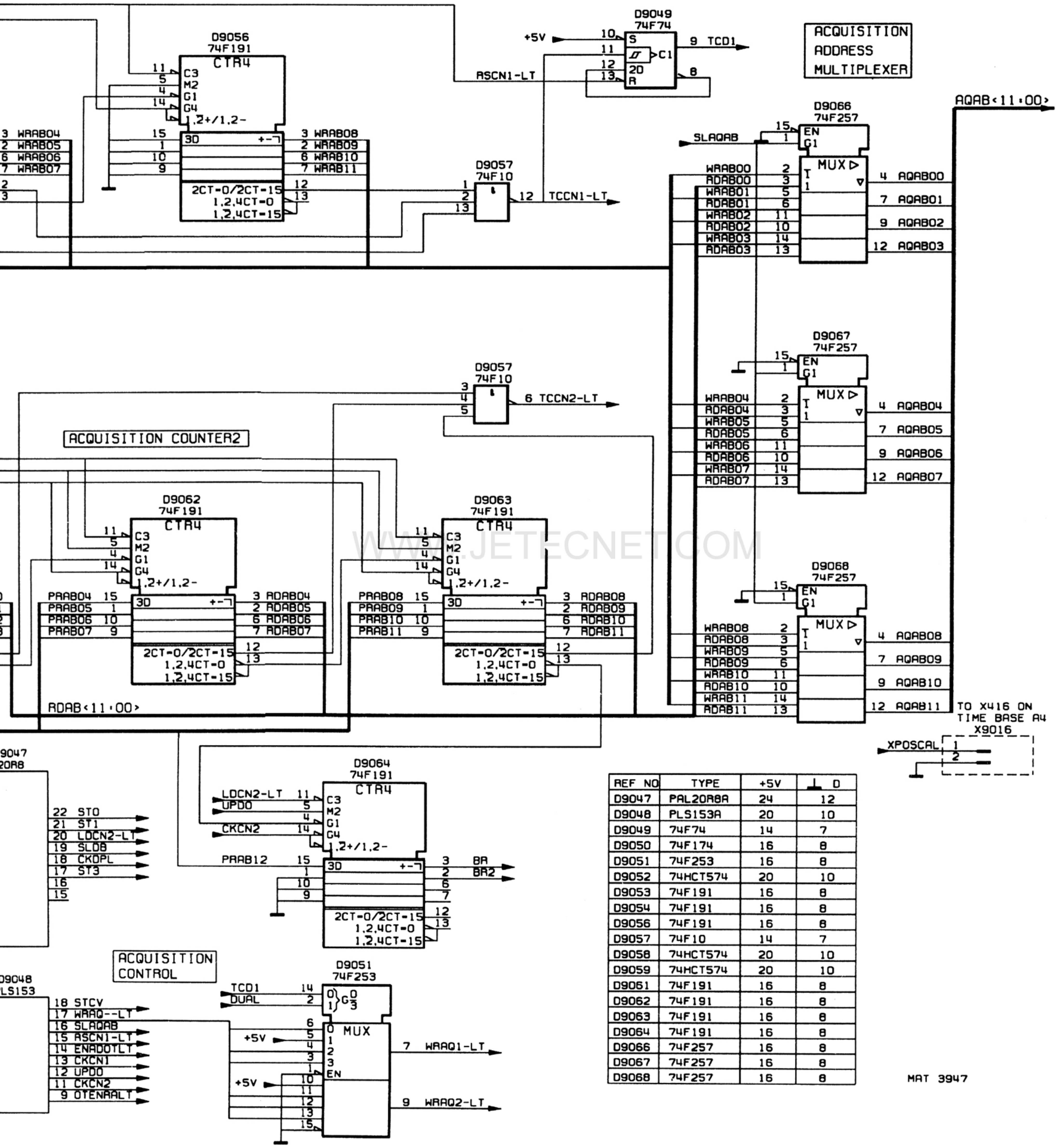


Figure 11.9 Circuit diagram of acquisition control logic



REF NO	TYPE	+5V	⊥ D
D9047	PAL20R8A	24	12
D9048	PLS153A	20	10
D9049	74F74	14	7
D9050	74F174	16	8
D9051	74F253	16	8
D9052	74HCT574	20	10
D9053	74F191	16	8
D9054	74F191	16	8
D9056	74F191	16	8
D9057	74F10	14	7
D9058	74HCT574	20	10
D9059	74HCT574	20	10
D9061	74F191	16	8
D9062	74F191	16	8
D9063	74F191	16	8
D9064	74F191	16	8
D9066	74F257	16	8
D9067	74F257	16	8
D9068	74F257	16	8

MAT 3947

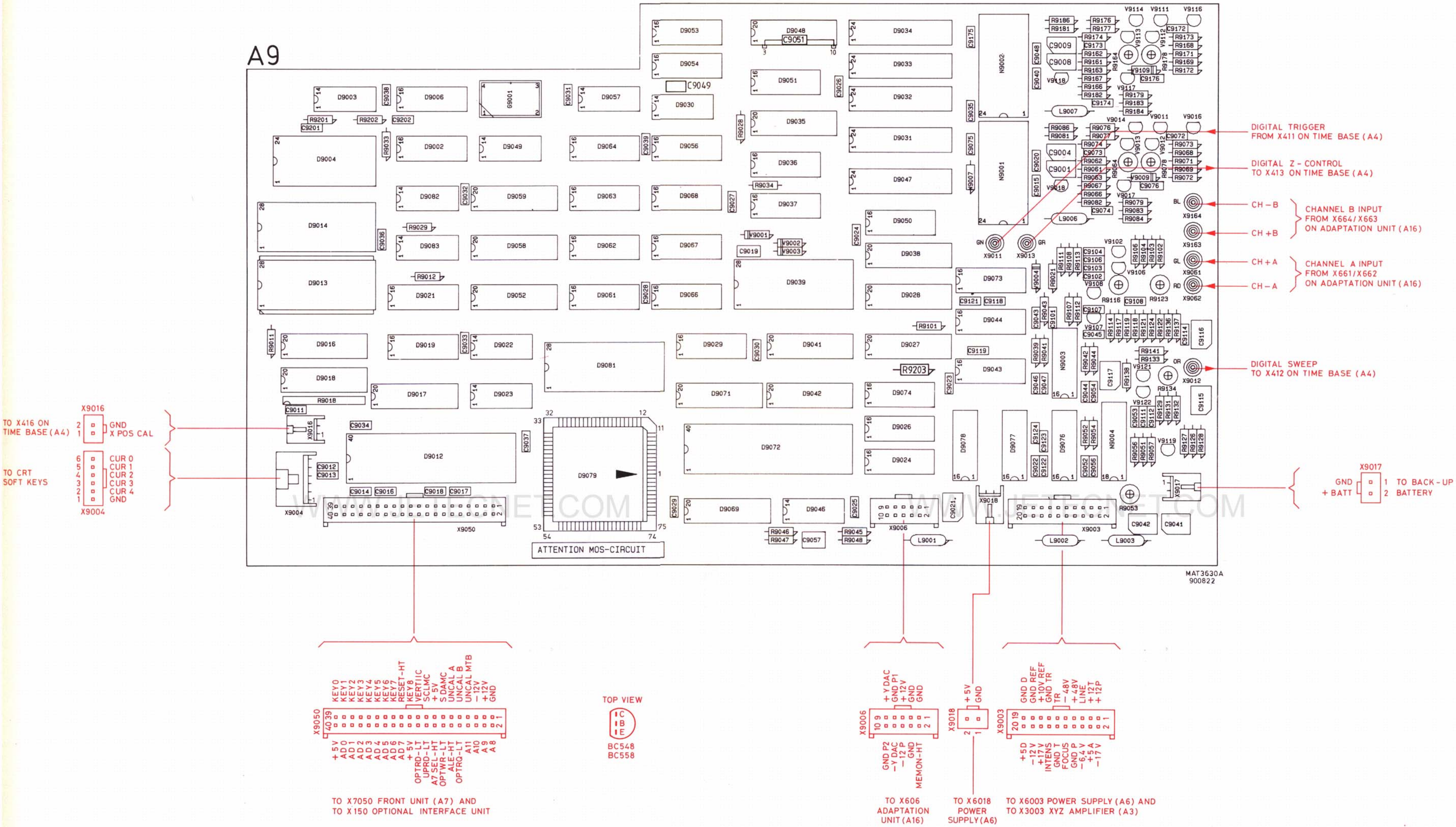


Figure 11.10 Digital unit, p.c.b. lay-out

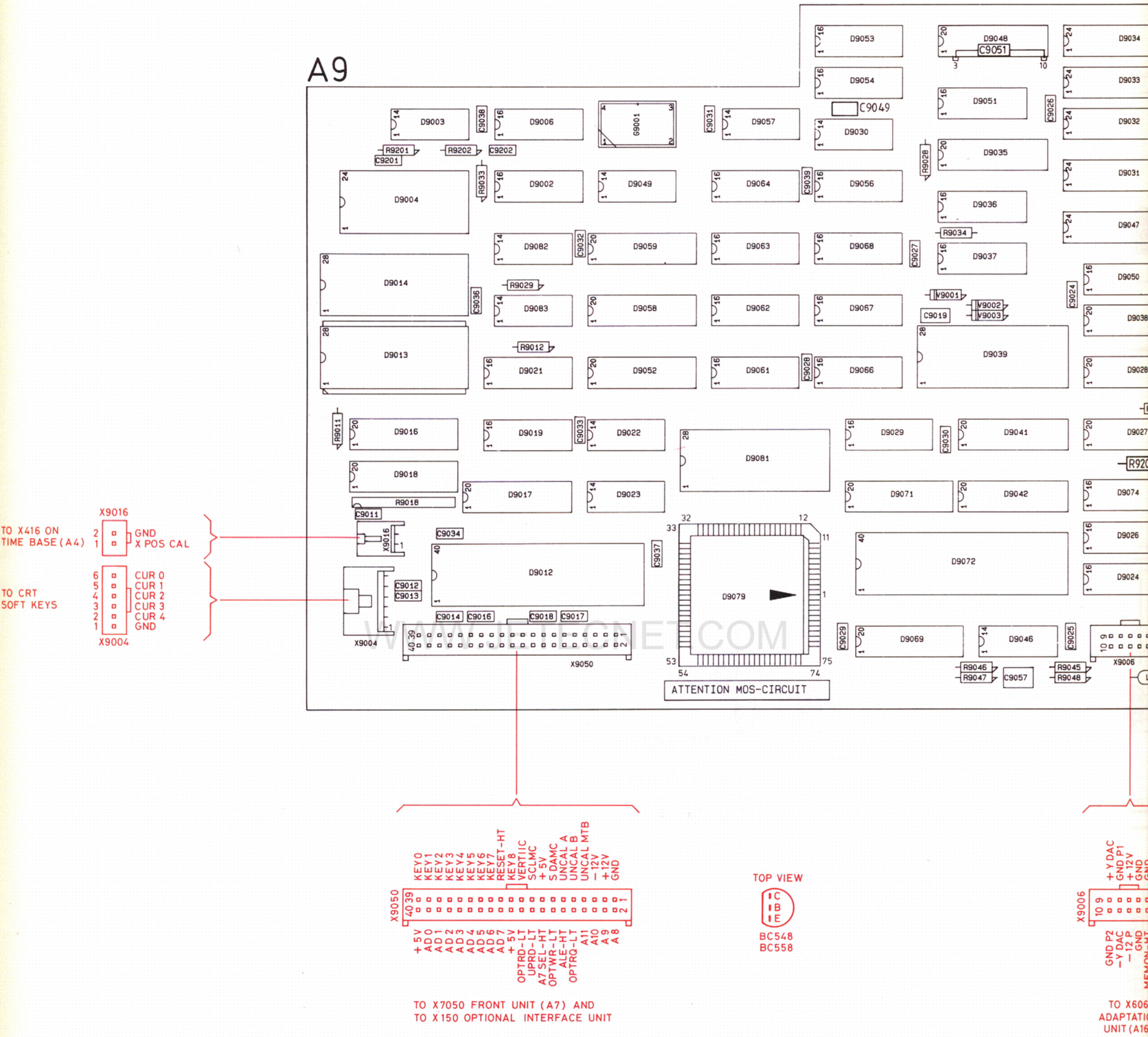


Figure 11.10 Dig

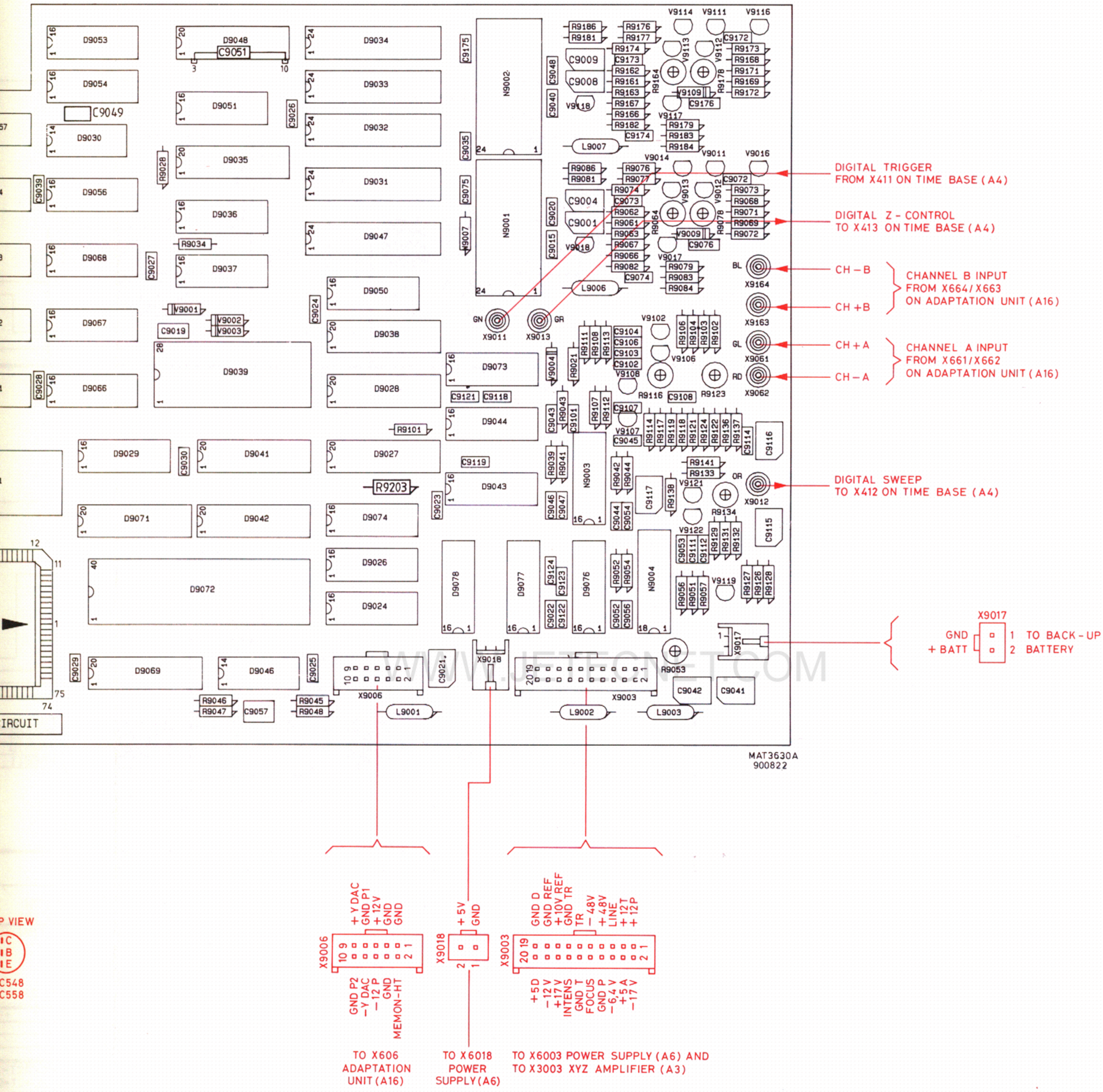
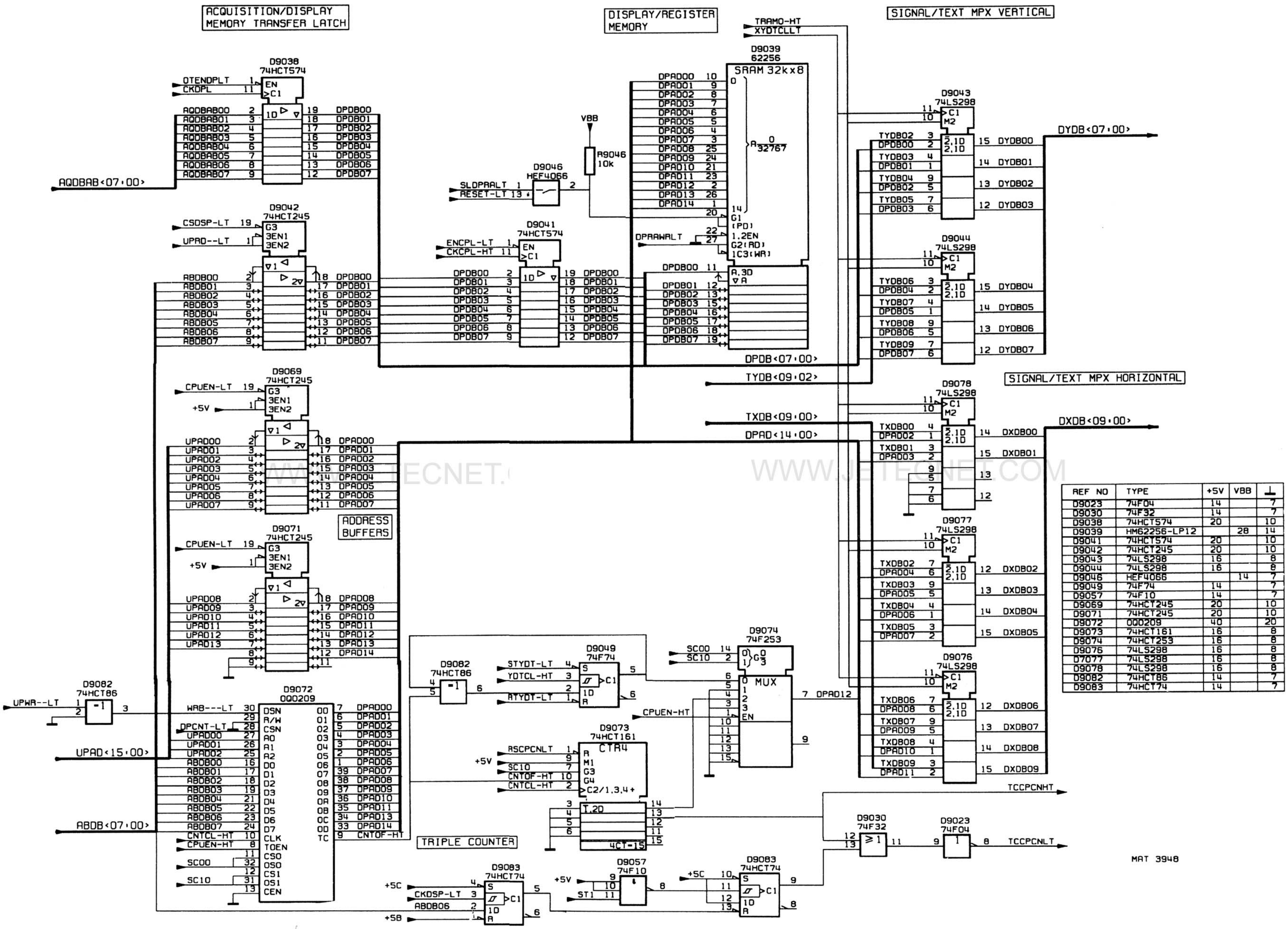


Figure 11.10 Digital unit, p.c.b. lay-out



REF NO	TYPE	+5V	VBB	⊥
D9023	74F04	14		7
D9030	74F32	14		7
D9038	74HCT574	20		10
D9039	HM62256-LP12		28	14
D9041	74HCT574	20		10
D9042	74HCT245	20		10
D9043	74LS298	16		8
D9044	74LS298	16		8
D9046	HEF4066		14	7
D9049	74F74	14		7
D9057	74F10	14		7
D9069	74HCT245	20		10
D9071	74HCT245	20		10
D9072	0Q0209	40		20
D9073	74HCT161	16		8
D9074	74HCT253	16		8
D9076	74LS298	16		8
D7077	74LS298	16		8
D9078	74LS298	16		8
D9082	74HCT86	14		7
D9083	74HCT74	14		7

Figure 11.11 Circuit diagram of display logic

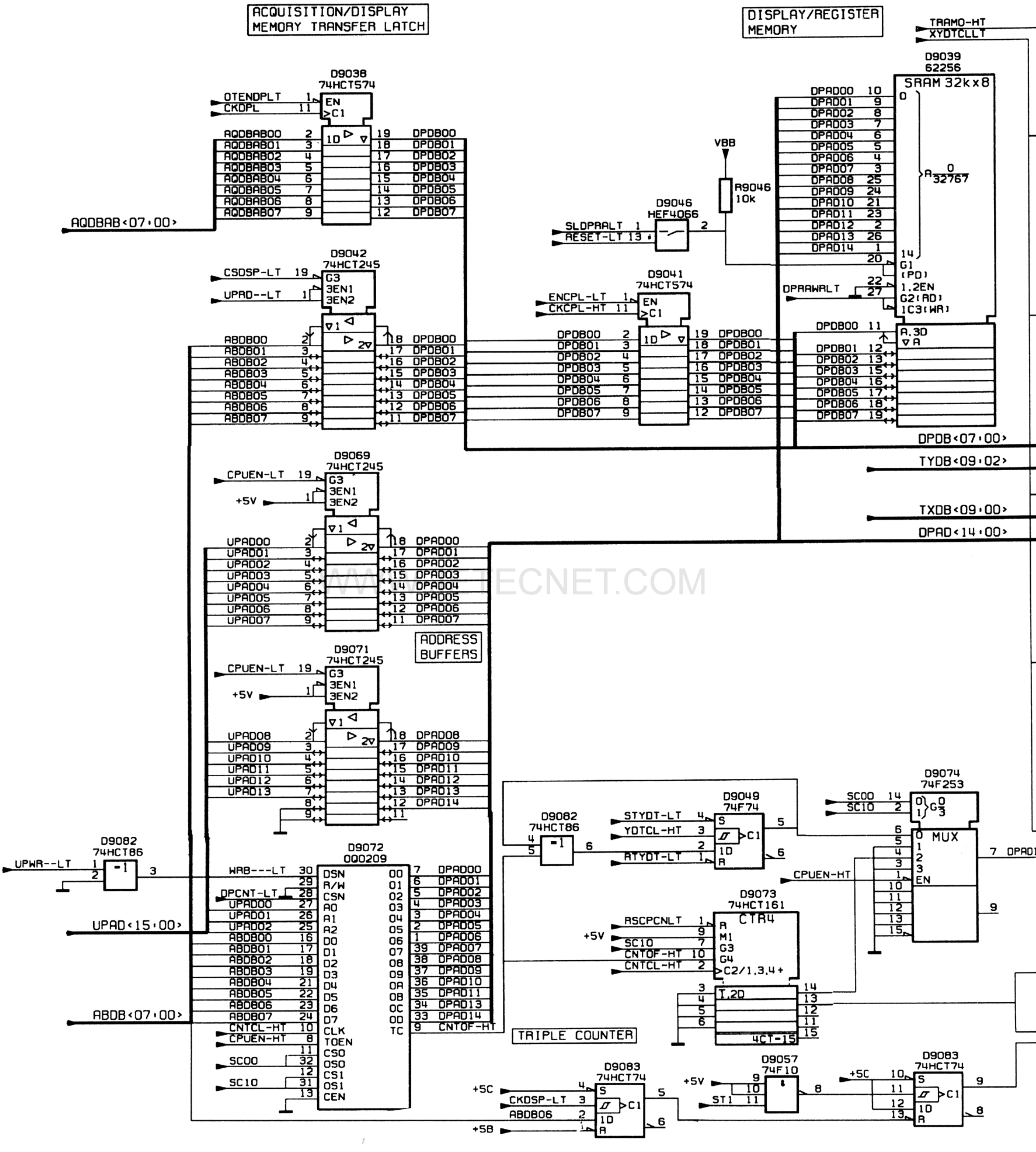
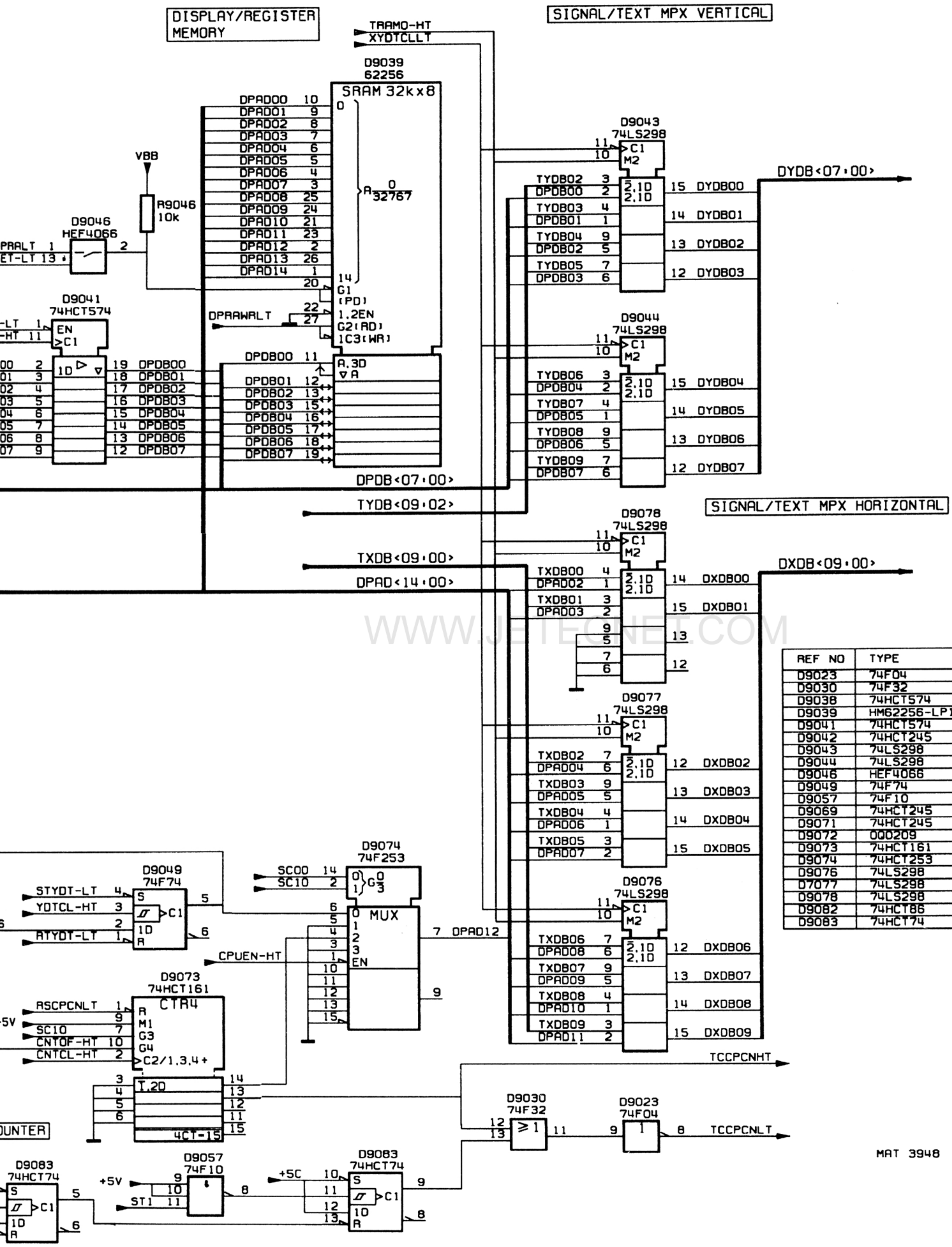


Figure 11.11 Circuit diagram of display logic



REF NO	TYPE	+5V	VBB	⊥
D9023	74F04	14		7
D9030	74F32	14		7
D9038	74HCT574	20		10
D9039	HM62256-LP12		28	14
D9041	74HCT574	20		10
D9042	74HCT245	20		10
D9043	74LS298	16		8
D9044	74LS298	16		8
D9046	HEF4066		14	7
D9049	74F74	14		7
D9057	74F10	14		7
D9069	74HCT245	20		10
D9071	74HCT245	20		10
D9072	0Q0209	40		20
D9073	74HCT161	16		8
D9074	74HCT253	16		8
D9076	74LS298	16		8
D7077	74LS298	16		8
D9078	74LS298	16		8
D9082	74HCT86	14		7
D9083	74HCT74	14		7

MAT 3948

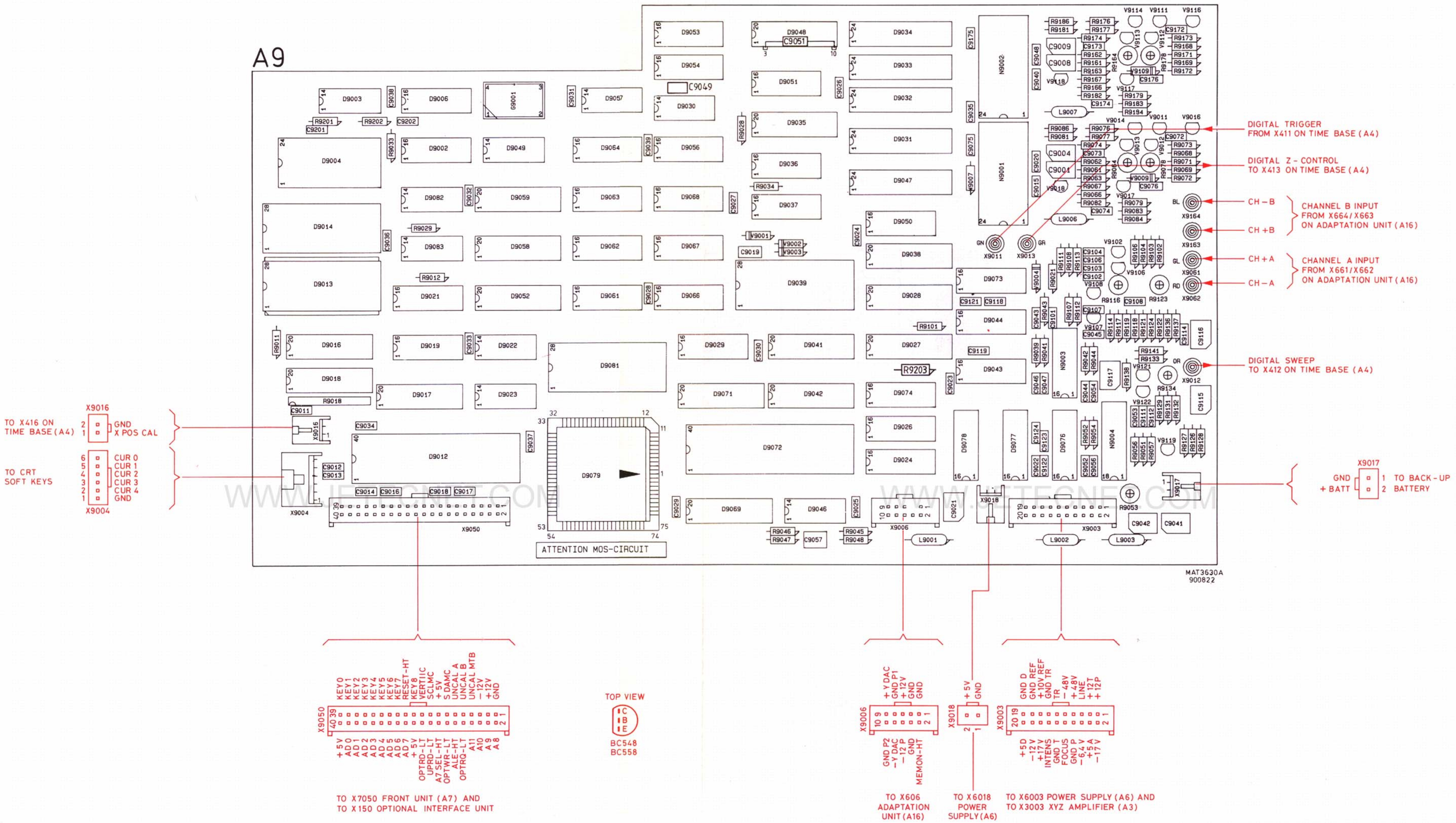


Figure 11.12 Digital unit, p.c.b. lay-out

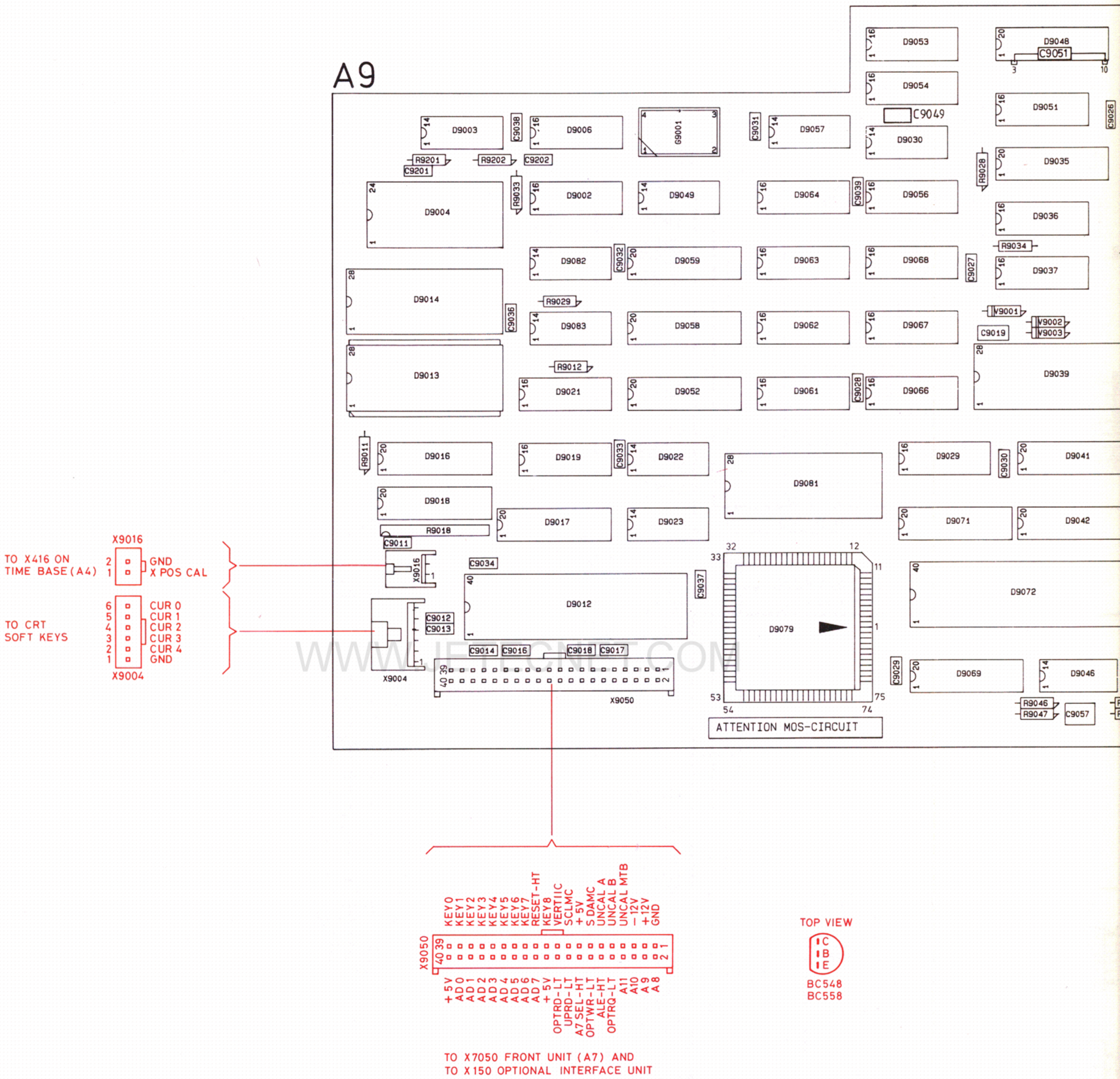

A9
TO X416 ON
TIME BASE (A4)
X9016
GND
X POS CAL
TO CRT
SOFT KEYS
CUR 0
CUR 1
CUR 2
CUR 3
CUR 4
GND
X9004
X9050
ATTENTION MOS-CIRCUIT
KEY0
KEY1
KEY2
KEY3
KEY4
KEY5
KEY6
KEY7
RESET-HT
KEY8
VERTIC
SCLMC
+5V
SDAMC
UNCAL A
UNCAL B
UNCAL MTB
-12V
+12V
GND
+5V
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
+5V
OPTRD-LT
UPRD-LT
A7SEL-HT
OPTWR-LT
ALE-HT
OPTRQ-LT
A11
A10
A9
A8
TO X7050 FRONT UNIT (A7) AND
TO X150 OPTIONAL INTERFACE UNIT
TOP VIEW
C
B
E
BC548
BC558

Figure 1

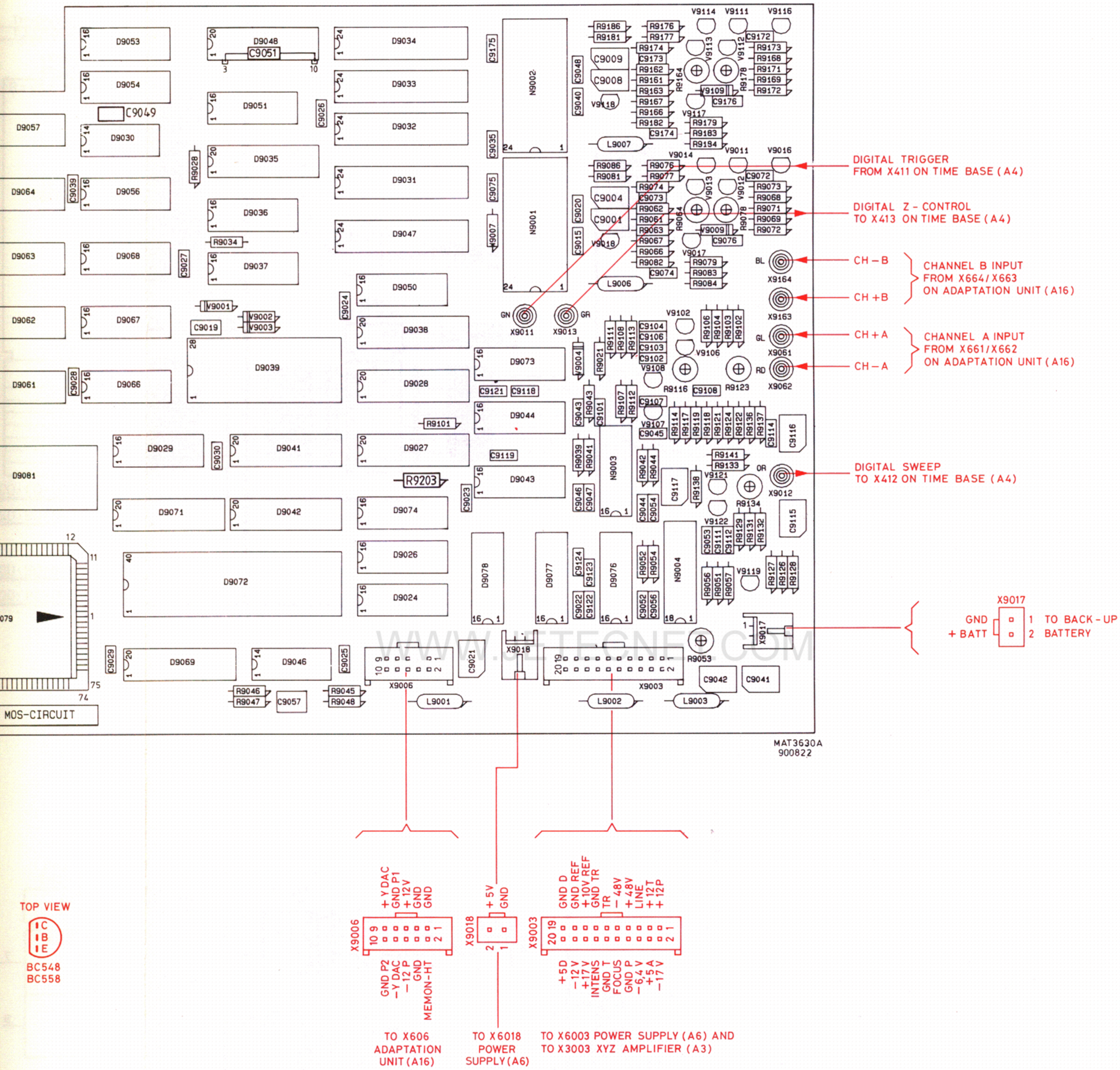
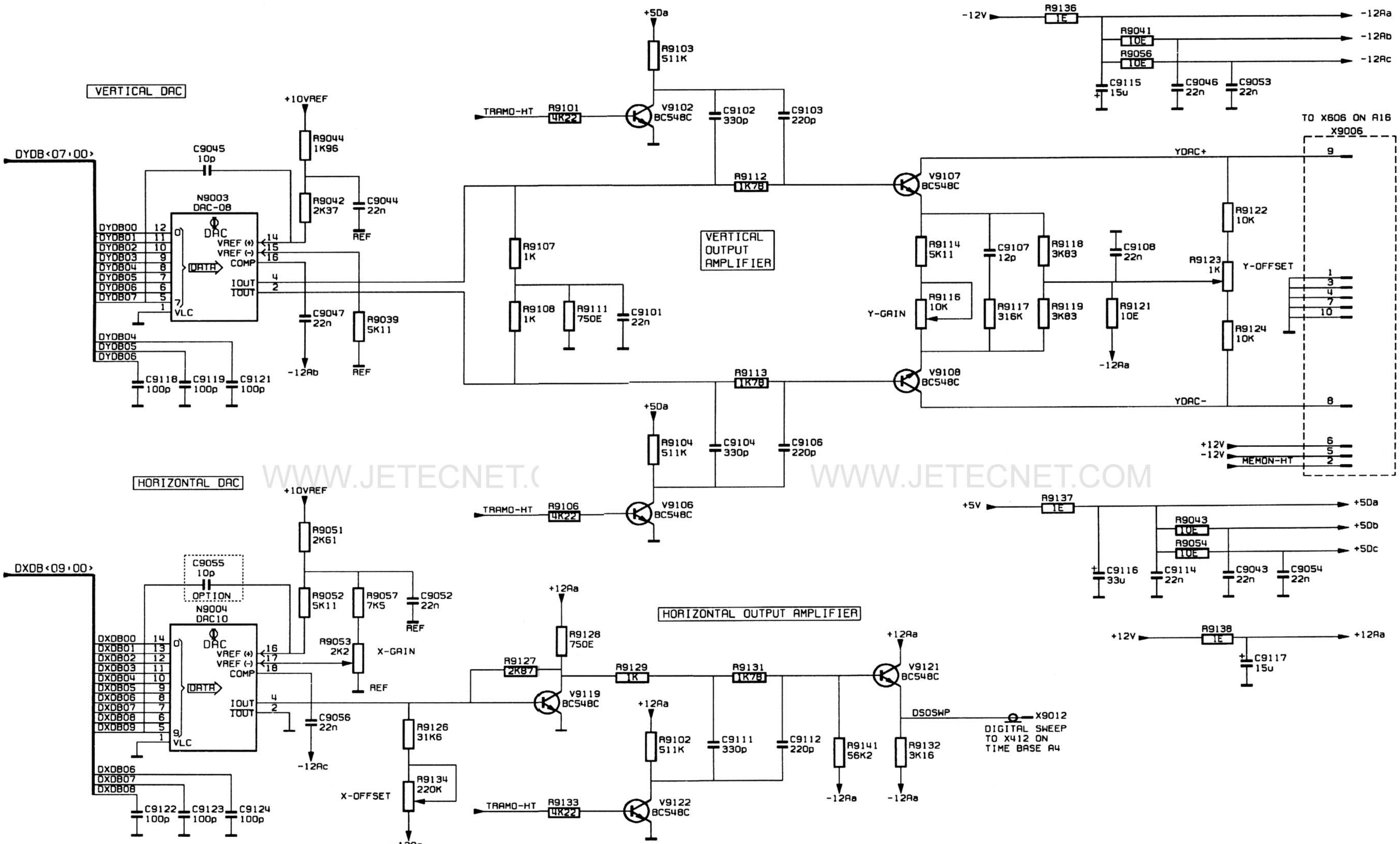


Figure 11.12 Digital unit, p.c.b. lay-out



REF NO	TYPE	+5Db	+5Dc	-12Ab	-12Ac
N9003	DAC08	13		3	
N9004	DAC10		15		3

MAT 3949

Figure 11.13 Circuit diagram of DAC-circuits

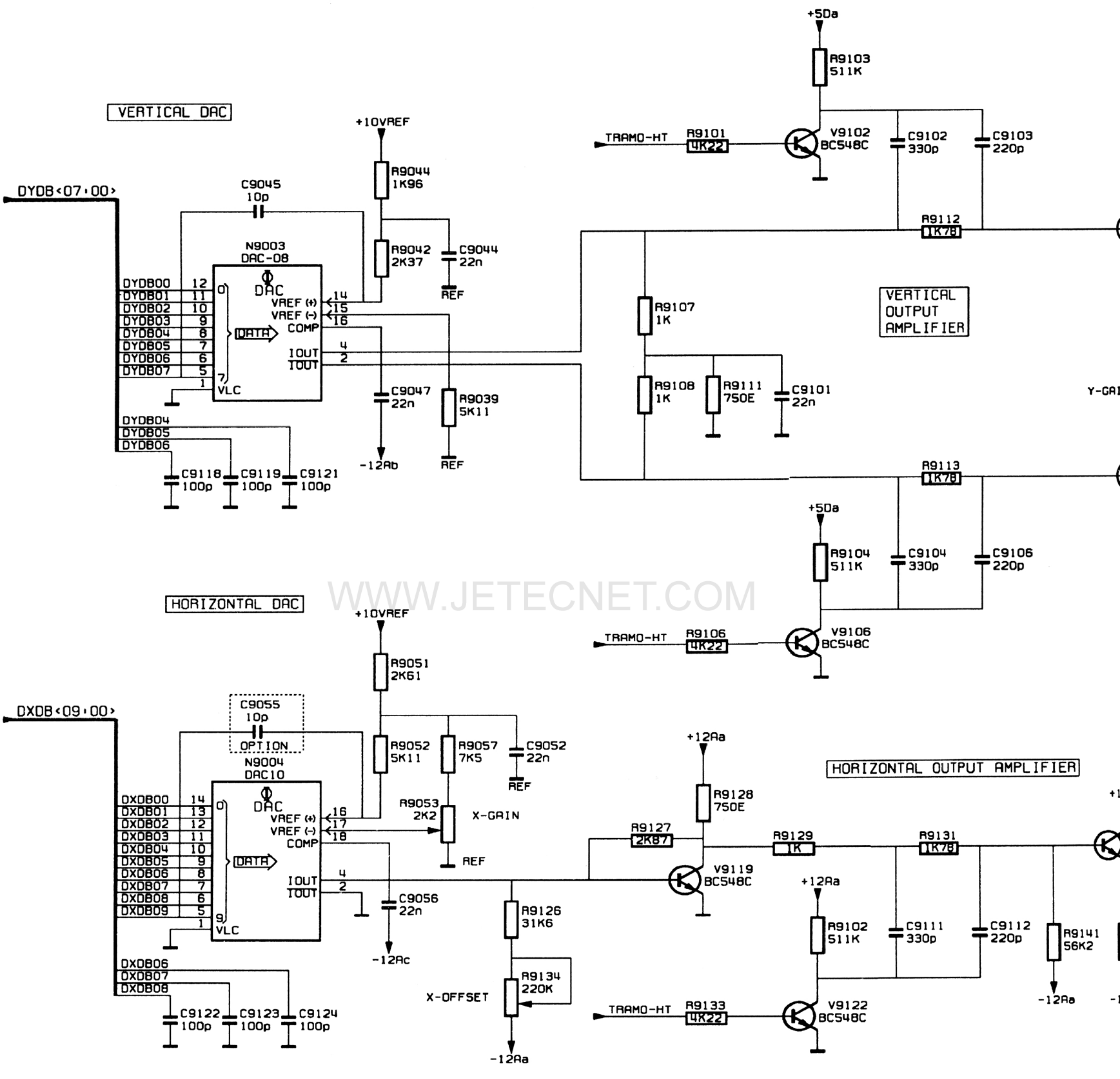
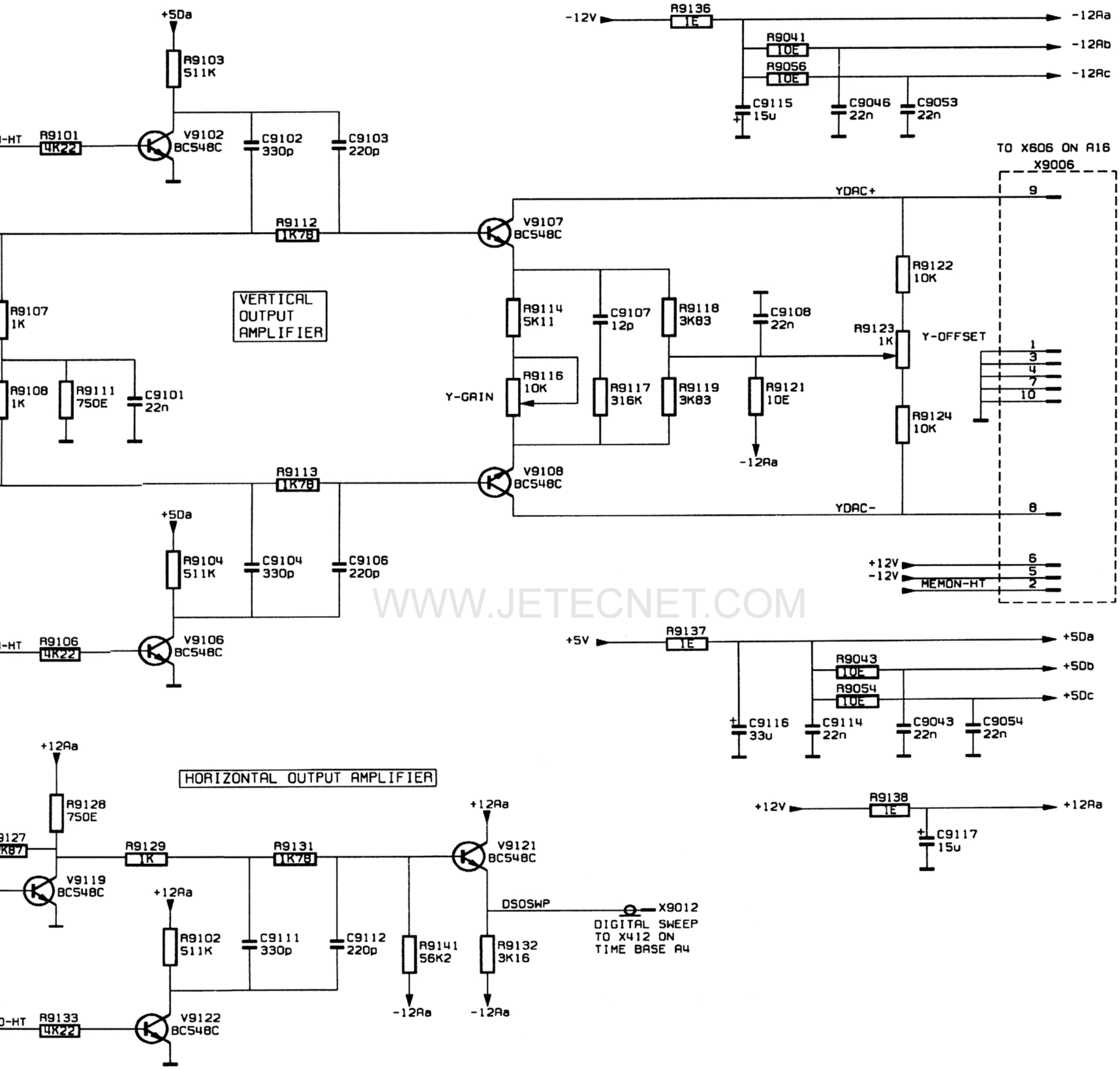


Figure 11.13 Circuit diagram of DAC-circuits



REF NO	TYPE	+5Db	+5Dc	-12Ab	-12Ac
N9003	DAC08	13		3	
N9004	DAC10		15		3

MAT 3949

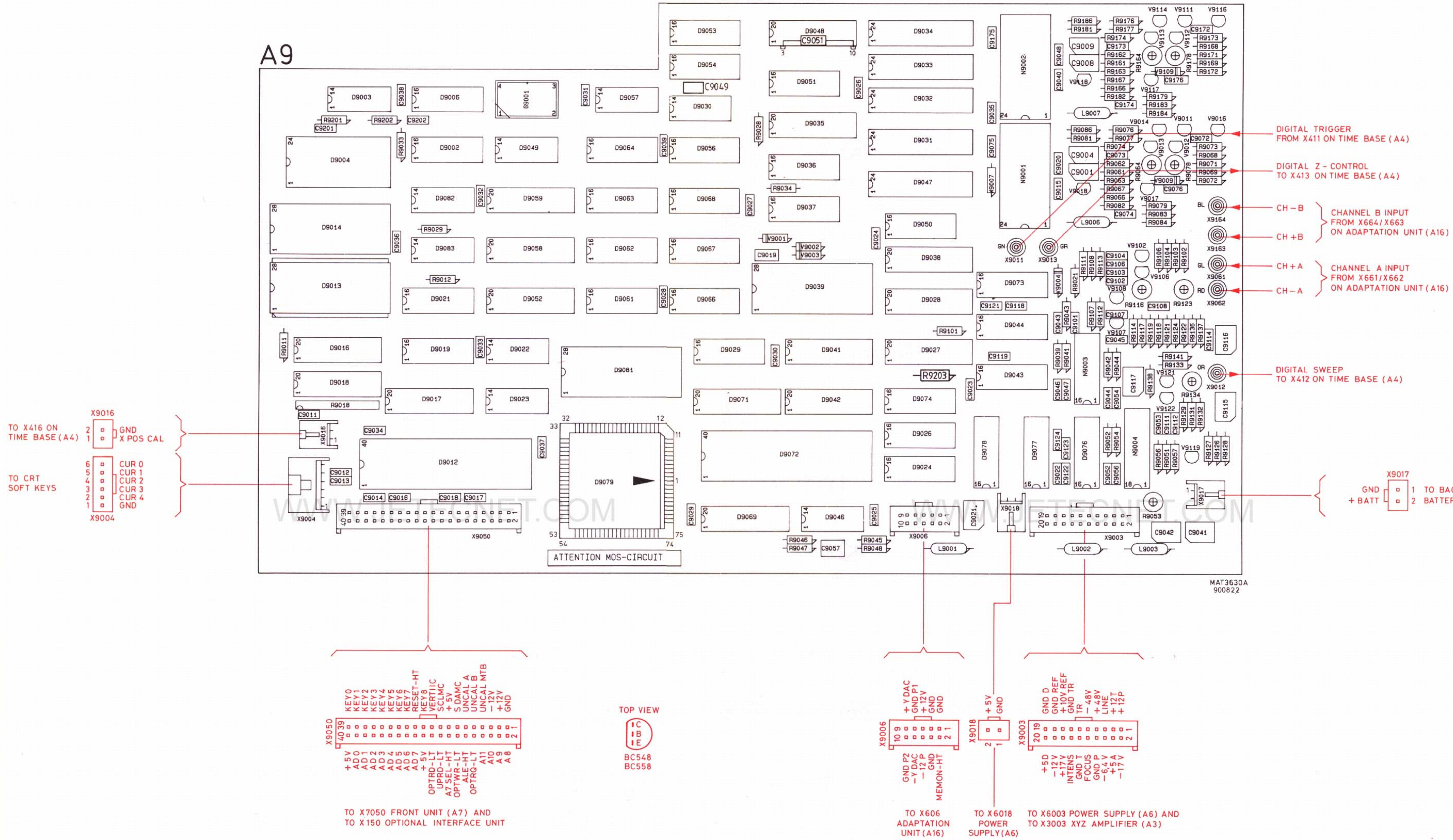


Figure 11.14 Digital unit, p.c.b. lay-out

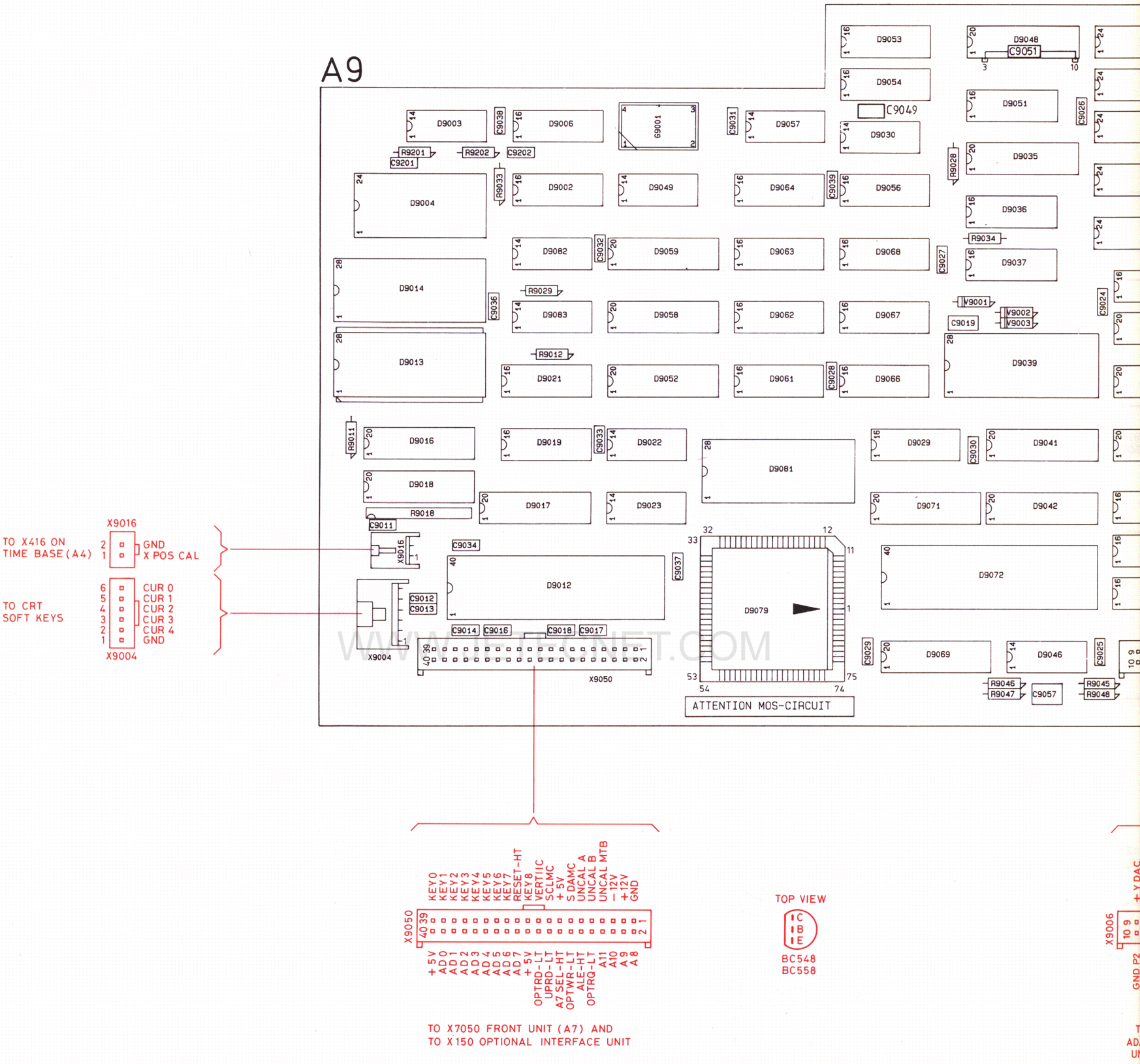


Figure 11.14 D

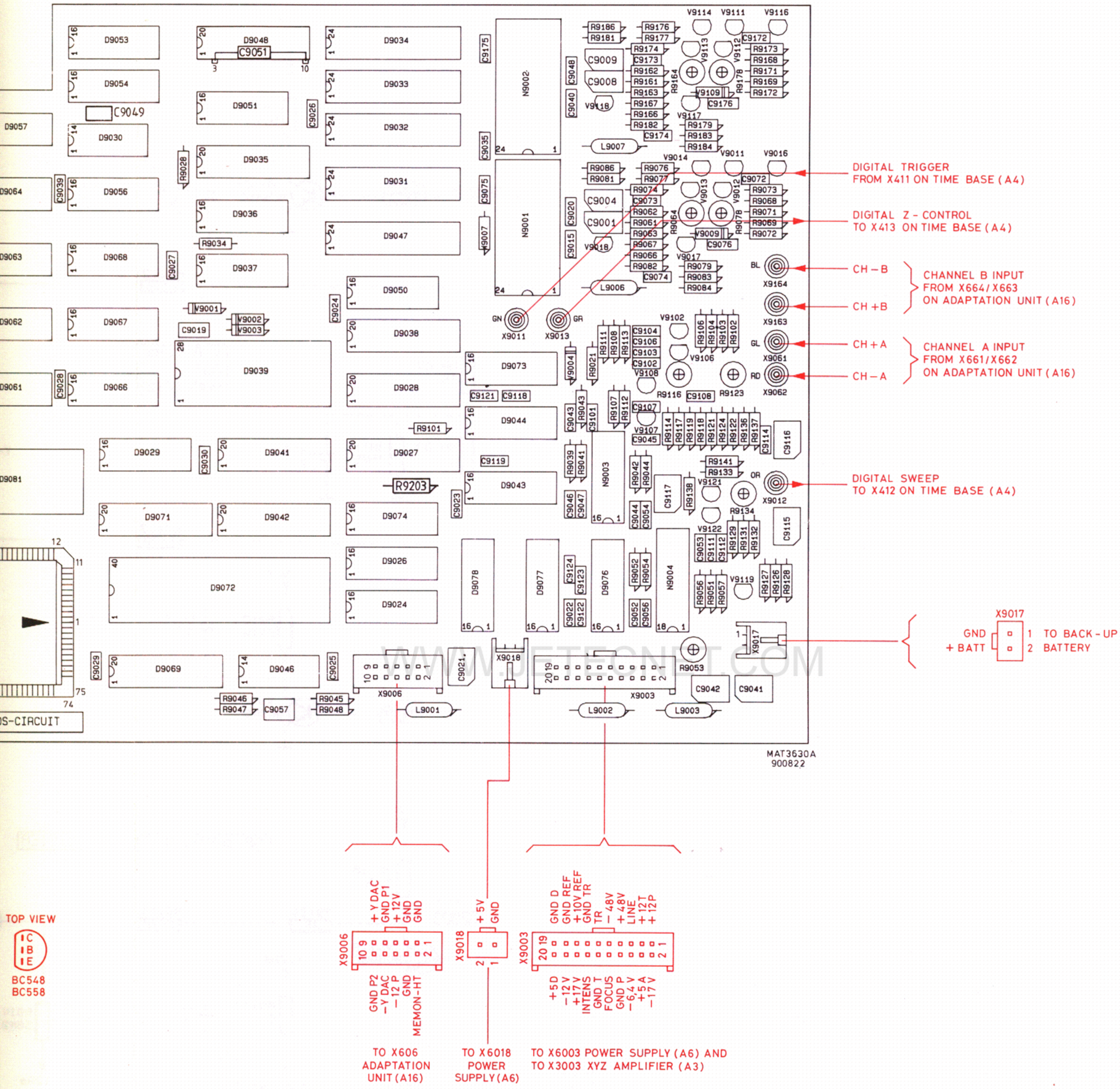
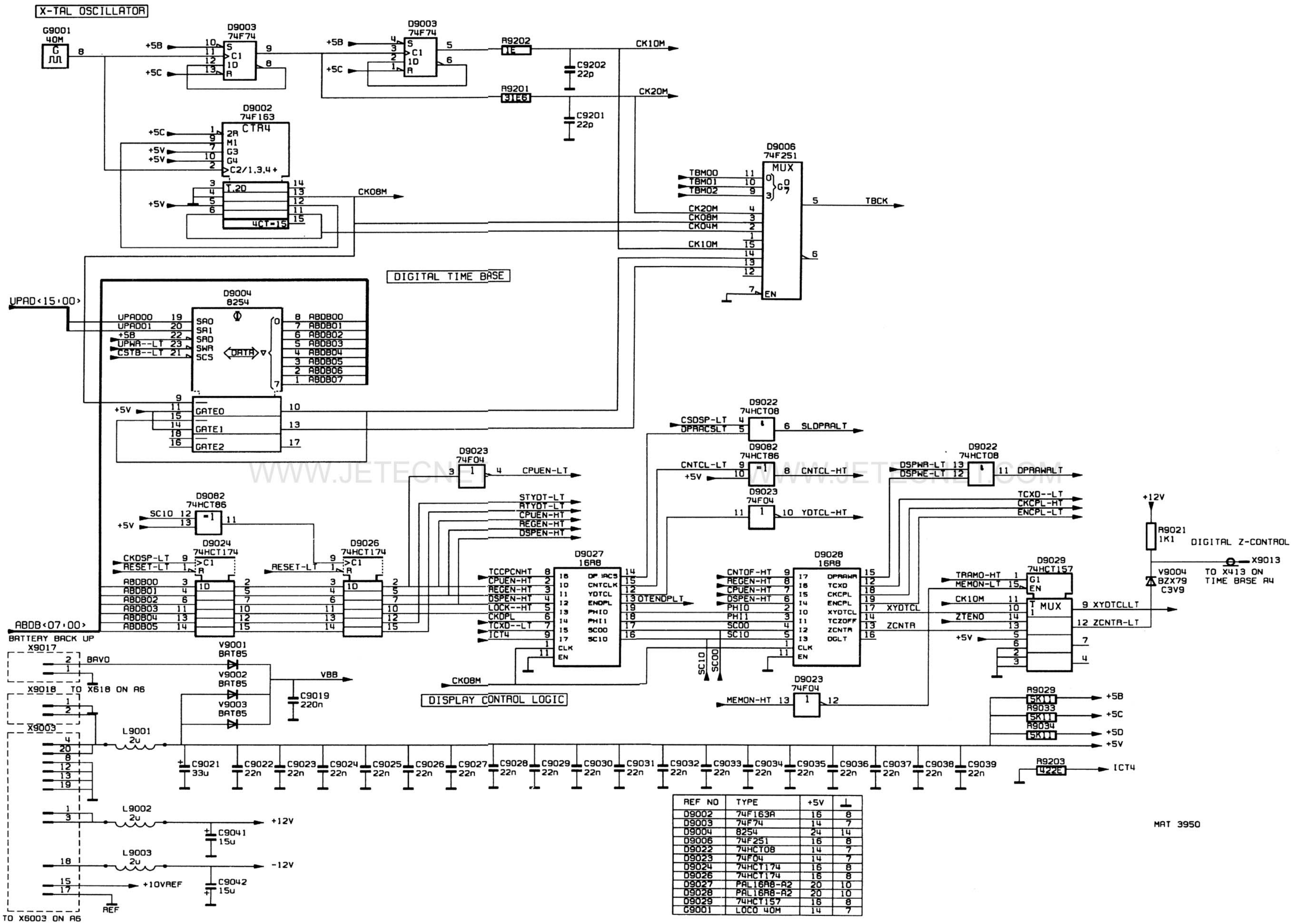
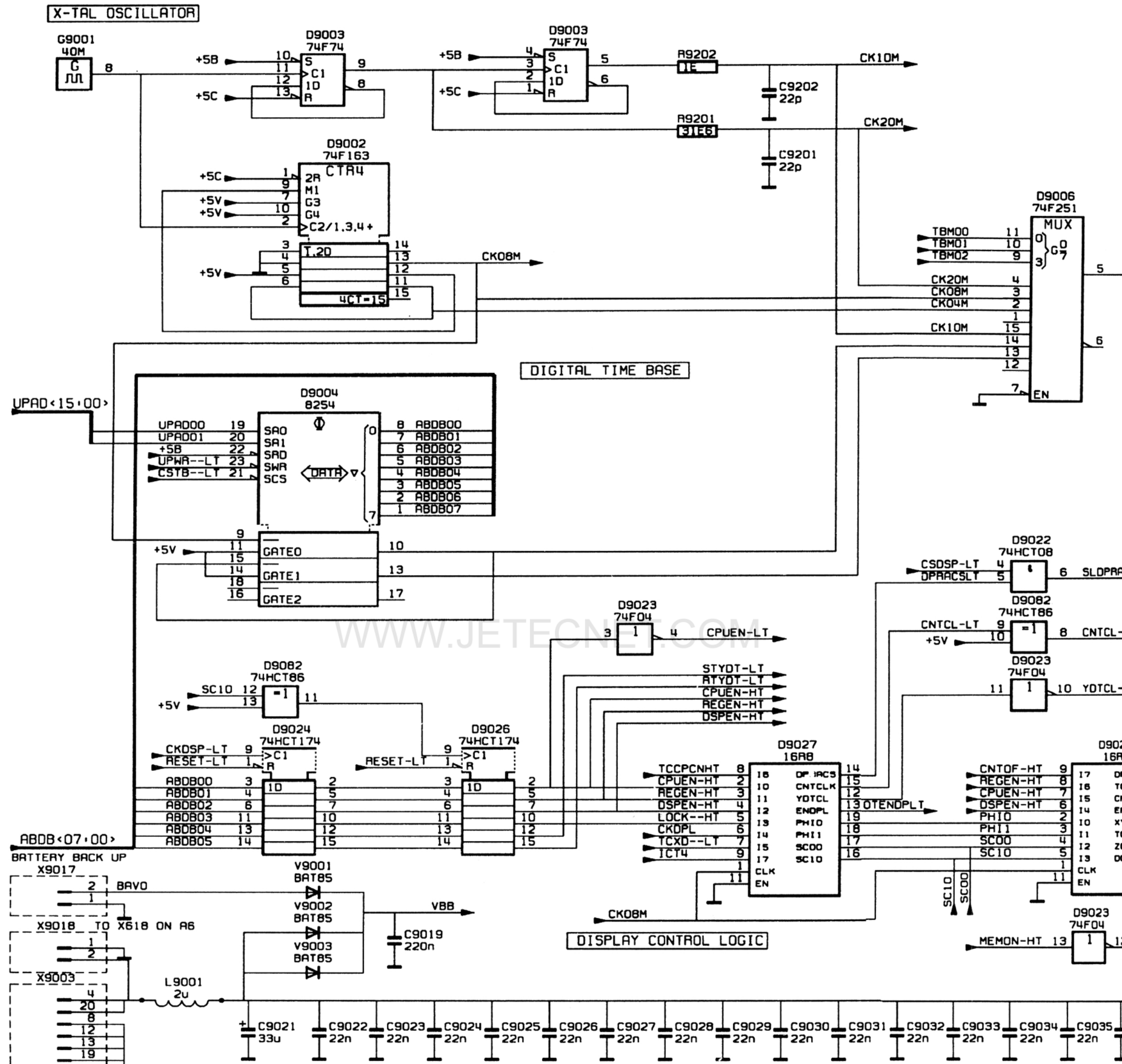


Figure 11.14 Digital unit, p.c.b. lay-out



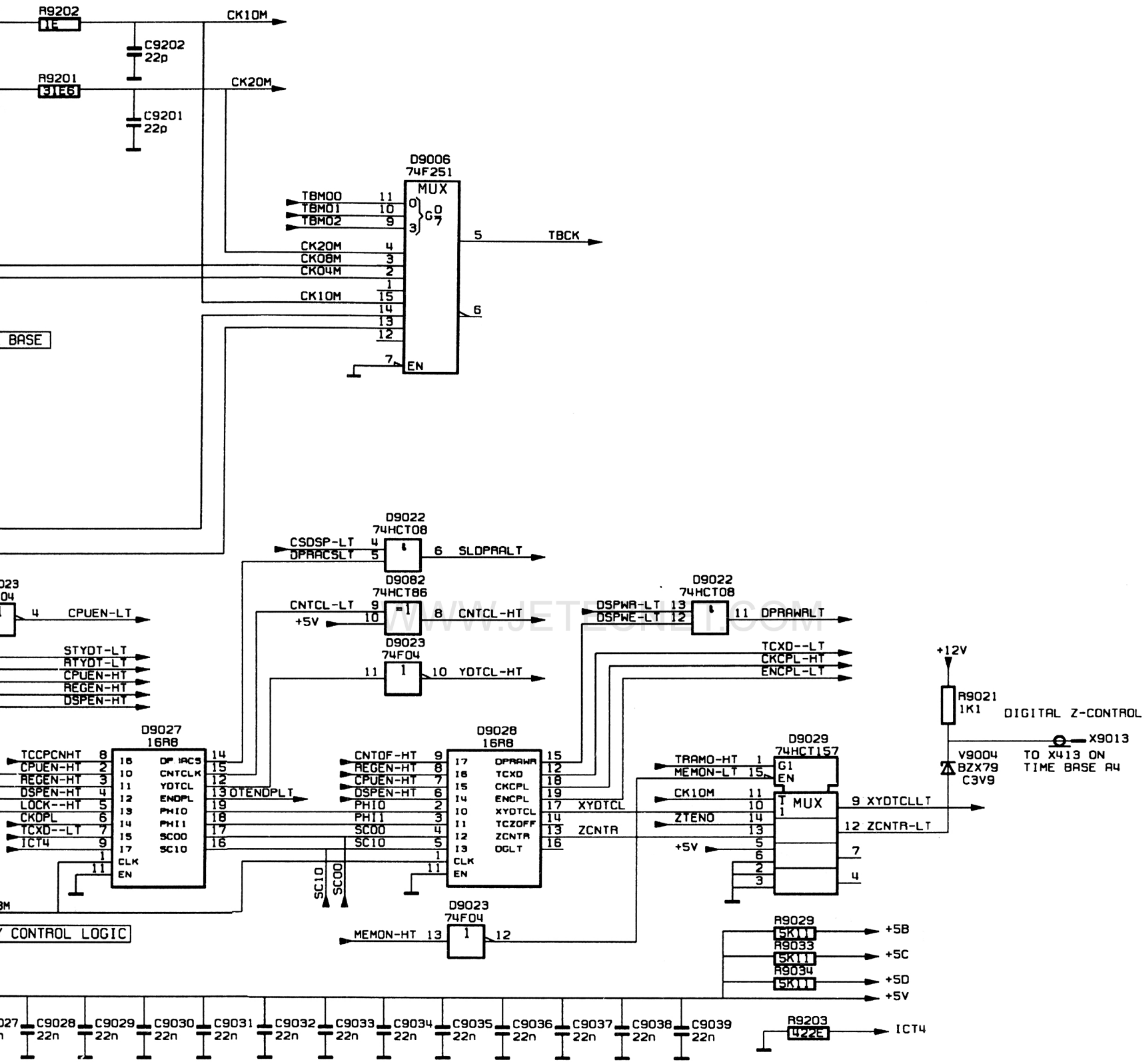
REF NO	TYPE	+5V	⊥
D9002	74F163A	16	8
D9003	74F74	14	7
D9004	8254	24	14
D9006	74F251	16	8
D9022	74HCT08	14	7
D9023	74F04	14	7
D9024	74HCT174	16	8
D9026	74HCT174	16	8
D9027	PAL16R8-A2	20	10
D9028	PAL16R8-A2	20	10
D9029	74HCT157	16	8
G9001	LOCO 40M	14	7

Figure 11.15 Circuit diagram of display and time base control



REF NO	TYPE	+5V
D9002	74F163A	16
D9003	74F74	14
D9004	8254	24
D9006	74F251	16
D9022	74HCT08	14
D9023	74F04	14
D9024	74HCT174	16
D9026	74HCT174	16
D9027	PAL16R8-A2	20
D9028	PAL16R8-A2	20
D9029	74HCT157	16
G9001	LOCO 40M	14

Figure 11.15 Circuit diagram of display and time base control



REF NO	TYPE	+5V	⊥
D9002	74F163A	16	8
D9003	74F74	14	7
D9004	8254	24	14
D9006	74F251	16	8
D9022	74HCT08	14	7
D9023	74F04	14	7
D9024	74HCT174	16	8
D9026	74HCT174	16	8
D9027	PAL16R8-A2	20	10
D9028	PAL16R8-A2	20	10
D9029	74HCT157	16	8
G9001	LOCO 40M	14	7

MAT 3950

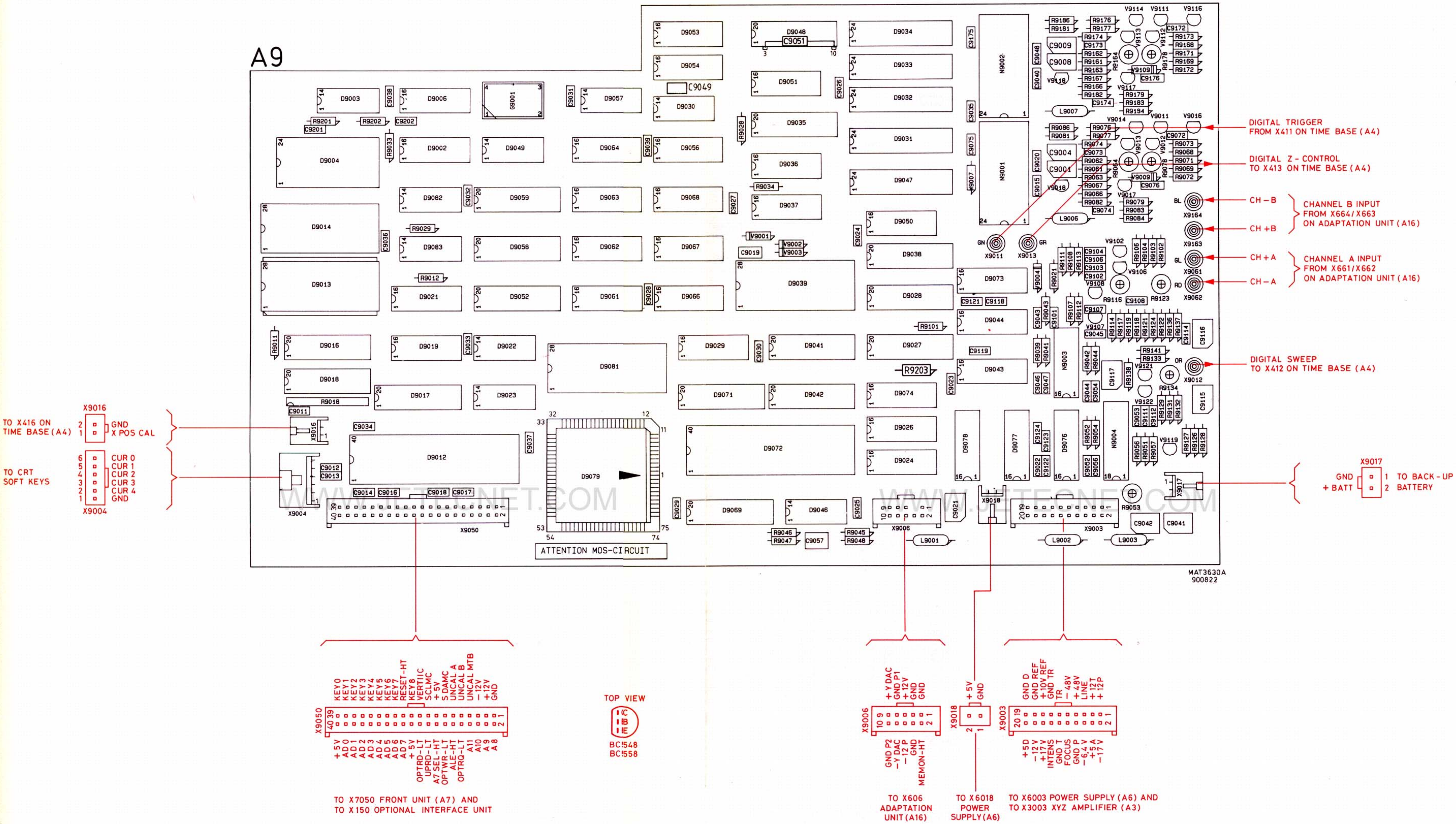


Figure 11.16 Digital unit, p.c.b. lay-out

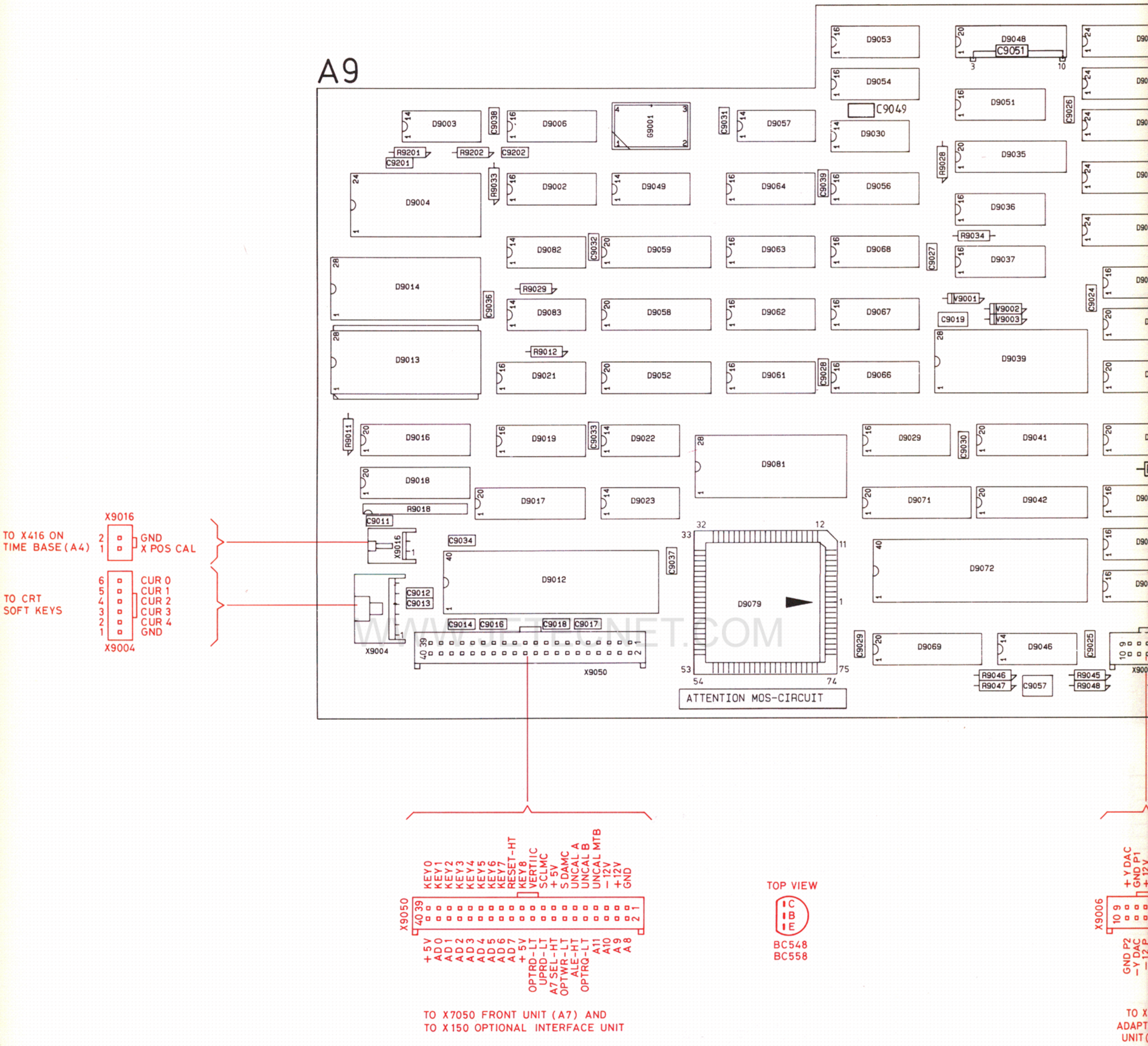

A9
TO X416 ON TIME BASE (A4)
X9016
GND
X POS CAL
TO CRT SOFT KEYS
CUR 0
CUR 1
CUR 2
CUR 3
CUR 4
GND
X9004
X9050
ATTENTION MOS-CIRCUIT
D9079
KEY0 KEY1 KEY2 KEY3 KEY4 KEY5 KEY6 KEY7 KEY8 RESET-HT VERTIIC SCLMC +5V S DAMC UNCAL A UNCAL B UNCAL MTB -12V +12V GND
+5V AD0 AD1 AD2 AD3 AD4 AD5 AD6 AD7 +5V OPTRD-LT UPRD-LT A7 SEL-HT OPTWR-LT ALE-HT OPTRQ-LT A11 A10 A9 A8
TO X7050 FRONT UNIT (A7) AND
TO X150 OPTIONAL INTERFACE UNIT
TOP VIEW
C B E
BC548
BC558
X9006
+Y DAC
GND P1
GND P2
-Y DAC

Figure 11.16

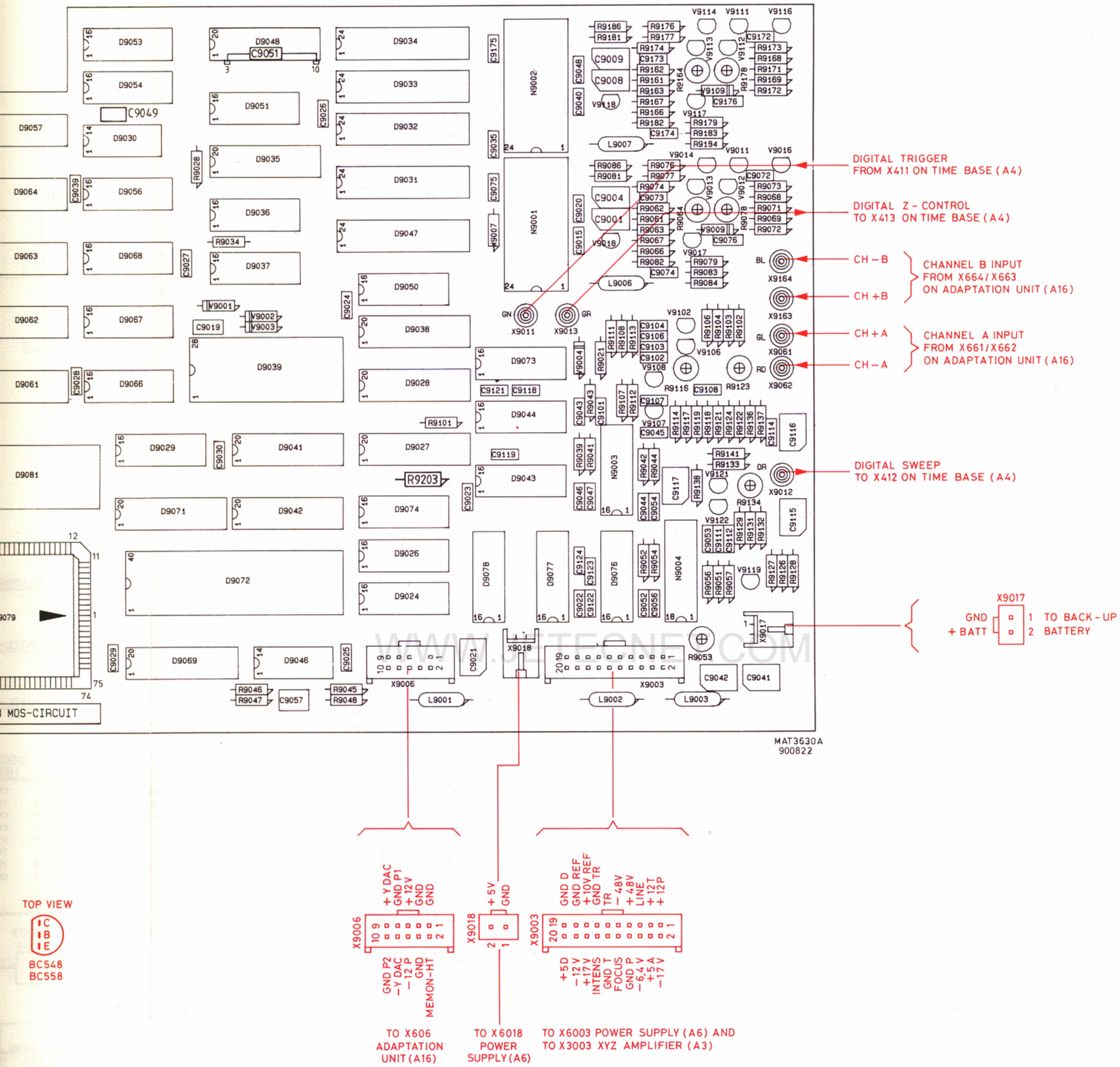
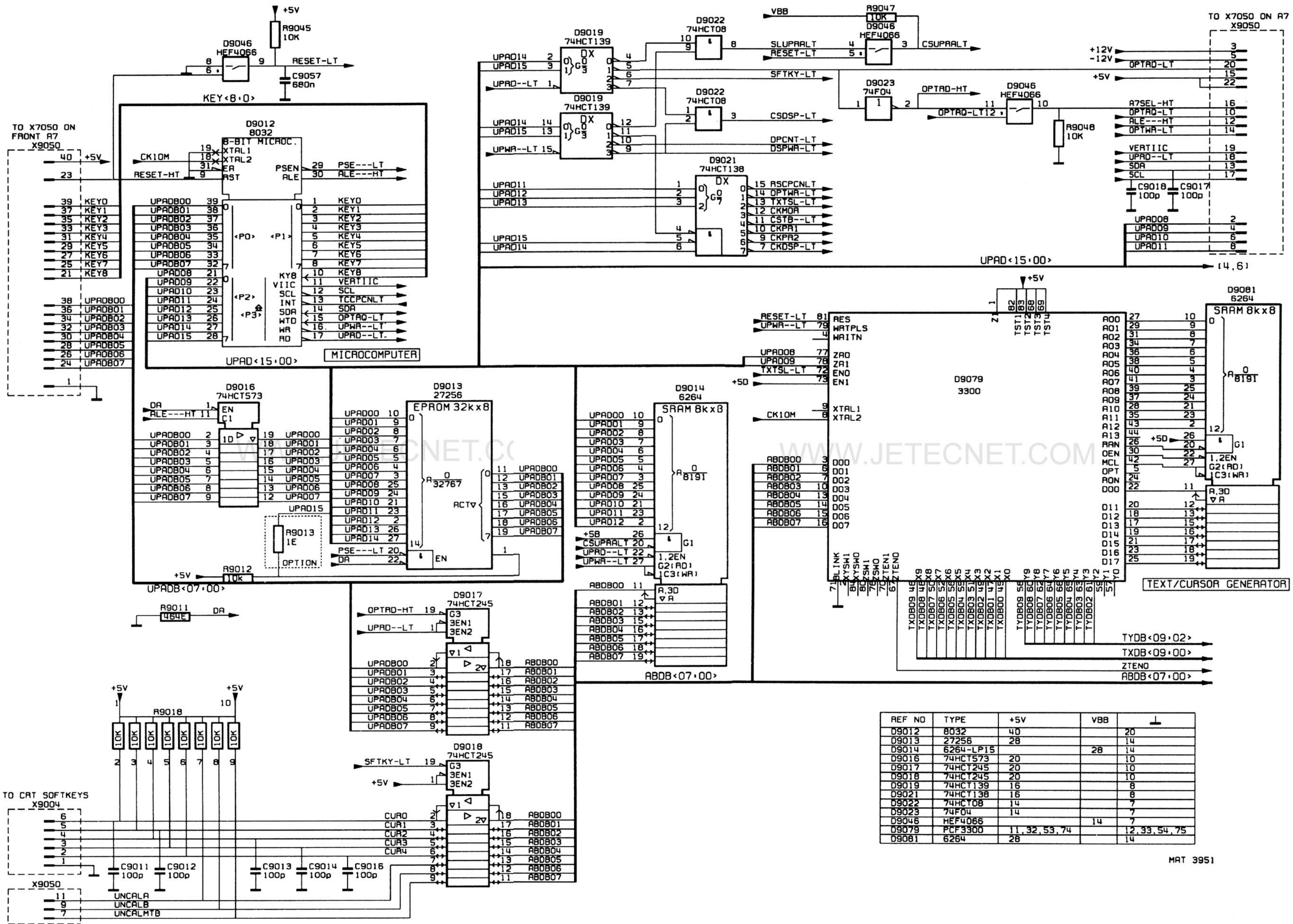


Figure 11.16 Digital unit, p.c.b. lay-out



REF NO	TYPE	+5V	VBB	⊥
D9012	8032	40		20
D9013	27256	28		14
D9014	6264-LP15		28	14
D9016	74HCT573	20		10
D9017	74HCT245	20		10
D9018	74HCT245	20		10
D9019	74HCT139	16		8
D9021	74HCT138	16		8
D9022	74HCT08	14		7
D9023	74F04	14		7
D9046	HEF4066		14	7
D9079	PCF3300	11,32,53,74		12,33,54,75
D9081	6264	28		14

MAT 3951

Figure 11.17 Circuit diagram of CPU logic

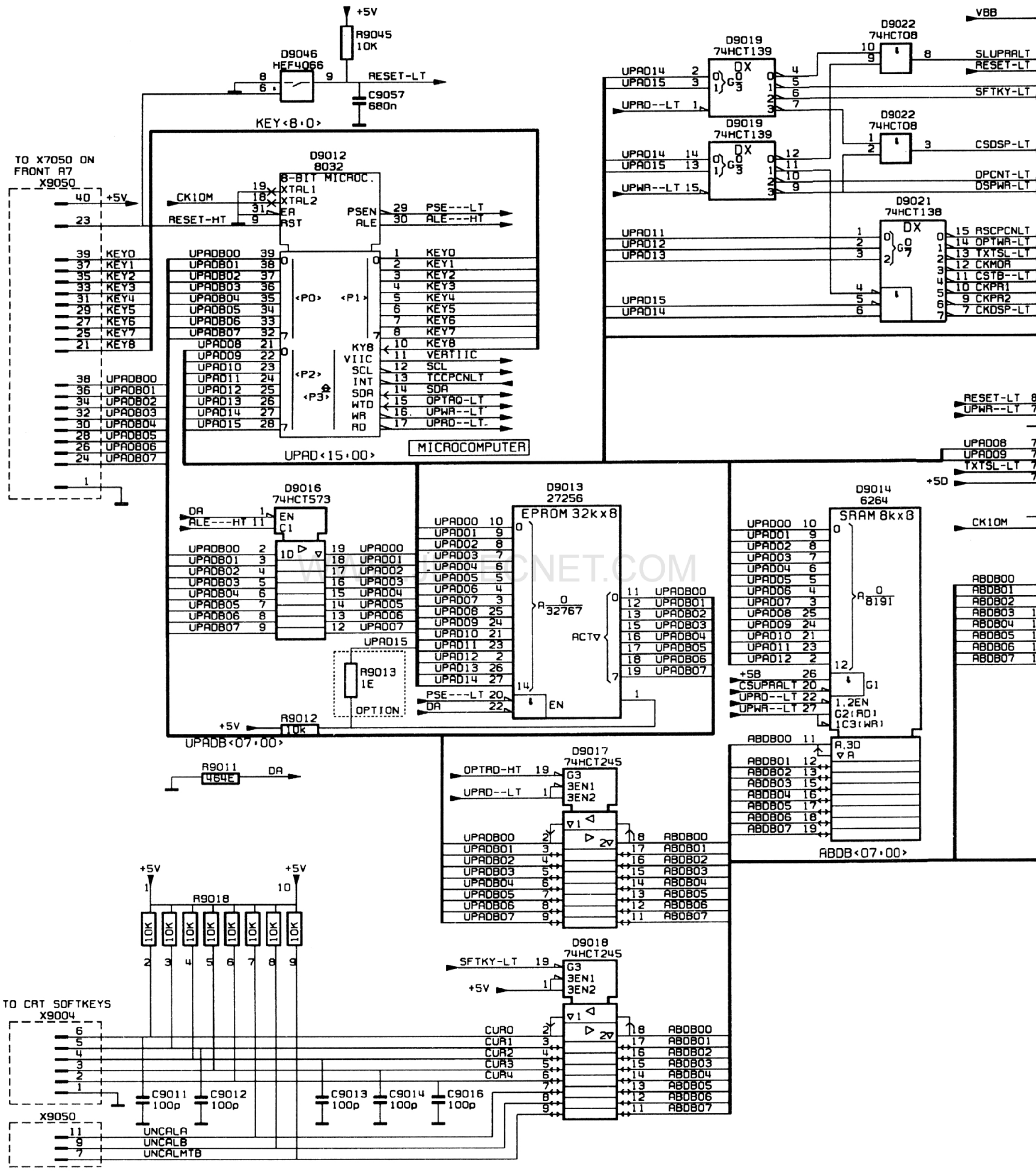
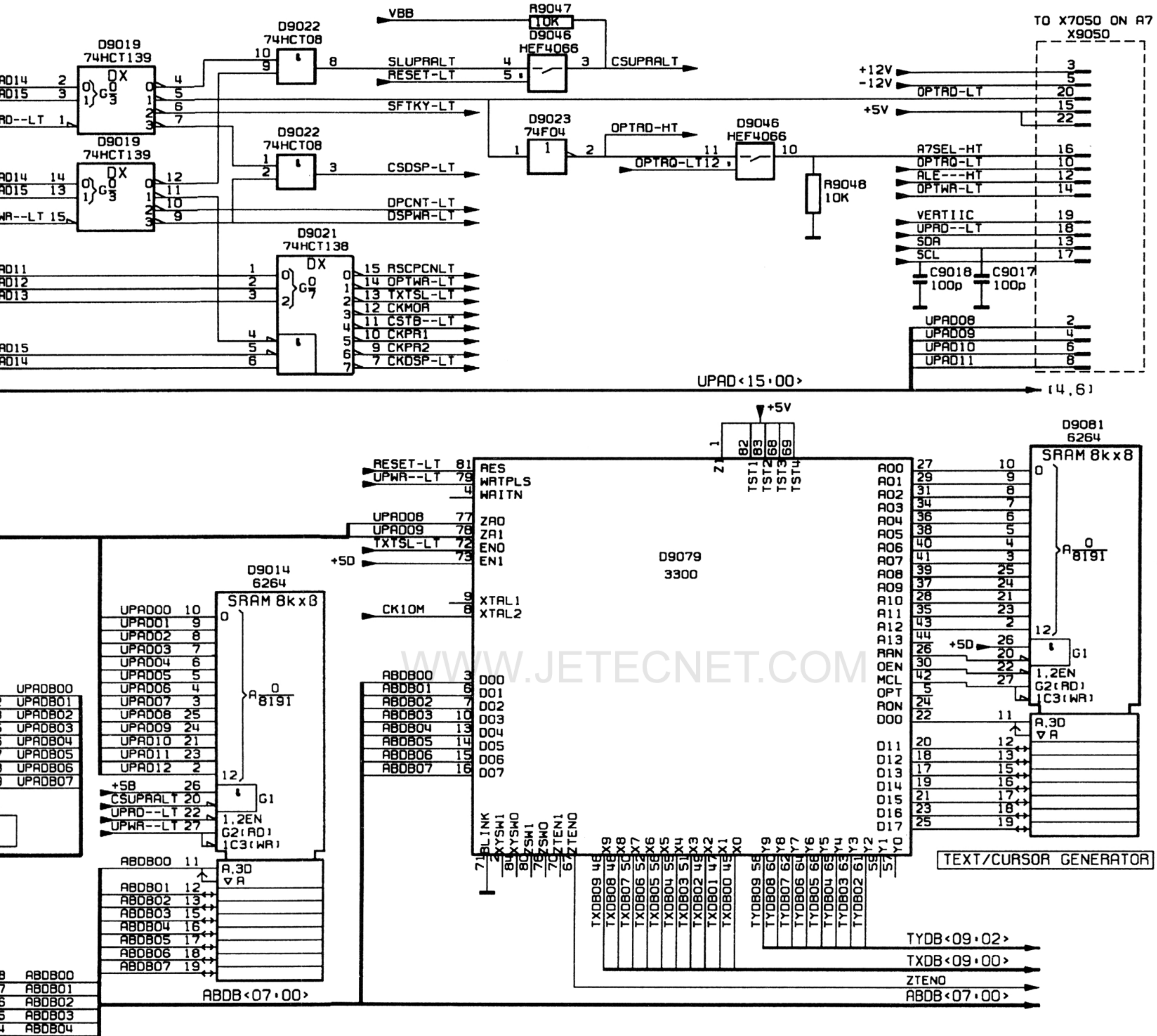


Figure 11.17 Circuit diagram of CPU logic



REF NO	TYPE	+5V	VBB	⊥
D9012	8032	40		20
D9013	27256	28		14
D9014	6264-LP15		28	14
D9016	74HCT573	20		10
D9017	74HCT245	20		10
D9018	74HCT245	20		10
D9019	74HCT139	16		8
D9021	74HCT138	16		8
D9022	74HCT08	14		7
D9023	74F04	14		7
D9046	HEF4066		14	7
D9079	PCF3300	11,32,53,74		12,33,54,75
D9081	6264	28		14

MAT 3951

12 ADAPTATION UNIT (A16)

12.1 VERTICAL DISPLAY MODE SWITCH

The adaptation unit consists of diode switches. Depending on the selection of real-time mode or digital memory mode, the current signals of channels A and B are applied via the so-called "analogue signal path" or the so-called "digital signal path".
The diode switches are under control of the signals SHAR and SHARN.
The selection table is as follows:

signal	real-time mode	digital memory mode
MEMON-HT	LOW	HIGH
SHAR	-12 V	+12 V
SHARN	+12 V	-12 V

12.2 REAL TIME MODE AMPLIFIER

Selection of the analog signals path means that the current signals of channels A and B are directly coupled to the inputs of the analogue vertical channel switch D601 via diodes V609, V611, V612 and V613. The two devices D601 and D602 are connected in parallel and have the following switch selections:

	D601		D602	
	pin 10	pin 11	pin 10	pin 11
A	1	0	0	0
B	0	1	0	0
TRIG LEVEL VIEW	0	0	1	0
ADD	1	1	0	0
DIGITAL	0	0	0	1

Furthermore all possible 2, 3 or 4 channel combinations are possible in alternated and chopped display (see also chapter 5).

The stage comprises the following real-time functions:

- Channel B normal/invert (HIGH is invert) on D601-11.
  (The balance between normal/invert can be adjusted with R2212, see chapter 5)
- Trigger view invert (HIGH is invert) on D602-2.

The output is applied to the delay line driver on unit A2.

Channel A position control is obtained via long-tailed pair amplifier V626 and V627. This circuit is sourced by current source V628 and driven by N601. The channel B position control is identical but also includes a multiplexer D603 for normal/invert function.

12.3 DIGITAL MEMORY AMPLIFIER

Selection of the digital signal path means that the current signals of channels A and B are coupled to the common-base amplifier V616, V617, V621 and V622.
Because of the +12 V level of SHAR these transistors conduct and the currents are routed to the output. The output currents are applied to the digital unit A9.

The position controls for both channels are determined by the same circuit as for the real-time path.

Next, MEMON-HT also causes the selection of the vertical current signals -YDAC and +YDAC. These signals are now routed to the delay- line driver via D602 on unit A2. Note that the DLD1 and DLD2 outputs are only interconnected on A2 (see also figure 5.1).

In digital memory mode, selection can be made for trigger level view by applying a high level to D602-10. This d.c. signal is received from the trigger level view pre-amplifier on unit A2.

12.4 SIGNAL NAME LIST

Signal name	Description	Signal source	Signal destination(s)
CHA	Channel A selection	D2603	D601
CH+A	Channel +A output	V616	R702
CH-A	Channel -A output	V617	R707
CH+AI	Channel +A input	D2002	V611 - V618 - R638
CH-AI	Channel -A input	D2002	V609 - V619 - R639
CHB	Channel B selection	D2603	D601
CH+B	Channel +B output	V622	R702
CH-B	channel -B output	V621	R701
CH+AI	Channel +B input	D2102	V613 - V624 - R653
CH-AI	Channel -B input	D2102	V612 - V623 - R652
DLD1	Delay line driver ch A	D601	D2203
DLD2	Delay line driver ch B	D602	D2203
INVAM	Invert ch A	D2602	D602
INVB	Invert ch B	D2602	D601 - D603
MEMOM-HT	Memory on	D222	R601
POS A	Position ch A	R2200	R634
POS B	Position ch B	R2220	R629
+TRIG	+ Trigger	R2404	D602
-TRIG	- Trigger	R2412	D602
TRGVW	Trigger view	D2603	D602
SHAR	Store hardware	V604/V606	V614 - V615
SHARN	Store hardware not	V608	V634 - V635
+YDAC	+ Y DAC signal	V531	R617
-YDAC	- Y DAC signal	V532	R616

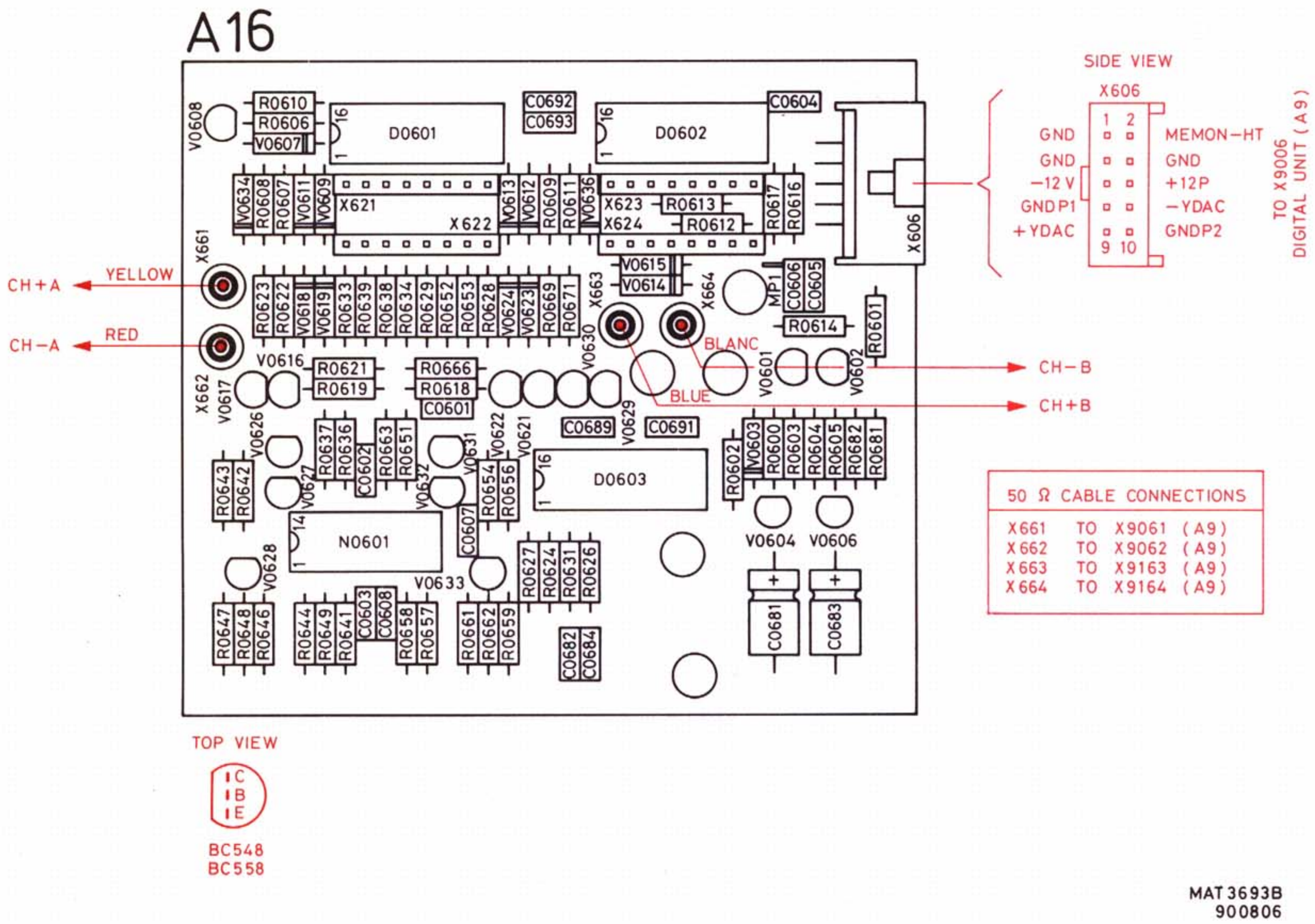


Figure 12.1 Adaptation unit, p.c.b. lay-out.

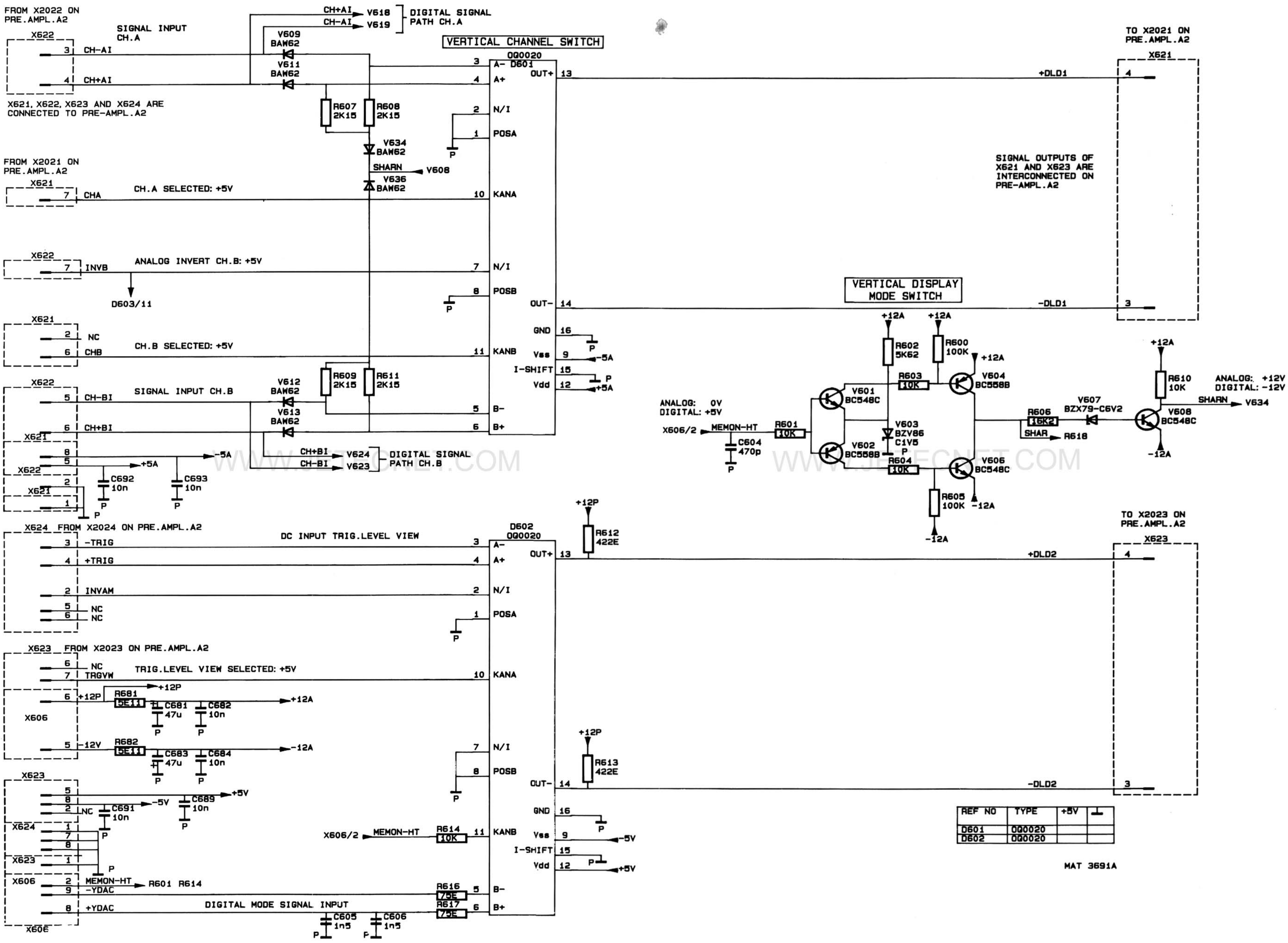
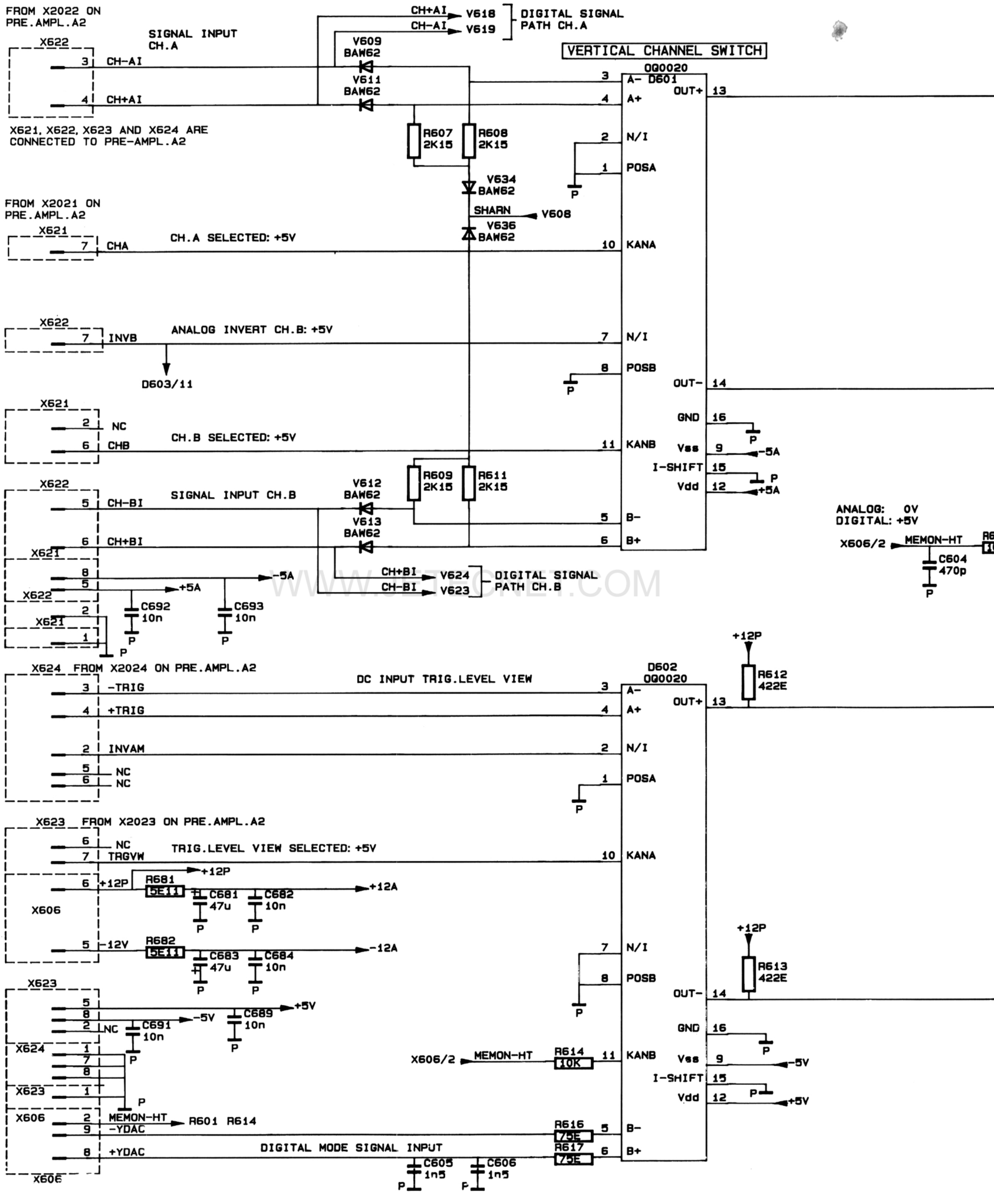
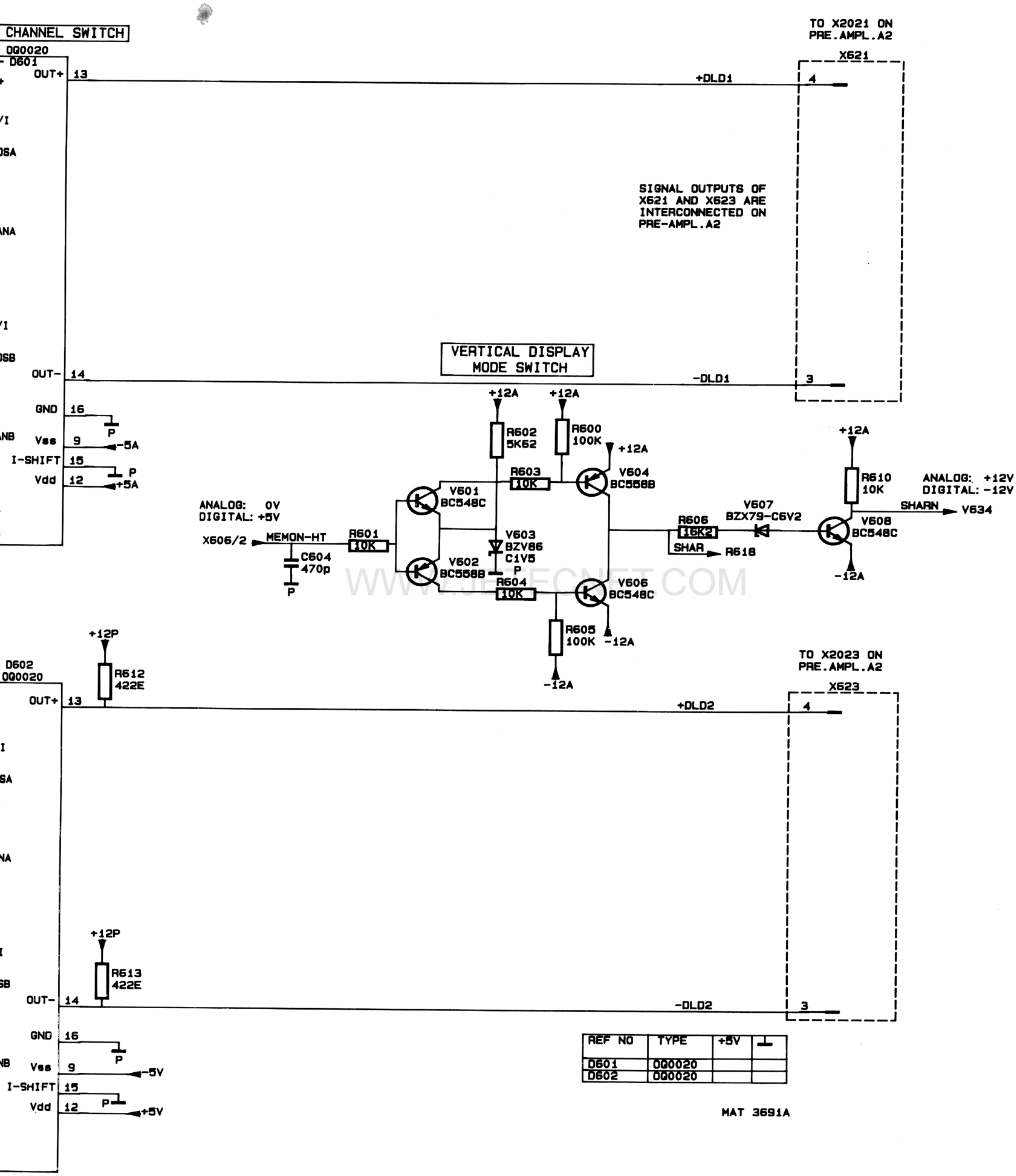


Figure 12.2 Circuit diagram of adaptation unit, section 1



FROM X2022 ON PRE.AMPL.A2
SIGNAL INPUT CH.A
X622
CH-AI
CH+AI
V609 BAW62
V611 BAW62
V618
V619
DIGITAL SIGNAL PATH CH.A
VERTICAL CHANNEL SWITCH
OQ0020 D601
A-
A+
OUT+
N/I
POSA
X621, X622, X623 AND X624 ARE CONNECTED TO PRE-AMPL.A2
R607 2K15
R608 2K15
V634 BAW62
SHARN
V608
V636 BAW62
FROM X2021 ON PRE.AMPL.A2
X621
CHA
CH.A SELECTED: +5V
KANA
ANALOG INVERT CH.B: +5V
INVB
D603/11
POSB
OUT-
NC
CHB
CH.B SELECTED: +5V
KANB
GND
Vss
I-SHIFT
Vdd
-5A
+5A
R609 2K15
R611 2K15
SIGNAL INPUT CH.B
CH-BI
CH+BI
V612 BAW62
V613 BAW62
B-
B+
V624
V623
DIGITAL SIGNAL PATH CH.B
C692 10n
C693 10n
ANALOG: 0V
DIGITAL: +5V
X606/2
MEMON-HT
C604 470p
X624 FROM X2024 ON PRE.AMPL.A2
-TRIG
+TRIG
INVAM
DC INPUT TRIG.LEVEL VIEW
D602 0Q0020
R612 422E
+12P
X623 FROM X2023 ON PRE.AMPL.A2
TRGVW
TRIG.LEVEL VIEW SELECTED: +5V
X606
R681 5E11
C681 47u
C682 10n
+12A
-12V
R682 5E11
C683 47u
C684 10n
-12A
R613 422E
C691 10n
C689 10n
+5V
-5V
R614 10K
R601 R614
-YDAC
+YDAC
DIGITAL MODE SIGNAL INPUT
R616 75E
R617 75E
C605 1n5
C606 1n5



REF NO	TYPE	+5V	⊥
D601	0Q0020		
D602	0Q0020		

Figure 12.2 Circuit diagram of adaptation unit, section 1

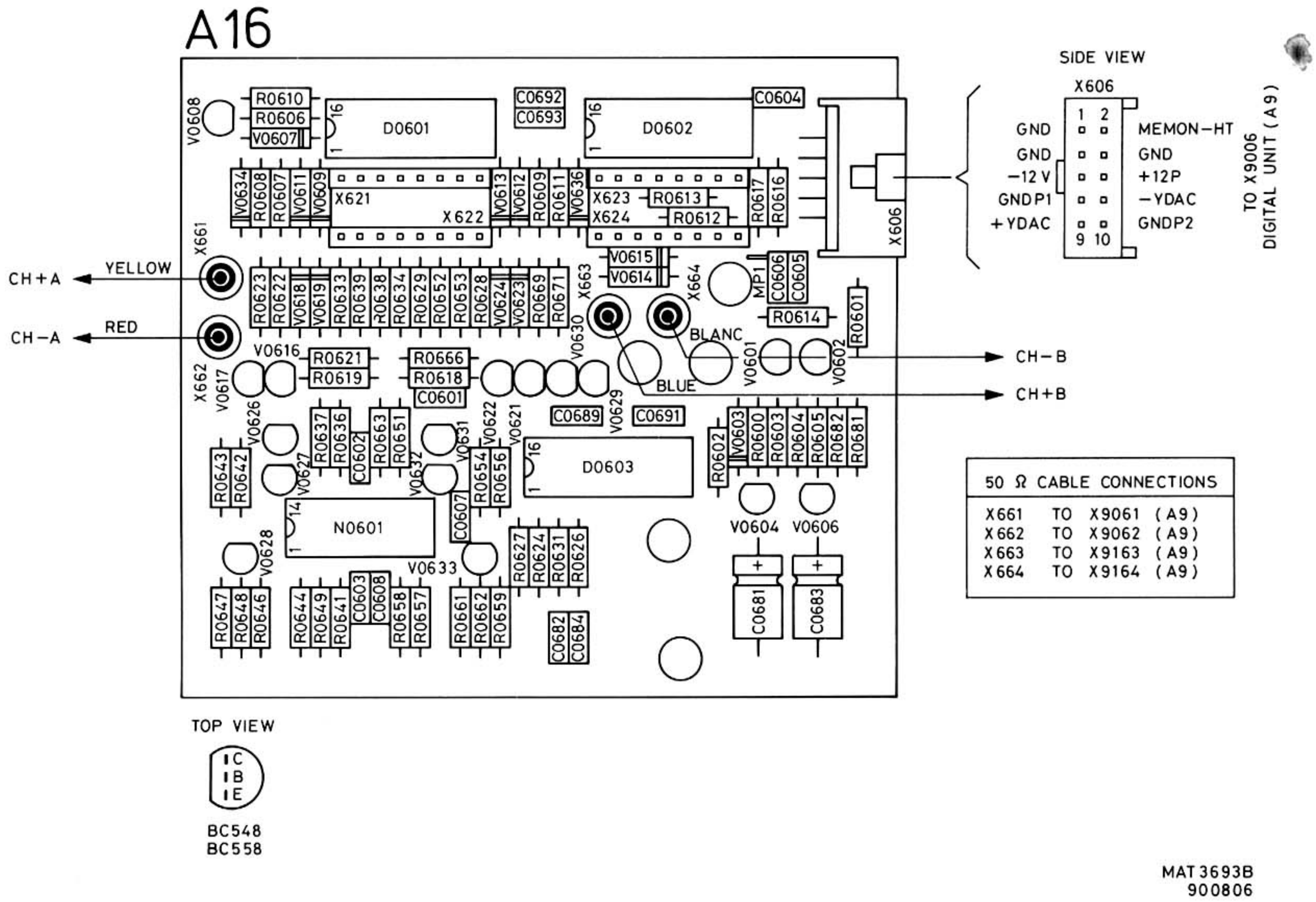
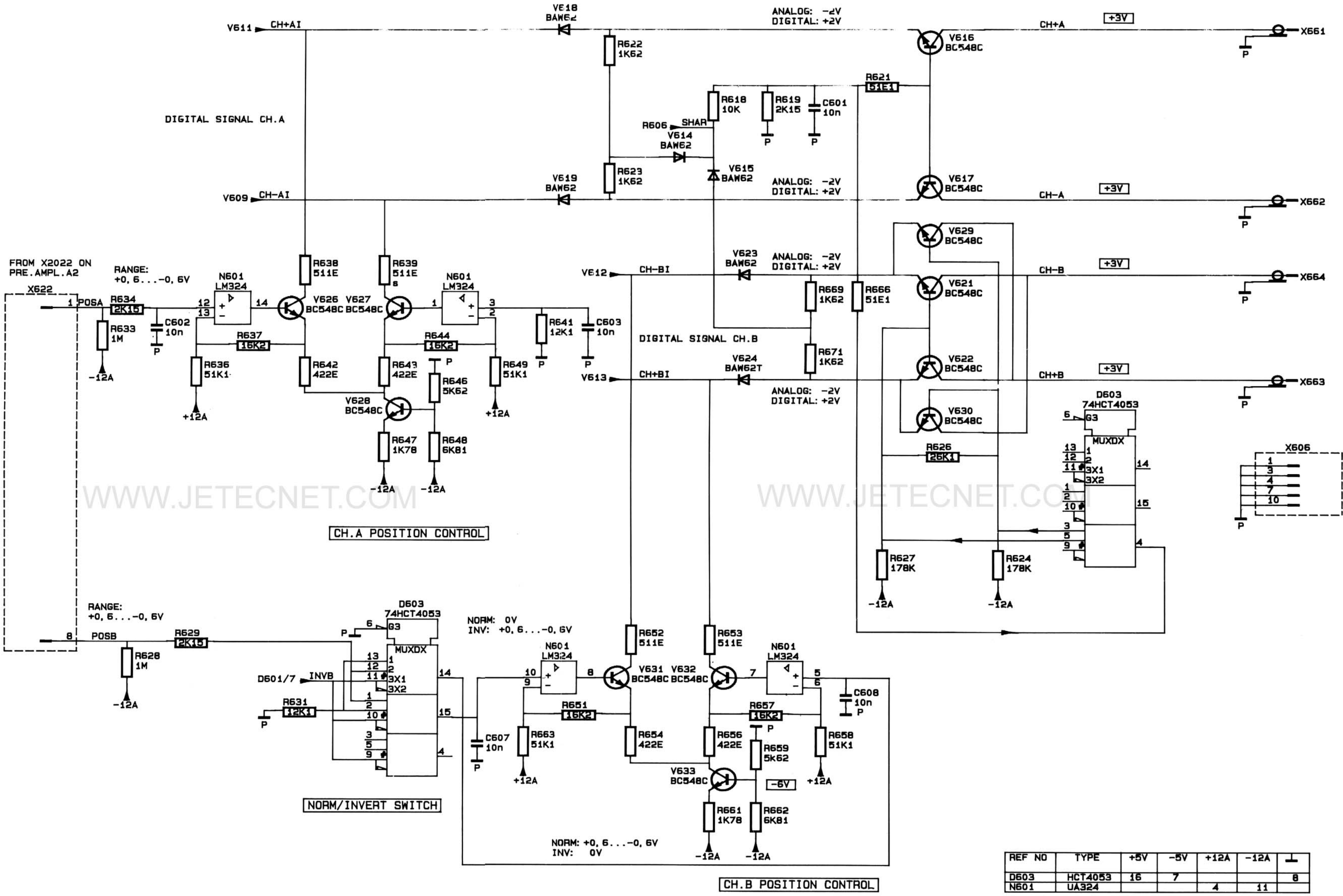
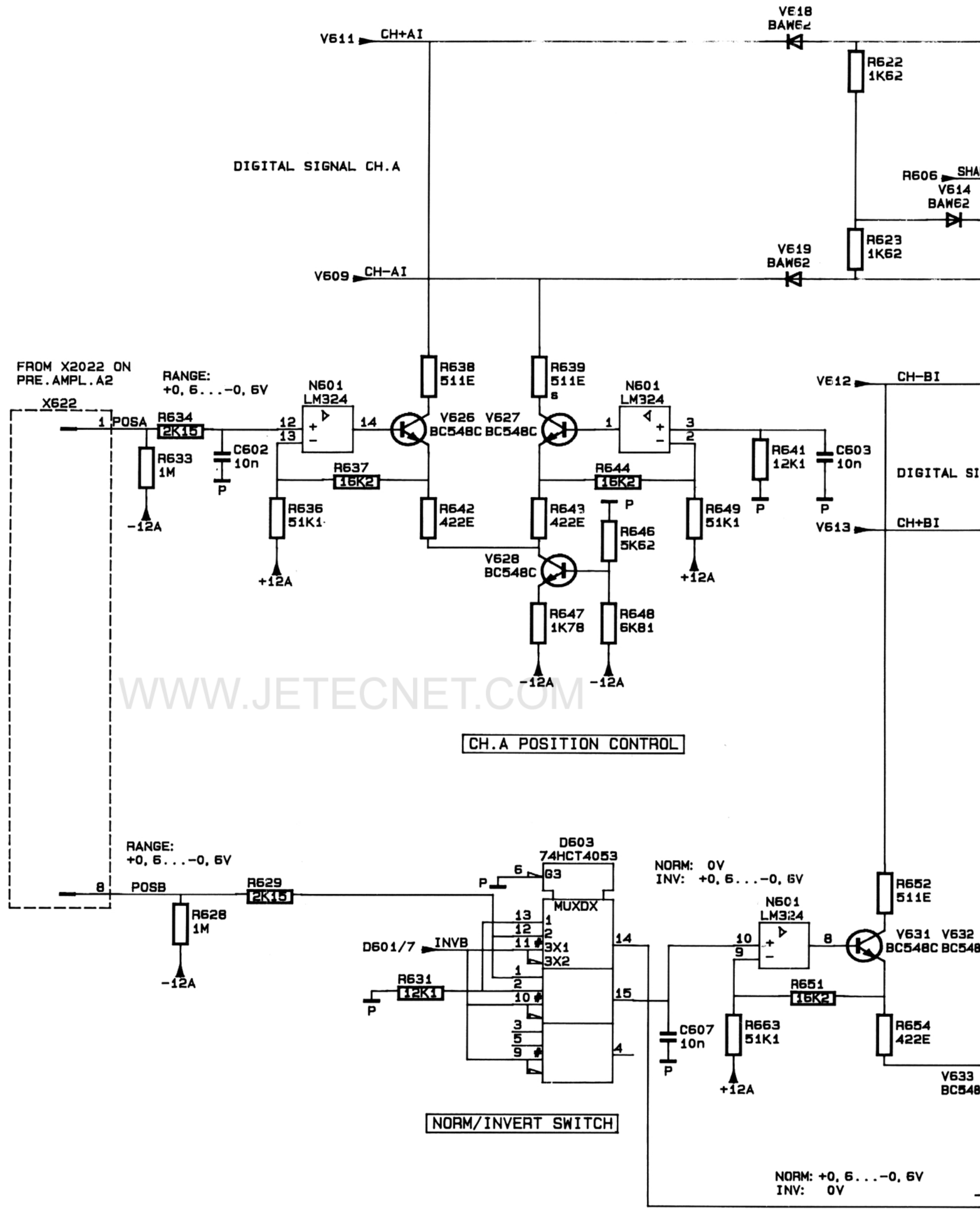


Figure 12.3 Adaptation unit, p.c.b. lay-out.

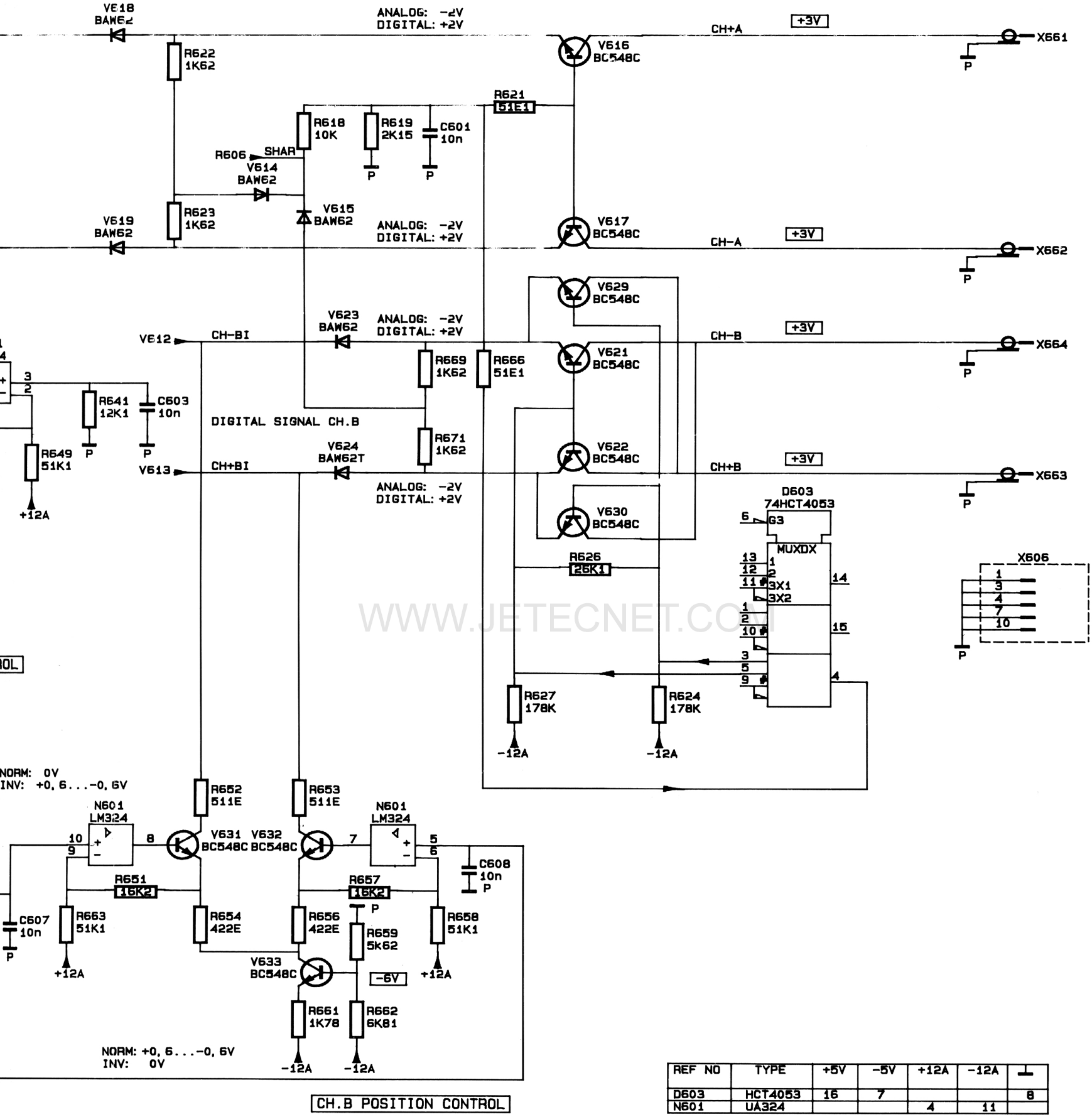


REF NO	TYPE	+5V	-5V	+12A	-12A	⊥
D603	HCT4053	16	7			8
N601	UA324			4	11	

Figure 12.4 Circuit diagram of adaptation unit, section 2


V611 CH+AI
V618 BAW62
R622 1K62
DIGITAL SIGNAL CH.A
R606 SHA
V614 BAW62
R623 1K62
V619 BAW62
V609 CH-AI
FROM X2022 ON PRE.AMPL.A2
X622
RANGE: +0, 6...-0, 6V
POSA
R634 2K15
R633 1M
C602 10n
N601 LM324
R637 16K2
R636 51K1
V626 BC548C
V627 BC548C
R638 511E
R639 511E
R642 422E
R643 422E
R644 16K2
N601 LM324
R641 12K1
C603 10n
R649 51K1
R646 5K62
V628 BC548C
R647 1K78
R648 6K81
V612 CH-BI
V613 CH+BI
DIGITAL SI
CH.A POSITION CONTROL
RANGE: +0, 6...-0, 6V
POSB
R629 2K15
R628 1M
D603 74HCT4053
MUXDX
D601/7 INVB
R631 12K1
NORM: 0V
INV: +0, 6...-0, 6V
N601 LM324
C607 10n
R663 51K1
R651 16K2
R652 511E
V631 BC548C
V632 BC548
R654 422E
V633 BC548
NORM/INVERT SWITCH
NORM: +0, 6...-0, 6V
INV: 0V

Figu



REF NO	TYPE	+5V	-5V	+12A	-12A	⊥
D603	HCT4053	16	7			8
N601	UA324			4	11	

MAT 3692B

Figure 12.4 Circuit diagram of adaptation unit, section 2

13 PERFORMANCE TEST

13.1 GENERAL INFORMATION

WARNING: **Before switching-on, ensure that the instrument has been installed in accordance with the Installation Instructions, outlined in Section 2 of the Operation Guide.**

This procedure is intended to:

- Check the instrument's specification.
- Be used for incoming inspection to determine the acceptability of newly purchased instruments and/or recently recalibrated instruments.
- Check the necessity of recalibration after the specified recalibration intervals.

NOTE: The procedure does not check every facet of the instrument's calibration; rather, it is concerned primarily with those parts of the instrument which are essential to measurement accuracy and correct operation. Removing the instrument's covers is not necessary to perform this procedure. All tests are made from the outside of the instrument.

If the test is started within a short period after switching-on, bear in mind that steps may be out of specification, due to insufficient warming-up time.

Warming-up time under average conditions is 30 minutes.

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

IMPORTANT NOTES

- Unless otherwise stated, set the 3 VAR controls into position CAL, the 3 POS controls and TRIG LEVEL into the centre position, HOLD OFF at MIN.

- The input voltage has to be supplied to the A-input; unless otherwise stated. Set the TB switch to a suitable position; unless otherwise stated.

- Tolerances given are for the instrument under test and do not include test equipment error. Bear in mind that the test equipment is properly terminated.

- In some tests, channel B appears in parentheses after channel A, e.g. A(B). This indicates that the channel A test should be performed first, then the test for channel B.

13.2 RECOMMENDED TEST EQUIPMENT

Type of instrument	Required specification	Example of recommended instrument
Function generator	Freq: 1 MHz ... 10 MHz Sine-wave/square-wave Ampl: 0...20 V (pp) DC offset −5 ... +5 V Rise-time ≤ 30 ns Duty cycle 50 %	Philips PM 5134
Constant amplitude sine-wave generator	Freq: 50 kHz ... 100 MHz. Constant pp. amplitude of 120 mV and 3 V.	Tektronix SG 503
Square-wave calibration generator	For ampl. calibration: Freq: 1 kHz Ampl: 10 mV... 50 V For rise-time measurements: Freq: 1 MHz Ampl: 10 ... 500 mV Rise-time: ≤ 1 ns	Tektronix PG 506
Time marker generator	Repetition rate: 0,5 s ... 5 ns	Tektronix TG 501
Digital multimeter	Wide voltage and current ranges.	Philips PM 2525 with AC, DC and resistance ranges. High-voltage probe. Required: 1 % accuracy, PM 9246
Variable voltage transformer (VARIAC)	Well insulated output voltage 90 ... 264 V (ac)	Philips order. number 2422 529 00005
Watt meter		NORMA type D 1150
TV pattern generator with video output		Philips PM 5518
Oscilloscope	The bandwidth must be the same or higher than the bandwidth of the instrument under test.	Philips PM 3055
50 Ω cables, 75 Ω cable, 50 Ω terminations, 75 Ω termination, 10:1 attenuator, T-piece, power splitter	Tektronix and Philips BNC types for fast rise-time square-wave, high freq. sine-wave and other applications	TEK 012-0482-00 TEK 012-0074-00 TEK 011-0049-01 TEK 011-0055-01 TEK 011-0059-02 PHI PM 9067 PHI PM 9584/02
Trimming tools		Philips 800NTX (ord. kit number 4822 310 50095) or Bernstein nr. 1-250

13.3 TEST PROCEDURE

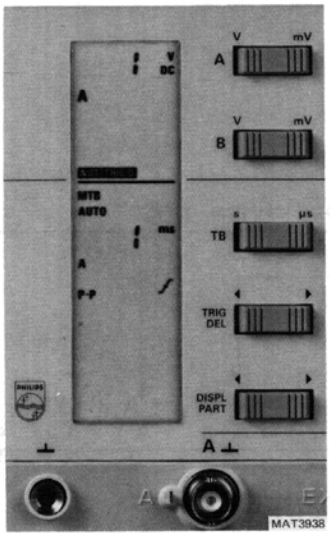


Figure 13.1 SOFTSTART condition.

13.3.1 Preliminary settings

test equipment:

None

settings/procedure and requirements:

1 – Switch-on the oscilloscope under test.
2 – Check that all LCD segments on the frontpanel of the oscilloscope are on for approximately 1 second.
3 – Press pushbutton RESET and keep it pressed, then press AUTO SET, the LCD will show an asterisk (*) and a flashing 0.0.
4 – Press the CRT function control APPL, the LCD will show 1.0 flashing.
5 – Press the CRT function control STANDARD SETTING.
6 – Check that the front controls of the oscilloscope are set in the softstart condition as indicated in figure 13.1.
7 – At the start of every test, the AUTO SET button must be pressed (after the input signal is applied).
8 – Press the AUTO SET button to leave the softstart condition.

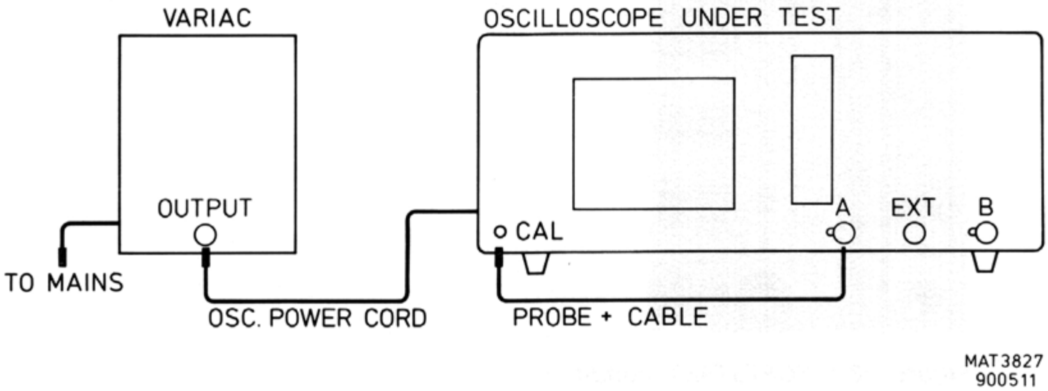
13.3.2 Power supply

In this test the correct working of the power supply at all possible line voltages is tested.

test equipment:

Variable voltage transformer (VARIAC)

test set-up:



settings/procedure:

1 – Adjust the input line voltage to the oscilloscope (output from VARIAC) to a desired value between 100 and 240 V (r.m.s.), frequency 50...400 Hz.
2 – Press POWER ON button of the oscilloscope.
3 – Apply the CAL signal provided on the front panel of the oscilloscope to input A, e.g. by means of a probe.
4 – Press the AUTO SET button.

requirements:

1 – Oscilloscope must start at any input voltage between 100 and 240 V.
2 – The instrument's performance does not change over the indicated voltage range; the displayed CAL signal is distortion-free and has equal intensity.

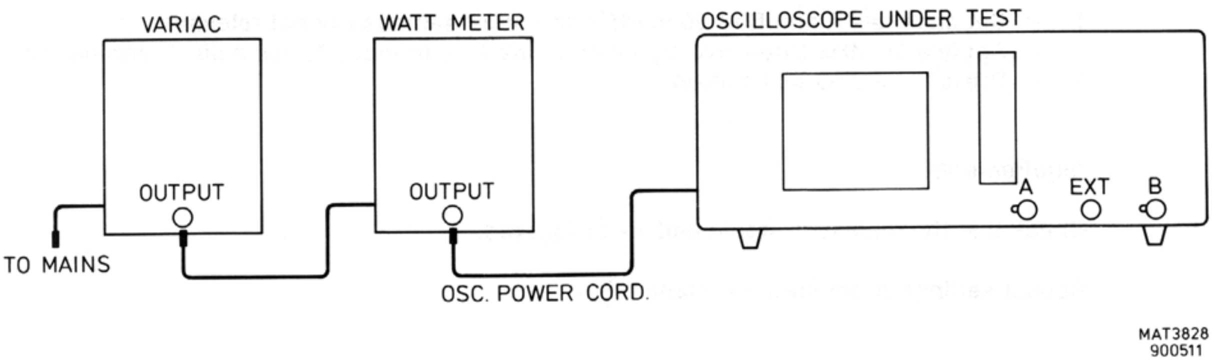
13.3.3 Power consumption

This test checks the power consumption of the oscilloscope.

test equipment:

- Variable voltage transformer (VARIAC)
- Watt meter

test set-up:



settings/procedure:

1 – Adjust the input voltage (output from VARIAC) to the oscilloscope to the nominal line voltage.
2 – Press POWER ON button of the oscilloscope.

requirements:

Power consumption is maximum 55 W.

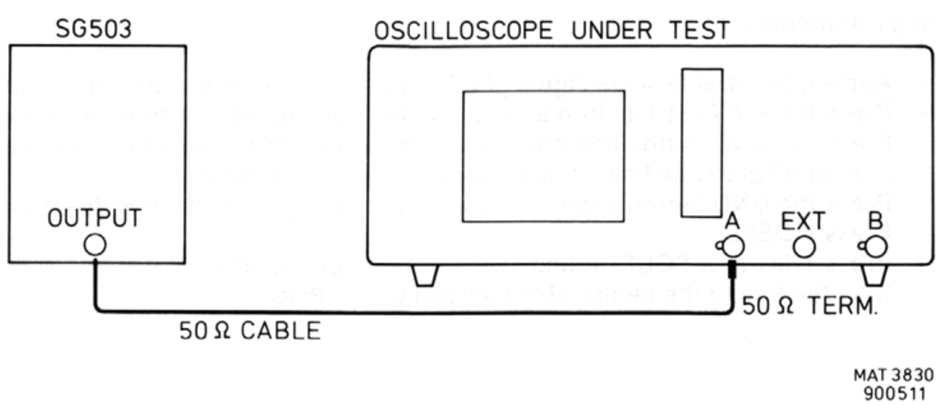
13.3.4 Auto set

This test checks the correct working of the auto set function.

test equipment:

Constant amplitude sine-wave generator (SG 503)

test set-up:



settings/procedure:

1 – Set channels A and B to 20 mV/div; the other settings are not relevant.
2 – Apply a 50 MHz sine-wave signal of 60 mV (pp) to input A; use a 50 Ω termination.
3 – Press the AUTO SET button.

requirements:

Check that the display is stable and well-triggered.

Repeat settings/procedure for channel B.

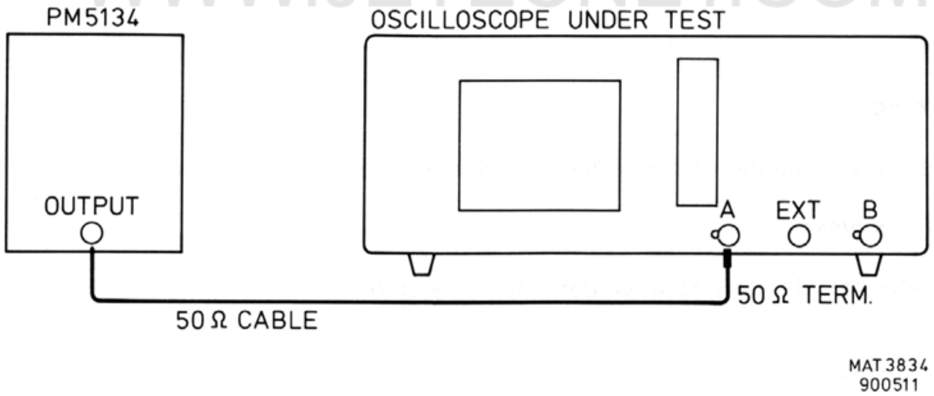
13.3.5 Orthogonality

In this test the angle between the horizontal and vertical deflection plates, the so called orthogonality, is checked.

test equipment:

LF sine-wave generator (function generator, PM 5134)

test set-up:



settings/procedure:

1 – Apply a 50 Hz sine-wave signal of 8 V (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button and adjust the input signal to a trace-height of 8 div.
3 – Press the GND button and check that the straight line is exactly in parallel with the horizontal graticule lines. If not, readjust the trace rotation.
4 – Press the GND button again and check that the signal of 8 div is displayed.
5 – Press X DEFL.
6 – Press TRIG or X SOURCE and select B as trigger source.
7 – Shift the line to the centre of the screen with X POS.

requirements:

1 – Check that the vertical line is in parallel with the vertical graticule line in the centre of the screen.
2 – Verify that the angle with respect to the horizontal graticule lines is 90° ± 1° as indicated in figure 13.2.

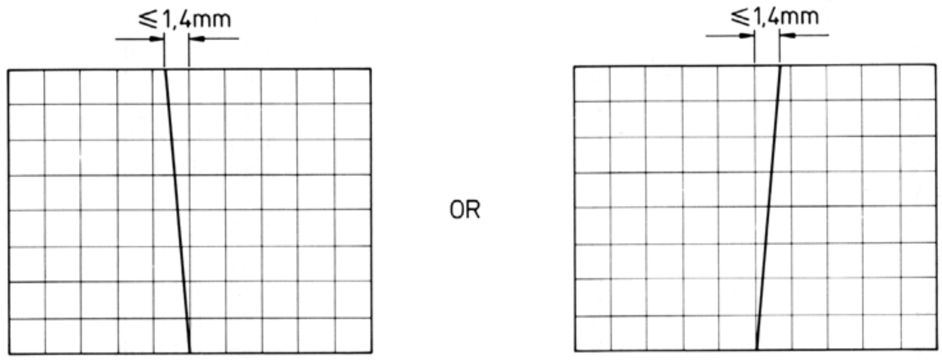


Figure 13.2. Orthogonality

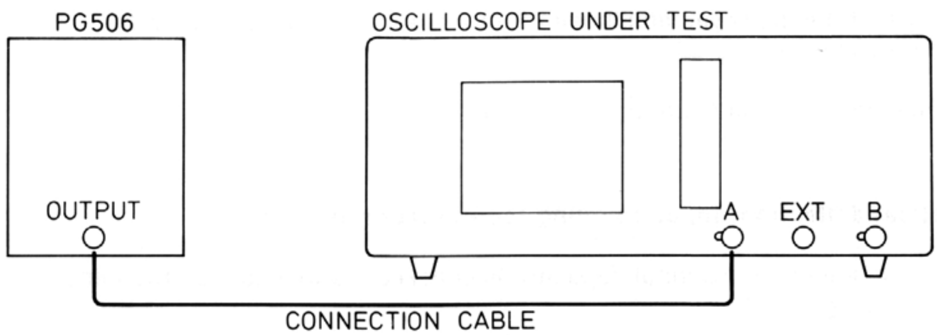
13.3.6 Vertical deflection; deflection coefficients

The vertical deflection coefficients of both channels A and B are checked by means of a calibrated signal.

test equipment:

Square-wave calibration generator (PG 506)

test set-up:



settings/procedure:

1 – Apply a 1 kHz square-wave signal of 10 mV to input A. Generator in position STD AMPL.
2 – Press the AUTO SET button.

3 – Set channel A to 2 mV/div and to DC.
4 – Change the input voltage and the setting of channel A according to the table below and check that the amplitude of the signal agrees with this table.

requirements:

Input voltage (pp)	A(B) setting	Requirements
10 mV	2 mV	4,85...5,15 div
20 mV	5 mV	3,88...4,12 div
50 mV	10 mV	4,85...5,15 div
0,1 V	20 mV	4,85...5,15 div
0,2 V	50 mV	3,88...4,12 div
0,5 V	0,1 V	4,85...5,15 div
1 V	0,2 V	4,85...5,15 div
2 V	0,5 V	3,88...4,12 div
5 V	1 V	4,85...5,15 div
10 V	2 V	4,85...5,15 div
20 V	5 V	3,88...4,12 div
50 V	10 V	4,85...5,15 div

Repeat settings/procedure for channel B.

13.3.7 Vertical deflection; variable gain control range (continuation of 13.3.6)

In this test the range of the vertical variable gain control is checked.

settings/procedure:

1 – Apply a square-wave signal of 5 V to input A and press AUTO SET.
2 – Set channel A to 1 V/div and to DC.
3 – Turn the VAR control of channel A fully counter clockwise.

requirements:

Verify that the displayed amplitude is not more than 2 div (ratio 1 : 2,5) and turn VAR back to CAL position.

Repeat settings/procedure for channel B.

13.3.8 Vertical deflection; input coupling (continuation of 13.3.7)

The function of the AC input capacitor is checked, as well as the grounding function of the coupling switch.

settings/procedure:

Turn the VAR control knob fully clockwise.

requirements:

Check for both channel A and B.

1 – Press the GND button and check that the signal disappears and that a straight line is displayed.
2 – Press the GND button again, then the AC/DC button and check that the signal shifts upwards when DC is pressed.

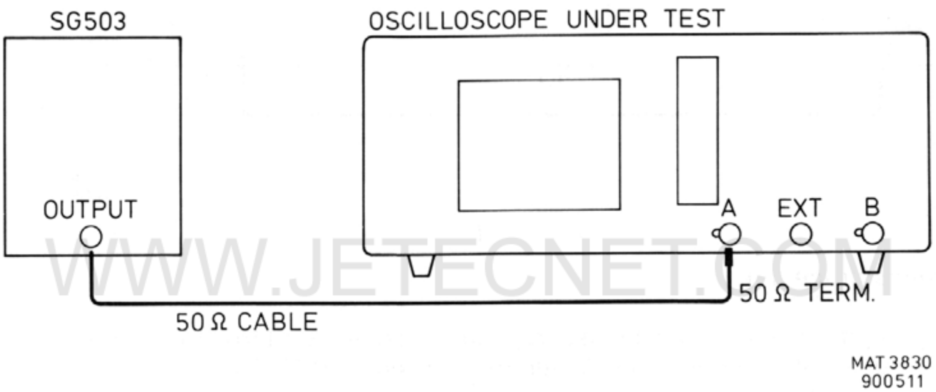
13.3.9 Vertical deflection; frequency response

This test is performed to verify the vertical bandwidth.

test equipment:

Constant amplitude sine-wave generator (SG 503)

test set-up:



settings/procedure:

1 – Apply a 50 kHz sine-wave signal of 120 mV (pp) to input A and press the AUTO SET button; use a 50 Ω termination.
2 – Set channel A to 20 mV/div and VAR to CAL.
3 – Adjust the input signal to a trace-height of exactly 6 div.
4 – Increase the frequency up to 60 MHz (slowly) and verify that the vertical deflection is 4,2 div or more over the complete bandwidth range.
5 – Reduce the amplitude of the input signal to 12 mV and the frequency to 50 kHz.
6 – Set channel A to 2 mV/div and adjust the input signal to a trace-height of exactly 6 div.
7 – Increase the frequency up to 35 MHz (slowly) and check that the vertical deflection is 4,2 div or more over the complete bandwidth range.

requirements:

The vertical deflection must be 4,2 div or more.

Repeat settings/procedure for channel B.

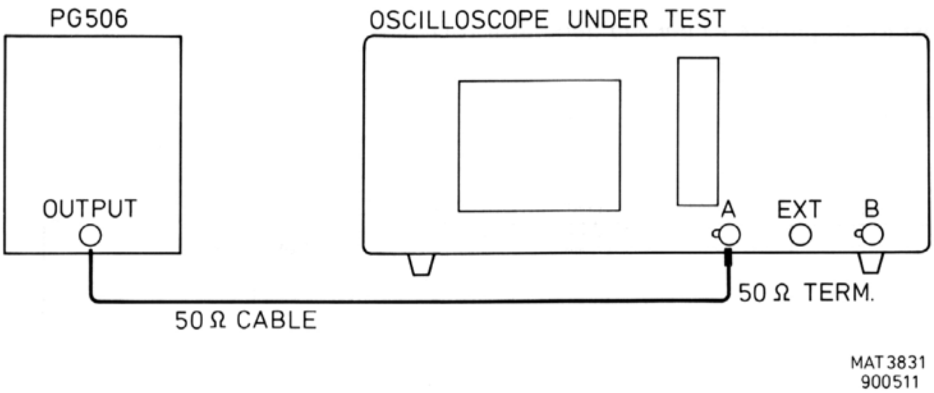
13.3.10 Vertical deflection; rise-time

By means of a fast rise-time pulse the rise-time of the oscilloscope is checked.

test equipment:

Fast rise-time square-wave generator (PG 506)

test set-up:



settings/procedure:

1 – Apply a fast rise-time pulse, repetition frequency 1 MHz, to input A; use a 50 Ω termination. Generator in position FAST RISE.
2 – Set A to 100 mV/div.
3 – Press X MAGN.
4 – Set TB to 5 ns/div.
5 – Position the rising edge of the signal to the horizontal centre of the screen, by means of the X POS control.
6 – Adjust the trace-height exactly between the dotted lines 0 % and 100 % (5 div).

requirements:

Important: $tr\ (measured) = \sqrt{tr\ (input\ signal)^2 + tr\ (oscilloscope)^2}$

1 – Check the rise-time, measured between the 10 % and 90 % lines (4 div).
2 – The rise-time measured must be 5,8 ns (1,16 div) or less.

Repeat settings/procedure for channel B.

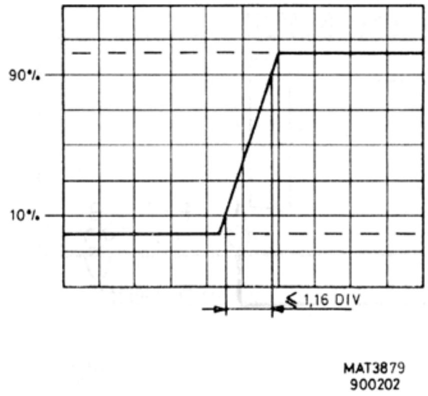


Figure 13.3 Rise-time.

13.3.11 Vertical deflection; noise

The noise, caused by the instrument's amplifiers, may not exceed a certain value. This value is checked by the following procedure.

test equipment:

None

settings/procedure:

1 – Press A/B: channel A and B on.
2 – Set channel A and B to 20 mV/div.
3 – Press ALT/CHOP for CHOP mode.
4 – Press GND of both channels, for grounded input coupling.

requirements:

Ensure that the traces are not thicker than 0,1 div (0,5 subdiv).

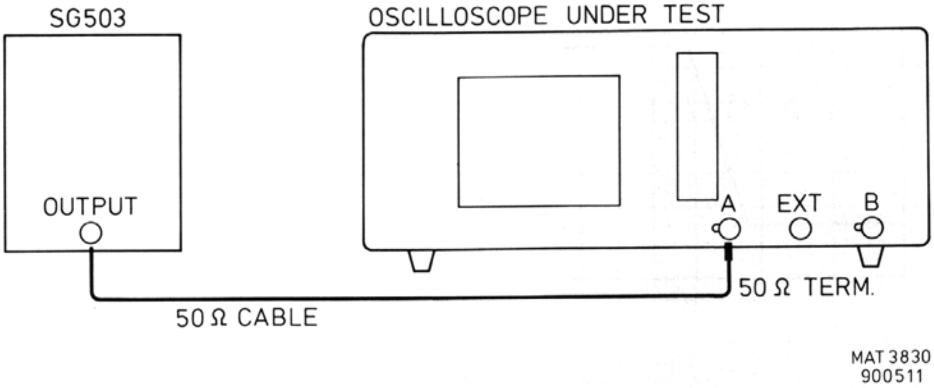
13.3.12 Vertical deflection; dynamic range at 10 MHz

A certain overdrive of the oscilloscope must be allowed. In practice, a signal of 24 divisions must be displayed distortion-free at low frequencies.

test equipment:

Constant amplitude sine-wave generator (SG 503)

test set-up:



settings/procedure:

1 – Apply a 10 MHz sine-wave signal of 2,4 V (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button and set A to 0,1 V/div.
3 – Shift the sine-wave vertically over the screen by means of the Y POS control.

requirements:

Verify that top and bottom of the sine-wave signal of 24 divisions can be displayed distortion-free.
Repeat settings/procedure for channel B.

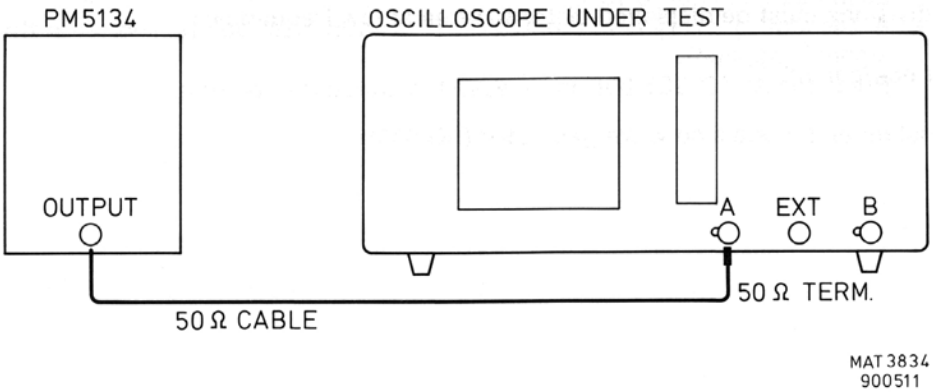
13.3.13 Vertical deflection; position range

The range of the vertical shift is checked by means of a signal of 16 divisions.

test equipment:

LF sine-wave generator (function generator, PM 5134)

test set-up:



settings/procedure:

1 – Apply a 1 kHz sine-wave signal of 8 V (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button and set A to 0,5 V/div.

requirements:

Rotate the Y POS control of channel A fully clockwise and counter clockwise and check that the top and bottom of the signal can be positioned on the vertical centre of the screen.

Repeat settings/procedure for channel B.

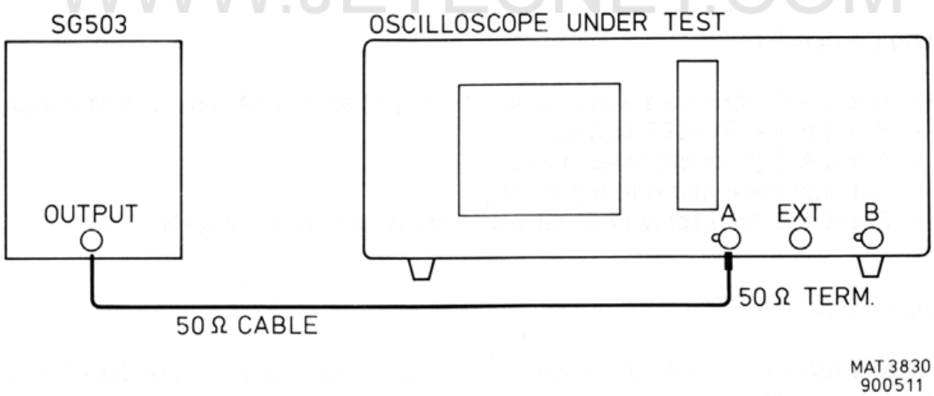
13.3.14 Vertical deflection; cross talk between A and B at 10 MHz

Both channels A and B influence each other. A certain amount of interference is allowed, this is checked here.

test equipment:

Constant amplitude sine-wave generator (SG 503)

test set-up:



settings/procedure:

1 – Apply a 10 MHz sine-wave signal of 4 V (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button.
3 – Press A/B (both channels displayed).
4 – Set channel A and B to 0,5 V/div.
5 – Press A/B, to display channel B and press GND of channel B.

requirements:

Verify that the trace-height of the channel without input signal is less than 0,08 div, (better than 1 : 100).

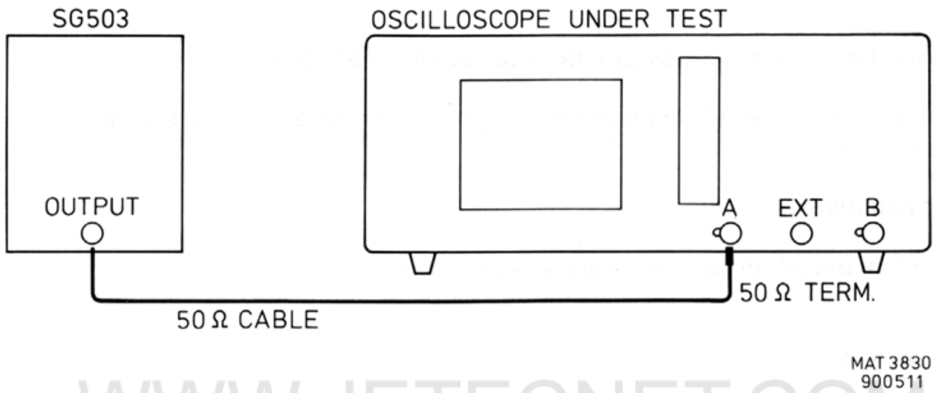
13.3.15 Vertical deflection; cross talk between A and B at 60 MHz

At higher frequencies the interference between the two channels is more. Now, the test is carried out at a high frequency.

test equipment:

Constant amplitude sine-wave generator (SG 503)

test set-up:



settings/procedure:

1 – Apply a 60 MHz sine-wave signal of 4 V (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button.
3 – Press A/B (both channels displayed).
4 – Set channel A and B to 0,5 V/div.
5 – Press A/B, to display channel B and press GND of channel B.

requirements:

Verify that the trace-height of the channel without input signal is less than 0,16 div, (better than 1 : 50).

Repeat settings/procedure for channel B.

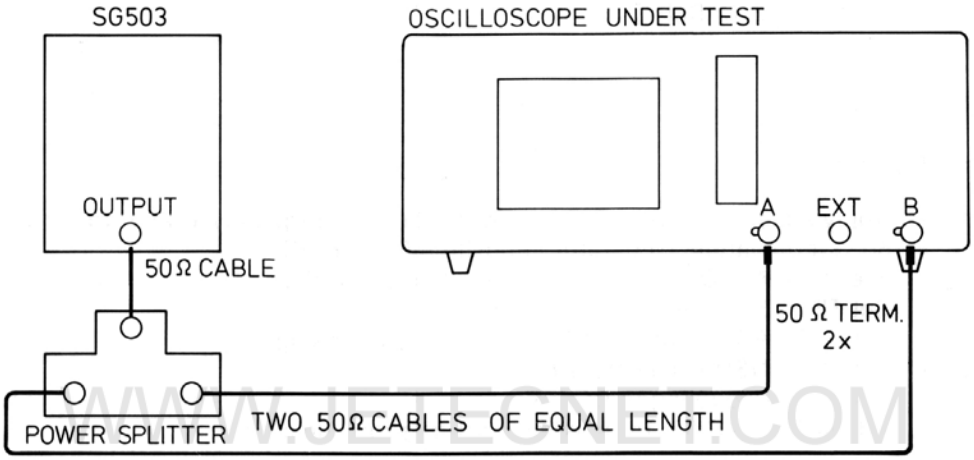
13.3.16 Vertical deflection; common mode rejection ratio

The common mode rejection ratio (CMRR) indicates the susceptibility to common mode signals, this is checked in this test.

test equipment:

- HF constant amplitude sine-wave generator (SG 503)
- Power splitter

test set-up:



settings/procedure:

1 – Apply a 1 MHz sine-wave signal of 4 V (pp) to inputs A and B. Use a power splitter and two cables of equal length to A and B. Use 50 Ω terminations.
2 – Press the AUTO SET button.
3 – Set A and B to 0,5 V/div and adjust the input voltage to exactly 4 div.
4 – Set A and B to 0,2 V/div and input coupling to DC.
5 – Press ADD/INVERT 3 times (ADD and INVERT on).
6 – Adjust the VAR controls of A and B for minimum trace-height of the straight line.
7 – Press A/B 2 times, only the straight line is visible now.
8 – Readjust one of the VAR controls for minimum trace-height.

requirements:

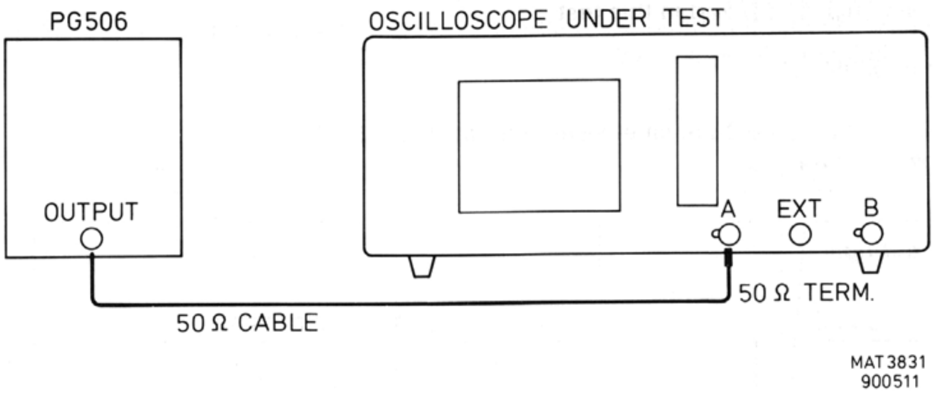
Check that the trace-height of the A – B signal is less than 0,1 div.

13.3.17 Vertical deflection; visual signal delay

It must be possible to observe the rising edge of a pulse. Therefore, a certain signal delay is introduced in the instrument. This delay is checked in this test.

test equipment:

Square-wave calibration generator (PG 506) *test set-up*:



settings/procedure:

1 – Apply a fast rise-time (≤ 1 ns) signal of 0,5 V, frequency 1 MHz, to input A; use a 50 Ω termination. Generator in position FAST RISE.
2 – Press the AUTO SET button and set A to 0,1 V/div.
3 – Set TB to 50 ns/div.
4 – Press X MAGN and turn X POS to display the rising edge.
5 – Turn INTENSITY fully clockwise.
6 – Set trigger coupling to DC.
7 – Adjust TRIG LEVEL for maximum visual signal delay.

requirements:

Verify that the visual signal delay is at least 15 ns (3 div).

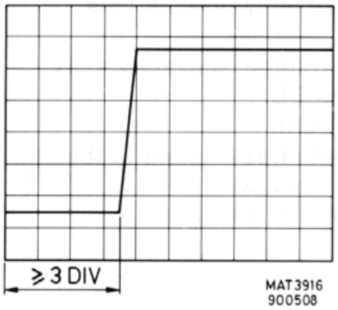


Figure 13.4 Visual signal delay.

13.3.18 Vertical deflection; base line jump

Several adjustments of balance, offset and jump, are checked here.

test equipment:

None

settings/procedure
and requirements:

This test must be done in the service menu OFFS-A.
To enter this menu proceed as follows:
Press RESET and keep it pressed, then press AUTO SET,
the LCD will show an asterisk (*).
Attenuator balance:

1 – Select OFFS-A of CRT function controls.
2 – Check LCD display: "3.0" flashing.
3 – The attenuator is switched between the 1-2-5 positions.
4 – Verify that both spots do not jump more than 0,2 div (1 subdiv).
If necessary, turn Y POS to show 2 spots.

VAR balance:

1 – Press mV of channel A UP-DOWN control.
2 – Check LCD display: "3.1" flashing.
3 – Rotate VAR control of channel A.
4 – Verify that spot A does not shift more than 0,2 div (1 subdiv).
5 – Reset VAR control back to CAL.
6 – Rotate VAR control of channel B.
7 – Verify that spot B does not shift more than 0,2 div (1 subdiv).
8 – Reset VAR control back to CAL.

x1/x10 attenuator offset:

1 – Press mV of channel A UP-DOWN control
2 – Check LCD display: "3.2" flashing.
3 – Verify that both spots do not jump more than 0,3 div (1,5 subdiv).

NORMAL-INVERT jump:

1 – Press mV of channel A UP-DOWN control 4 times.
2 – Check LCD display: "3.6" flashing.
3 – Verify that the spot does not jump more than 0,2 div (1 subdiv).
4 – Press AUTO SET 2 times to leave the service menu.

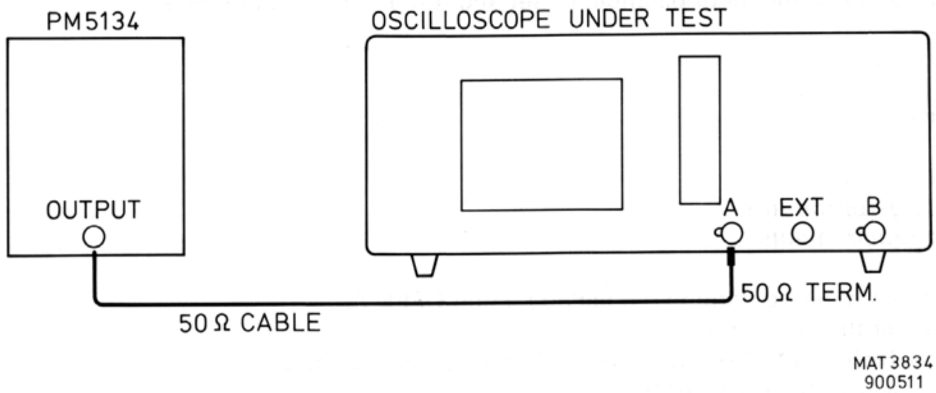
13.3.19 Horizontal deflection; X deflection

The correct working of the X-Y mode is tested.

test equipment:

LF sine-wave generator (function generator, PM 5134)

test set-up:



settings/procedure:

1 – Apply a 2 kHz sine-wave signal of 800 mV (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button and set A to 0,1 V/div.
3 – Adjust the input signal to a trace-height of 8 div.
4 – Press X DEFL and check that only the X DEFL is on.

requirements:

Verify that a line with an angle of 45° is displayed.

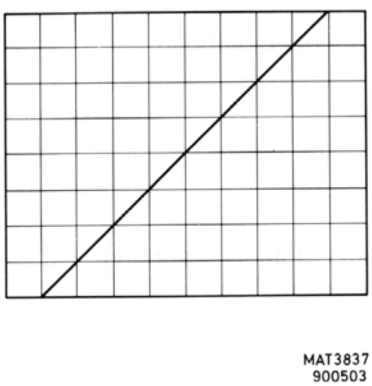


Figure 13.5 X deflection

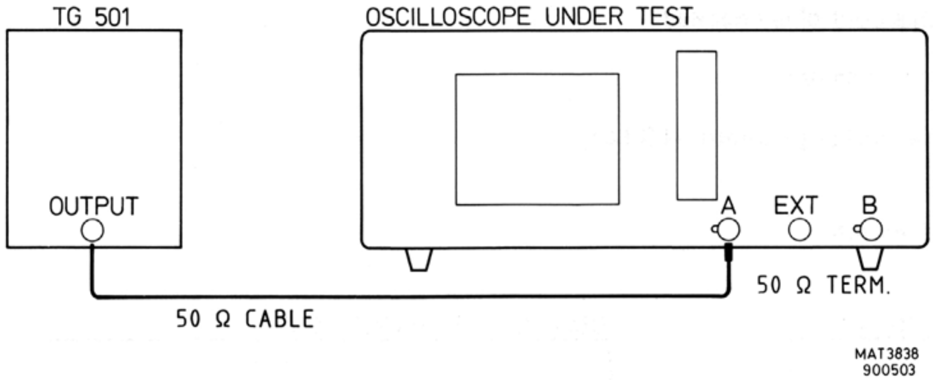
13.3.20 Horizontal deflection; time-base deflection coefficients

The deflection coefficients of the time-base generator are verified by means of a calibration signal.

test equipment:

Time marker generator (TG 501)

test set-up:



settings/procedure:

1 – Apply a 50 ns time marker signal to input A; use a 50 Ω termination.
2 – Press the AUTO SET button.
3 – Verify the deflection coefficients in TB x1 and TB x10 according to the table in requirements. Make use of the deflection error facility of the TG 501.

NOTE:
Error limits must be measured between the 2nd and 10th graticule line; there are 11 graticule lines.
In TB x10 measured on the central 10 div of the expanded TB of 100 div.

requirements:

Marker pulse at: TB x1	TB x10	TB setting	Max. error at: TB x1	TB x10
50 ns	5 ns	50 ns	± 3 %	± 4 %
0,1 μs	10 ns	0,1 μs	± 3 %	± 4 %
0,2 μs	20 ns	0,2 μs	± 3 %	± 4 %
0,5 μs	50 ns	0,5 μs	± 3 %	± 4 %
1 μs	0,1 μs	1 μs	± 3 %	± 4 %
2 μs	0,2 μs	2 μs	± 3 %	± 4 %
5 μs	0,5 μs	5 μs	± 3 %	± 4 %
10 μs	1 μs	10 μs	± 3 %	± 4 %
20 μs	2 μs	20 μs	± 3 %	± 4 %
50 μs	5 μs	50 μs	± 3 %	± 4 %
0,1 ms	10 μs	0,1 ms	± 3 %	± 4 %
0,2 ms	20 μs	0,2 ms	± 3 %	± 4 %
0,5 ms	50 μs	0,5 ms	± 3 %	± 4 %
1 ms	0,1 ms	1 ms	± 3 %	± 4 %
2 ms	0,2 ms	2ms	± 3 %	± 4 %
5 ms	0,5 ms	5 ms	± 3 %	± 4 %
10 ms	1 ms	10 ms	± 3 %	± 4 %
20 ms	2 ms	20 ms	± 3 %	± 4 %
50 ms	5 ms	50 ms	± 3 %	± 4 %
0,1 s	10 ms	0,1 s	± 3 %	± 4 %
0,2 s	20 ms	0,2 s	± 3 %	± 4 %
0,5 s	50 ms	0,5 s	± 3 %	± 4 %

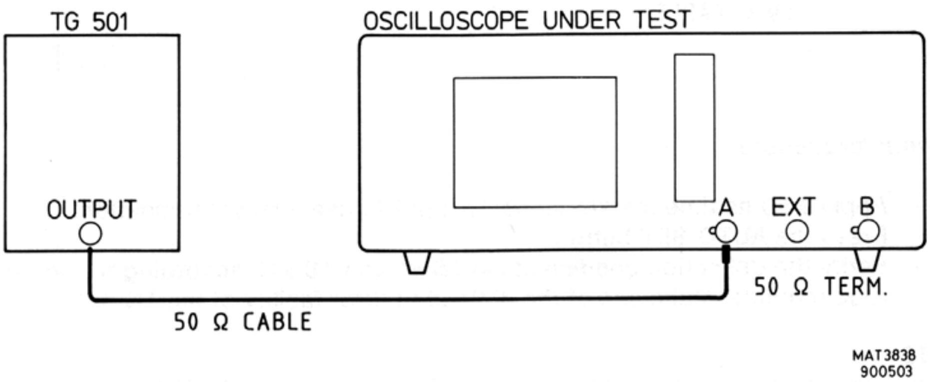
13.3.21 Horizontal deflection; variable control ratio (VAR TB)

The horizontal deflection coefficients can be varied by a variable control. Here, the range of this control is checked.

test equipment:

Time marker generator (TG 501)

test set-up:



settings/procedure:

1 – Apply a 1 μs time marker signal to input A; use a 50 Ω termination.
2 – Press the AUTO SET button.
3 – Set TB to 0,2 μs/div and VAR to CAL; time marker on the first and sixth graticule line. (distance between markers 5 div)
4 – Turn the TB VAR fully counter clockwise.

requirements:

Verify that the second marker is placed between the second and third graticule line. This means that the VAR control overlaps the time-base steps 0,2 to 0,5 μs (ratio 2,5 : 1).

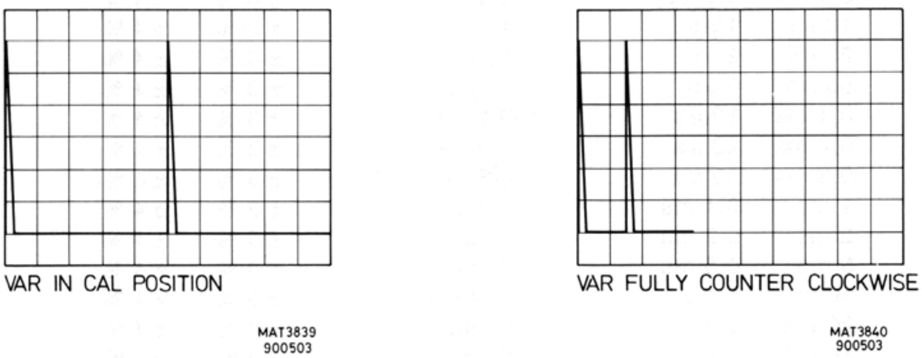


Figure 13.6 TB VAR range

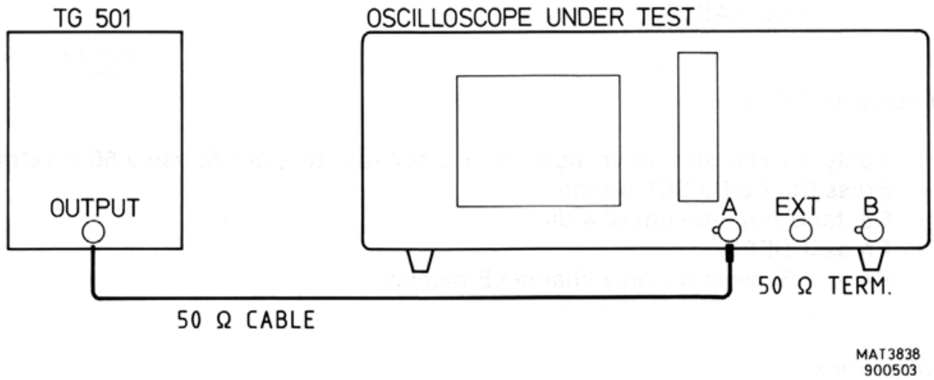
13.3.22 Horizontal deflection; TB magnifier balance

The magnitude of the horizontal amplification can be increased by 10. When switching from x1 to x10 a certain shift can appear. The maximum allowed shift is checked here.

test equipment:

Time marker generator (TG 501)

test set-up:



settings/procedure:

1 – Apply a 1 μs time marker signal to input A; use a 50 Ω termination.
2 – Set TB to 0,2 μs/div and VAR to CAL; time marker on the first and sixth graticule line.
3 – Set X MAGN on.
4 – Set the top of the second marker pulse exactly at the vertical centre of the graticule.
5 – Set X MAGN to off.

requirements:

Verify that the top of the second marker pulse is not shifted more than 0,5 div, when X MAGN is switched to off.

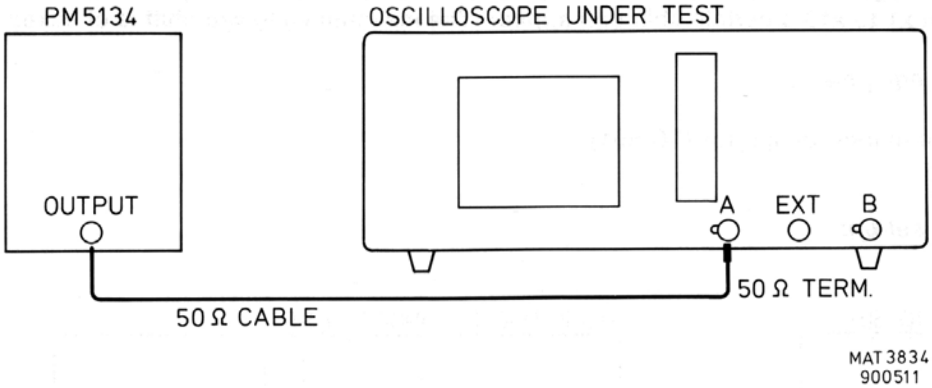
13.3.23 Horizontal deflection; X deflection coefficient via A

The amplification of the horizontal amplifier via the vertical amplifier is checked.

test equipment:

Sine-wave generator (function generator, PM 5134)

test set-up:



settings/procedure:

1 – Apply a 2 kHz sine-wave signal of 800 mV (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button.
3 – Set for a trace-height of 4 div.
4 – Press X DEFL.
5 – Press A/B twice for only channel B display.

requirements:

Verify that a horizontal line of 3,8...4,2 div is displayed.

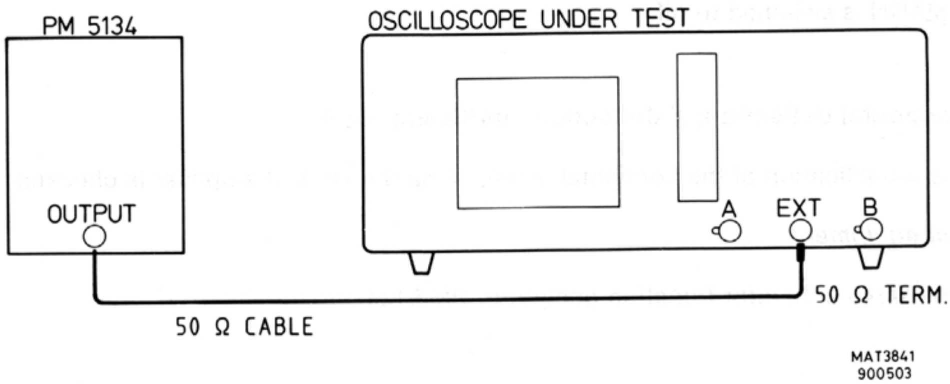
13.3.24 Horizontal deflection; X deflection coefficient via EXT

The amplification of the horizontal amplifier via the external input is checked.

test equipment:

Sine-wave generator (function generator, PM 5134)

test set-up:



settings/procedure:

1 – Apply a 2 kHz sine-wave signal of 1 V (pp) to input EXT; use a 50 Ω termination.
2 – Select EXT with TRIG or X SOURCE.
3 – Press X DEFL.

requirements:

Verify that a horizontal line of 9,5...10,5 div is displayed.

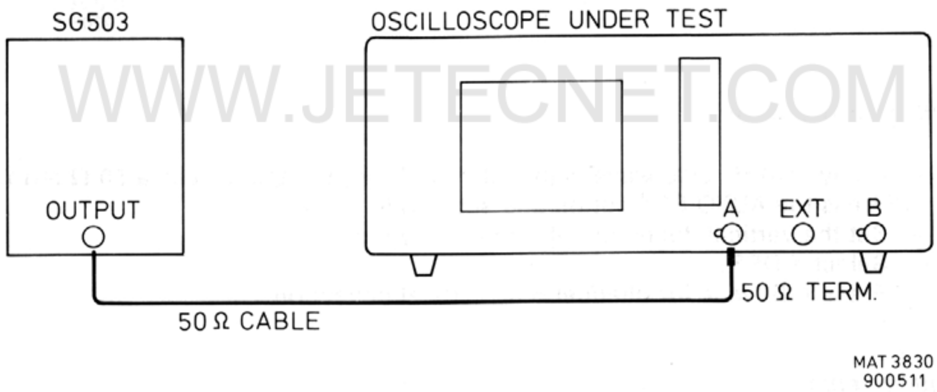
13.3.25 Horizontal deflection; frequency response 1

In this test, the bandwidth of the horizontal amplifier is verified.

test equipment:

Constant amplitude sine-wave generator (SG 503).

test set-up:



settings/procedure:

1 – Apply a 50 kHz sine-wave signal of 30 mV (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button and set A to 5 mV/div.
3 – Press X DEFL.
4 – Press A/B twice for channel B as vertical deflection.
5 – Adjust the input voltage for exactly 6 div horizontal deflection.
6 – Increase the input frequency up to 2 MHz.

requirements:

Verify that the trace width is at least 4,2 div over the complete bandwidth range.

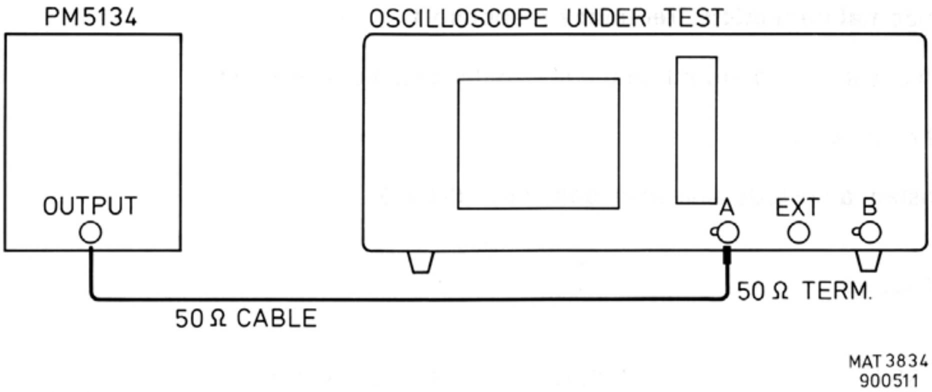
13.3.26 Horizontal deflection; frequency response 2

In this test, the function of the horizontal amplifier at low frequencies is checked.

test equipment:

LF sine-wave generator (function generator, PM 5134)

test set-up:



settings/procedure:

1 – Apply a 10 Hz sine-wave signal of 30 mV (pp) to input A; use a 50 Ω termination.
2 – Press the AUTO SET button and set A to 5 mV/div.
3 – Set the vertical deflection of A to exactly 6 div.
4 – Select X DEFL.
5 – Press A/B twice for channel B as vertical deflection.

requirements:

Ensure that the trace width is at least 4,2 div.

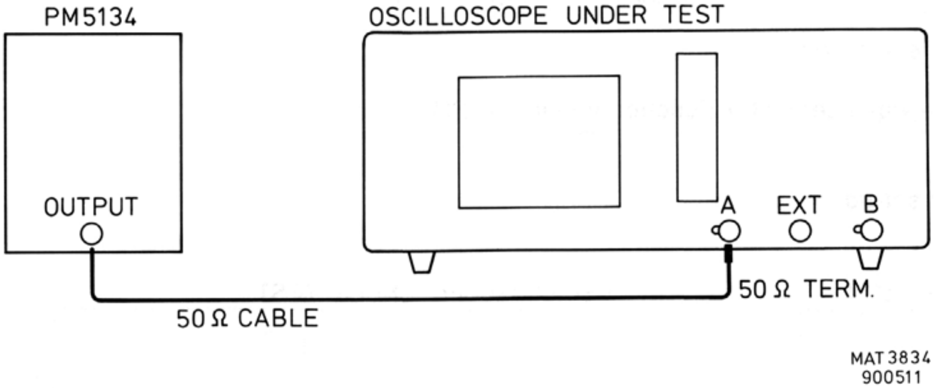
13.3.27 Maximum phase shift between horizontal and vertical deflection

There will be a certain phase shift between the horizontal and vertical amplifier. The value of this shift is measured here.

test equipment:

LF sine-wave generator (function generator, PM 5134)

test set-up:



settings/procedure:

1 – Apply a 2 kHz sine-wave signal of 1,2 V (pp) to channel A; use a 50 Ω termination.
2 – Press the AUTO SET button and set for a trace-height of exactly 6 div.
3 – Press X DEFL.
4 – Increase the input frequency to 100 kHz.

requirements:

Verify that the phase shift is less than 3°; this results in the display as shown in figure 13.7.

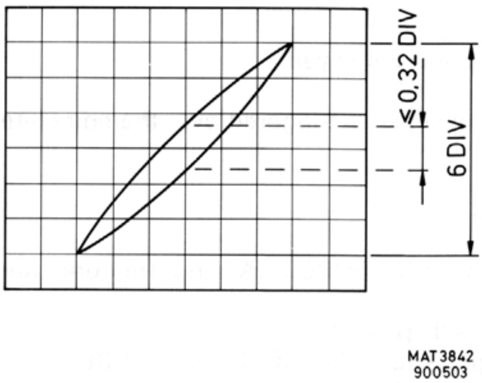


Figure 13.7 Phase shift

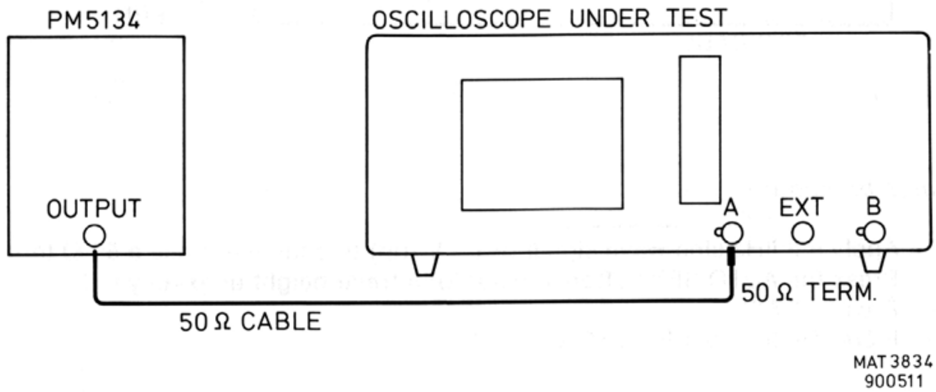
13.3.28 Triggering; sources and coupling

In this test, the various trigger sources and coupling modes are tested.

test equipment:

Sine-wave generator (function generator, PM 5134)

test set-up:



settings/procedure and requirements:

1 – Apply a 2 kHz sine-wave signal of 800 mV (pp) to input A; use a 50 Ω termination.
2 – Press AUTO SET and set the trace-height to 4 div.
3 – Press TRIG COUPL and select DC.
4 – Adjust TRIG LEVEL for a triggered signal.
5 – Check that a sine-wave signal of 4 div is displayed.
6 – Press TRIG COUPL and select p-p.
7 – Turn TRIG LEVEL and check that the signal is triggered over the complete range of this control.
8 – Connect the CAL signal to input B.
9 – Press A/B to display both channels.
10 – Set channel B to 0,2 V/div.
11 – Select B as trigger source with TRIG or X SOURCE, (A is not triggered and moves, B is triggered now and stable).
12 – Check that a square-wave of 6 div is displayed.
13 – Increase the input frequency to input A to 20 kHz (CAL signal to B).
14 – Press TRIG or X SOURCE 5 times, (A and B selected).
15 – Check that 2 well-triggered traces are displayed.

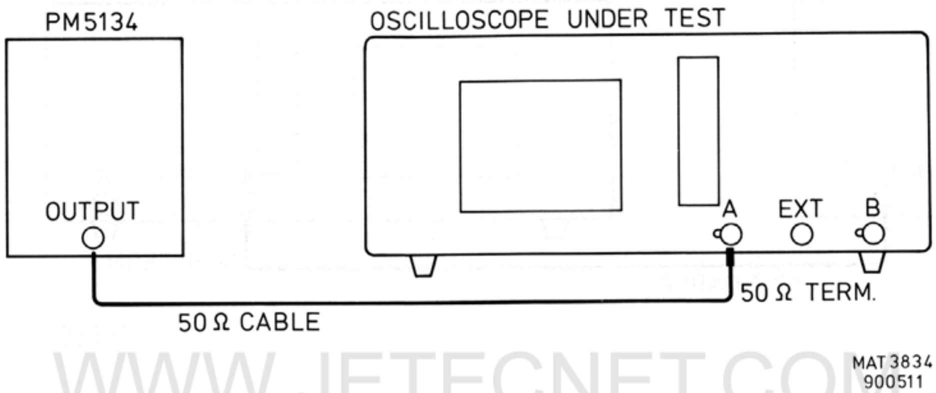
13.3.29 Triggering; slope selection and level control range

This test checks the range of the trigger level control and the correct working of the slope selection.

test equipment:

- LF sine-wave generator (function generator, PM 5134)
- T-piece

test set-up:



settings/procedure
and requirements:

1 – Apply a 2 kHz sine-wave signal of 1,6 V (pp) to input A; use a 50 Ω termination.
2 – Press AUTO SET and set A to 0,2 V/div at DC input coupling.
3 – Set TRIG COUPL for p-p triggering.
4 – Turn TRIG LEVEL fully clockwise and fully counter clockwise.
5 – Check that the signal is well-triggered over the complete TRIG LEVEL range.
6 – Set the TRIG LEVEL control in its mid-position.
7 – The start of the signal display must be in the vertical centre.
8 – Press TB TRIG MODE.
9 – Press SLOPE (_/‾ ‾_).
10 – Check that the sine-wave signal is inverted and that it is triggered on the negative slope.
– Press SLOPE once again.
12 – Press TRIG COUPL for DC coupling.
13 – Set A to 100 mV/div (16 div trace-height).
14 – Turn the TRIG LEVEL.
15 – Verify that the LEVEL range is more than +8 div and −8 div and that the signal is triggered on the positive slope. Use Y POS control.

Repeat this procedure for channel B.

Repeat this procedure for the same signal to inputs A and EXT together, by means of a T-piece, and select after step 2 EXT triggering by means of TRIG or X SOURCE.

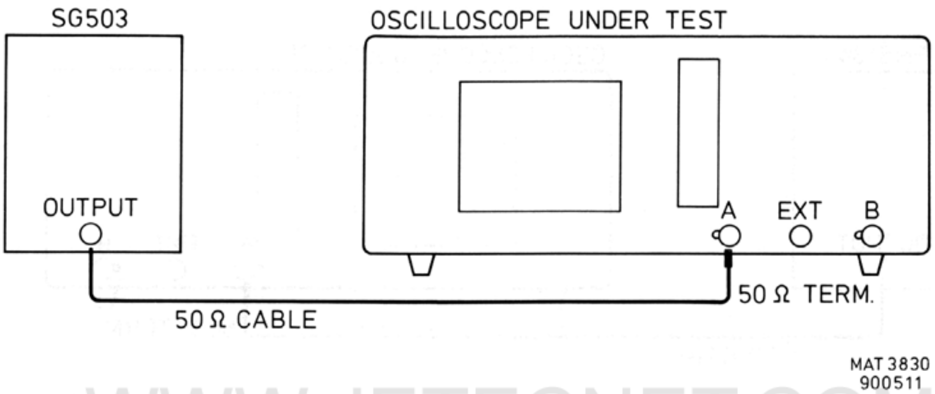
13.3.30 Triggering; trigger sensitivity via A and B

The trigger sensitivity depends on the amplitude and frequency of the trigger signal. In this test the sensitivity via the A and B inputs is checked.

test equipment:

Constant amplitude sine-wave generator (SG 503)

test set-up:



settings/procedure
and requirements:

1 – Apply a 10 MHz sine-wave signal of 250 mV (pp) to input A; use a 50 Ω termination.
2 – Press AUTO SET and set A to 0,2 V/div.
3 – Set AC/DC coupling of A to DC.
4 – Press TB TRIG MODE for TRIG mode.
5 – Press TRIG COUPL for DC trigger coupling.
6 – Turn TRIG LEVEL for a well-triggered signal.
7 – Decrease the amplitude of the input signal.
8 – Verify that the signal is well-triggered at amplitudes of 0,5 div and more.
9 – Decrease the input frequency to 50 kHz.
10 – Verify that the signal stays well-triggered at amplitudes of 0,5 div and more.
11 – Increase the input frequency to 50 MHz.
12 – Increase the input voltage to 1 div.
13 – Turn TRIG LEVEL.
14 – Verify that the signal is well-triggered at amplitudes of 1 div and more.
15 – Increase the input frequency to 100 MHz.
16 – Increase the input voltage to 3 div.
17 – Verify that the signal is well-triggered at amplitudes of 3 div and more.

Repeat this procedure for channel B.

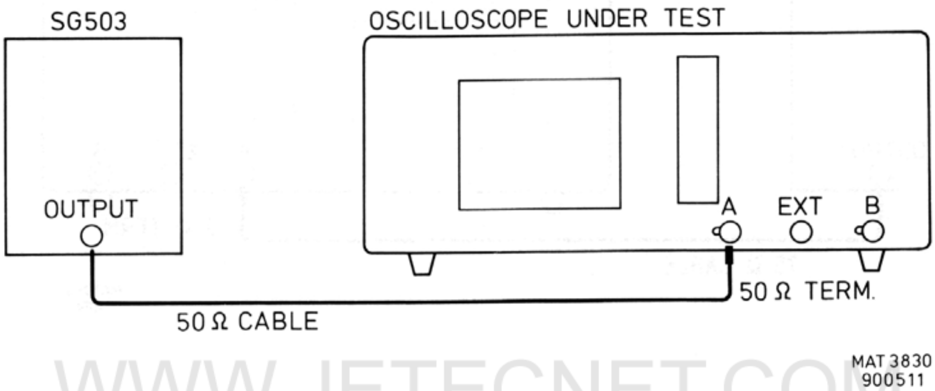
13.3.31 Triggering; trigger sensitivity via EXT

The trigger sensitivity depends on the amplitude and frequency of the trigger signal. In this test the sensitivity via the trigger input EXT is checked.

test equipment:

- Constant amplitude sine-wave generator (SG 503)
- T-piece

test set-up:



settings/procedure and requirements:

1 – Apply a 10 MHz sine-wave signal of 250 mV (pp) to input A; use a 50 Ω termination.
2 – Press AUTO SET and set A to 0,2 V/div.
3 – Set AC/DC coupling of A to DC and connect the input signal, by means of a T-piece, to inputs EXT and A together.
4 – Select EXT as trigger source by means of TRIG or X SOURCE.
5 – Press TB TRIG MODE for TRIG mode.
6 – Press TRIG COUPL for DC trigger coupling.
7 – Turn TRIG LEVEL for a well-triggered signal.
8 – Decrease the amplitude of the input signal.
9 – Verify that the signal is well-triggered at amplitudes of 50 mV and more.
10 – Decrease the input frequency to 50 kHz.
11 – Verify that the signal stays well-triggered at amplitudes of 50 mV and more.
12 – Increase the input frequency to 50 MHz.
13 – Increase the input voltage to 150 mV.
14 – Turn TRIG LEVEL.
15 – Verify that the signal is well-triggered at amplitudes of 150 mV and more.
16 – Increase the input frequency to 100 MHz.
17 – Increase the input voltage to 500 mV.
18 – Verify that the signal is well-triggered at amplitudes of 500 mV and more.

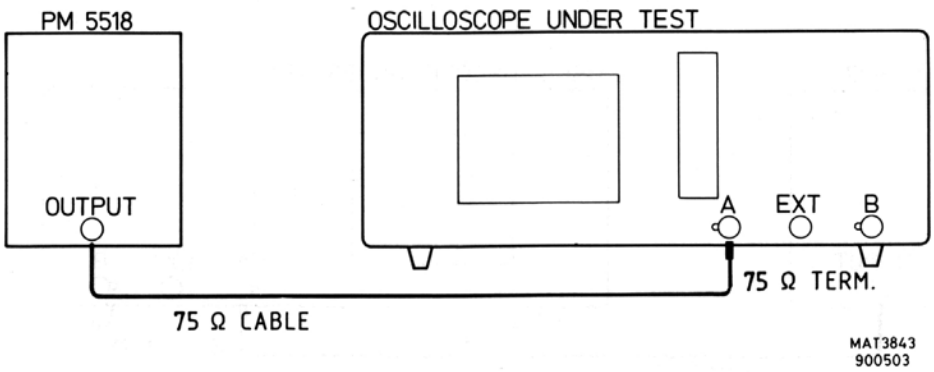
13.3.32 Triggering; trigger sensitivity TVL-TVF

This test checks the trigger sensitivity for television line- and frame signals.

test equipment:

TV pattern generator with video output (PM 5518)

test set-up:



settings/procedure:

1 – Apply a video signal to input A with an amplitude of about 1 V sync pulse amplitude; use a 75 Ω termination.
2 – Press the AUTO SET button.
3 – Press TB TRIG mode for TRIG mode.
4 – Press AC/DC for DC input coupling.
5 – Press TRIG COUPL for TVL and TVF.

requirements:

Decrease the amplitude of the input signal and verify that the signal is well-triggered on the narrow TVL and the wide TVF pulse, at sync pulse amplitudes of 0,7 div and more.

Repeat settings/procedure for channel B.

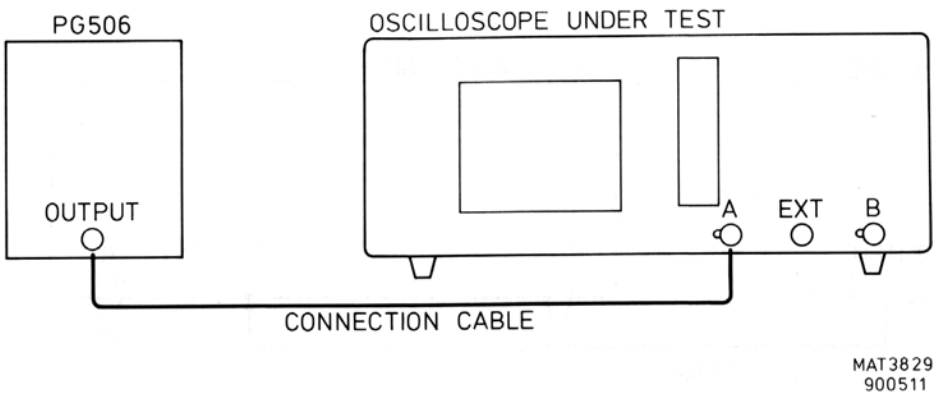
13.3.33 Cursors; voltage cursor accuracy

In this test the accuracy of the voltage cursors is checked.

test equipment:

Square-wave calibration generator (PG 506)

test set-up:



settings/procedure:

1 – Apply a 1 kHz square-wave voltage of 1 V to the channel A input.
2 – Press the AUTO SET button. If the instrument is in the LOCK mode, first press DIGITAL MEMORY.
3 – Set channel A to 0,2 V/div and to DC.
4 – Press DIGITAL MEMORY to switch the digital memory ON.
5 – Press LOCK.
6 – Select CURSORS by means of the CRT function control CURSORS. If CURSORS is not shown, first press the CRT function control RETURN until CURSORS appears.
7 – Press the CRT function control MODE.
8 – Press the CRT function control V-CURS ON/OFF to ON.
9 – Press the CRT function control V/RATIO to V.
10 – Press the CRT function control T-CURS ON/OFF to OFF.
11 – Press the CRT function control RETURN.
12 – Press the CRT function control V-CTRL.
13 – Position the REF cursor to the bottom of the waveform (in the middle of the line) by means of the CRT function control ↑ or ↓.
14 – Position the delta cursor (Δ) to the top of the waveform (in the middle of the line) by means of the CRT function control ↑ or ↓.

requirements:

Verify that the voltage cursor read-out at the top of the screen is 0,97...1,03 V.

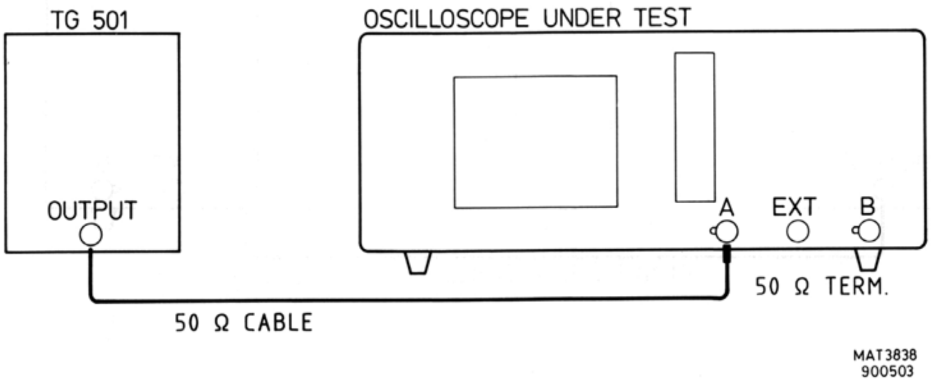
13.3.34 Cursors; time cursor accuracy

In this test the accuracy of the time cursors is checked.

test equipment:

Time marker generator (TG 501)

test set-up:



settings/procedure:

1 – Apply a 1 ms time marker signal to input A; use a 50 Ω termination.
2 – Press the AUTO SET button. If the instrument is in the LOCK mode, first press DIGITAL MEMORY.
3 – Press DIGITAL MEMORY to switch the digital memory ON.
4 – Set TB to 1 ms/div.
5 – Press LOCK.
6 – Select CURSORS by means of the CRT function control CURSORS. If CURSORS is not shown, first press the CRT function control RETURN until CURSORS appears.
7 – Press the CRT function control MODE.
8 – Press the CRT function control T-CURS ON/OFF to ON.
9 – Press the CRT function control V-CURS ON/OFF to OFF.
10 – Press the CRT function control T/PH/RATIO to T.
11 – Press the CRT function control RETURN.
12 – Press the CRT function control T-CTRL.
13 – Position the REF cursor and the delta cursor (Δ) by means of the CRT function controls ← and → so that they cover a distance of 8 time marker intervals; position the markers exactly to the top of the marker pulses.

requirements:

Check for a time cursor read-out of 7,99...8,01 ms.

Press DIGITAL MEMORY to switch the digital memory OFF.

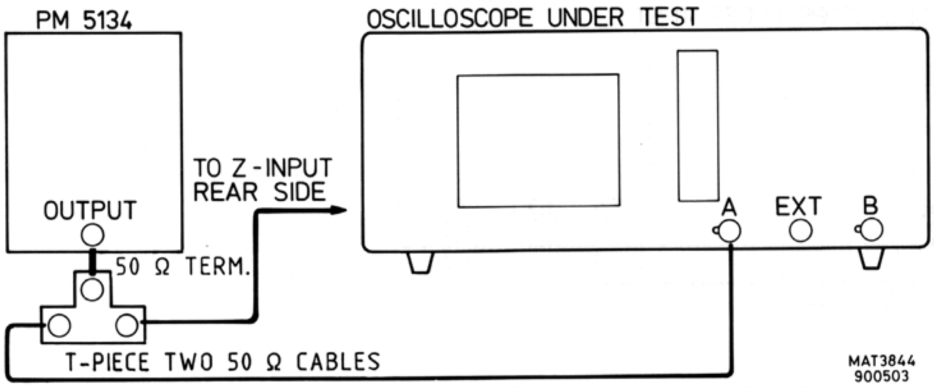
13.3.35 Z-MOD sensitivity

This test checks the sensitivity of the Z modulation facility.

test equipment:

- Square-wave generator (function generator, PM 5134)
- T-piece

test set-up:



settings/procedure and requirements:

1 – Apply a 1 kHz square-wave signal, duty cycle 50 %, amplitude 2,5 V, to input A.
2 – Press the AUTO SET button.
3 – Set TB to 0,5 ms/div.
4 – Set the trace of channel A in mid position.
5 – Apply the same signal by means of the T-piece to the Z-input (rear side).
6 – Check that only the bottom half of the square-wave signal is displayed. (500 μs blanking and 500 μs unblanking)
7 – Remove the Z-input.
8 – Decrease the input signal to 1 V.
9 – Reconnect the Z-input.
10 – Set A to 0,5 V /div.
11 – Check that the top half of the square-wave signal is visible with a lower intensity.
12 – Check that the top half of the signal is completely unblanked (visible with full intensity) at an input signal less than 0,8 V.

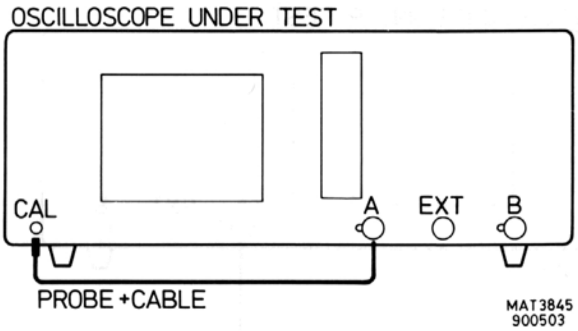
13.3.36 CAL signal; frequency and output voltage

The CAL signal is a calibration signal with fixed frequency and voltage. In this test, the values of frequency and voltage are checked.

test equipment:

None

test set-up:



settings/procedure:

1 – Connect the CAL signal to input A and press the AUTO SET button.
2 – Press GND of channel A.
3 – Set the trace in the centre of the screen.
4 – Press GND of channel A again.
5 – Select DC of A input coupling.

requirements:

1 – Check that a positive going square-wave signal of 1,2 V (pp) is displayed, i.e. 2,4 div at 0,5 V/div.
2 – Check that the frequency of the displayed signal is about 2 kHz, i.e. 5 div at 0,1 ms/div.

14 DISMANTLING THE INSTRUMENT

14.1 GENERAL INFORMATION

This section provides the dismantling procedures required for the removal of components during repair operations.
All circuit boards removed from the instrument must be adequately protected against damage, and all normal precautions regarding the use of tools must be observed.
During the dismantling a careful note must be made of all disconnected leads so that they can be reconnected to their correct terminals duringassembly.

CAUTION: Damage may result if:

- **The instrument is switched-on when a circuit board has been removed.**
- **A circuit board is removed within one minute after switching-off the instrument.**

14.2 REMOVING THE TOP AND BOTTOM COVERS

The instrument is protected by two covers: a top cover and a bottom cover. To remove these covers, proceed as follows:

- Slacken the two screws that secure both covers, located at the rear of the instrument.
- Gently push each cover backwards until it can be lifted.
- The covers can be removed by lifting them clear of the instrument.

14.3 ACCESS TO ADJUSTING ELEMENTS

After removing both covers (section 14.2), the digital unit and the time base unit have to be positioned vertically on the chassis. How to position these units is indicated in figure 14.1.

NOTE: For checking and adjusting the instrument it is not necessary to remove the bottom cover.

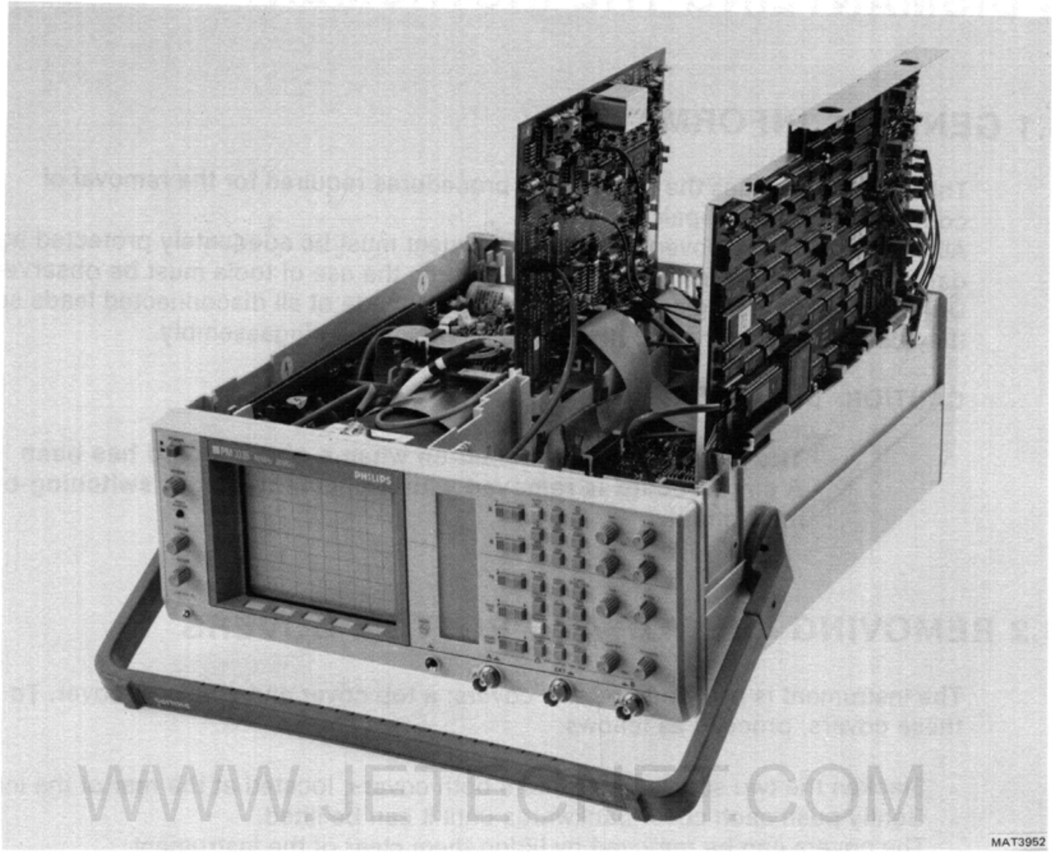


Figure 14.1 Access to all parts for adjusting the oscilloscope

15 ADJUSTING PROCEDURE

15.1 GENERAL INFORMATION

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

- Warming-up time under average conditions is 30 minutes.

- Where possible, instrument performance should be checked before any adjustment is made.

- 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 2.

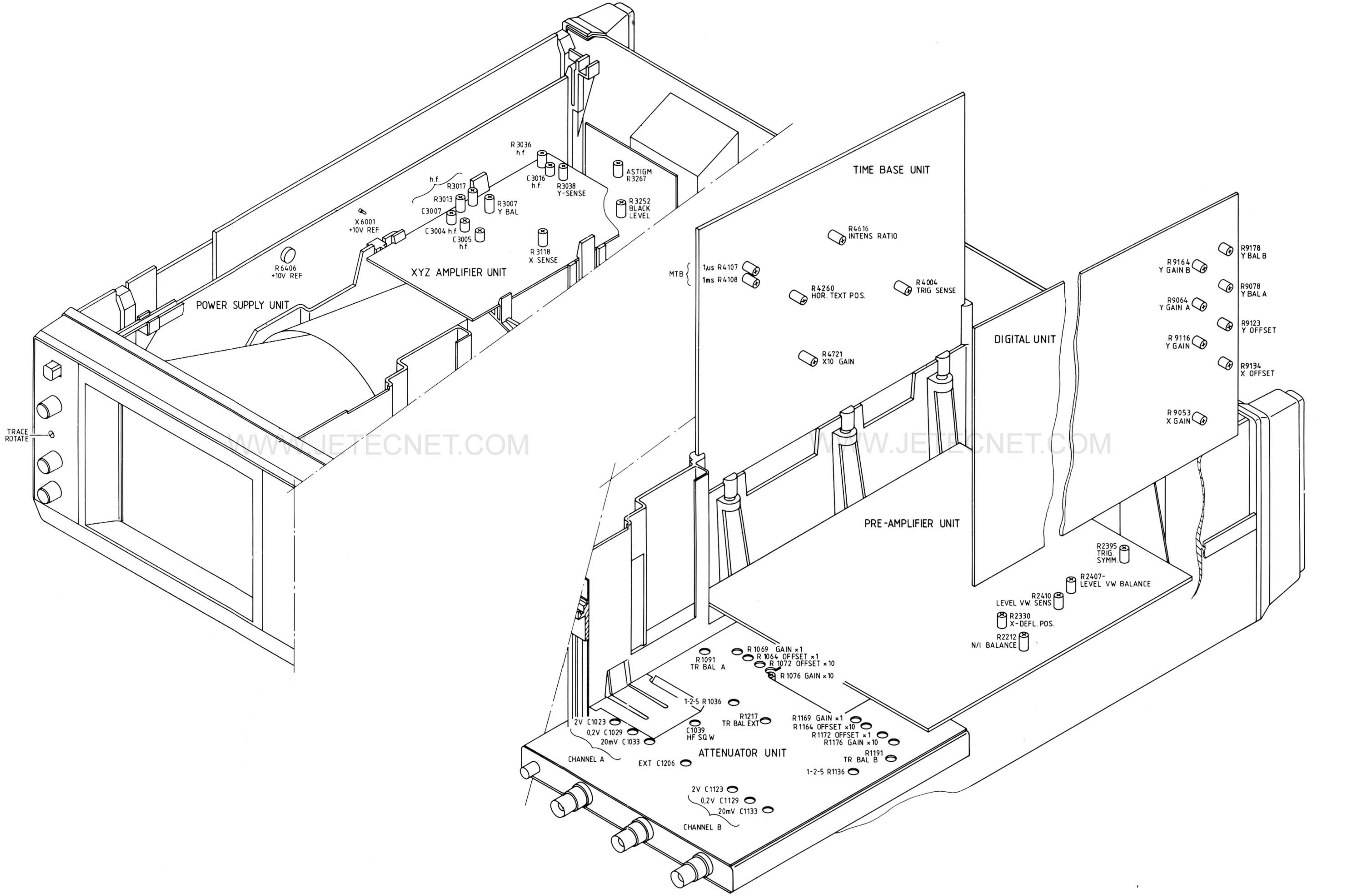
- Tolerances given are for the instrument under test and do not include test equipment error.

- The most accurate display adjustments are made with a stable, well-focused low intensity display.

- All controls that are mentioned without item numbers are located on the outside of the instrument.

- For a list of test equipment and tools required for the adjusting procedure refer to chapter 13.2.

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 qualified person who is aware of the hazard involved. Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.**



MAT3
900E

Figure 15.1 Adjusting elements

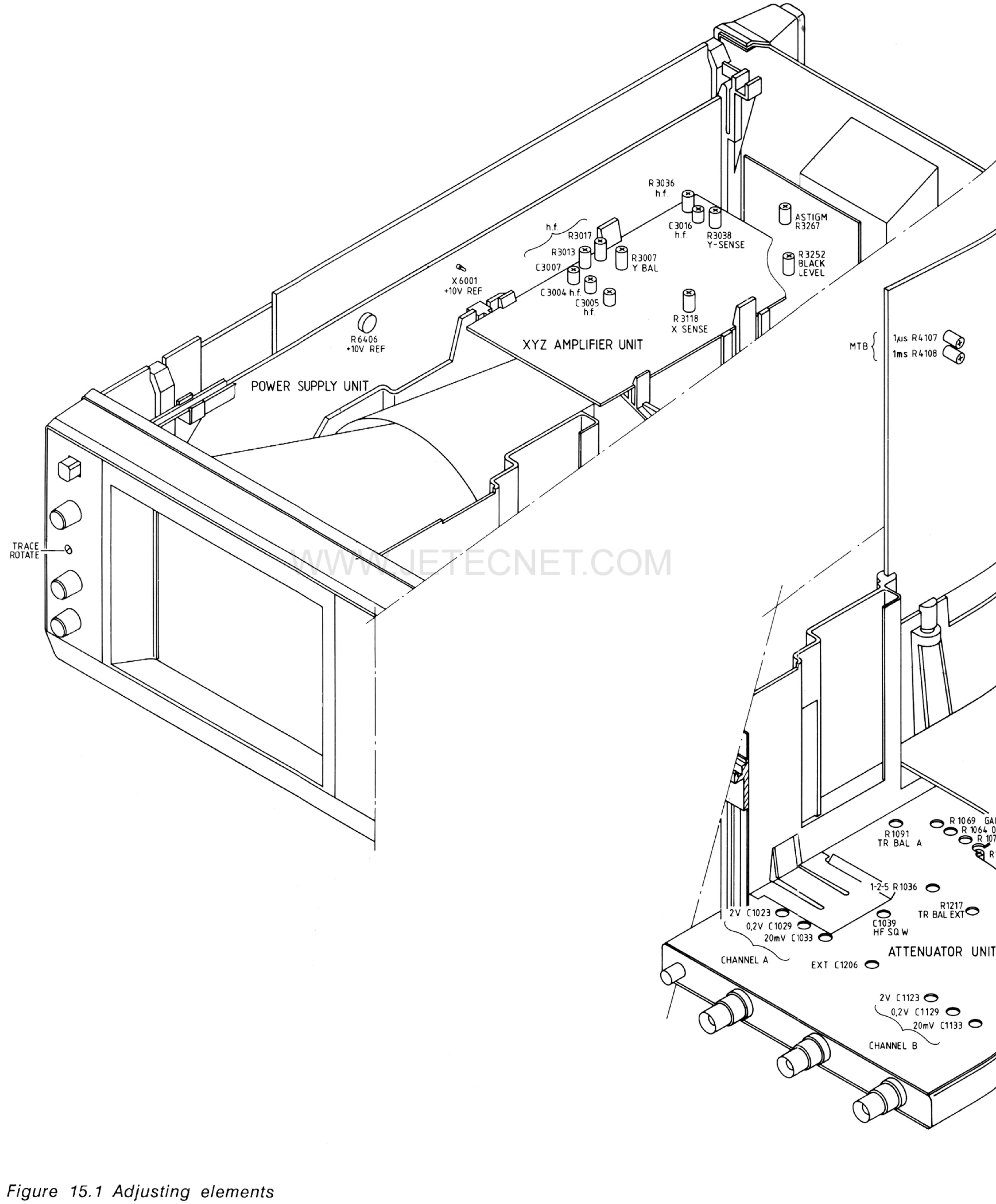
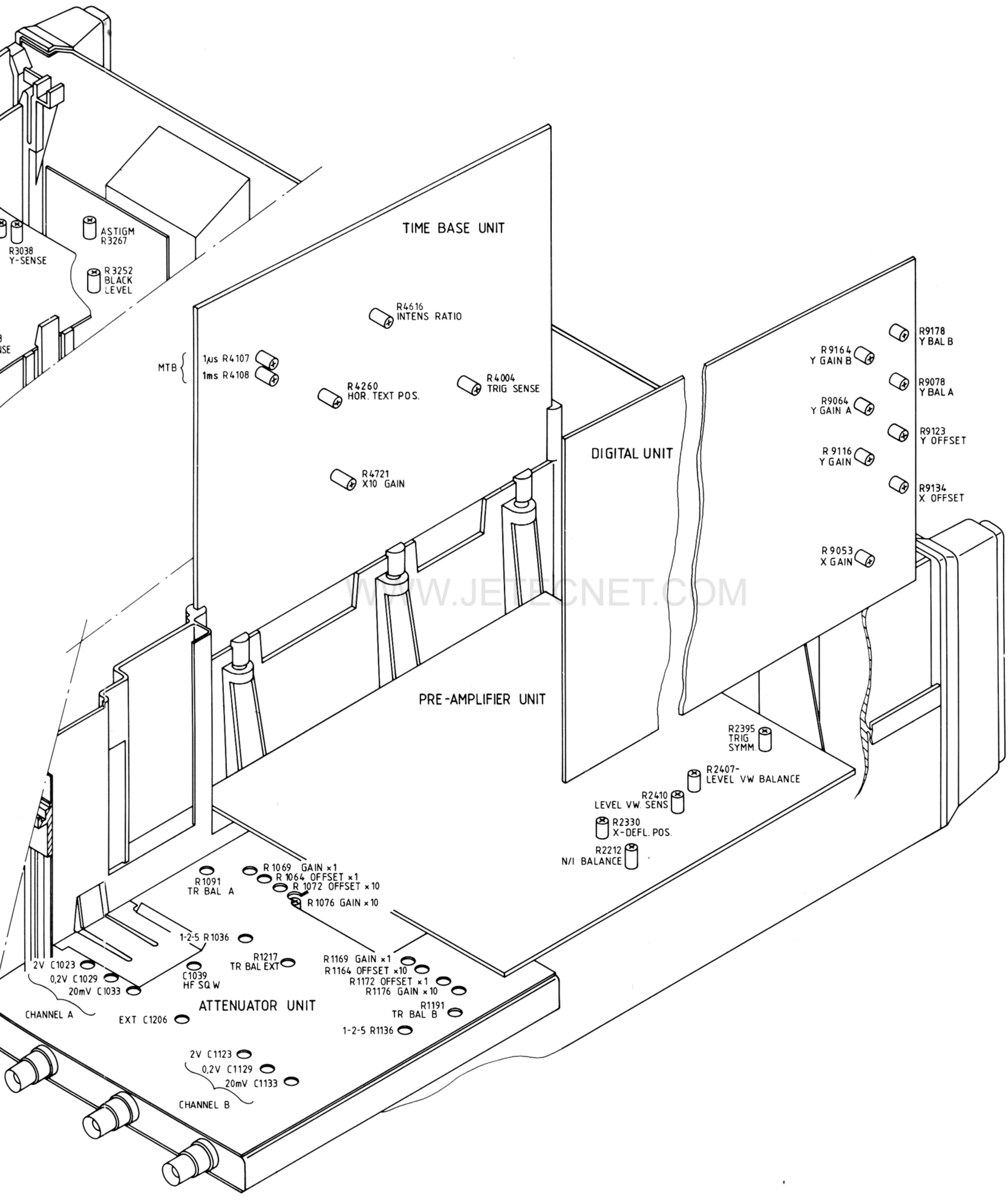


Figure 15.1 Adjusting elements



ASTIGM R3267
R3038 Y-SENSE
R3252 BLACK LEVEL
TIME BASE UNIT
R4616 INTENS RATIO
MTB
1μs R4107
1ms R4108
R4260 HOR. TEXT POS.
R4004 TRIG SENSE
R4721 X10 GAIN
DIGITAL UNIT
R9178 Y BAL B
R9164 Y GAIN B
R9078 Y BAL A
R9064 Y GAIN A
R9123 Y OFFSET
R9116 Y GAIN
R9134 X OFFSET
R9053 X GAIN
PRE-AMPLIFIER UNIT
R2395 TRIG SYMM.
R2407- LEVEL VW BALANCE
R2410 LEVEL VW. SENS
R2330 X-DEFL. POS.
R2212 N/I BALANCE
R1069 GAIN ×1
R1064 OFFSET ×1
R1072 OFFSET ×10
R1076 GAIN ×10
R1091 TR BAL A
1-2-5 R1036
R1217 TR BAL EXT
C1039 HF SQ.W
2V C1023
0,2V C1029
20mV C1033
CHANNEL A
R1169 GAIN ×1
R1164 OFFSET ×10
R1172 OFFSET ×1
R1176 GAIN ×10
R1191 TR BAL B
1-2-5 R1136
ATTENUATOR UNIT
EXT C1206
2V C1123
0,2V C1129
20mV C1133
CHANNEL B

MAT3
9008

15.2 SURVEY OF ADJUSTING ELEMENTS

Adjustment	Adjusting elements(s)	Unit	Signal type, Generatir, menu	Requirement
POWER SUPPLY (see section 15.3.2)				
+10 V supply	R6406 X6001	power supply	digital voltm.	10 V (+,- 10 mV)
CRT DISPLAY (see section 15.3.3)				
pre adjustment	R4616	time base	-	mid position
black level	R3252	CRT socket	-	INTENS 10° from c.c.w spot just invisible.
trace rotation	front	-		line parallel with graticule
Astimatism	R3267	CRT socket	function generator 1 kHz/6 div sine wave DIGITAL MEMORY on.	well defined trace + text
DISPLAY SECTION ADJUSTMENT OF DIGITAL MEMORY (see section 15.3.4)				
X-offset	R9134	dig.unit	service menu DISPLAY	correct X-pos.
Y-offset	R9123	dig.unit	service menu DISPLAY	correct Y-pos.
X-gain	R9053	dig.unit	service menu DISPLAY	10 div. X-defl.
Y-gain	R9116	dig.unit	service menu DISPLAY	6 div. Y-defl.
X-offset text	R4260	time base	service menu DISPLAY	correct X-pos of text

Adjustment	Adjustingl element(s)	Unit	Signal type, Generator, menu	Requirement
GAIN, LF S.Q. WAVE (see sections 15.3.5 and 15.3.6)				
EXT input	C1206	atten. unit	calibrated sq. wave: 0,5 V/ 1 kHz	dots at beginning + end of line same intensity
	R3118	XYZ ampl.	calibrated sq. wave: 0,5 V/ 1 kHz	5 div. horizontal
A input	R1069	atten. unit	calibrated sq. wave: 0,1 mV/ 1 kHz	5 div. vertical at A sens. 20 mV/div.
	C1033	atten. unit	calibrated sq. wave: 0,1 V/ 1 kHz	Straight pulse top at A sens. 20 mV/div.
	R3038	XYZ ampl.	calibrated sq. wave: 0,1 mV/ 1 kHz	5 div. vertical at A sens. 20 mV/div.
	R1076	atten. unit	calibrated sq. wave: 10 mV/ 1 kHz	5 div. vertical at A sens. 2 mV/div.
	C1029	atten. unit	calibrated sq. wave: 1 V/ 1 kHz	Straight pulse top at A sens. 0,2 V/div.
	C1023	atten. unit	calibrated sq. wave: 10 V/ 1 kHz	Straight pulse top at A sens. 2 V/div.
B input	C1133	atten. unit	calibrated sq. wave: 0,1 V/ 1 kHz	Straight pulse top at B sens. 20 mV/div.
	R1169	atten. unit	calibrated sq. wave 0,1 V/ 1 kHz	5 div. vertical at B sens. 20 mV/div.
	R1176	atten. unit	calibrated sq. wave: 10 mV/ 1 kHz	5 div. vertical at B sens. 2 mV/div.

Adjustment	Adjustingl element(s)	Unit	Signal type, Generator, menu	Requirement
	C1129	atten. unit	calibrated sq. wave: 1 V/ 1 kHz	Straight pulse top at A sens. 0,2 V/div.
	C1123	atten. unit	calibrated sq. wave: 10 V/ 1 kHz.	Straight pulse top at A sens 2 V/div.
OFFSET (see section 15.3.7)				
1-2-5 bal. A	R1036	atten. unit	serv.menu: 3.0	minimise jump
1-2-5 bal. B	R1136	atten. unit	serv.menu: 3.0	minimise jump
VAR balance A	R1064	atten. unit	serv.menu: 3.1	Turn VAR jump
VAR balance B	R1164	atten. unit	serv.menu: 3.1	Turn VAR jump
1-10 balance A	R1072	atten. unit	serv.menu: 3.2	VAR CAL jump
1-10 balance B	R1172	atten. unit	serv.menu: 3.2	VAR CAL jump
Trig.bal. A	R1091	atten. unit	serv.menu: 3.3	VAR CAL jump
Trig.bal. B	R1191	atten. unit	serv.menu: 3.4	VAR CAL jump
Trig.bal. EXT	R1217	atten. unit	serv.menu: 3.5	VAR CAL jump
Norm.Inv. bal.	R2212	preampl.	serv.menu: 3.6	VAR CAL jump
Final Y ampl.	R3007	XYZ-ampl.	serv.menu: 3.7	Minimise jump with LEVEL Centre line with R3007
X-DEFLECTION AND TRIGGERING (see section 15.3.8)				
X-defl. offset	R2330	preampl.	--	spot in horizontal mid of screen
Trigger sensitivity	(R2395)	preampl. factory adj	- --	adjustment in "mid" position
	R4004	time base	sine-wave 0,4/ 1kHz	triggered signal at + and - slope

Adjustment	Adjustingl element(s)	Unit	Signal type, Generator, menu	Requirement
LEVEL preset	R2410	preampl.	--	LEVEL pos. such that does not move when turning R2410
LEVEL VIEW balance	R2407	preampi.	sine-wave to A 8 V/ 1 kHz	min. jump between LEVEL VIEW on/off
LEVEL VIEW sensitivity	R2410	preampi.	sine-wave to A 8 V/ 1 kHz	LEVEL 3 div. up or down. Min. jump between LEVEL VIEW on/off
TIME BASE (see section 15.3.9)				
sweep speed:			time markers:	
1 ms/div.	R4108	time base	1 ms	max. accuracy between 2nd and 10th graticule line
1 us/div.	R4107	time base	1 us	max. accuracy between 2nd and 10th graticule line
X MAGN and 0,1 ms/div.	R4721	time base	0,1 us	max. accuracy between 2nd and 10th graticule line
HF SQ. WAVE (see section 15.3.10)				
			fast-rise sq. wave:	
Pulse response channel B	R3017	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	R3013 C3007	XYZ-ampl	100 mV/ 1 MHz	Optimal pulse response
	R3036 C3004	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	C3016	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	C3005	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
Pulse response channel A	C1039	atten. unit	100 mV/ 1MHz	Make channel A equal to B
A-offset	R9078	dig. unit	--	minimal line jump between memory on/off
A-gain	R9064	dig. unit	calibrated sq. wave 100mV5 i kHz	5 div. Y-defl. via channel 20 mV/div.
B-offset	R9178	dig. unit	--	minimal line jump between memory on/off
B-gain	R9164	dig. unit	calibrated sq. wave 100mV 1kHz	5 div. Y-defl. via channel 20 mV/div.

15.3 ADJUSTING PROCEDURE

The adjusting elements and measuring points are given in figure 15.1.

NOTE: Use always an insulated adjustment tool.

15.3.1 Preparation

Before starting the checking and adjusting procedure, it is necessary to be aware of the following.

- Unless otherwise indicated, the time base must be triggered on the channel that is selected for vertical display and the trigger path is P-P coupled. The time base must function in the AUTO mode and its sweep speed must be adjusted to give good display of the phenomena of interest. The INTENS and FOCUS control must be adjusted to a well- defined trace display.

- Preliminary setting of the controls:
  All VAR controls must be set in CAL position.
  All POS and LEVEL controls must be set in mid-position.
  The HOLD OFF control must be set to MIN position.

- The adjustments are done in the memory off mode (text DIGITAL MEMORY not visible in LCD), unless it is otherwise indicated.

- It is advised to take good notice of the LCD where all currently active functions are indicated. This because of the fact that many front panel keys make sequential access possible to various modes.

- Take care to remove the input voltage after each section.

- All signal values are peak-to-peak values (pk-pk), unless otherwise indicated.

For better access to the adjusting elements on the attenuator unit and the preamplifier unit, proceed as indicated in section 14.3.

ATTENTION: Do not readjust potentiometer R2395, situated on the Preamplifier unit. However, if this potentiometer is inadvertently turned, proceed as indicated in section 15.3.7. under "trigger sensitivity".

15.3.2 Power supply adjustment

- Connect the instrument to the mains voltage and switch the oscilloscope on.
- Connect a digital multimeter to connection point X6001 (+10V REF) on the power supply unit and the instrument's mass.
- Adjust R6406 so that the supply voltage is exactly +10 V (tolerance: +or- 0,01 V).

15.3.3 CRT display adjustment

Black level:
- Press AUTO SET.

- Press X DEFL key.
- Set the INTENS control to 10° from its left hand stop.
- Set R4616 on the time base in its mid position.
- Adjust R3252 on the CRT socket so that the spot is just invisible.

Trace rotation:
- Press X DEFL key again for deflection via MTB.
- Adjust the front-panel TRACE ROTATION control so that the trace runs exactly in parallel with the horizontal graticule lines.

Astigmatism:
- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Apply a 6 V/1 kHz sine-wave signal to input A.
- Set the INTENS control for normal brightness.
- Adjust R3267 on the CRT socket (and the FOCUS control) so that the trace is sharp and well-defined over the whole screen area.
- Press the DIGITAL MEMORY key (the instrument comes into the DIGITAL MEMORY mode) and the CURSORS softkey and check also if the text in the top and bottom of the screen is sharp and well-defined. Readjust R3267 on the CRT socket if necessary.

15.3.4 Gain and LF-sq.wave response EXT and A input

Adjustments located on attenuator unit, unless otherwise indicated.

Input EXT:

- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Press X DEFL.
- Select TRIG SOURCE "EXT DC".
- EXT input signal: calibrated sq.wave 0,5 V/1 kHz.
- Adjust C1206 for dots with equal intensity at the beginning and end of the horizontal line.
- Adjust R3118 on XYZ-amplifier for 5 div. horizontal deflection (+ or -0,1 div.).

Input A:

- Press the X DEFL key (instrument goes back to normal time base mode)
- Select TRIG SOURCE "A".
- A input signal: calibrated sq.wave 100 mV/1 kHz.
- Channel A sensitivity: 20 mV/div.
- Adjust R1069 for 5 div. vertical deflection (+ or - 0,1 div.).
- Remove the input signal.

15.3.5 Gain and LF-sq.wave response channel A(B)

Adjustments are located on attenuator unit, except R3038 that is located on XYZ-amplifier.

- Do the adjustments for channel A first. Then those mentioned between brackets for channel B.
- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Select TRIG SOURCE "A(B)".
- Adjust vertical gain to 5 div. (+ or - 0,1 div.) and pulse top as straight as possible (max. distortion + or - 0,075 div.). Use a calibrated sq.wave signal.

Input signal channel A(B)	Input sensitivity channel A(B)	Adjusting element sq.wave resp.	gain
0,1 V	20 mV/div.	C1033 (C1133)	R3038 (R1169)
10 mV	2 mV/div.	-	R1076 (R1176)
1 V	0,2 V/div.	C1029 (C1129)	-
10 V	2 V/div.	C1023 (C1123)	-

15.3.6 Offset channel A(B)

- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT-softkey OFFS-A.
- The successive steps in the following adjustment procedure must be selected with the channel A UP-DOWN control that is normally used to select the input sensitivity of channel A.
- The adjustments are located on the attenutor unit; unless otherwise noted in last column of table.

Adjustment step		Adjustment point	Max instab.	
3.0	1-2-5 balance A(B)	R1036 (R1136)	0,1 div.	
3.1	VAR-balance A(B)	R1064 (R1164)	0,2 div.	Turn VAR A(B)
3.2	x1/x10 balance A(B)	R1072 (R1172)	0,2 div.	VAR A(B) in CAL
3.3	Trig. balance A	R1091	0,3 div.	
3.4	Trig. balance B	R1191	0,3 div.	
3.5	Trig. balance EXT	R1217	0,3 div.	
3.6	Norm/Inv. bal. B	R2212	0,1 div.	on pre amplifier
3.7	Final Y bal.	R3007	0,2 div.	on XYZ-ampl. Minimise jump with TRIG LEVEL. Centre line with R3007.

- Press AUTO SET to leave the service menu.

15.3.7 X-deflection and triggering.

Adjustments on preamplifier unless otherwise noted.

X-deflection offset:
- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Operate the X POS control so that the start of the trace coincides exactly with the beginning of the graticule (in horizontal sense).
- Press the X DEFL key.
- Adjust R2330 so that the spot is exactly in the horizontal mid of the screen.

Trigger sensitivity:

Important: R2395 is a factory-adjustment and must not be turned. If it is turned by mistake, you have to proceed as follows:
- Connect a digital voltmeter between the signals TRIGM+ and TRIGM- (X4010/1 and 2) on the time base unit. Refer to the p.c.b. lay-out in chapter 7 for the position of this connector.
- Adjust R2395 so that the read-out of the voltmeter is 0 volt exactly

Now the adjustment of R4004:
- Press the X DEFL key (instrument goes back to normal time base mode)
- Apply a sinewave of 0,4 V/1 kHz to the channel A input.
- Operate the trigger slope (_/‾ ‾_) key repeatedly
- Adjust R4004 on the time base so that the signal is triggered in the two trigger slope positions.

Level view adjustment:
- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Press the GND key of channel A.
- Put the channel A trace in the vertical mid of the screen with the Y POS control and keep the control in that position.
- Select DC TRIGger COUPLing.
- Press the X DEFL key twice so that the LEVEL VIEW mode is activated (this is also indicated in the LCD).
- Put the TRIGger LEVEL control in such a position that the trace does not move when turning R2410 between its extreme positions. Keep the LEVEL control in this position.

- Press the X DEFL key in order to return to normal time base mode.
- Press the GND key of channel A so that this channel is not grounded anymore.
- Adjust the generator to a sinewave voltage of 8 V/1 kHz.
- Select a sweep speed of 50 ns/div for the time base: this stretches the sinewave into a line.
- Turn the INTENSity control fully clockwise to make the trace visible
- Switch the X DEFL key repeatedly between LEVEL VIEW and normal mode and adjust R2407 to minimal trace shift.

- Press the X DEFL key in order to switch the LEVEL VIEW mode on.
- Turn the TRIGger LEVEL control so that the line is 3 div above the the vertical mid of the graticule.
- Switch the X DEFL key repeatedly between LEVEL VIEW and normal mode and adjust R2410 so that the vertical shift of the trace is not more than 0,4 div.

- Press the X DEFL key in order to switch the LEVEL VIEW mode on.
- Turn the TRIGger LEVEL control so that the line is 3 div under the the vertical mid of the graticule.
- Switch the X DEFL key repeatedly between LEVEL VIEW and normal mode and readjust R2410 slightly if the vertical shift of the trace is more than 0,4 div.

15.3.8 Time base sweep speeds

Adjustments on time base unit.

- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Channel A input signal: time marker pulse 1 ms.
- Select an input sensitivity of 0,5 V/div for channel A.
- Adjust Y POS A, TRIG LEVEL and channel A input sensitivity for a well-readable display.
- Adjust R4108 so that 2nd and 10th marker pulse coincide with the corresponding graticule lines (max. deviation 0,16 div.). Use X POS for a correct horizontal position.

- Channel A input signal: time marker pulse 1 us.
- Time base sweep speed: 1 us/div.
- Adjust R4107 so that 2nd and 10th marker pulse coincide with corresponding graticule lines. Max. deviation 0,16 div.

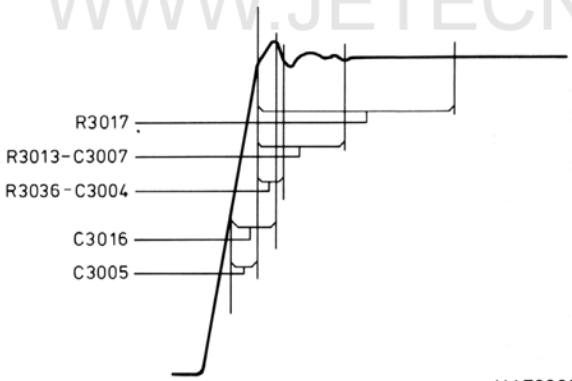
- Channel A input signal: time marker pulse 0,1 ms.
- Press X MAGN.
- Time base sweep speed: 0,1 ms/div.
- Adjust R4721 so that 2nd and 10th marker pulse coincide with corresponding graticule lines. Use X POS for a correct horizontal position; the control must stay approximately in its mid position. Max. deviation 0,24 div.
- Turn X POS fully clockwise and fully counter clockwise and check that the marker pulse deviation does not exceed 0,24 div.
- Remove the input signal.

15.3.9 HF sq.wave response channel B and A.

Adjustments on XYZ-amplifier.

- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Apply to channel B a square wave signal of 1MHz/>900mV with a fast rise time ≤ 1 ns via a 10:1 attenuator and terminated into 50 ohms
- Press A/B twice so that channel B is displayed.
- Select channel B as TRIGger SOURCE.
- Select an input sensitivity of 20 mV/div for channel B.
- Select a sweep speed of 0,1 us/div for the time base.
- Center the signal with the channel B Y POS control.
- Adjust R3013/C3007, R3036/C3004, C3005, C3016 and R3017 to a rising pulse edge with maximum steepness and a pulse top that is a flat as possible. Refer to the figure below. This figure also indicates the influence of the adjustments on certain parts of the rising edge and the top of the pulse. If necessary adapt the time base sweep speed and switch the X MAGN on to obtain a better view of the phenomena of interest.

- Check that the pulse via channel B has a rise-time of ≤ 5,9 ns and that pulse abberations are ≤ 0,2 div. peak-to-peak. Tilt must not exceed + or - 0,1 div.



MAT2233
860210

- Press key A/B so that channel A is displayed.
- Move the generator signal from input B to input A.
- Select channel A as the TRIGger SOURCE.
- Select an input sensitivity of 20 mV/div for channel A.
- Center the signal with the channel A Y POS control.
- Make the pulse response of channel A as much as possible equal to that of channel B with C1039 on the attenuator unit.
- Check that the pulse via channel A has a rise-time of ≤ 5,9 ns and that pulse abberations are ≤ 0,2 div. peak-to-peak. Tilt must not exceed + or - 0,1 div.

15.3.10 Display section adjustment of digital memory.

- Press the DIGITAL MEMORY key if the text DIGITAL MEMORY is present in the LCD (this switches the DIGITAL MEMORY off).
- Adjust control X POS so that the start of the trace begins exactly at the beginning of the graticule (in horizontal sense).
- Press the RESET key and keep it pressed while pressing the AUTO SET key: this gives access to the service menu.
- Press the CRT softkey DISPLAY: the test waveform that is indicated in the figure below appears on the screen.

- Adjust the X-offset with R9134 on the digital unit so that the waveform as indicated in the figure is obtained as much as possible.
- Adjust the Y-offset with R9123 on the digital unit so that the waveform as indicated in the figure is obtained as much as possible.
- Adjust the X-gain to 10 div with R9053 on the digital unit.
- Adjust the Y-gain to 6 div with R9116 on the digital unit.
- Adjust the X-offset of the text with R4260 on the time base so that the twosquares have a displacement of 0,1 div to the left compared with the horizontal mid of the screen. This will result in an exact position in the horizontal mid of the screen after the cabinet has been closed.
- Press AUTO SET in order to leave the service menu.
- Apply a time marker pulse of 1 us/div.
- Put the time base in 1 us/div and adjust the oscilloscope to a well-visible display of the marker pulses.
- Check that the marker pulses coincide exactly with the graticule lines; if not readjust R9053 slightly.

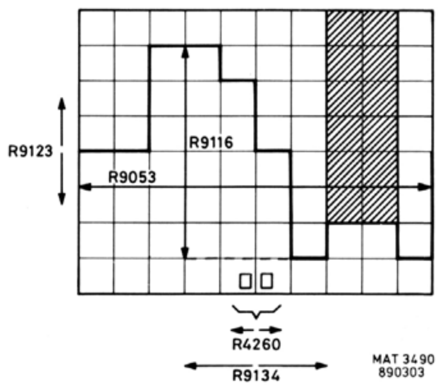


Figure 15.3 Display section adjustment

15.3.11 Gain and offset in digital memory mode.

All adjustments are located on the digital unit.

Channel A:
- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Select an input sensitivity of 20 mV/div for channel A.
- Press the GND key of channel A.
- Position the line exactly in the vertical mid of the screen.
- Operate the DIGITAL MEMORY key repeatedly and minimise the trace shift with R 9078.
- Press the GND key of channel A so that this channel is not grounded anymore.
- Apply a calibrated square wave signal of 100 mV/1 kHz to the A channel input.
- Adjust the amplitude of the signal to 5 div with R9064.

Channel B:
- Press RESET and keep it pressed while pressing AUTO SET: this gives access to the service menu.
- Press CRT softkey APPL.
- Press CRT softkey STANDARD SETTING: this brings the scope back to normal mode with predifined settings.
- Press the A/B key twice so that channel B is displayed.
- Select an input sensitivity of 20 mV/div for channel B.
- Press the GND key of channel B.
- Position the line exactly in the vertical mid of the screen.
- Operate the DIGITAL MEMORY key repeatedly and minimise the trace shift with R 9178.
- Press the GND key of channel B so that this channel is not grounded anymore.
- Select B as trigger source.
- Apply a calibrated square wave signal of 100 mV/1 kHz to the B channel input.
- Adjust the amplitude of the signal to 5 div with R9164.

16 CORRECTIVE MAINTENANCE

16.1 REPLACEMENTS

WARNING: **The EHT cable is directly connected to the CRT. When the EHT cable to the post-acceleration anode is disconnected, the cable must be discharged by shorting the terminal to the instrument's earth.**

16.1.1 Standard parts

Electrical and mechanical replacement parts can be obtained through your local PHILIPS/FLUKE 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 the instrument's performance, particularly at high frequencies. Always use direct-replacement components, unless it is known that a substitute will not degrade the instrument's performance.

16.1.2 Special parts

In addition to the standard electronic components, some special components are used:

- Components, manufactured or selected by Philips to meet specific performance requirements.
- Components which are important for the safety of the instrument.

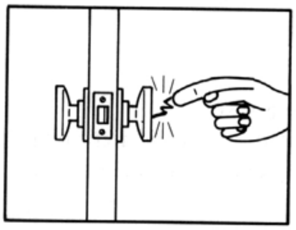
ATTENTION: Both type of components may only be replaced by components obtained through your local PHILIPS/FLUKE organisation of representative.

16.1.3 Transistors and Integrated Circuits

- Return transistors and IC's to their original positions, if removed during routine maintenance.
- Do not renew or switch semiconductor devices unnecessarily, as it may affect the calibration of the instrument.
- Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket or pcb-holes and cut the leads to the same length as on the component being renewed.
- When a device has been renewed, check the operation of the part of the instrument that may be affected.
- When re-installing power-supply transistors, use silicon grease to increase the heat-transfer capabilities.

WARNING: **Handle silicon grease with care. Avoid contact with the eyes. Wash hands thoroughly after use.**

16.2 STATIC SENSITIVE COMPONENTS



MAT3818

16.2.1 Introduction

The instrument in which the black/yellow "static sensitive components" symbol is present, contains electrical components that can be damaged by electrostatical discharge. This symbol can be found on every printed circuit board with static sensitive components. Though e.g. all our MOS integrated circuits incorporate protection against electrostatic discharge, they nevertheless can be damaged by accidental over-voltages.

MAT3850

Figure 16.1 Static sensitive symbol

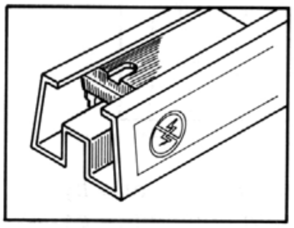
It is also possible that a delayed failure or "winding" effect may occur. When this happens the component will fail anywhere between two hours to six months later.

In storing and handling static sensitive components, the normal precautions for these devices are recommended. Handling and servicing static sensitive assemblies and components should be performed only at a static free workstation by qualified personnel.

CAUTION: Testing, handling and mounting call for special attention. Personnel, handling static sensitive devices, should normally be connected to ground via a high-ohmic resistor.

16.2.2 Storage and transport

Store and transport the circuits in their original packing until required for use. Alternatively, you may make use of a conductive material or a special IC carrier that either short-circuits all leads or insulates them from external contact.



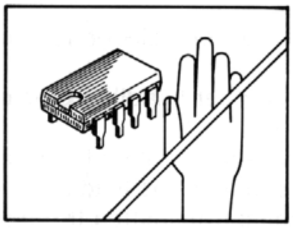
MAT3819

MAT3820

Examples of suitable anti-static packing material.

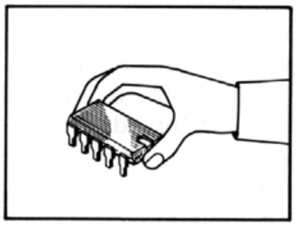
16.2.3 Testing or handling

Minimise handling as much as possible and handle the devices by the body.
Do not slide the devices over any surface.
Work on a conductive surface (e.g. conductive table top) when testing the circuits or transferring them from one carrier to another. Electrically connect the person doing the testing or handling to the conductive surface, for example via a conductive bracelet and a conductive cord. Connect all testing and handling equipment to the same potential. Signals should not be applied to the same surface or the inputs while the device power supply is off. All unused input leads should be connected either to the supply voltage or to ground. When handling plug-in units, handle only by the non-conductive edges and never touch the open edge connector except at a static-free work station.
Placing shorting strips on edge connectors helps to protect installed static sensitive devices.



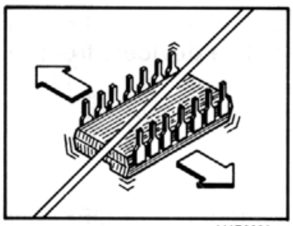
MAT3821

Minimize handling



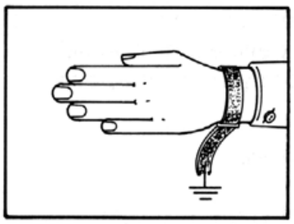
MAT3822

Handle the devices by the body



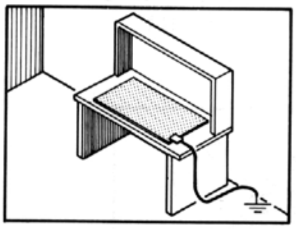
MAT3823

Do not slide the devices over any surface



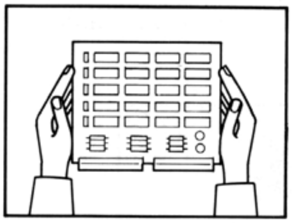
MAT3824

Wear a conductive bracelet



MAT3825

Use a workbench with conductive surface



MAT3826

Handle plug-in units only by the non-conductive edges.

16.2.4 Mounting

Mount static sensitive integrated circuits on printed circuit boards after all other components have been mounted. Take care that the circuits themselves, metal parts of the board, mounting tools and the person doing the mounting are kept at the same electric (ground) potential.

NOTE: If it is impossible to ground the printed-circuit board, the person mounting the circuits should touch the conductive parts of the board before bringing the static sensitive circuits into contact with it.

16.2.5 Soldering

Soldering iron tips, including those of low voltage irons, or soldering baths should also be kept at the same potential as the static sensitive circuits and the board.

16.2.6 Static charges

Dress personnel in clothing of non-electrostatic material (no wool, silk or synthetic fibres). Avoid these materials in the working area.
After the static sensitive circuits have been mounted, the proper handling precautions should still be observed.
Until the sub-assemblies are inserted into the complete system in which the proper voltages are supplied, the board is not more than an extention of the leads of the devices mounted on the board. To prevent static charges from being transmitted through the board wiring to the device it is recommended that conductive clips or conductive tape is put on the circuit board terminals.

16.2.7 Transient voltages

To prevent permanent damage due to transfer voltages, do not insert or remove static sensitive devices, or printed circuit boards with static sensitive devices, from test sockets or system with power on.

16.2.8 Voltage surges

Beware of voltage surges due to switching electrical equipment ON or OFF, relays and d.c. lines.

16.3 REMOVING THE UNITS AND MECHANICAL PARTS

NOTE: For installation, work in reversed sequence.

16.3.1 Attenuator unit (A1)

- First put the digital unit A9 in upright position. Refer to figure 16.4 that indicates this position.
- Push gently both clamping lips that secure the metal locking plate for the attenuator unit and remove the locking plate.
- Push the attenuator unit backwards for about 1 cm.
- Remove the front unit (see section 16.2.7).
- Remove the control knobs of the CRT control unit.
- Pull gently both clamping lips that secure the front profile gently backwards and loosen the front profile.

ATTENTION: To avoid damage, ensure that the BNCs of the attenuator unit are behind the front profile before loosening the front profile.

Now the attenuator unit can easily pulled out of the instrument after removing the connector with flat cable and the ground connector.

Dismantling the Attenuator unit:
- For access to the components of the unit, remove both upper and bottom covers.
- When removing the BNCs first unsolder the wire to the pcb and then unscrew the BNC-nut with a spanner of max. 5 mm thickness.

16.3.2 Pre-amplifier unit (A2) and Adaptation unit (A16)

- First put the digital unit A9 in upright position. Refer to figure 16.4 that indicates this position.
- Then remove the time-base unit (see section 16.2.4).
- Unlock the two p.c.b. supports
- The complete p.c.b. can be removed from the instrument after having removed all flat cables.

16.3.3 XYZ-amplifier unit (A3)

The XYZ amplifier unit incorporates two separate p.c.b.'s connected via a flat cable. One p.c.b. includes amongst other things the CRT socket and must be loosened first. For this, the CRT socket must be carefully removed from the CRT.

Now the part situated above the CRT can be removed as follows:

- Remove all flat cables and the delay line cable plug.
- Pull the clamping lips that secure the XYZ-amplifier unit p.c.b. outwards and take out the complete unit. Refer to figure 16.1.

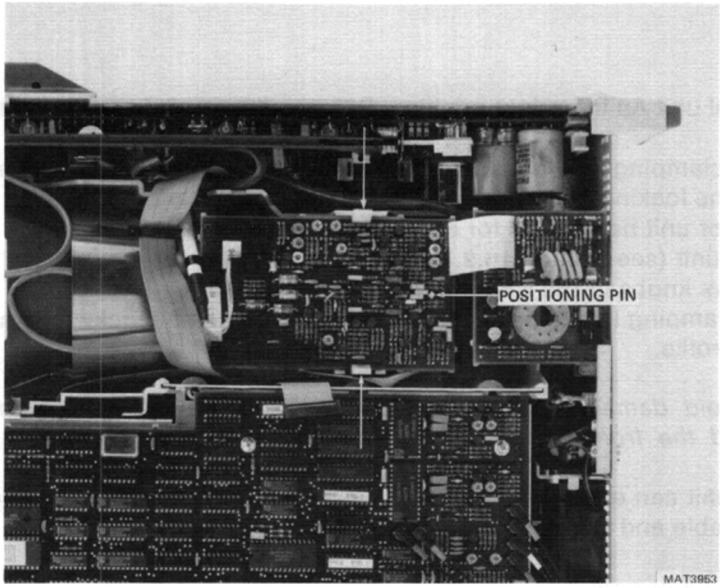


Figure 16.1 Clamping lips for XYZ-amplifier unit

16.3.4 Time-base unit (A4)

- Put the digital unit in upright position such as indicated in figure 16.4.
- Unlock the 3 plastic p.c.b. supports with the special tool that matches the diameter of the p.c.b. support (see section 16.7.2).
- The complete p.c.b. can be taken out of the instrument after having removed all flat cables. The time base can also be placed upright on the chassis: this is indicated in figure 16.4.

16.3.5 CRT control unit (A5)

- Remove the front unit (see section 16.3.7)
- Loosen the front profile (see section 16.3.1)
- Now the CRT control unit can be pulled out of the front profile after having removed the flat-cable and the CAL connector.

16.3.6 Power supply unit (A6)

WARNING: **Inside the power supply pcb there are many parts that carry dangerous high voltages. Some of these voltages remain some time after disconnecting the instrument from the mains. Therefore, it is recommended to wait at least five minutes after having disconnected the instrument from the mains, before removing the p.c.b. If working on the power supply unit under live condition cannot be avoided, it must be done by a qualified technician who is aware of the dangers involved.**
Moreover the use of a mains separation transformer is strongly recommended.

- Remove the extension shaft from the ON/OFF switch by pushing both ends together. When doing this take care not to loose the spring under the power on/off button.
- Push both clamping lips that secure the power supply unit.
- Lift the power supply unit outside the instrument.
- Place the p.c.b. in the unit slider.

NOTES: *- After the mentioned actions, the power supply unit can be measured under working conditions, provided that all cables are still connected to the unit.*
- The flat cable to the CRT control unit can easily be removed now when having positioned the power supply unit like described.

- Remove the two flat cables, the power supply cable, the two- and three-pole cable connectors and the EHT-connector from the CRT.

WARNING: The EHT cable is directly connected to the CRT. When the EHT cable to the post-acceleration anode is disconnected, the cable must be discharged by shorting the terminal to the instrument's earth.

- The power supply can now be taken out of the instrument.

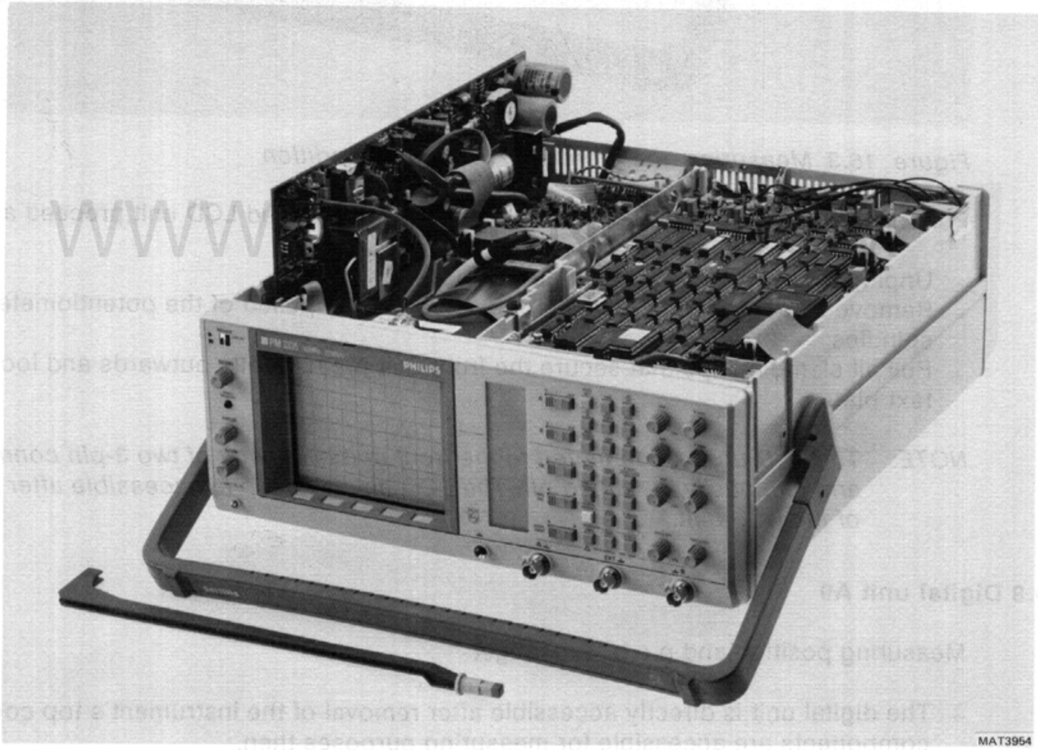


Figure 16.2 Power supply unit in service position.

16.3.7 Front unit (A7) and LCD unit (A8)

- Put the digital unit A9 and the time base unit A4 in their upright position such as indicated in figure 16.4.
- Unscrew the two screws, located at the rear of the front unit.
- Now the complete unit assembly can be slid out of the front profile of the instrument.

NOTE: *After the above actions, the front unit can be measured under working conditions, provided that the flat cable is still connected to the unit.*

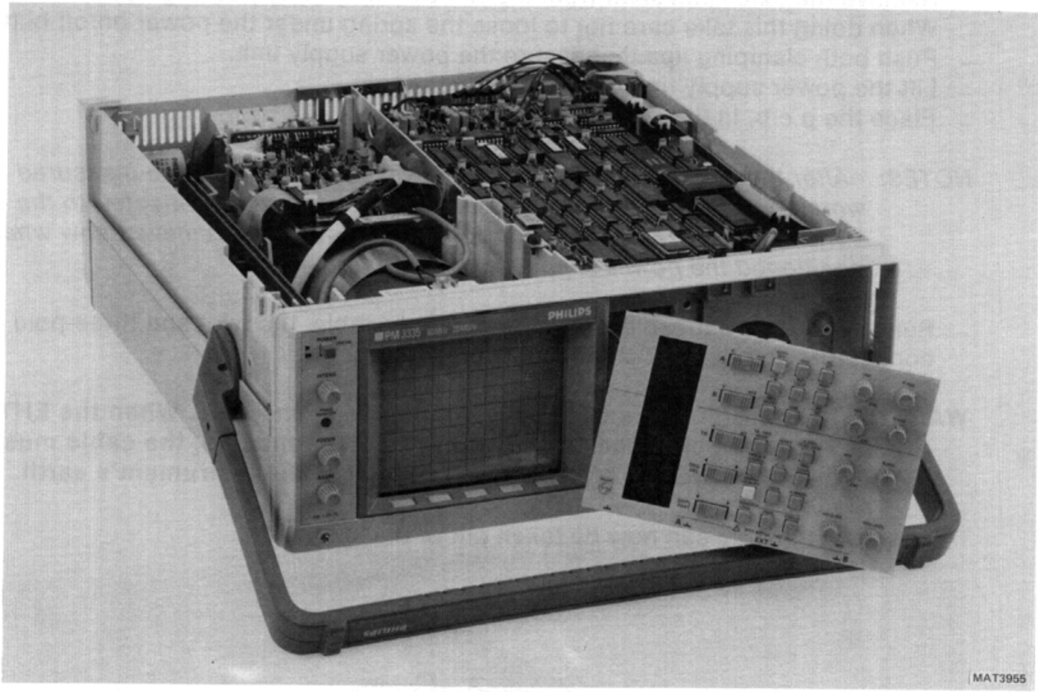


Figure 16.3 Measuring the front unit working condition

For accessibility to the component side of the front unit and LCD unit,proceed as follows:

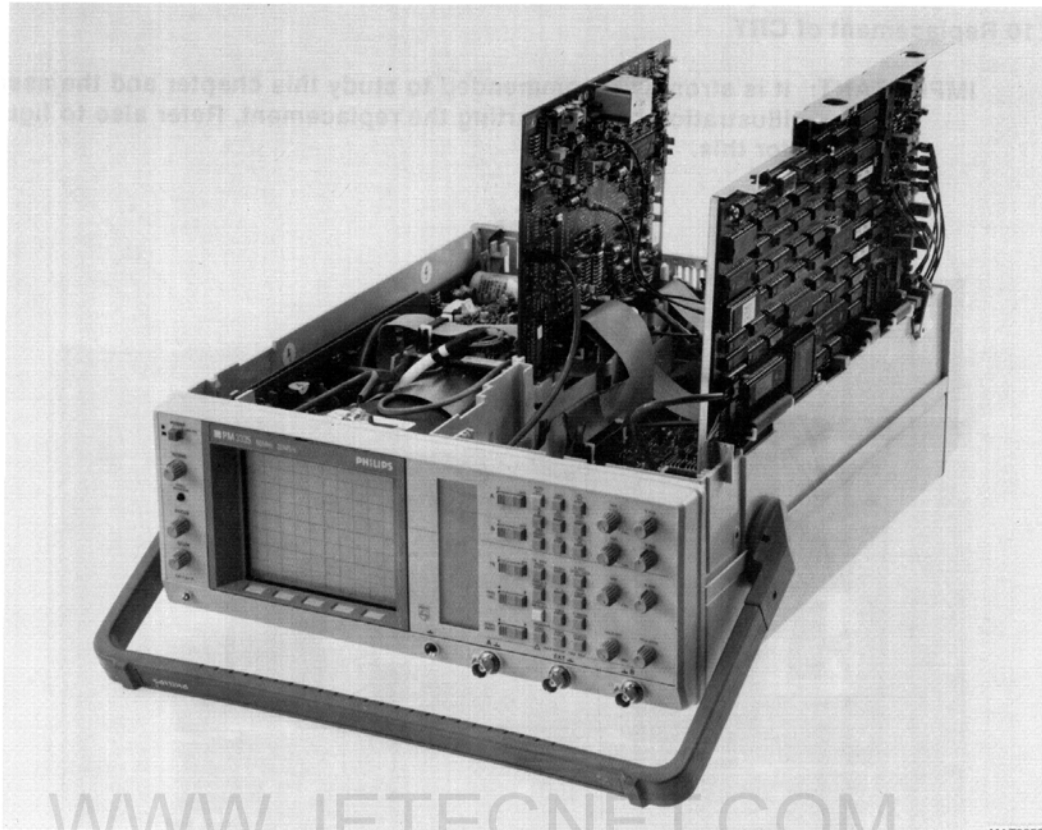
- Unplug the connector with flat cable.
- Remove all control knobs; the knobs can be easily pulled of the potentiometer spindles.
- Pull all clamping lips that secure the front unit p.c.b. gently outwards and loosen the text plate.

NOTE: The LCD unit is connected to the front unit by means of two 3-pin connectors and can easily be pulled off. The LCD display lamp is accessible after pulling of the LCD unit.

16.3.8 Digital unit A9

Measuring position and p.c.b. exchange:

- The digital unit is directly accessible after removal of the instrument's top cover: all components are accessible for measuring purposes then.
- The unit can be separated from its mounting plate after removal of the multipole and coaxial connectors and 6 mounting screws.
- The mounting plate is fixed to the right-hand side panel of the oscilloscope with 2 self-tapping screws.
- The digital unit (and its mounting plate) can be put in upright position such as indicated in figure 16.4.



MAT3952

Figure 16.4 Measuring digital unit A9 and time base unit A4 in upright position for measuring in working condition.

16.3.9 Removing the delay-line cable

The delay-line cable is a 54 cm cable that is connected between the preamplifier unit and the XYZ amplifier unit.

To remove the delay-line cable, proceed as follows:

- For access to the delay line cable, remove the digital unit, the time base unit and the pre-amplifier/adaptation unit.
- Unlock the plastic clamps that fix the cable to the instrument's chassis and to the units.
- Remove the plug that connects the delay-line cable to the pre- amplifier unit.
- Unlock the plastic clamp that fixes the cable to the XYZ-amplifier unit.
- Remove the plug that connects the delay-line cable to the XYZ- amplifier unit.

16.3.10 Replacement of CRT

IMPORTANT: It is strongly recommended to study this chapter and the associated illustration before starting the replacement. Refer also to figure 16.5 for this.

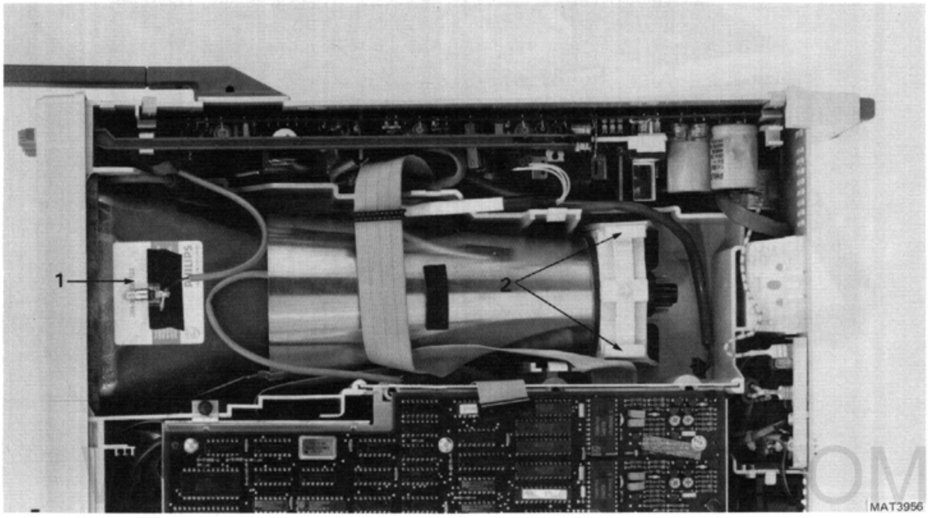


Figure 16.5 Removing the CRT

- Remove the XYZ-amplifier unit, see section 16.3.3.
- Remove the graticule lamp holder (1).
- Remove the bezel with the screen filter.
- Unlock the EHT-cable. Discharge the end of the cable to earth potential in order to prevent electric shock. This earth potential can be obtained via a measuring lead connected to the metal chassis plate at the rear panel of the oscilloscope.

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

- Push the two clamping lips that secure the CRT support (2) and gently lift the CRT, including metal shielding out of the instrument.

NOTE: Before re-assembling a new CRT, first remove its protective cover and place the CRT front rubber around the CRT-front.

16.4 SOLDERING TECHNIQUES

Working method:

- Carefully unsolder one after the other the soldering leads of the semi-conductor.
- Remove all superfluous soldering material. Use desolder braided wire; ordering code: 4822 321 40042.
- Check that the leads of the replacement part are clean and pre-tinned on the soldering place.
- Locate the replacement semi-conductor exactly on its place, and solder each lead 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 leads must not exceed 250° C. The use of solder with a low melting point is therefore recommended.
Take care not to damage the plastic encapsulation of the semi-conductor (softening point of the plastic is 150° C).

ATTENTION: When you are soldering inside the instrument, it is essential to use a low-voltage soldering iron, the tip of which must be earthened to the mass of the oscilloscope.

A suitable soldering irons is:

- Mini soldering iron station: WECP-COD3 (regulated transformer) and WELLER MLR-20 (mini soldering iron).

Ordinary 60/40 solder with core and 35 to 40 W 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.

16.5 INSTRUMENT REPACKING

If the instrument is to be shipped to a Service Centre for service or repair, attach a tag showing the full address and the name of the individual at the users firm that can be contacted. The Service Centre needs the complete instrument, its serial number and a fault description. If the original packing is not available, repack the instrument in such a way that no damage occurs during transport.

16.6 TROUBLE SHOOTING

16.6.1 Introduction

The following information is provided to facilitate trouble shooting. Information contained in other sections of the manual should also be used to locate the defect. An understanding of the circuit is helpful in locating troubles, particularly where integrated circuits are used. Refer to the circuit description for this information.

16.6.2 Trouble-shooting techniques

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

- Check if the settings of the controls of the oscilloscope are correct. Consult the Operating Instructions.
- 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 15. "Checking and Adjusting".
- Visually check the part of the oscilloscope in which the fault is suspected. In this way, it is possible to find faults such as bad soldering connections, bad interconnection plugs and wires, damaged components or transistors and IC's that are not correctly plugged into their sockets.
- Location of the circuit part in which the fault is suspected: the symptom often indicates this part of the circuit. If the power supply is defective the symptom will appear in several circuit parts.

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

- Transistors and diodes.
  Check the voltage between base and emitter (0,7 V approx. in conductive state) and the voltage between collector and emitter (0,2 V approx. in saturation) with a voltmeter or an oscilloscope. When removed from the p.c.b. it is possible to test the transistor with an ohmmeter since the 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 condition that the new component 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 descriptions in sections 3...19.
- Capacitors.
  Leakage can be traced with an ohmmeter adjusted to its 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 used: compare the measured value with the 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 the 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 waveform responses when HF signals are passed through the circuit. Also an inductance meter can be used.
- Data latches.
  To measure on inputs and outputs of data latches a measuring oscilloscope can be triggered by the clock signal which is connected to the clock input of the data latch. This measurement can only be made in this way when there is an acceptable repetition time of the clock signal. A too low clock pulse repetition time results in a low intensity of the trace on the measuring oscilloscope screen.
  The outputs can easily be checked by a voltmeter or oscilloscope.

16.6.3 Power-up routine

Every time the instrument is switched-on an initialisation program is executed. By simply watching the LCD after switching on, it can be determined if the microcomputer related control part of the oscilloscope is functioning correctly.

Directly after switching on, the instrument's internal serial control bus is checked and if everything is OK all segments in the LCD will light up. Passing this test means that the serial bus that controls the LCD and that puts the circuitry in the desired mode, functions correctly. This control bus is the so-called I2C bus and a general description of its configuration can be found in the explanation of the digital block diagram (where the control signals are generated) and the analog block diagram (where the control signals are setting the circuitry in the desired mode. The block diagram shows that the control signals are generated on the digital unit A9 and that the distribution occurs via the front unit A7.

After the test of the serial control bus, the RAM where the scope's settings are stored is tested. These settings are compared with a sumcheck figure. If the test is succesfully passed, the settings from before switching-on are becoming active and thus also visible in the LCD. If the sumcheck test is not passed (e.g. if the memory back-up batteries are not installed or empty), the RAM is tested byte for byte.
This is done by writing and reading 10101010 and 01010101 bit patterns in every memory location. If a fault is detected, the program keeps on trying to write and read into the defective memory address. This can be measured with an oscilloscope at the RAM's chip enable input and at the read and write inputs (half the frequency).
If this test is passed the instrument starts up with default settings and the LCD is updated correspondingly.

16.6.4 Trouble-shooting the power supply

To determine whether a certain fault condition is initiated by the power supply itself or by the connected oscilloscope circuits, a dummy load is listed in the table below. The table gives also an example of the resistor types that can be used to compose the dummy load. These resistors can be ordered at Concern Service.

Supply voltabe	Output current	Dummy resistance and their service ordering numbers
+ 5 V	2,4 A	2,9Ω-12W: 3 x 10Ω (4822 112 21052) and 22Ω (4822 11221063) in parallel.
- 6,4 V	930 mA	6,9Ω-6W: 8,2Ω (4822 112 41052) and 47Ω (4822 110 23072) in parallel.
+ 12 V	720 mA	17,2Ω-8,7W: 33Ω (4822 112 41067) and 39Ω (4822 112 43069) in parallel.
- 12 V	500 mA	24,7Ω-6W: 39Ω (4822 112 41069) and 68Ω (4822 112 41076) in parallel.
+ 17 V	340 mA	51Ω-6W: 1Ω (4822 110 23027) in serial with 2 x 100Ω (4822 112 41081) in parallel.
- 17 V	100 mA	171Ω-1,7W: 270Ω (4822 110 43092) and 470Ω (4822 110 43098) in parallel.
+ 48 V	140 mA	341Ω-7W: 330Ω (4822 112 41094) in serial with 12Ω (4822 110 23056) in parallel.
+ 48 V	40 mA	1k22-2W: 2k2 (4822 110 23116) and 2k7 (4822 110 23118) in parallel.

16.6.5. Wiring diagram

Figure 16.6 gives a survey of all interconnections between the printed circuit boards (p.c.b.'s) and the Cathode Ray Tube (C.R.T.)

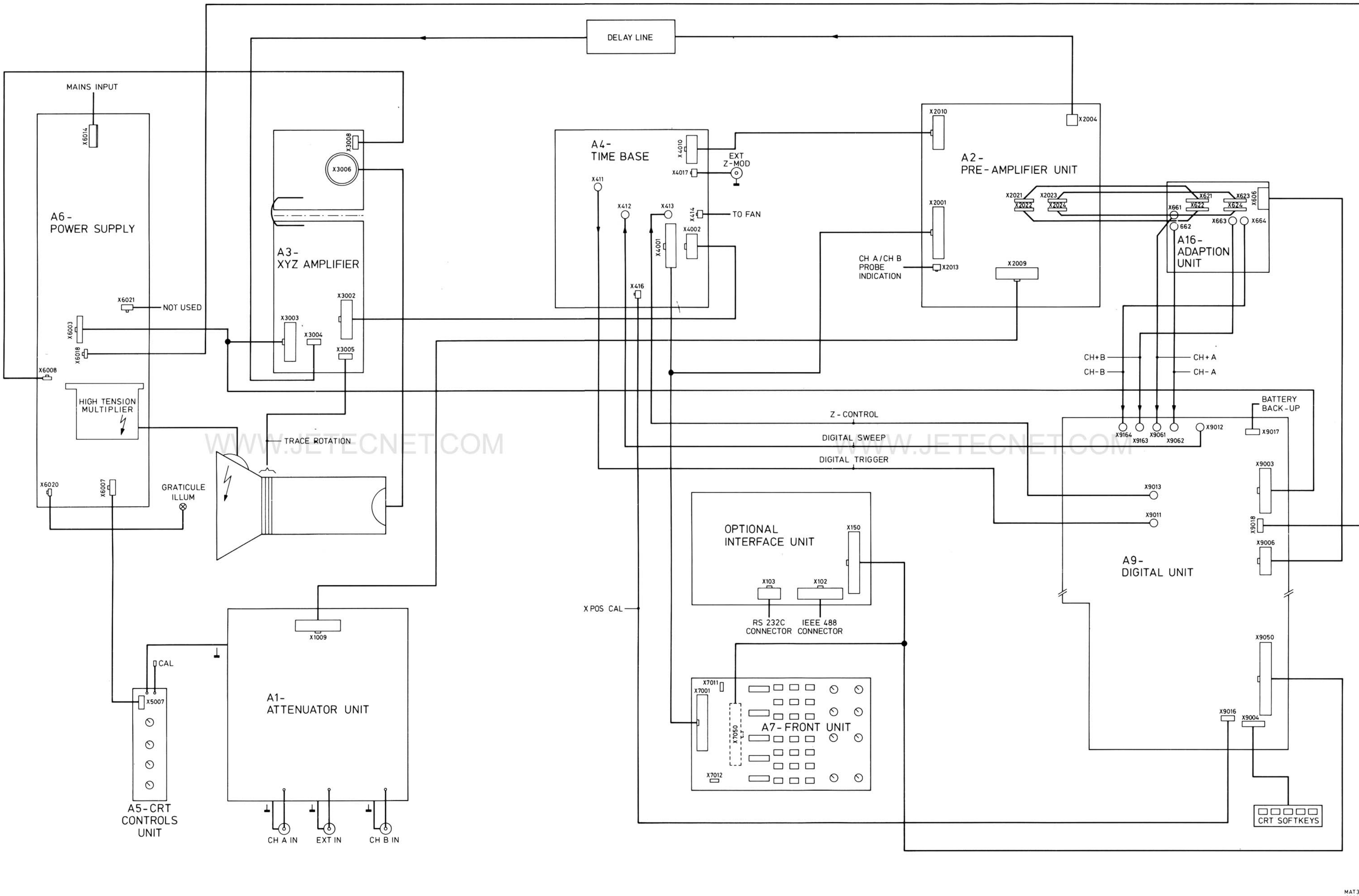
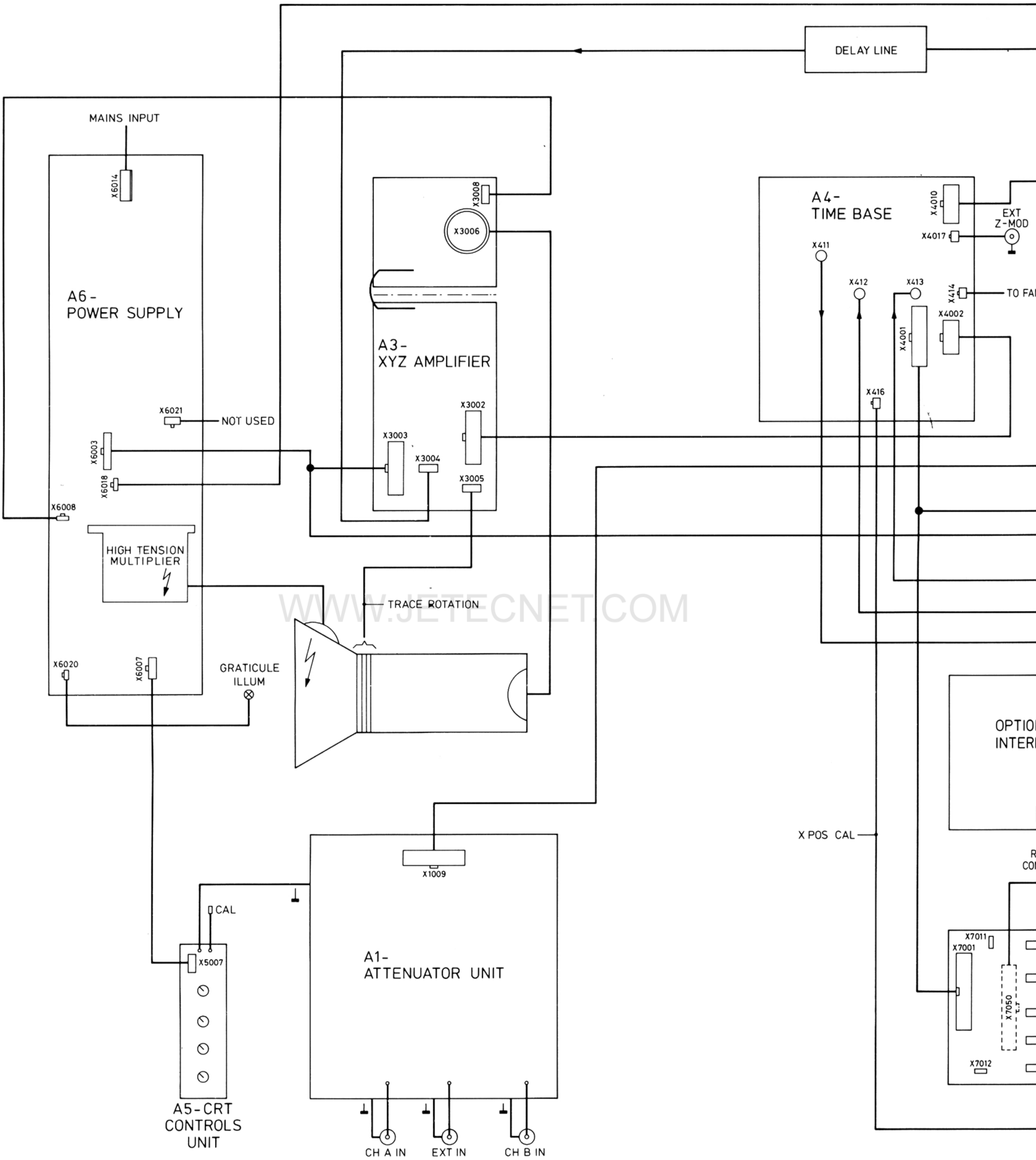


Figure 16.6 Wiring diagram



DELAY LINE
MAINS INPUT
X6014
A6-
POWER SUPPLY
X6021
NOT USED
X6003
X6018
X6008
HIGH TENSION
MULTIPLIER
X6020
X6007
GRATICULE
ILLUM
X3008
X3006
A3-
XYZ AMPLIFIER
X3002
X3003
X3004
X3005
TRACE ROTATION
A4-
TIME BASE
X4010
EXT
Z-MOD
X4017
X411
X412
X413
X414
TO FAN
X4001
X4002
X416
X POS CAL
X7011
X7001
X7050
X7012
X1009
CAL
X5007
A1-
ATTENUATOR UNIT
A5-CRT
CONTROLS
UNIT
CH A IN
EXT IN
CH B IN

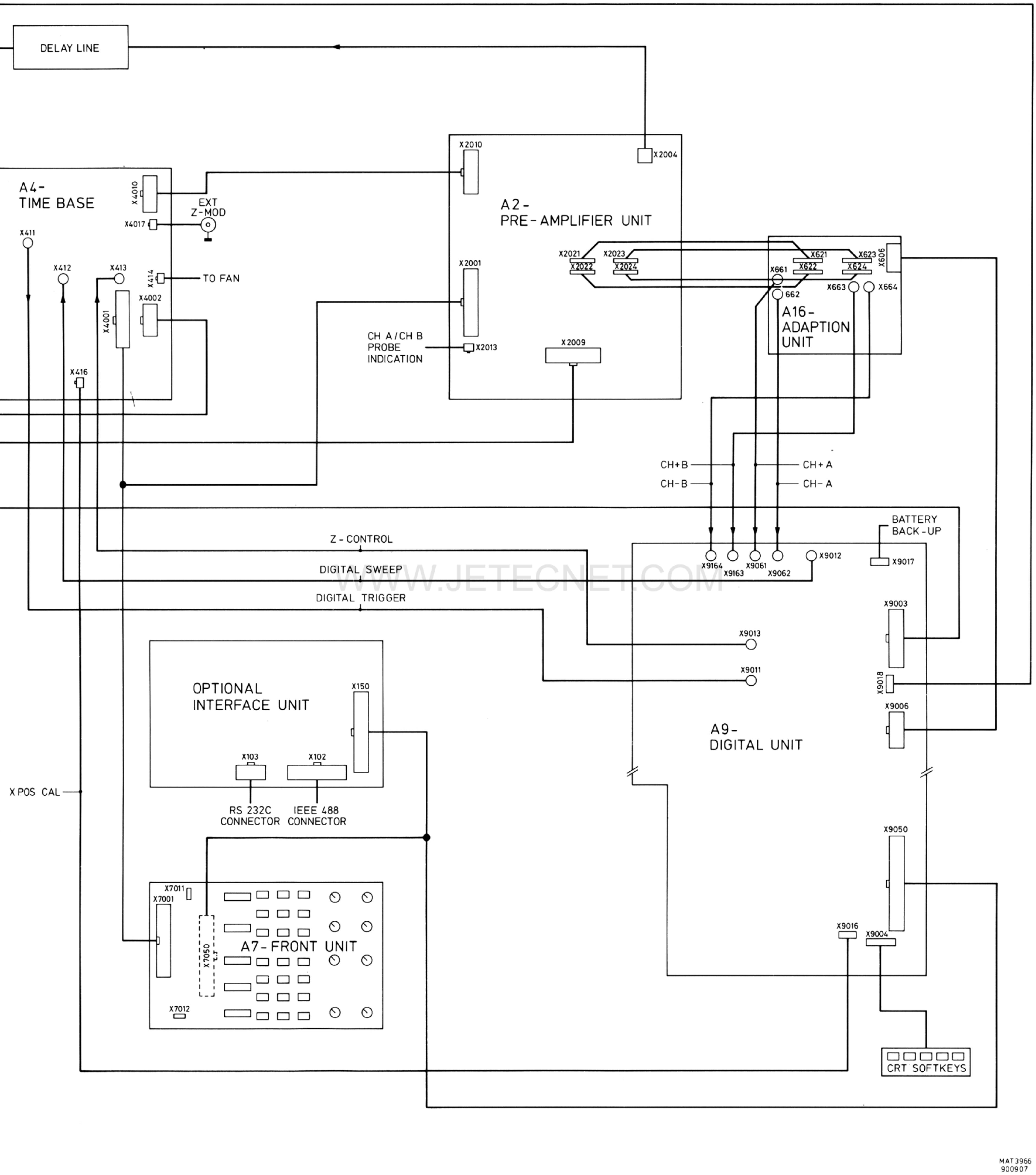


Figure 16.6 Wiring diagram

16.7 SPECIAL TOOLS

16.7.1 Trimming Kit SBC 317 - 4822 310 50095

The SBC 317 Trimming Kit matches every current trimming requirement for all products. The set contains 27 items (22 different bits, plus 3 bit holders and 2 extension pieces). The insulated holders and extension pieces make it easy to reach into a chassis and make accurate adjustments, without wasting time or risking shocks.
The SBC 317 Trimming Kit is packed in a flat transparent case. Several of the most commonly required bits are duplicated. In addition, a spare set of 8 bits is separately available as replacement (4822 310 50016).

The Trimming Kit contains the following parts:

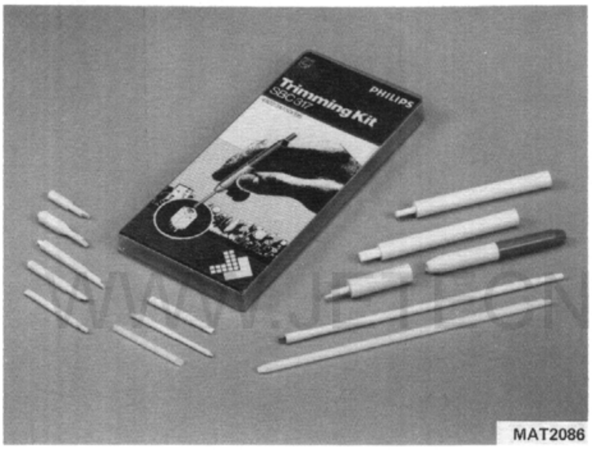
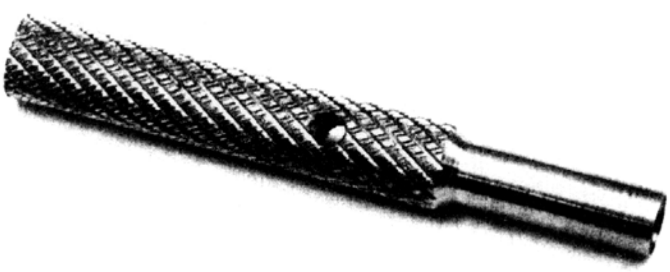


Figure 16.7 Trimming tool kit

16.7.2 p.c.b. Snapper - 5322 535 91942

A special tool is available for removal of the p.c.b. from the p.c.b. supports. Information on how to use this tool is given in chapter 16.2. The ordering number of this tool is 5322 535 91942



MAT 2239

Figure 16.8 p.c.b. Snapper

16.8 RECALIBRATION AFTER REPAIR

After any electrical component has been renewed the calibration of its associated circuit should be checked, as well as the calibration of other closely-related circuits.
Since the power supply affects all circuits, caiibration of the entire instrument should be checked it work has been done in the power supply or if the transformer has been renewed.

17 SAFETY INSPECTION AFTER REPAIR

17.1 GENERAL DIRECTIVES

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

17.2 SAFETY COMPONENTS

Components in the primary circuit may only be renewed by components selected by Philips, see also section 16.1.2.

17.3 CHECKING THE PROTECTIVE EARTH CONNECTION

The correct connection and condition is checked by visual control and by measuring the resistance between the protective lead connection at the plug and the cabinet/frame. The resistance shall not be more than 0,1 Ω. During measurement the mains cable should be removed from the mains. Resistance variations indicate a defect.

17.4 CHECKING THE INSULATION RESISTANCE

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

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

17.5 CHECKING THE LEAKAGE CURRENT

The leakage current shall be measured between each pole of the mains supply in turn, and all accessible conductive parts connected together (including the measuring earth terminal).
The leakage current is not excessive if the measured currents from the mentioned parts do not exceed 0,5 mA rms.

17.6 VOLTAGE TEST

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

18 PARTS LIST

(subject to alteration without notice, part numbers are for new **grey-coloured** cabinet parts)

18.1 MECHANICAL PARTS (Are indicated in figure 18.1)

Item	Qty	Ordering code	Description
1	1	5322 381 11119	Bezel
2	1	5322 414 60699	Positioning strip, plastic
3	1	5322 464 90484	Fixation strip
5	1	5322 480 30181	Contrast filter blue
6	1	5322 455 81083	Textfilm on bezel PM3335
6	1	5322 455 81107	Textfilm on bezel PM3337
7	1	5322 268 14052	CAL socket
8	1	4822 530 70296	Clamping spring for CAL socket
9	11	5322 414 60697	Control knob with spring
10	1	5322 464 90659	Front frame
11	1	5322 455 81105	Textfilm CRT unit
12	1	5322 455 81104	Textfilm for handle PM3335
13	1	5322 498 50308	Handle assembly
13a	2	5322 498 70091	Handle arret
13b	2	5322 529 50203	Spring dowel for handle arret
15a	1	5322 414 60698	Power-on knob, green-brown
15b	1	5322 492 41354	Spring for power-on knob
20	2	5322 498 50268	Locking clip for handle
21	1	5322 535 80735	Extension part for power-on switch
22	1	5322 447 91801	Upper cabinet
24	2	5322 462 10265	P.c.b. support for A3
27	2	5322 462 10264	P.c.b. guiding for A6
30	1	5322 464 90661	Chassis
37	6	5322 462 30304	P.c.b. support
38	1	5322 464 91802	Bottom cabinet
39	2	5322 464 90253	Attenuator cover
40	4	5322 462 41697	Bottom foot
41	3	5322 506 21188	BNC spacer ring
42	3	5322 532 41006	BNC extension bush
43	3	5322 267 10004	BNC socket
44	1	5322 256 91632	Front unit frame
45	1	5322 455 81108	Textfilm for front unit
46	23	5322 276 20489	Softkey brown-grey
47	1	5322 276 20493	Softkey white
48	1	5322 276 20492	Softkey green
49	5	5322 276 20491	UP-DOWN key brown-grey
50	2	5322 492 63354	Range indication spring
51	1	5322 450 60952	LCD window
54	1	5322 256 91631	Battery back-up holder
55	1	5322 361 10326	FAN assembly
56	2	5322 401 11278	Metal fastener for A9
57	2	5322 290 40257	Flat cable clamp
58	2	5322 256 64014	Battery holder
--	2	5322 255 40928	Heatsink for V3011 and V3012
--	2	5322 255 40059	Spacer for heatsink V3011, V3012
--	2	5322 401 10954	Delay line cable clamp

18.1 MECHANICAL PARTS (Are indicated in figure 18.1)

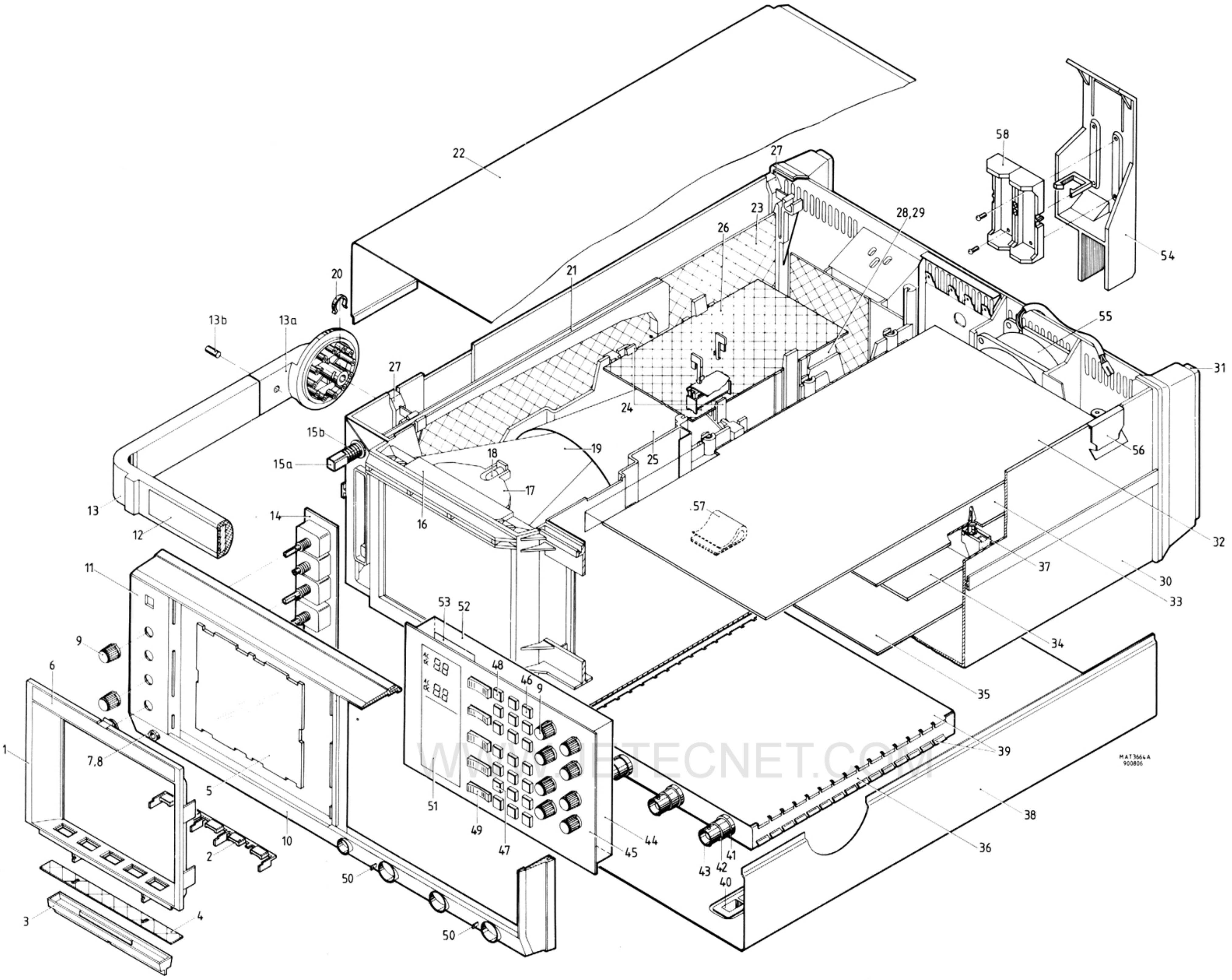


Figure 18.1 Exploded view

Mechanical parts located at rear panel

Item	Qty	Ordering code	Description
31	2	5322 462 41696	Rear foot
--	1	5322 267 10004	BNC socket for Z-MOD
--	2	5322 502 12003	Screws for mains input socket
--	1	5322 321 21616	Line cable, European version
--	1	5322 321 10446	Line cable, USA version
--	1	5322 321 21617	Line cable, British version
--	1	5322 321 21618	Line cable, Swiss version
--	1	5322 321 21781	Line cable, Australean version
--	1	5322 219 81119	Mains input socket, incl. fuse holder
--	1	4822 253 30024	Fuse 1,6A (for mains input)

Mechanical parts located around the Cathode Ray Tube

Item	Qty	Ordering code	Description
16	1	5322 460 60404	CRT front rubber
17	1	5322 462 40957	Light conductor for CRT
18	1	5322 134 40534	Lamp 28V-40mA
19	1	5322 131 20169	Cath. Ray Tube D14-372GH
25	1	5322 466 30163	CRT shielding
28	1	5322 466 30164	CRT manchet, rubber
29	1	5322 462 10263	CRT support, plastic

Printed circuit boards

Item	Unit nr.	Ordering code	Description
36	A1	5322 216 51114	Attenuator unit
-	A1	5322 464 90664	Attenuator bracket incl. BNC's
35	A2	5322 216 51258	Pre-amplifier unit
26	A3	5322 216 51117	XYZ-amplifier unit
33	A4	5322 216 51239	Time-base unit
14	A5	5322 216 51118	CRT-control unit
23	A6	5322 216 51195	Power supply unit
-	A6	4822 492 63051	Mounting clip for power transistors supply unit A6
-	A6	5322 255 41133	Isolation foil for power transistors supply unit A6
52	A7	5322 216 51259	Front unit
53	A8	5322 216 51207	LCD unit
32	A9	5322 216 51232	Digital unit A9
34	A16	5322 216 51204	Adaptation unit
-	A16	5322 492 70224	Clamping spring for A16
4	A18	5322 216 51209	Unit with 5 pushbuttons under CRT screen

18.2 CABLES AND CONNECTORS

18.2.1 Flatcables and connectors

For the flatcables used in this oscilloscope, the required version mustbe made by yourself with the following parts:

- Universal flatcable, 40 wires, length 60 cm 5322 323 50112

To get the required number of wires, the flat cable must be split by means of a pair of scissors or a knife. The cable must be cut to the required length.

- Flatcable connectors

The connectors can be mounted on the flatcable by means of a pair of pliers or in a bench-vice.

ATTENTION: Check the position of the flatcable in the connector before pressing the connector together.

The following connectors are available:

6 pole cable connector	X7019	5322 268 40301
10 pole cable connector	X606-X5007-X6007	5322 268 40234
20 pole cable connector	X2010-X3002-X3003 X4002-X4010-X6009 X7091	5322 268 40235
26 pole cable connector	X1009-X2009	5322 267 70175
34 pole cable connector	X2001-X4001	5322 268 40236
40 pole cable connector	X9050-X7050-(X150)	5322 267 70227

The following AMP-connectors are available:

2 pole-single, without contact pins	5322 268 40232
3 pole-single, without contact pins	5322 268 40233
bus contact for AMP-cable connector, per piece:	5322 268 20152
5 pole connector for power-in:	5322 267 50452
bus contact for connector, per piece:	5322 268 24128

NOTE: The flatcables are fixed onto the p.c.b. connectors by means of a pair of flatcable connector clamps, per piece *5322 401 11156*

18.2.2 P.c.b.-connectors (male headers)

Type	Item	Ordering number
2 pole-single	X414-X416-X2013-X4017 X6018-X6020	5322 265 20275
2 pole-single 90° type	X9016-X9017-X9018	5322 265 20356
3 pole-single	X6008-X6019	5322 265 30434
3 pole single	X7011-X7012	5322 265 30396
3 pole-single 90° type	X2004-X3004-X3005- X3008	5322 265 30433
5 pole-single	X6014	5322 265 40436
6 pole-single 90° type	X9004	5322 265 30741
10 pole-double	X606-X5007-X6007-X9006	5322 265 40485
10 pole-double 90° type	X606	5322 265 51188
20 pole-double	X2010-X3002-X3003 X4002-X4010-X6003 X9003	5322 265 51129
26 pole-double	X1009-X2009	5322 265 61071
34 pole-double	X9050-7050	5322 265 61069
34 pole-double 90° type	X7001	5322 265 61068
40 pole-double	X98-X808	5322 265 61072

18.2.3 50 Ω cables and connectors

The 50 Ω coax-cables are standerdized, so some cables are a little bit too long. The tules around the cable end may have a different colour; if necessary it can be replaced by the original one.

– Cable, 30 cm long, 90° type	5322 321 22617
– Cable, 45 cm long	5322 321 22616

The 50 Ω coax-connector socket consists of two parts, bush and pin.

– Outer part (bush)	5322 268 24116
– Inner part (pin)	5322 268 14141

18.2.4 Miscellaneous cables

– Delay line cable, 54 cm long	5322 321 21595
– Flex jump cable, used for interconnection for A3 - 11 pole.	5322 290 60605

18.2.5 Miscellaneous sockets and connectors

CRT socket		5322 255 40502
p.c.b. socket, 3 pole	(X7011, X7012)	5322 265 30396
p.c.b. socket, 3 pole	(X8011, X8012)	5322 267 40667
Socket for D9079		5322 255 40828
Socket for D801		5322 255 40815
p.c.b. socket, 8 pole	(X621, X622, X623, X624)	5322 265 40483
p.c.b. socket, 8 pole	(X2021, X2022, X2023, X2024	5322 267 50786

18.3 ELECTRICAL PARTS

18.3.1 CAPACITORS

POSNR	DESCRIPTION		ORDERING CODE
C 0601	-20+50%	10NF	4822 122 31414
C 0602	-20+50%	10NF	4822 122 31414
C 0603	-20+50%	10NF	4822 122 31414
C 0604	10%	470PF	4822 122 30034
C 0605	10%	1.5NF	4822 122 31169
C 0606	10%	1.5NF	4822 122 31169
C 0607	-20+50%	10NF	4822 122 31414
C 0608	-20+50%	10NF	4822 122 31414
C 0681	-10+50%	47UF	4822 124 20699
C 0682	-20+50%	10NF	4822 122 31414
C 0683	-10+50%	47UF	4822 124 20699
C 0684	-20+50%	10NF	4822 122 31414
C 0689	-20+50%	10NF	4822 122 31414
C 0691	-20+50%	10NF	4822 122 31414
C 0692	-20+50%	10NF	4822 122 31414
C 0693	-20+50%	10NF	4822 122 31414
C 1001	-20+50%	10NF	4822 122 31414
C 1002	400V 10%	22NF	5322 121 40308
C 1003	-20+50%	10NF	4822 122 31414
C 1004	-20+50%	10NF	4822 122 31414
C 1006	-20+50%	10NF	4822 122 31414
C 1007	0.25PF	1PF	5322 122 32773
C 1009	2%	33PF	5322 122 32072
C 1011	63V 10%	220NF	4822 121 42408
C 1012	63V 10%	220NF	4822 121 42408
C 1013	2%	15PF	4822 122 31823
C 1014	0.25PF	0.56PF	5322 122 32107
C 1016	0.25PF	3.3PF	5322 122 32549
C 1017	0.25PF	3.3PF	4822 122 31821
C 1018	0.25PF	2.7PF	5322 122 32894
C 1019	2%	33PF	5322 122 32072
C 1021	-20+50%	10NF	4822 122 31414
C 1022	2%	22PF	5322 122 32143
C 1023	7-10.0 PF	MUR	5322 125 11013
C 1024	-20+50%	10NF	4822 122 31414
C 1026	0.25PF	3.3PF	5322 122 32549
C 1027	0.25PF	2.2PF	5322 122 32774
C 1028	2%	33PF	5322 122 32072
C 1029	7-10.0 PF	MUR	5322 125 11013
C 1031	-20+50%	10NF	4822 122 31414
C 1032	2%	33PF	5322 122 32551
C 1033	7-10.0 PF	MUR	5322 125 11013
C 1034	-20+50%	10NF	4822 122 31414
C 1035	-20+50%	10NF	4822 122 31414
C 1036	2%	39PF	4822 122 31069
C 1037	2%	22PF	5322 122 32143
C 1038	2%	100PF	4822 122 31316
C 1039	25-2;3 PF	MUR	5322 125 11021
C 1040	2%	100PF	4822 122 31316
C 1041	63V 10%	100NF	5322 121 42492
C 1042	-20+50%	10NF	4822 122 31414
C 1043	-20+50%	10NF	4822 122 31414
C 1044	-20+50%	10NF	4822 122 31414
C 1045	-20+50%	10NF	4822 122 31414
C 1046	-10+50%	68UF	4822 124 20689
C 1047	0.25PF	4.7PF	4822 122 31822
C 1061	10%	470PF	4822 122 30034
C 1062	2.2PF		4822 122 31036
C 1064	1.5NF		4822 122 31169
C 1067	39PF		4822 122 31069
C 1068	-20+50%	10NF	4822 122 31414
C 1071	-20+50%	10NF	4822 122 31414
C 1072	-20+50%	10NF	4822 122 31414
C 1073	-20+50%	10NF	4822 122 31414
C 1074	-20+50%	10NF	4822 122 31414
C 1076	10%	1.5NF	4822 122 31169
C 1077	10%	1.5NF	4822 122 31169
C 1101	-20+50%	10NF	4822 122 31414
C 1102	400V 10%	22NF	5322 121 40308
C 1103	-20+50%	10NF	4822 122 31414
C 1104	-20+50%	10NF	4822 122 31414
C 1106	-20+50%	10NF	4822 122 31414
C 1107	0.25PF	1PF	5322 122 32773

POSNR	DESCRIPTION		ORDERING CODE
C 1109	2%	33PF	5322 122 32072
C 1111	63V 10%	220NF	4822 121 42408
C 1112	63V 10%	220NF	4822 121 42408
C 1113	2%	15PF	4822 122 31823
C 1114	0.25PF	0.56PF	5322 122 32107
C 1116	0.25PF	3.3PF	5322 122 32549
C 1117	0.25PF	3.3PF	4822 122 31821
C 1118	0.25PF	2.7PF	5322 122 32894
C 1119	2%	33PF	5322 122 32072
C 1121	-20+50%	10NF	4822 122 31414
C 1122	2%	22PF	5322 122 32143
C 1123	7-10.0 PF	MUR	5322 125 11013
C 1124	-20+50%	10NF	4822 122 31414
C 1126	0.25PF	3.3PF	5322 122 32549
C 1127	0.25PF	2.2PF	5322 122 32774
C 1128	2%	33PF	5322 122 32072
C 1129	7-10.0 PF	MUR	5322 125 11013
C 1131	-20+50%	10NF	4822 122 31414
C 1132	2%	33PF	5322 122 32551
C 1133	7-10.0 PF	MUR	5322 125 11013
C 1134	-20+50%	10NF	4822 122 31414
C 1135	-20+50%	10NF	4822 122 31414
C 1136	2%	39PF	4822 122 31069
C 1137	2%	22PF	5322 122 32143
C 1138	2%	100PF	4822 122 31316
C 1139	0.25PF	2.2PF	4822 122 31036
C 1140	2%	100PF	4822 122 31316
C 1141	63V 10%	100NF	5322 121 42492
C 1142	-20+50%	10NF	4822 122 31414
C 1143	-20+50%	10NF	4822 122 31414
C 1144	-20+50%	10NF	4822 122 31414
C 1145	-20+50%	10NF	4822 122 31414
C 1146	-10+50%	68UF	4822 124 20689
C 1147	0.25PF	4.7PF	4822 122 31822
C 1161	10%	470PF	4822 122 30034
C 1162	2.2PF		4822 122 31036
C 1164	1.5NF		4822 122 31169
C 1167	39PF		4822 122 31069
C 1168	-20+50%	10NF	4822 122 31414
C 1171	-20+50%	10NF	4822 122 31414
C 1172	-20+50%	10NF	4822 122 31414
C 1173	-20+50%	10NF	4822 122 31414
C 1174	-20+50%	10NF	4822 122 31414
C 1176	10%	1.5NF	4822 122 31169
C 1177	10%	1.5NF	4822 122 31169
C 1201	-20+50%	10NF	4822 122 31414
C 1202	400V 10%	22NF	5322 121 40308
C 1203	2%	33PF	5322 122 32551
C 1204	0.25PF	3.9PF	4822 122 31217
C 1206	7-10.0 PF	MUR	5322 125 11013
C 1207	2%	22PF	5322 122 32143
C 1208	-20+50%	10NF	4822 122 31414
C 1210	0.25PF	2.2PF	4822 122 31036
C 1211	-20+50%	10NF	4822 122 31414
C 1212	2%	100PF	4822 122 31316
C 1213	0.25PF	1.8PF	5322 122 32313
C 1214	0.25PF	0.68PF	4822 122 31215
C 1216	2%	12PF	4822 122 31056
C 1217	-20+50%	10NF	4822 122 31414
C 1401	-20+50%	10NF	4822 122 31414
C 1402	-20+50%	10NF	4822 122 31414
C 1403	-20+50%	10NF	4822 122 31414
C 1404	-10+50%	68UF	4822 124 20689
C 1405	-20+50%	10NF	4822 122 31414
C 1407	-20+50%	10NF	4822 122 31414
C 1408	-20+50%	10NF	4822 122 31414
C 1409	-10+50%	68UF	4822 124 20689
C 1411	-20+50%	10NF	4822 122 31414
C 1412	-20+50%	10NF	4822 122 31414
C 1413	-10+50%	47UF	4822 124 20699
C 1414	-20+50%	10NF	4822 122 31414
C 1420	-20+50%	10NF	4822 122 31414
C 1421	-20+50%	10NF	4822 122 31414
C 1422	-20+50%	10NF	4822 122 31414

POSNR	DESCRIPTION		ORDERING CODE
C 1423	-20+50%	10NF	4822 122 31414
C 1424	-10+50%	68UF	4822 124 20689
C 1427	-20+50%	10NF	4822 122 31414
C 1428	-20+50%	10NF	4822 122 31414
C 1429	-10+50%	68UF	4822 124 20689
C 1431	-20+50%	10NF	4822 122 31414
C 1432	-20+50%	10NF	4822 122 31414
C 1433	-10+50%	47UF	4822 124 20699
C 1434	-20+50%	10NF	4822 122 31414
C 1441	-20+50%	10NF	4822 122 31414
C 1442	-10+50%	68UF	4822 124 20689
C 1443	-20+50%	10NF	4822 122 31414
C 1444	-20+50%	10NF	4822 122 31414
C 1446	-10+50%	68UF	4822 124 20689
C 1447	-20+50%	10NF	4822 122 31414
C 2049	10%	1.5NF	4822 122 31169
C 2050	-20+50%	10NF	4822 122 31414
C 2051	10%	1.5NF	4822 122 31169
C 2149	10%	1.5NF	4822 122 31169
C 2150	-20+50%	10NF	4822 122 31414
C 2151	10%	1.5NF	4822 122 31169
C 2201	-20+50%	10NF	4822 122 31414
C 2203	-20+50%	10NF	4822 122 31414
C 2215	6.8PF		4822 122 31049
C 2216	0.25PF	2.7PF	4822 122 31038
C 2217	-20+50%	10NF	4822 122 31414
C 2218	0.25PF	2.7PF	4822 122 31038
C 2220	10PF		4822 122 32185
C 2221	10%	1.5NF	4822 122 31169
C 2222	0.25PF	8.2PF	4822 122 31052
C 2223	10%	1.5NF	4822 122 31169
C 2224	10%	1.5NF	4822 122 31169
C 2225	10%	470PF	4822 122 30034
C 2226	10%	470PF	4822 122 30034
C 2229	10%	470PF	4822 122 30034
C 2230	10%	470PF	4822 122 30034
C 2305	-20+50%	10NF	4822 122 31414
C 2306	10%	1.5NF	4822 122 31169
C 2307	10%	1.5NF	4822 122 31169
C 2317	1.5PF		5322 126 10225
C 2318	10%	470PF	4822 122 30034
C 2321	1.5PF		5322 126 10225
C 2326	-20+50%	10NF	4822 122 31414
C 2327	-20+50%	10NF	4822 122 31414
C 2328	63V 10%	100NF	5322 121 42492
C 2329	63V 10%	100NF	5322 121 42492
C 2331	63V 10%	100NF	5322 121 42492
C 2332	63V 10%	100NF	5322 121 42492
C 2333	63V 10%	100NF	5322 121 42492
C 2335	2%	12PF	4822 122 31056
C 2336	-20+50%	10NF	4822 122 31414
C 2337	-20+50%	10NF	4822 122 31414
C 2338	10%	470PF	4822 122 30034
C 2345	0.25PF	01.8PF	5322 122 32313
C 2346	10%	1.5NF	4822 122 31169
C 2348	10%	1.5NF	4822 122 31169
C 2350	0.25PF	2.7PF	4822 122 31038
C 2600	2%	22PF	5322 122 32143
C 2601	63V 10%	100NF	5322 121 42492
C 2602	-20+50%	10NF	4822 122 31414
C 2604	10%	1.5NF	4822 122 31169
C 2611	10%	1NF	5322 122 32331
C 2612	-20+50%	10NF	4822 122 31414
C 2613	10%	470PF	4822 122 30034
C 2616	10%	470PF	4822 122 30034
C 2701	-10+50%	100UF	4822 124 20679
C 2702	-20+50%	10NF	4822 122 31414
C 2703	-20+50%	10NF	4822 122 31414
C 2704	-20+50%	10NF	4822 122 31414
C 2706	-10+50%	100UF	4822 124 20679
C 2707	-20+50%	10NF	4822 122 31414
C 2708	-20+50%	10NF	4822 122 31414
C 2709	-20+50%	10NF	4822 122 31414
C 2711	-20+50%	10NF	4822 122 31414
C 2716	-10+50%	68UF	4822 124 20689
C 2717	-20+50%	10NF	4822 122 31414
C 2718	-20+50%	10NF	4822 122 31414
C 2722	-20+50%	10NF	4822 122 31414
C 2726	-10+50%	68UF	4822 124 20689
C 2727	-20+50%	10NF	4822 122 31414
C 2728	-20+50%	10NF	4822 122 31414
C 2741	-20+50%	10NF	4822 122 31414
C 2744	-20+50%	10NF	4822 122 31414
C 2746	-20+50%	10NF	4822 122 31414
C 2747	-10+50%	68UF	4822 124 20689
C 2748	-20+50%	10NF	4822 122 31414
C 2751	-10+50%	47UF	4822 124 20699
C 2752	-20+50%	10NF	4822 122 31414
C 2753	-20+50%	10NF	4822 122 31414
C 2754	-20+50%	10NF	4822 122 31414
C 2771	-20+50%	10NF	4822 122 31414
C 2772	-10+50%	150UF	4822 124 20672
C 2773	-20+50%	10NF	4822 122 31414
C 2774	-10+50%	68UF	4822 124 20689
C 2776	-20+50%	10NF	4822 122 31414
C 2777	63V 10%	100NF	5322 121 42492
C 2781	-20+50%	10NF	4822 122 31414
C 2801	3.3NF		4822 122 33891
C 2802	6.8NF		5322 122 31866
C 2803	6.8NF		5322 122 31866
C 2804	680PF		4822 122 31775
C 3001	-20+50%	10NF	4822 122 31414
C 3002	10%	1.5NF	4822 122 31169
C 3003	10%	1.5NF	4822 122 31169
C 3004	7-10.0 PF	MUR	5322 125 11013
C 3005	2-20PF	MUR	5322 125 50296
C 3007	7-10.0 PF	MUR	5322 125 11013
C 3008	0.25PF	8.2PF	4822 122 31052
C 3009	2%	12PF	4822 122 31056
C 3011	2%	68PF	4822 122 31349
C 3013	0.25PF	2.7PF	4822 122 31038
C 3014	0.25PF	2.7PF	4822 122 31038
C 3016	2-20PF	MUR	5322 125 50296
C 3017	-20+50%	10NF	4822 122 31414
C 3018	0.25PF	5.6PF	5322 122 32163
C 3021	-20+50%	10NF	4822 122 31414
C 3022	-20+50%	10NF	4822 122 31414
C 3101	10%	1.5NF	4822 122 31169
C 3102	10%	1.5NF	4822 122 31169
C 3103	7-10PF		5322 125 11013
C 3104	100V 10%	47NF	5322 121 42491
C 3105	-20+50%	10NF	4822 122 31414
C 3106	63V 10%	100NF	5322 121 42492
C 3107	0.25PF	2.7PF	4822 122 31038
C 3108	0.25PF	0.82PF	4822 122 31214
C 3109	63V 10%	100NF	5322 121 42492
C 3110	-20+50%	10NF	4822 122 31414
C 3111	-20+50%	10NF	4822 122 31414
C 3112	0.25PF	3.9PF	5322 122 34107
C 3113	0.25PF	0.82PF	4822 122 31214
C 3114	100V 10%	47NF	5322 121 42491
C 3116	63V 10%	100NF	5322 121 42492
C 3200	0.25PF	0.56PF	5322 122 32107
C 3201	0.25PF	0.56PF	5322 122 32107
C 3202	63V 10%	100NF	5322 121 42492
C 3203	63V 10%	100NF	5322 121 42492
C 3204	-20+50%	10NF	4822 122 31414
C 3206	63V 10%	100NF	5322 121 42492
C 3208	10%	470PF	4822 122 30034
C 3209	-10+10%	2.2NF	5322 122 33851
C 3211	-10+10%	2.2NF	5322 122 33851
C 3250	100V 10%	10NF	4822 121 41857
C 3251	63V 10%	220NF	4822 121 42408
C 3252	-10+10%	2.2NF	5322 122 33851
C 3253	-20+50%	10NF	4822 122 31414
C 3254	-20+50%	10NF	4822 122 31414
C 3256	0.25PF	0.56PF	5322 122 32107
C 3257	-20+50%	10NF	4822 122 31414
C 3258	-10+10%	2.2NF	5322 122 33851
C 3301	-20+50%	10NF	4822 122 31414
C 3302	-20+50%	10NF	4822 122 31414
C 3303	-10+50%	47UF	4822 124 20699
C 3304	-20+50%	10NF	4822 122 31414
C 3306	-20+50%	10NF	4822 122 31414
C 3307	-20+50%	10NF	4822 122 31414
C 3308	-20+50%	10NF	4822 122 31414
C 3309	-20+50%	10NF	4822 122 31414
C 3311	-20+50%	10NF	4822 122 31414
C 3312	-10+50%	47UF	4822 124 20699
C 3313	-20+50%	10NF	4822 122 31414
C 3314	-10+50%	15UF	4822 124 20729
C 3316	-20+50%	10NF	4822 122 31414
C 3317	-20+50%	10NF	4822 122 31414
C 3318	-20+50%	10NF	4822 122 31414
C 3319	-10+50%	15UF	4822 124 20729
C 3321	-20+50%	10NF	4822 122 31414
C 3322	-20+50%	10NF	4822 122 31414
C 3324	-20+50%	10NF	4822 122 31414
C 3326	-20+50%	10NF	4822 122 31414
C 4001	2%	100PF	4822 122 31316
C 4002	2%	100PF	4822 122 31316
C 4003	100V 10%	10NF	4822 121 41857
C 4004	10%	4.7NF	4822 122 31125
C 4005	10%	4.7NF	4822 122 31125
C 4006	-20+50%	10NF	4822 122 31414
C 4007	10%	470PF	4822 122 30034
C 4011	-20+50%	10NF	4822 122 31414
C 4028	2%	100PF	4822 122 31316

POSNR	DESCRIPTION	ORDERING CODE
C 4029	2% 100PF	4822 122 31316
C 4101	-20+50% 10NF	4822 122 31414
C 4103	-20+50% 10NF	4822 122 31414
C 4105	63V 10% 100NF	5322 121 42492
C 4106	-10+50% 150UF	4822 124 20672
C 4107	63V 10% 100NF	5322 121 42492
C 4108	2% 100PF	4822 122 31316
C 4109	-20+50% 10NF	4822 122 31414
C 4110	63V 10% 470NF	5322 121 42979
C 4112	-20+50% 10NF	4822 122 31414
C 4113	630V 1% 1NF	4822 121 50591
C 4114	100V 10% 10UF	5322 121 41727
C 4116	10% 1.5NF	4822 122 31169
C 4117	2% 100PF	4822 122 31316
C 4118	-20+50% 10NF	4822 122 31414
C 4120	63V 10% 100NF	5322 121 42492
C 4122	63V 10% 100NF	5322 121 42492
C 4123	-10+50% 47UF	4822 124 20699
C 4124	-20+50% 10NF	4822 122 31414
C 4126	-10+50% 47UF	4822 124 20699
C 4260	63V 10% 100NF	5322 121 42492
C 4301	63V 10% 100NF	5322 121 42492
C 4302	-10+50% 4.7UF	4822 124 20726
C 4303	100V 10% 10NF	4822 121 41857
C 4304	2% 220PF	4822 122 30094
C 4306	-20+50% 10NF	4822 122 31414
C 4307	-20+50% 10NF	4822 122 31414
C 4311	2% 100PF	4822 122 31316
C 4501	-20+50% 10NF	4822 122 31414
C 4502	-20+50% 10NF	4822 122 31414
C 4503	0.25PF 3.9PF	5322 122 34107
C 4521	63V 10% 100NF	5322 121 42492
C 4522	63V 10% 100NF	5322 121 42492
C 4601	63V 10% 100NF	5322 121 42492
C 4602	0.25PF 8.2PF	4822 122 31052
C 4603	0.25PF 8.2PF	4822 122 31052
C 4611	-20+50% 10NF	4822 122 31414
C 4612	-20+50% 10NF	4822 122 31414
C 4613	2% 10PF	4822 122 32185
C 4701	10% 1NF	5322 122 32331
C 4702	2% 220PF	4822 122 30094
C 4703	10% 1NF	5322 122 32331
C 4704	-20+50% 10NF	4822 122 31414
C 4801	-20+20% 2200UF	4822 124 21382
C 4804	-10+50% 150UF	4822 124 20672
C 4807	-20+50% 10NF	4822 122 31414
C 4808	-10+50% 68UF	4822 124 20689
C 4811	-20+50% 10NF	4822 122 31414
C 4815	-20+50% 10NF	4822 122 31414
C 4819	-20+50% 10NF	4822 122 31414
C 4820	-20+50% 10NF	4822 122 31414
C 4822	-20+50% 10NF	4822 122 31414
C 4825	-20+50% 10NF	4822 122 31414
C 4829	-20+50% 10NF	4822 122 31414
C 4831	-20+50% 10NF	4822 122 31414
C 4832	-10+50% 47UF	4822 124 20699
C 4833	-20+50% 10NF	4822 122 31414
C 4835	-20+50% 10NF	4822 122 31414
C 4836	-20+50% 10NF	4822 122 31414
C 4837	-10+50% 47UF	4822 124 20699
C 4839	2% 12PF	4822 122 31056
C 4888	-10+50% 47UF	4822 124 20699
C 4889	-10+50% 47UF	4822 124 20699
C 4891	-20+50% 10NF	4822 122 31414
C 4893	-20+50% 10NF	4822 122 31414
C 4895	-20+50% 10NF	4822 122 31414
C 4897	-20+50% 10NF	4822 122 31414
C 4898	-20+50% 10NF	4822 122 31414
C 4899	-20+50% 10NF	4822 122 31414
C 5001	-20+50% 10NF	4822 122 31414
C 5002	-20+50% 10NF	4822 122 31414
C 5003	-20+50% 10NF	4822 122 31414
C 5004	-20+50% 10NF	4822 122 31414
C 5006	-20+50% 10NF	4822 122 31414
C 6001	250V 10% 220NF	5322 121 44142
C 6002	ME275 20% 1NF	5322 121 42583
C 6003	63V 10% 100NF	5322 121 42492
C 6004	63V 10% 100NF	5322 121 42492
C 6005	-20+50% 1.5NF	5322 122 50092
C 6006	ME275 20% 1NF	5322 121 42583
C 6007	-10+50% 68UF	5322 124 22796
C 6008	-10+50% 68UF	5322 124 22796
C 6009	100V 10% 47NF	5322 121 42491
C 6011	-10+50% 33UF	4822 124 20712
C 6012	2% 220PF	4822 122 30094
C 6013	10% 4.7NF	4822 122 31125
C 6014	160V 1% 33NF	5322 121 50997
C 6017	2KV 5% 1.5NF	5322 121 43243
C 6018	10% 4.7NF	4822 122 31125
C 6031	100V 10% 10NF	4822 121 41857
C 6032	63V 10% 220NF	4822 121 42408
C 6033	100V 10% 10NF	4822 121 41857
C 6041	63V 10% 100NF	5322 121 42492
C 6042	63V 10% 100NF	5322 121 42492
C 6100	-20+20% 6800UF	4822 124 40692
C 6101	-20+20% 6800UF	4822 124 40692
C 6102	-10+50% 680UF	4822 124 20685
C 6103	1000UF/25V	5322 124 23276
C 6104	1000UF/25V	5322 124 23276
C 6106	1000UF/25V	5322 124 23276
C 6107	-10+50% 150UF	4822 124 20691
C 6108	1000UF/25V	5322 124 23276
C 6109	-10+50% 150UF	4822 124 20691
C 6111	1000UF/25V	5322 124 23276
C 6112	-10+50% 100UF	4822 124 20701
C 6113	-10+50% 100UF	4822 124 20701
C 6114	-10+50% 100UF	4822 124 20701
C 6116	-10+50% 68UF	4822 124 20734
C 6117	-10+50% 22UF	4822 124 20731
C 6119	-10+50% 22UF	4822 124 20731
C 6120	-20+50% 10NF	4822 122 31414
C 6121	-10+50% 22UF	4822 124 20731
C 6122	630V 1% 680PF	5322 121 51214
C 6131	63V 10% 470NF	5322 121 42979
C 6132	-10+50% 100UF	4822 124 20679
C 6133	63V 10% 100NF	5322 121 42492
C 6134	10% 1NF	5322 122 32331
C 6135	-20+50% 10NF	4822 122 31414
C 6201	100V 10% 47NF	5322 121 42491
C 6202	2% 47PF	4822 122 31072
C 6203	63V 10% 220NF	4822 121 42408
C 6204	63V 10% 100NF	5322 121 42492
C 6205	100V 10% 100NF	5322 121 42578
C 6206	10% 1NF	5322 122 32331
C 6207	10% 4.7NF	4822 122 31125
C 6208	-10+50% 68UF	4822 124 20734
C 6209	-20+50% 2.2NF	5322 122 50093
C 6210	100V 10% 100NF	5322 121 42578
C 6211	-20+50% 10NF	5322 122 50091
C 6212	-10+10% 33PF	5322 122 33081
C 6213	10% 4.7NF	4822 122 31125
C 6214	20% 470PF	5322 122 50086
C 6215	100V 10% 100NF	5322 121 42578
C 6311	-20+50% 10NF	4822 122 31414
C 6312	-20+50% 10NF	4822 122 31414
C 6401	63V 10% 100NF	5322 121 42492
C 6402	-10+50% 68UF	4822 124 20689
C 6500	-10+50% 68UF	4822 124 20689
C 6501	-20+50% 10NF	4822 122 31414
C 6502	100V 10% 10NF	4822 121 41857
C 6503	2% 100PF	4822 122 31316
C 6506	2% 100PF	4822 122 31316
C 7001	63V 10% 220NF	4822 121 42408
C 7004	-20+50% 10NF	4822 122 31414
C 7005	63V 10% 100NF	5322 121 42492
C 7006	-20+50% 10NF	4822 122 31414
C 7007	63V 10% 100NF	5322 121 42492
C 7008	10% 680PF	4822 122 30053
C 7009	63V 10% 100NF	5322 121 42492
C 7011	-20+50% 10NF	4822 122 31414
C 7012	-20+50% 10NF	4822 122 31414
C 7013	-20+50% 10NF	4822 122 31414
C 7017	-20+50% 10NF	4822 122 31414
C 7018	-20+50% 10NF	4822 122 31414
C 7019	-20+50% 10NF	4822 122 31414
C 7021	63V 10% 100NF	5322 121 42492
C 7100	-20+50% 10NF	4822 122 31414
C 7101	-20+50% 10NF	4822 122 31414
C 7102	-20+50% 10NF	4822 122 31414
C 7103	-20+50% 10NF	4822 122 31414
C 7104	-10+50% 220UF	4822 124 20681
C 7106	-10+50% 220UF	4822 124 20681
C 9001	-20+20% 10UF	5322 124 21956
C 9004	-20+20% 10UF	5322 124 21956
C 9005	-20+20% 10UF	5322 124 21956
C 9008	-20+20% 10UF	5322 124 21956
C 9009	-20+20% 10UF	5322 124 21956
C 9010	-20+20% 10UF	5322 124 21956
C 9011	2% 100PF	4822 122 31316
C 9012	2% 100PF	4822 122 31316
C 9013	2% 100PF	4822 122 31316
C 9014	2% 100PF	4822 122 31316
C 9015	2% 47PF	4822 122 31072
C 9016	2% 100PF	4822 122 31316
C 9017	2% 100PF	4822 122 31316
C 9018	2% 100PF	4822 122 31316
C 9019	63V 10% 220NF	4822 121 42408
C 9020	10% 2.2NF	4822 122 30114

POSNR	DESCRIPTION		ORDERING CODE
C 9021	-20+20%	33UF	5322 124 21957
C 9022	-20+80%	22NF	4822 122 30103
C 9023	-20+80%	22NF	4822 122 30103
C 9024	-20+80%	22NF	4822 122 30103
C 9025	-20+80%	22NF	4822 122 30103
C 9026	-20+80%	22NF	4822 122 30103
C 9027	-20+80%	22NF	4822 122 30103
C 9028	-20+80%	22NF	4822 122 30103
C 9029	-20+80%	22NF	4822 122 30103
C 9030	-20+80%	22NF	4822 122 30103
C 9031	-20+80%	22NF	4822 122 30103
C 9032	-20+80%	22NF	4822 122 30103
C 9033	-20+80%	22NF	4822 122 30103
C 9034	-20+80%	22NF	4822 122 30103
C 9035	-20+80%	22NF	4822 122 30103
C 9036	-20+80%	22NF	4822 122 30103
C 9037	-20+80%	22NF	4822 122 30103
C 9038	-20+80%	22NF	4822 122 30103
C 9039	-20+80%	22NF	4822 122 30103
C 9040	2%	47PF	4822 122 31072
C 9041	-20+20%	15UF	5322 124 21958
C 9042	-20+20%	15UF	5322 124 21958
C 9043	-20+80%	22NF	4822 122 30103
C 9044	-20+80%	22NF	4822 122 30103
C 9045	2%	10PF	4822 122 32185
C 9046	-20+80%	22NF	4822 122 30103
C 9047	-20+80%	22NF	4822 122 30103
C 9048	10%	2.2NF	4822 122 30114
C 9049	2%	47PF	4822 122 31072
C 9051	2%	56PF	4822 122 32027
C 9052	-20+80%	22NF	4822 122 30103
C 9053	-20+80%	22NF	4822 122 30103
C 9054	-20+80%	22NF	4822 122 30103
C 9055	2%	10PF	4822 122 32185
C 9056	-20+80%	22NF	4822 122 30103
C 9057	63V 10%	680NF	5322 121 42498
C 9072	10%	1.5NF	4822 122 31169
C 9073	10%	1.5NF	4822 122 31169
C 9074	0.25PF	8.2PF	4822 122 31194
C 9075	100V 10%	10NF	4822 121 41857
C 9076	63V 10%	100NF	5322 121 42492
C 9101	-20+80%	22NF	4822 122 30103
C 9102	2%	330PF	4822 122 31353
C 9103	2%	220PF	4822 122 30094
C 9104	2%	330PF	4822 122 31353
C 9106	2%	220PF	4822 122 30094
C 9107	2%	12PF	4822 122 31196
C 9108	-20+80%	22NF	4822 122 30103
C 9111	2%	330PF	4822 122 31353
C 9112	2%	220PF	4822 122 30094
C 9114	-20+80%	22NF	4822 122 30103
C 9115	-20+20%	15UF	5322 124 21958
C 9116	-20+20%	33UF	5322 124 21957
C 9117	-20+20%	15UF	5322 124 21958
C 9118	2%	100PF	4822 122 31316
C 9119	2%	100PF	4822 122 31316
C 9121	2%	100PF	4822 122 31316
C 9122	2%	100PF	4822 122 31316
C 9123	2%	100PF	4822 122 31316
C 9124	2%	100PF	4822 122 31316
C 9172	10%	1.5NF	4822 122 31169
C 9173	10%	1.5NF	4822 122 31169
C 9174	0.25PF	8.2PF	4822 122 31194
C 9175	100V 10%	10NF	4822 121 41857
C 9176	63V 10%	100NF	5322 121 42492
C 9201	2%	22PF	5322 122 32143
C 9202	2%	22PF	5322 122 32143

18.3.2 RESISTORS

POSNR	DESCRIPTION			ORDERING CODE
R 0600	MRS25	1%	100K	4822 050 21004
R 0601	MRS25	1%	10K	4822 050 21003
R 0602	MRS25	1%	5K62	4822 050 25622
R 0603	MRS25	1%	10K	4822 050 21003
R 0604	MRS25	1%	10K	4822 050 21003
R 0605	MRS25	1%	100K	4822 050 21004
R 0606	MRS25	1%	16K2	4822 050 21623
R 0607	MRS25	1%	2K15	4822 050 22152
R 0608	MRS25	1%	2K15	4822 050 22152
R 0609	MRS25	1%	2K15	4822 050 22152
R 0610	MRS25	1%	10K	4822 050 21003
R 0611	MRS25	1%	2K15	4822 050 22152
R 0612	MRS25	1%	422E	4822 050 24221
R 0613	MRS25	1%	422E	4822 050 24221
R 0614	MRS25	1%	10K	4822 050 21003
R 0616	MRS25	1%	75E	4822 050 27509
R 0617	MRS25	1%	75E	4822 050 27509
R 0618	MRS25	1%	10K	4822 050 21003
R 0619	MRS25	1%	2K15	4822 050 22152
R 0621	MRS25	1%	51E1	4822 050 25119
R 0622	MRS25	1%	1K62	4822 050 21622
R 0623	MRS25	1%	1K62	4822 050 21622
R 0624	MRS25	1%	178K	4822 050 21784
R 0626	MRS25	1%	26K1	4822 050 22613
R 0627	MRS25	1%	178K	4822 050 21784
R 0628	MRS25	1%	1M	4822 050 21005
R 0629	MRS25	1%	2K15	4822 050 22152
R 0631	MRS25	1%	12K1	4822 050 21213
R 0633	MRS25	1%	1M	4822 050 21005
R 0634	MRS25	1%	2K15	4822 050 22152
R 0636	MRS25	1%	51K1	4822 050 25113
R 0637	MRS25	1%	16K2	4822 050 21623
R 0638	MRS25	1%	511E	4822 050 25111
R 0639	MRS25	1%	511E	4822 050 25111
R 0641	MRS25	1%	12K1	4822 050 21213
R 0642	MRS25	1%	422E	4822 050 24221
R 0643	MRS25	1%	422E	4822 050 24221
R 0644	MRS25	1%	16K2	4822 050 21623
R 0646	MRS25	1%	5K62	4822 050 25622
R 0647	MRS25	1%	1K78	4822 050 21782
R 0648	MRS25	1%	6K81	4822 050 26812
R 0649	MRS25	1%	51K1	4822 050 25113
R 0651	MRS25	1%	16K2	4822 050 21623
R 0652	MRS25	1%	511E	4822 050 25111
R 0653	MRS25	1%	511E	4822 050 25111
R 0654	MRS25	1%	422E	4822 050 24221
R 0656	MRS25	1%	422E	4822 050 24221
R 0657	MRS25	1%	16K2	4822 050 21623
R 0658	MRS25	1%	51K1	4822 050 25113
R 0659	MRS25	1%	5K62	4822 050 25622
R 0661	MRS25	1%	1K78	4822 050 21782
R 0662	MRS25	1%	6K81	4822 050 26812
R 0663	MRS25	1%	51K1	4822 050 25113
R 0666	MRS25	1%	51E1	4822 050 25119
R 0669	MRS25	1%	1K62	4822 050 21622
R 0671	MRS25	1%	1K62	4822 050 21622
R 0681	MRS25	1%	5E11	4822 050 25118
R 0682	MRS25	1%	5E11	4822 050 25118
R 1001	MRS25	1%	1K	4822 050 21002
R 1002	MRS25	1%	42E2	4822 050 24229
R 1003	MRS25	1%	61E9	4822 050 26199
R 1004	1/4W	.25%	10K1	5322 116 53404
R 1006	MRS25	1%	121E	4822 050 21211
R 1007	0.4W	0.25%	900K	5322 116 53414
R 1008	MRS25	1%	10K	4822 050 21003
R 1009	MRS25	1%	21K5	4822 050 22153
R 1011	1/4W	.25%	111K	5322 116 53409
R 1012	0.4W	0.25%	750K	5322 116 53588
R 1013	1/4W	.25%	1M	5322 116 53398
R 1014	MRS25	1%	10K	4822 050 21003
R 1016	MRS25	1%	21K5	4822 050 22153
R 1017	1/4W	.25%	250K	5322 116 53587
R 1018	MRS25	1%	10E	4822 050 21009
R 1019	0.4W	0.25%	990K	5322 116 53415
R 1022	MRS25	1%	56E2	4822 050 25629
R 1023	VR25	10%	22M	5322 116 51785
R 1024	MRS25	1%	10E	4822 050 21009
R 1026	MRS25	1%	61E9	4822 050 26199
R 1027	VR25	10%	22M	5322 116 51785
R 1028	MRS25	1%	10E	4822 050 21009
R 1029	1/4W	.25%	1M	5322 116 53398
R 1031	VR25	10%	22M	5322 116 51785
R 1032	MRS25	1%	10E	4822 050 21009
R 1033	VR25	10%	22M	5322 116 51785
R 1034	MRS25	1%	1M	4822 050 21005
R 1035	MRS25	1%	100E	4822 050 21001
R 1036	0.3W	25%	22K	5322 105 20035
R 1037	MRS25	1%	100K	4822 050 21004
R 1038	VR25	10%	22M	5322 116 51785
R 1039	MRS25	1%	1K96	4822 050 21962
R 1040	MRS25	1%	287E	4822 050 22871
R 1041	MRS25	1%	1K96	4822 050 21962
R 1043	MRS25	1%	100E	4822 050 21001
R 1044	MRS25	1%	825E	4822 050 28251
R 1045	MRS25	1%	100E	4822 050 21001
R 1046	MRS25	1%	511E	4822 050 25111
R 1047	MRS25	1%	2K15	4822 050 22152
R 1048	MRS25	1%	5K11	4822 050 25112
R 1049	MRS25	1%	1K47	4822 050 21472
R 1050	MRS25	1%	100E	4822 050 21001

POSNR	DESCRIPTION	ORDERING CODE
R 1051	MRS25 1% 681E	4822 050 26811
R 1052	MRS25 1% 1K78	4822 050 21782
R 1053	1/4W .25% 250E	5322 116 53406
R 1054	MRS25 1% 100E	4822 050 21001
R 1055	MRS25 1% 1K78	4822 050 21782
R 1056	1/4W .25% 375E	5322 116 53407
R 1057	1/4W .25% 150E	5322 116 53399
R 1058	1/4W .25% 150E	5322 116 53399
R 1061	MRS25 1% 110E	4822 050 21101
R 1062	MRS25 1% 10E	4822 050 21009
R 1063	MRS25 1% 26K1	4822 050 22613
R 1064	0.3W 25% 10K	4822 105 10455
R 1066	21K5	4822 050 22153
R 1068	162E	4822 050 21621
R 1069	0.3W 25% 100E	5322 105 20029
R 1071	MRS25 1% 26K1	4822 050 22613
R 1072	0.3W 25% 10K	4822 105 10455
R 1073	6K81	4822 050 26812
R 1074	12K1	4822 050 21213
R 1076	0.3W 25% 100E	5322 105 20029
R 1077	51E1	4822 050 25119
R 1078	14K7	4822 050 21473
R 1079	MRS25 1% 1K62	4822 050 21622
R 1081	MRS25 1% 511E	4822 050 25111
R 1082	90K9	4822 050 29093
R 1083	10K	4822 050 21003
R 1084	100K	4822 050 21004
R 1086	10K	4822 050 21003
R 1088	MRS25 1% 100E	4822 050 21001
R 1089	MRS25 1% 422E	4822 050 24221
R 1091	0.3W 25% 100E	5322 105 20029
R 1092	MRS25 1% 10E	4822 050 21009
R 1093	MRS25 1% 422E	4822 050 24221
R 1094	MRS25 1% 100E	4822 050 21001
R 1096	MRS25 1% 100E	4822 050 21001
R 1097	MRS25 1% 100E	4822 050 21001
R 1098	MRS25 1% 1K21	4822 050 21212
R 1099	MRS25 1% 1K21	4822 050 21212
R 1101	MRS25 1% 1K	4822 050 21002
R 1102	MRS25 1% 42E2	4822 050 24229
R 1103	MRS25 1% 61E9	4822 050 26199
R 1104	1/4W .25% 10K1	5322 116 53404
R 1106	MRS25 1% 121E	4822 050 21211
R 1107	0.4W 0.25% 900K	5322 116 53414
R 1108	MRS25 1% 10K	4822 050 21003
R 1109	MRS25 1% 21K5	4822 050 22153
R 1111	1/4W .25% 111K	5322 116 53409
R 1112	0.4W 0.25% 750K	5322 116 53588
R 1113	1/4W .25% 1M	5322 116 53398
R 1114	MRS25 1% 10K	4822 050 21003
R 1116	MRS25 1% 21K5	4822 050 22153
R 1117	1/4W .25% 250K	5322 116 53587
R 1118	MRS25 1% 10E	4822 050 21009
R 1119	0.4W 0.25% 990K	5322 116 53415
R 1122	MRS25 1% 56E2	4822 050 25629
R 1123	VR25 10% 22M	5322 116 51785
R 1124	MRS25 1% 10E	4822 050 21009
R 1126	MRS25 1% 61E9	4822 050 26199
R 1127	VR25 10% 22M	5322 116 51785
R 1128	MRS25 1% 10E	4822 050 21009
R 1129	1/4W .25% 1M	5322 116 53398
R 1131	VR25 10% 22M	5322 116 51785
R 1132	MRS25 1% 10E	4822 050 21009
R 1133	VR25 10% 22M	5322 116 51785
R 1134	MRS25 1% 1M	4822 050 21005
R 1135	MRS25 1% 100E	4822 050 21001
R 1136	0.3W 25% 22K	5322 105 20035
R 1137	MRS25 1% 100K	4822 050 21004
R 1138	VR25 10% 22M	5322 116 51785
R 1139	MRS25 1% 1K96	4822 050 21962
R 1140	MRS25 1% 287E	4822 050 22871
R 1141	MRS25 1% 1K96	4822 050 21962
R 1143	MRS25 1% 100E	4822 050 21001
R 1144	MRS25 1% 825E	4822 050 28251
R 1145	MRS25 1% 100E	4822 050 21001
R 1146	MRS25 1% 511E	4822 050 25111
R 1147	MRS25 1% 2K15	4822 050 22152
R 1148	MRS25 1% 5K11	4822 050 25112
R 1149	MRS25 1% 1K47	4822 050 21472
R 1150	MRS25 1% 100E	4822 050 21001
R 1151	MRS25 1% 681E	4822 050 26811
R 1152	MRS25 1% 1K78	4822 050 21782
R 1153	1/4W .25% 250E	5322 116 53406
R 1154	MRS25 1% 100E	4822 050 21001
R 1155	MRS25 1% 1K78	4822 050 21782
R 1156	1/4W .25% 375E	5322 116 53407
R 1157	1/4W .25% 150E	5322 116 53399
R 1158	1/4W .25% 150E	5322 116 53399
R 1161	MRS25 1% 110E	4822 050 21101
R 1162	MRS25 1% 10E	4822 050 21009
R 1163	MRS25 1% 26K1	4822 050 22613
R 1164	0.3W 25% 10K	4822 105 10455
R 1166	21K5	4822 050 22153
R 1168	162E	4822 050 21621
R 1169	0.3W 25% 100E	5322 105 20029
R 1171	MRS25 1% 26K1	4822 050 22613
R 1172	0.3W 25% 10K	4822 105 10455
R 1173	6K81	4822 050 26812
R 1174	12K1	4822 050 21213
R 1176	0.3W 25% 100E	5322 105 20029
R 1177	51E1	4822 050 25119
R 1178	14K7	4822 050 21473
R 1179	MRS25 1% 1K62	4822 050 21622
R 1181	MRS25 1% 511E	4822 050 25111
R 1182	90K9	4822 050 29093
R 1183	10K	4822 050 21003
R 1184	100K	4822 050 21004
R 1186	10K	4822 050 21003
R 1188	MRS25 1% 100E	4822 050 21001
R 1189	MRS25 1% 422E	4822 050 24221
R 1191	0.3W 25% 100E	5322 105 20029
R 1192	MRS25 1% 10E	4822 050 21009
R 1193	MRS25 1% 422E	4822 050 24221
R 1194	MRS25 1% 100E	4822 050 21001
R 1196	MRS25 1% 100E	4822 050 21001
R 1197	MRS25 1% 100E	4822 050 21001
R 1198	MRS25 1% 1K21	4822 050 21212
R 1199	MRS25 1% 1K21	4822 050 21212
R 1201	MRS25 1% 1K	4822 050 21002
R 1202	MRS25 1% 68E1	4822 050 26819
R 1203	0.4W 0.1% 1M	5322 116 51605
R 1204	VR25 10% 22M	5322 116 51785
R 1206	MRS25 1% 1K96	4822 050 21962
R 1207	MRS25 1% 100E	4822 050 21001
R 1208	MRS25 1% 825E	4822 050 28251
R 1209	MRS25 1% 1M	4822 050 21005
R 1211	MRS25 1% 100E	4822 050 21001
R 1213	MRS25 1% 1M	4822 050 21005
R 1217	0.3W 25% 22K	5322 105 20035
R 1218	MRS25 1% 100K	4822 050 21004
R 1219	MRS25 1% 1K47	4822 050 21472
R 1221	MRS25 1% 681E	4822 050 26811
R 1222	MRS25 1% 2K87	4822 050 22872
R 1223	MRS25 1% 1K33	4822 050 21332
R 1224	MRS25 1% 1K	4822 050 21002
R 1226	MRS25 1% 5K11	4822 050 25112
R 1227	MRS25 1% 1K33	4822 050 21332
R 1228	MRS25 1% 100E	4822 050 21001
R 1229	MRS25 1% 750E	4822 050 27501
R 1231	MRS25 1% 750E	4822 050 27501
R 1232	MRS25 1% 82E5	4822 050 28259
R 1233	MRS25 1% 348E	4822 050 23481
R 1234	MRS25 1% 100E	4822 050 21001
R 1236	MRS25 1% 162E	4822 050 21621
R 1237	MRS25 1% 2K61	4822 050 22612
R 1238	MRS25 1% 100E	4822 050 21001
R 1239	MRS25 1% 7K5	4822 050 27502
R 1401	MRS25 1% 5E11	4822 050 25118
R 1402	5E11	4822 050 25118
R 1403	MRS25 1% 5E11	4822 050 25118
R 1404	MRS25 1% 5E11	4822 050 25118
R 1421	MRS25 1% 5E11	4822 050 25118
R 1422	5E11	4822 050 25118
R 1423	MRS25 1% 5E11	4822 050 25118
R 1424	MRS25 1% 5E11	4822 050 25118
R 1441	MRS25 1% 100E	4822 050 21001
R 1442	MRS25 1% 5E11	4822 050 25118
R 1443	MRS25 1% 5E11	4822 050 25118
R 2001	MRS25 1% 10E	4822 050 21009
R 2002	MRS25 1% 10E	4822 050 21009
R 2003	MRS25 1% 51E1	4822 050 25119
R 2004	MRS25 1% 51E1	4822 050 25119
R 2101	MRS25 1% 10E	4822 050 21009
R 2102	MRS25 1% 10E	4822 050 21009
R 2201	MRS25 1% 75K	4822 050 27503
R 2202	MRS25 1% 12K1	4822 050 21213
R 2203	MRS25 1% 215K	4822 050 22154
R 2204	MRS25 1% 10K	4822 050 21003
R 2205	2K2	4822 051 10222
R 2206	MRS25 1% 75K	4822 050 27503
R 2207	MRS25 1% 12K1	4822 050 21213
R 2208	MRS25 1% 215K	4822 050 22154
R 2209	MRS25 1% 10K	4822 050 21003
R 2210	2K2	4822 051 10222
R 2211	MRS25 1% 5K62	4822 050 25622
R 2212	0.3W 25% 10K	4822 105 10455
R 2213	MRS25 1% 23K7	4822 050 22373
R 2214	MRS25 1% 10K	4822 050 21003

POSNR	DESCRIPTION	ORDERING CODE
R 2215	2K2	4822 051 10222
R 2216	MRS25 1% 5K62	4822 050 25622
R 2222	MRS25 1% 1K96	4822 050 21962
R 2225	MRS25 1% 23K7	4822 050 22373
R 2230	MRS25 1% 147E	4822 050 21471
R 2231	MRS25 1% 422E	4822 050 24221
R 2232	MRS25 1% 383E	4822 050 23831
R 2234	31E6	4822 050 23169
R 2235	46E4	4822 050 24649
R 2236	MRS25 1% 681E	4822 050 26811
R 2237	MRS25 1% 383E	4822 050 23831
R 2239	MRS25 1% 348E	4822 050 23481
R 2241	MRS25 1% 1K	4822 050 21002
R 2242	MRS25 1% 383E	4822 050 23831
R 2243	MRS25 1% 681E	4822 050 26811
R 2244	31E6	4822 050 23169
R 2245	46E4	4822 050 24649
R 2246	MRS25 1% 422E	4822 050 24221
R 2247	MRS25 1% 383E	4822 050 23831
R 2250	31E6	4822 050 23169
R 2251	MRS25 1% 75E	4822 050 27509
R 2252	MRS25 1% 750E	4822 050 27501
R 2253	MRS25 1% 750E	4822 050 27501
R 2254	MRS25 1% 75E	4822 050 27509
R 2255	MRS25 1% 287E	4822 050 22871
R 2301	MRS25 1% 19K6	4822 050 21963
R 2302	MRS25 1% 19K6	4822 050 21963
R 2303	MRS25 1% 5K62	4822 050 25622
R 2304	MRS25 1% 5K62	4822 050 25622
R 2311	MRS25 1% 2K87	4822 050 22872
R 2315	MRS25 1% 100E	4822 050 21001
R 2316	MRS25 1% 100E	4822 050 21001
R 2317	MRS25 1% 1K	4822 050 21002
R 2318	MRS25 1% 1K	4822 050 21002
R 2319	MRS25 1% 5E11	4822 050 25118
R 2324	MRS25 1% 5K62	4822 050 25622
R 2325	MRS25 1% 5K62	4822 050 25622
R 2326	MRS25 1% 2K87	4822 050 22872
R 2327	MRS25 1% 3K83	4822 050 23832
R 2328	MRS25 1% 2K87	4822 050 22872
R 2329	MRS25 1% 825E	4822 050 28251
R 2330	0.3W 25% 10K	4822 105 10455
R 2333	MRS25 1% 5K62	4822 050 25622
R 2334	MRS25 1% 5K62	4822 050 25622
R 2335	10K	5322 116 80428
R 2336	21E5	4822 050 22159
R 2337	160E	4822 051 10161
R 2338	4.3K	5322 116 80605
R 2339	390E	5322 111 91205
R 2341	MRS25 1% 21E5	4822 050 22159
R 2342	160E	4822 051 10161
R 2344	510E	4822 051 10511
R 2345	100E	5322 116 80426
R 2346	MRS25 1% 681E	4822 050 26811
R 2348	8.2K	4822 051 10822
R 2350	5.1K	5322 111 91471
R 2351	560E	4822 051 10561
R 2352	820E	4822 051 10821
R 2357	MRS25 1% 681E	4822 050 26811
R 2358	510E	4822 051 10511
R 2360	100E	5322 116 80426
R 2361	5.1K	5322 111 91471
R 2365	MRS25 1% 23K7	4822 050 22373
R 2366	MRS25 1% 10K	4822 050 21003
R 2367	MRS25 1% 16K2	4822 050 21623
R 2369	MRS25 1% 68K1	4822 050 26813
R 2371	MRS25 1% 422E	4822 050 24221
R 2372	MRS25 1% 511E	4822 050 25111
R 2373	MRS25 1% 75K	4822 050 27503
R 2374	MRS25 1% 511E	4822 050 25111
R 2375	MRS25 1% 23K7	4822 050 22373
R 2376	VR25 10% 22M	5322 116 51785
R 2377	VR25 10% 22M	5322 116 51785
R 2378	VR25 10% 22M	5322 116 51785
R 2379	VR25 10% 22M	5322 116 51785
R 2380	MRS25 1% 750E	4822 050 27501
R 2381	MRS25 1% 2K61	4822 050 22612
R 2382	MRS25 1% 2K61	4822 050 22612
R 2383	MRS25 1% 1K	4822 050 21002
R 2384	MRS25 1% 750E	4822 050 27501
R 2386	MRS25 1% 1K	4822 050 21002
R 2387	MRS25 1% 750E	4822 050 27501
R 2388	MRS25 1% 1K	4822 050 21002
R 2389	MRS25 1% 1K	4822 050 21002
R 2391	MRS25 1% 42E2	4822 050 24229
R 2393	MRS25 1% 3K48	4822 050 23482
R 2394	MRS25 1% 100E	4822 050 21001
R 2395	0.3W 25% 220E	5322 105 20031

POSNR	DESCRIPTION	ORDERING CODE
R 2396	MRS25 1% 3K48	4822 050 23482
R 2397	MRS25 1% 42E2	4822 050 24229
R 2403	MRS25 1% 42E2	4822 050 24229
R 2404	MRS25 1% 1K33	4822 050 21332
R 2406	MRS25 1% 1K62	4822 050 21622
R 2407	0.3W 25% 220E	5322 105 20031
R 2408	MRS25 1% 1K33	4822 050 21332
R 2409	MRS25 1% 1K62	4822 050 21622
R 2410	0.3W 25% 1K	5322 105 20032
R 2411	MRS25 1% 42E2	4822 050 24229
R 2412	MRS25 1% 1K33	4822 050 21332
R 2416	MRS25 1% 1K	4822 050 21002
R 2418	MRS25 1% 5K62	4822 050 25622
R 2419	MRS25 1% 1K1	4822 050 21102
R 2420	MRS25 1% 133E	4822 050 21331
R 2421	MRS25 1% 5K62	4822 050 25622
R 2422	MRS25 1% 1K	4822 050 21002
R 2430	MRS25 1% 100K	4822 050 21004
R 2431	MRS25 1% 100K	4822 050 21004
R 2432	MRS25 1% 100K	4822 050 21004
R 2433	MRS25 1% 100K	4822 050 21004
R 2434	MRS25 1% 10K	4822 050 21003
R 2435	MRS25 1% 10K	4822 050 21003
R 2601	MRS25 1% 3K48	4822 050 23482
R 2602	MRS25 1% 5E11	4822 050 25118
R 2603	MRS25 1% 5K11	4822 050 25112
R 2604	MRS25 1% 5K11	4822 050 25112
R 2605	MRS25 1% 12K1	4822 050 21213
R 2606	MRS25 1% 1E	4822 050 21008
R 2610	MRS25 1% 10K	4822 050 21003
R 2611	MRS25 1% 1K	4822 050 21002
R 2621	MRS25 1% 422E	4822 050 24221
R 2622	MRS25 1% 681E	4822 050 26811
R 2623	MRS25 1% 1K1	4822 050 21102
R 2624	MRS25 1% 3K48	4822 050 23482
R 2625	MRS25 1% 681E	4822 050 26811
R 2626	MRS25 1% 6K81	4822 050 26812
R 2627	MRS25 1% 287E	4822 050 22871
R 2628	MRS25 1% 2K37	4822 050 22372
R 2629	MRS25 1% 10K	4822 050 21003
R 2631	MRS25 1% 10K	4822 050 21003
R 2632	MRS25 1% 383E	4822 050 23831
R 2635	MRS25 1% 10K	4822 050 21003
R 2701	MRS25 1% 1E	4822 050 21008
R 2702	MRS25 1% 26E1	4822 050 22619
R 2704	MRS25 1% 5E11	4822 050 25118
R 2712	MRS25 1% 5E11	4822 050 25118
R 2713	MRS25 1% 5E11	4822 050 25118
R 2714	MRS25 1% 5E11	4822 050 25118
R 2721	MRS25 1% 5E11	4822 050 25118
R 2722	MRS25 1% 1E	4822 050 21008
R 2723	MRS25 1% 5E11	4822 050 25118
R 2724	MRS25 1% 5E11	4822 050 25118
R 2740	MRS25 1% 5E11	4822 050 25118
R 2741	MRS25 1% 31E6	4822 050 23169
R 2742	MRS25 1% 5E11	4822 050 25118
R 2801	1K1	4822 116 82238
R 2802	1K	5322 116 80427
R 2803	2K	5322 116 80858
R 2804	1K	5322 116 80427
R 2806	5K1	5322 111 91471
R 2807	1K	5322 116 80427
R 2808	2K	5322 116 80858
R 2809	510E	4822 051 10511
R 2811	510E	4822 051 10511
R 2812	510E	4822 051 10511
R 2813	510E	4822 051 10511
R 2814	1K	5322 116 80427
R 2816	1K	5322 116 80427
R 2817	750E	4822 116 82384
R 2818	750E	4822 116 82384
R 2819	1K1	4822 116 82238
R 2821	1K6	5322 116 80596
R 2822	1K	5322 116 80427
R 2823	1K	5322 116 80427
R 2824	1K	5322 116 80427
R 2826	2K	5322 116 80858
R 2827	2K	5322 116 80858
R 2828	2K	5322 116 80858
R 2829	360E	5322 116 80861
R 2831	330E	4822 051 10331
R 2832	3K3	4822 051 10332
R 2833	3K3	4822 051 10332
R 2834	360E	5322 116 80861
R 2836	330E	4822 051 10331
R 3001	MRS25 1% 147E	4822 050 21471
R 3002	MRS25 1% 316E	4822 050 23161
R 3003	MRS25 1% 1K47	4822 050 21472
R 3004	MRS25 1% 422E	4822 050 24221

POSNR	DESCRIPTION	ORDERING CODE
R 3006	MRS25 1% 2K37	4822 050 22372
R 3007	0.3W 25% 2K2	5322 105 20033
R 3008	MRS25 1% 121E	4822 050 21211
R 3009	MRS25 1% 3K83	4822 050 23832
R 3011	MRS25 1% 121E	4822 050 21211
R 3012	MRS25 1% 316E	4822 050 23161
R 3013	0.3W 25% 10K	4822 105 10455
R 3014	MRS25 1% 2K87	4822 050 22872
R 3015	MRS25 1% 316E	4822 050 23161
R 3016	MRS25 1% 2K37	4822 050 22372
R 3017	0.3W 25% 22K	5322 105 20035
R 3018	3K48	4822 050 23482
R 3020	MRS25 1% 10E	4822 050 21009
R 3021	MRS25 1% 464E	4822 050 24641
R 3022	MRS25 1% 750E	4822 050 27501
R 3023	MRS25 1% 348E	4822 050 23481
R 3024	MRS25 1% 750E	4822 050 27501
R 3025	MRS25 1% 10E	4822 050 21009
R 3026	MRS25 1% 464E	4822 050 24641
R 3027	MRS25 1% 42E2	4822 050 24229
R 3028	MRS25 1% 42E2	4822 050 24229
R 3029	MRS25 1% 3K16	4822 050 23162
R 3031	MRS25 1% 402E	4822 050 24021
R 3032	MRS25 1% 31E6	4822 050 23169
R 3033	MRS25 1% 100E	4822 050 21001
R 3034	MRS25 1% 162E	4822 050 21621
R 3036	220E POTM.	5322 105 20031
R 3037	MRS25 1% 100E	4822 050 21001
R 3038	0.3W 25% 470E	5322 105 20028
R 3039	MRS25 1% 42E2	4822 050 24229
R 3041	MRS25 1% 316E	4822 050 23161
R 3042	MRS25 1% 110E	4822 050 21101
R 3043	MRS25 1% 110E	4822 050 21101
R 3044	MRS25 1% 110E	4822 050 21101
R 3046	MRS25 1% 110E	4822 050 21101
R 3047	MRS25 1% 42E2	4822 050 24229
R 3048	MRS25 1% 42E2	4822 050 24229
R 3049	MRS25 1% 51K1	4822 050 25113
R 3050	MRS25 1% 42E2	4822 050 24229
R 3051	MRS25 1% 51K1	4822 050 25113
R 3052	MRS25 1% 42E2	4822 050 24229
R 3060	MRS25 1% 110E	4822 050 21101
R 3061	MRS25 1% 110E	4822 050 21101
R 3062	MRS25 1% 110E	4822 050 21101
R 3063	MRS25 1% 110E	4822 050 21101
R 3064	MRS25 1% 110E	4822 050 21101
R 3066	MRS25 1% 110E	4822 050 21101
R 3067	MRS25 1% 110E	4822 050 21101
R 3068	MRS25 1% 110E	4822 050 21101
R 3100	MRS25 1% 42E2	4822 050 24229
R 3101	MRS25 1% 5K62	4822 050 25622
R 3102	MRS25 1% 562E	4822 050 25621
R 3103	MRS25 1% 1K21	4822 050 21212
R 3104	MRS25 1% 6K81	4822 050 26812
R 3106	MRS25 1% 42E2	4822 050 24229
R 3107	MRS25 1% 2K87	4822 050 22872
R 3108	MRS25 1% 825E	4822 050 28251
R 3109	MRS25 1% 6K19	4822 050 26192
R 3110	MRS25 1% 42E2	4822 050 24229
R 3111	MRS25 1% 42E2	4822 050 24229
R 3112	MRS25 1% 7K5	4822 050 27502
R 3113	MRS25 1% 1K21	4822 050 21212
R 3114	MRS25 1% 5K62	4822 050 25622
R 3115	MRS25 1% 42E2	4822 050 24229
R 3116	MRS25 1% 562E	4822 050 25621
R 3117	MRS25 1% 4K64	4822 050 24642
R 3118	0.3W 25% 1K	5322 105 20032
R 3119	MRS25 1% 4K64	4822 050 24642
R 3120	MRS25 1% 42E2	4822 050 24229
R 3121	MRS25 1% 15K4	4822 050 21543
R 3122	MRS25 1% 2K37	4822 050 22372
R 3124	MRS25 1% 619E	4822 050 26191
R 3125	MRS25 1% 26E1	4822 050 22619
R 3126	MRS25 1% 14K7	4822 050 21473
R 3127	MRS25 1% 1K33	4822 050 21332
R 3128	MRS25 1% 825E	4822 050 28251
R 3129	MRS25 1% 1K1	4822 050 21102
R 3130	MRS25 1% 26E1	4822 050 22619
R 3131	MRS25 1% 1K33	4822 050 21332
R 3132	MRS25 1% 825E	4822 050 28251
R 3133	MRS25 1% 6K19	4822 050 26192
R 3134	MRS25 1% 14K7	4822 050 21473
R 3136	MRS25 1% 1K	4822 050 21002
R 3137	MRS25 1% 15K4	4822 050 21543
R 3138	MRS25 1% 2K37	4822 050 22372
R 3139	MRS25 1% 619E	4822 050 26191
R 3141	MRS25 1% 316E	4822 050 23161
R 3142	MRS25 1% 316E	4822 050 23161
R 3143	MRS25 1% 10E	4822 050 21009
R 3144	MRS25 1% 10E	4822 050 21009
R 3147	0.5W 10% 3K3	5322 116 30234
R 3148	MRS25 1% 9K09	4822 050 29092
R 3149	MRS25 1% 511E	4822 050 25111
R 3200	MRS25 1% 6K81	4822 050 26812
R 3201	MRS25 1% 1K21	4822 050 21212
R 3202	MRS25 1% 100E	4822 050 21001
R 3203	MRS25 1% 16K2	4822 050 21623
R 3204	MRS25 1% 562E	4822 050 25621
R 3205	MRS25 1% 4K64	4822 050 24642
R 3206	MRS25 1% 4K64	4822 050 24642
R 3207	MRS25 1% 82K5	4822 050 28253
R 3208	MRS25 1% 7K5	4822 050 27502
R 3209	MRS25 1% 1K	4822 050 21002
R 3210	MRS25 1% 42E2	4822 050 24229
R 3211	MRS25 1% 10K	4822 050 21003
R 3212	MRS25 1% 1K47	4822 050 21472
R 3213	MRS25 1% 23K7	4822 050 22373
R 3214	MRS25 1% 31K6	4822 050 23163
R 3215	MRS25 1% 4K64	4822 050 24642
R 3216	MRS25 1% 178K	4822 050 21784
R 3217	MRS25 1% 511E	4822 050 25111
R 3218	MRS25 1% 61K9	4822 050 26193
R 3219	MRS25 1% 1M	4822 050 21005
R 3221	MRS25 1% 100E	4822 050 21001
R 3222	MRS25 1% 100K	4822 050 21004
R 3223	MRS25 1% 38K3	4822 050 23833
R 3224	MRS25 1% 2K37	4822 050 22372
R 3226	MRS25 1% 100E	4822 050 21001
R 3250	MRS25 1% 2K37	4822 050 22372
R 3251	MRS25 1% 1M	4822 050 21005
R 3253	MRS25 1% 75K	4822 050 27503
R 3254	MRS25 1% 1K	4822 050 21002
R 3256	MRS25 1% 178K	4822 050 21784
R 3257	MRS25 1% 825K	4822 050 28254
R 3258	VR25 5% 3M3	4822 053 20335
R 3259	VR25 5% 3M3	4822 053 20335
R 3261	VR25 5% 3M3	4822 053 20335
R 3263	VR25 5% 3M3	4822 053 20335
R 3267	25% 47K	5322 105 20037
R 3268	MRS25 1% 681K	4822 050 26814
R 3269	MRS25 1% 15K4	4822 050 21543
R 3270	MRS25 1% 23K7	4822 050 22373
R 3271	MRS25 1% 14K7	4822 050 21473
R 3273	MRS25 1% 215K	4822 050 22154
R 3301	MRS25 1% 10E	4822 050 21009
R 3302	MRS25 1% 1E	4822 050 21008
R 3303	MRS25 1% 5E11	4822 050 25118
R 3304	MRS25 1% 5E11	4822 050 25118
R 3306	MRS25 1% 2K87	4822 050 22872
R 3308	MRS25 1% 10E	4822 050 21009
R 3309	MRS25 1% 5E11	4822 050 25118
R 3311	MRS25 1% 5E11	4822 050 25118
R 3312	MRS25 1% 5E11	4822 050 25118
R 3313	MRS25 1% 10E	4822 050 21009
R 4001	MRS25 1% 51E1	4822 050 25119
R 4002	MRS25 1% 51E1	4822 050 25119
R 4003	MRS25 1% 2K61	4822 050 22612
R 4004	0.3W 25% 1K	5322 105 20032
R 4006	MRS25 1% 10K	4822 050 21003
R 4007	MRS25 1% 100E	4822 050 21001
R 4008	MRS25 1% 100E	4822 050 21001
R 4009	MRS25 1% 1K	4822 050 21002
R 4011	MRS25 1% 2K15	4822 050 22152
R 4012	MRS25 1% 100E	4822 050 21001
R 4013	MRS25 1% 100E	4822 050 21001
R 4014	MRS25 1% 909E	4822 050 29091
R 4016	MRS25 1% 909E	4822 050 29091
R 4017	MRS25 1% 100E	4822 050 21001
R 4019	MRS25 1% 51E1	4822 050 25119
R 4021	MRS25 1% 1K47	4822 050 21472
R 4022	MRS25 1% 511E	4822 050 25111
R 4023	MRS25 1% 562E	4822 050 25621
R 4026	MRS25 1% 909E	4822 050 29091
R 4027	MRS25 1% 5K62	4822 050 25622
R 4028	MRS25 1% 1K	4822 050 21002
R 4029	MRS25 1% 2K37	4822 050 22372
R 4031	MRS25 1% 1M	4822 050 21005
R 4032	MRS25 1% 5K11	4822 050 25112
R 4033	MRS25 1% 2K61	4822 050 22612
R 4041	MRS25 1% 5K11	4822 050 25112
R 4042	MRS25 1% 3K16	4822 050 23162
R 4043	MRS25 1% 5K11	4822 050 25112
R 4044	MRS25 1% 681K	4822 050 26814
R 4046	MRS25 1% 10K	4822 050 21003
R 4047	MRS25 1% 12K1	4822 050 21213
R 4086	MRS25 1% 909E	4822 050 29091
R 4101	MRS25 1% 100K	4822 050 21004
R 4102	MRS25 1% 4K64	4822 050 24642

POSNR	DESCRIPTION	ORDERING CODE
R 4103	MRS25 1% 11K	4822 050 21103
R 4104	MRS25 1% 46K4	4822 050 24643
R 4106	MRS25 1% 422E	4822 050 24221
R 4107	0.3W 25% 10K	4822 105 10455
R 4108	0.3W 25% 10K	4822 105 10455
R 4109	MRS25 1% 5K11	4822 050 25112
R 4111	MRS25 1% 12K1	4822 050 21213
R 4117	MRS25 1% 3K16	4822 050 23162
R 4118	1/4W .25% 50E	5322 116 53405
R 4119	1/4W .25% 50E	5322 116 53405
R 4120	MRS25 1% 1K	4822 050 21002
R 4121	1/4W .25% 150E	5322 116 53399
R 4122	1/4W .25% 250E	5322 116 53406
R 4123	1/4W .25% 500E	5322 116 53408
R 4124	1/4W .25% 1K5	5322 116 53401
R 4125	MRS25 1% 100E	4822 050 21001
R 4126	MRS25 1% 9K09	4822 050 29092
R 4127	MRS25 1% 1K62	4822 050 21622
R 4129	MRS25 1% 1M	4822 050 21005
R 4130	MRS25 1% 1K	4822 050 21002
R 4131	MRS25 1% 5K11	4822 050 25112
R 4132	MRS25 1% 5K11	4822 050 25112
R 4134	MRS25 1% 10K	4822 050 21003
R 4135	MRS25 1% 1K	4822 050 21002
R 4136	MRS25 1% 10K	4822 050 21003
R 4137	MRS25 1% 14K7	4822 050 21473
R 4138	MRS25 1% 5E11	4822 050 25118
R 4139	MRS25 1% 10K	4822 050 21003
R 4140	MRS25 1% 10K	4822 050 21003
R 4141	MRS25 1% 14K7	4822 050 21473
R 4142	MRS25 1% 100E	4822 050 21001
R 4143	1/4W 0.1% 20K	5322 116 52697
R 4144	1/4W 0.1% 202E	5322 116 53413
R 4145	MRS25 1% 1K	4822 050 21002
R 4146	MRS25 1% 10K	4822 050 21003
R 4147	MRS25 1% 511E	4822 050 25111
R 4148	MRS25 1% 21K5	4822 050 22153
R 4149	MRS25 1% 31E6	4822 050 23169
R 4150	MRS25 1% 9E09	4822 050 29098
R 4151	MRS25 1% 2K61	4822 050 22612
R 4152	MRS25 1% 162E	4822 050 21621
R 4153	MRS25 1% 1K1	4822 050 21102
R 4154	MRS25 1% 1K78	4822 050 21782
R 4155	MRS25 1% 2K15	4822 050 22152
R 4156	MRS25 1% 1M	4822 050 21005
R 4157	MRS25 1% 1E	4822 050 21008
R 4158	MRS25 1% 1M	4822 050 21005
R 4159	MRS25 1% 2K15	4822 050 22152
R 4160	MRS25 1% 100E	4822 050 21001
R 4161	MRS25 1% 10K	4822 050 21003
R 4162	MRS25 1% 100E	4822 050 21001
R 4163	MRS25 1% 5E11	4822 050 25118
R 4164	MRS25 1% 100E	4822 050 21001
R 4253	MRS25 1% 1K	4822 050 21002
R 4258	MRS25 1% 4K64	4822 050 24642
R 4259	MRS25 1% 4K64	4822 050 24642
R 4260	0.3W 25% 1K	5322 105 20032
R 4261	MRS25 1% 10K	4822 050 21003
R 4262	MRS25 1% 10K	4822 050 21003
R 4263	MRS25 1% 5K11	4822 050 25112
R 4265	MRS25 1% 100E	4822 050 21001
R 4301	MRS25 1% 51K1	4822 050 25113
R 4302	MRS25 1% 51K1	4822 050 25113
R 4303	MRS25 1% 6K81	4822 050 26812
R 4304	MRS25 1% 5K11	4822 050 25112
R 4305	MRS25 1% 51K1	4822 050 25113
R 4306	MRS25 1% 681E	4822 050 26811
R .307	MRS25 1% 5K11	4822 050 25112
R 4308	MRS25 1% 10K	4822 050 21003
R 4309	MRS25 1% 8K25	4822 050 28252
R 4310	MRS25 1% 100E	4822 050 21001
R 4311	MRS25 1% 10K	4822 050 21003
R 4312	MRS25 1% 9K09	4822 050 29092
R 4313	MRS25 1% 7K5	4822 050 27502
R 4314	MRS25 1% 8K25	4822 050 28252
R 4330	MRS25 1% 5K11	4822 050 25112
R 4331	MRS25 1% 21K5	4822 050 22153
R 4332	MRS25 1% 4K22	4822 050 24222
R 4334	MRS25 1% 2K15	4822 050 22152
R 4404	MRS25 1% 2K37	4822 050 22372
R 4411	MRS25 1% 2K37	4822 050 22372
R 4501	MRS25 1% 13K3	4822 050 21333
R 4502	MRS25 1% 4K22	4822 050 24222
R 4503	MRS25 1% 6K81	4822 050 26812
R 4504	MRS25 1% 13K3	4822 050 21333
R 4505	MRS25 1% 511E	4822 050 25111
R 4506	MRS25 1% 2K15	4822 050 22152
R 4507	MRS25 1% 750E	4822 050 27501

POSNR	DESCRIPTION	ORDERING CODE
R 4508	MRS25 1% 11K	4822 050 21103
R 4509	MRS25 1% 2K15	4822 050 22152
R 4513	MRS25 1% 1K47	4822 050 21472
R 4521	MRS25 1% 16K2	4822 050 21623
R 4522	MRS25 1% 23K7	4822 050 22373
R 4523	MRS25 1% 16K2	4822 050 21623
R 4524	MRS25 1% 14K7	4822 050 21473
R 4526	MRS25 1% 2K37	4822 050 22372
R 4527	MRS25 1% 19K6	4822 050 21963
R 4528	MRS25 1% 5K62	4822 050 25622
R 4529	MRS25 1% 21K5	4822 050 22153
R 4531	MRS25 1% 10K	4822 050 21003
R 4532	MRS25 1% 10K	4822 050 21003
R 4533	MRS25 1% 3K48	4822 050 23482
R 4601	MRS25 1% 2K37	4822 050 22372
R 4602	MRS25 1% 26K1	4822 050 22613
R 4603	MRS25 1% 23K7	4822 050 22373
R 4604	MRS25 1% 100K	4822 050 21004
R 4606	MRS25 1% 909E	4822 050 29091
R 4607	MRS25 1% 100E	4822 050 21001
R 4608	MRS25 1% 1K	4822 050 21002
R 4609	MRS25 1% 42E2	4822 050 24229
R 4611	MRS25 1% 10K	4822 050 21003
R 4612	MRS25 1% 7K5	4822 050 27502
R 4613	MRS25 1% 10K	4822 050 21003
R 4614	MRS25 1% 51K1	4822 050 25113
R 4616	0.3W 25% 1K	5322 105 20032
R 4617	MRS25 1% 6K81	4822 050 26812
R 4618	MRS25 1% 11K	4822 050 21103
R 4619	MRS25 1% 8K25	4822 050 28252
R 4620	MRS25 1% 7K5	4822 050 27502
R 4621	MRS25 1% 909E	4822 050 29091
R 4622	MRS25 1% 100E	4822 050 21001
R 4625	MRS25 1% 100E	4822 050 21001
R 4626	MRS25 1% 100E	4822 050 21001
R 4627	MRS25 1% 10K	4822 050 21003
R 4628	MRS25 1% 1K	4822 050 21002
R 4629	MRS25 1% 8K25	4822 050 28252
R 4631	MRS25 1% 1K	4822 050 21002
R 4632	MRS25 1% 100E	4822 050 21001
R 4633	MRS25 1% 1K	4822 050 21002
R 4634	MRS25 1% 1K	4822 050 21002
R 4636	MRS25 1% 1M	4822 050 21005
R 4639	MRS25 1% 383E	4822 050 23831
R 4701	MRS25 1% 42E2	4822 050 24229
R 4703	MRS25 1% 562E	4822 050 25621
R 4705	MRS25 1% 1K	4822 050 21002
R 4706	MRS25 1% 100E	4822 050 21001
R 4707	MRS25 1% 511E	4822 050 25111
R 4708	MRS25 1% 2K87	4822 050 22872
R 4709	MRS25 1% 681E	4822 050 26811
R 4711	MRS25 1% 6K19	4822 050 26192
R 4712	MRS25 1% 511E	4822 050 25111
R 4713	MRS25 1% 1M	4822 050 21005
R 4714	MRS25 1% 1M	4822 050 21005
R 4716	MRS25 1% 6K81	4822 050 26812
R 4717	MRS25 1% 8K25	4822 050 28252
R 4718	MRS25 1% 1K	4822 050 21002
R 4719	MRS25 1% 100E	4822 050 21001
R 4721	0.3W 25% 1K	5322 105 20032
R 4722	MRS25 1% 46K4	4822 050 24643
R 4723	MRS25 1% 681K	4822 050 26814
R 4724	MRS25 1% 42E2	4822 050 24229
R 4725	MRS25 1% 4K22	4822 050 24222
R 4726	MRS25 1% 100K	4822 050 21004
R 4727	MRS25 1% 6K81	4822 050 26812
R 4728	MRS25 1% 562E	4822 050 25621
R 4801	MRS25 1% 5E11	4822 050 25118
R 4804	MRS25 1% 5E11	4822 050 25118
R 4807	MRS25 1% 5E11	4822 050 25118
R 4809	MRS25 1% 5E11	4822 050 25118
R 4819	MRS25 1% 5E11	4822 050 25118
R 4820	MRS25 1% 5E11	4822 050 25118
R 4822	MRS25 1% 5E11	4822 050 25118
R 4825	MRS25 1% 5E11	4822 050 25118
R 4829	MRS25 1% 5E11	4822 050 25118
R 4831	MRS25 1% 5E11	4822 050 25118
R 4833	MRS25 1% 5E11	4822 050 25118
R 4835	MRS25 1% 5E11	4822 050 25118
R 4836	MRS25 1% 5E11	4822 050 25118
R 4841	MRS25 1% 10K	4822 050 21003
R 4891	MRS25 1% 5E11	4822 050 25118
R 4893	MRS25 1% 5E11	4822 050 25118
R 4894	MRS25 1% 5E11	4822 050 25118
R 4901	MRS25 1% 562E	4822 050 25621
R 4904	MRS25 1% 1E	4822 050 21008
R 5001	PP17 20% 10K	5322 101 30546
R 5002	PP17 20% 10K	5322 101 30547
R 5003	PP17 20% 10K	5322 101 30546

POSNR	DESCRIPTION	ORDERING CODE
R 5004	PP17 20% 10K	5322 101 30546
R 6001	1.7A 20% 82E	4822 116 30069
R 6002	MRS25 1% 383K	4822 050 23834
R 6003	MRS25 1% 383K	4822 050 23834
R 6004	MRS25 1% 316E	4822 050 23161
R 6005	MRS25 1% 464E	4822 050 24641
R 6006	MRS25 1% 10K	4822 050 21003
R 6007	MRS25 1% 10K	4822 050 21003
R 6008	MRS25 1% 316E	4822 050 23161
R 6009	0.5W 10% 1K5	4822 116 30248
R 6010	MRS25 1% 14K7	4822 050 21473
R 6011	MRS25 1% 237E	4822 050 22371
R 6012	MRS25 1% 178E	4822 050 21781
R 6013	MRS25 1% 100E	4822 050 21001
R 6014	MRS25 1% 3E16	4822 050 23168
R 6016	MRS25 1% 10K	4822 050 21003
R 6017	MRS25 1% 1E	4822 050 21008
R 6018	MRS25 1% 1E	4822 050 21008
R 6019	MRS25 1% 10K	4822 050 21003
R 6020	MRS25 1% 21E5	4822 050 22159
R 6021	MRS25 1% 10K	4822 050 21003
R 6022	MRS25 1% 10K	4822 050 21003
R 6031	MRS25 1% 383E	4822 050 23831
R 6032	1/4W .25% 5K62	5322 116 80473
R 6033	1/4W .25% 7K5	5322 116 80474
R 6034	MRS25 1% 6K19	4822 050 26192
R 6036	MRS25 1% 7K5	4822 050 27502
R 6037	MRS25 1% 31K6	4822 050 23163
R 6038	MRS25 1% 100E	4822 050 21001
R 6039	MRS25 1% 10E	4822 050 21009
R 6041	MRS25 1% 3K83	4822 050 23832
R 6042	MRS25 1% 3K83	4822 050 23832
R 6043	MRS25 1% 100K	4822 050 21004
R 6044	MRS25 1% 100K	4822 050 21004
R 6101	MRS25 1% 100E	4822 050 21001
R 6102	MRS25 1% 100E	4822 050 21001
R 6103	MRS25 1% 1K	4822 050 21002
R 6131	MRS25 1% 10E	4822 050 21009
R 6132	MRS25 1% 100K	4822 050 21004
R 6133	MRS25 1% 100K	4822 050 21004
R 6134	MRS25 1% 1K	4822 050 21002
R 6136	MRS25 1% 4K64	4822 050 24642
R 6137	MRS25 1% 316E	4822 050 23161
R 6138	MRS25 1% 1K	4822 050 21002
R 6139	MRS25 1% 100E	4822 050 21001
R 6201	1/4W .25% 160K	5322 116 53412
R 6202	VR37 1% 31M6	5322 116 64103
R 6203	MRS25 1% 100K	4822 050 21004
R 6204	MRS25 1% 10K	4822 050 21003
R 6205	MRS25 1% 1K	4822 050 21002
R 6206	MRS25 1% 16K2	4822 050 21623
R 6207	MRS25 1% 51E1	4822 050 25119
R 6208	MRS25 1% 464E	4822 050 24641
R 6209	MRS25 1% 4K64	4822 050 24642
R 6211	MRS25 1% 46K4	4822 050 24643
R 6212	MRS25 1% 4K64	4822 050 24642
R 6213	MRS25 1% 215E	4822 050 22151
R 6214	VR25 5% 10M	4822 110 72214
R 6216	MRS25 1% 100E	4822 050 21001
R 6217	MRS25 1% 1E	4822 050 21008
R 6300	MRS25 1% 2K61	4822 050 22612
R 6301	MRS25 1% 464E	4822 050 24641
R 6302	MRS25 1% 909E	4822 050 29091
R 6303	MRS25 1% 3K83	4822 050 23832
R 6304	MRS25 1% 6K81	4822 050 26812
R 6311	MRS25 1% 750E	4822 050 27501
R 6312	MRS25 1% 4K22	4822 050 24222
R 6313	MRS25 1% 825E	4822 050 28251
R 6401	MRS25 1% 1K78	4822 050 21782
R 6402	MRS25 1% 178K	4822 050 21784
R 6403	MRS25 1% 215E	4822 050 22151
R 6404	7K5	4822 050 27502
R 6406	26K1	4822 050 22613
R 6407	4K22	4822 050 24222
R 6408	MTP10 20% 10K	5322 100 10113
R 6500	MRS25 1% 10E	4822 050 21009
R 6501	MRS25 1% 511E	4822 050 25111
R 6502	MRS25 1% 100K	4822 050 21004
R 6503	MRS25 1% 5K11	4822 050 25112
R 6504	MRS25 1% 19K6	4822 050 21963
R 6506	MRS25 1% 5K62	4822 050 25622
R 6507	MRS25 1% 511E	4822 050 25111
R 6508	1/4W .25% 3K67	5322 116 53411
R 6509	1/4W .25% 500E	5322 116 53408
R 6511	MRS25 1% 562E	4822 050 25621
R 7005	PP17 20% 10K	5322 101 30546
R 7006	PP17 20% 10K	5322 101 30546
R 7007	PP17 20% 10K	5322 101 30546
R 7008	PP17 20% 10K	5 22 101 30546
R 7009	PP17 20% 10K	5322 101 30546
R 7010	PP17 20% 10K	5322 101 30546
R 7011	PP17 20% 10K	5322 101 30546
R 7012	PP17 20% 10K	5322 101 30546
R 7021	MRS25 1% 11K	4822 050 21103
R 7022	MRS25 1% 10K	4822 050 21003
R 7023	MRS25 1% 90K9	4822 050 29093
R 7024	MRS25 1% 1K	4822 050 21002
R 7025	MRS25 1% 51E1	4822 050 25119
R 7026	MRS25 1% 4K64	4822 050 24642
R 7027	MRS25 1% 3K83	4822 050 23832
R 7028	MRS25 1% 3K83	4822 050 23832
R 7029	MRS25 1% 1K	4822 050 21002
R 7031	MRS25 1% 1K	4822 050 21002
R 7032	MRS25 1% 75K	4822 050 27503
R 7033	MRS25 1% 5K11	4822 050 25112
R 7034	MRS25 1% 162E	4822 050 21621
R 7036	0.5W 10% 2K2	4822 116 30254
R 7037	MRS25 1% 1K1	4822 050 21102
R 7038	MRS25 1% 1M	4822 050 21005
R 7041	MRS25 1% 3K83	4822 050 23832
R 7042	MRS25 1% 3K83	4822 050 23832
R 7043	MRS25 1% 1M	4822 050 21005
R 7102	MRS25 1% 100E	4822 050 21001
R 8001	MCR18 1% 10K	4822 051 10103
R 9011	MRS25 1% 464E	4822 050 24641
R 9012	MRS25 1% 10K	4822 050 21003
R 9013	MRS25 1% 1E	4822 050 21008
R 9018	-105-103 10K	5322 111 90473
R 9021	MRS25 1% 1K1	4822 050 21102
R 9028	MRS25 1% 464E	4822 050 24641
R 9029	MRS25 1% 5K11	4822 050 25112
R 9033	MRS25 1% 5K11	4822 050 25112
R 9034	MRS25 1% 5K11	4822 050 25112
R 9039	MRS25 1% 5K11	4822 050 25112
R 9041	MRS25 1% 10E	4822 050 21009
R 9042	MRS25 1% 2K37	4822 050 22372
R 9043	MRS25 1% 10E	4822 050 21009
R 9044	MRS25 1% 1K96	4822 050 21962
R 9045	MRS25 1% 10K	4822 050 21003
R 9046	MRS25 1% 10K	4822 050 21003
R 9047	MRS25 1% 10K	4822 050 21003
R 9048	MRS25 1% 10K	4822 050 21003
R 9051	MRS25 1% 2K61	4822 050 22612
R 9052	MRS25 1% 5K11	4822 050 25112
R 9053	0.3W 25% 2K2	5322 105 20033
R 9054	MRS25 1% 10E	4822 050 21009
R 9056	MRS25 1% 10E	4822 050 21009
R 9057	MRS25 1% 7K5	4822 050 27502
R 9061	MRS25 1% 1K	4822 050 21002
R 9062	MRS25 1% 51E1	4822 050 25119
R 9063	MRS25 1% 215E	4822 050 22151
R 9064	0.3W 25% 2K2	5322 105 20033
R 9066	MRS25 1% 51E1	4822 050 25119
R 9067	MRS25 1% 1K	4822 050 21002
R 9068	MRS25 1% 6K19	4822 050 26192
R 9069	MRS25 1% 3K48	4822 050 23482
R 9071	MRS25 1% 51E1	4822 050 25119
R 9072	MRS25 1% 51E1	4822 050 25119
R 9073	MRS25 1% 750E	4822 050 27501
R 9074	MRS25 1% 750E	4822 050 27501
R 9076	MRS25 1% 422E	4822 050 24221
R 9077	MRS25 1% 422E	4822 050 24221
R 9078	2.2K	5322 105 20033
R 9079	4K22	4822 050 24222
R 9081	MRS25 1% 5E11	4822 050 25118
R 9082	MRS25 1% 1K	4822 050 21002
R 9083	MRS25 1% 1K	4822 050 21002
R 9084	MRS25 1% 51E1	4822 050 25119
R 9086	MRS25 1% 2K15	4822 050 22152
R 9101	MRS25 1% 4K22	4822 050 24222
R 9102	MRS25 1% 511K	4822 050 25114
R 9103	MRS25 1% 511K	4822 050 25114
R 9104	MRS25 1% 511K	4822 050 25114
R 9106	MRS25 1% 4K22	4822 050 24222
R 9107	MRS25 1% 1K	4822 050 21002
R 9108	MRS25 1% 1K	4822 050 21002
R 9111	MRS25 1% 750E	4822 050 27501
R 9112	MRS25 1% 1K78	4822 050 21782
R 9113	MRS25 1% 1K78	4822 050 21782
R 9114	MRS25 1% 5K11	4822 050 25112
R 9116	0.3W 25% 10K	4822 105 10455
R 9117	MRS25 1% 316K	4822 050 23164
R 9118	MRS25 1% 3K83	4822 050 23832
R 9119	MRS25 1% 3K83	4822 050 23832
R 9121	MRS25 1% 10E	4822 050 21009
R 9122	MRS25 1% 10K	4822 050 21003
R 9123	0.3W 25% 1K	5322 105 20032
R 9124	MRS25 1% 10K	4822 050 21003
R 9126	MRS25 1% 31K6	4822 050 23163

POSNR	DESCRIPTION	ORDERING CODE
R 9127	MRS25 1% 2K87	4822 050 22872
R 9128	MRS25 1% 750E	4822 050 27501
R 9129	MRS25 1% 1K	4822 050 21002
R 9131	MRS25 1% 1K78	4822 050 21782
R 9132	MRS25 1% 3K16	4822 050 23162
R 9133	MRS25 1% 4K22	4822 050 24222
R 9134	0.3W 25% 220K	5322 105 20039
R 9136	MRS25 1% 1E	4822 050 21008
R 9137	MRS25 1% 1E	4822 050 21008
R 9138	MRS25 1% 1E	4822 050 21008
R 9141	MRS25 1% 56K2	4822 050 25623
R 9161	MRS25 1% 1K	4822 050 21002
R 9162	MRS25 1% 51E1	4822 050 25119
R 9163	MRS25 1% 215E	4822 050 22151
R 9164	0.3W 25% 2K2	5322 105 20033
R 9166	MRS25 1% 51E1	4822 050 25119
R 9167	MRS25 1% 1K	4822 050 21002
R 9168	MRS25 1% 6K19	4822 050 26192
R 9169	MRS25 1% 3K48	4822 050 23482
R 9171	MRS25 1% 51E1	4822 050 25119
R 9172	MRS25 1% 51E1	4822 050 25119
R 9173	MRS25 1% 750E	4822 050 27501
R 9174	MRS25 1% 750E	4822 050 27501
R 9176	MRS25 1% 422E	4822 050 24221
R 9177	MRS25 1% 422E	4822 050 24221
R 9178	2.2K	5322 105 20033
R 9179	4K22	4822 050 24222
R 9181	MRS25 1% 5E11	4822 050 25118
R 9182	MRS25 1% 1K	4822 050 21002
R 9183	MRS25 1% 1K	4822 050 21002
R 9184	MRS25 1% 51E1	4822 050 25119
R 9186	MRS25 1% 2K15	4822 050 22152
R 9201	MRS25 1% 31E6	4822 050 23169
R 9202	MRS25 1% 31E6	4822 050 23169
R 9203	MRS25 1% 422E	4822 050 24221
U 3262	VR25 5% 7M5	4822 053 20755

18.3.3 COILS

POSNR	DESCRIPTION		ORDERING CODE
L 1001	0.22UH 10%	TDK	5322 157 53284
L 1101	0.22UH 10%	TDK	5322 157 53284
L 1401	1500UH	TDK	4822 156 21293
L 1402	1500UH	TDK	4822 156 21293
L 1403	1500UH	TDK	4822 156 21293
L 1421	1500UH	TDK	4822 156 21293
L 1422	1500UH	TDK	4822 156 21293
L 1423	1500UH	TDK	4822 156 21293
L 3001	2.2UH 10%	TDK	5322 157 53509
L 3002	2.2UH 10%	TDK	5322 157 53509
L 3003	2.7UH 10%	TDK	5322 157 53511
L 4101	2.0UH	TDK	4822 157 51757
L 4801	0.01H	TDK	5322 157 53019
L 6000	100UH	TDK	5322 157 52363
L 6001	100UH	TDK	5322 157 52363
L 6002	100UH	TDK	5322 157 52363
L 6003	5.6UH		4822 157 52259
L 6004	220UH	TDK	5322 157 53524
L 6006	220UH	TDK	5322 157 53524
L 6101	10UH	TDK	5322 157 52513
L 6102	47UF		4822 152 10106
L 6103	100UH	TDK	5322 157 52363
L 6104	100UH	TDK	5322 157 52363
L 6106	82UH		4822 158 10563
L 6107	82UH		4822 158 10563
L 6108	82UH		4822 158 10563
L 6109	82UH		4822 158 10563
L 6111	15UH		5322 157 52539
L 6201	82UH		4822 158 10563
L 6501	82UH		4822 158 10563
L 7101	15UH		5322 157 52539
L 9001	2.0UH	TDK	4822 157 51757
L 9002	2.0UH	TDK	4822 157 51757
L 9003	2.0UH	TDK	4822 157 51757
L 9006	2.0UH	TDK	4822 157 51757
L 9007	2.0UH	TDK	4822 157 51757

18.3.4 SEMI-CONDUCTORS

POSNR	DESCRIPTION		ORDERING CODE
V 0001	D14-372GH	PEL	5322 131 20169
V 0601	BC548C	PEL	4822 130 44196
V 0602	BC558B	PEL	4822 130 44197
V 0603	BZV86-C1V4	PEL	4822 130 81423
V 0604	BC558B	PEL	4822 130 44197
V 0606	BC548C	PEL	4822 130 44196
V 0607	BZX79-C6V2	PEL	4822 130 34167
V 0608	BC548C	PEL	4822 130 44196
V 0609	BAW62	PEL	4822 130 30613
V 0611	BAW62	PEL	4822 130 30613
V 0612	BAW62	PEL	4822 130 30613
V 0613	BAW62	PEL	4822 130 30613
V 0614	BAW62	PEL	4822 130 30613
V 0615	BAW62	PEL	4822 130 30613
V 0616	BC548C	PEL	4822 130 44196
V 0617	BC548C	PEL	4822 130 44196
V 0618	BAW62	PEL	4822 130 30613
V 0619	BAW62	PEL	4822 130 30613
V 0621	BC548C	PEL	4822 130 44196
V 0622	BC548C	PEL	4822 130 44196
V 0623	BAW62	PEL	4822 130 30613
V 0624	BAW62	PEL	4822 130 30613
V 0626	BC548C	PEL	4822 130 44196
V 0627	BC548C	PEL	4822 130 44196
V 0628	BC548C	PEL	4822 130 44196
V 0629	BC548C	PEL	4822 130 44196
V 0630	BC548C	PEL	4822 130 44196
V 0631	BC548C	PEL	4822 130 44196
V 0632	BC548C	PEL	4822 130 44196
V 0633	BC548C	PEL	4822 130 44196
V 0634	BAW62	PEL	4822 130 30613
V 0636	BAW62	PEL	4822 130 30613
V 1000	BA483	PEL	4822 130 32656
V 1001	BF324	PEL	4822 130 41448
V 1002	BF324	PEL	4822 130 41448
V 1003	ON4401 SET		5322 310 10325
V 1004	BA483	PEL	4822 130 32656
V 1005	BA483	PEL	4822 130 32656
V 1006	ON4401 SET		5322 310 10325
V 1007	BA483	PEL	4822 130 32656
V 1008	BA483	PEL	4822 130 32656
V 1009	BA483	PEL	4822 130 32656
V 1010	BZX79-C10	PEL	4822 130 61219
V 1011	ON4401 SET		5322 310 10325
V 1012	BA483	PEL	4822 130 32656
V 1013	BA483	PEL	4822 130 32656
V 1014	BA483	PEL	4822 130 32656
V 1016	ON4401 SET		5322 310 10325
V 1017	BA483	PEL	4822 130 32656
V 1019	BF199	PEL	4822 130 44154
V 1021	BF199	PEL	4822 130 44154
V 1022	BF324	PEL	4822 130 41448
V 1023	BZX79-C5V6	PEL	4822 130 34173
V 1024	BF370	PEL	4822 130 42589
V 1061	BAW62	PEL	4822 130 30613
V 1062	BAW62	PEL	4822 130 30613
V 1063	BF324	PEL	4822 130 41448
V 1064	BF324	PEL	4822 130 41448
V 1100	BA483	PEL	4822 130 32656
V 1101	BF324	PEL	4822 130 41448
V 1102	BF324	PEL	4822 130 41448
V 1103	ON4401 SET		5322 310 10325
V 1104	BA483	PEL	4822 130 32656
V 1105	BA483	PEL	4822 130 32656
V 1106	ON4401 SET		5322 310 10325
V 1107	BA483	PEL	4822 130 32656
V 1108	BA483	PEL	4822 130 32656
V 1109	BA483	PEL	4822 130 32656
V 1110	BZX79-C10	PEL	4822 130 61219
V 1111	ON4401 SET		5322 310 10325
V 1112	BA483	PEL	4822 130 32656
V 1113	BA483	PEL	4822 130 32656
V 1114	BA483	PEL	4822 130 32656
V 1116	ON4401 SET		5322 310 10325
V 1117	BA483	PEL	4822 130 32656
V 1119	BF199	PEL	4822 130 44154
V 1121	BF199	PEL	4822 130 44154
V 1122	BF324	PEL	4822 130 41448
V 1123	BZX79-C5V6	PEL	4822 130 34173
V 1124	BF370	PEL	4822 130 42589
V 1161	BAW62	PEL	4822 130 30613
V 1162	BAW62	PEL	4822 130 30613
V 1163	BF324	PEL	4822 130 41448
V 1164	BF324	PEL	4822 130 41448
V 1200	BZV86-C1V4	PEL	4822 130 81423

POSNR	DESCRIPTION		ORDERING CODE
V 1201	0N4401	PEL	5322 130 61498
V 1202	BA483	PEL	4822 130 32656
V 1203	BA483	PEL	4822 130 32656
V 1204	BF199	PEL	4822 130 44154
V 1205	BZX79-C8V2	PEL	4822 130 34382
V 1206	BF199	PEL	4822 130 44154
V 1207	BF324	PEL	4822 130 41448
V 1208	BZX79-C5V6	PEL	4822 130 34173
V 1209	BF199	PEL	4822 130 44154
V 1211	BF324	PEL	4822 130 41448
V 1212	BF324	PEL	4822 130 41448
V 1213	BF324	PEL	4822 130 41448
V 2001	BZV86-C2V0	PEL	4822 130 81424
V 2002	BZV86-C2V0	PEL	4822 130 81424
V 2003	BZX79-C3V0	PEL	4822 130 31881
V 2101	BZV86-C2V0	PEL	4822 130 81424
V 2102	BZV86-C2V0	PEL	4822 130 81424
V 2103	BZX79-C3V0	PEL	4822 130 31881
V 2308	BZX79-C5V1	PEL	4822 130 34233
V 2309	BZX79-C5V1	PEL	4822 130 34233
V 2310	BC558B	PEL	4822 130 44197
V 2311	BC858B		5322 130 41983
V 2312	BC858B		5322 130 41983
V 2313	BAV99		5322 130 34337
V 2314	BAW62	PEL	4822 130 30613
V 2316	BF550R		4822 130 60687
V 2317	BC848C		5322 130 42136
V 2318	BF550		4822 130 42131
V 2319	BF550		4822 130 42131
V 2321	BF550R		4822 130 60687
V 2325	BAW62	PEL	4822 130 30613
V 2326	BAW62	PEL	4822 130 30613
V 2327	BC558B	PEL	4822 130 44197
V 2328	BZX79-C5V1	PEL	4822 130 34233
V 2329	BZX79-C9V1	PEL	4822 130 30862
V 2331	BC558B	PEL	4822 130 44197
V 2332	BC558B	PEL	4822 130 44197
V 2333	BC558B	PEL	4822 130 44197
V 2334	BC558B	PEL	4822 130 44197
V 2341	BF199	PEL	4822 130 44154
V 2342	BF199	PEL	4822 130 44154
V 2347	BF199	PEL	4822 130 44154
V 2349	BF199	PEL	4822 130 44154
V 2356	BC548C	PEL	4822 130 44196
V 2357	BC548C	PEL	4822 130 44196
V 2366	BAW62	PEL	4822 130 30613
V 2367	BAW62	PEL	4822 130 30613
V 2368	BAW62	PEL	4822 130 30613
V 2369	BAW62	PEL	4822 130 30613
V 2370	BC548C	PEL	4822 130 44196
V 2371	BC558B	PEL	4822 130 44197
V 2601	BZX79-C6V2	PEL	4822 130 34167
V 2602	BC548C	PEL	4822 130 44196
V 2611	BF199	PEL	4822 130 44154
V 2612	BF199	PEL	4822 130 44154
V 2615	BC548C	PEL	4822 130 44196
V 2616	BZV86-C1V4	PEL	4822 130 81423
V 2801	BF550		4822 130 42131
V 2802	BF550R		4822 130 60687
V 2803	BF550		4822 130 42131
V 2804	BF550R		4822 130 60687
V 3001	BF324	PEL	4822 130 41448
V 3002	BF324	PEL	4822 130 41448
V 3003	BC558B	PEL	4822 130 44197
V 3004	BF324	PEL	4822 130 41448
V 3006	BF324	PEL	4822 130 41448
V 3007	BC548C	PEL	4822 130 44196
V 3008	BF370	PEL	4822 130 42589
V 3009	BF370	PEL	4822 130 42589
V 3011	2N3866-01	PEL	5322 130 41799
V 3012	2N3866-01	PEL	5322 130 41799
V 3013	BZX79-B27	PEL	4822 130 34379
V 3014	BZX79-B27	PEL	4822 130 34379
V 3016	BAW62	PEL	4822 130 30613
V 3101	BF324	PEL	4822 130 41448
V 3102	BF324	PEL	4822 130 41448
V 3103	BF324	PEL	4822 130 41448
V 3104	BC558B	PEL	4822 130 44197
V 3106	BF324	PEL	4822 130 41448
V 3108	BF472	PEL	5322 130 42535
V 3109	BF370	PEL	4822 130 42589
V 3111	BF370	PEL	4822 130 42589
V 3112	2N5551	PEL	5322 130 44491
V 3113	BZX79-B5V6	PEL	4822 130 34173
V 3114	2N5551	PEL	5322 130 44491
V 3116	BF472	PEL	5322 130 42535
V 3200	BF370	PEL	4822 130 42589
V 3201	BF370	PEL	4822 130 42589
V 3202	2N5401	PEL	5322 130 42534
V 3203	2N5551	PEL	5322 130 44491
V 3204	BF423	PEL	4822 130 41646
V 3205	BZX79-B5V6	PEL	4822 130 34173
V 3206	BAW62	PEL	4822 130 30613
V 3207	BC548C	PEL	4822 130 44196
V 3208	BF423	PEL	4822 130 41646
V 3209	BAW62	PEL	4822 130 30613
V 3211	BAW62	PEL	4822 130 30613
V 3212	BZX79-B68	PEL	4822 130 30864
V 3213	BC548C	PEL	4822 130 44196
V 3214	BAW62	PEL	4822 130 30613
V 3215	BAW62	PEL	4822 130 30613
V 3216	BZX79-C9V1	PEL	4822 130 30862
V 3217	BAW62	PEL	4822 130 30613
V 3251	BF423	PEL	4822 130 41646
V 3252	BZX79-C6V2	PEL	4822 130 34167
V 3253	BF423	PEL	4822 130 41646
V 3254	BF423	PEL	4822 130 41646
V 3256	BF423	PEL	4822 130 41646
V 3257	BAV21	PEL	4822 130 30842
V 3301	BZX79-C6V2	PEL	4822 130 34167
V 4001	BF199	PEL	4822 130 44154
V 4002	BF199	PEL	4822 130 44154
V 4003	BF324	PEL	4822 130 41448
V 4004	BF324	PEL	4822 130 41448
V 4005	BZX79-C6V2	PEL	4822 130 34167
V 4006	BAW62	PEL	4822 130 30613
V 4008	BFQ22S	PEL	5322 130 42031
V 4009	BC548C	PEL	4822 130 44196
V 4011	BC548C	PEL	4822 130 44196
V 4012	BC548C	PEL	4822 130 44196
V 4013	BZX79-C5V1	PEL	4822 130 34233
V 4014	BC548C	PEL	4822 130 44196
V 4016	BZX79-C3V6	PEL	5322 130 34834
V 4017	BAW62	PEL	4822 130 30613
V 4018	BC548C	PEL	4822 130 44196
V 4021	BC548C	PEL	4822 130 44196
V 4022	BAW62	PEL	4822 130 30613
V 4023	BC548C	PEL	4822 130 44196
V 4101	BC558B	PEL	4822 130 44197
V 4102	BAW62	PEL	4822 130 30613
V 4103	BAW62	PEL	4822 130 30613
V 4104	BC548C	PEL	4822 130 44196
V 4106	BAW62	PEL	4822 130 30613
V 4107	BC327	PEL	4822 130 40854
V 4108	BC548C	PEL	4822 130 44196
V 4109	BC558B	PEL	4822 130 44197
V 4111	BC558B	PEL	4822 130 44197
V 4112	BSX20	PEL	4822 130 41705
V 4113	BZV86-C1V4	PEL	4822 130 81423
V 4114	BSX20	PEL	4822 130 41705
V 4115	BZX79-C6V2	PEL	4822 130 34167
V 4116	BAW62	PEL	4822 130 30613
V 4117	BC548C	PEL	4822 130 44196
V 4118	BC548C	PEL	4822 130 44196
V 4119	BF199	PEL	4822 130 44154
V 4120	BAW62	PEL	4822 130 30613
V 4121	BC548C	PEL	4822 130 44196
V 4122	BAW62	PEL	4822 130 30613
V 4123	BAW62	PEL	4822 130 30613
V 4216	BAW62	PEL	4822 130 30613
V 4217	BC548C	PEL	4822 130 44196
V 4300	BZX79-C6V2	PEL	4822 130 34167
V 4301	BC558B	PEL	4822 130 44197
V 4302	BC548C	PEL	4822 130 44196
V 4304	BC558B	PEL	4822 130 44197
V 4305	BZX79-C9V1	PEL	4822 130 30862
V 4306	BAW62	PEL	4822 130 30613
V 4307	BC548C	PEL	4822 130 44196
V 4308	BZV86-C1V4	PEL	4822 130 81423
V 4309	BC548C	PEL	4822 130 44196
V 4321	BAW62	PEL	4822 130 30613
V 4322	BC548C	PEL	4822 130 44196
V 4323	BC548C	PEL	4822 130 44196
V 4500	BAW62	PEL	4822 130 30613
V 4501	BC548C	PEL	4822 130 44196
V 4502	BC548C	PEL	4822 130 44196
V 4503	BC548C	PEL	4822 130 44196
V 4504	BC548C	PEL	4822 130 44196
V 4505	BAW62	PEL	4822 130 30613
V 4506	BC548C	PEL	4822 130 44196
V 4510	BC558B	PEL	4822 130 44197
V 4511	BC558B	PEL	4322 130 44197
V 4512	BC558B	PEL	4822 130 44197
V 4513	BC558B	PEL	4822 130 44197
V 4514	BC558B	PEL	4822 130 44197
V 4516	BAW62	PEL	4822 130 30613
V 4517	BAW62	PEL	4822 130 30613
V 4518	BAW62	PEL	4822 130 30613

POSNR	DESCRIPTION		ORDERING CODE
V 4519	BAW62	PEL	4822 130 30613
V 4521	BAW62	PEL	4822 130 30613
V 4522	BAW62	PEL	4822 130 30613
V 4523	BC548C	PEL	4822 130 44196
V 4601	BAW62	PEL	4822 130 30613
V 4602	BAW62	PEL	4822 130 30613
V 4603	BAW62	PEL	4822 130 30613
V 4611	BF199	PEL	4822 130 44154
V 4612	BF199	PEL	4822 130 44154
V 4613	BAW62	PEL	4822 130 30613
V 4614	BAW62	PEL	4822 130 30613
V 4616	BC548C	PEL	4822 130 44196
V 4617	BAW62	PEL	4822 130 30613
V 4618	BAW62	PEL	4822 130 30613
V 4702	BF324	PEL	4822 130 41448
V 4703	BAW62	PEL	4822 130 30613
V 4706	BF324	PEL	4822 130 41448
V 4707	BC558B	PEL	4822 130 44197
V 4708	BF324	PEL	4822 130 41448
V 4709	BC558B	PEL	4822 130 44197
V 4710	BC548C	PEL	4822 130 44196
V 4711	BAW62	PEL	4822 130 30613
V 4712	BF324	PEL	4822 130 41448
V 4713	BAW62	PEL	4822 130 30613
V 6001	BYV96E	PEL	5322 130 34979
V 6002	BYV96E	PEL	5322 130 34979
V 6003	BYV96E	PEL	5322 130 34979
V 6004	BYV96E	PEL	5322 130 34979
V 6007	BAX12	PEL	5322 130 34605
V 6008	BAX12	PEL	5322 130 34605
V 6009	BC337	PEL	4822 130 40855
V 6011	BAX12	PEL	5322 130 34605
V 6012	BZX79-C15	PEL	4822 130 34281
V 6013	BRY39	PEL	5322 130 40482
V 6014	BUK456-800B		5322 130 43926
V 6016	BYV27-150	PEL	4822 130 31628
V 6017	BYV96E	PEL	5322 130 34979
V 6018	BUW12A	PEL	5322 130 42114
V 6019	BYV26C	PEL	4822 130 32343
V 6021	BZX79-C3V0	PEL	4822 130 31881
V 6031	BZX79-C3V6	PEL	5322 130 34834
V 6101	MBR2545CT	MOT	5322 130 81179
V 6102	MBR1045		5322 130 82041
V 6104	BYV28-150	PEL	5322 130 32043
V 6106	BYV27-150	PEL	4822 130 31628
V 6107	BYV95C	PEL	4822 130 41487
V 6108	BYV27-150	PEL	4822 130 31628
V 6109	BYV95C	PEL	4822 130 41487
V 6110	BYV27-150	PEL	4822 130 31628
V 6113	BYV95C	PEL	4822 130 41487
V 6115	BYV27-150	PEL	4822 130 31628
V 6116	BYV27-150	PEL	4822 130 31628
V 6131	BAX12	PEL	5322 130 34605
V 6132	BAW62	PEL	4822 130 30613
V 6133	BZX79-C6V2	PEL	4822 130 34167
V 6134	BC337	PEL	4822 130 40855
V 6136	BF423	PEL	4822 130 41646
V 6137	BF423	PEL	4822 130 41646
V 6138	BZX79-C5V6	PEL	4822 130 34173
V 6201	BC327	PEL	4822 130 40854
V 6202	BZX79-C15	PEL	4822 130 34281
V 6203	BAV21	PEL	4822 130 30842
V 6204	BAV21	PEL	4822 130 30842
V 6206	BAV21	PEL	4822 130 30842
V 6207	BYV27-150	PEL	4822 130 31628
V 6208	BUV26A	PEL	5322 130 42722
V 6209	BY509	PEL	4822 130 41485
V 6211	BC337	PEL	4822 130 40855
V 6301	BC548C	PEL	4822 130 44196
V 6302	BC558B	PEL	4822 130 44197
V 6303	BC337	PEL	4822 130 40855
V 6304	BC327	PEL	4822 130 40854
V 6311	BC337	PEL	4822 130 40855
V 6312	BDX78	PEL	5322 130 44278
V 6401	BZV11	PEL	5322 130 34294
V 6402	BAX12	PEL	5322 130 34605
V 6403	BC337	PEL	4822 130 40855
V 7001	BAW62	PEL	4822 130 30613
V 7002	BC548C	PEL	4822 130 44196
V 7101	BAW62	PEL	4822 130 30613
V 9001	BAT85	PEL	4822 130 31983
V 9002	BAT85	PEL	4822 130 31983
V 9003	BAT85	PEL	4822 130 31983
V 9004	BZX79-C3V9	PEL	4822 130 31981
V 9009	BAT85	PEL	4822 130 31983
V 9011	BC558B	PEL	4822 130 44197
V 9012	BC558B	PEL	4822 130 44197
V 9013	BC558B	PEL	4822 130 44197
V 9014	BC548C	PEL	4822 130 44196
V 9016	BC548C	PEL	4822 130 44196
V 9017	BC548C	PEL	4822 130 44196
V 9018	BC548C	PEL	4822 130 44196
V 9102	BC548C	PEL	4822 130 44196
V 9106	BC548C	PEL	4822 130 44196
V 9107	BC548C	PEL	4822 130 44196
V 9108	BC548C	PEL	4822 130 44196
V 9109	BAT85	PEL	4822 130 31983
V 9111	BC558B	PEL	4822 130 44197
V 9112	BC558B	PEL	4822 130 44197
V 9113	BC558B	PEL	4822 130 44197
V 9114	BC548C	PEL	4822 130 44196
V 9116	BC548C	PEL	4822 130 44196
V 9117	BC548C	PEL	4822 130 44196
V 9118	BC548C	PEL	4822 130 44196
V 9119	BC548C	PEL	4822 130 44196
V 9121	BC548C	PEL	4822 130 44196
V 9122	BC548C	PEL	4822 130 44196

18.3.5 INTEGRATED CIRCUITS

D 0601	PLIFIER		5322 209 80991
D 0602	PLIFIER		5322 209 80991
D 0603	C74HCT4053P	PEL	4822 209 71584
D 1001	TEA1017/N9	PEL	5322 209 60191
D 1061	0Q0221.2		5322 209 11878
D 1101	TEA1017/N9	PEL	5322 209 60191
D 1161	0Q0221.2		5322 209 11878
D 2002	0Q0205.2		5322 209 73576
D 2102	0Q0205.2		5322 209 73576
D 2301	0Q0205.2		5322 209 73576
D 2302	PLIFIER		5322 209 80991
D 2303	PLIFIER		5322 209 80991
D 2601	HEF4053BP	PEL	5322 209 10576
D 2602	TEA1017/N9	PEL	5322 209 60191
D 2801	0Q0208		5322 209 71707
D 2802	PCF8574T		5322 209 11578
D 4001	TEA1017/N9	PEL	5322 209 60191
D 4002	TEA1017/N9	PEL	5322 209 60191
D 4101	HEF4053BP	PEL	5322 209 10576
D 4102	HEF4051BP	PEL	4822 209 10262
D 6201			5322 321 21597
D 6501	HEF4066BP	PEL	5322 209 10357
D 7002	HEF4053BP	PEL	5322 209 10576
D 7002	SN74LS38N		5322 209 85605
D 7003	PC74HCT259P	PEL	5322 209 11115
D 7003	SN74LS259BN		5322 209 86007
D 7006	SN74LS244N	MOT	5322 209 86017
D 7006	SN74LS244N		5322 209 86017
D 8001	PCF8577T	PEL	5322 209 70024
D 8002	PCF8577T	PEL	5322 209 70024
D 8003	PCF8577T	PEL	5322 209 70024
D 9002	74F163APC	FSC	5322 209 83343
D 9003	74F74PC	FSC	5322 209 81474
D 9004	P8254	INT	5322 209 82406
D 9006	74F251APC	FSC	5322 209 71656
D 9012	P8032AH	INT	5322 209 11318
D 9013	PROM		5322 209 51682
D 9014	M6264ALP-12	HIT	5322 209 60192
D 9016	PC74HCT573P	PEL	5322 209 11488
D 9017	PC74HCT245P	PEL	5322 209 11117
D 9018	PC74HCT245P	PEL	5322 209 11117
D 9019	PC74HCT139P	PEL	5322 209 11112
D 9021	PC74HCT138P	PEL	5322 209 11111
D 9022	PC74HCT08P	PEL	5322 209 11265
D 9023	74F04PC	FSC	5322 209 81577
D 9024	PC74HCT174P	PEL	5322 209 11478
D 9026	PC74HCT174P	PEL	5322 209 11478
D 9027	PAL		5322 209 51683
D 9028	PAL		5322 209 51684
D 9029	PC74HCT157P	PEL	5322 209 11263
D 9030	74F32PC	FSC	4822 209 82133
D 9031	HM6716P-30	HIT	5322 209 61135
D 9032	HM6716P-30	HIT	5322 209 61135
D 9033	HM6716P-30	HIT	5322 209 61135
D 9034	HM6716P-30	HIT	5322 209 61135
D 9035	74F245PC	FSC	5322 209 82169
D 9036	PC74HCT257P	PEL	5322 209 11114
D 9037	PC74HCT257P	PEL	5322 209 11114
D 9038	PC74HCT574P	PEL	5322 209 11489
D 9039	M62256LP-12	HIT	5322 209 72129
D 9041	PC74HCT574P	PEL	5322 209 11489
D 9042	PC74HCT245P	PEL	5322 209 11117
D 9043	N74LS298N	SIG	5322 209 85937
D 9044	N74LS298N	SIG	5322 209 85937

POSNR	DESCRIPTION		ORDERING CODE
D 9046	HEF4066BP	PEL	5322 209 10357
D 9047	PAL		5322 209 51685
D 9048	FPLA		5322 209 51686
D 9049	74F74PC	FSC	5322 209 81474
D 9050	74F174PC	FSC	5322 209 83326
D 9051	74F253PC	FSC	5322 209 81771
D 9052	PC74HCT574P	PEL	5322 209 11489
D 9053	74F191PC	FSC	5322 209 81676
D 9054	74F191PC	FSC	5322 209 81676
D 9056	74F191PC	FSC	5322 209 81676
D 9057	74F10PC	FSC	5322 209 81681
D 9058	PC74HCT574P	PEL	5322 209 11489
D 9059	PC74HCT574P	PEL	5322 209 11489
D 9061	74F191PC	FSC	5322 209 81676
D 9062	74F191PC	FSC	5322 209 81676
D 9063	74F191PC	FSC	5322 209 81676
D 9064	74F191PC	FSC	5322 209 81676
D 9066	74F257APC	FSC	5322 209 71672
D 9067	74F257APC	FSC	5322 209 71672
D 9068	74F257APC	FSC	5322 209 71672
D 9069	PC74HCT245P	PEL	5322 209 11117
D 9071	PC74HCT245P	PEL	5322 209 11117
D 9073	PC74HCT161P	PEL	5322 209 11476
D 9074	74F253PC	FSC	5322 209 81771
D 9076	N74LS298N	SIG	5322 209 85937
D 9077	N74LS298N	SIG	5322 209 85937
D 9078	N74LS298N	SIG	5322 209 85937
D 9079	PCF 3300 WP/016		5322 209 62982
D 9081	M6264ALP-12	HIT	5322 209 60192
D 9082	PC74HCT86P	PEL	5322 209 11473
D 9083	PC74HCT74P	PEL	5322 209 11109
N 0601	LM324N	NSC	4822 209 80587
N 1001	OP-77GP	PMI	5322 130 60937
N 1101	OP-77GP	PMI	5322 130 60937
N 1201	LF356N	NSC	5322 209 86451
N 1201	LF356N		5322 209 86451
N 2203	CA3227E		5322 209 72568
N 4101	LM324N	NSC	4822 209 80587
N 4101	LM324N		4822 209 80587
N 4102	OP-77GP	PMI	5322 130 60937
N 4103	TL080CP	T.I	5322 209 72464
N 4601	CA3102E	RCA	5322 209 72657
N 6001	LM358N	NSC	4822 209 70672
N 6002	LM358N	NSC	4822 209 70672
N 7001	LM339AN	NSC	5322 209 60188
N 9001	TDA8703/C1	PEL	5322 209 61133
N 9002	TDA8703/C1	PEL	5322 209 61133
N 9003	DAC-08EP	PMI	5322 209 11253
N 9004	DAC10FX	PMI	5322 209 71665

18.3.6 MISCELLANEOUS

POSNR	DESCRIPTION	ORDERING CODE
E 0001	T13/4 28V 80MA	5322 134 40534
E 8001	60MA MGG9012	5322 134 40849
G 9001	RQ-0-50-40M S.R	5322 242 72575
H 6001	CNX35 PEL	5322 130 90137
H 8002	LPH1545-1 PEL	5322 209 60193
K 1001	DRELAIS IL 12 V	5322 280 20125
K 1002	DRELAIS IL 12 V	5322 280 20125
K 1003	DRELAIS IL 12 V	5322 280 20125
K 1004	DRELAIS IL 12 V	5322 280 20125
K 1006	DRELAIS IL 12 V	5322 280 20125
K 1007	DRELAIS IL 12 V	5322 280 20125
K 1008	DRELAIS IL 12 V	5322 280 20125
K 1101	DRELAIS IL 12 V	5322 280 20125
K 1102	DRELAIS IL 12 V	5322 280 20125
K 1103	DRELAIS IL 12 V	5322 280 20125
K 1104	DRELAIS IL 12 V	5322 280 20125
K 1106	DRELAIS IL 12 V	5322 280 20125
K 1107	DRELAIS IL 12 V	5322 280 20125
K 1108	DRELAIS IL 12 V	5322 280 20125
K 1201	DRELAIS IL 12 V	5322 280 20125
K 4101	DRELAIS IL 12 V	5322 280 20125
S 6001		5322 276 11859
S 7002	BR	5322 277 10878
S 7004	BR	5322 277 10878
S 7006	BR	5322 277 10878
S 7008	BR	5322 277 10878
S 7010	BR	5322 277 10878
S 7012		5322 276 11857

POSNR	DESCRIPTION	ORDERING CODE
S 7013		5322 276 11856
S 7014		5322 276 11856
S 7015		5322 276 11856
S 7016		5322 276 11856
S 7017		5322 276 11856
S 7018		5322 276 11856
S 7019		5322 276 11856
S 7020		5322 276 11856
S 7021		5322 276 11856
S 7022		5322 276 11856
S 7023		5322 276 11856
S 7024		5322 276 11856
S 7025		5322 276 11856
S 7026		5322 276 11856
S 7028		5322 276 11856
S 7029		5322 276 11856
S 7030		5322 276 11856
S 7031		5322 276 11856
S 7032		5322 276 11856
X 0411		5322 268 14141
X 0412		5322 268 14141
X 0413		5322 268 14141
X 0414	2-P SNG STRGHT	5322 265 20275
X 0416	2-P SNG STRGHT	5322 265 20275
X 0606	10-P DBL RT.ANG	5322 265 51188
X 0621	8P SNG ST12.7MM	5322 265 40483
X 0622	8P SNG ST12.7MM	5322 265 40483
X 0623	8P SNG ST12.7MM	5322 265 40483
X 0624	8P SNG ST12.7MM	5322 265 40483
X 1009	26-P DBL STRGHT	5322 265 61071
X 2001	34-P DBL STRGHT	5322 265 61069
X 2004	3-P SNG RT.ANG	5322 265 30433
X 2009	26-P DBL STRGHT	5322 265 61071
X 2010	20-P DBL STRGHT	5322 265 51129
X 2013	2-P SNG STRGHT	5322 265 20275
X 2021	8P SNG ST10.2MM	5322 267 50786
X 2022	8P SNG ST10.2MM	5322 267 50786
X 2023	8P SNG ST10.2MM	5322 267 50786
X 2024	8P SNG ST10.2MM	5322 267 50786
X 3002	20-P DBL STRGHT	5322 265 51129
X 3003	20-P DBL STRGHT	5322 265 51129
X 3004	3-P SNG RT.ANG	5322 265 30433
X 3005	3-P SNG RT.ANG	5322 265 30433
X 3006	55595 PEL	5322 255 40502
X 3008	3-P SNG RT.ANG	5322 265 30433
X 4001	34-P DBL STRGHT	5322 265 61069
X 4002	20-P DBL STRGHT	5322 265 51129
X 4010	20-P DBL STRGHT	5322 265 51129
X 4017	2-P SNG STRGHT	5322 265 20275
X 5007	10-P DBL STRGHT	5322 265 40485
X 6003	20-P DBL STRGHT	5322 265 51129
X 6007	10-P DBL STRGHT	5322 265 40485
X 6008	3-P SNG STRGHT	5322 265 30434
X 6014	5-P SNG STRGHT	5322 265 30436
X 6018	2-P SNG STRGHT	5322 265 20275
X 6019	3-P SNG STRGHT	5322 265 30434
X 6020	2-P SNG STRGHT	5322 265 20275
X 7001	34-P DBL RT.ANG	5322 265 61068
X 7050	40-P DBL STRGHT	5322 265 61072
X 8011	3P SNG 2.54	5322 267 40667
X 8012	3P SNG 2.54	5322 267 40667
X 9003	20-P DBL STRGHT	5322 265 51129
X 9004	6-P SNG RT.ANG	5322 265 30741
X 9006	10-P DBL STRGHT	5322 265 40485
X 9011		5322 268 14141
X 9012		5322 268 14141
X 9013		5322 268 14141
X 9016	2-P SNG RT.ANG	5322 265 20356
X 9017	2-P SNG RT.ANG	5322 265 20356
X 9018	2-P SNG RT.ANG	5322 265 20356
X 9050	40-P DBL STRGHT	5322 265 61072
X 9061		5322 268 14141
X 9062		5322 268 14141
X 9163		5322 268 14141
X 9164		5322 268 14141