50 MHz Digital Storage Oscilloscope
PM3350-PM3352

Service Manual

4822 872 05338
890801

MAT3046

WARNING: These servicing instructions are for use by qualified personnel only. To avoid electric shock do not perform any servicing other than that contained in the Operating Instructions unless you are fully qualified to do so.

PHILIPS

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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.

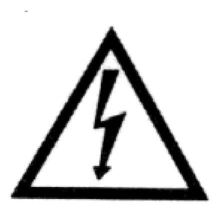
1.3 CAUTION AND WARNING STATEMENTS

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 pracites 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 23).
- After repair and maintenance in the primary circuit, safety inspection and tests, as mentioned in section 23 have to be performed.

2 CHARACTERISTICS

A. Performance Characteristics

Properties expressed in numerical values with stated tolerance are guaranteed by PHILIPS. Specified non-tolerance numerical values indicate those that could be nominally expected from the mean of a range of identical instruments.
This specification is valid after the instrument has warmed up for 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 .

Mass: 9,5 kg

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

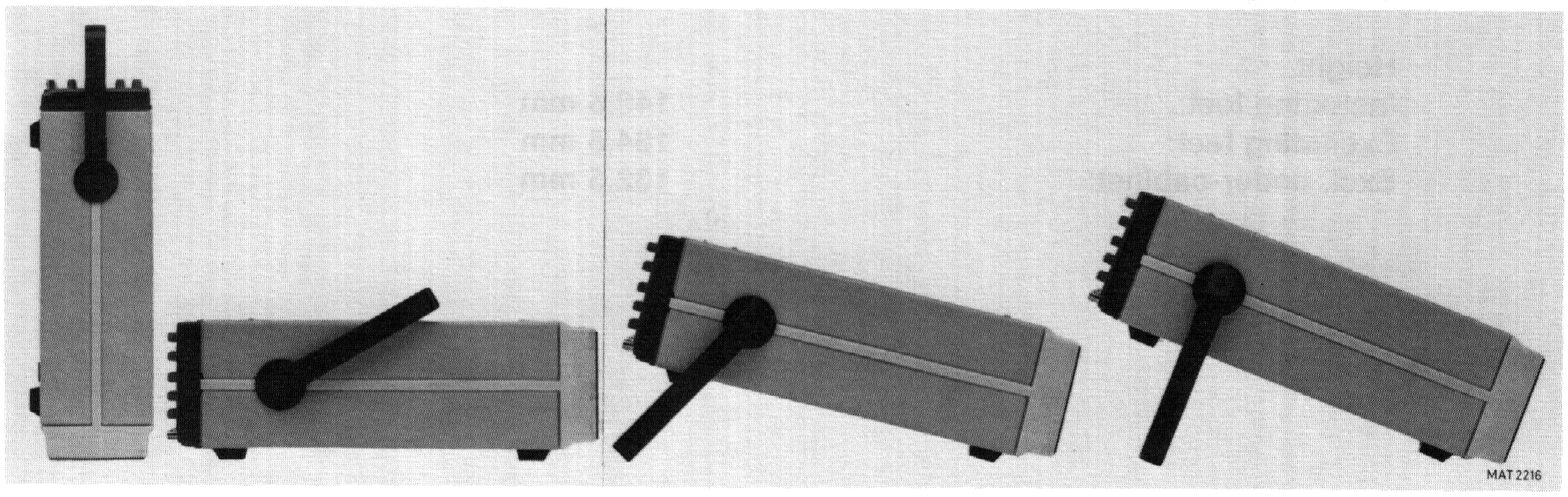


Figure 2.2 Operating positions

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.1 DISPLAY

* CRT		
Type number	PHILIPS D14-372	
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 (P31)	Standard persistence (7 ms)
Option	GM (P7)	Long persistence (30 ms)
* Total acceleration voltage	16 kV	
* Graticule:		
Engravings	Internal fixed	
Division 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 only
* Orthogonality	90 ± 1°	Measured in zero point
* Illumination	Continuously variable	By means of potentiometer

2.2 VERTICAL DEFLECTION OR Y AXIS

* 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 adjustment range	1 : >2,5	
* Error limit	±3%	Only in calibrated position
* Input impedance	1 MΩ ±2%	Measured below 1 MHz
Paralleled by	20 pF ±2 pF	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		
20 mV/div...10 V/div	≥ 50 MHz	Input 6 div. sine-wave.
2 mV/div...10 mV/div	≥ 35 MHz	Input 6 div. sine-wave.
* Rise-time		
20 mV/div. ... 10 V/div	< 7 ns	Calculated from 0,35/ f at -3 dB
2 mV/div. ... 10 mV/div	< 10 ns	Calculated from 0,35/ f at -3 dB
* Noise		
20 mV/div. ... 10 V/div	< 0,1 div	Measured visually. Pick up on open BNC excluded.
2 mV/div. ... 10 mV/div	< 0,25 div	Measured visually. Pick up on open BNC excluded.
* Lower -3 dB point	≤ 10 Hz	In AC position, 6 div. sine-wave
* Dynamic range		
d.c. ...10 MHz	> 24 div	vernier in cal. position
10 MHz...50 MHz	> 8 div	vernier in cal. position
* Min position range	± 8 div	
* 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		Both channels same attenuator setting, vernier adjusted for best CMRR; measured with max. 8 div. (± 4 div) each channel
at 1 MHz	1 : > 100	
* Visible signal delay	> 15 ns	Max. intensity, measured from line start to trigger point.
* Base line jump:		
between attenuator steps 20 mV...10 V	< 0,2 div	
Additional jump between 10 mV...20 mV	< 0,3 div	
Normal Invert jump	< 0,2 div	Only channel B
ADD jump	< 0,6 div.	When A and B are positioned in screen centre (20 mV...10V).
Variable jump	< 0,2 div	Max. jump between any two positions of the variable potmeter

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.3 HORIZONTAL DEFLECTION OR X AXIS

2.3.1 Time-base

* Time coefficient	0,5 s/div...50 ns/div	In 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	< 0,5 div	Shift start of sweep in x10 in mid-screen position, then switch to x1.
* Hold-Off		
Min to max 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	In 1, 2, 5 sequence + variable
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° DC...100 kHz	DC coupled
* Dynamic range	> 24 div DC...100 kHz	DC coupled

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

2.4 TRIGGERING

* Trig. mode AUTO (auto free run)	 Bright line in absence of trigger signal	 Auto free run starts 100 ms (typ.) after no trigger pulse.
TRIGGERED		Switches automatically to free run if one of the display channels is grounded.
SINGLE		In multi-channel mode (alternate) 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	In line, trigger source is always the mains. Line trigger amplitude depends on line input voltage. Approx. 6 div. at 220 V mains voltage and 50 Hz frequency.
* TRIGGER COUPLING	Peak-to-peak (p-p), DC, TVL, TVF	
* LEVEL range Peak-to-peak:	 Related to peak-to-peak value	 p-p coupling is DC rejected
DC internal	> ± 8 div.	
DC external	> ± 800 mV	
TVL/TVF	Fixed level	
* Trigger slope	+/-	Slope sign in LCD. For TVL/TVF, + or - is used to indicate positive or negative video

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* TRIGGER SENSITIVITY		
Internal		
DC...10 MHz	> 0,5 div.	Trig. coupling DC.
At 50 MHz	> 1,0 div.	Trig. coupling DC.
At 100 MHz	> 3,0 div.	Trig. coupling DC.
External		
DC...10 MHz	> 50 mV	Trig. coupling DC.
At 50 MHz	> 150 mV	Trig. coupling DC.
At 100 MHz	> 500 mV	Trig. coupling DC.
TVL/TVF internal	> 0,7 div.	Sync. pulse
TVL/TVF external	> 70 mV	Sync. pulse

2.5 SIGNAL ACQUISITION

* Sampling type		
at 0,5 μs/div. ...50 s/div.	Real time	
* Maximum sample rate:		Sample rate depends on time/div setting
Real time	100 megasamples/s	
* Vertical (voltage) resolution	8 bits	0,4% of full range of 10 divisions.
* Horizontal (time) resolution:		
in single channel acquisition		
at 5 ms/div...50 s/div	4096 samples/acquisition	1 Sample = 0,025% of full record.
at 0,5 μs/div...2 ms/div	512 samples/acquisition	1 Sample = 0,2% of full record.
in dual channel acquisition		
at 5 ms/div...50 s/div	2048 samples/acquisition	1 Sample = 0,05% of full record.
at 0,5 μs/div...2 ms/div	512 samples/acquisition	1 Sample = 0,2 % of full record.
* Record length	10,2 x time/div	Display in unmagnified position.
* Acquisition time	10,2 x time/div	
real-time:		
at 0,5 μs/div...5 ms/div	+30 ms...50 ms	exclusive delay time
at 5 ms/div...0,5 s/div	+50 ms...70 ms	exclusive delay time
* Sources	Channel A, Channel B	Channel B can be inverted before acquisition
* Acquisiton modes	1 Channel only	Full memory available for 1 channel
	2 Channels	Simultaneously sampled; 2 channels share memory.

2.6 CHANNELS A AND B

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Frequency response:		Z source = 25 Ω
Lower transition point of BW:		
Input coupling in DC position	d.c.	
Input coupling in AC position	≤ 10 Hz	
Upper transition point of BW (amb 15...35°C)	≥ 20 MHz (-3 dB)	Deviation max. 3 MHz for ambient 0...40°C.
* Max. base line instability:		
Jump (Ambient: 15...35°C):		Add 25% for ambient 0...40°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 position
Temperature coef.	0,05 div/K	Measured in 20 mV/div position

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.7 TIME BASE

* Modes	Recurrent	
	Single shot	
	Multiple shot	Up to 2 shots
	Roll	Will be stopped by trigger
* Time coefficients:		
In recurrent	0,5 μs/div. ...0,5 s/div.	
In single shot and multiple shot	0,5 μs/div. ...50 s/div.	
Error limit (Ambient: 15...35°C)		
In real time mode	± 1 %	Add 0,5 % for ambient: 0...40°C
up to memory	± 0,1%	

2.8 TRIGGER

* Trigger delay range:		
In real time	-10... + 250 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	4096 words	
register	4096 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.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.10 DISPLAY

* Sources	Channel A, Channel B, Register A, Register B	In any combination
* Display expansion horizontal	1x...32x	Value of trigger delay setting in LCD is based on unmagnified display
* Display manipulations	dot join	Including digital interpolation at 0,5 μs/div...2 ms/div
* Display part range horizontal	full memory	The displayed part of the magnified memory can be chosen

2.11 CALCULATION FACILITIES

* Functions	Peak-to-peak value Rise or fall time Frequency	Between cursors indicated by markers.

2.12 AUTO SETTING

* Settling time	3 s (typical)	Auto set is done in analog mode.

2.13 CURSORS

* Horizontal resolution:		
in single channel mode	1 : 4096	
in dual channel mode	1 : 2048	
at 2 ms/div...0,5 μs/div	1 : 512 1 : 1024	display in dots display in dot-join
* Vertical resolution	1 : 256	over 10 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	Displayed part of memory	Cursors can not pass each other. (X-position is ignored).
* Time cursors:		
Error limit	± 0,2 %	Cursors follow the trace

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION

2.14 POWER SUPPLY

* Line input voltage a.c.:		One range
Nominal	100 V...240 V	
Limits of operation	90 V...264 V	
* Line frequency:		
Nominal	50 Hz...400 Hz	
Limits of operation	43 Hz...445 Hz	
* Safety requirements within specification of:	IEC 348 CLASS I UL 1244 VDE 0411 CSA 556 B	
* Power consumption (AC source)		At nominal source voltage
Nominal	70 W	

2.15 SUNDRIES

* Z-MODulation		TTL-compatible
ViH	≥ 2,0 V	Blanks display.
ViL	≤ 0,8 V	Max. intensity.
Minimum pulse width for blanking	25 ns	Analog control between ViH and ViL is possible.
* CAL output		To calibrate drop or tilt of probes. The output may be short-circuited to ground.
Output voltage	1,2 V ± 1%	Rectangular output voltage.
Frequency	2 kHz	
* Data and settings retention:		When instrument is switched off or during mains failure. The oscilloscope settings and traces are saved.
Memory back-up voltage	2...3,5 V	
Memory back-up current drain	Typical 25 μA	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 5 years	At 25°C, with recommended (fresh) batteries.
* Temperature range	0... +70°C	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
		At -40...0°C settings retention is uncertain. It is advised to remove batteries from the instrument when it is stored during longer (24h) period below -30°C or above 60°C. WARNING: UNDER NO CIRCUMSTANCES BATTERIES SHOULD BE LEFT IN INSTRUMENT AT TEMPERATURES BEYOND THE RATED RANGE OF THE BATTERY SPECIFICATIONS!
* Analog plot output		
Connector	DIN plug 9 pin female	
Functions	Memory dump	Register selectable
Sensitivity	1 V/full memory ± 3%	Horizontal and vertical
Pen lift	TTL compatible	Pen-up is software selectable (0 or 1). Open collector output; max. 12 V.
Plot time per dot	20 ms...2000 ms	Software selectable
Plot sequence	Channel A first	With more traces in sequence A, B, RA, RB if present.

2.16 ENVIRONMENTAL CHARACTERISTICS

The environmental data mentioned in this manual are based on the results of the manufacturer's checking procedures. Details on 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-28800 C, type III, CLASS 5 Style D	Except for front cover.
* Temperature:		
operating temp. range within specification	10°C...40°C	MIL-T-28800 C par. 3.9.2.3. tested cf. par. 4.5.5.1.1.
Limits of operating temperature range	0°C...40°C	MIL-T-28800 C par. 3.9.3.3. tested cf. par. 4.5.5.1.1.
Non-operating (storage):	-40°C... +75°C	Cf. MIL-T-28800 C parr. 3.9.2.3. tested cf. par. 4.5.5.1.1.
* Max. humidity operating/non-operating	95% RH	10...30°C

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* 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
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%	

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* EMI (Electronic Magnetic Interference) meets requirements of	MIL-STD-461 CLASS B	Applicable requirements of part 7
	CE03, CE07 RE02	
	CS01, CS02, CS06 RS02, RS03	No malfunction Fieldstrength 10 V/m (10 kHz...30 MHz), 5 V/m (30 kHz...1 GHz)
* Magnetic radiated susceptibility Maximum deflection factor	2 mm/Gs	Tested conforming IEC 351-1 par 5.1.3.1 Measured with instrument in a homogeneous magnetic field (in any direction with respect to instrument) with a flux intensity (p-p value) of 1,42 mT (14,2 gauss) and of symmetrical sine-wave form with a frequency of 45 Hz...66 Hz

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	Except for power cord, unless shipped with North American power plug
	CSA 556 B	

3 INTRODUCTION TO CIRCUIT DESCRIPTION AND BLOCK DIAGRAM DESCRIPTION

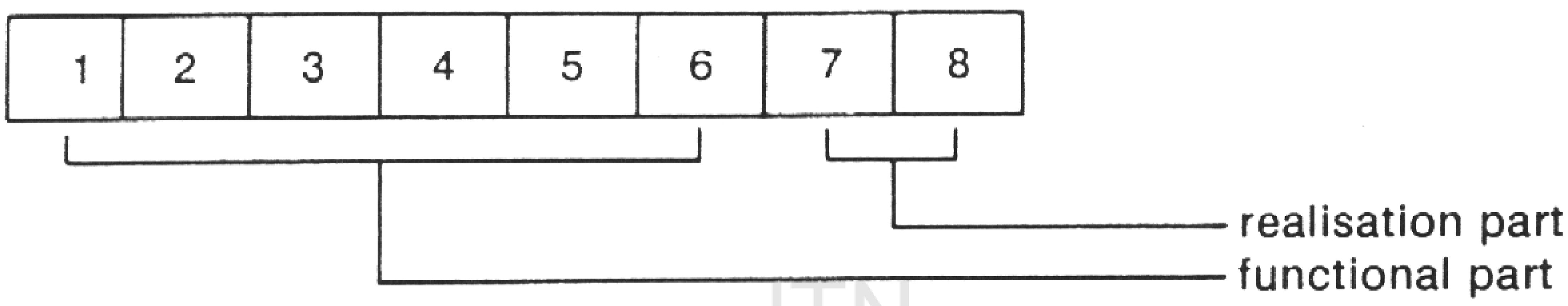
3.1 INTRODUCTION TO CIRCUIT DESCRIPTION

3.1.1 General

The functioning of the circuits is described per printed-circuit board (p.c.b.). For every p.c.b. a separate chapter (4...19) 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 name consists 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.

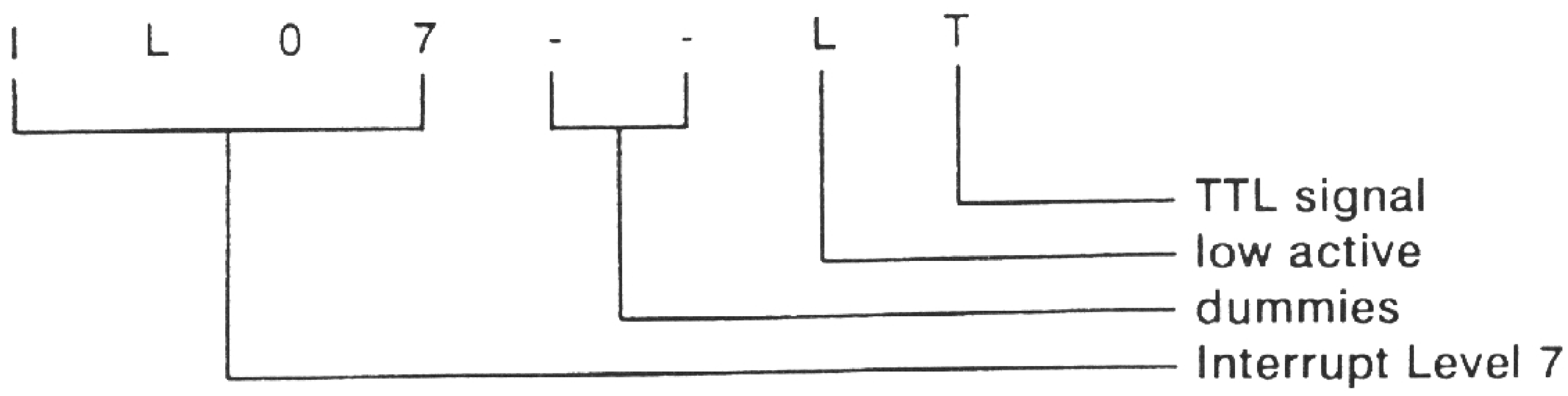
The first character of the realisation part has the following meaning:

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:	analog
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 realisation part can also be used for a serial number e.g. to indicate a buffered version of a signal.

Example: CHPT--01

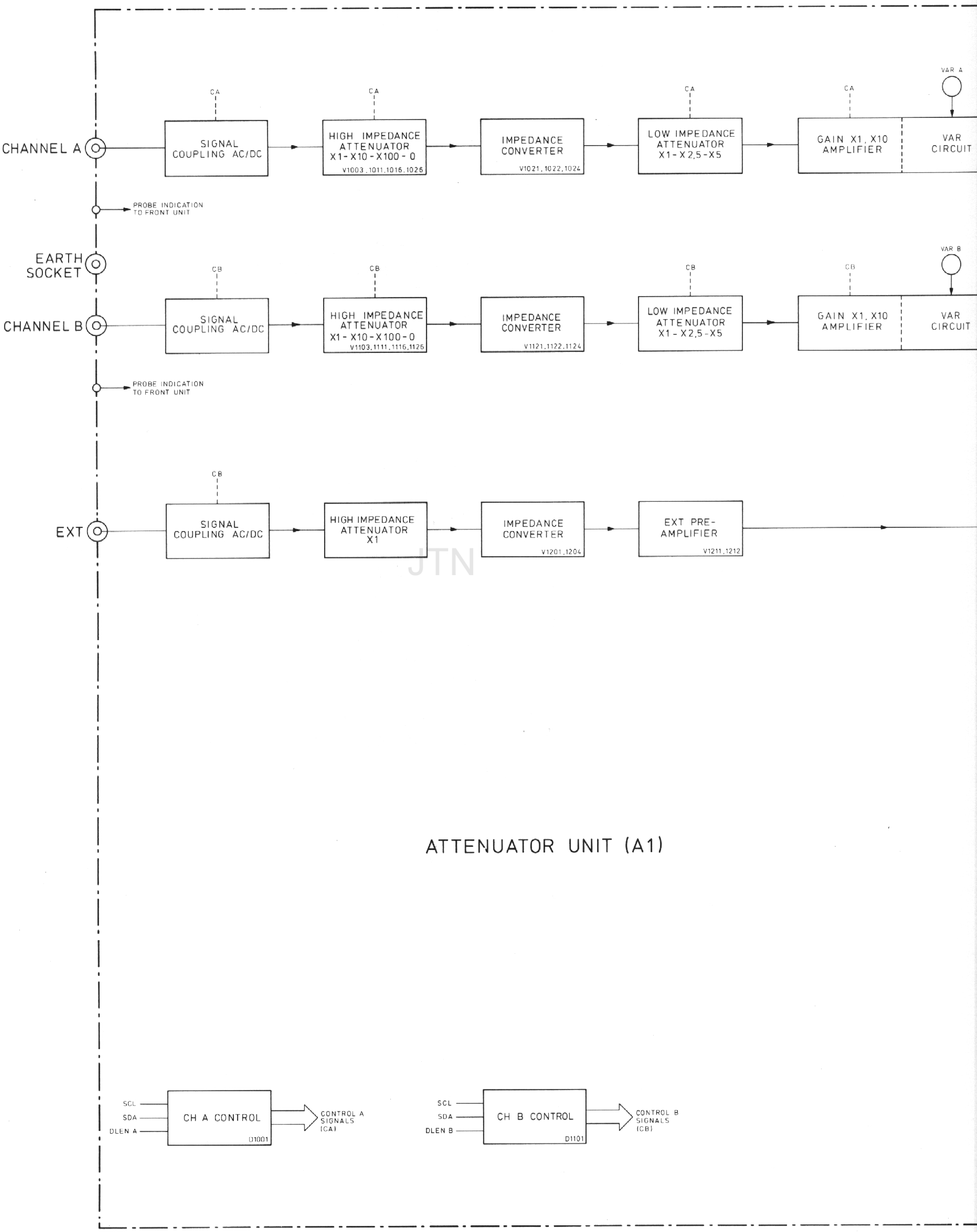
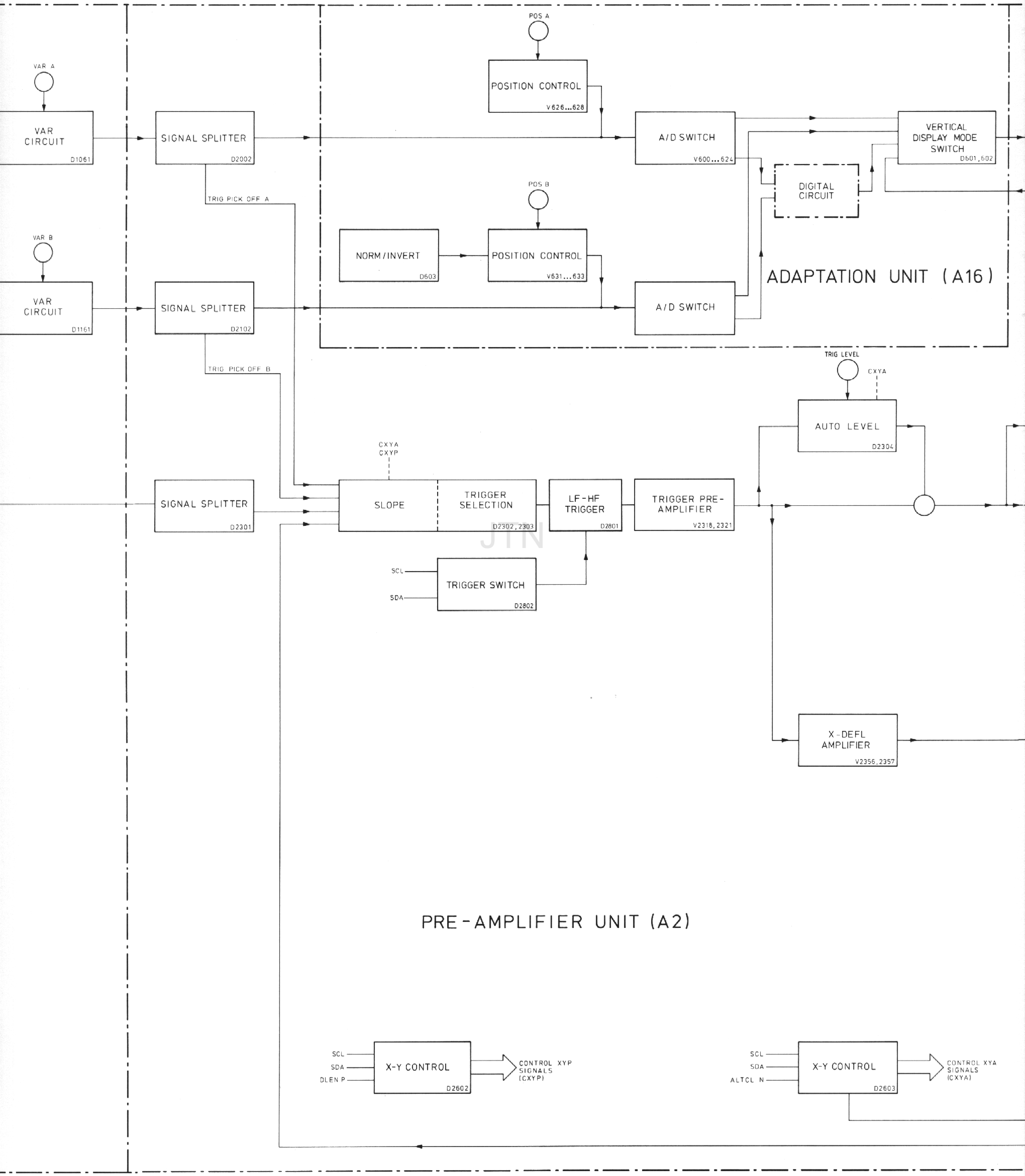
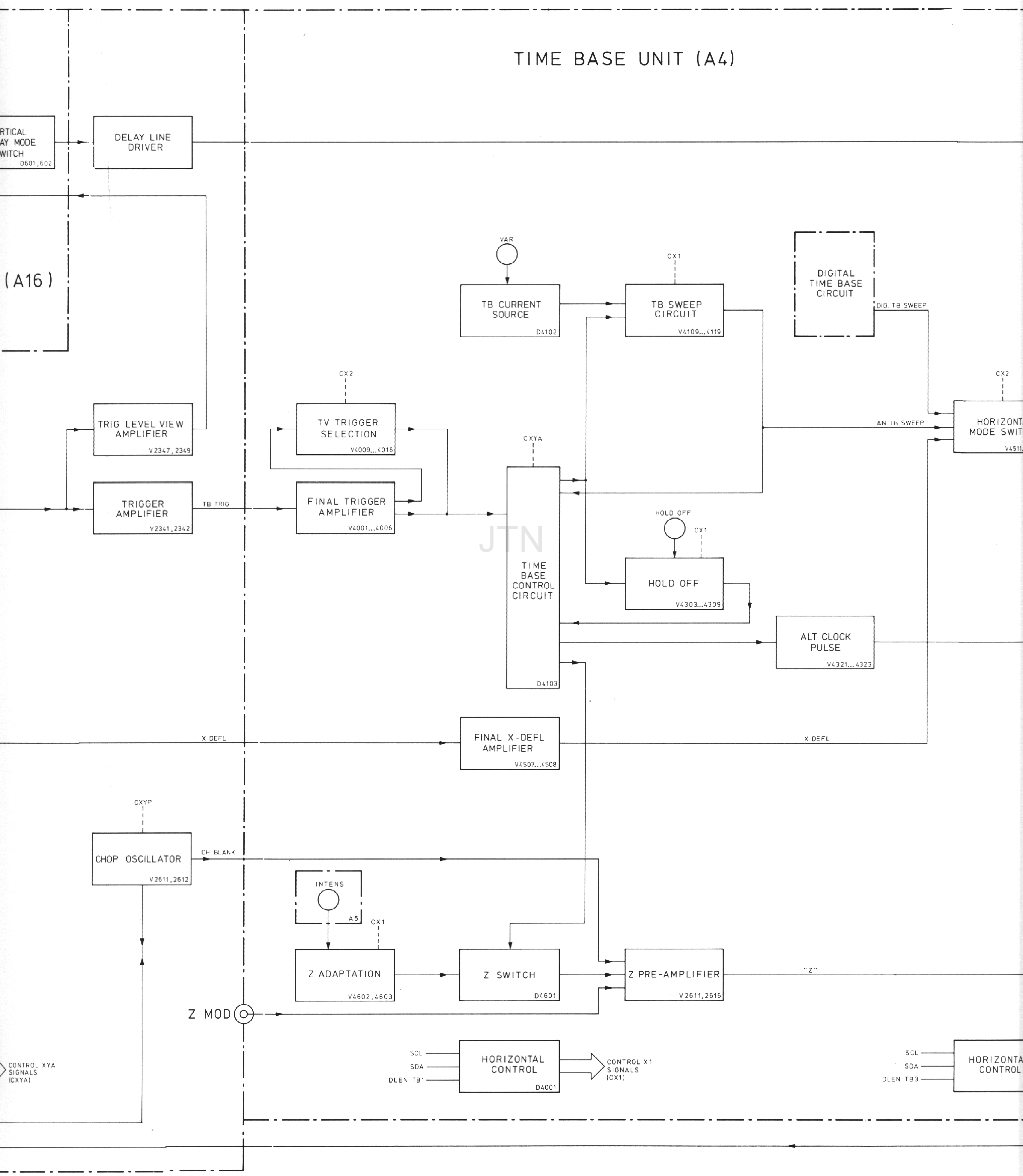
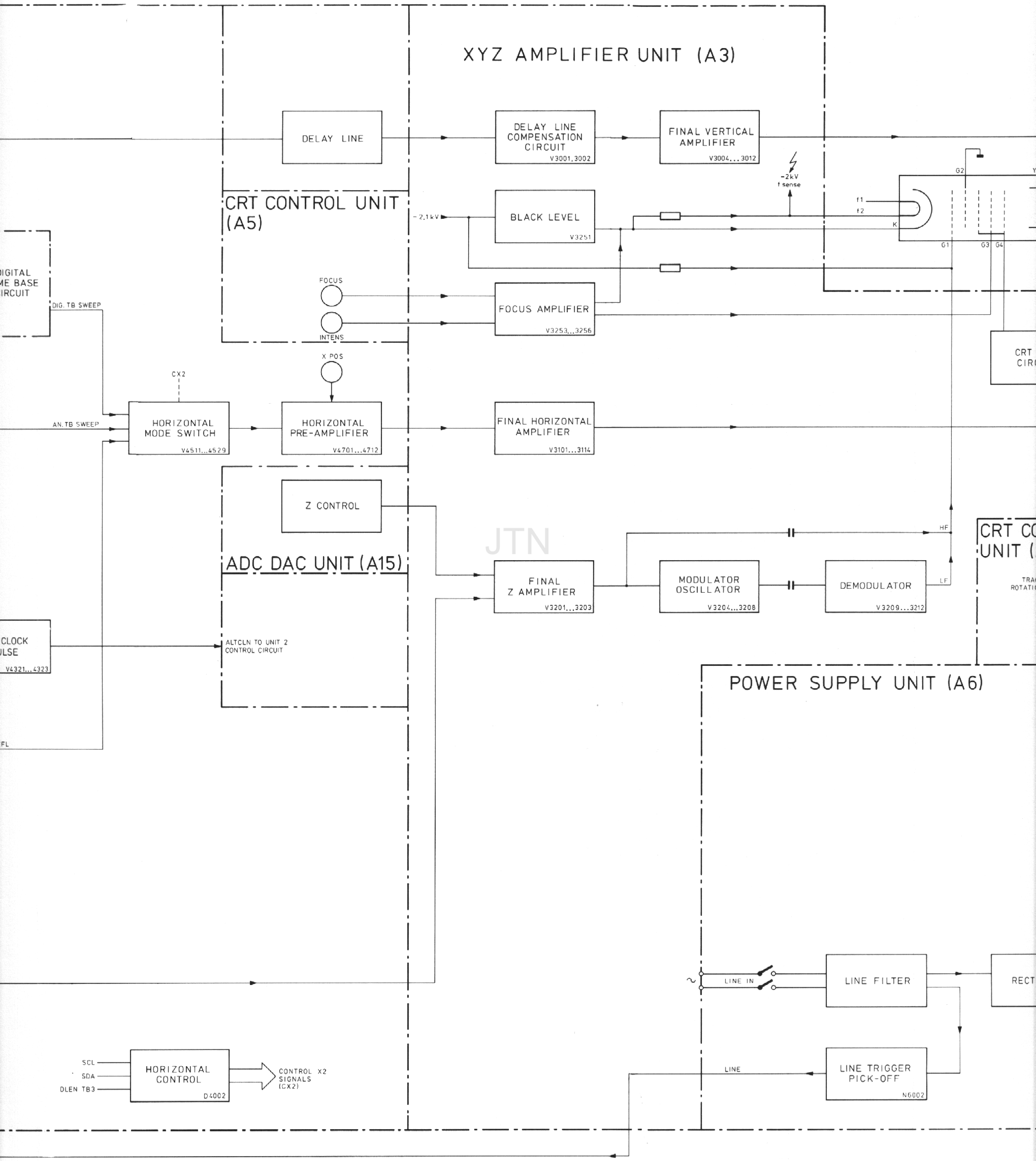
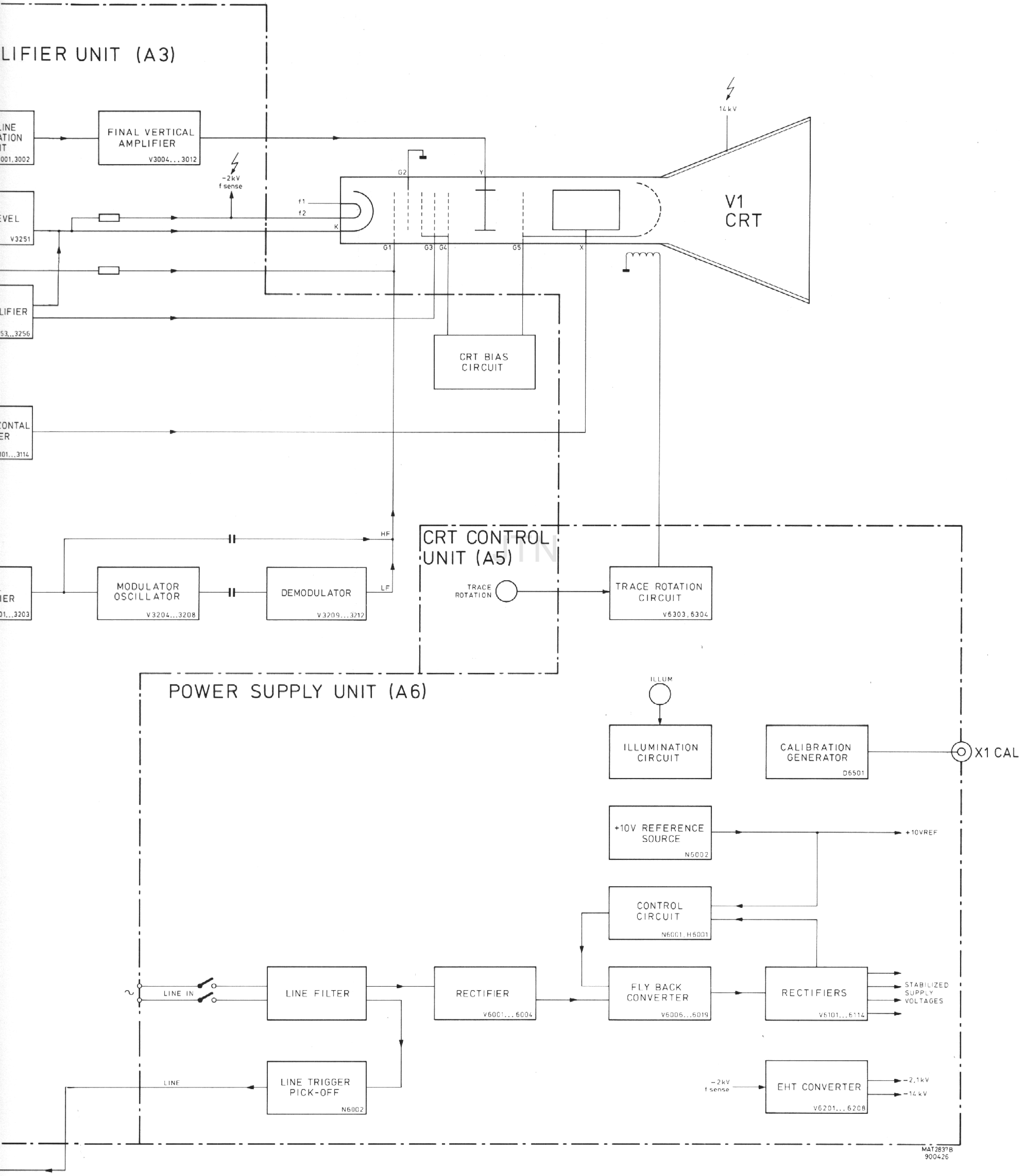


Figure 3.1 Block diagram, analog part


POS A
VAR A
POSITION CONTROL
V626...628
VAR CIRCUIT
D1061
SIGNAL SPLITTER
D2002
A/D SWITCH
V600...624
VERTICAL DISPLAY MODE SWITCH
D601,602
TRIG PICK OFF A
DIGITAL CIRCUIT
POS B
VAR B
NORM/INVERT
D603
POSITION CONTROL
V631...633
ADAPTATION UNIT (A16)
VAR CIRCUIT
D1161
SIGNAL SPLITTER
D2102
A/D SWITCH
TRIG PICK OFF B
TRIG LEVEL
CXYA
AUTO LEVEL
D2304
CXYA
CXYP
SIGNAL SPLITTER
D2301
SLOPE
TRIGGER SELECTION
D2302,2303
LF-HF TRIGGER
D2801
TRIGGER PRE-AMPLIFIER
V2318,2321
SCL
SDA
TRIGGER SWITCH
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
CONTROL XYA SIGNALS (CXYA)


TIME BASE UNIT (A4)
RTICAL
AY MODE
WITCH
D601,602
DELAY LINE
DRIVER
(A16)
VAR
TB CURRENT
SOURCE
D4102
CX1
TB SWEEP
CIRCUIT
V4109...4119
DIGITAL
TIME BASE
CIRCUIT
DIG. TB SWEEP
CX2
TRIG LEVEL VIEW
AMPLIFIER
V2347,2349
TV TRIGGER
SELECTION
V4009...4018
CXYA
AN. TB SWEEP
HORIZONT
MODE SWIT
V4511
TRIGGER
AMPLIFIER
V2341,2342
TB TRIG
FINAL TRIGGER
AMPLIFIER
V4001...4006
HOLD OFF
CX1
TIME
BASE
CONTROL
CIRCUIT
D4103
HOLD OFF
V4303...4309
ALT CLOCK
PULSE
V4321...4323
X DEFL
FINAL X-DEFL
AMPLIFIER
V4507...4508
X DEFL
CXYP
CHOP OSCILLATOR
V2611,2612
CH BLANK
INTENS
A5
CX1
Z ADAPTATION
V4602,4603
Z SWITCH
D4601
Z PRE-AMPLIFIER
V2611,2616
"Z"
Z MOD
CONTROL XYA
SIGNALS
(CXYA)
SCL
SDA
DLEN TB1
HORIZONTAL
CONTROL
D4001
CONTROL X1
SIGNALS
(CX1)
SCL
SDA
DLEN TB3
HORIZONTA
CONTROL


XYZ AMPLIFIER UNIT (A3)
DELAY LINE
DELAY LINE COMPENSATION CIRCUIT
V3001,3002
FINAL VERTICAL AMPLIFIER
V3004...3012
CRT CONTROL UNIT (A5)
-2,1kV
BLACK LEVEL
V3251
-2kV
f sense
f1
f2
K
G1
G2
G3
G4
DIGITAL
ME BASE
IRCUIT
DIG. TB SWEEP
FOCUS
INTENS
FOCUS AMPLIFIER
V3253...3256
CRT
CIR
X POS
CX2
AN. TB SWEEP
HORIZONTAL MODE SWITCH
V4511...4529
HORIZONTAL PRE-AMPLIFIER
V4701...4712
FINAL HORIZONTAL AMPLIFIER
V3101...3114
Z CONTROL
ADC DAC UNIT (A15)
HF
LF
CRT CO
UNIT (
TRA
ROTATI
FINAL Z AMPLIFIER
V3201...3203
MODULATOR OSCILLATOR
V3204...3208
DEMODULATOR
V3209...3212
CLOCK
ULSE
V4321...4323
ALTCLN TO UNIT 2 CONTROL CIRCUIT
FL
POWER SUPPLY UNIT (A6)
LINE IN
LINE FILTER
RECT
LINE
LINE TRIGGER PICK-OFF
N6002
SCL
SDA
DLEN TB3
HORIZONTAL CONTROL
D4002
CONTROL X2 SIGNALS (CX2)



LIFIER UNIT (A3)
FINAL VERTICAL AMPLIFIER
V3004...3012
−2kV f sense
14kV
G2
Y
f1
f2
K
G1
G3
G4
G5
X
V1 CRT
V3251
CRT BIAS CIRCUIT
CRT CONTROL UNIT (A5)
HF
LF
MODULATOR OSCILLATOR
V3204...3208
DEMODULATOR
V3209...3212
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
V6005...6019
RECTIFIERS
V6101...6114
STABILIZED SUPPLY VOLTAGES
LINE
LINE TRIGGER PICK-OFF
N6002
−2kV f sense
EHT CONVERTER
V6201...6208
−2,1kV
−14kV
MAT2837B 900426

Signal name list:

The digital unit description in Chapters 12...19 contains a list with the signal names used in that unit given in alphabetical order.
After each name, a description is given and on which unit the signal is generated. Only if the signal is generated on the unit itself, are the other units on which the signal is used (signal destination(s)) mentioned, otherwise a minus sign is filled in. If the signal flows over more units in sequence, the path is indicated.

Some signals may have more signal sources, because the sources have open-collector output circuits, or 3-state output circuits. In this case the sources are mentioned, separated with a plus (+) sign.

A number of power supply lines and ground lines are not mentioned on the signal name lists because they appear in almost every unit.

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
100- 100	A11	IEEE unit
200- 299	A12	CPU unit
300- 399	A13	DCL unit
400- 499	A14	ACL unit
500- 599	A15	ADC DAC unit
600- 699	A16	Adaptation unit
700- 799	A17	Mini CCD
800- 999	A18	P^2CCD 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. The interconnections between all p.c.b.'s are given in the interconnection diagram of figure 23.6. In order to assist in cross-reference with the circuit diagrams, the blocks in the block diagram include the item numbers of the active components they contain.
Furthermore, the blocks are grouped together per printed-circuit board, or a part 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 (μP) 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 VAR 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 mV- 5 mV and 10mV 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 the EXT PRE-AMPLIFIER.

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.

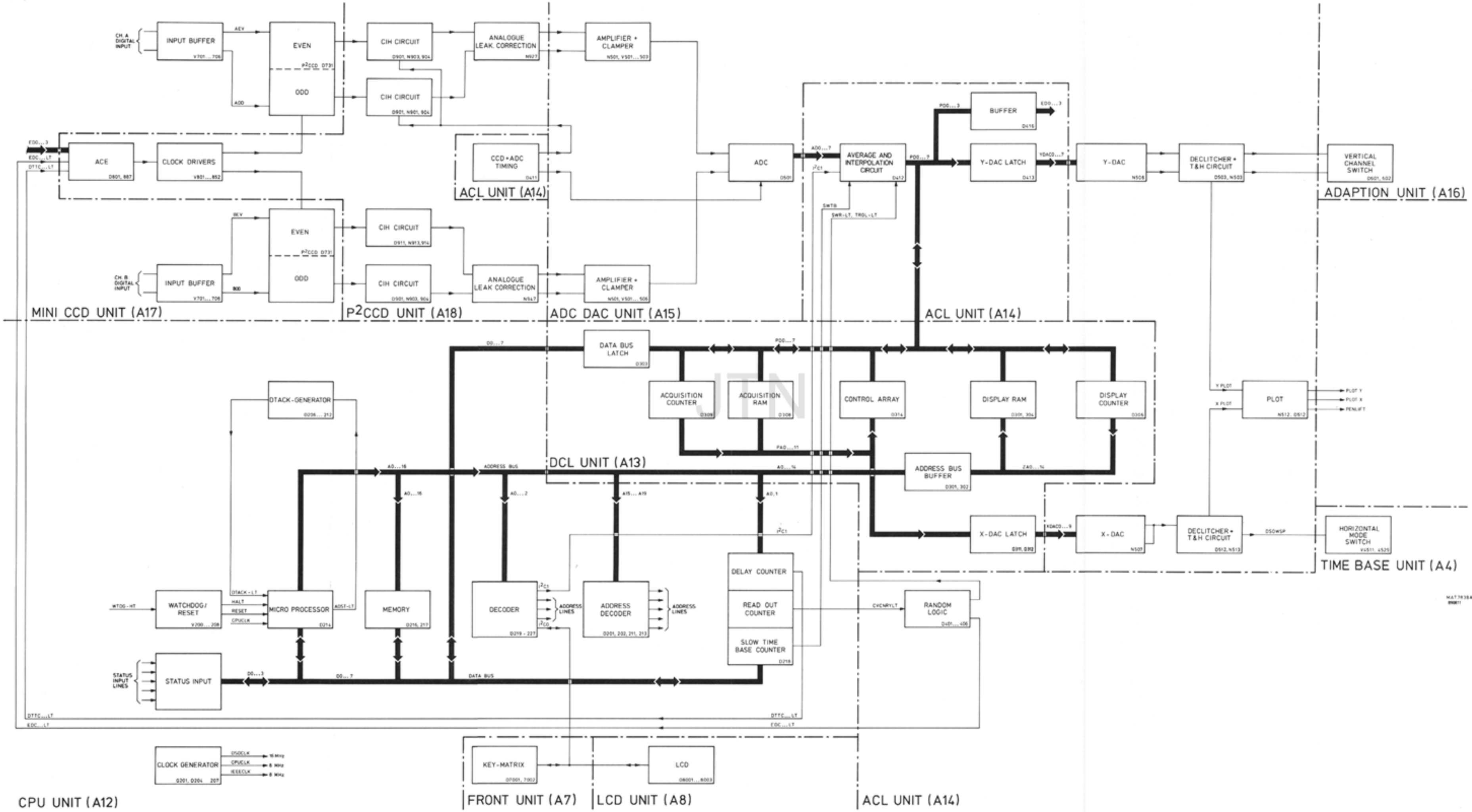


Figure 3.2 Block diagram, digital part

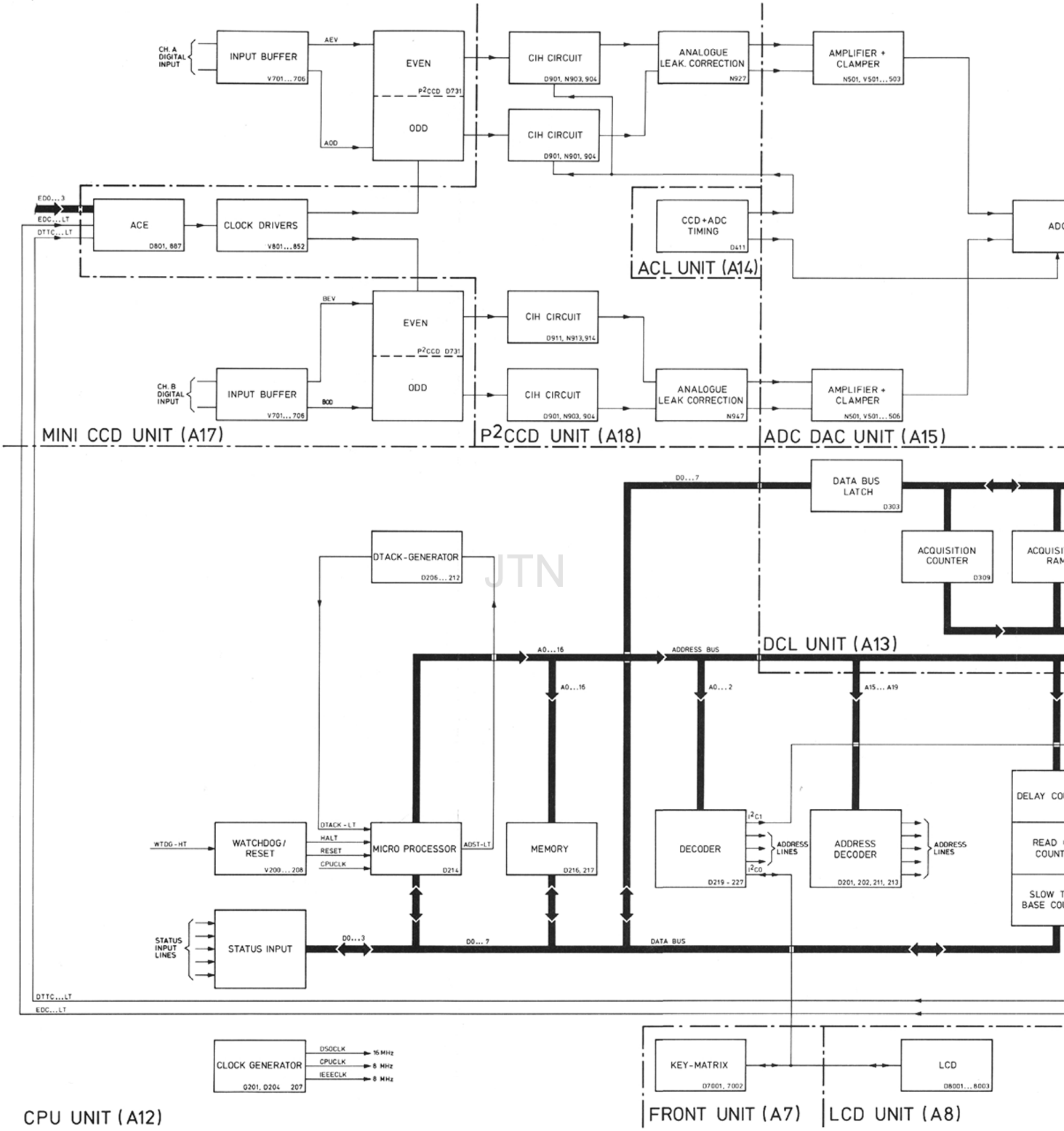
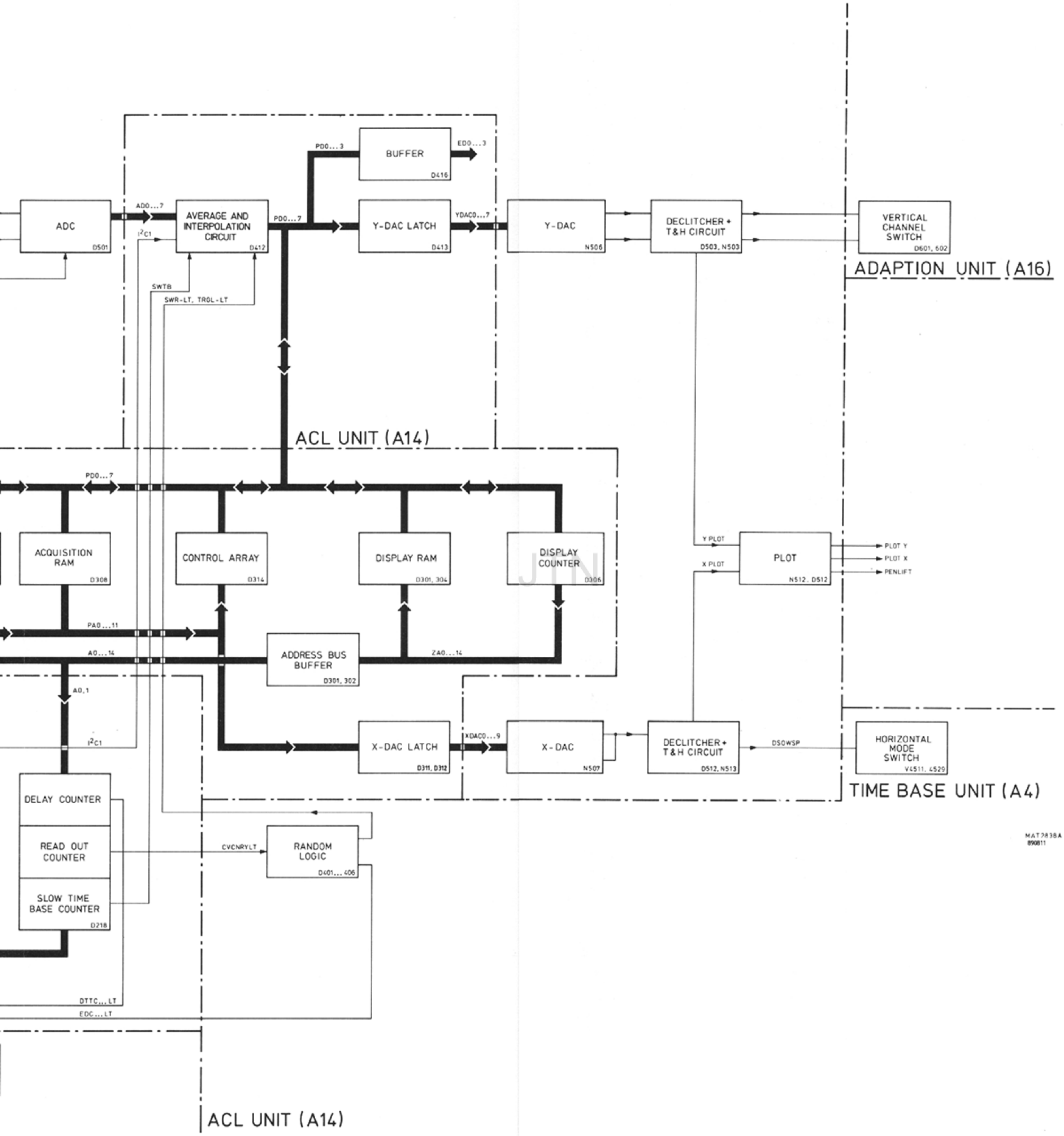


Figure 3.2 Block diagram, digital part



ADC
D501
AD0...7
I2C1
AVERAGE AND INTERPOLATION CIRCUIT
D412
SWTB
SWR-LT, TRGL-LT
PD0...3
BUFFER
D416
ED0...3
PD0...7
Y-DAC LATCH
D413
YDAC0...7
Y-DAC
N506
DECLITCHER + T&H CIRCUIT
D503, N503
VERTICAL CHANNEL SWITCH
D601, 602
ADAPTION UNIT (A16)
ACL UNIT (A14)
PD0...7
ACQUISITION RAM
D308
CONTROL ARRAY
D314
DISPLAY RAM
D301, 304
DISPLAY COUNTER
D306
PA0...11
A0...14
ADDRESS BUS BUFFER
D301, 302
ZA0...14
Y PLOT
X PLOT
PLOT
N512, D512
PLOT Y
PLOT X
PENLIFT
A0,1
I2C1
X-DAC LATCH
D311, D312
XDAC0...9
X-DAC
N507
DECLITCHER + T&H CIRCUIT
D512, N513
DSOWSP
HORIZONTAL MODE SWITCH
V4511, 4529
TIME BASE UNIT (A4)
DELAY COUNTER
READ OUT COUNTER
SLOW TIME BASE COUNTER
D218
CVCNRYLT
RANDOM LOGIC
D401...406
DTTC...LT
EDC...LT
ACL UNIT (A14)
MAT2838A
890811

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 CXYP and CXYA signals, generated by the X-Y CONTROL blocks.

*** Vertical channels A and B:**

Both channels are completely identical and receive their input signal 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 real time 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 both channels A and B (composite triggering), from the EXT SIGNAL SPLITTER or from the LINE TRIGGER PICK-OFF. Inverting 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 TRIG 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 TRIG 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 level.

*** 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 directly routed to the TIME-BASE CONTROL CIRCUIT or first 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 TB CURRENT SOURCE applies the sawtooth charging current to the TB SWEEP CIRCUIT. This block generates the time base sawtooth signal, which is routed to the HORIZONTAL DISPLAY MODE SWITCH.

The HOLD OFF and the ALT CLOCK PULSE 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 ALTCLN-pulse, the output of the ALT CLOCK PULSE block, 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 this 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. The signal is then fed to the DELAY LINE COMPENSATION. This block compensates the signal fordistortion, originating from 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 BLACK LEVEL block provides the correct presetting (- 100 V) of the cathode voltage.

The CRT BIAS circuit 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 (unit A6)

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 TB 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 P²CCD circuits and control logic (unit A17 and A18)

The P^2CCD unit (Profiled Peristaltic Charged Coupled Device) incorporates two mini CCD units (one for each channel), the P^2CCD driver circuits and the P^2CCD output circuits. The two mini CCD units are mounted as separate units on the main board.
The vertical channels A and B for the signals to be displayed are identical. Each channel comprises an INPUT BUFFER, P^2CCD, odd and even CIH (Clamp Integrate Hold) circuit and the ANALOGLEAKAGE CORRECTION.

Signals derived from the A/D switch on the adaptation unit are passing the P^2CCD circuits. These P^2CCDs act as analogue shift registers which are able to store signal samples in a rhythm that depends on the selected time base speed. This rhythm is generated by the ACE (Advanced Customised ECL) and applied to the P^2CCDs via the CLOCK DRIVERS. For time-base speeds which cannot be handled by the ADC any more, the P^2CCD devices are used for time conversions. This means that signal samples can be sampled by the P^2CCDs in a high rhythm and later converted by an ADC circuit in a lower rhythm. This lower rhythm is generated by the READ OUT COUNTER. Each channel contains a P^2CCD which, in its turn, contains two sections of 256 signal samples.

The P^2CCD is fully controlled by the ACE, which delivers control signals and which also controls the CLOCK DRIVERS.

The outputs of the P^2CCDs are applied to fast CIH circuits. These circuits are able to hold the signal information for a time that is long enough for the track-and-hold circuit to take it over. The CIH circuits are controlled by the CCD and ADC TIMING.

The ANALOG LEAKAGE CORRECTION corrects the signals for leakage.

3.2.8 ADC circuit (unit A15)

The signal derived from the P^2CCD unit must first be clamped into the correct input signal for the ADC. This ADC converts the signal to an 8-bit digital word and is able to perform conversion at a maximum speed of 50 kHz. This conversion is controlled by the CCD + ADC TIMING.

3.2.9 Signal processing unit (unit A13 and A14)

The signal processing circuit consists of an AVERAGE AND INTERPOLATION circuit, an ACQUISITION circuit and a DISPLAY circuit. It takes data from the ADC, performs calculation on it and sends the data to the Y-DAC latch or it reads/writes the data from/to the microprocessor. The address of the data is put into the X-DAC latch.

The AVERAGE AND INTERPOLATION circuit averages the differences between the odd and even channels and calculates also 512 linear interpolated points between each of the 512 samples. The output data is transferred to the Y-DAC latch or to the memories.

During time intervals of 500 ns each, the different data transports occur in the following sequence:

- data is written in the ACQUISITION MEMORY, addressed by the ACQUISITION COUNTER.
- data is copied to the bidirectional latch in the CONTROL ARRAY.
- data is written in the DISPLAY MEMORY, addressed by the DISPLAY COUNTER.
- data is written in the Y-DAC LATCH.

Finally, during the last time interval the microprocessor is connected to the DISPLAY RAM via the DATA BUS LATCH and ADDRESS BUS BUFFER. The data from the microprocessor can influence several functions such as text, plot, dots, etc.

3.2.10 Y-DAC and X-DAC circuits (unit A15)

The Y-DAC and X-DAC convert the 8-bit data and 13-bit address information into analog signals again. Glitches on the output of both DACs are removed by the DEGLITCHER-circuits. Next the signals are fed via a TRACK&HOLD circuit, dot-join circuit, VERTICAL CHANNEL SWITCH or HORIZONTAL MODE SWITCH to the analogue circuits.

3.2.11 Microprocessor system (unit A12)

The microprocessor system mainly consists of a powerful 68008 μP, a RAM for data and a ROM containing the system software. The microprocessor is running at a frequency of 8 MHz provided by a CLOCK GENERATOR. This generator in its turn is driven by a 16 MHz crystal oscillator.

DECODERS decode a number of addresses resulting in the various address lines that are fed to the different circuits. Also the I^2C busses are decoded.

A WATCHDOG/RESET circuit detects abnormal program sequences via an output port and resets the microprocessor via the RESET and HALT lines in order to restart the program again.

The STATUS input reads the different status information of the instrument for the microprocessor.

4 ATTENUATOR UNIT (A1)

4.1 VERTICAL ATTENUATORS

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

All relay and FET switches are controlled by the microprocessor via the I^2C bus. The TEA 1017 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
(L = low impedance relais, H = high impedance FET, F = input coupling relais)

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
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 (OQ0203)**, 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 (R1164) and gain adjustment R1069 (R1169).
- Gain x10 (pin 6 and 7) with offset adjusting R1072 (R1172) and gain adjustment R1076 (R1176).
- x1/x10 control 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 basic 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.

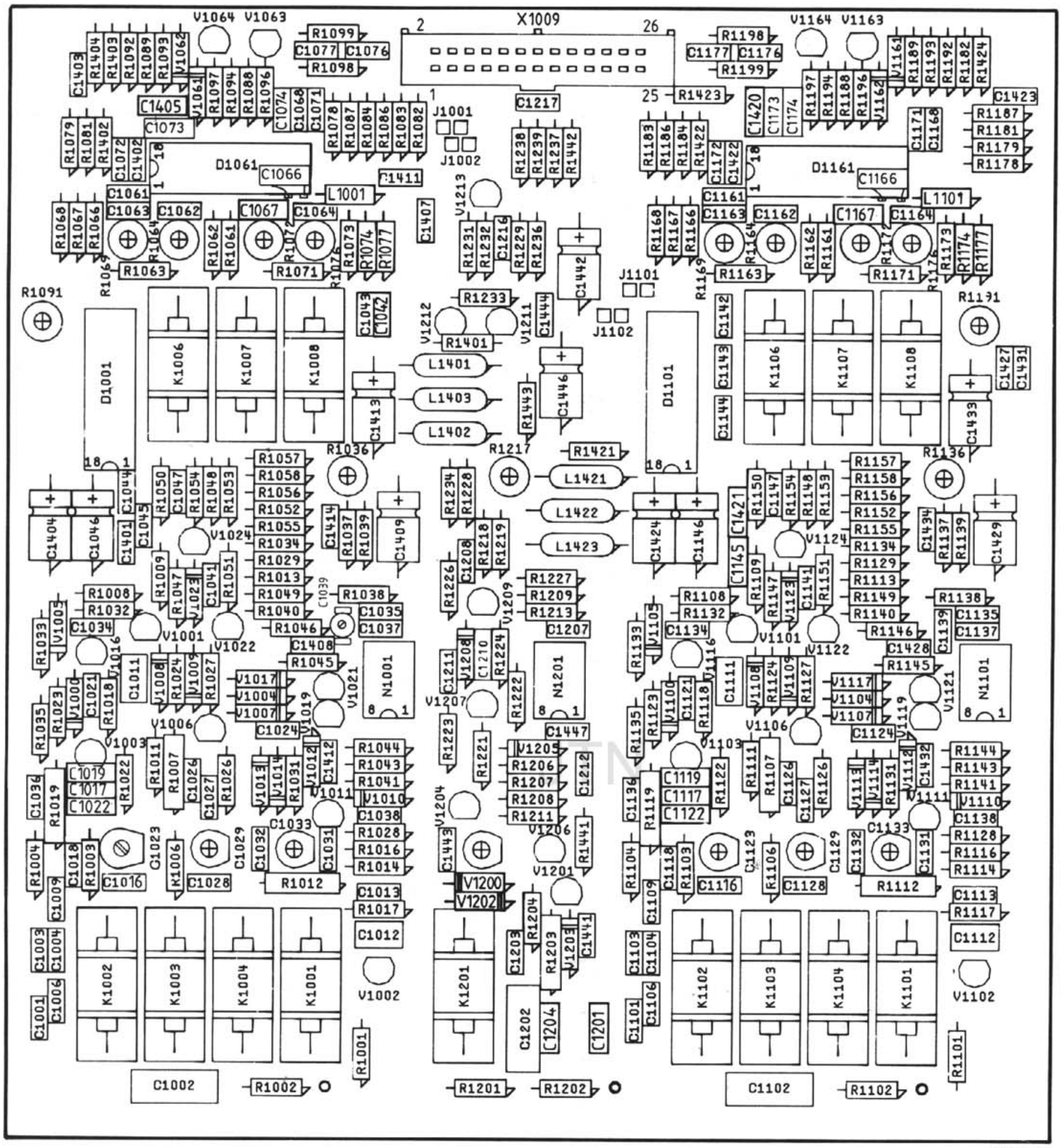


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Figure 4.2 Attenuator unit pcb

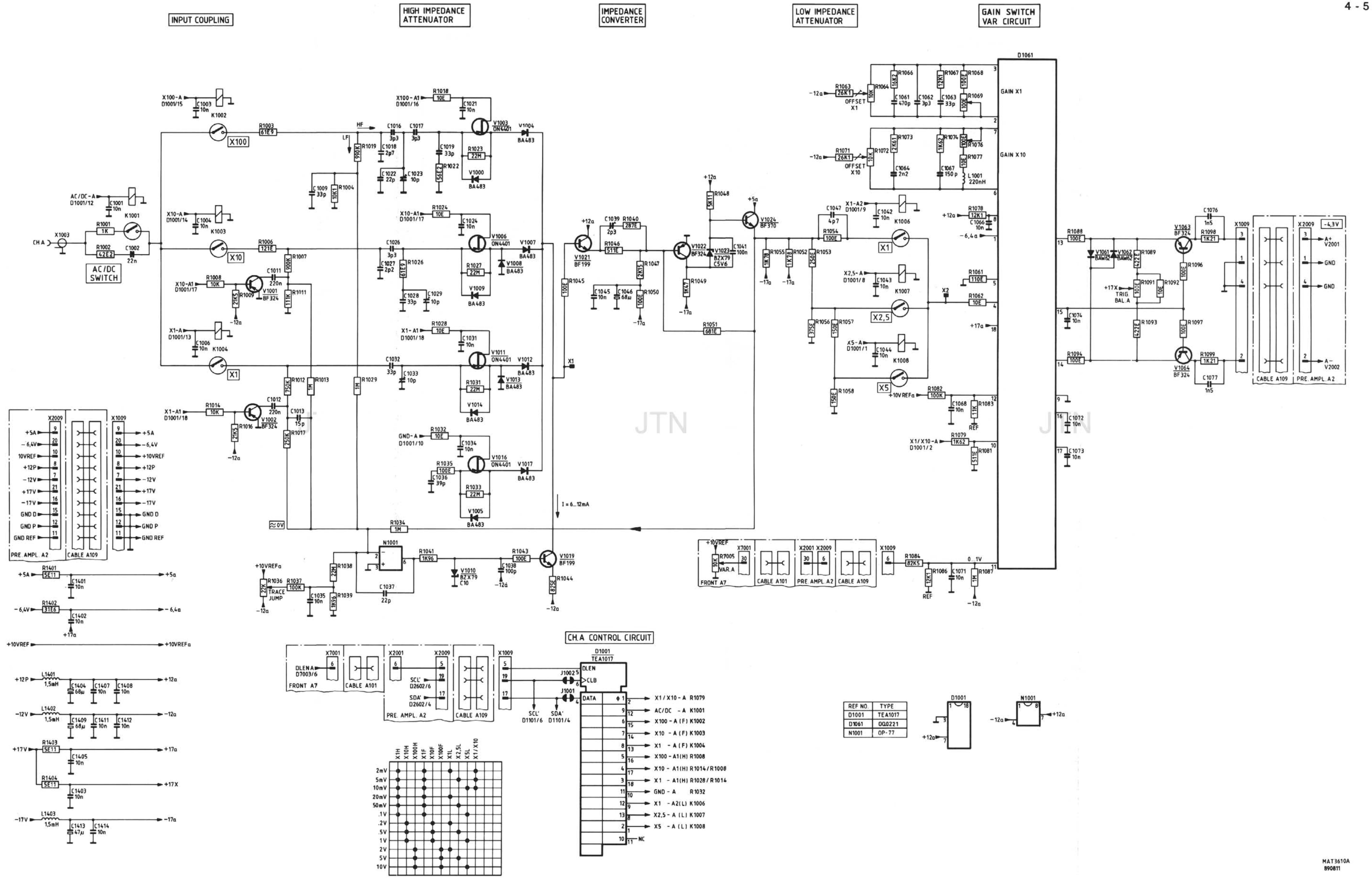
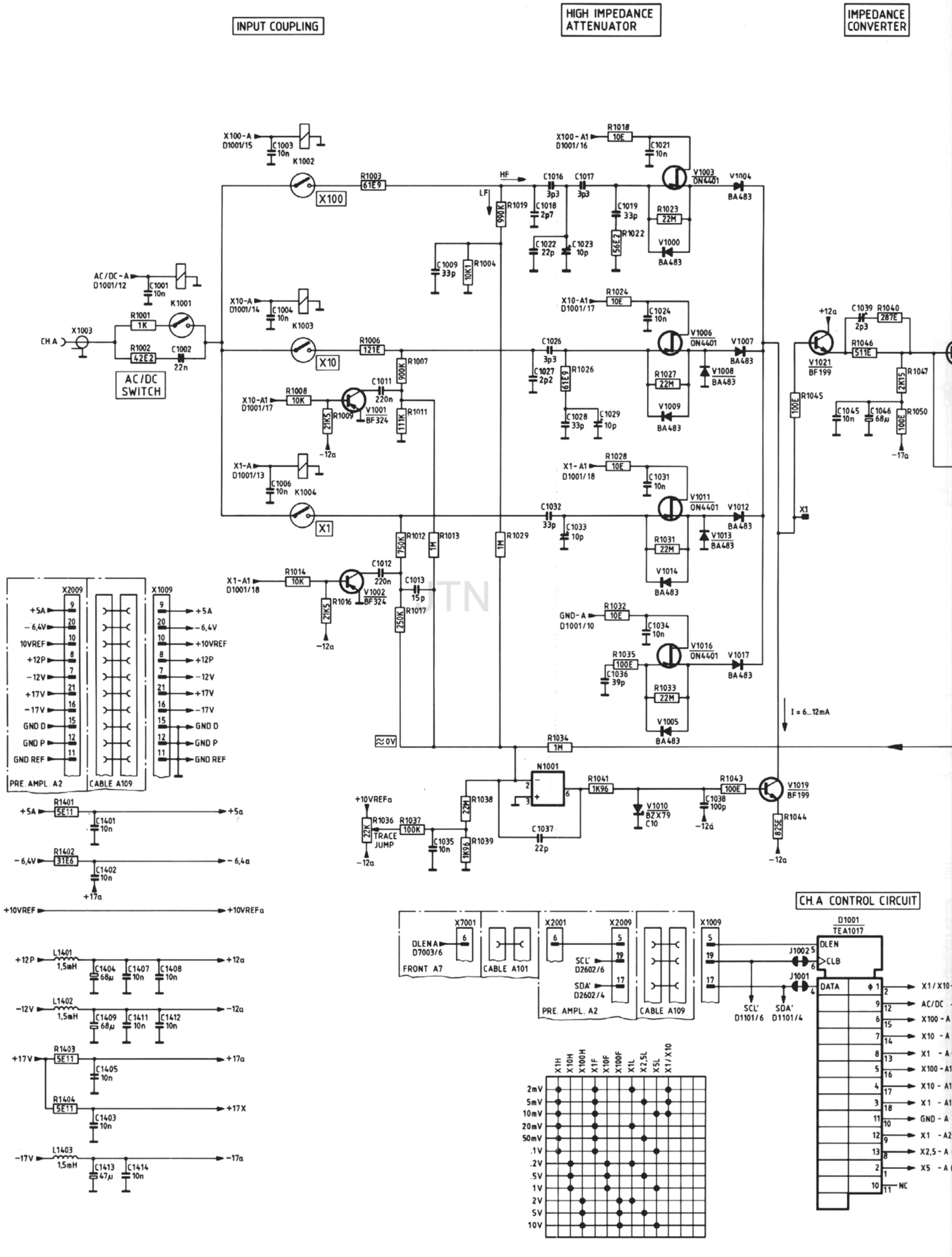
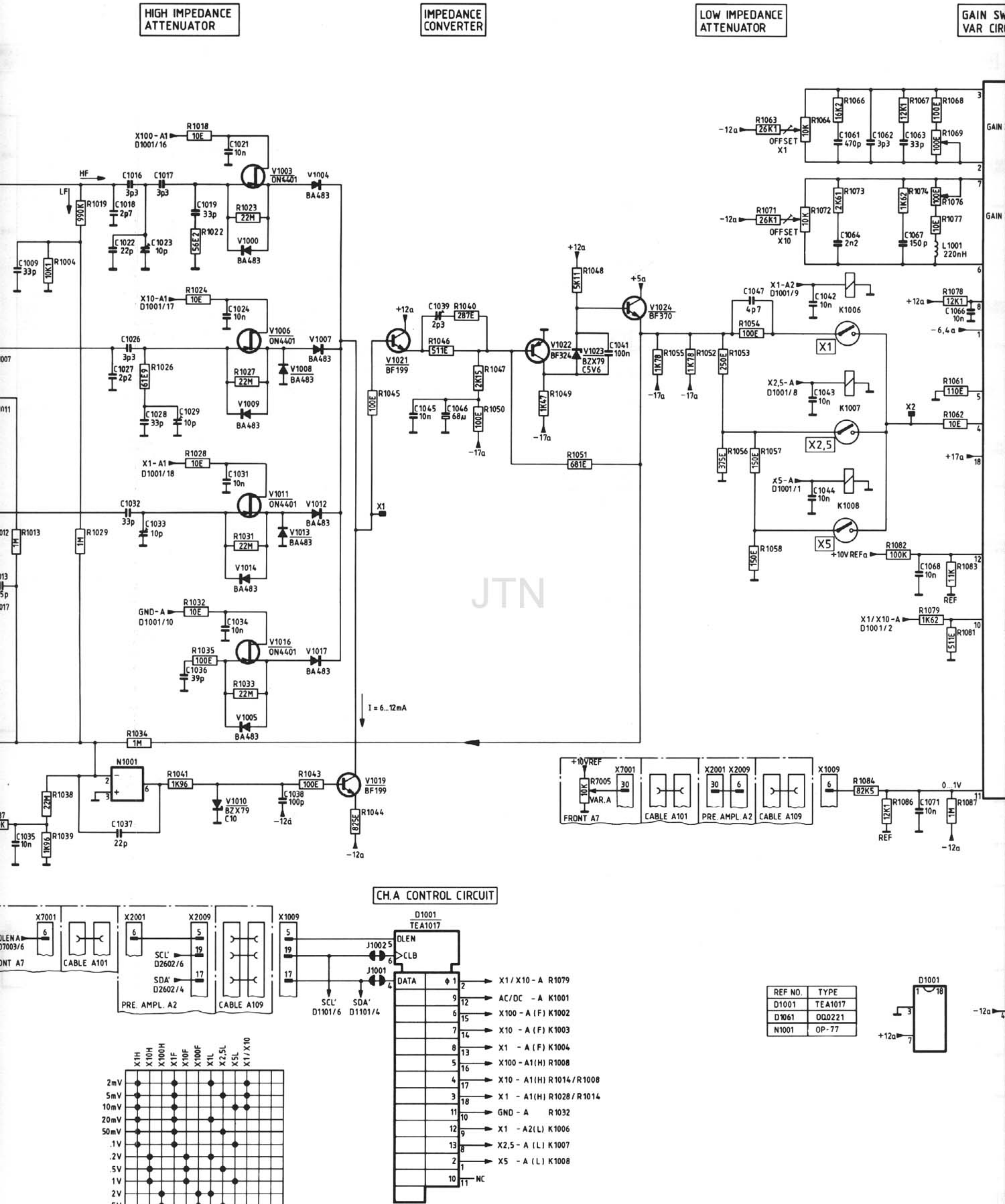


Figure 4.3 Circuit diagram of attenuator: ch. A

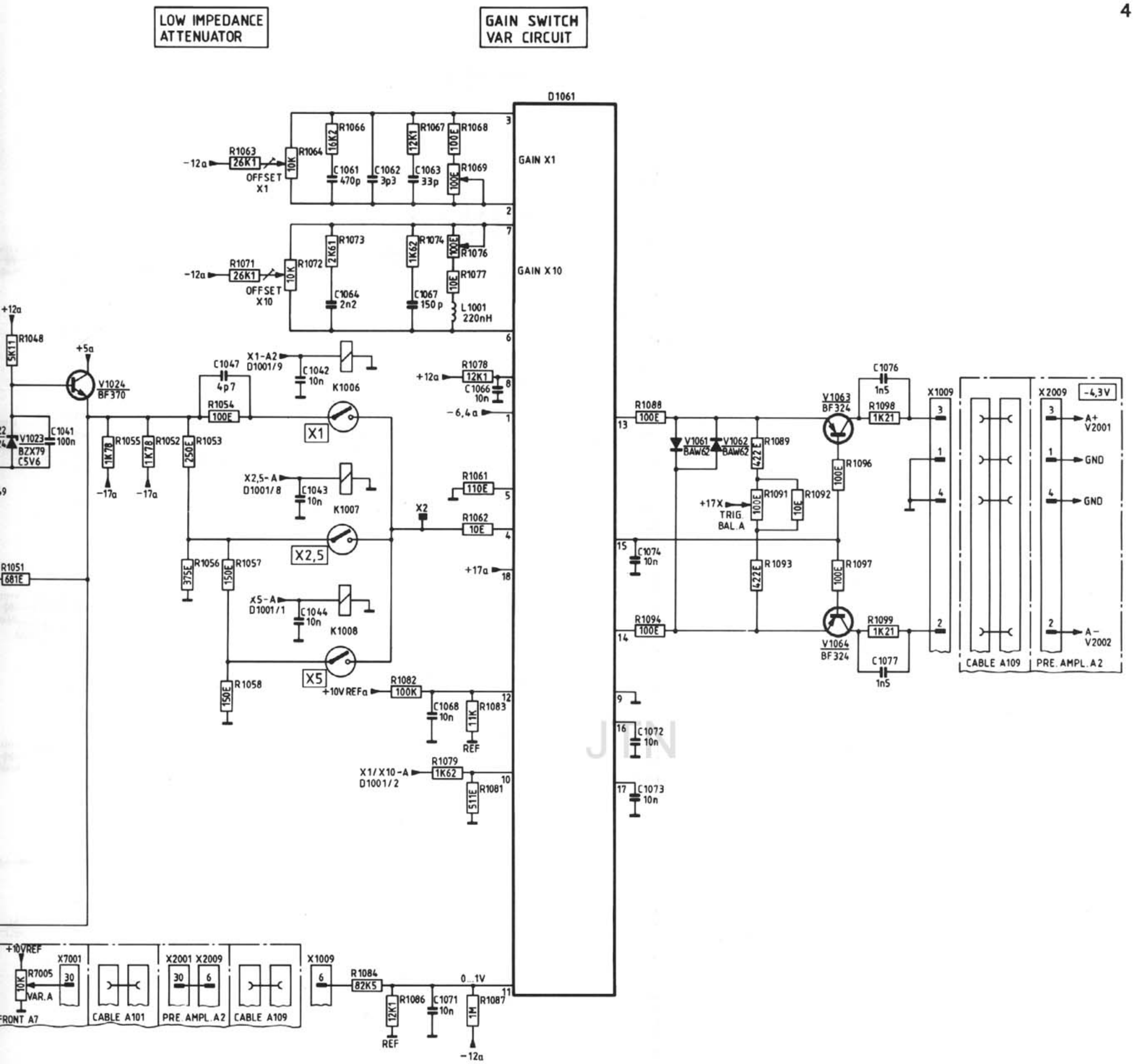


	X1H	X10H	X100H	X1F	X10F	X100F	X1L	X2,5L	X5L	X1/X10
2mV	●			●			●			●
5mV	●			●				●		●
10mV	●			●					●	●
20mV	●			●			●			
50mV	●			●				●		
.1V	●			●					●	
.2V		●			●		●			
.5V		●			●			●		
1V		●			●				●	
2V			●			●	●			
5V			●			●		●		
10V			●			●			●	



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

REF. NO.	TYPE
D1001	TEA1017
D1061	OQ0221
N1001	OP-77



REF NO.	TYPE
D1001	TEA1017
D1061	OQ0221
N1001	OP-77

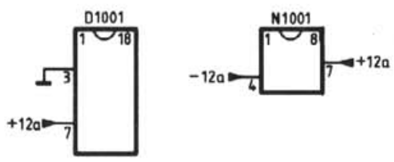


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Figure 4.3 Circuit diagram of attenuator: ch. A

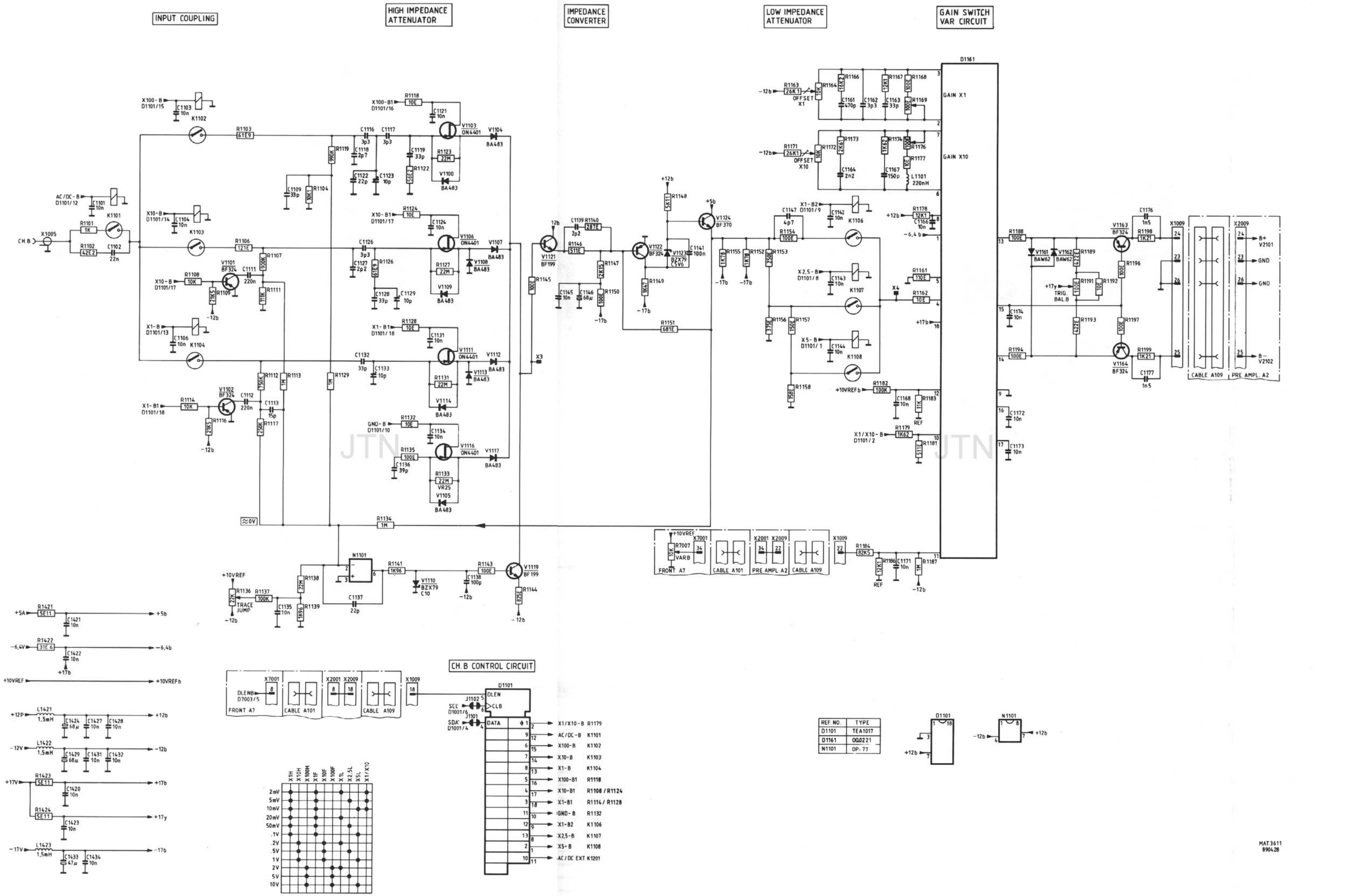


Figure 4.4 Circuit diagram of attenuator: ch. B

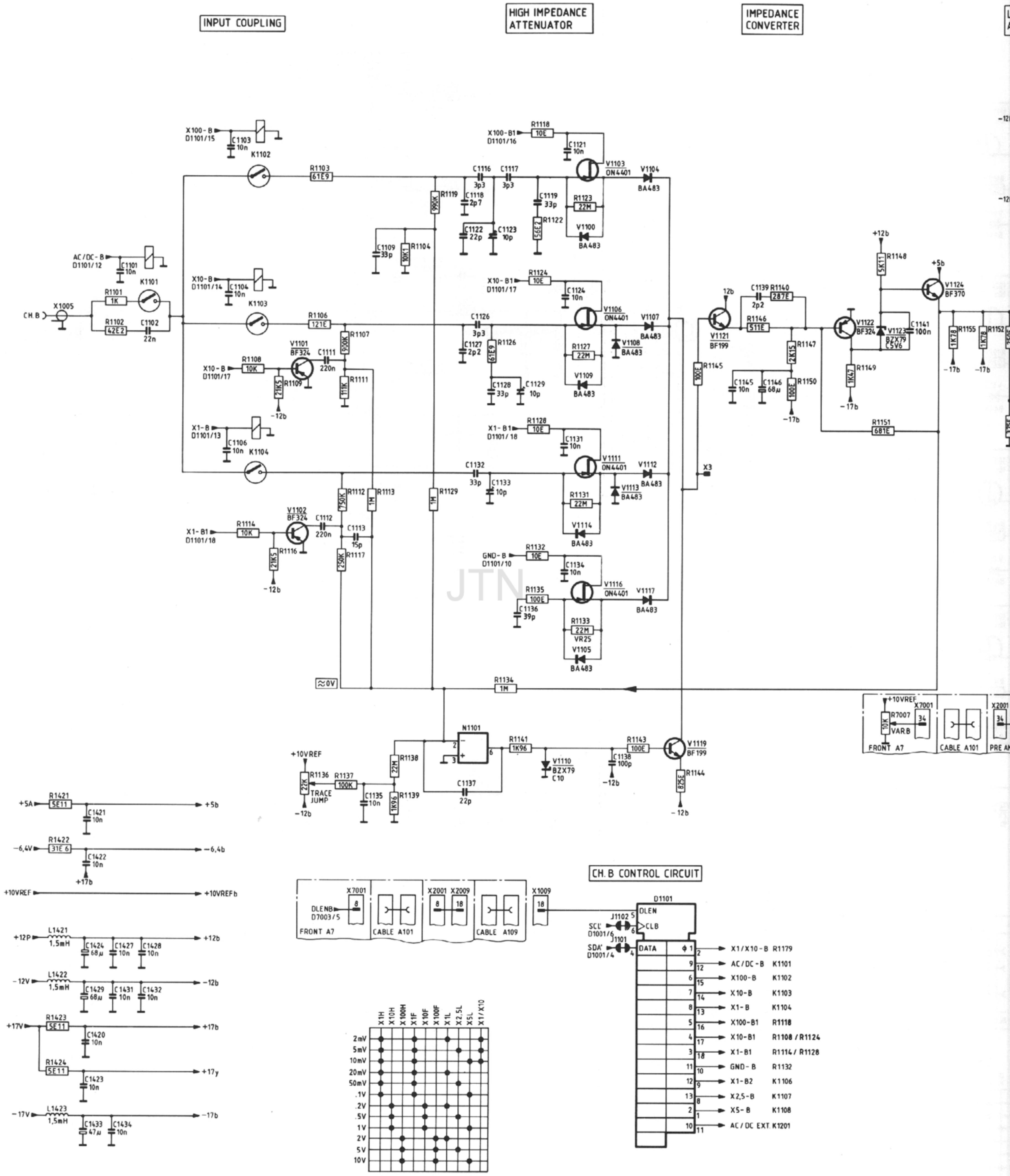
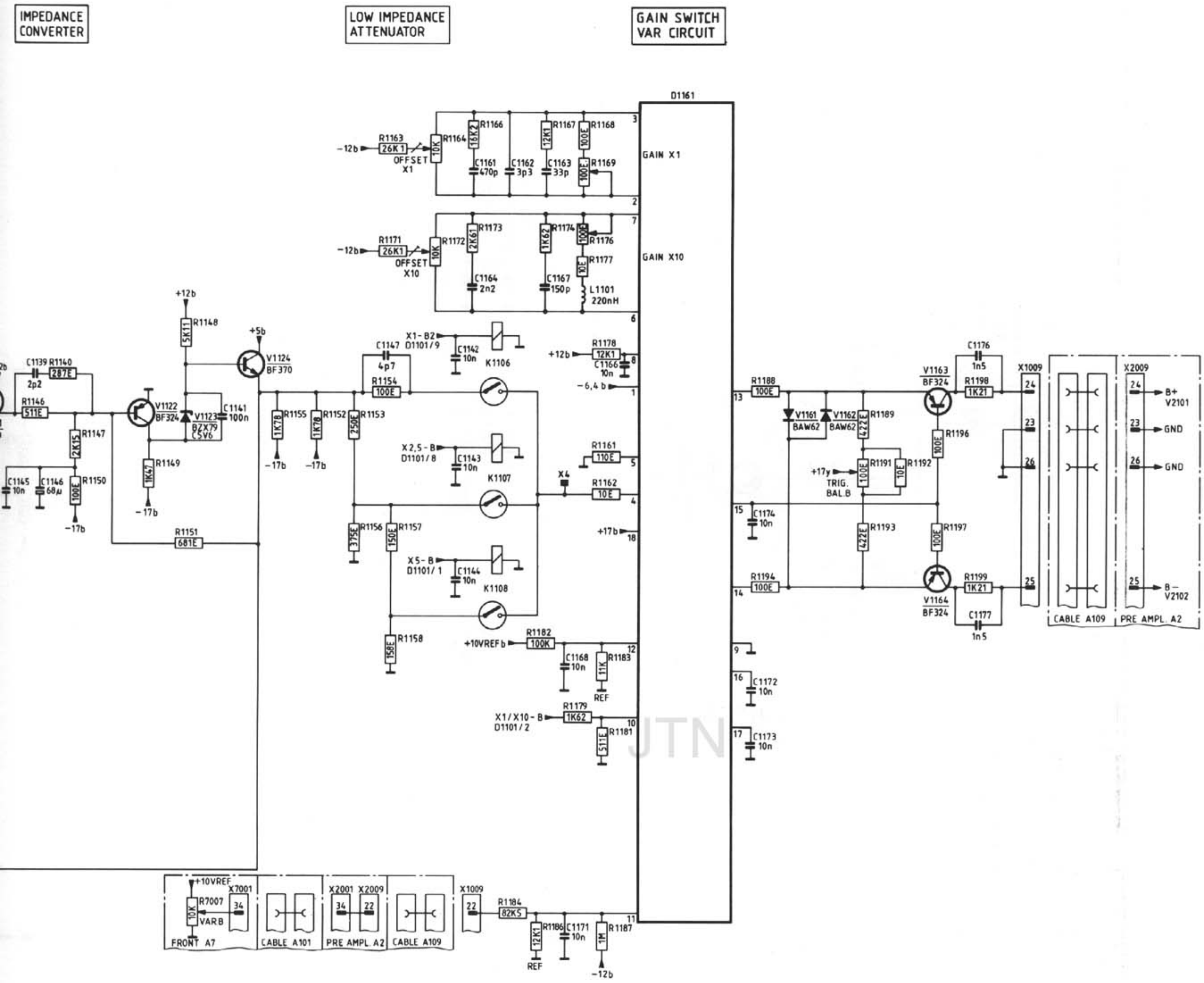
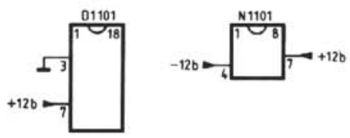


Figure 4.4 Circuit diagram of attenuator: ch. B



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

REF. NO.	TYPE
D1101	TEA1017
D1161	OQ0221
N1101	OP-77



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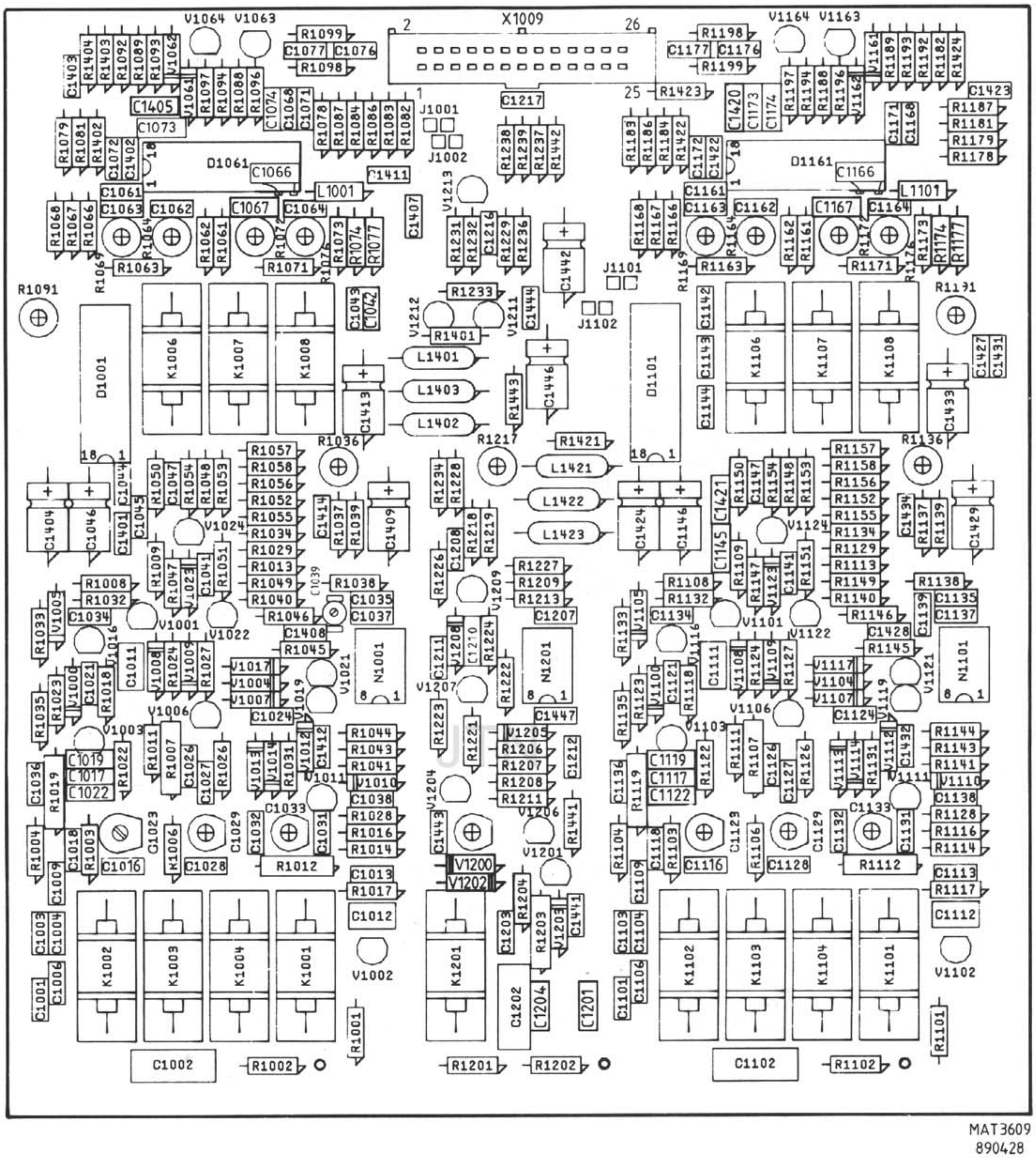
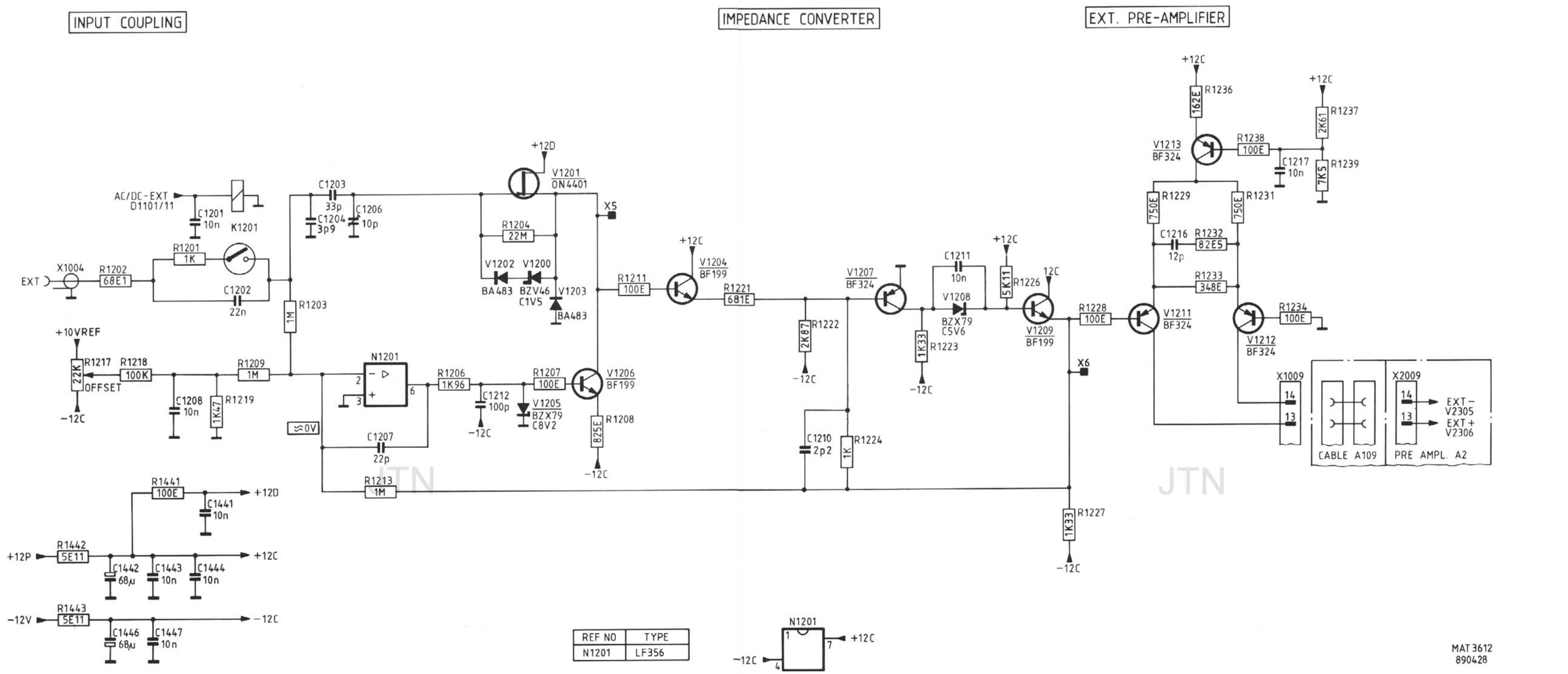
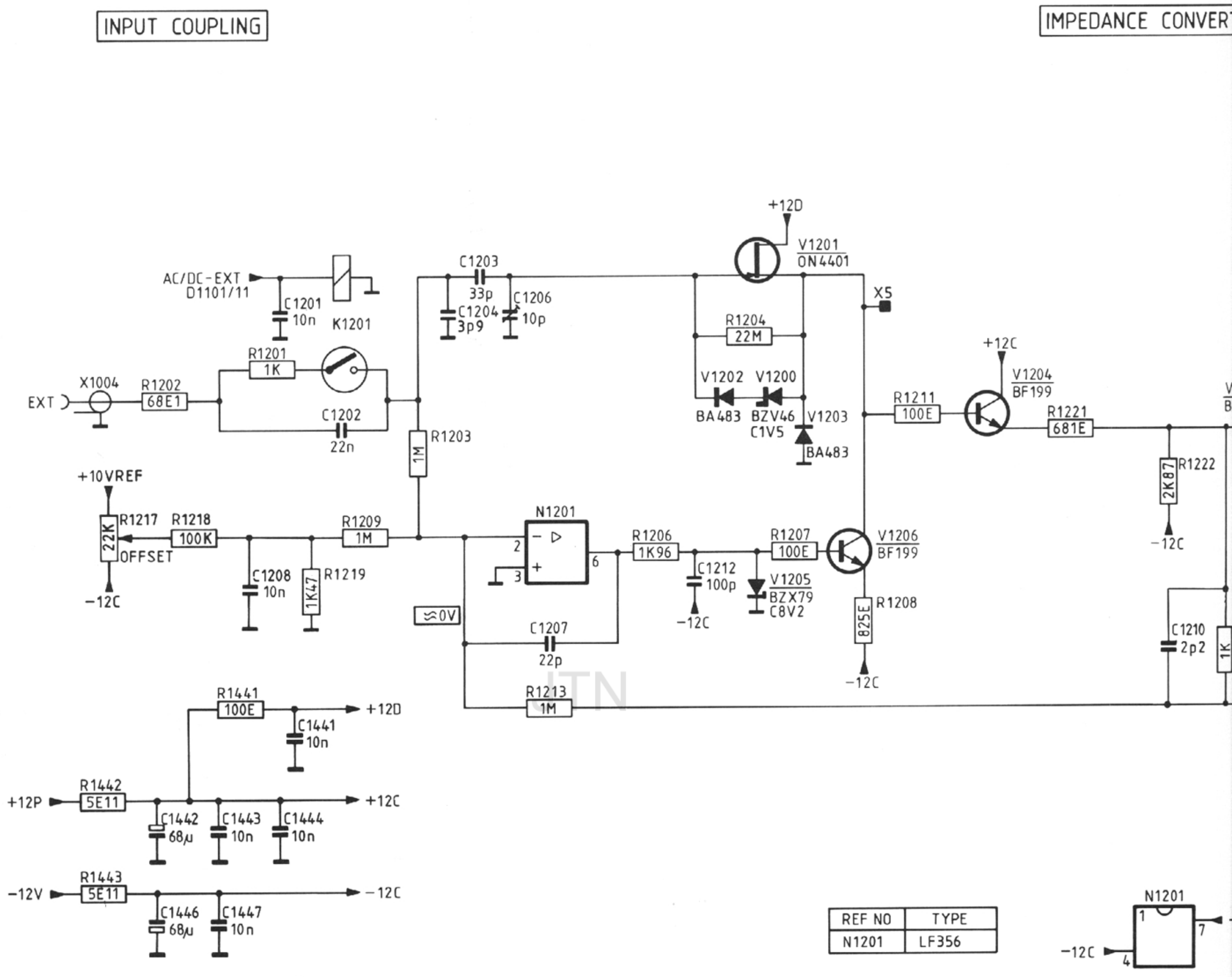


Figure 4.5 Attenuator unit pcb



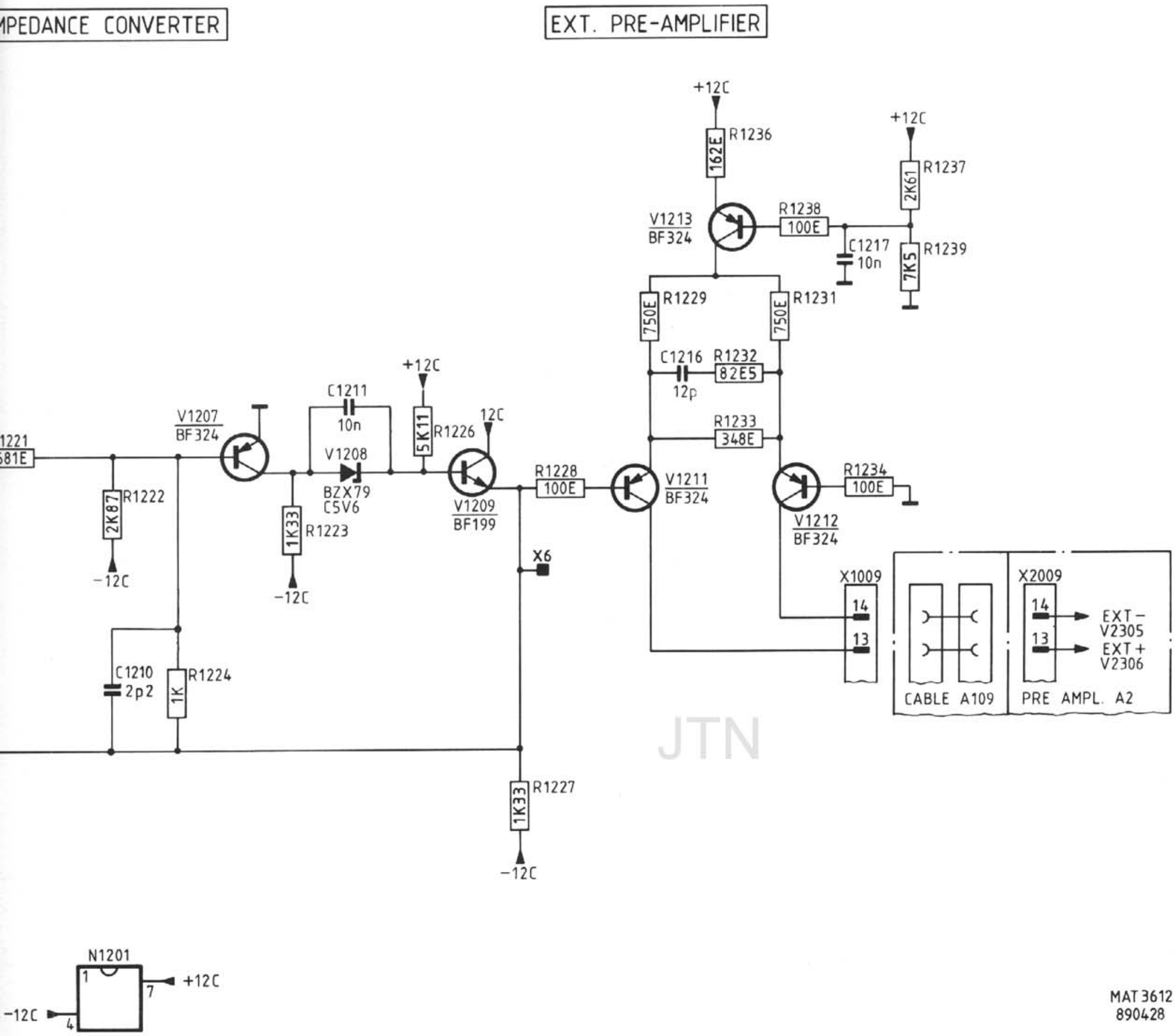
REF NO	TYPE
N1201	LF356

Figure 4.6 Circuit diagram of attenuator: EXT



REF NO	TYPE
N1201	LF356

Figure 4.6 Circuit diagram of attenuator: EXT


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

The pre-amplifier unit consists of:

- Vertical pre-amplifier
- Trigger pre-amplifier
- Pre-amplifier control, incl. CHOPPER oscillator

The adaptation unit A16 is also mounted on this board.
(This unit is described separately in chapter 17.)

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

5.1 VERTICAL PRE-AMPLIFIER

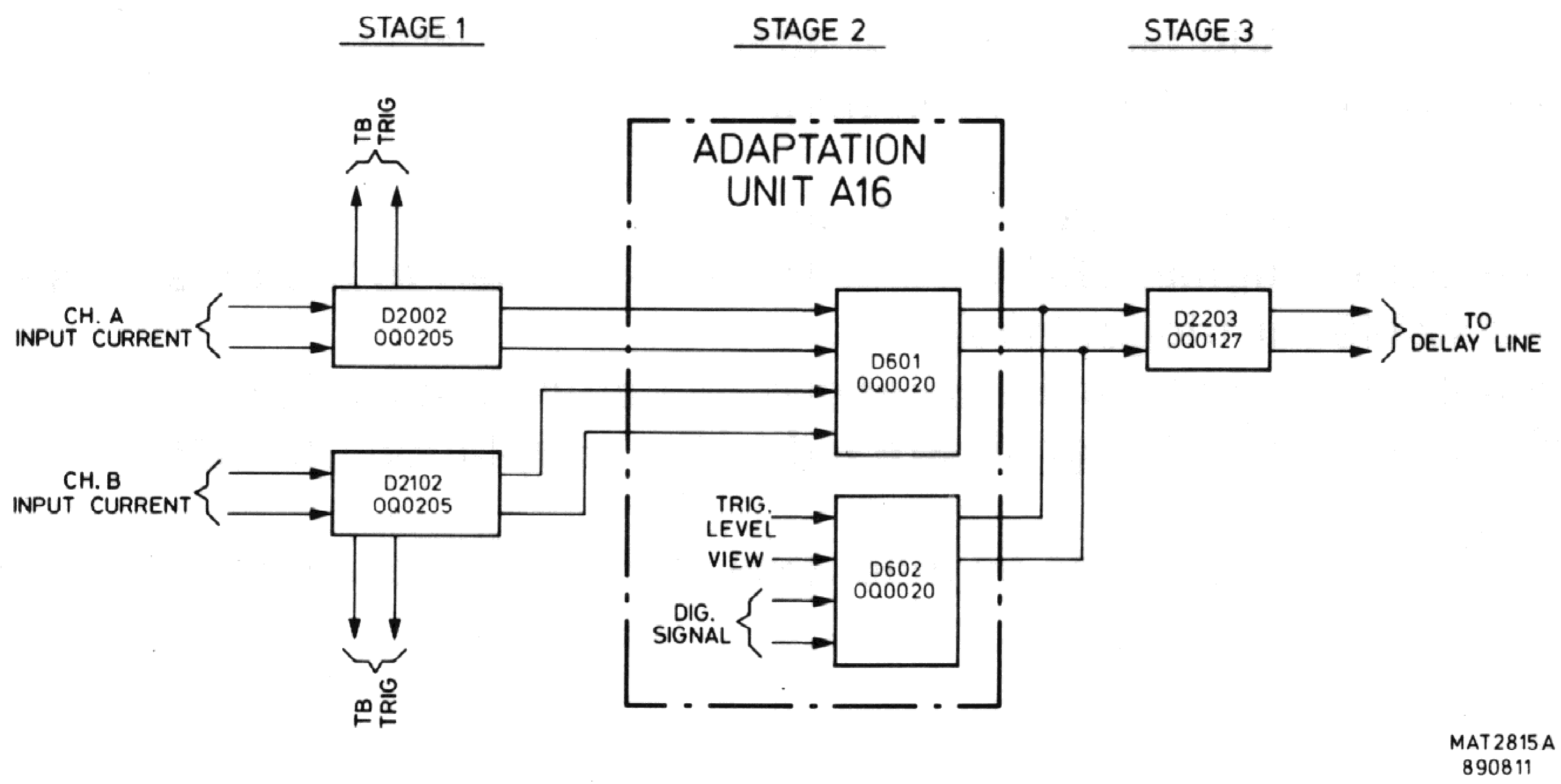

Figure 5.1 The three stages of the vertical pre-amplifier

The vertical pre-amplifier consists of three stages.

Stage 1: The signal splitter (OQ205) 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 channel (pin 7 and 10)
- TB triggering (pin 5 and 12), see section 5.2.

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

Stage 2 (unit A16): see the description of A16.

Stage 3 (D2203) serves as delay line driver where the output current of both OQ0020s is converted into voltage signals applied to the delay line. The current for this stage and for D2201 and D2202 is fed 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	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 signals are copied into identical differential output current signals for EXT TB signal (pin 6 and 11).

The symmetrical output currents from D2302 (13, 14) and D2303 (13, 14) are converted into a symmetrical voltage again in the common-base circuit V2316, V2319 followed by a shunt feedback circuit V2318 and V2321. Note that the sensitivity at the collectors of V2318 and V2321 is 110 mV/DIV.

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 the adaptation unit A16.

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

a. **Peak-peak**

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 TRIG LEVEL control R7012, connected to D2304(1).

b. **Triggering**

In this case the level range is 16 div. The trigger 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 TRIG 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 outputlevel 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 1/2\C bus (SDA andSCL), 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.

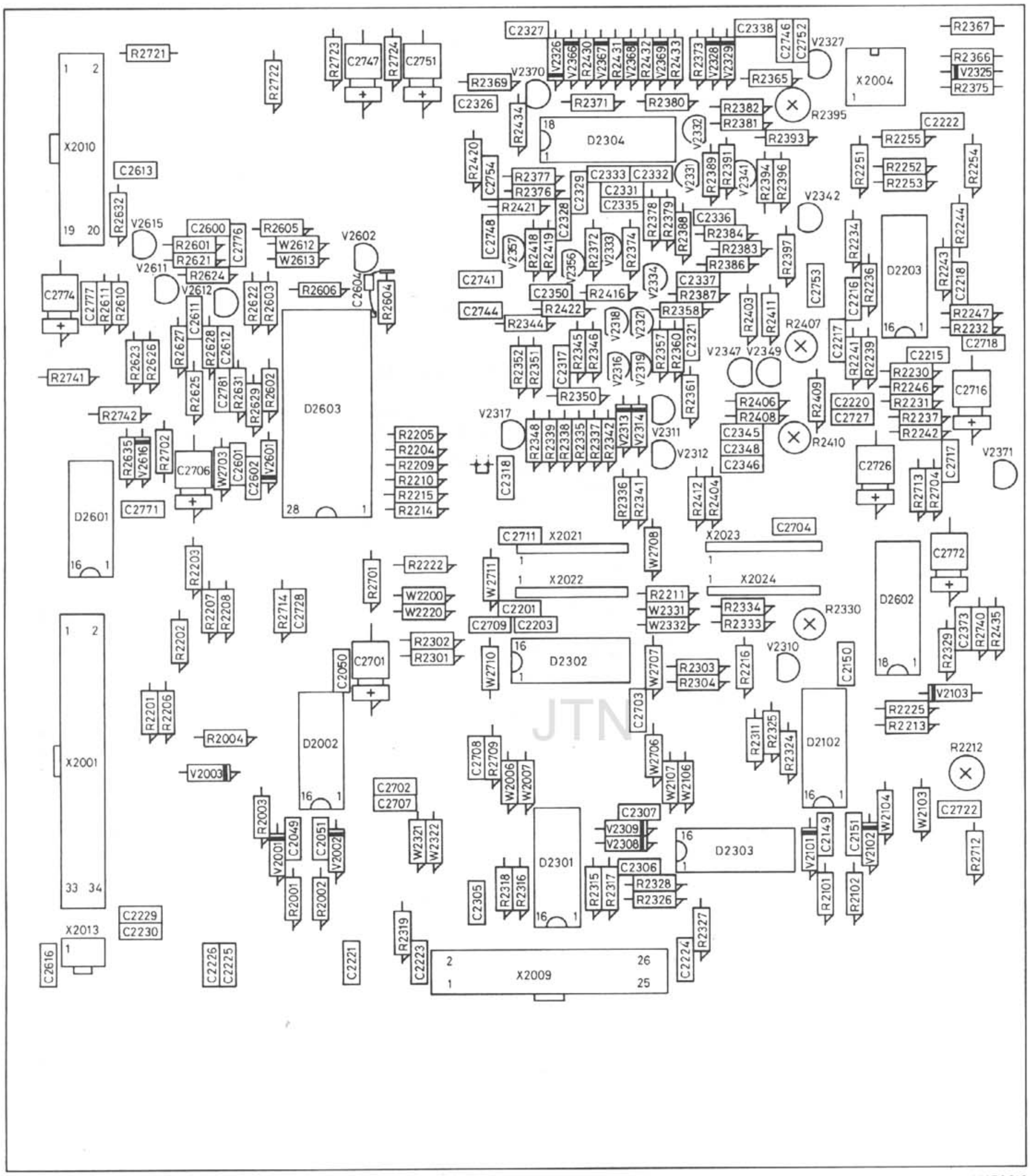

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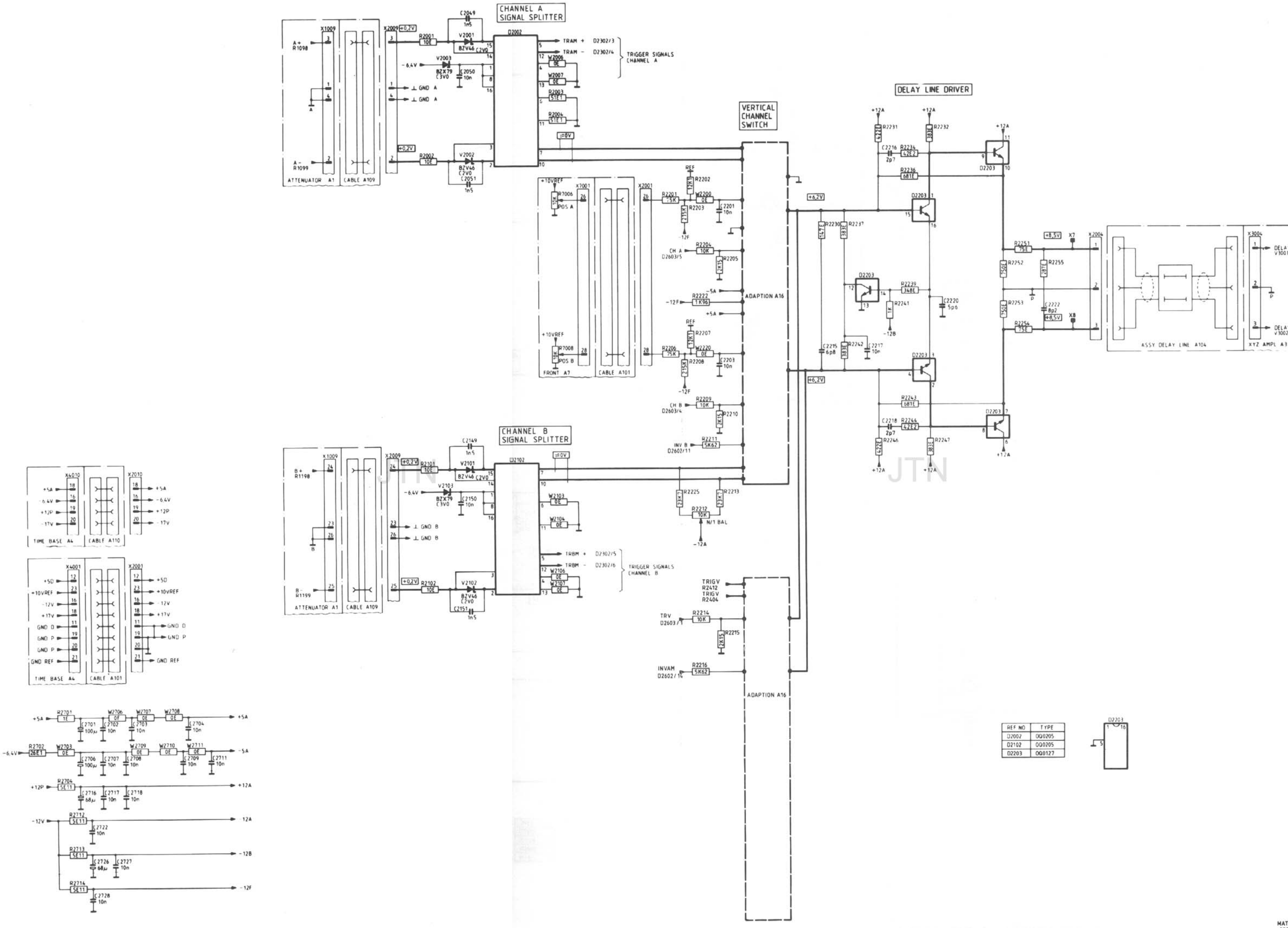
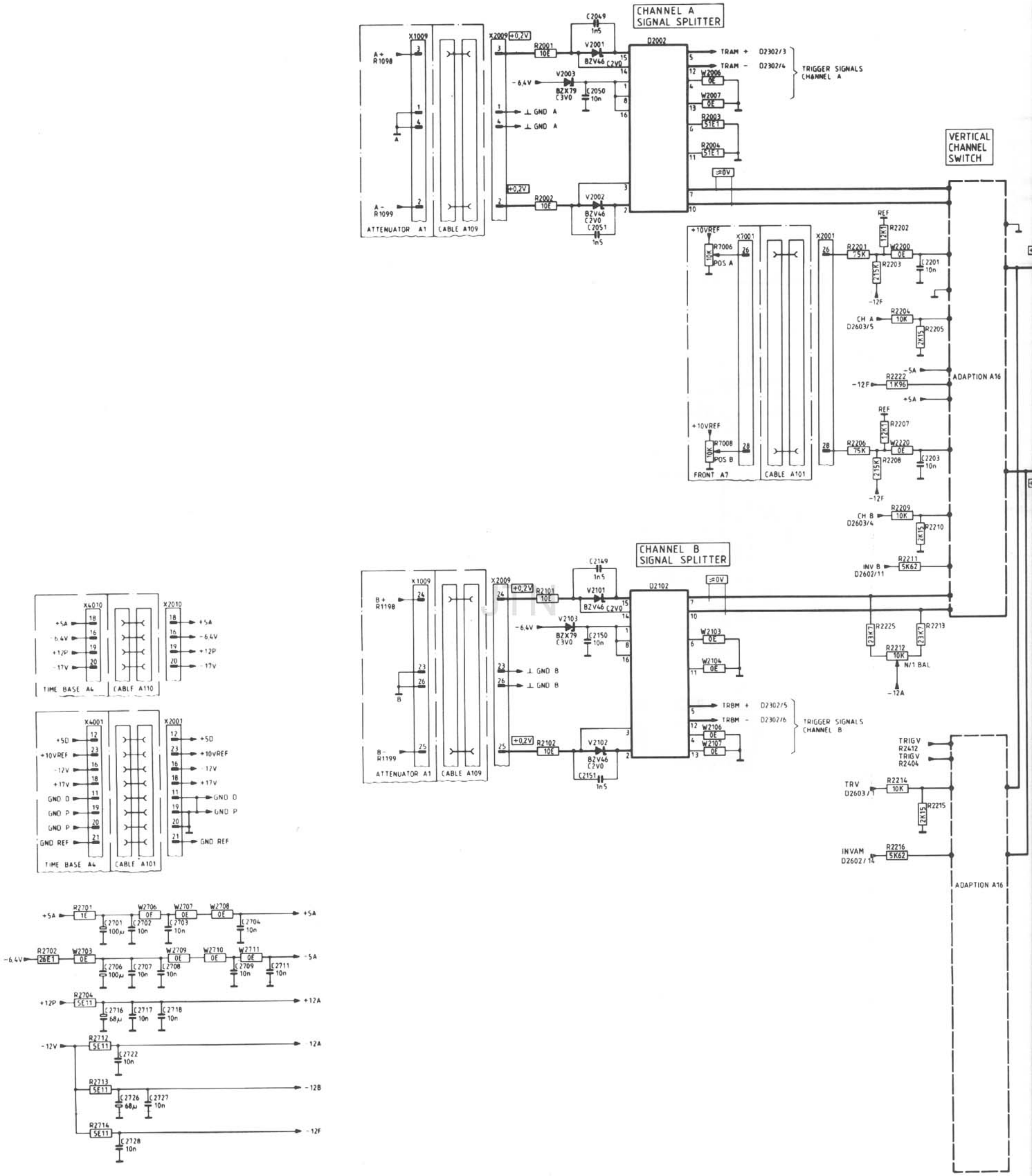
Figure 5.2 Pre-amplifier unit p.c.b.

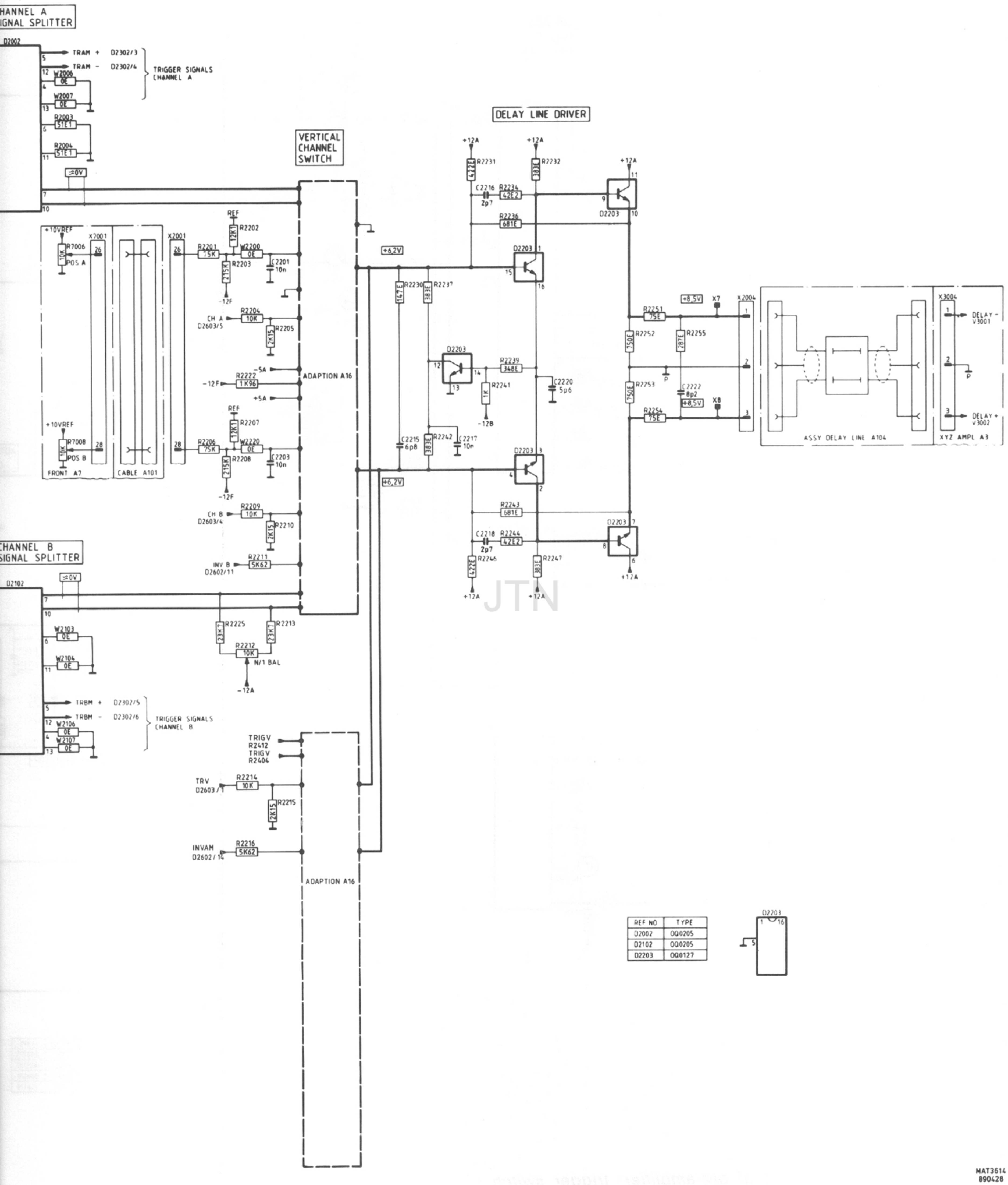


REF NO	TYPE
D2002	OQ0205
D2102	OQ0205
D2203	OQ0127

Figure 5.3 Circuit diagram of pre-amplifier: chan. switch and delay line driver

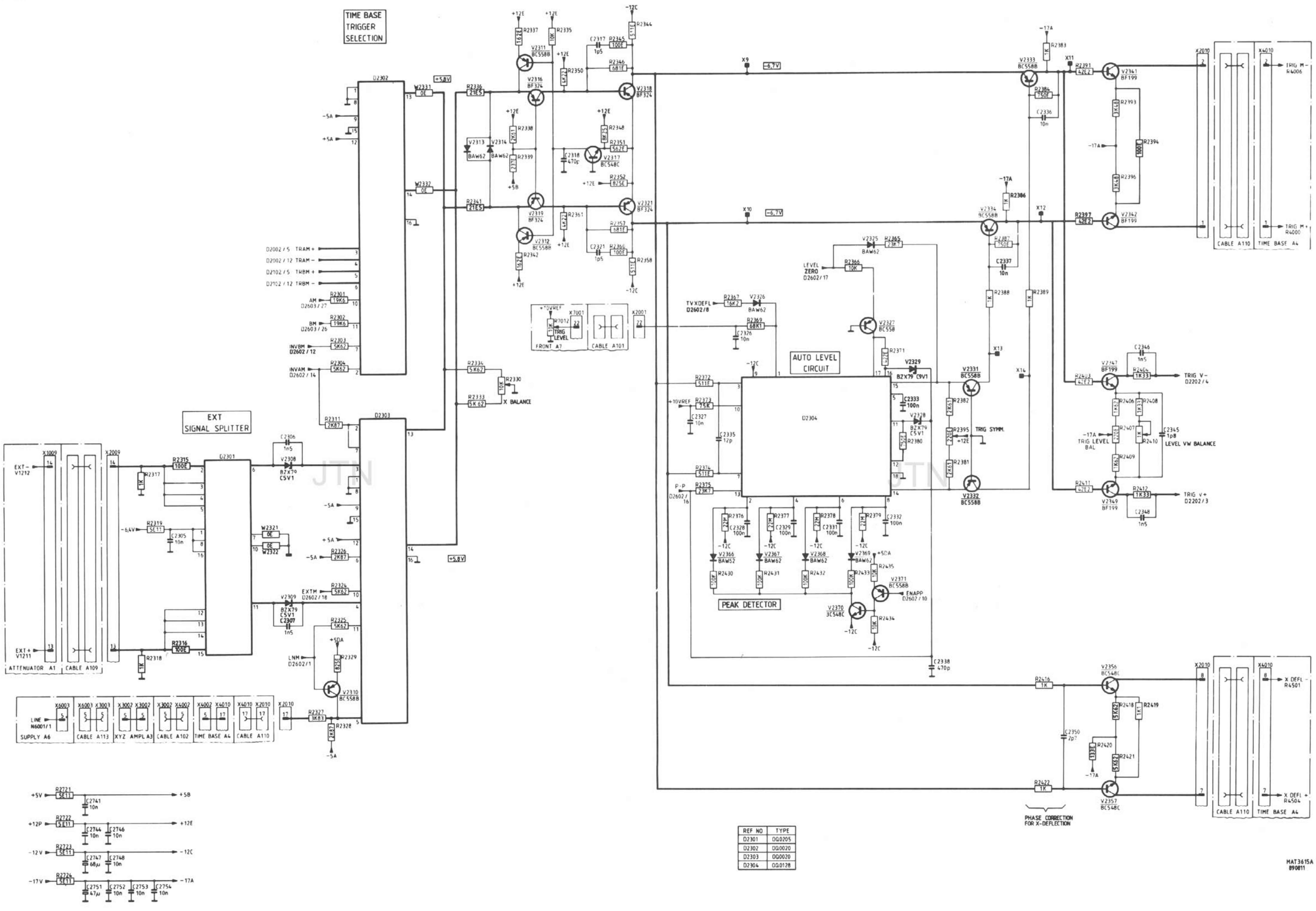

CHANNEL A SIGNAL SPLITTER
CHANNEL B SIGNAL SPLITTER
VERTICAL CHANNEL SWITCH
TRIGGER SIGNALS CHANNEL A
TRIGGER SIGNALS CHANNEL B
ATTENUATOR A1
CABLE A109
FRONT A7
CABLE A101
TIME BASE A4
CABLE A110
ADAPTION A16
D2002
D2102
TRAM +
TRAM -
TRBM +
TRBM -
GND A
GND B
POS A
POS B
CH A
CH B
INV B
N/1 BAL
TRIGV
TRV
INVAM
GND D
GND P
GND REF

Figure



REF NO	TYPE
D2002	OQ0205
D2102	OQ0205
D2203	OQ0127

Figure 5.3 Circuit diagram of pre-amplifier: chan. switch and delay line driver



REF NO	TYPE
D2301	OQ0205
D2302	OQ0020
D2303	OQ0020
D2304	OQ0128

Figure 5.4 Circuit diagram of pre-amplifier: trigger switch

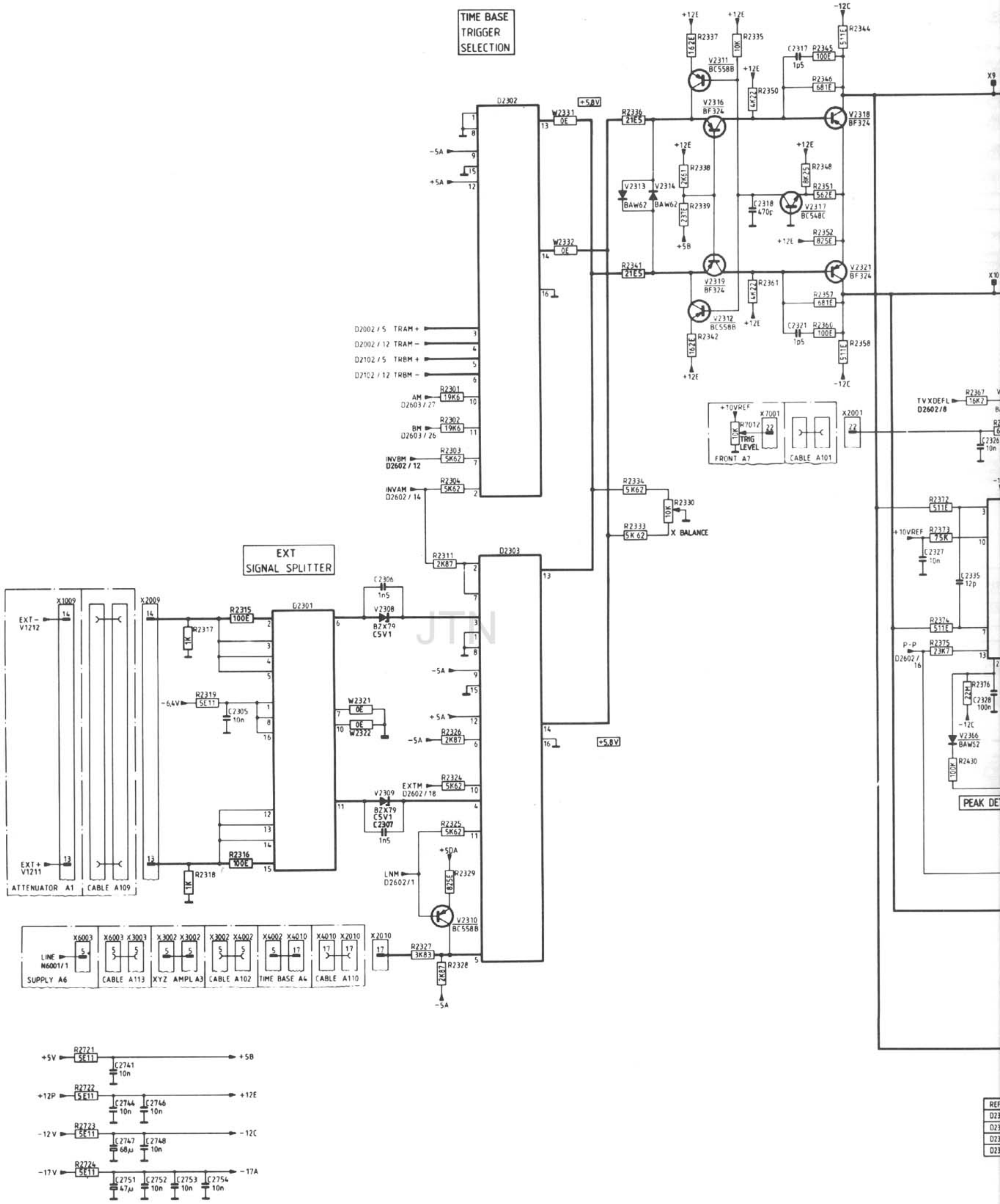
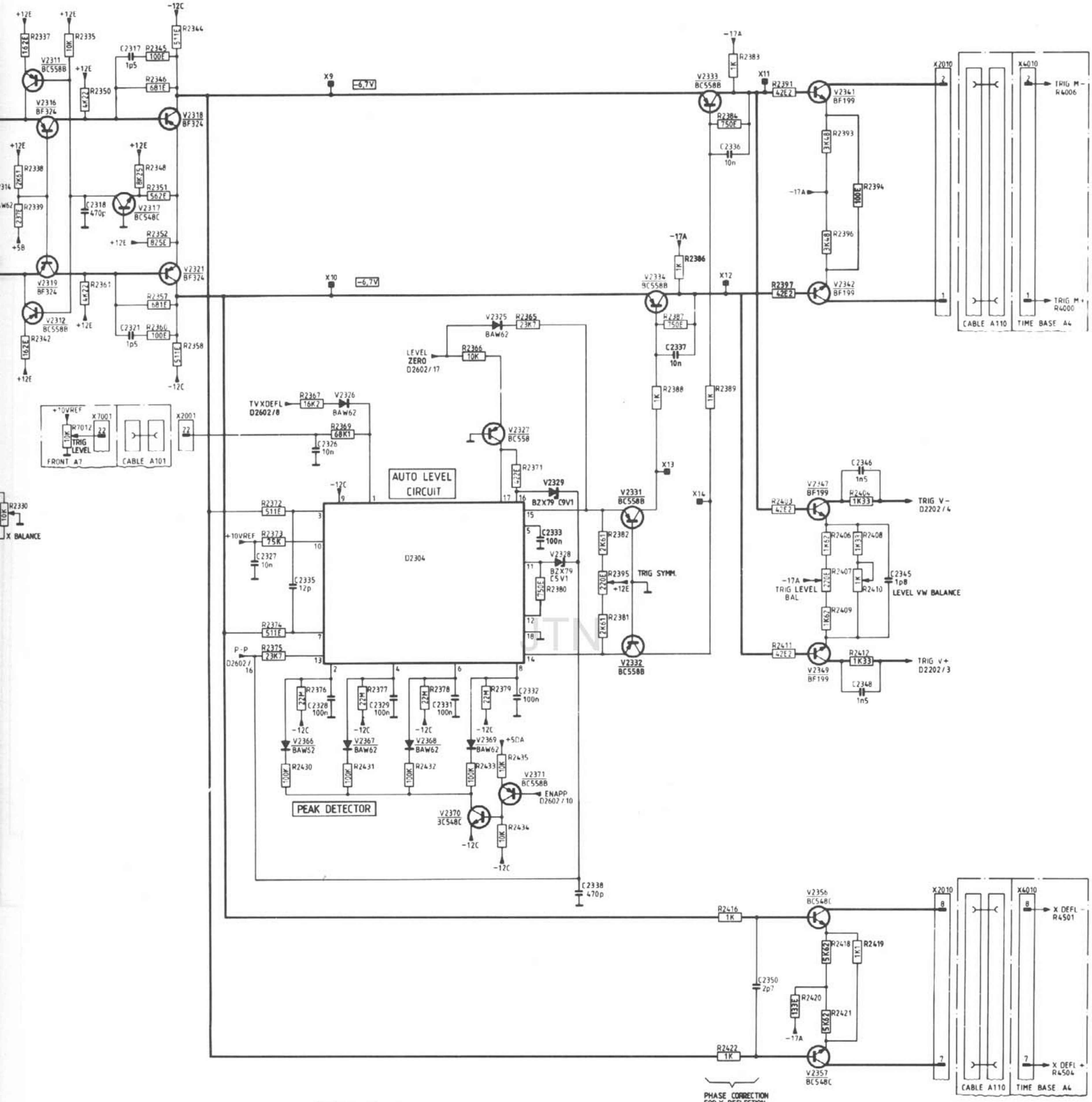


Figure 5.4 Circuit diagram of pre-amplifier: trigger switch



REF NO	TYPE
D2301	0Q0205
D2302	0Q0020
D2303	0Q0020
D2304	0Q0128

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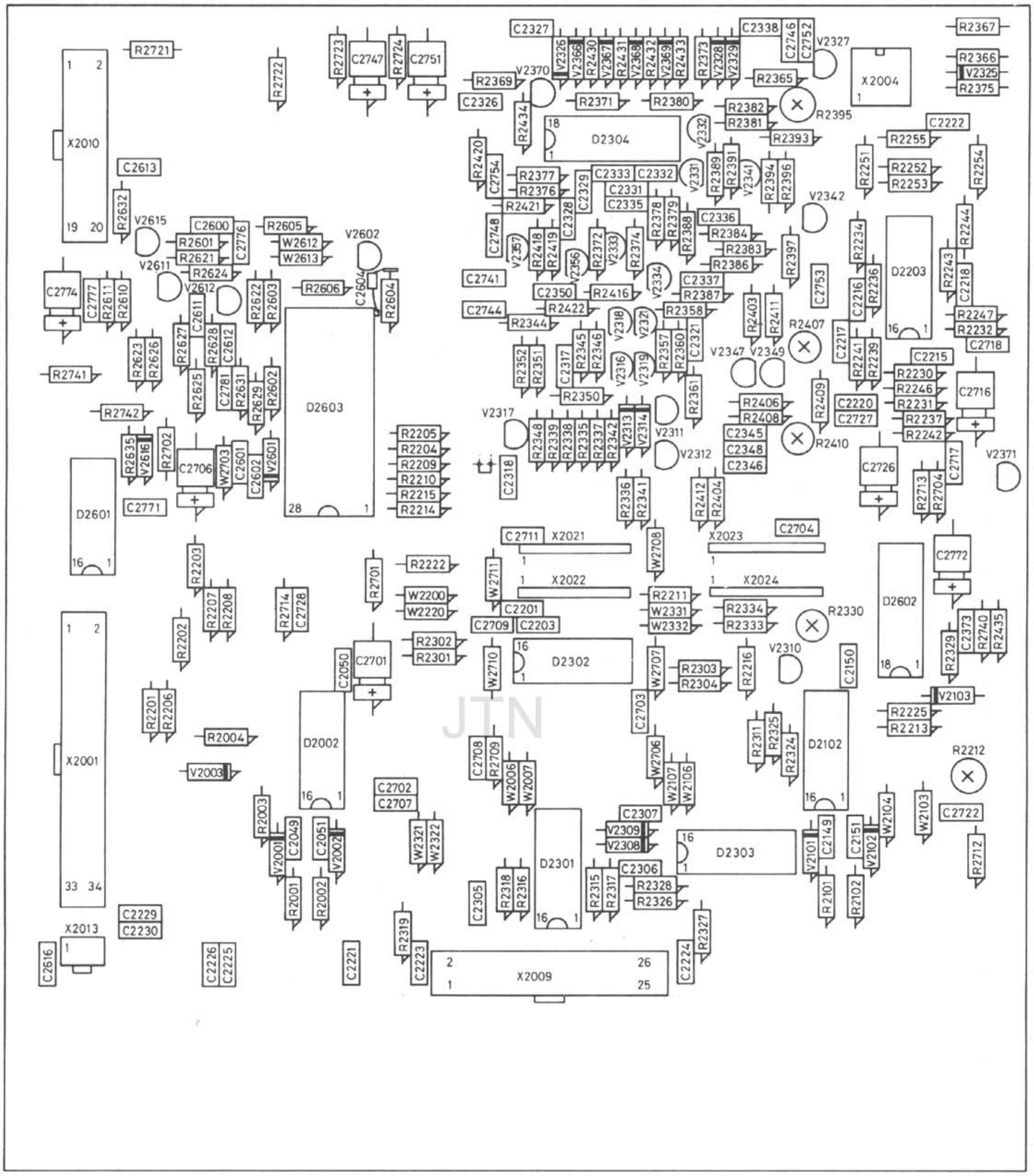

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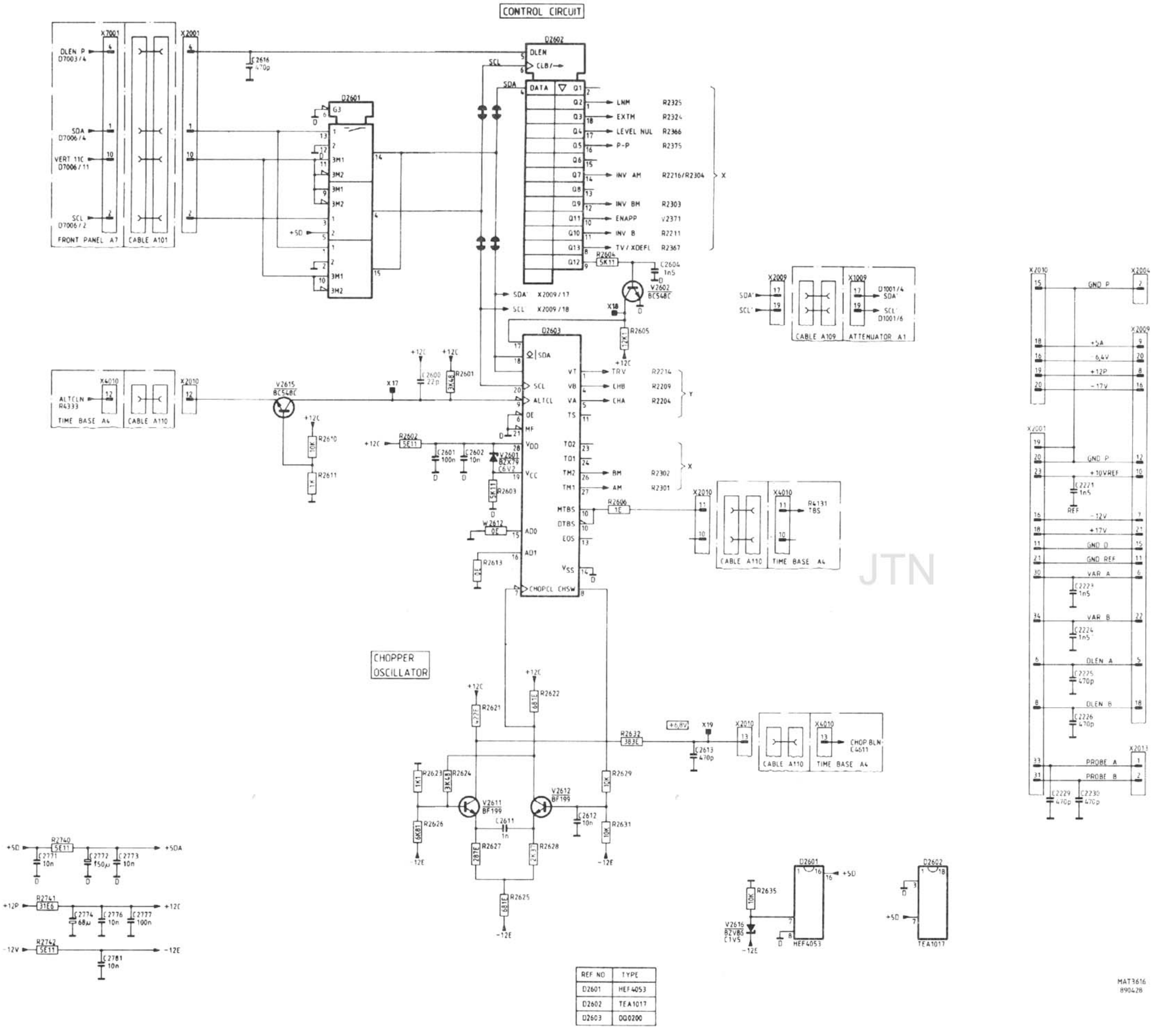
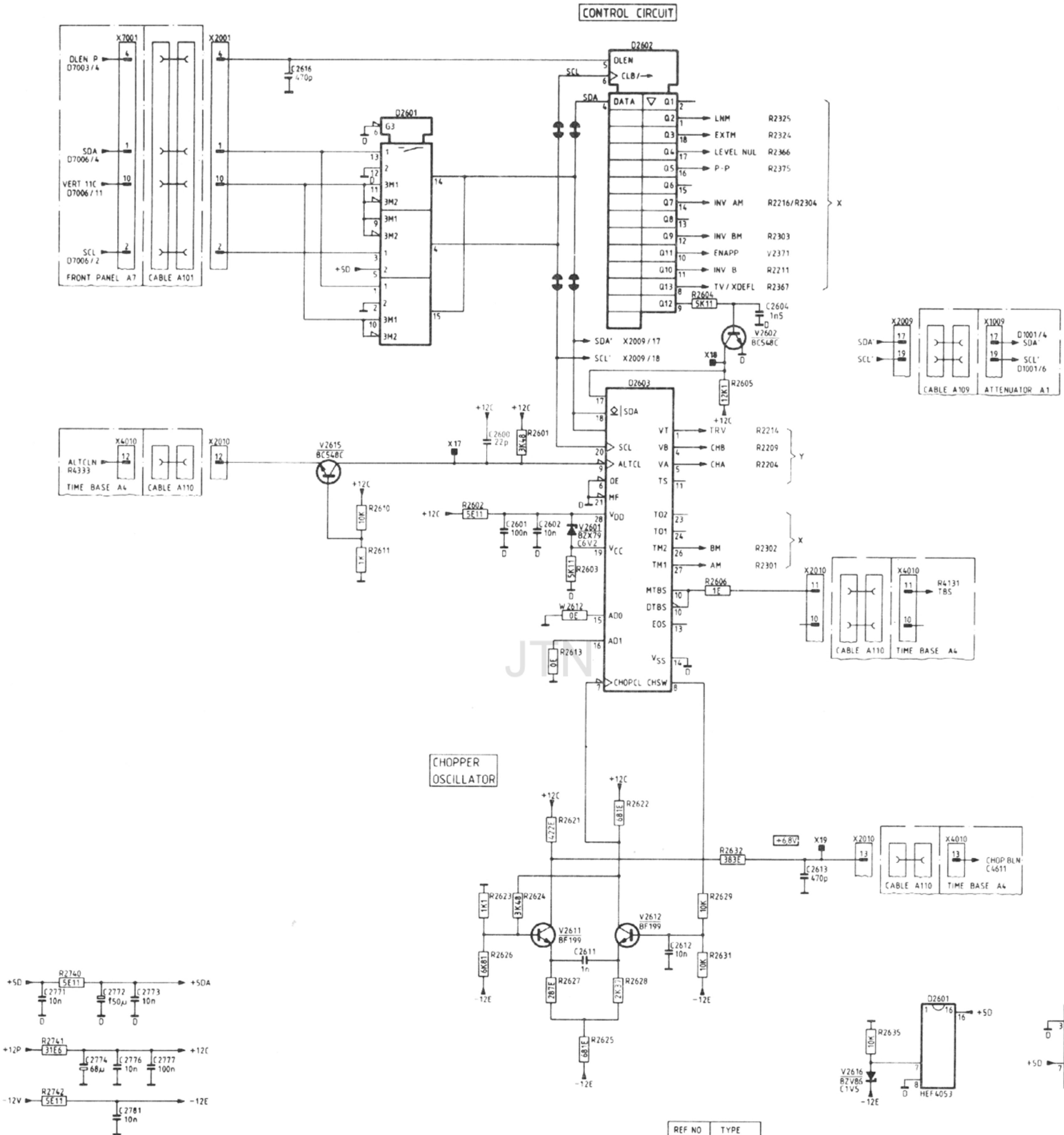
Figure 5.5 Pre-amplifier unit p.c.b.



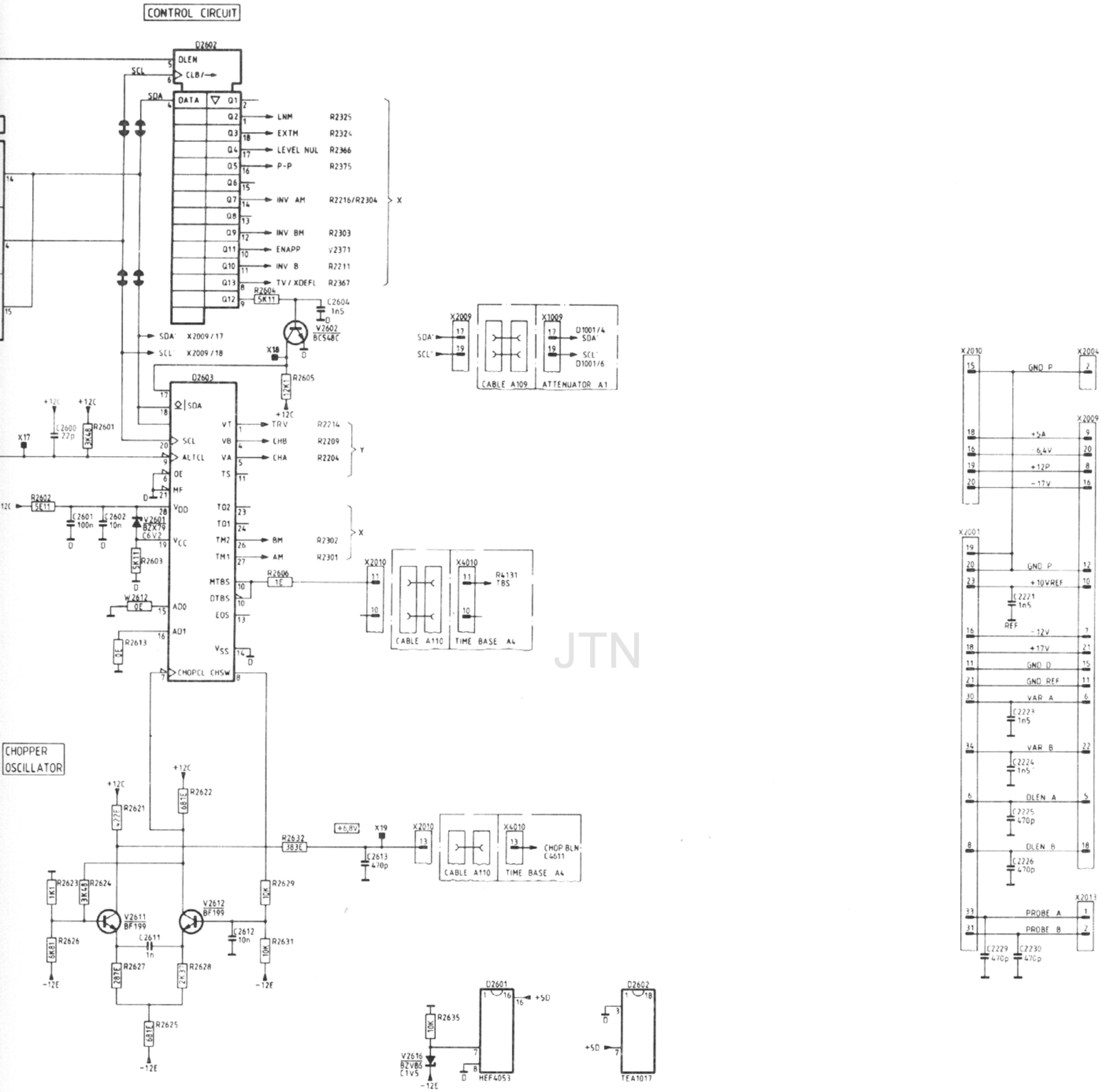
REF NO	TYPE
D2601	HEF4053
D2602	TEA1017
D2603	OQ0200

Figure 5.6 Circuit diagram of pre-amplifier: logic control



REF NO	TYPE
D2601	HEF4053
D2602	TEA1017
D2603	OQ0200

Figure 5.6 Circuit diagram of pre-amplifier: logic control



REF NO	TYPE
D2601	HEF4053
D2602	TEA1017
D2603	OQ0200

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: logic control

6 XYZ-AMPLIFIER UNIT (A3)

6.1 INTRODUCTION

Unit A3 incorporates two separate pcb's which are connected via X3001. One pcb includes among other things the CRT socket and is connected at the rear of the CRT. The other pcb, comprising the proper final X, Y and Z amplifiers, is situated at the upper side of the 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 correct vertical signal to the Y-deflection plates of the CRT. For this, the signal is processed in four stages:

- V3001, V3002 as a series feedback amplifier, including a delay line compensation network and potentiometer R3007 controlling 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.
  In this stage the input voltage is converted into a current signal.

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

- V3008, V3009 as 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 side. Note that the output again supplies a current signal.

- V3011, V3012 as 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 665 E = 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 as 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 as a series feedback amplifier, including a 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 theactual final amplifier, which converts the deflection current into the proper deflection voltage for the X-deflection plates of the CRT. Transistors V3108 and 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 maintains the 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.

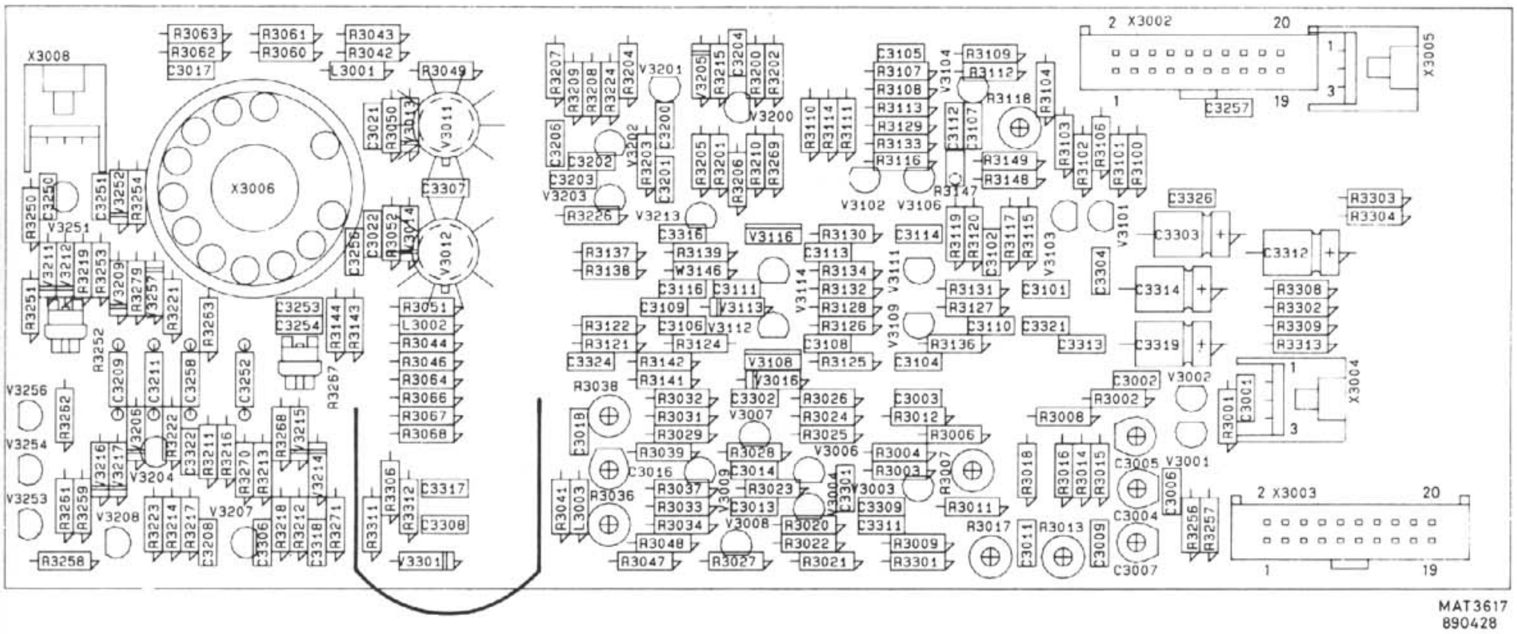
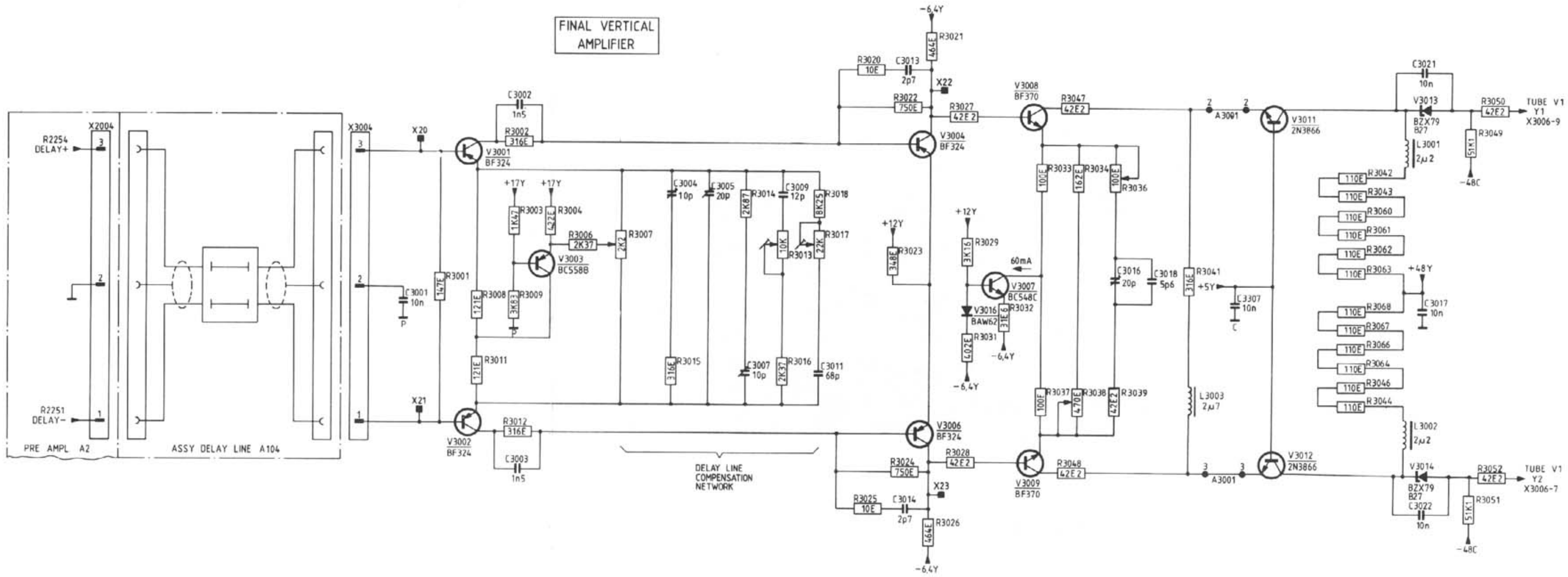
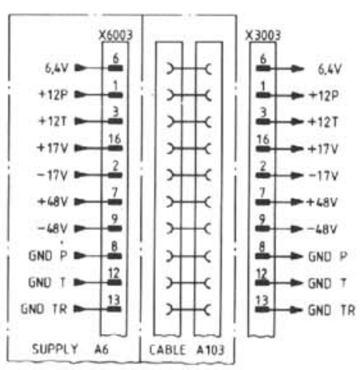
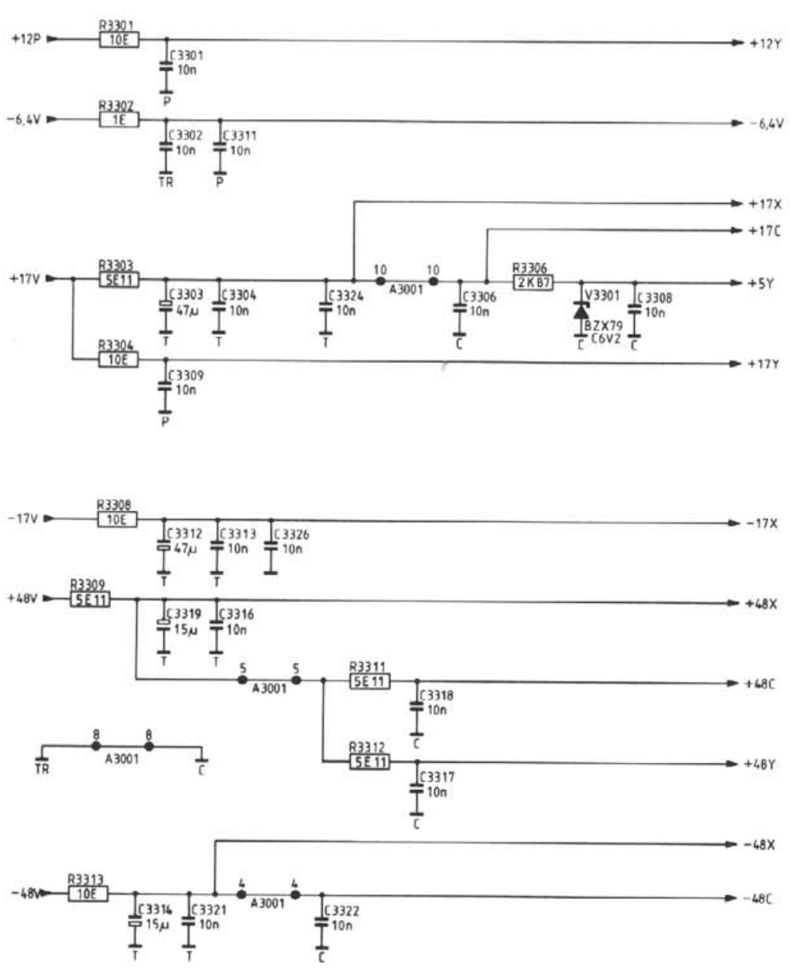


Figure 6.1 XYZ amplifier p.c.b.







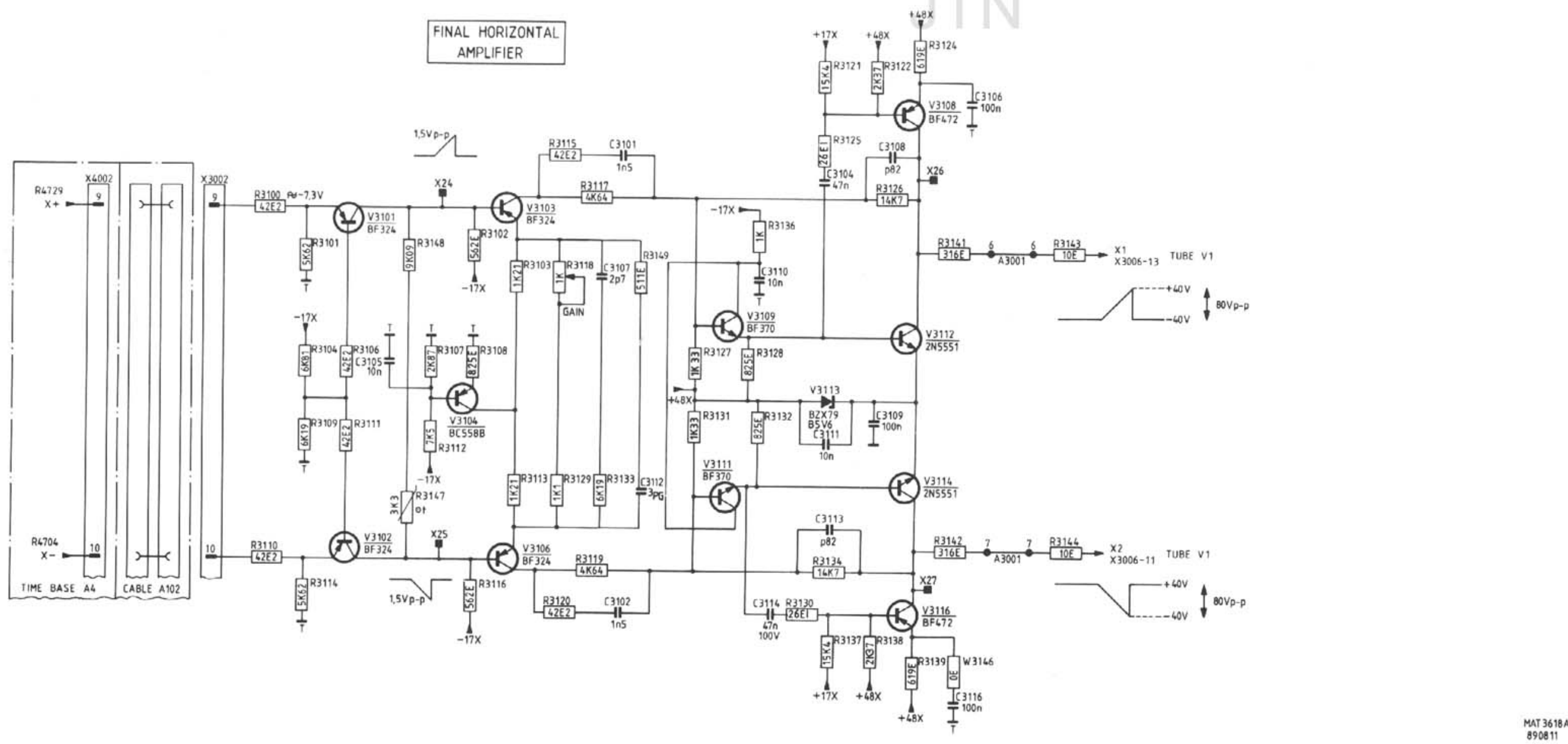
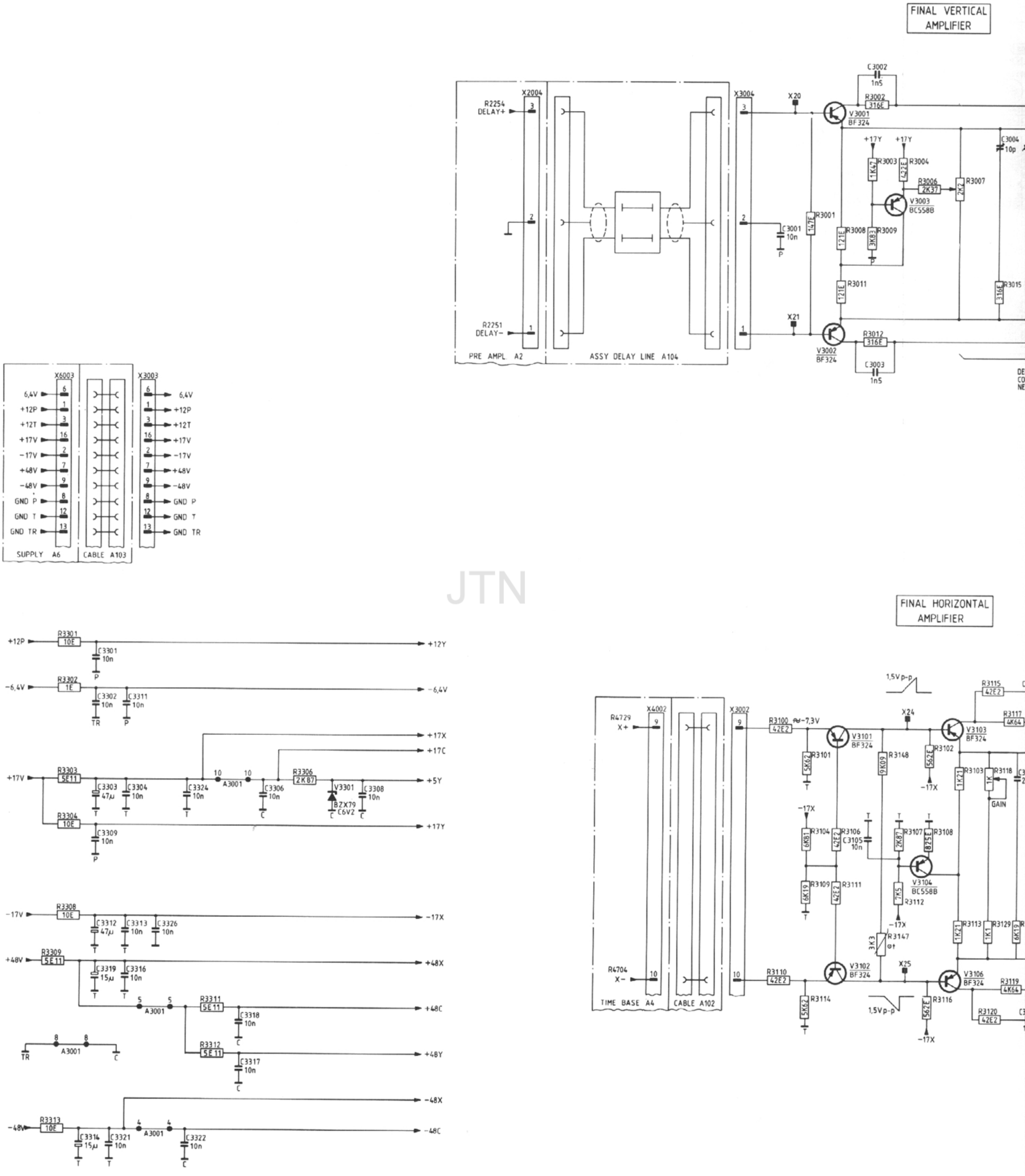


Figure 6.2 Circuit diagram of XYZ amplifiers: final X and Y amplifiers


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

Figu

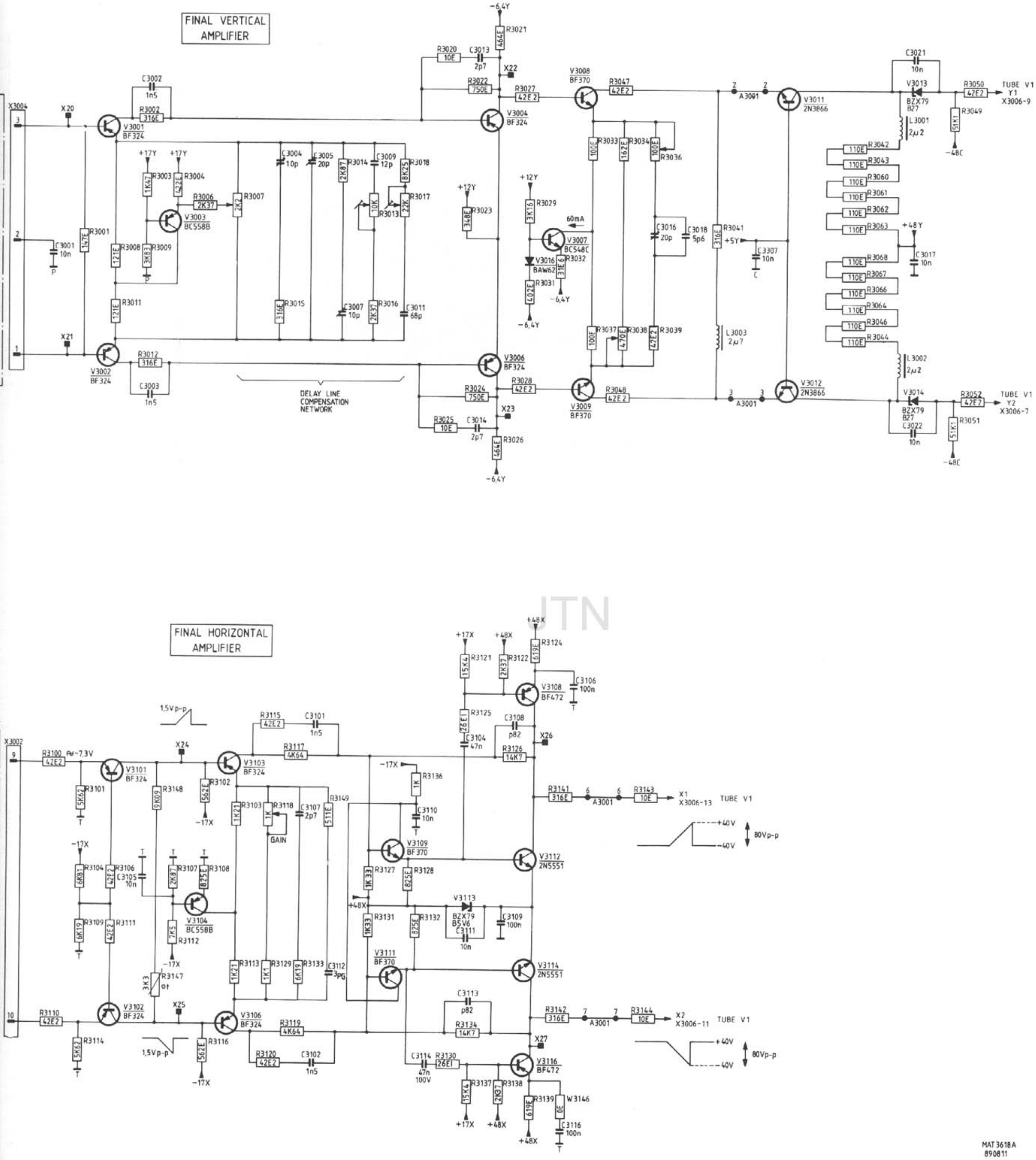


Figure 6.2 Circuit diagram of XYZ amplifiers: final X and Y amplifiers

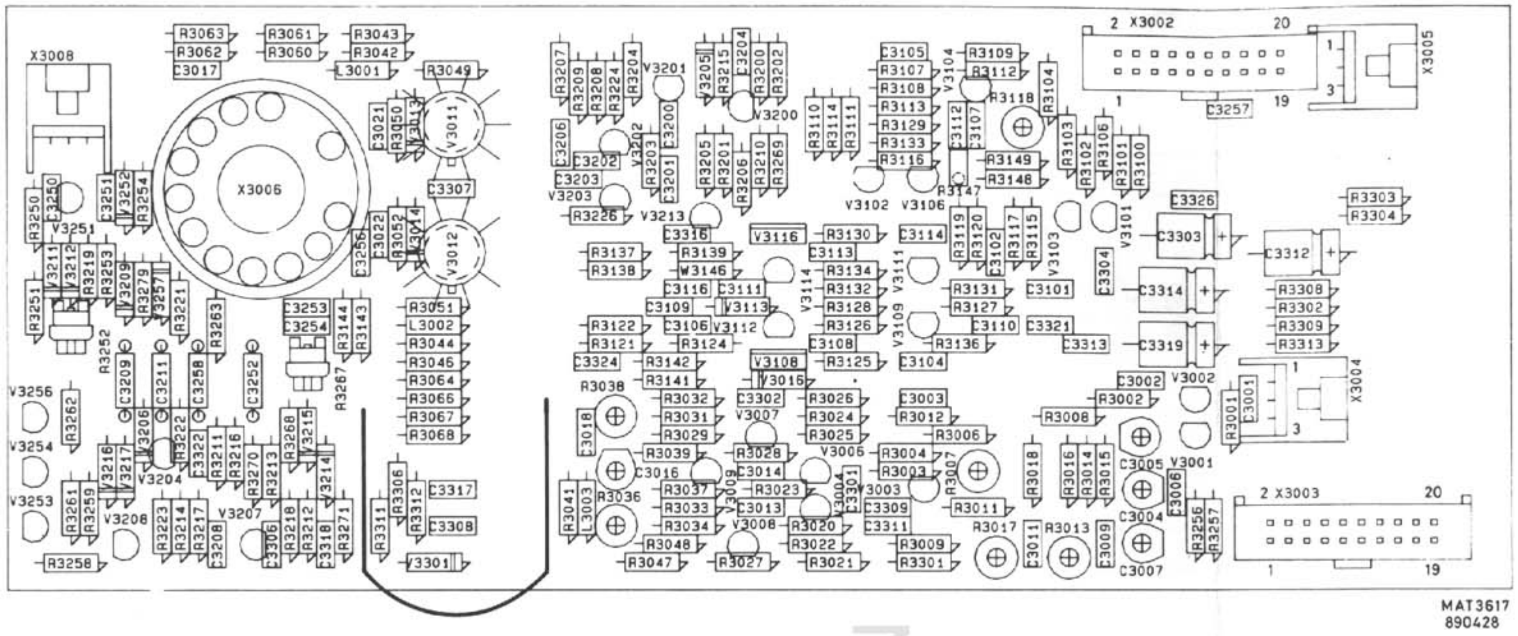


Figure 6.3 XYZ amplifier unit p.c.b.

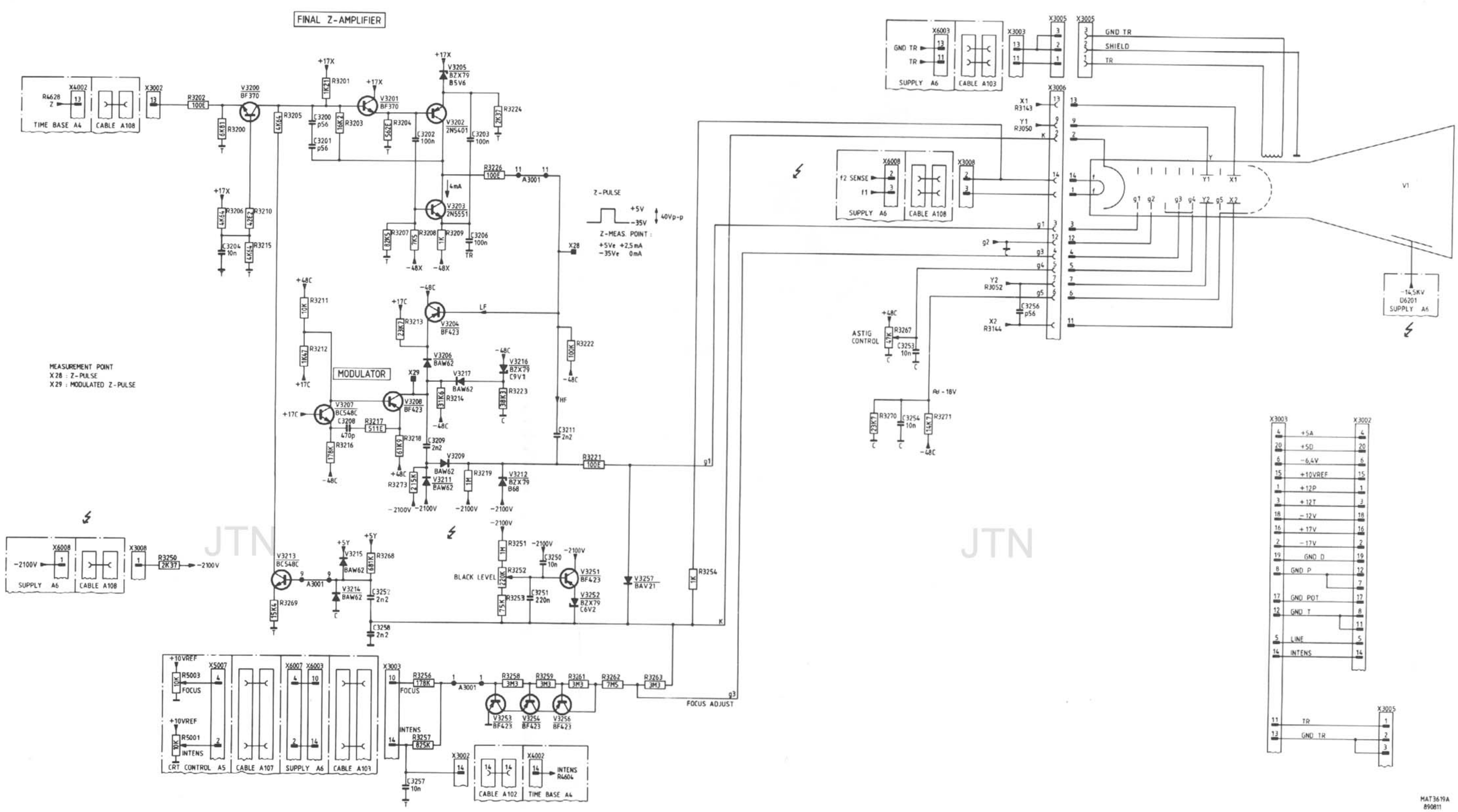
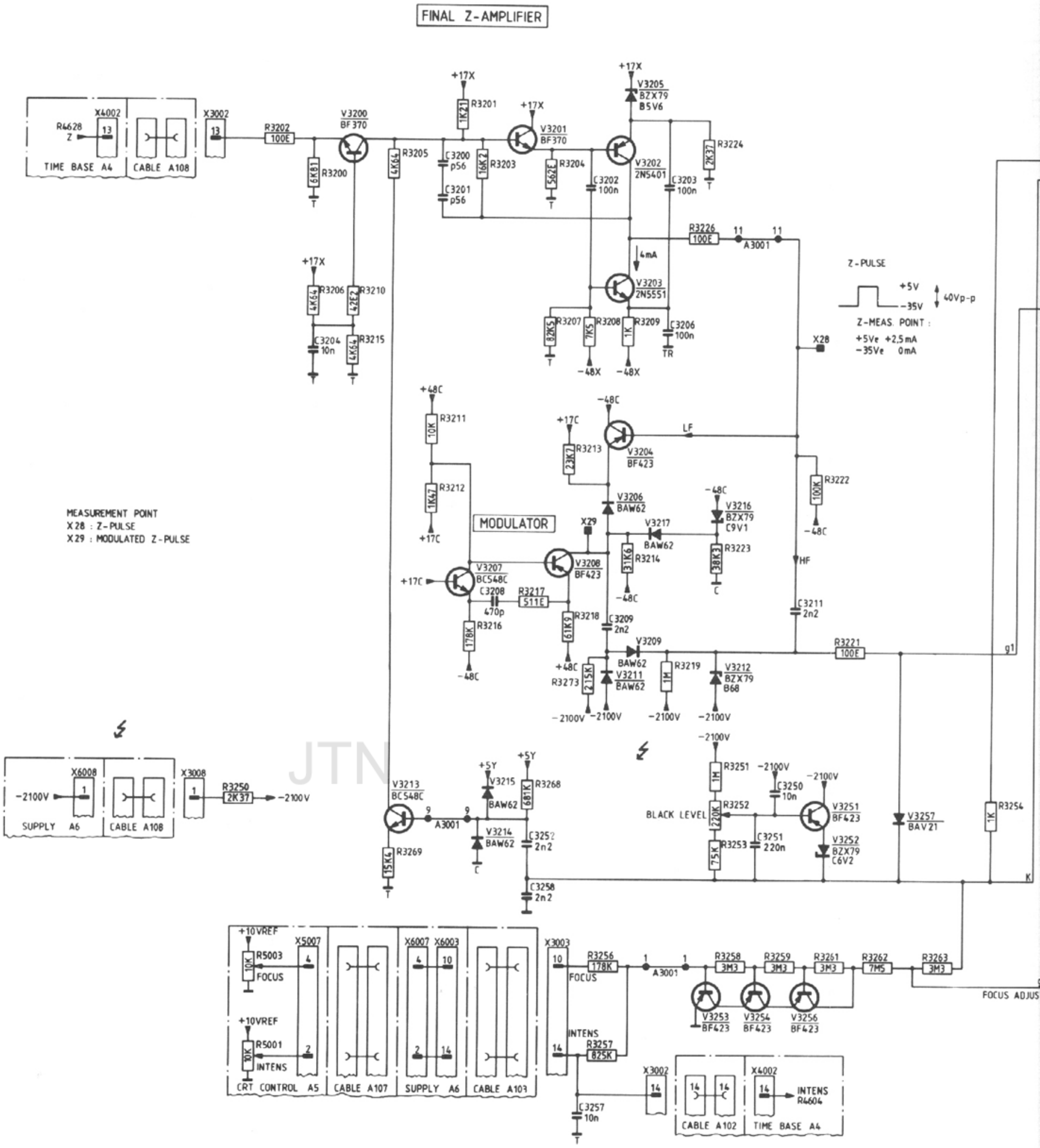


Figure 6.4 Circuit diagram of XYZ amplifiers: Z amplifier and CRT circuit


FINAL Z-AMPLIFIER
MODULATOR
MEASUREMENT POINT
X 28 : Z-PULSE
X 29 : MODULATED Z-PULSE
Z-PULSE
+5V
-35V
40Vp-p
Z-MEAS. POINT :
+5Ve +2,5 mA
-35Ve 0mA
BLACK LEVEL
TIME BASE A4
CABLE A108
SUPPLY A6
CRT CONTROL A5
CABLE A107
CABLE A103
CABLE A102
FOCUS
INTENS
FOCUS ADJUS
LF
HF
g1
K

Figu

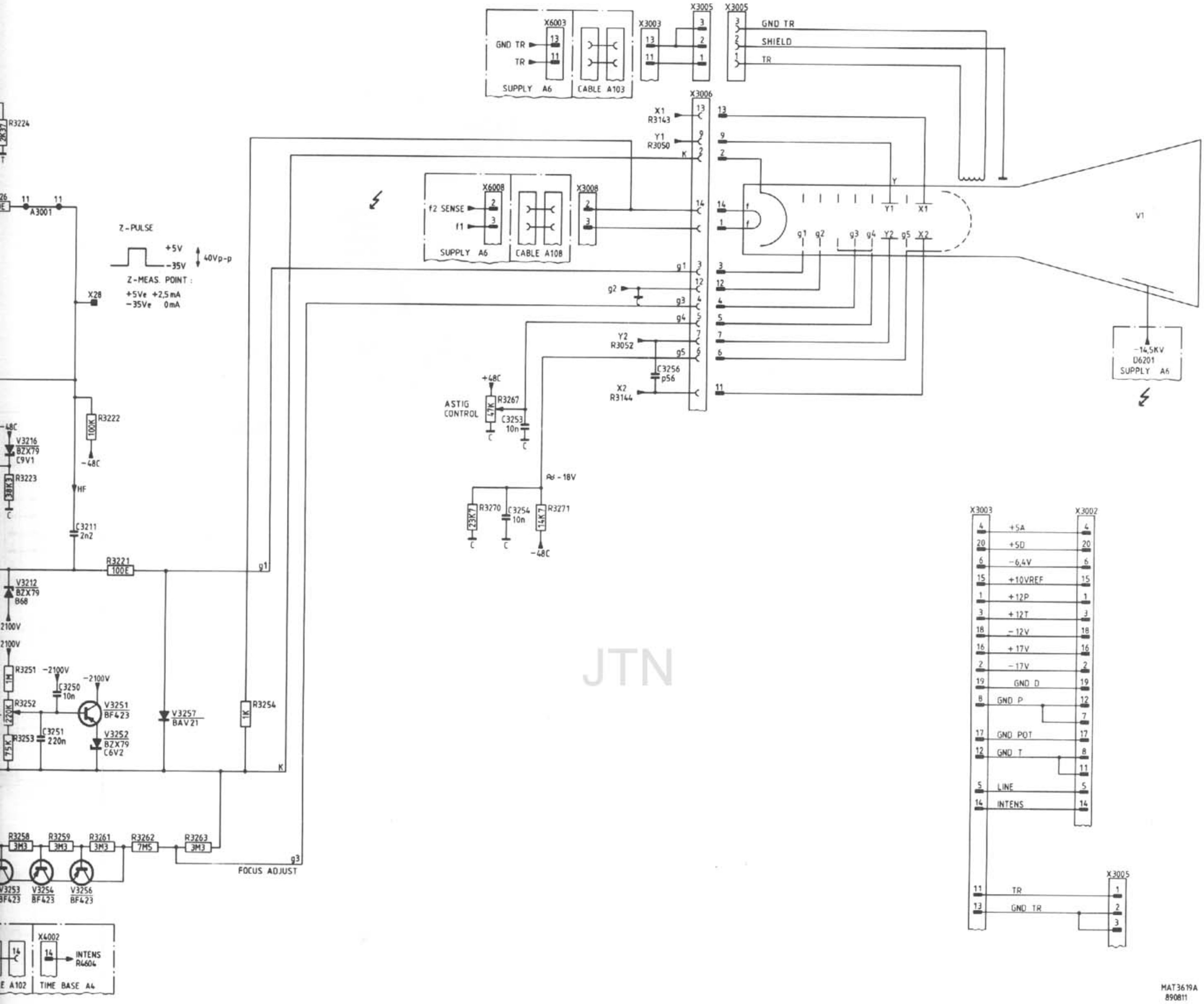


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Figure 6.4 Circuit diagram of XYZ amplifiers: Z amplifier and CRT circuit

7 TIME-BASE UNIT (A4)

The time-base unit consists of:

- Trigger amplifier
- Timing circuit
- Sweep generator
- X DEFL amplifier, incl. horizontal 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 7.6.

All control pulses for this unit are generated by the time-base control circuit, 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 trigger voltage via the shunt feedback amplifier V4003 and V4006. The amplification of this trigger signal is the summation of the voltage swings across R4002 and R4003, which are proportional to the current swing of TRIGM+ and TRIGM-.

* **TV triggering**:

When the signal TVMTB goes LOW, the normal trigger path is blocked via V4005 and V4007 and the trigger signal is routed via the TV trigger stage V4009...V4018. Transistor V4009 serves to clip the synchronisation pulse and LINE/FRAME selection is obtained by 4016.

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.

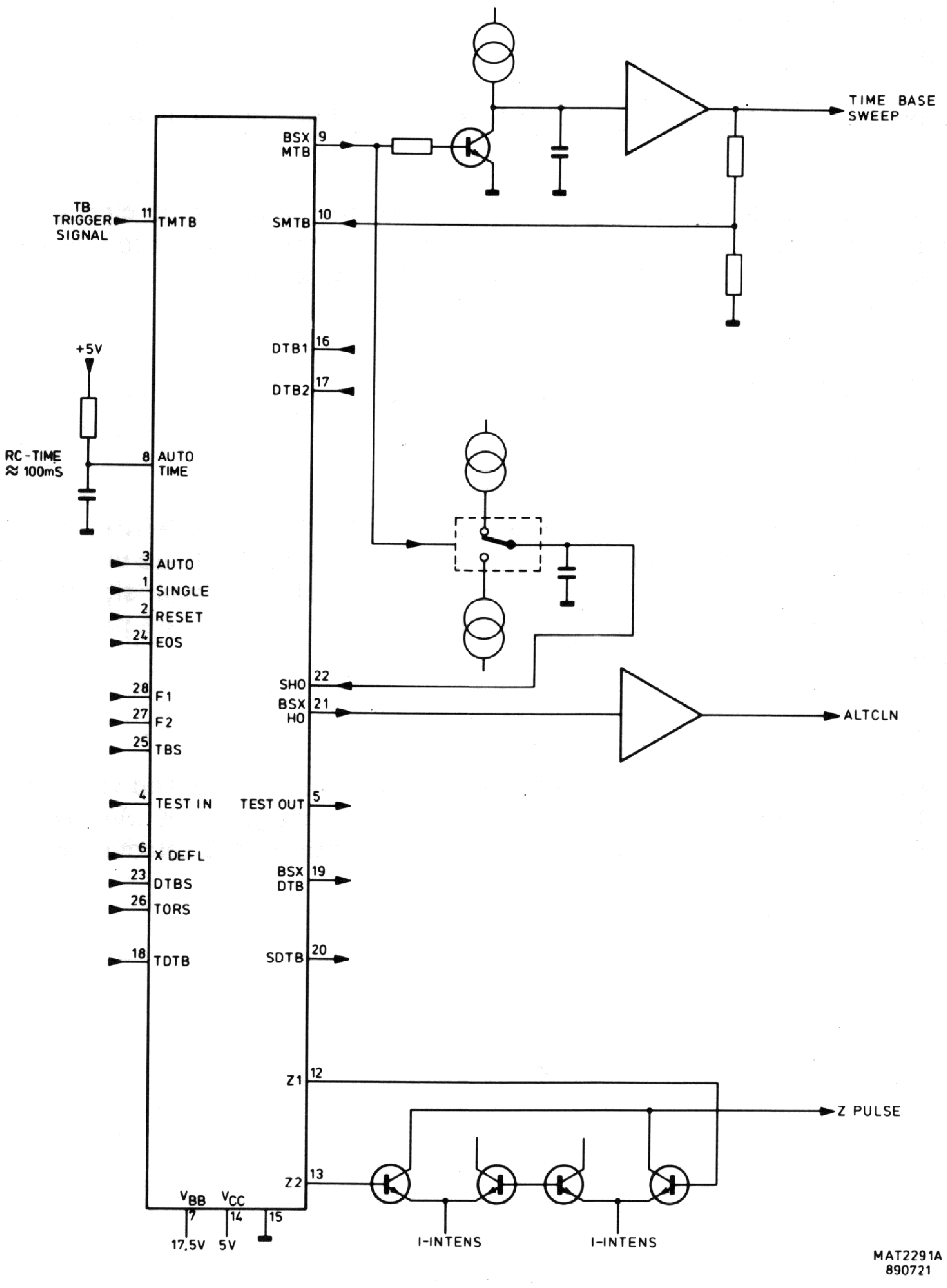


Figure 7.1 D4103 configuration

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 isfree-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 1	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	CLKHLDHT	SCHMITT-input	Determines the hold mode of the track & hold circuit.
17	DTB2	-	not used, connected to ground.
18	TDTB	-	not used, connected to ground.
19	CLKHLDLT	TTL-output	Determines the hold mode of the track & hold circuit.
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 +5Z.
24	EOS	-	not used; connected to +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	F2	TTL-input }	Determines the time-base display
28	F1	TTL-input }	mode (both LOW).

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

7.3 SWEEP GENERATORS

*** TB sweep generator** (see figure 7.2):

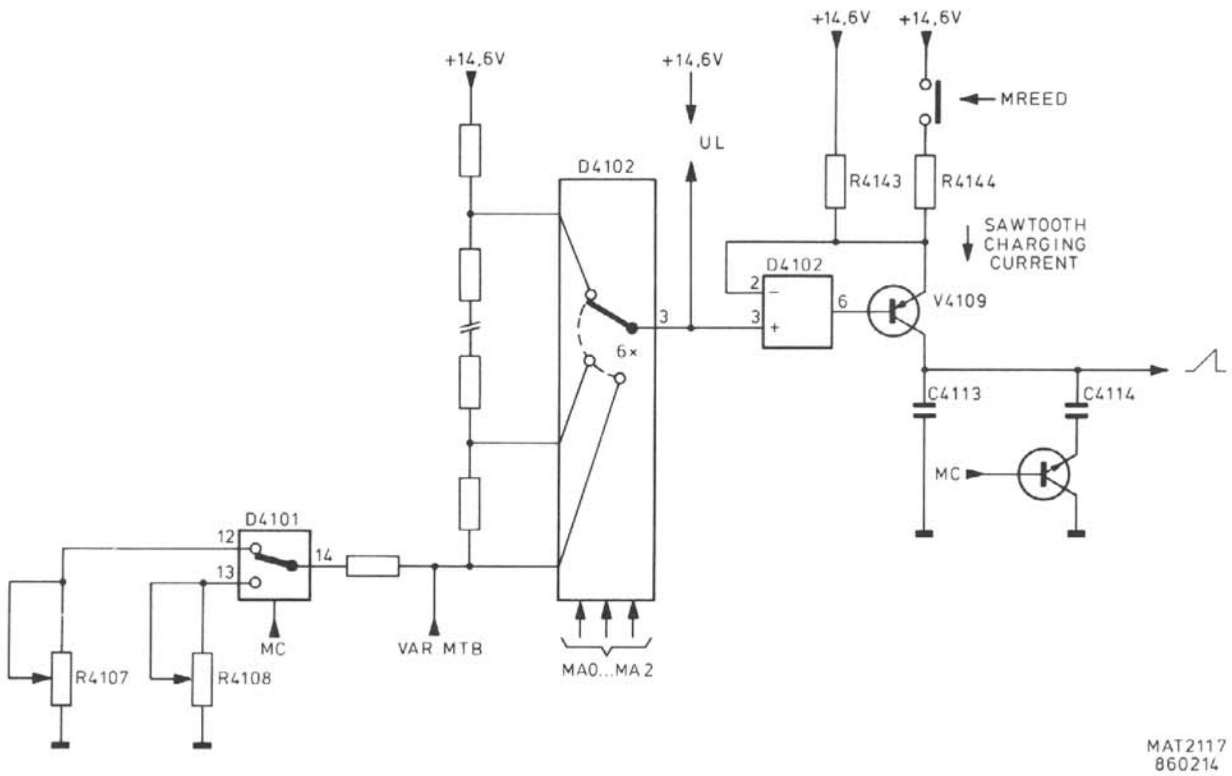


Figure 7.2 Simplified diagram of the time-base sweep generator

The sawtooth charging current:

$$Ic = \frac{Uc}{R4143\ (+\ R4144)}$$

determines the sweep speed via C4113 and C4114. These capacitors are discharged by V4114. 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...100μs) and R4108 (200 μs...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.

Function table for the sweep generator in ANALOG time-base modes:

sweep speed	MA2	MA1	MA0	MREED	MC
50 ns/div.	1	1	1	0	0
.1 µs/div.	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/div.	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/div.	0	1	0	1	1
.2	0	0	1	1	1
.5	0	0	0	1	1

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

The sawtooth current is fed to the buffer circuit, where the h.f. sweep components (to 2 µsec) are routed via C4116 and V4118, V4119.
The l.f. sweep components (0,5 sec...2 µsec) are 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 10 µs) 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	Analog 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 1 and pin 8. 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 7 of both current sources.

To prevent burn-in of the CRT in the lower sweep speeds 50 μsec...0,5 sec, signal ZB is LOW and reduces the voltage to pin 2 and pin 7.

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

*** Z Pre-amplifier**:
In normal condition, all 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 e-c to the +5 kV 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 e-c to the +5 kV rail.

7.6 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

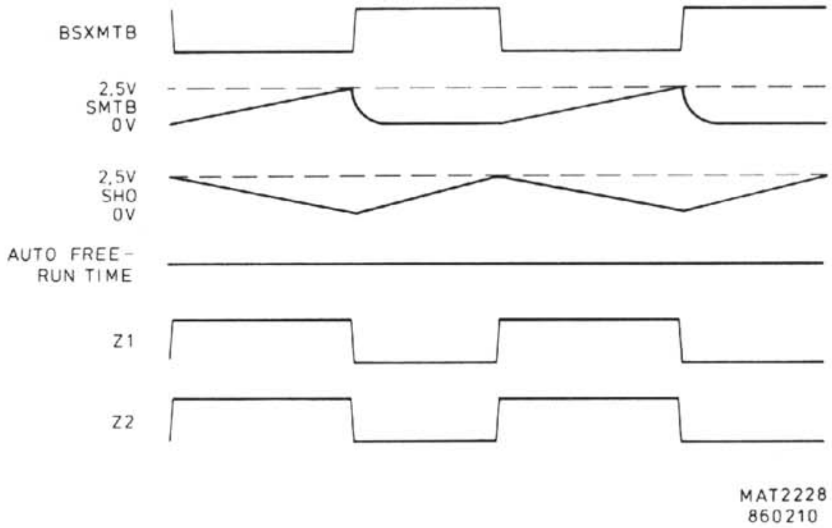
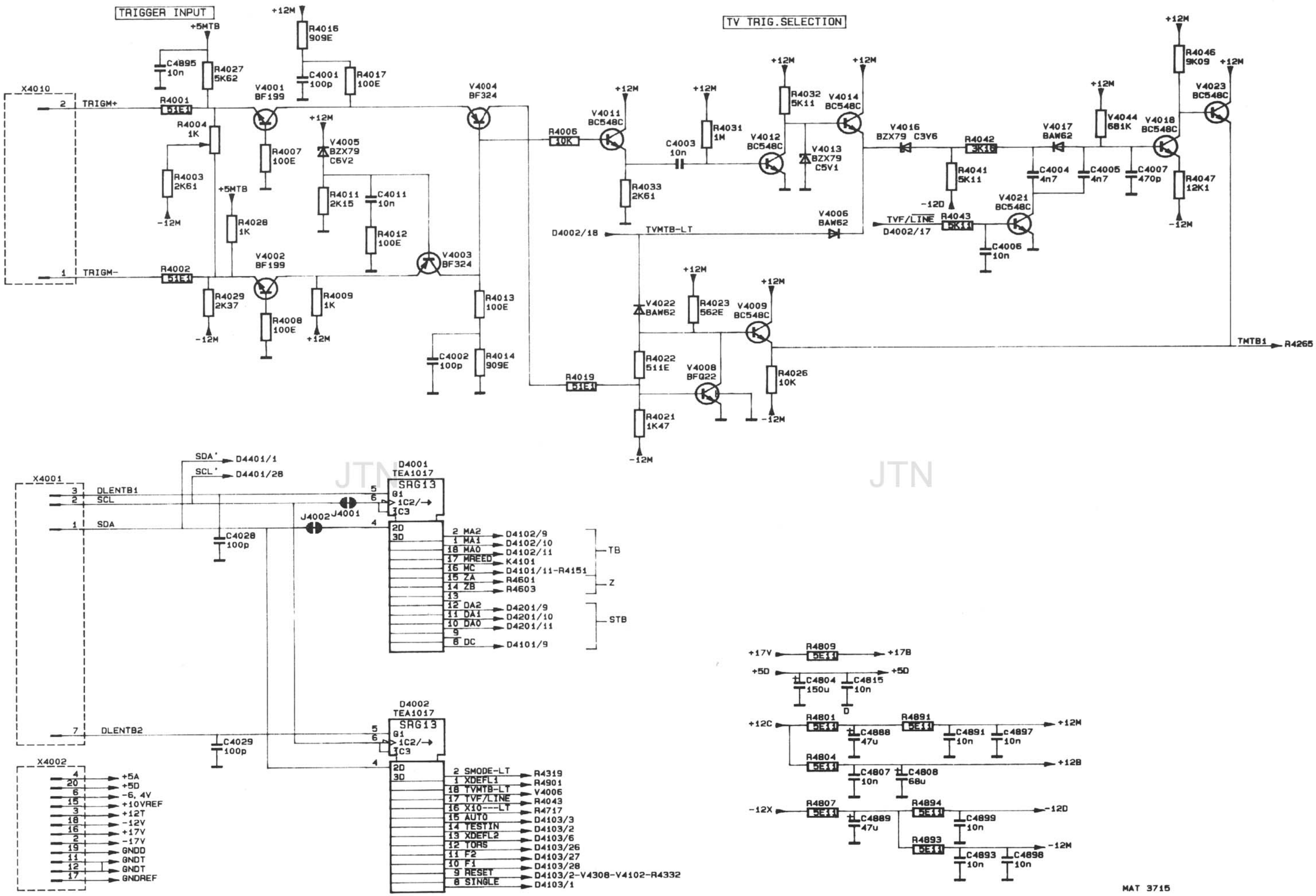
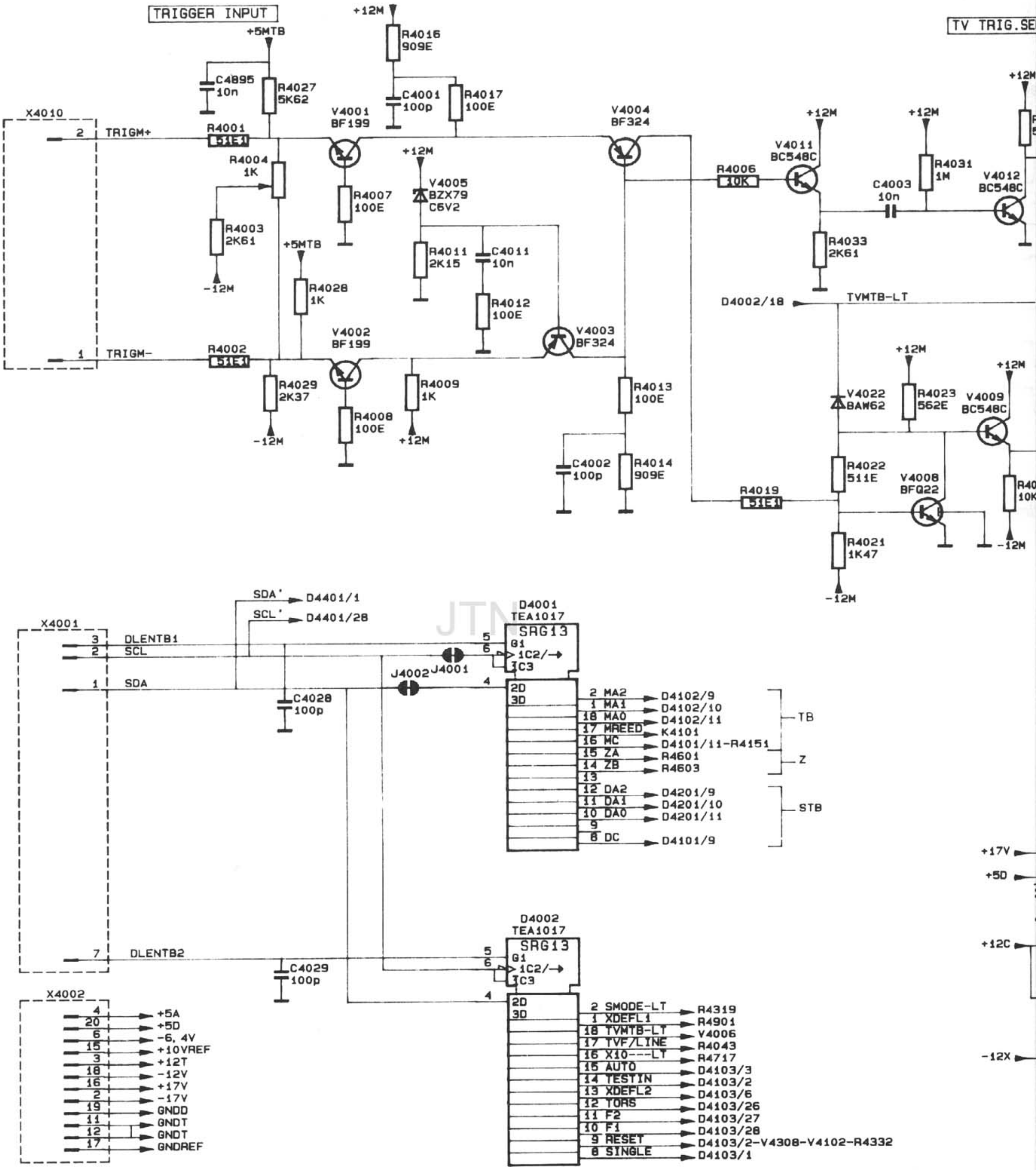


Figure 7.3 Free-running sweep-timing diagram

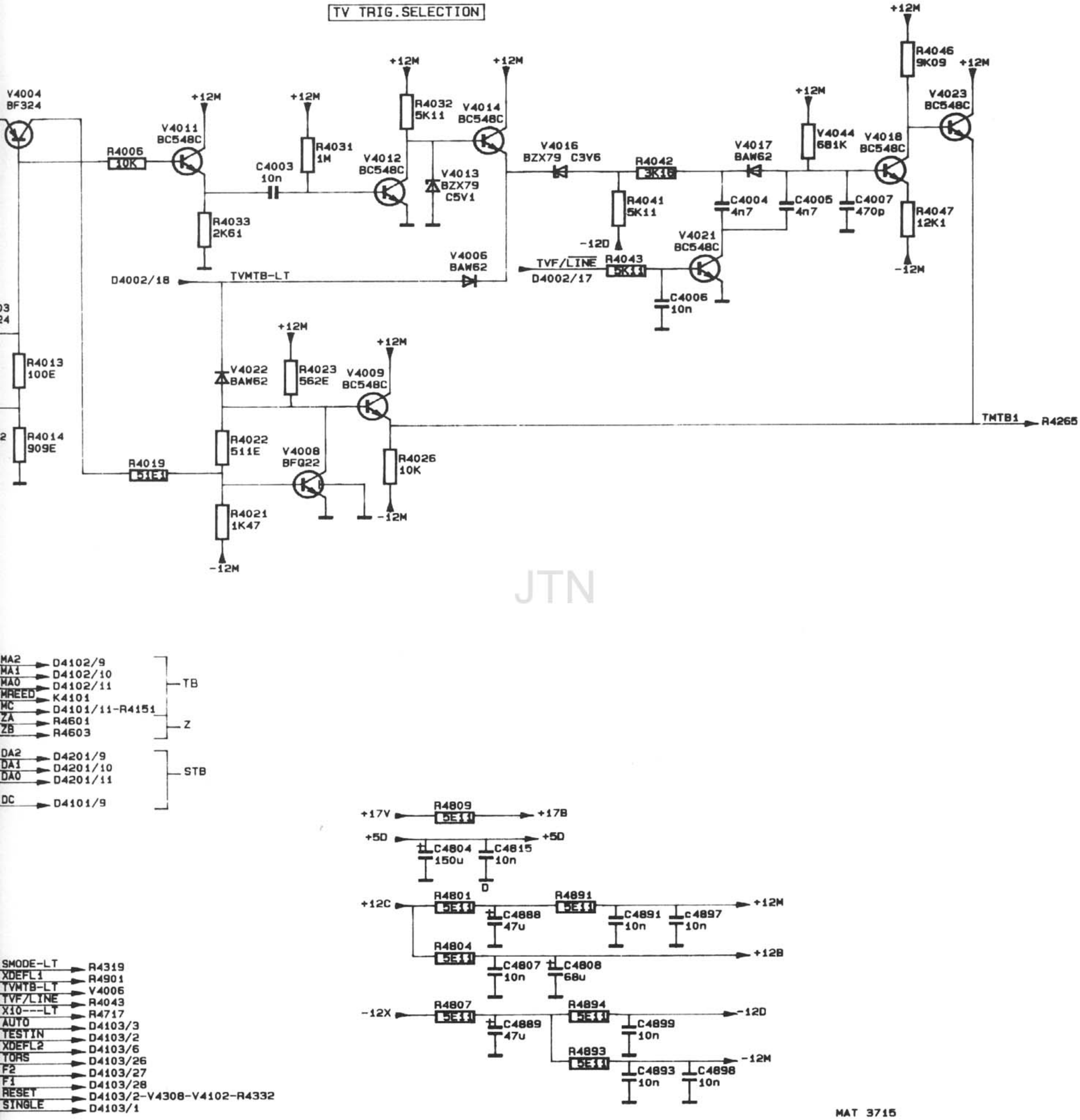


REF NO	TYPE	+5D	+12B	⊥ D
D4001	TEA1017		7	3
D4002	TEA1017	7		3
D4103	OQ0201			

Figure 7.4 Circuit diagram of time-base: trigger amplifier



REF NO	TYPE	+5D	+1
D4001	TEA1017		7
D4002	TEA1017	7	
D4103	0Q0201		



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

Figure 7.4 Circuit diagram of time-base: trigger amplifier

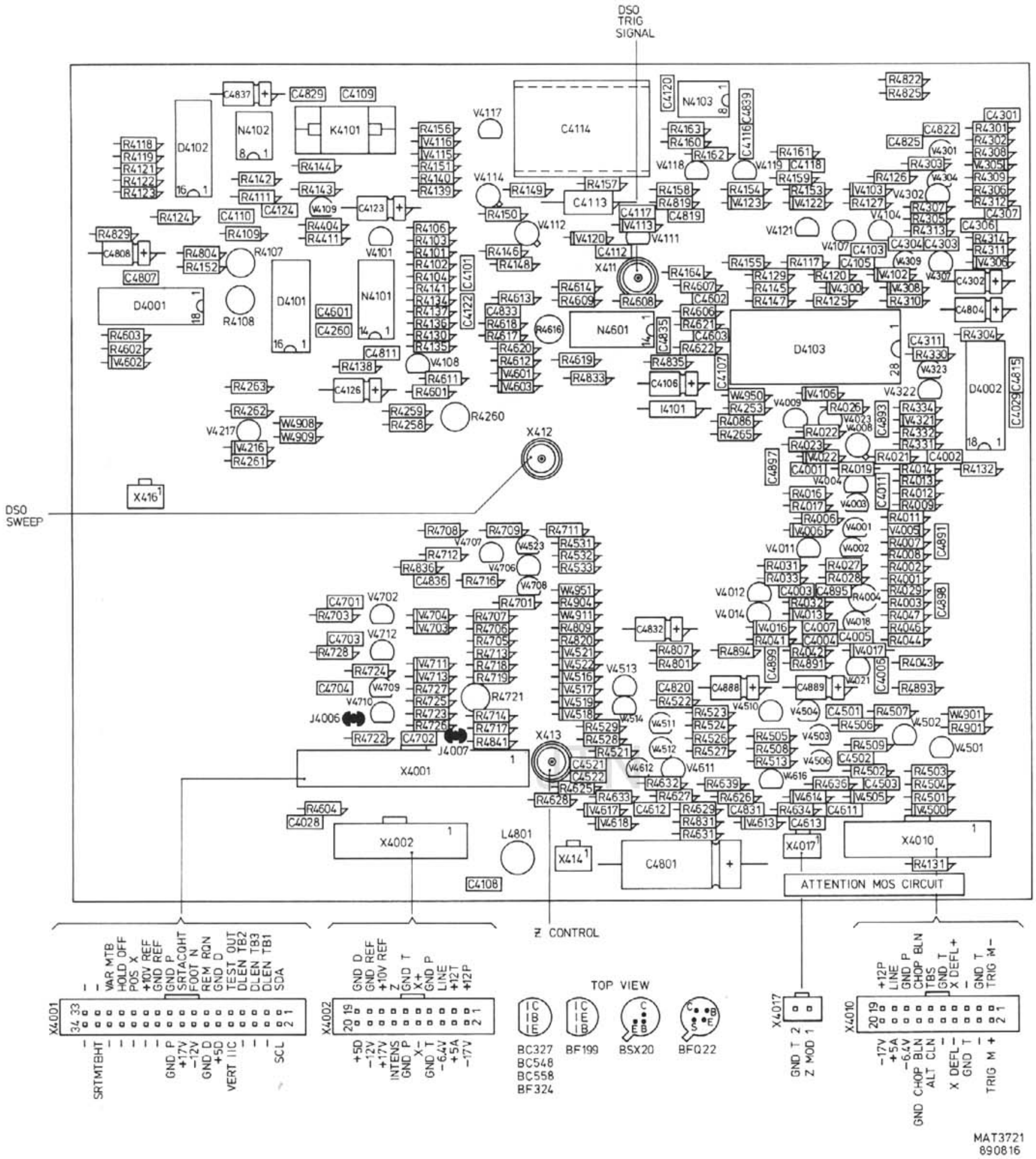
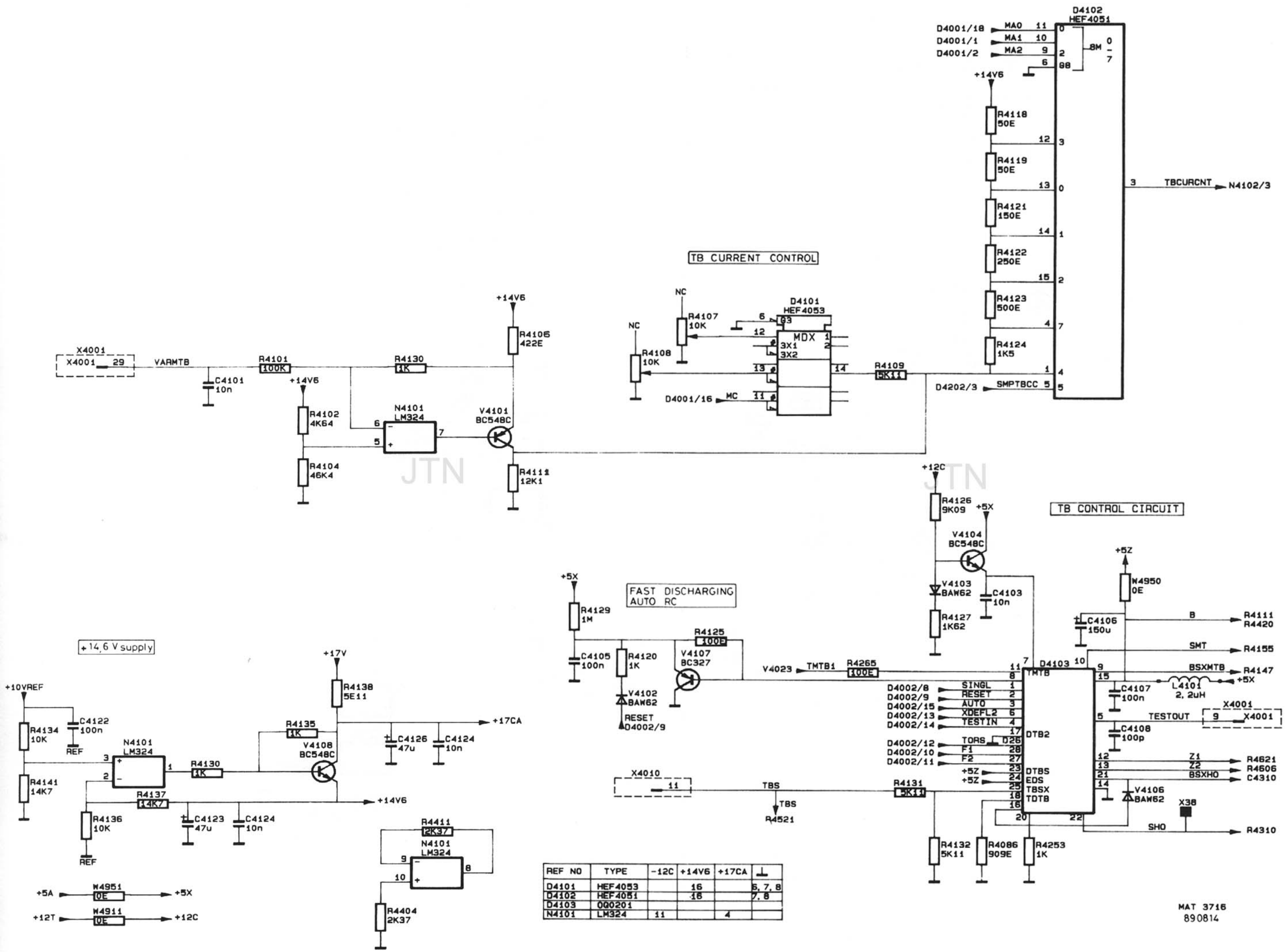
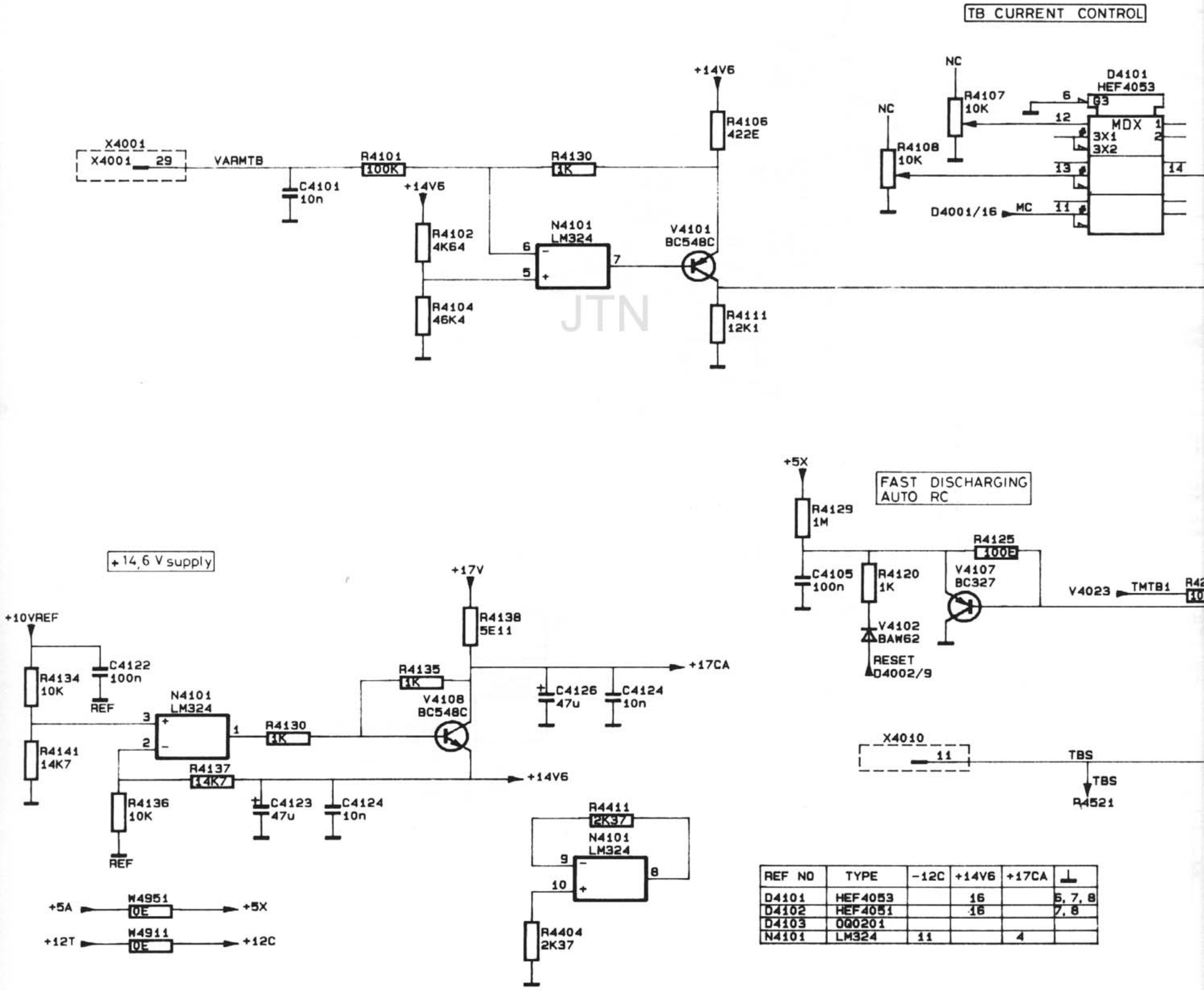


Figure 7.5 Time-base unit p.c.b.



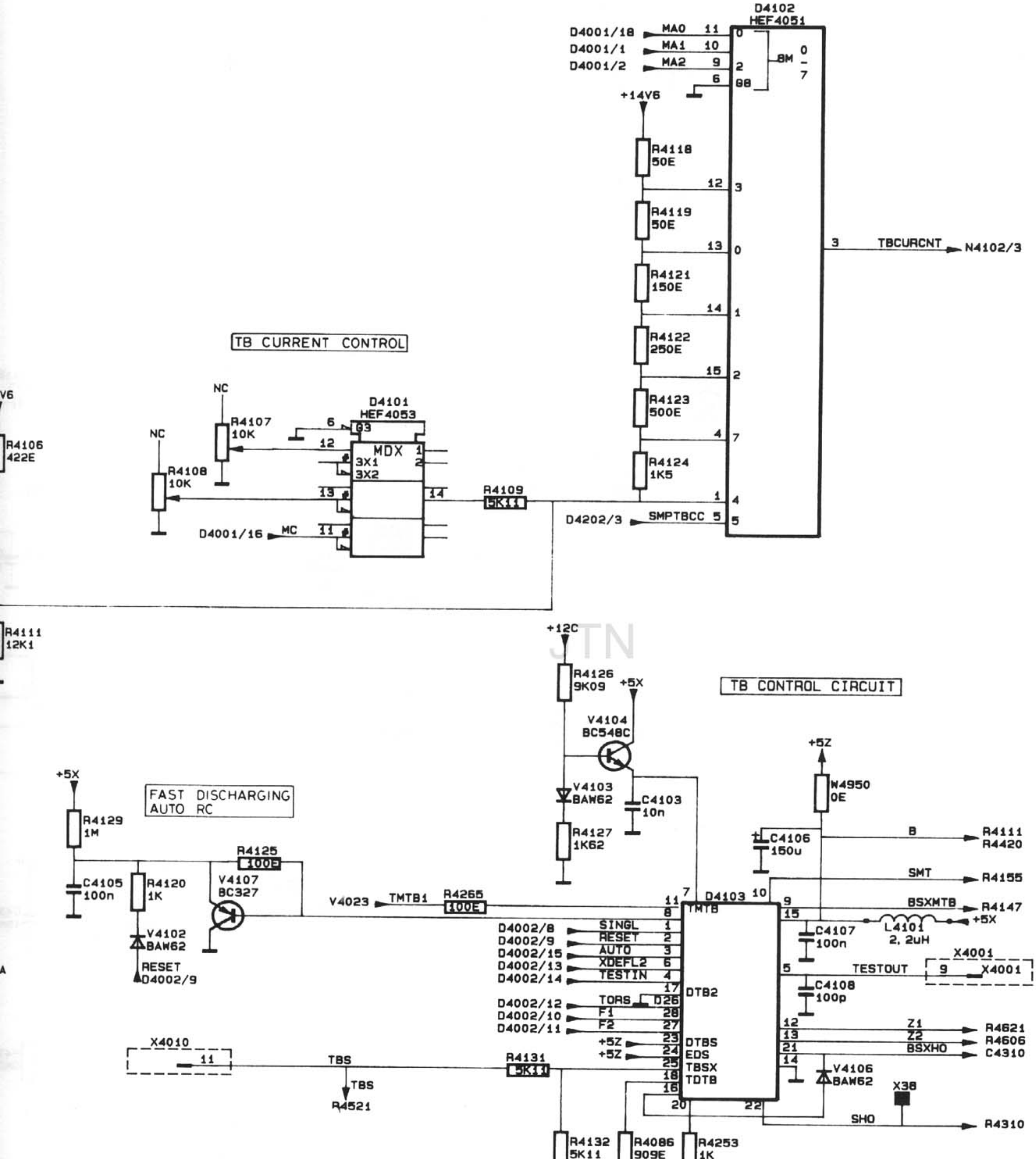
REF NO	TYPE	-12C	+14V6	+17CA	⊥
D4101	HEF4053		16		6, 7, 8
D4102	HEF4051		16		7, 8
D4103	OQ0201				
N4101	LM324	11		4	

Figure 7.6 Circuit diagram of time-base: TB control and TB current control



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

Figure 7.6 Circuit



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

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Figure 7.6 Circuit diagram of time-base: TB control and TB current control

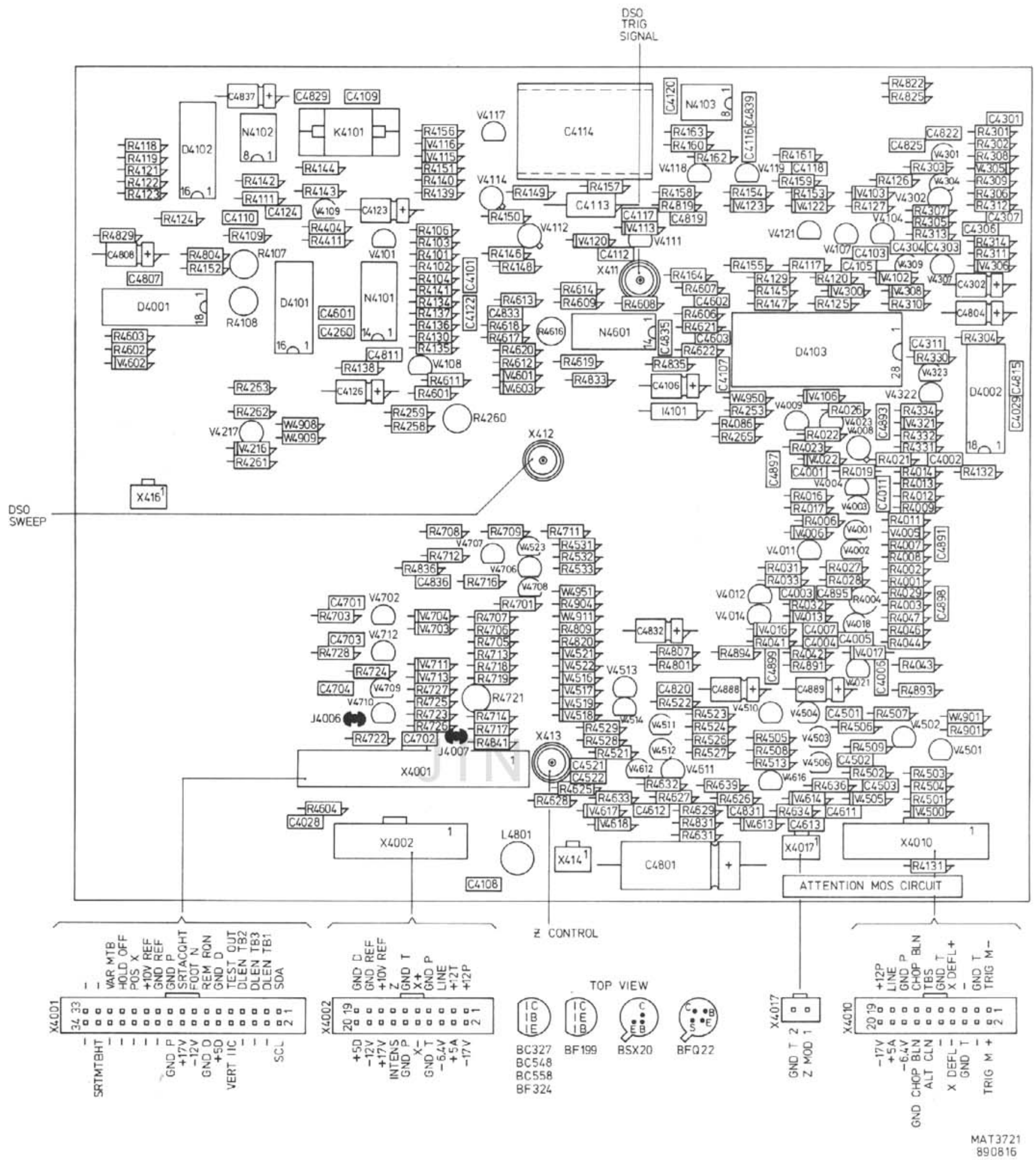
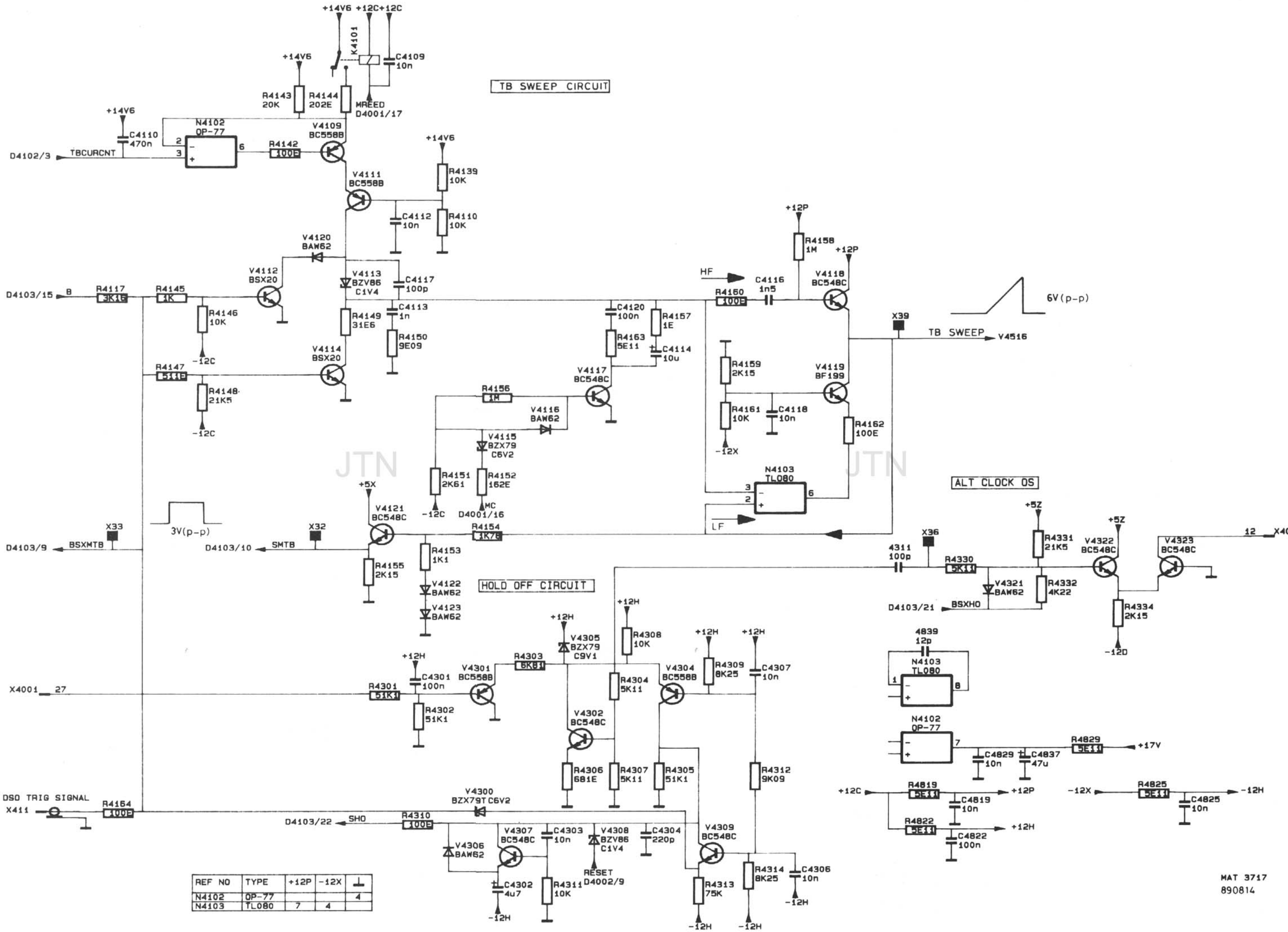
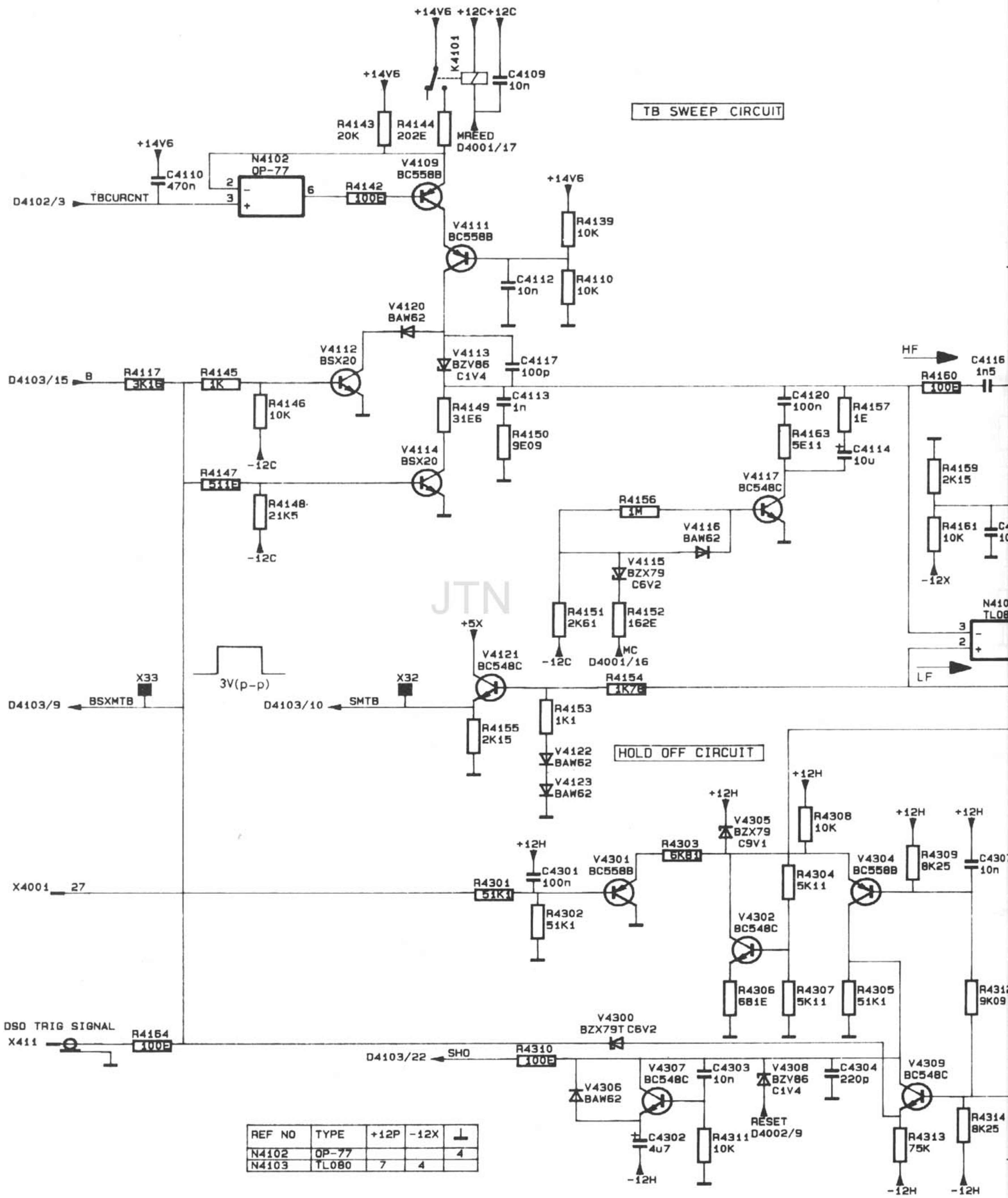


Figure 7.8 Time-base unit p.c.b.



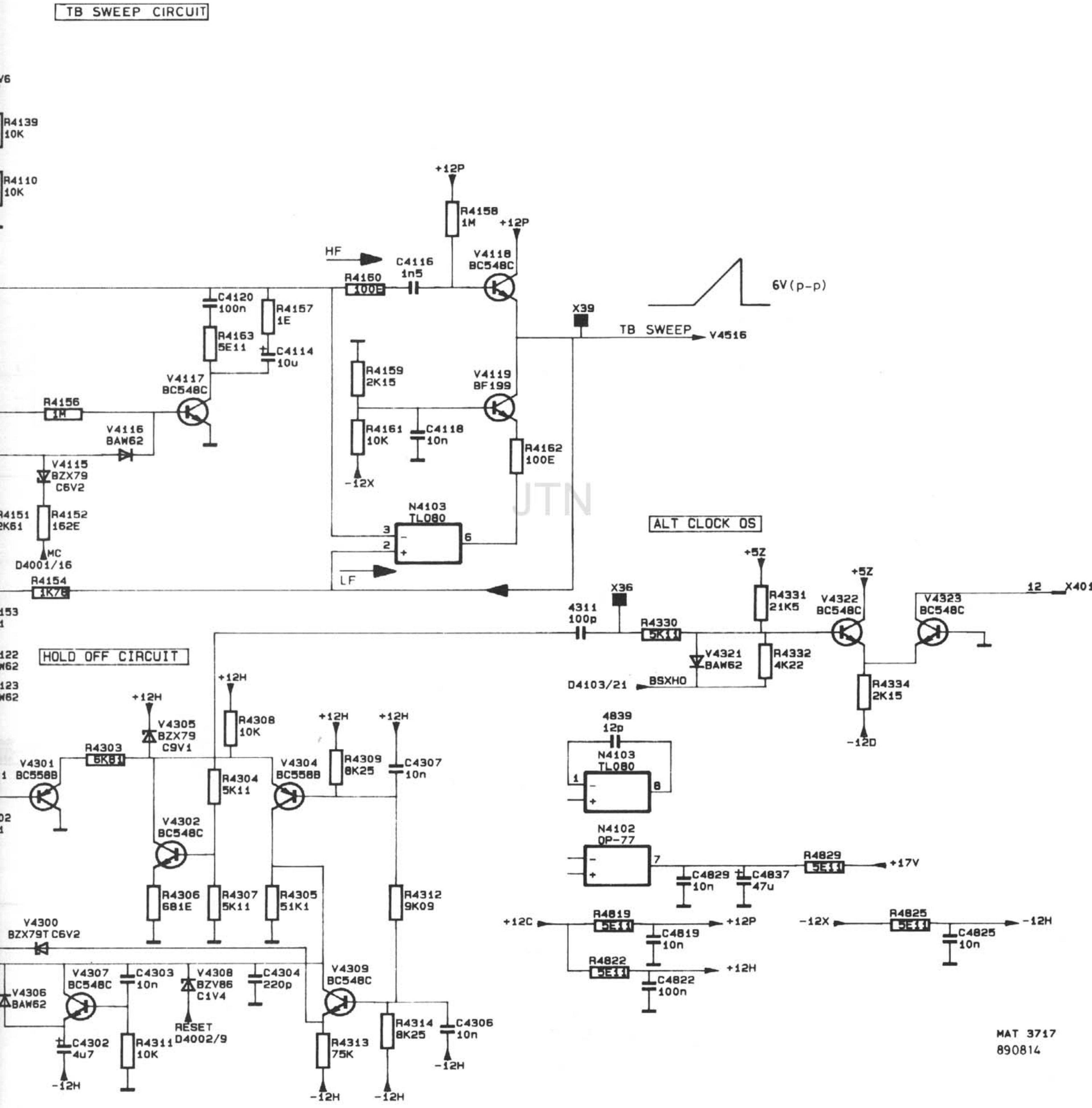
REF NO	TYPE	+12P	-12X	⊥
N4102	OP-77			4
N4103	TL080	7	4	

Figure 7.7 Circuit diagram of time-base: TB sweep circuit



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

Figure 7.7 Circuit diagram of time-base: TB sweep circuit


TB SWEEP CIRCUIT
R4139
10K
R4110
10K
+12P
R4158
1M
+12P
HF
C4116
1n5
V4118
BC548C
R4160
100E
6V(p-p)
C4120
100n
R4157
1E
X39
TB SWEEP
V4516
R4163
5E11
C4114
10u
V4117
BC548C
R4159
2K15
V4119
BF199
R4156
1M
V4116
BAW62
R4161
10K
C4118
10n
R4162
100E
V4115
BZX79
C6V2
-12X
R4152
162E
N4103
TL080
ALT CLOCK OS
MC
D4001/16
LF
R4154
1K78
+5Z
X36
+5Z
R4331
21K5
V4322
BC548C
V4323
BC548C
12
4311
100p
R4330
5K11
HOLD OFF CIRCUIT
V4321
BAW62
R4332
4K22
+12H
D4103/21
BSXHO
R4334
2K15
+12H
V4305
BZX79
C9V1
R4308
10K
+12H
+12H
4839
12p
-12D
R4303
6K81
N4103
TL080
V4301
BC558B
V4304
BC558B
R4309
8K25
C4307
10n
R4304
5K11
V4302
BC548C
N4102
OP-77
R4829
5E11
+17V
C4829
10n
C4837
47u
R4306
681E
R4307
5K11
R4305
51K1
R4312
9K09
R4819
5E11
+12C
+12P
C4819
10n
-12X
R4825
5E11
-12H
C4825
10n
V4300
BZX79T C6V2
R4822
5E11
+12H
C4822
100n
V4307
BC548C
C4303
10n
V4308
BZV86
C1V4
C4304
220p
V4309
BC548C
V4306
BAW62
RESET
D4002/9
R4314
8K25
C4306
10n
C4302
4u7
R4311
10K
R4313
75K
-12H
-12H
-12H
-12H
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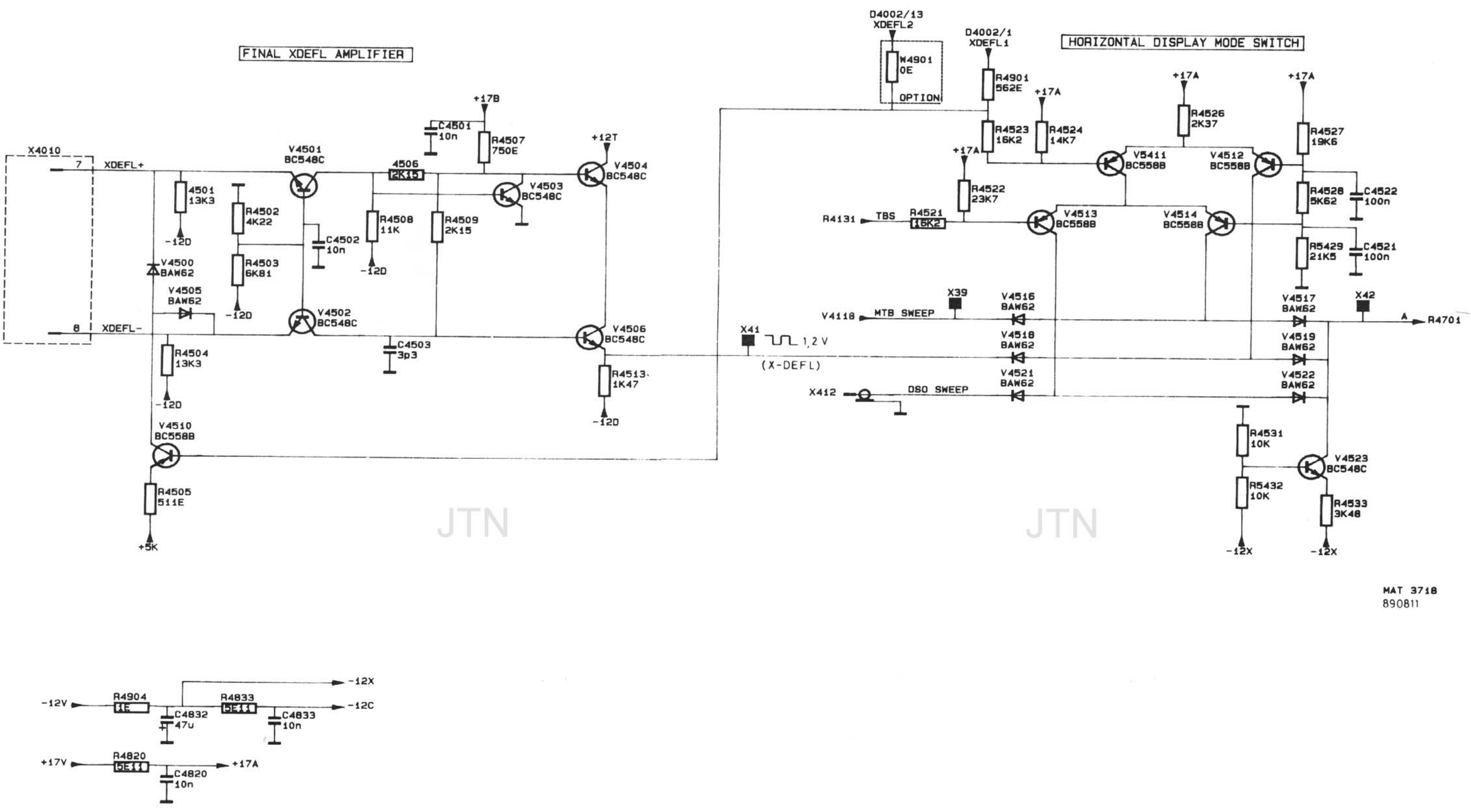


Figure 7.9 Circuit diagram of time-base: final XDEFL-amplifier

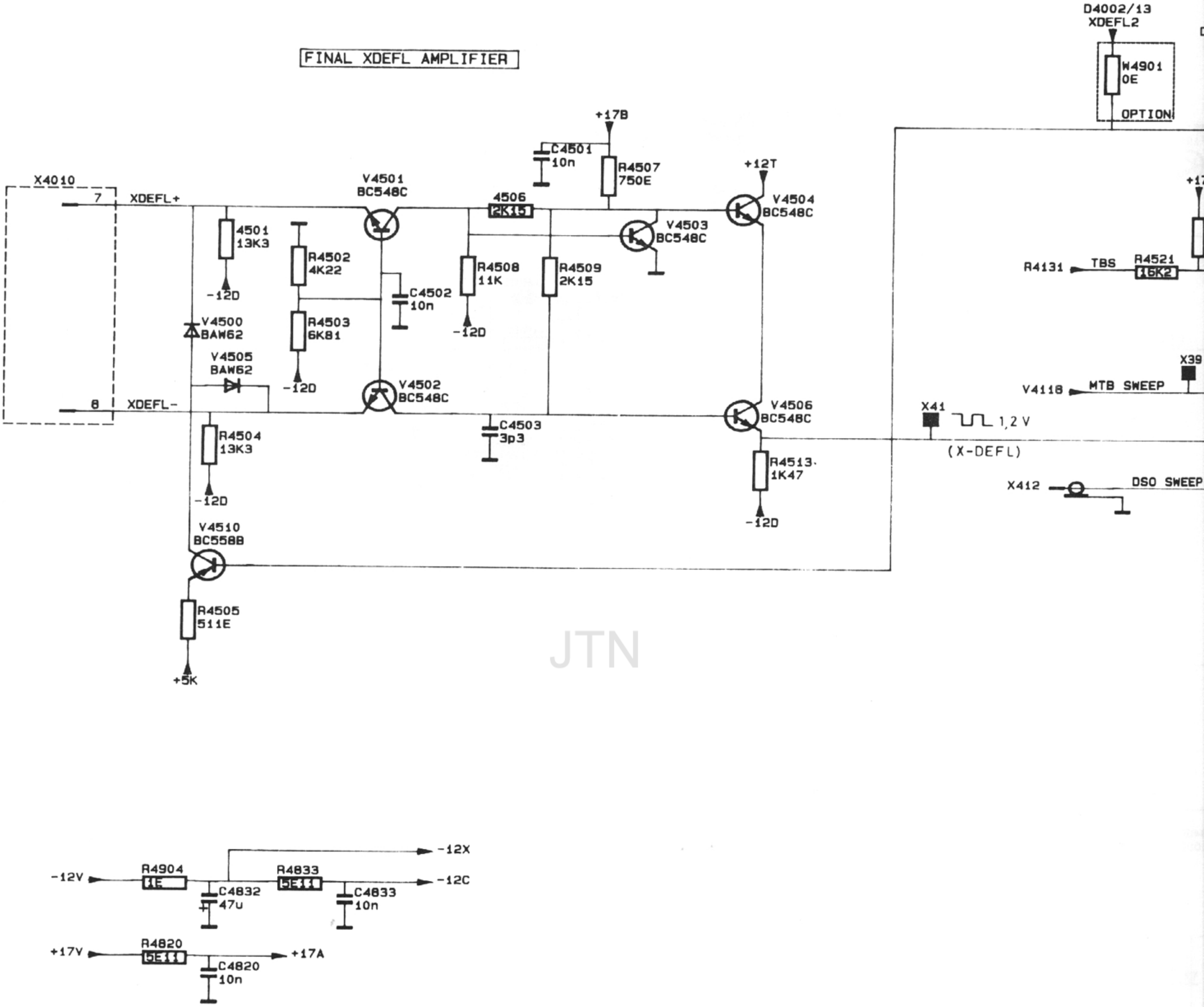
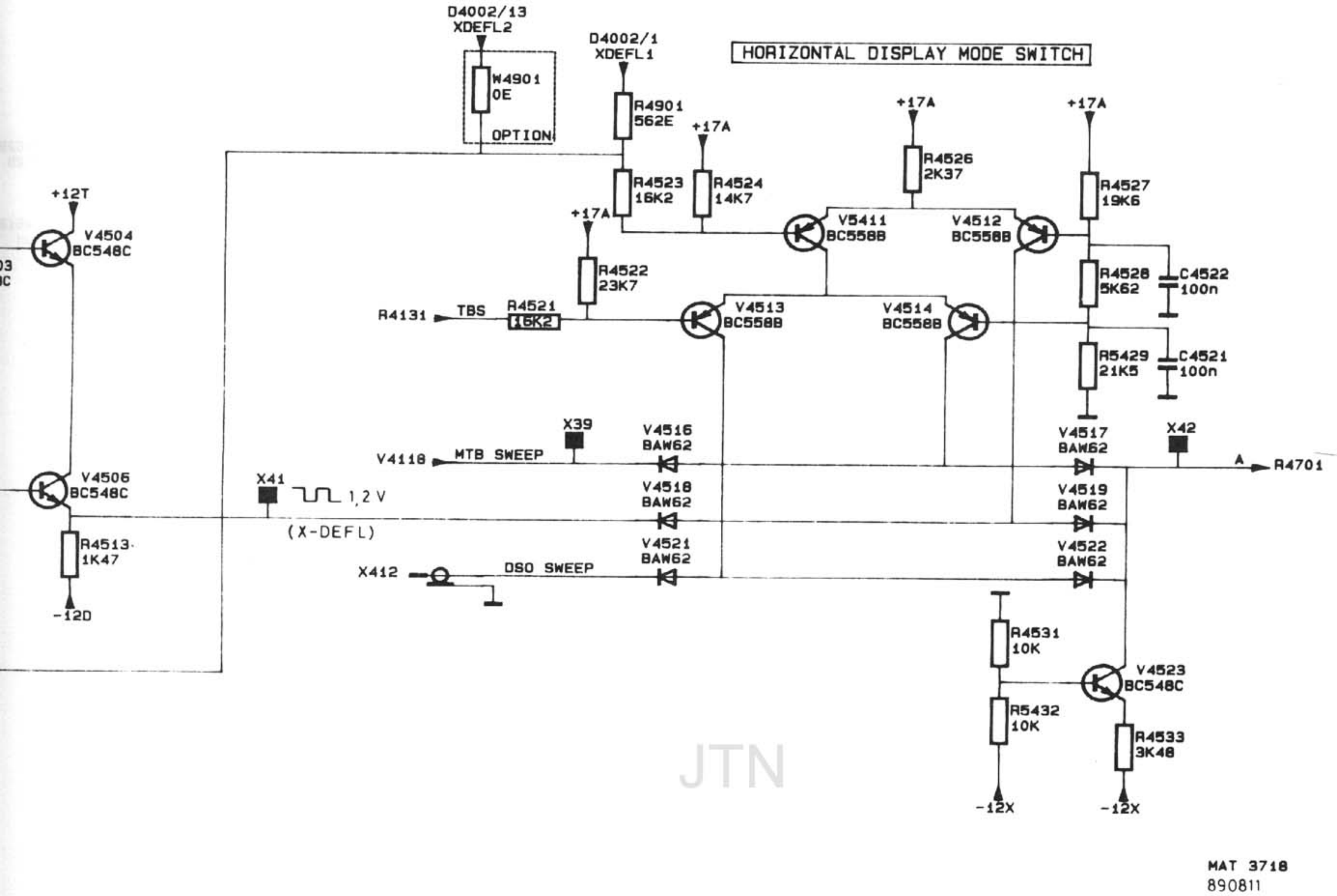


Figure 7.9 Circuit diagram of time-base: final XDEFL-amplifier


HORIZONTAL DISPLAY MODE SWITCH
D4002/13
XDEFL2
W4901
0E
OPTION
D4002/1
XDEFL1
R4901
562E
+17A
R4523
16K2
R4524
14K7
R4526
2K37
R4527
19K6
V5411
BC558B
V4512
BC558B
R4522
23K7
R4131
TBS
R4521
16K2
V4513
BC558B
V4514
BC558B
R4528
5K62
C4522
100n
R5429
21K5
C4521
100n
+12T
V4504
BC548C
V4506
BC548C
R4513
1K47
-12D
V4118
MTB SWEEP
X39
V4516
BAW62
V4517
BAW62
X42
A
R4701
X41
1,2 V
(X-DEFL)
V4518
BAW62
V4519
BAW62
V4521
BAW62
V4522
BAW62
X412
DSO SWEEP
R4531
10K
R5432
10K
V4523
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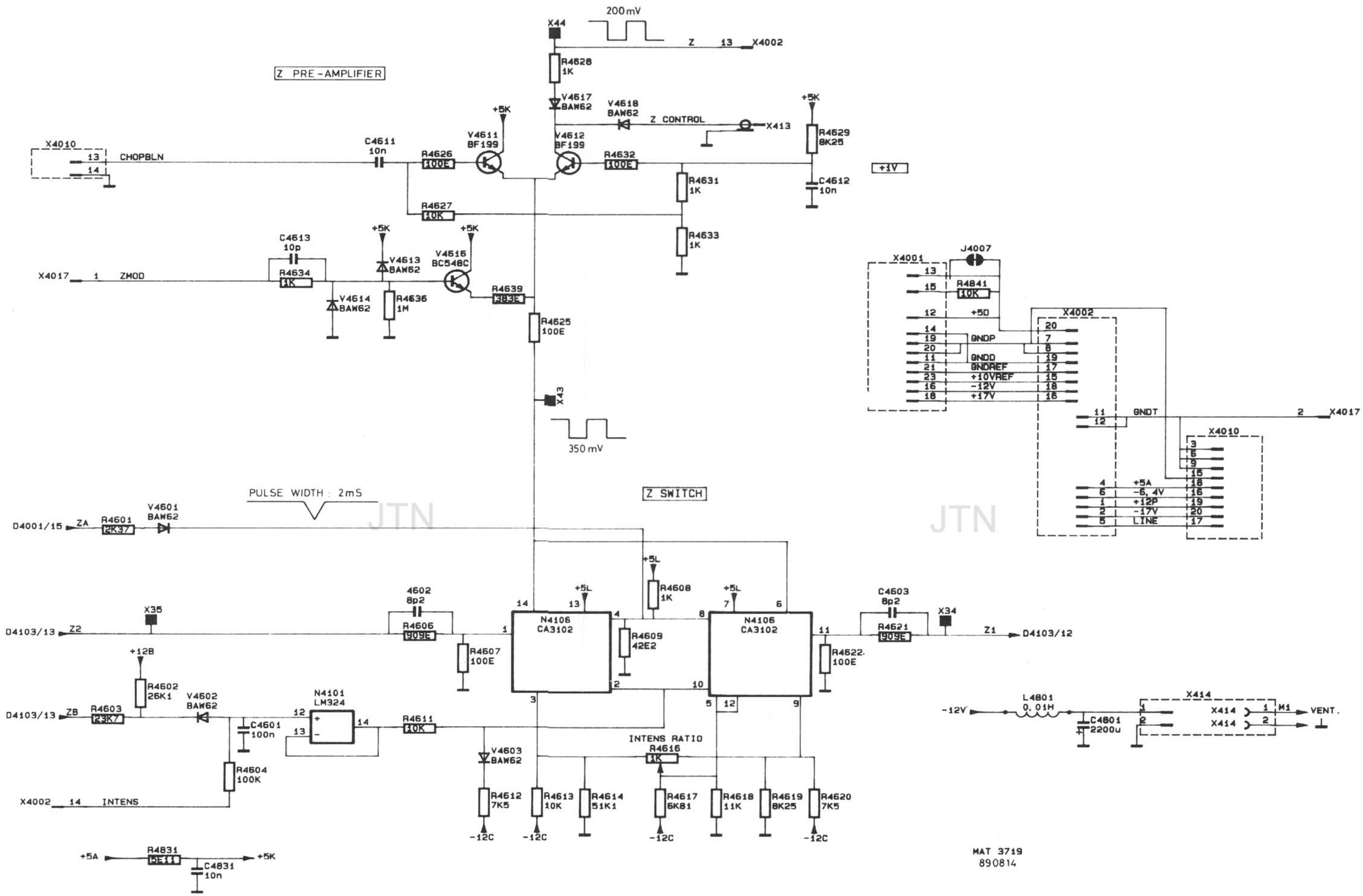
R4533
3K48
-12X
MAT 3718
890811



REF NO	TYPE
N4101	LM324
N4601	CA3101

Figure 7.10 Circuit diagram of time-base unit: Z pre-amplifier and Z switch

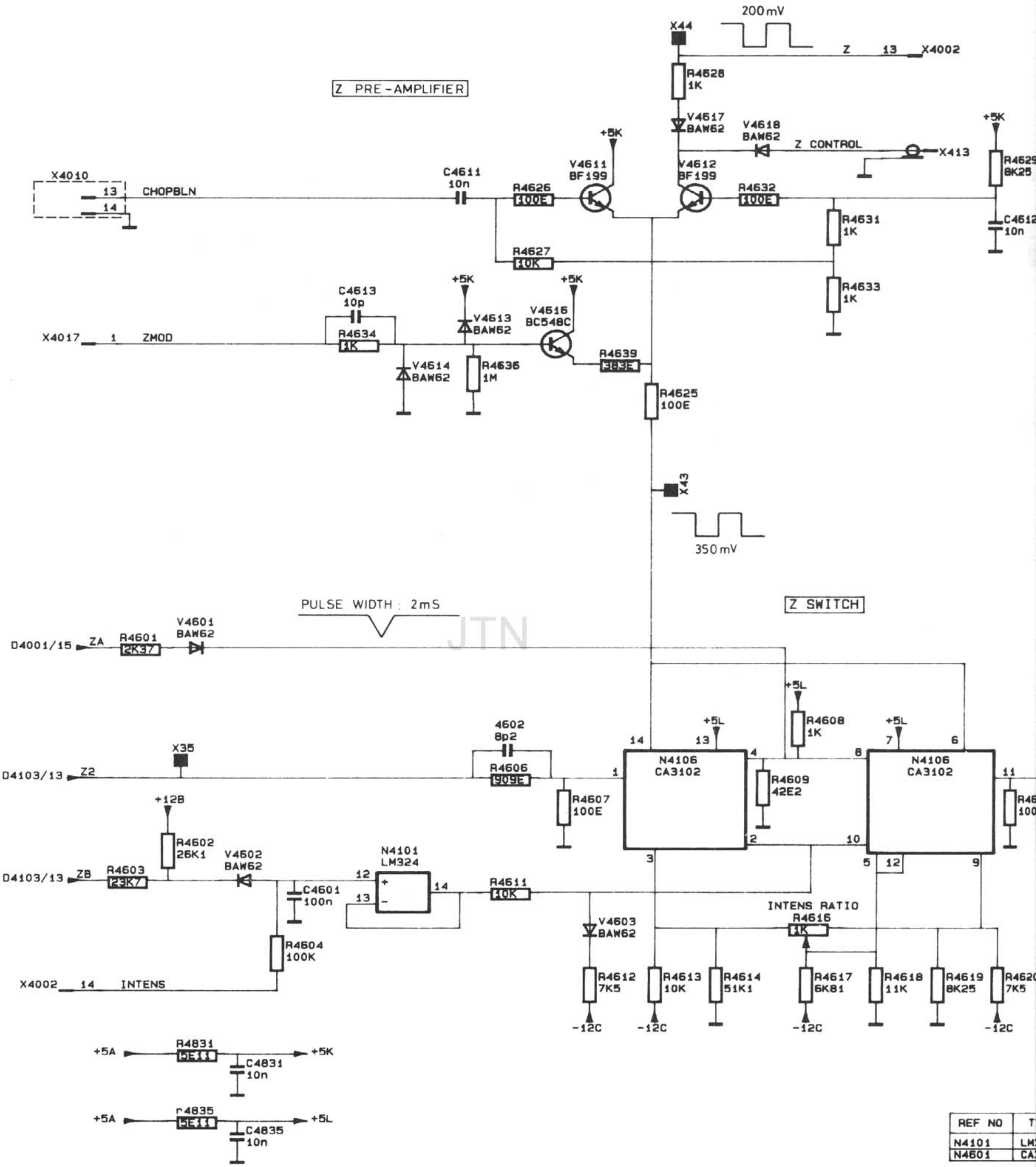
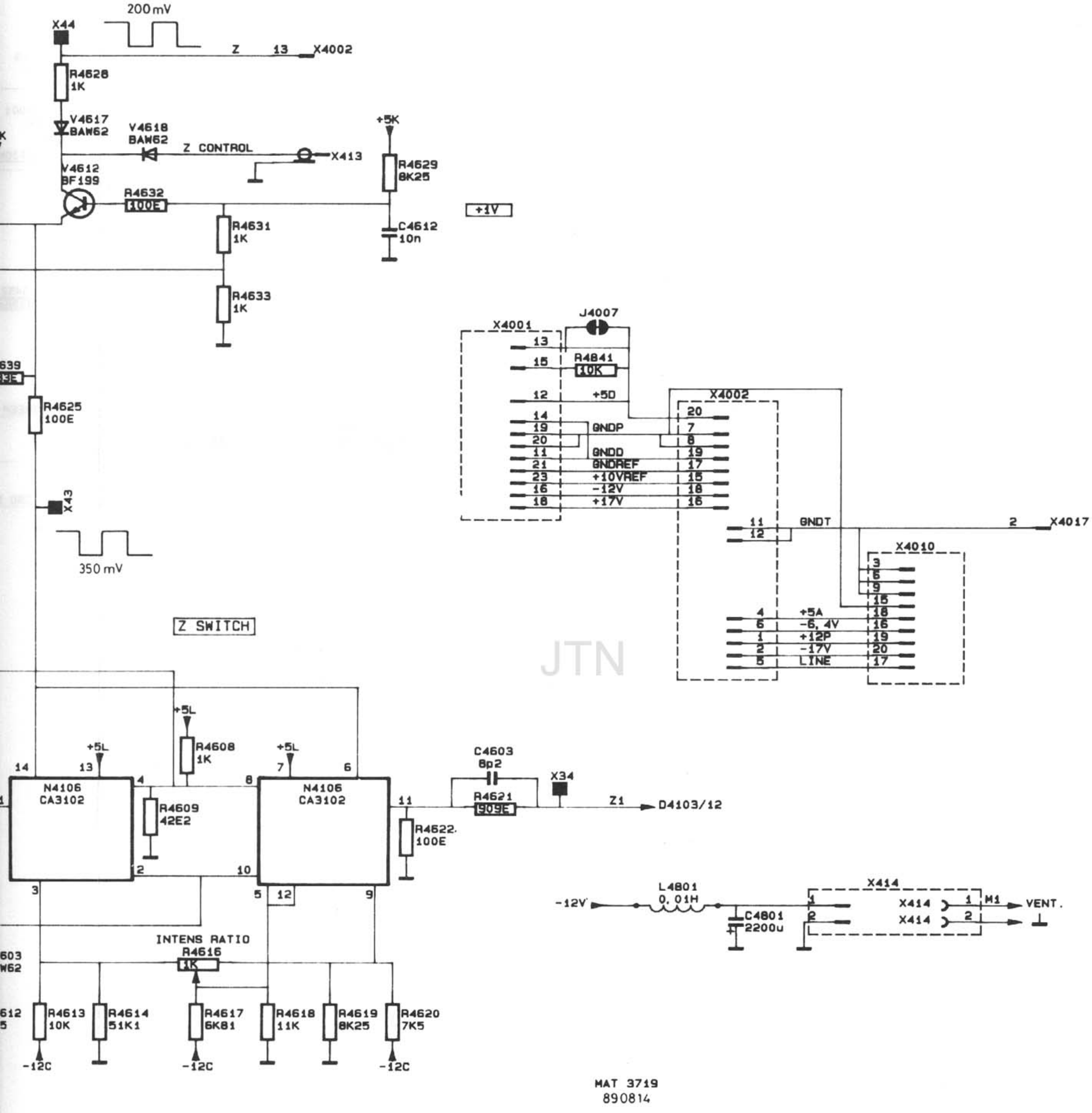


Figure 7.10 Circuit diag



REF NO	TYPE
N4101	LM324
N4601	CA3101

Figure 7.10 Circuit diagram of time-base unit: Z pre-amplifier and Z switch

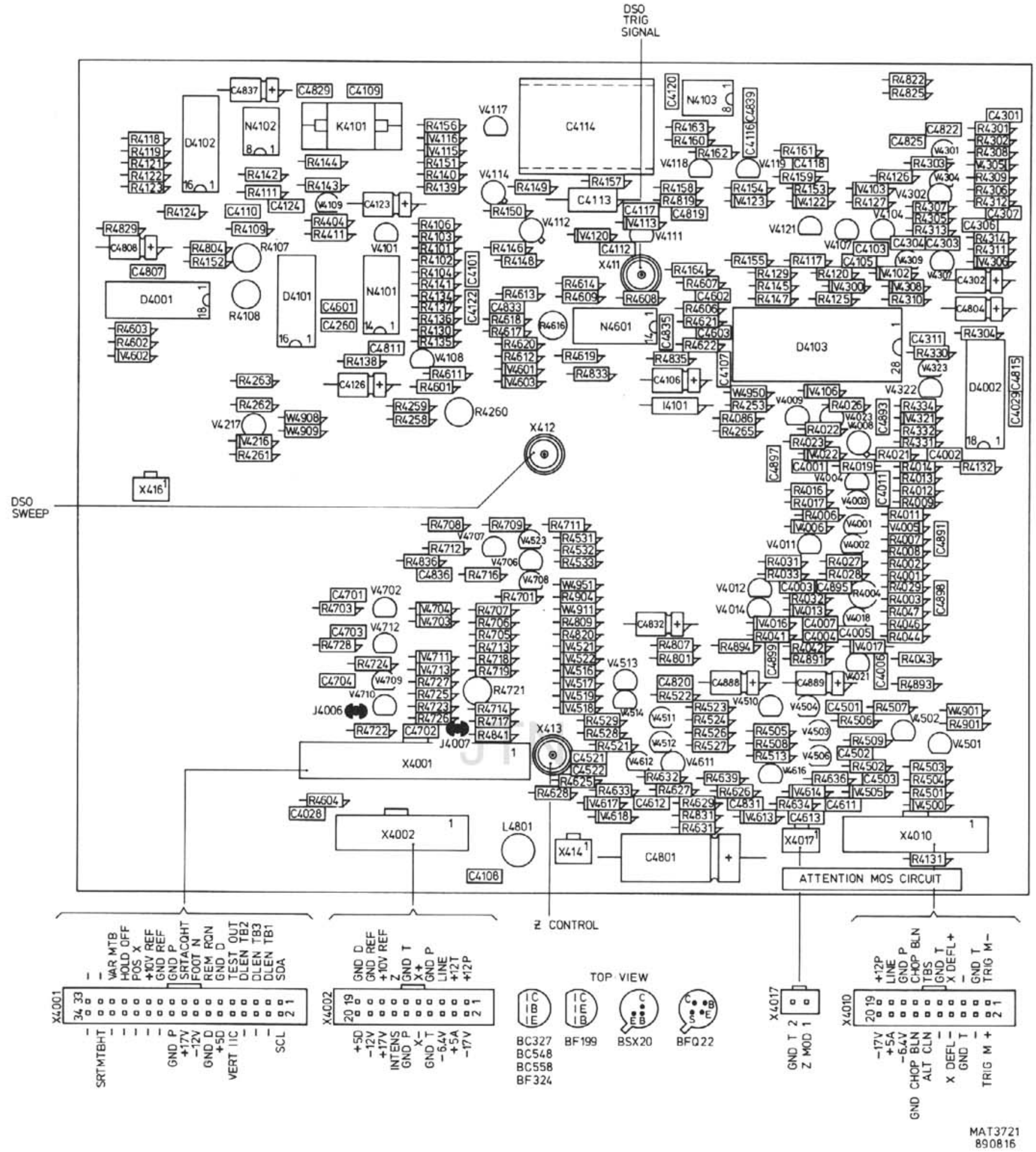


Figure 7.11 Time-base unit p.c.b

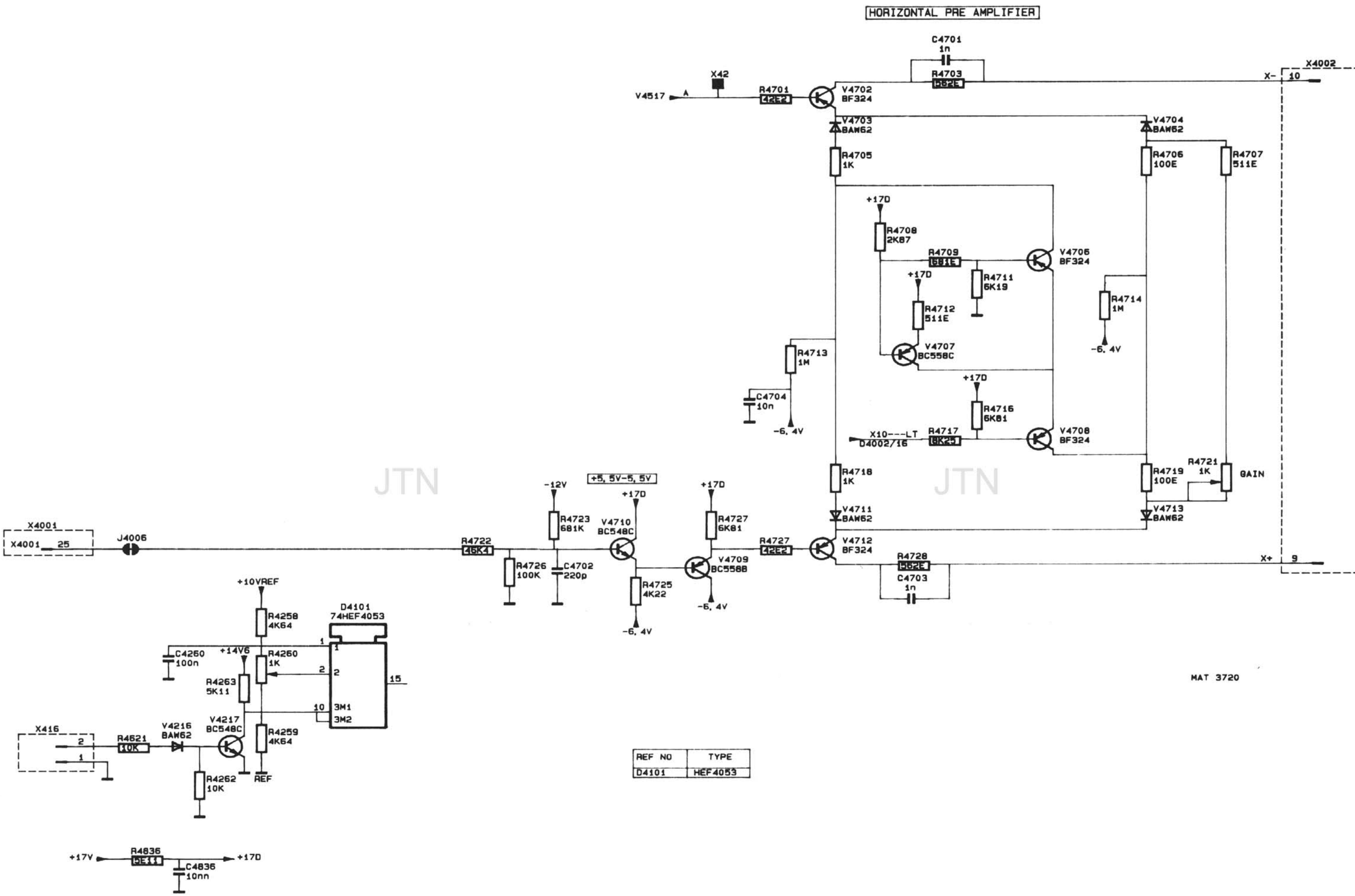
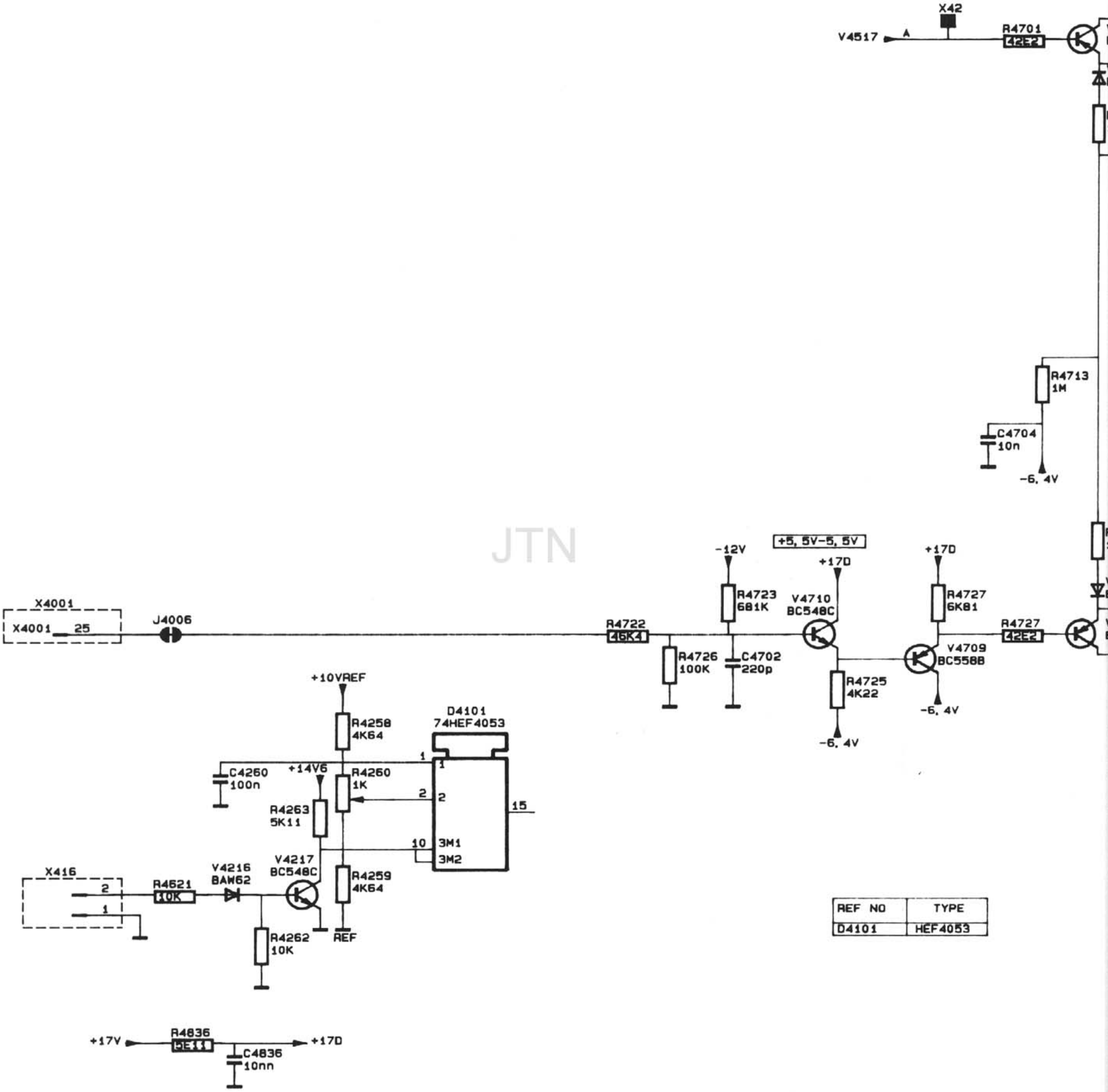
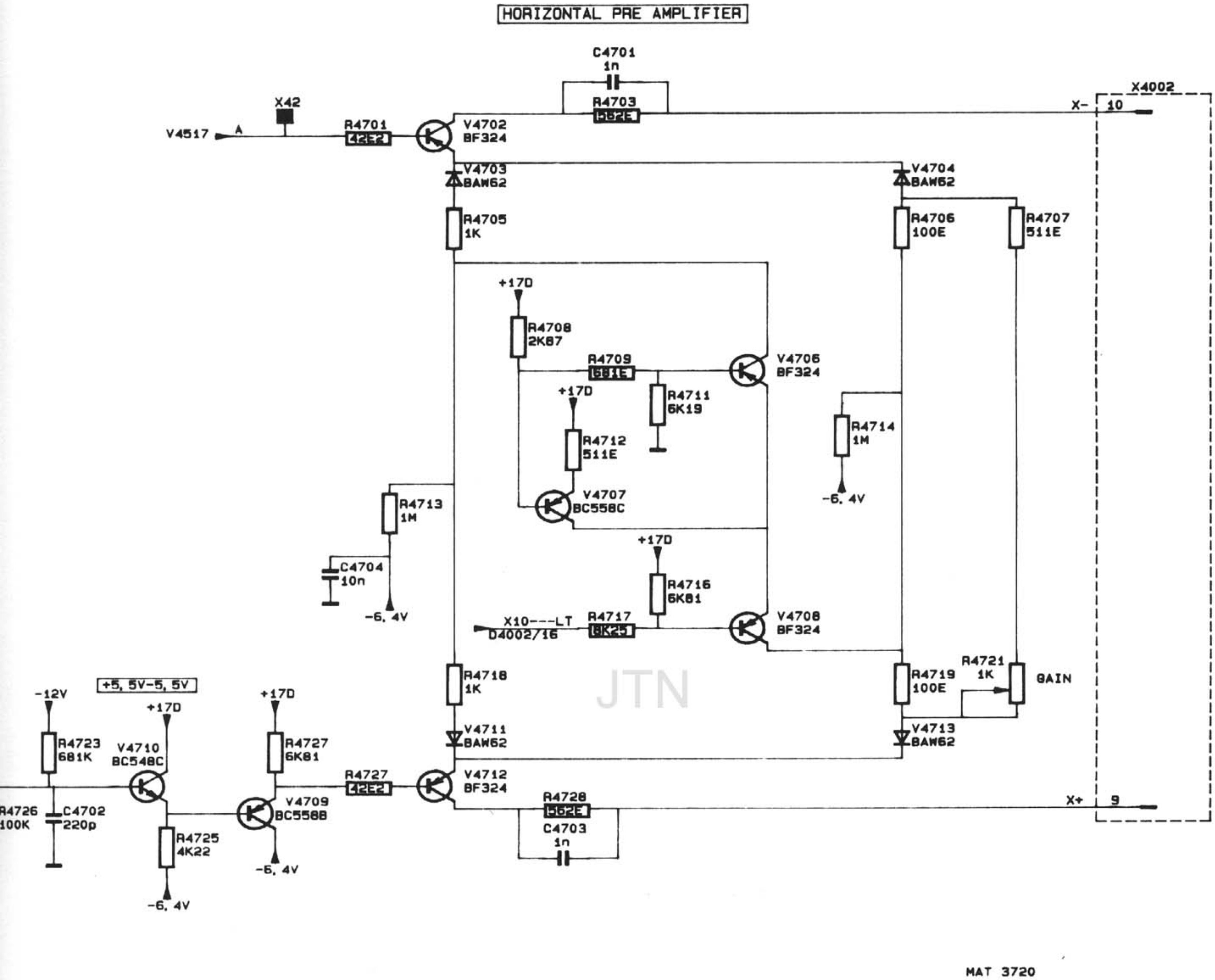


Figure 7.12 Circuit diagram of time-base: Horizontal pre-amplifier



REF NO	TYPE
D4101	HEF4053



REF NO	TYPE
D4101	HEF4053

Figure 7.12 Circuit diagram of time-base: Horizontal pre-amplifier

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 influence the associated circuits is described together with the description of the relevant circuit part.

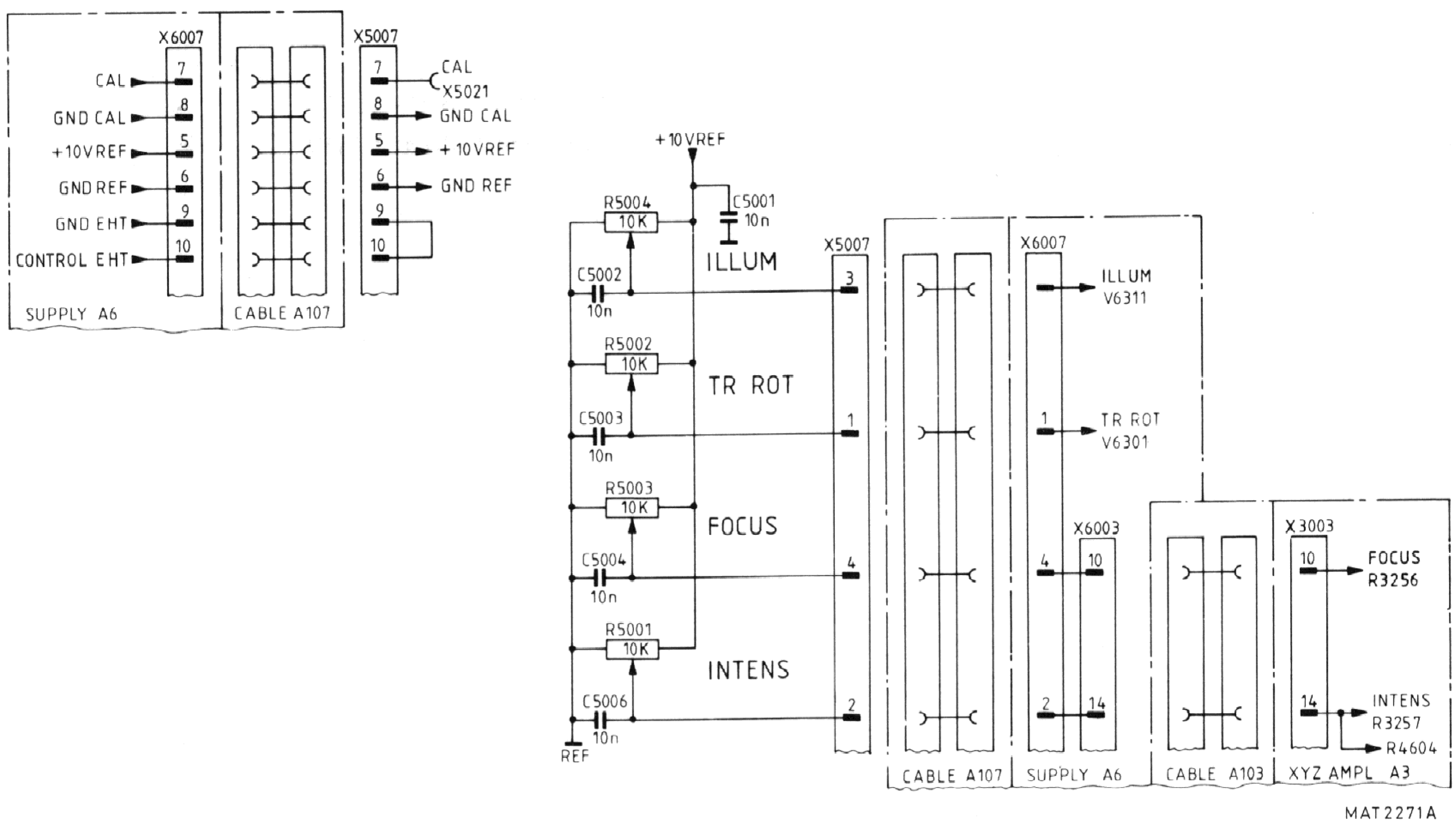


Figure 8.1 Circuit diagram of CRT control

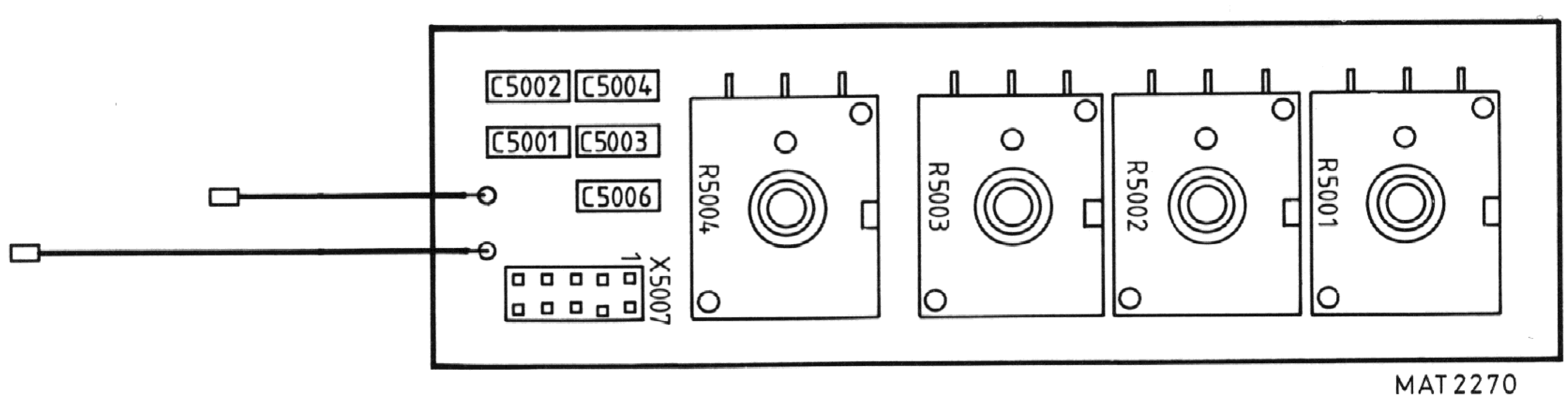


Figure 8.2 CRT control unit p.c.b.

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...264 V a.c.
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 Vac: 30 kHz approx and for 220 Vac: 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 gain 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)

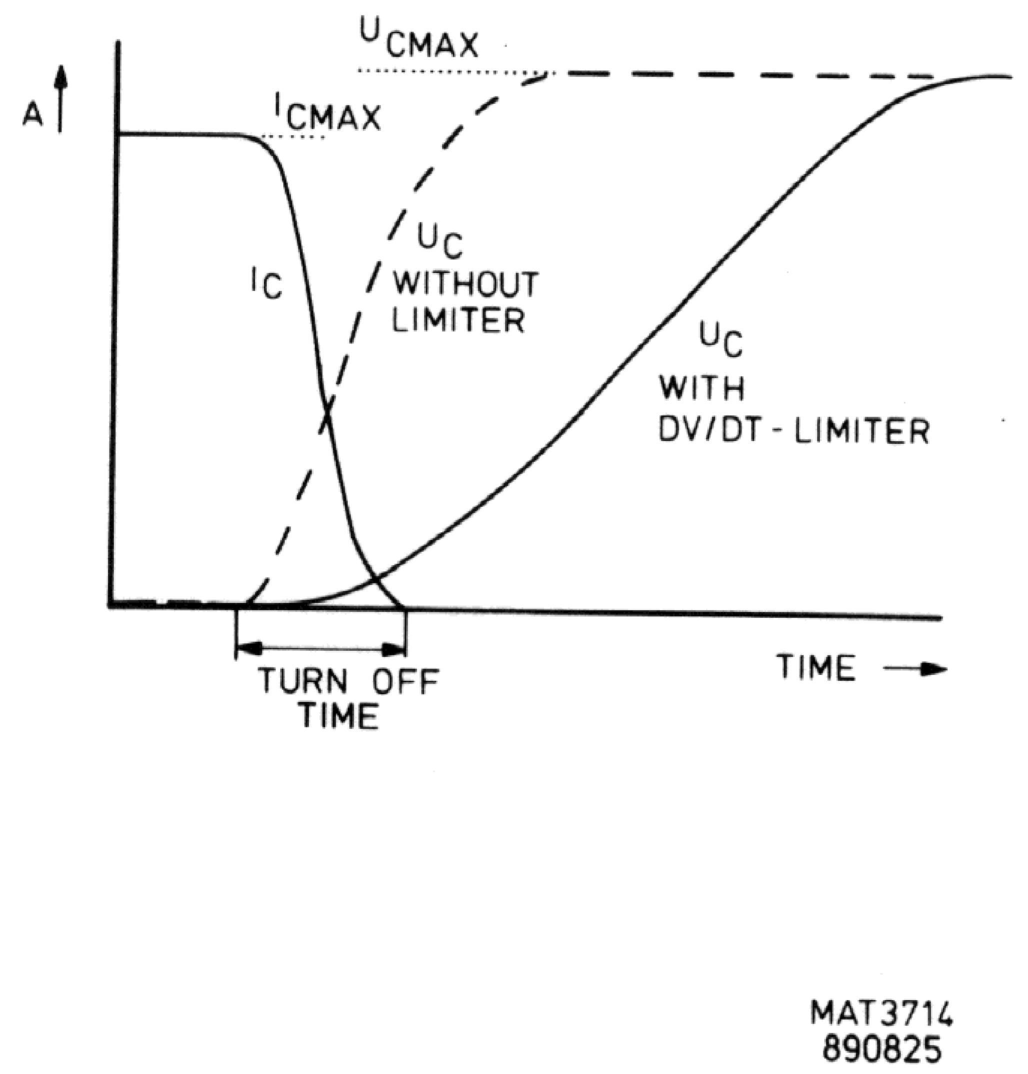


Figure 9.1 Collector-voltage and -current waveforms of V6018 (switching off).

By slowing down the increase of Uc (i.e. limiting dv/dt), the product P = Uc Ic of the collector voltage Uc and the collector currrent 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 !*

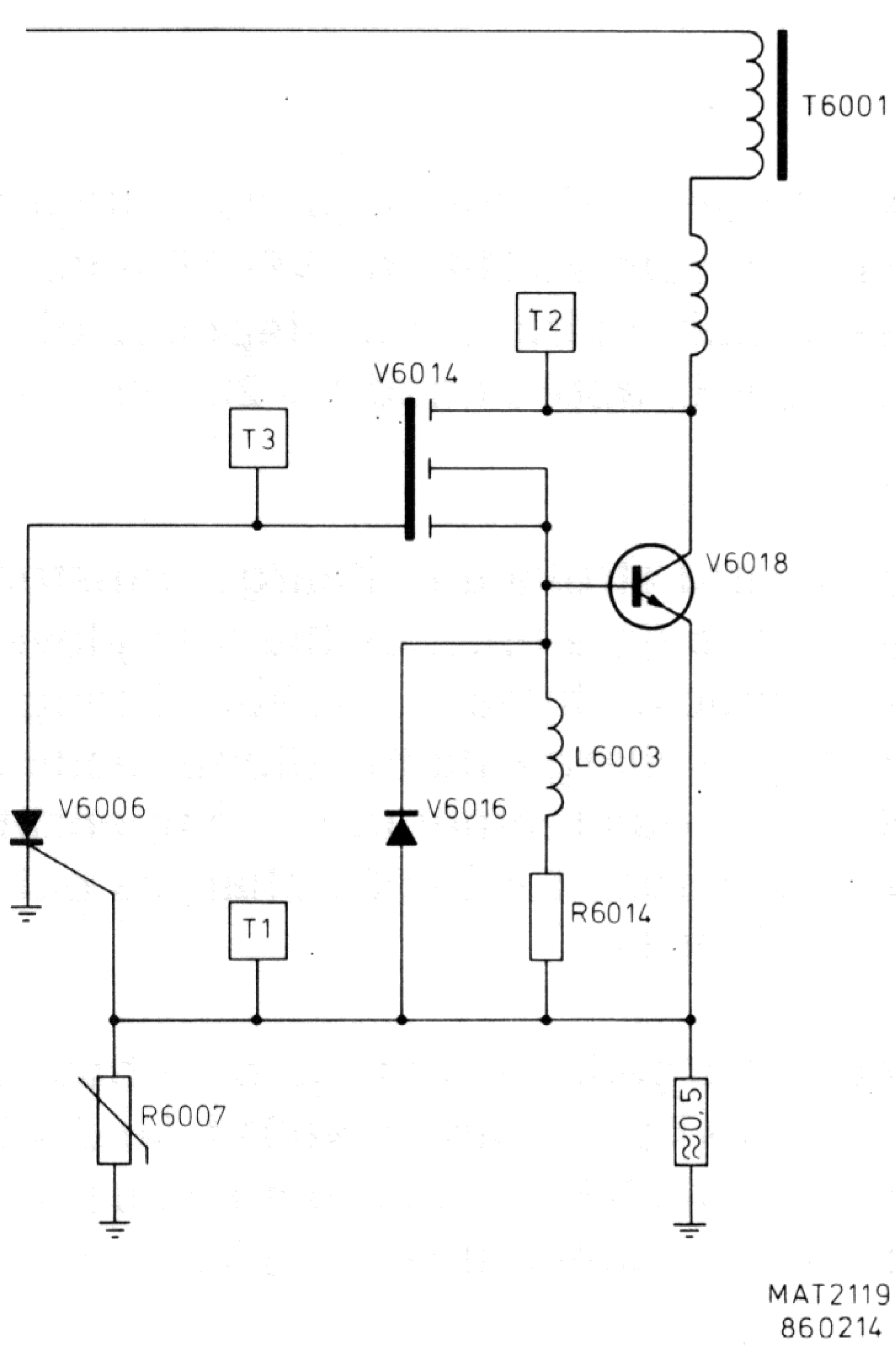


Figure 9.2 Converter circuit

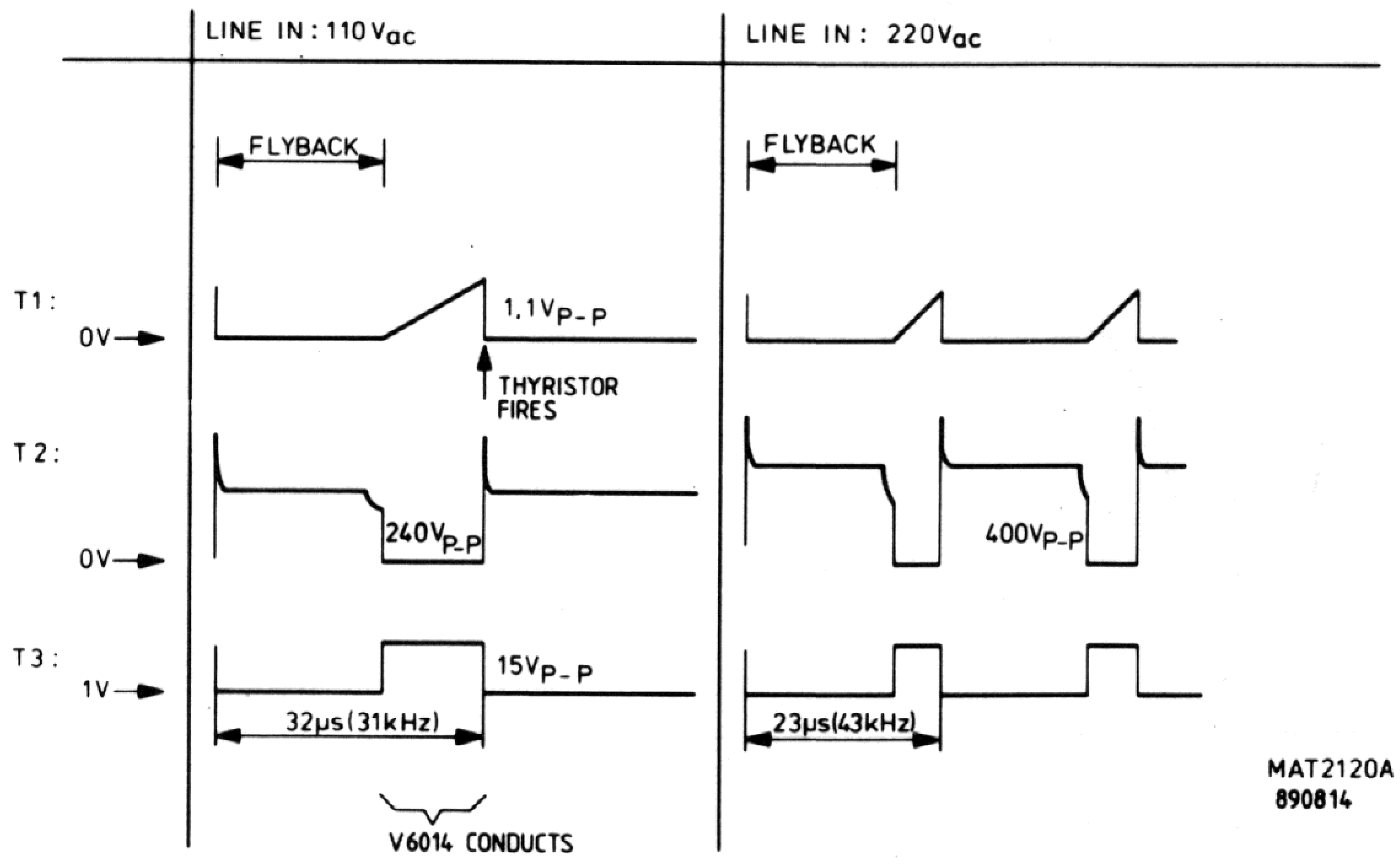


Figure 9.3 Timing diagram converter circuit

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

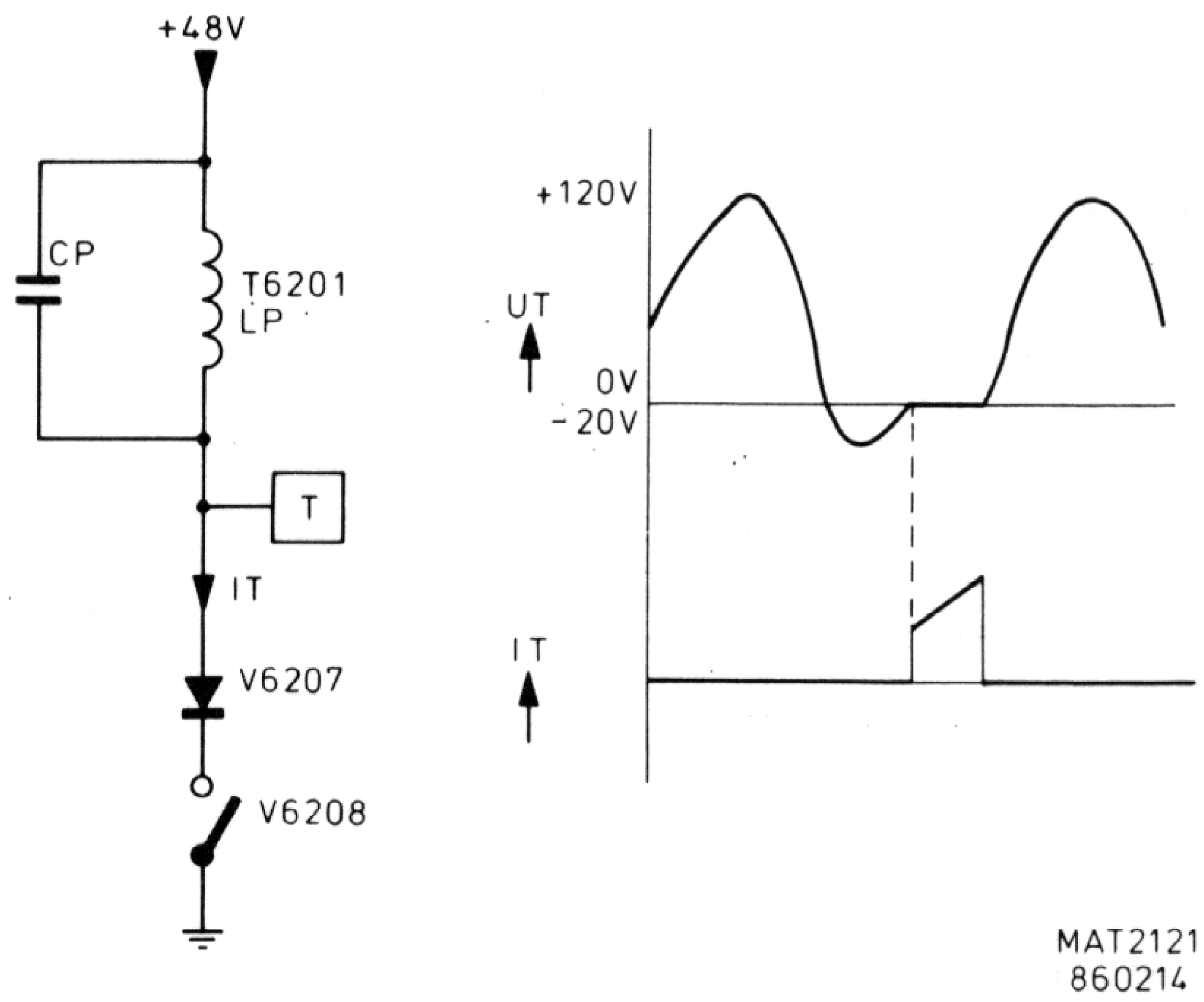


Figure 9.4 HT oscillator

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 an 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.

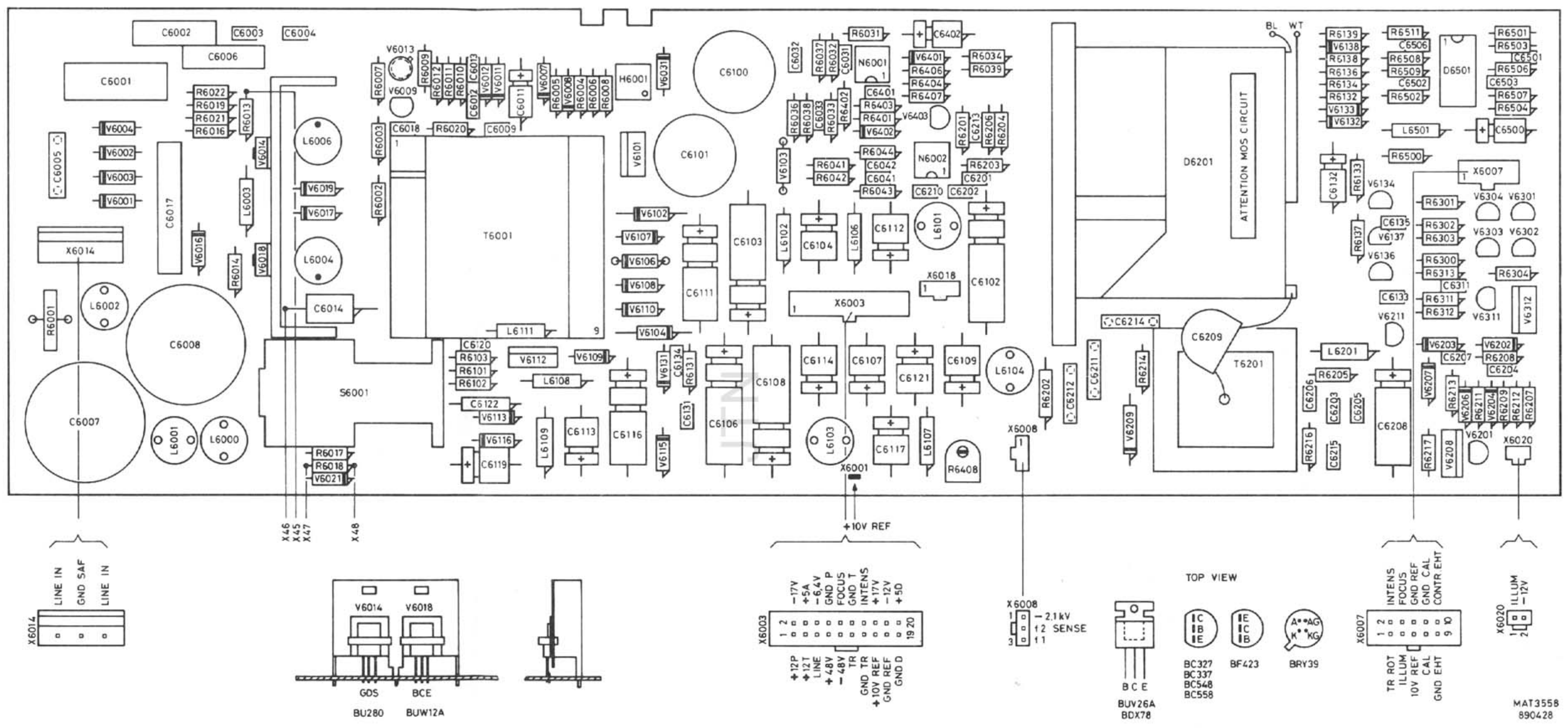


Figure 9.5 Power supply unit p.c.b.

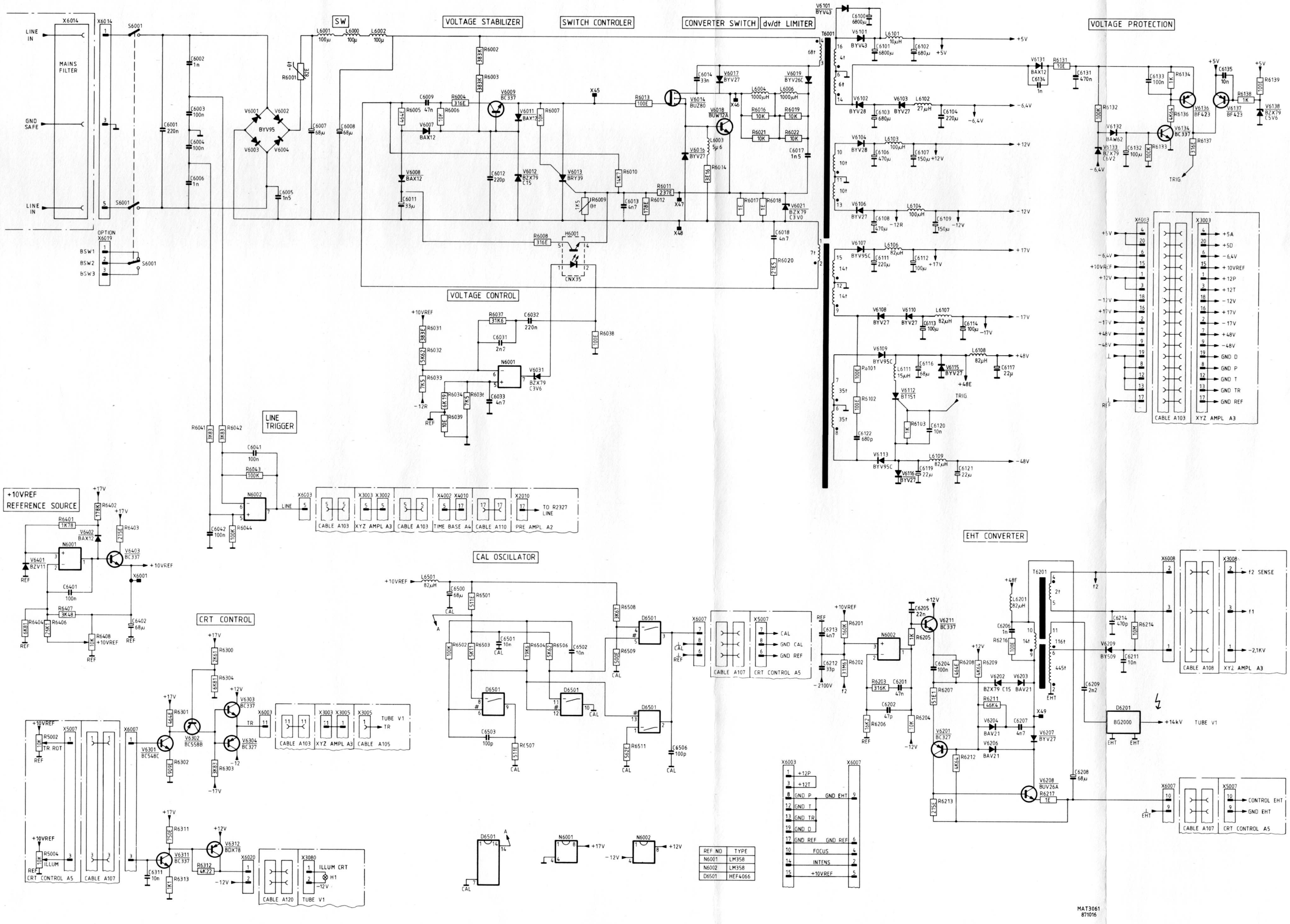


Figure 9.5 Circuit diagram of power supply

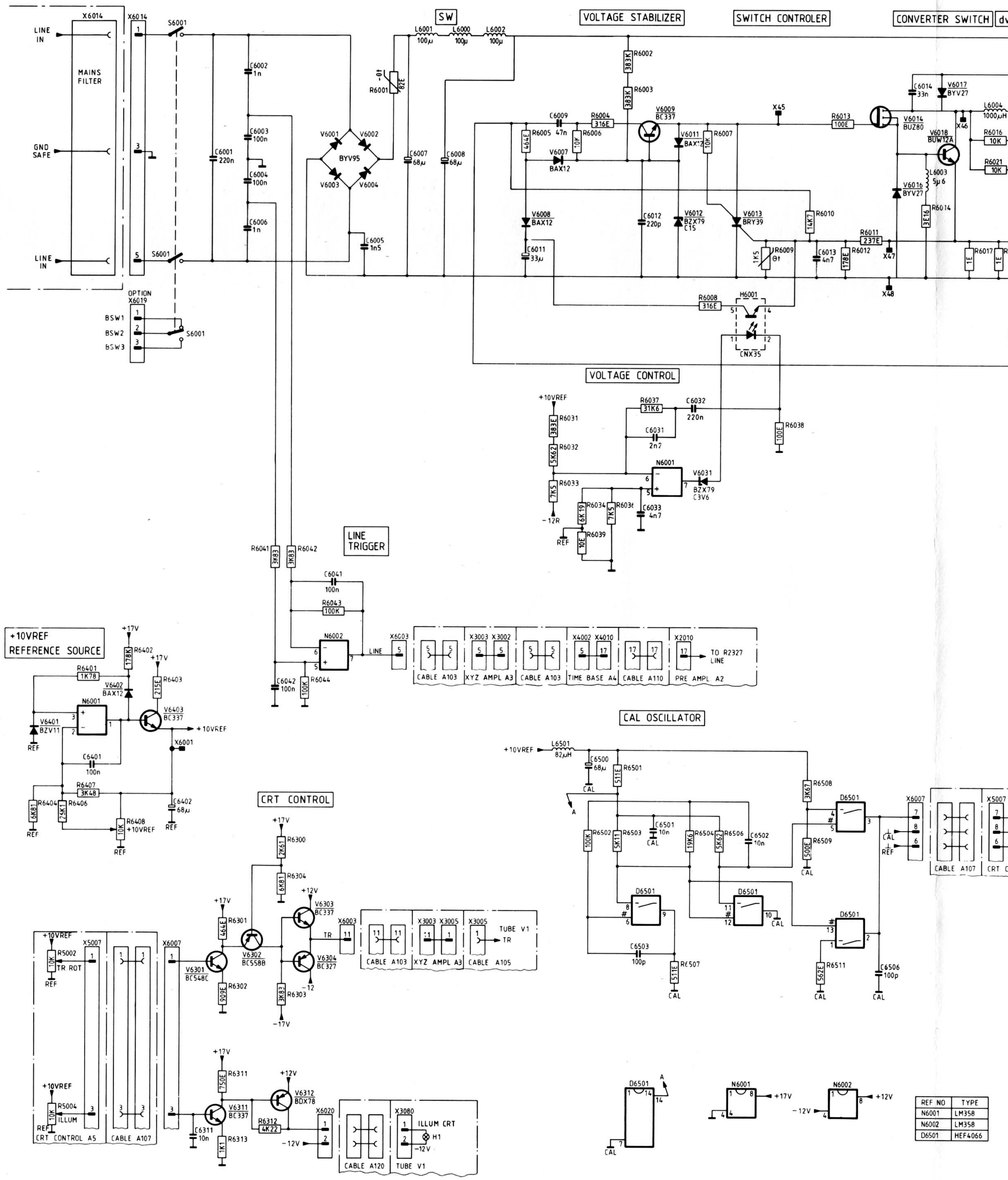
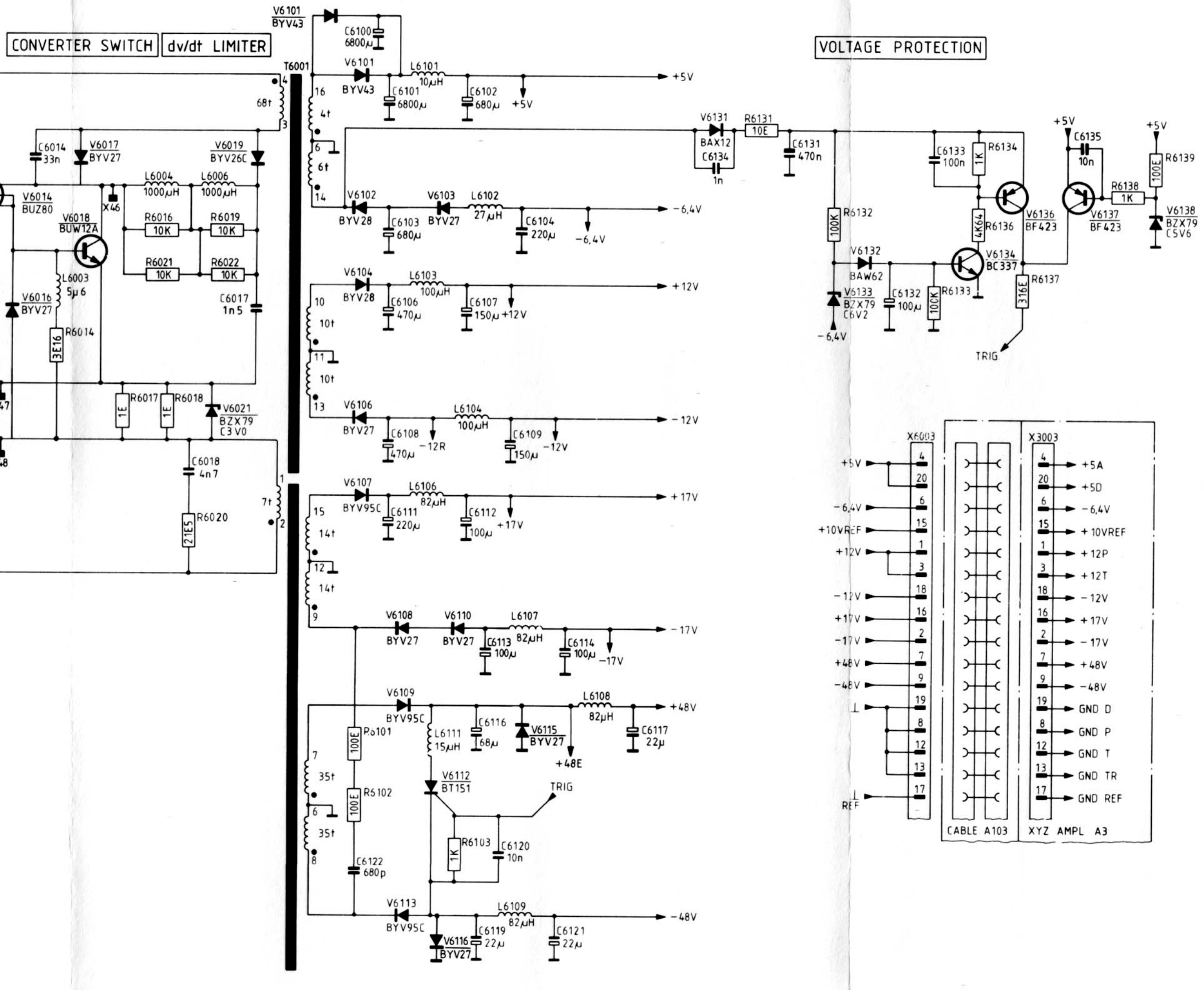
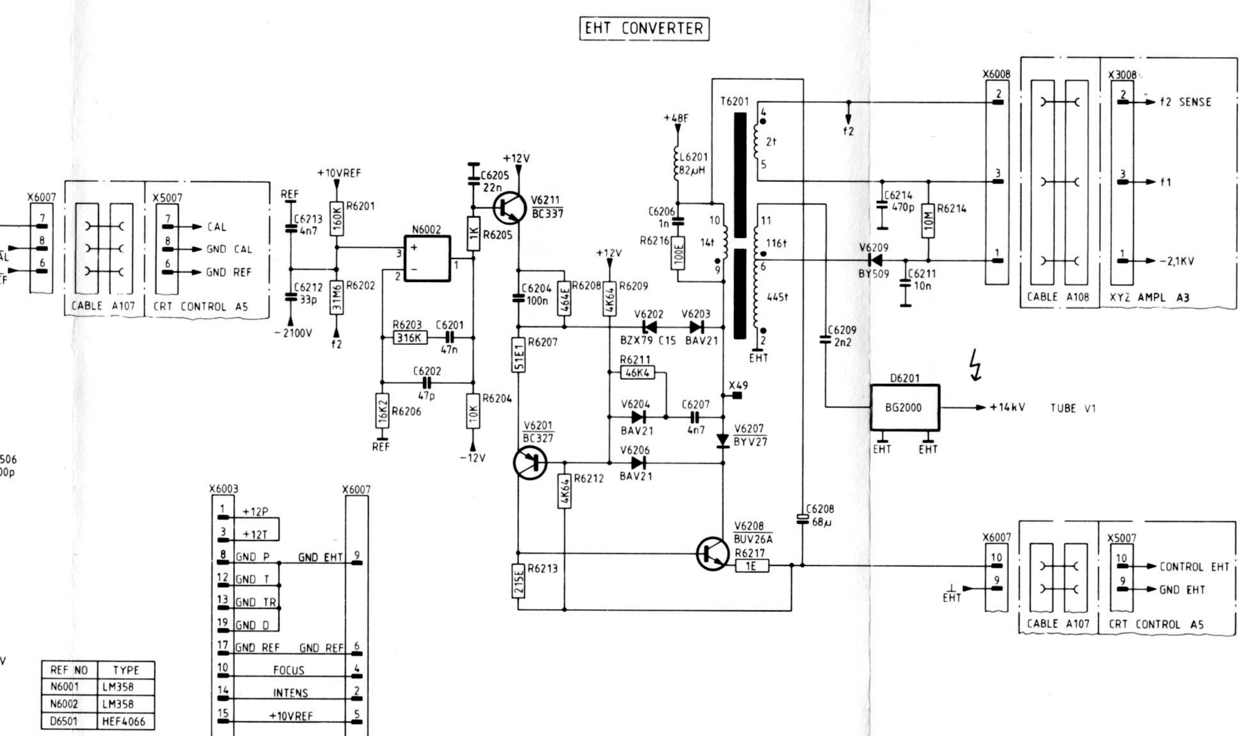


Figure 9.5 Circuit diagram of power supply

3350





REF NO	TYPE
N6001	LM358
N6002	LM358
D6501	HEF4066

MAT3061
871016

10 FRONT UNIT (A7-A8)

The front unit consists of:

- the key-matrix
- the front controls and indicator
- the LCD display

10.1 KEY-MATRIX

The key matrix is connected to two remote 8 bit I/O ports. ROW 1...8 is applied to D7001 and COLUMN 1...8 is applied to D7002. Depending on the softkey which is depressed, a certain ROW and COLUMN will be influenced. This is read by the SDA0 line and thus by the microprocessor. The lines ROW 1, COL 1, COL 3, COL 5, COL 6 and COL 7 are also connected to the cursor unit A9 and read the cursor softkeys.

10.2 FRONT CONTROLS AND INDICATOR

The front-panel controls give a voltage between 0...10 V to the various circuits. To determine the UNCAL position of VAR A, VAR B or VAR, the dc voltages on the slider of the potentiometer are applied to comparator N7001. When the voltage level of the control is lower than 0,7 V, the I^2C bus reads a logic high. Then the microprocessor adapts the LCD display to indicate the CAL status (e.g. no flashing " > " segment visible)

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 following table:

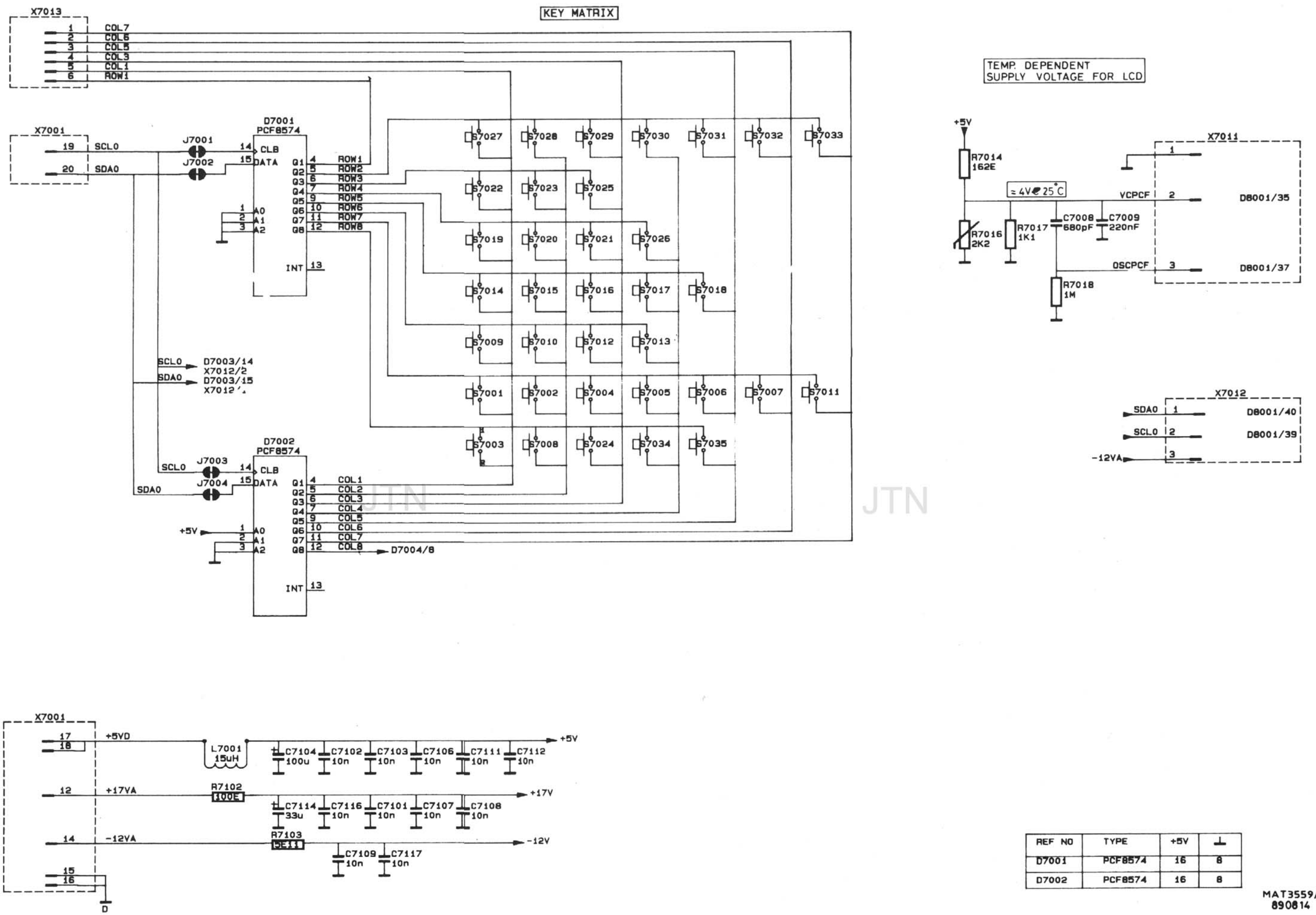
Pin 3 (16)	Pin 6 (17)	Pin 7 (12)	V/DIV attenuation
2k32	0	0	x10
6k98	1	0	x100
7k68	0	1	x1
10k	1	1	x1

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 also decreases.
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.



REF NO	TYPE	+5V	⊥
D7001	PCF8574	16	8
D7002	PCF8574	16	8

Figure 10.1 Circuit diagram of front unit: key matrix

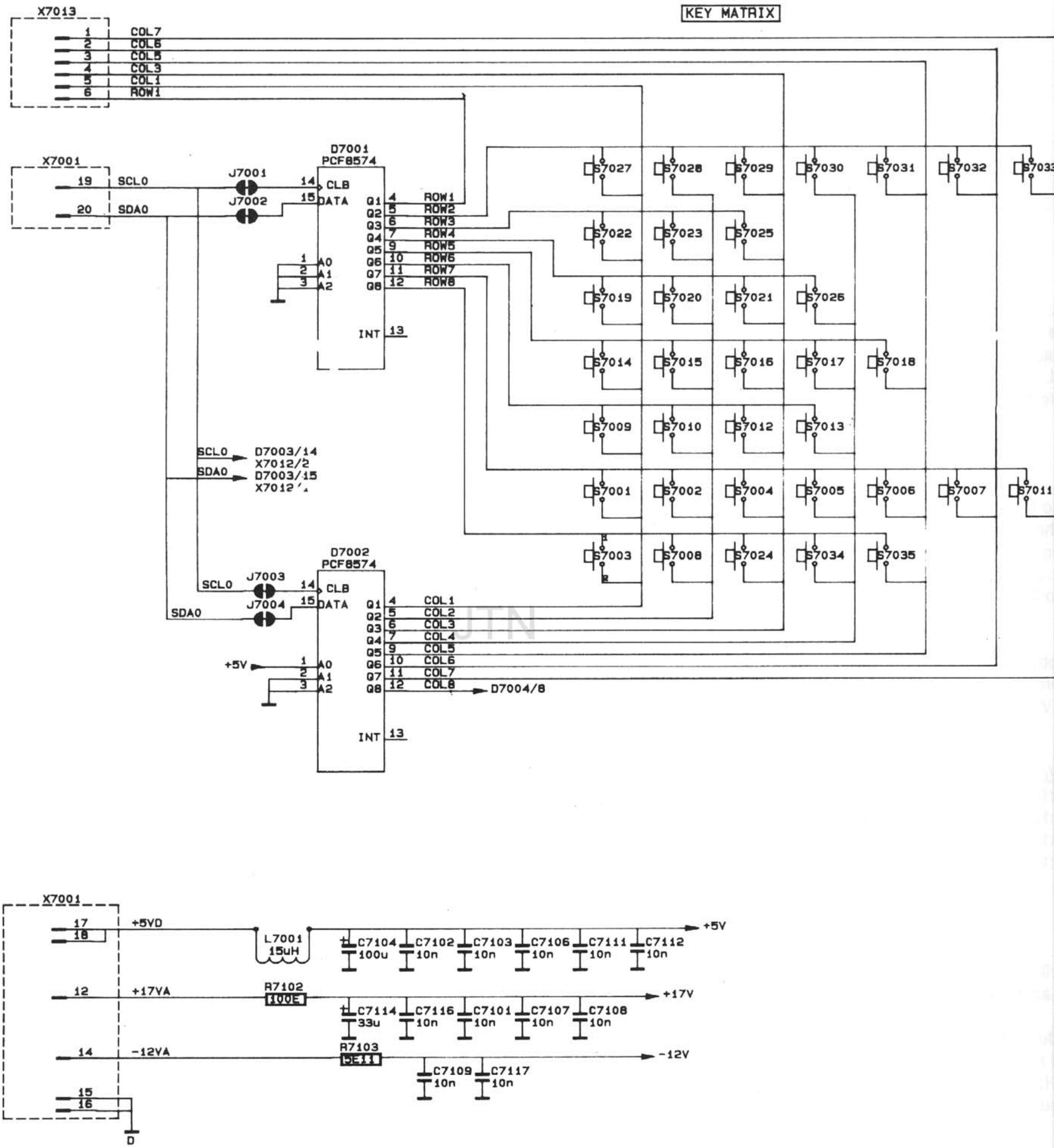
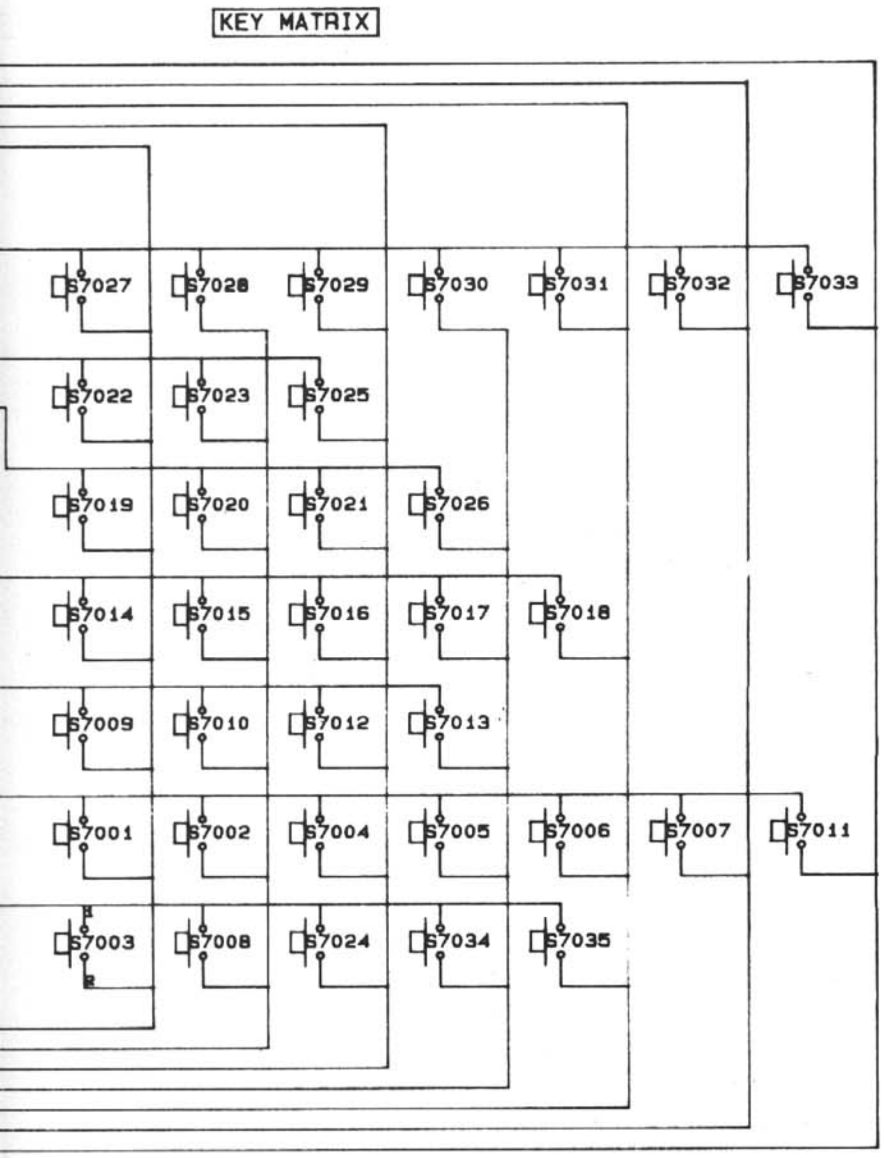
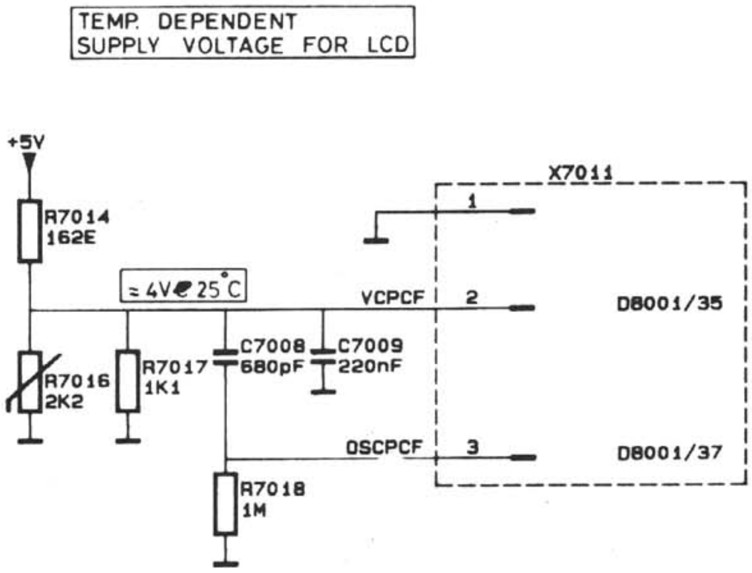
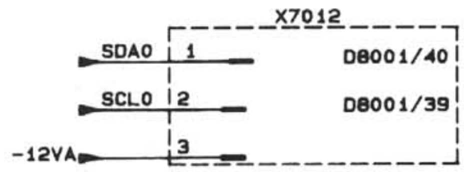
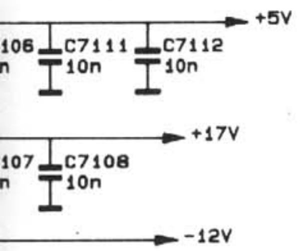


Figure 10.1 Circuit diagram of front unit: key matrix









REF NO	TYPE	+5V	⊥
D7001	PCF8574	16	8
D7002	PCF8574	16	8

MAT3559A
890814

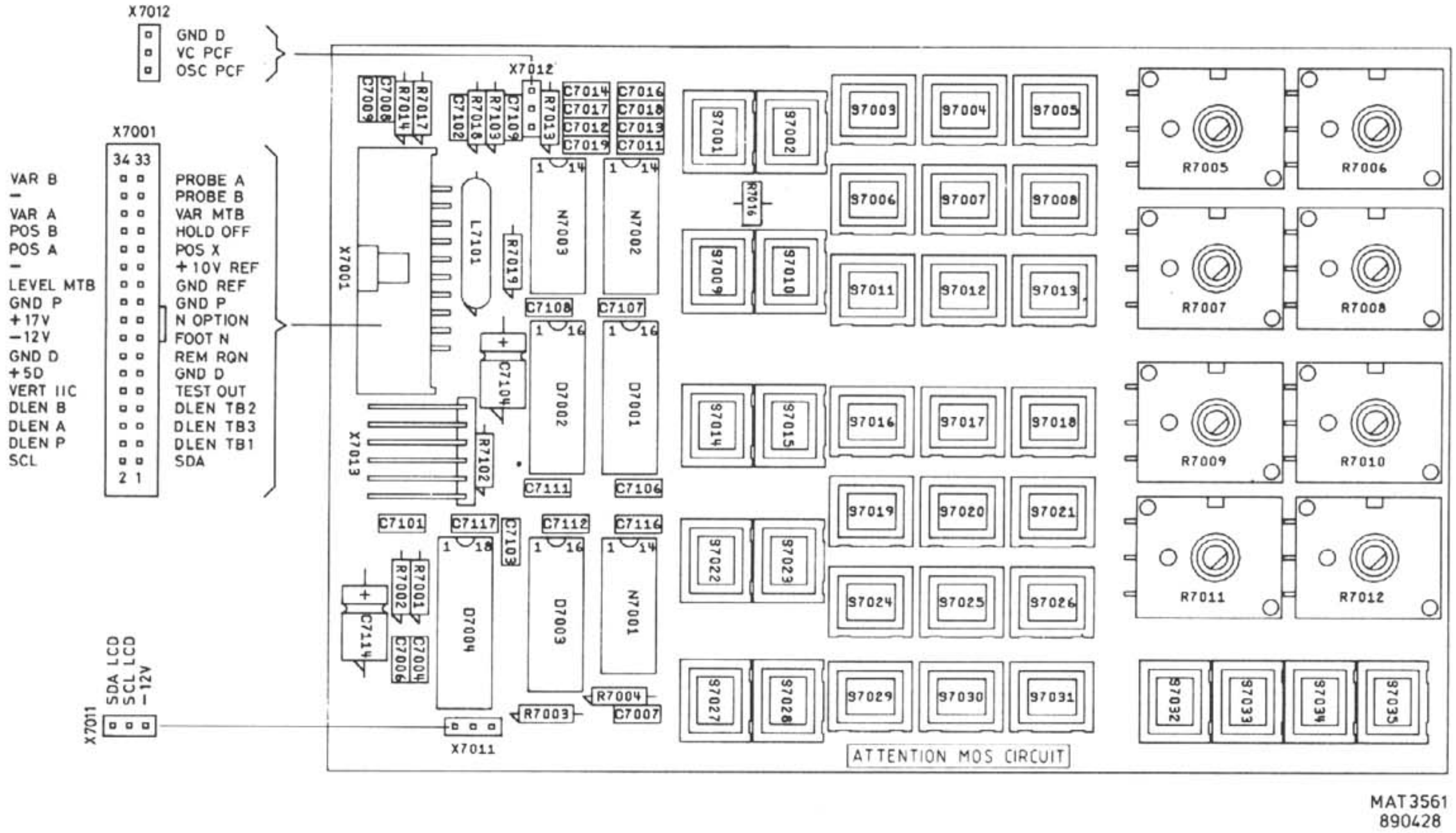
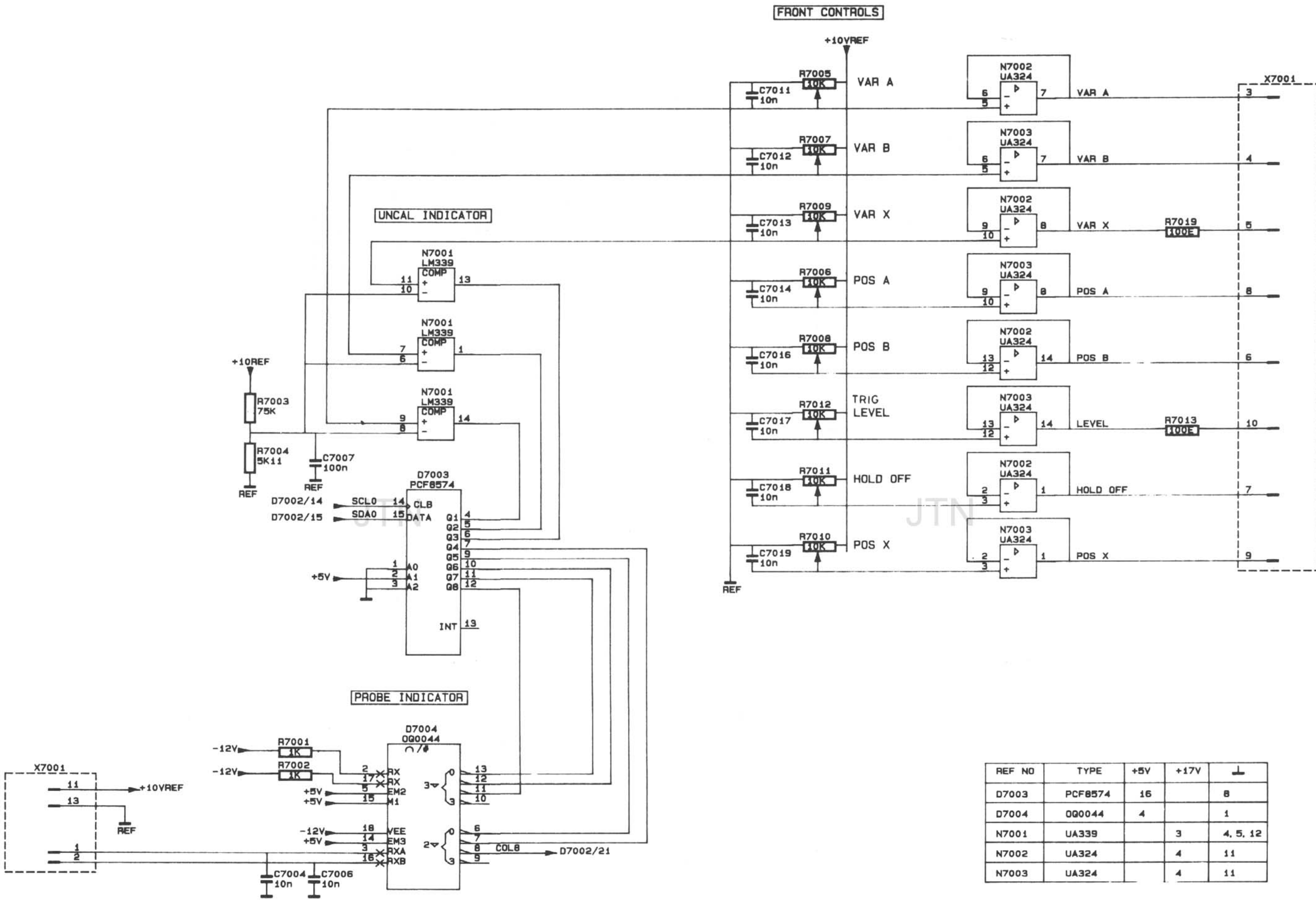


Figure 10.2 Front unit p.c.b.



REF NO	TYPE	+5V	+17V	⊥
D7003	PCF8574	16		8
D7004	0Q0044	4		1
N7001	UA339		3	4, 5, 12
N7002	UA324		4	11
N7003	UA324		4	11

MAT3560A
890811

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

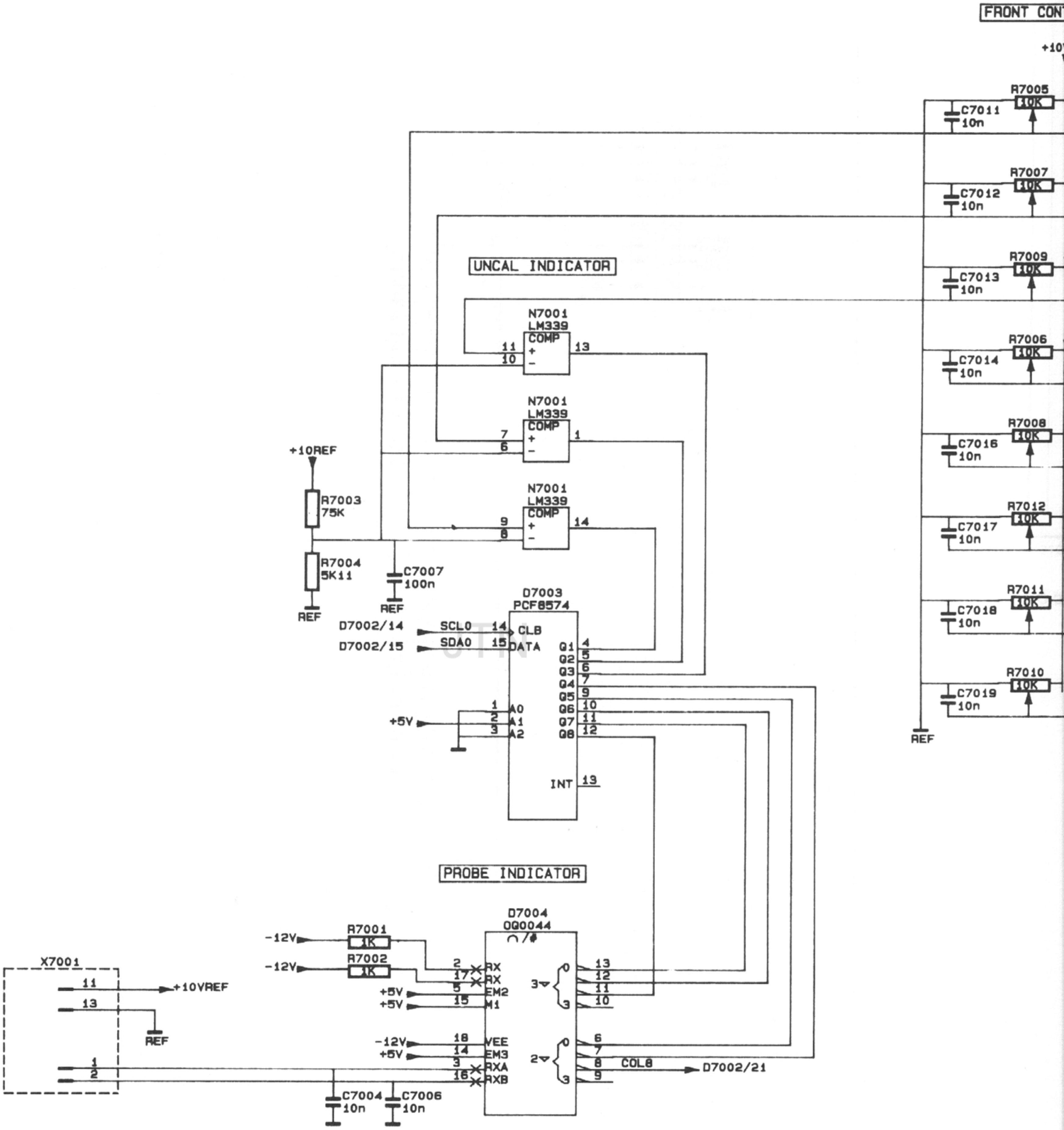
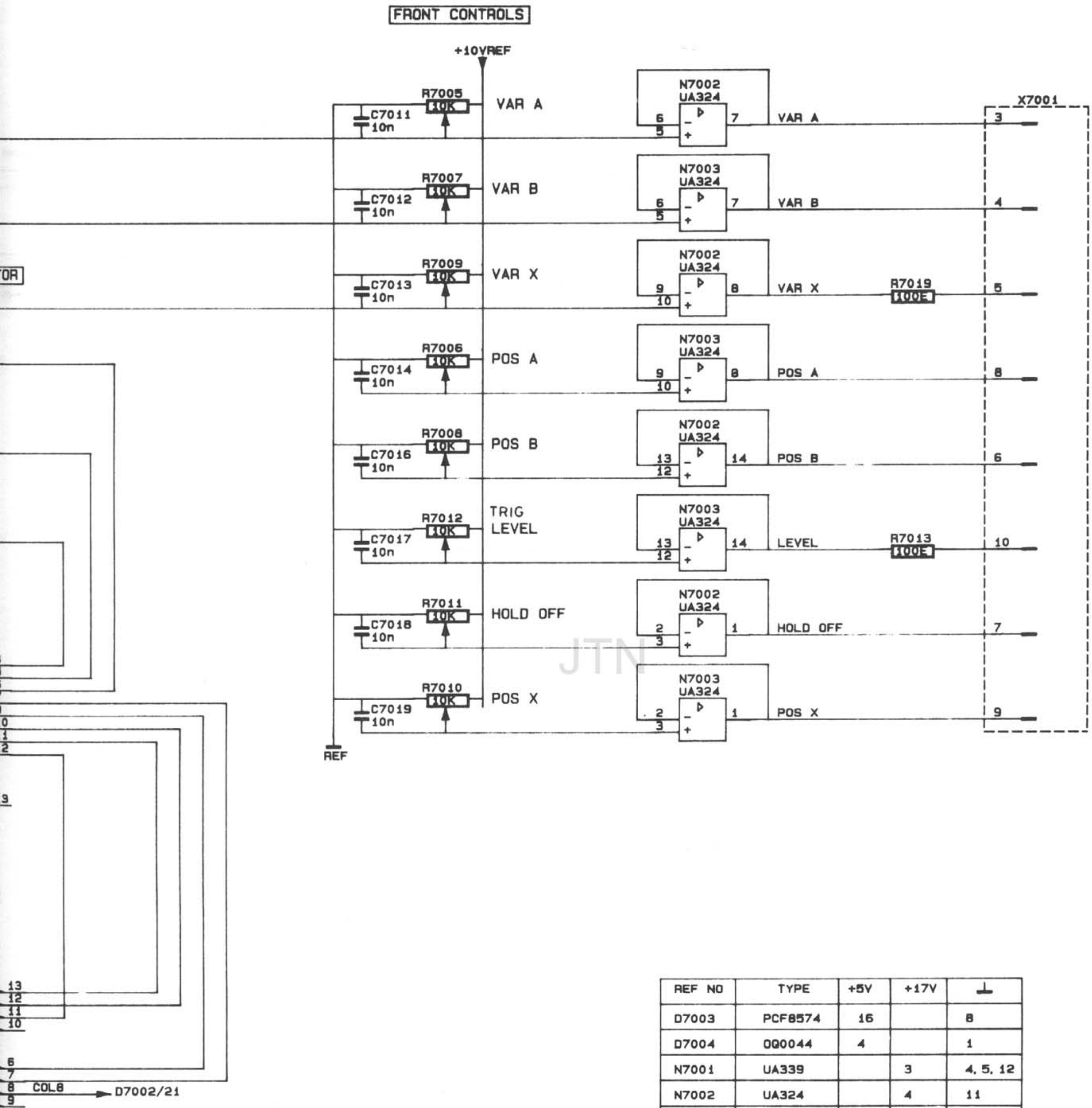


Figure 10.3 Circui



REF NO	TYPE	+5V	+17V	⊥
D7003	PCF8574	16		8
D7004	0Q0044	4		1
N7001	UA339		3	4, 5, 12
N7002	UA324		4	11
N7003	UA324		4	11

MAT3560A
890811

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

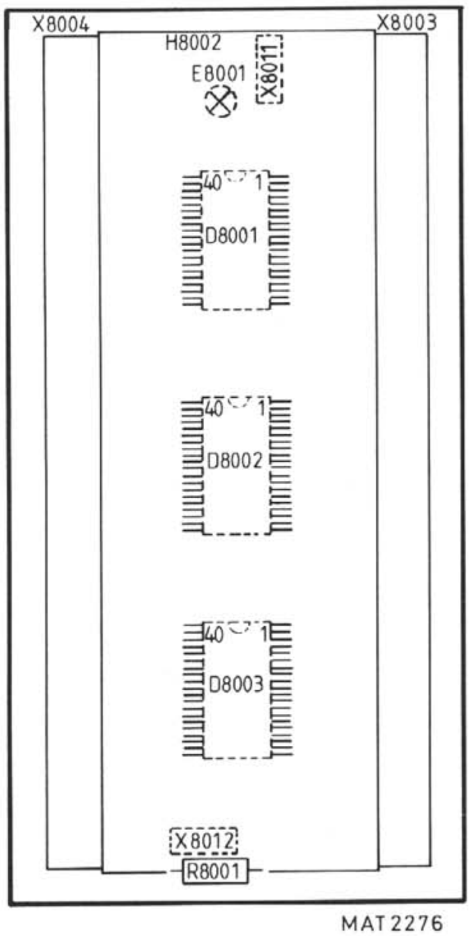
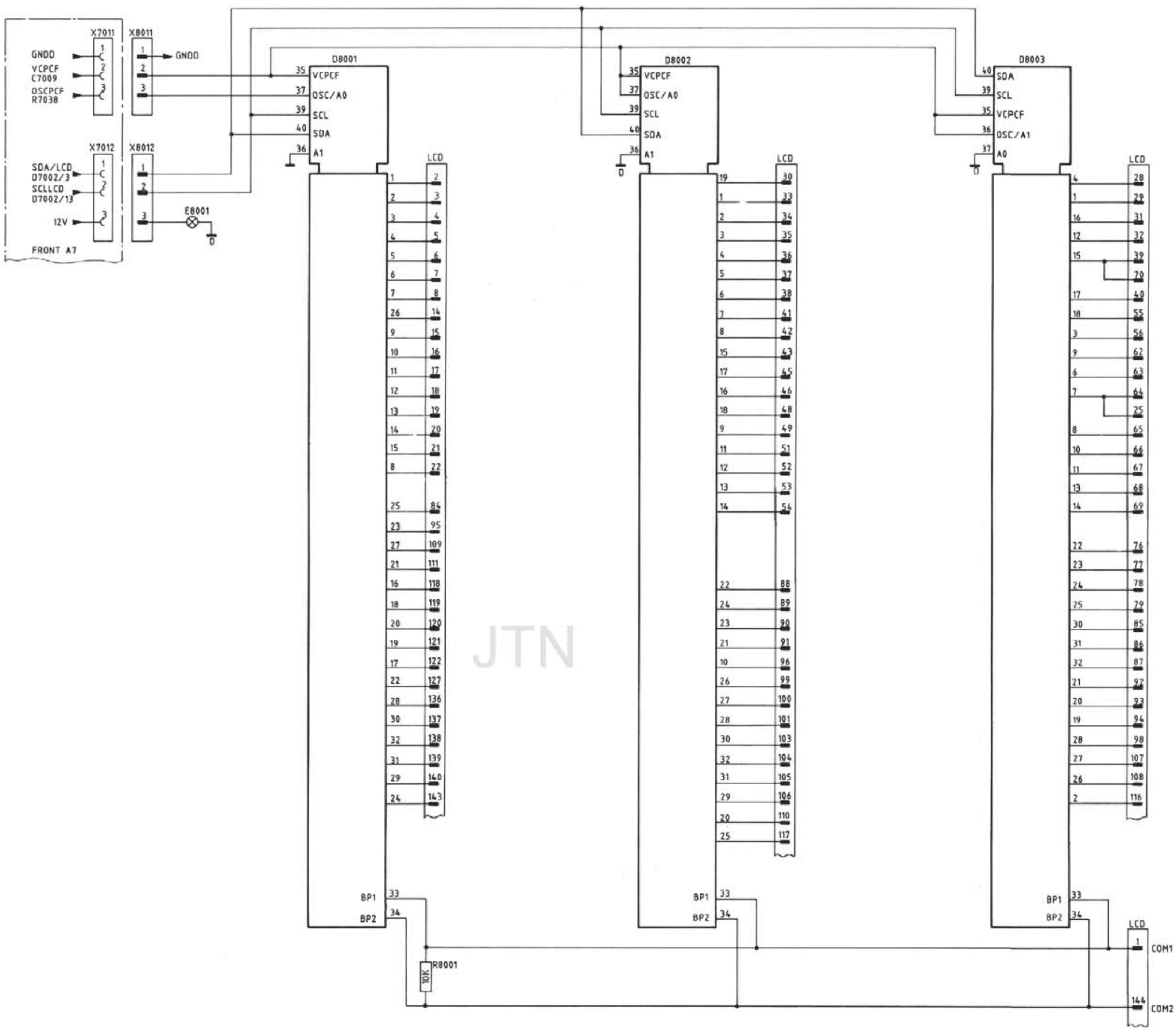


Figure 10.4 LCD unit p.c.b.



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

Figure 10.5 Circuit diagram of LCD unit

LCD				
	COM1		COM2	
PIN	DISPLAY	SEGMENT	DISPLAY	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	

LCD				
	COM1		COM2	
PIN	DISPLAY	SEGMENT	DISPLAY	SEGMENT
1		COM1		
2	2	a	2	f
3	2	b		
4	2	g	2	e
5	2	c	2	d
6		rf		)
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		rf		)
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		)		rf
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 MOTHERBOARD UNIT (A10)

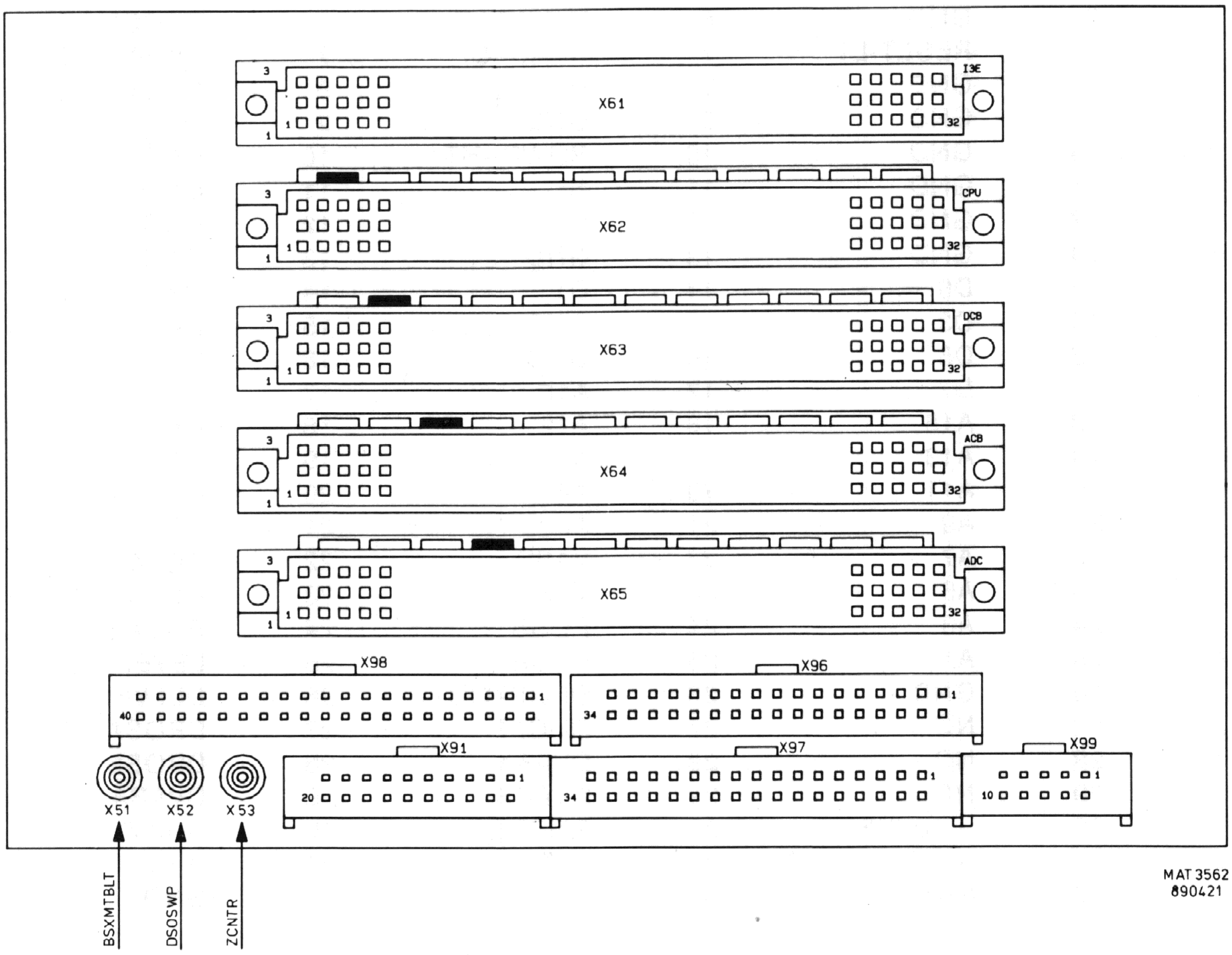


Figure 11.1 Motherboard unit p.c.b.

A complete signal name list of all motherboard connectors is given on the next pages.

CONNECTOR PINNINGS X61

A		B		C	
1	-17V	1	GND	1	-6,4V
2	+12T	2	GND	2	GND
3	GND	3	GND	3	GND
4	RESET-HT	4	DGPTCSLT	4	IEEECSLT
5	NC	5	NC	5	ROM2CSLT
6	GND	6	WRITE-LT	6	DACCS-LT
7	RESET-LT	7	READ--LT	7	SDA0
8	GND	8	IEEECLK	8	SCL0
9	GND	9	GND	9	NC
10	GND	10	RDWR--HT	10	GND
11	GND	11	NC	11	GND
12	GND	12	NC	12	GND
13	GND	13	GND	13	GND
14	D0	14	D1	14	D2
15	D3	15	GND	15	D4
16	D5	16	GND	16	D6
17	D7	17	A16	17	A14
18	A15	18	A12	18	A10
19	A13	19	A8	19	A6
20	A11	20	A4	20	A2
21	A9	21	A0	21	GND
22	A7	22	VARB	22	VARX
23	A5	23	VARA	23	HOLDOFF
24	A3	24	POSB	24	POSXOUT
25	A1	25	POSA	25	LEVEL
26	GND	26	DPOSXOUT	26	DLEVEL
27	NC	27	DHOFF	27	DPOSA
28	NC	28	DVARX	28	DPOSB
29	NC	29	DVARB	29	DVARA
30	+10VREF	30	GNDREF	30	+17V
31	+5V	31	+5V	31	+5V
32	GND	32	GND	32	GND

CONNECTOR PINNINGS X62

A		B		C	
1	SCL	1	SRTTB-LT	1	RDADD-LT
2	RESET-HT	2	GND	2	GND
3	DCCLK	3	DTTC--LT	3	MEMON-LT
4	GND	4	DGPTCSLT	4	IEEECSLT
5	DELTRGHT	5	GND	5	ROM2CSLT
6	RSTACQLT	6	WRITE-LT	6	DACCS-LT
7	RESER-LT	7	READ--LT	7	SDA0
8	DSOCLK	8	IEEECLK	8	SCL0
9	DSPINTLT	9	TBSTNCHT	9	GND
10	SWR---HT	10	SWTBCLKT	10	DSOACKLT
11	ENCVCNHT	11	SWTBCLK	11	DSOCS-LT
12	CVCNRYLT	12	GND	12	DTST--LT
13	RDWR--HT	13	GND	13	GND
14	D0	14	D1	14	D2
15	D3	15	GND	15	D4
16	D5	16	NC	16	D6
17	D7	17	NC	17	A16
18	A15	18	NC	18	A14
19	A13	19	GND	19	A12
20	A11	20	GND	20	A10
21	A9	21	GND	21	A8
22	A7	22	GNDB	22	A6
23	A5	23	NC	23	A4
24	A3	24	NC	24	A2
25	A1	25	DLENY-HT	25	A0
26	DLENX-HT	26	GND	26	DLENB-HT
27	DLENA-HT	27	TESTO-HT	27	VERIICHT
28	DLENP-HT	28	DLENT2HT	28	DLENT1HT
29	SDA1	29	EDC---LT	29	SCL1
30	+10VREF	30	GNDREF	30	+17V
31	+5V	31	+5V	31	+5V
32	GND	32	GND	32	GND

CONNECTOR PINNINGS X63

A		B		C	
1	SCL	1	GND	1	RES5
2	RESET-HT	2	GND	2	BATT
3	TBWE--HT	3	DCWE--HT	3	STWE--HT
4	PENLFT	4	GND	4	MEMON-HT
5	PLOT--HT	5	DELTRGHT	5	DOTS--LT
6	ZON---LT	6	NC	6	SC0---HT
7	OSCON-LT	7	NC	7	RESET-LT
8	TCINN-HT	8	TRIGENHT	8	DSOCLK
9	INVA0-HT	9	DATEN-HT	9	DSPINTLT
10	MIDCLKHT	10	XYDLE-HT	10	DSOCS-LT
11	RES7	11	OLCLK	11	DSOCS-LT
12	WRSMP-HT	12	MDOE--LT	12	DTST--LT
13	RSTH--LT	13	POSXOFHT	13	RDWR--HT
14	GND	14	D1	14	D0
15	GND	15	D3	15	D2
16	PD0	16	PD1	16	D4
17	PD2	17	PD3	17	D5
18	PD4	18	PD5	18	D6
19	PD6	19	PD7	19	D7
20	XDAC0	20	SC1---HT	20	GND
21	XDAC1	21	GND	21	A16
22	XDAC2	22	A15	22	A14
23	XDAC3	23	A13	23	A12
24	XDAC4	24	A11	24	A10
25	XDAC5	25	A9	25	A8
26	XDAC6	26	A7	26	A6
27	XDAC7	27	A5	27	A4
28	XDAC8	28	A3	28	A2
29	XDAC9	29	A1	29	A0
30	RES1	30	RES2	30	GND
31	+5V	31	+5V	31	+5V
32	GND	32	GND	32	GND

CONNECTOR PINNINGS X64

A		B		C	
1	SCL	1	GND	1	RES5
2	RESET-HT	2	GND	2	MEMON-HT
3	CDRD--HT	3	TCEV--LT	3	SWCK
4	RSSW--HT	4	DISOD-HT	4	INTOD-HT
5	PLOT--HT	5	DELTRGHT	5	DOTS--LT
6	EDC---LT	6	RSTEV-LT	6	RSTOD-LT
7	BSXMTBLT	7	SC0---HT	7	DISEV-HT
8	OSCON-LT	8	TCINN-HT	8	TRIGENHT
9	RSTACQLT	9	INVA0-HT	9	DATEN-HT
10	DTUF--HT	10	MIDCLK	10	XYDLE-HT
11	SRTACQHT	11	RES7	11	OLCLK
12	CHB---LT	12	WRSMP-HT	12	MDOE--LT
13	GND	13	RSTH--LT	13	GND
14	CHA---LT	14	SWR---HT	14	TBSYNCHT
15	NC	15	ENCVCNHT	15	SWTBCLK
16	STCONVLT	16	CVCNRYLT	16	SWTB
17	CHSEL1HT	17	CHSEL0HT	17	NC
18	AD1	18	AD0	18	SDA1
19	AD3	19	AD2	19	SCL1
20	AD5	20	AD4	20	SC1---HT
21	AD7	21	AD6	21	NC
22	YDAC0	22	ED0	22	PD0
23	YDAC1	23	ED1	23	PD1
24	YDAC2	24	ED2	24	PD2
25	YDAC3	25	ED3	25	PD3
26	YDAC4	26	HOLDB-LT	26	PD4
27	YDAC5	27	SRTTB-LT	27	PD5
28	YDAC6	28	SRTMTBHT	28	PD6
29	YDAC7	29	CCDENBHT	29	PD7
30	RES1	30	RES2	30	DLENX-HT
31	+5V	31	+5V	31	+5V
32	GND	32	GND	32	GND

CONNECTOR PINNINGS X65

A		B		C	
1	GND	1	+5A	1	-6,4V
2	GND	2	+5A	2	+5A
3	MEMON-HT	3	BATT	3	+12T
4	GNDP2	4	GNDP2	4	GNDP2
5	+YDAC	5	GNDP2	5	-YDAC
6	GNDP1	6	GNDP1	6	GNDP1
7	CHAEV	7	GNDP1	7	CHAOD
8	GNDA	8	GNDA	8	GNDA
9	CHBEV	9	GNDA	9	CHBOD
10	GNDB	10	GNDB	10	GNDB
11	ZCNTR	11	GNDB	11	DSOSWP
12	PLOT--HT	12	AIN4	12	DOTS--LT
13	ZON---LT	13	GND	13	SC0---HT
14	POSXOFHT	14	GND	14	PENLFT
15	POSX	15	+17V	15	STCONVLT
16	POSXOUT	16	GND	16	CHSEL1HT
17	AD1	17	GND	17	CHSEL0HT
18	AD3	18	GND	18	AD0
19	AD5	19	GND	19	AD2
20	AD7	20	GND	20	AD4
21	XDAC0	21	GND	21	AD6
22	XDAC1	22	GND	22	YDAC0
23	XDAC2	23	NC	23	YDAC1
24	XDAC3	24	NC	24	YDAC2
25	XDAC4	25	GND	25	YDAC3
26	XDAC5	26	GND	26	YDAC4
27	XDAC6	27	GND	27	YDAC5
28	XDAC7	28	GND	28	YDAC6
29	XDAC8	29	GND	29	YDAC7
30	XDAC9	30	+10VREF	30	-12V
31	+5V	31	+5V	31	+5V
32	GND	32	GND	32	GND

CONNECTOR PINNINGS X91

1	PRBA	2	PRBB
3	VARA	4	VARB
5	VARX	6	POSB
7	HOLDOFF	8	POSA
9	POSX	10	LEVEL
11	+10VREF	12	+17V
15	GND	16	GND
17	+5V	18	+5V
19	SCL0	20	SDA0

CONNECTOR PINNINGS X98

1	GNDB	2	CHBEV
3	CHBOD	4	GNDA
5	CHAOD	6	CHAEV
7	GNDP1	8	+YDAC
9	-YDAC	10	GNDP2
11	MEMON-HT	12	RSTOD-LT
13	DISEV-HT	14	RSTEV-LT
15	SWTB	16	DISOD-HT
17	INTEV-HT	18	INTOD-HT
19	SAMPLEHT	20	CDRD--HT
21	DCCLK	22	TCEV--LT
23	ED3	24	DTUF--LT
25	ED2	26	EDC---LT
27	ED1	28	DTTC--LT
29	ED0	30	RSSW--HT
31	DCWE--HT	32	SWCK
33	OSCON-LT	34	TBWE--HT
35	+12T	36	STWE--HT
37	+5A	38	-17V
39	-6,4V	40	GND

CONNECTOR PINNINGS X99

1	+17V	2	CCDENBHT
3	HOLDB-LT	4	GND
5	CHA---LT	6	+5V
7	CHB---LT	8	GND
9	ADCIN4	10	GNDP

50 OHM CONNECTOR PINNINGS

X51	BSXMTBLT
X52	DSOSWP
X53	ZCNTR

12 OPTIONS (A11)

The optionslot on the Motherboard (connector X65) is reserved for optional expansions for this instrument.
Description of the option will be given in separate manuals.

13 CPU UNIT (A12)

13.1 INTRODUCTION

This unit mainly consists of a powerful 68008 microprocessor configuration with PROM, address decoders, I/O buffers and a clock generator. The microprocessor runs at a clock frequency of 8 MHz. The microprocessor has an asynchronous bus structure with a 20-bit address bus and an 8-bit databus. Asynchronous means that the microprocessor waits for a "data acknowledge" signal before continuing. This enables the microprocessor to handle different access times in the circuit.
To provide specific serial data transfer possibilities, the microprocessor system also contains an I^2C bus interface.
The I^2C bus is for 2-way, 3-line communication between different ICs or modules. The three lines are a serial data line (SDA), a serial clock line (SCL) and ground. The SDA and SCL lines must be connected to a positive supply via pull-up resistors when connected to the output stages of a device. Data transfer may be initiated only when the bus is not busy.

13.2 MEMORY MAP

Only a part of the complete address range is used, according to the following memory map. The map gives also the memory select signals, generated by device D201.

Address (hex)		Decoding		Signal	Connected to
00000 1FFFF		ROM1		ROM1CSLT	D216-24
20000 3FFFF		ROM2 (not used)		ROM2CSLT	--
40000 5FFFF	40000 48000 50000 58000	RDIC0-LT RDIC1-LT -- RSPLT-LT	WRIIC-LT MFOUT-LT -- --	MFIOCSLT	D202-4
60000 7FFFF		RAM		RAMCS-LT	D217-20
80000 9FFFF		IEEE or RS232 (optional)		IEEECSLT	D116-8
A0000 BFFFF		TIMER		TMRCS-LT	D218-21
C0000 DFFFF	C0000 D0000	Digital control DAC		DCPTCSLT	D213-1 and D213-12
E0000 FFFF		various		DSOCS-LT	D314-7

The signal MFIOCSLT is decoded again by D202. When RDWR--HT is high, this determines the read status of the decoded signals; when it is low this determines the write status. The coding of MFIOCSLT is as follows:

Address range (Hex)	Read	Write
40000-47FFF	RDIC0-LT	WRIIC-LT
48000-4FFFF	RDIC1-LT	MFOUT-LT
50000-57FFF	--	--
58000-5FFFF	RSPLT-LT	--

The signal DCPTCSLT is decoded by D213 and, controlled by A16, gives the DACCS-LT and DGPTCS-LT signals.

The signal DSOCS-LT is applied to the DCL unit A13 and selects among other things the acquisition RAM or the display RAM.

13.3 CIRCUIT DESCRIPTION

The **MICROPROCESSOR** D214 is connected via the DATA bus D0...D7 to the **PROM** D216, to the **RAM** D217, to the **TIMER** D218 and to the DCL unit A13.
D216 contains 128K x 8 Read Only Memory, while D217 contains 8K x 8 Random Access Memory. Both devices are addressed via the ADDRESS bus.

The **TIMER** D218 consists of three separate timers which are controlled by the microprocessor:

- GATE 0 forms the delay counter (not active!)
- GATE 1 forms the read-out counter
- GATE 2 forms the slow time base counter

After the timer has counted the value determined by the value on the data bus, the output becomes low.

ATTENTION: Because for this instrument (PM3350A/55) the delay counter is formed by D441, D442, D443 and D444 on unit A14, output signal DTTC--LT has been disabled by the removing of resistor R229. However, this board can also been used for servicing older instruments (PM3350) by means of inserting R229. Take notice that in older instruments unit A14 must be of an older type, so without D441 ... D444.

The **C-BUS DECODER** decodes the DLEN signals for the various circuits at the time that the signal MFOUT-LT is low.
It gives the following decoding:

Address (Hex)	Signal
48000	DLENP-HT
48001	DLENT1-HT
48002	DLENT2-HT
48003	VERIIC-HT
48004	N.C.
48005	DLENB-HT
48006	DLENX-HT
48007	DLENA-HT

Note that for servicing, soldering joints are added in the p.c.b. tracks connecting the circuits. These can be used to localize a fault in the I^2C bus by means of interrupting the bus connection.

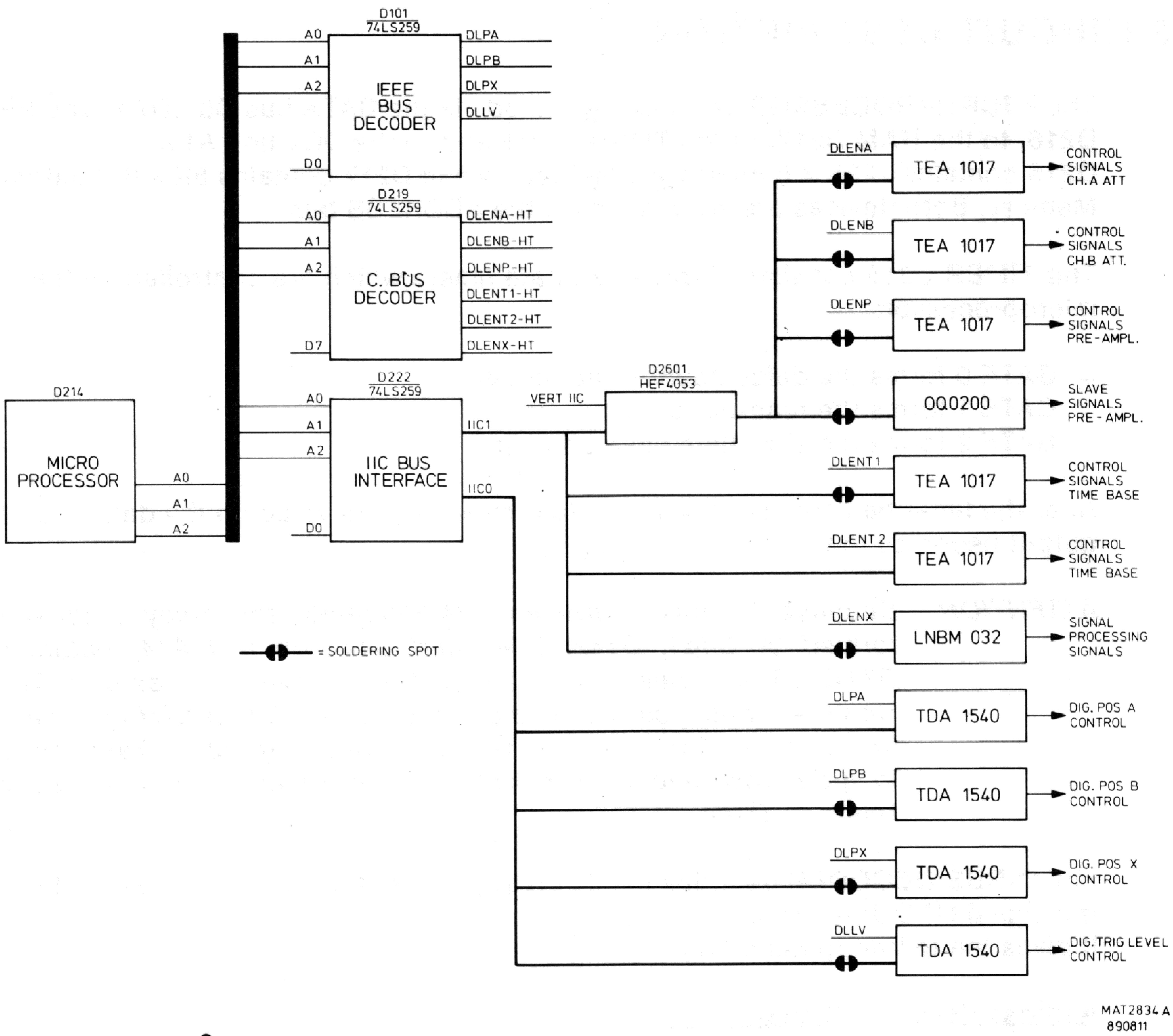


Figure 13.1 I²C bus structure

The **I²C BUS INTERFACE** D222 decodes the I²C bus and other signals at the time when WRIIC-LT is low. It gives the following decoding:

Address	Signal	Description
40000	SDA	Serial data
40001	SCL	Serial clock
40002	SEL0	Selection I²C bus 0
40003	SEL1	Selection I²C bus 1
40004	--	--
40005	RSNT-HT	Resets 20 ms timer D207
40006	WTDG-HT	Watchdog control
40007	MEMON-HT	Memory on signal

Next the signals SDA, SCL, SEL0 and SEL1 are decoded to the I²C 0 bus and I²C 1 bus by D223.

The **STATUS INPUT** device D221 serves as an input port to read the following status info:

- SWR---HT , sweep ready
- DELTRGLT , indication for delay trigger input
- SCL 1 ,
- SDA 1 , indication for I²C 1 bus
- SDA 0 ,
- SCL 0 , indication for I²C 0 bus
- TEST0-HT , indication for triggered mode
- EDC---LT , enable delay counter

When the enable inputs RDIC0-LT and RDIC1-LT become low, the status input is read and copied in the accumulator of the microprocessor via the data bus.

The **CLOCK GENERATOR** consists of a complete integrated oscillator of 16 MHz (G201) and a number of divider stages.
The table below gives the frequency of the generated signals.

Name	Frequency
DSOCLK	16 MHz
CPUCLK	8 MHz
IEEECLK	8 MHz
INTCLK	32 kHz

The **20 ms INTERRUPT** device D207 interrupts the microprocessor each 20 ms so that a new screen can be written.

The **DTACK GENERATOR** basically consists of D212, D209 and D211.

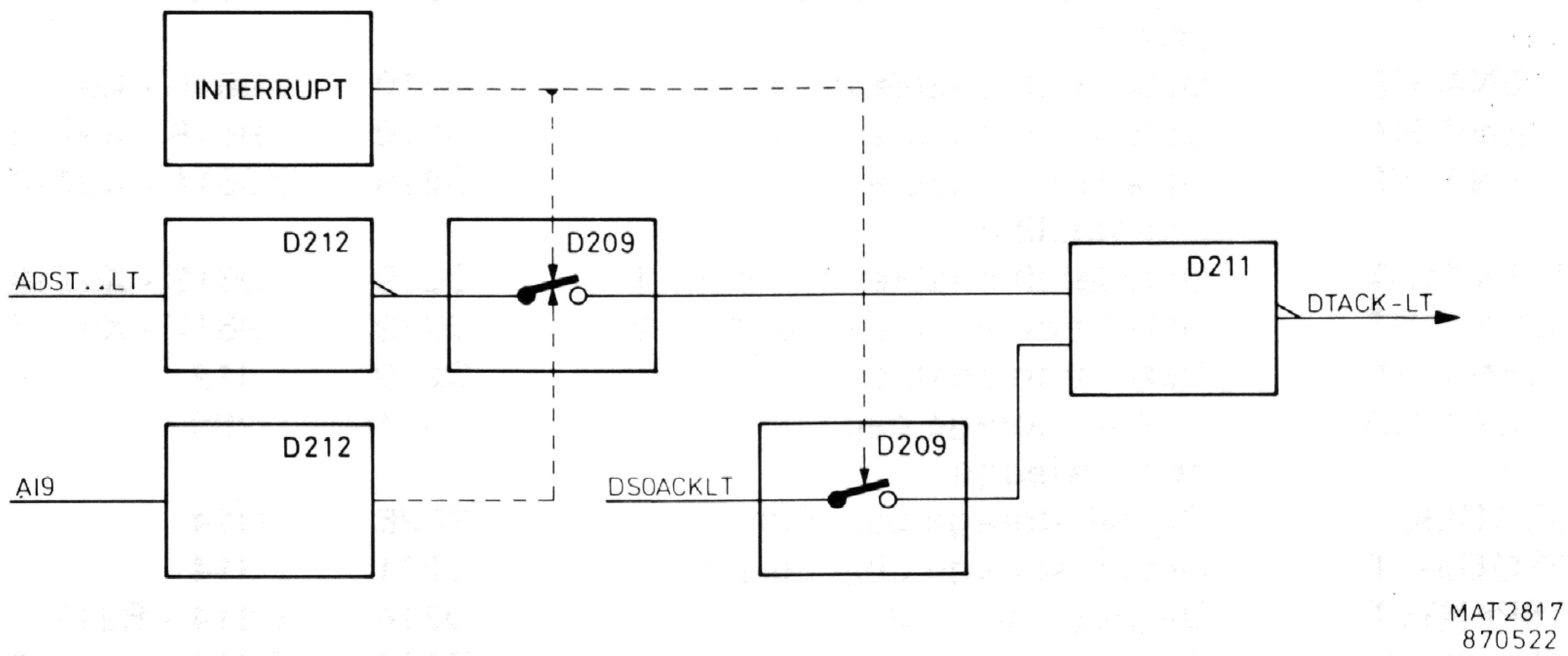


Figure 13.2 DTACK generator

The microprocessor generates the address strobe ADST--LT as a message that the address put on the address bus is valid. This signal is applied to D212-3 and converted into the data acknowledge DTACK-LT signal.This signal indicates that the data is valid. The DTACK-LT signal can be interrupted in two ways:

- display interrupt; this starts writing a new trace A, B, RA or RB.
  Now FC0, FC1 and FC2 are high with the result that a low level is applied to D209-13. This blocks the ADST path.

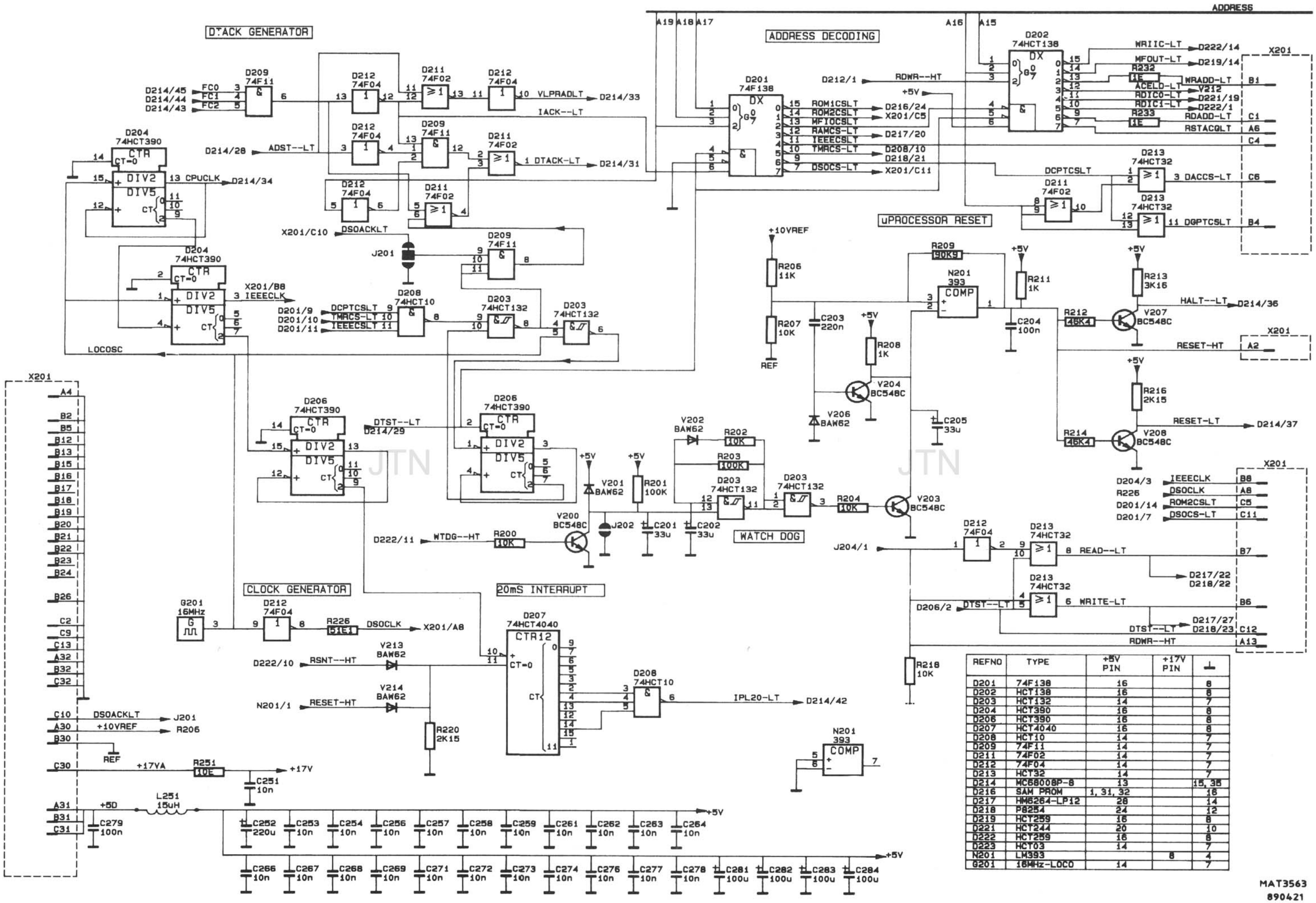
- 20 ms interrupt, this starts writing a new screen. When address line A19 is high, a low level is applied to D209-2 which also blocks the ADST path. Now DSOACKLT controls the DTACK-LT pulse via D211-3 or D206 takes care for a peripheral acknowledge.

The **MICROPROCESSOR RESET** circuit consists of the power-up reset and the watchdog circuit.
After switching-on, transistor V204 conducts so that the RESET-LT and HALT-LT signals are low, initiating the main program. After the supply voltages are within their specifications the signals are released and the microprocessor is ready for use.
The WATCHDOG is a facility to control the correct function of the software. In normal condition the WTDG--HT is low; this causes capacitor C201 to charge. But each 1,5 s the WTDG--HT is high for a short moment so that C201 is discharged again. When the WTDG--HT signal is not active (low), C201 will charge until D203-13 is high so that D203-11 goes high. This results in V203 conducting so HALT-LT and RESET-LT become low, thus initiating the main program again.

13.4 SIGNAL NAME LIST

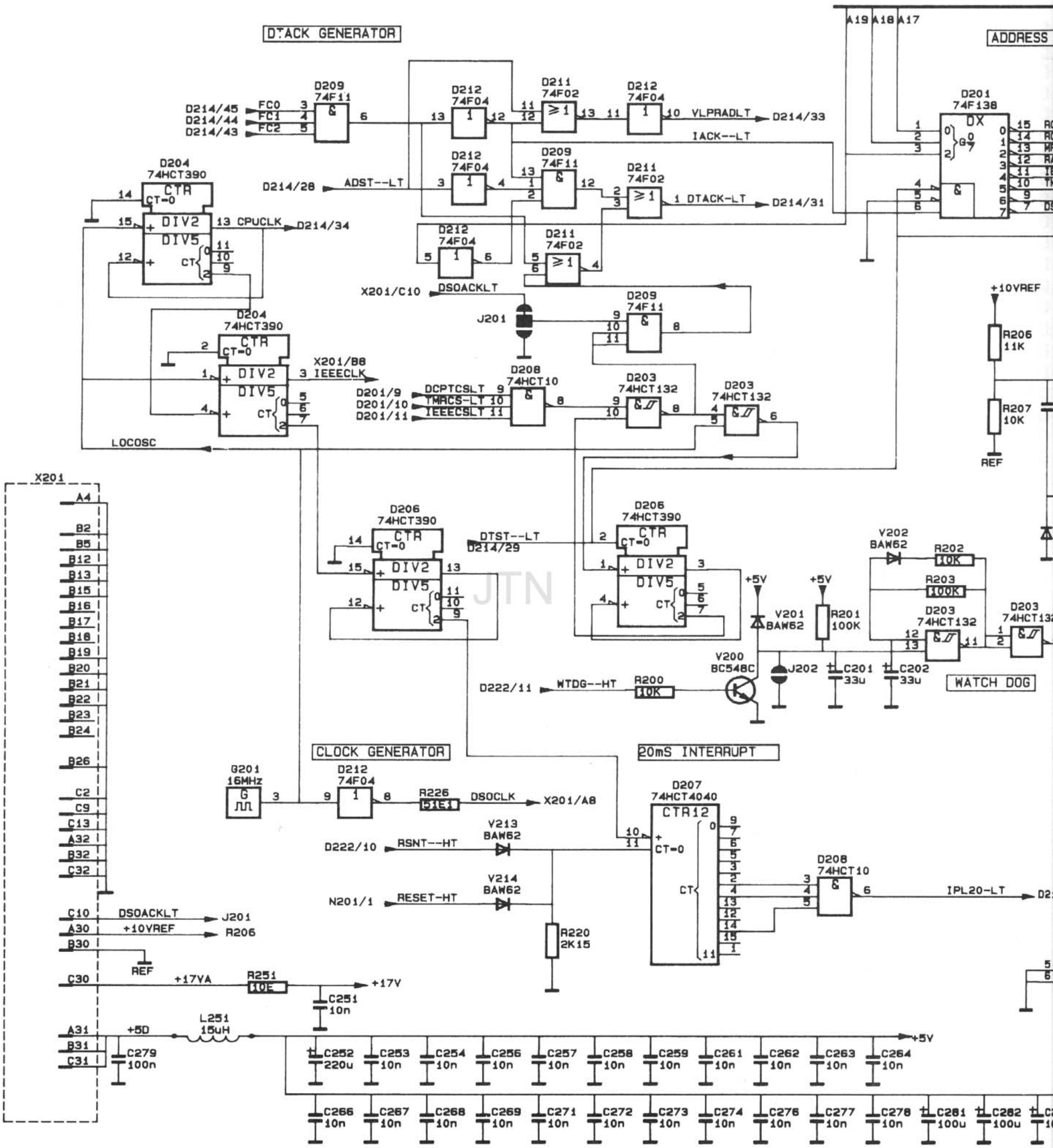
Signal name	Description	Signal source	Signal destination(s)
A0...16	Address bus	D214	D216 - D217 - D301 - D302 - D316 - D307 - D318
ADST-LT	Address strobe	D214	D212
CPUCLK	CPU clock	D204	D214
CVCNRYLT	Conversion counter ready	D218	D403 - D406
D0...7	Data bus	D214	D218 - D303 - D216 - D217 - D221
DACCS-LT	Digital analog conversion chip select	D213	D101
DCCLK	Delay counter clock	R886	D218
DELTRGHT	Delay trigger	D314	D221 - D402
DGPTCSLT	Digital pot.meter chip select	D213	D102
DLENA-HT	Data latch enable ch. A	D219	X9616 - X9716
DLENB-HT	Data latch enable ch. B	D219	X9618 - X9718
DLENP-HT	Data latch enable pre-amplifier	D219	X9614 - X9714
DLENT1HT	Data latch enable time-base 1	D219	X9613 - X9713
DLENT2HT	Data latch enable time-base 2	D219	X9617 - X9717
DLENX-HT	Data latch enable X	D219	D412
DSOACKLT	Digital storage osc. acknowledge	D314	D209
DSOCLK	Digital storage osc. clock	R226	D314
DSOCS-LT	Digital storage chip select	D201	D314
DSPLNTLT	Display interrupt	D314	D214 - R217
DTACK-LT	Data acknowledge	D211	D214
DTST-LT	Data strobe	D214	D201 - D202 - D206 D213 - D314 - D316
DTTC-LT	Delay trigger terminal count	D218	D801
EDC--LT	Enable delay counter	R401	D221 - D801
ENCVCNHT	Enable conversion counter	D406	D218
FC0...2	Functional code 0...2	D214	D209
HALT-LT	Halt	V207	D214
IACK-LT	Interrupt acknowledge	D212	D201 - D209 - D211
IEEECLK	IEEE clock	D204	D116
IEEECSLT	IEEE chip select	D201	D208
IPL20-LT	Interrupt priority level	D208	D214
MFIOCSLT	MF input/output chip select	D201	D202
MFOUT-LT	MF output enable	D202	D219
MEMON-HT	Memory on	D222	R601 - R602
RAMCS-LT	Ram chip select	D201	D217
RDIC0-LT	Read IIC bus 0	D202	D221
RDIC1-LT	Read IIC bus 1	D202	D221
RDWR-HT	Read/ Write	D303	D212 - D214 - D306 - D309
READ-LT	Read	D213	D218
RESET--HT	Reset	N201	D116 - D314 - D318
RESET-LT	Reset	V208	R191 - D214 - D318
ROM1CS-LT	ROM 1 chip select	D201	D216
ROM2CS-LT	ROM 2 chip select	D201	--
RSNT-HT	Reset interrupt	D222	D207
RSTACQLT	Reset acquisition	D202	D402 - D403
SCL	Serial clock	D222	D223

Signal name	Description	Signal source	Signal destination(s)
SCL0	Serial clock 0	D221	D223 - N102 - D7001 - D7002
SCL1	Serial clock 1	D223	D221 - D412
SDA	Serial data	D222	D223
SDA0	Serial data 0	D221	D223 - N101 - D7001 - D7002
SDA1	Serial data 1	D223	D222 - D412
SEL0	Select 0	D222	D223
SEL1	Select 1	D222	D223
SWR---HT	Sweep ready	D403	D221
SWTB	Slow time base	D218	D412 - D801
SWTBCLK	Slow time base clock	D409	D218 - D411
TBSYNCHT	Time base synchronisation	D403	D218
TESTO-HT	Test out	D4103	D221
TMRCS-LT	Timer chip select	D201	D208 - D218
VERIICHT	Vertical IIC select	D219	D2601
VLPRADLT	Valid peripheral address	D212	D214
WRIIC-LT	Write IIC	D202	D222
WRITE-LT	Write	D213	D116 - D217 - D218
WTDG	Watchdog	D222	R200



REFNO	TYPE	+5V PIN	+17V PIN	⊥
D201	74F138	16		8
D202	HCT138	16		8
D203	HCT132	14		7
D204	HCT390	16		8
D206	HCT390	16		8
D207	HCT4040	16		8
D208	HCT10	14		7
D209	74F11	14		7
D211	74F02	14		7
D212	74F04	14		7
D213	HCT32	14		7
D214	MC68008P-8	13		15, 35
D216	SAM PROM	1, 31, 32		16
D217	HM6264-LP12	28		14
D218	P8254	24		12
D219	HCT259	16		8
D221	HCT244	20		10
D222	HCT259	16		8
D223	HCT03	14		7
N201	LM393		8	4
G201	16MHz-LOCO	14		7

Figure 13.3 Circuit diagram of CPU unit: part 1


DTACK GENERATOR
ADDRESS
CLOCK GENERATOR
20mS INTERRUPT
WATCH DOG
D209 74F11
D212 74F04
D211 74F02
D204 74HCT390
D201 74F138
D208 74HCT10
D203 74HCT132
D206 74HCT390
D207 74HCT4040
G201 16MHz
X201
D214/45 FC0
D214/44 FC1
D214/43 FC2
VLPRADLT D214/33
IACK--LT
DTACK-LT D214/31
D214/28 ADST--LT
CPUCLK D214/34
X201/C10 DSOACKLT
J201
X201/B8 IEEECLK
D201/9 DCPTCSLT
D201/10 TMRCS-LT
D201/11 IEEECSLT
LOCOSC
DTST--LT D214/29
+10VREF
R206 11K
R207 10K
REF
V202 BAW62
R202 10K
R203 100K
V201 BAW62
R201 100K
V200 BC548C
J202
C201 33u
C202 33u
D222/11 WTDG--HT
R200 10K
R226 51E1
DSOCLK X201/A8
V213 BAW62
D222/10 RSNT--HT
V214 BAW62
N201/1 RESET-HT
R220 2K15
IPL20-LT
DSOACKLT J201
+10VREF R206
REF
+17VA
R251 10E
+17V
C251 10n
+5D
L251 15uH
+5V
C279 100n
C252 220u
C253 10n
C254 10n
C256 10n
C257 10n
C258 10n
C259 10n
C261 10n
C262 10n
C263 10n
C264 10n
C266 10n
C267 10n
C268 10n
C269 10n
C271 10n
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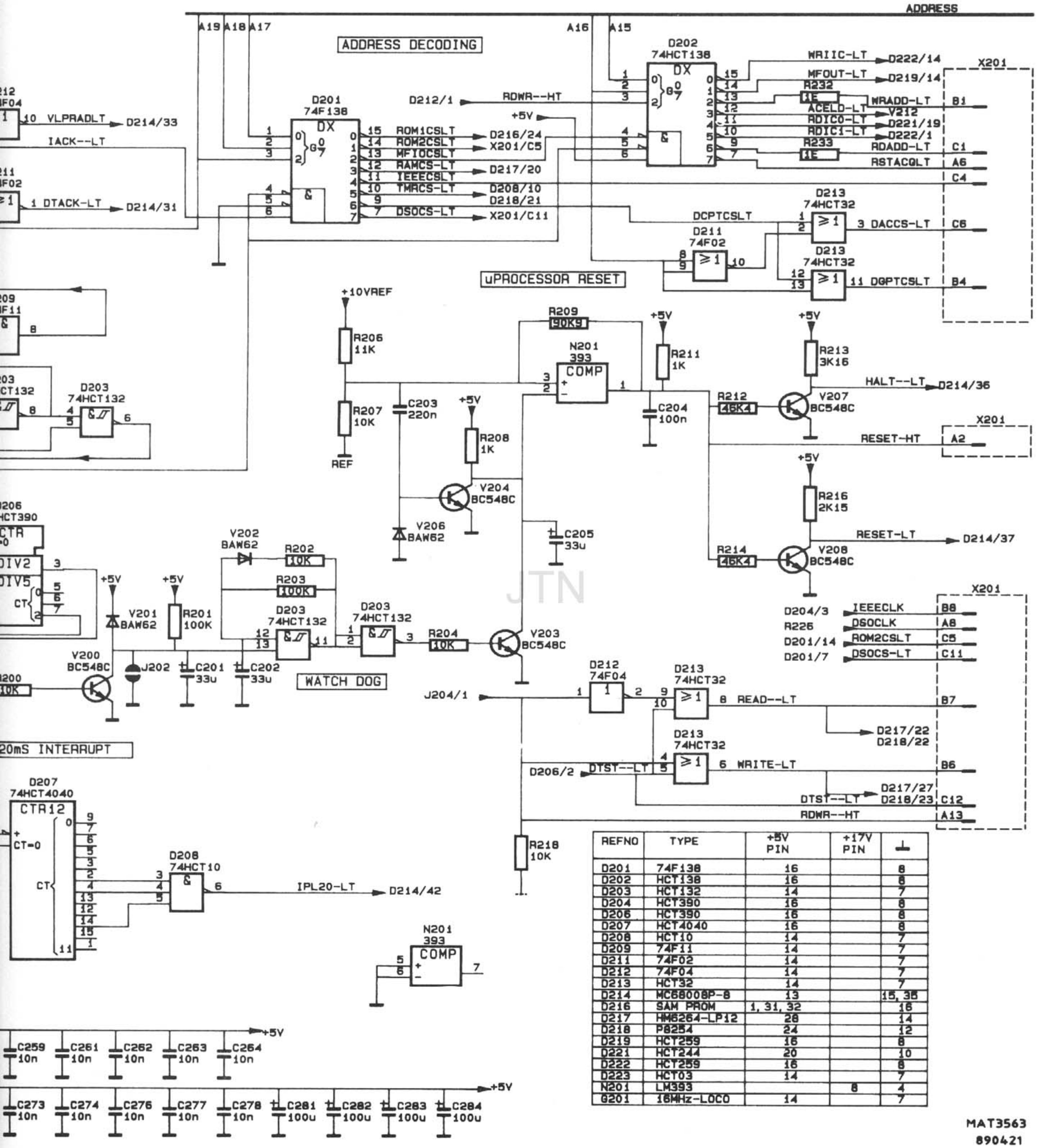
C277 10n
C278 10n
C281 100u
C282 100u
A19 A18 A17



REFNO	TYPE	+5V PIN	+17V PIN	⊥
D201	74F138	16		8
D202	HCT138	16		8
D203	HCT132	14		7
D204	HCT390	16		8
D206	HCT390	16		8
D207	HCT4040	16		8
D208	HCT10	14		7
D209	74F11	14		7
D211	74F02	14		7
D212	74F04	14		7
D213	HCT32	14		7
D214	MC68008P-8	13		15, 38
D216	SAM PROM	1, 31, 32		16
D217	HM6264-LP12	28		14
D218	P8254	24		12
D219	HCT259	16		8
D221	HCT244	20		10
D222	HCT259	16		8
D223	HCT03	14		7
N201	LM393		8	4
G201	16MHz-LOCO	14		7

Figure 13.3 Circuit diagram of CPU unit: part 1

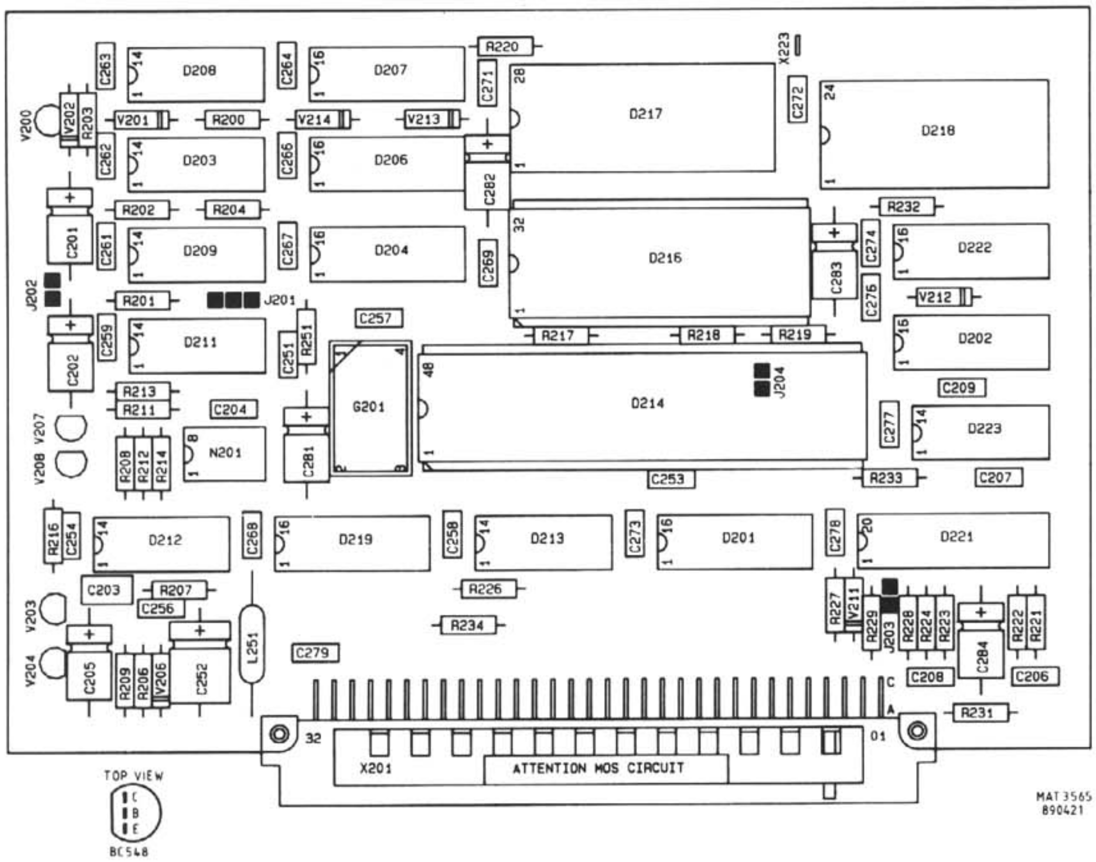


Figure 13.4 CPU unit p.c.b.

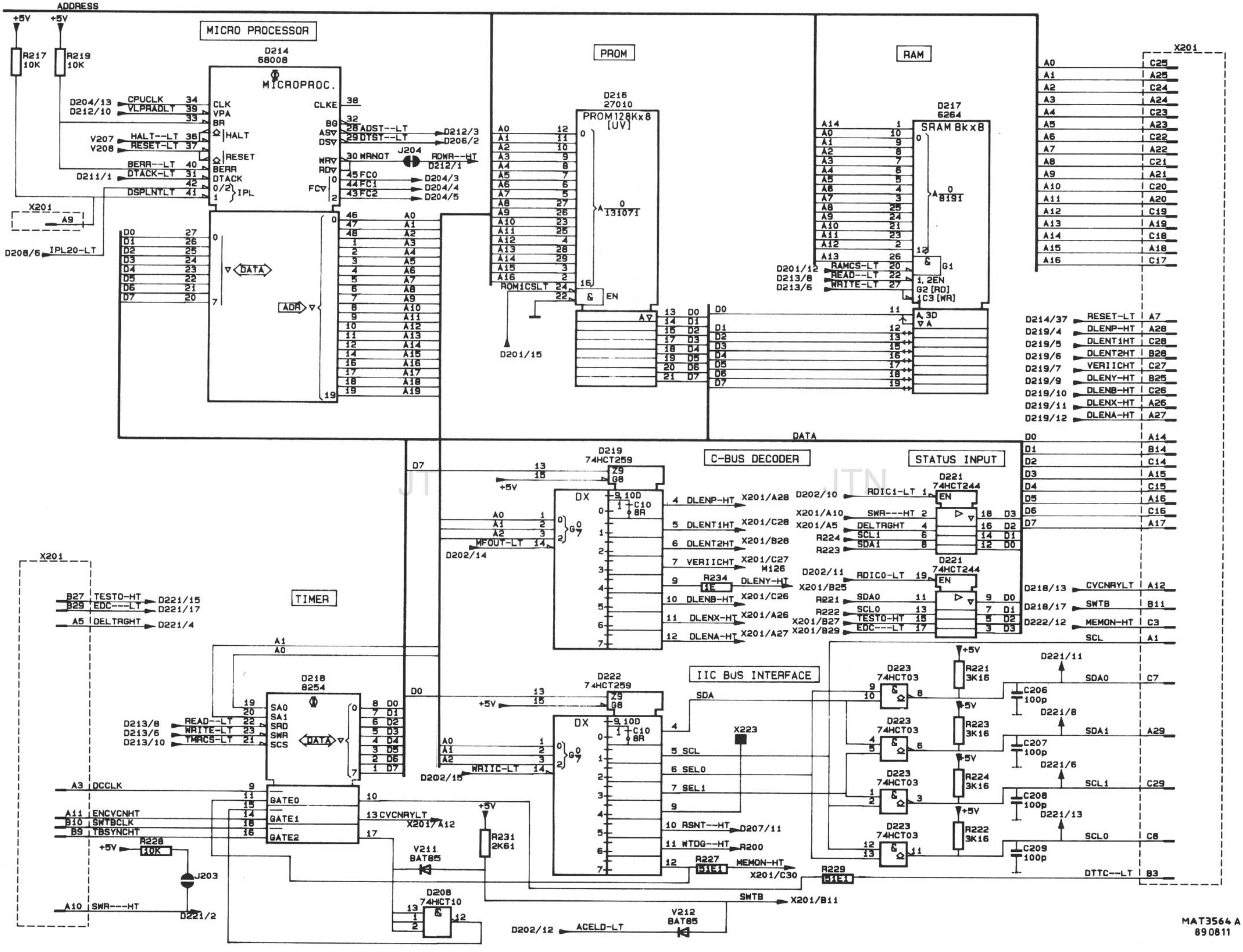


Figure 13.5 Circuit diagram of CPU unit: part 2

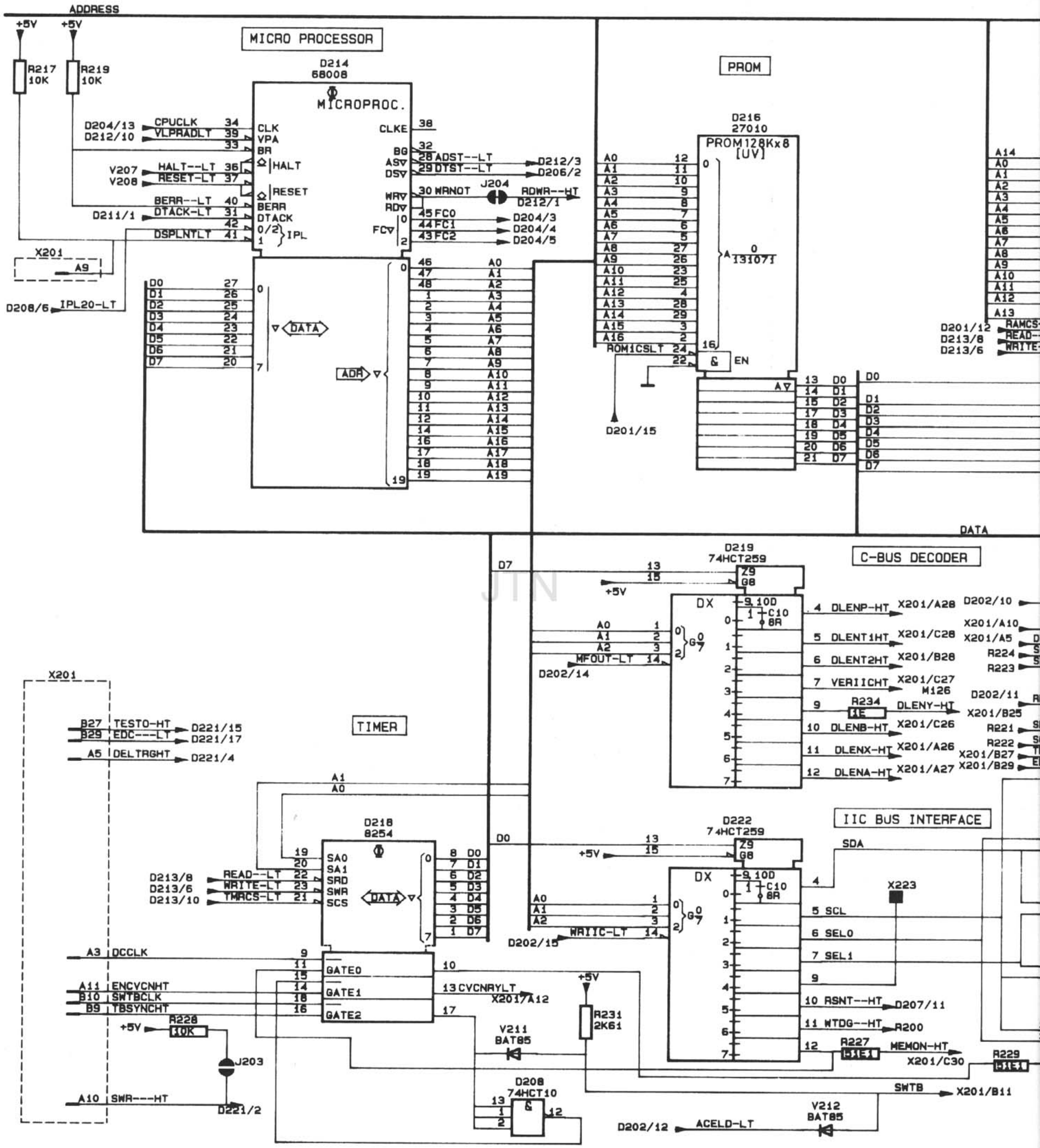


Figure 13.5 Circuit

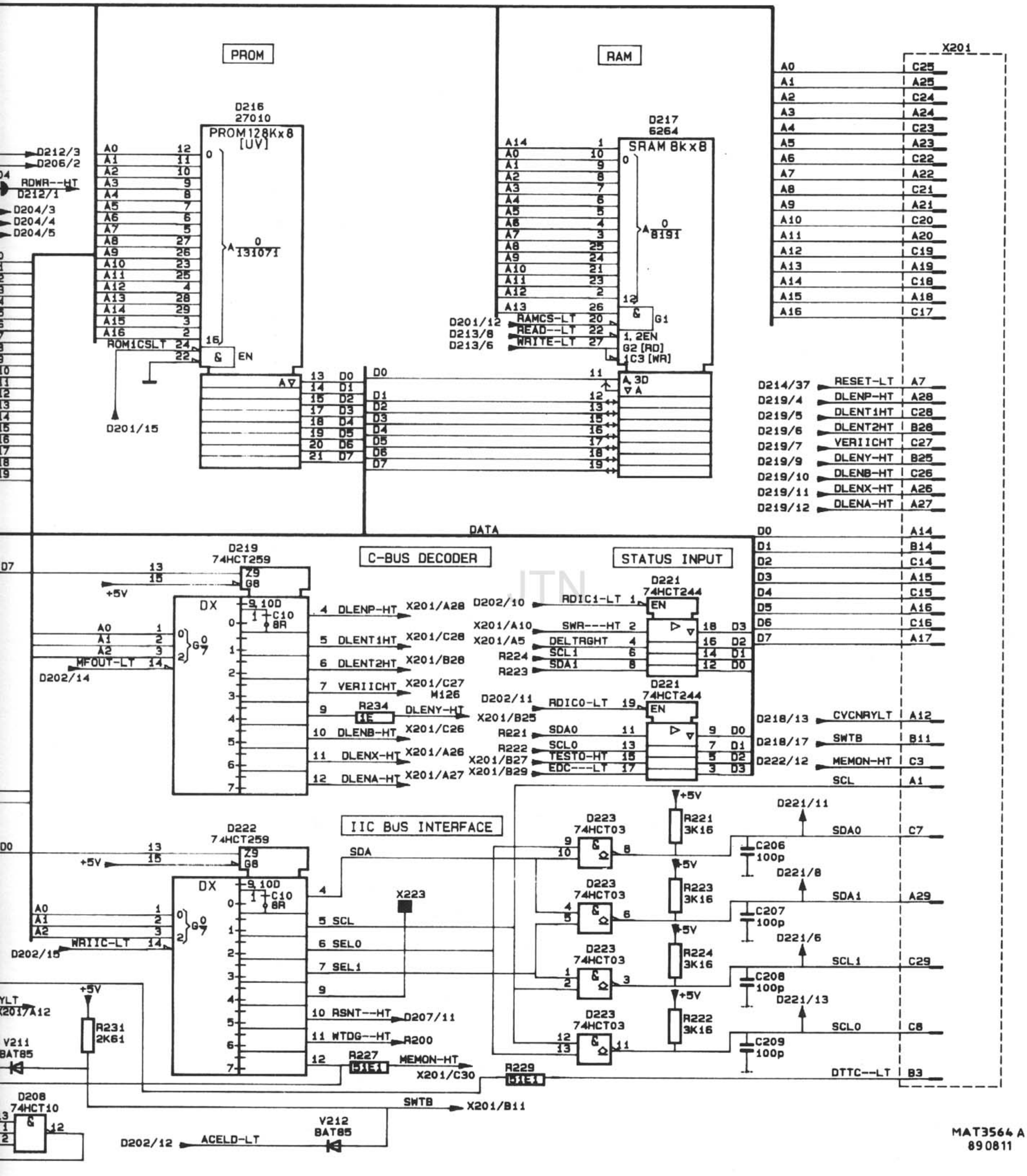


Figure 13.5 Circuit diagram of CPU unit: part 2

14 DCL UNIT (A13)

The DCL (Display ControL) unit consists of:

- acquisition memory with associated components
- display memory with associated components
- control array
- dots + plotter control

14.1 ORGANISATION OF THE MEMORY

The memory consists of a 8k x 8 static RAM (Random Access Memory) D308, and a 32k x 8 static RAM D304.
D308 is called the acquisition memory.

D304 is called the display memory. This device is divided into:
- 4k byte trace memory
- 4k register back-up memory
- 4k text memory

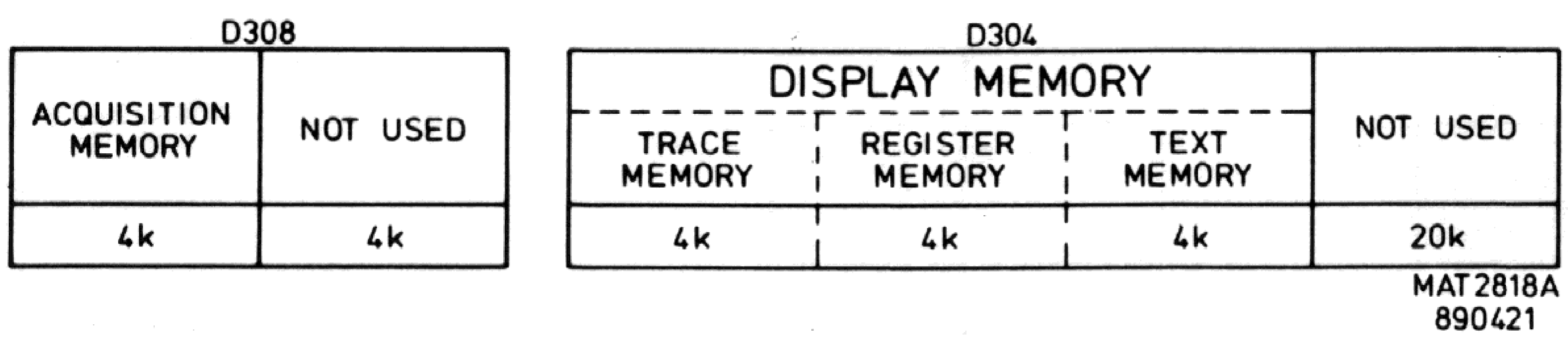


Figure 14.1 Organisation of the memory

Notice that the display memory is provided with a battery back-up circuit. When the instrument is switched off, the RAM D304 keeps its supply voltage Vbb by means of an analog OR-gate V301-V302.

Addressing of the memories is achieved by two counters, COUNTER 1 (D309) and COUNTER 2 (D306), or by the microprocessor. Both counters are divided in three similar 12-bit counters selected by the OS0-pin 32 and OS1-pin 31 inputs. The TC output pin 9 detects an overflow of a counter. These signals are applied to the control array D314.

14.2 INTRODUCTION TO THE SAMPLE TRANSPORTS

The digital processor unit must generate the timing signals for the following sample-transports:

- Transport of signal samples from the ADC unit A15 to the acquisition memory.
- Transport of signal samples from the acquisition memory to the display (trace) memory.
- Transport of signal samples from the display (trace) memory to the CRT screen.
- Reading/writing of signal samples by the microprocessor from/to the display memory.

As well as the counters, the microprocessor is connected to the address bus ZA0 ...14. The microprocessor is buffered with a 14-bit tri-state buffer D301 and D302. The counters have access to the address bus sequentially. If a counter requires access to the address bus, this occurs in a certain time interval of 500 ns and is controlled by the signals SC0...SC4. SC2 and SC3 are inside the control array D314 and are not visible.

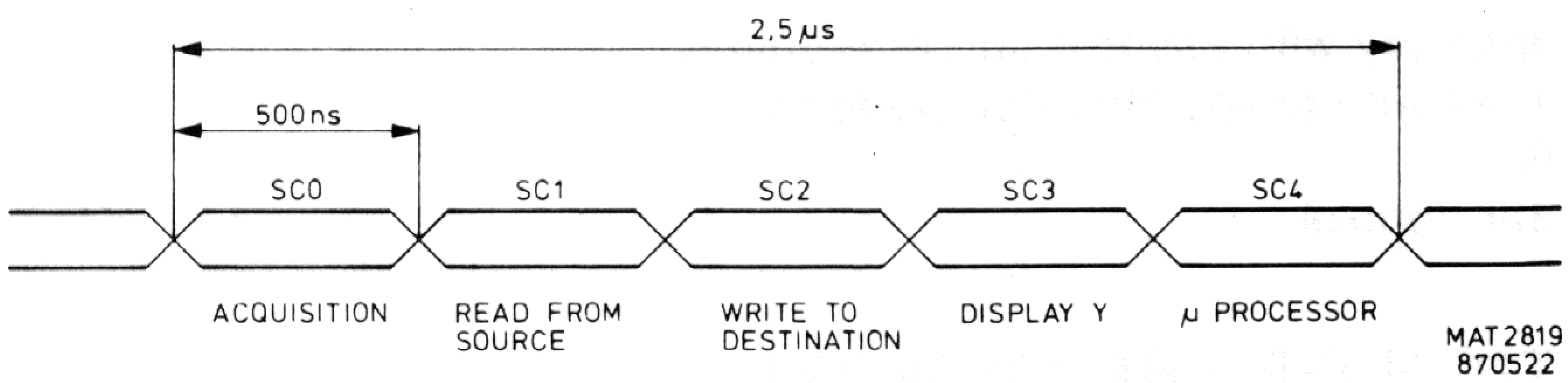


Figure 14.2 Display cycle controlled by SC0...4

The different sample transports are described separately in the next sections.

14.3 SIGNAL ACQUISITION

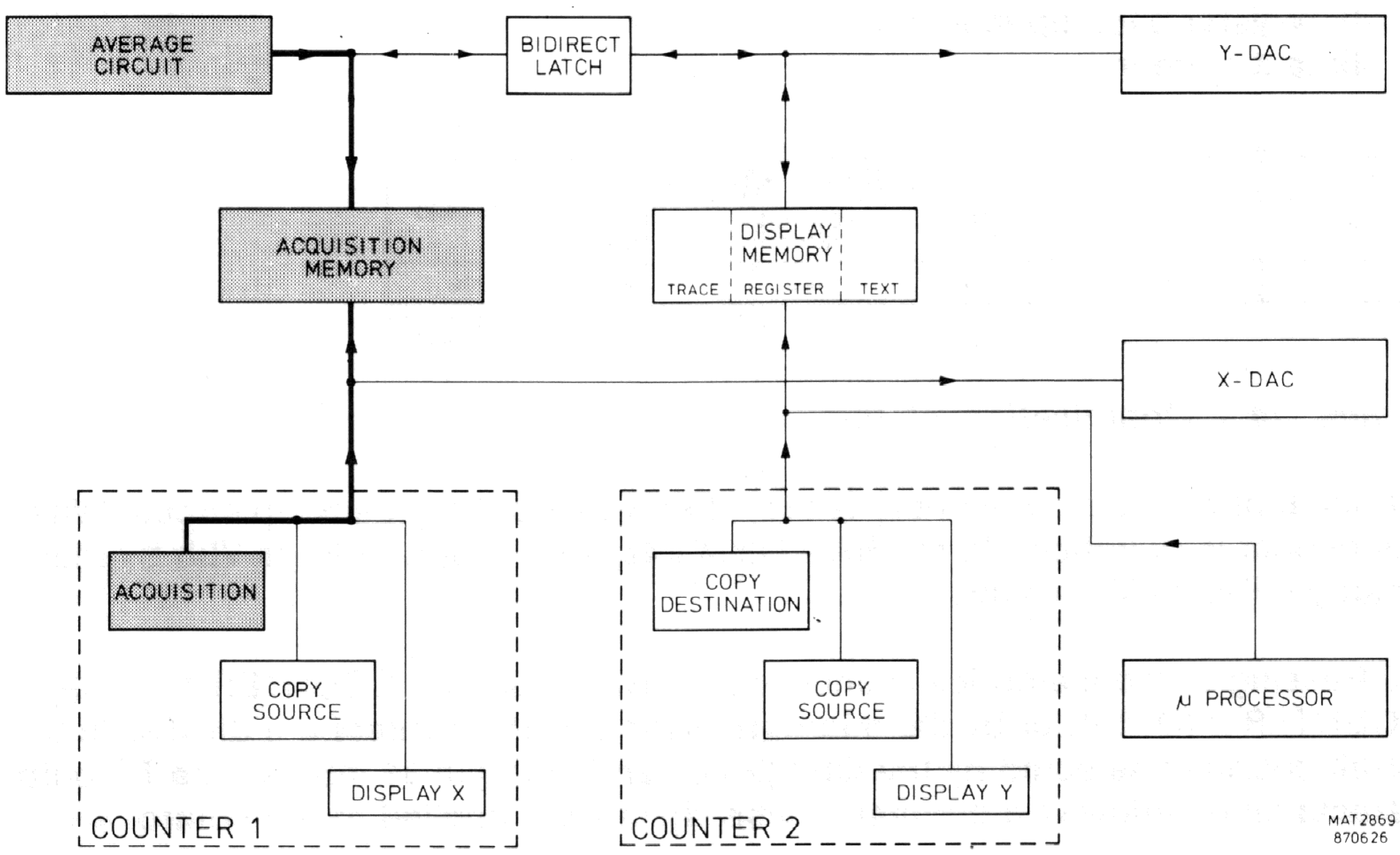


Figure 14.3 Block diagram of signal acquisition

The three blocks inside the dotted blocks (marked "counter 1" and "counter 2") indicate the three possible modes the counter can operate in.
During SC0 and if WRSMP is high the samples are taken from the average circuit on unit A14. These samples are put on the data bus PD0 ...7 and written in the acquisition memory D308. The addressing is obtained by the acquisition counter D309.

14.4 COPYING SAMPLES TO DISPLAY MEMORY

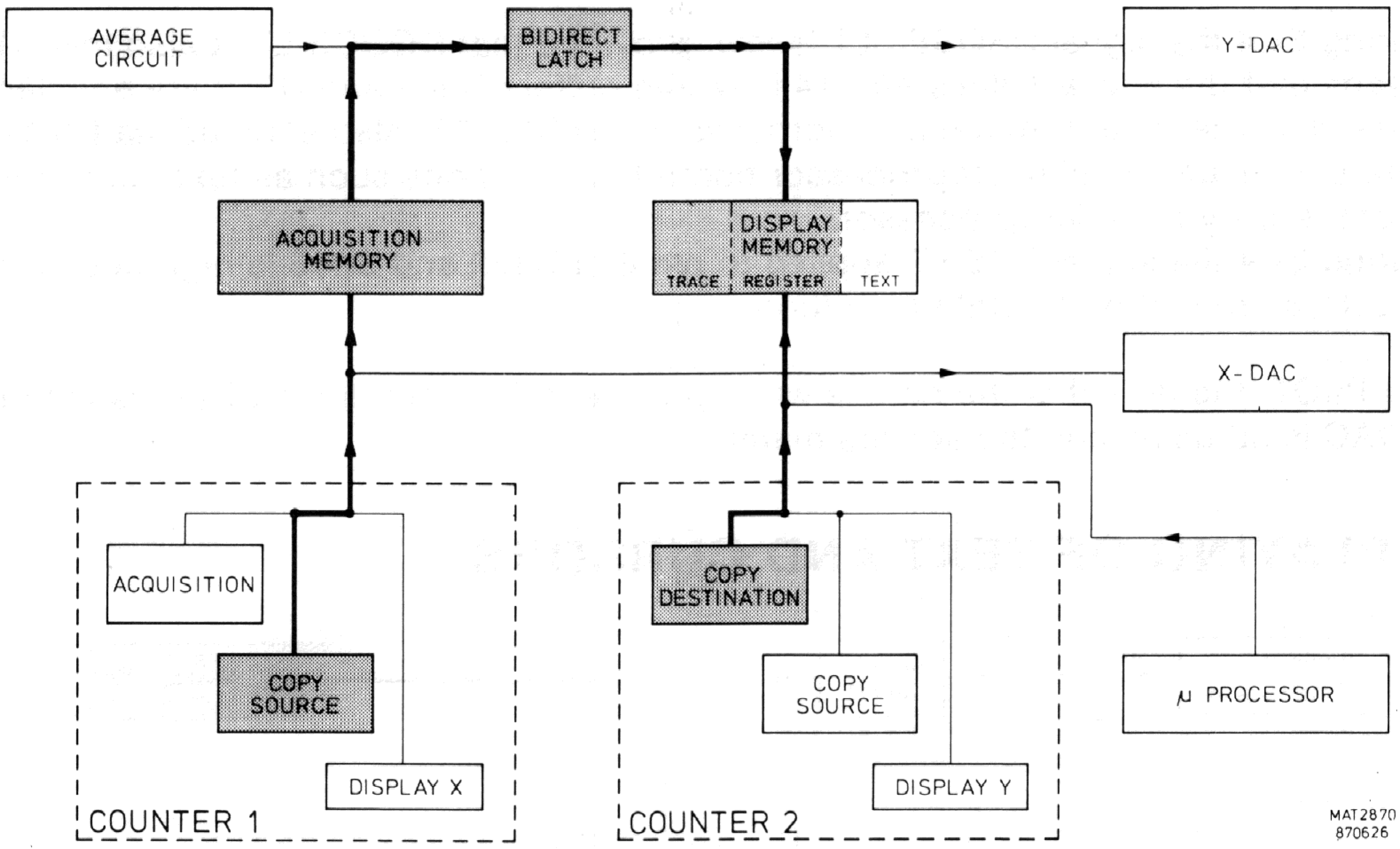


Figure 14.4 Block diagram of copying samples to display memory

During SC1 the data from the acquisition memory is read by counter 1 D309 and is written into the bidirectional latch of D314.
Then during SC2 the copy destination counter of D306 reads the data from the latch and writes this data into the display memory D304.

14.5 DISPLAYING OF TRACE AND REGISTER

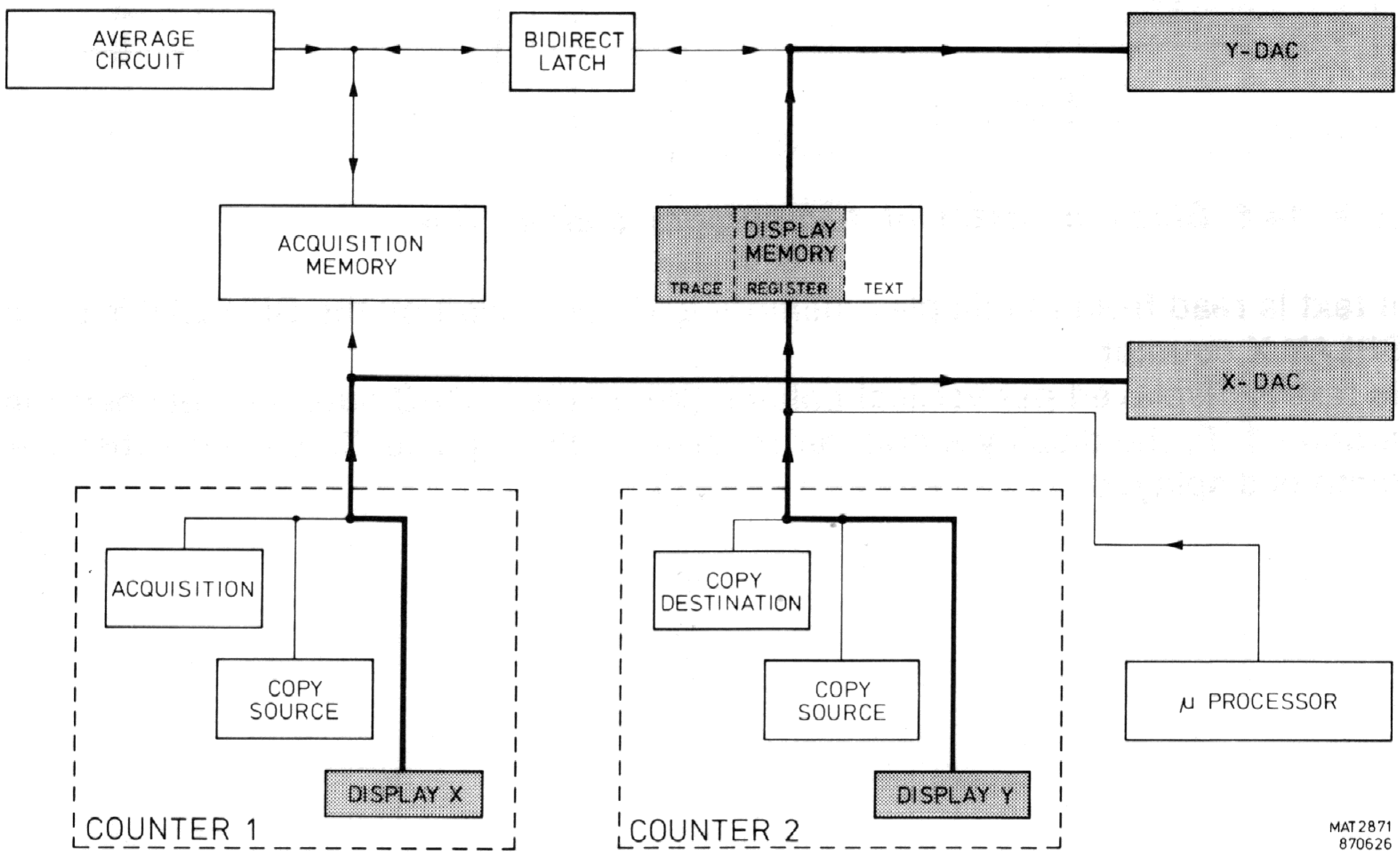


Figure 14.5 Block diagram of trace/register display flow

During SC3, the data from the display memory D304 is read by display counter D306 and is written to the Y-DAC latch D413 on unit A14. The X address is determined by counter D309 and is latched in D311 and D312. These addresses are clocked by the signal XYDLE generated by D314.

14.6 MICROPROCESSOR MANIPULATION

During SC4 the signal DSOSEL-LT is low, provided that DCOCS-LT is also low. This means that the address lines A0...14 from the buffers D301 and D302 are enabled. At the same time the data from the microprocessor bus D0...7 is also enabled via D303. This data can influence all microprocessor controlled functions such as text, plot, dots, also addressed by the microprocessor.
During SC4 the signal TOE-LT applied to pin 8 of D309 and D306 is high because both counters are in their tri-state condition.

For PLOT, the time that the data is written to the Y-DAC and the address is written to the X-DAC is adjustable in the service menu.

14.7 DISPLAYING OF TEXT AND CURSORS

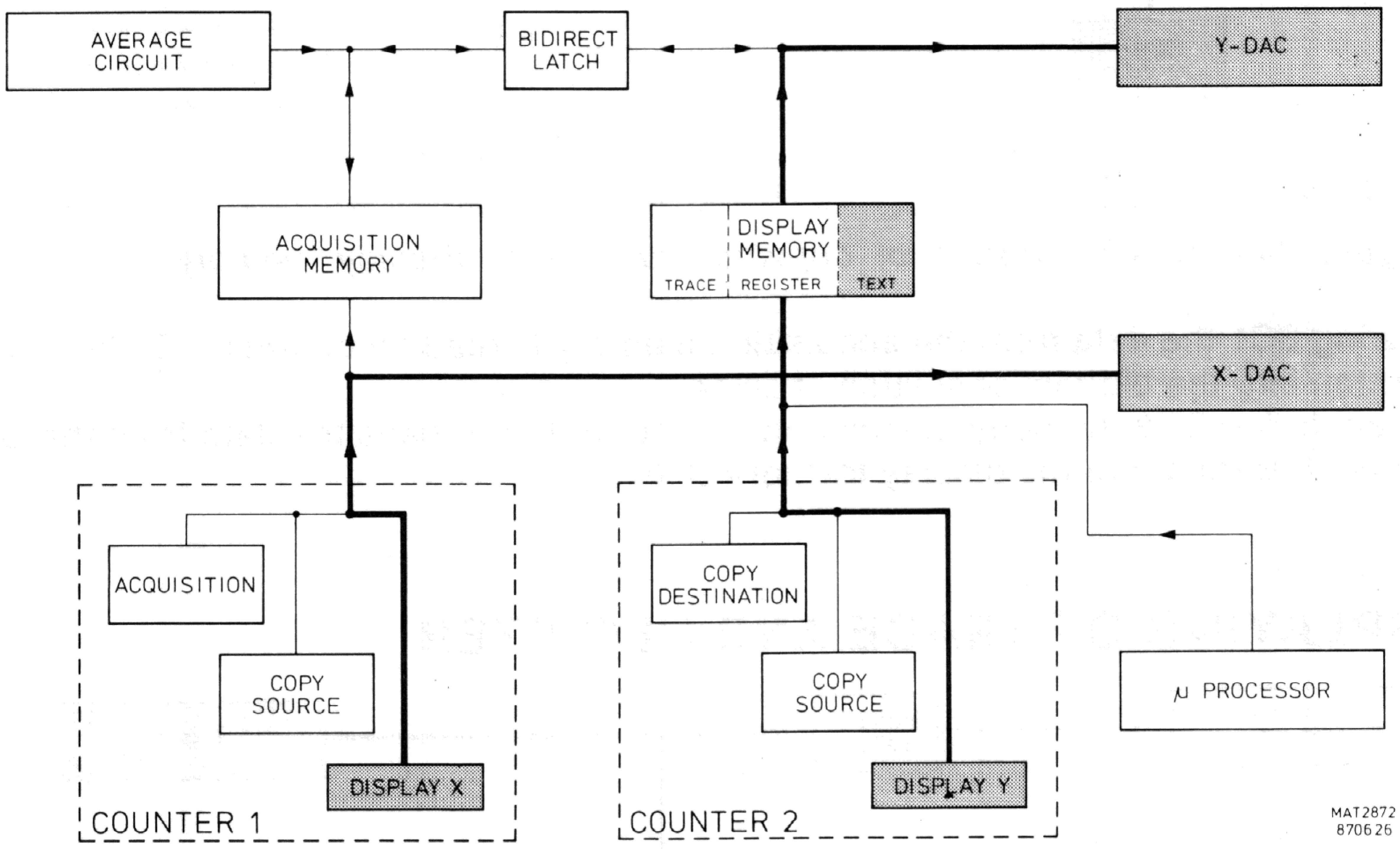


Figure 14.6 Block diagram of text/cursors display flow

The text is read from the display memory and addressed by the DISPLAY Y counter and DISPLAY X counter.
This text is displayed per vertical column. When the Y-DAC data has reached the control character $FF, the display X counter receives a clock-pulse. This means that the next column is displayed.

14.8 CLEARING THE DISPLAY MEMORY

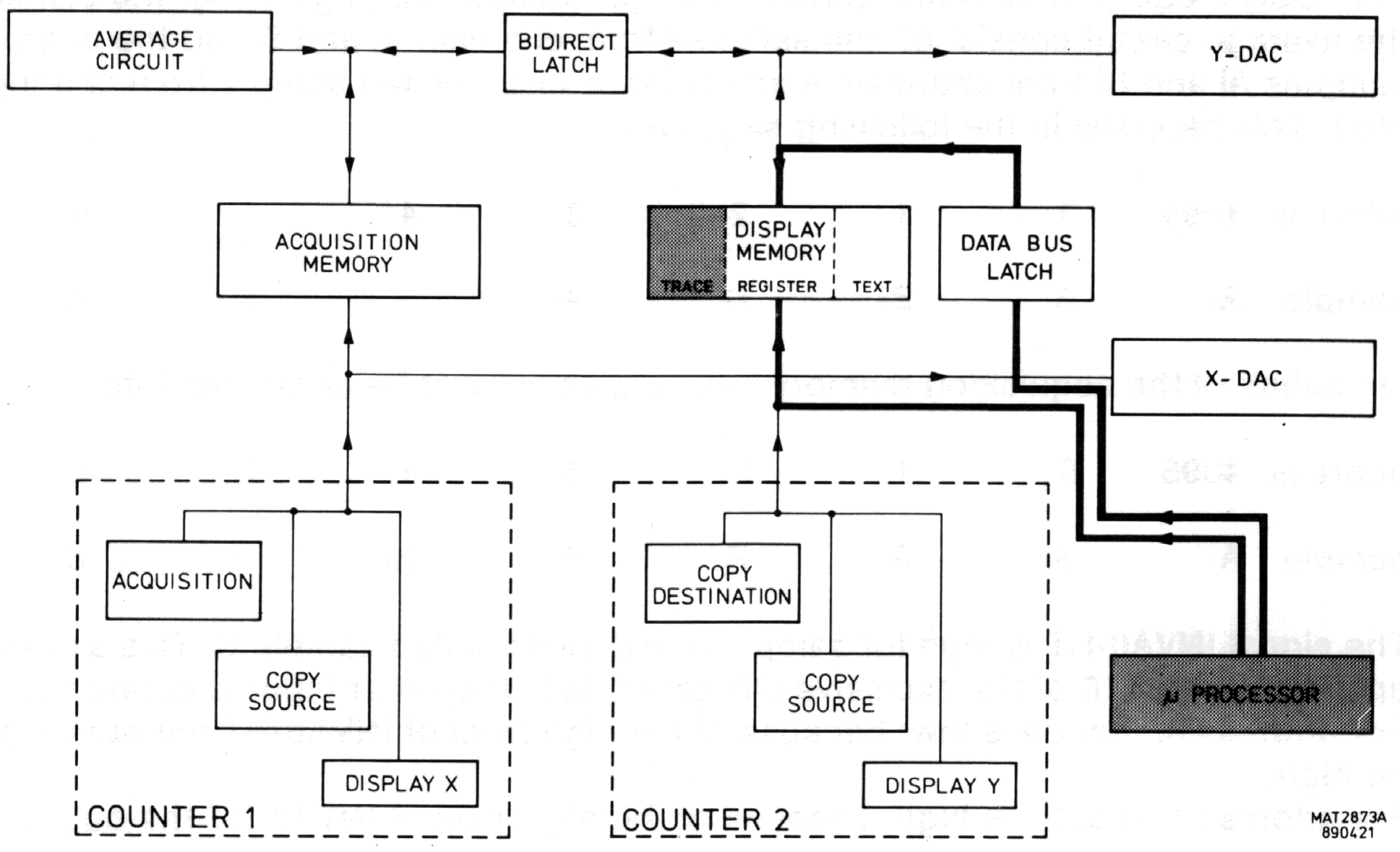


Figure 14.7 Block diagram of the clear function

When the clear function is active by means of the microprocessor, the display memory is written with $80 ($00) by the C.P.U. This means that the complete trace is cleared.

14.9 CLEARING THE ACQUISITION MEMORY

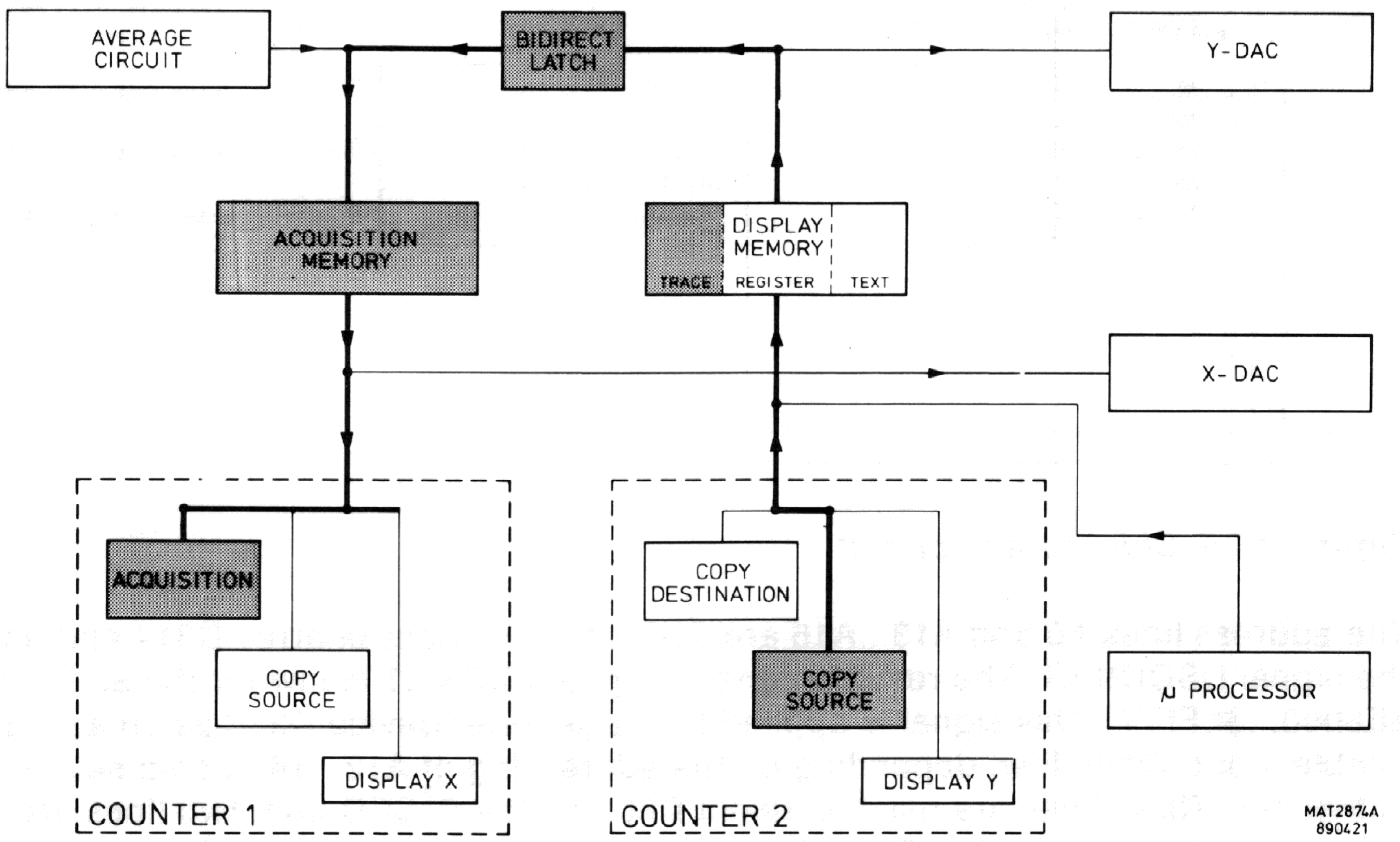


Figure 14.8 Block-diagram of the clear function

After the microprocessor has cleared the display memory, these samples are written into the bidirectional latch by means of the copy source counter of D306. Then the acquisition counter of D309 writes these samples from the latch into the acquisition memory.

14.10 EXOR D307

In P^2CCD mode (P mode) and Direct mode (D1 mode, see page 18-4), the samples from the average circuit consist of the samples from channels A and B and the interpolated samples Ai and Bi from channels A and B (Ai = interpolated sample from channel A, etc.). This happens in the following sequence:

address	4095	0	1	2	3	4	5	6
sample	Ai	A	Bi	B	Ai	A	Bi	A

On behalf of the acquisition memory this sequence must be converted into:

address	4095	0	1	2	3	4	5	6
sample	Ai	Bi	A	B	Ai	Bi	A	B

The signal INVA0-HT is high for sample A and interpolated sample B. This signal is applied to input 10 of the exclusive OR-gate D307. The other input is connected to PA0.
For address 0, input 9 is low; because of the high level of INVA0-HT the output pin 8 will be high.
For address 1, input 9 is high; because of the high level of INVA0-HT the output pin 8 will be low, etc.
Thus inverting of address line PA0 during sample A and interpolated sample B is obtained.

14.11 CHIP SELECT

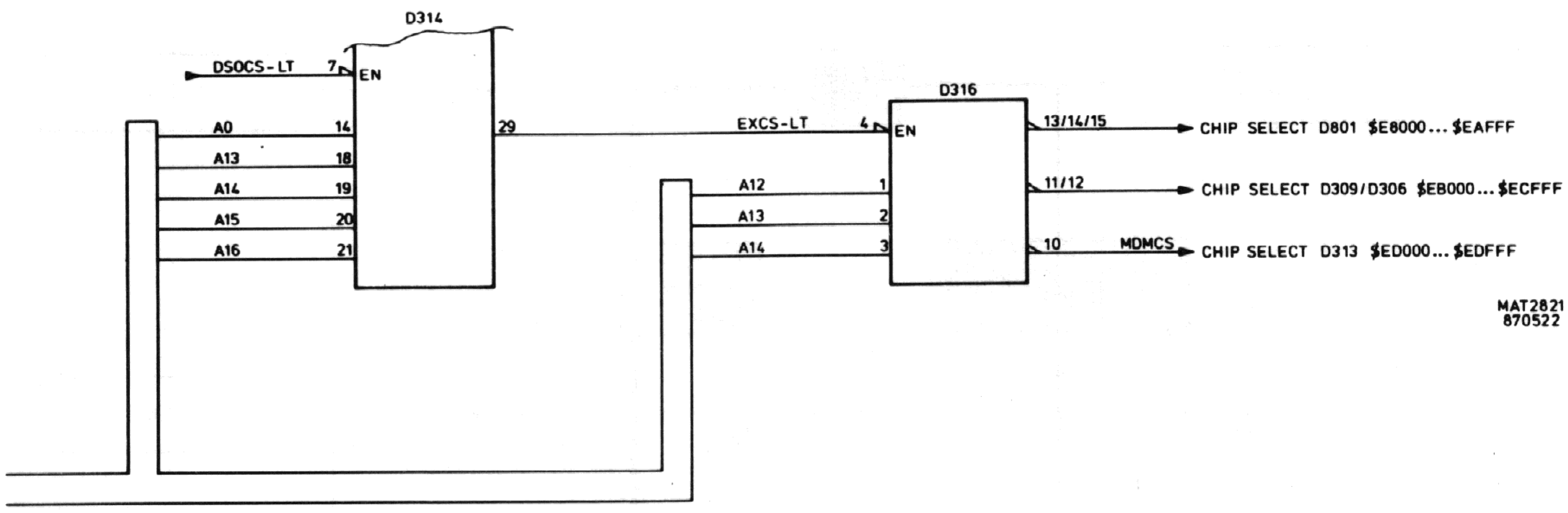


Figure 14.9 Chip select circuit

The address lines A0 and A13...A16 are applied to the control array D314 and enabled by the signal DSOCS-LT. The resulting enable signal EXCS-LT is low for the addresses $E8000...$EFFFF. This signal is applied to the decoder device D316 as an active low enable input. When low, depending on the addressing of A12...14, a chip select output is active low. Three lines are used to select D801 on the P^2CCD unit, two lines are used to select the two counters D306 or D309 and one line is used to select D313.

14.12 DOTS AND PLOTTER CONTROL

Addressed by BA0...BA2 which are simultaneously with A0...A2 the data on PD0 is applied to one of six output lines. These static lines DOTS-LT, PLOT-HT, PENLIFT, POSXOF-HT, TRIGEN-HT and OSCON-LT control several functions in the instrument such as among other things, the DOTS and plotter.

14.13 TIMING DIAGRAM

The following figure gives the timing diagram for the gate array D314 for the display cycle.

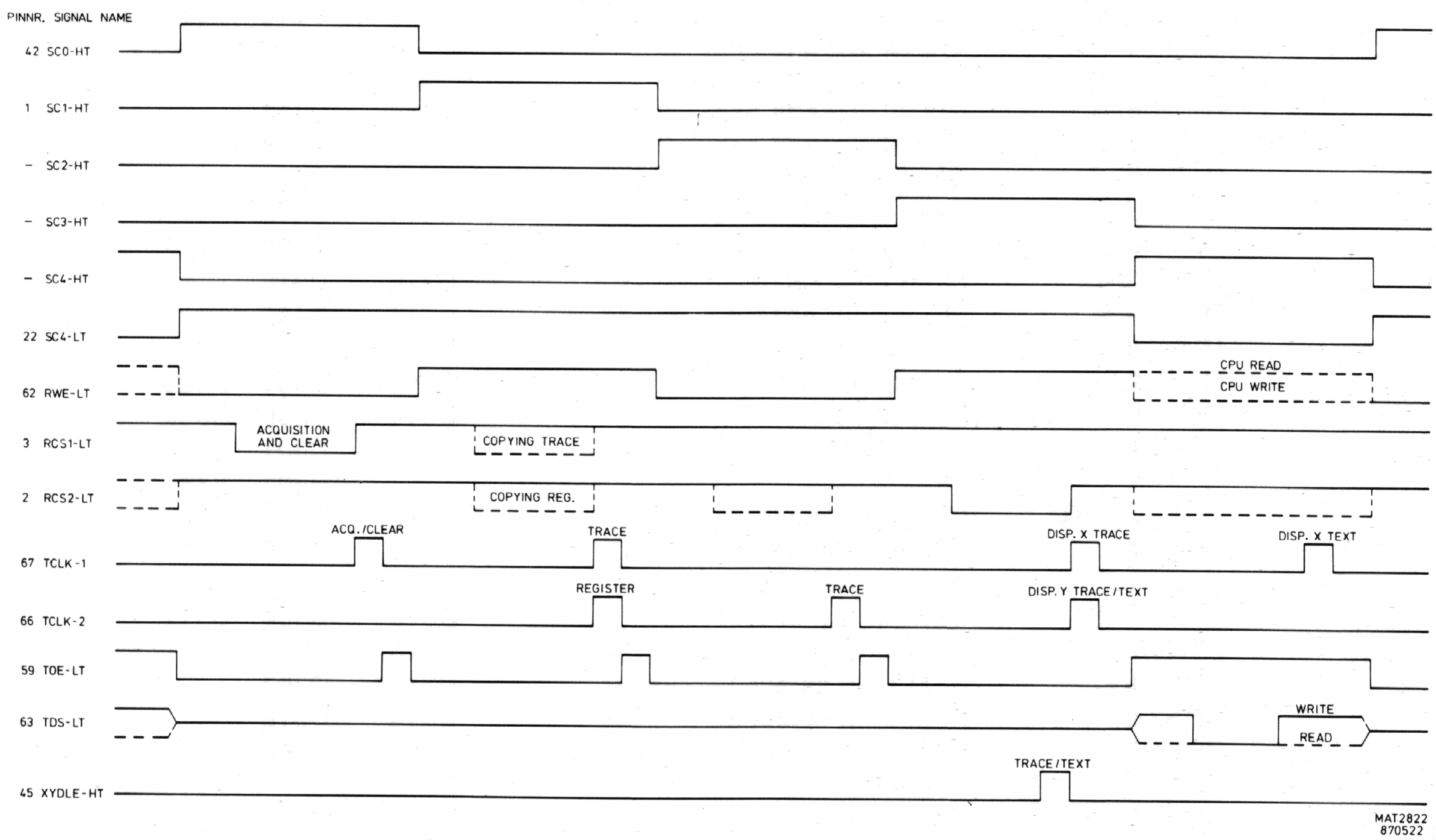
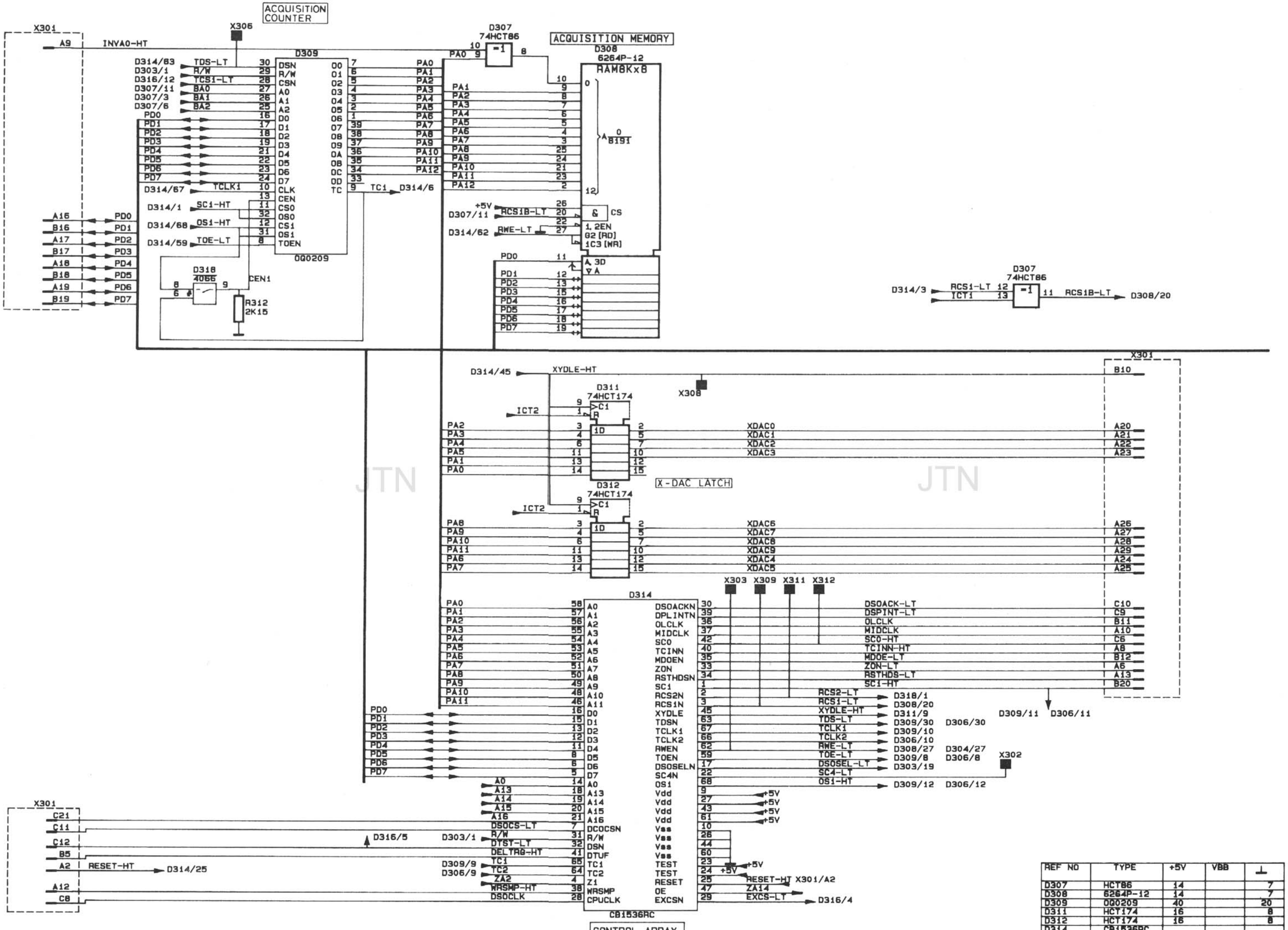


Figure 14.10 Timing diagram for D314

14.14 SIGNAL NAME LIST

Signal name	Description	Signal source	Signal destination(s)
A0...16	Address bus	D214	D216 - D217 - D301 - D303
BA0...2	Buffered address bus	D318	D306 - D307 - D313
D0...D7	Data bus	D216	D116 - D214 - D217 - D303
DATEN-HT	Data enable	D313	D416
DCWE--HT	Delay counter write	D316	D801
DLTRG-HT	Delay trigger	D402	D314 - D406
DOTS--LT	Control signal for dot join	D313	D503 - D505
DTST-LT	Data strobe	D214	D201 - D202 - D206 D213 - D314 - D316
DSOACK-LT	Digital storage osc. acknowledge	D314	D209
DSOSEL-LT	Digital storage osc.	D314	D303
DSOCS-LT	Digital storage osc.	D201	D314
DSPINTLT	Display interrupt	D314	D214
EXCSLT	External chip select	D314	D316
INVAO-HT	Invert address 0	D407	D307
MDMCS-LT	MDM chip select	D316	D313
MDOE-LT	MD output enable	D314	D412
MIDCLK	MID clock	D314	D409
OLCLK-PT	Output logic clock	D314	D401 - D409
OS1-HT	Output select 1	D314	D306 - D309
OSCON	Oscillator on	D313	D401 - D406 - D801 - R862
POSXOF-HT	Control X POS	D313	R555
PD0...7	Buffered bidirectional tri-state data bus	D303	D309 - D413
PLOT--HT	Control signal plot	D313	D504 - D512
PENLIFT	Control signal penlift	D313	R614
RCS1-LT	RAM chip select 1	D314	D307
RCS2-LT	RAM chip select 2	D314	D318
RCS1B-LT	RAM chip select 1 buffered	D307	D308
RCS2B-LT	RAM chip select 2 buffered	D318	D304
RDWR-HT	Read/write	D214	D212 - D213
RESET-HT	Reset, high active	D318	D116 - R211 - R212 - R213 - D314
RESET-LT	Reset, low active	V208	R191 - D214 - D318
R/W	Read/ write	D303	D306 - D309 - D314
RWE-LT	RAM write	D314	D304 - D308
RSTHDS-LT		D314	D401
SC0--HT	State counter 0	D314	D407 - D408
SC1--HT	State counter 1	D314	D408
STWE-LT	Status write	D316	D801
TBWE-LT	Time base write	D316	D801
TC1	Terminal count 1	D309	D314
TC2	Terminal count 2	D306	D314

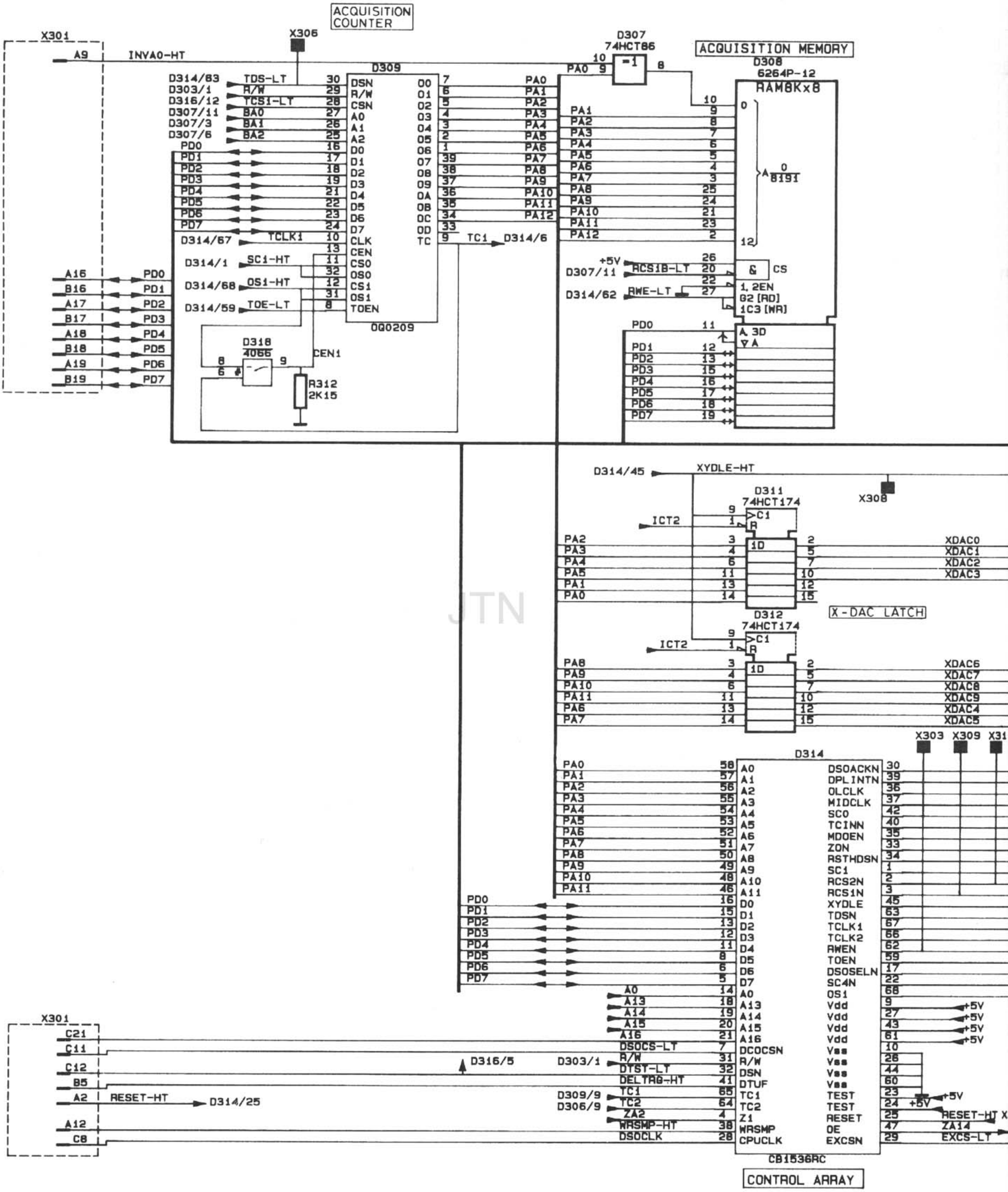
Signal name	Description	Signal source	Signal destinartion(s)
TCINN-PT	Terminal count in	D314	D404
TCS1-LT	Teller chip select 1	D316	D309
TCS2-LT	Tellerchip select 2	D316	D306
TCLK1	Teller clock 1	D314	D309
TCLK2	Teller clock 2	D314	D306
TDS-LT	Teller data strobe	D314	D306 - D309
TOE-LT	Teller output enable	D314	D306 - D309
TRIGENHT	Trigger enable	D313	D402 - D402 - D406
WRSMP-HT	Write sample	D412	D314
XDAC0...9	Data for X DAC	D311/D312	N507
XYDLE-HT	X DAC and Y DAC latch enable	D311	D302 - D304
ZA0...14	Buffered tri-state address bus	D306	D302 - D304
ZON---LT	Control intensity	D314	D504
PA0...12	Buffered tri-state data bus	D309	D308

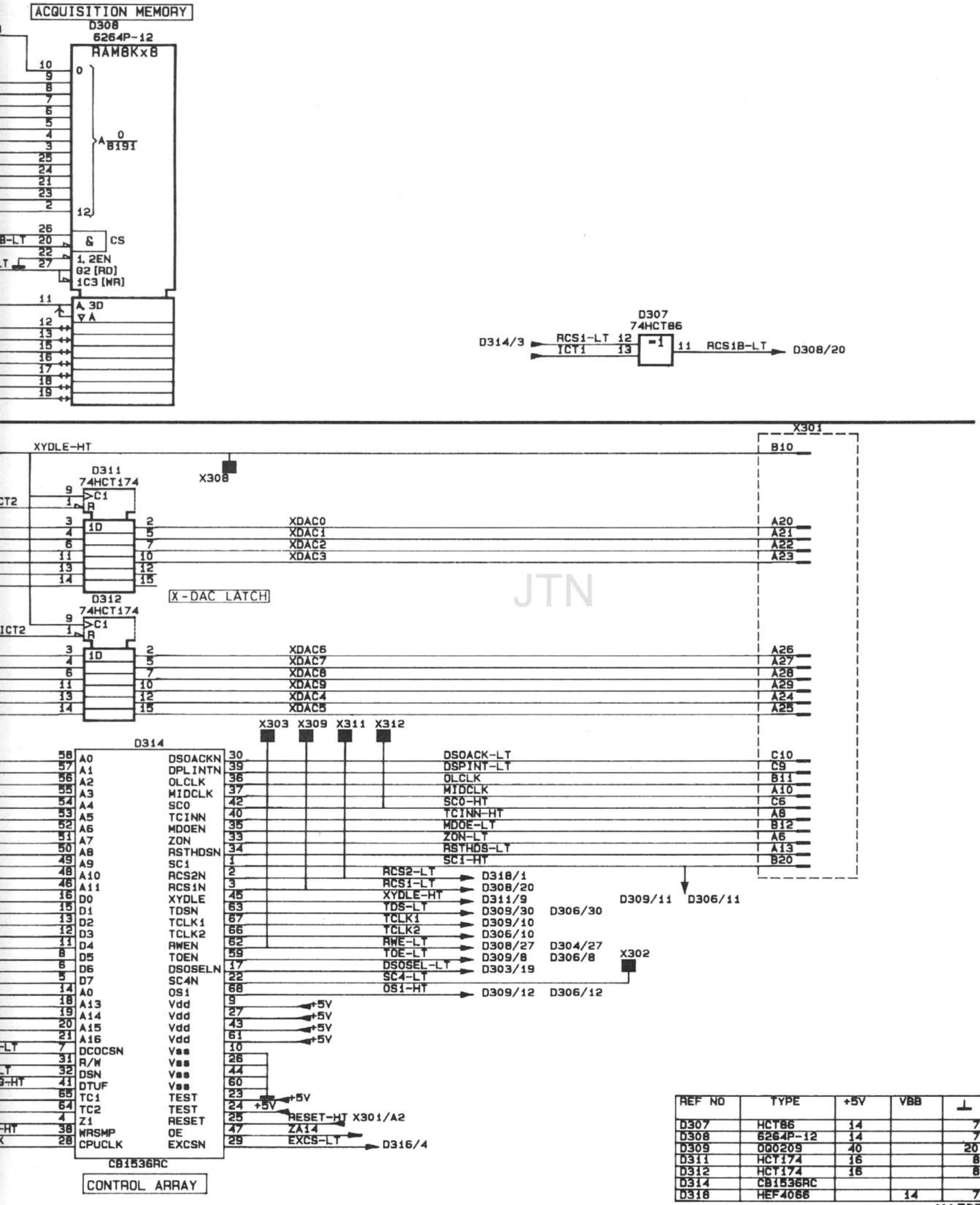


REF NO	TYPE	+5V	VBB	⊥
D307	HCT86	14		7
D308	6264P-12	14		7
D309	0Q0209	40		20
D311	HCT174	16		8
D312	HCT174	16		8
D314	CB1536RC			
D318	HEF4066		14	7

MAT3566 A
890814

Figure 14.11 Circuit diagram of DCL unit: acquisition memory

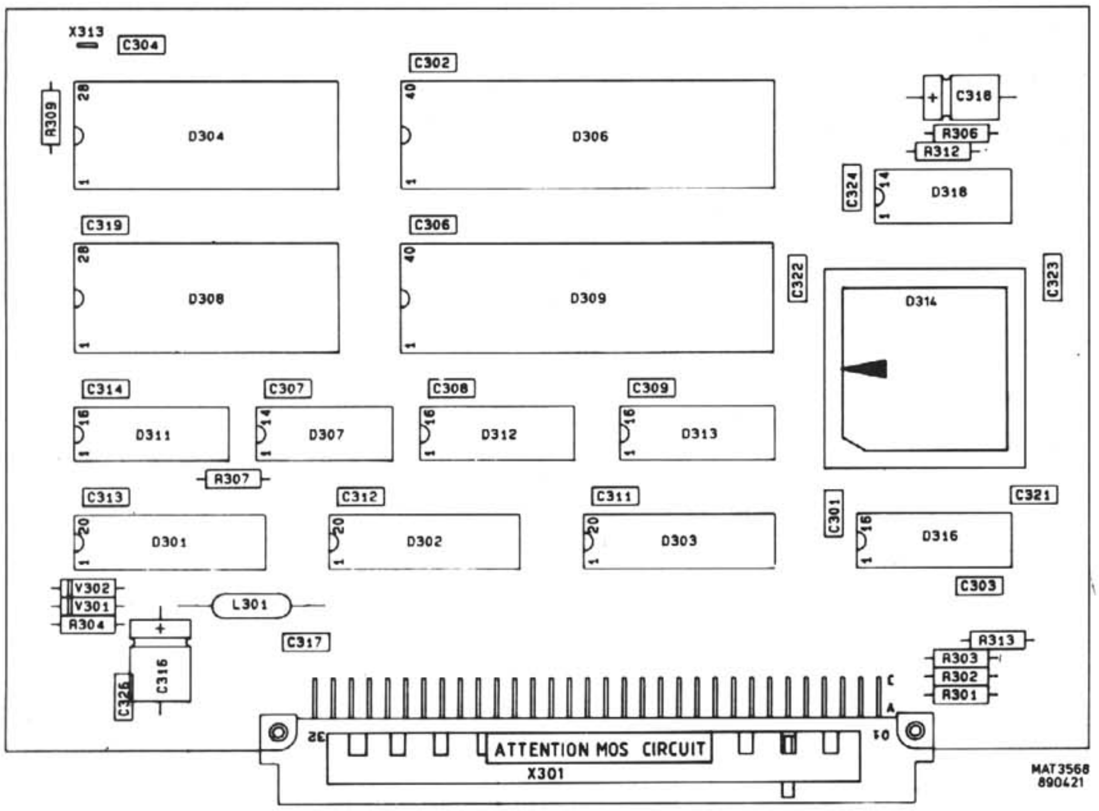

ACQUISITION COUNTER
ACQUISITION MEMORY
X-DAC LATCH
CONTROL ARRAY
D309
0Q0209
D307
74HCT86
D308
6264P-12
RAM8Kx8
D318
4066
R312
2K15
D311
74HCT174
D312
74HCT174
D314
CB1536RC
X301
X306
X308
X303
X309



REF NO	TYPE	+5V	VBB	⊥
D307	HCT86	14		7
D308	6264P-12	14		7
D309	0Q0209	40		20
D311	HCT174	16		8
D312	HCT174	16		8
D314	CB1536RC			
D318	HEF4066		14	7

MAT3566 A
890814

Figure 14.11 Circuit diagram of DCL unit: acquisition memory



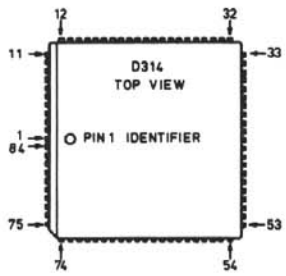
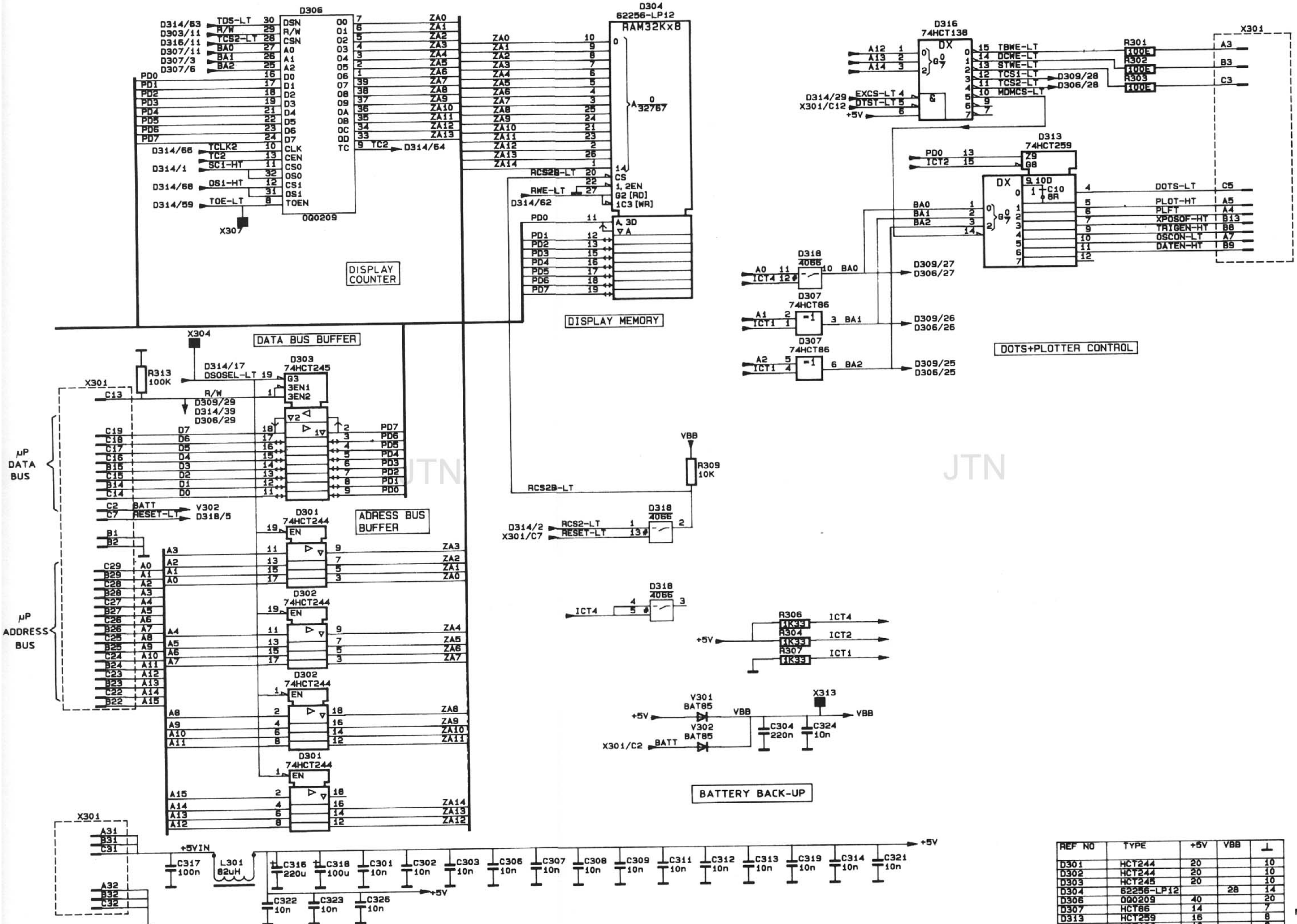


Figure 14.12 DCL unit p.c.b.



REF NO	TYPE	+5V	VBB	⊥
D301	HCT244	20		10
D302	HCT244	20		10
D303	HCT245	20		10
D304	62256-LP12		28	14
D306	0Q0209	40		20
D307	HCT86	14		7
D313	HCT259	16		8
D316	HCT138	16		8

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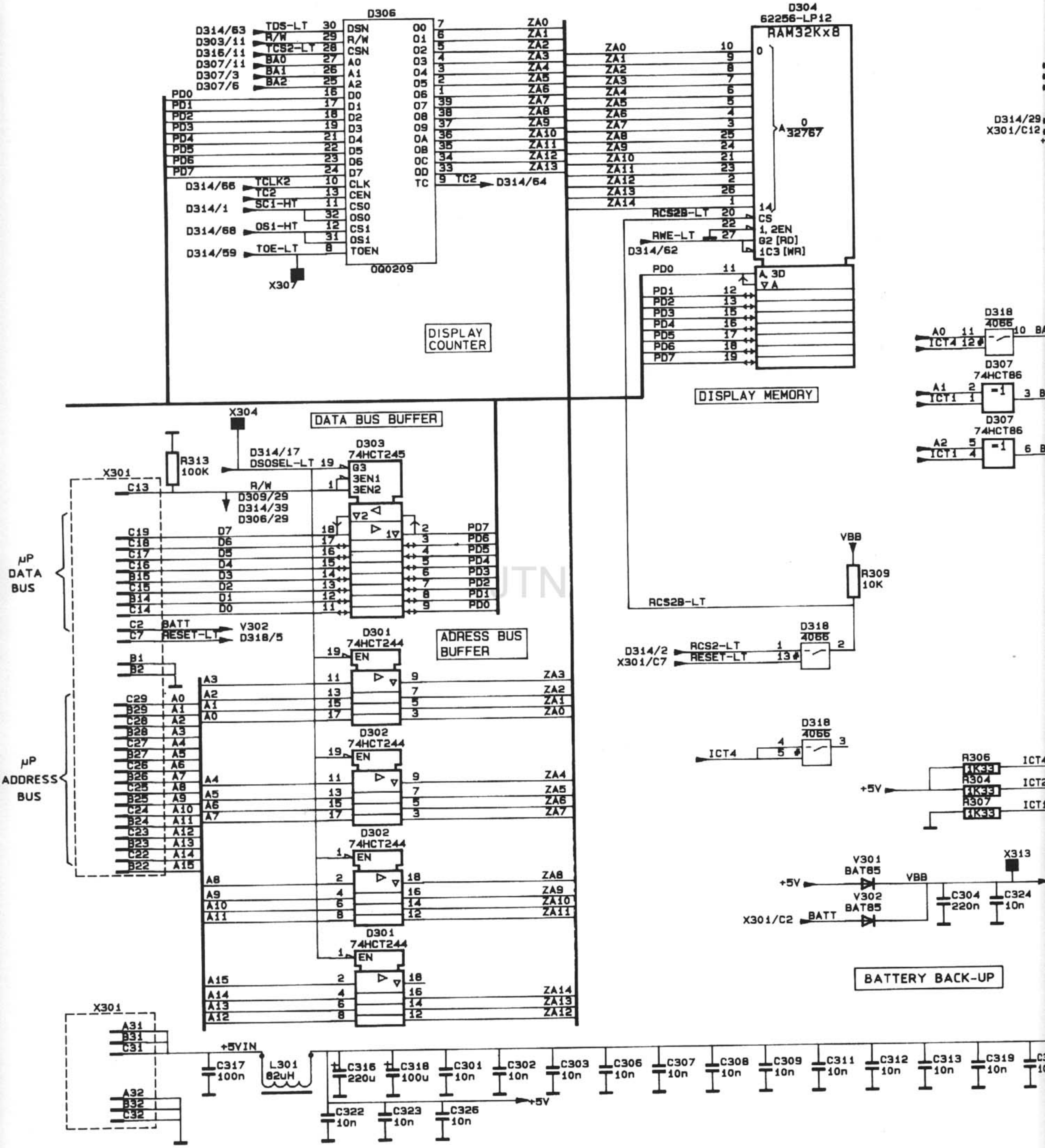
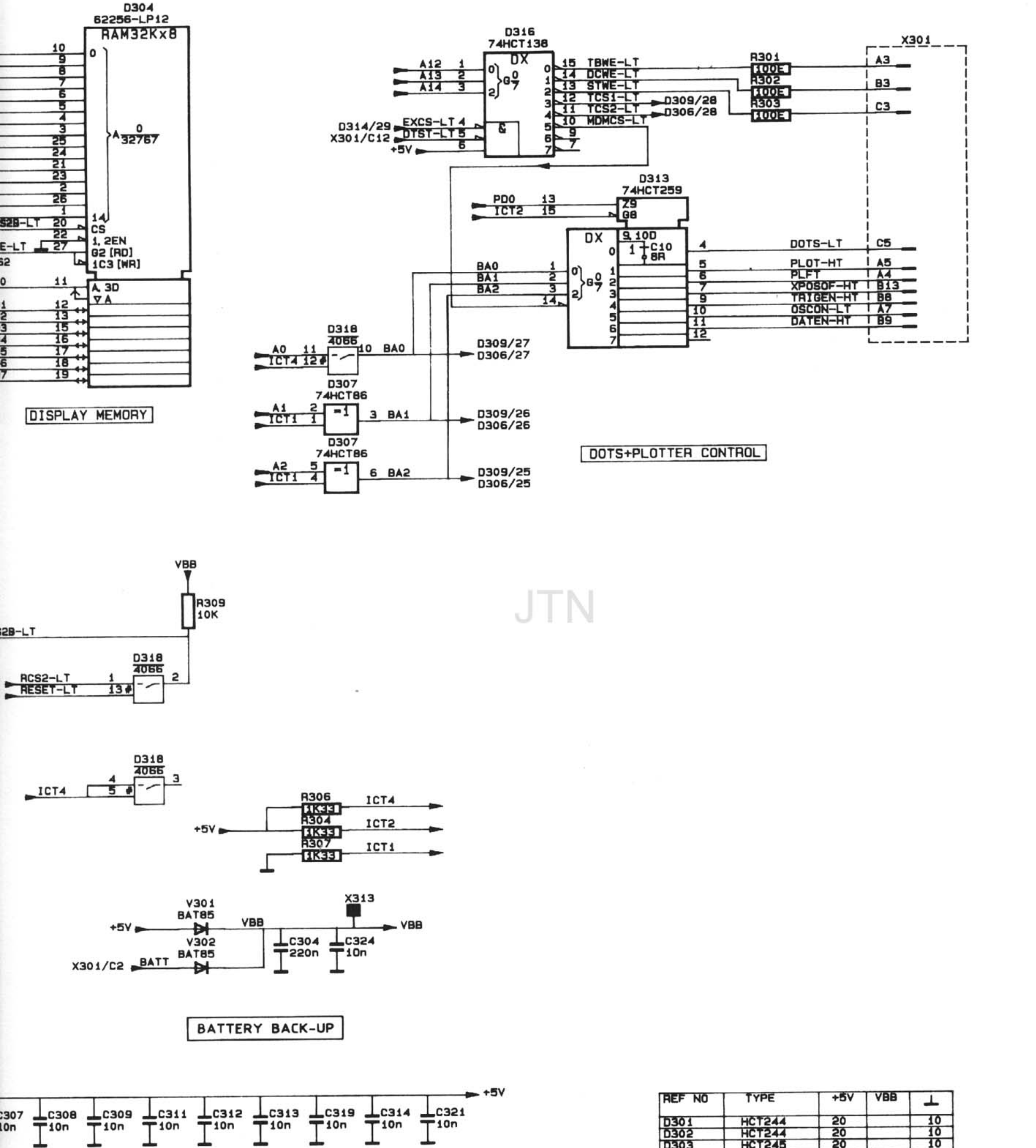
Figure 14.13 Circuit diagram of DCL unit: display memory



DISPLAY COUNTER
D306
0Q0209
D304
62256-LP12
RAM32Kx8
DISPLAY MEMORY
DATA BUS BUFFER
D303
74HCT245
ADRESS BUS BUFFER
D301
74HCT244
D302
74HCT244
μP DATA BUS
μP ADDRESS BUS
X301
X304
X307
X313
R313 100K
R309 10K
D318 4066
D307 74HCT86
R306 1K33
R304 1K33
R307 1K33
V301 BAT85
V302 BAT85
C304 220n
C324 10n
BATTERY BACK-UP
+5VIN
L301 82uH
C317 100n
C316 220u
C318 100u
C301 10n
C302 10n
C303 10n
C306 10n
C307 10n
C308 10n
C309 10n
C311 10n
C312 10n
C313 10n
C319 10n
C322 10n
C323 10n
C326 10n
+5V
VBB
RCS2B-LT
RWE-LT
RCS2-LT
RESET-LT
DSOSEL-LT
TDS-LT
TCS2-LT
TOE-LT



REF NO	TYPE	+5V	VBB	⊥
D301	HCT244	20		10
D302	HCT244	20		10
D303	HCT245	20		10
D304	62256-LP12		28	14
D306	OQ0209	40		20
D307	HCT86	14		7
D313	HCT259	16		8
D316	HCT138	16		8

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Figure 14.13 Circuit diagram of DCL unit: display memory

15 ACL UNIT (A14)

The ACL (Acquisition ControL) unit consists of:

- trigger control
- CCD + ADC timing
- average and interpolation circuit
- delay counter (PM3355/57 only)

15.1 TRIGGER CONTROL

The trigger control determines the start of the acquisition.
A timing diagram of the trigger control is given in figure 15.1.

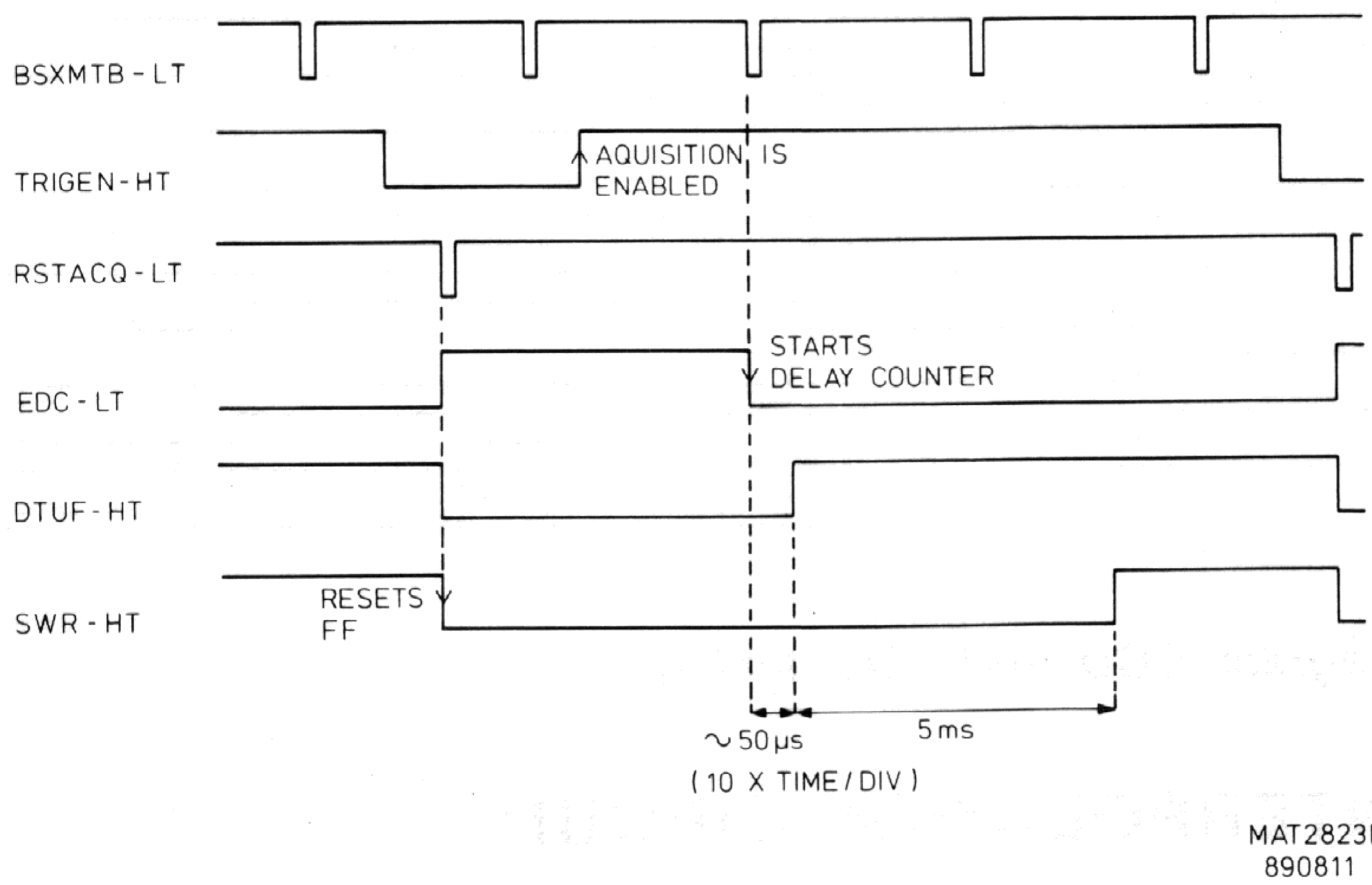


Figure 15.1 Timing diagram of the trigger control.
(TB = 5 μs and PRE-TRIG = 0)

At the moment that TRIGEN-HT is low and RSTACQLT-LT becomes low, flip- flops D403 and D404 are reset.
Now TCINN-HT, generated by the microprocessor, can go high after the acquisition counter has counted the pre-trigger value. Then TRIGEN-HT is high again so that the acquisition is enabled.
The high level of TCINN-HT clocks D404, as a result D404-9 is high and D404-2 is enabled waiting for a new trigger signal BSXMTB-LT. When this signal is low, then EDC-LT is low and starts the delay counter.
At the moment that the EDC has counted, signal DTUF-HT is high which enables D402 and therefore SWTB is clocked through.

15.2 CCD + ADC TIMING

The clock pulse OLCLK-HT is derived from D314 (on unit A13). The pulse is 800 kHz for the P-mode and 640 kHz for the D-mode and is applied to the timer D409. Enabled by a high level on pin 10, this counter operates and the outputs Q0 (400/320 kHz), Q1 (200/160 kHz) and Q2 (100/80 kHz) are fed to D411. D408 serves for synchronisation between SC0 and WRSMP-HT.
The PAL (Programmable Array Logic) chip D411 generates several control pulses for the CCD logic.
The signals DISEV-HT, DISOD-HT, RSTOD-LT, RSTEV-LT, SAMPLEHT, INTOD-HT and INTEV-HT are fed to the P^2CCD output circuit on unit A18. The signals STCONV- HT, CHSEL0-HT and CHSEL1-HT are fed to the ADC on unit A15.

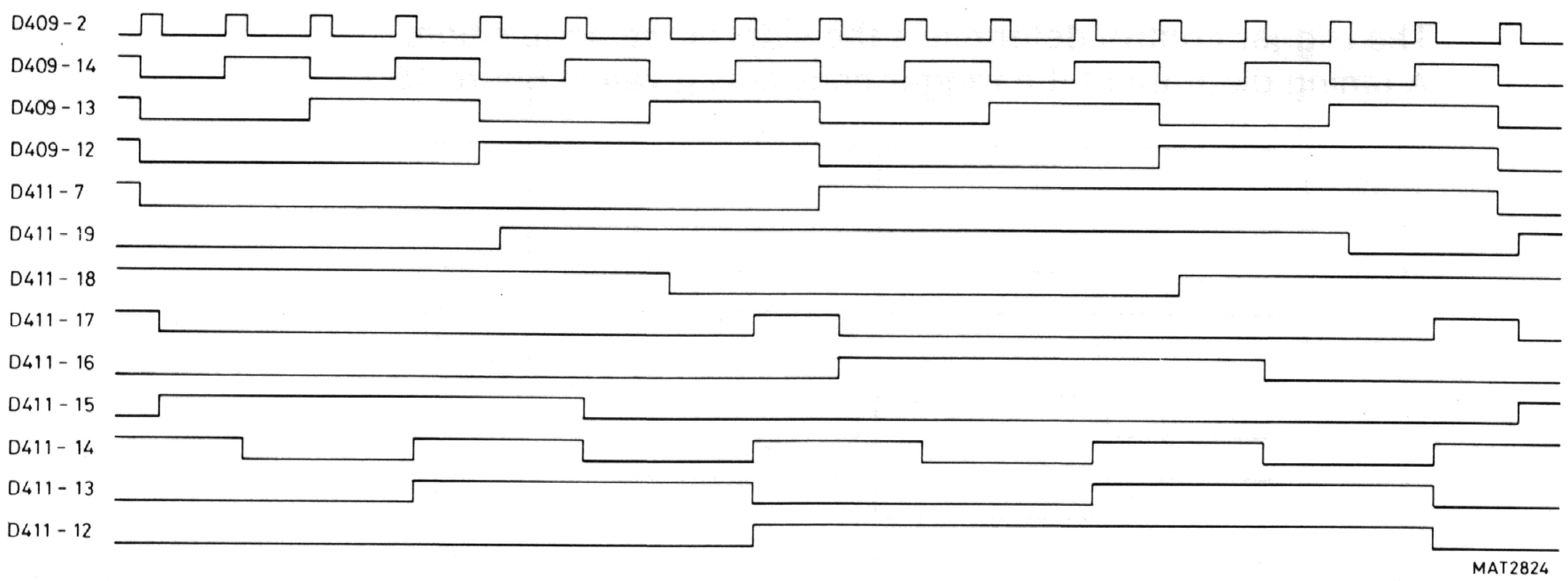


Figure 15.2 Timing diagram CCD and ADC timing

15.3 AVERAGE AND INTERPOLATION CIRCUIT

The ADC bus is generated on the ADCDAC unit A15. This bus is applied to the signal processor device D412.
The P^2CCD is split up into two parts (EVEN and ODD channel) and the samples of the EVEN channel have another gain and offset than the ODD channel. D412 averages these differences according to the formula

$$Am = \frac{An + (An - 1)}{2}$$

An = value of n-th sample
Am = value of averaged sample

Next D412 calculates also 512 linear interpolated points between each of the 512 samples according to the formula

$$Ac = \frac{Am + (An - 1)}{2}$$

Ac = value of interpolated sample

These averaged and interpolated samples are written into the acquisition memory for signal manipulation, see chapter 14.
The output bus PD0... PD7 is applied to the memories on unit A13 for display manipulation and to the Y-DAC latch D413.
When XYDLE-HT is high, this device is enabled to receive the PD-bus and transfers it to the YDAC0... YDAC7 bus.
This bus is fed to the Y-DAC on the ADCDAC unit A15.
The four least-significant bits ED0... ED3 are applied to the P^2CCD panel A18. These lines preset the ACE on this unit.

15.4 SIGNAL NAME LIST

Signal name	Description	Signal source	Signal destination(s)
AD0...7	Data bus from ADC circuit	N505	D412
BSXMTB-LT		D4103	D401
CCDENBHT	CCD enable	R447	R1637
CDRD-HT	CCD read	R883	D404 - D411
CHSEL0HT	Channel select 0	D411	N505
CHSEL1HT	Channel select 1	D411	N505
CVCNRYLT	Conversion counter ready	D218	D403 - D406
DATEN-HT	Data enable	D313	D416
DLENX-HT	Data latch enable X	D219	D412
DMODE-HT	Direct mode	D412	D408
DMODE-LT	Direct mode	D412	D408
DISEV-HT	Discharge even	R403	D921 - D922
DISOD-HT	Discharge odd	R404	D921 - D922
DLTRG-HT	Delay trigger	D402	D314 - D406
DTUF-HT	Delay trigger underslow	R884	D402
ED0...3	Buffered data bus	R413...R417	D801
EDC--LT	Enable delay counter	R401	D221 - D801
ENCVCN-HT	Enable conversion counter	D406	D218
INVA-HT	Invert A	D412	D407
INVA0-HT	Invert address A0	D407	D307
INTEV-HT	Integrate even	R411	D911
INTOD-HT	Integrate odd	R409	D901
MIDCLK	Mid clock	D314	D412
MDOE-LT	MD output enable	D314	D412
OLCLK-HT	Output logic clock	D314	D401 - D409
OSCON	Oscillator on	D313	D401 - D406 - D801
PD0...7	Buffered bidirectional tri-state data bus	D303	D413
RSTACKLT	Reset acquisition	D202	D402 - D403
RSTEV-LT	Reset even	R407	R751
RSTH-LT	Reset	D314	D401
RSTH-HT	Reset	D401	D412
RSTOD-LT	Reset odd	R406	R781
RSSW-HT	Reset slow clock	R407	D801
SDA1	Serial data 1	D223	R223 - D412
SC0--HT	State counter 0	D314	D407 - D408
SC1--HT	State counter 1	D314	D408
SCL1	Serial clock 1	D223	D412
SAMPLEHT	Sample clock CIH	R408	D411 - D922
STCONVHT	Start conversion	D411	N505
SWCK	Slow clock	R412	D801
SWTBCLK	Slow time base clock	D409	D218 - D411
SWR--HT	Sweep ready	D403	D221
SWR--LT	Sweep ready	D403	D412
SWTB	Slow time base	D218	D412 - D801
TBSYNCHT	Time base synchronisation	D403	D402 - D412
TBSYNCLT	Time base synchronisation	D403	D412
TCEV-LT	Transport clock even	882	D401 - D408 - D411
TCINN-HT	Terminal count in	D314	D404
TRGLTC		D403	D412
TRIGENHT	Trigger enable	D313	D403 - D404 - D406
WRSMP-HT	Write sample	D412	D314
XYDLE-HT	A DAC and Y DAC latch enable	D314	R427
YDAC0...7	Data bus for Y DAC	D413	N506

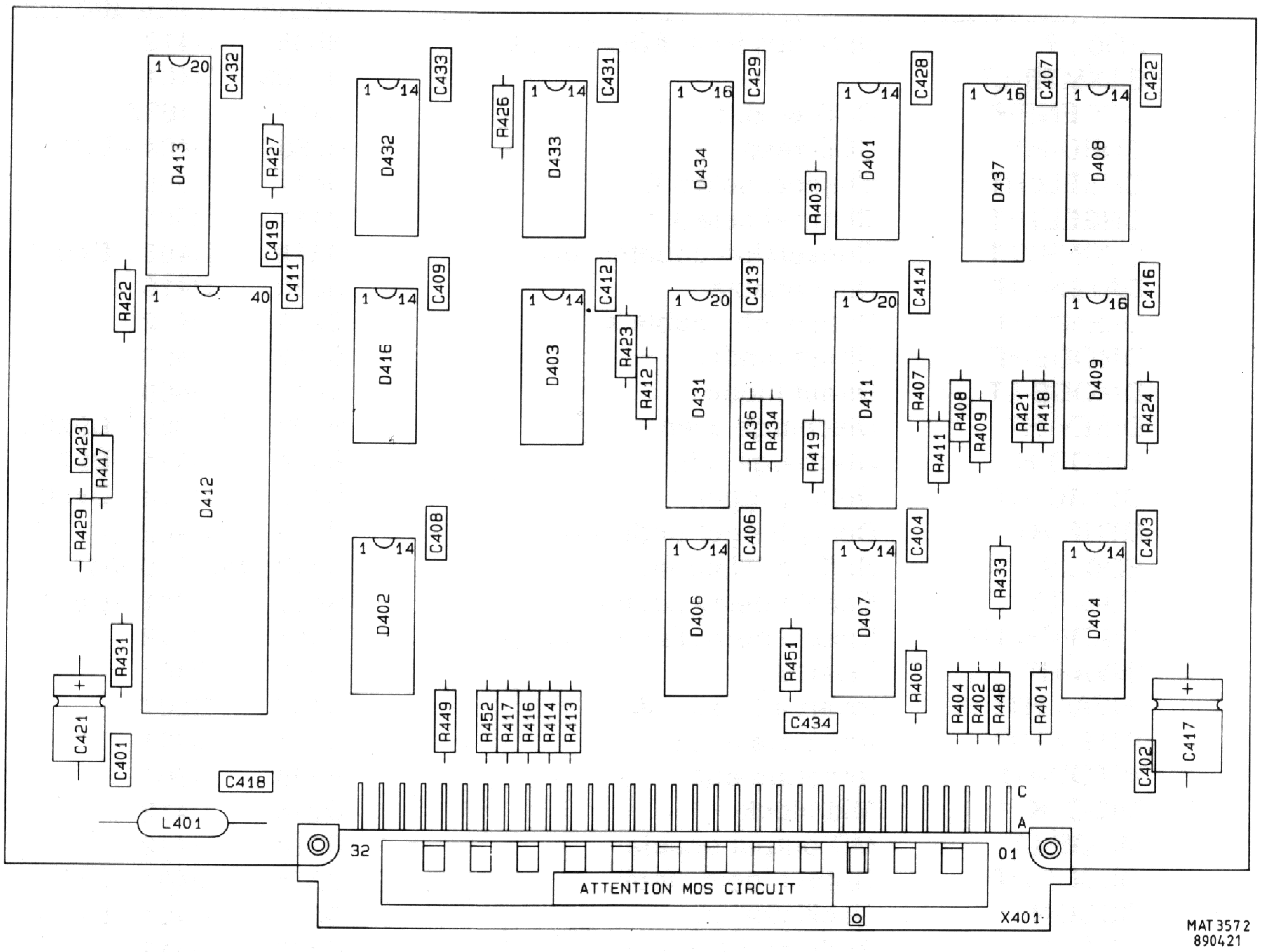
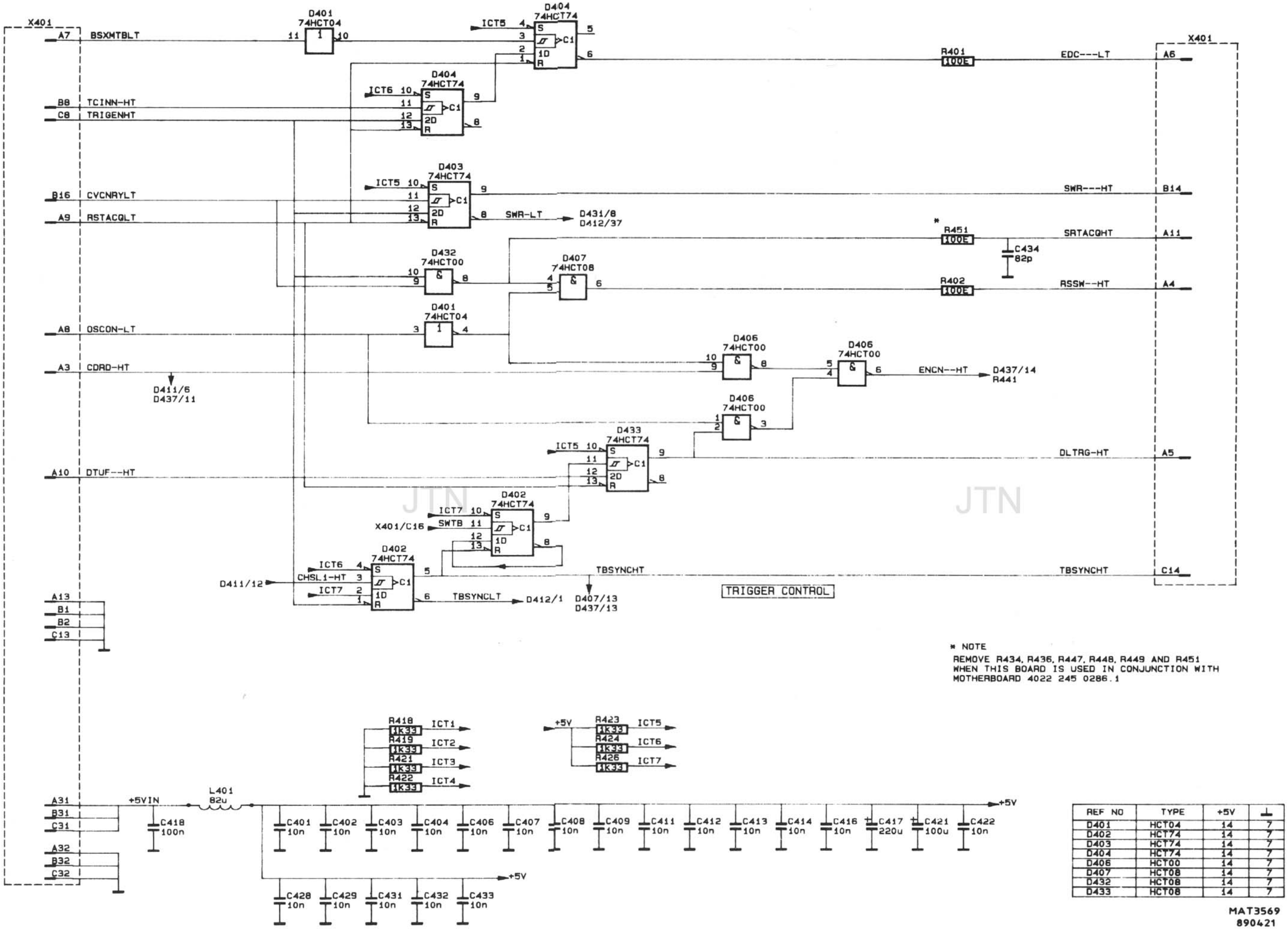


Figure 15.3 ACL unit p.c.b.

15.4 SIGNAL NAME LIST



* NOTE
REMOVE R434, R436, R447, R448, R449 AND R451
WHEN THIS BOARD IS USED IN CONJUNCTION WITH
MOTHERBOARD 4022 245 0286.1

REF NO	TYPE	+5V	⊥
D401	HCT04	14	7
D402	HCT74	14	7
D403	HCT74	14	7
D404	HCT74	14	7
D406	HCT00	14	7
D407	HCT08	14	7
D432	HCT08	14	7
D433	HCT08	14	7

Figure 15.4 Circuit diagram of ACL unit: part 1

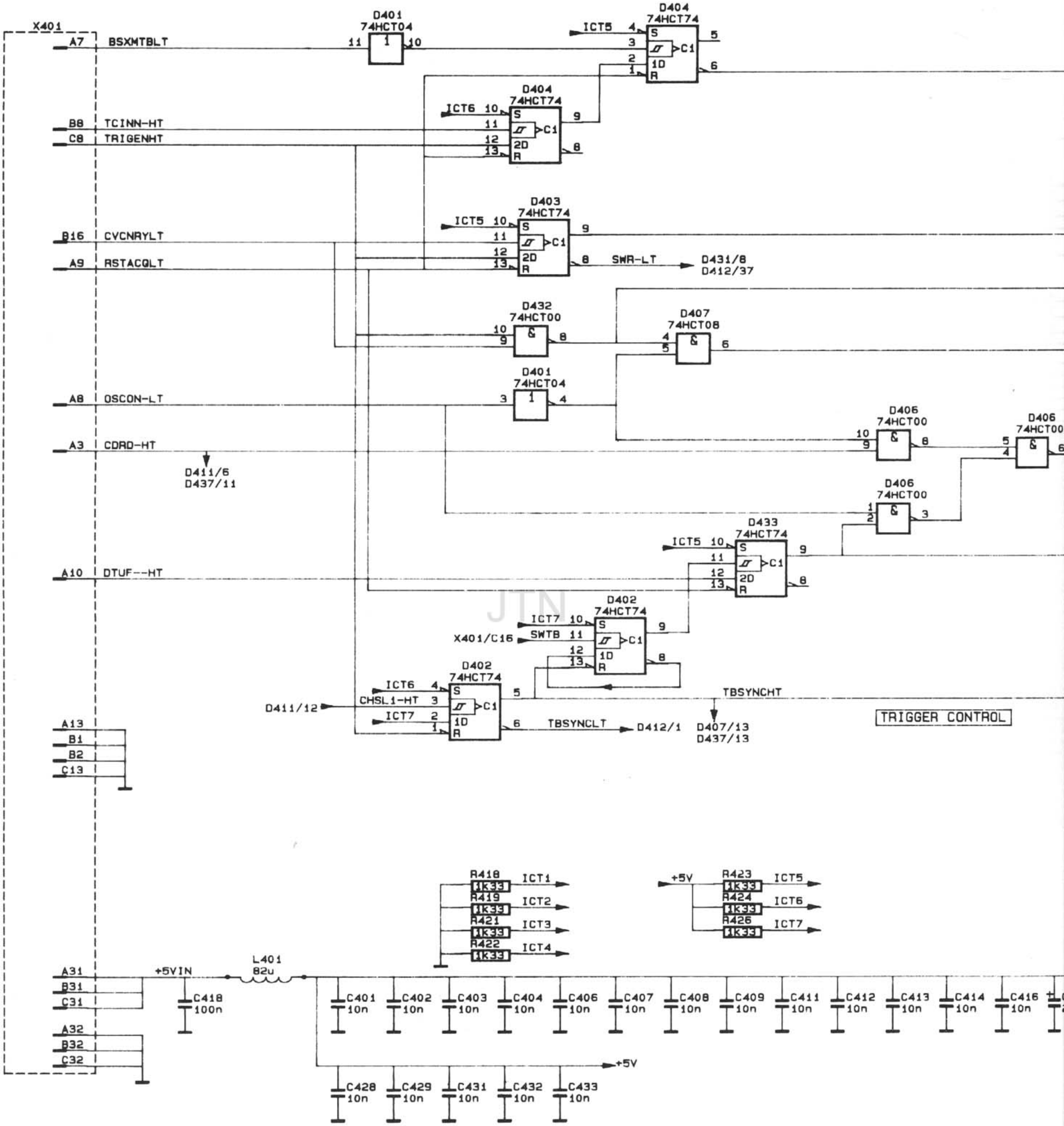
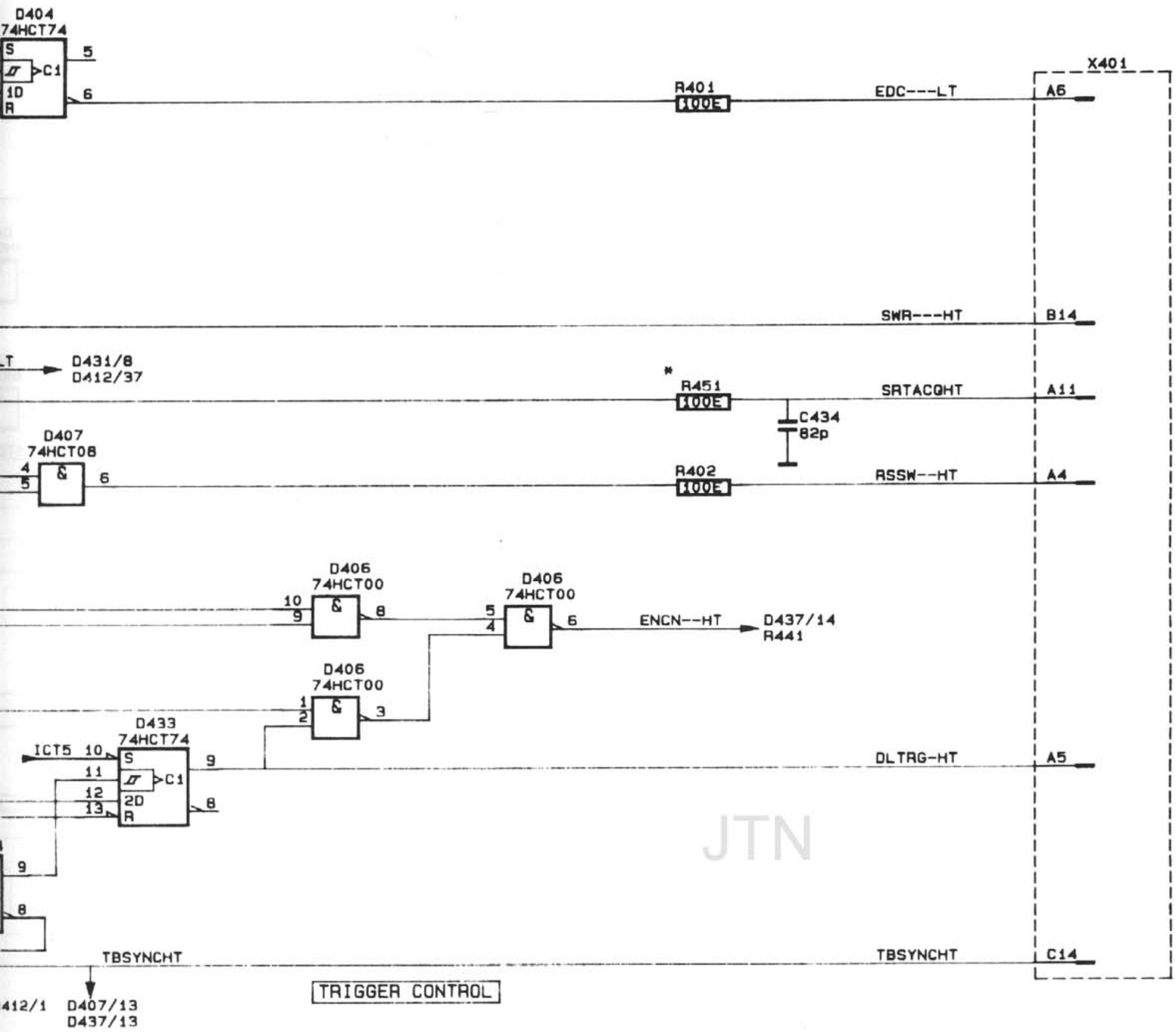
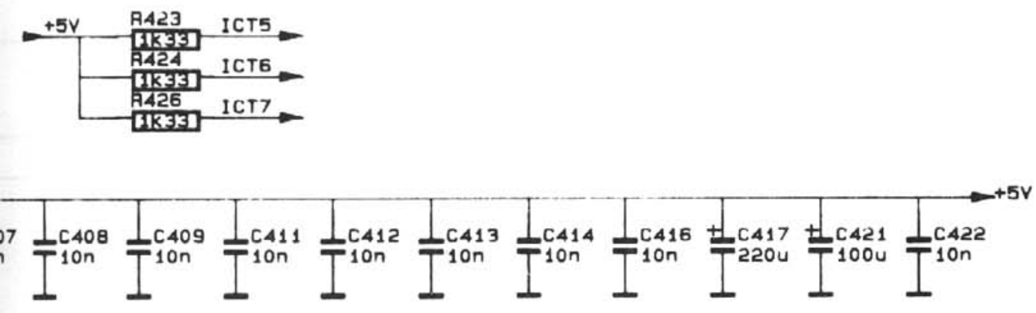


Figure 15.4 Circuit diagram of ACL unit: part 1



* NOTE

REMOVE R434, R436, R447, R448, R449 AND R451
WHEN THIS BOARD IS USED IN CONJUNCTION WITH
MOTHERBOARD 4022 245 0286.1



REF NO	TYPE	+5V	⊥
D401	HCT04	14	7
D402	HCT74	14	7
D403	HCT74	14	7
D404	HCT74	14	7
D406	HCT00	14	7
D407	HCT08	14	7
D432	HCT08	14	7
D433	HCT08	14	7

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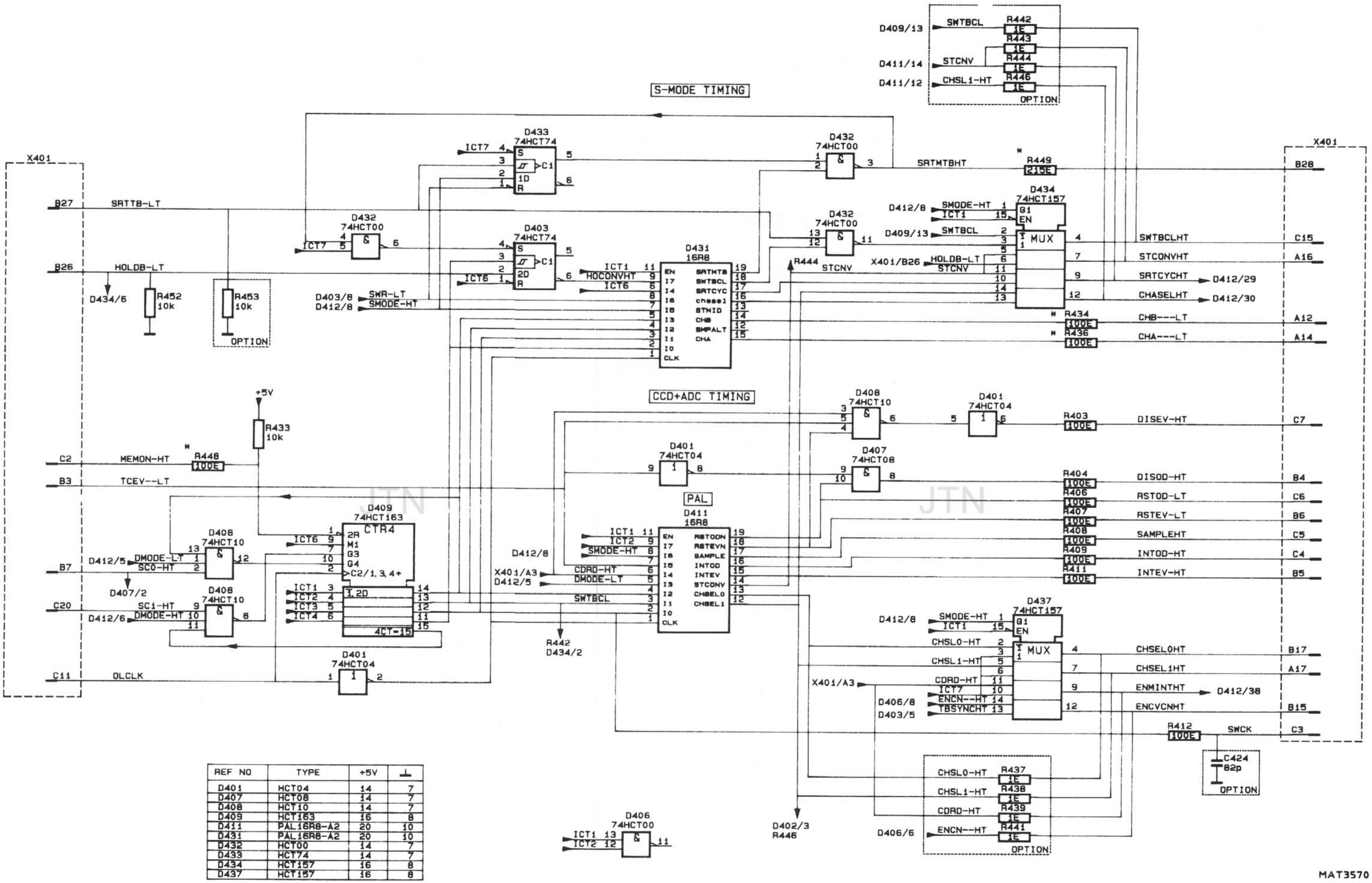
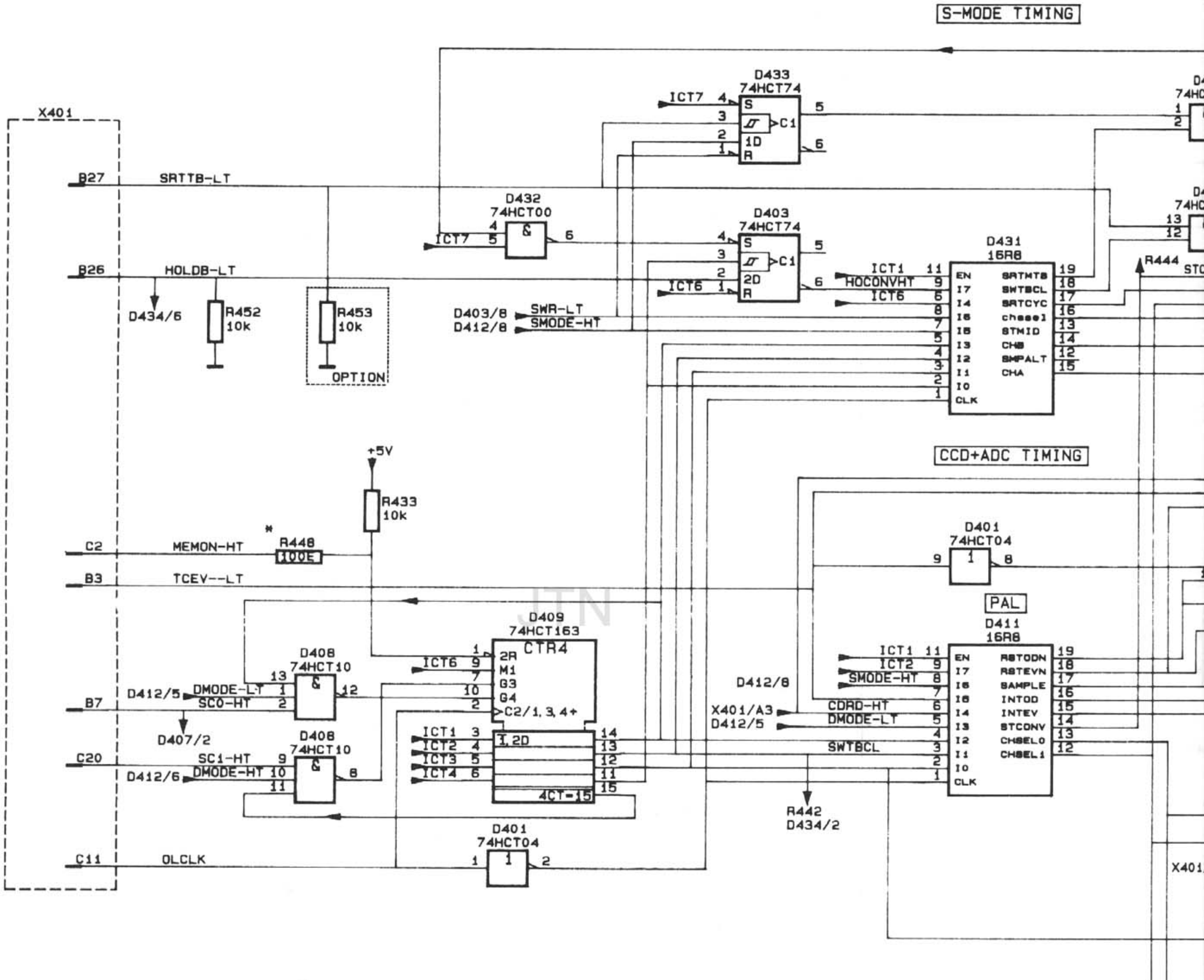
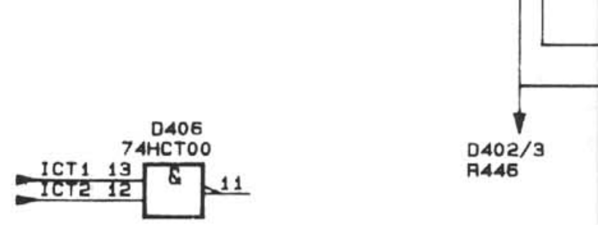


REF NO	TYPE	+5V	⊥
D401	HCT04	14	7
D407	HCT08	14	7
D408	HCT10	14	7
D409	HCT163	16	8
D411	PAL16R8-A2	20	10
D431	PAL16R8-A2	20	10
D432	HCT00	14	7
D433	HCT74	14	7
D434	HCT157	16	8
D437	HCT157	16	8

Figure 15.5 Circuit diagram of ACL unit: part 2





REF NO	TYPE	+5V	⊥
D401	HCT04	14	7
D407	HCT08	14	7
D408	HCT10	14	7
D409	HCT163	16	8
D411	PAL16R8-A2	20	10
D431	PAL16R8-A2	20	10
D432	HCT00	14	7
D433	HCT74	14	7
D434	HCT157	16	8
D437	HCT157	16	8

Figure 15.5 Circuit d

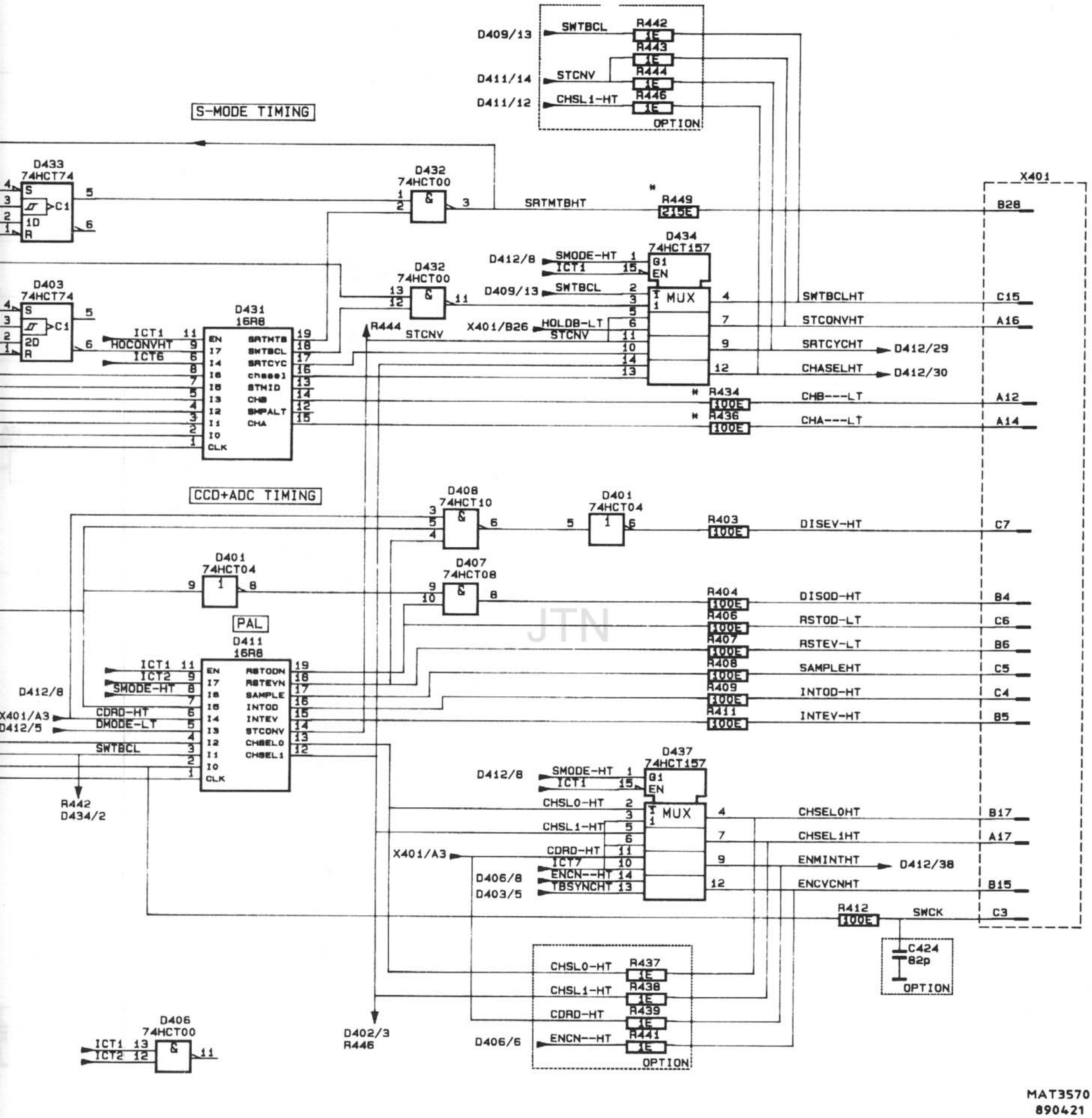


Figure 15.5 Circuit diagram of ACL unit: part 2

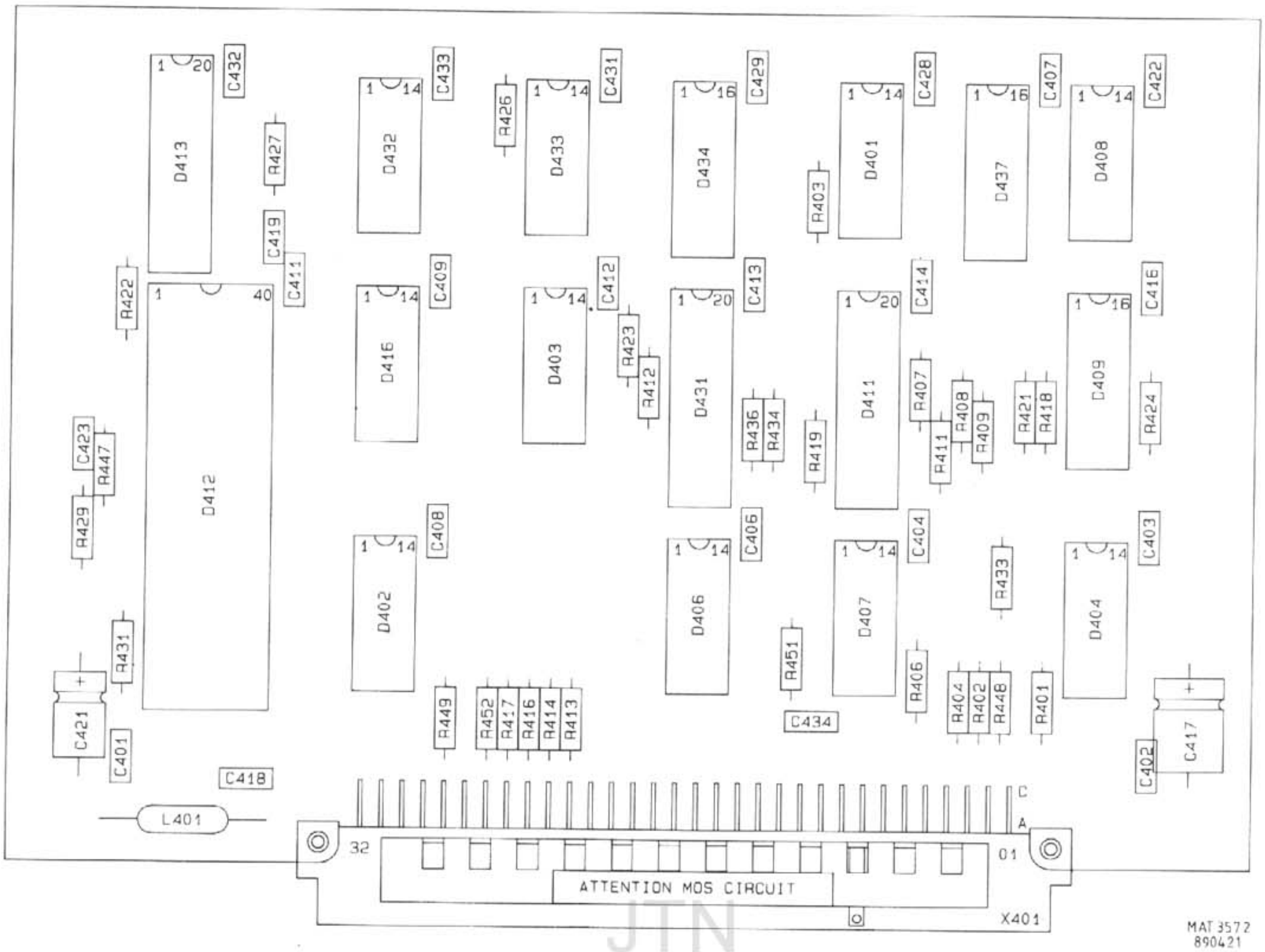
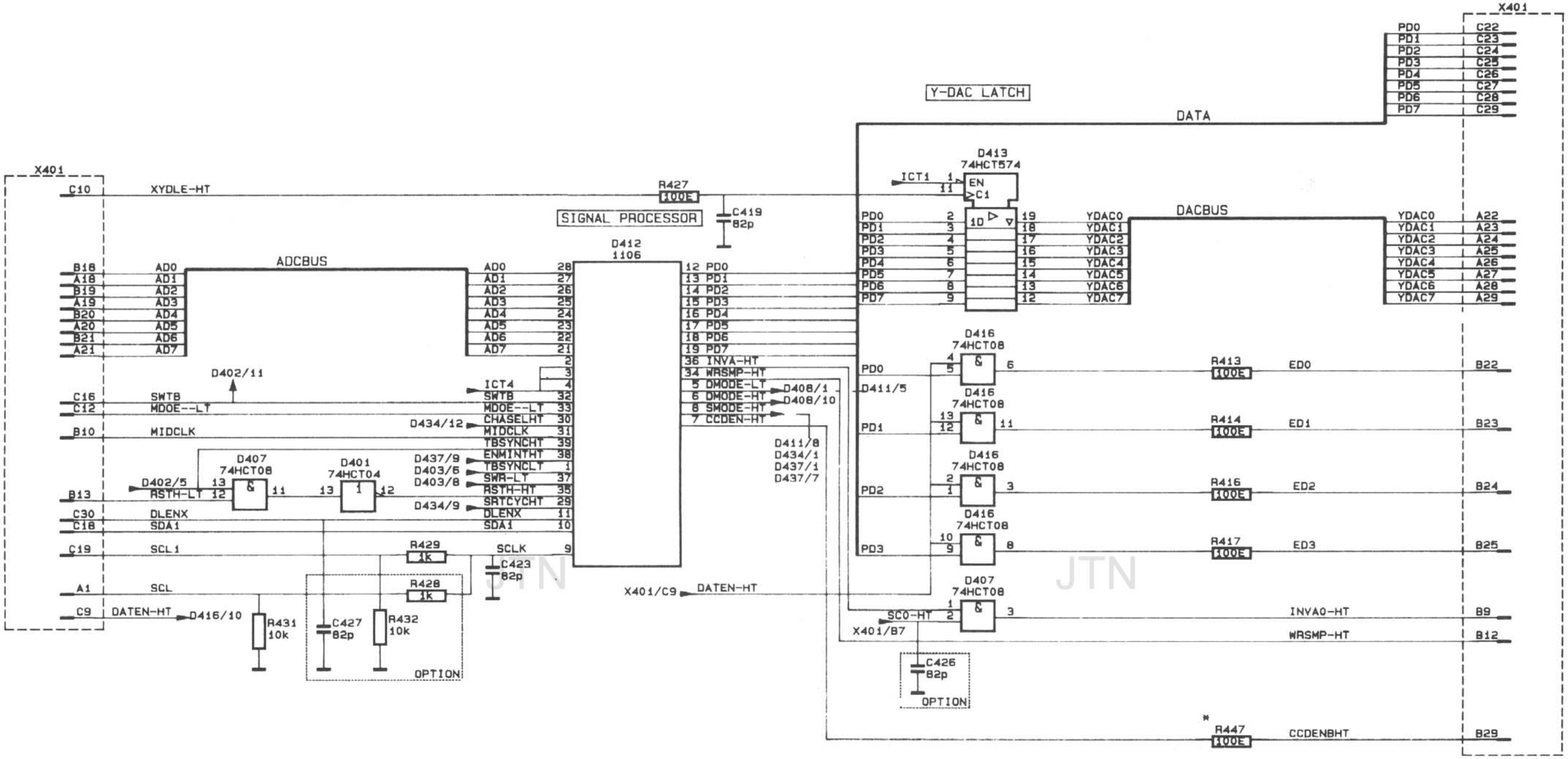


Figure 15.6 ACL unit p.c.b.



REF NO	TYPE	+5V	⊥
D401	HCT04	14	7
D407	HCT08	14	7
D412	PCF1106	40	20
D413	HCT574	20	10
D416	HCT08	14	7

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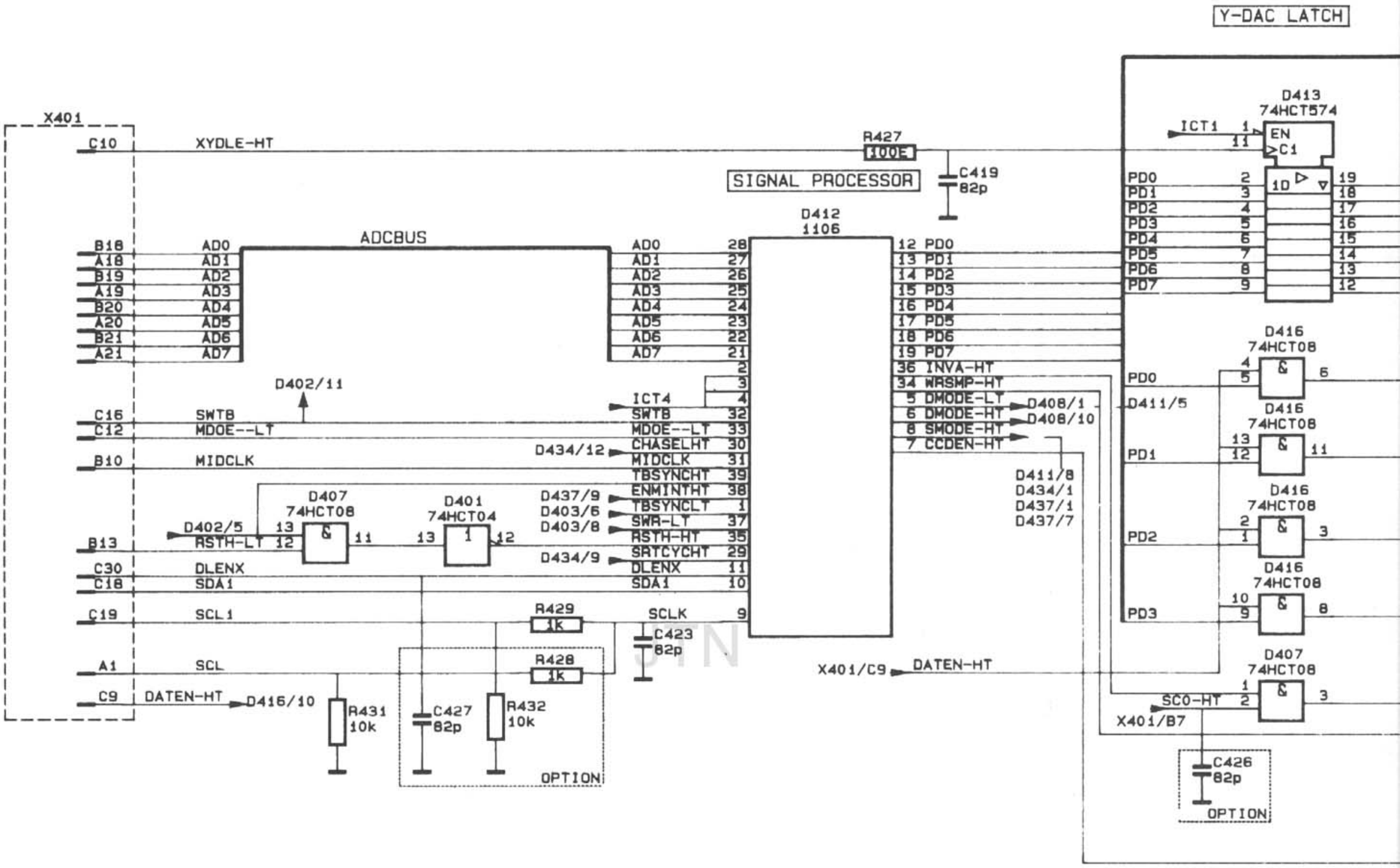
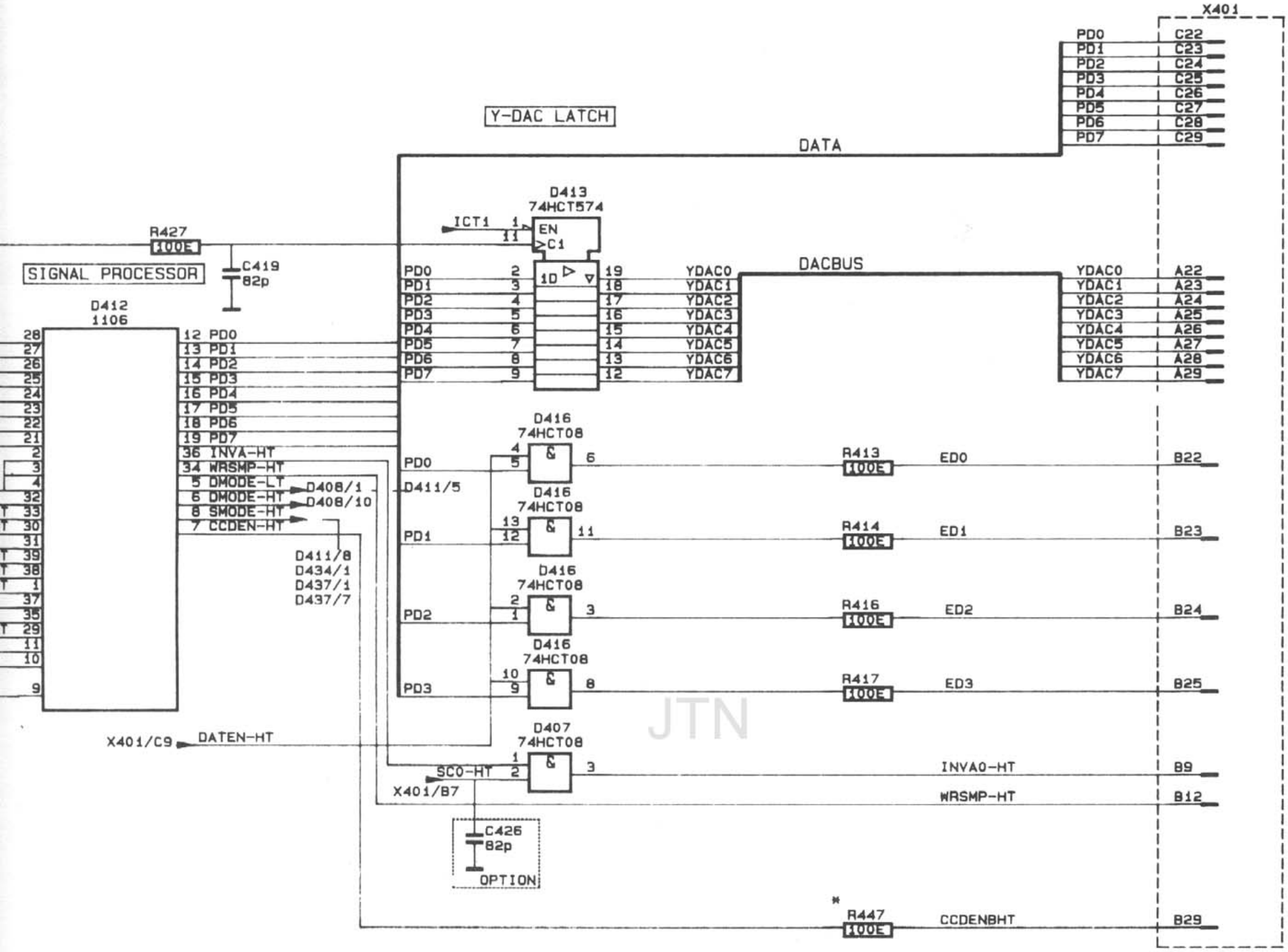
Figure 15.7 Circuit diagram of ACL unit: part 3



Y-DAC LATCH
SIGNAL PROCESSOR
X401
C10
XYDLE-HT
R427
100E
C419
82p
D413
74HCT574
ICT1
EN
C1
1D
ADCBUS
D412
1106
B18
A18
B19
A19
B20
A20
B21
A21
AD0
AD1
AD2
AD3
AD4
AD5
AD6
AD7
PD0
PD1
PD2
PD3
PD4
PD5
PD6
PD7
36 INVA-HT
34 WRSMP-HT
5 DMODE-LT
6 DMODE-HT
8 SMODE-HT
7 CCDEN-HT
D408/1
D408/10
D411/5
D411/8
D434/1
D437/1
D437/7
D402/11
C16
SWTB
C12
MDOE--LT
B10
MIDCLK
ICT4
CHASELHT
MIDCLK
TBSYNCHT
ENMINTHT
TBSYNCLT
SWR-LT
RSTH-HT
SRTCYCHT
DLENX
SDA1
D434/12
D437/9
D403/6
D403/8
D434/9
D407
74HCT08
D401
74HCT04
D402/5
B13
RSTH-LT
C30
DLENX
C18
SDA1
C19
SCL1
R429
1k
SCLK
C423
82p
A1
SCL
R428
1k
C9
DATEN-HT
D416/10
R431
10k
C427
82p
R432
10k
OPTION
X401/C9
DATEN-HT
D416
74HCT08
SC0-HT
X401/B7
C426
82p
OPTION



REF NO	TYPE	+5V	⊥
D401	HCT04	14	7
D407	HCT08	14	7
D412	PCF1106	40	20
D413	HCT574	20	10
D416	HCT08	14	7

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Figure 15.7 Circuit diagram of ACL unit: part 3

16 ADC DAC UNIT (A15)

The ADC DAC unit consists of:

- ADC circuit
- vertical DAC circuit (Y-DAC)
- horizontal DAC circuit (X-DAC)
- X POS switch circuit
- Z control circuit
- plot and penlift circuit

16.1 ADC CIRCUIT

The four signal samples CHAEV, CHAOD, CHBEV and CHBOD are derived from the P^2CCD unit. The samples for each channel are first fed to differential amplifier N501. This device compares both input signals and gives the following results for a sine wave signal with 10 divisions amplitude.

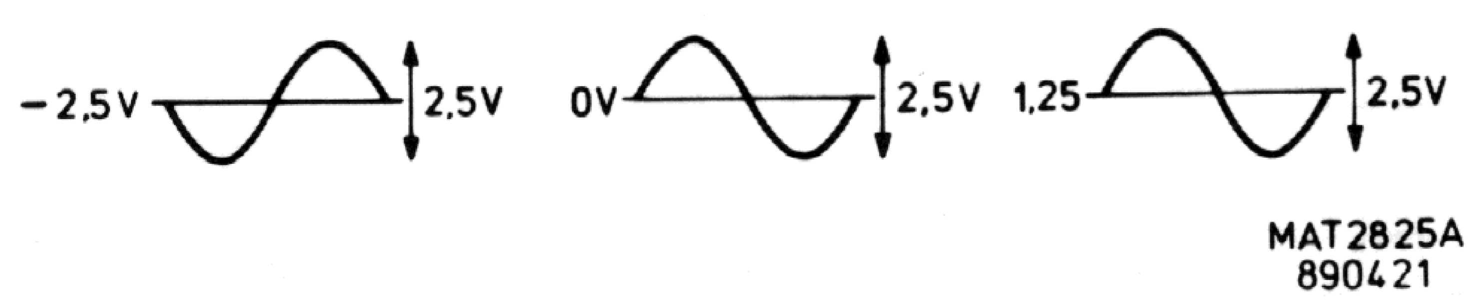


Figure 16.1 Waveforms on N501

The output signal is limited for an amplitude between -0,3 V... +3,0 V by the limiting diodes V501...V506 to protect the ADC input and then applied to the ADC N505.

This ADC, AD7824 is a high-speed-4-channel 8-bit analog-to-digital converter with a conversion time of 2,5 μs per channel. Two channels are used for the AIN1 and AIN3 signals. Next, it has two digital inputs A0 and A1 for channel selection.

CHS0	CHS1	Signal	Channel selected
0	0	AIN1	A
1	0	AIN3	B
0	1	--	--
1	1	--	--

Conversion is started at the falling edge of the STCONVLT pulse while the data AD0...7 is present on the output at the rising edge of the STCONVLT pulse.

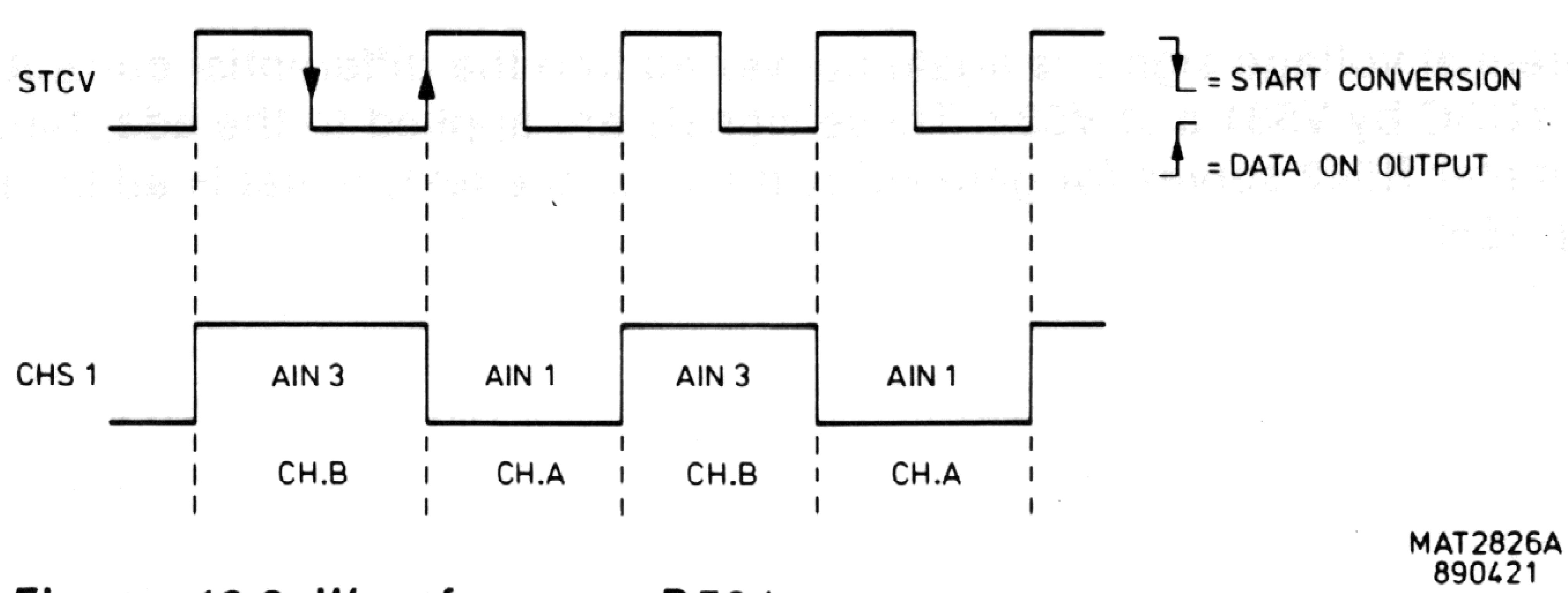


Figure 16.2 Waveform on D501

The value of the 8-bit data is determined by the input signal.
AD0...7 is 0000 0000 (00H) for an input voltage of 0 V and 1111 1111 (FFH) for an input voltage of +2,5 V. This AD-bus is applied to the ACL unit A14 for signal acquisition.

16.2 VERTICAL DAC CIRCUIT (Y-DAC)

The 8-bit Y-DAC bus derived from the ACL unit A14 is applied to DAC N506. The 8-bit digital-to-analogue converter converts the value of YDAC0...7 into a differential current signal. The reference current is 2 mA. The differential current is converted into a differential voltage by V521 and V522.

During refreshment of the 8-bit data, glitches appear on the output current. These glitches are removed by D503.

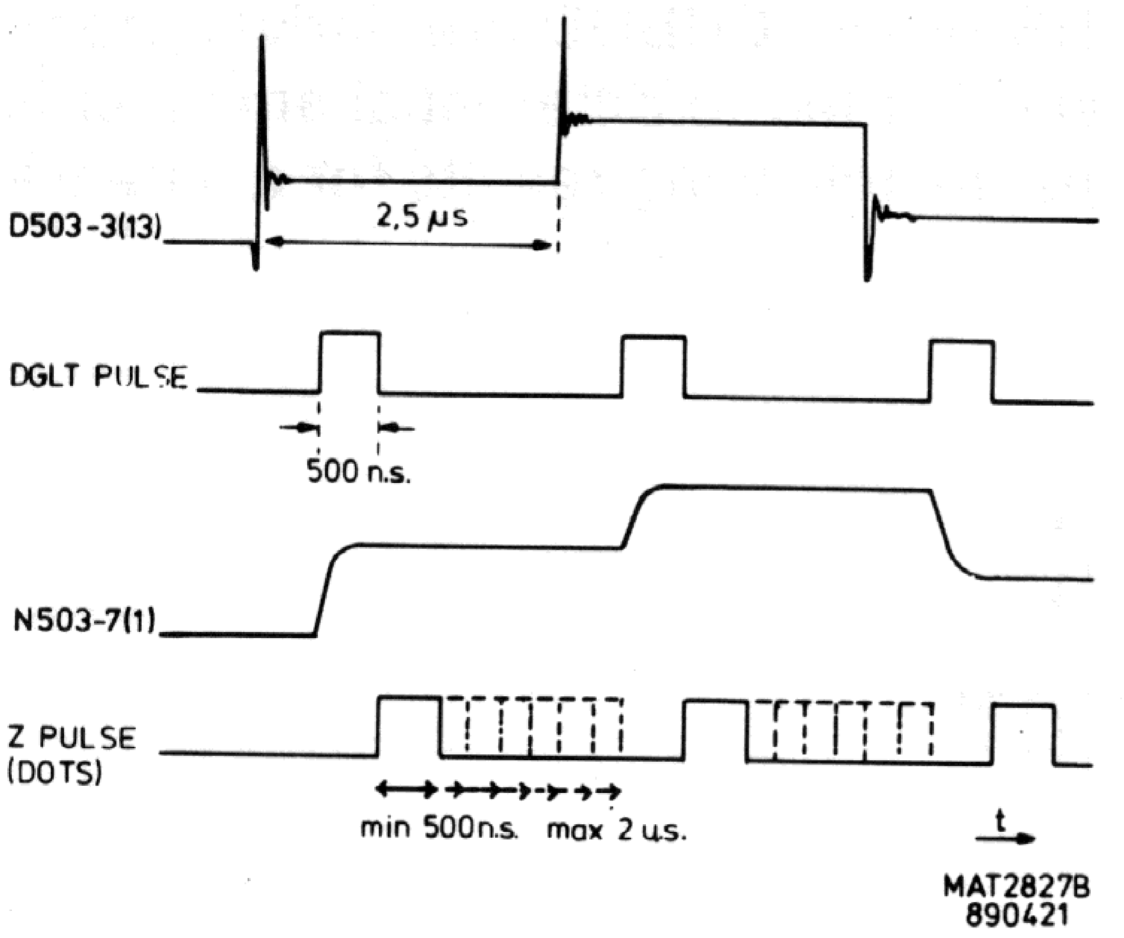


Figure 16.3 Waveform on deglitch circuit

Only when the DGLT pulse goes high, the hold capacitor C521 (C522) is charged to the value of the differential voltage. The charging time of C521-R532 (C522-R533) is much lower than the 500 ns of the DGLT pulse, so the hold capacitors will be fully charged. Because both capacitors are buffered by N503, they keep charged when DGLT is low for 2 µs until DGLT is high again. Then the capacitors will charge to the new value. Notice that DGLT is only high when the differential voltage on D503-3 (13) has become stable.

When DOT-JOIN is depressed, DOTS--LT is high. In this case, four integration capacitors C523...C527 are in circuit. The differential signal voltage is then loaded with these four capacitors. During the horizontal sweeps the Z pulse is constant high so the space between two dots is also intensified on the screen.

The + PLOT and - PLOT signals are fed to the plot and penlift circuit.

Next the differential voltage signal is again converted into the differential current signals +YDAC and -YDAC by V531 and V532. These signals are applied to the adaptation unit A16. Potentiometer R542 serves for gain adjustment for the text, offset is adjusted by potentiometer R550.

16.3 HORIZONTAL DAC CIRCUIT (X-DAC)

This circuit is basically similar to the vertical DAC circuit. However, the symmetrical current output of 10-bit DAC N507-4 (2) is converted into a asymmetrical voltage by N511. The amplitude of the sawtooth on D512-3 is 2,5 V. This signal is applied to the input of the deglitch circuit.

N513 serves as an output buffer and gives the digital sawtooth sweep of 0 V ... 5 V. This sweep is applied to the time-base unit A4.

16.4 X POS SWITCH CIRCUIT

The front-panel X POS control or R553 is switched to the POSXOUT output via a diode switch V553 ... V557. This switch is under control of the signal POSXOFHT. When POSXOFHT is low, the front-panel control POS X is active and determines the X position of the signal on the screen. But, during the time that the text is written on the screen, POSXOFHT is high. This means that the X position of the text is fixed by means of R553.

16.5 Z CONTROL

The brightness on the screen is controlled by three signals:

- PLOT--HT, dims the brightness when the instrument is in plot action.
- DOTS--LT, dims the brightness when the screen is dot-joined.
- ZON---LT, switches off the intensity during the flyback of the digital sawtooth or between two dots.

These TTL signals are first fed to D504 which converts the amplitude to 12 V. Because pin 15 is connected to +5 V the device is always enabled.

16.5.1 Plot mode

During the plot action, the signals PLOT--HT and DOTS--LT are high. This means that a part of the current source on unit A4 is floating (mainly) through resistor R565 and R566 so that the brightness on the screen is dimmed. During the flyback between two traces, signal ZON---LT is high so that the trace is fully blanked.

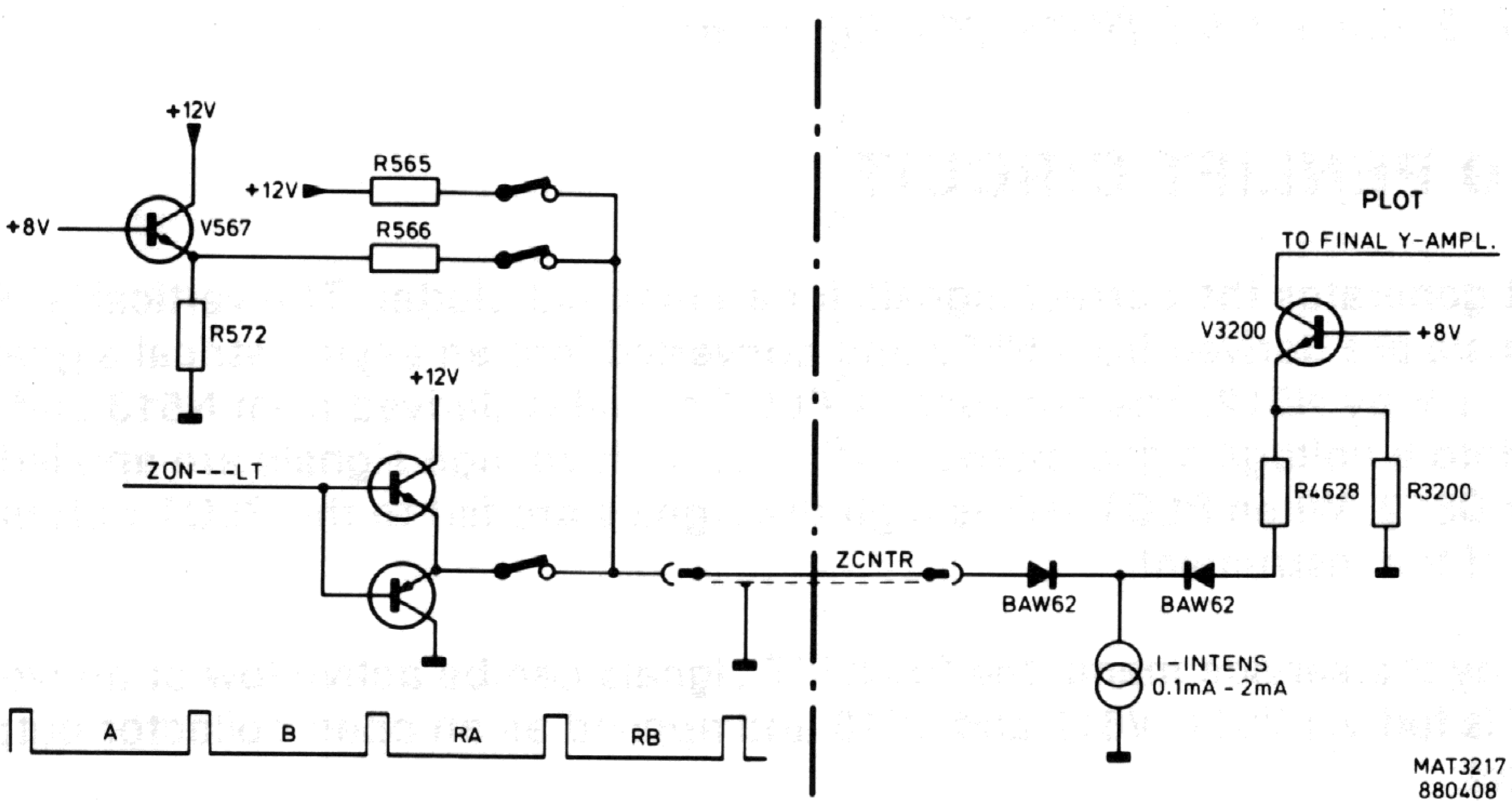


Figure 16.4 Z control fot PLOT mode

16.5.2 Dots-/dots-joined mode

In dots mode the signals PLOT--HT and DOTS--LT are low. This means that blanking is only controlled by the ZON---LT pulse. This pulse is high and thus the trace is blanked during the flyback and the time between the dots.

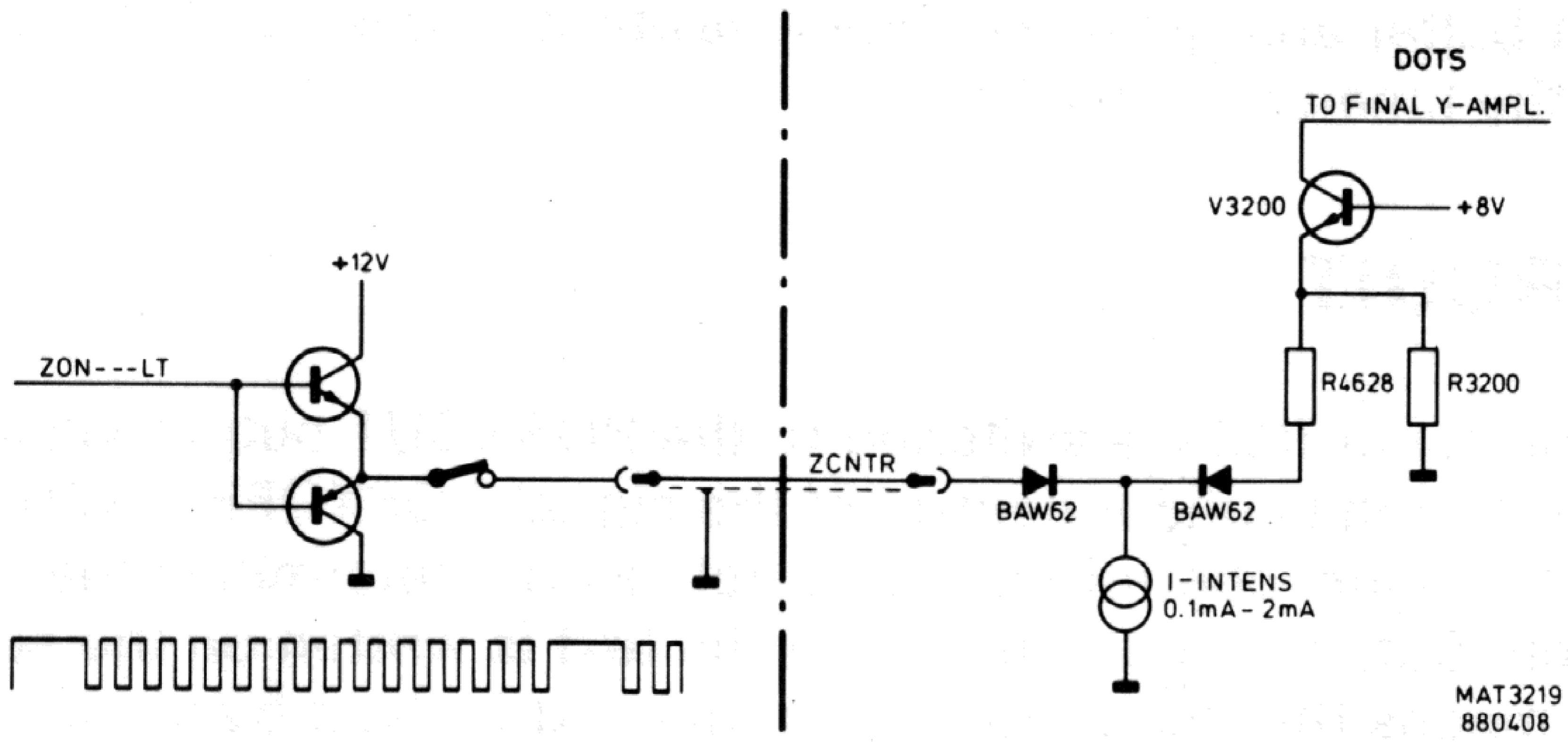


Figure 16.5 Z control for DOTS mode

When dots-joined is selected, the signal PLOT--HT is low and DOTS--LT is high. This means that when the trace is written, the brightness is dimmed, because a part of the current source on unit A4 is floating through resistor R566. During the flyback, signal ZON---LT is high so that the trace is fully blanked. Note that the period between two dots is not blanked now.

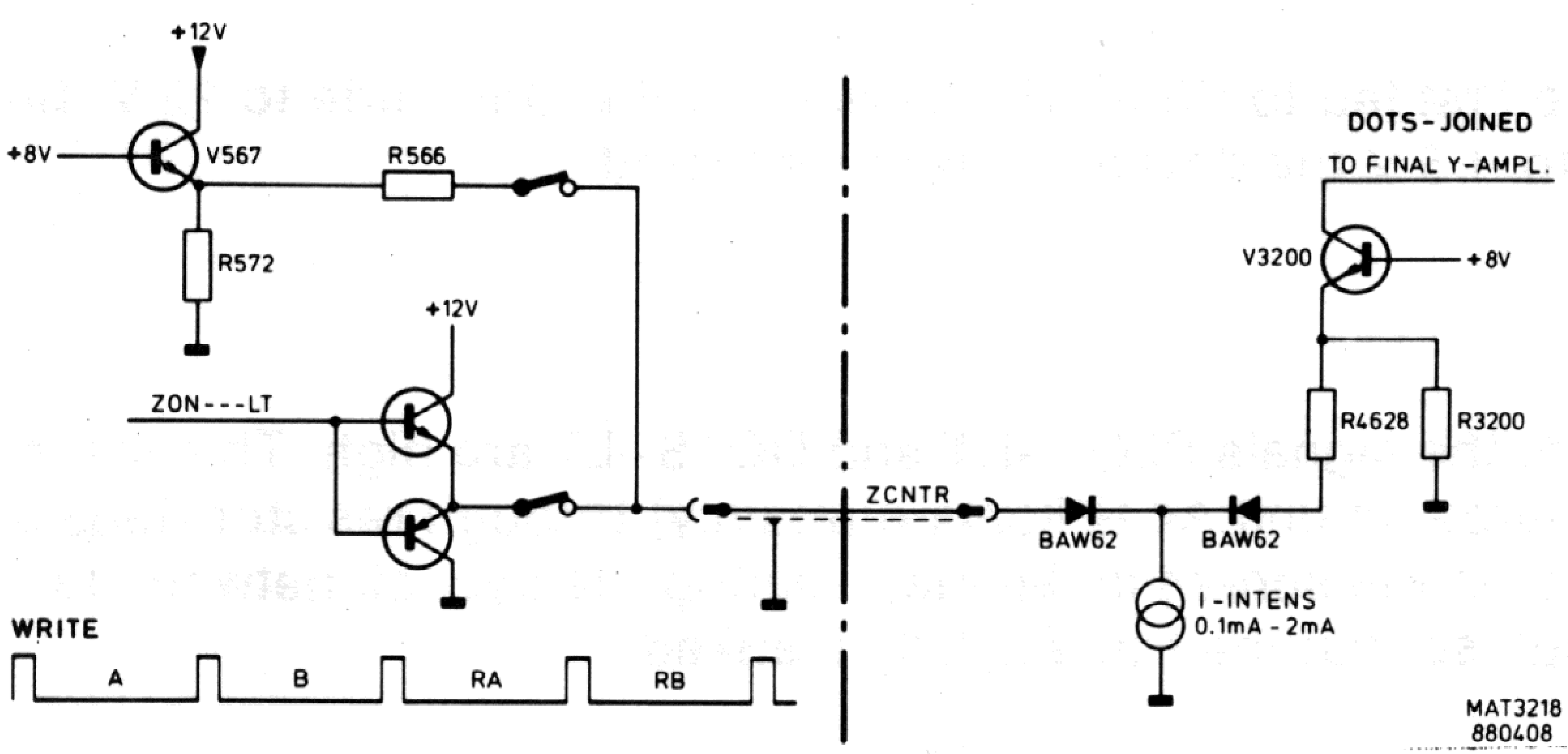


Figure 16.6 Z control for DOTS JOINED mode

16.6 PLOT AND PENLIFT CIRCUIT

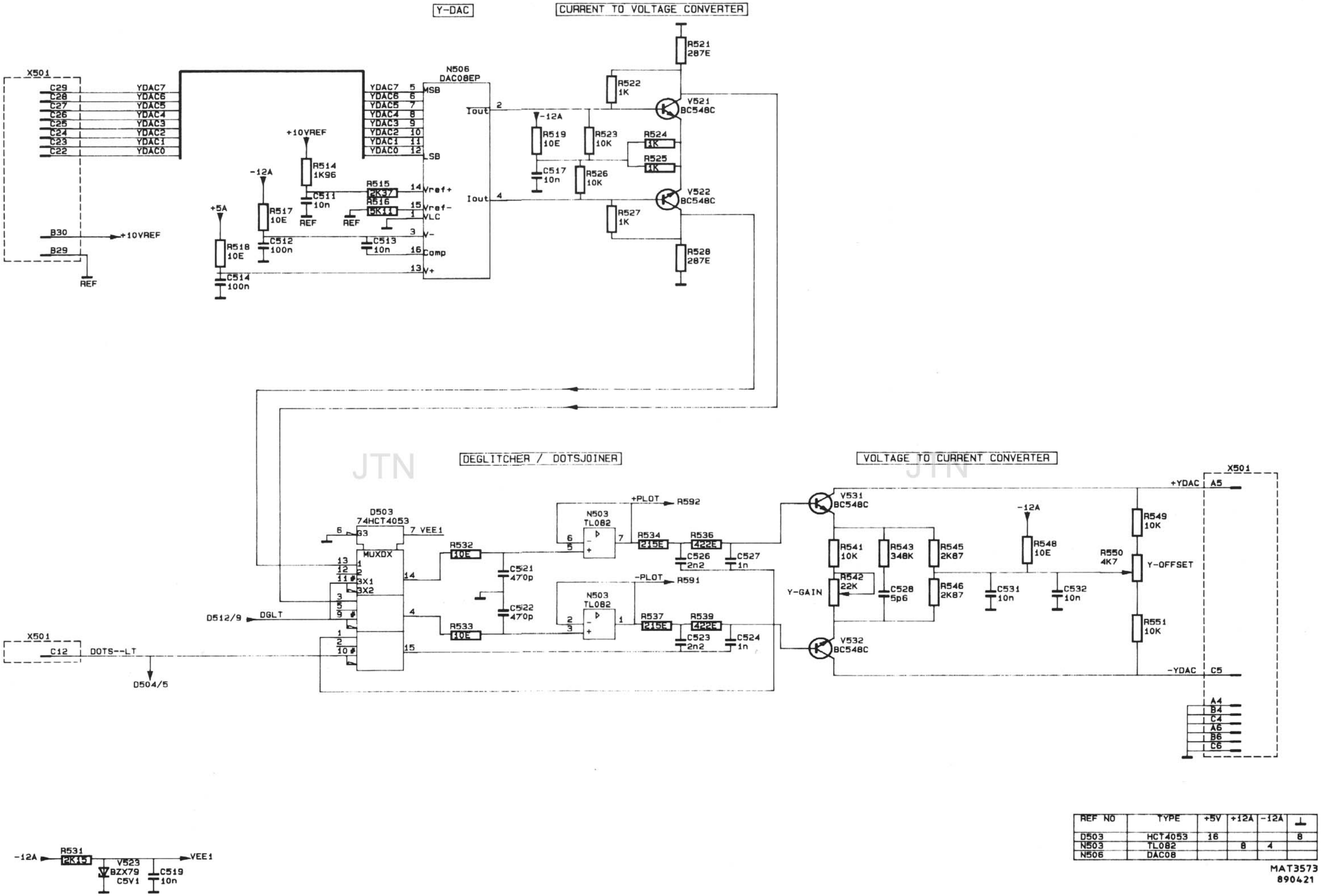
This circuit generates the correct signals for an external plotter. The vertical + PLOT and - PLOT signals are derived from N503 and converted into an asymmetrical signal between 0...1 V by N512. The horizonal X PLOT signal is derived from N513 and also converted into a voltage signal between 0...1 V. Both voltage signals are applied to multiplexer D512. When PLOT--HT is high the signals are fed to the PLOT output socket at the rear of the instrument.

Selectable by the service menu, the PENLIFT signals can be active low or active high. This signal is fed via V611, V612 and V613 and applied as an open-collector output to the PLOT socket.

The signals PLOT--HT and PENLIFT are derived from D313 on the DCL circuit A13.

16.7 SIGNAL NAME LIST

Signal name	Description	Signal source	Signal destination(s)
AD0...7	Data bus from ADC circuit	N505	D412
BATT	Battery voltage	X501/B3	V302
CHAEV	Channel A even	R937	R501
CHAOD	Channel A odd	R927	R502
CHBEV	Channel B even	R957	R508
CHBOD	Channel B odd	R947	R509
CHSEL0	Channel select 0	D411	N505
CHSEL1	Channel select 1	D411	N505
DGLT	Deglitch control	R584	D503 - D512
DSOSWP	Digital storage osc. sweep	N513	V4521
DOTS--LT	Control signal for dot join	D313	D503 - D504 - R596
PENLIFT	Penlift	D313	R614
PLOT--HT	Control signal for plot	D313	D504 - D512
PLOT-X	Plot X	R608	X505/1
PLOT-Y	Plot Y	R611	X505/3
+PLOT	Pos. plot	N503	R592
-PLOT	Neg. plot	N503	R591
POSX	X position	N7003	D113 - R560
POSXOFHT	Position off	D313	V555
POSXOUT	X position out	V554/V557	R4722
SC0--HT	State counter 0	D314	R584
STCONVHT	Start conversion	D411	N505
XDAC0...9	Data bus for X DAC	D311/D312	N507
XPLOT	X plot signal	N513	R587
YDAC0...7	Data bus for Y DAC	D413	N506
+YDAC	Pos. Y DAC out	V531	R1616
-YDAC	Neg. Y DAC out	V532	R1617
ZCNTR	Z control	D505	V4618
ZON---LT	Z on control	D314	D504



REF NO	TYPE	+5V	+12A	-12A	⊥
D503	HCT4053	16			8
N503	TL082		8	4	
N506	DAC08				

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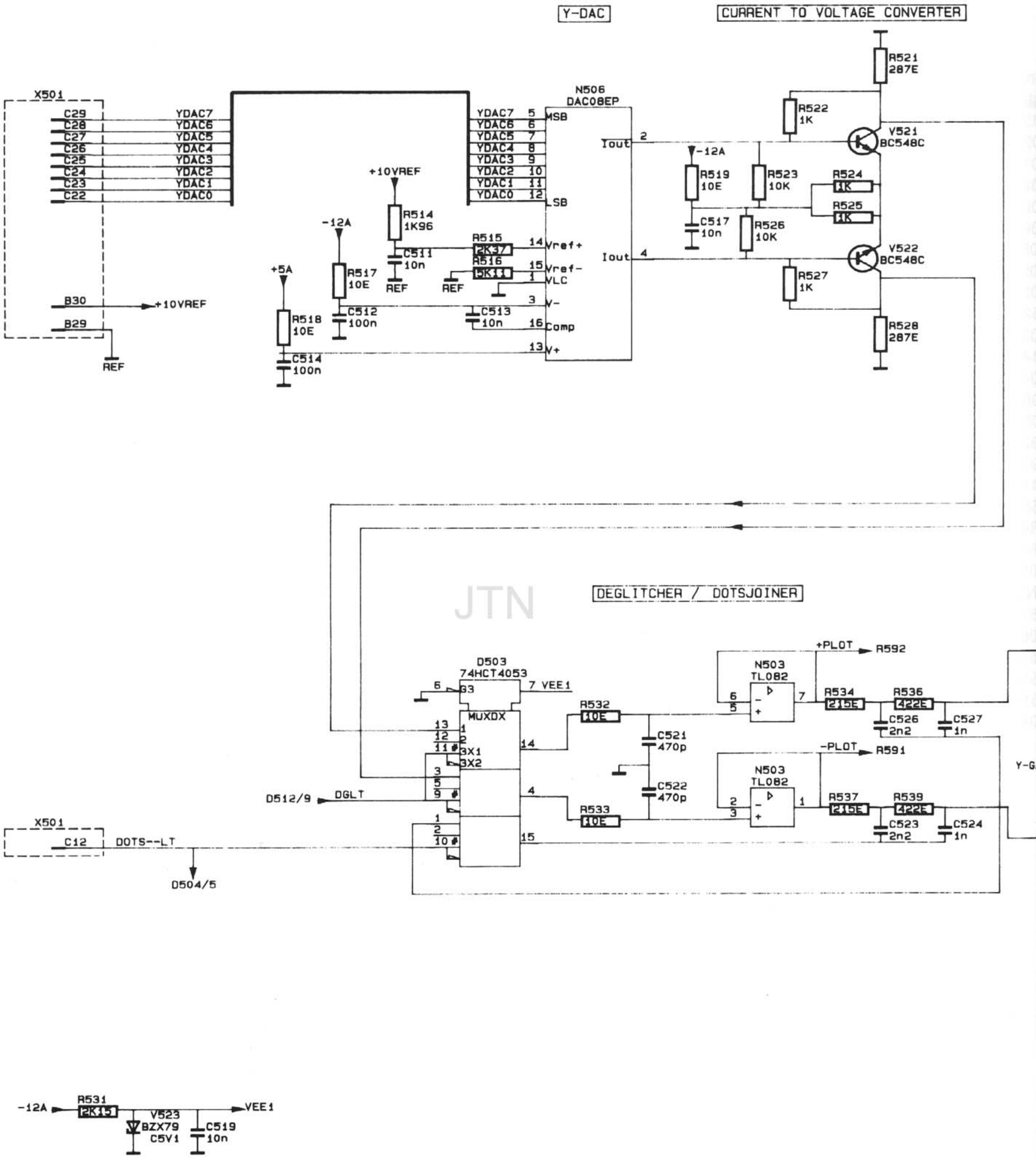
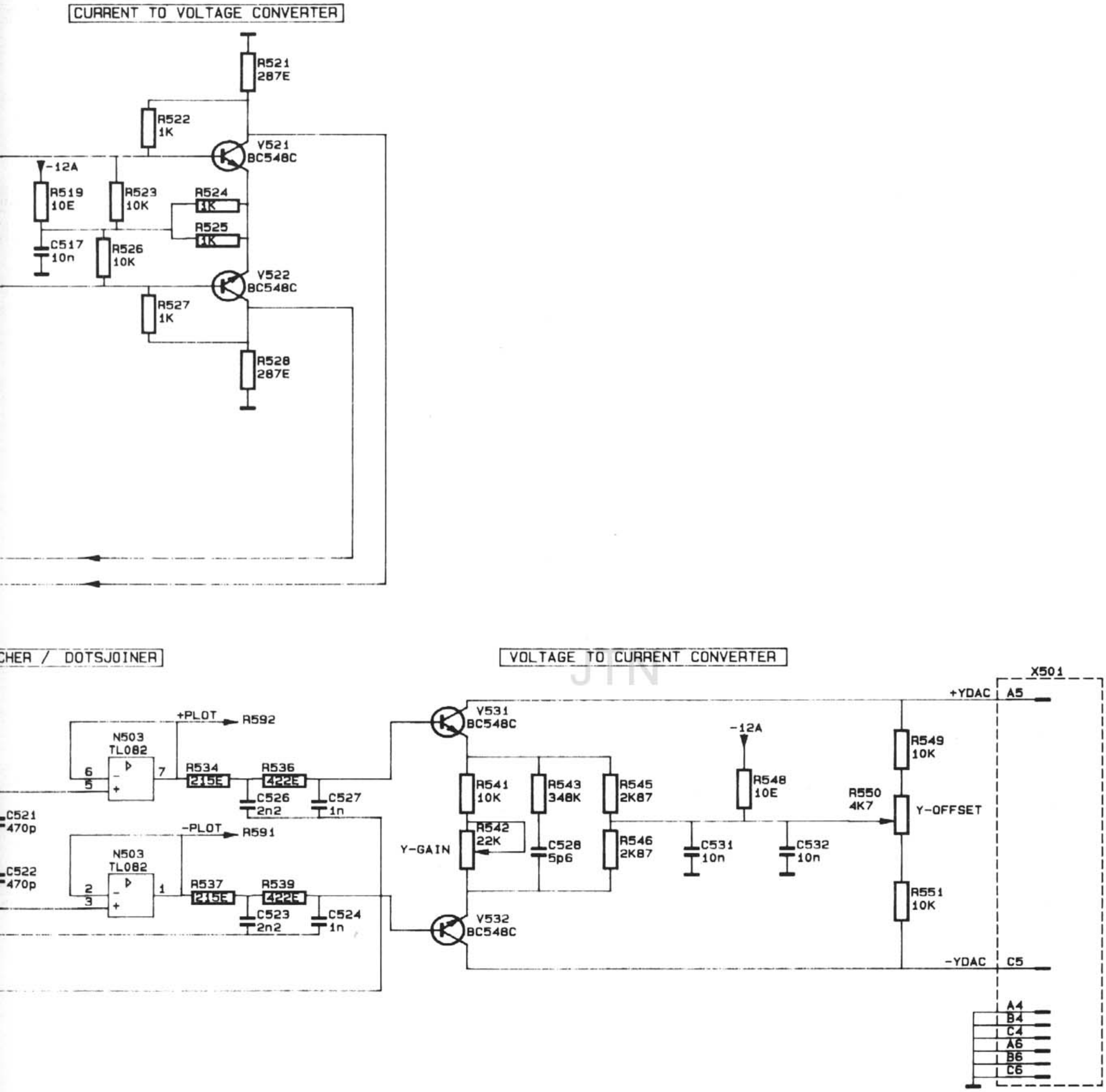
Figure 16.7 Circuit diagram of ADC DAC unit: Y DAC circuit


Y-DAC
CURRENT TO VOLTAGE CONVERTER
X501
C29 C28 C27 C26 C25 C24 C23 C22
YDAC7 YDAC6 YDAC5 YDAC4 YDAC3 YDAC2 YDAC1 YDAC0
B30
+10VREF
B29
REF
N506
DAC08EP
MSB
LSB
Iout
Vref+
Vref-
VLC
V-
Comp
V+
+10VREF
R514 1K96
C511 10n
R515 2K37
R516 5K11
-12A
R517 10E
C512 100n
C513 10n
+5A
R518 10E
C514 100n
R519 10E
C517 10n
R523 10K
R526 10K
R524 1K
R525 1K
R521 287E
R522 1K
V521 BC548C
V522 BC548C
R527 1K
R528 287E
DEGLITCHER / DOTSJOINER
D503
74HCT4053
G3
7 VEE1
MUXDX
3X1
3X2
R532 10E
R533 10E
C521 470p
C522 470p
N503 TL082
+PLOT
R592
-PLOT
R591
R534 215E
R536 422E
C526 2n2
C527 1n
R537 215E
R539 422E
C523 2n2
C524 1n
Y-G
D512/9
DGLT
X501
C12
DOTS--LT
D504/5
-12A
R531 2K15
V523 BZX79 C5V1
C519 10n
VEE1



REF NO	TYPE	+5V	+12A	-12A	⊥
D503	HCT4053	16			8
N503	TL082		8	4	
N506	DAC08				

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Figure 16.7 Circuit diagram of ADC DAC unit: Y DAC circuit

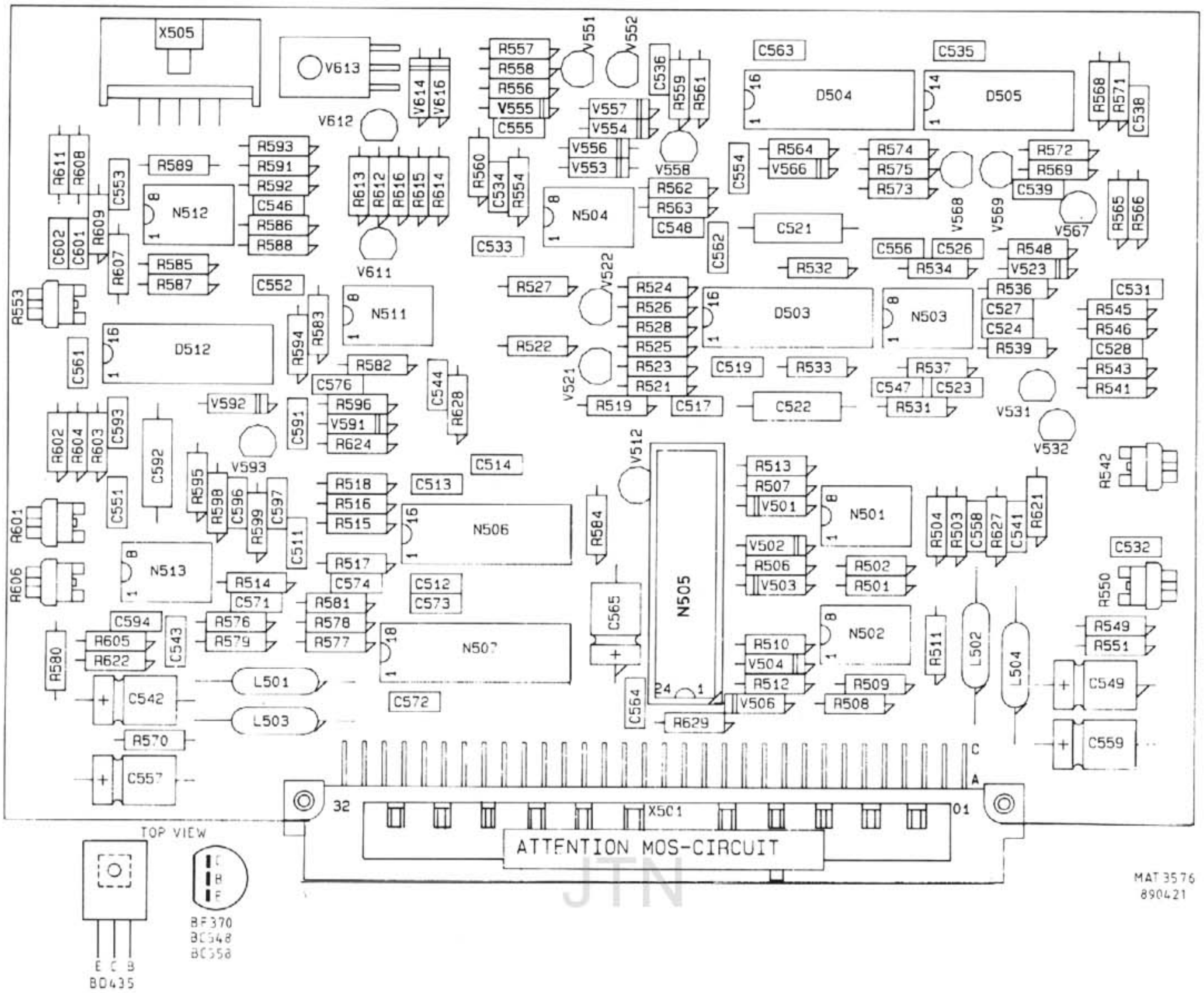
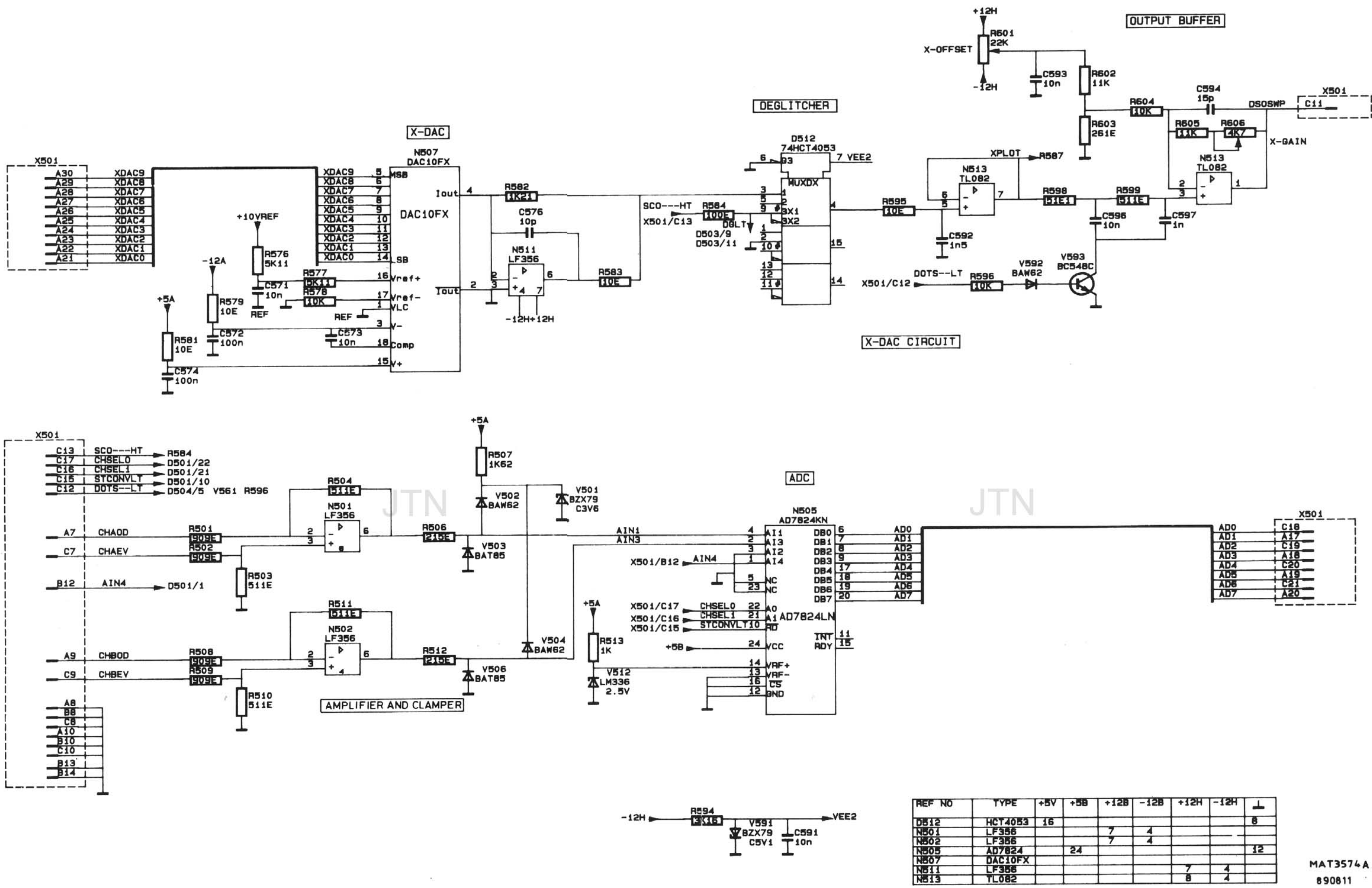
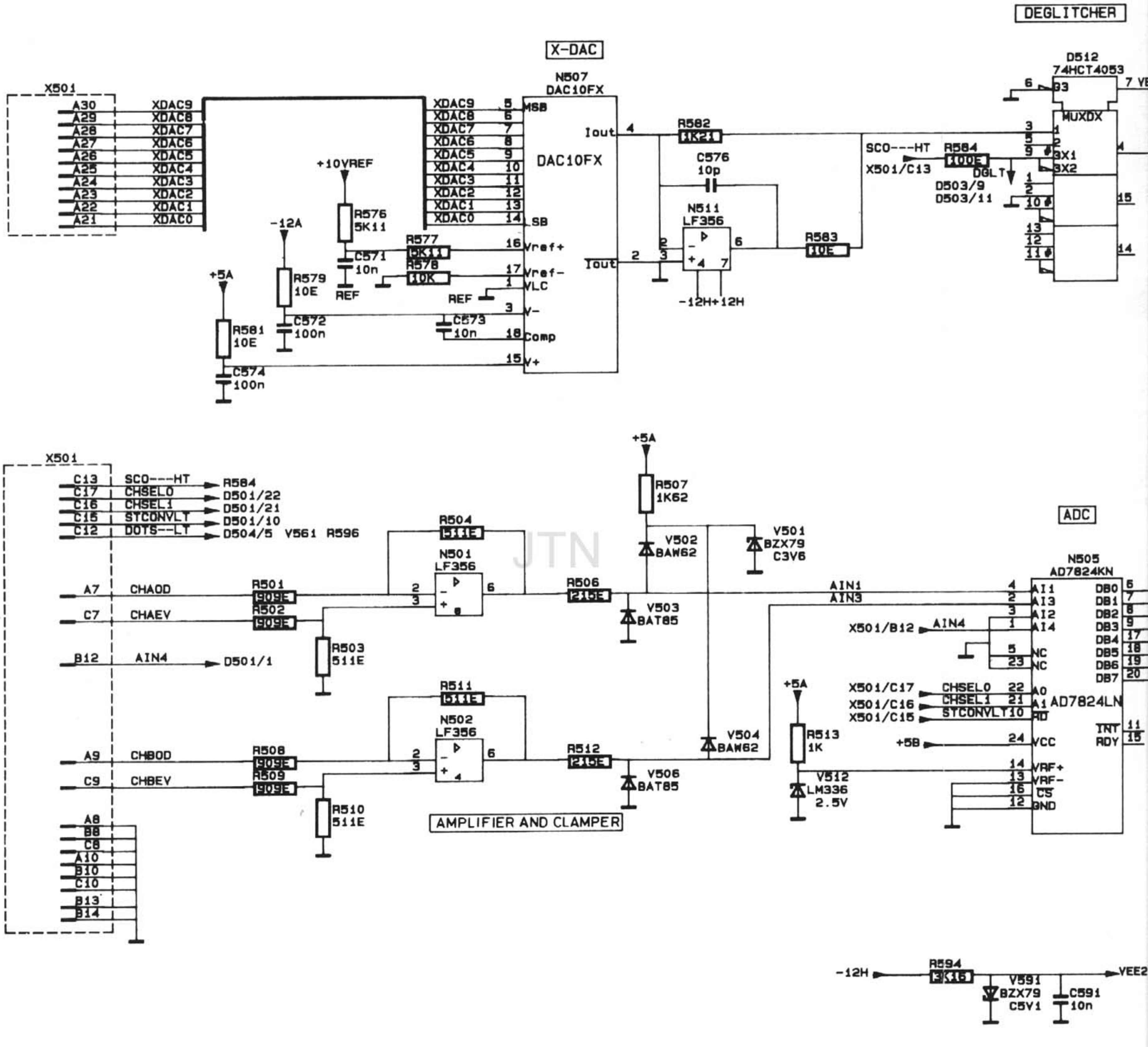


Figure 16.8 ADC DAC unit p.c.b.

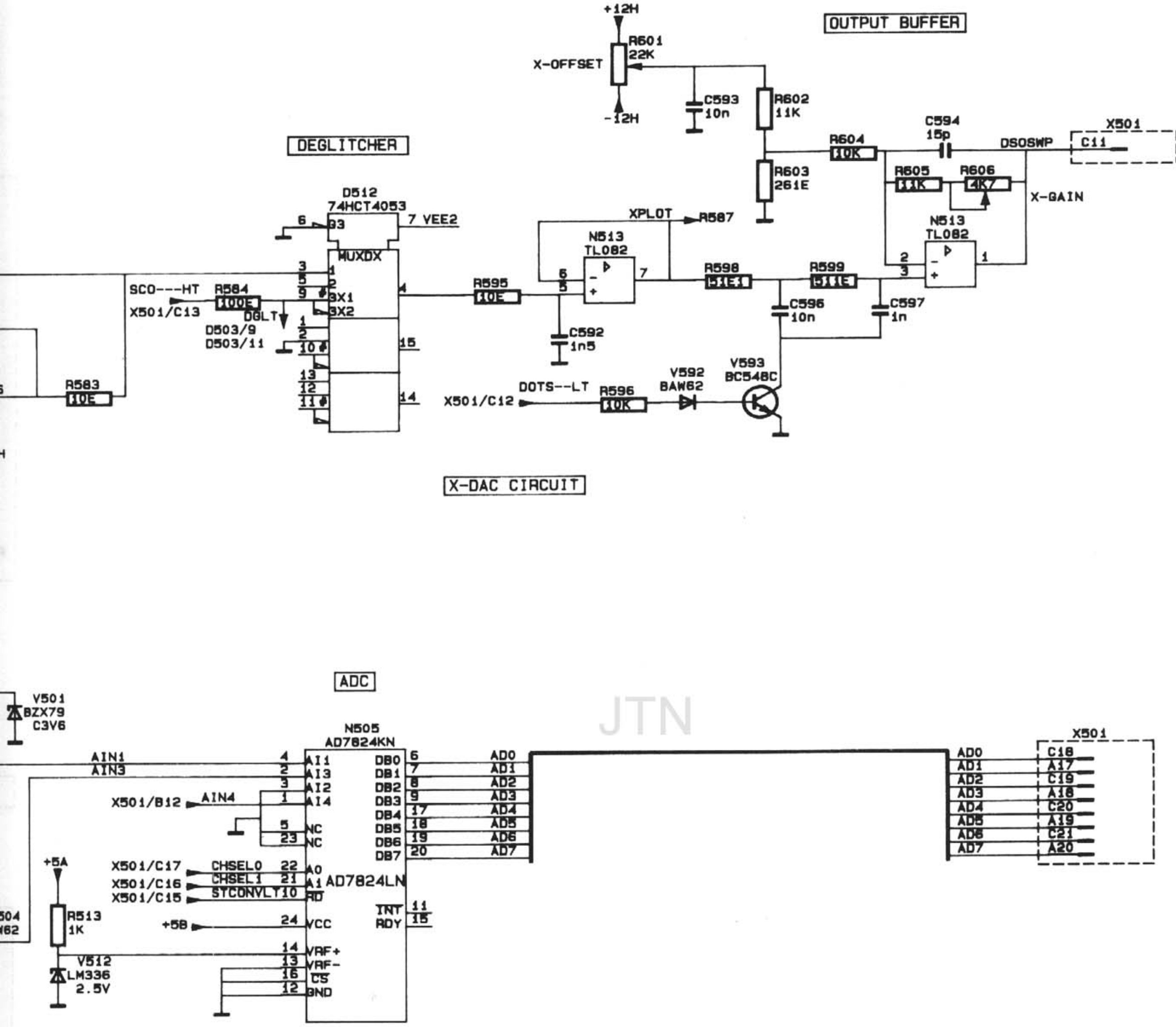


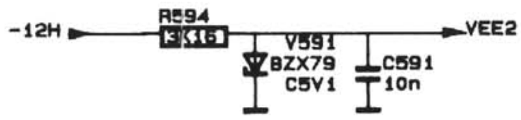
REF NO	TYPE	+5V	+5B	+12B	-12B	+12H	-12H	⊥
D512	HCT4053	16						8
N501	LF356			7	4			
N502	LF356			7	4			
N505	AD7824		24					12
N507	DAC10FX							
N511	LF356					7	4	
N513	TL082					8	4	

Figure 16.9 Circuit diagram of ADC DAC unit: X-DAC and ADC circuit


DEGLITCHER
X-DAC
D512
74HCT4053
MUXDX
N507
DAC10FX
X501
XDAC9
XDAC8
XDAC7
XDAC6
XDAC5
XDAC4
XDAC3
XDAC2
XDAC1
XDAC0
MSB
LSB
Iout
R582
1K21
C576
10p
SCO---HT
X501/C13
R584
100E
DGLT
D503/9
D503/11
+10VREF
R576
5K11
-12A
R577
5K11
R578
10K
C571
10n
REF
Vref+
Vref-
VLC
V-
Comp
V+
+5A
R579
10E
C572
100n
C573
10n
R581
10E
C574
100n
N511
LF356
R583
10E
-12H+12H
CHSEL0
CHSEL1
STCONVLT
DOTS--LT
D501/22
D501/21
D501/10
D504/5 V561 R596
R507
1K62
V501
BZX79
C3V6
V502
BAW62
ADC
N505
AD7824KN
AD7824LN
R504
511E
N501
LF356
CHAOD
CHAEV
R501
909E
R502
909E
R503
511E
R506
215E
V503
BAT85
AIN1
AIN3
AIN4
X501/B12
D501/1
R511
511E
N502
LF356
CHBOD
CHBEV
R508
909E
R509
909E
R510
511E
R512
215E
V506
BAT85
V504
BAW62
AMPLIFIER AND CLAMPER
R513
1K
V512
LM336
2.5V
X501/C17
X501/C16
X501/C15
+5B
VCC
VRF+
VRF-
CS
GND
INT
RDY
R594
3K16
V591
BZX79
C5V1
C591
10n
-12H
VEE2

Fig





REF NO	TYPE	+5V	+5B	+12B	-12B	+12H	-12H	⊥
D512	HCT4053	16						8
N501	LF356			7	4			
N502	LF356			7	4			
N505	AD7824		24					12
N507	DAC10FX							
N511	LF356					7	4	
N513	TL082					8	4	

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Figure 16.9 Circuit diagram of ADC DAC unit: X-DAC and ADC circuit

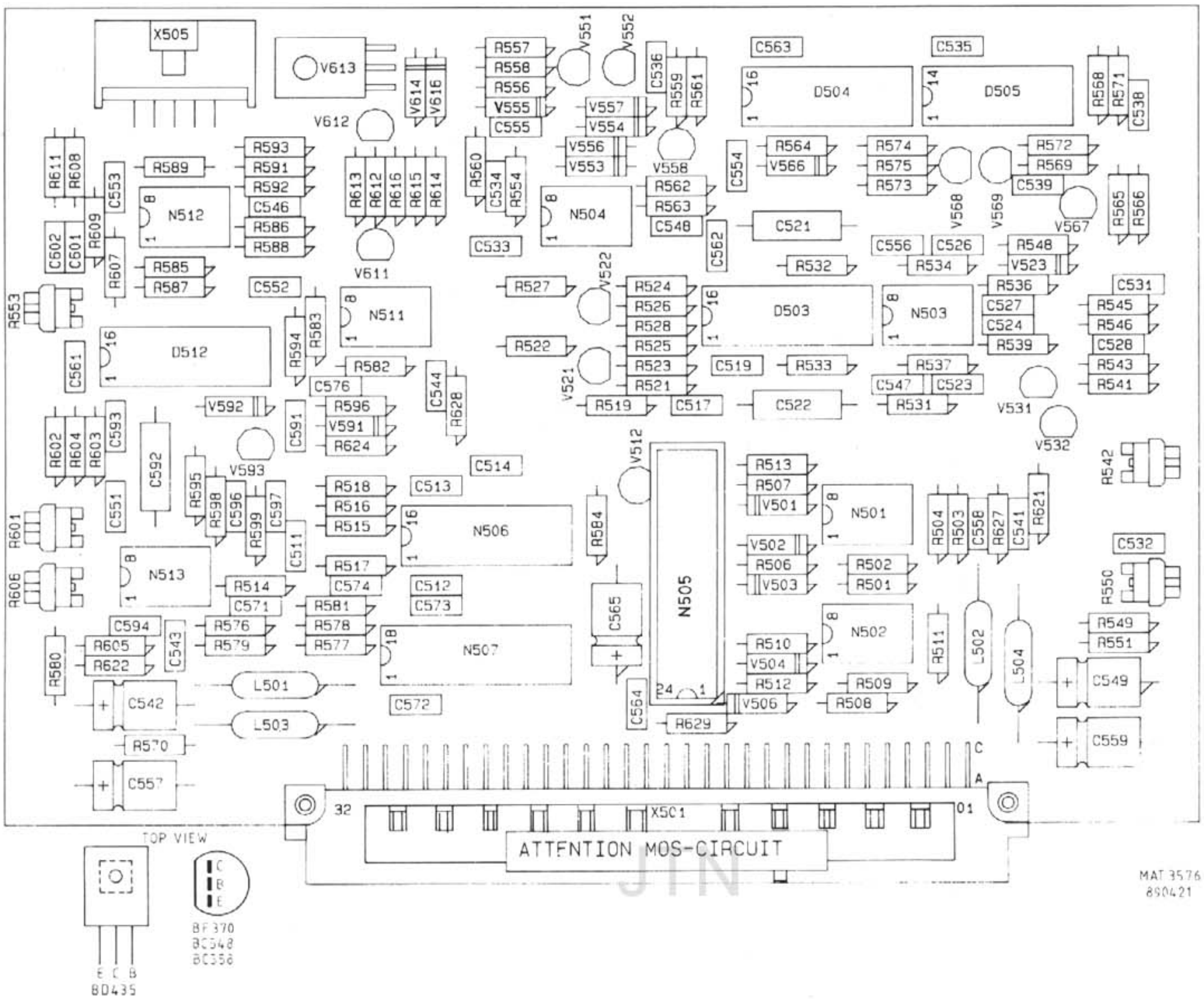
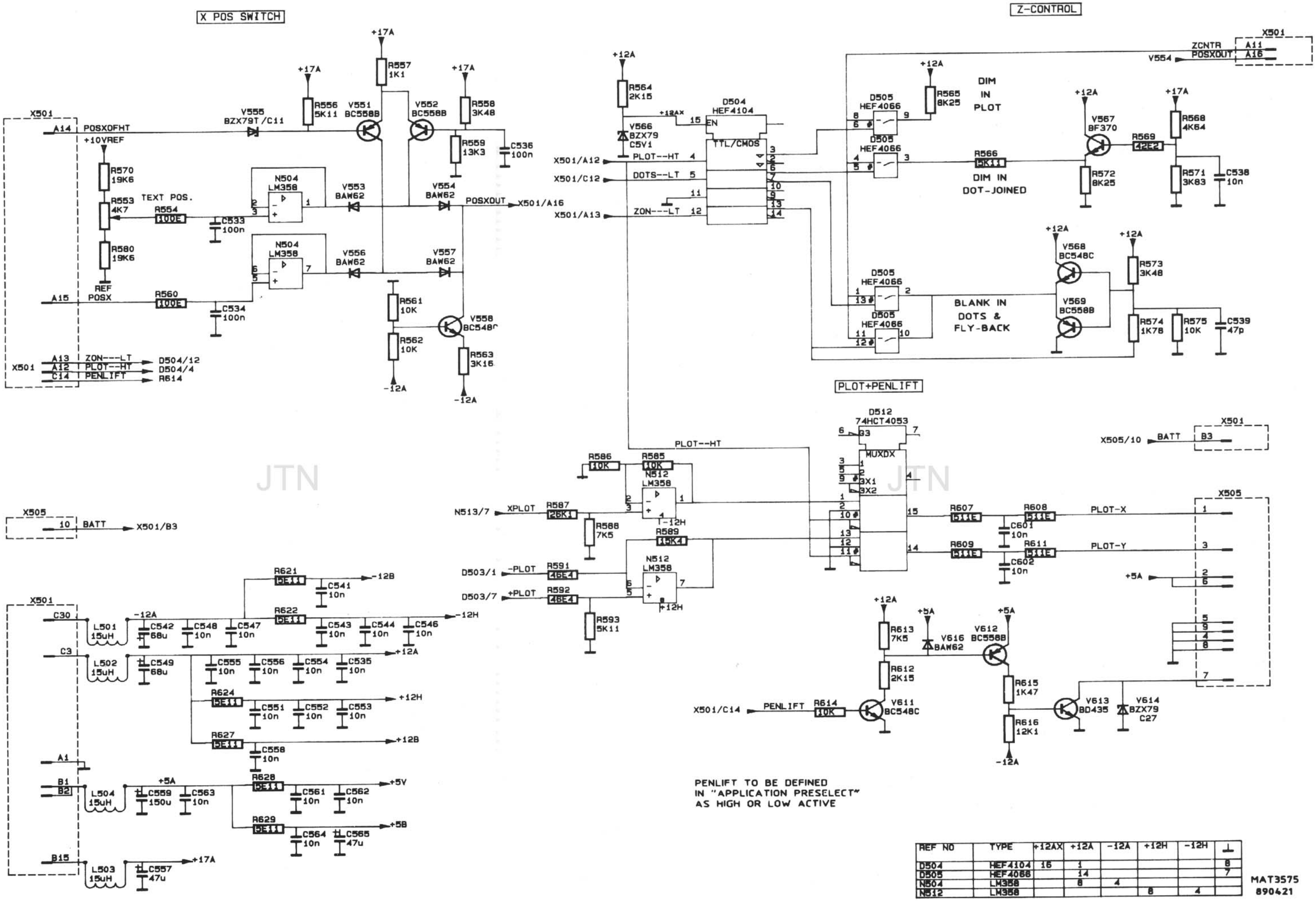
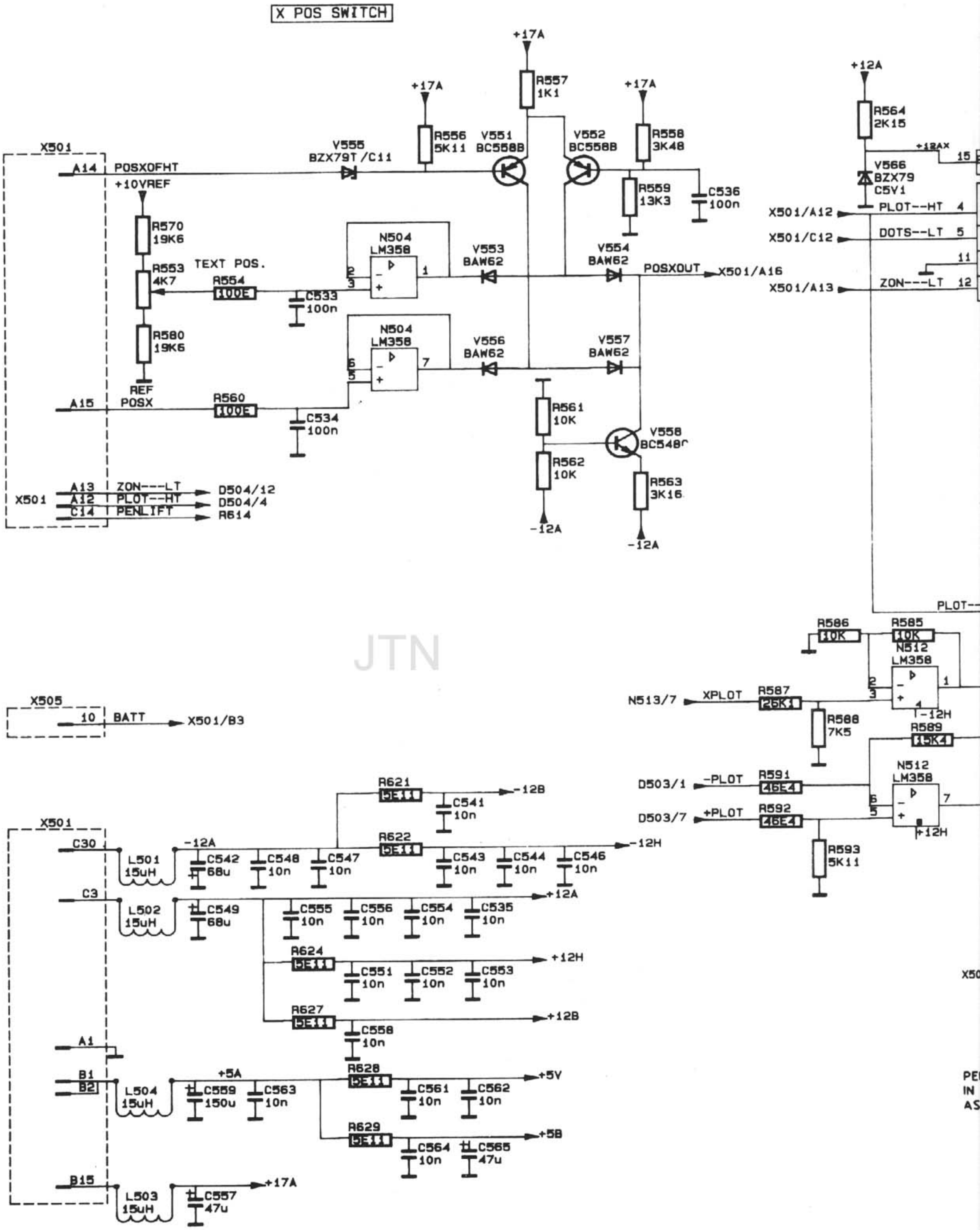


Figure 16.10 ADC DAC unit p.c.b.

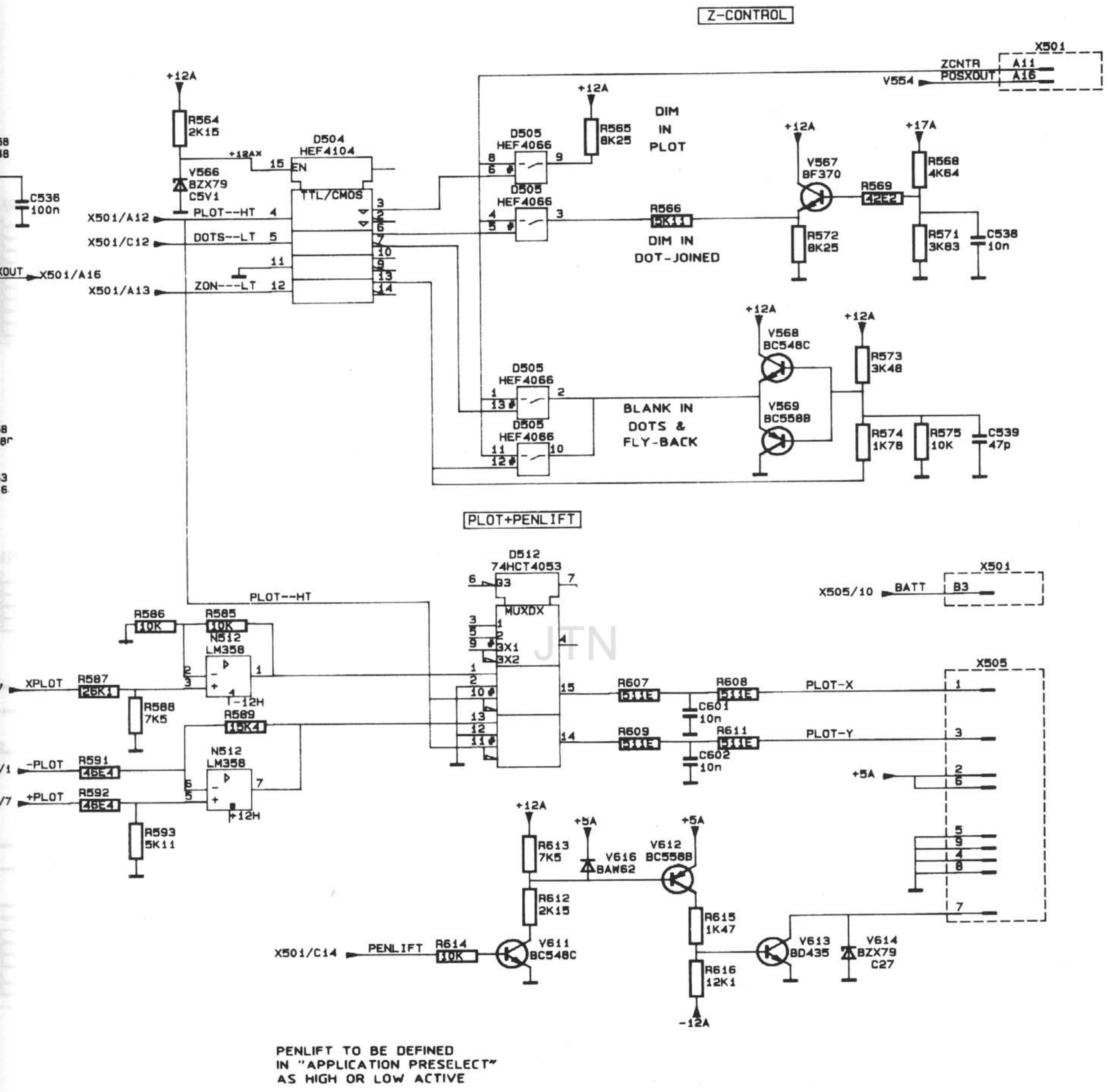


REF NO	TYPE	+12AX	+12A	-12A	+12H	-12H	⊥
D504	HEF4104	16	1				8
D505	HEF4066		14				7
N504	LM358		8	4			
N512	LM358				8	4	

Figure 16.11 Circuit diagram of ADC DAC unit: part 3


X POS SWITCH
X501
A14
POSXOFHT
+10VREF
R570
19K6
R553
4K7
TEXT POS.
R554
100E
R580
19K6
REF
POSX
A15
R560
100E
C533
100n
C534
100n
N504
LM358
V555
BZX79T/C11
+17A
R556
5K11
V551
BC558B
R557
1K1
V552
BC558B
R558
3K48
R559
13K3
C536
100n
V553
BAW62
V554
BAW62
POSXOUT
X501/A16
V556
BAW62
V557
BAW62
R561
10K
R562
10K
V558
BC548C
R563
3K16
-12A
A13
ZON---LT
D504/12
A12
PLOT--HT
D504/4
C14
PENLIFT
R614
+12A
R564
2K15
V566
BZX79
C5V1
X501/A12
PLOT--HT
X501/C12
DOTS--LT
X501/A13
ZON---LT
R586
10K
R585
10K
N512
LM358
N513/7
XPLOT
R587
26K1
R588
7K5
-12H
R589
15K4
D503/1
-PLOT
R591
46E4
D503/7
+PLOT
R592
46E4
R593
5K11
+12H
X505
10
BATT
X501/B3
R621
5E11
C541
10n
-12B
C30
L501
15uH
C542
68u
C548
10n
C547
10n
R622
5E11
C543
10n
C544
10n
C546
10n
-12H
C3
L502
15uH
C549
68u
C555
10n
C556
10n
C554
10n
C535
10n
R624
5E11
C551
10n
C552
10n
C553
10n
+12H
R627
5E11
C558
10n
+12B
A1
B1
B2
L504
15uH
+5A
C559
150u
C563
10n
R628
5E11
C561
10n
C562
10n
+5V
R629
5E11
C564
10n
C565
47u
+5B
B15
L503
15uH
C557
47u
+17A

Figure



PENLIFT TO BE DEFINED
IN "APPLICATION PRESELECT"
AS HIGH OR LOW ACTIVE

REF NO	TYPE	+12AX	+12A	-12A	+12H	-12H	⊥
D504	HEF4104	16	1				8
D505	HEF4066		14				7
N504	LM358		8	4			
N512	LM358				8	4	

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Figure 16.11 Circuit diagram of ADC DAC unit: part 3

17 ADAPTATION UNIT (A16)

17.1 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

17.2 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 analog 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 section 5.4).

The stage comprises the following real-time functions:

- Channel B normal/invert (HIGH is invert) on D601-7.
  (The balance between normal/invert can be adjusted with R2212, see section 5.1)
- 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.

17.3 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 P^2CCD unit A18.

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.

17.4 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
MEMON-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

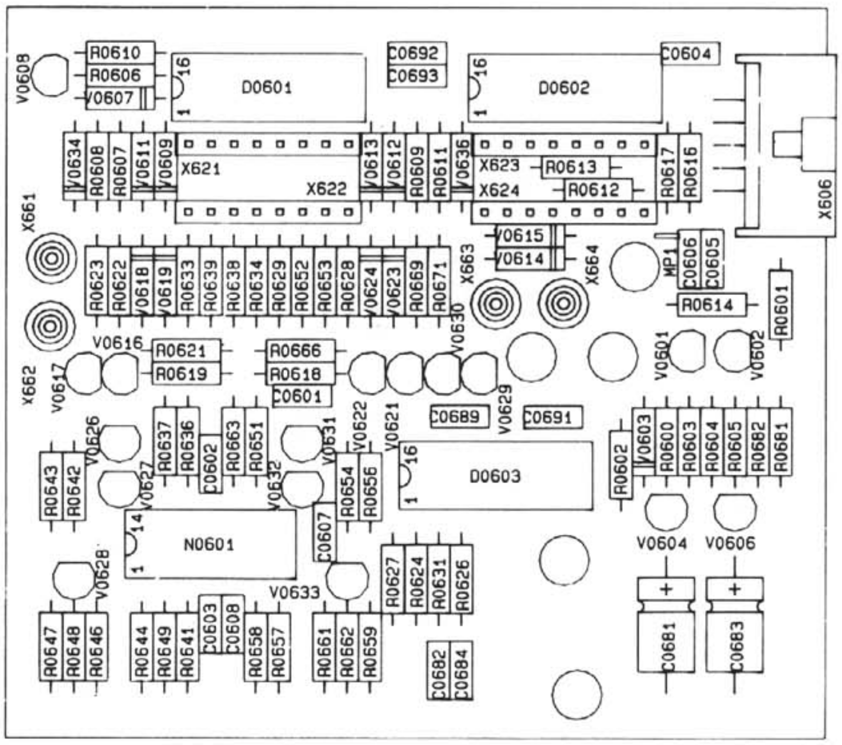

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Figure 17.1 Adaptation unit p.c.b.

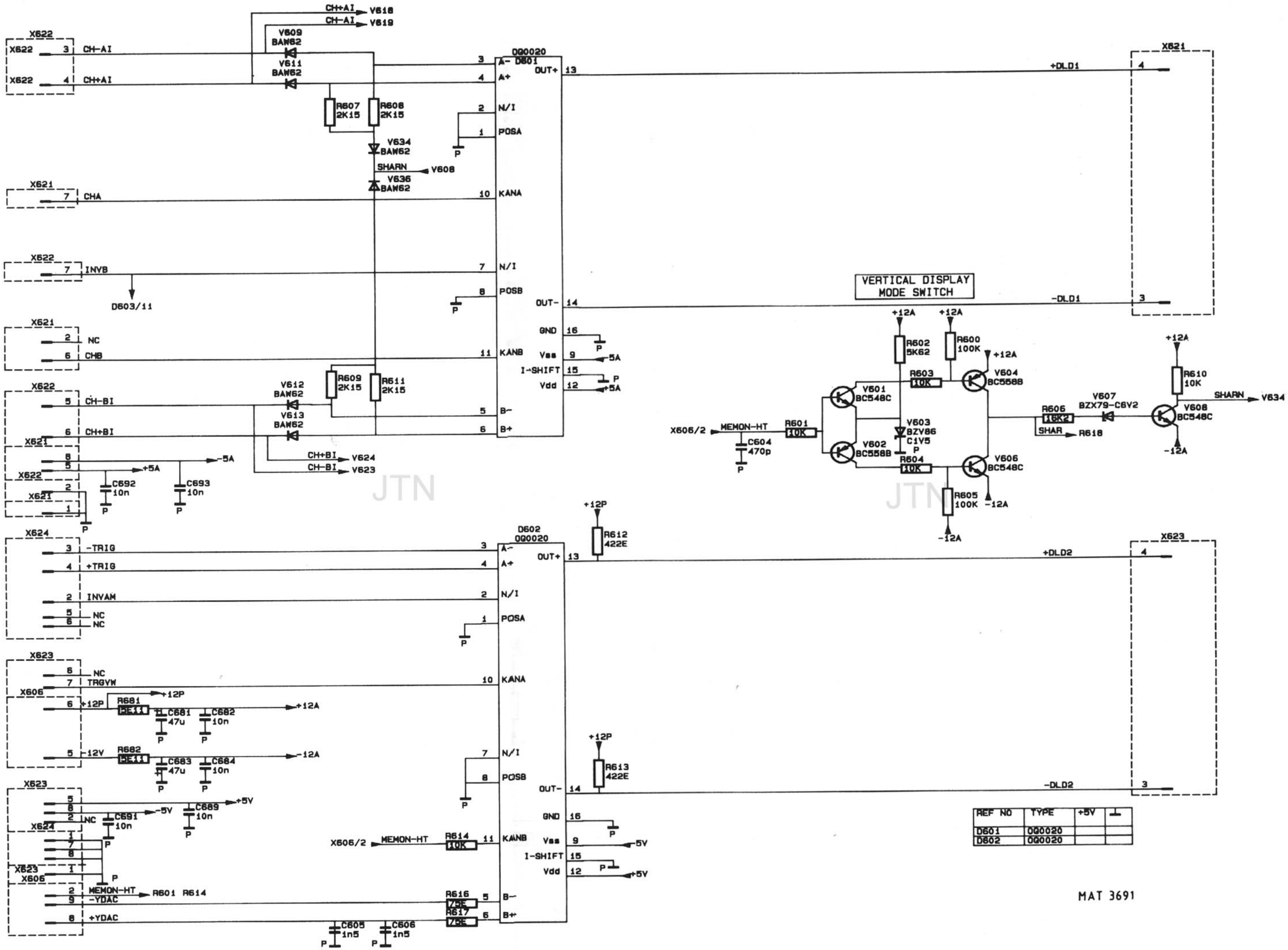


Figure 17.2 Circuit diagram of adaptation unit: part 1

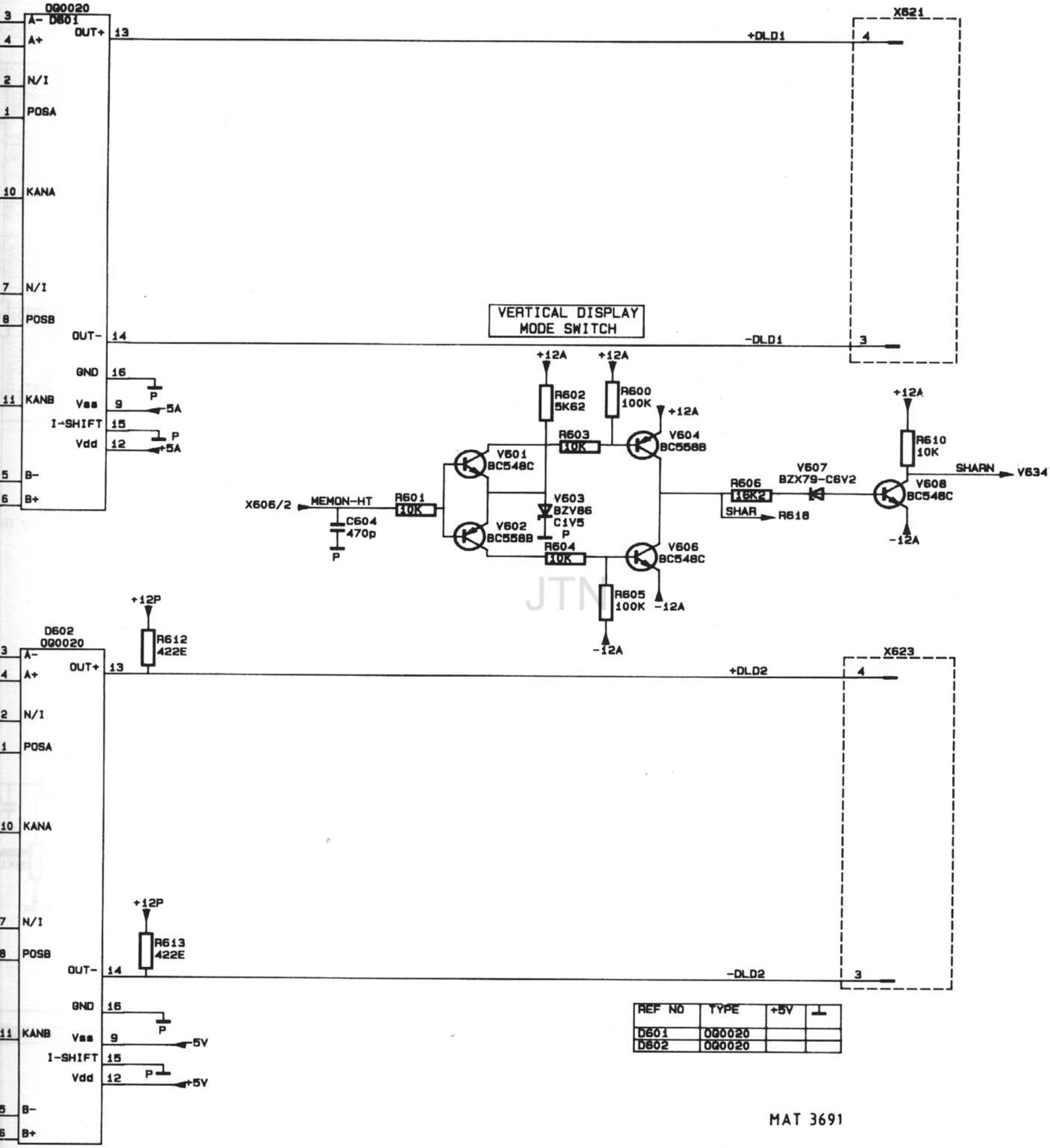
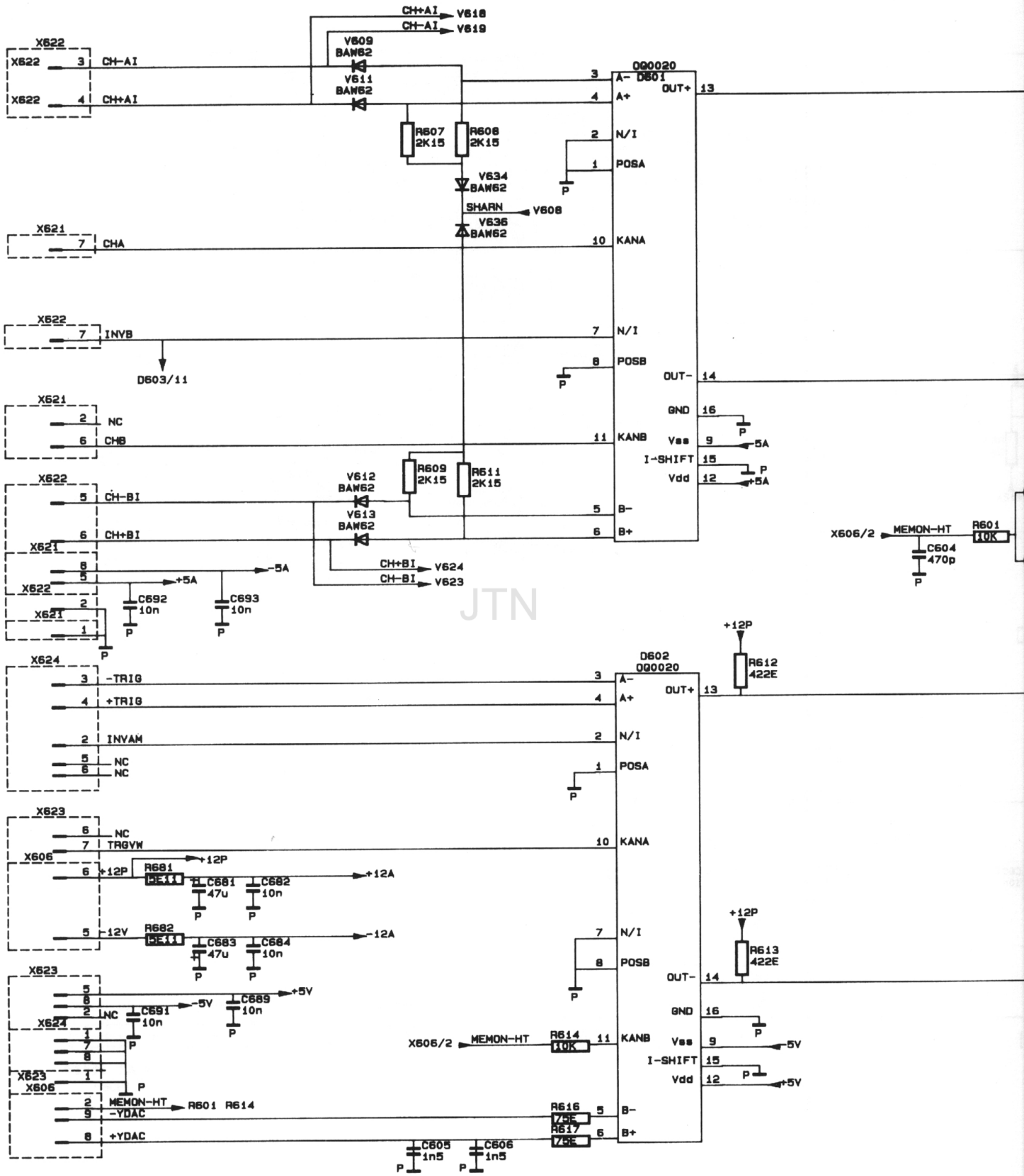
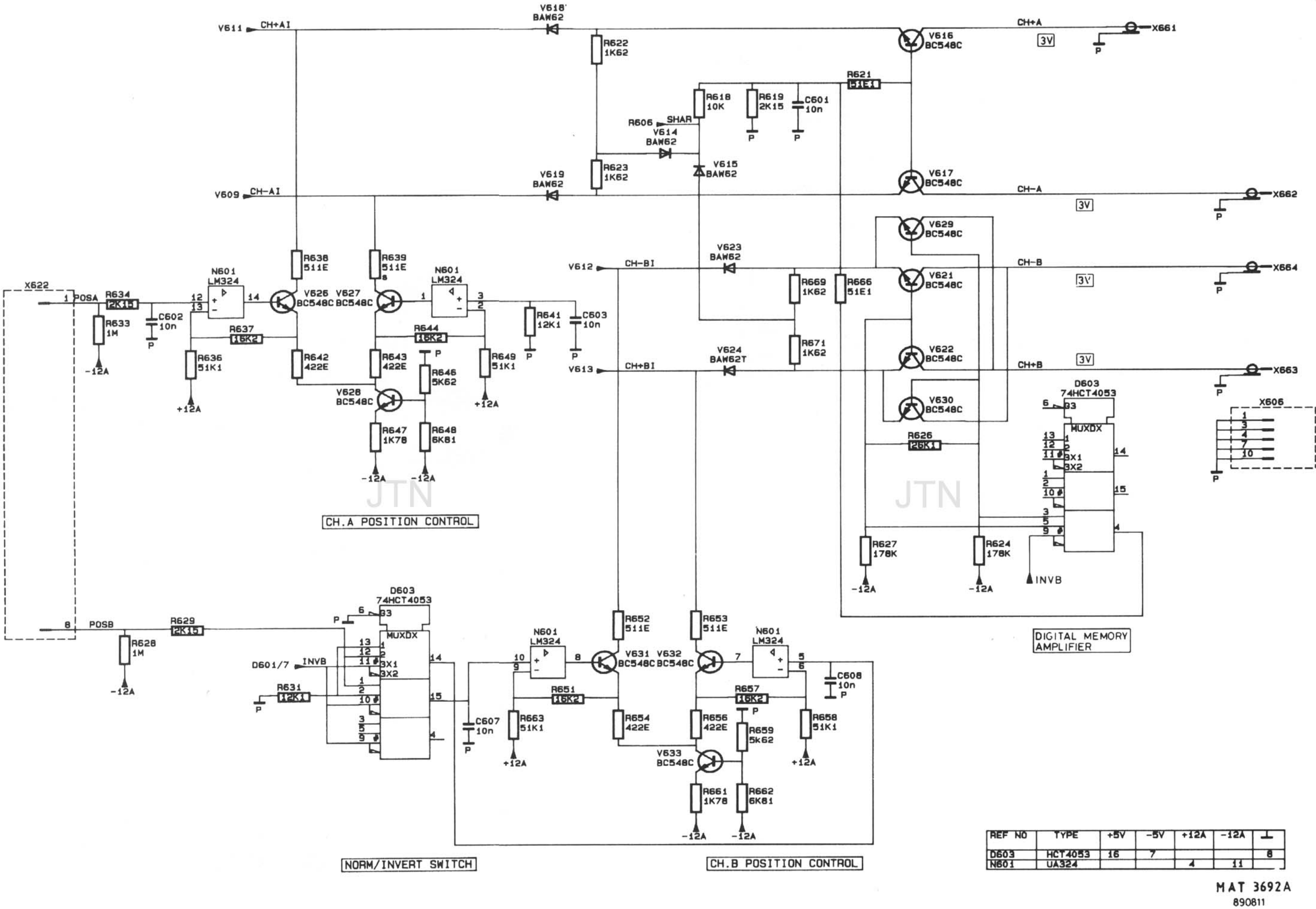


Figure 17.2 Circuit diagram of adaptation unit: part 1



X622
CH-AI
CH+AI
V618
V619
V609 BAW62
V611 BAW62
R607 2K15
R608 2K15
V634 BAW62
SHARN
V608
V636 BAW62
D601 DG0020
A-
A+
N/I
POSA
KANA
POSB
OUT+
OUT-
GND
KANB
Vss
I-SHIFT
Vdd
B-
B+
X621
CHA
INVB
D603/11
NC
CHB
R609 2K15
R611 2K15
V612 BAW62
V613 BAW62
CH-BI
CH+BI
V624
V623
-5A
+5A
C692 10n
C693 10n
X606/2
MEMON-HT
R601 10K
C604 470p
X624
-TRIG
+TRIG
INVAM
D602 DG0020
+12P
R612 422E
R613 422E
X623
TRGVW
X606
R681
R682
C681 47u
C682 10n
C683 47u
C684 10n
+12A
-12V
-12A
+5V
-5V
C691 10n
C689 10n
R614 10K
R601 R614
-YDAC
+YDAC
R616 75E
R617 75E
C605 1n5
C606 1n5
JTN



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

Figure 17.3 Adaptation unit p.c.b.

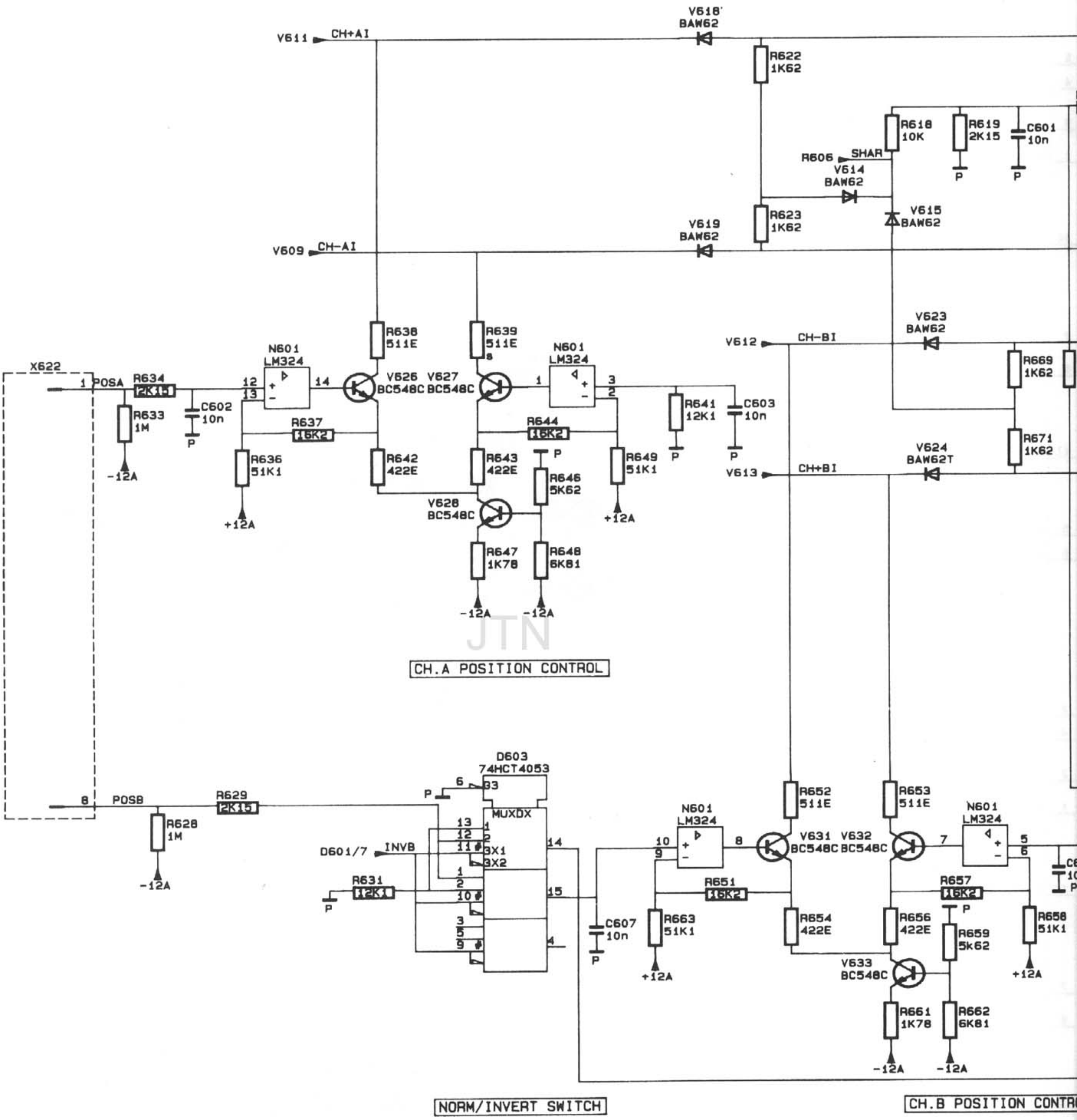
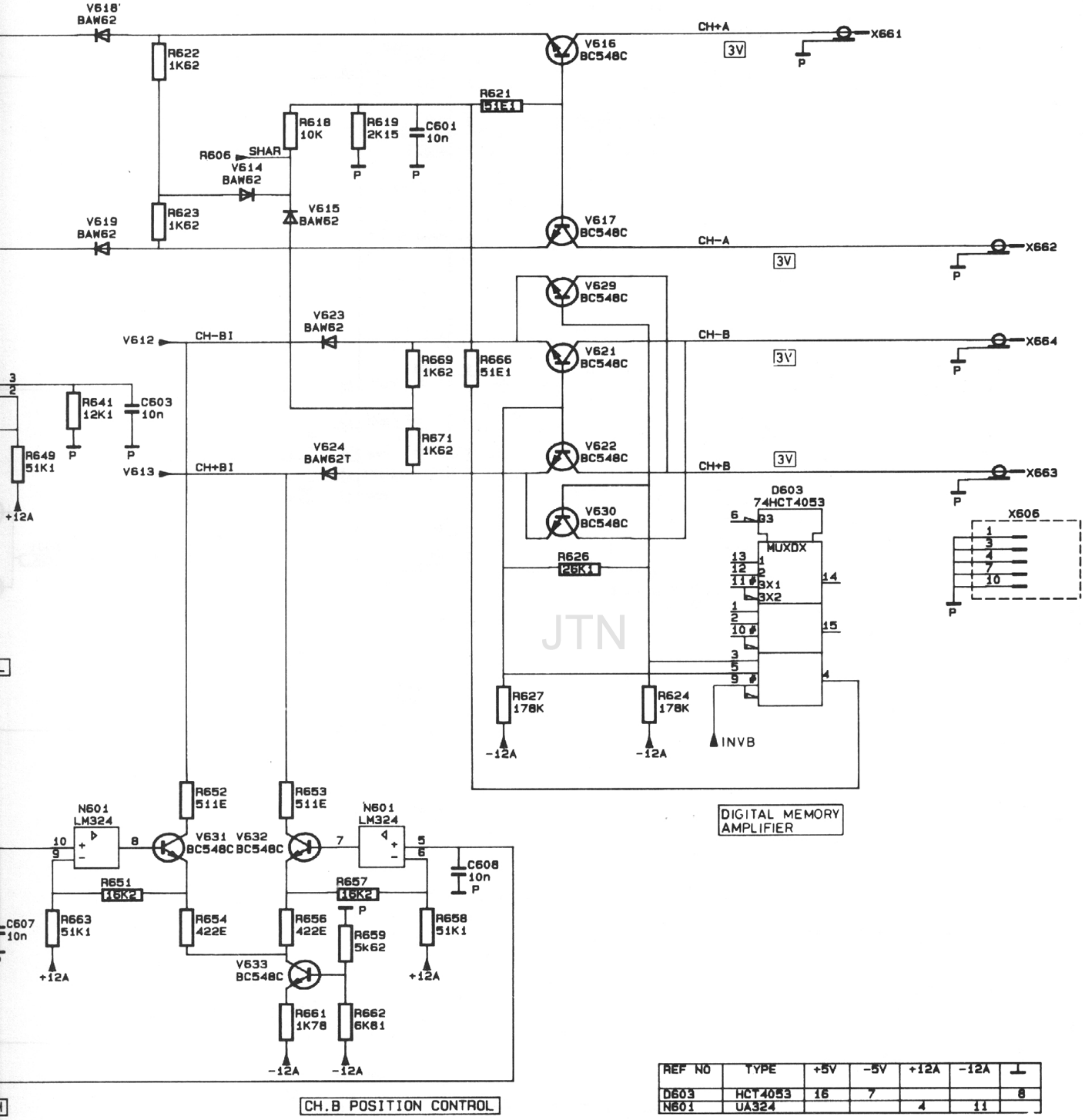


Figure 17.3 Adaptation unit p.c.b.



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

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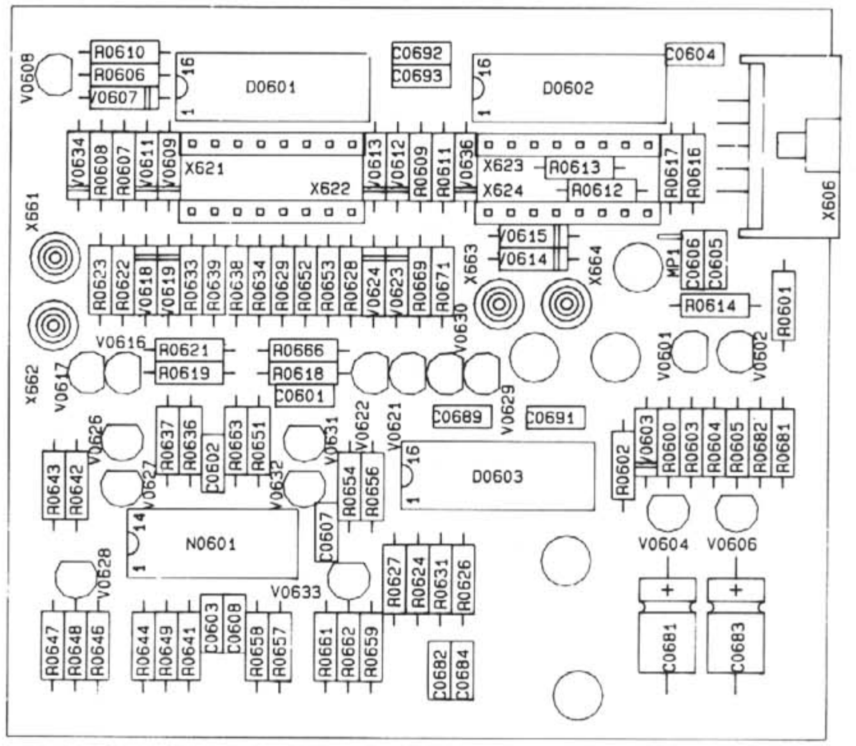

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Figure 17.4 Circuit diagram of adaptation unit: part 2

18 MINI CCD UNIT (A17)

18.1 INTRODUCTION

The P^2CCDs for channels A and B are situated on the mini CCD units A17 which are mounted on unit A18. The mini CCD units for ch. A and ch. B are identical.

WARNING: The P^2CCD is a MOS device, which is highly sensitive to electrostatic discharges. It is not possible to replace it without causing damage, due to electrostatic discharges.

The P^2CCD (Profiled Peristaltic Charge Coupled Device) - OQ0204 - which is basically an analog shift register, consists of an ODD-side and an EVEN-side. Each side consists of a sample gate of 256 stages, through which the samples can be shifted, and an output gate (see figure 18.1).

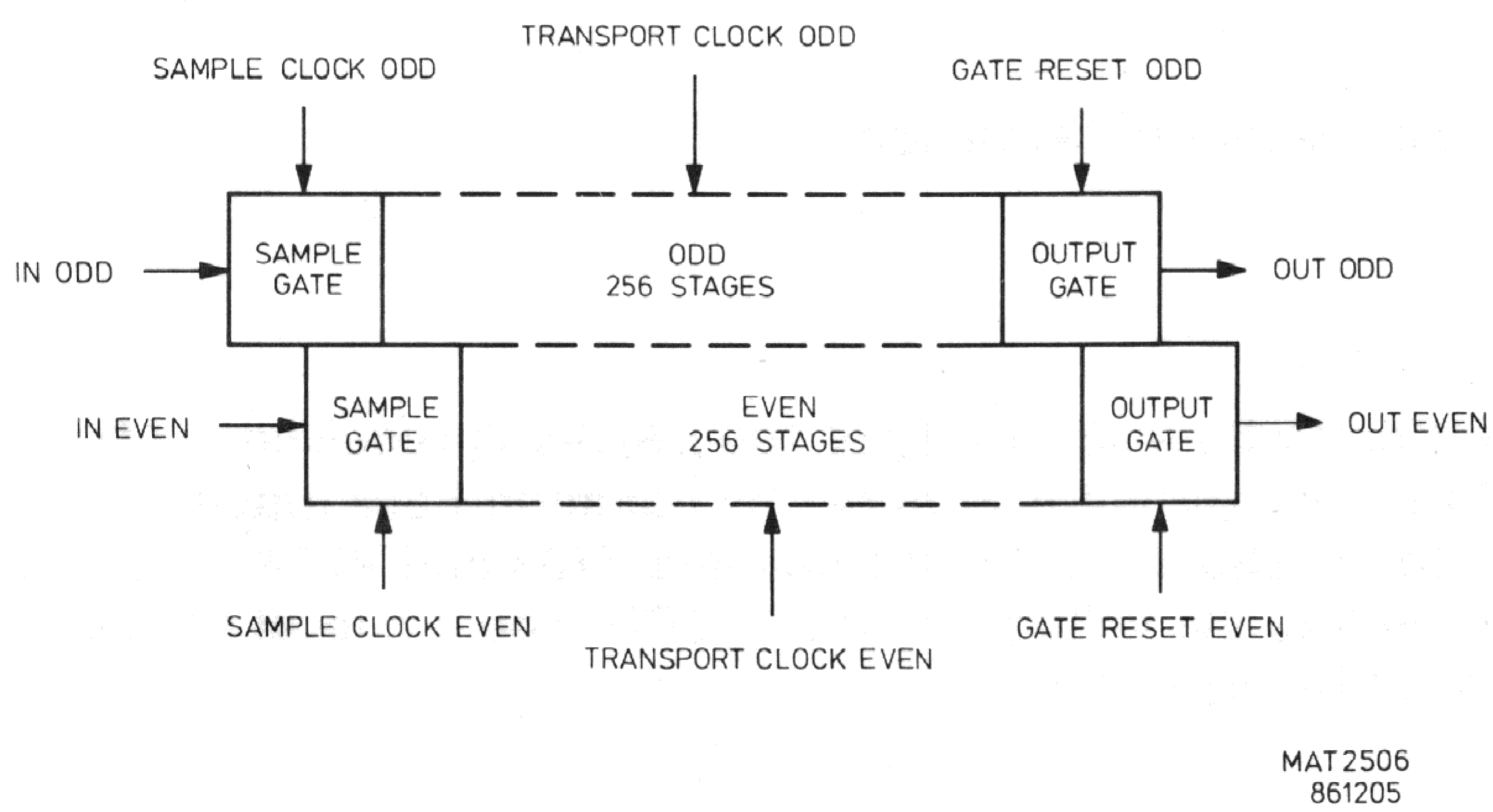


Figure 18.1 Schematic diagram of a P^2CCD circuit

The clock signals of the ODD and the EVEN side are always in anti-phase(see figure 18.2).

- On the rising edge of the sample clock, a sample of the input signal is taken.
- On the falling edge of the sample clock, this sample is shifted to the first stage
- On the falling edge of the transport clock, all samples in all stages are shifted (transferred) one stage. The last sample is transferred to the output stage. The output stage is enabled when the gate reset signal is 0 V.

The P^2CCD circuit applies the samples to the Clamp, Integrate and Hold circuit (CIH circuit) on unit A18, which takes over the samples. Then the gate reset signal is +12 V again, which resets the output capacitor.

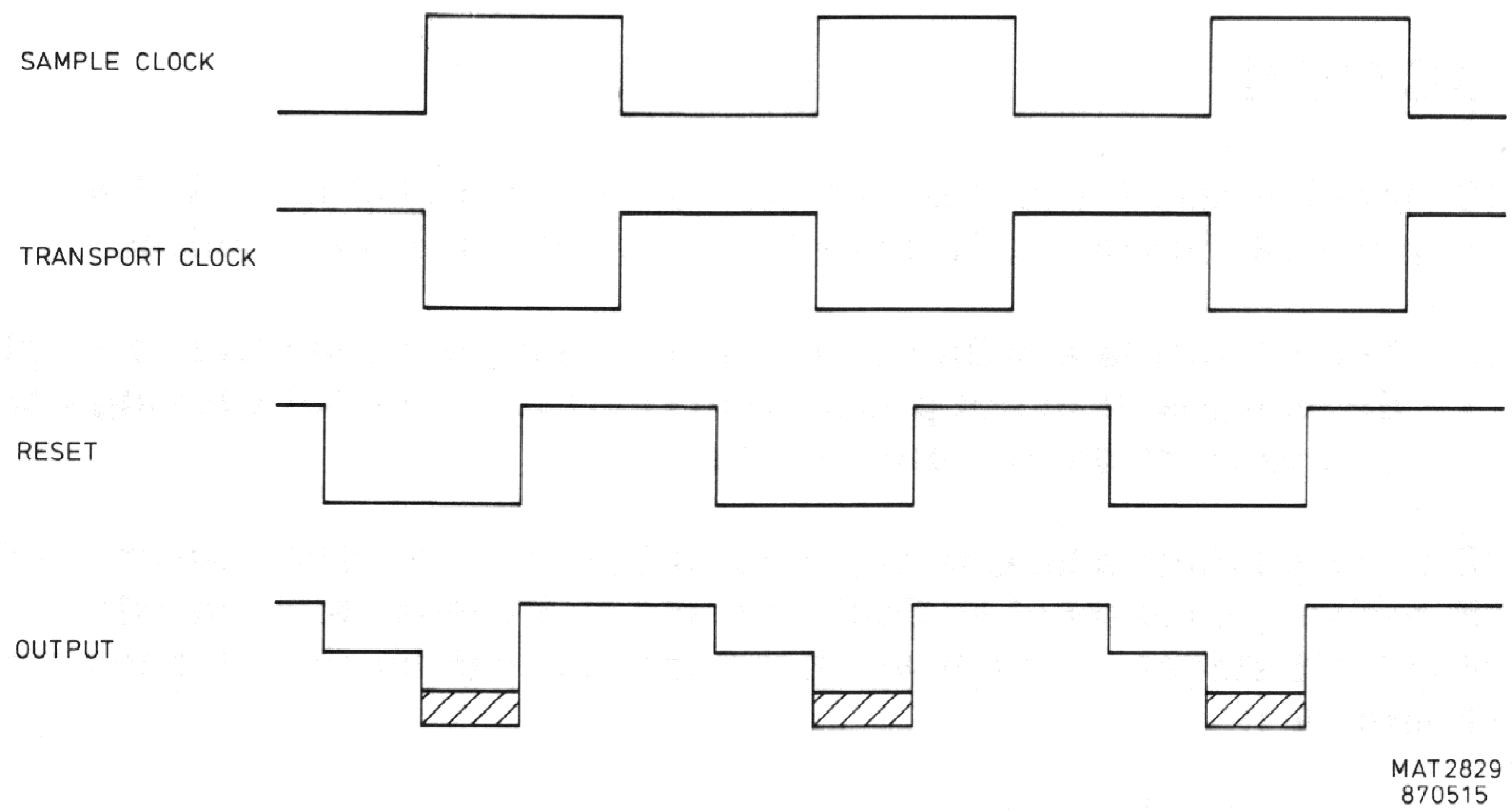


Figure 18.2 Sample and transport sequence

18.2 INPUT BUFFER

The differential input current with a sensitivity of 100 μA/DIV is received via 50 Ω cables from adaptation unit A16. This current is buffered by common-base amplifiers V701 and V702 and then applied to the shunt feedback amplifiers V703 and V704. This stage converts the input current into the voltage for the P^2CCD. The d.c level of this signal is controlled by the DCIA (or DCIB) signal.

18.3 P^2CCD - OQ0204

The P^2CCD circuit OQ0204 has the following pin connectors.

Pin	Name	Description
1	INE	Same signal as SAMPLE CLOCK EVEN but d.c. shifted. This d.c. value can be varied by potentiometer R894 for ch. A or R892 for ch. B on unit A18.
2	G1E	d.c. barrier voltage level. This d.c. value can be varied by potentiometer R974 for ch. A or R977 for ch. B on unit A18.
3	G2E	Input signal, even. The input signal can be varied by potentiometer R966 for ch. A or R970 for ch. B on unit A18.
4	G3E	SAMPLE CLOCK EVEN, takes samples of the input signal.
5	G4E	Same signal as SAMPLE CLOCK EVEN but d.c. shifted.
6	CL1IN	TRANSPORT CLOCK EVEN, transfers the samples in all 256 even stages one stage further.
7	CL2IN	Same signal as TRANSPORT CLOCK EVEN but d.c. shifted
8	SUB	Default value of -2 V approx.
9	CL20	n.c.

Pin	Name	Description
10	CL10	n.c.
11	GSP	GATE SEPARATION. Default value of +4,8 V approx.
12	OUT EVEN	Output signal even.
13	DRSE	DRAIN RESET EVEN. Default value of +19,2 V approx.
14	GRE	GATE RESET EVEN signal. When 0 V, the even output is enabled, when +12 V, the even output is disabled.
15	GRO	GATE RESET ODD signal. When 0 V, the odd output is enabled, when +12 V, the odd output is disabled.
16	DRSO	DRAIN RESET ODD. Default value of +19,2 approx.
17	OUT ODD	Output signal odd.
18	DSFS	Supply voltage of +25 V.
19	CL30	n.c.
20	CL40	n.c.
21	SUB	Default value of -2 V approx.
22	CL40	Same signal as TRANSPORT CLOCK ODD but d.c. shifted.
23	CL30	TRANSPORT CLOCK ODD, transfers the samples in all 256 odd stages one stage further.
24	G40	Same signal as SAMPLE CLOCK ODD but d.c. shifted.
25	G30	SAMPLE CLOCK ODD, takes samples of the input signal.
26	G20	Input voltage, odd. The input signal can be varied by potentiometer R966 for ch. A or R970 for ch. B on unit A18.
27	G10	d.c. barrier voltage level. This d.c. value can be varied by potentiometer R974 for ch. A or R977 for ch. B on unit A18.
28	INO	Same signal as SAMPLE CLOCK ODD but d.c. shifted. This d.c. value can be varied by potentiometer R894 for ch. A or R892 for ch. B on unit A18.

The output signals are buffered by emitter-followers V736 for EVEN and V766 for ODD and then applied to multiplexers D901 and D911 on the P^2CCD unit A18.

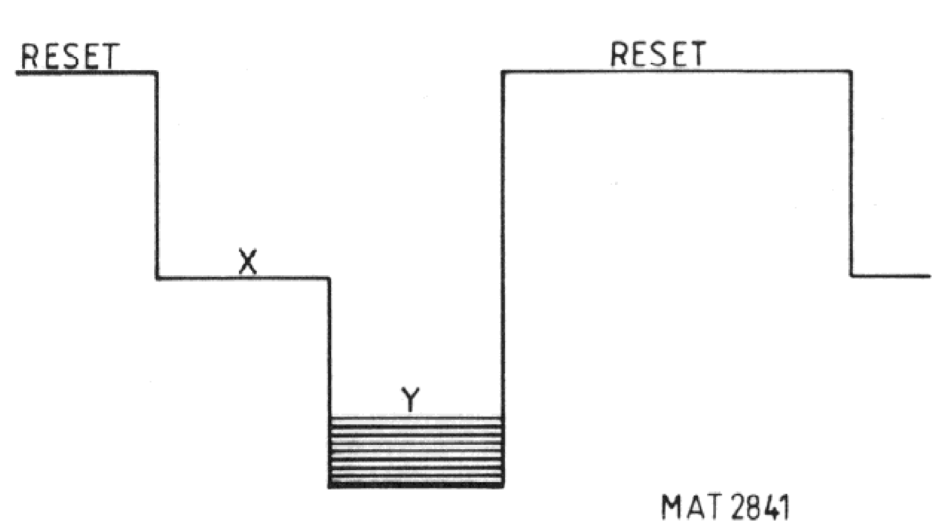


Figure 18.3 Output signal

While the output stage of the P^2CCD is reset by the GRE signal (for even samples, or GRO for odd samples) its output voltage is about 19,2 V. This voltage is determined by a resistor divider network at the DRSE input (pin 13 of the P^2CCD).
When the RESET is removed, the output drops to an undefined level X. On the falling edge of the transport clock, the sample leaves the output stage of the P^2CCD. Now the output voltage drops to level Y. The voltage difference between level X and level Y represents the value of the sample.
This voltage difference is detected by the input of the CIH circuit (see section 19.4).

The following table gives a list of sample clock frequencies and the slower read-out frequencies for all time-base position (P = P^2CCD-mode, D = Direct mode, R = Roll mode).

TIME/DIV	mode	sample clock freq.	read-out freq.
0,5 μs	P	50 MHz	50 kHz
1 μs	P	25 MHz	50 kHz
2 μs	P	12,5 MHz	50 kHz
5 μs	P	5 MHz	50 kHz
10 μs	P	2,5 MHz	50 kHz
20 μs	P	1,25 MHz	50 kHz
50 μs	P	500 kHz	50 kHz
0,1 ms	P	250 kHz	50 kHz
0,2 ms	P	125 kHz	50 kHz
0,5 ms	D1	50 kHz	50 kHz
1 ms	D1	50 kHz	50 kHz
2 ms	D1	50 kHz	50 kHz
5 ms	D2	40 kHz	40 kHz
10 ms	D2	40 kHz	40 kHz
20 ms	D2	40 kHz	40 kHz
50 ms	D2	40 kHz	40 kHz
0,1 s	D2	40 kHz	40 kHz
0,2 s	D2	40 kHz	40 kHz
0,5 s	D2	40 kHz	40 kHz
1 s	R	40 kHz	40 kHz
2 s	R	40 kHz	40 kHz
5 s	R	40 kHz	40 kHz
10 s	R	40 kHz	40 kHz
20 s	R	40 kHz	40 kHz
50 s	R	40 kHz	40 kHz

Note: *In P and D1 mode (time-base settings: 0,5 μs/div...2 ms/div), the P^2CCDs act as time converters: the read-in frequency is higher then the read-out frequency. In D2 and R mode (time-base settings: 5 ms/div...0,5s/div), the P^2CCDs act as analog shift registers: the read-in frequency is the same as the read-out frequency.*

18.4 SIGNAL NAME LIST

Signal name	Description	Signal source	Signal destination(s)
BARA	Barriër ch. A	R974	R770
BARB	Barriër ch. B	R977	R770
BIASA	Bias voltage ch. A	R894	N701
BIASB	Bias voltage ch. B	R892	N701
CH+A	Channel +A input	V616	R702
CH-A	Channel -A input	V617	R707
CH+B	Channel +B input	V622	R702
CH-B	Channel -B input	V621	R701
DCIA	DC level in ch. A	N921	R715
DCIB	DC level in ch. B	N922	R715
DCOA	DC level out ch. A	R717/R718	N921
DCOB	DC level out ch. B	R717/R718	N922
OUTAEV	Output ch. A even	V736	D911
OUTAOD	Output ch. A odd	V766	D901
OUTBEV	Output ch. B even	V736	D911
OUTBOD	Output ch. B odd	V766	D901
RSTEV-LT	Reset even	R407	R751
RSTOD-LT	Reset odd	R406	R781
SCEAM	Sample clock even ch. A	L806	D731
SCEBM	Sample clock even ch. B	L836	D731
SCOAM	Sample clock odd ch. A	L801	D731
SCOBM	Sample clock add ch. B	L831	D731
TCEAM	Transport clock even ch. A	L822	D731
TCEBM	Transport clock even ch. B	L852	D731
TCOAM	Transport clock odd ch. A	L816	D731
TCOBM	Transport clock odd ch. B	L846	D731

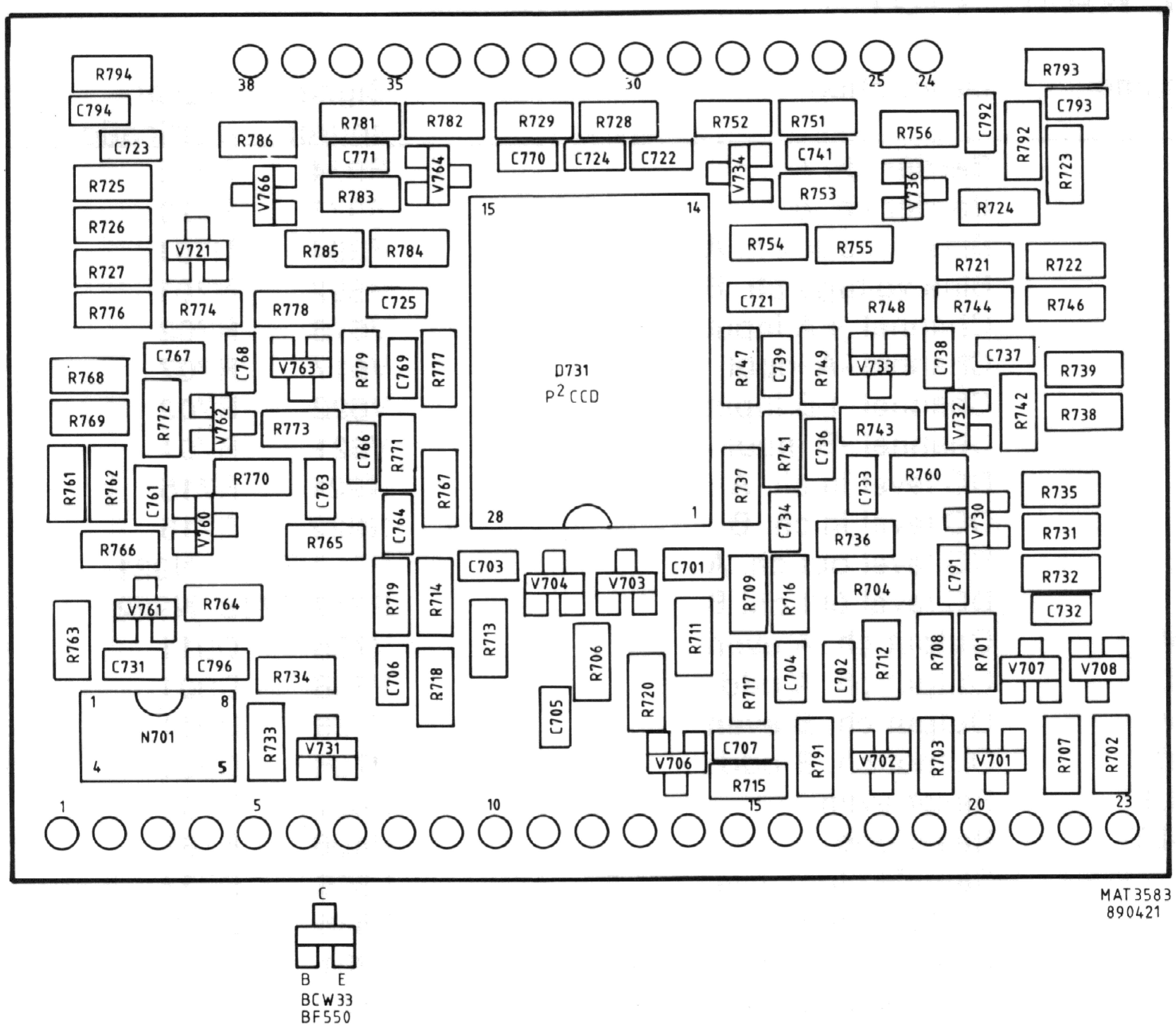


Figure 18.4 Mini CCD unit p.c.b.

18.4 SIGNAL NAME LIST

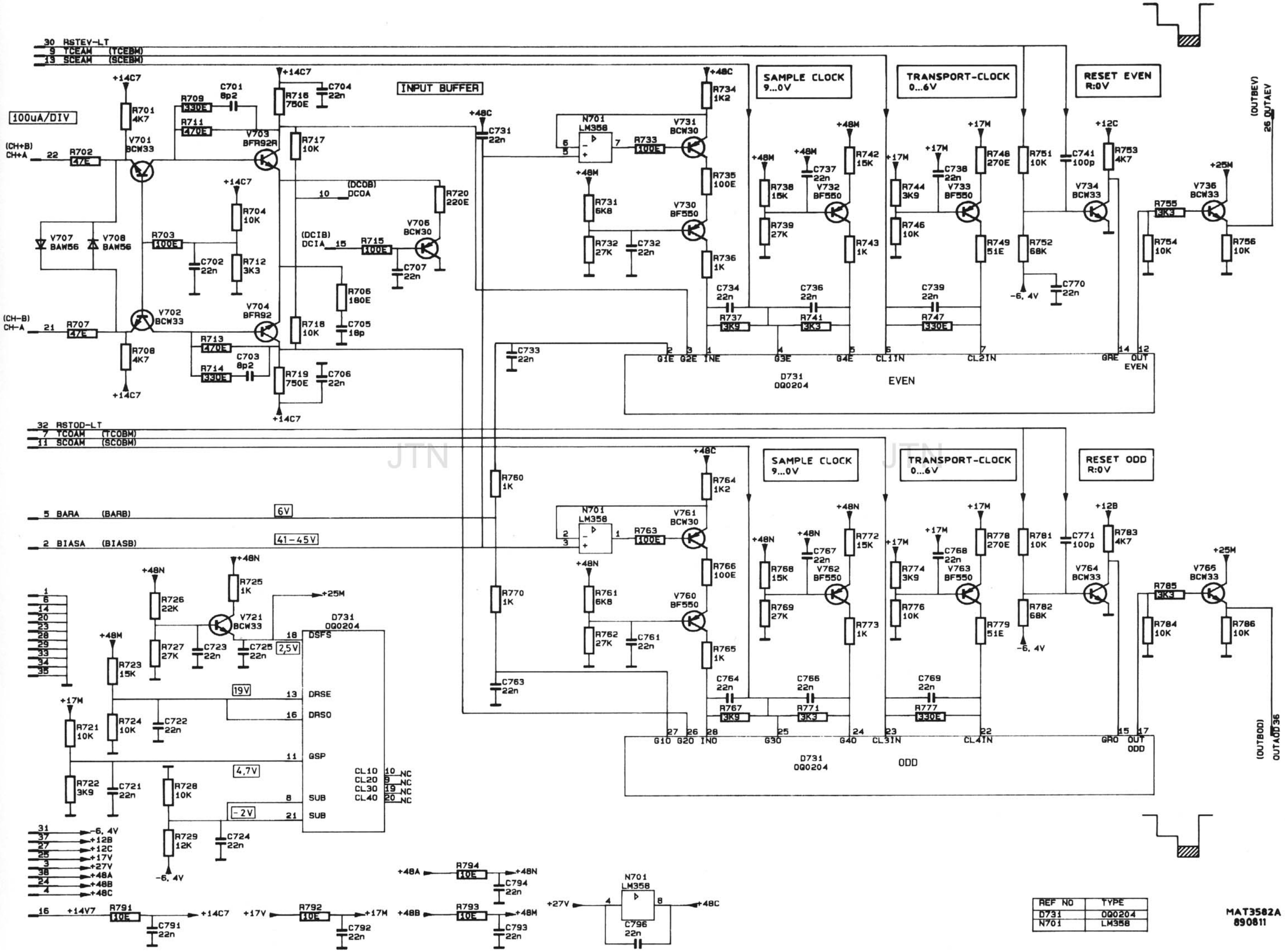


Figure 18.5 Circuit diagram of mini CCD unit

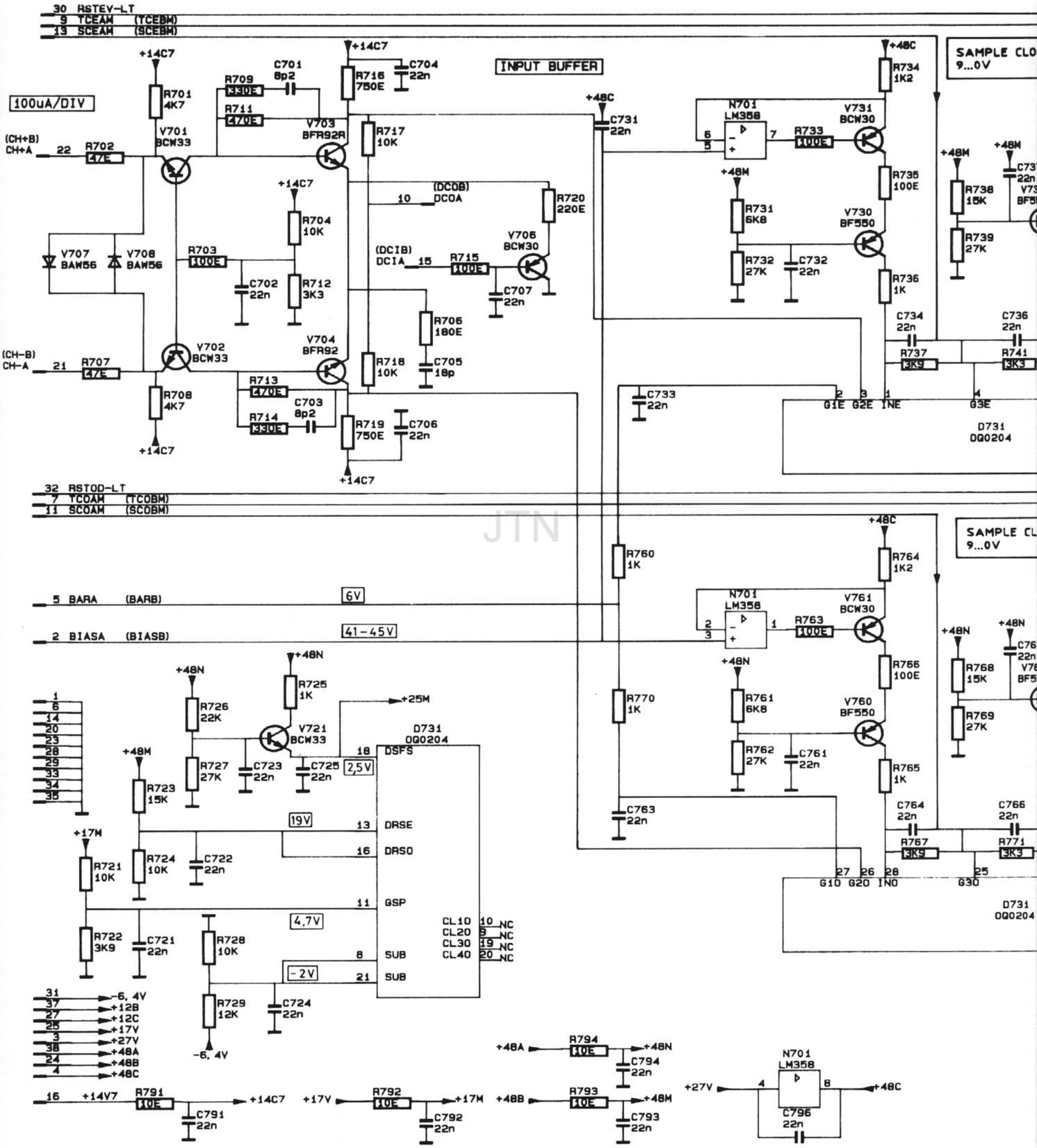
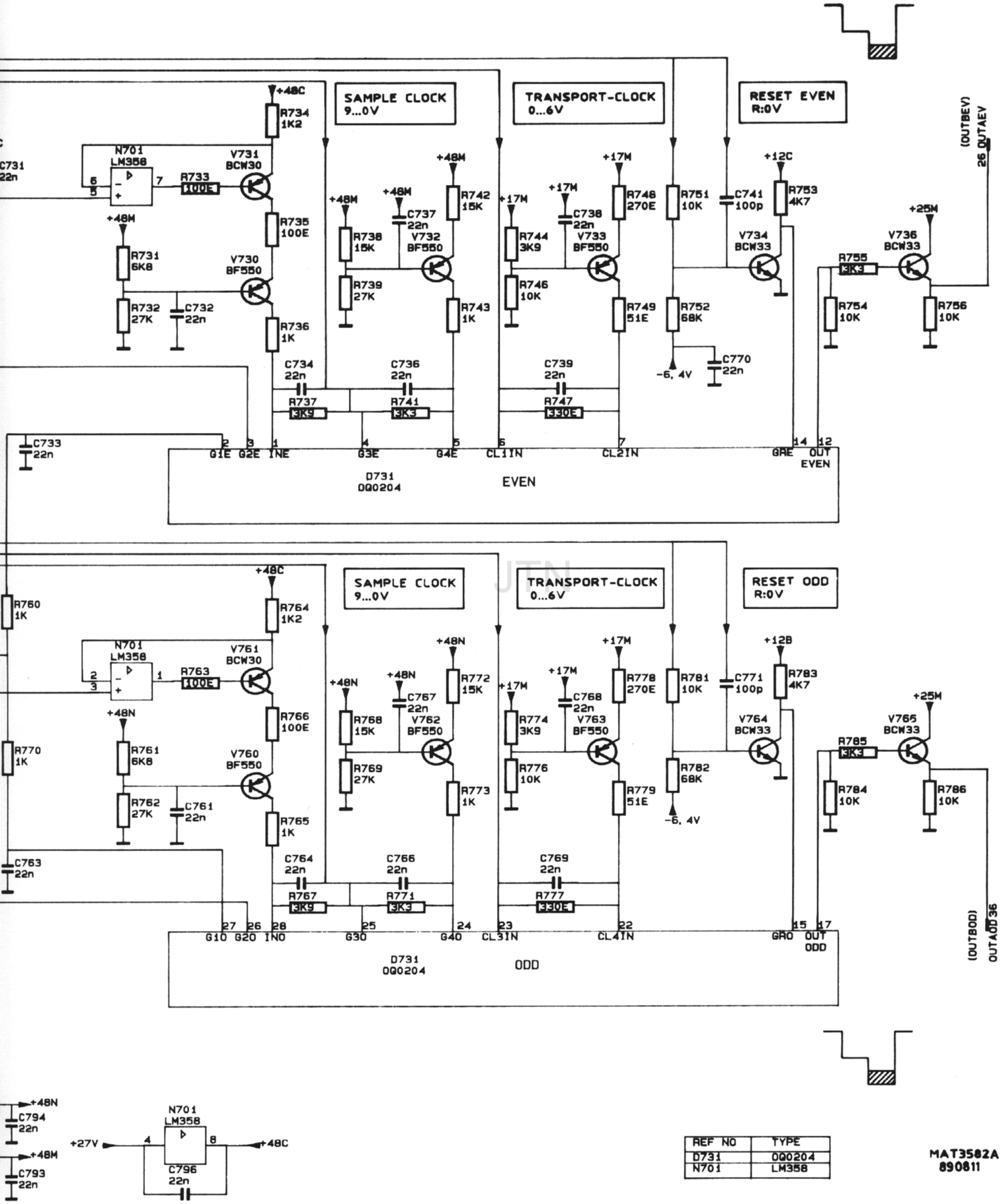


Figure 18.5 Circuit diagram of mini CCD unit



REF NO	TYPE
D731	0Q0204
N701	LM358

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19 P^2CCD UNIT (A18)

The P^2CCD unit consists of:

- The ACE (Advanced Customised ECL) device with associated circuit
- The clock drivers circuits
- The Mini CCD default circuits
- The P^2CCD output circuit

The two mini CCD units which are mounted on this unit, are described separately in Chapter 18.

19.1 ACE (ADVANCED CUSTOMISED ECL)

The CCD logic and fast time-base divider are integrated in an ECL-GATE-ARRAY D801. It contains various fast dividers to generate the sample and transport clock from the FCH and FCL signals in P-mode. It also contains the logic for the change over to the slow clock (SWCK) for the read out stroke in P-mode. In the Direct mode the sample and transport clocks are derived from SWTB.

In D-mode, the sample and transport clock has a clock-frequency of 50 kHz (D1 mode) or 40 kHz (D2 mode). These frequencies are derived from signal SWCK (100 kHz in D1 mode and 80 kHz in D2 mode).

In P-mode the delay counter indicates the moment when the P^2CCD is read. The delay counter consists of a 4-bit presettable counter, internal in the ECL-GATE-ARRAY, and a 16-bit external counter D887.

The output lines are at ECL level (-0,9 V...-1,7 V).
The output signals TCEV, CDRD, DTUF and DCC are buffered and converted into a TTL level.

The digital time-base generator in P-mode is driven by a 100 MHz crystal oscillator. The oscillator can be switched-on and -off by the signal OSCON-LT.

19.2 CLOCK DRIVERS

Each SAMPLE AND TRANSPORT clock driver consists of two transistors with a current source. To increase the bandwidth of the signal, a coil is added between the collector and the gate capacitance of the P^2CCD; the sample clock drivers are buffered by a bridged T-network.

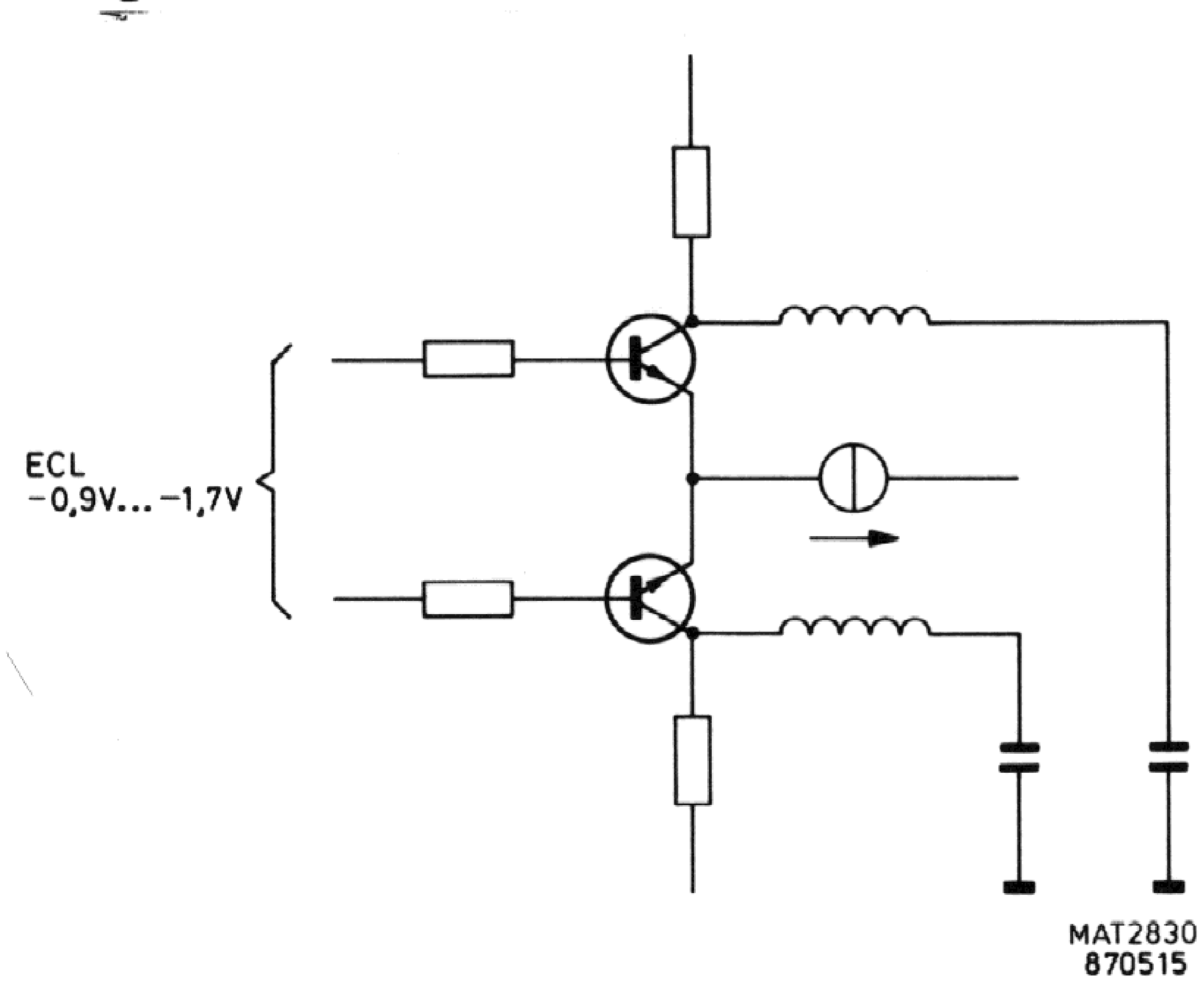


Figure 19.1 Principle of the sample clock drivers

The inputs are at ECL level (-0,9 V...-1,7 V) and are derived from the ACE. These are converted into a 0 ... 9 V signal for the sample clock drivers or 0...6 V signal for the transport clock drivers.

19.3 MINI CCD DEFAULT CIRCUITS

The default settings BIAS A (BIAS B) and +27 V for the P^2CCD are obtained by resistor dividers or by a zener diode. The d.c. value of BIAS A (BIAS B) can be varied by potentiometer R894 (R892).

The level shifter D921 converts the TTL signals DISOD-HT, DISEV-HT, SPOD and SPEV into the same signals but at CMOS level (signal between 0... +12 V). The sample signal SAMPLEHT is split up into a sample Odd or sample Even signal by D922.

19.4 P^2CCD OUTPUT

The P^2CCD output circuit consists of 4 CIH (Clamp Integrate Hold) circuits, followed by the analog leakage correction.

Since channel A and B are identical (and the even and odd side of each channel are identical) only channel A odd side of the CIH is described.

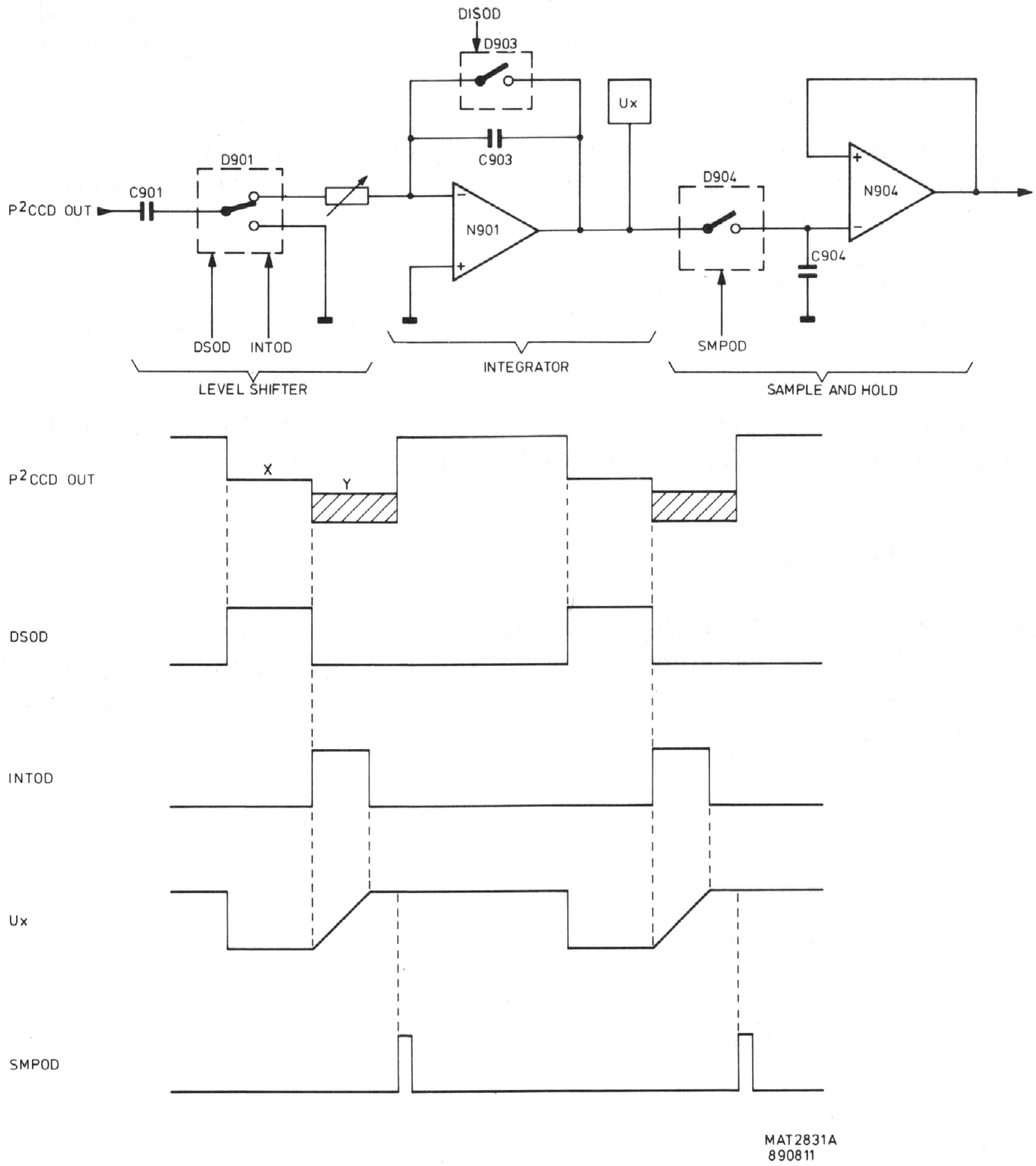


Figure 19.2 CIH circuit

The CIH receives its signal from the P^{2}CCD.
The first stage is multiplexer D901, which serves as a level shifter. D901 detects the voltage difference between level X and Y which represents the value of the sample and sets the voltage reference level X to 0 V. When DSOD is high, capacitor C901 is clamped to ground and charged to the voltage X. Then, when INTOD is high, capacitor C901 passes this d.c. sample voltage Y-X to the next stage.

The second stage, integrator N901 has two functions: it filters and amplifies the sample voltage. During the time that INTOD is high the sample voltage is present and the output of N901 is rising linearly. Then when INTOD is low again, the output of N901 gives a constant voltage. Next, when DISOD is high capacitor C903 is short-circuited by D903 and is discharged so that it is ready for a new cycle. The output of this stage is buffered by a dual FET V903.

The third stage is the sample and hold circuit D904. The constant output voltage of the previous stage charges the hold capacitor C904 during the time that SMPOD is high. If SMPOD is low, the capacitor C904 is isolated from the second stage and holds its charge; the output voltage of N904 is now constant.

The outputs of the odd and even signals of ch. A (B) are applied to the analog leakage correction.

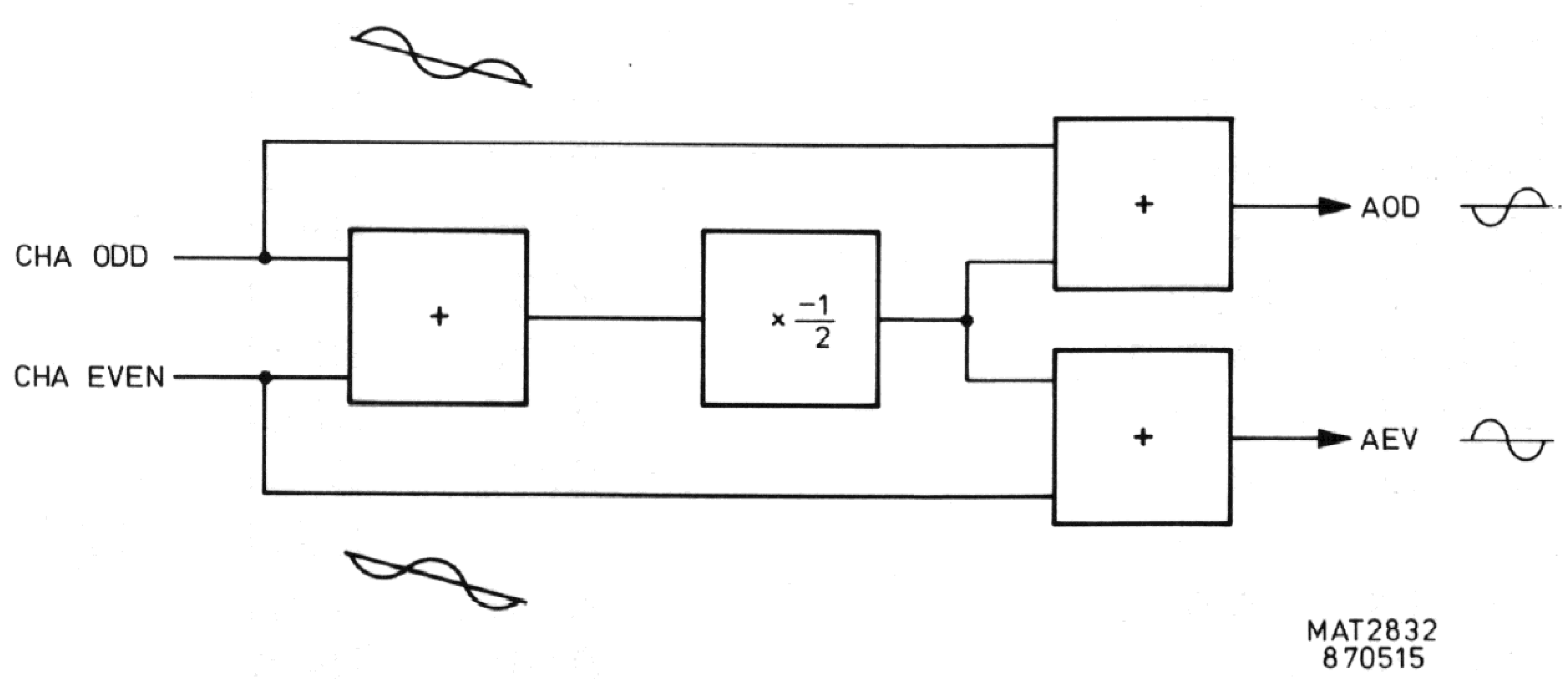


Figure 19.3 Analog leakage correction

The two samples CH.A ODD and CH.A EVEN contain the samples with a certain analog common leakage. The odd and even signals are in anti-phase while the leakage is in phase. The circuit can be split into three phases:

- Adding of both signals by R904 and R909. This results in a double leakage signal on N905-6.
- Amplification by -1/2 by N905. The result is a pure leakage signal on N905-7.
- Adding the pure leakage signal to the ch. A odd (or: ch. A even) signal by N927-2. This results in the AOD and AEV signals.

In this way, the final samples AOD and AEV are corrected for leakage. These samples are applied to the ADC circuit on unit A15.

19.5 SIGNAL NAME LIST

Signal name	Description	Signal source	Signal destination(s)
BARA	Barriër ch. A	R974	R760 - R770
BARA	Barriër ch. A	R974	R760 - R770
BARB	Barriër ch. B	R977	R760 - R770
BIASA	Bias voltage ch. A	R894	N701
BIASB	Bias voltage ch. B	R892	N701

Signal name	Description	Signal source	Signal destination(s)
CDRD-HT	CCD read	R883	D406 - D411
CHAOD	Channel A odd signal	R927	R501
CHAEV	Channel A even signal	R937	R502
CHBOD	Channel B odd signal	R947	R508
CHBEV	Channel B even signal	R957	R509
DCCLK	Delay counter clock	R886	D218
DCIA	DC level in ch. A	N921	R715
DCIB	DC level in ch. B	N922	R715
DCOA	DC level out ch. A	R717/718	R968
DCOB	DC level out ch. B	R717/718	R972
DCWE-HT	Delay counter write	D316	D801
DISEV-HT	Discharge even (5V)	R403	D921 - D922
DISOD-HT	Discharge odd (5V)	R404	D921 - D922
DSEV-HT	Discharge even (12V)	D921	D903
DSOD-HT	Discharge odd (12V)	D921	D903
DTTC-LT	Delay trigger terminal count	D218	D801
DTUF-HT	Delay trigger underflow	R884	D402
ED0...3	Buffered data bus	R413...417	D801
EDC--LT	Enable delay counter	R401	D221 - D801
FCH	Fast clock high	R874	D801
FCL	Fast clock low	R875	D801
INTEV-HT	Integrate even	R411	D911
INTOD-HT	Integrate odd	R409	D901
OUTAEV	Output ch. A even	V736	D911
OUTAOD	Output ch A odd	V766	D901
OUTBEV	Output ch. A even	V736	D911
OUTBOD	Output ch. B odd	V766	D901
OSCON-LT	Oscillator on	D313	D401 - D406 - D801 - R862
RSSW	Reset slow clock	R407	D801
SAMPLEHT	Sample clock	R408	D922
SCEA	Sample clock even ch. A	D801	R806
SCEAM	Sample clock even ch. A	L806	D731
SCEB	Sample clock even ch. B	D801	R836
SCEBM	Sample clock even ch. B	L836	D731
SCOA	Sample clock odd ch. A	D801	R801
SCOAM	Sample clock odd ch. A	L801	D731
SCOB	Sample cleck odd ch. B	D801	R831
SCOBM	Sample clock odd ch. B	L831	D731
SMPEV-HT	Sample even	D921	D914
SMPOD-HT	Sample odd	D921	D904
STWE-HT	Status write	D316	D801
SWCK	Slow clock	D412	D801
SWTB	Slow time base	D218	D801 - D412
TBWE-HT	Time base write	D316	D801
TCEA	Transport clock even ch. A	D801	R822
TCEAM	Transport clock even ch. A	L822	D731 - R747
TCEB	Transport clock even ch. B	D801	R852
TCEBM	Transport clock even ch. B	L852	D731 - R747
TCEV-LT	Transport clock even	R882	D401 - D408 - D411
TCOA	Transport clock odd ch. A	D801	R816
TCOAM	Transport clock odd ch. A	L816	D731 - R777
TCOB	Transport clock odd ch. B	D801	R846
TCOBM	Transport clock odd ch. B	L846	D731 - R777

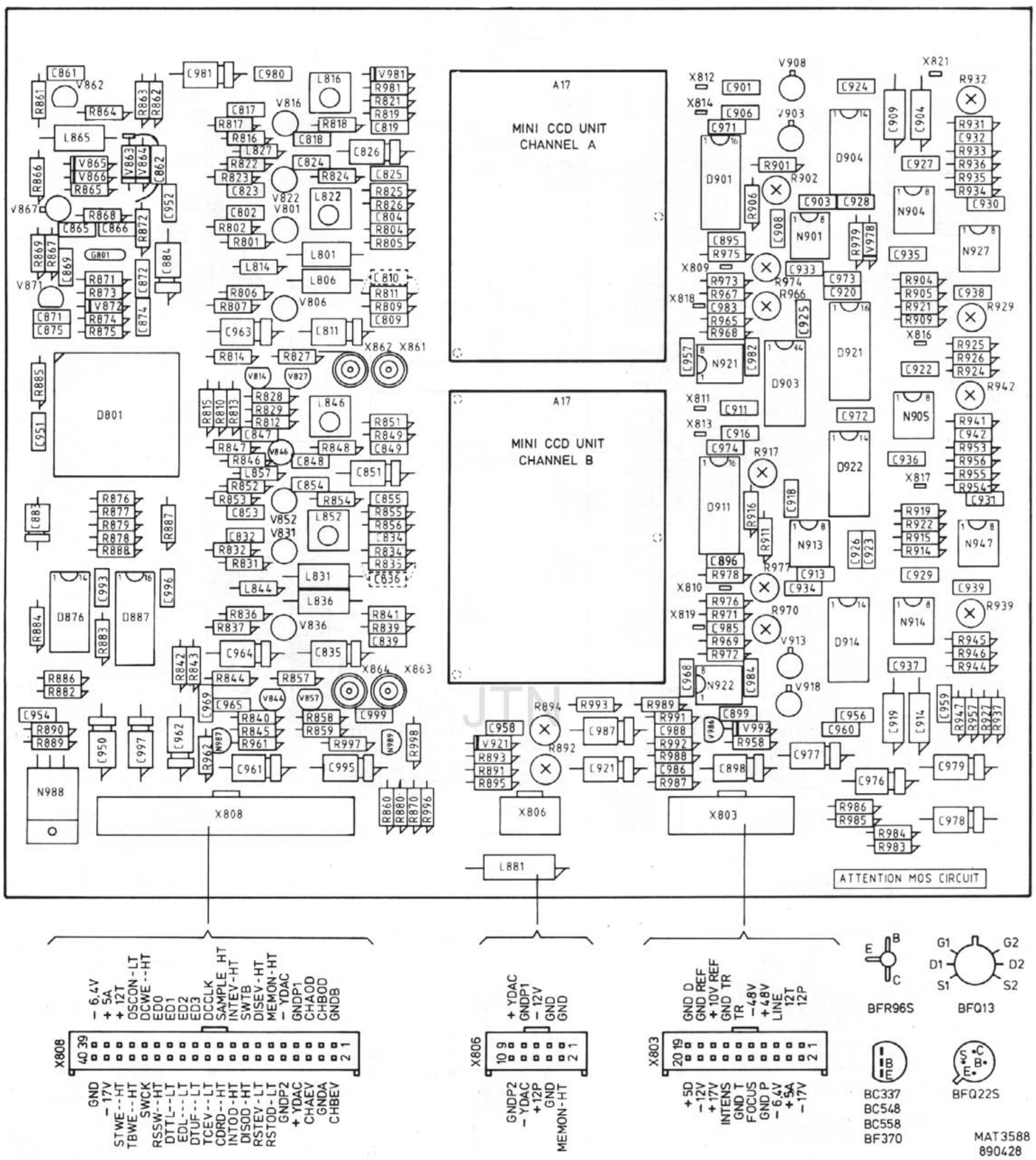
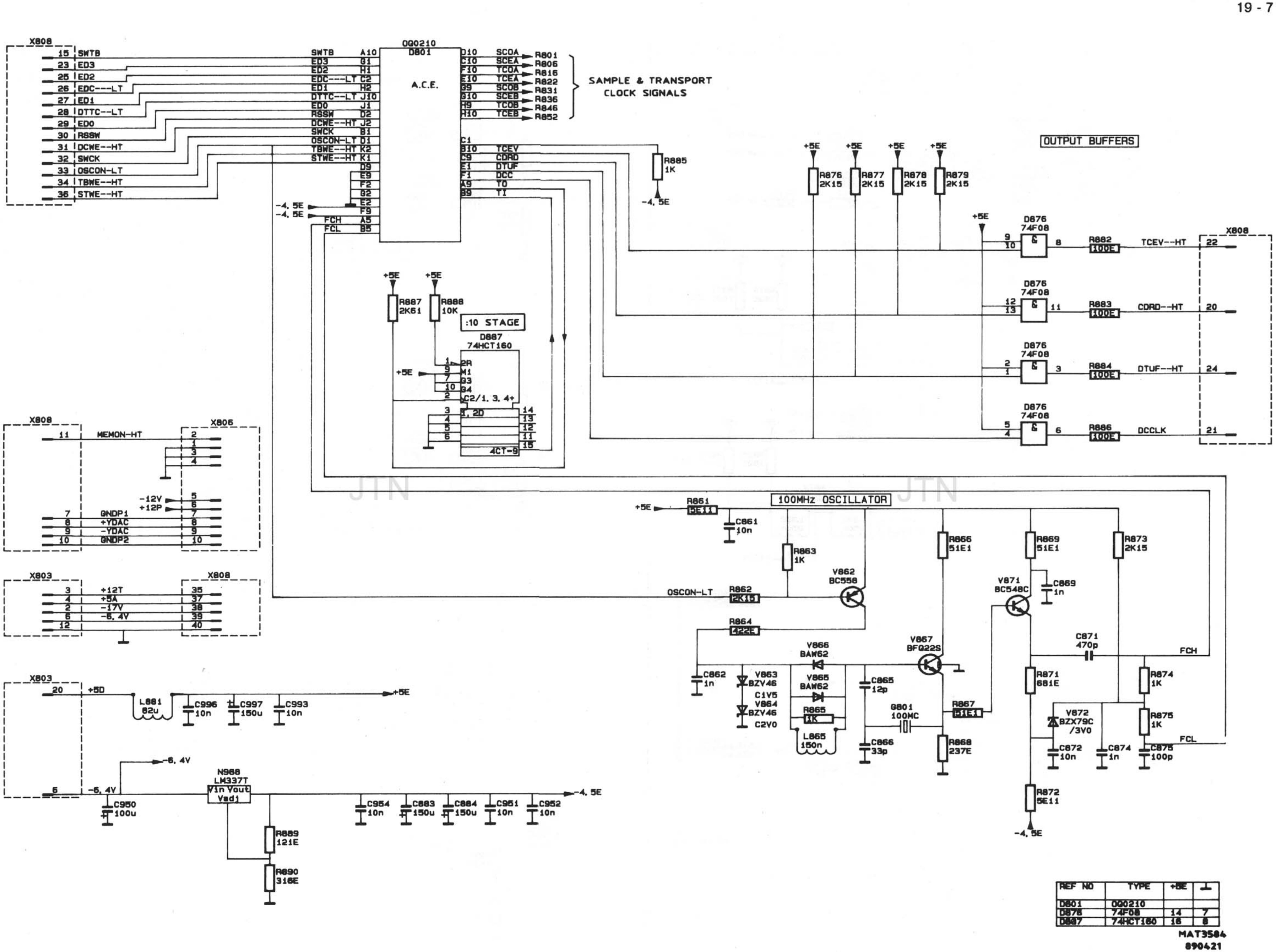
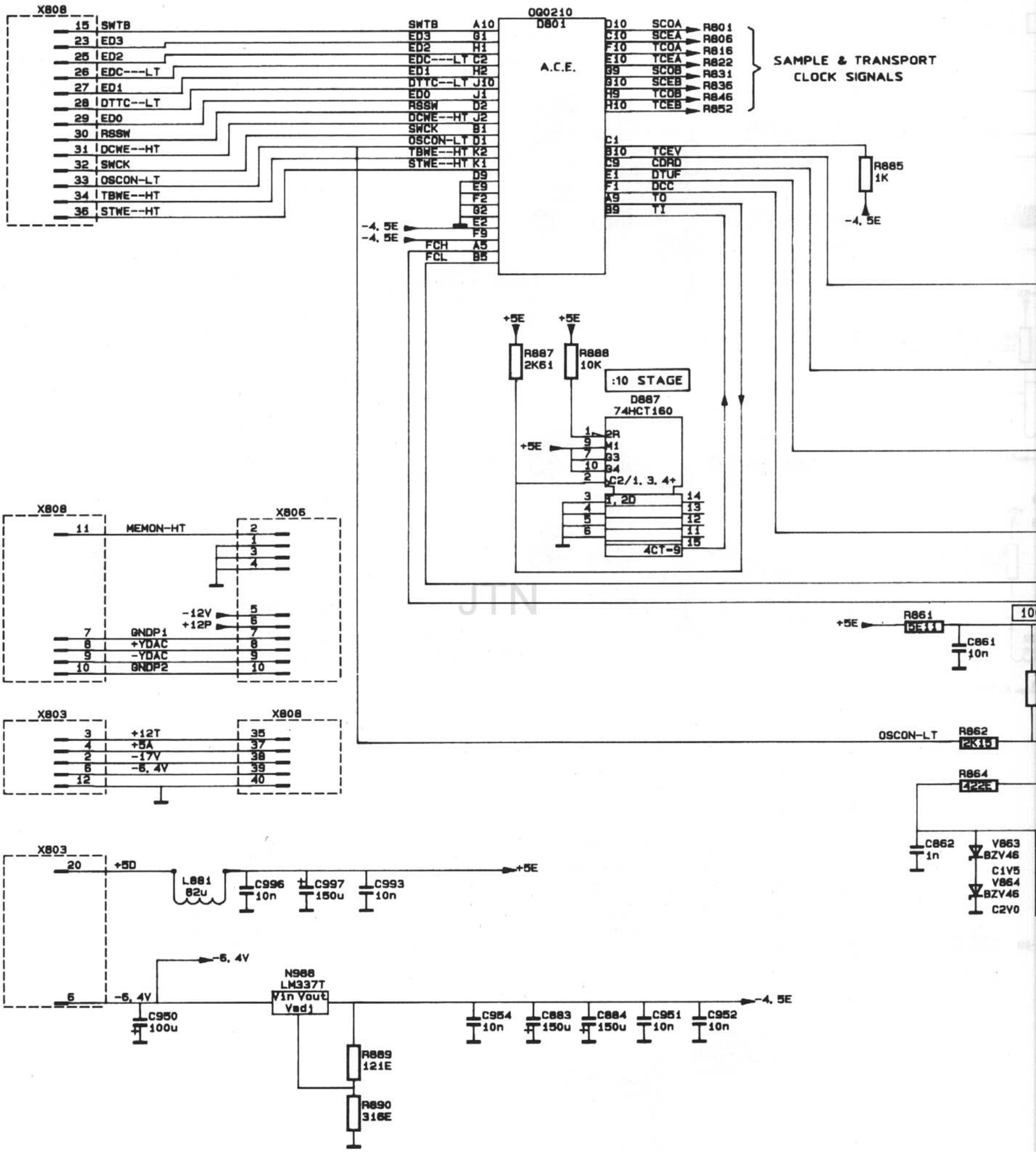


Figure 19.4 P^2CCD unit p.c.b.



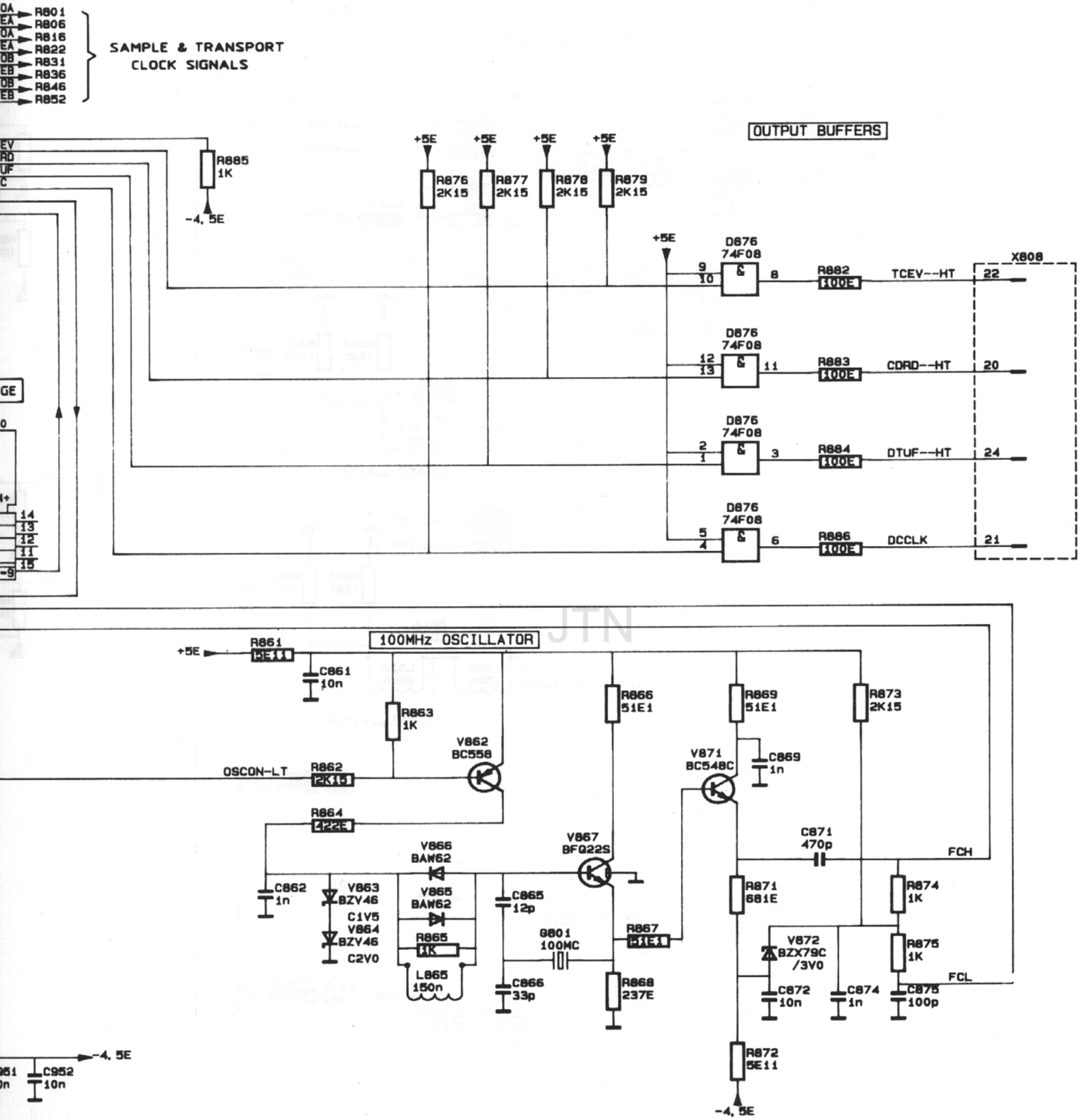
REF NO	TYPE	+5E	⊥
D801	OQ0210		
D876	74F08	14	7
D887	74HCT160	16	8

Figure 19.5 Circuit diagram of P^2CCD: ACE



X808
15 SWTB
23 ED3
25 ED2
26 EDC---LT
27 ED1
28 DTTC--LT
29 ED0
30 RSSW
31 DCWE--HT
32 SWCK
33 OSCON-LT
34 TBWE--HT
36 STWE--HT
OQ0210
D801
A.C.E.
SCOA
SCEA
TCOA
TCEA
SCOB
SCEB
TCOB
TCEB
R801
R806
R816
R822
R831
R836
R846
R852
SAMPLE & TRANSPORT
CLOCK SIGNALS
TCEV
CDRD
DTUF
DCC
TO
TI
R885
1K
-4, 5E
FCH
FCL
R887
2K61
R888
10K
+5E
:10 STAGE
D887
74HCT160
C2/1, 3, 4+
1, 2D
4CT=9
MEMON-HT
X806
-12V
+12P
GNDP1
+YDAC
-YDAC
GNDP2
X803
+12T
+5A
-17V
-6, 4V
R861
5E11
C861
10n
OSCON-LT
R862
2K15
R864
422E
C862
1n
V863
BZV46
C1V5
V864
BZV46
C2V0
+5D
L881
82u
C996
10n
C997
150u
C993
10n
N988
LM337T
Vin Vout
Vadj
C950
100u
C954
10n
C883
150u
C884
150u
C951
10n
C952
10n
R889
121E
R890
316E

Figure 19



REF NO	TYPE	+5E	⊥
D801	000210		
D876	74F08	14	7
D887	74HCT160	16	8

MAT3584
890421

Figure 19.5 Circuit diagram of P^2CCD: ACE

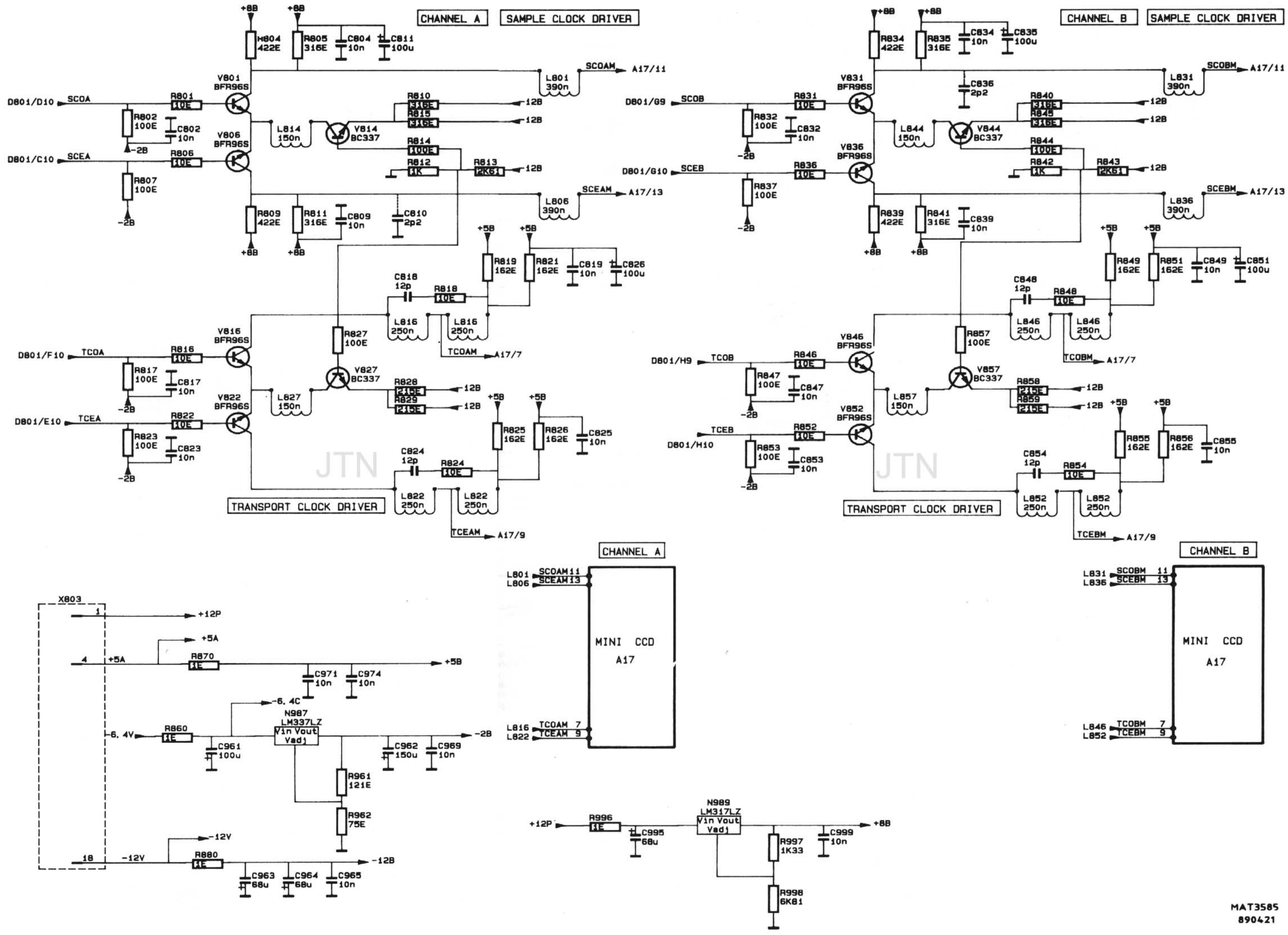


Figure 19.6 Circuit diagram of P^2CCD: clock drivers

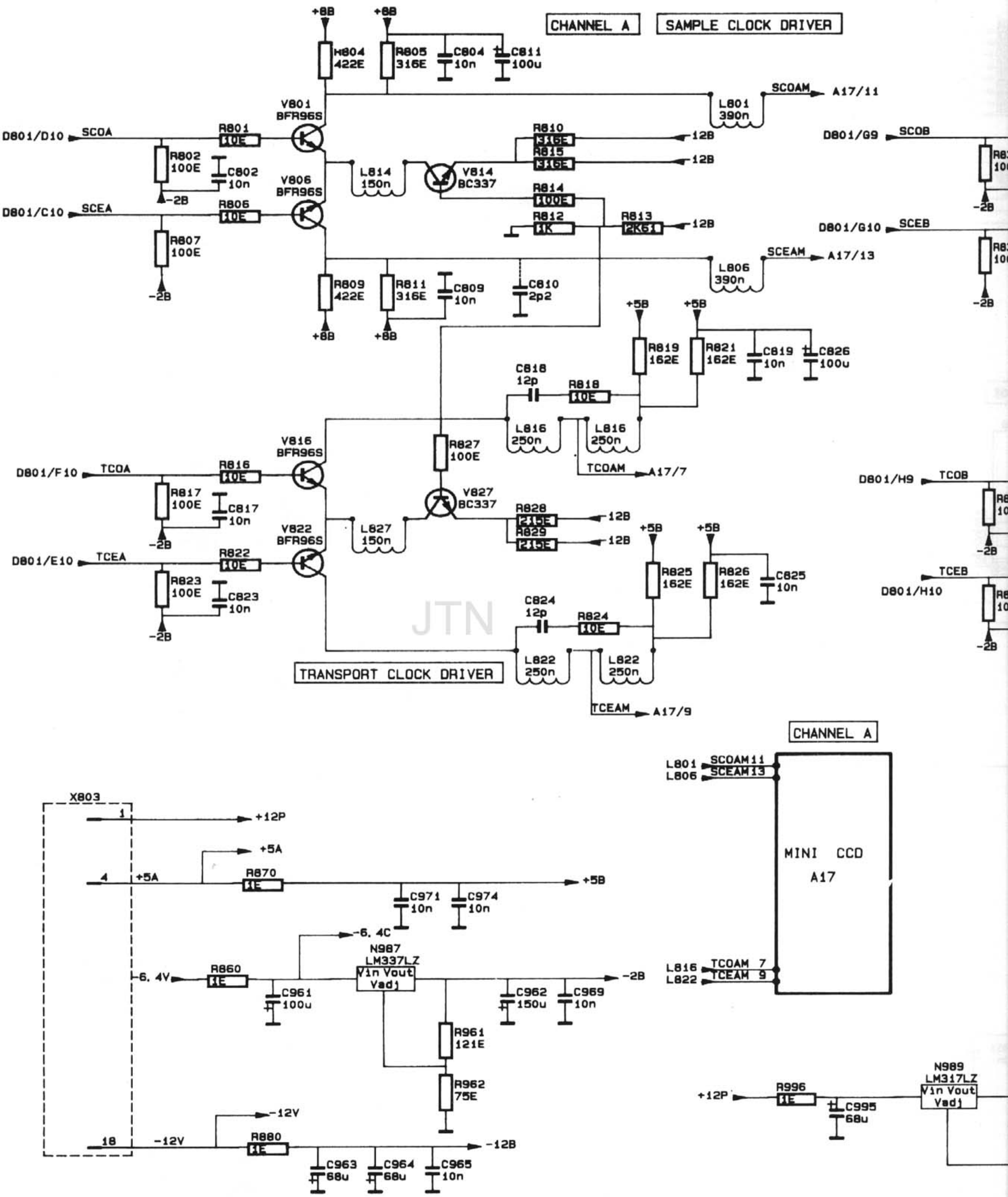
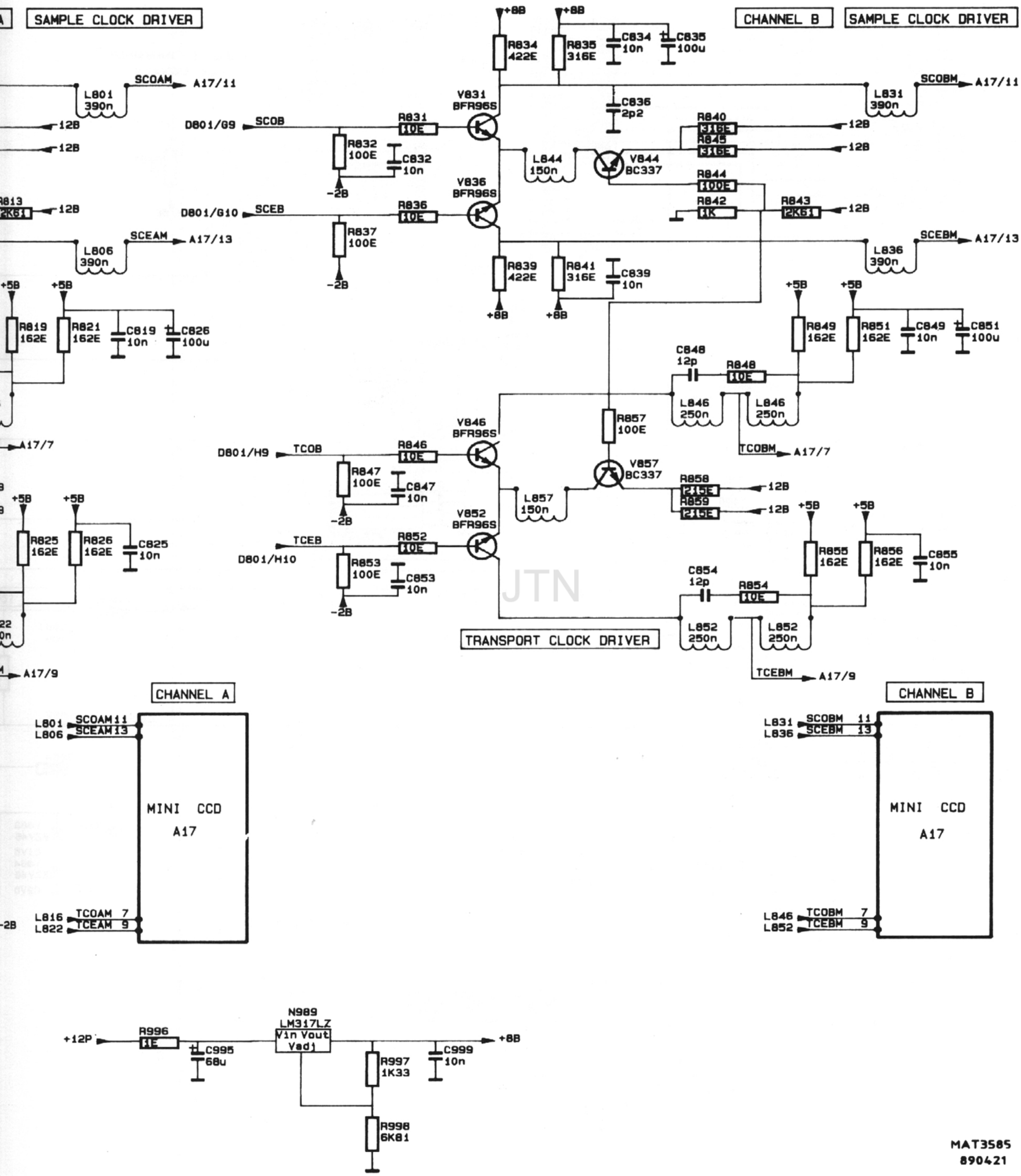


Figure 19.6 Circuit diagram of P^2CCD: clock drivers



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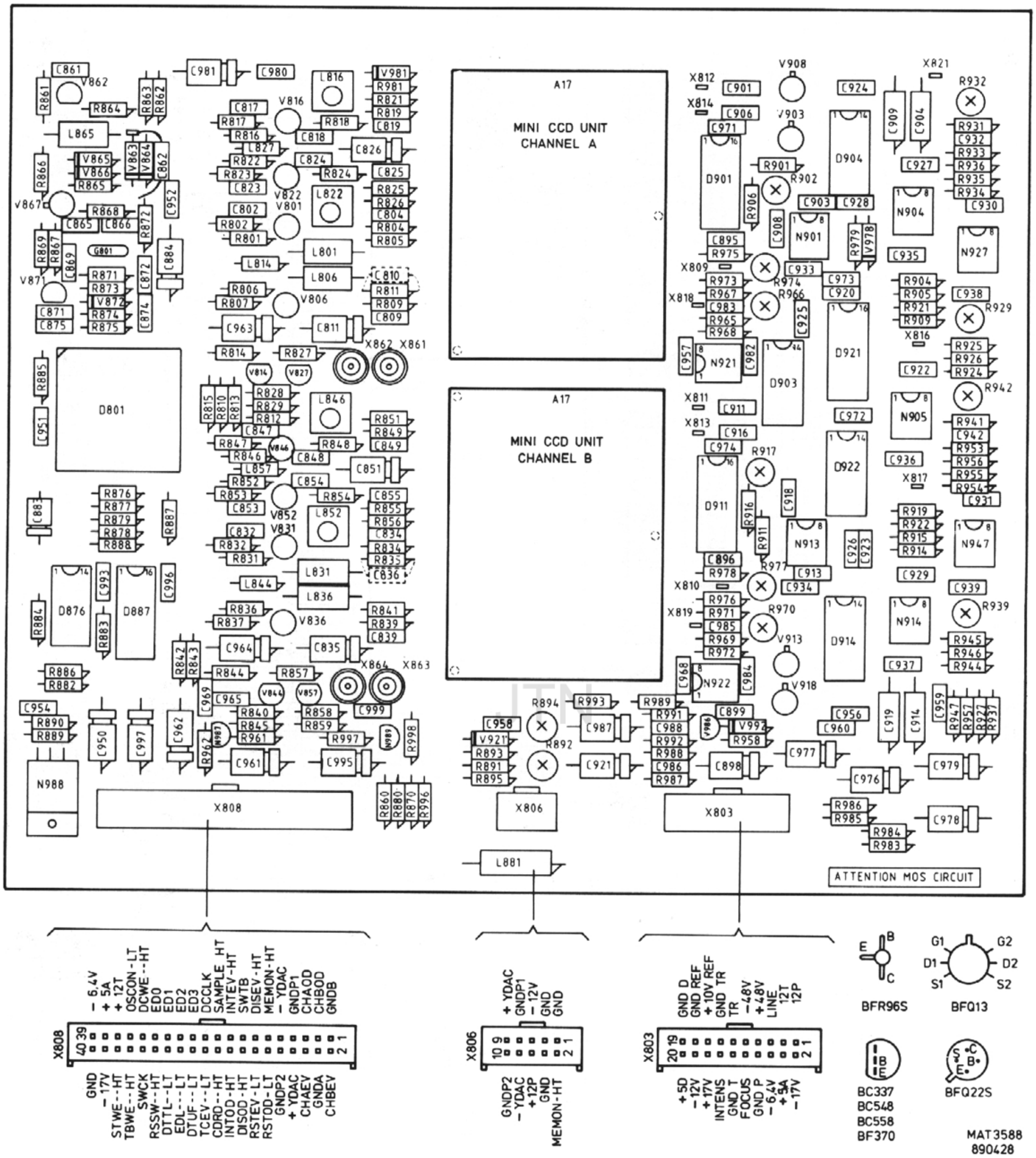
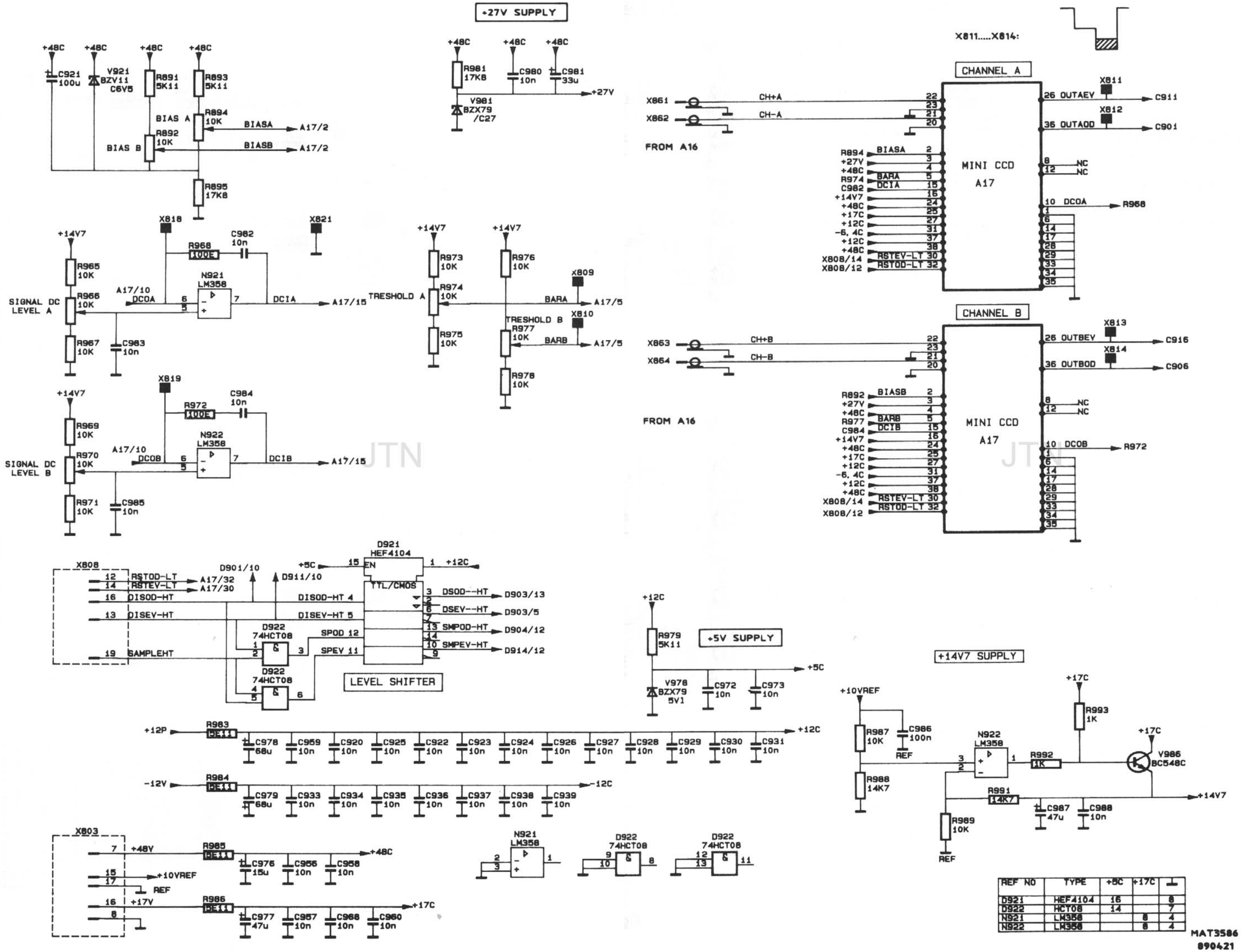


Figure 19.7 P²CCD unit p.c.b.



REF NO	TYPE	+5C	+17C	⊥
D921	HEF4104	16		8
D922	HCT08	14		7
N921	LM358		8	4
N922	LM358		8	4

Figure 19.8 Circuit diagram of P²CCD: part 3

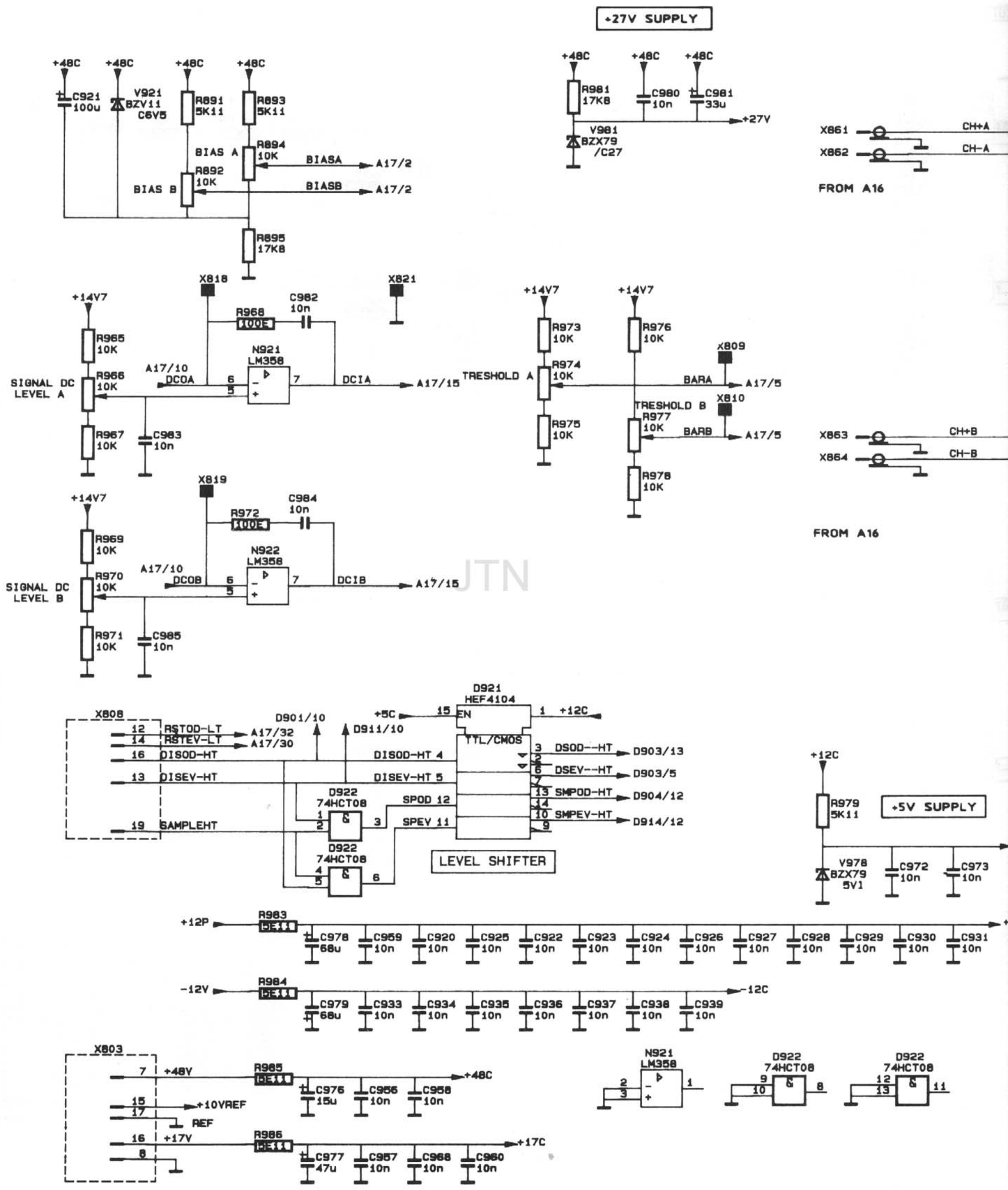
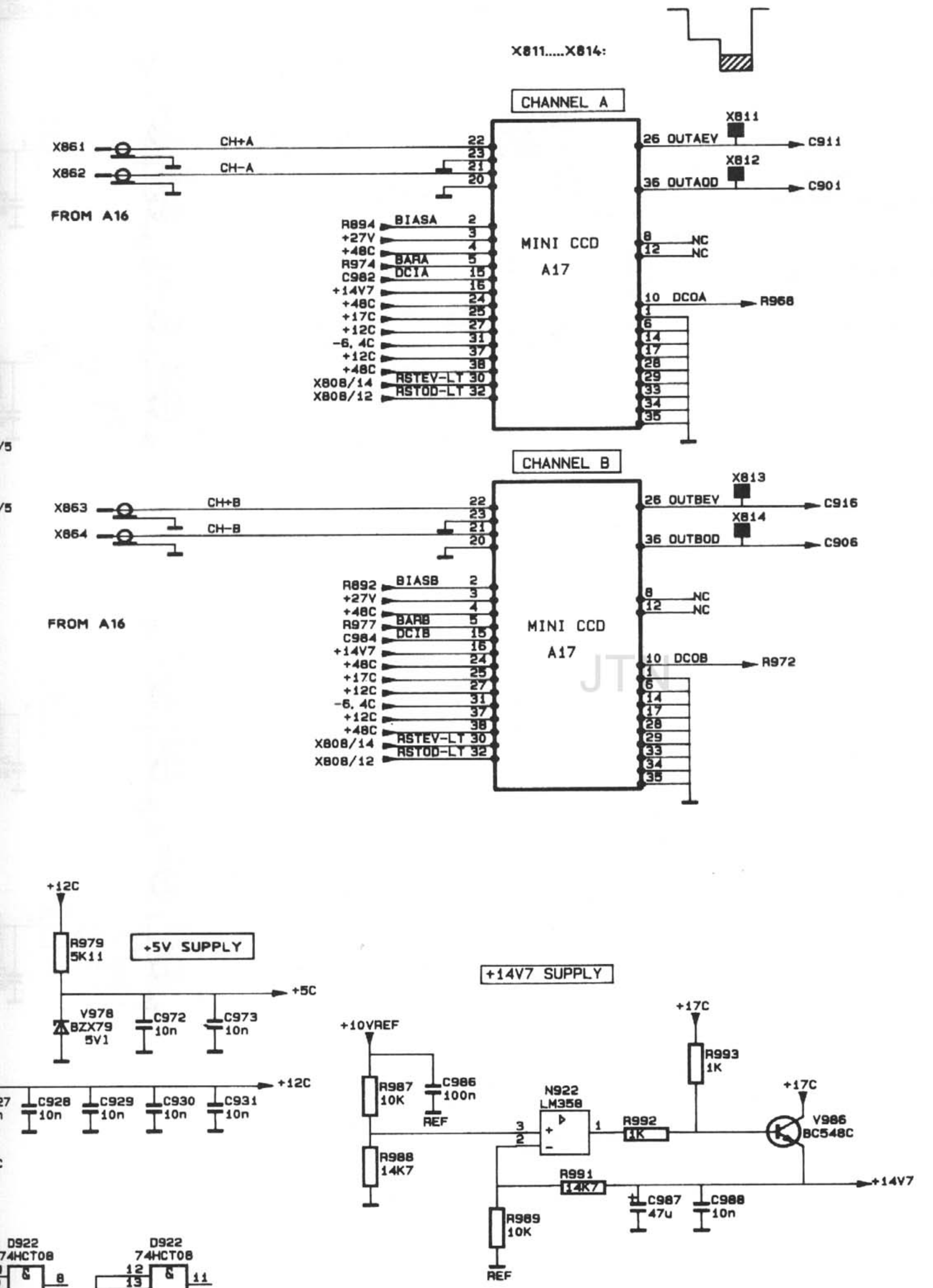


Figure 19.8 Circuit diagram of P^2CCD: part 3



REF NO	TYPE	+5C	+17C	⊥
D921	HEF4104	16		8
D922	HCT08	14		7
N921	LM358		8	4
N922	LM358		8	4

MAT3586
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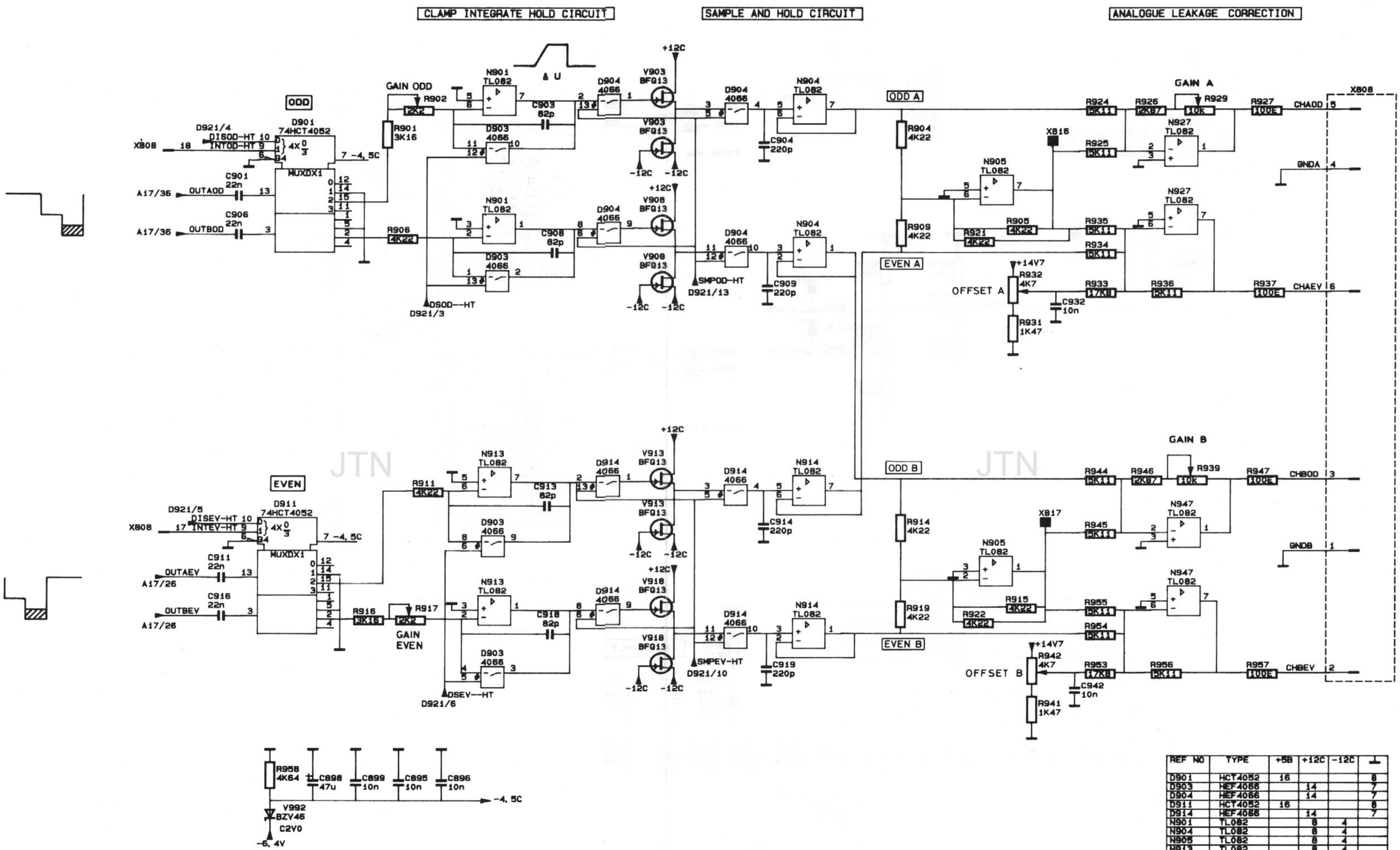

REF NO	TYPE	+5B	+12C	-12C	⊥
D901	HCT4052	16			8
D903	HEF4066		14		7
D904	HEF4066		14		7
D911	HCT4052	16			8
D914	HEF4066		14		7
N901	TL082		8	4	
N904	TL082		8	4	
N905	TL082		8	4	
N913	TL082		8	4	
N914	TL082		8	4	
N927	TL082		8	4	
N947	TL082		8	4	

MAT3587A
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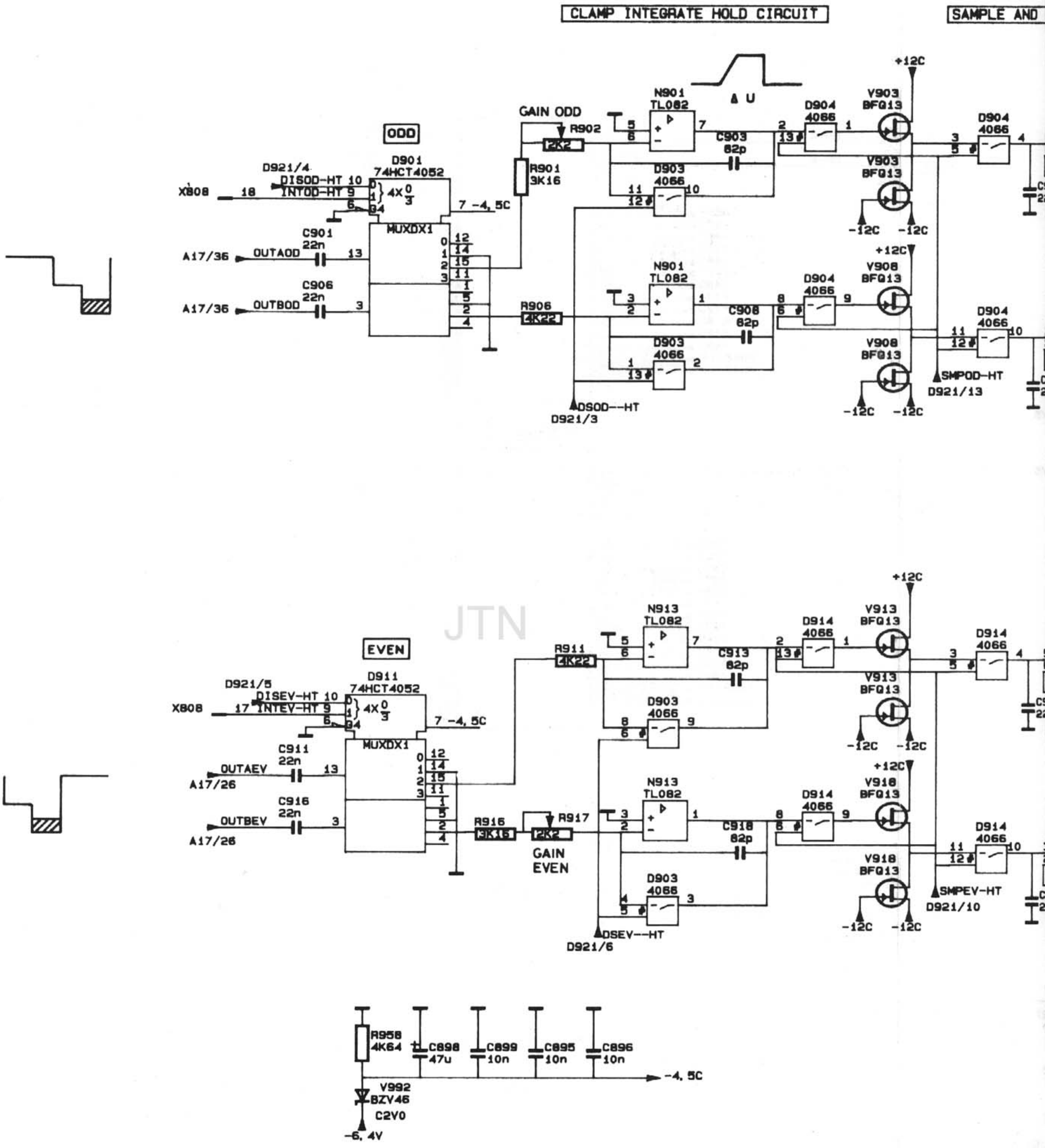
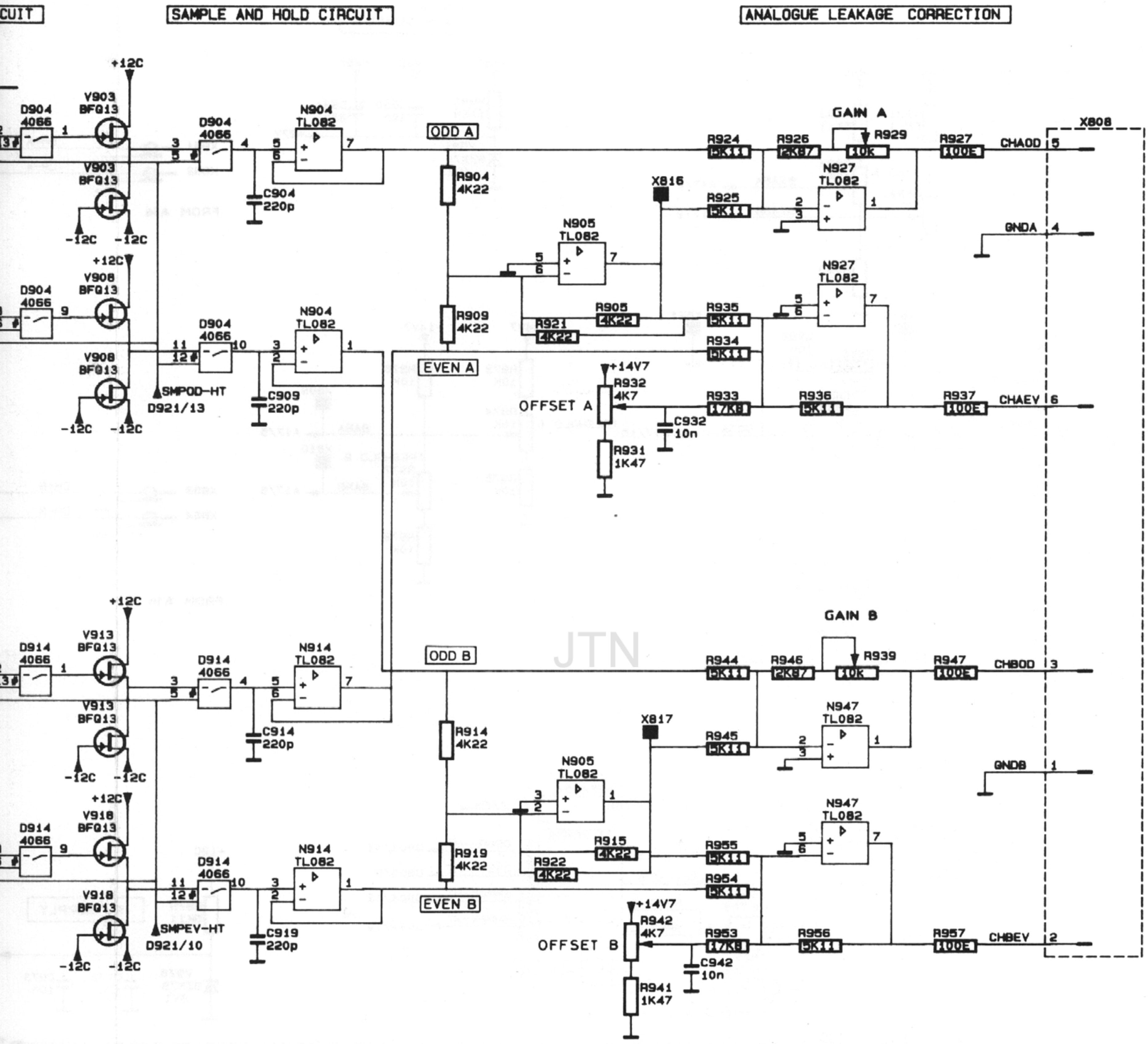
Figure 19.9 Circuit diagram of P²CCD: CIH circuit


CLAMP INTEGRATE HOLD CIRCUIT
SAMPLE AND
ODD
EVEN
D901
74HCT4052
D911
74HCT4052
MUXDX1
4X 0/3
D921/4
DISOD-HT
INTOD-HT
D921/5
DISEV-HT
INTEV-HT
X808
7 -4, 5C
C901
22n
OUTAOD
A17/36
C906
22n
OUTBOD
C911
22n
OUTAEV
A17/26
C916
22n
OUTBEV
GAIN ODD
R902
2K2
R901
3K16
R906
4K22
R911
4K22
R916
3K16
R917
2K2
GAIN
EVEN
N901
TL082
N913
TL082
Δ U
C903
82p
C908
82p
C913
82p
C918
82p
D903
4066
D904
4066
D914
4066
V903
BFQ13
V908
BFQ13
V913
BFQ13
V918
BFQ13
+12C
-12C
DSOD--HT
D921/3
DSEV--HT
D921/6
SMPOD-HT
D921/13
SMPEV-HT
D921/10
R958
4K64
C898
47u
C899
10n
C895
10n
C896
10n
-4, 5C
V992
BZV46
C2V0
-6, 4V

Figur



REF NO	TYPE	+5B	+12C	-12C	⊥
D901	HCT4052	16			8
D903	HEF4066		14		7
D904	HEF4066		14		7
D911	HCT4052	16			8
D914	HEF4066		14		7
N901	TL082		8	4	
N904	TL082		8	4	
N905	TL082		8	4	
N913	TL082		8	4	
N914	TL082		8	4	
N927	TL082		8	4	
N947	TL082		8	4	

MAT3587A
890811

Figure 19.9 Circuit diagram of P^2CCD: CIH circuit

20 PERFORMANCE CHECK

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

NOTE: The procedure does not check every facet of the instruments calibration; rather, it is concerned primarily with those parts of the instrument which are essential to measurement accuracy and correct operation. Removing the instruments covers is not necessary to perform this procedure. All checks are made from the 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 performance checks are made with a stable, well-focussed, low- intensity display. Unless otherwise noted, adjust the intensity and trigger-level controls as needed.

IMPORTANT NOTES

- At the start of every check, the controls always should occupy the **AUTO SET** position, unless otherwise stated.

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

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

- In this chapter, in some checks, channel B is mentioned between brackets behind channel A. It is advised to perform first channel A checks. After that, the checks for channel B can be done.

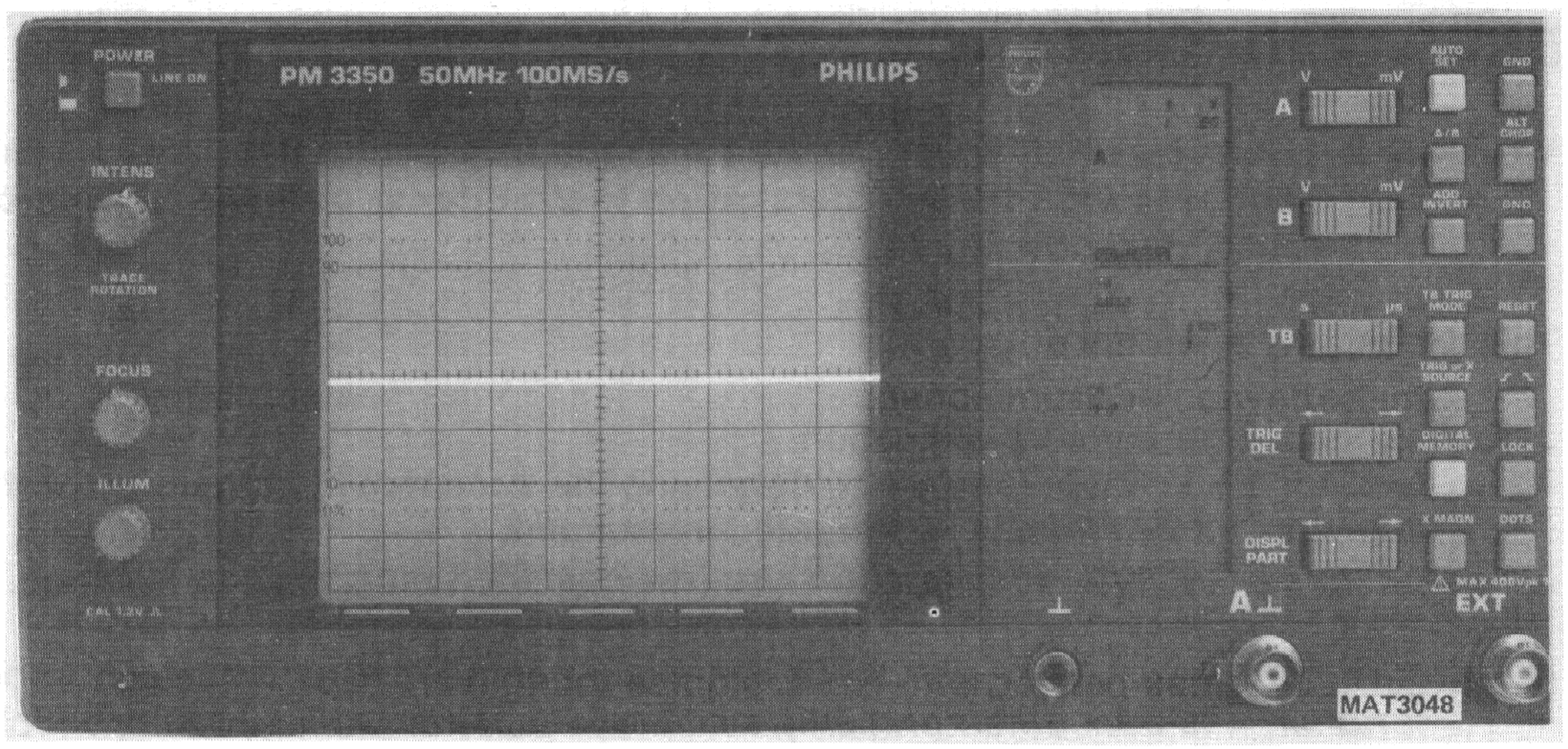


Figure 20.1 SOFTSTART condition

20.2 PRELIMINARY SETTINGS

- Switch-on the instrument (no input signal).
- Check if all LCD segments are on for approx. 1 sec.
- Press MENU and AUTO SET in sequence.
- Check if the frontcontrols are set in the softstart condition as indicated in figure 20.1.
- At the start of every check only AUTO SET must be pressed (after the input signal is applied).

20.3 RECOMMENDED TEST EQUIPMENT

The test equipment that must be used for this performance check is as given in section 22.2, except:

- Trimming tool kit
- Oscilloscope
- Digital multimeter

20.4 CHECKING PROCEDURE

20.4.1 Power supply
(characteristics section 2.14)

*** SUBJECT**	**Line voltage input**
TEST EQUIPMENT	Variable mains transformer
MAINS VOLTAGE	Between 100 V and 240 V ac (r.m.s.) Frequency: 50 Hz...400 Hz
SETTINGS	- Press POWER ON - Apply CAL signal to input A - Press AUTO SET
REQUIREMENTS	- Starts at any mains voltage between 100 V...240 ac (r.m.s.) - Instruments performance does not change over indicated mains voltage range; displayed CAL signal distortion-free and with equal intensity.
MEASURING RESULTS	....

*** SUBJECT**	**Power Consumption (ac source)**
TEST EQUIPMENT	Wattmeter (moving iron meter)
MAINS VOLTAGE	Mains voltage 220 V (r.m.s.).
SETTINGS	Press POWER ON
REQUIREMENTS	Consumes : 70W
MEASURING RESULTS	....

20.4.2 Vertical deflection or Y-axis
(characteristics section 2.2)

*** SUBJECT**	**Vertical Deflection coefficients and input coupling of Channels A and B**
TEST EQUIPMENT	Square-wave calibration generator (PG506)
INPUT VOLTAGE	Square-wave signal 1 kHz to input A(B), amplitude 10 mVpp...20 Vpp in 1-2-5 steps
SETTINGS AND REQUIREMENTS	- Apply a 1 kHz square wave signal of 10 mV to input A(B) - Set A (B) to 2 mV/div. - Check if the amplitude of the signal is 5 div. (+or- 3%) - Increase the input amplitude and vertical sensitivity with the following steps:

Input voltage (pp)	A (B) setting	Requirements	Measuring results
10 mV	2 mV	5 div.(+or-3%)	....
20 mV	5 mV	4 div.(+or-3%)	....
50 mV	10 mV	5 div.(+or-3%)	....
0,1 V	20 mV	5 div.(+or-3%)	....

Input voltage (pp)	A (B) setting	Requirements	Measuring results
0,2 V	50 mV	4 div.(+or-3%)	....
0,5 V	100 mV	5 div.(+or-3%)	....
1 V	200 mV	5 div.(+or-3%)	....
2 V	500 mV	4 div.(+or-3%)	....
5 V	1 V	5 div.(+or-3%)	....
10 V	2 V	5 div.(+or-3%)	....
20 V	5 V	4 div.(+or-3%)	....
50 V	10 V	5 div.(+or-3%)	....

*** SUBJECT** **Variable gain control range (continued procedure of previous subject)**

SETTING - Turn VAR control fully anti-clockwise

REQUIREMENTS - Check if displayed amplitude is not more than 2 div. (1:2,5)

MEASURING RESULTS ....

* SUBJECT Input coupling (continued procedure of previous subject)

SETTINGS AND REQUIREMENTS
- Turn VAR control fully clockwise.
- Press "GND"; check if input signal is interrupted.
- Press "GND" again and then AC/DC
- Check if in DC position the signal shifts upwards

MEASURING RESULTS ....

*** SUBJECT** **Frequency response**

TEST EQUIPMENT Constant amplitude sine-wave generator (SG503)

INPUT VOLTAGE Constant amplitude sine-wave signal, 120 mV, frequency 50 kHz...50 MHz to input A (B).

SETTINGS AND REQUIREMENTS
- Set A (B) to 20 mV/div.
- Apply 50 kHz sine-wave signal to A (B)
- Adjust trace height to exactly 6 div.
- Increase the frequency of the input signal up to 50 MHz.
- Check if the vertical deflection is $\geq$ 4,2 div. (-3 dB) over the complete bandwidth range (50 MHz).
- Reduce the amplitude of the input signal to 12 mV and the frequency to 50 kHz.
- Set A (B) to 2 mV.
- Adjust the trace height to exactly 6 div.
- Increase the frequency up to 35 MHz.
- Check if the vertical deflection is $\geq$ 4,2 div.(-3 dB) over the complete bandwidth range (35 MHz)

MEASURING RESULTS ....

*** SUBJECT**	**Rise-Time**
IMPORTANT	THE RISE TIME IS A CALCULATED VALUE, ACCORDING FORMULA: BANDWIDTH x RISE-TIME = 0,35
TEST EQUIPMENT	Fast-rise square-wave generator (PG506)
INPUT VOLTAGE	Fast-rise square-wave signal ≤ 1 ns to input A (B), frequency: 1MHz.
SETTINGS	- Set A(B) to 50 mV/div - Press TB MAGN - Set TB to 5 ns/div - Adjust the trace height exactly between the dotted lines 0% and 100% (5 div.)
REQUIREMENTS	Important: $T_R \text{ (measured)} = \sqrt{T_R \text{ (input signal)}^2 + T_R \text{ (oscilloscope)}^2}$ - Check the rise-time, measured between the 10% and 90% lines (4 div.): rise-time must be 7 ns or less.
MEASURING RESULTS	....
*** SUBJECT**	**Noise**
TEST EQUIPMENT-	-
INPUT VOLTAGE	-.
SETTINGS	- Press A/B: channel A and B on - Set channel A and B to 20 mV/div. - Press ALT/CHOP for CHOP mode - Press GND of both channels for grounded input coupling
REQUIREMENT	- Check if the traces are not thicker than 0,5 subdiv.
MEASURING RESULTS	....
*** SUBJECT**	**Vertical Dynamic range**
TEST EQUIPMENT	Constant amplitude sine-wave generator
INPUT VOLTAGE	Sine-wave signal of 10 MHz, 2,4 Vpp to input A(B)
SETTINGS	- Apply sine-wave signal of 10 MHz, 2,4 Vpp to input A(B). - Set A (B) to 100 mV/div. - Shift with the Y POS control the sine-wave vertically over the screen.

REQUIREMENT	- Check if the top and bottom of the sine-wave signal can be displayed distortion-free (24 div. trace height).
INPUT VOLTAGE	Sine-wave signal of 50 MHz, 1,6 Vpp to input A(B)
SETTINGS	- Set A (B) to 200 mV/div. - Set the trace height to exactly 8 div. - Increase the frequency of the input signal up to 50 MHz
REQUIREMENT	- Check if a sine-wave signal of 8 div. is displayed distortion-free.
MEASURING RESULTS	....
*** SUBJECT**	**Position range (vertical)**
TEST EQUIPMENT	LF Sine-wave generator
INPUT VOLTAGE	Sine-wave signal of 1 kHz, 8 V to input A(B)
SETTINGS	- Adjust the channel A (B) input sensitivity to 1 V/div. - Apply a sine-wave of 1 kHz/8 div. to the channel A (B) input. - Adjust the channel A (B) input sensitivity to 500 mV/div. - Rotate the channel A (B) Y POS control fully clockwise and anti-clockwise
REQUIREMENT	- Check if the top and the bottom of the signal can be positioned on the vertical centre line of the screen.
MEASURING RESULTS	....
*** SUBJECT**	**Cross talk between channels A and B at 10 MHz**
TEST EQUIPMENT	Sine-wave calibration generator (SG503)
INPUT VOLTAGE	Sine-wave signal 10 MHz, 4 V to input A(B)
SETTINGS	- Set channel A and B to 0,5 V/div. - Apply sine-wave input signal to input A(B) - Set the trace height to 8 div. - Press A/B (channel with input signal off).
REQUIREMENTS	- Check if trace height of channel without input signal B(A) is $< 0{,}08$ div. (1:> 100)
MEASURING RESULTS	....
*** SUBJECT**	**Cross talk between channels A and B at 50 MHz**
TEST EQUIPMENT	HF sine-wave generator (SG503)
INPUT VOLTAGE	50 MHz sine-wave signal, 4 V to input A(B)
SETTINGS	- Do the same settings as indicated above
REQUIREMENTS	- Check if trace height of channel without input signal B(A) is $< 0{,}16$ div. (1:> 50)
MEASURING RESULTS	....

*** SUBJECT**	**Common Mode Rejection Ratio**
TEST EQUIPMENT	HF constant Amplitude sine-wave generator (SG503)
INPUT VOLTAGE	Sine wave signal 1 MHz, 4 Vpp to inputs A and B
SETTINGS	- Set A and B to 500 mV/div. (8 div.) - Set input coupling of channels A and B to DC - Press ADD/INVERT three times (ADD and INVERT on) - Adjust the VAR controls for minimum trace height difference of channel A and B
REQUIREMENT	- Check if the trace height of the A-B signal is < 0,08 div.
MEASURING RESULTS	....
*** SUBJECT**	**LF linearity (vertical)**
TEST EQUIPMENT	LF square-wave generator
INPUT VOLTAGE	Square-wave signal 50 kHz, 200 mV to input A(B)
SETTINGS	- Set A (B) to 100 mV/div. - Set the square-wave signal in the vertical centreof the screen. - Adjust the square-wave signal to exactly 2 div. trace height. - Shift the signal with the Y POS control to the two upper and lower divisions of the screen.
REQUIREMENT	- Check if the trace height in the two upper and lower div. is 2 div. (max. ampl. deviation must be < 3%)
MEASURING RESULTS	....
*** SUBJECT**	**Visual Signal Delay**
TEST EQUIPMENT	Square wave calibration generator (PG506)
INPUT VOLTAGE	Fast-rise input signal 1 MHz, ≤ 1 ns, 0,5 V to input A
SETTINGS	- Apply fast-rise input signal to input A - Press AUTO SET - Set A to 100 mV/div. - Set TB to 50 ns/div. - Press TB MAGN and turn X POS. - Set INTENSITY fully clock-wise. - Set trigger coupling to DC. - Adjust LEVEL for maximum visual signal delay.
REQUIREMENT	- Check if visual signal delay is at least 15 ns
MEASURING RESULTS	....

* SUBJECT	**Base line jump**
TEST EQUIPMENT-	--
INPUT VOLTAGE	--
SETTINGS	Attenuator balance

Attenuator balance

- This check must be done in the service menu OFFS-A.
  To enter this menu proceed as follows:
- Press MENU and keep it pressed and then press AUTO SET.
- Select OFFS-A of CRT function controls.
- Check LCD display: "3.0" flashing.
- The attenuator is now switched between the 1-2-5 positions.
- Check if the base line do not jump more than 1 subdiv.

VAR balance

- Press mV of ch. A UP-DOWN control.
- Check LCD display: "3.1" flashing.
- Rotate VAR control of channel A and B
- Check if the base lines do not jump more than 1 subdiv.

X1/X10 attenuator offset

- Press mV of ch. A UP-DOWN control.
- Check LCD display: "3.2" flashing.
- Check if the base lines do not jump more than 1,5 subdiv.

NORMAL-INVERT jump

- Press mV of ch. A UP-DOWN control four times.
- Check LCD display: "3.6" flashing.
- Check if the displayed point does not jump more than 1 subdiv.
- Press AUTO SET two times to leave the SERVICE MENU

MEASURING RESULTS ....

20.4.3 Horizontal deflection or X-axis
(characteristics section 2.3)

*** SUBJECT**	**OFFSET of trigger point**
TEST EQUIPMENT	--
INPUT VOLTAGE	--
SETTINGS AND REQUIREMENT	- This check must be done in the SERVICE MENU OFFS-A. To enter this menu proceed as follows: - Press MENU and keep it pressed and then press AUTO SET. - Select OFFS-A of CRT function controls. - Press mV of ch. A UP-DOWN control three times. - Check LCD display: "3.3" flashing. - Turn Y POS of channel B and set the point in vertical centre of the screen. - Check if the displayed point does not jump more than 1,5 subdiv horizontally - Press mV of ch. A UP-DOWN control. - Check LCD display: "3.4" flashing. - Turn Y POS of A and set point in the vertical centre - Check if the displayed point does not jump more than 1,5 subdiv. horizontally - Press mV of ch. A UP-DOWN control. - Check LCD display: "3.5" flashing. - Turn Y POS of B and set point in vertical centre - Check if the displayed point does not jump more than 1,5 subdiv. - Press AUTO SET two times to leave the SERVICE MENU
MEASURING RESULTS	....

*** SUBJECT**	**X Deflection**
TEST EQUIPMENT	LF sine-wave generator
INPUT VOLTAGE	Sine wave signal 2 kHz, 3 div. trace height to input A
SETTINGS AND REQUIREMENTS	- Press AUTO SET - Set the trace height to 3 div. - Press X DEFL - Check if only X DEFL is on - Select A of trigger source. - Check if a line under an angle of 45° is displayed.
MEASURING RESULTS	....

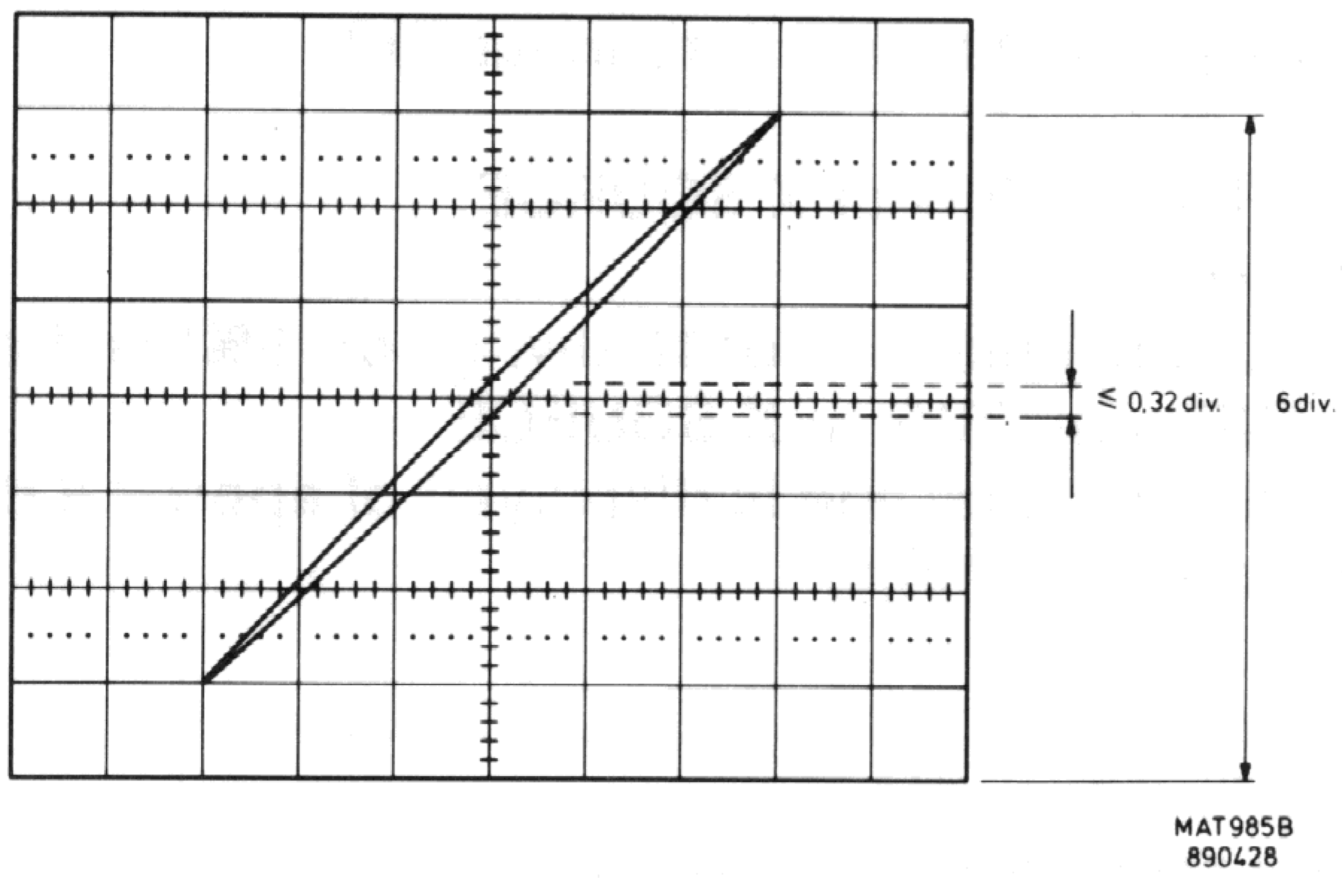
* SUBJECT	**Deflection coefficient**
TEST EQUIPMENT	Time marker generator (TG501)
INPUT VOLTAGE	Time marker signal 50 ns...0,5 s
SETTINGS	- Apply a time marker signal of 50 ns to input A - Press AUTO SET
REQUIREMENT	- Check the deflection coefficients in TB X1 and TB X10 according the table below:

Time marker pulse	TB setting	Max. coeff. error TB X1	TB X10 TB MAGN on	Measuring results
50 ns	50 ns	3%	4%	....
0,1 μs	0,1 μs	3%	4%	....
0,2 μs	0,2 μs	3%	4%	....
0,5 μs	0,5 μs	3%	4%	....
1 μs	1 μs	3%	4%	....
2 μs	2 μs	3%	4%	....
5 μs	5 μs	3%	4%	....
10 μs	10 μs	3%	4%	....
20 μs	20 μs	3%	4%	....
50 μs	50 μs	3%	4%	....
0,1 ms	0,1 ms	3%	4%	....
0,2 ms	0,2 ms	3%	4%	....
0,5 ms	0,5 ms	3%	4%	....
1 ms	1 ms	3%	4%	....
2 ms	2 ms	3%	4%	....
5 ms	5 ms	3%	4%	....
10 ms	10 ms	3%	4%	....
20 ms	20 ms	3%	4%	....
50 ms	50 ms	3%	4%	....
0,1 s	0,1 s	3%	4%	....
0,2 s	0,2 s	3%	4%	....
0,5 s	0,5 s	3%	4%	....

* SUBJECT	**Variable control ratio (VAR TB) and TB Magnifier balance**
TEST EQUIPMENT	Time marker generator (TG501)
INPUT VOLTAGE	Time marker signal 1 μs to input A
SETTINGS	- Set TB to 0,2 μs/div; marker on first and sixth graticule line - Set the TB VAR fully anti-clockwise
REQUIREMENT	- Check if the VAR control range overlaps the time-base steps 0,2 μs to 0,5 μs; first marker on first graticule line and second marker on the third graticule line or closer to the first marker (2,5:1)
SETTINGS	- Set the TB VAR control fully clockwise - Press TB MAGN to on. - Set the top of the first marker pulse exactly in the vertical centre of the graticule - Press TB MAGN to off.

REQUIREMENT	- Check if the top of the second marker pulse is not shifted more than 2,5 subdiv.
MEASURING RESULTS	....
*** SUBJECT**	**Horizontal Deflection coefficients**
TEST EQUIPMENT	Sine wave generator
INPUT VOLTAGE	Sine wave signal 2 kHz, 4 div. trace height to input A
SETTINGS	- Press EXT X DEFL - Press A/B twice for only ch. B display - Select A as X DEFL source with TRIG or X SOURCE
REQUIREMENT	- Check if a horizontal line of 4 div. is displayed (+or- 5%).
INPUT VOLTAGE	- Sine wave signal 2 kHz, 1 V to input EXT
SETTINGS AND REQIREMENTS	- Select EXT with TRIG or X SOURCE - Press X DEFL - Check if a horizontal line of 10 div. (+or- 5%) is displayed. - Select LINE with TRIG or X SOURCE - Check if a horizontal line is displayed of approx 8 div. (at 220 V mains voltage)
MEASURING RESULTS	....
*** SUBJECT**	**Frequency response (horizontal)**
TEST EQUIPMENT	Constant amplitude sine-wave generator (PG506)
INPUT VOLTAGE	Constant amplitude sine-wave signal, 30 mV, 50 kHz...2 MHz to input A
SETTINGS	- Set A to 5 mV/div - Apply a 50 kHz sine-wave signal to input A - Press X DEFL - Select A as horizontal defl. source with TRIG or X SOURCE - Press A/B twice for ch. B as vertical deflection. - Adjust the input voltage for exactly 6 div. horizontal defl. - Increase the frequency of the input signal up to 2 MHz
REQUIREMENTS	- Check if the trace width is at least 4,2 div. (-3 dB) over the complete bandwidth range.
MEASURING RESULTS	....
TEST EQUIPMENT	LF Sine-wave generator
INPUT VOLTAGE	Sine-wave signal, 10 Hz, 6 div. trace height to input A
SETTINGS	- Set the vertical deflection of A to exactly 6 div. - Select X DEFL and A as X DEFL source - Set input coupling A to AC. - Press A/B twice for ch. B as vertical deflection.

REQUIREMENT	- Ensure that the trace width is at least 4.2 div (-3 dB).
MEASURING RESULTS	....
*** SUBJECT**	**Maximum phase shift between horizontal and vertical defl.**
TEST EQUIPMENT	LF sine-wave generator
INPUT VOLTAGE	Sine wave signal, 2 kHz...100 kHz, trace height 6 div.
SETTINGS	- Press X DEFL - Select A for horizontal deflection with TRIG or X SOURCE - Set the trace height to exactly 6 div. - Increase the input frequency up to 100 kHz.
REQUIREMENT	- Check if the phase shift < 3° (see figure below)



MEASURING RESULTS	....

20.4.4 Triggering
(characteristics section 2.4.)

*** SUBJECT**	**Trigger Sources and trigger coupling**
TEST EQUIPMENT	Square-wave generator
INPUT VOLTAGE	Square-wave signal 2 kHz, 4 div. trace height to input A (EXT)
SETTINGS AND REQUIREMENTS	- Set the trace height to 4 div. - Press TRIG COUPL and select DC - Adjust LEVEL for a triggered signal - Check if a square wave signal is displayed of 4 div. - Press TRIG COUPL and select p-p - Turn LEVEL and check if the signal is triggered over the complete level range. - Connect CAL signal to input B - Set B to 200 mV. - Select B as trigger source with TRIG or X SOURCE (A is not triggered) - Check if a square wave of 6 div. is displayed - Increase the freq. of the square-wave signal to input A up to 20 kHz (CAL signal to B) - Press TRIG or X SOURCE four times (A and B selected.) - Check if two well triggered traces are displayed. - Remove input signals

MEASURING RESULTS	....
***SUBJECT**	**Slope selection and Level control range.**
TEST EQUIPMENT	LF Sine-wave generator
INPUT VOLTAGE	Sine-wave signal 2 kHz - 800 mV to input A (B) (EXT)
SETTINGS AND REQUIREMENTS	- Set A(B) to 0,1 V/div (DC input coupling) - Press TRIG COUPL for p-p triggering - Turn LEVEL fully clockwise and fully anti- clockwise - Check if the signal is well triggered over the complete LEVEL range - Set the LEVEL control in its mid-position - Start of signal display must be in the vertical centre - Press TB TRIG (TRIG mode) - Press SLOPE - Check if the sine-wave signal is inverted and is triggered on the negative slope. - Press SLOPE once again - Press TRIG COUPL for DC coupling. - Set A(B) to 50 mV/div (16 div. trace height) - Turn the LEVEL - Check if the LEVEL range is > +or- 8 div. and if the signal is triggered on the positive slope. - Remove input signal
MEASURING RESULTS	....
*** SUBJECT**	**Trigger Sensitivity**
TEST EQUIPMENT	Sine-wave generator (SG503)
INPUT VOLTAGE	Sine-wave signal 10 MHz-(50 MHz)-(100 MHz) to input A (B) (EXT)
SETTINGS AND REQUIREMENTS	- Press AC/DC (input coupling of A(B) to DC) - Press TB TRIG MODE for TRIG mode - Press TRIG COUPL for DC trigger coupling - Apply a sine-wave signal of 10 MHz approx., 250 mVpp to input A(B) - Set A(B) to 0,2 V/div. - Decrease amplitude of input signal - Turn LEVEL - Check if the signal is well-triggered at amplitudes ≥ 0,5 div. - Decrease the frequency of the input signal to 50 kHz - Check if the signal stays well-triggered at amplitudes ≥ 0,5 div. - Increase the frequency of the input signal up to 50 MHz. - Increase amplitude of input signal to approx 1 div. - Turn LEVEL - Check if the signal is well-triggered at amplitudes ≥ 1 div. - Increase the frequency of the input signal up to 100 MHz - Increase amplitude to approx 3 div. - Check if the signal is well-triggered at amplitudes ≥ 3 div. - Remove input signal
MEASURING RESULTS	....

* SUBJECT	**Trigger sensitivity TVL-TVF**
TEST EQUIPMENT	TV pattern generator with video output (PM5518)
INPUT VOLTAGE	Video signal to input A (B)
SETTINGS	- Press TB TRIG mode for TRIG mode - Press AC/DC for DC input coupling - Apply a video signal to input A(B) with an amplitude of 0,7 div. sync. pulse amplitude - Press TRIG COUPL for TVL and TVF
REQUIREMENTS	- Check for a stable triggering on TVL and TVF at sync. amplitudes of 0,7 div.
MEASURING RESULTS	....

20.4.5 Cursors
(characteristics section 2.13)

* SUBJECT	**Voltage cursor accuracy**
TEST EQUIPMENT	SQ. wave calibration generator
SETTINGS	- Apply a sq. wave voltage of 1 Vpp to the ch. A input. - Set A to 200 mV/div. - Press DIGITAL MEMORY - Press LOCK. - Select CURSORS of CRT function controls. - Position the 1st cursor in the horizontal mid of top of the waveform. - Position the 2nd cursor in the horizontal mid of bottom of the waveform.
REQUIREMENT	Check for a voltage cursor read-out at the top of the screen of 1.00 V + or - 30 mV.
MEASURING RESULTS	....
* SUBJECT	**Time cursor accuracy**
TEST EQUIPMENT	Time marker generator
SETTINGS	- Apply an 1 ms time marker signal to the ch. A input. - Press DIGITAL MEMORY. - Set TB to 1 ms/div. - Press LOCK. - Select CURSORS of CRT function controls. - Position the 1st cursor and the 2nd cursor so that they cover a distance of 8 time marker intervals.
REQUIREMENT	Check for a time cursor read-out of 8.00 ms, + or - 0,0016 ms.
MEASURING RESULTS	....

20.4.6 Auxiliary inputs and outputs
(characteristics section 2.16)

*** SUBJECT**	**Z-MOD Sensitivity**
TEST EQUIPMENT	Square-wave generator
INPUT VOLTAGE	Square-wave signal, 1 kHz, duty cycle 50%, amplitude 0...5 Vpp to input A and Z-in (rear side)
SETTINGS AND REQUIREMENTS	- Set TB to 0,5 ms/div. - Set the trace of A in mid-position - Select DC for channel A input coupling - Apply square-wave signal of 2,5 Vpp, 1 kHz to input A and Z-MOD input. (base line 0 V) - Check if only the bottom half of the square wave signal is displayed (500 μs blanking and 500 μs unblanking) - Decrease the amplitude of the input signal to 1 Vpp. - Set A to 0,5 V/div. - Check if the top half of the square-wave signal is visible with a lower intensity and will be completely unblanked at an input voltage of < 0,8 V
MEASURING RESULTS	....
*** SUBJECT**	**CAL Frequency and output voltage**
TEST EQUIPMENT-	--
INPUT VOLTAGE	CAL output signal to input A
SETTINGS	- Press 0 of channel A - Set the trace in the centre of the screen - Press 0 of channel A - Select DC of A input coupling
REQUIREMENTS	- Check if a positive going square wave signal is displayed of 1,2 Vpp, frequency 2 kHz
MEASURING RESULTS	....

21 DISMANTLING THE INSTRUMENT

21.1 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 during assembly.

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.**

21.2 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.

21.3 ACCESS TO THE ADJUSTING ELEMENTS

After removing both covers (section 21.2), the P^2CCD unit and the time base unit have to fix vertically in the chassis.

NOTE: To avoid damage of the flatcables, the metal bracket that fixes the P^2CCD unit have to be removed from the chassis first. Then you can easily fix the P^2CCD unit vertically in the chassis.

Next the digital unit (A10 ... A15) has to be removed out of the instrument. It can be placed beside the instrument using the metal cover as a bottom plate. The four already existing holes in this cover must be used to position the digital unit in this place.

If necessary, the power supply unit can be lifted out of the instrument. To do so, proceed as follows:

- Push both parts at the back of the extension shaft towards each other, so that the extension shaft can easily be loosened from the ON/OFF switch on the power supply unit.
- Remove the complete extension shaft.
- Push both lips that secure the power supply unit sidewards and gently lift this unit out of the instrument.
- Fix the power supply unit in the available p.c.b. guide fixing.

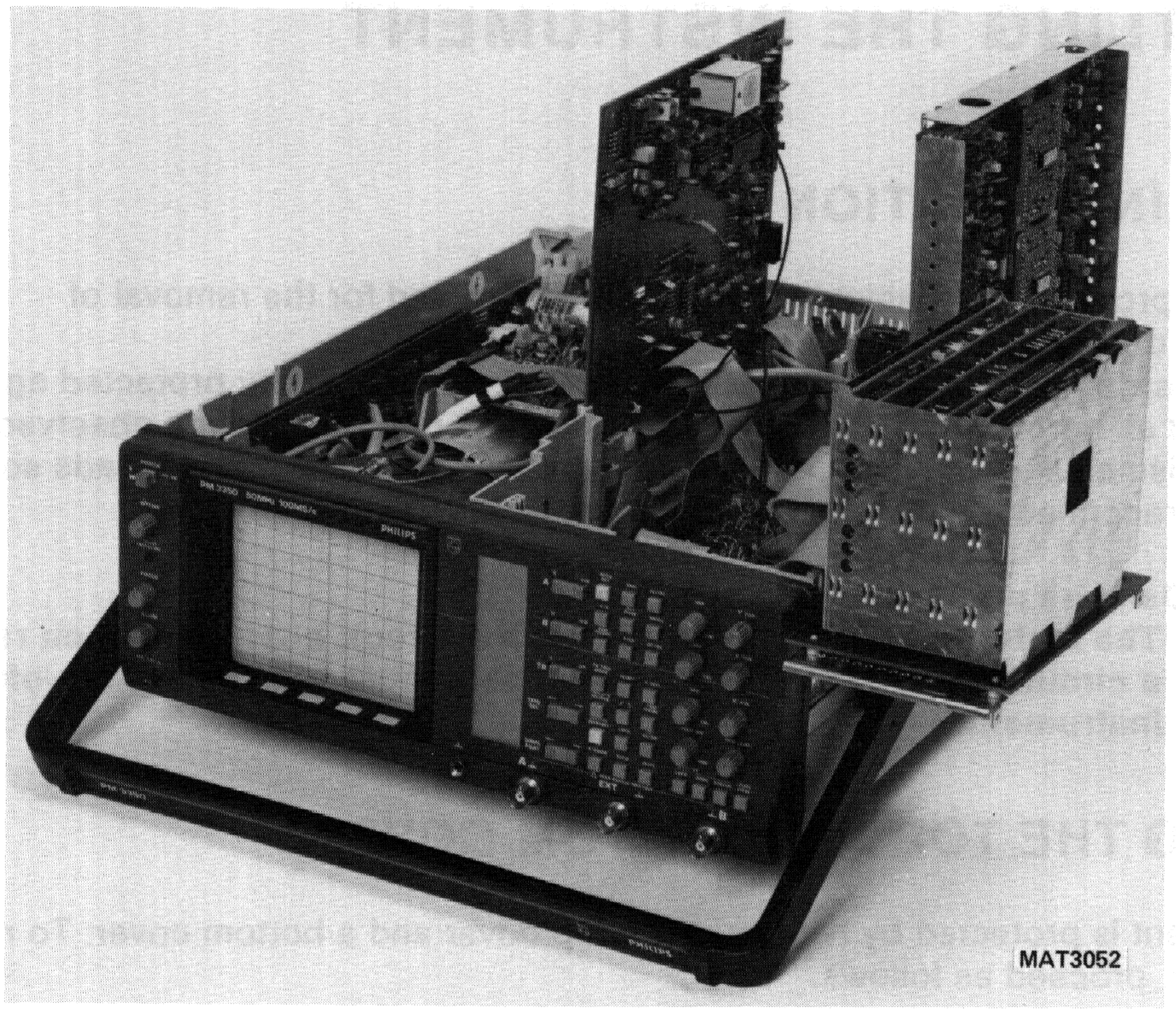


Figure 21.1 Access to all parts for checking and adjusting

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

22 CHECKING AND ADJUSTING

22.1 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.

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.

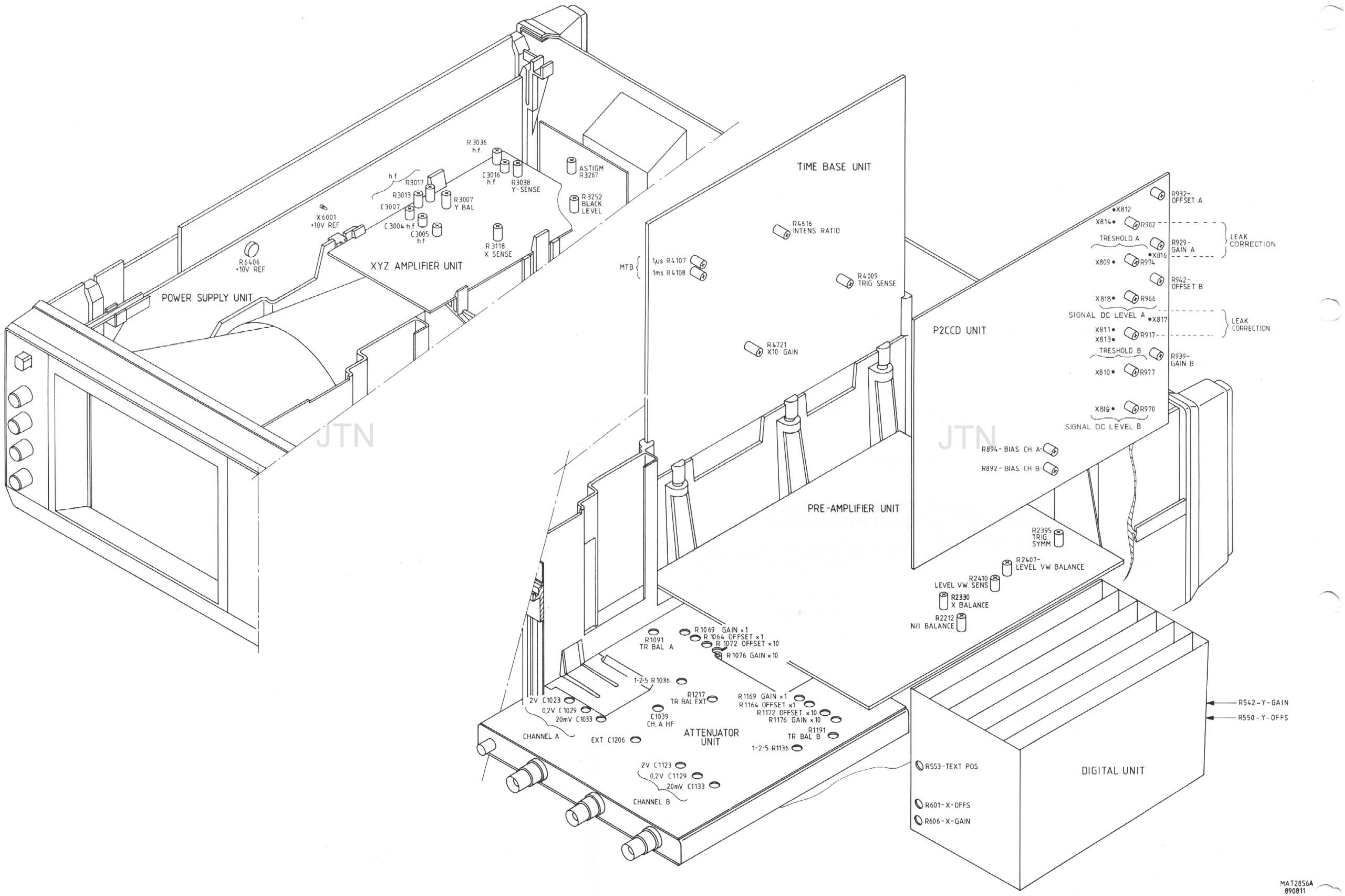
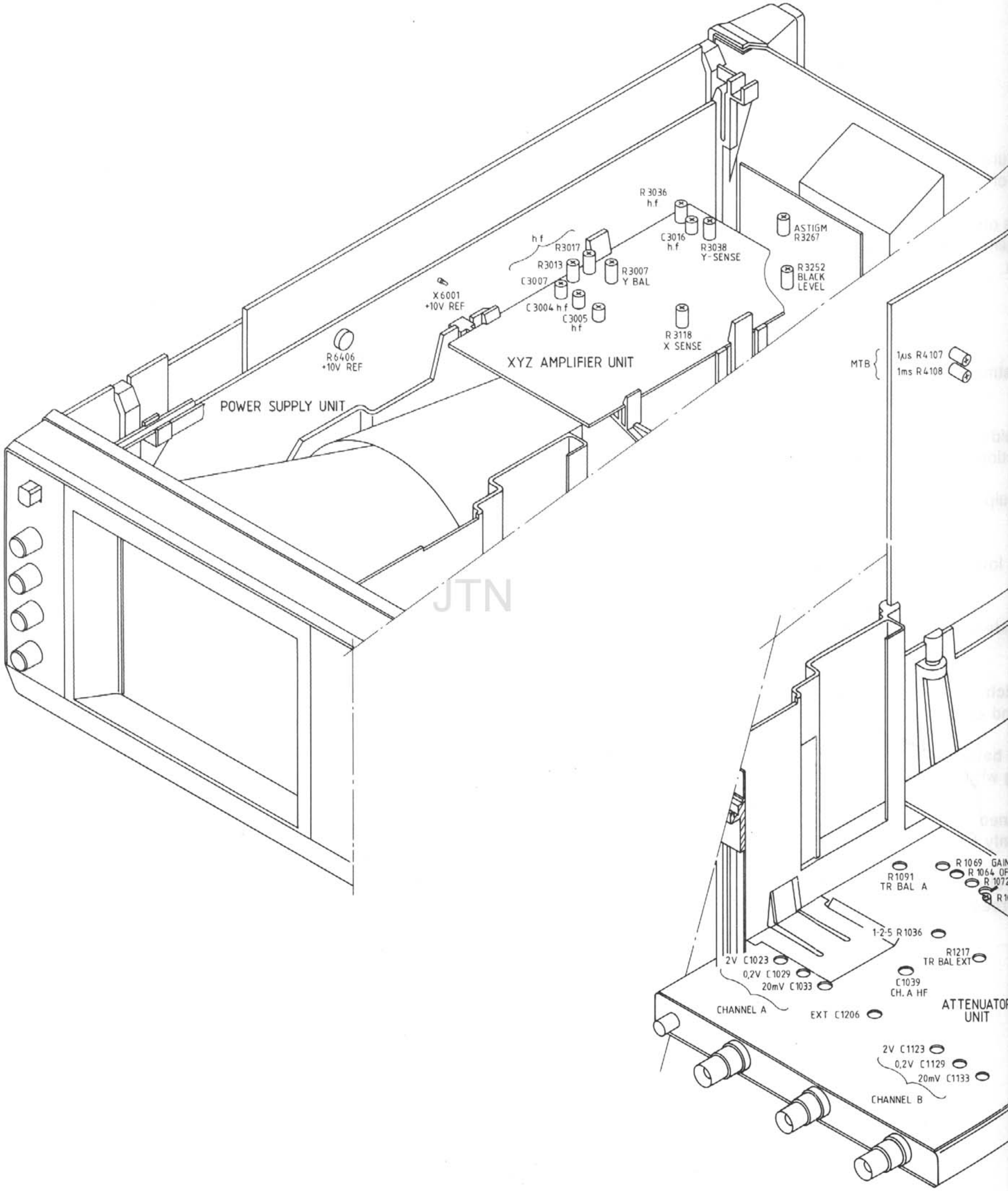


Figure 22.1 Adjusting elements


R 3036
h.f
h.f
R3017
R3013
C3007
C3004 h.f
C3005
h.f
R3007
Y BAL
C3016
h.f
R3038
Y-SENSE
ASTIGM
R3267
R 3252
BLACK
LEVEL
R 3118
X SENSE
X 6001
+10V REF
R 6406
+10V REF
XYZ AMPLIFIER UNIT
POWER SUPPLY UNIT
MTB
1μs R4107
1ms R4108
R 1069
R 1064
R1091
TR BAL A
1-2-5 R1036
R1217
TR BAL EXT
2V C1023
0,2V C1029
20mV C1033
CHANNEL A
C1039
CH. A HF
EXT C1206
ATTENUATOR
UNIT
2V C1123
0,2V C1129
20mV C1133
CHANNEL B

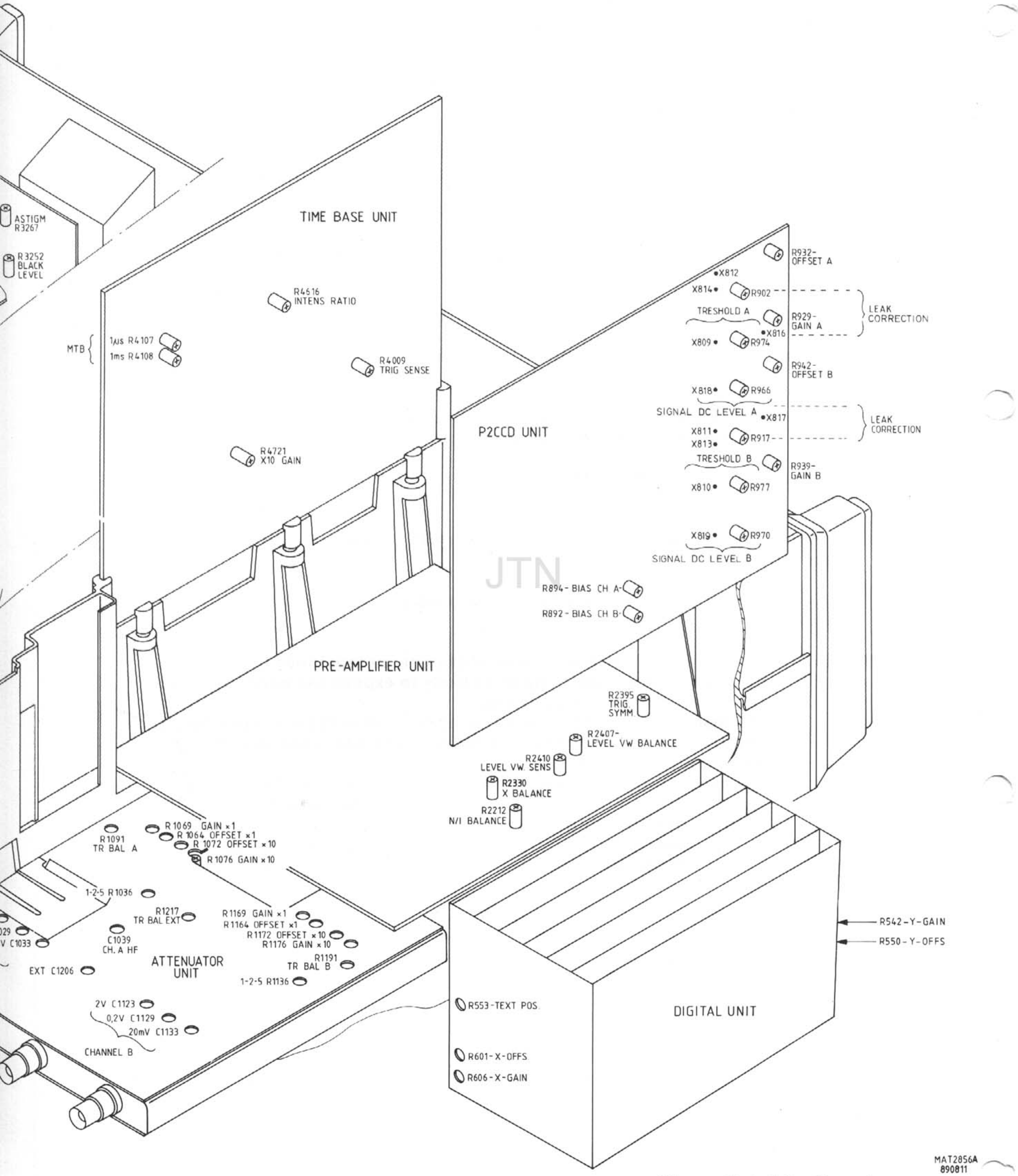


Figure 22.1 Adjusting elements

22.2 RECOMMENDED TEST AND CALIBRATION EQUIPMENT

Type of instrument	Required specification	Example of recommended instrument
Function generator	Freq.: 1 MHz ... 10 MHz Sine-wave/Square-wave Ampl.0...20 Vpp DC offset 0...± 5 V Rise-time ≤ 30 ns Duty cycle 50 %	Philips PM5134
Constant amplitude sine-wave generator	Freq.: 100 kHz ... 50 MHz Const. ampl. of 120 mVpp and 3 Vpp	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 mV ... 500 mV Rise-time: ≤ 1 ns	Tektronox PG 506
Time-marker generator	Repetition rate: 0,5 s ... 0,05 μs	Tektronix TG 501
Digital multimeter	Wide voltage, current and resistance ranges.High-voltage probe required, accuracy 0,1% PM9246	Philips PM2524
Oscilloscope	The bandwidth must be the same or higher than the bandwidth of the instrument under test.	Philips PM3055
Variable mains tranformer	Well-insulated output voltage 90...264 Vac	Philips ord.number 2422 529 00005
Moving-iron meter		
Dummy probe 2:1	1 MΩ ± 0,1 %//20 pF	
Cables, T-piece, 10:1 attenuator, terminations for the generators	General Radio types for fast rise-time square-wave and high freq. sine-wave. BNC-types for other applications	
Trimming tool kit		Philips 800NTX (ordering number 4822 310 50015)

22.3 SURVEY OF ADJUSTING ELEMENTS

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
POWER SUPPLY (see section 22.4.2)				
+10 V supply	R6406 X6001	power supply	digital voltm.	10 V (± 10 mV)
CRT DISPLAY (see section 22.4.3)				
pre adjustment	R4616	time base	--	mid position
black level line parr.	R3252	CRT socket	--	INTENS 10° from c.c.w. spot just not visible
TRACE ROTATION	front	--	--	graticule
Astimatism	R3267	CRT socket	function generator 1 kHz/6 div. sine wave	well defined trace
GAIN, LF S.Q. WAVE (see sections 22.4.4 and 22.4.5)				
EXT input	C1206	atten. unit	calibrated sq. wave: 0,5 V/ 1 kHz	dots at beginning and end of line
	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.

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
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.
	C1129	atten. unit	calibrated sq. wave: 1 V/ 1 kHz	Straight pulse top at A sens. 0,2 V/div.
	C1132	atten. unit	calibrated sq. wave: 10 V/ 1 kHz	Straight pulse top at A sens. 2 V/div.
OFFSET (see section 22.4.6)				
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	preamplifier	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
TRIGGERING (see section 22.4.7)				
trigg.symmetry	R2395	preamplifier	sine-wave to A	max. symmetry
trigger gap	R4009	time base	4 V/1 kHz	min. gap
trigg.symmetry	R2395	preamplifier	sine-wave to A	max. symmetry
trigger gap	R4009	time base	0,4 V/1 kHz	min. gap
LEVEL preset	R2410	preamplifier	sine-wave to A 8 V/1 kHz	LEVEL pos. such that does not move when turning R2410

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
LEVEL VIEW balance	R2407	preamplifier	sine-wave to A 8 V/1 kHz	min. jump between LEVEL VIEW on/off.
LEVEL VIEW sensitivity	R2410	preamplifier	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 22.4.8)				
sweep speed: 1 ms/div.	R4108	time base	time markers: 1 ms	max. accuracy between 2nd and 10th graticule line
1 μs/div.	R4107	time base	1 μs	max. accuracy between 2nd and 10th graticule line
X MAGN and 0,1 ms/div.	R4721	time base	0,1 μs	max. accuracy between 2nd and 10th graticule line
HF SQ. WAVE (see section 22.4.9)				
cross talk A,B	R3017	XYZ-ampl.	fast-rise sq. wave: 100 mV/ 10 kHz	minimal cross-talk
pulse response A (B)	R3013	XYZ-ampl.	100 mV/ 1 MHz	A sens: 20 mV/div.
	C3007	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	R3017	XYZ-ampl.	100 mV/ 1 MHz	
	C3004	XYZ-ampl.	100 mV/ 1 MHz	A sens: 20 mV/div.
	C3005	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	C3016	XYZ-ampl.	100 mV/ 1 MHz	X MAGN on
	R3036	XYZ-ampl.	100 mV/ 1 MHz	

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
Pulse response channel A	C1039	attenuator unit	100 mV/1 MHz	Make channel A equal to B
P^2CCD ADJUST (see section 22.4.10)				DIGITAL MEMORY
Treshold A	R974, X809	P^2CCD unit	digital voltm.	6 V d.c
Treshold B	R977, X810	P^2CCD unit	digital voltm.	6 V d.c
Bias charge A	R894	P^2CCD unit	digital voltm.	43,3 V
Bias charge B	R892	P^2CCD unit	digital voltm.	43,3 V
Signal DC level A	R966, X811 X812	P^2CCD unit	measuring oscilloscope	300 mV d.c.
Signal DC level B	R970, X813 X814	P^2CCD unit	measuring oscilloscope	300 mV d.c.
Leakage corr. A	R902, X816	P^2CCD unit	measuring oscilloscope	line
Leakage corr. B	R917, X817	P^2CCD unit	measuring oscilloscope	line
DISPLAY SECTION (see section 22.4.11)			service menu DISPLAY	DIGITAL MEMORY on
Y-offset	R550	digital unit	step 1	display vertical mid
Y-gain	R542	digital unit	step 2	6 div. vertical
X-offset	R601	digital unit	step 3	display horizontal mid
X-gain	R606	digital unit	step 4	10 div. horizontal
Text position	R553	digital unit	step 5	text in horizontal mid

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
GAIN OFFSET (see section 22.4.12)				
Offset A	R932	digital unit	--	Position 2,5 divisions downwards with DIGITAL MEMORY on
Gain A	R929	digital unit	calibrated sq. wave: 100 mV/ 1 kHz	A sens.: 20 mV/div. 5 div. deflection
Offset A	R932	digital unit	--	Position vertical mid with DIGITAL MEMORY on
Offset B	R942	digital unit	--	Position 2,5 divisions downwards with DIGITAL MEMORY on
Gain B	R939	digital unit	calibrated sq. wave: 100 mV/ 1 kHz	B sens.: 20 mV/div 5 div. deflection
Offset B	R942	digital unit	--	Position vertical mid with DIGITAL MEMORY on
Invert offset	R896	digital unit	--	Position trace in vertical mid with INVERT on.

22.4 CHECKING AND ADJUSTING PROCEDURE

The adjusting elements and measuring points are given in figure 22.1.

NOTE: Use always an insulated adjustment tool.

22.4.1 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.
- 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 time base unit and the power supply unit, proceed as indicated in section 21.3.

ATTENTION: Do not readjust potentiometer R2395, situated on the Pre-amplifier unit. However, if this potentiometer is inadvertently turned, proceed as follows:
- Set R2395 in its mid-position.
- Readjust R4009 according to section 22.4.7.

22.4.2 Power supply adjustment

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

22.4.3 CRT display adjustment

Black level:
- Press X DEFL key.
- Set the INTENS control to 10° from its left hand stop.
- Set R4616 in its mid position.
- Adjust R3252 so that the spot is just not visible.

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:
- Apply a 120 mV/1 kHz sine-wave signal to input A.
- Press AUTO SET key.
- Set the INTENS control for normal brightness.
- Adjust R3267 (and the FOCUS control) so that the trace is sharp and well-defined over the whole screen area.

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

Adjustments on attenuator unit, unless otherwise indicated.

Input EXT:
- Press MENU and then AUTO SET.
- Press X DEFL.
- Select TRIG SOURCE "EXT".
- Select TRIG COUPL "DC".
- EXT input signal: calibrated sq.wave 0,5 V/1 kHz.
- Adjust C1206 for equal dots at beginning and end of horizontal line.
- Adjust R3118 on XYZ-amplifier for 5 div. horizontal deflection (+ or -0,1 div.).

Input A:
- Select TRIG SOURCE "B".
- 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.

22.4.5 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 MENU and then AUTO SET.
- 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	Input sensitivity	Adjusting elements	
channel A(B)	channel A(B)	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)	--

22.4.6 Offset channel A(B)

Service menu:

- Y POS A (B) controls: mid-position.
- Press MENU and keep it pressed. Then press AUTO SET in order to reach 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 for the input sensitivities.
- 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 1-10 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 Y bal.	R3007	0,2 div.	on pre amplifier Minimise jump with TRIG LEVEL. Centre line with R3007.

- Press AUTO SET to leave the service menu.

22.4.7 Triggering

Adjustments on preamplifier unless otherwise noted.

- Press MENU and then AUTO SET.
- Channel A input signal: 0,4 V/1 kHz sine-wave.
- TRIGGER LEVEL: mid position.
- Trigger slope pushbutton must be continuously switched.
- Adjust R4009 (time base) for a well triggered display.

- Channel A input signal: 8 V/1 kHz sine-wave.
- Select TRIGGER COUPL "DC".
- Press LEVEL VIEW.
- Put TRIG LEVEL in such a position that line does not move when turning R2410 between its utmost positions. Keep TRIG LEVEL in this position.

- Switch LEVEL VIEW off.
- Time base sweep speed: 50 ns/div.
- INTENS control: fully clockwise.
- Adjust R2407 for minimal trace jump (+ or - 0,4 div. max) when switching LEVEL VIEW on and off.

- Switch LEVEL VIEW on.
- Shift the line with TRIG LEVEL 3 div. upwards or downwards from its present situation (within graticule).
- Adjust R2410 for minimal trace jump (+ or - 0,2 div. max) when switching LEVEL VIEW on and off.
- Remove the input signal.

22.4.8 Time-base sweep speeds

Adjustments on time-base unit.

- Press MENU and keep it pressed. Then press AUTO SET.
- Select TRIG COUPL "DC".
- Channel A input signal: time marker pulse 1 ms.
- 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 μs.
- Time base sweep speed: 1 μs/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.

22.4.9 HF sq.wave response

Adjustments on XYZ-amplifier.

- Press MENU and keep it pressed. Then press AUTO SET.
- Channel A input signal: fast rise time sq.wave 10 kHz/100 mV/rise time $\leq$ 1 ns via external 10:1 attenuator and 50 ohm termination resistor.
- Select channel A and B for vertical display.
- Channel A and B input sensitivity: 10 mV/div.
- Time base sweep speed: 50 μs/div.
- Adjust R3017 for minimal cross-talk from channel A into B (max. interference on B 0,05 div.).

- Select channel B for vertical display and TRIGGER SOURCE.
- Channel B input signal: increase frequency to 1 MHz. Adjust the generator's output voltage for 5 div. vertical deflection.
- Channel B input sensitivity: 20 mV/div.

- Adjust R3013 and C3007 for a pulse top as flat as possible. Also small readjustment of R3017 may be necessary: however bear in mind that R3017 also influences the crosstalk.

- Press X MAGN for *10.
- Adjust C3004, C3005, C3016 and R3036 for a pulse top as flat as possible.

- Select channel A for vertical display and TRIGGER SOURCE.
- Channel A input signal: frequency = 1 MHz. Generator's output voltage is set for 5 div. vertical deflection.
- Channel A input sensitivity: 20 mV/div.
- Press X MAGN for *1.

- Make the pulse response of channel A as much as possible equal to that of channel B with C1039 on the attenuator unit.

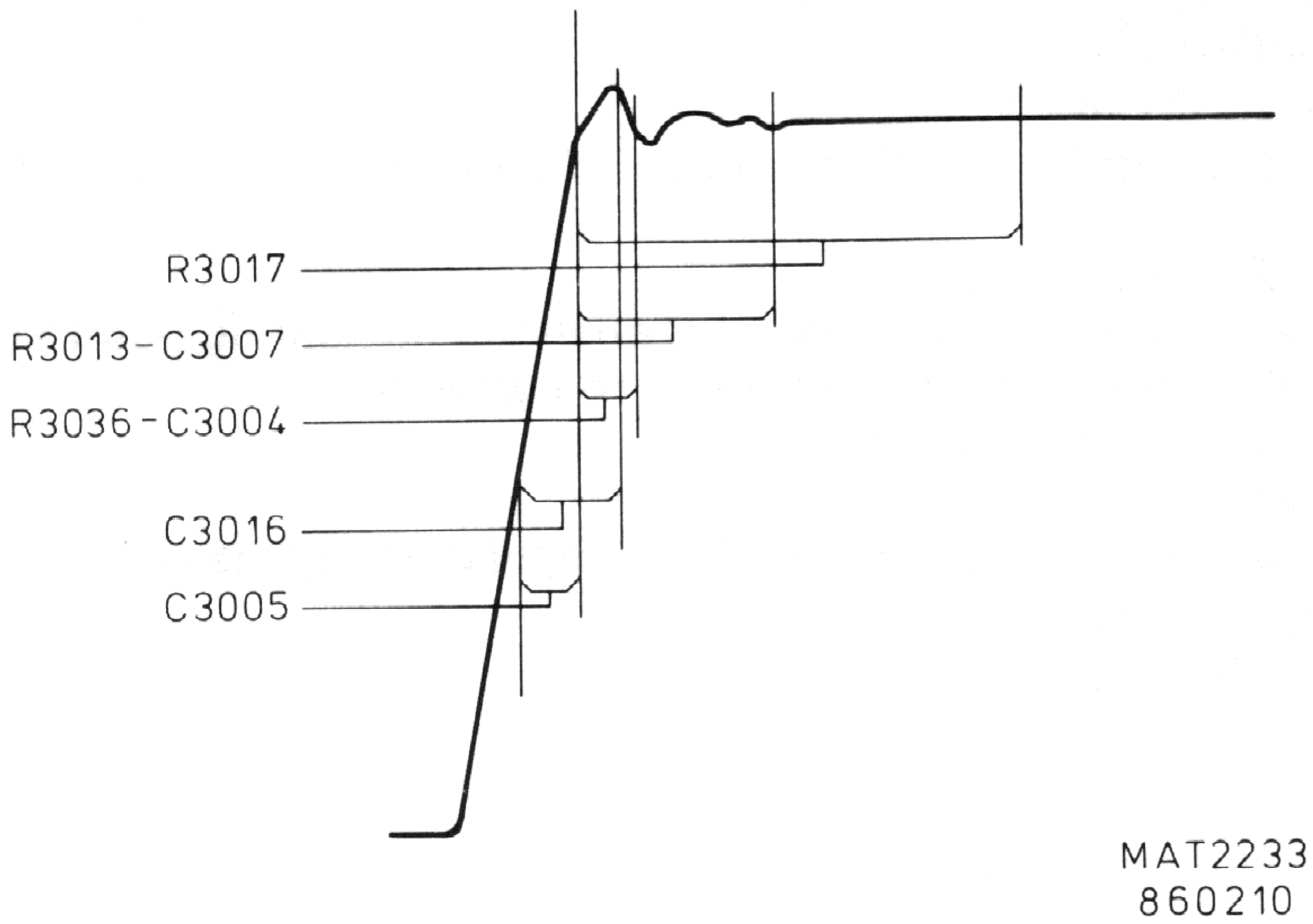


Figure 22.2 Square-wave response

- Check that the pulse via channel A has a rise-time of ≤ 7 ns and that pulse abberations are ≤ 0,2 div. peak-to-peak. Tilt must not exceed + or - 0,1 div.

22.4.10 P²CCD-adjustment (DIGITAL mode)

Adjustments located on P²CCD-unit.

Treshold A (B):
- Switch DIGITAL MEMORY on.
- Select channel A and B for vertical display.
- Y POS A and Y POS B must stay in mid position during the adjustments in this chapter.
- Adjust the d.c. voltage between measuring point X809 (X810) and earth to 6 V (+ or - 100 mV) with R974 (R977).

Bias charge A (B):
- Adjust the d.c. voltage between connector point 2 of A17 of ch. A (ch. B) and earth to 43,3 V (+ or - 0,1 V) with R894 (R892).

Linearity A (B):
- Press MENU and then AUTO SET.
- Select channel A and B for vertical display.
- Switch DIGITAL MEMORY on.
- Channel A and B sensitivity: 0,1 V/div.
- Connect a measuring oscilloscope with a.c. coupled input to measuring point X812 (X814) and earth.
- Channel A (B) input coupling: GND.
- Adjust R966 (R970) so that the the voltage V between the measuring point X812 (X814) and earth is 300 mV (+ or - 30 mV). Refer to figure 22.3.
- Channel A (B) input signal: triangular 1 V/1 kHz.
- Channel A (B) input coupling: DC.
- Check with the measuring oscilloscope that the triangular voltage is visible in the bottom level of the measured signal.
- Disconnect the input signal.

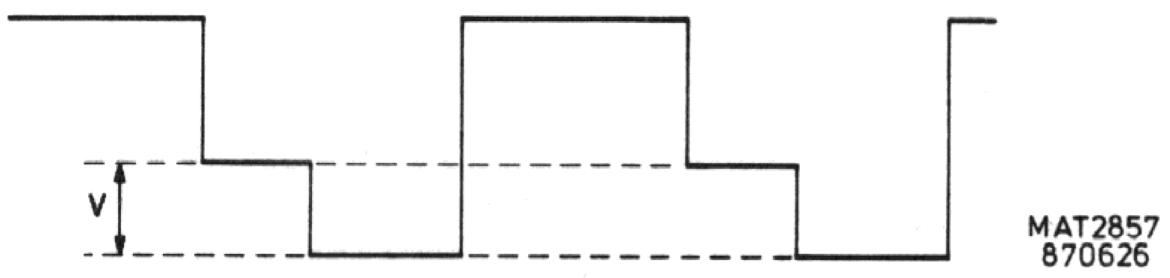


Figure 22.3 Linearity adjustments

Leakage correction:
- Channel A (B) input signal: square wave 800 mV/1 kHz.
- Connect a measuring oscilloscope with a.c. coupled input to measuring point X816 (X817) and earth.
- Adjust R902 (R917) so that the square wave signal has become a line.
- Remove input signal.

22.4.11 Display section adjustments

All adjustments are located on the front unit, unless otherwise noted.

DAC and text adjustments:
- Press MENU and then AUTO SET.
- Adjust X POS so that trace starts at first vertical graticule line.
- Press MENU and keep it pressed. Then press AUTO SET in order to reach Service menu.
- Press CRT softkey DISPLAY.
  The CRT now shows the picture as given in figure 24.4.
- Adjust INTENS and FOCUS for a good display.

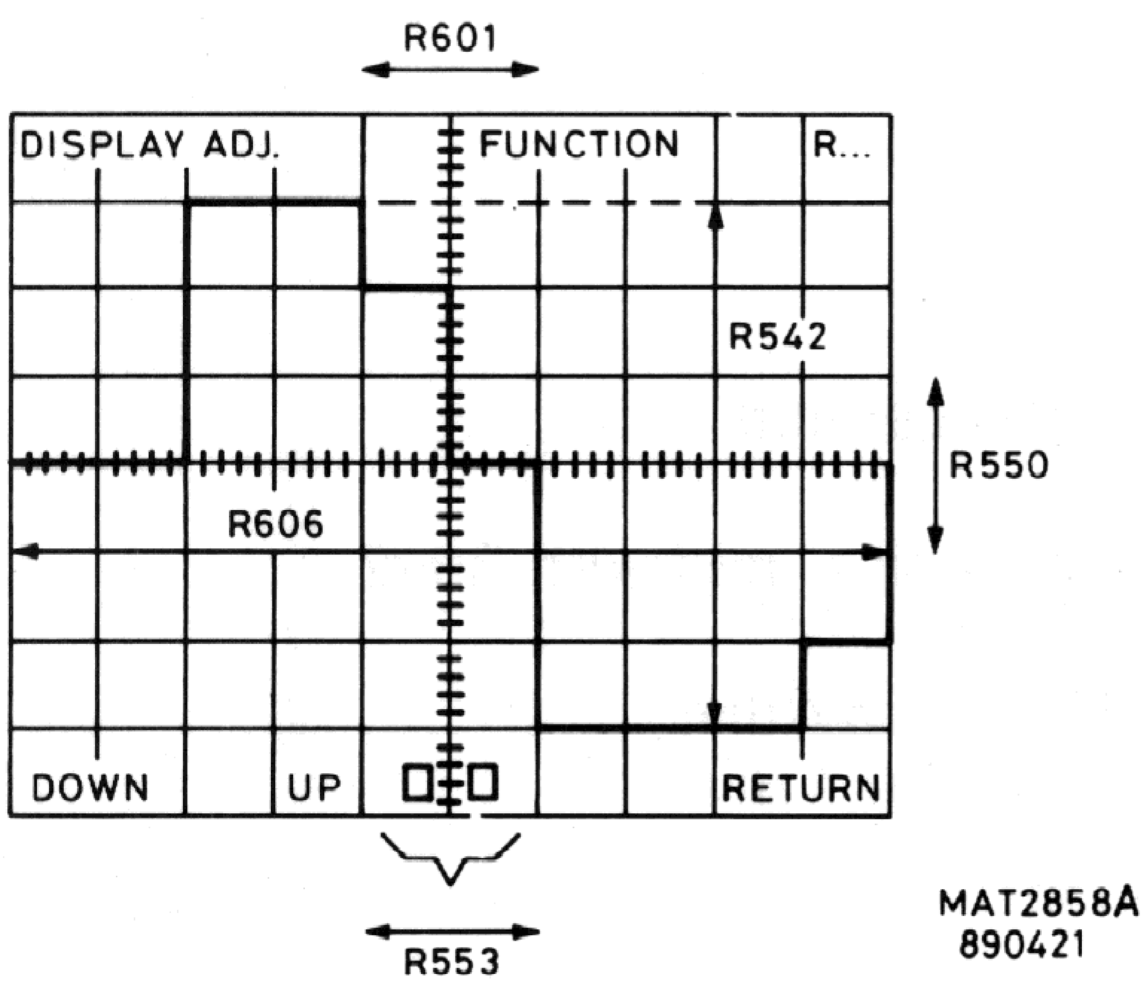


Figure 22.4 DAC and text adjustments

- Do the adjustments steps describe in the table:

Step	Adjustment	Requirement
1	R550, Y-offset	display in vertical mid (+ or - 0,07 div.)
2	R542, Y-gain	6 div. pk-to-pk, + or - 0,07 div.
3	R601, X-offset	display horizontal mid (+ or - 0,2 div.)
4	R606, X-gain	10 div. pk-to-pk, + or - 0,12 div.
5	R553, text pos.	text in horizontal mid, + or - 0,2 div.

- Press AUTO SET to leave the service menu.

22.4.12 Gain and offset channel A (B)

All adjustments located on P^2CCD-unit.

For channel A:
- Press MENU and then AUTO SET.
- Channel A sensitivity: 20 mV/div.
- Channel A coupling: GND.
- Adjust Y POS A 2,5 div. downwards from vertical mid.
- Switch DIGITAL MEMORY on.
- Position the trace 2,5 div. downwards from vertical mid with R932.

- Channel A coupling: switch GND off.
- Channel A input signal: calibrated sq.wave 100 mV/div.
- Adjust R929 to 5 div. vertical deflection (+ or - 0,1 div.).
- Channel A coupling: GND.
- Switch DIGITAL MEMORY off.
- Position the trace in vertical mid.
- Switch DIGITAL MEMORY on.
- Position the trace in vertical mid of screen with R932 (+ or - 0,2 div.).
- Remove input signal.

For channel B:

- Press MENU and then AUTO SET.
- Vertical display and TRIG SOURCE: B.
- Channel B sensitivity: 20 mV/div.
- Channel B coupling: GND.
- Adjust Y POS B 2,5 div. downwards from vertical mid.
- Switch DIGITAL MEMORY on.
- Position the trace 2,5 div. downwards from vertical mid with R942.
- Channel B coupling: switch GND off.
- Channel B input signal: calibrated sq.wave 100 mV/div.
- Adjust R939 to 5 div. vertical deflection (+ or - 0,1 div.).
- Channel B coupling: GND.
- Switch DIGITAL MEMORY off.
- Position the trace in vertical mid.
- Switch DIGITAL MEMORY on.
- Position the trace in vertical mid of screen with R942 (+ or - 0,2 div.).

- Switch the INVERT mode on.
- Position the trace in vertical mid of screen with R896.
- Remove input signal.

23 CORRECTIVE MAINTENANCE

23.1 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.

23.1.1 Standard parts

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

NOTE: Physical size and shape of a componenent 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.

23.1.2 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 organisation of representative.

23.1.3 Transistors and Integrated Circuits

- Return transistors and IC's to their original positions, if removed during routine maintenance.
- Do not renew or switch semi-conductor 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.

23.1.4 Static-sensitive components

This instrument contains electrical components that are susceptible to damage from static discharge. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

23.1.5 Handling MOS devices

Though all our MOS integrated circuits incorporate protection against electrostatic discharges, they can nevertheless be damaged by accidental over-voltages. In storing and handling them, the following precautions are recommended.

CAUTION: Testing or handling and mounting calls for special attention regarding personal safety. Personnel handling MOS devices should normally be connected to ground via a resistor.

23.1.5.1 Storage and transport

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

23.1.5.2 Testing or handling

Work on a conductive surface (e.g. metal table top) when testing the circuits or transfering them from one carrier to another. Electrically connect the person doing the testing or handling to the conductive surface, for example by a metal bracelet and a conductive cord to a chain. Connect all testing and handling equipment to the same surface. Signals should not be applied to the same surface. Signals should not be applied to the inputs while the device power supply is off. All unused input leads should be connected either to the supply voltage or to ground.

23.1.5.3 Mounting

Mount MOS 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 electrical (ground) potential.
If it is impossible to ground the printed-circuit board, the person mounting the circuits should touch the board before bringing the MOS circuits into contact with it.

23.1.5.4 Soldering

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

23.1.5.5 Static charges

Dress personnel in clothing of non-electrostatic material (no wool, silk or synthetic fibres). After the MOS circuits have been mounted, the proper handling precautions should still 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 extension 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.

23.1.5.6 Transient voltages

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

23.1.5.7 *Voltage surges*

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

23.1.6 Soldering and desoldering of surface mounted devices

23.1.6.1 *Introduction*

This description gives you a method for replacing surface mounted devices (SMD's) and incorporates subjects such as:

- required tools and materials.
- how to arrange the S.M.D.-workshop. (see figure 23.1).
- general hints for S.M.D.-handling.
- interchanging S.M.D.'s.

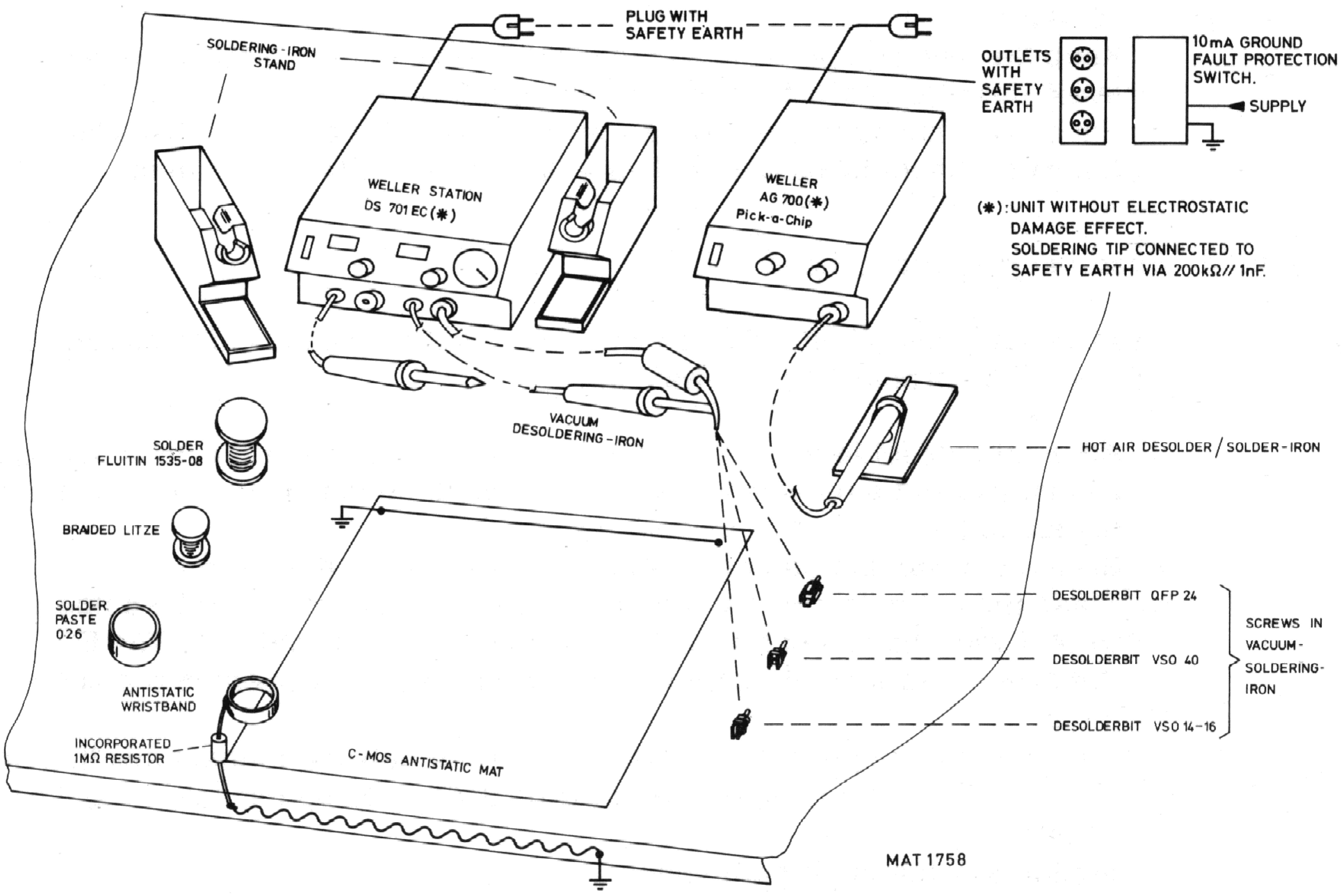


Figure 23.1 Arrangement of working area for SMD exchange and MOS device

23.1.6.2 *Required tools and materials*

The following tools are necessary:

- A hot-air soldering/desoldering station for components with two or three leads: Weller AG 700 pick-a-chip.
- A vacuum, temperature controlled, soldering/desoldering station for components with four or more connections: Weller DS 701 EC.
- Desoldering accessories that can be attached to the Weller DS 701 EC-equipment: for dual-in-line S.M.D.'s VSO 40 (with 40 connections such as used on the LCD-unit) the type with Weller ordering code 587 13 703.
- A working area that has been secured against electro static discharge (E.S.D.).
- A pair of tweezers.

NOTE: The Weller equipment can be ordered via your local Weller-dealer.

The following material is necessary:

- "Fluittin" solder diameter of 0,8 mm, 15/35, Sn Pb 60.
- Solder paste 026.
- Components. Since not all the components are marked, they must be kept in their original packing in order to avoid interchanging them.
- Desoldering braided wire.

23.1.6.3 *General hints for s.m.d.-mounting*

- Protection against E.S.D.: since the working area must be suitable for repair of MOS-devices, some precautions must be taken (see figure 23.1). All repairs must be done earthened which means that the repair surface, the soldering iron and the technician must be connected to the earth potential. This is achieved by using a C-MOS antistatic mat that must be connected to earth. The service- technician is connected to earth by wearing an antistatic wristband.
- Components: desoldered components cannot be used again since desoldering is done at a temperature of 350° C while they can only whitstand 240° Celcius for max. 10 sec.
- Keep the new components as long as possible in their original packing in order to avoid damage and mixing up new and old S.M.D.'s.
- For an optimal supply of heat a working area must be used, that does not lead away the heat: the antistatic mat in figure 23.1. meets this requirement.

23.1.6.4 *Interchanging the s.m.d.'s*

Use the equipment Weller DS 701 EC and attach the suitable desoldering piece for VSO 40. Then proceed as follows:

- Adjust the desoldering temperature to 350° C and place the desoldering piece on the IC that has to be removed. (Take care that all connections of the IC are equally heated up).
- Switch the vacuum on and lift the component from the p.c.b.
- Clean the p.c.b. tracks, on which the new component has to be soldered, with braided wire or with the use of the vacuum desoldering equipment DS 701 EC.
- Put solder paste on the connections of the new component and position it on the p.c.b.
- Position the component by soldering first the outside connections in a crosswise manner. Soldering temperature must be 240° C. Keep the soldering time as short as possible.
- Solder now the other connections.
- If necessary you must remove superfluons rests of solder with the use of braided wire.

23.2 REMOVING THE UNITS AND MECHANICAL PARTS

NOTE: For installation, reverse the sequence.

23.2.1 Attenuator unit (A1)

- First remove the digital unit (see section 23.2.8).
- 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 23.2.7).
- 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.

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

- First remove the P^2CCD unit (see section 23.2.9).
- Then remove the time-base unit (see section 23.2.4).
- Unlock the two p.c.b. supports
- The complete p.c.b. can be removed from the instrument after having removed all flat cables.

23.2.3 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 among other things the CRT socket and must be loosened first. For this, the CRT socket must be gently 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 all six clamping lips that secure the XYZ-amplifier unit p.c.b. outwards and take out the complete unit.

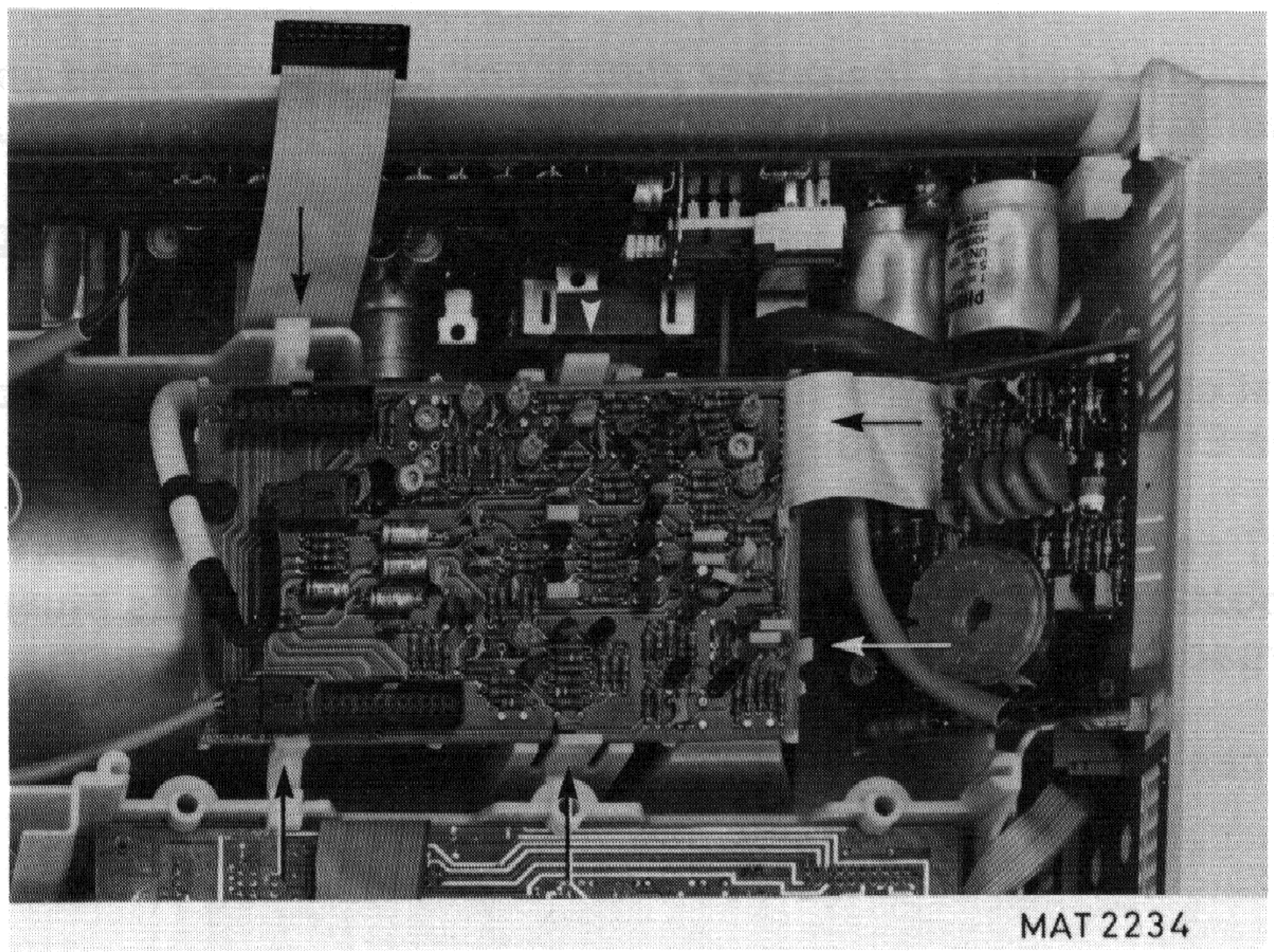


Figure 23.2 Six clamping lips for XYZ-amplifier unit

23.2.4 Time-base unit (A4)

- Remove the P^2CCD unit (see section 23.2.9).
- Unlock the p.c.b. support with a special tool that fits the diameter of the p.c.b. support (see section 23.6.2).
- The complete p.c.b. can be taken out of the instrument after having removed all flat cables.

23.2.5 CRT control unit (A5)

- Remove the front unit (see section 23.2.7)
- Loosen the front profile (see section 23.2.1)
- Now the CRT control unit can be pulled out of the front profile after having removed the flat-cable and the CAL connector.

23.2.6 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.

- Remove the extension shaft from the ON/OFF switch by pushing both clamps of the shaft together.
- 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.

NOTE: 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 easilly be removed now when removing this unit.

- 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.

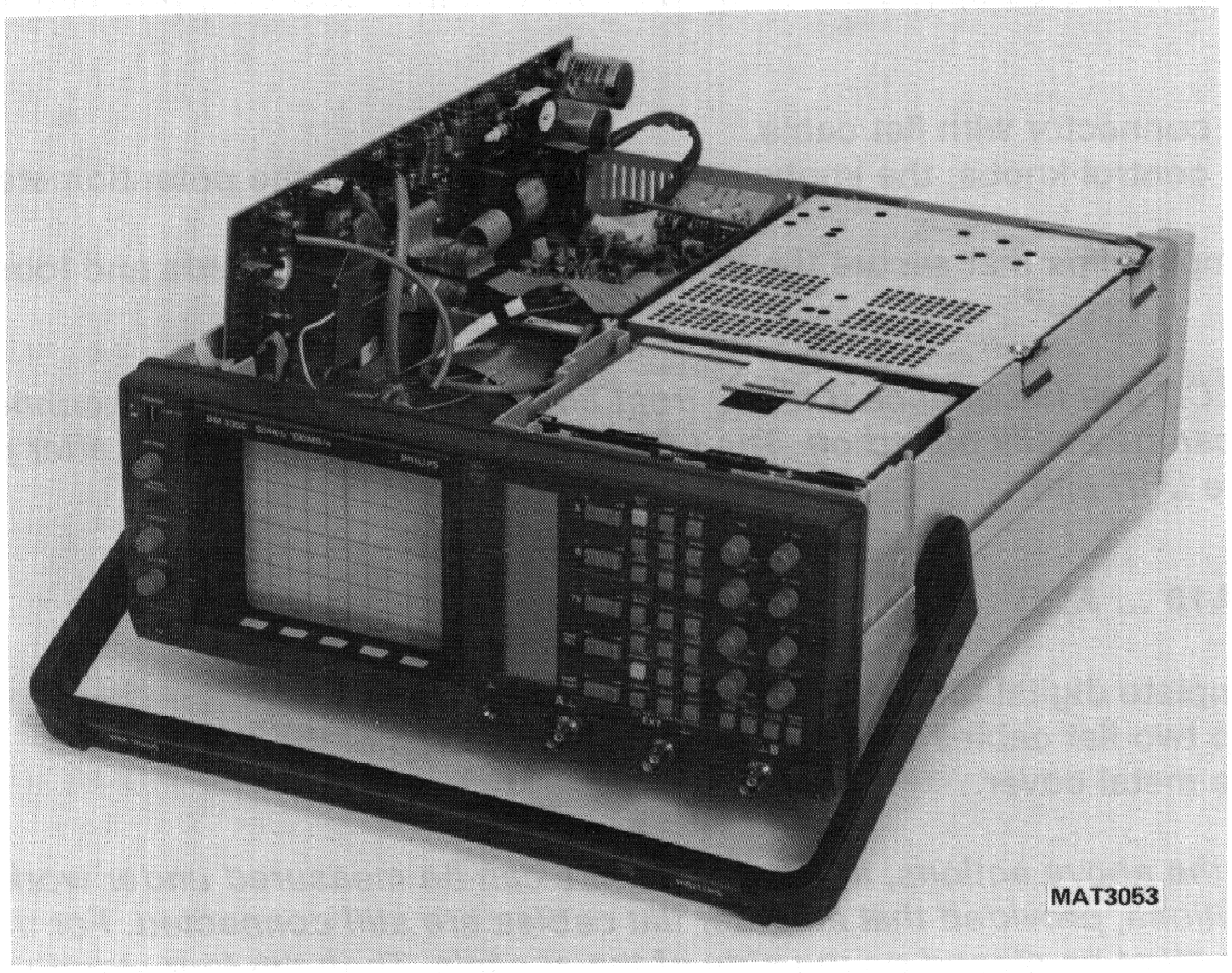


Figure 23.3 Power supply unit outside the instrument

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

- 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.

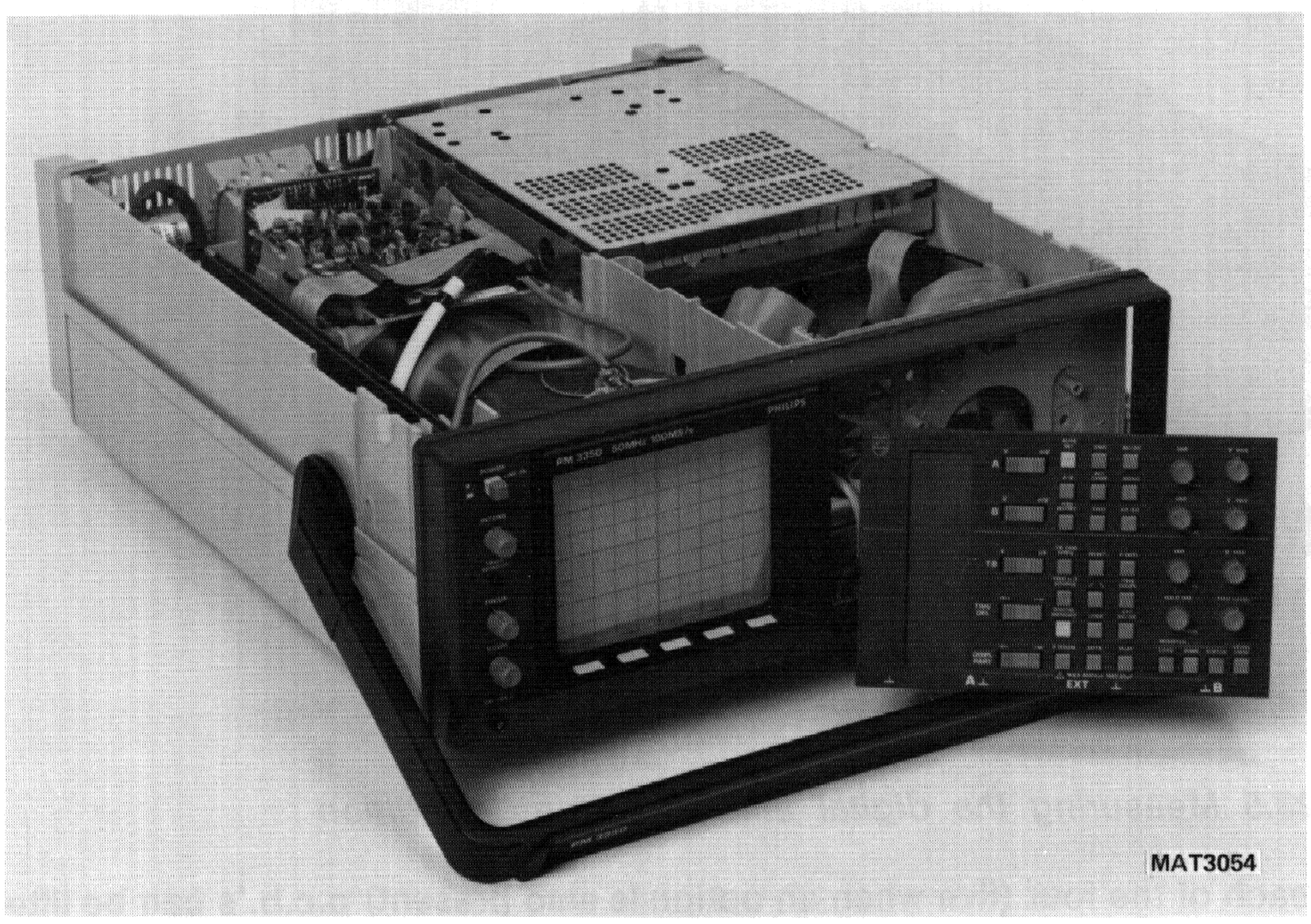


Figure 23.4 Measuring the front unit working condition

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 off 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 be easily pulled off. The LCD display lamp is accessible after pulling off the LCD unit.*

23.2.8 Digital unit (A10 ... A15)

- Lift the complete digital unit outside the instrument.
- Remove the two flat cables that are connected at the top of the unit.
- Remove the metal cover.

NOTE: *After the above actions, all separate units can be measured under working conditions, provided that all other flat cables are still connected. For this the cover must be placed on the side of the chassis. Then the four stand-ups on unit A10 must be placed in the four already existing holes on the cover.(See figure 23.5.)*

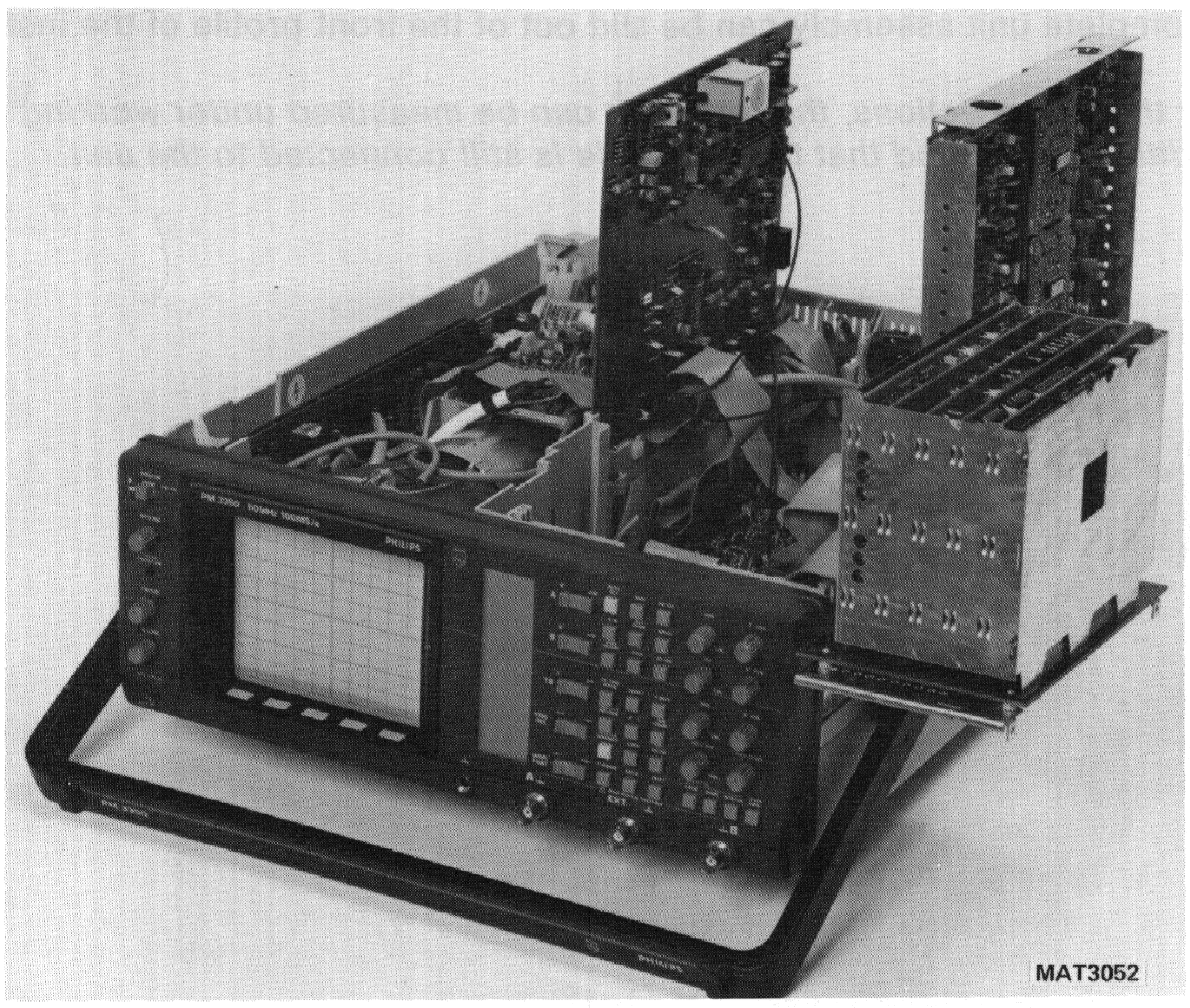


Figure 23.5 Measuring the digital unit in working condition

- Now each of the four (five when an option is also present) p.c.b.'s can be lifted out of the digital unit.

23.2.9 P²CCD unit (A18) and mini CCD unit (A17)

- Unscrew the two screws that fix the metal cover to the chassis and take-off the cover.
- The complete p.c.b. with metal under cover can be taken out of the instrument after removing all 50 Ω cables, all flat cables and the metal bracket on the chassis.
- Now the p.c.b. can be removed from the metal under-cover by unscrewing the four screws.
- The mini CCD units can easily be taken out of their sockets.

23.2.10 Removing the delay-line cable

The delay-line cable is a 54 cm cable that is connected to the amplifier unit and to the XYZ amplifier unit.
To remove the delay-line cable, proceed as follows:

- For access to the delay line cable, remove the time-base unit (see section 23.2.4) and the pre-amplifier unit (see section 23.2.2).
- 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.
- Unscrew 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.

23.2.11 Replacement of CRT

IMPORTANT: It is strongly recommended to study of this chapter and the associated illustration (figure 23.6) before starting replacement.

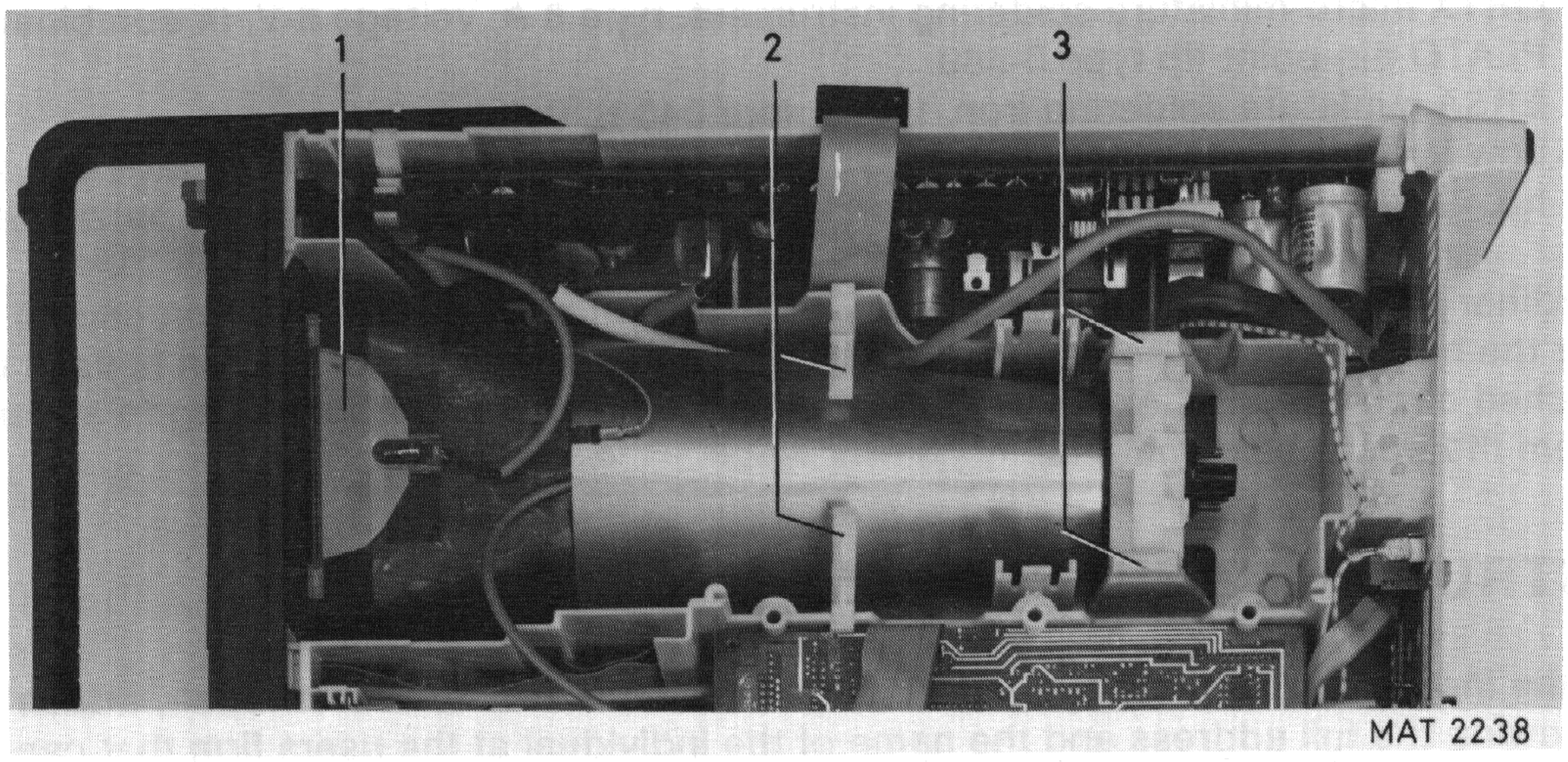


Figure 23.6 Removing the CRT

- Remove the XYZ-amplifier unit, see section 23.2.3.
- Remove the graticule lamp holder (1).
- Remove the bezel with the screen filter.
- Remove the two plastic pcb supports (2).
- Unlock the EHT-cable.

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 (3) and gently lift the CRT, incl. 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.*

23.3 SOLDERING TECHNIQUES

Working method:

- Carefully unsolder the soldering leads of a semi-conductor, one after the other.
- Remove all superfluous soldering material. Use a suction iron of suction litze wire.
- 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 earthed to the mass of the oscilloscope.*

Suitable soldering irons are:

- ORYX micro-miniature soldering instrument, type 6 A, voltage 6 V, in combination with PLATO pin-point tip type 0-569.
- ERSA miniature soldering iron, type minor 040 B, voltage 6 V.
- Low Voltage Mini Soldering Iron, type 800/12 W-6 V, power 12 W, voltage 6 V, order no. 4822 395 10004, in combination with 1 mm pin-point tip, order no. 4822 395 10012.

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.

23.4 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.

23.5 TROUBLE SHOOTING

23.5.1 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.

23.5.2 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 22. "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 undertest 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.

23.5.3 Power-up routine

Every time the instrument is switched-on the following initialisation program is executed:

- Checking the CPU.
- Initialisation of the I^2C bus (if correct, all relevant LCD segments light for about 1 sec).
- Back up test.
- Initialisation of the variables.
- Checking if service routine is required (if yes, the program will continue with the service routine).
- Checking the "WATCH-DOG" on A12 .
- Eventually initialisation of the option.

If during the program-run a circuit is found to be faulty, the program stops. It is recommended to switch-off and after a few seconds switch- on again. This will reset the micro-computer controlled system automatically. If the instrument goes in the same faulty situation again, the following procedure indicates how to handle. If no failure is found, all relevant LCD-segments will be lighting for about one second. After this the normal program is executed.

PROCEDURE:

Check if the LCD is lighting for about one second. If not, close solder-joint J202 on unit A12 and measure on testpin X223. If a square-wave is measured with a 6 μs high period and a 8 μs low period then the μProc. RAM is defective or one or more address/data lines are short circuited. If the LCD has lighted for about one second and the program stops, close also solder-joint J202 and measure on testpin X223. If now a pulse is measured with a 5 μs high period and a 15 μs low period then the I^2C bus is defective. On the SCL a clockpulse must be present when a softkey (e.g. AUTO SET) is depressed while the SDA gives the data information (looks like a random pulse).
If one of these signals is not present, you can localize on what unit the fault exists. This can be done by first unplug connector X1009, X2001 or X101 on resp. A1, A2 and A11. To localize what serial- parallel conversion IC is defective, you can disconnect the solder joint in the SDA and SCL print track lead to that IC. The following IC's can disconnected in this way: D1001, D1101, D2602, D2603, D4001, D4002, D4401, N103, N104 and N106 (see also figure 23.8).

When the instrument restarts every time again, this means the WATCHDOG is initiating the main program (see also section 13.3), the watchdog can be disabled. This can be done by means of removing R204 on unit A12. When disabled, pin 36 and pin 37 of the microprocessor are set to a low level.

23.5.4 I²C structure

The I²C bus is for 2-way, 3-line communication between different ICs or modules. The three lines are a serial data line (SDA), a serial clock line (SCL) and ground. Both lines must be connected to a positive supply via a pull-up resistor when connected to the output stages of a device. Data transfer may be initiated only when the bus is not busy.

The lines SDA and SCL are fed to the various circuits, where depending on the addressing, the serial information is converted into the different control signals (see figure 23.7).

Note that for servicing, solder joints are added in the p.c.b. tracks connecting the circuits. These can be used to localize a fault in the I²C bus by means of interrupting the bus connection.

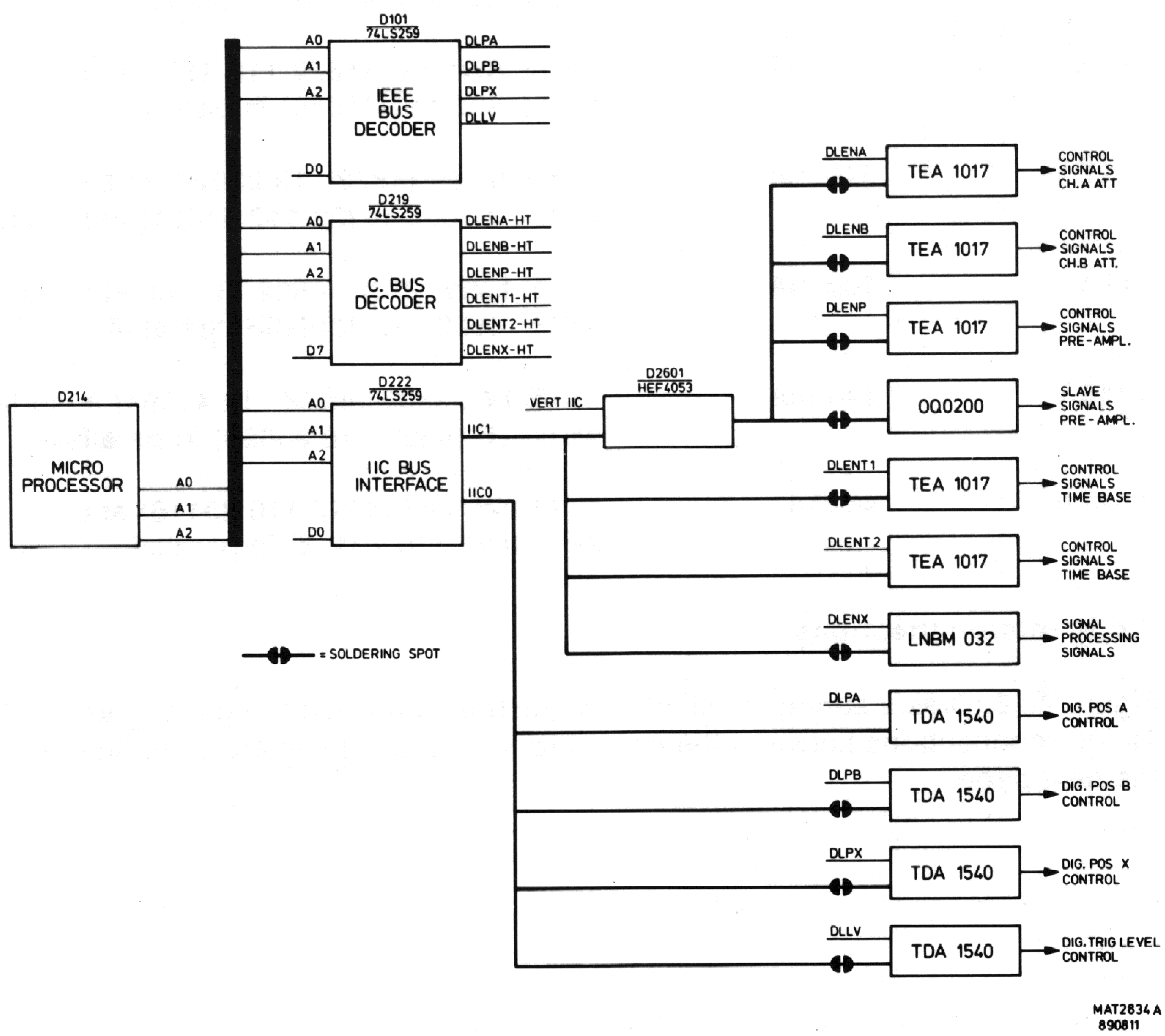


Figure 23.7 I²C structure

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

23.5.6 P.c.b. interconnections

Figure 23.8 gives a survey of all interconnections between the p.c.b.'s and to the CRT. All interconnections between the connectors on board level are given in the diagram on the next page.

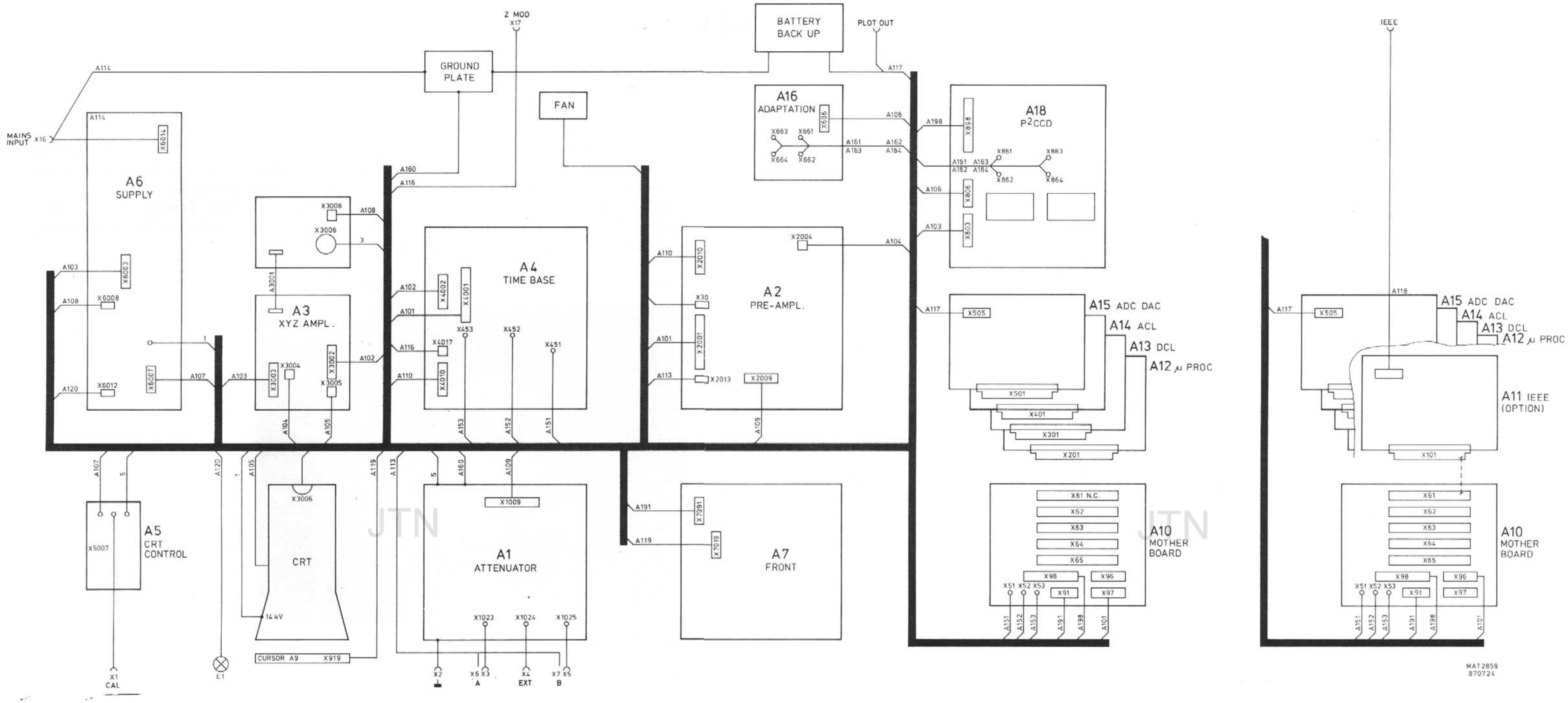


Figure 23.8 P.c.b. interconnections

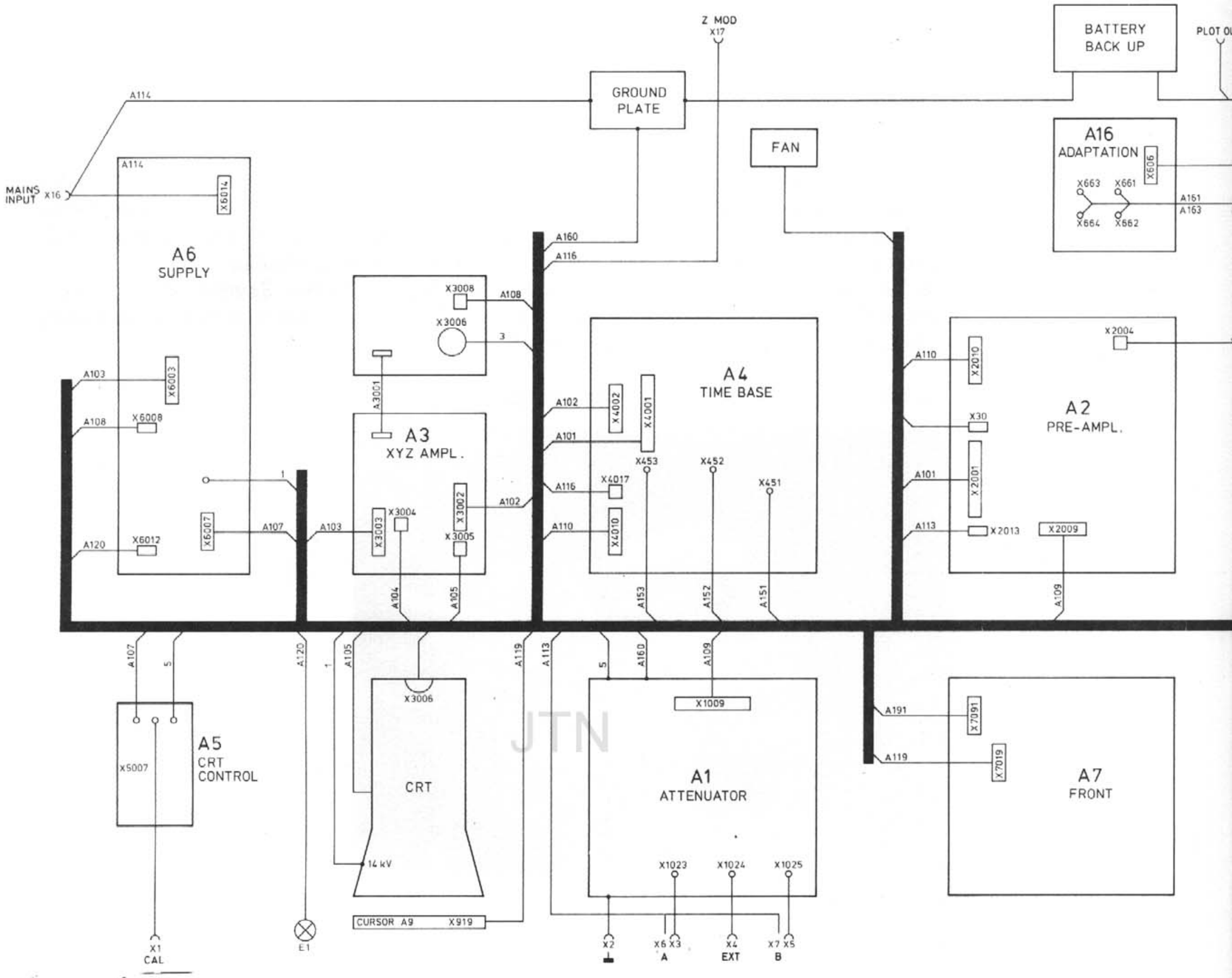
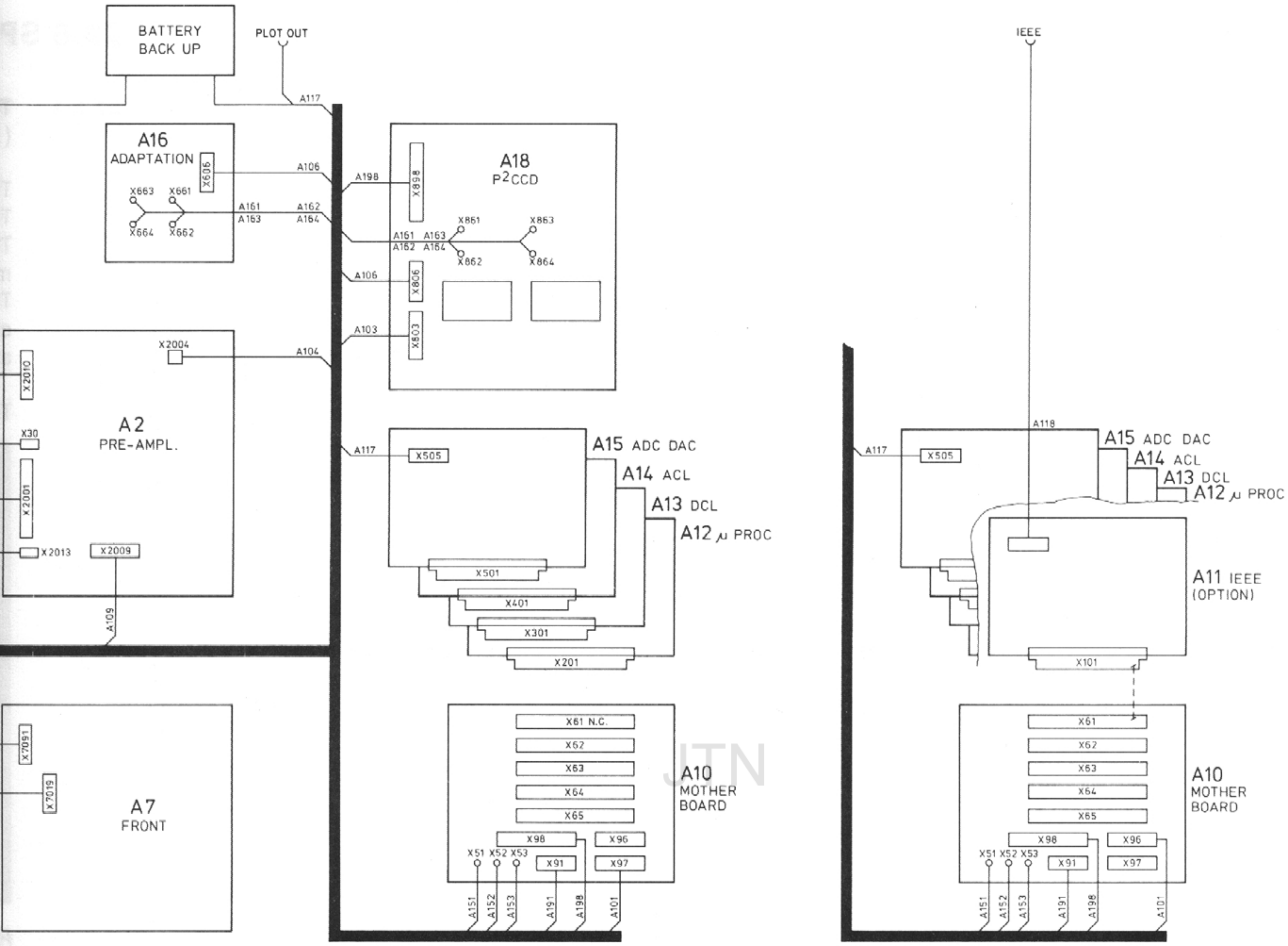


Figure 23.8 P.c.b. interconnections



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23.6 SPECIAL TOOLS

23.6.1 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:

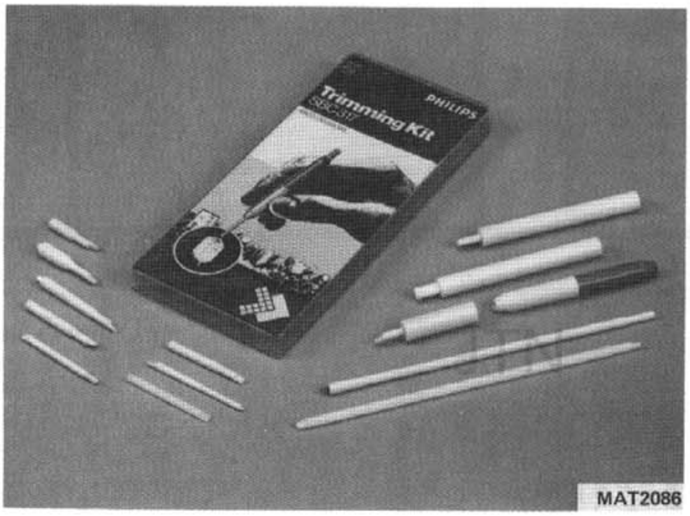


Figure 23.9 Trimming tool kit

23.6.2 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 23.2. The ordering number of this tool is 5322 535 91942

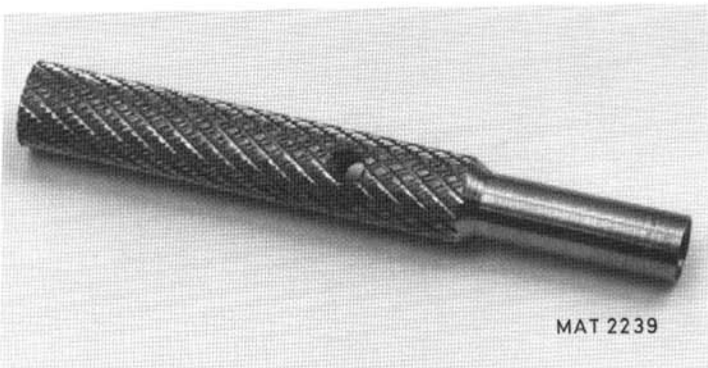


Figure 23.10 p.c.b. Snapper

23.6.3 Extension board
(5322 216 51211)

For test and repair purposes the unit A11...A15 can be plugged in their connectors via an extension board. This board is available under codenumber 5322 216 51211.

23.7 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, calibration of the entire instrument should be checked it work has been done in the power supply or if the transformer has been renewed.

24 SAFETY INSPECTION

24.1 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.

24.2 SAFETY COMPONENTS

Components in the primary circuit may only be renewed by components selected by Philips, see also section 23.1.2.

24.3 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.

24.4 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).

24.5 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.

24.6 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.

25 PARTS LIST

(subject to alteration without notice)

25.1 MECHANICAL PARTS

25.1.1 Mechanical parts indicated in figure 25.1.

Item	Qty	Ordering code	Description
1	1	5322 459 20503	Bezel
1a	1	5322 414 20213	Button
1b	1	5322 464 90484	Cover
2	1	5322 480 30181	Contrast filter blue
3	1	5322 455 81058	Textfilm on bezel PM3350
3	1	5322 455 81062	Textfilm on bezel PM3352
4	1	5322 268 14052	CAL socket
5	1	4822 530 70296	Clamping spring for CAL socket
6	11	5322 414 10018	Control knob with spring
7	1	5322 464 90252	Front frame
8	1	5322 455 81026	Textfilm CRT unit
9	1	5322 455 81057	Textfilm for handle PM3350
10	1	5322 498 50219	Handle assembly
11	1	5322 414 60142	Power-on knob, green-brown
12	2	5322 492 63355	Spring for handle
13	1	5322 535 80735	Extension part for power-on switch
14	1	5322 447 91499	Upper cabinet
15	2	5322 462 10265	P.c.b. guiding for A3
16	2	5322 462 10264	P.c.b. support for A6
17	1	5322 464 90486	Chassis
18	6	5322 462 30304	P.c.b. support
19	1	5322 464 90249	Bottom cabinet
20	2	5322 447 91487	Attenuator cover
21	4	5322 462 50325	Bottom foot
22	3	5322 506 21188	BNC spacer ring
23	3	5322 532 41006	BNC extension bush
24	3	5322 267 10004	BNC socket
25	1	5322 464 90254	Front unit frame
26	1	5322 455 81061	Textfilm for front unit
27	23	5322 276 11856	Softkey brown
28	1	5322 276 12332	Softkey mushroom
29	1	5322 276 11857	Softkey green
30	5	5322 277 10878	UP-DOWN key brown
32	2	5322 492 63354	Range indication spring
33	1	5322 450 60952	LCD window
34	1	5322 256 60289	Battery back-up holder
35	1	5322 361 10326	FAN assembly
36	4	5322 462 30377	Panel support
37	4	4822 530 70296	Panel support clamp
38	1	5322 417 20154	Metal fastener for A18
39	2	5322 290 40257	Flat cable clamp
40	2	5322 532 11588	Rubber support
41	2	5322 256 64014	Battery holder
--	3	5322 255 40054	Heatsink for V3011 and V3012
--	2	5322 401 10954	Delay line cable clamp
--	1	5322 492 70224	Clamping spring for A16

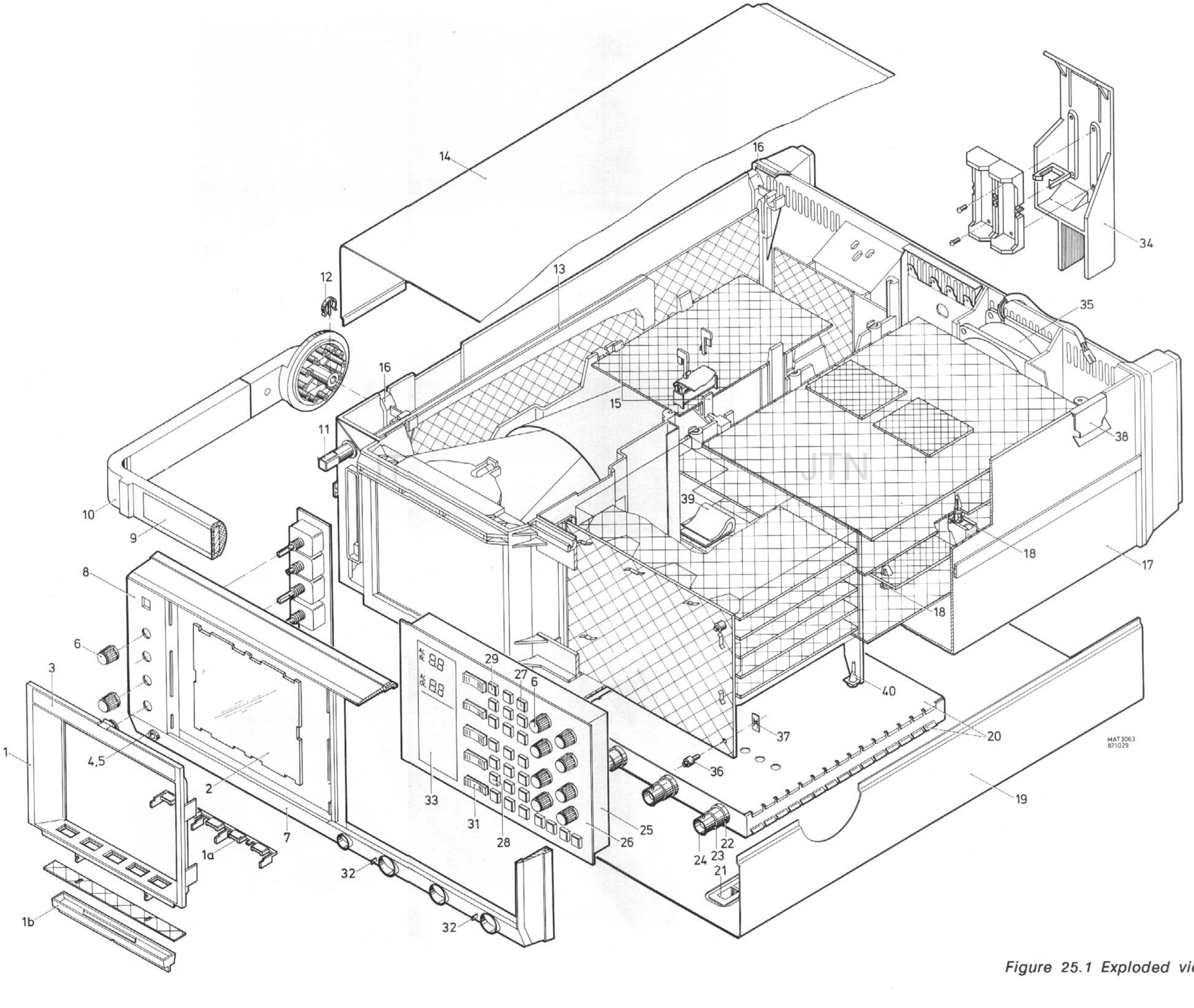
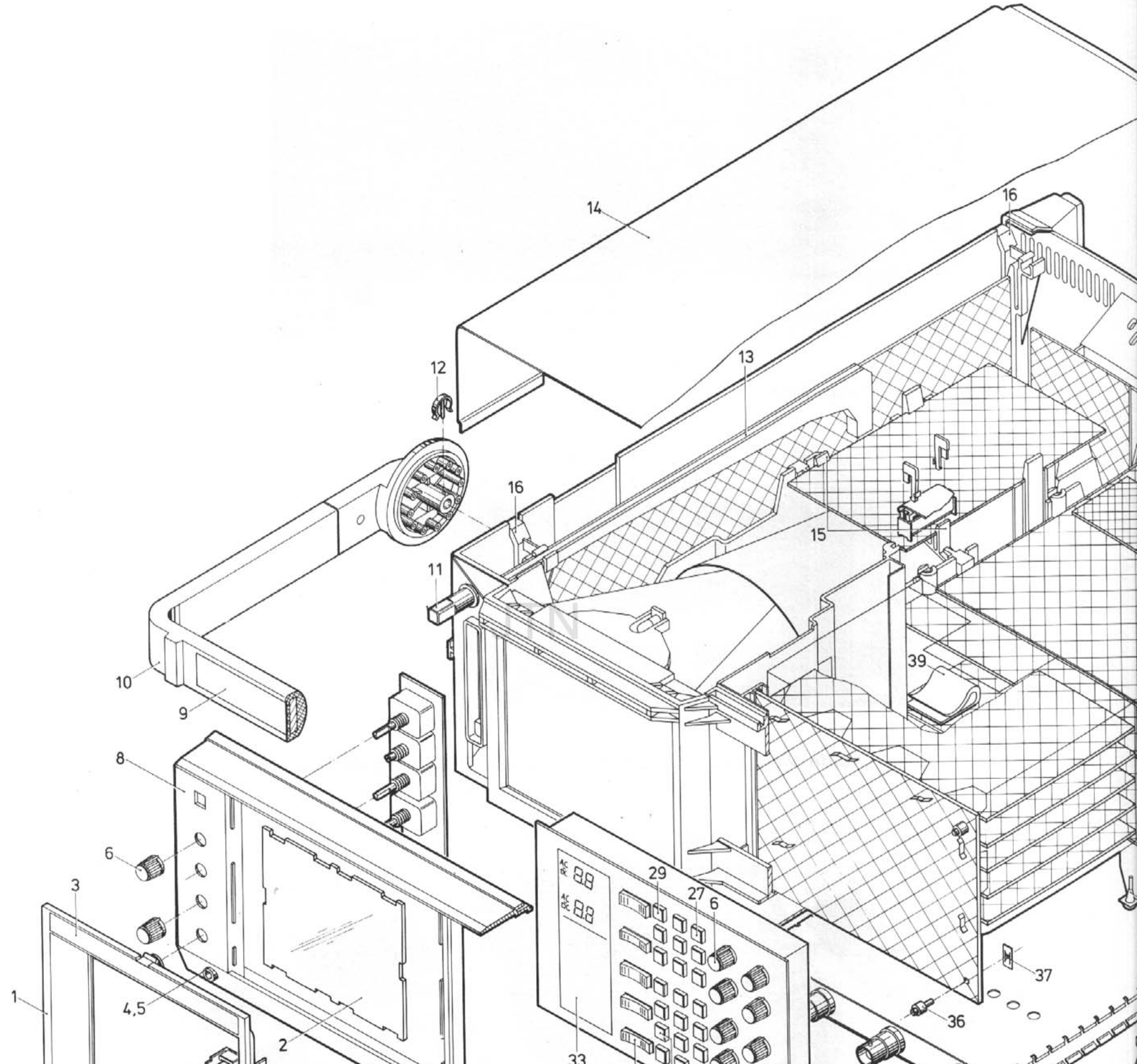


Figure 25.1 Exploded view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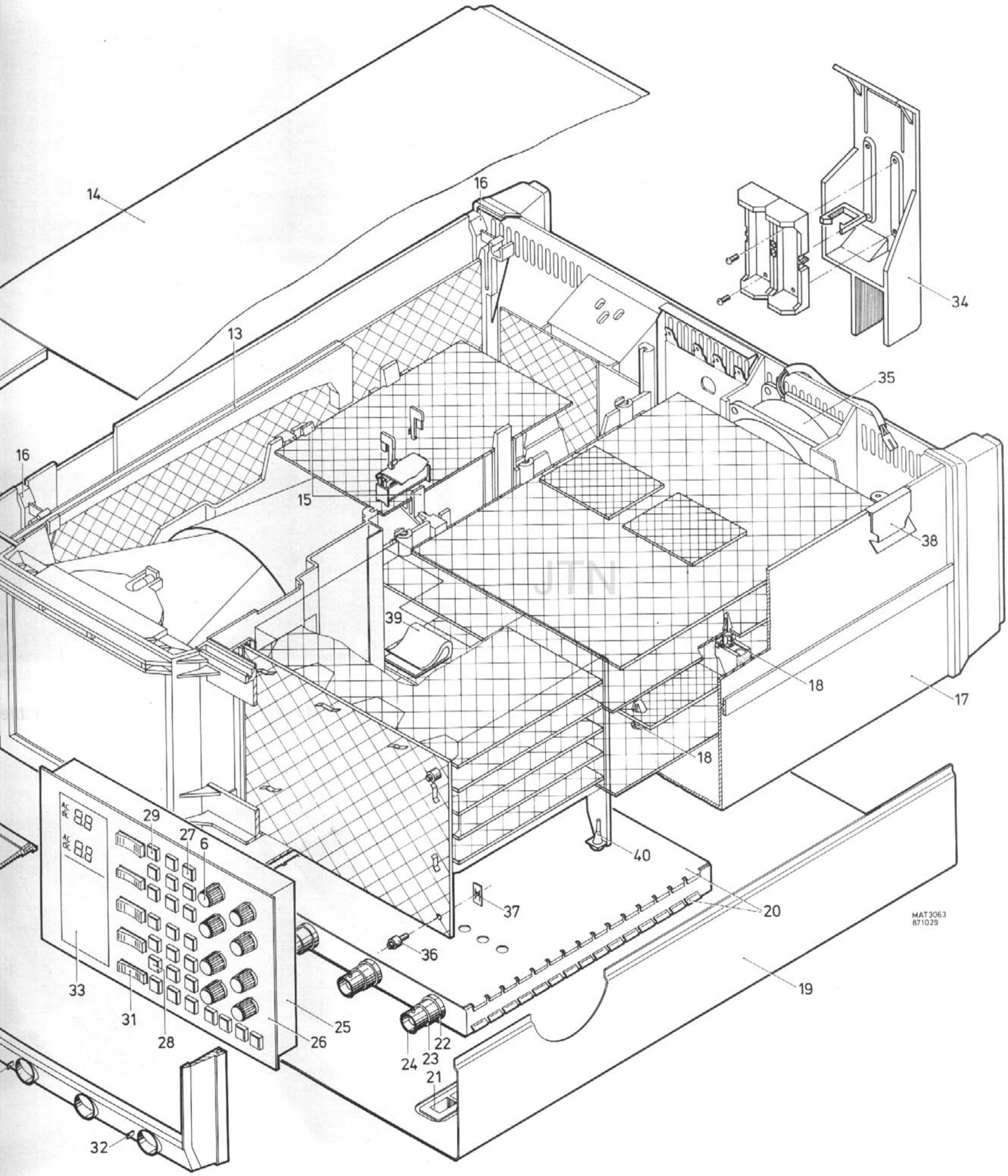

Figure 25.1 Exploded view

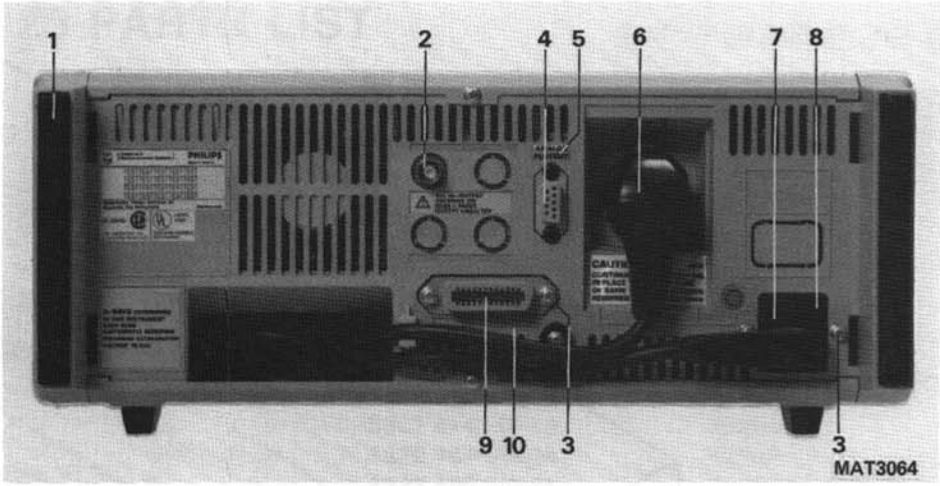

Figure 25.2 Rear view

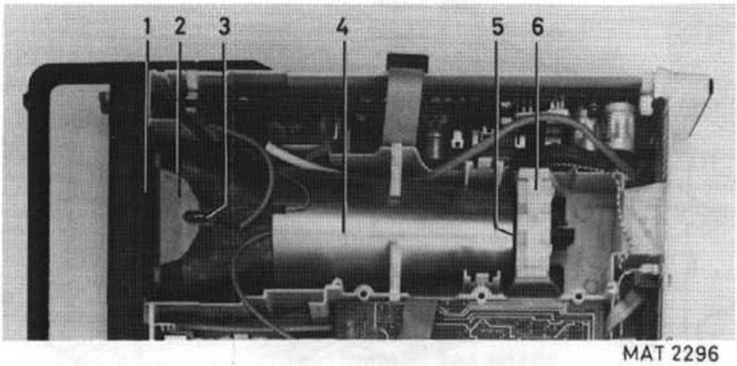

Figure 25.3 Inside view showing the parts in the CRT compartiment

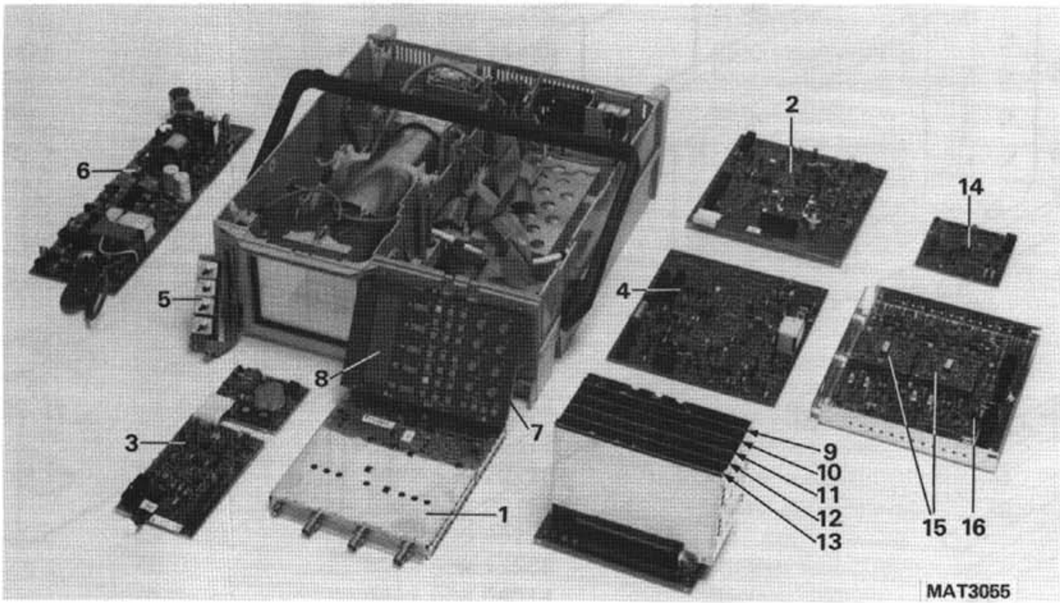

Figure 25.4 View of the units

25.1.2 Mechanical parts indicated in figure 25.2

Item	Qty	Ordering code	Description
1	2	5322 462 50324	Rear foot
2	1	5322 267 10004	BNC socket for Z-MOD
3	4	5322 502 12003	Screws for ANALOG PLOT OUT and Mains input sockets.
4	1	5322 321 22614	Analog plot out socket.
5	1	5322 455 81059	Analog plot out sticker
6	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
7	1	5322 219 81119	Mains input socket, incl. fuse holder
8	1	4822 253 30024	Fuse 1,6A (for mains input)

25.1.3 Mechanical parts indicated in figure 25.3

Item	Qty	Ordering code	Description
1	1	5322 460 60404	CRT front rubber
2	1	5322 462 40957	Light conductor for CRT
3	1	5322 134 40534	Lamp 28V-80mA
4	1	5322 466 30163	CRT shielding
5	1	5322 466 30164	CRT manchet, rubber
6	1	5322 462 10263	CRT support

25.2 UNITS

(see figure 25.4)

Item	Unit nr.	Ordering code	Description
1	A1	5322 216 51114	Attenuator unit
2	A2	5322 216 51196	Pre-amplifier unit
3	A3	5322 216 51117	XYZ-amplifier unit
4	A4	5322 216 51208	Time-base unit
5	A5	5322 216 51118	CRT-control unit
6	A6	5322 216 51195	Power supply unit
7	A7	5322 216 51197	Front unit
8	A8	5322 216 51207	LCD unit
-	A10	5322 216 51252	Motherboard
9a	A11	5322 216 51198	IEEE-488 unit (optional)
9b	A11	5322 216 51212	RS232-C unit (optional)
10	A12	5322 216 51199	Microprocessor unit
11	A13	5322 216 51201	DCL unit
12	A14	5322 216 51202	ACL unit
13	A15	5322 216 51203	ADC-DAC UNIT
14	A16	5322 216 51204	Adaptation unit
15	A17	5322 216 51205	Mini CCD unit
16	A18	5322 210 51206	P^2CCD unit
17	A19	5322 216 51209	Cursor unit

25.3 CABLES AND CONNECTORS

25.3.1 Flatcables and connectors

For the flatcables used in this oscilloscope, the required version must be 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:

Type	Item	Ordering number
6 pole cable connector	X7019	5322 268 40301
10 pole cable connector	X505-X606-X806-X4016-X5007-X6007	5322 268 40234
20 pole cable connector	X91-X803-X2010-X3002-X3003-X4002 X4010-X6009-X7091	5322 268 40235
26 pole cable connector	X102-X1009-X2009	5322 267 70175
34 pole cable connector	X96(X97)-X2001-X4001	5322 268 40236
40 pole cable connector	X98-X808	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

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

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

Type	Item	Ordering number
2 pole-single	X2013-X4017-X6020	5322 265 20275
3 pole-single	X6006-X6019	5322 265 30434
3 pole single	X7011-X7012	5322 265 30396
3 pole-single	X6018 (power supply)	5322 265 40435
3 pole-single 90° type	X2004-X3004-X3005-X3008	5322 265 30433
5 pole-single	X6014	5322 265 40436
6 pole-single	X7013	5322 265 30591
10 pole-double	X606-X806-X4016-X5007-X6007	5322 265 40485
10 pole-double 90° type	X505	5322 265 51188
20 pole-double	X91-X803-X2010-X3002-X3003-X4002-X4010-X6003-X709	5322 265 51129
26 pole-double	X102-X1009-X2009	5322 265 61071
34 pole-double	X96-X97-X2001-X4001	5322 265 61069
40 pole-double	X98-X808	5322 265 61072

25.3.3 50 Ω cables and connectors

The 50 Ω coax-cables are standardized, so some cables are a little bit too long.
The tules around the cable end might have a different colour; if necessary they 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

25.3.4 Miscellaneous cables

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

25.3.5 Miscellaneous sockets and connectors

CRT socket	5322 255 40502
p.c.b. socket, 96 pole, triple	5322 267 70167
p.c.b. connector, 96 pole, triple	5322 265 61029
Socket for D314	5322 255 40677
Socket for D801	5322 255 40815
Socket for D214, 48 pins	5322 255 40851
Socket for D216, 32 pins	5322 255 40829
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

25.4 ELECTRICAL PARTS

25.4.1 Capacitors

POSNR	DESCRIPTION		ORDERING CODE
C 0201	-10+50%	33UF	4822 124 20712
C 0202	-10+50%	33UF	4822 124 20712
C 0203	63V 10%	220NF	4822 121 42408
C 0204	63V 10%	100NF	5322 121 42492
C 0205	-10+50%	33UF	4822 124 20712
C 0206	2%	100PF	4822 122 31316
C 0207	2%	100PF	4822 122 31316
C 0208	2%	100PF	4822 122 31316
C 0209	2%	100PF	4822 122 31316
C 0251	-20+50%	10NF	4822 122 31414
C 0252	-10+50%	220UF	4822 124 20681
C 0253	-20+50%	10NF	4822 122 31414
C 0254	-20+50%	10NF	4822 122 31414
C 0256	-20+50%	10NF	4822 122 31414
C 0257	-20+50%	10NF	4822 122 31414
C 0258	-20+50%	10NF	4822 122 31414
C 0259	-20+50%	10NF	4822 122 31414
C 0261	-20+50%	10NF	4822 122 31414
C 0262	-20+50%	10NF	4822 122 31414
C 0263	-20+50%	10NF	4822 122 31414
C 0264	-20+50%	10NF	4822 122 31414
C 0266	-20+50%	10NF	4822 122 31414
C 0267	-20+50%	10NF	4822 122 31414
C 0268	-20+50%	10NF	4822 122 31414
C 0269	-20+50%	10NF	4822 122 31414
C 0271	-20+50%	10NF	4822 122 31414
C 0272	-20+50%	10NF	4822 122 31414
C 0273	-20+50%	10NF	4822 122 31414
C 0274	-20+50%	10NF	4822 122 31414
C 0276	-20+50%	10NF	4822 122 31414
C 0277	-20+50%	10NF	4822 122 31414
C 0278	-20+50%	10NF	4822 122 31414
C 0279	63V 10%	100NF	5322 121 42492
C 0281	-10+50%	100UF	4822 124 20679
C 0282	-10+50%	100UF	4822 124 20679
C 0283	-10+50%	100UF	4822 124 20679
C 0284	-10+50%	100UF	4822 124 20679
C 0301	-20+50%	10NF	4822 122 31414
C 0302	-20+50%	10NF	4822 122 31414
C 0303	-20+50%	10NF	4822 122 31414
C 0304	63V 10%	220NF	4822 121 42408
C 0306	-20+50%	10NF	4822 122 31414
C 0307	-20+50%	10NF	4822 122 31414
C 0308	-20+50%	10NF	4822 122 31414
C 0309	-20+50%	10NF	4822 122 31414
C 0311	-20+50%	10NF	4822 122 31414
C 0312	-20+50%	10NF	4822 122 31414
C 0313	-20+50%	10NF	4822 122 31414
C 0314	-20+50%	10NF	4822 122 31414
C 0316	-10+50%	220UF	4822 124 20681
C 0317	63V 10%	100NF	5322 121 42492
C 0318	-10+50%	100UF	4822 124 20679
C 0319	-20+50%	10NF	4822 122 31414
C 0321	-20+50%	10NF	4822 122 31414
C 0322	-20+50%	10NF	4822 122 31414
C 0323	-20+50%	10NF	4822 122 31414
C 0324	-20+50%	10NF	4822 122 31414
C 0326	-20+50%	10NF	4822 122 31414
C 0401	-20+50%	10NF	4822 122 31414
C 0402	-20+50%	10NF	4822 122 31414
C 0403	-20+50%	10NF	4822 122 31414
C 0404	-20+50%	10NF	4822 122 31414
C 0406	-20+50%	10NF	4822 122 31414
C 0407	-20+50%	10NF	4822 122 31414
C 0408	-20+50%	10NF	4822 122 31414
C 0409	-20+50%	10NF	4822 122 31414
C 0411	-20+50%	10NF	4822 122 31414
C 0412	-20+50%	10NF	4822 122 31414
C 0413	-20+50%	10NF	4822 122 31414
C 0414	-20+50%	10NF	4822 122 31414
C 0416	-20+50%	10NF	4822 122 31414
C 0417	-10+50%	220UF	4822 124 20681
C 0418	63V 10%	100NF	5322 121 42492
C 0419	2%	82PF	4822 122 31237
C 0421	-10+50%	100UF	4822 124 20679
C 0422	-20+50%	10NF	4822 122 31414
C 0423	2%	82PF	4822 122 31237
C 0428	-20+50%	10NF	4822 122 31414
C 0429	-20+50%	10NF	4822 122 31414
C 0431	-20+50%	10NF	4822 122 31414
C 0432	-20+50%	10NF	4822 122 31414
C 0433	-20+50%	10NF	4822 122 31414
C 0434	2%	82PF	4822 122 31237
C 0511	-20+50%	10NF	4822 122 31414
C 0512	63V 10%	100NF	5322 121 42492
C 0513	-20+50%	10NF	4822 122 31414
C 0514	63V 10%	100NF	5322 121 42492
C 0517	-20+50%	10NF	4822 122 31414
C 0519	-20+50%	10NF	4822 122 31414
C 0521	630V 1%	470PF	5322 121 50999
C 0522	630V 1%	470PF	5322 121 50999
C 0523	10%	2.2NF	4822 122 30114
C 0524	10%	1NF	4822 122 30027
C 0526	10%	2.2NF	4822 122 30114
C 0527	10%	1NF	4822 122 30027
C 0528	0.25PF	5.6PF	5322 122 32163
C 0531	-20+50%	10NF	4822 122 31414
C 0532	-20+50%	10NF	4822 122 31414
C 0533	63V 10%	100NF	5322 121 42492
C 0534	63V 10%	100NF	5322 121 42492
C 0535	-20+50%	10NF	4822 122 31414
C 0536	63V 10%	100NF	5322 121 42492
C 0538	-20+50%	10NF	4822 122 31414
C 0539	2%	47PF	4822 122 31072
C 0541	-20+50%	10NF	4822 122 31414
C 0542	-10+50%	68UF	4822 124 20689
C 0543	-20+50%	10NF	4822 122 31414
C 0544	-20+50%	10NF	4822 122 31414
C 0546	-20+50%	10NF	4822 122 31414
C 0547	-20+50%	10NF	4822 122 31414
C 0548	-20+50%	10NF	4822 122 31414
C 0549	-10+50%	68UF	4822 124 20689
C 0551	-20+50%	10NF	4822 122 31414
C 0552	-20+50%	10NF	4822 122 31414
C 0553	-20+50%	10NF	4822 122 31414
C 0554	-20+50%	10NF	4822 122 31414
C 0555	-20+50%	10NF	4822 122 31414
C 0556	-20+50%	10NF	4822 122 31414
C 0557	-10+50%	47UF	4822 124 20699
C 0558	-20+50%	10NF	4822 122 31414
C 0559	-10+50%	150UF	4822 124 20672
C 0561	-20+50%	10NF	4822 122 31414
C 0562	-20+50%	10NF	4822 122 31414
C 0563	-20+50%	10NF	4822 122 31414
C 0564	-20+50%	10NF	4822 122 31414
C 0565	-10+50%	47UF	4822 124 20699
C 0571	-20+50%	10NF	4822 122 31414
C 0572	63V 10%	100NF	5322 121 42492
C 0573	-20+50%	10NF	4822 122 31414
C 0574	63V 10%	100NF	5322 121 42492
C 0576	2%	10PF	4822 122 32185
C 0591	-20+50%	10NF	4822 122 31414
C 0592	250V 1%	1.5NF	4822 121 42729
C 0593	-20+50%	10NF	4822 122 31414
C 0594	2%	15PF	4822 122 31823
C 0596	100V 10%	10NF	4822 121 41857
C 0597	10%	1NF	4822 122 30027
C 0601	-20+50%	10NF	4822 122 31414
C 0601	-20+50%	10NF	4822 122 31414
C 0602	-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 0701	V 0.5PF	8.2PF	5322 122 33244
C 0702	V 10%	22NF	5322 122 32654
C 0703	V 0.5PF	8.2PF	5322 122 33244
C 0704	V 10%	22NF	5322 122 32654
C 0705	V 5%	18PF	5322 122 32965
C 0706	V 10%	22NF	5322 122 32654
C 0707	V 10%	22NF	5322 122 32654

POSNR	DESCRIPTION	ORDERING CODE
C 0721	V 10% 22NF	5322 122 32654
C 0722	V 10% 22NF	5322 122 32654
C 0723	V 10% 22NF	5322 122 32654
C 0724	V 10% 22NF	5322 122 32654
C 0725	V 10% 22NF	5322 122 32654
C 0731	V 10% 22NF	5322 122 32654
C 0732	V 10% 22NF	5322 122 32654
C 0733	V 10% 22NF	5322 122 32654
C 0734	V 10% 22NF	5322 122 32654
C 0736	V 10% 22NF	5322 122 32654
C 0737	V 10% 22NF	5322 122 32654
C 0738	V 10% 22NF	5322 122 32654
C 0739	V 10% 22NF	5322 122 32654
C 0741	V 5% 100PF	5322 122 32531
C 0761	V 10% 22NF	5322 122 32654
C 0763	V 10% 22NF	5322 122 32654
C 0764	V 10% 22NF	5322 122 32654
C 0766	V 10% 22NF	5322 122 32654
C 0767	V 10% 22NF	5322 122 32654
C 0768	V 10% 22NF	5322 122 32654
C 0769	V 10% 22NF	5322 122 32654
C 0770	V 10% 22NF	5322 122 32654
C 0771	V 5% 100PF	5322 122 32531
C 0791	V 10% 22NF	5322 122 32654
C 0792	V 10% 22NF	5322 122 32654
C 0793	V 10% 22NF	5322 122 32654
C 0794	V 10% 22NF	5322 122 32654
C 0796	V 10% 22NF	5322 122 32654
C 0802	-20+50% 10NF	4822 122 31414
C 0804	-20+50% 10NF	4822 122 31414
C 0809	-20+50% 10NF	4822 122 31414
C 0810	0.25PF 2.2PF	4822 122 31036
C 0811	-10+50% 100UF	4822 124 20679
C 0817	-20+50% 10NF	4822 122 31414
C 0818	2% 12PF	4822 122 31056
C 0819	-20+50% 10NF	4822 122 31414
C 0823	-20+50% 10NF	4822 122 31414
C 0824	2% 12PF	4822 122 31056
C 0825	-20+50% 10NF	4822 122 31414
C 0826	-10+50% 100UF	4822 124 20679
C 0832	-20+50% 10NF	4822 122 31414
C 0834	-20+50% 10NF	4822 122 31414
C 0835	-10+50% 100UF	4822 124 20679
C 0836	0.25PF 2.2PF	4822 122 31036
C 0839	-20+50% 10NF	4822 122 31414
C 0847	-20+50% 10NF	4822 122 31414
C 0848	2% 12PF	4822 122 31056
C 0849	-20+50% 10NF	4822 122 31414
C 0851	-10+50% 100UF	4822 124 20679
C 0853	-20+50% 10NF	4822 122 31414
C 0854	2% 12PF	4822 122 31056
C 0855	-20+50% 10NF	4822 122 31414
C 0861	-20+50% 10NF	4822 122 31414
C 0862	10% 1NF	4822 122 30027
C 0865	2% 12PF	4822 122 31056
C 0866	2% 33PF	5322 122 32072
C 0869	10% 1NF	4822 122 30027
C 0871	10% 470PF	4822 122 30034
C 0872	-20+50% 10NF	4822 122 31414
C 0874	10% 1NF	4822 122 30027
C 0875	2% 100PF	4822 122 31316
C 0883	-10+50% 150UF	4822 124 20672
C 0884	-10+50% 150UF	4822 124 20672
C 0895	-20+50% 10NF	4822 122 31414
C 0896	-20+50% 10NF	4822 122 31414
C 0898	-10+50% 47UF	4822 124 20699
C 0899	-20+50% 10NF	4822 122 31414
C 0901	100V 10% 22NF	4822 121 41856
C 0903	2% 82PF	4822 122 31237
C 0904	400V 1% 220PF	4822 122 31173
C 0906	100V 10% 22NF	4822 121 41856
C 0908	2% 82PF	4822 122 31237
C 0909	400V 1% 220PF	4822 122 31173
C 0911	100V 10% 22NF	4822 121 41856
C 0913	2% 82PF	4822 122 31237
C 0914	400V 1% 220PF	4822 122 31173
C 0916	100V 10% 22NF	4822 121 41856
C 0918	2% 82PF	4822 122 31237
C 0919	400V 1% 220PF	4822 122 31173
C 0920	-20+50% 10NF	4822 122 31414
C 0921	-10+50% 100UF	4822 124 20679
C 0922	-20+50% 10NF	4822 122 31414
C 0923	-20+50% 10NF	4822 122 31414
C 0924	-20+50% 10NF	4822 122 31414
C 0925	-20+50% 10NF	4822 122 31414
C 0926	-20+50% 10NF	4822 122 31414
C 0927	-20+50% 10NF	4822 122 31414
C 0928	-20+50% 10NF	4822 122 31414
C 0929	-20+50% 10NF	4822 122 31414
C 0930	-20+50% 10NF	4822 122 31414
C 0931	-20+50% 10NF	4822 122 31414
C 0932	-20+50% 10NF	4822 122 31414
C 0933	-20+50% 10NF	4822 122 31414
C 0934	-20+50% 10NF	4822 122 31414
C 0935	-20+50% 10NF	4822 122 31414
C 0936	-20+50% 10NF	4822 122 31414
C 0937	-20+50% 10NF	4822 122 31414
C 0938	-20+50% 10NF	4822 122 31414
C 0939	-20+50% 10NF	4822 122 31414
C 0942	-20+50% 10NF	4822 122 31414
C 0950	-10+50% 100UF	4822 124 20679
C 0951	-20+50% 10NF	4822 122 31414
C 0952	-20+50% 10NF	4822 122 31414
C 0954	-20+50% 10NF	4822 122 31414
C 0956	-20+50% 10NF	4822 122 31414
C 0957	-20+50% 10NF	4822 122 31414
C 0958	-20+50% 10NF	4822 122 31414
C 0959	-20+50% 10NF	4822 122 31414
C 0960	-20+50% 10NF	4822 122 31414
C 0961	-10+50% 100UF	4822 124 20679
C 0962	-10+50% 150UF	4822 124 20672
C 0963	-10+50% 68UF	4822 124 20689
C 0964	-10+50% 68UF	4822 124 20689
C 0965	-20+50% 10NF	4822 122 31414
C 0968	-20+50% 10NF	4822 122 31414
C 0969	-20+50% 10NF	4822 122 31414
C 0971	-20+50% 10NF	4822 122 31414
C 0972	-20+50% 10NF	4822 122 31414
C 0973	-20+50% 10NF	4822 122 31414
C 0974	-20+50% 10NF	4822 122 31414
C 0976	-10+50% 15UF	4822 124 20729
C 0977	-10+50% 47UF	4822 124 20699
C 0978	-10+50% 68UF	4822 124 20689
C 0979	-10+50% 68UF	4822 124 20689
C 0980	-20+50% 10NF	4822 122 31414
C 0981	-10+50% 33UF	4822 124 20712
C 0982	-20+50% 10NF	4822 122 31414
C 0983	-20+50% 10NF	4822 122 31414
C 0984	-20+50% 10NF	4822 122 31414
C 0985	-20+50% 10NF	4822 122 31414
C 0986	63V 10% 100NF	5322 121 42492
C 0987	-10+50% 47UF	4822 124 20699
C 0988	-20+50% 10NF	4822 122 31414
C 0993	-20+50% 10NF	4822 122 31414
C 0995	-10+50% 68UF	4822 124 20689
C 0996	-20+50% 10NF	4822 122 31414
C 0997	-10+50% 150UF	4822 124 20672
C 0999	-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 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 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 32551
C 1021	-20+50% 10NF	4822 122 31414
C 1022	2% 22PF	5322 122 32417
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 32551
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 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	MRS25 1% 562E	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	0.25PF 2.2PF	4822 122 31036
C 1063	10% 4.7NF	4822 122 31125
C 1064	10% 1.5NF	4822 122 31169
C 1067	2% 39PF	4822 122 31069

POSNR	DESCRIPTION		ORDERING CODE
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 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 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 32551
C 1121	-20+50%	10NF	4822 122 31414
C 1122	2%	33PF	5322 122 32551
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 32551
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 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	0.25PF	2.2PF	4822 122 31036
C 1163	10%	4.7NF	4822 122 31125
C 1164	10%	1.5NF	4822 122 31169
C 1167	2%	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 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
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

POSNR	DESCRIPTION		ORDERING CODE
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	0.25PF	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	2%	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	0.25PF	1.5PF	5322 122 32101
C 2318	10%	470PF	4822 122 30034
C 2321	0.25PF	1.5PF	5322 122 32101
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	4822 122 30027
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

POSNR	DESCRIPTION		ORDERING CODE
C 3001	-20+50%	10NF	4822 122 31414
C 3001	-20+50%	10NF	4822 122 31414
C 3002	10%	1.5NF	4822 122 31169
C 3002	10%	1.5NF	4822 122 31169
C 3003	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 3004	7-10.0 PF	MUR	5322 125 11013
C 3005	2-20PF	MUR	5322 125 50296
C 3005	2-20PF	MUR	5322 125 50296
C 3006	0.25PF	5.6PF	5322 122 32163
C 3007	7-10.0 PF	MUR	5322 125 11013
C 3007	7-10.0 PF	MUR	5322 125 11013
C 3009	2%	12PF	4822 122 31056
C 3009	2%	15PF	4822 122 31823
C 3011	2%	68PF	4822 122 31349
C 3011	2%	68PF	4822 122 31349
C 3013	0.25PF	2.7PF	4822 122 31038
C 3013	0.25PF	2.7PF	4822 122 31038
C 3014	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 3016	2-20PF	MUR	5322 125 50296
C 3017	-20+50%	10NF	4822 122 31414
C 3017	-20+50%	10NF	4822 122 31414
C 3018	0.25PF	5.6PF	5322 122 32163
C 3018	0.25PF	5.6PF	5322 122 32163
C 3021	-20+50%	10NF	4822 122 31414
C 3021	-20+50%	10NF	4822 122 31414
C 3022	-20+50%	10NF	4822 122 31414
C 3022	-20+50%	10NF	4822 122 31414
C 3101	10%	1.5NF	4822 122 31169
C 3101	10%	1.5NF	4822 122 31169
C 3102	10%	1.5NF	4822 122 31169
C 3102	10%	1.5NF	4822 122 31169
C 3104	100V 10%	47NF	5322 121 42491
C 3104	100V 10%	47NF	5322 121 42491
C 3105	-20+50%	10NF	4822 122 31414
C 3105	-20+50%	10NF	4822 122 31414
C 3106	63V 10%	100NF	5322 121 42492
C 3106	63V 10%	100NF	5322 121 42492
C 3107	0.25PF	2.7PF	4822 122 31038
C 3107	0.25PF	2.7PF	4822 122 31038
C 3108	0.25PF	0.82PF	4822 122 31214
C 3108	0.25PF	0.82PF	4822 122 31214
C 3109	63V 10%	100NF	5322 121 42492
C 3109	63V 10%	100NF	5322 121 42492
C 3110	-20+50%	10NF	4822 122 31414
C 3110	-20+50%	10NF	4822 122 31414
C 3111	-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 3113	0.25PF	0.82PF	4822 122 31214
C 3114	100V 10%	47NF	5322 121 42491
C 3114	100V 10%	47NF	5322 121 42491
C 3116	63V 10%	100NF	5322 121 42492
C 3116	63V 10%	100NF	5322 121 42492
C 3200	0.25PF	0.56PF	5322 122 32107
C 3200	0.25PF	0.56PF	5322 122 32107
C 3201	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 3202	63V 10%	100NF	5322 121 42492
C 3203	63V 10%	100NF	5322 121 42492
C 3203	63V 10%	100NF	5322 121 42492
C 3204	-20+50%	10NF	4822 122 31414
C 3204	-20+50%	10NF	4822 122 31414
C 3206	63V 10%	100NF	5322 121 42492
C 3206	63V 10%	100NF	5322 121 42492
C 3208	10%	470PF	4822 122 30034
C 3208	10%	470PF	4822 122 30034
C 3209	-10+10%	2.2NF	5322 122 33851
C 3209	-10+10%	2.2NF	5322 122 33851
C 3211	-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 3250	100V 10%	10NF	4822 121 41857
C 3251	63V 10%	220NF	4822 121 42408
C 3251	100V 10%	47NF	5322 121 42491
C 3252	-10+10%	2.2NF	5322 122 33851
C 3252	-10+10%	2.2NF	5322 122 33851
C 3253	-20+50%	10NF	4822 122 31414
C 3253	-20+50%	10NF	4822 122 31414
C 3254	-20+50%	10NF	4822 122 31414
C 3254	-20+50%	10NF	4822 122 31414
C 3256	0.25PF	0.56PF	5322 122 32107
C 3256	0.25PF	0.56PF	5322 122 32107
C 3257	-20+50%	10NF	4822 122 31414
C 3257	-20+50%	10NF	4822 122 31414

POSNR	DESCRIPTION		ORDERING CODE
C 3258	-10+10%	2.2NF	5322 122 33851
C 3258	-10+10%	2.2NF	5322 122 33851
C 3301	-20+50%	10NF	4822 122 31414
C 3301	-20+50%	10NF	4822 122 31414
C 3302	-20+50%	10NF	4822 122 31414
C 3302	-20+50%	10NF	4822 122 31414
C 3303	-10+50%	47UF	4822 124 20699
C 3303	-10+50%	47UF	4822 124 20699
C 3304	-20+50%	10NF	4822 122 31414
C 3304	-20+50%	10NF	4822 122 31414
C 3306	-20+50%	10NF	4822 122 31414
C 3306	-20+50%	10NF	4822 122 31414
C 3307	-20+50%	10NF	4822 122 31414
C 3307	-20+50%	10NF	4822 122 31414
C 3308	-20+50%	10NF	4822 122 31414
C 3308	-20+50%	10NF	4822 122 31414
C 3309	-20+50%	10NF	4822 122 31414
C 3309	-20+50%	10NF	4822 122 31414
C 3311	-20+50%	10NF	4822 122 31414
C 3311	-20+50%	10NF	4822 122 31414
C 3312	-10+50%	47UF	4822 124 20699
C 3312	-10+50%	47UF	4822 124 20699
C 3313	-20+50%	10NF	4822 122 31414
C 3313	-20+50%	10NF	4822 122 31414
C 3314	-10+50%	15UF	4822 124 20729
C 3314	-10+50%	15UF	4822 124 20729
C 3316	-20+50%	10NF	4822 122 31414
C 3316	-20+50%	10NF	4822 122 31414
C 3317	-20+50%	10NF	4822 122 31414
C 3317	-20+50%	10NF	4822 122 31414
C 3318	-20+50%	10NF	4822 122 31414
C 3318	-20+50%	10NF	4822 122 31414
C 3319	-10+50%	15UF	4822 124 20729
C 3319	-10+50%	15UF	4822 124 20729
C 3321	-20+50%	10NF	4822 122 31414
C 3321	-20+50%	10NF	4822 122 31414
C 3322	-20+50%	10NF	4822 122 31414
C 3322	-20+50%	10NF	4822 122 31414
C 3324	-20+50%	10NF	4822 122 31414
C 3324	-20+50%	10NF	4822 122 31414
C 3326	-20+50%	10NF	4822 122 31414
C 3326	-20+50%	10NF	4822 122 31414
C 4001	63V 10%	100NF	5322 121 42492
C 4002	-10+50%	47UF	4822 124 20699
C 4003	63V 10%	100NF	5322 121 42492
C 4004	-20+50%	10NF	4822 122 31414
C 4005	-20+50%	10NF	4822 122 31414
C 4006	10%	4.7NF	4822 122 31125
C 4007	10%	4.7NF	4822 122 31125
C 4008	10%	470PF	4822 122 30034
C 4009	0.25PF	3.9PF	5322 122 34107
C 4011	2%	100PF	4822 122 31316
C 4022	-20+50%	10NF	4822 122 31414
C 4028	2%	100PF	4822 122 31316
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	-20+50%	10NF	4822 122 31414
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	100V 10%	47NF	5322 121 42491
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 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%	330PF	4822 122 31353
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

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C 4612	-20+50% 10NF	4822 122 31414
C 4613	2% 10PF	4822 122 32185
C 4701	10% 1NF	4822 122 30027
C 4702	2% 220PF	4822 122 30094
C 4703	10% 1NF	4822 122 30027
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 4812	-10+50% 47UF	4822 124 20699
C 4813	-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 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	-10+50% 680UF	4822 124 20685
C 6104	-10+50% 220UF	4822 124 20681
C 6106	-10+50% 470UF	4822 124 20695
C 6107	-10+50% 150UF	4822 124 20691
C 6108	-10+50% 470UF	4822 124 20695
C 6109	-10+50% 150UF	4822 124 20691
C 6111	-10+50% 220UF	4822 124 20704
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	4822 122 30027
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	4822 122 30027
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 7004	-20+50% 10NF	4822 122 31414
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% 220NF	4822 121 42408
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 7014	-20+50% 10NF	4822 122 31414
C 7016	-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 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% 100UF	4822 124 20679
C 7106	-20+50% 10NF	4822 122 31414
C 7107	-20+50% 10NF	4822 122 31414
C 7108	-20+50% 10NF	4822 122 31414
C 7109	-20+50% 10NF	4822 122 31414
C 7111	-20+50% 10NF	4822 122 31414
C 7112	-20+50% 10NF	4822 122 31414
C 7114	-10+50% 33UF	4822 124 20712
C 7116	-20+50% 10NF	4822 122 31414
C 7117	-20+50% 10NF	4822 122 31414

25.4.2 Resistors

R 0200	MRS25	1% 10K	4822 116 53022
R 0201	MRS25	1% 100K	4822 116 52973
R 0202	MRS25	1% 10K	4822 116 53022
R 0203	MRS25	1% 100K	4822 116 52973
R 0204	MRS25	1% 10K	4822 116 53022
R 0206	MRS25	1% 11K	4822 116 52907
R 0207	MRS25	1% 10K	4822 116 53022
R 0208	MRS25	1% 1K	4822 116 53108
R 0209	MRS25	1% 90K9	5322 116 53582
R 0211	MRS25	1% 1K	4822 116 53108
R 0212	MRS25	1% 46K4	5322 116 53314
R 0213	MRS25	1% 3K16	4822 116 53021
R 0214	MRS25	1% 46K4	5322 116 53314
R 0216	MRS25	1% 2K15	5322 116 53239
R 0217	MRS25	1% 10K	4822 116 53022
R 0218	MRS25	1% 10K	4822 116 53022
R 0219	MRS25	1% 10K	4822 116 53022
R 0220	MRS25	1% 2K15	5322 116 53239
R 0221	MRS25	1% 3K16	4822 116 53021
R 0222	MRS25	1% 3K16	4822 116 53021
R 0223	MRS25	1% 3K16	4822 116 53021
R 0224	MRS25	1% 3K16	4822 116 53021
R 0226	MRS25	1% 51E1	5322 116 53213
R 0227	MRS25	1% 51E1	5322 116 53213
R 0228	MRS25	1% 10K	4822 116 53022
R 0229	MRS25	1% 51E1	5322 116 53213
R 0231	MRS25	1% 2K61	5322 116 53327
R 0232	MRS25	1% 1E	4822 116 52976
R 0233	MRS25	1% 1E	4822 116 52976
R 0234	MRS25	1% 1E	4822 116 52976
R 0251	MRS25	1% 10E	4822 116 52891
R 0301	MRS25	1% 100E	5322 116 53126
R 0302	MRS25	1% 100E	5322 116 53126
R 0303	MRS25	1% 100E	5322 116 53126
R 0304	MRS25	1% 1K33	5322 116 53512
R 0306	MRS25	1% 1K33	5322 116 53512
R 0307	MRS25	1% 1K33	5322 116 53512
R 0309	MRS25	1% 10K	4822 116 53022
R 0312	MRS25	1% 2K15	5322 116 53239
R 0313	MRS25	1% 100K	4822 116 52973
R 0401	MRS25	1% 100E	5322 116 53126
R 0402	MRS25	1% 100E	5322 116 53126
R 0403	MRS25	1% 100E	5322 116 53126
R 0404	MRS25	1% 100E	5322 116 53126
R 0406	MRS25	1% 100E	5322 116 53126
R 0407	MRS25	1% 100E	5322 116 53126
R 0408	MRS25	1% 100E	5322 116 53126

POSNR	DESCRIPTION	ORDERING CODE
R 0409	MRS25 1% 100E	5322 116 53126
R 0411	MRS25 1% 100E	5322 116 53126
R 0412	MRS25 1% 100E	5322 116 53126
R 0413	MRS25 1% 100E	5322 116 53126
R 0414	MRS25 1% 100E	5322 116 53126
R 0416	MRS25 1% 100E	5322 116 53126
R 0417	MRS25 1% 100E	5322 116 53126
R 0418	MRS25 1% 1K33	5322 116 53512
R 0419	MRS25 1% 1K33	5322 116 53512
R 0421	MRS25 1% 1K33	5322 116 53512
R 0422	MRS25 1% 1K33	5322 116 53512
R 0423	MRS25 1% 1K33	5322 116 53512
R 0424	MRS25 1% 1K33	5322 116 53512
R 0426	MRS25 1% 1K33	5322 116 53512
R 0427	MRS25 1% 100E	5322 116 53126
R 0429	MRS25 1% 1K	4822 116 53108
R 0431	MRS25 1% 10K	4822 116 53022
R 0433	MRS25 1% 10K	4822 116 53022
R 0434	MRS25 1% 100E	5322 116 53126
R 0436	MRS25 1% 100E	5322 116 53126
R 0437	MRS25 1% 1E	4822 116 52976
R 0438	MRS25 1% 1E	4822 116 52976
R 0439	MRS25 1% 1E	4822 116 52976
R 0441	MRS25 1% 1E	4822 116 52976
R 0442	MRS25 1% 1E	4822 116 52976
R 0443	MRS25 1% 1E	4822 116 52976
R 0444	MRS25 1% 1E	4822 116 52976
R 0446	MRS25 1% 1E	4822 116 52976
R 0447	MRS25 1% 100E	5322 116 53126
R 0448	MRS25 1% 100E	5322 116 53126
R 0449	MRS25 1% 215E	5322 116 53325
R 0451	MRS25 1% 100E	5322 116 53126
R 0452	MRS25 1% 10K	4822 116 53022
R 0501	MRS25 1% 909E	4822 116 53533
R 0502	MRS25 1% 909E	4822 116 53533
R 0503	MRS25 1% 511E	5322 116 53135
R 0504	MRS25 1% 511E	5322 116 53135
R 0506	MRS25 1% 215E	5322 116 53325
R 0507	MRS25 1% 1K62	5322 116 53257
R 0508	MRS25 1% 909E	4822 116 53533
R 0509	MRS25 1% 909E	4822 116 53533
R 0510	MRS25 1% 511E	5322 116 53135
R 0511	MRS25 1% 511E	5322 116 53135
R 0512	MRS25 1% 215E	5322 116 53325
R 0513	MRS25 1% 1K	4822 116 53108
R 0514	MRS25 1% 1K96	5322 116 53237
R 0515	MRS25 1% 2K37	5322 116 53503
R 0516	MRS25 1% 5K11	5322 116 53494
R 0517	MRS25 1% 10E	4822 116 52891
R 0518	MRS25 1% 10E	4822 116 52891
R 0519	MRS25 1% 10E	4822 116 52891
R 0521	MRS25 1% 287E	5322 116 53221
R 0522	MRS25 1% 1K	4822 116 53108
R 0523	MRS25 1% 10K	4822 116 53022
R 0524	MRS25 1% 1K	4822 116 53108
R 0525	MRS25 1% 1K	4822 116 53108
R 0526	MRS25 1% 10K	4822 116 53022
R 0527	MRS25 1% 1K	4822 116 53108
R 0528	MRS25 1% 287E	5322 116 53221
R 0531	MRS25 1% 2K15	5322 116 53239
R 0532	MRS25 1% 10E	4822 116 52891
R 0533	MRS25 1% 10E	4822 116 52891
R 0534	MRS25 1% 215E	5322 116 53325
R 0536	MRS25 1% 422E	5322 116 53592
R 0537	MRS25 1% 215E	5322 116 53325
R 0538	MRS25 1% 51E1	5322 116 53213
R 0539	MRS25 1% 422E	5322 116 53592
R 0541	MRS25 1% 10K	4822 116 53022
R 0542	0.3W 25% 22K	5322 105 20043
R 0543	MRS25 1% 348K	5322 116 80115
R 0545	MRS25 1% 2K87	5322 116 53513
R 0546	MRS25 1% 2K87	5322 116 53513
R 0548	MRS25 1% 10E	4822 116 52891
R 0549	MRS25 1% 10K	4822 116 53022
R 0550	0.3W 25% 4K7	5322 105 20042
R 0551	MRS25 1% 10K	4822 116 53022
R 0553	0.3W 25% 4K7	5322 105 20042
R 0554	MRS25 1% 100E	5322 116 53126
R 0556	MRS25 1% 5K11	5322 116 53494
R 0557	MRS25 1% 1K1	5322 116 53473
R 0558	MRS25 1% 3K48	4822 116 53315
R 0559	MRS25 1% 13K3	5322 116 53489
R 0560	MRS25 1% 100E	5322 116 53126
R 0561	MRS25 1% 10K	4822 116 53022
R 0562	MRS25 1% 10K	4822 116 53022
R 0563	MRS25 1% 3K16	4822 116 53021
R 0564	MRS25 1% 2K15	5322 116 53239
R 0565	MRS25 1% 8K25	5322 116 53267
R 0566	MRS25 1% 5K11	5322 116 53494
R 0568	MRS25 1% 4K64	5322 116 53212
R 0569	MRS25 1% 42E2	5322 116 53515
R 0571	MRS25 1% 3K83	4822 116 53079
R 0572	MRS25 1% 8K25	5322 116 53267
R 0573	MRS25 1% 3K48	4822 116 53315
R 0574	MRS25 1% 1K78	5322 116 53208
R 0575	MRS25 1% 10K	4822 116 53022
R 0576	MRS25 1% 5K11	5322 116 53494
R 0577	MRS25 1% 5K11	5322 116 53494
R 0578	MRS25 1% 10K	4822 116 53022
R 0579	MRS25 1% 10E	4822 116 52891
R 0581	MRS25 1% 10E	4822 116 52891
R 0582	MRS25 1% 1K21	4822 116 52956
R 0583	MRS25 1% 10E	4822 116 52891
R 0584	MRS25 1% 100E	5322 116 53126
R 0585	MRS25 1% 10K	4822 116 53022
R 0586	MRS25 1% 10K	4822 116 53022
R 0587	MRS25 1% 26K1	5322 116 53261
R 0588	MRS25 1% 7K5	4822 116 53028
R 0589	MRS25 1% 15K4	5322 116 53234
R 0591	MRS25 1% 46K4	5322 116 53314
R 0592	MRS25 1% 46K4	5322 116 53314
R 0593	MRS25 1% 5K11	5322 116 53494
R 0594	MRS25 1% 3K16	4822 116 53021
R 0595	MRS25 1% 10E	4822 116 52891
R 0596	MRS25 1% 10K	4822 116 53022
R 0598	MRS25 1% 51E1	5322 116 53213
R 0599	MRS25 1% 511E	5322 116 53135
R 0600	MRS25 1% 100K	4822 116 52973
R 0601	0.3W 25% 22K	5322 105 20043
R 0601	MRS25 1% 10K	4822 116 53022
R 0602	MRS25 1% 11K	4822 116 52907
R 0602	MRS25 1% 5K62	5322 116 53495
R 0603	MRS25 1% 261E	5322 116 53549
R 0603	MRS25 1% 10K	4822 116 53022
R 0604	MRS25 1% 10K	4822 116 53022
R 0604	MRS25 1% 10K	4822 116 53022
R 0605	MRS25 1% 11K	4822 116 52907
R 0605	MRS25 1% 100K	4822 116 52973
R 0606	0.3W 25% 4K7	5322 105 20042
R 0606	MRS25 1% 16K2	5322 116 53589
R 0607	MRS25 1% 511E	5322 116 53135
R 0607	MRS25 1% 2K15	5322 116 53239
R 0608	MRS25 1% 511E	5322 116 53135
R 0608	MRS25 1% 2K15	5322 116 53239
R 0609	MRS25 1% 511E	5322 116 53135
R 0609	MRS25 1% 2K15	5322 116 53239
R 0610	MRS25 1% 10K	4822 116 53022
R 0611	MRS25 1% 511E	5322 116 53135
R 0611	MRS25 1% 2K15	5322 116 53239
R 0612	MRS25 1% 2K15	5322 116 53239
R 0612	MRS25 1% 422E	5322 116 53592
R 0613	MRS25 1% 7K5	4822 116 53028
R 0613	MRS25 1% 422E	5322 116 53592
R 0614	MRS25 1% 10K	4822 116 53022
R 0614	MRS25 1% 10K	4822 116 53022
R 0615	MRS25 1% 1K47	5322 116 53185
R 0616	MRS25 1% 12K1	4822 116 52957
R 0616	MRS25 1% 75E	5322 116 53339
R 0617	MRS25 1% 75E	5322 116 53339
R 0618	MRS25 1% 10K	4822 116 53022
R 0619	MRS25 1% 2K15	5322 116 53239
R 0621	MRS25 1% 5E11	4822 116 52999
R 0621	MRS25 1% 51E1	5322 116 53213
R 0622	MRS25 1% 5E11	4822 116 52999
R 0622	MRS25 1% 1K62	5322 116 53257
R 0623	MRS25 1% 1K62	5322 116 53257
R 0624	MRS25 1% 5E11	4822 116 52999
R 0624	MRS25 1% 178K	5322 116 53555
R 0626	MRS25 1% 26K1	5322 116 53261
R 0627	MRS25 1% 5E11	4822 116 52999
R 0627	MRS25 1% 178K	5322 116 53555
R 0628	MRS25 1% 5E11	4822 116 52999
R 0628	MRS25 1% 1M	4822 116 52843
R 0629	MRS25 1% 5E11	4822 116 52999
R 0629	MRS25 1% 2K15	5322 116 53239
R 0631	MRS25 1% 12K1	4822 116 52957
R 0633	MRS25 1% 1M	4822 116 52843
R 0634	MRS25 1% 2K15	5322 116 53239
R 0636	MRS25 1% 51K1	4822 116 53121
R 0637	MRS25 1% 16K2	5322 116 53589
R 0638	MRS25 1% 511E	5322 116 53135
R 0639	MRS25 1% 511E	5322 116 53135
R 0641	MRS25 1% 12K1	4822 116 52957
R 0642	MRS25 1% 422E	5322 116 53592
R 0643	MRS25 1% 422E	5322 116 53592
R 0644	MRS25 1% 16K2	5322 116 53589
R 0646	MRS25 1% 5K62	5322 116 53495
R 0647	MRS25 1% 1K78	5322 116 53208
R 0648	MRS25 1% 6K81	5322 116 53252
R 0649	MRS25 1% 51K1	4822 116 53121

POSNR	DESCRIPTION	ORDERING CODE
R 0651	MRS25 1% 16K2	5322 116 53589
R 0652	MRS25 1% 511E	5322 116 53135
R 0653	MRS25 1% 511E	5322 116 53135
R 0654	MRS25 1% 422E	5322 116 53592
R 0656	MRS25 1% 422E	5322 116 53592
R 0657	MRS25 1% 16K2	5322 116 53589
R 0658	MRS25 1% 51K1	4822 116 53121
R 0659	MRS25 1% 5K62	5322 116 53495
R 0661	MRS25 1% 1K78	5322 116 53208
R 0662	MRS25 1% 6K81	5322 116 53252
R 0663	MRS25 1% 51K1	4822 116 53121
R 0666	MRS25 1% 51E1	5322 116 53213
R 0669	MRS25 1% 1K62	5322 116 53257
R 0671	MRS25 1% 1K62	5322 116 53257
R 0681	MRS25 1% 5E11	4822 116 52999
R 0682	MRS25 1% 5E11	4822 116 52999
R 0701	MCR18 1% 4K7	5322 111 90111
R 0702	MCR18 1% 47E	4822 111 90217
R 0703	MCR18 1% 100E	5322 111 91134
R 0704	MCR18 1% 10K	4822 111 90249
R 0706	MCR18 1% 180E	5322 111 90242
R 0707	MCR18 1% 47E	4822 111 90217
R 0708	MCR18 1% 4K7	5322 111 90111
R 0709	MCR18 1% 330E	5322 111 90106
R 0711	MCR18 1% 470E	5322 111 90109
R 0712	MCR18 1% 3K3	4822 111 90157
R 0713	MCR18 1% 470E	5322 111 90109
R 0714	MCR18 1% 330E	5322 111 90106
R 0715	MCR18 1% 100E	5322 111 91134
R 0716	MCR18 1% 750E	5322 111 91539
R 0717	MCR18 1% 10K	4822 111 90249
R 0718	MCR18 1% 10K	4822 111 90249
R 0719	MCR18 1% 750E	5322 111 91539
R 0720	MCR18 1% 220E	4822 111 90178
R 0721	MCR18 1% 10K	4822 111 90249
R 0722	MCR18 1% 3K9	5322 111 91135
R 0723	MCR18 1% 15K	4822 111 90196
R 0724	MCR18 1% 10K	4822 111 90249
R 0725	MCR18 1% 1K	5322 111 90092
R 0726	MCR18 1% 22K	5322 111 91349
R 0727	MCR18 1% 27K	4822 111 90542
R 0728	MCR18 1% 10K	4822 111 90249
R 0729	MCR18 1% 12K	4822 111 90253
R 0731	MCR18 1% 6K8	4822 111 90544
R 0732	MCR18 1% 27K	4822 111 90542
R 0733	MCR18 1% 100E	5322 111 91134
R 0734	MCR18 1% 1K2	5322 111 90096
R 0735	MCR18 1% 100E	5322 111 91134
R 0736	MCR18 1% 1K	5322 111 90092
R 0737	MCR18 1% 3K9	5322 111 91135
R 0738	MCR18 1% 15K	4822 111 90196
R 0739	MCR18 1% 27K	4822 111 90542
R 0741	MCR18 1% 3K3	4822 111 90157
R 0742	MCR18 1% 15K	4822 111 90196
R 0743	MCR18 1% 1K	5322 111 90092
R 0744	MCR18 1% 3K9	5322 111 91135
R 0746	MCR18 1% 10K	4822 111 90249
R 0747	MCR18 1% 330E	5322 111 90106
R 0748	MCR18 1% 270E	4822 111 90154
R 0749	MCR18 1% 51E	5322 111 91352
R 0751	MCR18 1% 10K	4822 111 90249
R 0752	MCR18 1% 68K	4822 111 90202
R 0753	MCR18 1% 4K7	5322 111 90111
R 0754	MCR18 1% 10K	4822 111 90249
R 0755	MCR18 1% 3K3	4822 111 90157
R 0756	MCR18 1% 10K	4822 111 90249
R 0760	MCR18 1% 1K	5322 111 90092
R 0761	MCR18 1% 6K8	4822 111 90544
R 0762	MCR18 1% 27K	4822 111 90542
R 0763	MCR18 1% 100E	5322 111 91134
R 0764	MCR18 1% 1K2	5322 111 90096
R 0765	MCR18 1% 1K	5322 111 90092
R 0766	MCR18 1% 100E	5322 111 91134
R 0767	MCR18 1% 3K9	5322 111 91135
R 0768	MCR18 1% 15K	4822 111 90196
R 0769	MCR18 1% 27K	4822 111 90542
R 0770	MCR18 1% 1K	5322 111 90092
R 0771	MCR18 1% 3K3	4822 111 90157
R 0772	MCR18 1% 15K	4822 111 90196
R 0773	MCR18 1% 1K	5322 111 90092
R 0774	MCR18 1% 3K9	5322 111 91135
R 0776	MCR18 1% 10K	4822 111 90249
R 0777	MCR18 1% 330E	5322 111 90106
R 0778	MCR18 1% 270E	4822 111 90154
R 0779	MCR18 1% 51E	5322 111 91352
R 0781	MCR18 1% 10K	4822 111 90249
R 0782	MCR18 1% 68K	4822 111 90202
R 0783	MCR18 1% 4K7	5322 111 90111
R 0784	MCR18 1% 10K	4822 111 90249
R 0785	MCR18 1% 3K3	4822 111 90157

POSNR	DESCRIPTION	ORDERING CODE
R 0786	MCR18 1% 10K	4822 111 90249
R 0791	MCR18 1% 10E	5322 111 90095
R 0792	MCR18 1% 10E	5322 111 90095
R 0793	MCR18 1% 10E	5322 111 90095
R 0794	MCR18 1% 10E	5322 111 90095
R 0801	MRS25 1% 10E	4822 116 52891
R 0802	MRS25 1% 100E	5322 116 53126
R 0804	MRS25 1% 422E	5322 116 53592
R 0805	MRS25 1% 316E	5322 116 53499
R 0806	MRS25 1% 10E	4822 116 52891
R 0807	MRS25 1% 100E	5322 116 53126
R 0809	MRS25 1% 422E	5322 116 53592
R 0810	MRS25 1% 316E	5322 116 53499
R 0811	MRS25 1% 316E	5322 116 53499
R 0812	MRS25 1% 1K	4822 116 53108
R 0813	MRS25 1% 2K61	5322 116 53327
R 0814	MRS25 1% 100E	5322 116 53126
R 0815	MRS25 1% 316E	5322 116 53499
R 0816	MRS25 1% 10E	4822 116 52891
R 0817	MRS25 1% 100E	5322 116 53126
R 0818	MRS25 1% 10E	4822 116 52891
R 0819	MRS25 1% 162E	5322 116 53523
R 0821	MRS25 1% 162E	5322 116 53523
R 0822	MRS25 1% 10E	4822 116 52891
R 0823	MRS25 1% 100E	5322 116 53126
R 0824	MRS25 1% 10E	4822 116 52891
R 0825	MRS25 1% 162E	5322 116 53523
R 0826	MRS25 1% 162E	5322 116 53523
R 0827	MRS25 1% 100E	5322 116 53126
R 0828	MRS25 1% 215E	5322 116 53325
R 0829	MRS25 1% 215E	5322 116 53325
R 0831	MRS25 1% 10E	4822 116 52891
R 0832	MRS25 1% 100E	5322 116 53126
R 0834	MRS25 1% 422E	5322 116 53592
R 0835	MRS25 1% 316E	5322 116 53499
R 0836	MRS25 1% 10E	4822 116 52891
R 0837	MRS25 1% 100E	5322 116 53126
R 0839	MRS25 1% 422E	5322 116 53592
R 0840	MRS25 1% 316E	5322 116 53499
R 0841	MRS25 1% 316E	5322 116 53499
R 0842	MRS25 1% 1K	4822 116 53108
R 0843	MRS25 1% 2K61	5322 116 53327
R 0844	MRS25 1% 100E	5322 116 53126
R 0845	MRS25 1% 316E	5322 116 53499
R 0846	MRS25 1% 10E	4822 116 52891
R 0847	MRS25 1% 100E	5322 116 53126
R 0848	MRS25 1% 10E	4822 116 52891
R 0849	MRS25 1% 162E	5322 116 53523
R 0851	MRS25 1% 162E	5322 116 53523
R 0852	MRS25 1% 10E	4822 116 52891
R 0853	MRS25 1% 100E	5322 116 53126
R 0854	MRS25 1% 10E	4822 116 52891
R 0855	MRS25 1% 162E	5322 116 53523
R 0856	MRS25 1% 162E	5322 116 53523
R 0857	MRS25 1% 100E	5322 116 53126
R 0858	MRS25 1% 215E	5322 116 53325
R 0859	MRS25 1% 215E	5322 116 53325
R 0860	MRS25 1% 1E	4822 116 52976
R 0861	MRS25 1% 5E11	4822 116 52999
R 0862	MRS25 1% 2K15	5322 116 53239
R 0863	MRS25 1% 1K	4822 116 53108
R 0864	MRS25 1% 422E	5322 116 53592
R 0865	MRS25 1% 1K	4822 116 53108
R 0866	MRS25 1% 51E1	5322 116 53213
R 0867	MRS25 1% 51E1	5322 116 53213
R 0868	MRS25 1% 237E	5322 116 53259
R 0869	MRS25 1% 51E1	5322 116 53213
R 0870	MRS25 1% 1E	4822 116 52976
R 0871	MRS25 1% 681E	4822 116 53123
R 0872	MRS25 1% 5E11	4822 116 52999
R 0873	MRS25 1% 2K15	5322 116 53239
R 0874	MRS25 1% 1K	4822 116 53108
R 0875	MRS25 1% 1K	4822 116 53108
R 0876	MRS25 1% 2K15	5322 116 53239
R 0877	MRS25 1% 2K15	5322 116 53239
R 0878	MRS25 1% 2K15	5322 116 53239
R 0879	MRS25 1% 2K15	5322 116 53239
R 0880	MRS25 1% 1E	4822 116 52976
R 0882	MRS25 1% 100E	5322 116 53126
R 0883	MRS25 1% 100E	5322 116 53126
R 0884	MRS25 1% 100E	5322 116 53126
R 0885	MRS25 1% 1K	4822 116 53108
R 0886	MRS25 1% 100E	5322 116 53126
R 0887	MRS25 1% 2K61	5322 116 53327
R 0888	MRS25 1% 10K	4822 116 53022
R 0889	MRS25 1% 121E	4822 116 52955
R 0890	MRS25 1% 316E	5322 116 53499
R 0891	MRS25 1% 5K11	5322 116 53494
R 0892	0.3W 25% 10K	4822 105 10455
R 0893	MRS25 1% 5K11	5322 116 53494
R 0894	0.3W 25% 10K	4822 105 10455

POSNR	DESCRIPTION	ORDERING CODE
R 0895	MRS25 1% 17K8	5322 116 53235
R 0901	MRS25 1% 3K16	4822 116 53021
R 0902	0.3W 25% 2K2	5322 105 20033
R 0904	MRS25 1% 4K22	5322 116 53246
R 0905	MRS25 1% 4K22	5322 116 53246
R 0906	MRS25 1% 4K22	5322 116 53246
R 0909	MRS25 1% 4K22	5322 116 53246
R 0911	MRS25 1% 4K22	5322 116 53246
R 0914	MRS25 1% 4K22	5322 116 53246
R 0915	MRS25 1% 4K22	5322 116 53246
R 0916	MRS25 1% 3K16	4822 116 53021
R 0917	0.3W 25% 2K2	5322 105 20033
R 0919	MRS25 1% 4K22	5322 116 53246
R 0921	MRS25 1% 4K22	5322 116 53246
R 0922	MRS25 1% 4K22	5322 116 53246
R 0924	MRS25 1% 5K11	5322 116 53494
R 0925	MRS25 1% 5K11	5322 116 53494
R 0926	MRS25 1% 2K87	5322 116 53513
R 0927	MRS25 1% 100E	5322 116 53126
R 0929	0.3W 25% 10K	4822 105 10455
R 0931	MRS25 1% 1K47	5322 116 53185
R 0932	0.3W 25% 4K7	5322 105 20034
R 0933	MRS25 1% 17K8	5322 116 53235
R 0934	MRS25 1% 5K11	5322 116 53494
R 0935	MRS25 1% 5K11	5322 116 53494
R 0936	MRS25 1% 5K11	5322 116 53494
R 0937	MRS25 1% 100E	5322 116 53126
R 0939	0.3W 25% 10K	4822 105 10455
R 0941	MRS25 1% 1K47	5322 116 53185
R 0942	0.3W 25% 4K7	5322 105 20034
R 0944	MRS25 1% 5K11	5322 116 53494
R 0945	MRS25 1% 5K11	5322 116 53494
R 0946	MRS25 1% 2K87	5322 116 53513
R 0947	MRS25 1% 100E	5322 116 53126
R 0953	MRS25 1% 17K8	5322 116 53235
R 0954	MRS25 1% 5K11	5322 116 53494
R 0955	MRS25 1% 5K11	5322 116 53494
R 0956	MRS25 1% 5K11	5322 116 53494
R 0957	MRS25 1% 100E	5322 116 53126
R 0958	MRS25 1% 4K64	5322 116 53212
R 0961	MRS25 1% 121E	4822 116 52955
R 0962	MRS25 1% 75E	5322 116 53339
R 0965	MRS25 1% 10K	4822 116 53022
R 0966	0.3W 25% 10K	4822 105 10455
R 0967	MRS25 1% 10K	4822 116 53022
R 0968	MRS25 1% 100E	5322 116 53126
R 0969	MRS25 1% 10K	4822 116 53022
R 0970	0.3W 25% 10K	4822 105 10455
R 0971	MRS25 1% 10K	4822 116 53022
R 0972	MRS25 1% 100E	5322 116 53126
R 0973	MRS25 1% 10K	4822 116 53022
R 0974	0.3W 25% 10K	4822 105 10455
R 0975	MRS25 1% 10K	4822 116 53022
R 0976	MRS25 1% 10K	4822 116 53022
R 0977	0.3W 25% 10K	4822 105 10455
R 0978	MRS25 1% 10K	4822 116 53022
R 0979	MRS25 1% 5K11	5322 116 53494
R 0981	MRS25 1% 17K8	5322 116 53235
R 0983	MRS25 1% 5E11	4822 116 52999
R 0984	MRS25 1% 5E11	4822 116 52999
R 0985	MRS25 1% 5E11	4822 116 52999
R 0986	MRS25 1% 5E11	4822 116 52999
R 0987	MRS25 1% 10K	4822 116 53022
R 0988	MRS25 1% 14K7	4822 116 53531
R 0989	MRS25 1% 10K	4822 116 53022
R 0991	MRS25 1% 14K7	4822 116 53531
R 0992	MRS25 1% 1K	4822 116 53108
R 0993	MRS25 1% 1K	4822 116 53108
R 0996	MRS25 1% 1E	4822 116 52976
R 0997	MRS25 1% 1K33	5322 116 53512
R 0998	MRS25 1% 6K81	5322 116 53252
R 1001	MRS25 1% 1K	4822 116 53108
R 1002	MRS25 1% 42E2	5322 116 53515
R 1003	MRS25 1% 61E9	5322 116 53645
R 1004	1/4W .25% 10K1	5322 116 53404
R 1006	MRS25 1% 121E	4822 116 52955
R 1007	0.4W 0.25% 900K	5322 116 53414
R 1008	MRS25 1% 10K	4822 116 53022
R 1009	MRS25 1% 21K5	5322 116 53241
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 116 53022
R 1016	MRS25 1% 21K5	5322 116 53241
R 1017	1/4W .25% 250K	5322 116 53587
R 1018	MRS25 1% 10E	4822 116 52891
R 1019	0.4W 0.25% 990K	5322 116 53415
R 1022	MRS25 1% 56E2	5322 116 53644
R 1023	VR25 10%	5322 116 51785
R 1024	MRS25 1% 10E	4822 116 52891

POSNR	DESCRIPTION	ORDERING CODE
R 1026	MRS25 1% 61E9	5322 116 53645
R 1027	VR25 10%	5322 116 51785
R 1028	MRS25 1% 10E	4822 116 52891
R 1029	1/4W .25% 1M	5322 116 53398
R 1031	VR25 10%	5322 116 51785
R 1032	MRS25 1% 10E	4822 116 52891
R 1033	VR25 10%	5322 116 51785
R 1034	MRS25 1% 1M	4822 116 52843
R 1035	MRS25 1% 100E	5322 116 53126
R 1036	0.3W 25% 22K	5322 105 20035
R 1037	MRS25 1% 100K	4822 116 52973
R 1038	VR25 10%	5322 116 51785
R 1039	MRS25 1% 1K96	5322 116 53237
R 1040	MRS25 1% 287E	5322 116 53221
R 1041	MRS25 1% 1K96	5322 116 53237
R 1043	MRS25 1% 100E	5322 116 53126
R 1044	MRS25 1% 825E	5322 116 53541
R 1045	MRS25 1% 100E	5322 116 53126
R 1046	MRS25 1% 511E	5322 116 53135
R 1047	MRS25 1% 2K15	5322 116 53239
R 1048	MRS25 1% 5K11	5322 116 53494
R 1049	MRS25 1% 1K47	5322 116 53185
R 1050	MRS25 1% 100E	5322 116 53126
R 1051	MRS25 1% 681E	4822 116 53123
R 1052	MRS25 1% 1K78	5322 116 53208
R 1053	1/4W .25% 250E	5322 116 53406
R 1054	MRS25 1% 100E	5322 116 53126
R 1055	MRS25 1% 1K78	5322 116 53208
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 116 52906
R 1062	MRS25 1% 10E	4822 116 52891
R 1063	MRS25 1% 26K1	5322 116 53261
R 1064	0.3W 25% 10K	4822 105 10455
R 1066	MRS25 1% 21K5	5322 116 53241
R 1067	MRS25 1% 31K6	5322 116 53262
R 1068	MRS25 1% 162E	5322 116 53523
R 1069	0.3W 25% 100E	5322 105 20029
R 1071	MRS25 1% 26K1	5322 116 53261
R 1072	0.3W 25% 10K	4822 105 10455
R 1073	MRS25 1% 6K81	5322 116 53252
R 1074	MRS25 1% 12K1	4822 116 52957
R 1076	0.3W 25% 100E	5322 105 20029
R 1077	MRS25 1% 51E1	5322 116 53213
R 1078	MRS25 1% 14K7	4822 116 53531
R 1079	MRS25 1% 1K62	5322 116 53257
R 1081	MRS25 1% 511E	5322 116 53135
R 1082	MRS25 1% 90K9	5322 116 53582
R 1083	MRS25 1% 10K	4822 116 53022
R 1084	MRS25 1% 100K	4822 116 52973
R 1086	MRS25 1% 10K	4822 116 53022
R 1088	MRS25 1% 100E	5322 116 53126
R 1089	MRS25 1% 422E	5322 116 53592
R 1091	0.3W 25% 100E	5322 105 20029
R 1092	MRS25 1% 10E	4822 116 52891
R 1093	MRS25 1% 422E	5322 116 53592
R 1094	MRS25 1% 100E	5322 116 53126
R 1096	MRS25 1% 100E	5322 116 53126
R 1097	MRS25 1% 100E	5322 116 53126
R 1098	MRS25 1% 1K21	4822 116 52956
R 1099	MRS25 1% 1K21	4822 116 52956
R 1101	MRS25 1% 1K	4822 116 53108
R 1102	MRS25 1% 42E2	5322 116 53515
R 1103	MRS25 1% 61E9	5322 116 53645
R 1104	1/4W .25% 10K1	5322 116 53404
R 1106	MRS25 1% 121E	4822 116 52955
R 1107	0.4W 0.25% 900K	5322 116 53414
R 1108	MRS25 1% 10K	4822 116 53022
R 1109	MRS25 1% 21K5	5322 116 53241
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 116 53022
R 1116	MRS25 1% 21K5	5322 116 53241
R 1117	1/4W .25% 250K	5322 116 53587
R 1118	MRS25 1% 10E	4822 116 52891
R 1119	0.4W 0.25% 990K	5322 116 53415
R 1122	MRS25 1% 56E2	5322 116 53644
R 1123	VR25 10%	5322 116 51785
R 1124	MRS25 1% 10E	4822 116 52891
R 1126	MRS25 1% 61E9	5322 116 53645
R 1127	VR25 10%	5322 116 51785
R 1128	MRS25 1% 10E	4822 116 52891
R 1129	1/4W .25% 1M	5322 116 53398
R 1131	VR25 10%	5322 116 51785
R 1132	MRS25 1% 10E	4822 116 52891
R 1133	VR25 10%	5322 116 51785
R 1134	MRS25 1% 1M	4822 116 52843
R 1135	MRS25 1% 100E	5322 116 53126
R 1136	0.3W 25% 22K	5322 105 20035

POSNR	DESCRIPTION	ORDERING CODE
R 1137	MRS25 1% 100K	4822 116 52973
R 1138	VR25 10%	5322 116 51785
R 1139	MRS25 1% 1K96	5322 116 53237
R 1140	MRS25 1% 287E	5322 116 53221
R 1141	MRS25 1% 1K96	5322 116 53237
R 1143	MRS25 1% 100E	5322 116 53126
R 1144	MRS25 1% 825E	5322 116 53541
R 1145	MRS25 1% 100E	5322 116 53126
R 1146	MRS25 1% 511E	5322 116 53135
R 1147	MRS25 1% 2K15	5322 116 53239
R 1148	MRS25 1% 5K11	5322 116 53494
R 1149	MRS25 1% 1K47	5322 116 53185
R 1150	MRS25 1% 100E	5322 116 53126
R 1151	MRS25 1% 681E	4822 116 53123
R 1152	MRS25 1% 1K78	5322 116 53208
R 1153	1/4W .25% 250E	5322 116 53406
R 1154	MRS25 1% 100E	5322 116 53126
R 1155	MRS25 1% 1K78	5322 116 53208
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 116 52906
R 1162	MRS25 1% 10E	4822 116 52891
R 1163	MRS25 1% 26K1	5322 116 53261
R 1164	0.3W 25% 10K	4822 105 10455
R 1166	MRS25 1% 21K5	5322 116 53241
R 1167	MRS25 1% 31K6	5322 116 53262
R 1168	MRS25 1% 162E	5322 116 53523
R 1169	0.3W 25% 100E	5322 105 20029
R 1171	MRS25 1% 26K1	5322 116 53261
R 1172	0.3W 25% 10K	4822 105 10455
R 1173	MRS25 1% 6K81	5322 116 53252
R 1174	MRS25 1% 12K1	4822 116 52957
R 1176	0.3W 25% 100E	5322 105 20029
R 1177	MRS25 1% 51E1	5322 116 53213
R 1178	MRS25 1% 14K7	4822 116 53531
R 1179	MRS25 1% 1K62	5322 116 53257
R 1181	MRS25 1% 511E	5322 116 53135
R 1182	MRS25 1% 90K9	5322 116 53582
R 1183	MRS25 1% 10K	4822 116 53022
R 1184	MRS25 1% 100K	4822 116 52973
R 1186	MRS25 1% 10K	4822 116 53022
R 1188	MRS25 1% 100E	5322 116 53126
R 1189	MRS25 1% 422E	5322 116 53592
R 1191	0.3W 25% 100E	5322 105 20029
R 1192	MRS25 1% 10E	4822 116 52891
R 1193	MRS25 1% 422E	5322 116 53592
R 1194	MRS25 1% 100E	5322 116 53126
R 1196	MRS25 1% 100E	5322 116 53126
R 1197	MRS25 1% 100E	5322 116 53126
R 1198	MRS25 1% 1K21	4822 116 52956
R 1199	MRS25 1% 1K21	4822 116 52956
R 1201	MRS25 1% 1K	4822 116 53108
R 1202	MRS25 1% 68E1	5322 116 53264
R 1203	0.4W 0.1% 1M	5322 116 51605
R 1204	VR25 10%	5322 116 51785
R 1206	MRS25 1% 1K96	5322 116 53237
R 1207	MRS25 1% 100E	5322 116 53126
R 1208	MRS25 1% 825E	5322 116 53541
R 1209	MRS25 1% 1M	4822 116 52843
R 1211	MRS25 1% 100E	5322 116 53126
R 1213	MRS25 1% 1M	4822 116 52843
R 1217	0.3W 25% 22K	5322 105 20035
R 1218	MRS25 1% 100K	4822 116 52973
R 1219	MRS25 1% 1K47	5322 116 53185
R 1221	MRS25 1% 681E	4822 116 53123
R 1222	MRS25 1% 2K87	5322 116 53513
R 1223	MRS25 1% 1K33	5322 116 53512
R 1224	MRS25 1% 1K	4822 116 53108
R 1226	MRS25 1% 5K11	5322 116 53494
R 1227	MRS25 1% 1K33	5322 116 53512
R 1228	MRS25 1% 100E	5322 116 53126
R 1229	MRS25 1% 750E	5322 116 53265
R 1231	MRS25 1% 750E	5322 116 53265
R 1232	MRS25 1% 82E5	5322 116 53538
R 1233	MRS25 1% 348E	5322 116 53591
R 1234	MRS25 1% 100E	5322 116 53126
R 1236	MRS25 1% 162E	5322 116 53523
R 1237	MRS25 1% 2K61	5322 116 53327
R 1238	MRS25 1% 100E	5322 116 53126
R 1239	MRS25 1% 7K5	4822 116 53028
R 1401	MRS25 1% 5E11	4822 116 52999
R 1402	MRS25 1% 5E11	4822 116 52999
R 1403	MRS25 1% 5E11	4822 116 52999
R 1404	MRS25 1% 5E11	4822 116 52999
R 1421	MRS25 1% 5E11	4822 116 52999
R 1422	MRS25 1% 5E11	4822 116 52999
R 1423	MRS25 1% 5E11	4822 116 52999
R 1424	MRS25 1% 5E11	4822 116 52999
R 1441	MRS25 1% 100E	5322 116 53126

POSNR	DESCRIPTION	ORDERING CODE
R 1442	MRS25 1% 5E11	4822 116 52999
R 1443	MRS25 1% 5E11	4822 116 52999
R 2001	MRS25 1% 10E	4822 116 52891
R 2002	MRS25 1% 10E	4822 116 52891
R 2003	MRS25 1% 51E1	5322 116 53213
R 2004	MRS25 1% 51E1	5322 116 53213
R 2101	MRS25 1% 10E	4822 116 52891
R 2102	MRS25 1% 10E	4822 116 52891
R 2201	MRS25 1% 75K	5322 116 53266
R 2202	MRS25 1% 12K1	4822 116 52957
R 2203	MRS25 1% 215K	5322 116 53425
R 2204	MRS25 1% 10K	4822 116 53022
R 2205	MRS25 1% 2K15	5322 116 53239
R 2206	MRS25 1% 75K	5322 116 53266
R 2207	MRS25 1% 12K1	4822 116 52957
R 2208	MRS25 1% 215K	5322 116 53425
R 2209	MRS25 1% 10K	4822 116 53022
R 2210	MRS25 1% 2K15	5322 116 53239
R 2211	MRS25 1% 5K62	5322 116 53495
R 2212	0.3W 25% 10K	4822 105 10455
R 2213	MRS25 1% 23K7	5322 116 53537
R 2214	MRS25 1% 10K	4822 116 53022
R 2215	MRS25 1% 2K15	5322 116 53239
R 2216	MRS25 1% 5K62	5322 116 53495
R 2222	MRS25 1% 1K96	5322 116 53237
R 2225	MRS25 1% 23K7	5322 116 53537
R 2230	MRS25 1% 147E	5322 116 53497
R 2231	MRS25 1% 422E	5322 116 53592
R 2232	MRS25 1% 383E	5322 116 53332
R 2234	MRS25 1% 31E6	5322 116 54964
R 2235	MRS25 1% 46E4	5322 116 53248
R 2236	MRS25 1% 681E	4822 116 53123
R 2237	MRS25 1% 383E	5322 116 53332
R 2239	MRS25 1% 348E	5322 116 53591
R 2241	MRS25 1% 1K	4822 116 53108
R 2242	MRS25 1% 383E	5322 116 53332
R 2243	MRS25 1% 681E	4822 116 53123
R 2244	MRS25 1% 31E6	5322 116 54964
R 2245	MRS25 1% 46E4	5322 116 53248
R 2246	MRS25 1% 422E	5322 116 53592
R 2247	MRS25 1% 383E	5322 116 53332
R 2251	MRS25 1% 75E	5322 116 53339
R 2252	MRS25 1% 750E	5322 116 53265
R 2253	MRS25 1% 750E	5322 116 53265
R 2254	MRS25 1% 75E	5322 116 53339
R 2255	MRS25 1% 287E	5322 116 53221
R 2301	MRS25 1% 19K6	5322 116 53258
R 2302	MRS25 1% 19K6	5322 116 53258
R 2303	MRS25 1% 5K62	5322 116 53495
R 2304	MRS25 1% 5K62	5322 116 53495
R 2311	MRS25 1% 2K87	5322 116 53513
R 2315	MRS25 1% 100E	5322 116 53126
R 2316	MRS25 1% 100E	5322 116 53126
R 2317	MRS25 1% 1K	4822 116 53108
R 2318	MRS25 1% 1K	4822 116 53108
R 2319	MRS25 1% 5E11	4822 116 52999
R 2324	MRS25 1% 5K62	5322 116 53495
R 2325	MRS25 1% 5K62	5322 116 53495
R 2326	MRS25 1% 2K87	5322 116 53513
R 2327	MRS25 1% 3K83	4822 116 53079
R 2328	MRS25 1% 2K87	5322 116 53513
R 2329	MRS25 1% 825E	5322 116 53541
R 2330	0.3W 25% 10K	4822 105 10455
R 2333	MRS25 1% 5K62	5322 116 53495
R 2334	MRS25 1% 5K62	5322 116 53495
R 2335	MRS25 1% 10K	4822 116 53022
R 2336	MRS25 1% 21E5	5322 116 53426
R 2337	MRS25 1% 162E	5322 116 53523
R 2338	MRS25 1% 2K61	5322 116 53327
R 2339	MRS25 1% 237E	5322 116 53259
R 2341	MRS25 1% 21E5	5322 116 53426
R 2342	MRS25 1% 162E	5322 116 53523
R 2344	MRS25 1% 511E	5322 116 53135
R 2345	MRS25 1% 100E	5322 116 53126
R 2346	MRS25 1% 681E	4822 116 53123
R 2348	MRS25 1% 8K25	5322 116 53267
R 2350	MRS25 1% 4K22	5322 116 53246
R 2351	MRS25 1% 562E	5322 116 53214
R 2352	MRS25 1% 825E	5322 116 53541
R 2357	MRS25 1% 681E	4822 116 53123
R 2358	MRS25 1% 511E	5322 116 53135
R 2360	MRS25 1% 100E	5322 116 53126
R 2361	MRS25 1% 4K22	5322 116 53246
R 2365	MRS25 1% 23K7	5322 116 53537
R 2366	MRS25 1% 10K	4822 116 53022
R 2367	MRS25 1% 16K2	5322 116 53589
R 2369	MRS25 1% 68K1	5322 116 53338
R 2371	MRS25 1% 422E	5322 116 53592
R 2372	MRS25 1% 511E	5322 116 53135
R 2373	MRS25 1% 75K	5322 116 53266

POSNR	DESCRIPTION	ORDERING CODE
R 2374	MRS25 1% 511E	5322 116 53135
R 2375	MRS25 1% 23K7	5322 116 53537
R 2376	VR25 10%	5322 116 51785
R 2377	VR25 10%	5322 116 51785
R 2378	VR25 10%	5322 116 51785
R 2379	VR25 10%	5322 116 51785
R 2380	MRS25 1% 750E	5322 116 53265
R 2381	MRS25 1% 2K61	5322 116 53327
R 2382	MRS25 1% 2K61	5322 116 53327
R 2383	MRS25 1% 1K	4822 116 53108
R 2384	MRS25 1% 750E	5322 116 53265
R 2386	MRS25 1% 1K	4822 116 53108
R 2387	MRS25 1% 750E	5322 116 53265
R 2388	MRS25 1% 1K	4822 116 53108
R 2389	MRS25 1% 1K	4822 116 53108
R 2391	MRS25 1% 42E2	5322 116 53515
R 2393	MRS25 1% 3K48	4822 116 53315
R 2394	MRS25 1% 100E	5322 116 53126
R 2395	0.3W 25% 220E	5322 105 20031
R 2396	MRS25 1% 3K48	4822 116 53315
R 2397	MRS25 1% 42E2	5322 116 53515
R 2403	MRS25 1% 42E2	5322 116 53515
R 2404	MRS25 1% 1K33	5322 116 53512
R 2406	MRS25 1% 1K62	5322 116 53257
R 2407	0.3W 25% 220E	5322 105 20031
R 2408	MRS25 1% 1K33	5322 116 53512
R 2409	MRS25 1% 1K62	5322 116 53257
R 2410	0.3W 25% 1K	5322 105 20032
R 2411	MRS25 1% 42E2	5322 116 53515
R 2412	MRS25 1% 1K33	5322 116 53512
R 2416	MRS25 1% 1K	4822 116 53108
R 2418	MRS25 1% 5K62	5322 116 53495
R 2419	MRS25 1% 1K1	5322 116 53473
R 2420	MRS25 1% 133E	5322 116 53424
R 2421	MRS25 1% 5K62	5322 116 53495
R 2422	MRS25 1% 1K	4822 116 53108
R 2430	MRS25 1% 100K	4822 116 52973
R 2431	MRS25 1% 100K	4822 116 52973
R 2432	MRS25 1% 100K	4822 116 52973
R 2433	MRS25 1% 100K	4822 116 52973
R 2434	MRS25 1% 10K	4822 116 53022
R 2435	MRS25 1% 10K	4822 116 53022
R 2601	MRS25 1% 3K48	4822 116 53315
R 2602	MRS25 1% 5E11	4822 116 52999
R 2603	MRS25 1% 5K11	5322 116 53494
R 2604	MRS25 1% 5K11	5322 116 53494
R 2605	MRS25 1% 12K1	4822 116 52957
R 2606	MRS25 1% 1E	4822 116 52976
R 2610	MRS25 1% 10K	4822 116 53022
R 2611	MRS25 1% 1K	4822 116 53108
R 2621	MRS25 1% 422E	5322 116 53592
R 2622	MRS25 1% 681E	4822 116 53123
R 2623	MRS25 1% 1K1	5322 116 53473
R 2624	MRS25 1% 3K48	4822 116 53315
R 2625	MRS25 1% 681E	4822 116 53123
R 2626	MRS25 1% 6K81	5322 116 53252
R 2627	MRS25 1% 287E	5322 116 53221
R 2628	MRS25 1% 2K37	5322 116 53503
R 2629	MRS25 1% 10K	4822 116 53022
R 2631	MRS25 1% 10K	4822 116 53022
R 2632	MRS25 1% 383E	5322 116 53332
R 2635	MRS25 1% 10K	4822 116 53022
R 2701	MRS25 1% 1E	4822 116 52976
R 2702	MRS25 1% 26E1	5322 116 53723
R 2704	MRS25 1% 5E11	4822 116 52999
R 2712	MRS25 1% 5E11	4822 116 52999
R 2713	MRS25 1% 5E11	4822 116 52999
R 2714	MRS25 1% 5E11	4822 116 52999
R 2721	MRS25 1% 5E11	4822 116 52999
R 2722	MRS25 1% 1E	4822 116 52976
R 2723	MRS25 1% 5E11	4822 116 52999
R 2724	MRS25 1% 5E11	4822 116 52999
R 2740	MRS25 1% 5E11	4822 116 52999
R 2741	MRS25 1% 31E6	5322 116 54964
R 2742	MRS25 1% 5E11	4822 116 52999
R 3001	MRS25 1% 147E	5322 116 53497
R 3001	MRS25 1% 147E	5322 116 53497
R 3002	MRS25 1% 316E	5322 116 53499
R 3002	MRS25 1% 316E	5322 116 53499
R 3003	MRS25 1% 1K47	5322 116 53185
R 3003	MRS25 1% 1K47	5322 116 53185
R 3004	MRS25 1% 422E	5322 116 53592
R 3004	MRS25 1% 422E	5322 116 53592
R 3006	MRS25 1% 2K37	5322 116 53503
R 3006	MRS25 1% 2K37	5322 116 53503
R 3007	0.3W 25% 2K2	5322 105 20033
R 3007	0.3W 25% 2K2	5322 105 20033
R 3008	MRS25 1% 121E	4822 116 52955
R 3008	MRS25 1% 121E	4822 116 52955
R 3009	MRS25 1% 3K83	4822 116 53079
R 3009	MRS25 1% 3K83	4822 116 53079
R 3011	MRS25 1% 121E	4822 116 52955
R 3011	MRS25 1% 121E	4822 116 52955
R 3012	MRS25 1% 316E	5322 116 53499
R 3012	MRS25 1% 316E	5322 116 53499
R 3013	0.3W 25% 10K	4822 105 10455
R 3013	0.3W 25% 10K	4822 105 10455
R 3014	MRS25 1% 2K87	5322 116 53513
R 3014	MRS25 1% 1K21	4822 116 52956
R 3015	MRS25 1% 316E	5322 116 53499
R 3015	MRS25 1% 316E	5322 116 53499
R 3016	MRS25 1% 2K37	5322 116 53503
R 3016	MRS25 1% 2K37	5322 116 53503
R 3017	0.3W 25% 22K	5322 105 20035
R 3017	0.3W 25% 22K	5322 105 20035
R 3018	MRS25 1% 8K25	5322 116 53267
R 3018	MRS25 1% 8K25	5322 116 53267
R 3020	MRS25 1% 10E	4822 116 52891
R 3020	MRS25 1% 10E	4822 116 52891
R 3021	MRS25 1% 464E	5322 116 53232
R 3021	MRS25 1% 464E	5322 116 53232
R 3022	MRS25 1% 750E	5322 116 53265
R 3022	MRS25 1% 750E	5322 116 53265
R 3023	MRS25 1% 348E	5322 116 53591
R 3023	MRS25 1% 348E	5322 116 53591
R 3024	MRS25 1% 750E	5322 116 53265
R 3024	MRS25 1% 750E	5322 116 53265
R 3025	MRS25 1% 10E	4822 116 52891
R 3025	MRS25 1% 10E	4822 116 52891
R 3026	MRS25 1% 464E	5322 116 53232
R 3026	MRS25 1% 464E	5322 116 53232
R 3027	MRS25 1% 42E2	5322 116 53515
R 3027	MRS25 1% 42E2	5322 116 53515
R 3028	MRS25 1% 42E2	5322 116 53515
R 3028	MRS25 1% 42E2	5322 116 53515
R 3029	MRS25 1% 3K16	4822 116 53021
R 3029	MRS25 1% 681E	4822 116 53123
R 3031	MRS25 1% 402E	5322 116 53639
R 3031	MRS25 1% 511E	5322 116 53135
R 3032	MRS25 1% 31E6	5322 116 54964
R 3032	MRS25 1% 31E6	5322 116 54964
R 3033	MRS25 1% 100E	5322 116 53126
R 3033	MRS25 1% 100E	5322 116 53126
R 3034	MRS25 1% 162E	5322 116 53523
R 3034	MRS25 1% 162E	5322 116 53523
R 3036	0.3W 25% 100E	5322 105 20029
R 3036	0.3W 25% 100E	5322 105 20029
R 3037	MRS25 1% 100E	5322 116 53126
R 3037	MRS25 1% 100E	5322 116 53126
R 3038	0.3W 25% 470E	5322 105 20028
R 3038	0.3W 25% 470E	5322 105 20028
R 3039	MRS25 1% 42E2	5322 116 53515
R 3039	MRS25 1% 42E2	5322 116 53515
R 3041	MRS25 1% 316E	5322 116 53499
R 3041	MRS25 1% 316E	5322 116 53499
R 3042	MRS25 1% 110E	4822 116 52906
R 3042	MR52 1% 1K33	5322 116 52164
R 3043	MRS25 1% 110E	4822 116 52906
R 3043	MR52 1% 1K33	5322 116 52164
R 3044	MRS25 1% 110E	4822 116 52906
R 3044	MR52 1% 1K33	5322 116 52164
R 3046	MRS25 1% 110E	4822 116 52906
R 3046	MR52 1% 1K33	5322 116 52164
R 3047	MRS25 1% 42E2	5322 116 53515
R 3047	MRS25 1% 42E2	5322 116 53515
R 3048	MRS25 1% 42E2	5322 116 53515
R 3048	MRS25 1% 42E2	5322 116 53515
R 3049	MRS25 1% 51K1	4822 116 53121
R 3049	MRS25 1% 100K	4822 116 52973
R 3050	MRS25 1% 42E2	5322 116 53515
R 3050	MRS25 1% 42E2	5322 116 53515
R 3051	MRS25 1% 51K1	4822 116 53121
R 3051	MRS25 1% 100K	4822 116 52973
R 3052	MRS25 1% 42E2	5322 116 53515
R 3052	MRS25 1% 42E2	5322 116 53515
R 3060	MRS25 1% 110E	4822 116 52906
R 3061	MRS25 1% 110E	4822 116 52906
R 3062	MRS25 1% 110E	4822 116 52906
R 3063	MRS25 1% 110E	4822 116 52906
R 3064	MRS25 1% 110E	4822 116 52906
R 3066	MRS25 1% 110E	4822 116 52906
R 3067	MRS25 1% 110E	4822 116 52906
R 3068	MRS25 1% 110E	4822 116 52906
R 3100	MRS25 1% 42E2	5322 116 53515
R 3100	MRS25 1% 42E2	5322 116 53515
R 3101	MRS25 1% 5K62	5322 116 53495
R 3101	MRS25 1% 5K62	5322 116 53495
R 3102	MRS25 1% 562E	5322 116 53214
R 3102	MRS25 1% 562E	5322 116 53214
R 3103	MRS25 1% 1K21	4822 116 52956

POSNR	DESCRIPTION	ORDERING CODE
R 3103	MRS25 1% 1K21	4822 116 52956
R 3104	MRS25 1% 6K81	5322 116 53252
R 3104	MRS25 1% 6K81	5322 116 53252
R 3106	MRS25 1% 42E2	5322 116 53515
R 3106	MRS25 1% 42E2	5322 116 53515
R 3107	MRS25 1% 2K87	5322 116 53513
R 3107	MRS25 1% 2K87	5322 116 53513
R 3108	MRS25 1% 825E	5322 116 53541
R 3108	MRS25 1% 825E	5322 116 53541
R 3109	MRS25 1% 6K19	5322 116 53263
R 3109	MRS25 1% 6K19	5322 116 53263
R 3110	MRS25 1% 42E2	5322 116 53515
R 3110	MRS25 1% 42E2	5322 116 53515
R 3111	MRS25 1% 42E2	5322 116 53515
R 3111	MRS25 1% 42E2	5322 116 53515
R 3112	MRS25 1% 7K5	4822 116 53028
R 3112	MRS25 1% 7K5	4822 116 53028
R 3113	MRS25 1% 1K21	4822 116 52956
R 3113	MRS25 1% 1K21	4822 116 52956
R 3114	MRS25 1% 5K62	5322 116 53495
R 3114	MRS25 1% 5K62	5322 116 53495
R 3115	MRS25 1% 42E2	5322 116 53515
R 3115	MRS25 1% 42E2	5322 116 53515
R 3116	MRS25 1% 562E	5322 116 53214
R 3116	MRS25 1% 562E	5322 116 53214
R 3117	MRS25 1% 4K64	5322 116 53212
R 3117	MRS25 1% 4K64	5322 116 53212
R 3118	0.3W 25% 1K	5322 105 20032
R 3118	0.3W 25% 1K	5322 105 20032
R 3119	MRS25 1% 4K64	5322 116 53212
R 3119	MRS25 1% 4K64	5322 116 53212
R 3120	MRS25 1% 42E2	5322 116 53515
R 3120	MRS25 1% 42E2	5322 116 53515
R 3121	MRS25 1% 15K4	5322 116 53234
R 3121	MRS25 1% 46K4	5322 116 53314
R 3122	MRS25 1% 2K37	5322 116 53503
R 3122	MRS25 1% 6K81	5322 116 53252
R 3124	MRS25 1% 619E	5322 116 53337
R 3124	MRS25 1% 619E	5322 116 53337
R 3125	MRS25 1% 26E1	5322 116 53723
R 3125	MRS25 1% 42E2	5322 116 53515
R 3126	MRS25 1% 14K7	4822 116 53531
R 3126	MRS25 1% 14K7	4822 116 53531
R 3127	MRS25 1% 1K33	5322 116 53512
R 3127	MRS25 1% 1K33	5322 116 53512
R 3128	MRS25 1% 825E	5322 116 53541
R 3128	MRS25 1% 825E	5322 116 53541
R 3129	MRS25 1% 1K1	5322 116 53473
R 3129	MRS25 1% 1K1	5322 116 53473
R 3130	MRS25 1% 26E1	5322 116 53723
R 3130	MRS25 1% 42E2	5322 116 53515
R 3131	MRS25 1% 1K33	5322 116 53512
R 3131	MRS25 1% 1K33	5322 116 53512
R 3132	MRS25 1% 825E	5322 116 53541
R 3132	MRS25 1% 825E	5322 116 53541
R 3133	MRS25 1% 6K19	5322 116 53263
R 3133	MRS25 1% 6K19	5322 116 53263
R 3134	MRS25 1% 14K7	4822 116 53531
R 3134	MRS25 1% 14K7	4822 116 53531
R 3136	MRS25 1% 1K	4822 116 53108
R 3136	MRS25 1% 1K	4822 116 53108
R 3137	MRS25 1% 15K4	5322 116 53234
R 3137	MRS25 1% 46K4	5322 116 53314
R 3138	MRS25 1% 2K37	5322 116 53503
R 3138	MRS25 1% 6K81	5322 116 53252
R 3139	MRS25 1% 619E	5322 116 53337
R 3139	MRS25 1% 619E	5322 116 53337
R 3141	MRS25 1% 316E	5322 116 53499
R 3141	MRS25 1% 316E	5322 116 53499
R 3142	MRS25 1% 316E	5322 116 53499
R 3142	MRS25 1% 316E	5322 116 53499
R 3143	MRS25 1% 10E	4822 116 52891
R 3143	MRS25 1% 10E	4822 116 52891
R 3144	MRS25 1% 10E	4822 116 52891
R 3144	MRS25 1% 10E	4822 116 52891
R 3146	MRS25 1% 316E	5322 116 53499
R 3147	0.5W 10% 3K3	5322 116 30234
R 3147	0.5W 10% 3K3	5322 116 30234
R 3148	MRS25 1% 9K09	5322 116 53253
R 3148	MRS25 1% 9K09	5322 116 53253
R 3149	MRS25 1% 511E	5322 116 53135
R 3200	MRS25 1% 6K81	5322 116 53252
R 3200	MRS25 1% 8K25	5322 116 53267
R 3201	MRS25 1% 1K21	4822 116 52956
R 3201	MRS25 1% 1K21	4822 116 52956
R 3202	MRS25 1% 100E	5322 116 53126
R 3202	MRS25 1% 100E	5322 116 53126
R 3203	MRS25 1% 16K2	5322 116 53589
R 3203	MRS25 1% 16K2	5322 116 53589
R 3204	MRS25 1% 562E	5322 116 53214
R 3204	MRS25 1% 562E	5322 116 53214

POSNR	DESCRIPTION	ORDERING CODE
R 3205	MRS25 1% 4K64	5322 116 53212
R 3205	MRS25 1% 4K64	5322 116 53212
R 3206	MRS25 1% 4K64	5322 116 53212
R 3206	MRS25 1% 4K64	5322 116 53212
R 3207	MRS25 1% 82K5	5322 116 53581
R 3207	MRS25 1% 82K5	5322 116 53581
R 3208	MRS25 1% 7K5	4822 116 53028
R 3208	MRS25 1% 7K5	4822 116 53028
R 3209	MRS25 1% 1K	4822 116 53108
R 3209	MRS25 1% 1K	4822 116 53108
R 3210	MRS25 1% 42E2	5322 116 53515
R 3210	MRS25 1% 42E2	5322 116 53515
R 3211	MRS25 1% 10K	4822 116 53022
R 3211	MRS25 1% 10K	4822 116 53022
R 3212	MRS25 1% 1K47	5322 116 53185
R 3212	MRS25 1% 1K47	5322 116 53185
R 3213	MRS25 1% 23K7	5322 116 53537
R 3213	MRS25 1% 23K7	5322 116 53537
R 3214	MRS25 1% 51K1	4822 116 53121
R 3215	MRS25 1% 4K64	5322 116 53212
R 3215	MRS25 1% 4K64	5322 116 53212
R 3216	MRS25 1% 178K	5322 116 53555
R 3216	MRS25 1% 178K	5322 116 53555
R 3217	MRS25 1% 511E	5322 116 53135
R 3217	MRS25 1% 511E	5322 116 53135
R 3218	MRS25 1% 61K9	5322 116 53233
R 3218	MRS25 1% 51K1	4822 116 53121
R 3219	MRS25 1% 1M	4822 116 52843
R 3219	MRS25 1% 1M	4822 116 52843
R 3221	MRS25 1% 100E	5322 116 53126
R 3221	MRS25 1% 100E	5322 116 53126
R 3222	MRS25 1% 100K	4822 116 52973
R 3222	MRS25 1% 100K	4822 116 52973
R 3223	MRS25 1% 38K3	5322 116 53526
R 3223	MRS25 1% 51K1	4822 116 53121
R 3224	MRS25 1% 2K37	5322 116 53503
R 3224	MRS25 1% 2K37	5322 116 53503
R 3226	MRS25 1% 100E	5322 116 53126
R 3226	MRS25 1% 100E	5322 116 53126
R 3250	MRS25 1% 2K37	5322 116 53503
R 3250	MRS25 1% 2K37	5322 116 53503
R 3251	MRS25 1% 1M	4822 116 52843
R 3251	MRS25 1% 1M	4822 116 52843
R 3253	MRS25 1% 75K	5322 116 53266
R 3253	MRS25 1% 75K	5322 116 53266
R 3254	MRS25 1% 1K	4822 116 53108
R 3254	MRS25 1% 1K	4822 116 53108
R 3256	MRS25 1% 178K	5322 116 53555
R 3256	MRS25 1% 178K	5322 116 53555
R 3257	MRS25 1% 825K	5322 116 53341
R 3257	MRS25 1% 825K	5322 116 53341
R 3258	VR25 5% 3M3	4822 110 72201
R 3258	VR25 5% 3M3	4822 110 72201
R 3259	VR25 5% 3M3	4822 110 72201
R 3259	VR25 5% 3M3	4822 110 72201
R 3261	VR25 5% 3M3	4822 110 72201
R 3261	VR25 5% 3M3	4822 110 72201
R 3262	VR25 5% 7M5	5322 116 60131
R 3263	VR25 5% 3M3	4822 110 72201
R 3263	VR25 5% 3M3	4822 110 72201
R 3267	25% 47K	5322 105 20037
R 3267	25% 47K	5322 105 20037
R 3268	MRS25 1% 681K	5322 116 53593
R 3268	MRS25 1% 681K	5322 116 53593
R 3269	MRS25 1% 15K4	5322 116 53234
R 3269	MRS25 1% 15K4	5322 116 53234
R 3270	MRS25 1% 23K7	5322 116 53537
R 3270	MRS25 1% 23K7	5322 116 53537
R 3271	MRS25 1% 14K7	4822 116 53531
R 3271	MRS25 1% 14K7	4822 116 53531
R 3273	MRS25 1% 215K	5322 116 53425
R 3301	MRS25 1% 10E	4822 116 52891
R 3301	MRS25 1% 10E	4822 116 52891
R 3302	MRS25 1% 1E	4822 116 52976
R 3302	MRS25 1% 1E	4822 116 52976
R 3303	MRS25 1% 5E11	4822 116 52999
R 3303	MRS25 1% 5E11	4822 116 52999
R 3304	MRS25 1% 5E11	4822 116 52999
R 3304	MRS25 1% 5E11	4822 116 52999
R 3306	MRS25 1% 2K87	5322 116 53513
R 3306	MRS25 1% 2K87	5322 116 53513
R 3308	MRS25 1% 10E	4822 116 52891
R 3308	MRS25 1% 10E	4822 116 52891
R 3309	MRS25 1% 5E11	4822 116 52999
R 3309	MRS25 1% 5E11	4822 116 52999
R 3311	MRS25 1% 5E11	4822 116 52999
R 3311	MRS25 1% 5E11	4822 116 52999
R 3312	MRS25 1% 5E11	4822 116 52999
R 3312	MRS25 1% 5E11	4822 116 52999
R 3313	MRS25 1% 10E	4822 116 52891
R 3313	MRS25 1% 10E	4822 116 52891

POSNR	DESCRIPTION	ORDERING CODE
R 4000	MRS25 1% 51E1	5322 116 53213
R 4001	MRS25 1% 619E	5322 116 53337
R 4002	MRS25 1% 511E	5322 116 53135
R 4003	MRS25 1% 511E	5322 116 53135
R 4004	MRS25 1% 6K19	5322 116 53263
R 4005	MRS25 1% 100E	5322 116 53126
R 4006	MRS25 1% 51E1	5322 116 53213
R 4007	MRS25 1% 1K47	5322 116 53185
R 4008	MRS25 1% 100E	5322 116 53126
R 4009	0.3W 25% 1K	5322 105 20032
R 4010	MRS25 1% 511E	5322 116 53135
R 4011	MRS25 1% 5K11	5322 116 53494
R 4012	MRS25 1% 1K78	5322 116 53208
R 4013	MRS25 1% 1M	4822 116 52843
R 4014	MRS25 1% 5K11	5322 116 53494
R 4015	MRS25 1% 1K	4822 116 53108
R 4016	MRS25 1% 5K11	5322 116 53494
R 4017	MRS25 1% 2K87	5322 116 53513
R 4018	MRS25 1% 5K11	5322 116 53494
R 4019	MRS25 1% 681K	5322 116 53593
R 4020	MRS25 1% 1K62	5322 116 53257
R 4021	MRS25 1% 10K	4822 116 53022
R 4022	MRS25 1% 4K22	5322 116 53246
R 4023	MRS25 1% 12K1	4822 116 52957
R 4024	MRS25 1% 1K	4822 116 53108
R 4025	MRS25 1% 1K	4822 116 53108
R 4026	MRS25 1% 5K11	5322 116 53494
R 4027	MRS25 1% 2K15	5322 116 53239
R 4101	MRS25 1% 100K	4822 116 52973
R 4102	MRS25 1% 4K64	5322 116 53212
R 4103	MRS25 1% 11K	4822 116 52907
R 4104	MRS25 1% 46K4	5322 116 53314
R 4106	MRS25 1% 422E	5322 116 53592
R 4107	0.3W 25% 10K	4822 105 10455
R 4108	0.3W 25% 10K	4822 105 10455
R 4109	MRS25 1% 5K11	5322 116 53494
R 4111	MRS25 1% 12K1	4822 116 52957
R 4117	MRS25 1% 3K16	4822 116 53021
R 4118	1/4W .25% 50E	5322 116 53405
R 4119	1/4W .25% 50E	5322 116 53405
R 4120	MRS25 1% 1K	4822 116 53108
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	5322 116 53126
R 4126	MRS25 1% 9K09	5322 116 53253
R 4127	MRS25 1% 1K62	5322 116 53257
R 4129	MRS25 1% 1M	4822 116 52843
R 4130	MRS25 1% 1K	4822 116 53108
R 4131	MRS25 1% 5K11	5322 116 53494
R 4132	MRS25 1% 5K11	5322 116 53494
R 4134	MRS25 1% 10K	4822 116 53022
R 4135	MRS25 1% 1K	4822 116 53108
R 4136	MRS25 1% 10K	4822 116 53022
R 4137	MRS25 1% 14K7	4822 116 53531
R 4138	MRS25 1% 5E11	4822 116 52999
R 4139	MRS25 1% 10K	4822 116 53022
R 4140	MRS25 1% 10K	4822 116 53022
R 4141	MRS25 1% 14K7	4822 116 53531
R 4142	MRS25 1% 100E	5322 116 53126
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 116 53108
R 4146	MRS25 1% 10K	4822 116 53022
R 4147	MRS25 1% 511E	5322 116 53135
R 4148	MRS25 1% 21K5	5322 116 53241
R 4149	MRS25 1% 31E6	5322 116 54964
R 4150	MRS25 1% 9E09	5322 116 53516
R 4151	MRS25 1% 2K61	5322 116 53327
R 4152	MRS25 1% 162E	5322 116 53523
R 4153	MRS25 1% 1K1	5322 116 53473
R 4154	MRS25 1% 1K78	5322 116 53208
R 4155	MRS25 1% 2K15	5322 116 53239
R 4156	MRS25 1% 1M	4822 116 52843
R 4157	MRS25 1% 1E	4822 116 52976
R 4158	MRS25 1% 1M	4822 116 52843
R 4159	MRS25 1% 2K15	5322 116 53239
R 4160	MRS25 1% 100E	5322 116 53126
R 4161	MRS25 1% 10K	4822 116 53022
R 4162	MRS25 1% 100E	5322 116 53126
R 4163	MRS25 1% 5E11	4822 116 52999
R 4164	MRS25 1% 100E	5322 116 53126
R 4301	MRS25 1% 51K1	4822 116 53121
R 4302	MRS25 1% 51K1	4822 116 53121
R 4303	MRS25 1% 6K81	5322 116 53252
R 4304	MRS25 1% 5K11	5322 116 53494
R 4305	MRS25 1% 51K1	4822 116 53121
R 4306	MRS25 1% 681E	4822 116 53123
R 4307	MRS25 1% 5K11	5322 116 53494

POSNR	DESCRIPTION	ORDERING CODE
R 4308	MRS25 1% 10K	4822 116 53022
R 4309	MRS25 1% 8K25	5322 116 53267
R 4310	MRS25 1% 100E	5322 116 53126
R 4311	MRS25 1% 10K	4822 116 53022
R 4312	MRS25 1% 9K09	5322 116 53253
R 4313	MRS25 1% 7K5	4822 116 53028
R 4314	MRS25 1% 8K25	5322 116 53267
R 4330	MRS25 1% 5K11	5322 116 53494
R 4331	MRS25 1% 21K5	5322 116 53241
R 4332	MRS25 1% 4K22	5322 116 53246
R 4334	MRS25 1% 2K15	5322 116 53239
R 4501	MRS25 1% 13K3	5322 116 53489
R 4502	MRS25 1% 4K22	5322 116 53246
R 4503	MRS25 1% 6K81	5322 116 53252
R 4504	MRS25 1% 13K3	5322 116 53489
R 4505	MRS25 1% 511E	5322 116 53135
R 4506	MRS25 1% 2K15	5322 116 53239
R 4507	MRS25 1% 750E	5322 116 53265
R 4508	MRS25 1% 11K	4822 116 52907
R 4509	MRS25 1% 2K15	5322 116 53239
R 4513	MRS25 1% 1K47	5322 116 53185
R 4521	MRS25 1% 16K2	5322 116 53589
R 4522	MRS25 1% 23K7	5322 116 53537
R 4523	MRS25 1% 16K2	5322 116 53589
R 4524	MRS25 1% 14K7	4822 116 53531
R 4526	MRS25 1% 2K37	5322 116 53503
R 4527	MRS25 1% 19K6	5322 116 53258
R 4528	MRS25 1% 5K62	5322 116 53495
R 4529	MRS25 1% 21K5	5322 116 53241
R 4531	MRS25 1% 10K	4822 116 53022
R 4532	MRS25 1% 10K	4822 116 53022
R 4533	MRS25 1% 3K48	4822 116 53315
R 4601	MRS25 1% 2K37	5322 116 53503
R 4602	MRS25 1% 26K1	5322 116 53261
R 4603	MRS25 1% 23K7	5322 116 53537
R 4604	MRS25 1% 100K	4822 116 52973
R 4606	MRS25 1% 909E	4822 116 53533
R 4607	MRS25 1% 100E	5322 116 53126
R 4608	MRS25 1% 1K	4822 116 53108
R 4609	MRS25 1% 42E2	5322 116 53515
R 4611	MRS25 1% 10K	4822 116 53022
R 4612	MRS25 1% 7K5	4822 116 53028
R 4613	MRS25 1% 7K5	4822 116 53028
R 4614	MRS25 1% 8K25	5322 116 53267
R 4616	0.3W 25% 1K	5322 105 20032
R 4617	MRS25 1% 6K81	5322 116 53252
R 4618	MRS25 1% 11K	4822 116 52907
R 4619	MRS25 1% 51K1	4822 116 53121
R 4620	MRS25 1% 10K	4822 116 53022
R 4621	MRS25 1% 909E	4822 116 53533
R 4622	MRS25 1% 100E	5322 116 53126
R 4625	MRS25 1% 100E	5322 116 53126
R 4626	MRS25 1% 100E	5322 116 53126
R 4627	MRS25 1% 10K	4822 116 53022
R 4628	MRS25 1% 1K	4822 116 53108
R 4629	MRS25 1% 8K25	5322 116 53267
R 4631	MRS25 1% 1K	4822 116 53108
R 4632	MRS25 1% 100E	5322 116 53126
R 4633	MRS25 1% 1K	4822 116 53108
R 4634	MRS25 1% 1K	4822 116 53108
R 4636	MRS25 1% 1M	4822 116 52843
R 4639	MRS25 1% 383E	5322 116 53332
R 4701	MRS25 1% 42E2	5322 116 53515
R 4703	MRS25 1% 562E	5322 116 53214
R 4705	MRS25 1% 1K	4822 116 53108
R 4706	MRS25 1% 100E	5322 116 53126
R 4707	MRS25 1% 511E	5322 116 53135
R 4708	MRS25 1% 2K87	5322 116 53513
R 4709	MRS25 1% 681E	4822 116 53123
R 4711	MRS25 1% 6K19	5322 116 53263
R 4712	MRS25 1% 511E	5322 116 53135
R 4713	MRS25 1% 1M	4822 116 52843
R 4714	MRS25 1% 1M	4822 116 52843
R 4716	MRS25 1% 6K81	5322 116 53252
R 4717	MRS25 1% 8K25	5322 116 53267
R 4718	MRS25 1% 1K	4822 116 53108
R 4719	MRS25 1% 100E	5322 116 53126
R 4721	0.3W 25% 1K	5322 105 20032
R 4722	MRS25 1% 46K4	5322 116 53314
R 4723	MRS25 1% 681K	5322 116 53593
R 4724	MRS25 1% 42E2	5322 116 53515
R 4725	MRS25 1% 4K22	5322 116 53246
R 4726	MRS25 1% 100K	4822 116 52973
R 4727	MRS25 1% 6K81	5322 116 53252
R 4728	MRS25 1% 562E	5322 116 53214
R 4801	MRS25 1% 5E11	4822 116 52999
R 4804	MRS25 1% 5E11	4822 116 52999
R 4807	MRS25 1% 5E11	4822 116 52999
R 4809	MRS25 1% 5E11	4822 116 52999
R 4819	MRS25 1% 5E11	4822 116 52999

POSNR	DESCRIPTION	ORDERING CODE
R 4820	MRS25 1% 5E11	4822 116 52999
R 4822	MRS25 1% 5E11	4822 116 52999
R 4825	MRS25 1% 5E11	4822 116 52999
R 4829	MRS25 1% 5E11	4822 116 52999
R 4831	MRS25 1% 5E11	4822 116 52999
R 4833	MRS25 1% 5E11	4822 116 52999
R 4835	MRS25 1% 5E11	4822 116 52999
R 4836	MRS25 1% 5E11	4822 116 52999
R 4838	MRS25 1% 100E	5322 116 53126
R 4839	MRS25 1% 100E	5322 116 53126
R 4841	MRS25 1% 10K	4822 116 53022
R 4901	MRS25 1% 562E	5322 116 53214
R 4904	MRS25 1% 1E	4822 116 52976
R 5001	PP17 20% 10K	5322 101 30546
R 5002	PP17 20% 10K	5322 101 30547
R 5003	PP17 20% 10K	5322 101 30546
R 5004	PP17 20% 10K	5322 101 30546
R 6001	1.7A 20% 82E	4822 116 30069
R 6002	MRS25 1% 383K	5322 116 53576
R 6003	MRS25 1% 383K	5322 116 53576
R 6004	MRS25 1% 316E	5322 116 53499
R 6005	MRS25 1% 464E	5322 116 53232
R 6006	MRS25 1% 10K	4822 116 53022
R 6007	MRS25 1% 10K	4822 116 53022
R 6008	MRS25 1% 316E	5322 116 53499
R 6009	0.5W 10% 1K5	4822 116 30248
R 6010	MRS25 1% 14K7	4822 116 53531
R 6011	MRS25 1% 237E	5322 116 53259
R 6012	MRS25 1% 178E	5322 116 53572
R 6013	MRS25 1% 100E	5322 116 53126
R 6014	MRS25 1% 3E16	4822 116 52993
R 6016	MRS25 1% 10K	4822 116 53022
R 6017	MRS25 1% 1E	4822 116 52976
R 6018	MRS25 1% 1E	4822 116 52976
R 6019	MRS25 1% 10K	4822 116 53022
R 6020	MRS25 1% 21E5	5322 116 53426
R 6021	MRS25 1% 10K	4822 116 53022
R 6022	MRS25 1% 10K	4822 116 53022
R 6031	MRS25 1% 383E	5322 116 53332
R 6032	1/4W .25% 5K62	5322 116 80473
R 6033	1/4W .25% 7K5	5322 116 80474
R 6034	MRS25 1% 6K19	5322 116 53263
R 6036	MRS25 1% 7K5	4822 116 53028
R 6037	MRS25 1% 31K6	5322 116 53262
R 6038	MRS25 1% 100E	5322 116 53126
R 6039	MRS25 1% 10E	4822 116 52891
R 6041	MRS25 1% 3K83	4822 116 53079
R 6042	MRS25 1% 3K83	4822 116 53079
R 6043	MRS25 1% 100K	4822 116 52973
R 6044	MRS25 1% 100K	4822 116 52973
R 6101	MRS25 1% 100E	5322 116 53126
R 6102	MRS25 1% 100E	5322 116 53126
R 6103	MRS25 1% 1K	4822 116 53108
R 6131	MRS25 1% 10E	4822 116 52891
R 6132	MRS25 1% 100K	4822 116 52973
R 6133	MRS25 1% 100K	4822 116 52973
R 6134	MRS25 1% 1K	4822 116 53108
R 6136	MRS25 1% 4K64	5322 116 53212
R 6137	MRS25 1% 316E	5322 116 53499
R 6138	MRS25 1% 1K	4822 116 53108
R 6139	MRS25 1% 100E	5322 116 53126
R 6201	1/4W .25% 160K	5322 116 53412
R 6202	VR37 1% 31M6	5322 116 64103
R 6203	MRS25 1% 100K	4822 116 52973
R 6204	MRS25 1% 10K	4822 116 53022
R 6205	MRS25 1% 1K	4822 116 53108
R 6206	MRS25 1% 16K2	5322 116 53589
R 6207	MRS25 1% 51E1	5322 116 53213
R 6208	MRS25 1% 464E	5322 116 53232
R 6209	MRS25 1% 4K64	5322 116 53212
R 6211	MRS25 1% 46K4	5322 116 53314
R 6212	MRS25 1% 4K64	5322 116 53212
R 6213	MRS25 1% 215E	5322 116 53325
R 6214	VR25 5% 10M	4822 110 72214
R 6216	MRS25 1% 100E	5322 116 53126
R 6217	MRS25 1% 1E	4822 116 52976
R 6300	MRS25 1% 2K61	5322 116 53327
R 6301	MRS25 1% 464E	5322 116 53232
R 6302	MRS25 1% 909E	4822 116 53533
R 6303	MRS25 1% 3K83	4822 116 53079
R 6304	MRS25 1% 6K81	5322 116 53252
R 6311	MRS25 1% 750E	5322 116 53265
R 6312	MRS25 1% 4K22	5322 116 53246
R 6313	MRS25 1% 825E	5322 116 53541
R 6401	MRS25 1% 1K78	5322 116 53208
R 6402	MRS25 1% 178K	5322 116 53555
R 6403	MRS25 1% 215E	5322 116 53325
R 6404	MRS25 1% 6K81	5322 116 53252
R 6406	MRS25 1% 26K1	5322 116 53261
R 6407	MRS25 1% 3K48	4822 116 53315

POSNR	DESCRIPTION	ORDERING CODE
R 6408	MTP10 20% 10K	5322 100 10113
R 6500	MRS25 1% 10E	4822 116 52891
R 6501	MRS25 1% 511E	5322 116 53135
R 6502	MRS25 1% 100K	4822 116 52973
R 6503	MRS25 1% 5K11	5322 116 53494
R 6504	MRS25 1% 19K6	5322 116 53258
R 6506	MRS25 1% 5K62	5322 116 53495
R 6507	MRS25 1% 511E	5322 116 53135
R 6508	1/4W .25% 3K67	5322 116 53411
R 6509	1/4W .25% 500E	5322 116 53408
R 6511	562E 1% 0,6W	5322 116 53214
R 7001	MRS25 1% 1K	4822 116 53108
R 7002	MRS25 1% 1K	4822 116 53108
R 7003	MRS25 1% 75K	5322 116 53266
R 7004	MRS25 1% 5K11	5322 116 53494
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	5322 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 7013	MRS25 1% 100E	5322 116 53126
R 7014	MRS25 1% 162E	5322 116 53523
R 7016	0.5W 10% 2K2	4822 116 30254
R 7017	MRS25 1% 1K1	5322 116 53473
R 7018	MRS25 1% 1M	4822 116 52843
R 7019	MRS25 1% 100E	5322 116 53126
R 7102	MRS25 1% 100E	5322 116 53126
R 7103	MRS25 1% 5E11	4822 116 52999
R 8001	MCR18 1% 10K	4822 111 90249

25.4.3 Coils

L 0201	15UH	5322 157 52539
L 0301	82UH	4822 158 10563
L 0401	82UH	4822 158 10563
L 0501	82UH	4822 158 10563
L 0502	82UH	4822 158 10563
L 0503	82UH	4822 158 10563
L 0504	82UH	4822 158 10563
L 0801	0.39UH 10% TDK	5322 157 53334
L 0806	0.39UH 10% TDK	5322 157 53334
L 0814	0.15UH 10% TDK	5322 157 53347
L 0827	0.15UH 10% TDK	5322 157 53347
L 0831	0.39UH 10% TDK	5322 157 53334
L 0836	0.39UH 10% TDK	5322 157 53334
L 0844	0.15UH 10% TDK	5322 157 53347
L 0857	0.15UH 10% TDK	5322 157 53347
L 0865	0.15UH 10% TDK	5322 157 53333
L 0881	82UH	4822 158 10563
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 3001	2.0UH TDK	4822 157 51757
L 3002	2.2UH 10% TDK	5322 157 53509
L 3002	2.0UH TDK	4822 157 51757
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	82UH	4822 158 10563
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 0816	0.52 µH	5322 157 53335
L 0822	0.52 µH	5322 157 53335
L 0846	0.52 µH	5322 157 53335
L 0852	0.52 µH	5322 157 53335

25.4.4 Semi-conductors

POSNR	DESCRIPTION		ORDERING CODE
V 0200	BC548C	PEL	4822 130 44196
V 0201	BAW62	PEL	4822 130 30613
V 0202	BAW62	PEL	4822 130 30613
V 0203	BC548C	PEL	4822 130 44196
V 0204	BC548C	PEL	4822 130 44196
V 0206	BAW62	PEL	4822 130 30613
V 0207	BC548C	PEL	4822 130 44196
V 0208	BC548C	PEL	4822 130 44196
V 0211	BAT85	PEL	4822 130 31983
V 0212	BAT85	PEL	4822 130 31983
V 0213	BAW62	PEL	4822 130 30613
V 0214	BAW62	PEL	4822 130 30613
V 0301	BAT85	PEL	4822 130 31983
V 0302	BAT85	PEL	4822 130 31983
V 0501	BZX79-C3V6	PEL	5322 130 34834
V 0502	BAW62	PEL	4822 130 30613
V 0503	BAT85	PEL	4822 130 31983
V 0504	BAW62	PEL	4822 130 30613
V 0506	BAT85	PEL	4822 130 31983
V 0512	LM336Z-2.5	NSC	5322 209 81329
V 0521	BC548C	PEL	4822 130 44196
V 0522	BC548C	PEL	4822 130 44196
V 0523	BZX79-C5V1	PEL	4822 130 34233
V 0531	BC548C	PEL	4822 130 44196
V 0532	BC548C	PEL	4822 130 44196
V 0551	BC558B	PEL	4822 130 44197
V 0552	BC558B	PEL	4822 130 44197
V 0553	BAW62	PEL	4822 130 30613
V 0554	BAW62	PEL	4822 130 30613
V 0555	BZX79-C11	PEL	4822 130 34488
V 0556	BAW62	PEL	4822 130 30613
V 0557	BAW62	PEL	4822 130 30613
V 0558	BC548C	PEL	4822 130 44196
V 0566	BZX79-C5V1	PEL	4822 130 34233
V 0567	BF370	PEL	4822 130 42589
V 0568	BC548C	PEL	4822 130 44196
V 0569	BC558B	PEL	4822 130 44197
V 0591	BZX79-C5V1	PEL	4822 130 34233
V 0592	BAW62	PEL	4822 130 30613
V 0593	BC548C	PEL	4822 130 44196
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	BC548C	PEL	4822 130 44196
V 0611	BAW62	PEL	4822 130 30613
V 0612	BC558B	PEL	4822 130 44197
V 0612	BAW62	PEL	4822 130 30613
V 0613	BAW62	PEL	4822 130 30613
V 0614	BZX79-B27	PEL	4822 130 34379
V 0614	BAW62	PEL	4822 130 30613
V 0615	BAW62	PEL	4822 130 30613
V 0616	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 0701	BCW33	PEL	5322 130 44337
V 0702	BCW33	PEL	5322 130 44337
V 0703	BFR92R	PEL	5322 130 44606
V 0704	BFR92	PEL	5322 130 42145
V 0706	BCW30	PEL	5322 130 44335
V 0707	BAW56	PEL	5322 130 30691
V 0708	BAW56	PEL	5322 130 30691
V 0721	BCW33	PEL	5322 130 44337
V 0730	BF550	PEL	4822 130 42131
V 0731	BCW30	PEL	5322 130 44335
V 0732	BF550	PEL	4822 130 42131
V 0733	BF550	PEL	4822 130 42131
V 0734	BCW33	PEL	5322 130 44337
V 0736	BCW33	PEL	5322 130 44337
V 0760	BF550	PEL	4822 130 42131
V 0761	BCW30	PEL	5322 130 44335
V 0762	BF550	PEL	4822 130 42131
V 0763	BF550	PEL	4822 130 42131
V 0764	BCW33	PEL	5322 130 44337
V 0766	BCW33	PEL	5322 130 44337
V 0801	BFR96S/02	PEL	5322 130 42244
V 0806	BFR96S/02	PEL	5322 130 42244
V 0814	BC337	PEL	4822 130 40855
V 0816	BFR96S/02	PEL	5322 130 42244
V 0822	BFR96S/02	PEL	5322 130 42244
V 0827	BC337	PEL	4822 130 40855
V 0831	BFR96S/02	PEL	5322 130 42244
V 0836	BFR96S/02	PEL	5322 130 42244
V 0844	BC337	PEL	4822 130 40855
V 0846	BFR96S/02	PEL	5322 130 42244
V 0852	BFR96S/02	PEL	5322 130 42244
V 0857	BC337	PEL	4822 130 40855
V 0862	BC558B	PEL	4822 130 44197
V 0863	BZV86-C1V4	PEL	4822 130 81423
V 0864	BZV86-C2V0	PEL	4822 130 81424
V 0865	BAW62	PEL	4822 130 30613
V 0866	BAW62	PEL	4822 130 30613
V 0867	BFQ22S	PEL	5322 130 42031
V 0871	BC548C	PEL	4822 130 44196
V 0872	BZX79-C3V0	PEL	4822 130 31881
V 0903	BFQ13	PEL	5322 130 44404
V 0908	BFQ13	PEL	5322 130 44404
V 0913	BFQ13	PEL	5322 130 44404
V 0918	BFQ13	PEL	5322 130 44404
V 0921	BZV11	PEL	5322 130 34294
V 0978	BZX79-C5V1	PEL	4822 130 34233
V 0981	BZX79-B27	PEL	4822 130 34379
V 0986	BC548C	PEL	4822 130 44196
V 0992	BZV86-C2V0	PEL	4822 130 81424
V 1000	BA483	PEL	4822 130 32656
V 1001	BF324	PEL	4822 130 41448
V 1002	BF324	PEL	4822 130 41448
V 1003	ON4401	PEL	5322 130 61498
V 1004	BA483	PEL	4822 130 32656
V 1005	BA483	PEL	4822 130 32656
V 1006	ON4401	PEL	5322 130 61498
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 34297
V 1011	ON4401	PEL	5322 130 61498
V 1012	BA483	PEL	4822 130 32656
V 1013	BA483	PEL	4822 130 32656
V 1014	BA483	PEL	4822 130 32656
V 1016	ON4401	PEL	5322 130 61498
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	PEL	5322 130 61498
V 1104	BA483	PEL	4822 130 32656
V 1105	BA483	PEL	4822 130 32656
V 1106	ON4401	PEL	5322 130 61498
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 34297
V 1111	ON4401	PEL	5322 130 61498
V 1112	BA483	PEL	4822 130 32656
V 1113	BA483	PEL	4822 130 32656
V 1114	BA483	PEL	4822 130 32656
V 1116	ON4401	PEL	5322 130 61498
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

POSNR	DESCRIPTION		ORDERING CODE
V 1163	BF324	PEL	4822 130 41448
V 1164	BF324	PEL	4822 130 41448
V 1200	BZV86-C1V4	PEL	4822 130 81423
V 1201	ON4401	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	BC558B	PEL	4822 130 44197
V 2312	BC558B	PEL	4822 130 44197
V 2313	BAW62	PEL	4822 130 30613
V 2314	BAW62	PEL	4822 130 30613
V 2316	BF324	PEL	4822 130 41448
V 2317	BC548C	PEL	4822 130 44196
V 2318	BF324	PEL	4822 130 41448
V 2319	BF324	PEL	4822 130 41448
V 2321	BF324	PEL	4822 130 41448
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 3001	BF324	PEL	4822 130 41448
V 3001	BF324	PEL	4822 130 41448
V 3002	BF324	PEL	4822 130 41448
V 3002	BF324	PEL	4822 130 41448
V 3003	BC558B	PEL	4822 130 44197
V 3003	BC558B	PEL	4822 130 44197
V 3004	BF324	PEL	4822 130 41448
V 3004	BF324	PEL	4822 130 41448
V 3006	BF324	PEL	4822 130 41448
V 3006	BF324	PEL	4822 130 41448
V 3007	BC548C	PEL	4822 130 44196
V 3007	BC548C	PEL	4822 130 44196
V 3008	BF370	PEL	4822 130 42589
V 3008	BF370	PEL	4822 130 42589
V 3009	BF370	PEL	4822 130 42589
V 3009	BF370	PEL	4822 130 42589
V 3011	2N3866-01	PEL	5322 130 41799
V 3011	2N3866-01	PEL	5322 130 41799
V 3012	2N3866-01	PEL	5322 130 41799
V 3012	2N3866-01	PEL	5322 130 41799
V 3013	BZX79-B27	PEL	4822 130 34379
V 3013	BZX79-B27	PEL	4822 130 34379
V 3014	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 3101	BF324	PEL	4822 130 41448
V 3102	BF324	PEL	4822 130 41448
V 3102	BF324	PEL	4822 130 41448
V 3103	BF324	PEL	4822 130 41448
V 3103	BF324	PEL	4822 130 41448
V 3104	BC558B	PEL	4822 130 44197
V 3104	BC558B	PEL	4822 130 44197
V 3106	BF324	PEL	4822 130 41448
V 3106	BF324	PEL	4822 130 41448
V 3108	BF472	PEL	5322 130 42535
V 3108	2N5401	PEL	5322 130 42534
V 3109	BF370	PEL	4822 130 42589
V 3109	BF370	PEL	4822 130 42589
V 3111	BF370	PEL	4822 130 42589
V 3111	BF370	PEL	4822 130 42589
V 3112	2N5551	PEL	5322 130 44491
V 3112	2N5551	PEL	5322 130 44491
V 3113	BZX79-B5V6	PEL	4822 130 34173
V 3113	BZX79-B5V6	PEL	4822 130 34173
V 3114	2N5551	PEL	5322 130 44491
V 3114	2N5551	PEL	5322 130 44491
V 3116	BF472	PEL	5322 130 42535
V 3116	2N5401	PEL	5322 130 42534
V 3200	BF370	PEL	4822 130 42589
V 3200	BF370	PEL	4822 130 42589
V 3201	BF370	PEL	4822 130 42589
V 3201	BF370	PEL	4822 130 42589
V 3202	2N5401	PEL	5322 130 42534
V 3202	2N5401	PEL	5322 130 42534
V 3203	2N5551	PEL	5322 130 44491
V 3203	2N5551	PEL	5322 130 44491
V 3204	BF423	PEL	4822 130 41646
V 3204	BF423	PEL	4822 130 41646
V 3205	BZX79-B5V6	PEL	4822 130 34173
V 3205	BZX79-B5V6	PEL	4822 130 34173
V 3206	BAW62	PEL	4822 130 30613
V 3206	BAW62	PEL	4822 130 30613
V 3207	BC548C	PEL	4822 130 44196
V 3207	BC548C	PEL	4822 130 44196
V 3208	BF423	PEL	4822 130 41646
V 3208	BF423	PEL	4822 130 41646
V 3209	BAW62	PEL	4822 130 30613
V 3209	BAW62	PEL	4822 130 30613
V 3211	BAW62	PEL	4822 130 30613
V 3211	BAW62	PEL	4822 130 30613
V 3212	BZX79-B68	PEL	4822 130 30864
V 3212	BZX79-B68	PEL	4822 130 30864
V 3213	BC548C	PEL	4822 130 44196
V 3213	BC548C	PEL	4822 130 44196
V 3214	BAW62	PEL	4822 130 30613
V 3214	BAW62	PEL	4822 130 30613
V 3215	BAW62	PEL	4822 130 30613
V 3215	BAW62	PEL	4822 130 30613
V 3216	BZX79-C9V1	PEL	4822 130 30862
V 3216	BZX79-C9V1	PEL	4822 130 30862
V 3217	BAW62	PEL	4822 130 30613
V 3217	BAW62	PEL	4822 130 30613
V 3251	BF423	PEL	4822 130 41646
V 3251	BF423	PEL	4822 130 41646
V 3252	BZX79-C6V2	PEL	4822 130 34167
V 3252	BZX79-C6V2	PEL	4822 130 34167
V 3253	BF423	PEL	4822 130 41646
V 3253	BF423	PEL	4822 130 41646
V 3254	BF423	PEL	4822 130 41646
V 3254	BF423	PEL	4822 130 41646
V 3256	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 3301	BZX79-C6V2	PEL	4822 130 34167
V 4001	BF199	PEL	4822 130 44154
V 4002	BF199	PEL	4822 130 44154
V 4003	BF199	PEL	4822 130 44154
V 4004	BC548C	PEL	4822 130 44196
V 4005	BC558B	PEL	4822 130 44197
V 4006	BF763	PEL	5322 130 61148
V 4007	BAW62	PEL	4822 130 30613
V 4008	BAW62	PEL	4822 130 30613
V 4009	BC548C	PEL	4822 130 44196
V 4011	BZX79-C5V1	PEL	4822 130 34233
V 4012	BC548C	PEL	4822 130 44196
V 4013	BZX79-C3V6	PEL	5322 130 34834
V 4014	BAW62	PEL	4822 130 30613
V 4016	BC548C	PEL	4822 130 44196
V 4017	BC548C	PEL	4822 130 44196
V 4018	BC548C	PEL	4822 130 44196
V 4019	BZX79-C3V6	PEL	5322 130 34834
V 4020	BAW62	PEL	4822 130 30613
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

POSNR	DESCRIPTION		ORDERING CODE
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 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	4822 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
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 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 4704	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 4801	BZV86-C1V4	PEL	4822 130 81423
V 4806	BAX12	PEL	5322 130 34605
V 4807	BAX12	PEL	5322 130 34605
V 4808	BAX12	PEL	5322 130 34605
V 4809	BAX12	PEL	5322 130 34605
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	BUZ80	SIE	5322 130 42816
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	BYW95C	PEL	4822 130 41602

POSNR	DESCRIPTION		ORDERING CODE
V 6103	BYV95C	PEL	4822 130 41487
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

25.4.5 Intergrated circuits

D 0201	74F138PC	FSC	5322 209 82366
D 0202	PC74HCT138P	PEL	5322 209 11111
D 0203	PC74HCT132P	PEL	4822 209 83044
D 0204	PC74HCT390P	PEL	5322 209 11483
D 0206	PC74HCT390P	PEL	5322 209 11483
D 0207	C74HCT4040P	PEL	5322 209 72465
D 0208	PC74HCT10P	PEL	5322 209 11107
D 0209	74F11PC	FSC	5322 209 81536
D 0211	74F02PC	FSC	5322 209 81535
D 0212	74F04PC	FSC	5322 209 81577
D 0213	PC74HCT32P	PEL	5322 209 11266
D 0214	MC68008P8	MOT	5322 209 11593
D 0216	D27010-250V05		5322 209 51425
D 0217	M6264ALP-12	HIT	5322 209 60192
D 0218	P8254	INT	5322 209 82406
D 0219	PC74HCT259P	PEL	5322 209 51446
D 0221	PC74HCT244P	PEL	5322 209 11116
D 0222	PC74HCT259P	PEL	5322 209 11115
D 0223	PC74HCT03P	PEL	5322 209 11316
D 0301	PC74HCT244P	PEL	5322 209 11116
D 0302	PC74HCT244P	PEL	5322 209 11116
D 0303	PC74HCT245P	PEL	5322 209 11117
D 0304	M62256LP-12	HIT	5322 209 72129
D 0307	PC74HCT86P	PEL	5322 209 11473
D 0308	M6264ALP-12	HIT	5322 209 60192
D 0311	PC74HCT174P	PEL	5322 209 11478
D 0312	PC74HCT174P	PEL	5322 209 11478
D 0313	PC74HCT259P	PEL	5322 209 11115
D 0316	PC74HCT138P	PEL	5322 209 11111
D 0318	HEF4066BP	PEL	5322 209 10357
D 0401	PC74HCT04P	PEL	4822 209 82341
D 0402	PC74HCT74P	PEL	5322 209 11109
D 0403	PC74HCT74P	PEL	5322 209 11109
D 0404	PC74HCT74P	PEL	5322 209 11109
D 0406	PC74HCT00P	PEL	5322 209 11105
D 0407	PC74HCT08P	PEL	5322 209 11265
D 0408	PC74HCT10P	PEL	5322 209 11107
D 0409	PC74HCT163P	PEL	5322 209 11267
D 0411	AL16R8A-2CN	MMI	5322 209 51424
D 0413	PC74HCT574P	PEL	5322 209 11489
D 0416	PC74HCT08P	PEL	5322 209 11265
D 0431	AL16R8A-2CN	MMI	5322 209 51424
D 0432	PC74HCT00P	PEL	5322 209 11105
D 0433	PC74HCT74P	PEL	5322 209 11109
D 0434	PC74HCT157P	PEL	5322 209 11263
D 0437	PC74HCT157P	PEL	5322 209 11263
D 0503	C74HCT4053P	PEL	4822 209 71584
D 0504	HEF4104BP	PEL	4822 209 10273

POSNR	DESCRIPTION		ORDERING CODE
D 0505	HEF4066BP	PEL	5322 209 10357
D 0512	C74HCT4053P	PEL	4822 209 71584
D 0601	PLIFIER		5322 209 80991
D 0602	PLIFIER		5322 209 80991
D 0603	C74HCT4053P	PEL	4822 209 71584
D 0876	74F08PC	FSC	5322 209 81574
D 0887	PC74HCT160P	PEL	5322 209 72516
D 0901	C74HCT4052P	PEL	4822 209 71583
D 0903	HEF4066BP	PEL	5322 209 10357
D 0904	HEF4066BP	PEL	5322 209 10357
D 0911	C74HCT4052P	PEL	4822 209 71583
D 0914	HEF4066BP	PEL	5322 209 10357
D 0921	HEF4104BP	PEL	4822 209 10273
D 0922	PC74HCT08P	PEL	5322 209 11265
D 1001	TEA1017/N9	PEL	5322 209 60191
D 1101	TEA1017/N9	PEL	5322 209 60191
D 2203	CA3227E	RCA	5322 209 72568
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 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	BG2000-641-505		5322 321 21597
D 6501	HEF4066BP	PEL	5322 209 10357
D 7001	PCF8574P	PEL	5322 209 10883
D 7002	PCF8574P	PEL	5322 209 10883
D 7003	PCF8574P	PEL	5322 209 10883
D 8001	PCF8577T	PEL	5322 209 70024
D 8002	PCF8577T	PEL	5322 209 70024
D 8003	PCF8577T	PEL	5322 209 70024
D 0306	OQ 0209		5322 209 11603
D 0309	OQ 0209		5322 209 11603
D0412	PCF1106P/029		5322 209 72941
D 0601	OQ 0020		5322 209 80991
D 0602	OQ 0020		5322 209 80991
D 0801	OQ 0210		5322 209 11604
D 2002	OQ 0205N2		5322 209 73576
D 2102	OQ 0205N2		5322 209 73576
D 2150	OQ 0205N2		5322 209 73576
D 2201	OQ 0020		5322 209 80991
D 2202	OQ 0020		5322 209 80991
D 2302	OQ 0020		5322 209 80991
D 2303	OQ 0020		5322 209 80991
D 2304	OQ 0128		5322 209 82925
D 2603	OQ 0200		5322 209 82924
D 4103	OQ 0201		5322 209 70391
D 7004	OQ 0044		5322 209 11008
	OQ 0221N2		5322 209 11878
N 0201	LM393N	NSC	4822 209 80797
N 0501	LF356N	NSC	5322 209 86451
N 0502	LF356N	NSC	5322 209 86451
N 0503	TL082CP	T.I	5322 209 86064
N 0504	LM358N	NSC	4822 209 70672
N 0505	AD7824KN	MAX	5322 209 72942
N 0506	DAC-08EP	PMI	5322 209 11253
N 0507	DAC10FX	PMI	5322 209 71665
N 0511	LF356N	NSC	5322 209 86451
N 0512	LM358N	NSC	4822 209 70672
N 0513	TL082CP	T.I	5322 209 86064
N 0601	LM324N	NSC	4822 209 80587
N 0701	LM358D	MOT	5322 209 82941
N 0901	TL082CP	T.I	5322 209 86064
N 0904	TL082CP	T.I	5322 209 86064
N 0905	TL082CP	T.I	5322 209 86064
N 0913	TL082CP	T.I	5322 209 86064
N 0914	TL082CP	T.I	5322 209 86064
N 0921	LM358N	NSC	4822 209 70672
N 0922	LM358N	NSC	4822 209 70672
N 0927	TL082CP	T.I	5322 209 86064
N 0947	TL082CP	T.I	5322 209 86064
N 0987	LM337LZ	NSC	5322 209 83228
N 0988	LM337T	N.S	5322 209 81236
N 0989	LM317LZ	MOT	5322 209 82943
N 1001	OP-77GP	PMI	5322 130 60937
N 1101	OP-77GP	PMI	5322 130 60937
N 1201	LF356N	NSC	5322 209 86451
N 4101	LM324N	NSC	4822 209 80587
N 4102	OP-77GP	PMI	5322 130 60937
N 4103	TL080CP	T.I	5322 209 72464
N 4601	TCA240	PEL	4822 209 80629
N 6001	LM358N	NSC	4822 209 70672
N 6002	LM358N	NSC	4822 209 70672
N 7001	LM339AN	NSC	5322 209 60188
N 7002	LM324N	NSC	4822 209 80587
N 7003	LM324N	NSC	4822 209 80587

POSNR DESCRIPTION ORDERING CODE

25.4.6 Cathode ray tube

V 0001	D14-372GH	PEL	5322 131 20169

25.4.7 Miscellaneous

		ORDERING CODE
A 0301		5322 216 51117
A 0501	NT	5322 216 51118
E 0001	T13/4 28V 80MA	5322 134 40534
E 8001	60MA MGG9012	5322 134 40849
G 0201	Q-0-100-16M S.R	5322 242 71445
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 1901	1-P 1VA 1MA	5322 276 12544
S 1902	1-P 1VA 1MA	5322 276 12544
S 1903	1-P 1VA 1MA	5322 276 12544
S 1904	1-P 1VA 1MA	5322 276 12544
S 1905	1-P 1VA 1MA	5322 276 12544
S 6001		5322 276 11859
S 7001	BR	5322 277 10878
S 7003		5322 276 11857
S 7004		5322 276 11856
S 7005		5322 276 11856
S 7006		5322 276 11856
S 7007		5322 276 11856
S 7008		5322 276 11856
S 7009	BR	5322 277 10878
S 7011		5322 276 11856
S 7012		5322 276 11856
S 7013		5322 276 11856
S 7014	BR	5322 277 10878
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	BR	5322 277 10878
S 7025		5322 276 11856
S 7026		5322 276 11856
S 7027	BR	5322 277 10878
S 7029		5322 276 11856
S 7030		5322 276 11856
S 7031		5322 276 11856
S 7032		5322 276 11856
S 7033		5322 276 11856
S 7034		5322 276 11856
S 7035		5322 276 11856
U 3262	VR25 5% 7M5	5322 116 60131
T 6001	TRANSFORMER	5322 146 30591
T 6201	TRANSFORMER	5322 146 30592
HS MULTIPLIER		5322 321 21597