50 MHz Digital Storage Oscilloscope

PM3335 – PM3337

Service Manual

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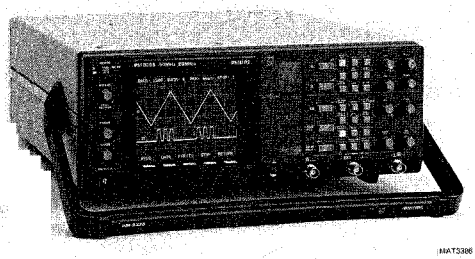

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WARNING: These servicing instructions are for use by qualified personnel only. To reduce the risk of electric shock do not perform any servicing other then that specified in the Operating Instructions unless you are fully qualified to do so.

PHILIPS

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

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

CONTENTS

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 $\geq$ 1000 V (red)

Live part (black/yellow)

Read the operating instructions

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

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

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

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

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

1.6.5 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 15).

1.6.6 After repair and maintenance in the primary circuit, safety inspection and tests, as mentioned in section 15 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

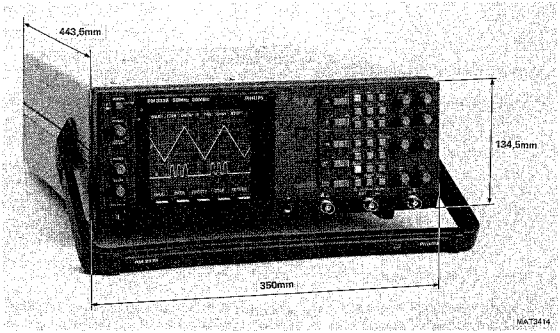

Figure 2.1 Dimensions of oscilloscope PM3335.

* Mass : 8,5 kg

* Operating positions:

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

D. CONTENTS

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.1	DISPLAY		
	* CRT		
	Type No	PHILIPS D 14-372	
	Measuring area (h x w)	80 x 100 mm	8 x 10 div. 1 div. = 10 mm 1 subdiv. (sd) = 2 mm
	* Screen type		
	Standard	GH (P 31)	Standard persistence (7 ms)
	Option	GM (P 7)	Long persistence (30 ms)
	* Total acceleration voltage	16 kV	
	* Graticule:		
	Engravings	Internal fixed	
	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 of screen
	* Orthogonality	90^{o} +/- 1^{o}	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 gain control range	1 : >2,5	
	* Error limit	+/- 3%	Only in calibrated position.
	* Input impedance	1 M ohm +/-2%	Measured below 1 MHz
	Paralleled by	20 pF +/-2pF	Measured below 1 MHz

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Max. input voltage	400 V (d.c. + a.c. peak)	
Max. test voltage (rms)	500 V	Max. duration 60 s.
* Bandwidth for 20 mV...10 V	> 50 MHz (-3dB, amb. 15..35°C)	Input 6 div. sine-wave. Deviation max. 5MHz for ambient 0 ... 50°C
* Bandwidth for 2 mV, 5 mV and 10 mV	> 35 MHz	Input 6 div. sine-wave.
* Rise-time	7 ns or less	Calculated from 0,35/f-3 dB
* Noise 20 mV...10 V	< 0,5 sd	Measured visually. Pick up on open BNC excluded.
* Lower - 3 dB point	< 10 Hz	In AC position, 6 div. sine-wave
* Dynamic range		
@ 1 MHz	+/- 12 div.	Vernier in CAL position.
@ 50 MHz	> 8 div.	Vernier in CAL position.
* Position range	> +/- 8 div.	Vernier in CAL position.
* Cross talk between channels		Both channels same attenuator setting. Input max. 8 div. sine-wave.
@ 10 MHz	1 : > 100	2, 5 and 10 V are excluded.
@ 50 MHz	1 : > 50	2, 5 and 10 V are excluded.
* Common Mode Rejection Ratio @ 1 MHz	1 : > 100	Both channels same attenuator setting, vernier adjusted for best CMRR; measured with max. 8 div. (+/- 4 div.) each channel.
* Visible signal delay	> 15 ns	Max. intensity, measured from line start to trigger point.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Base-line jump: between attenuator steps		
20 mV...10 V	< 1 sd	
Additional jump between 10 mV <---> 20 mV	< 1,5 sd	
Normal Invert jump	< 1 sd	Only channel B.
ADD jump	< 0,6 div.	When A and B are positioned in screen centre (20 mV...10 V).
Variable jump	< 1 sd	Max.jump in any two positions of the VARiable control.

2.3 HORIZONTAL DEFLECTION OR X AXIS

2.3.1 Time Base

* Time coeff.	0,5 s...50 ns	1, 2, 5 sequence (magn.off)
Error limit	+/-3 %	Measured at -4...+4 div. from screen centre.
* Horizontal position range	Start of sweep and 10th div. must be shifted over screen centre	
* Variable control ratio	1 : > 2,5	
* Time Base magnifier	Expansion x10	Not valid in X-deflection.
Error limit	+/-4 %	Measured at +4...- 4 div. from screen centre. Excluding first 50 ns and last 50 ns.
* Horizontal magnifier balance x10 ---> x1	< 2,5 sd	Shift start of sweep in x10 in mid-screen position, then switch to x1.
* Hold-Off Minimum to maximum hold-off time ratio	1 : > 10	Minimum hold off time is related to time base setting.

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.3.2	X-deflection		
	* Deflection coeff. Via channel A or B	2 mV/div...10 V/div 1, 2, 5 sequence.	
	Via EXT input	100 mV/div.	
	* Error limit Via channel A or B	+/- 5%	
	Via EXT input	+/- 5%	
	* Bandwidth	DC .... > 2 MHz	DC coupled
	* Phase shift between X and Y-deflection	< 3^{o} @ 100 kHz	DC coupled
	* Dynamic range	> 24 div. DC... 100 kHz	DC coupled
2.3.3	EXT input		
	* Input impedance Paralleled by	1 M ohm +/- 2% 20 pF +/- 2 pF	f_o < 1 MHz f_o < 1 MHz
⚠	* Max. input voltage	400 V (d.c. + a.c. peak)	
	Max. test voltage (rms)	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 trig.pulse.
	TRIGgered		Switches automatically to auto free run if one of the display channels is grounded.
	SINGLE		In multi-channel mode (alternated) each channel is armed after reset; if sweep has already started, sweep is not finished. Not applicable in peak-to-peak coupling.
	* Trigger source A, B, Composite (A/B), EXT, Line		Line trigger source always triggers on mains frequency. Line trigger amplitude depends on line input voltage. Approx. 6 div. @ 220 VAC input voltage.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* 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	> (+ or - 8 div.)	
DC EXTernal	> (+ or - 800 mV)	
TVL/TVF	Fixed level	
* Trigger slope	+/-	Slope sign in LCD. For TVL/TVF use + or - to chose positive or negative video
* Trigger sensivity		
INTERNAL		
0 - 10 MHz	< 0,5 div.	Trig. coupling DC.
@ 50 MHz	< 1,0 div.	Trig. coupling DC.
@ 100 MHz	< 3,0 div.	Trig. coupling DC.
EXTERNAL		
0 - 10 MHz	< 50 mV	Trig. coupling DC.
@ 50 MHz	< 150 mV	Trig. coupling DC.
@ 100 MHz	< 500 mV	Trig. coupling DC.
TVL/F INTERNAL	< 0,7 div.	Sync. pulse.
TVL/F EXTERNAL	< 70 mV	Sync. pulse.

2.5 SIGNAL ACQUISITION

* Sampling type @10us/div ... 50s/div	Real time	
* Maximum sample rate:		Sample rate depends on time/div setting
single channel	20 Megasamples/s	
dual channel	20 Megasamples/s	
* Vertical (voltage) Resolution	8 bits	(=0,4% of full range of 10 div)

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Horizontal (time) Resolution: in single channel acquisition:		
in 20us/div... 50s/div	8192 samp./ acquisition	1 Sample = 0,0125% of full record.
10 us/div	4096 samp./ acquisition	1 Sample = 0,024% of full record.
in dual channel acquisition 10us ...50s/div	4096 samp./ acquisition	1 Sample = 0,024% of full record.
* Record length	20,4 x time/div	Display in unmagnified position.
* Acquisition time: real time 10us/div ... 50s/div	20,4 x time/div	
	+ 0 ... 20ms	excluding delay time
* Sources	Channel A Channel B	Channel B can be inverted before acquisition.
* Acquisition modes	1 Channel only	Full memory available for 1 channel.
	2 Channels	Simultaneously sampled; 2 channels share memory.

2.6 CHANNELS A AND B

* Frequency response: Lower transition point of BW		
Input coupling in DC position	d.c.	
Input coupling in AC position	$\leq$ 10Hz	
Upper transition point of BW:		
In memory on mode (Ambient: 15 ... 35 °C)	$\geq$ 10MHz(-3dB)	Deviation max. 3MHz for ambient: 0 ... 50 °C.
In memory off mode (Ambient: 15 ... 35 °C)	$\geq$ 50MHz(-3dB)	Deviation max. 5MHz for ambient: 0 ... 50°C.

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
	* Max. base line instability: Jump (Ambient: 15 ... 35 °C):		Add 25% for ambient: 0 ... 50 °C.
	when switching to memory mode:	0,3 div	
	when actuating INVertor switch between any time /div positions	0,3 div 0,5 div	
	Drift	0,1 div/h	}Measured in 20 mV/div
	Temperature coefficient	± 0,05 div/K	}position. }
2.7	TIME BASE		
	* Modes	Recurrent Single shot Multiple shot	Up to 2 shots.
	* Time coefficients: in recurrent	10 us/div ... 50 s/div	
	in single shot & multiple shot	10 us/div ... 50 s/div	
	error limit (Ambient 15 .. 35°C) in real time mode	±1%	Add 0,5% for ambient: 0 ... 50 °C.
	up to memory	±0,1%	
2.8	TRIGGER		
	* Trigger delay: range	-20 ... 0 div	Selectable in divisions.
	accuracy	± 0,3 div	
	* Trigger level view		Indication in LCD.
	inaccuracy	≤ 0,5 div	

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.9	MEMORY		
	* Memory size:		
	registers	2	
	register depth:		
	acquisition	8K words	
	register	8K words	
	wordlength	8 bits	
	* Functions	Clear	
		Load	Contents of acquisition are saved in register
		Lock	Memory system is locked. If lock is not active the signal is written into the acquisition memory.
2.10	DISPLAY		
	* Sources	Channel A	}
		Channel B	}In any combination
		Register A	}
		Register B	}
	* Display expansion horizontal	0,5x, 1x, 2x, 4x, 8x, 16x and 32x.	
	* Number of displayed samples:		
	single trace	4K/channel	
	two traces	2K/channel	
	three traces	1K/channel	
	four traces	1K/channel	
2.11	CALCULATION FACILITIES		
	* Functions	Ratio, Phase dV, dt, 1/dt	
2.12	AUTO SETTING		
	* Settling time	3s (typ.)	Auto set is done in analog mode.

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.13	CURSORS		
	* Horizontal resolution: in single channel mode	1:1000	Over 10 div
	in dual channel mode	1:1000	
	* Vertical resolution	1:200	8 div
	* Read out resolution	3 Digits	
	* Voltage cursors: error limit amb. 15 ... 35 °C	±3%	Referred to input at BNC, error of probes etc. excluded. Add 3% for ambient 0 .. 40 °C.
	cursor range	Full range	Cursors can not pass not each other. X-position is neglected.
	* Time cursors error limit	±0,1%	
2.14	POWER SUPPLY		
⚠	* Line voltage a.c. Nominal	100...240 V	One range.
	Limits of operation	90...250 V	
	* Line frequency Nominal	50...400 Hz	
	Limits of operation	43...445 Hz	
	* Safety requirements within specification of: IEC 348 CLASS I UL 1244 VDE 0411 CSA 556 B		
	* Power consumption (a.c. source)	55W nominal	At nominal source voltage

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

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.

CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
* Meets environmental requirements of:	MIL-T-28800 C, type III, CLASS 5 Style D	Class 5, except for operating temperature: 0 ... 40°C. Style D, except for front cover.
* Temperature:		Memory back-up batteries removed from instrument, unless batteries meet temperature specifications (see also 2.15).
operating:		
min. low temperature	0 °C	Cf. MIL-T-28800 C parr. 3.9.2.3. tested cf. par. 4.5.5.1.1.
max. high temperature	+50 °C	Cf. MIL-T-28800 C parr. 3.9.2.4. tested cf. par. 4.5.5.1.1.
non-operating (storage):		
min. low temperature	-40 °C	Cf. MIL-T-28800 C parr. 3.9.2.3. tested cf. par. 4.5.5.1.1.
max. high temperature	+75°C	Cf. MIL-T-28800 C parr. 3.9.2.4. tested cf. par. 4.5.5.1.1.
* Max. humidity operating non-operating	95% RH	+10...30°C
* Max. altitude:		MIL-T-28800 C par. 3.9.3. tested, par. 4.5.5.2.
operating	4,5 km (15000 feet)	Maximum. Operating Temperature derated 3°C for each km, for each 3000 feet, above sea level.
non-operating (storage)	12 km (40 000 feet)	

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

	CHARACTERISTICS	SPECIFICATION	ADDITIONAL INFORMATION
2.17	SAFETY		
	* Meets requirements of	IEC 348 CLASS I VDE 0411	Except for power cord, unless shipped with Universal European power plug.
		UL 1244 CSA 556 B	Except for power cord, unless shipped with North American power plug.
2.18	OPTIONAL VERSIONS		
	* General		These options can be factory installed only.
	* Power cord		Length 2,1 m (82,7 in)
		Universal European North American United Kingdom Australian Swiss	VDE, KEMA listed (option .01) CSA, UL listed (option .03) BSI listed (option .04) SAA listed (option .08) SAV listed (option .05)
	* Cabinet	Rack mount	PM3337 PM3337/40. with IEEE+RS232-interface installed.
	* Interface	IEEE-488/IEC-625 including RS 232-C	Option 40. Dump to plotters: PM 8153/1, PM 8153/6, PM 8154, PM 8155, HP 7475A and HP 7550. Dump to printers: FX80 and HP 2225 Thinkjet.
		RS 232-C dump only	Option 50. Dump to plotters: PM 8153/1, PM8153/6, PM 8154, PM 8155, HP 7475A and HP 7550. Dump to printers: FX80 and HP 2225 Thinkjet.

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3. INTRODUCTION TO CIRCUIT DESCRIPTION AND BLOCK DIAGRAM DESCRIPTION

3.1 INTRODUCTION TO CIRCUIT DESCRIPTION

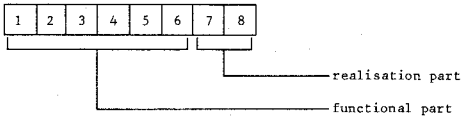
3.1.1 General

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

3.1.2 Explanation of signal name set-up

Signal 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.

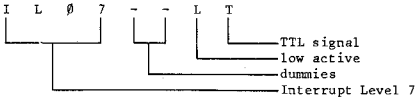
The first character of the realisation part has the following meaning:

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:

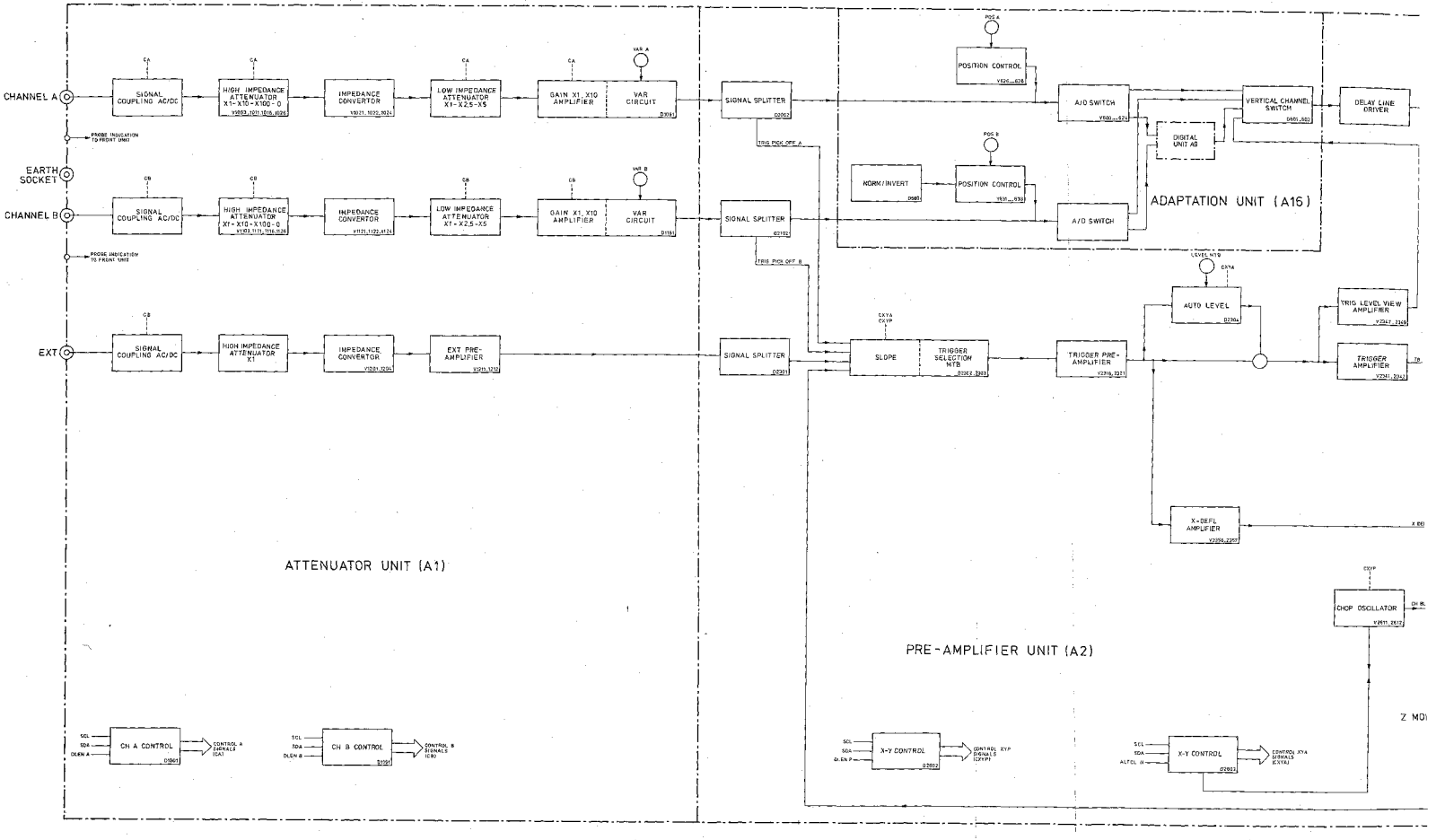
A: analogue
C: CMOS 12 V or 15 V
D: CMOS 5 V
E: ECL -4,5 V or -5,2 V
T: TTL 5 V or HCT

Example: I L Ø 7 - - L T

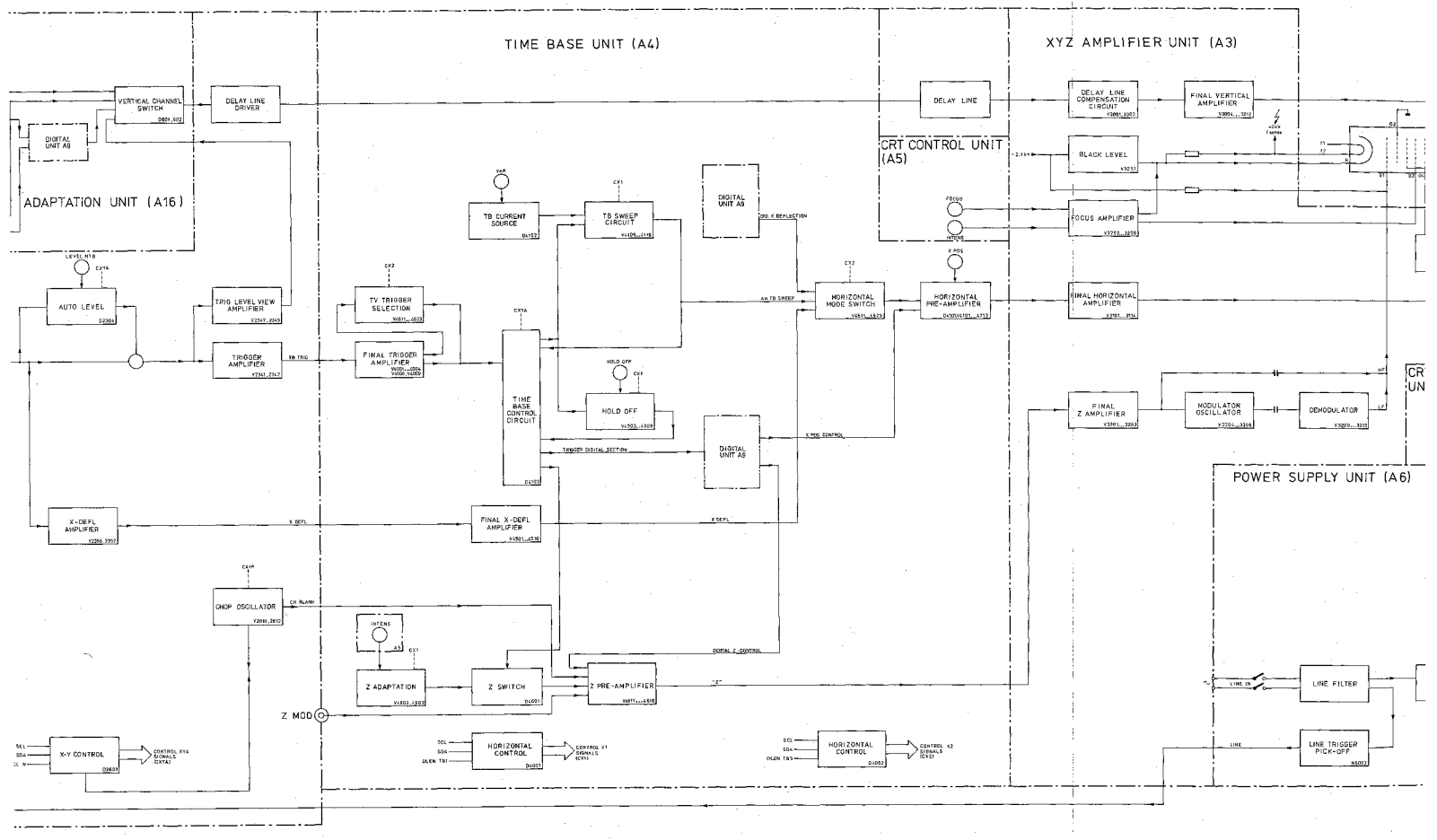


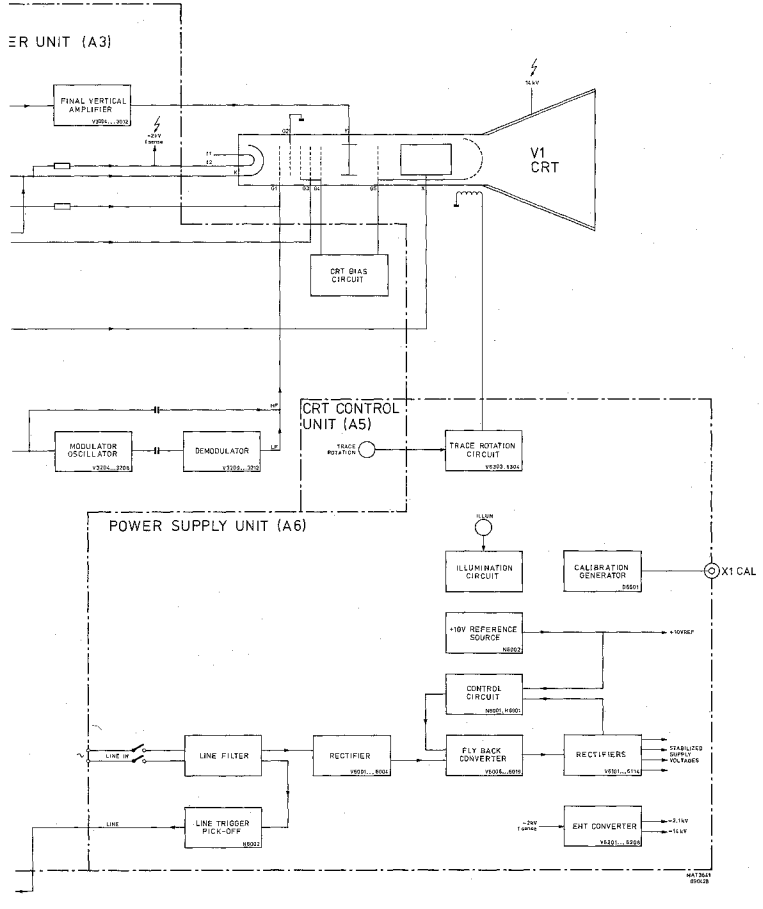
Sometimes the functional part can also be used for a serial number e.g. to indicate a buffered version of a signal.

Example: CHPT--Ø1



gure 3.1 Block diagram, analog part


TIME BASE UNIT (A4)
XYZ AMPLIFIER UNIT (A3)
CRT CONTROL UNIT (A5)
ADAPTATION UNIT (A16)
POWER SUPPLY UNIT (A6)
VERTICAL CHANNEL SWITCH
DELAY LINE DRIVER
DIGITAL UNIT A8
DELAY LINE
DELAY LINE COMPENSATION CIRCUIT
FINAL VERTICAL AMPLIFIER
BLACK LEVEL
FOCUS AMPLIFIER
AUTO LEVEL
TRIG LEVEL VIEW AMPLIFIER
TRIGGER AMPLIFIER
TV TRIGGER SELECTION
FINAL TRIGGER AMPLIFIER
TB CURRENT SOURCE
TB SWEEP CIRCUIT
TIME BASE CONTROL CIRCUIT
HOLD OFF
HORIZONTAL MODE SWITCH
HORIZONTAL PRE-AMPLIFIER
FINAL HORIZONTAL AMPLIFIER
FINAL Z AMPLIFIER
MODULATOR OSCILLATOR
DEMODULATOR
X-DEFL AMPLIFIER
FINAL X-DEFL AMPLIFIER
CHOP OSCILLATOR
Z ADAPTATION
Z SWITCH
Z PRE-AMPLIFIER
X-Y CONTROL
HORIZONTAL CONTROL
LINE FILTER
LINE TRIGGER PICK-OFF



Signal name list:

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

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

3.1.3 Location of electrical parts

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

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

3.2 BLOCK DIAGRAM DESCRIPTION (see figure 3.1 and 3.2)

3.2.1 Introduction

This block diagram description is based around all the important functional blocks and their interconnections. In order to assist in cross-reference with the circuit diagrams, the blocks include the item numbers of the active components they contain.
Furthermore, the blocks are grouped together per printed-circuit board, or 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 (uP) system.

3.2.2 Attenuator unit (unit A1)

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

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

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

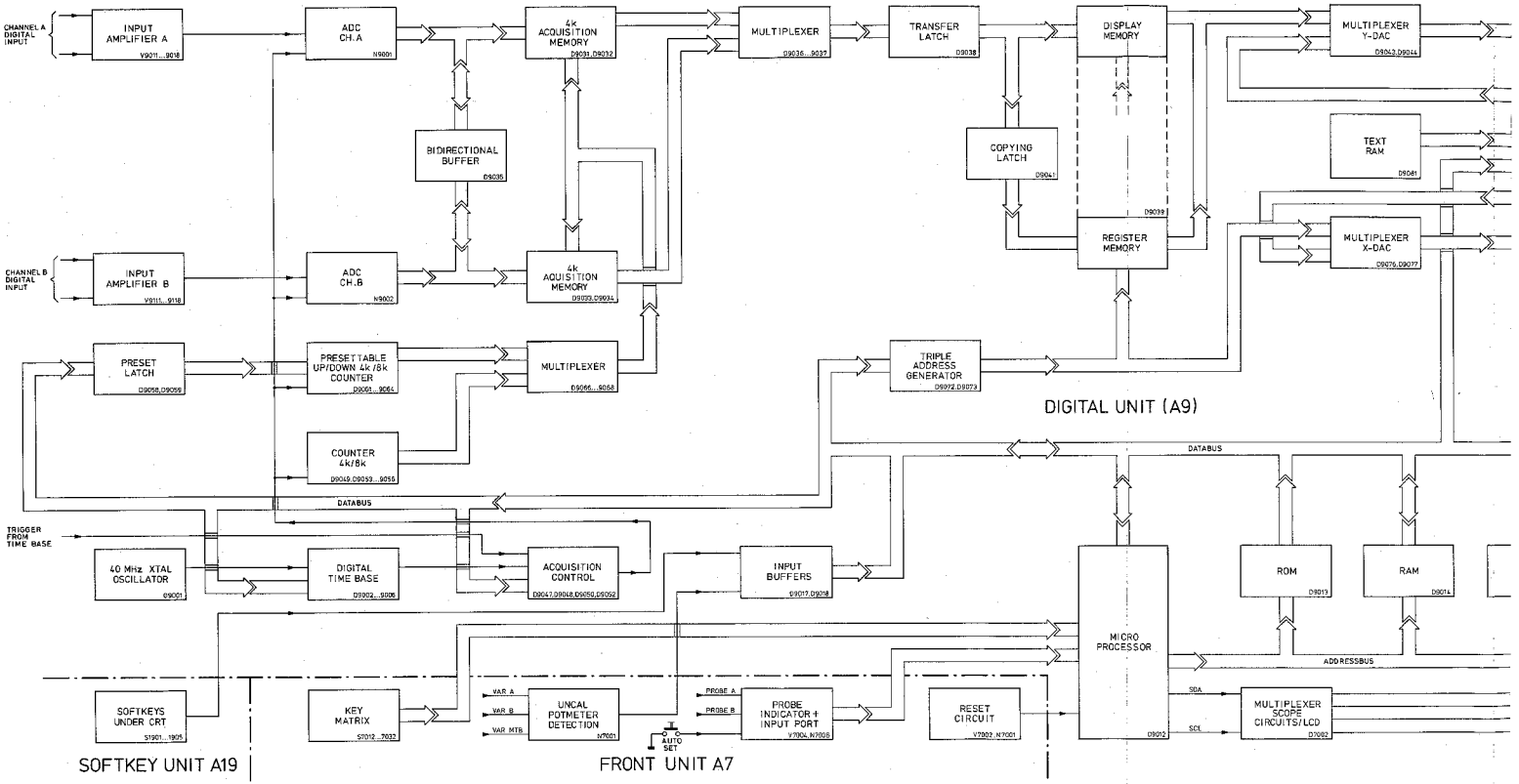
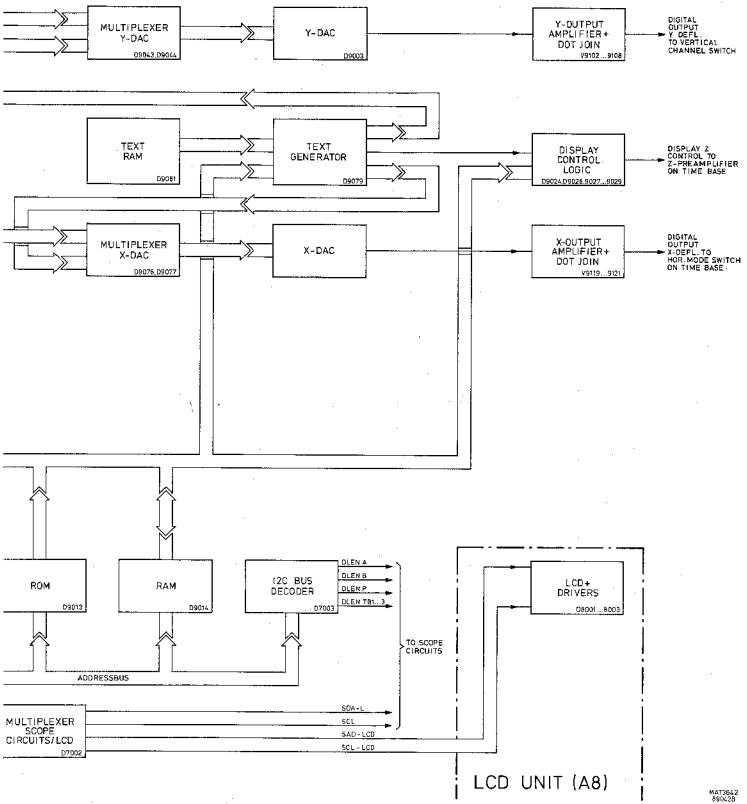


Figure 3.2 Block diagram, digital part



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

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

* Vertical channels A and B:

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

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

On the adaptation unit, vertical shift of the displayed signal is achieved by the front-panel POSITION control.
Switching between the 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 trigger level and can be used to determine the trigger point of the signal.

* Trigger circuit:

The SLOPE/TRIGGER SELECTION block receives a trigger signal from one of the vertical channels A or B, from the EXT SIGNAL SPLITTER or from the LINE TRIGGER PICK-OFF.
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 LEVEL signal, direct to the TRIGGER AMPLIFIER
- to the AUTO LEVEL block. This block contains the different trigger facilities and levelling of the trigger signal is influenced by the front-panel LEVEL control. The output of this path is routed again to the summation point to influence the direct trigger signal.
- to the X-DEFL AMPLIFIER for X-deflection facility. This block incorporates a phase correction circuit for the X-Y display.

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

* Chopper oscillator circuit:

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

3.2.4 Time-base unit (unit A4)

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

* Time-base (TB):
The trigger signal can be either routed via the FINAL TRIGGER AMPLIFIER to the TIME-BASE CONTROL CIRCUIT or 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 CURRENT SOURCE applies the sawtooth charging current to the sweep circuit. This block generates the time base sawtooth signal, which is routed to the HORIZONTAL DISPLAY MODE SWITCH..

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

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

3.2.5 XYZ unit (unit A3)

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

* Final vertical amplifier:

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

* Final horizontal amplifier:

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

* Blanking circuit:

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

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

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

* CRT control circuits:

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

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

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

3.2.6 Power supply unit

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

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

* Auxiliary circuits:

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

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

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

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

Introduction.
The blockdiagram of the digital sections can roughly be split up into three main parts. These parts are:
- Signal acquisition: this section captures signal samples and places them in the acquisition memories.
- The memory and display part are used to store the signal and to display it on the CRT screen.
- The control section that is based upon a microprocessor takes care that the signal display and acquisition function correctly. Moreover it reads all the instrument's knobs and controls all analog and digital circuits.

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

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

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

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

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

The addressing of the DISPLAY MEMORY and the REGISTER MEMORY is done by the TRIPLE ADDRESS GENERATOR. This block is controlled by the MICRO-PROCESSOR and contains three separate address generators. They have the following purposes:
- The addressing of the display memory during the information transfer from ACQUISITION MEMORIES to the DISPLAY MEMORY.
- The addressing of the DISPLAY/REGISTER MEMORY during the transfer of information between these memory blocks.
- The addressing of the DISPLAY and REGISTER MEMORY during the display on the CRT screen of their contents. The contents of the addressed memory locations is applied to the vertical Y DAC and then to the Y OUTPUT AMPLIFIER. The address itself is applied to the horizontal X DAC and then to the X OUTPUT AMPLIFIER.

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

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

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

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

4. ATTENUATOR UNIT (A1)

4.1 VERTICAL ATTENUATORS

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

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

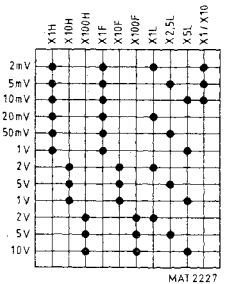


Figure 4.1 Table of attenuator settings

The channel A attenuator consists of in five stages:

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

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

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

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

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

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

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

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

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

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

4.2 EXTERNAL INPUT

The external input can be subdivided into four stages:

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

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

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

Impedance converter, is 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.

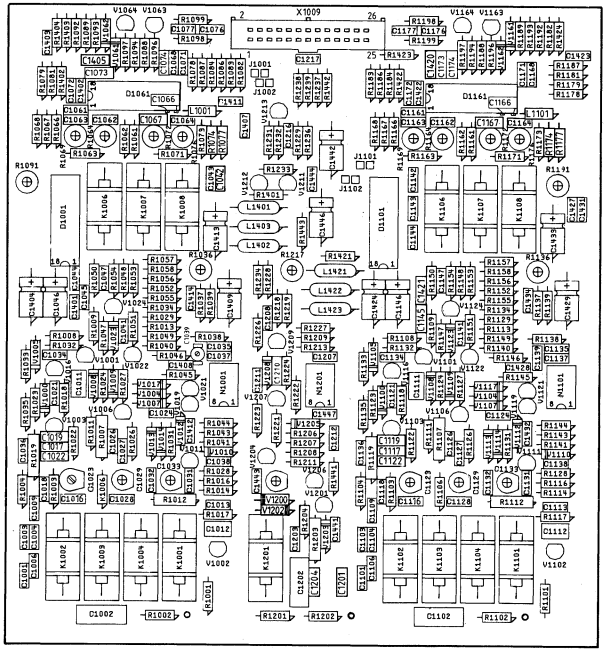
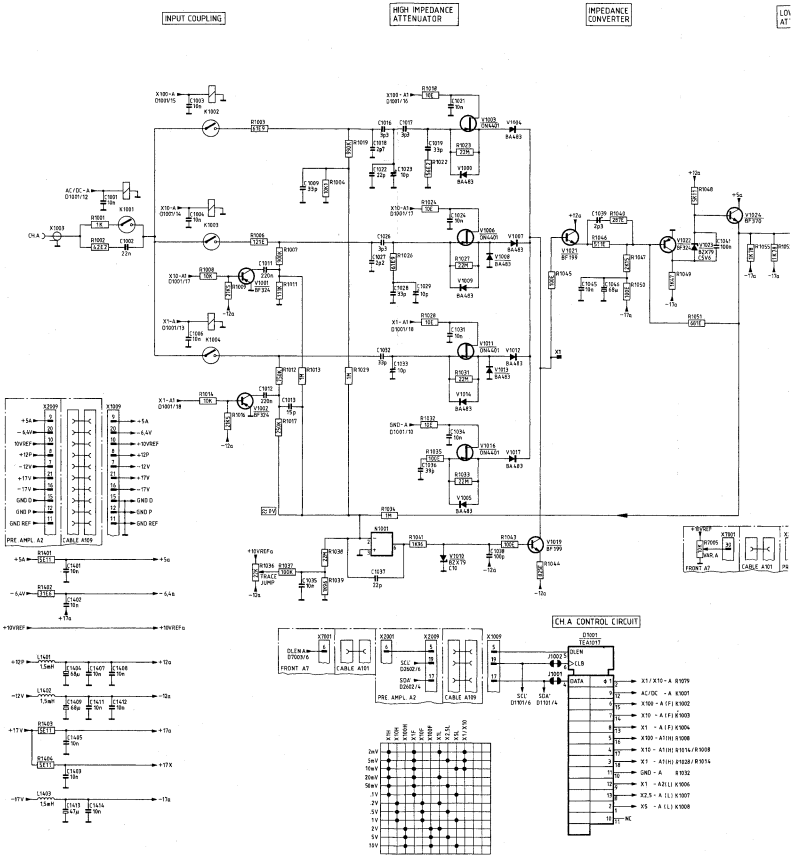


Figure 4.2 Attenuator unit p.c.b.



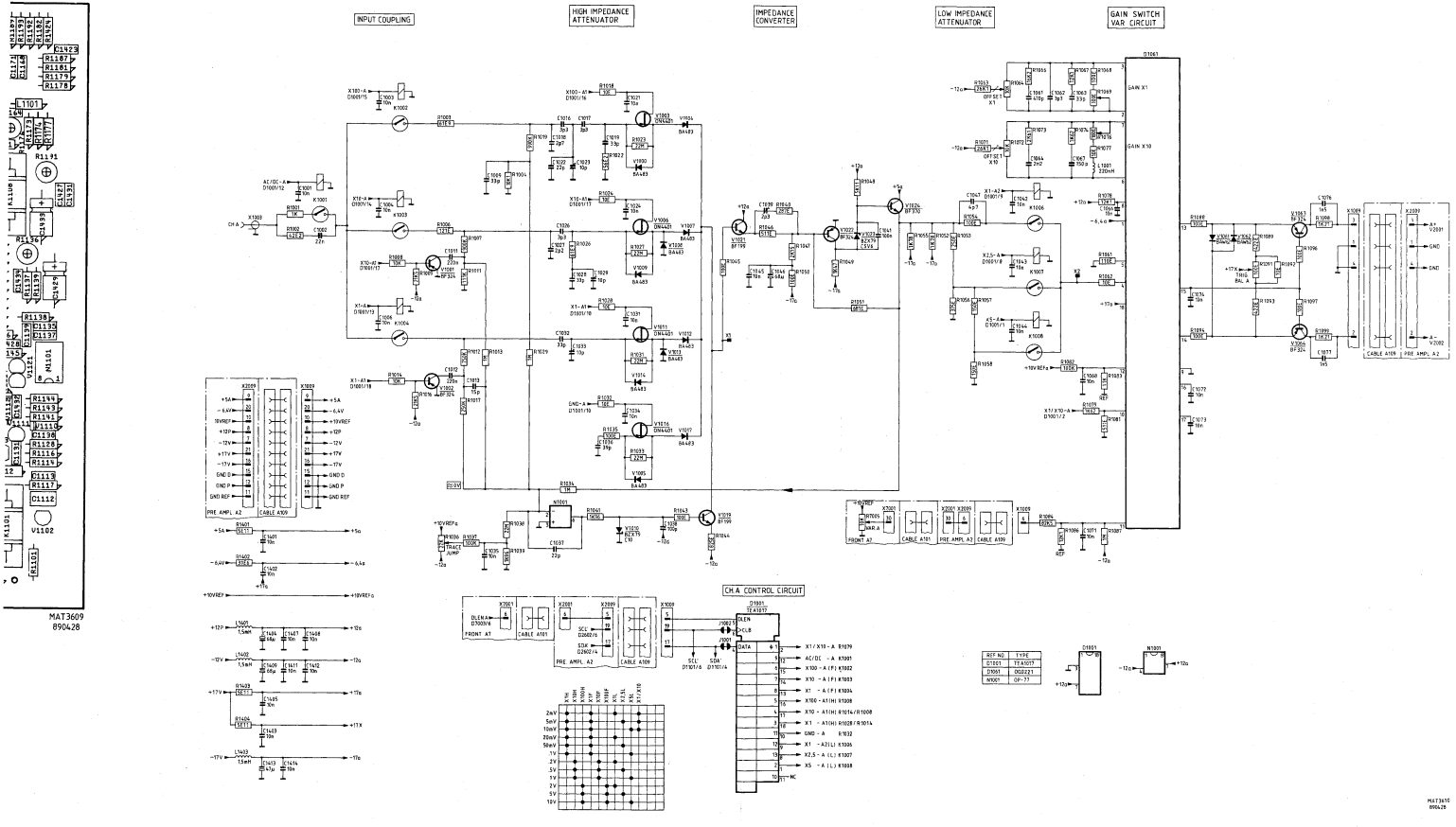


Figure 4.3 Circuit diagram of attenuator, ch.A

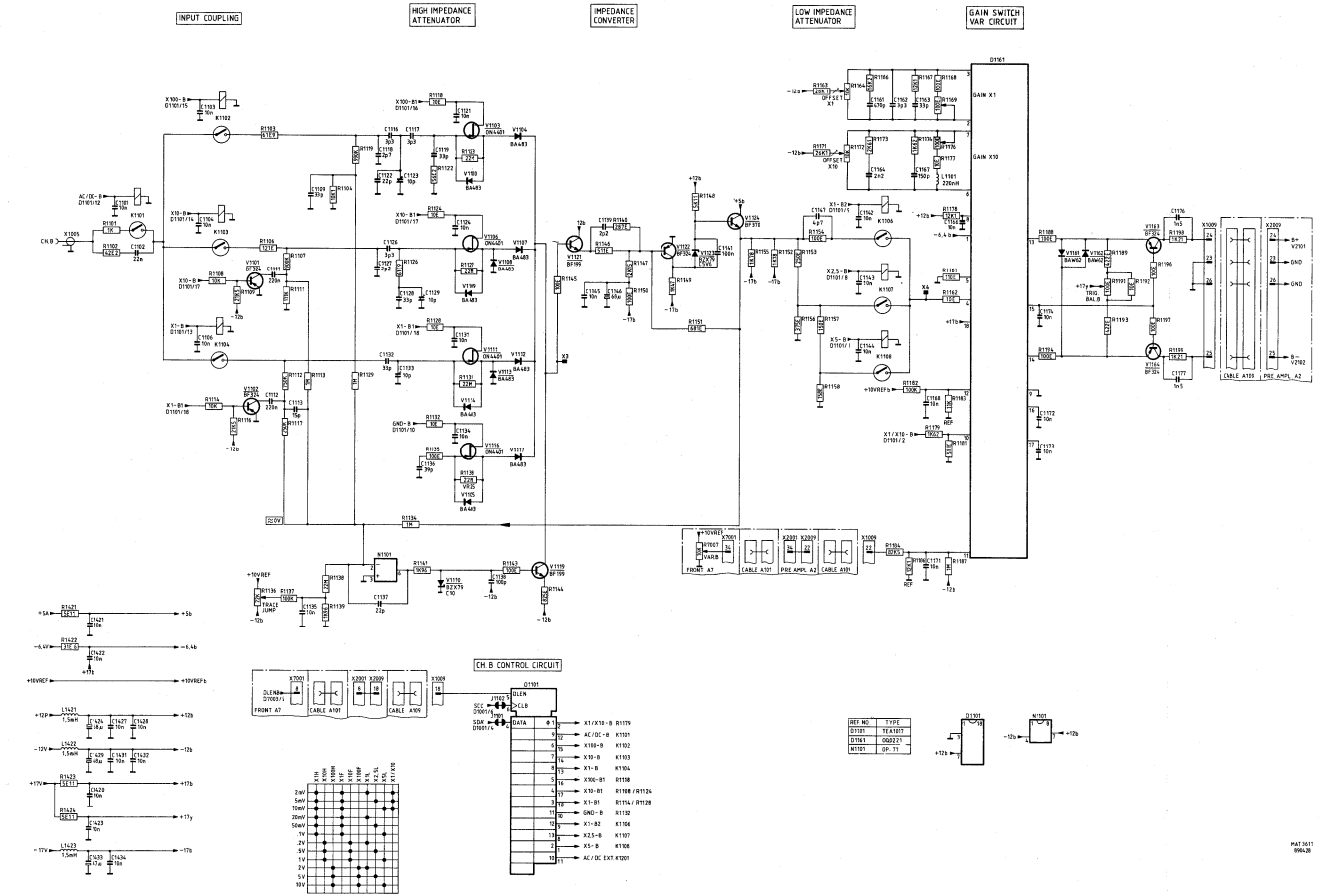
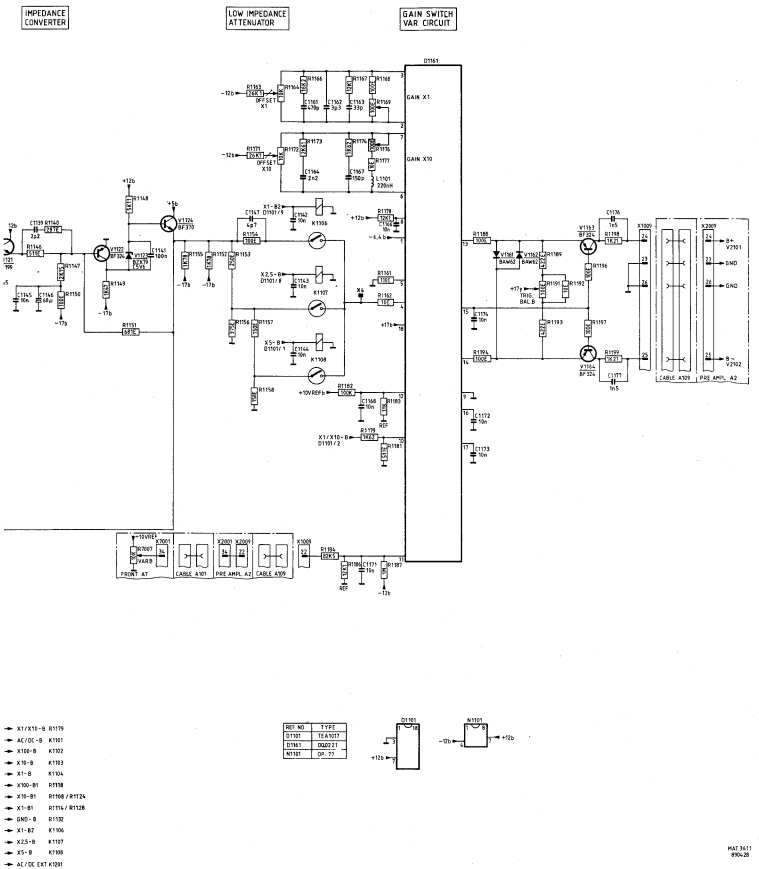


Figure 4.4 Circuit diagram of attenuator, ch.B



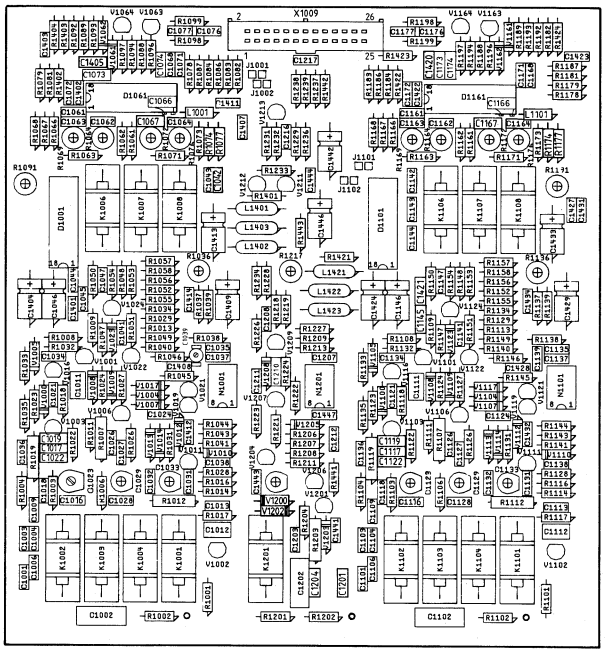


Figure 4.5 Attenuator unit p.c.b.

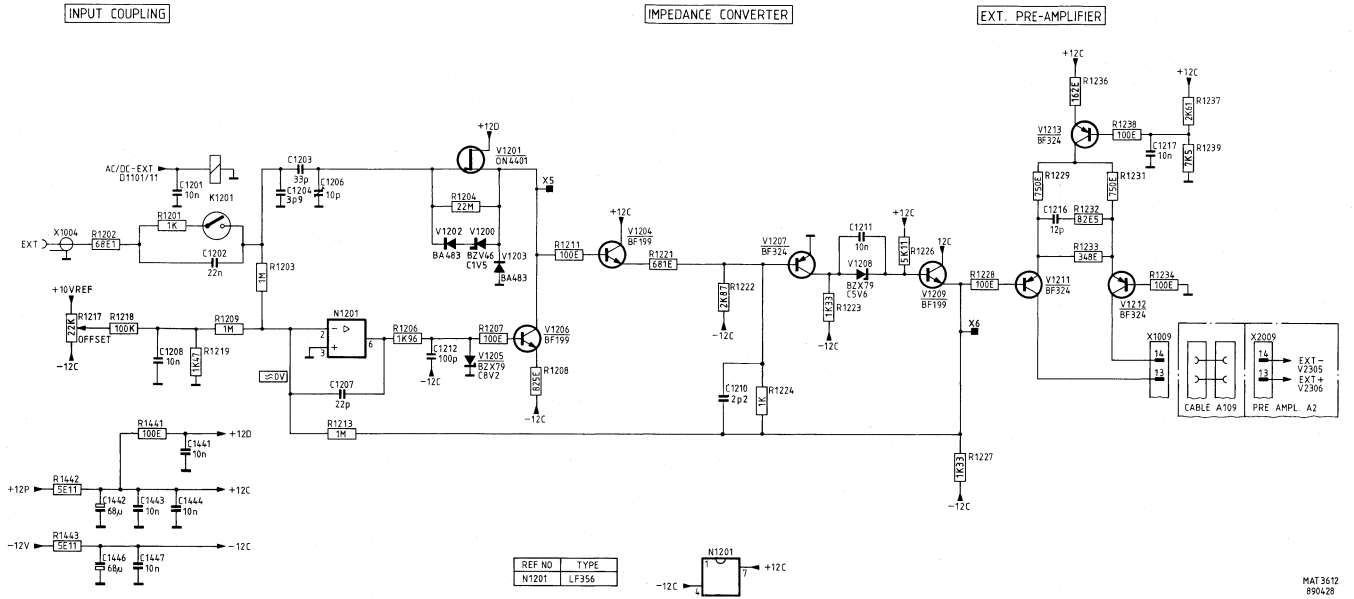


Figure 4.6 Circuit diagram of attenuator, EXT

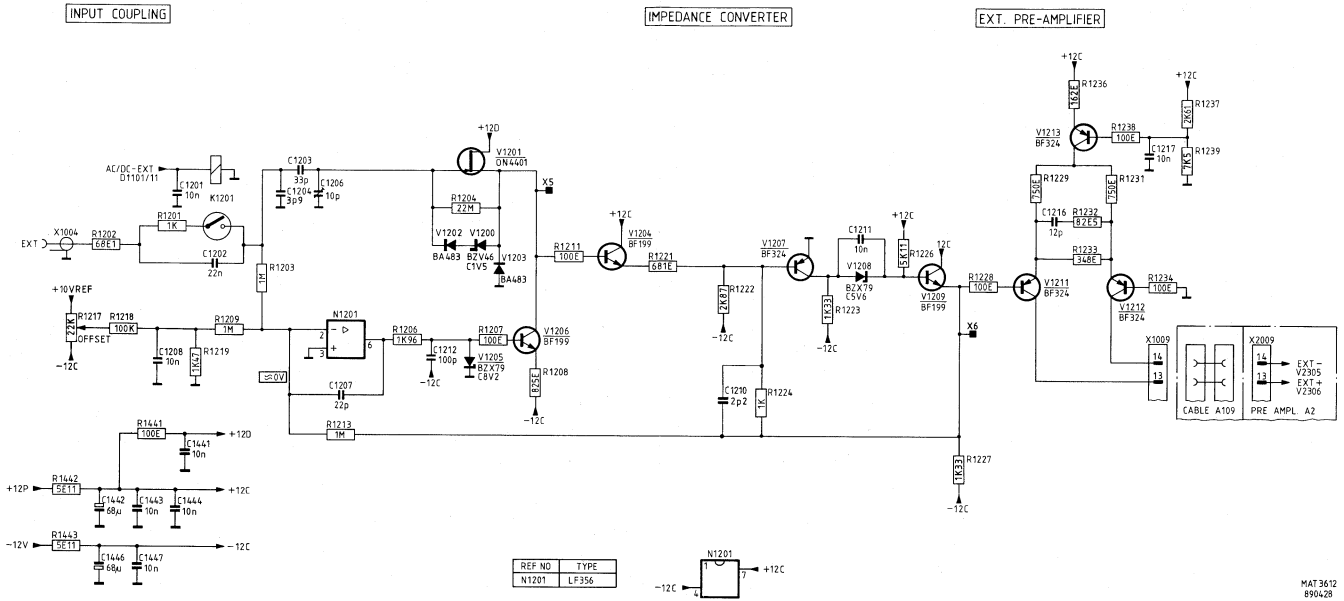


Figure 4.6 Circuit diagram of attenuator, EXT

5. PRE-AMPLIFIER UNIT (A2)

The pre-amplifier unit consists of:

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

Next, the adaptation unit A16 is mounted on this board.
This unit is described separately in chapter 17.

All control pulses for this unit are generated by the pre-amplifier control circuit, via the I²C bus (see Section 5.4).

5.1 VERTICAL PRE-AMPLIFIER

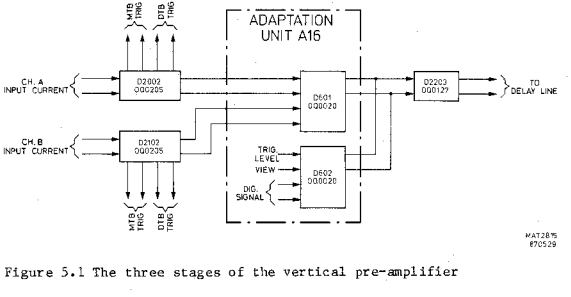


Figure 5.1 The three stages of the vertical pre-amplifier

The vertical pre-amplifier consists of three stages.

The signal splitter (QQ0205) receives its input signal for channel A (B) from the attenuator unit and copies this signal into two identical differential output current signals for:

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

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

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

Stage 3 (D2203) serves as delay line driver where the output current of both QQ0020's is converted into voltage signal applied to the delay line. The current for this stage and for the QQ0020's D601 and D602 on adaption unit A16 is supplied via R2231 and R2246.
The current regulation for the common-mode circuit is achieved by transistor D2203 (12, 13, 14).

5.2 TB TRIGGER PRE-AMPLIFIER

Trigger possibilities are:

	Signal name	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)
EXTERNAL	EXT-, EXT+	D2303(3,4)	EXTM	D2303(10)	INVAM	D2303(2)
line	LINE	D2303(5)	LNM	D2303(11)	INVAM	D2303(7)

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

The symmetrical output currents from D2302 (13, 14) and D2303 (13, 14) are 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 D602/3,4 on 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 LEVEL control R7012, connected to D2304(1).

b. Triggering

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

c. TV triggering

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

d. Auto

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

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

5.3 PRE-AMPLIFIER CONTROL

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

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

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

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

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

- 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, AD0 must be HIGH 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.

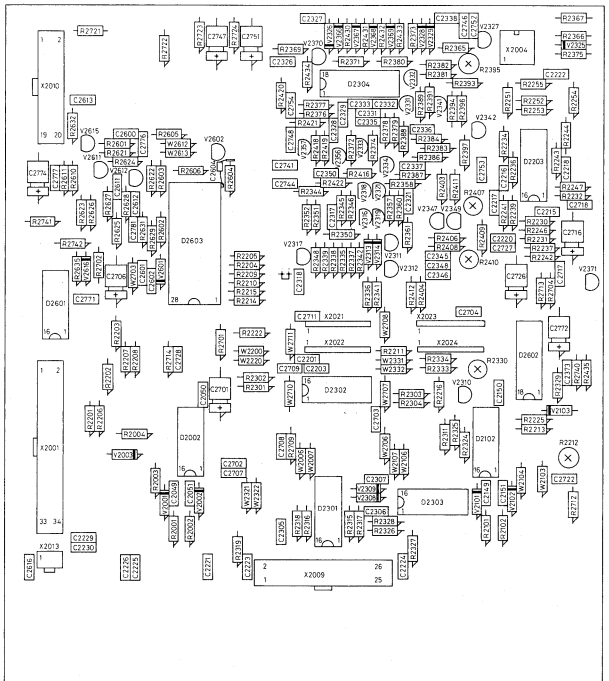


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Figure 5.2 Pre-amplifier unit p.c.b.

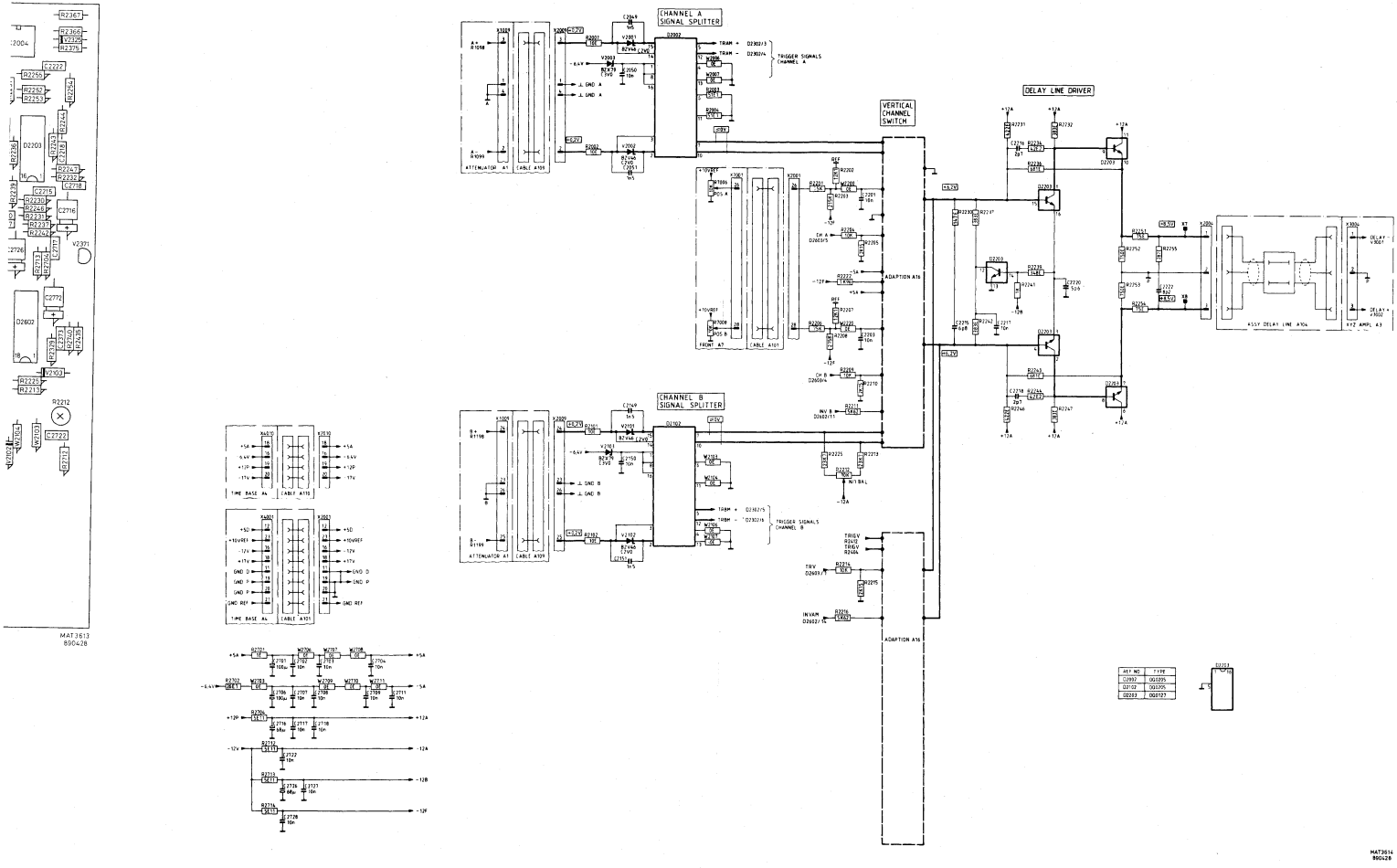


Figure 5.3 Circuit diagram of pre-amplifier, channel switch and delay line driver

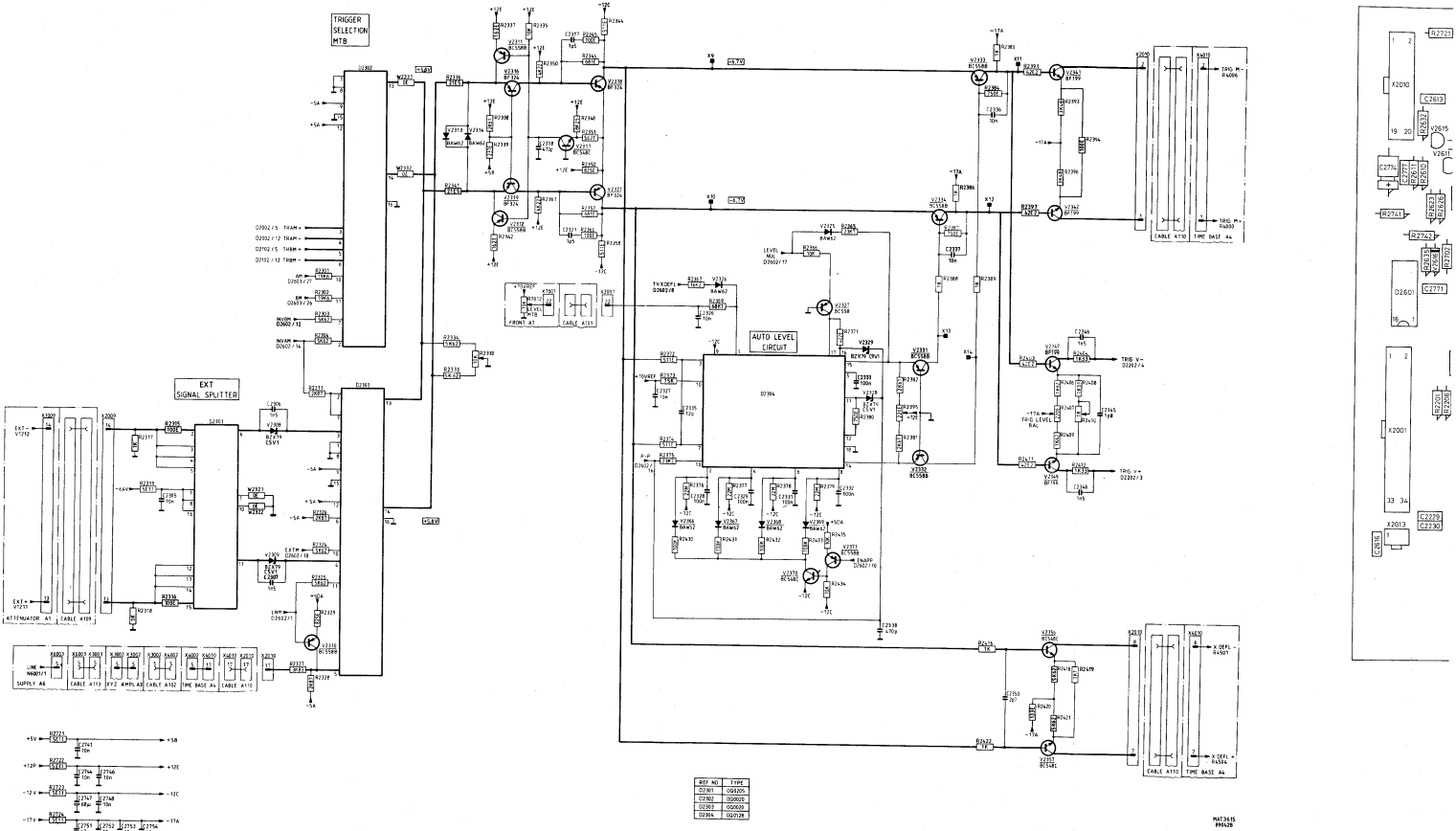
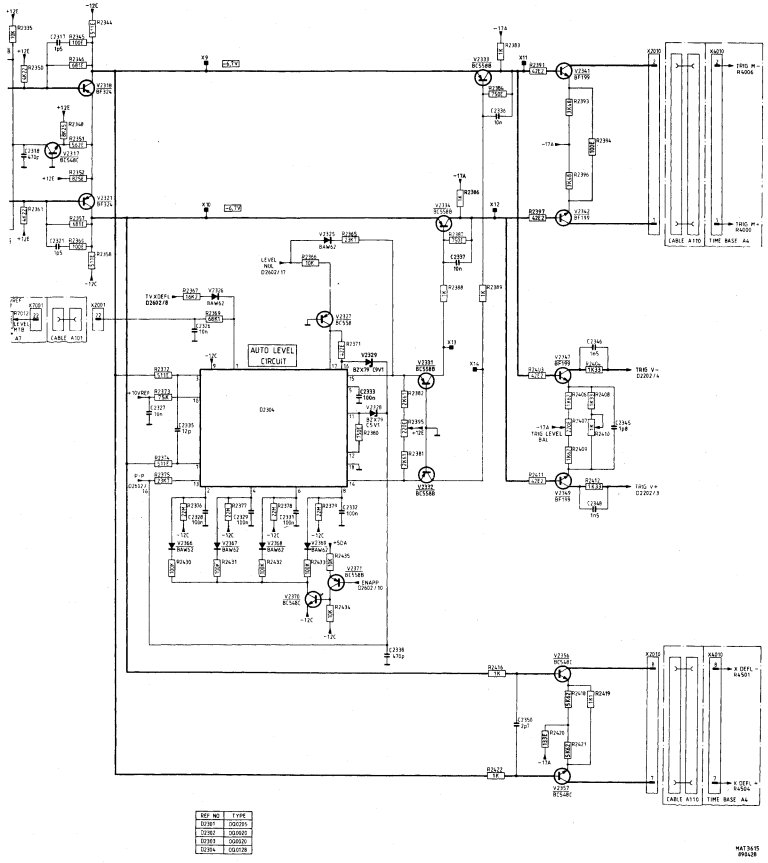


Figure 5.4 Circuit diagram of pre-amplifier, trigger switch



REF NO	TYPE
D2301	050095
D2302	050025
D2303	050020
D2304	050028

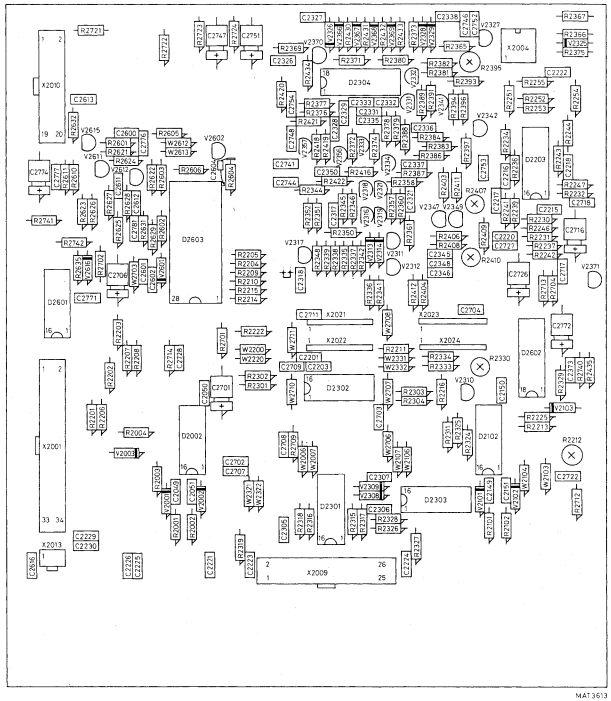


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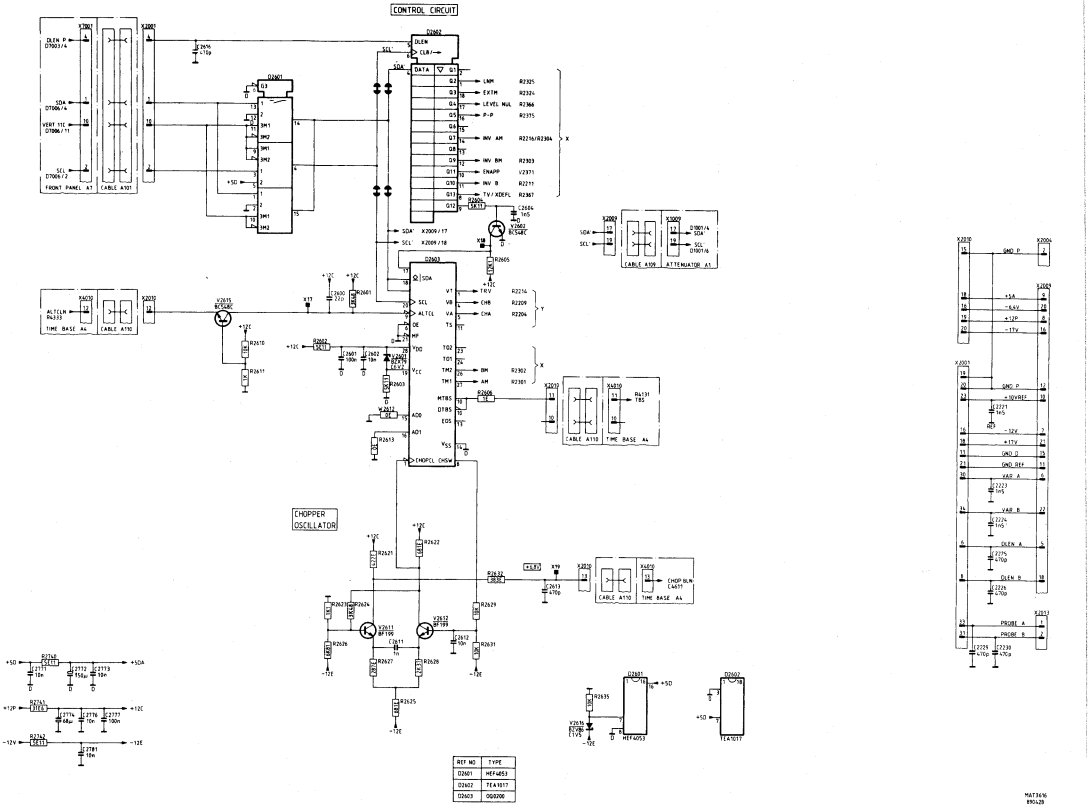
Figure 5.5 Pre-amplifier unit p.c.b.



REF NO.	TYPE
D2601	MEF4053
D2602	TEA1017
D2603	OQ0200

Figure 5.6 Circuit diagram of pre-amplifier, logic control

6. XYZ-AMPLIFIER UNIT (A3)

6.1 INTRODUCTION

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

The XYZ-amplifier unit consists of:

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

6.2 FINAL VERTICAL (Y) AMPLIFIER

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

- V3001, V3002 is a series feedback amplifier, including a delay line compensation network and potentiometer R3007 that controls current source V3003 for correction of any unbalance in the Y-deflection plates of the CRT. These circuits are connected between the emitters of both transistors V3001 and V3002.
  In this stage the input voltage is converted into a current signal.
- V3004, V3006 is a shunt feedback amplifier, which gives a voltage signal to the next stage.
- V3008, V3009 is a series feedback amplifier, including a final RC-correction network and potentiometer R3038 for gain adjustment to compensate the different CRT sensitivities. V3007 supplies a constant current of 60 mA, i.e. 30 mA for each half. Note that the output again supplies a current signal.
- V3011, V3012 is a common-base amplifier for buffering the final Y-amplifier to the Y-deflection plates. The maximum amplitude on each deflection plate is: 30 mA x 655 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 is a common-base amplifier. The current "I" on the collector of both transistors determines the voltage across R3102 and R3116. This voltage is about 1,5 V p-p and feeds the next stage.
- V3103, V3106 is a series feedback amplifier, including an RC-correction network for optimum linearity of the trace and potentiometer R3118 for x1 amplifier adjustment, mounted between the emitters of both transistors. V3104 serves as current source.

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

6.4 FINAL BLANKING (Z) AMPLIFIER AND CRT

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

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

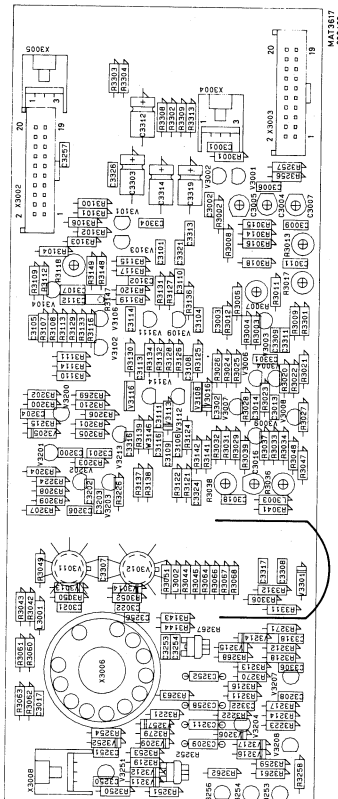
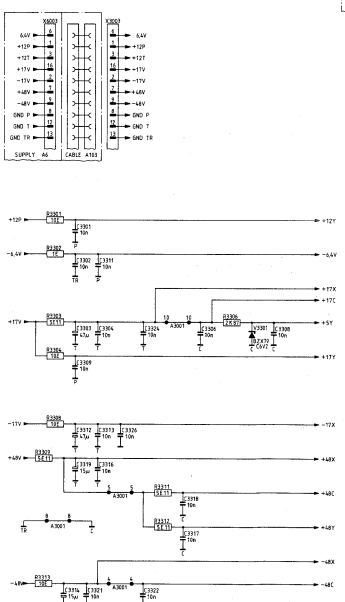
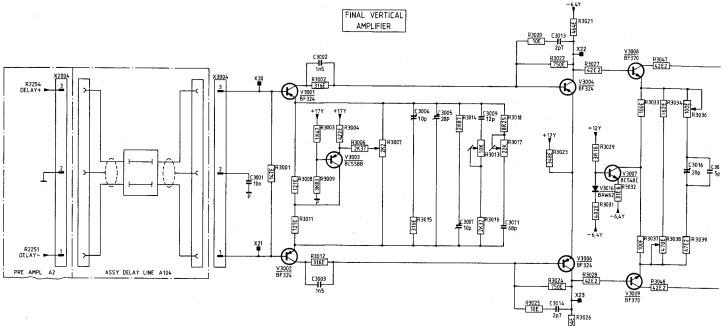


Figure 6.1 XYZ amplifier p.c.b.





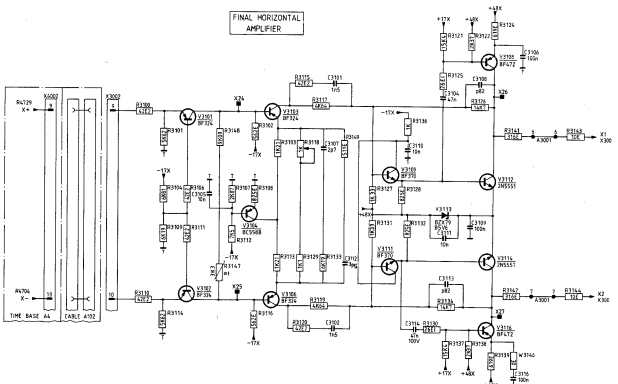
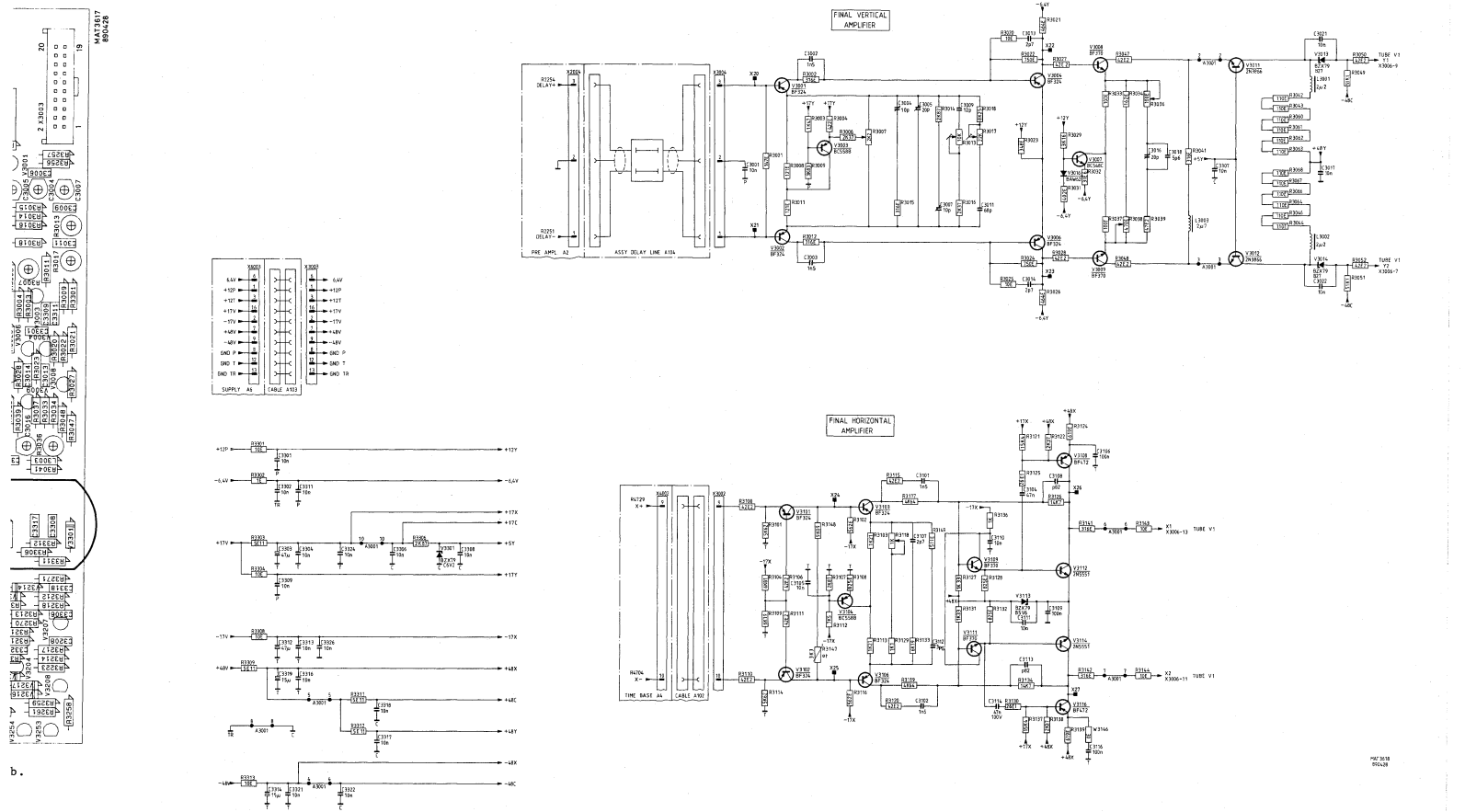


Figure 6.2 Circ
fina



b.

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

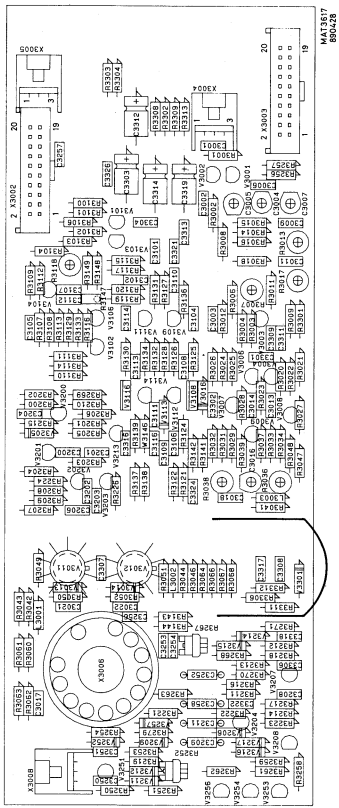


Figure 6.3 XYZ amplifier unit p.c.b.

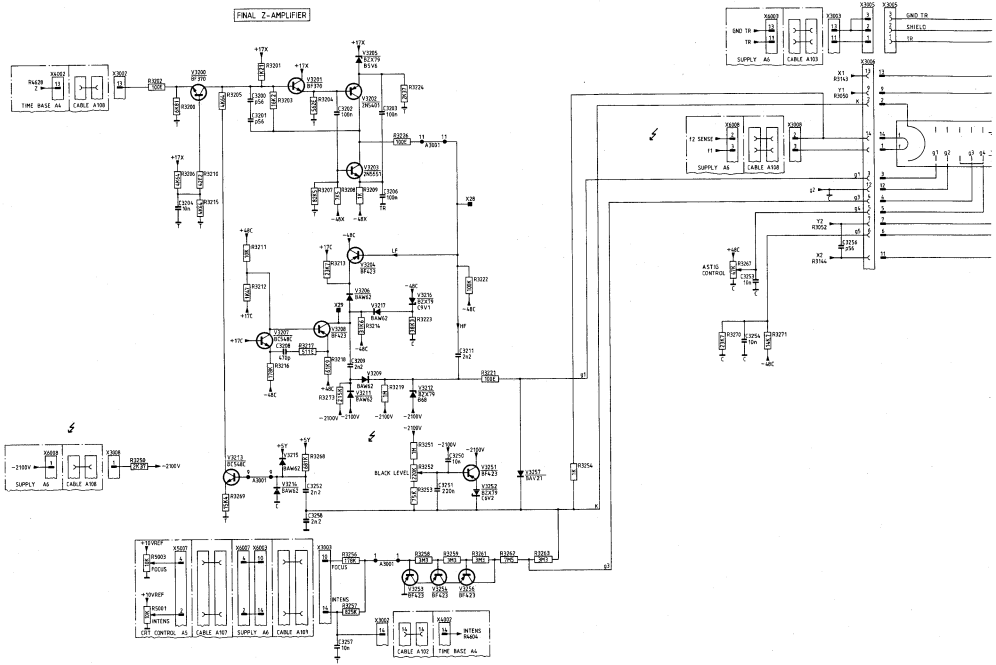
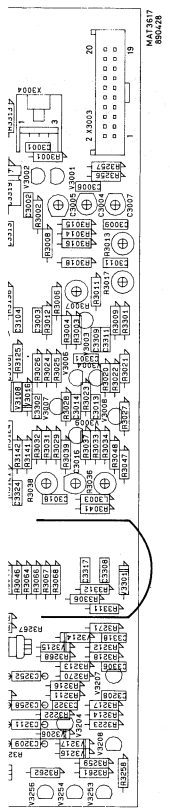


Figure 6.4 Circuit diagram of XYZ amplifiers, Z



er unit p.c.b.

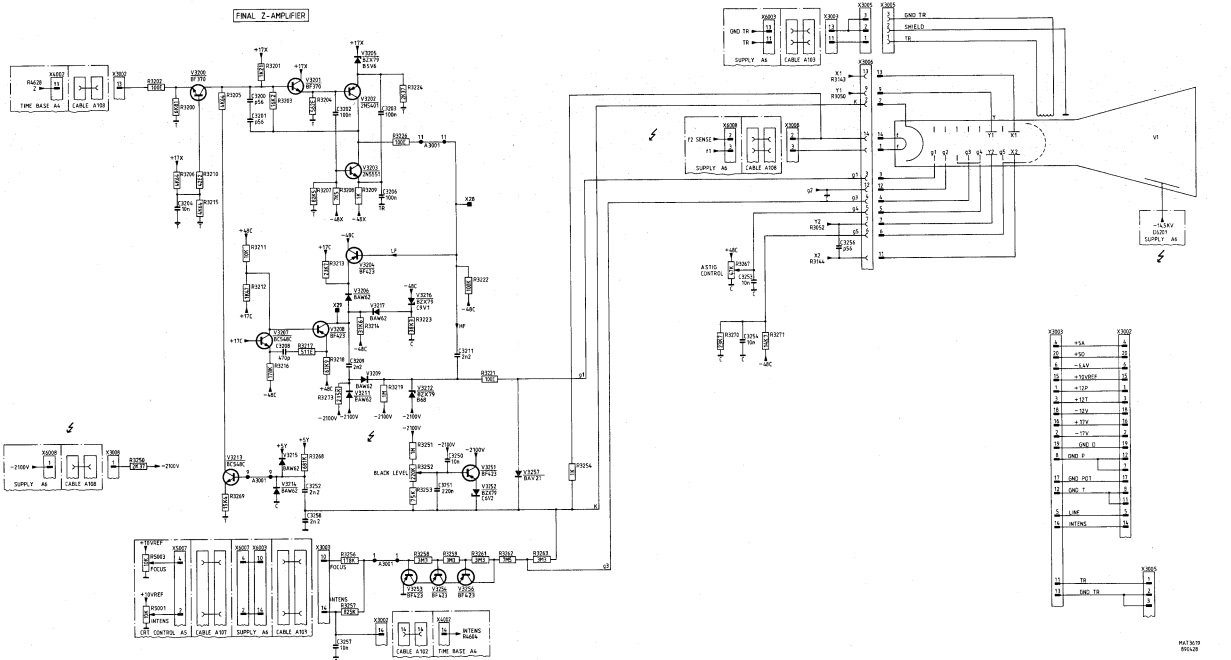


Figure 6.4 Circuit diagram of XYZ amplifiers, Z amplifier and CRT circuit

7. TIME-BASE UNIT (A4)

The time-base unit consists of:

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

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

All control pulses for this unit are generated by the time-base 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 summation amplifier V4004, the shunt feedback amplifier V4008 and the emitterfollower V4009. The summation amplifier adds the base signal voltage of V4004 (caused by TRIGM-) and the collector signal current of V4001 (caused by TRIGM+).

* TV triggering:

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

7.2 TIMING CIRCUIT (see figure 7.1)

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

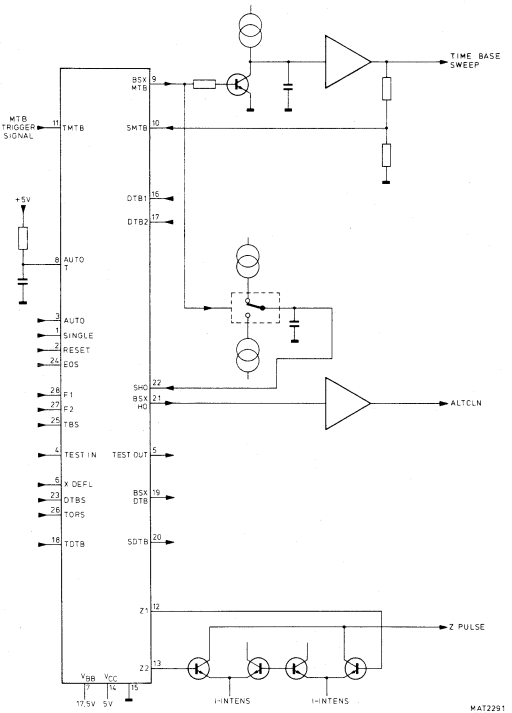


Figure 7.1 D4103 configuration

D4103 has the following relevant pin connections:

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

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

7.3 SWEEP GENERATOR

* TB sweep generator (see figure 7.2):

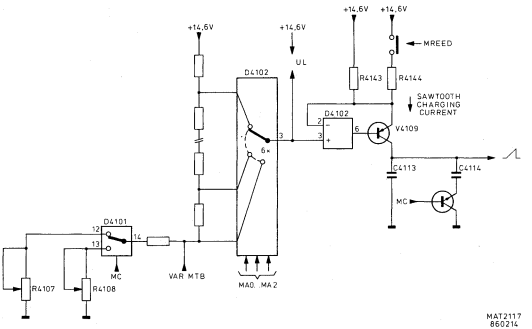


Figure 7.2 Simplified diagram of the time-base sweep generator

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

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

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

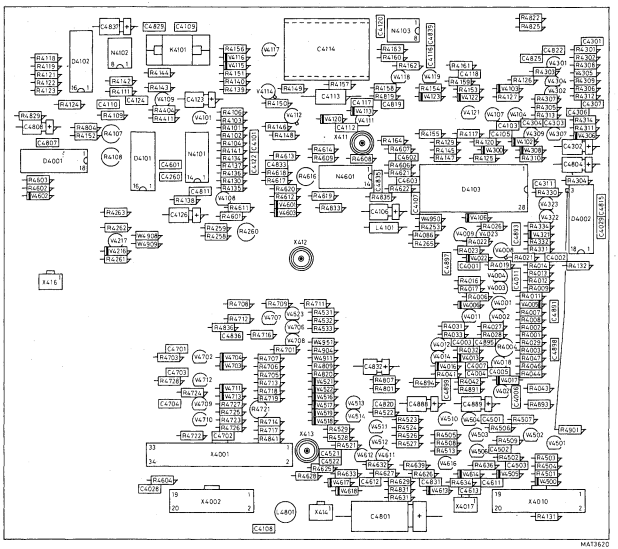
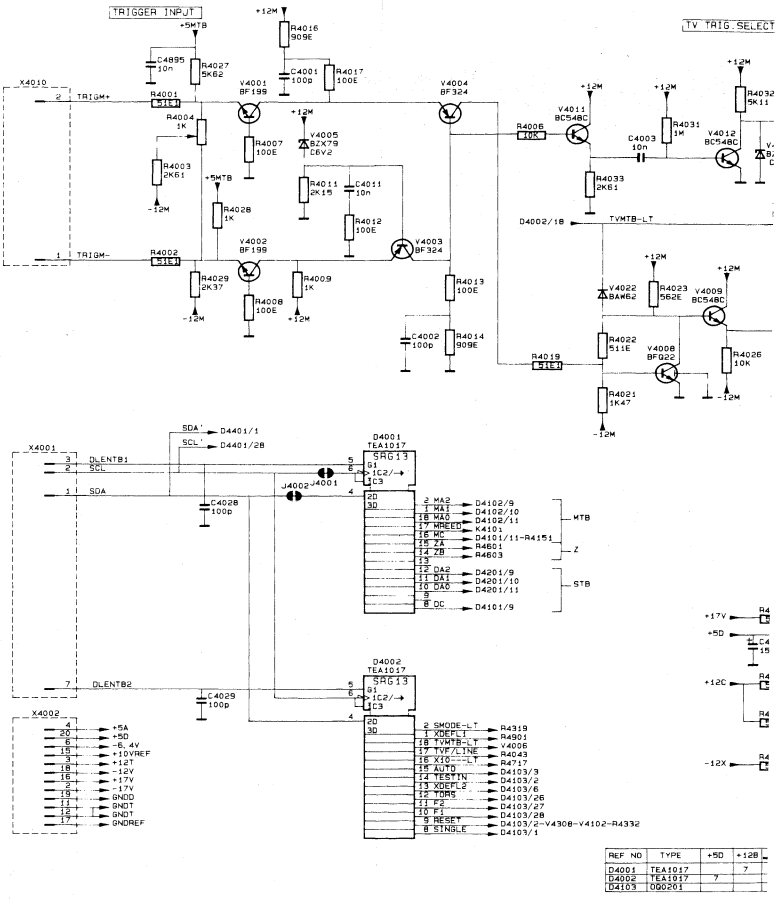


Figure 7.4 Time-base unit p.c.b.



REF ND	TYPE	+5D	+12B
D4001	TEA1017		7
D4002	TEA1017	7	
D4103	090201		

F

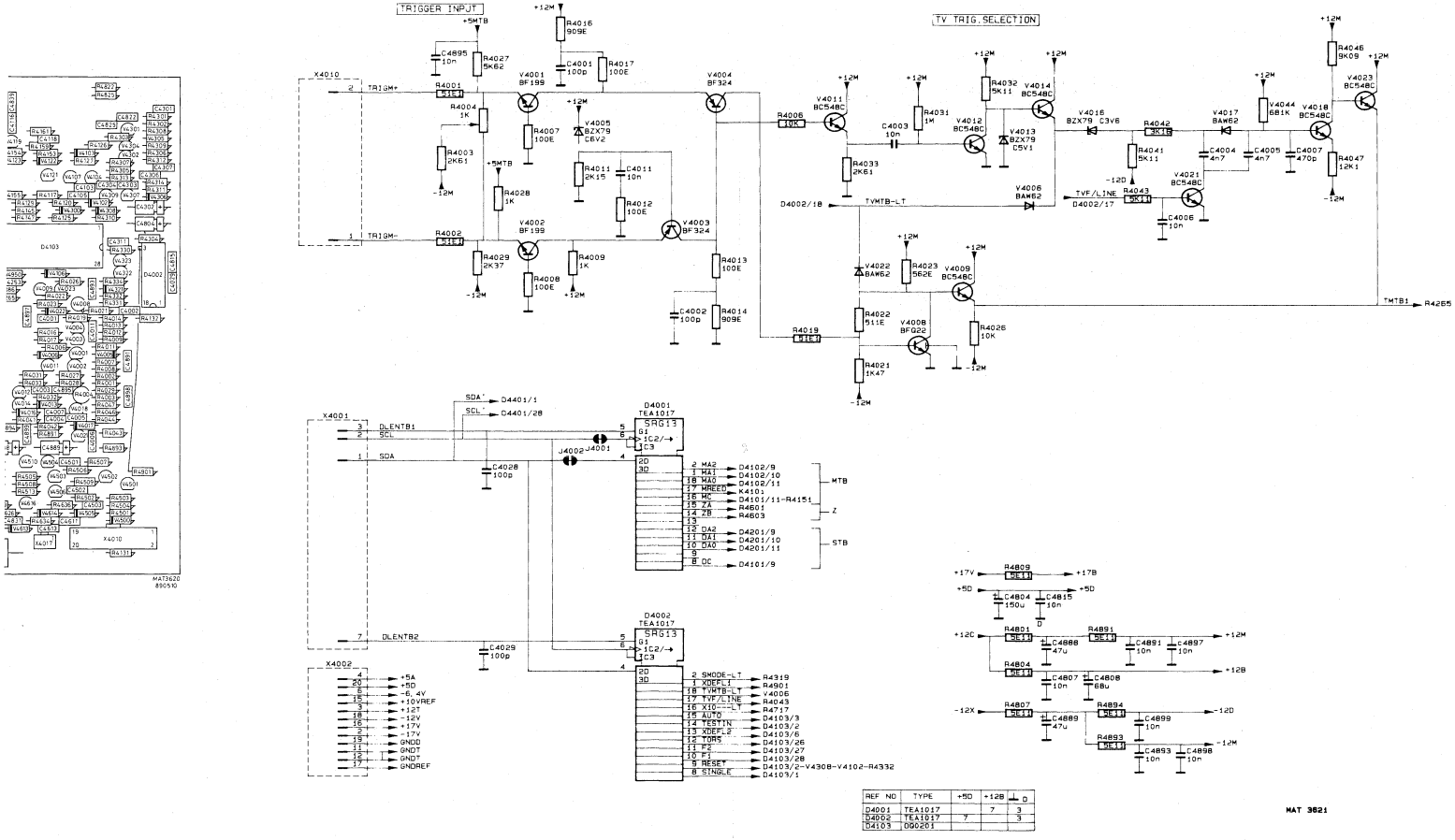


Figure 7.5 Circuit diagram of time-base, trigger amplifier

The function table for the sweep generator is given below:

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

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

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

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

* Hold-off circuit:

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

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

7.4 X DEFL AMPLIFIER AND DISPLAY MODE SWITCH

* X DEFL amplifier:

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

* Horizontal display mode switch:

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

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

7.5 Z-AMPLIFIER

* Z-switch:

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

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

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

* Z Pre-amplifier:

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

However, there are two conditions for additional blanking:

- In the chopped mode of the vertical channels the display is blanked during switching over between channels. This happens by connecting the CHOPBLN pulse to V4611. When this pulse is HIGH, transistor V4611 conducts and a part of the blanking current flows via V4611 emitter-collector to the +5 K (+5V supply) rail.
- if a HIGH level is applied to the external Z MOD input on the rear panel, this signal causes conducting of V4616 so that a part of the blanking current flows via V4616 emitter-collector to the +5 K rail.

7.6 HORIZONTAL PREAMPLIFIER

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

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

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

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

7.7 TIMING DIAGRAM

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

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

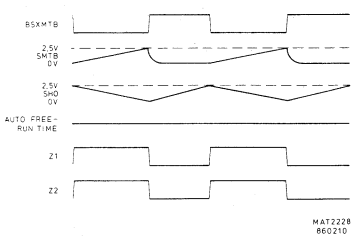
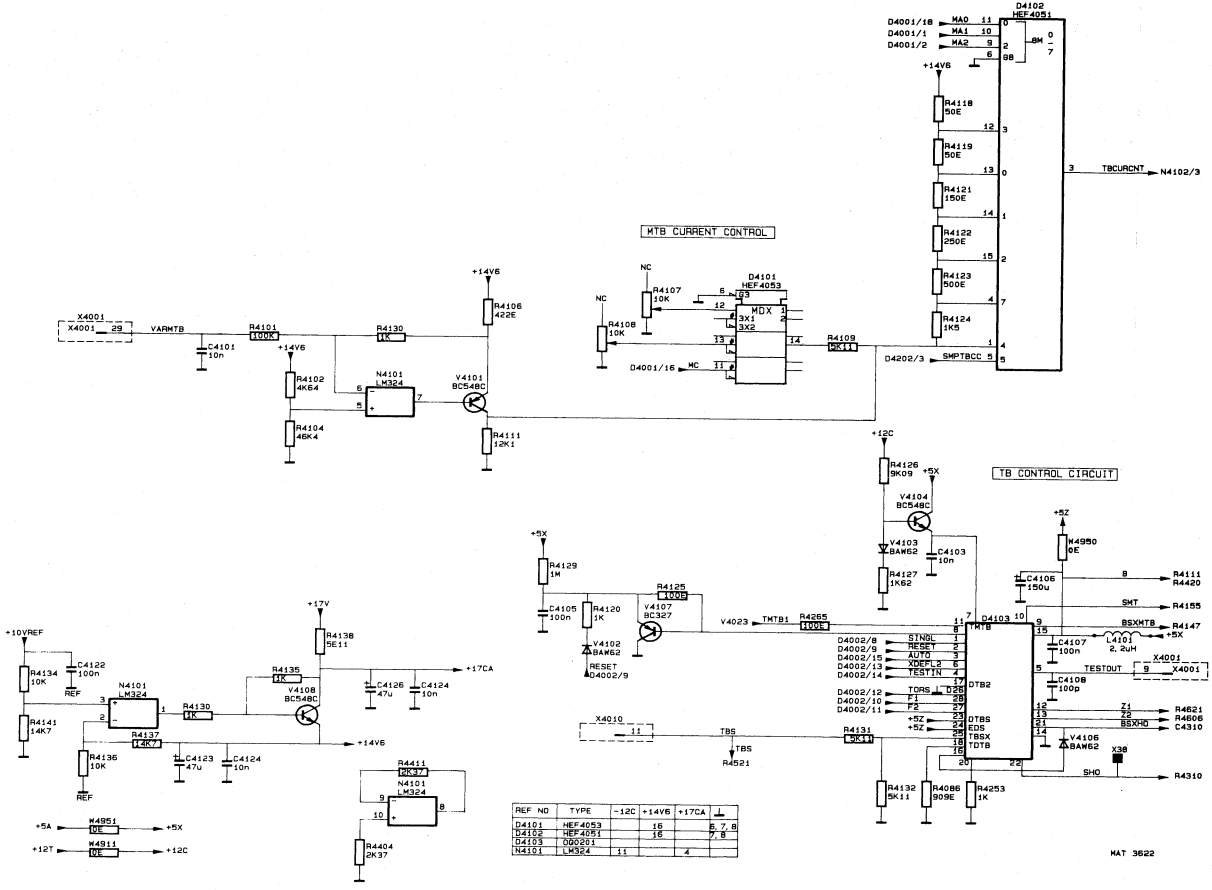
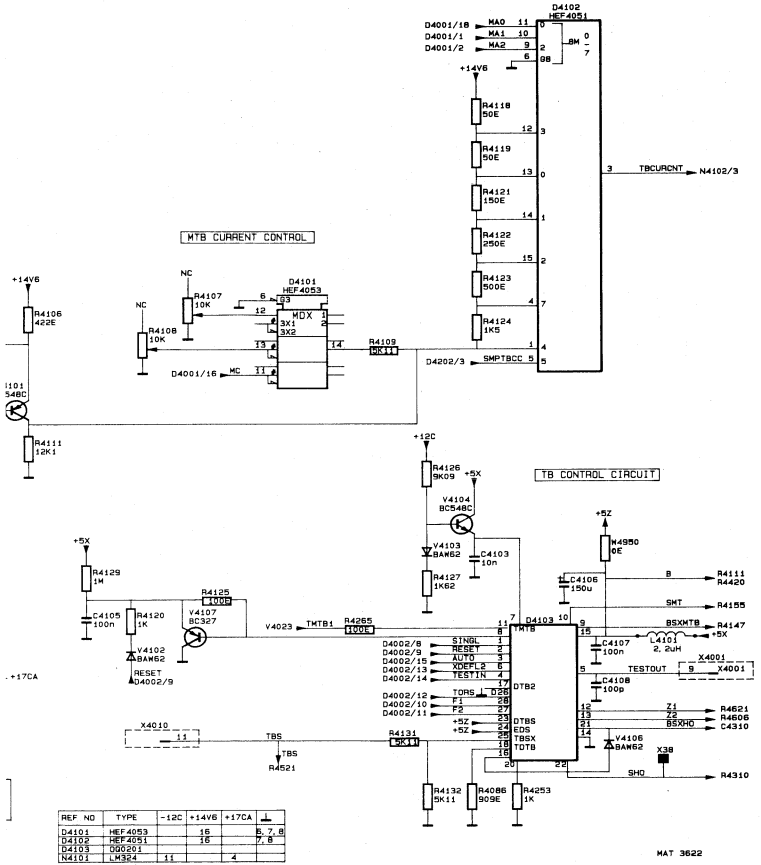


Figure 7.3 Free-running sweep-timing diagram



REF NO	TYPE	-12C	+14V6	+17CA	⊥
D4101	HEF4053		16		8, 7, 6
D4102	HEF4051		16		7, 8
D4103	QQ0201				
N4101	LM324	11		4	

Figure 7.6 Circuit diagram of time-base, timing circuit and control



REF NO	TYPE	-12C	+14V6	+17CA	⏚
D4101	HEF4053		16		8, 7, 8
D4102	HEF4051		16		7, 8
D4103	000201				
N4101	LM324	11		4	

nd control

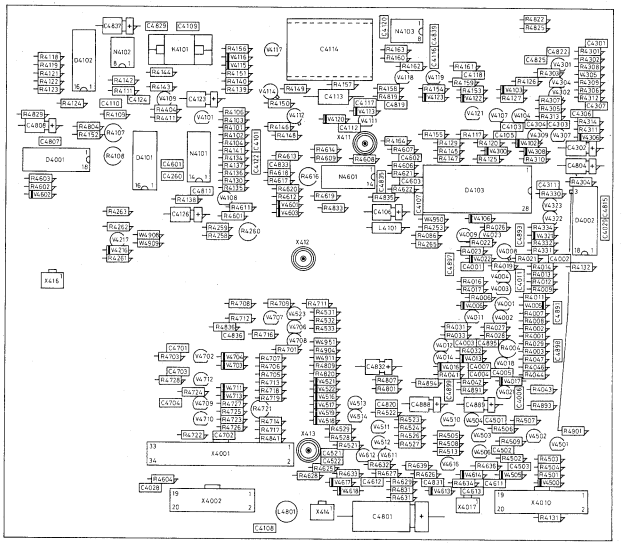
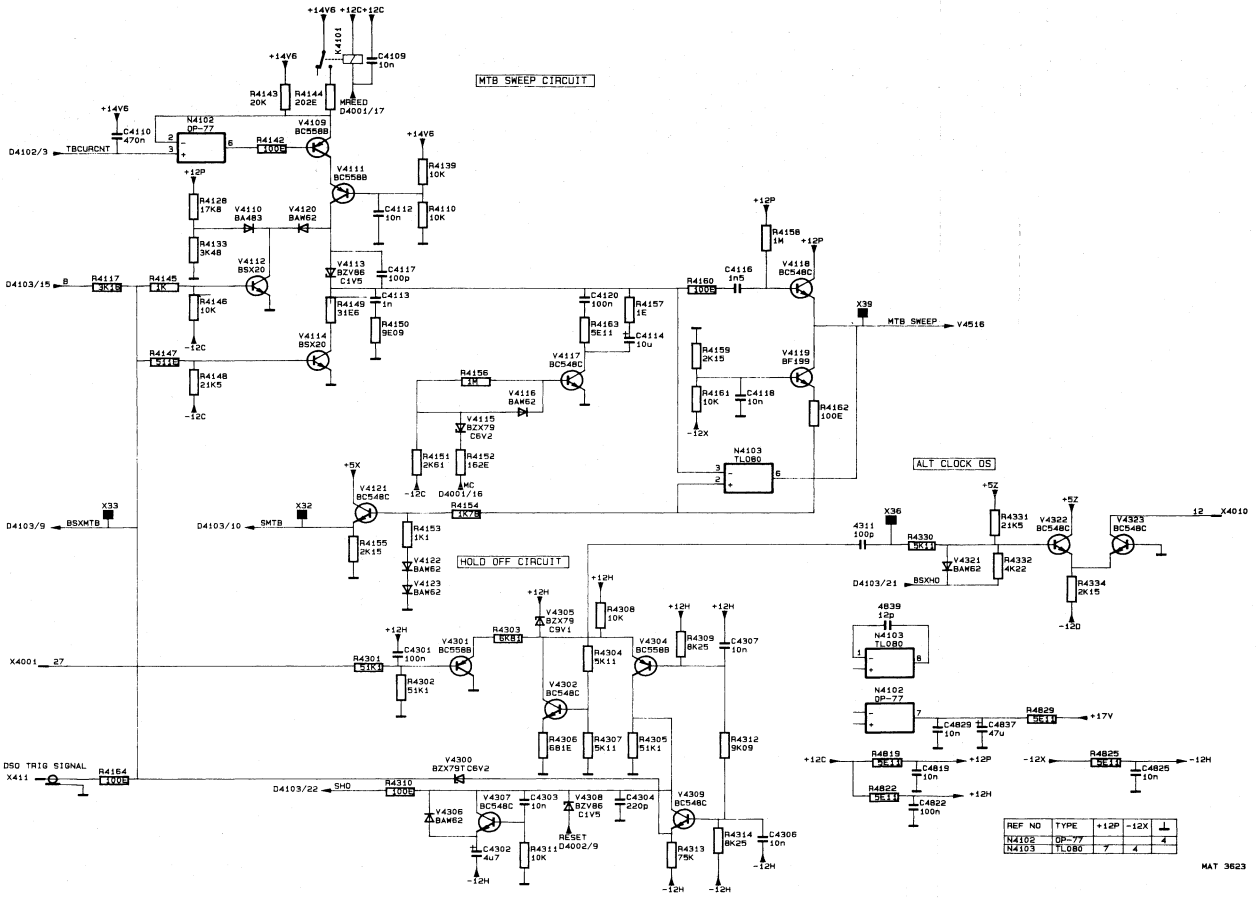


Figure 7.7 Time-base unit p.c.b.



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

Figure 7.8 Circuit diagram of time-base, sweep generator and hold-off

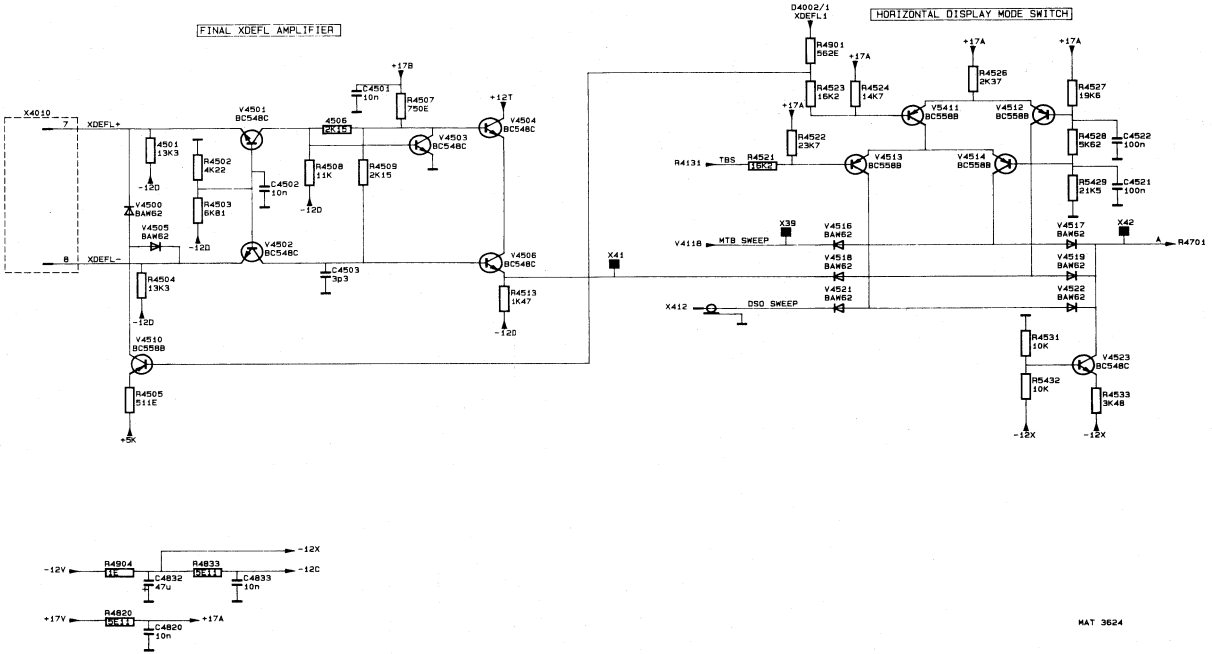


Figure 7.9 Circuit diagram of time-base, X-deflection selection

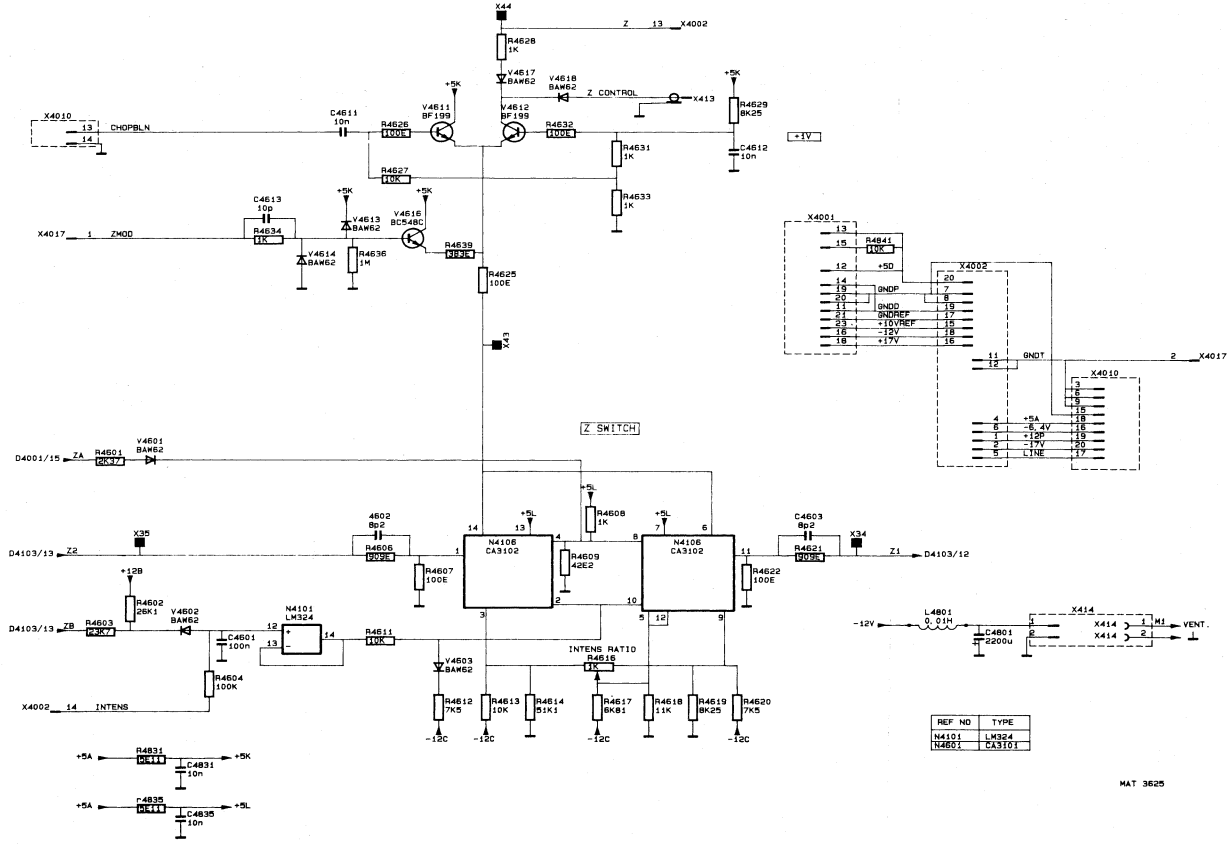


Figure 7.10 Circuit diagram of time-base, Z-amplifier

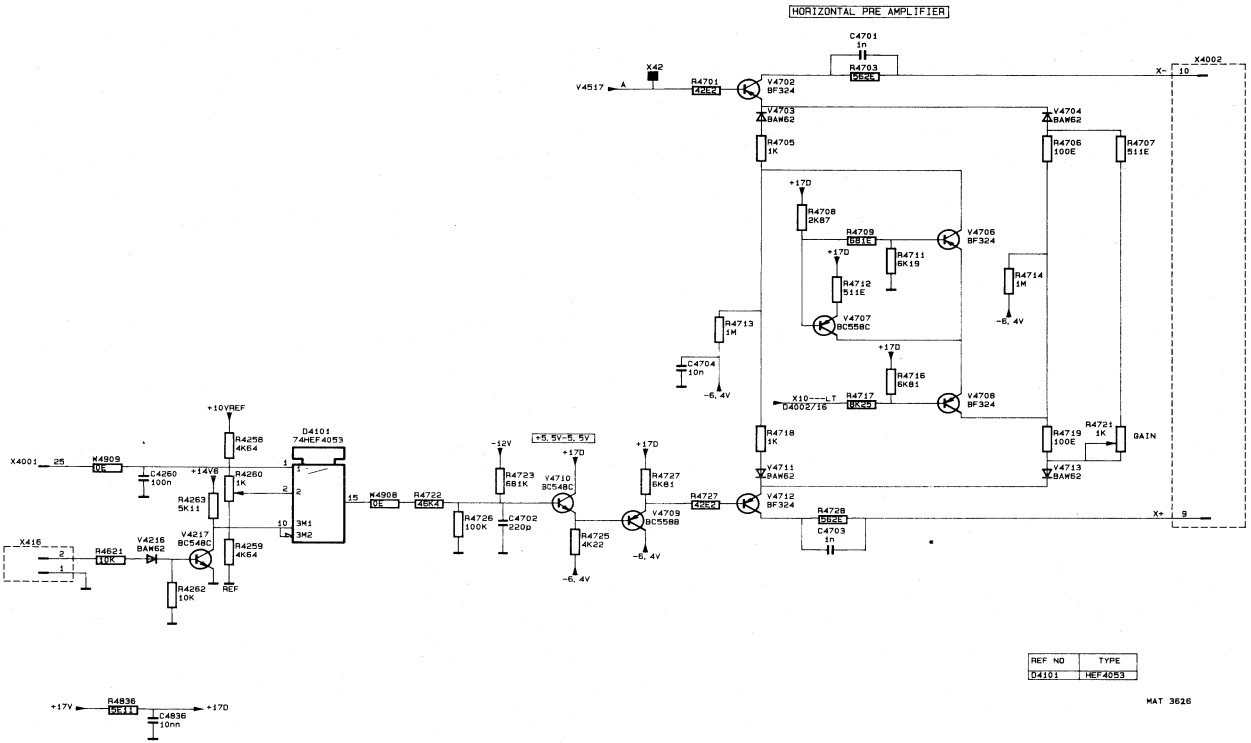


Figure 7.11 Circuit diagram of time-base, horizontal pre-amplifier

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

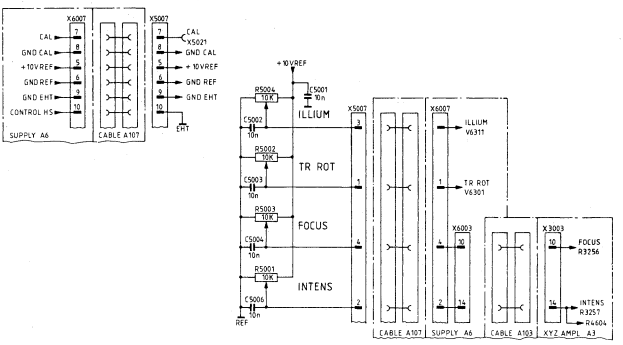


Figure 8.1 Circuit diagram of CRT control

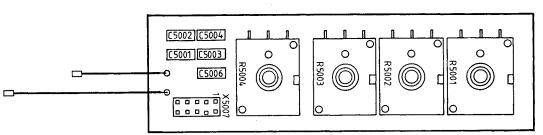


Figure 8.2 CRT control unit p.c.b.

9. POWER SUPPLY UNIT (A6)

Basically, the power supply unit consists of:

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

9.1 INPUT CIRCUIT

The instrument may be powered from a nominal mains voltage of 90 V...264 V a.c.
The mains voltage is primary protected by a fuse of 1 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 three chokes. Depending on the mains voltage, the rectified voltage is 120 V...370 V.

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

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

9.2 CONVERTER CIRCUIT (see figure 9.1 and figure 9.2)

The flyback converters consists of transistor V6014 and V6018 and their associated components. The converter frequency depends on the LINE IN amplitude and is for 110 Vac: 30 kHz approx. For 220 Vac: 45 kHz approx.

Transistors V6014 and T6018 conduct on the forward stroke and charge transformer T6001. The thyristor V6013 fires when the voltage on the gate reaches the firing level (0,6 V approx). Consequently, V6018 blocks - V6014 blocks, for the duration of the flyback stroke, during which the secondary windings discharge via the diode rectifiers into the smoothing capacitors. The NTC resistor R6009 provides temperature compensation for the firing point of the thyristor.

During the flyback, capacitor C6009 charges again via the path T6001-1,V6012, V6009, R6004, C6009 and T6001-2.

The voltage stabilizer with transistor V6009 gives a square-wave 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 eliminate the switching spikes present on the collector of V6018 (measuring point X46).

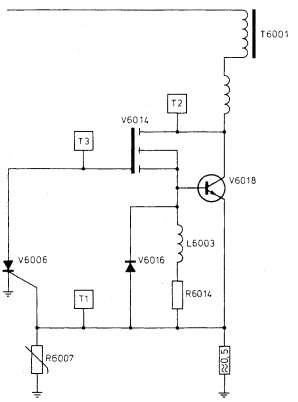


Figure 9.1 Converter circuit

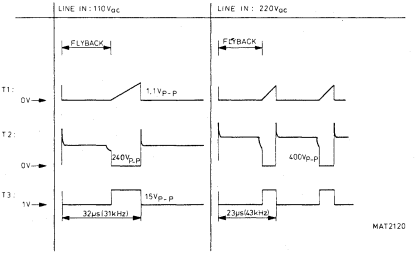


Figure 9.2 Timing diagram converter circuit

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.

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

9.4 HT SUPPLY

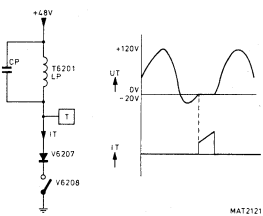


Figure 9.3 HT oscillator

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 analogue switches D6501(8-9) and D6501(11-12) 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.

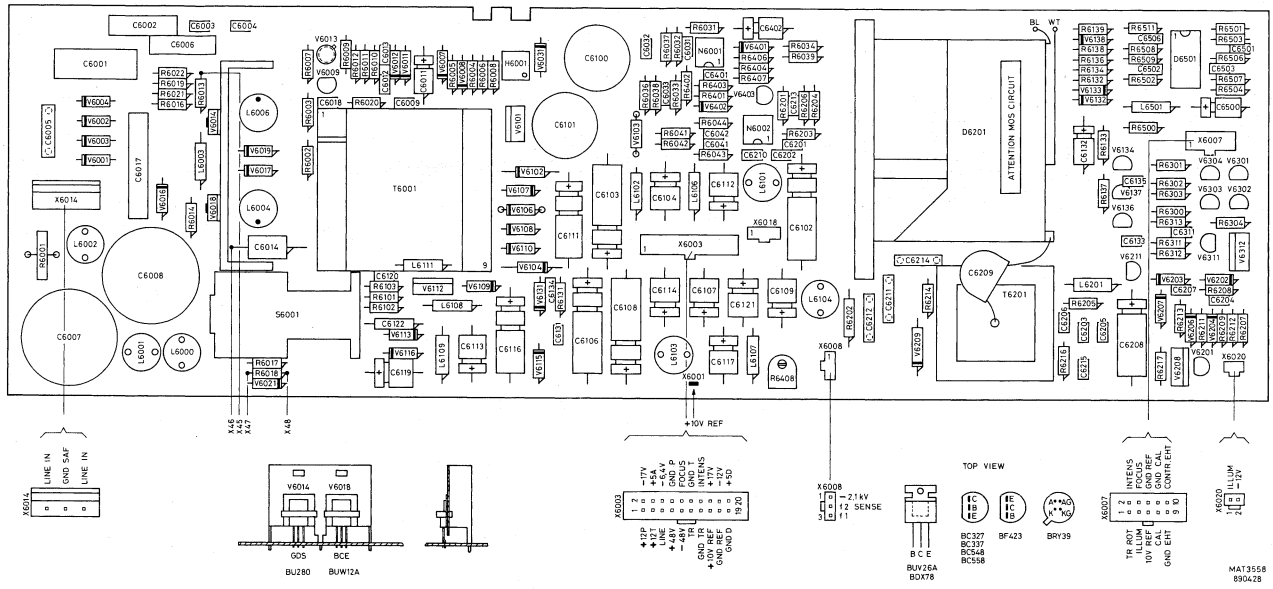


Figure 9.4 Power supply unit p.c.b.

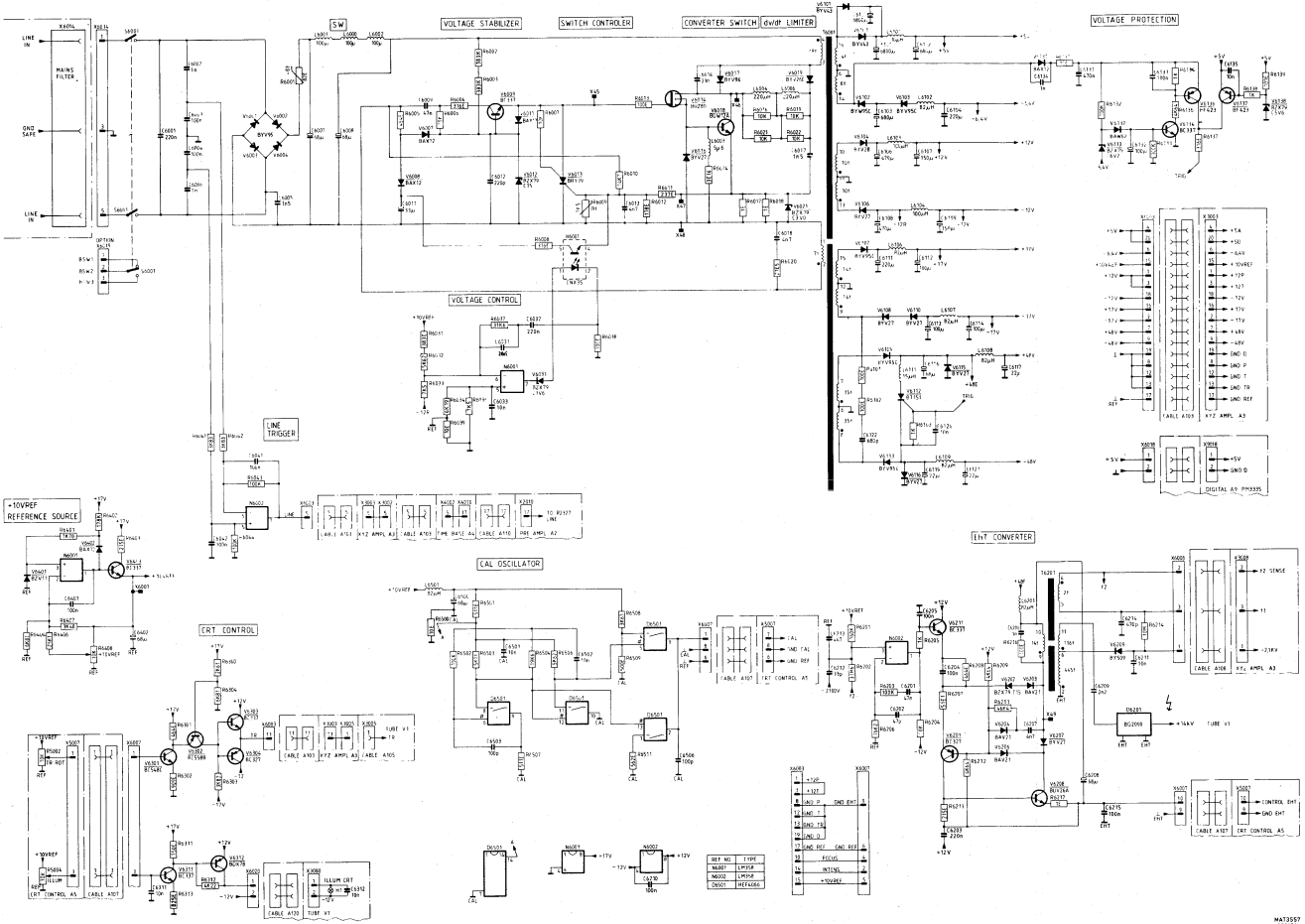


Figure 9.5 Circuit diagram of power supply

10. FRONT UNIT (A7-A8)

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

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

10.1 KEY-MATRIX AND RESET CIRCUIT

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

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

10.2 FRONT PANEL CONTROLS, PROBE INDICATOR AND AUXILIARY CIRCUITS

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

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

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

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

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

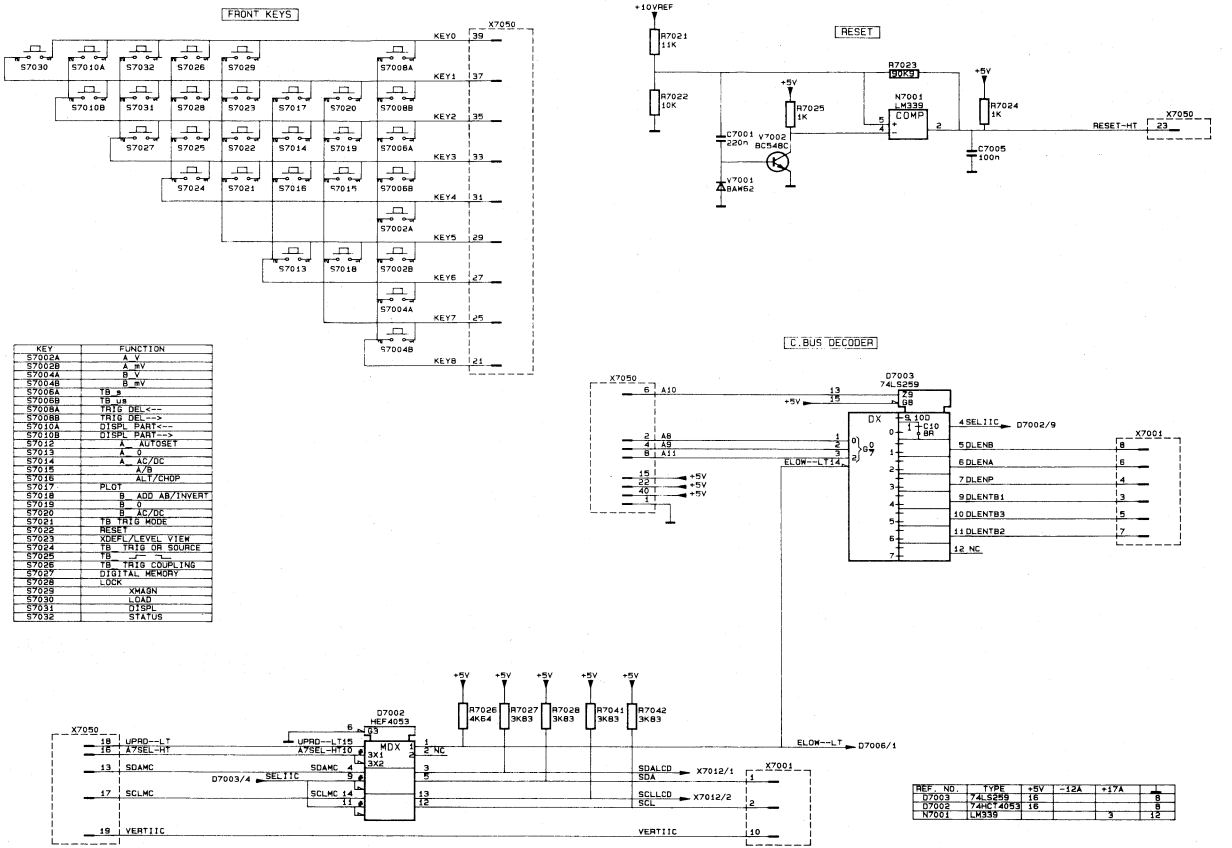
D7003 decodes the address lines A8, A9 and A11 into the DLEN (Data Latch Enable) signals that select one of the serial-parallel conversion circuits.

10.3 LCD DISPLAY CIRCUIT

The LCD is driven by three drivers D8001, D8002 and D8003 (PCF8577). The temperature dependent supply voltage VCPCF is 4 V approx. at 25°C When the temperature increases, this voltage decreases. This is achieved by NTC resistor R7036. As a result the intensity of the LCD is constant over a wide temperature range.
The single-pin built-in oscillator on pin 37 of D8001 provides the modulation frequency for the LCD segment driver outputs. Capacitor C7008 and resistor R7018 are connected to this pin to form the oscillator, with a frequency of 150 Hz approx. Pin 36 and pin 37 are used to determine the LCD driver address in the I²C bus.

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

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



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

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

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

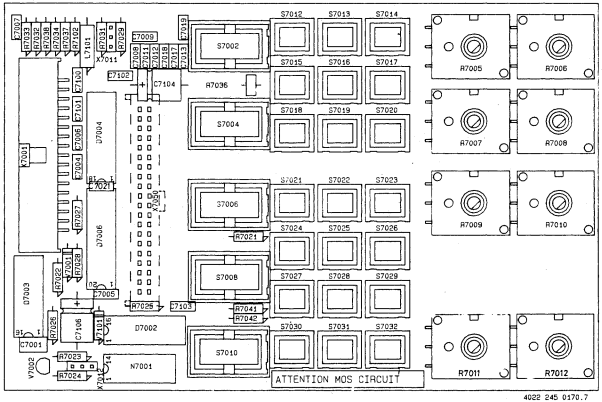
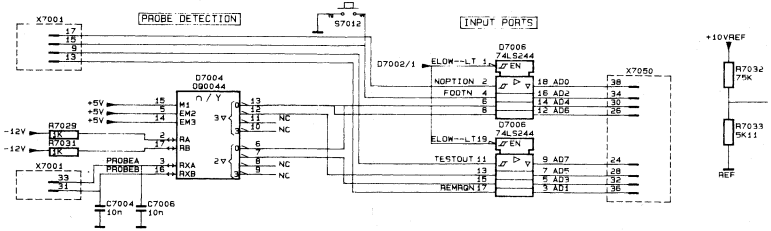
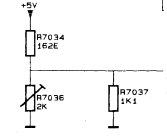
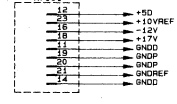
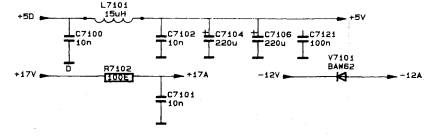


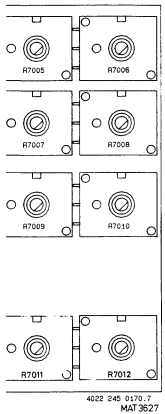
Figure 10.2 Front unit p.c.b.

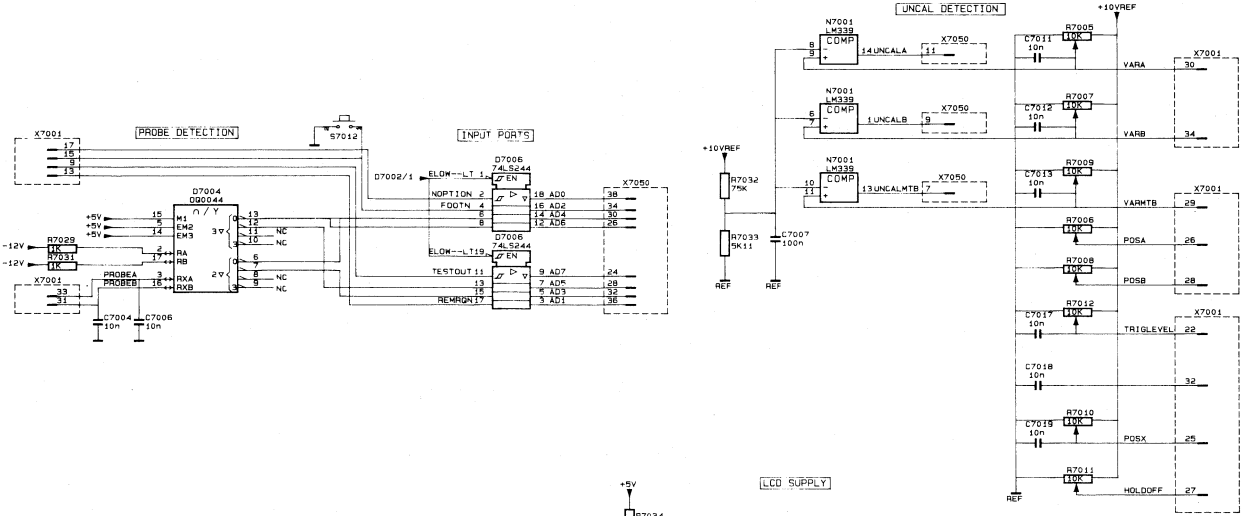


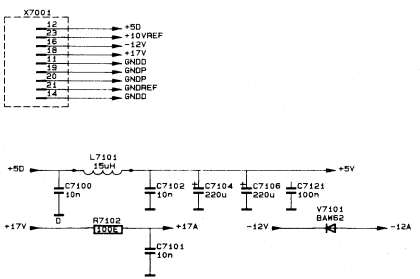












REF NO	TYPE	+5V	-12V	+17A	
D7004	Q00044	4	18		7
D7006	74LS244	20	18		10
N7001	LM339			3	12

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

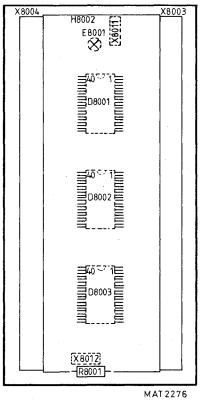
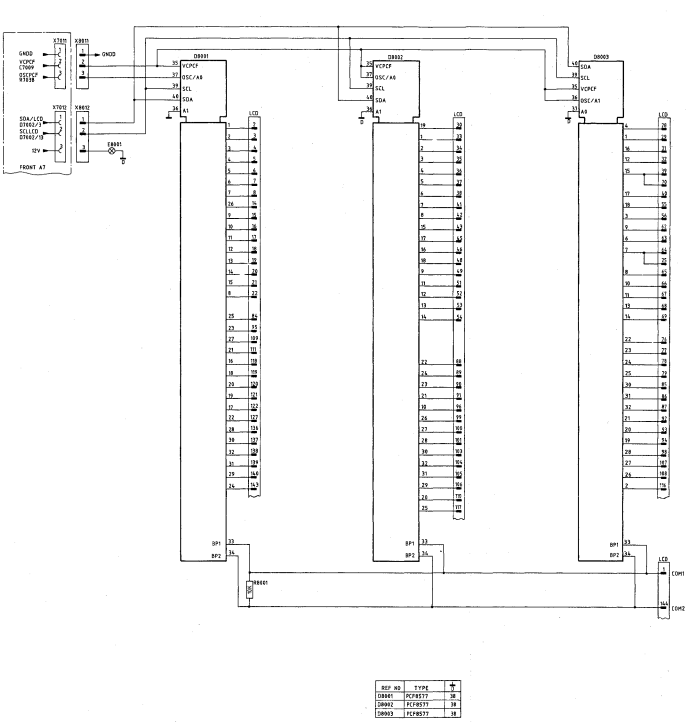
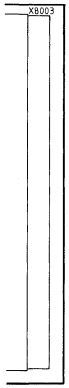


Figure 10.4 LCD unit p.c.b.

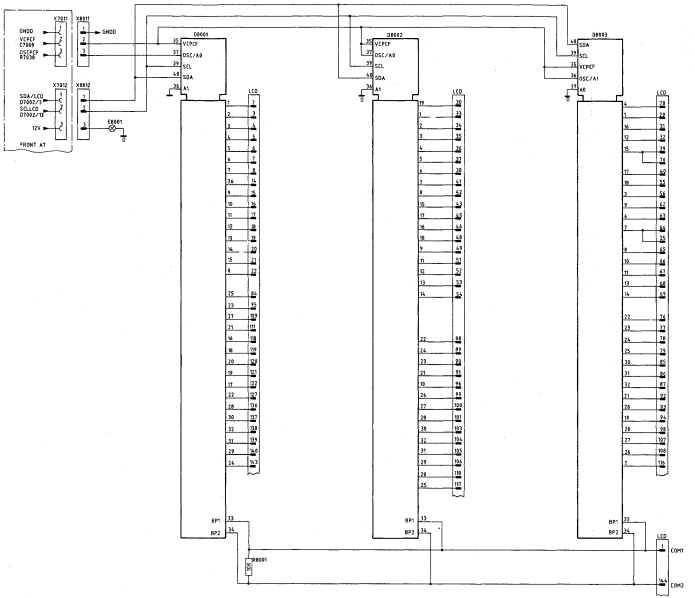


REF NO	TYPE	
DB001	PCF8577	38
DB002	PCF8577	38
DB003	PCF8577	38

Figure 10.5 Circuit diagr



nit p.c.b.



REF NO	TYPE	⏚
D8001	PCF8577	30
D8002	PCF8577	38
D8003	PCF8577	38

LCD			
	COM1		COM2
PIN	DISPLAY	SEGMENT	DISPLAY	SEGMENT
1&3				COM3
3&2	x1			INV
3&2	NC			NC
3&1	NC			NC
1&6	1	e	1	f
1&5	1	g	1	a
1&8	1	c	1	d
1&7	1	b		P1
1&6		ALT		A
1&5	NC			NC
1&4	NC			NC
1&3	NC			NC
1&2	NC			NC
1&1	NC			NC
1&0	NC			NC
1&9	NC			NC
1&8	NC			NC
1&7	x2			INV
1&6	NC			NC
1&5	NC			NC
1&4	NC			NC
1&3	NC			NC
1&2	NC			NC
1&1	NC			NC
1&0	NC			NC
1&9	NC			NC
1&8	TRIG			AUTO
1&7	NC			NC
1&6	NC			NC
1&5	NC			NC
1&4	NC			NC
1&3	x4			x3
1&2	g		5	e
1&1	c		5	d
1&0	g		6	e
1&7	c		6	d
1&6	g		7	e
1&5	c		7	d
1&4	3			MAGN
1&3	2			L
1&2	NC		NC	
1&1	10			B
1&0	EXT			A
1&9	DC			P.P
1&8	V%,TV			P
1&7				Y7,P
1&6	y4			Y5,P
1&5				DIGITAL MEMORY
1&4	y1			Y2,P
1&3	g		8	e
1&2	c		8	d
1&1	g		9	e
1&0	c		9	d
1&9	b			P6
1&8	g		10	e
1&7	c		10	d
1&6	b			P7
1&5	c		11	d
1&4	LOCK			REG
1&3	NC			NC
1&2	NC			NC
1&1	NC			NC
1&0	NC			NC
1&9	x3			y1
1&8	x3			x4
1&7	x4			x5
1&6				REMOTE
1&5	NC			NC
1&4	NC			NC
1&3	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		\		\
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		c		\
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		\		*
38		x		P
39		x		
40		16		x9
41		x5		x8
42		x6		x7
43		LINE		DC
44	NC		NC	
45		8		AC
46		LP		MP
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		8,V,2,x5,y3		
65		x10		x16
66		x14		x12
67		x11		x12
68		x10		x9
69		x7		x8
70				MENU
71	NC		NC	
72	NC		NC	

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07/076

Figure 10.5 Circuit diagram of LCD unit

11. DIGITAL UNIT (A9)

INPUT AMPLIFIERS AND ADC CIRCUIT

This part of the circuit comprises two identical circuits (one for channel A and one for channel B) of which the channel A circuit is explained.
Every circuit incorporates an analog input amplifier followed by an analog into digital converter (ADC). The balanced current signal from V616/V617 (V621/V622 in channel B) on the adaptation unit A16 is applied to the emitters of common base circuit V9011/V9012. The signal currents in every branch are equal (0,1 mA/div) and are in antiphase. Trimming potentiometer R9064 is used for gain adjustment. The biasing currents in both branches are equal.
With no signal, the currents through V9011, V9016 and V9012, V9013, V9014 are equal and no current is running towards the base of V9017. V9017 is a shuntfeedback amplifier that converts current into voltage signal. The voltage amplitude is determined by the resistance value of R9083; C9074 limits the bandwidth of this stage. The output voltage of V9017 is applied to pin 8 of the ADC N9001 via emitterfollower V9018. The biasing voltage at the output of the emitter follower is adjusted to +2,5V with offset adjustment R9078. The inputvoltage range of the ADC lies between +1,6 and +3,4V.
The emitter of common base transistor V9013 is always at +0,6V which is identical to the base voltage of V9017. The transistors V9014, V9016 serve as a current mirror: if due to signal the current applied to V9011 sinks with e.g.0,1 mA the current in V9012 rises with the same amount. The current mirror on its turn adds this signal current and as a result the current in R9083 increases with 0,2 mA.

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

11.2 ACQUISITION MEMORIES

This diagram incorporates the 8K acquisition memory. The memory is loaded with the output information of the two ADC's. In dual channel mode the channel A ADC output (AQDB00 ... 07) is providing the information that is loaded into the 4K memory D9031, D9032. The channel B ADC information is loaded into the other 4K memory D9033, D9034. The information is loaded into the memory if pin 18 (Chip Select RAM) and pin 21 (write acquisition) are both low. The 12 bit memory address (necessary to address 4K) is AQAB00 (least significant bit) ... AQAB11 (most significant bit). This address is generated by an address generator that is present on the acquisition control logic. With address line AQAB11 low the memories D9031 and D9033 are enabled. Via inverter D9023/5,6 the memories D9032 and D9034 are enabled if address line AQAB11 is high.
If only one channel is selected, the full 8K memory is available for that channel. If channel A is selected, the 4K memory D9031, D9032 is loaded and then via bidirectional buffer D9035 the 4K memory D9033, D9034. If channel B is selected, the 4K memory D9033, D9034 is loaded and then via bidirectionalbuffer D9035 the 4K memory D9031, D9032. The bidirectional buffer is controlled by or gate D9030/9,10,8. The input signals for these gates are explained on the next circuit diagram where they are generated. The output signals ENAD1-LTand ENAD2-LT are the enable signals for ADC 1 and ADC 2.

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

11.3 ACQUISITION CONTROL LOGIG

The acquisition control logic plays the central role in the signal acquisition:
it generates all the necessary control signals for the ADC's, the aquisition memories, two counters and the exchange of data from acquisition part to the display part of the instrument.
The diagram comprises two counters. Counter 1 consists of the 4-bit counters D9053, D9054, D9056 and D-flipflop D9049. This counter can only count upwards and can be preset to 0000 by control signal RSCN1-LT (reset counter 1) because its data inputs are connected to 0V. The clockpulse for counter 1 is CKCN1(clockpulse counter 1).
Counter 2 consists of the 4-bit counters D9061, D9062, D9063 and D9064. This counter can be preset to a certain preset value by control signal LDCN2-LT (load counter 2). This 13-bit preset value comes from the outputs of the latches D9058, D9059. These latches are loaded in advance by the instrument's microprocessor via the control signals CKPR1 (clock pretrigger) and CKPR2. Moreover counter 2 can count up or down: this is controlled by the signal UPDO (up/down). The counter counts up with UPDO being low and its counts down with UPDO high. Both counters have a range of 0 ... 4K in dual channel mode: two 4K memories for respectively channel A and B are adressed in parallel. The range in single channel mode is 8K because the two 4K memories are placed behind each other so that 8K must be adressed by the counter. The two-position multiplexers D9066, D9067 and D9068 select the address for the acquisition memory: this can be either the outputs of counter 1 (SLAQAB/selectacquisition address bus = low) or the outputs of counter 2 (SLAQAB = high).

The acquisition system can take in information in two different modes that depend on the TIME/DIV setting of the instrument. The modes are D1 mode for 10us ... 1ms/div and D2 for 2ms ... 50s/div. The difference between the two modes is that in the D2 mode the waveform is built up on the CRT screen while the acquisition is busy taking-in signal samples.
Working principle of D1 mode (refer to timing diagram, the signals STate0 and STate1 are also given because they can serve as a reference):

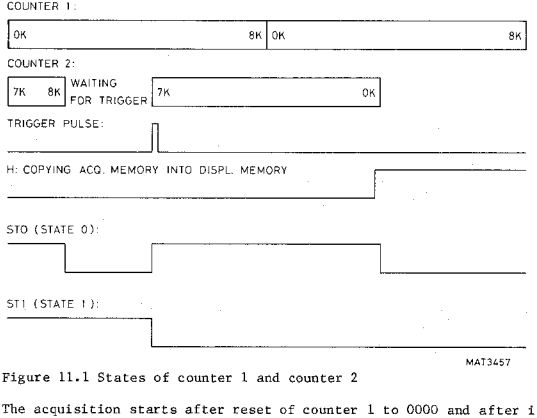


Figure 11.1 States of counter 1 and counter 2

The acquisition starts after reset of counter 1 to 0000 and after it has preset counter 2 to the so-called precharge-value. This value depends on the adjusted pretrigger value. If this value is e.g. -3 div, the precharge-value is in single channel 8192 - (3 * 400) = 6992 (7K approx) because 1 div equals 400 samples then. In dual channel the value is 4096 - (3 * 200) = 3496 because 1 div equals 200 samples then. The now following example is based upon a pretrigger value of -3 div in single channel mode:
the acquisition starts with counter 1 at 0000 and counts upwards so that the digitized signal samples from the ADC are placed in successive acquisition memory locations. At the same time counter 2 counts up from the precharge value towards 8192. The system can not trigger during this period; this assures that at least 3 div of signal are stored in memory before a trigger can occur. The clockpulse frequencies for counter 1 and 2 are equal during this mode. At the moment that counter 2 has reached 8192, it is reset to the precharge value (in this example 6992) and switched to count down mode. The system now is able to get triggered and stands waiting for a trigger pulse. This trigger pulse comes as "DSO TRIG SIGNAL" from connector X411 on the time base. It is applied to X9011 and consequently to D9050/pin13. Inbetween counter 1 goes on counting up and adressing successive acquision memory locations. Counter 2 starts to count down from 6992 ... 0000 if the trigger occurs. This goes on until the value 0000 is reached: now counter 2 and also counter 1stop. This is the moment that the acquisition memory contents are copied into the display memory. How this is done will be explained on the next diagram "display logic". However bear in mind that the copying of the acquisition memory starts at the counter 1 address succeeding to the address where the acquisition stopped. The aquisition memory contents are copied into the display memory locations starting with address 0000 and onwards. The copy action stops if the display memory has received 8K signal samples. After this a new acquisition stroke starts, and so on. However after a reset command in single (multiple) shot mode, only 1 (2) acquisition stroke is performed.

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

The remaining circuitry on this diagram is control circuitry. Among this circuitry are FPLA (field programmable logic array) D9048 and PAL (programmable array logic) D9047.
The FPLA and the PAL can both be regarded as a programmed read only memory where a certain combination of inputs results in a combination of outputs. The relation between in- and outputs is determined by the way the device has been programmed. The difference between PAL and FPLA lies in the internal programming possibilities of both devices.
The FPLA D9048 produces a number of control signals: STCV is used for the ADC's, WRAQ--LT is used via multiplexer D9064 to control the acquisition memories, SLAQAB controls the write/read address multiplexer, RSCN1-LT and CKCN1 control the write counter, ENADOTLT (enable ADC output) is used for the ADC's, UPDO and CKCN2 control the read counter, OTENRALT (output enable RAM)enables the acquisition memory.
The PAL D9047 produces also a number of control signals. ST0 (state 0) and ST1 represent the four different modes of the acquisition system. These modes are:
- counter 2 counting up the precharge value.
- system stands waiting for a trigger.
- counting down after the trigger until the information transfer starts.
- information transfer from acquisition memory to display memory.

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

11.4 DISPLAY LOGIC

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

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

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

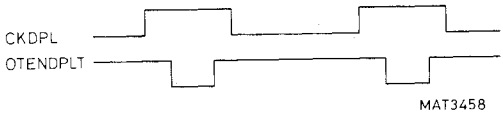


Figure 11.2 Timing diagram of signal transfer

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

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

The horizontal deflection is initiated by 10 bits DPAD02 ... DPAD11 that are applied to the X DAC via multiplexers D9078, D9077, D9076. With the multiplexers in opposite position text and cursors are displayed. There are 4K signal samples for one CRT screen and only 1K (equals 10 bits) for horizontal addressing. This means that at every horizontal position 4 signal samples are displayed. Now the role of the counters in D9072 on the display cycle:
one counter addresses 4K out of the 32K memory range. For this purpose 15 bits are necessary: 14 bits from the counter inside D9072 and 1 bit DPAD12 from Dflipflop D9049. The counter inside D9072 is presettable because of theinstrument´s display part function. The contents of the addressed memory location is placed in latch D9041. Now the counter inside D9072 that is responsable for the X deflection is applied to the outputs. Ten bits of information DPAD02 ... DPAD11 are applied via multiplexers to the X DAC. This counter must be able to count in steps of 1, 2, 4, 8, 16, 32 or 64. This inconnection with the instrument´s X EXPAND functions. Now the contents of latch D9041 is applied to the Y DAC while counter D9072 output determines the horizontal position of the dot on the screen via the X DAC.

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

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

11.5 DAC CIRCUITS

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

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

11.6 DISPLAY AND TIME BASE CONTROL

This diagram comprises the digital time base and logic for display control.
The digital time base is driven by 40MHz X-tal oscillator G9001. The 40MHz output signal is divided by two cascaded D-flipflops D9003 so that 20 and 10MHz square waves are available. Divider D9002 divides the 40MHz signal into 4 and 8 MHz signals for the the digital time base. The signals of 20, 10, 8 and 4 MHz are used for the fastest sweep speeds. They can be selected via multiplexer D9006. This multiplexer is controlled by address lines TBM00,TBM01, TBM02 that come from latch D9052 on circuit diagram "acquisition control logic". The 20MHz signal is used for 10 and 20us/div in single channel. For 20us/div dual channel 10MHz is used. 8MHz (4MHz) is used for 50us/div in single (dual) channel mode.
The 8MHz signal is also routed to a programmable divider D9004. Output pin 10 of this device is used for sweep speeds 0,5ms ... 0,5 s/div. This output signal is applied to the input (pin 15) of a second divider that makes the sweep speeds 1 ... 50 s/div. The programmable divider is controlled by the microcomputer via the data lines ABDB00 ... ABDB07 and the address lines UPAD00, UPAD01. Other control lines from the microcomputer are UFWR (microprocessor write) and CSTB (chip select time base).

The display control logic:
this part of the circuit generates the control signals for the display section.
The circuit is controlled by the microcomputer data bits ABDB00 ... ABDB06 via latch D9024. The latch is loaded with the information on the data bus via signal CKDSP-LT (clock display). Because the display system works asynchroneously from the microcomputer, the latch D9024 is followed by a second latch D9026 that is read out by the signal SC10 that is synchroneous with the 8MHz clock of the display control logic. The control signals that are generated by the two PAL´s D9027, D9028 and multiplexer D9029. A PAL is a programmable array logic of which the function is already discussed during the explanation of circuit diagram of acquisition control logic. The multiplexer D9029 is enabled indigital memory mode (MEMON-LT low). The multiplexer positions are determined by TRAMO-HT (trace mode; H if signals are displayed, L if text/cursors are displayed). D9029 makes two output signals of which ZCONTR-LT is used to determine the intensity of the spot on the screen via V4618on the time base. A low level switches the display on. This level is determined by ZCONTR (signal display) or by ZTENO(text/cursor display). This last signal comes from the text/cursor generator.
The other D9029 output signal XYDTCLLT switches the multiplexers D9043 ...D9076 that switch the Y and X defection in memory on between signal and cursor/text display. This signal is the 10MHz clock in case of text/cursor display and XYDTCL in case of signal display. The most important output signals that are generated in the display control logic are:

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

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

The following timing signals are used:

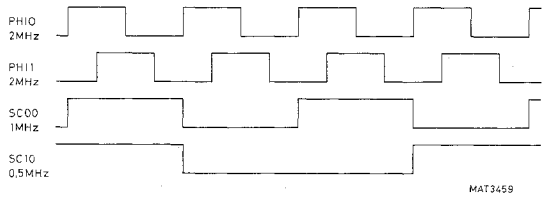


Figure 11.3 Timing diagram display and time base control

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

11.7 CPU LOGIC

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

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

The remaining circuitry on this diagram consists of decoding circuitry. D9019 incorporates two demultiplexers. Depending on a two bit address, one out of the four output lines is low if the enable output is low. D9021 is a demultiplexer with 8 outputs of which one is low at a time depending on a three bit address and if two enable lines are low and one line is high. Some of the control signals that are generated in this circut are:
- CSDSP-LT (chip select display): enables the latch D9042 that gives the microcomputer direct access to the display/register memory.
- DPCNT-LT (display counter chip select): microcomputer can write data into display counter D9072.
- RSCPCNLT: reset pulse for the counter that controls the data transfer between acquisition and display memory.
- OPTWR-LT (option write):
- TXTSL-LT (text select): microcomputer can enable text generator via this line.
- CKMOR (clock mode register): clockpulse for latch D9052 that serves as mode register in acquisition control logic.
- CSTB--LT (chip select time base): chip select for time base IC D9004.
- CKPR1, CKPR2 (clock preset 1/2): clock pulse for latches that are loaded with the preset value for a 8K counter on the acquisition control logic.
- CKDSP-LT: clock pulse for latch D9024 on display mode control logic.

11.8 SIGNAL NAME LIST

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

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

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

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

Signal Name	Description	Signal Source	Signal Destination
AQDB00//03	Acquisition data bus	N9001	D9031, D9032, D9035, D9036
AQDB04//07	Acquisition data bus	N9001	D9031, D9032, D9035, D9037
AQDB10//13	Acquisition data bus	N9002	D9033, D9034 D9035, D9036
AQDB14//17	Acquisition data bus	N9002	D9033, D9034 D9035, D9037
AQDBAB00//03	Acquisition data bus A/B	D9036	D9038
AQDBAB04//07	Acquisition data bus A/B	D9037	D9038
DPAD00,01	Display address	D9069	D9039, D9072
DPAD02,03	Display address	D9069	D9039, D9072 D9078
DPAD04//07	Display address	D9069	D9039, D9072 D9077
DPAD08//11	Display address	D9071	D9039, D9072 D9076
DPAD12//14	Display address	D9071	D9039, D9072
DPDB00//03	Display data bus	D9038 D9042	D9039, D9041 D9043
DPDB04//07	Display data bus	D9038 D9042	D9039, D9041 D9044
DXDB00,01	Deflection X data bus	D9078	N9004
DXDB02//05	Deflection X data bus	D9077	D9004
DXDB06//09	Deflection X data bus	D9076	D9004
DYDB00//03	Deflection Y data bus	D9043	D9003
DYDB04//07	Deflection Y data bus	D9044	D9003
PRAB00//03	Pretrigger address bus	D9058	D9061
PRAB04//07	Pretrigger address bus	D9058	D9062
PRAB08//11	Pretrigger address bus	D9059	D9063
PRAB12	Pretrigger address bus	D9059	D9064

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

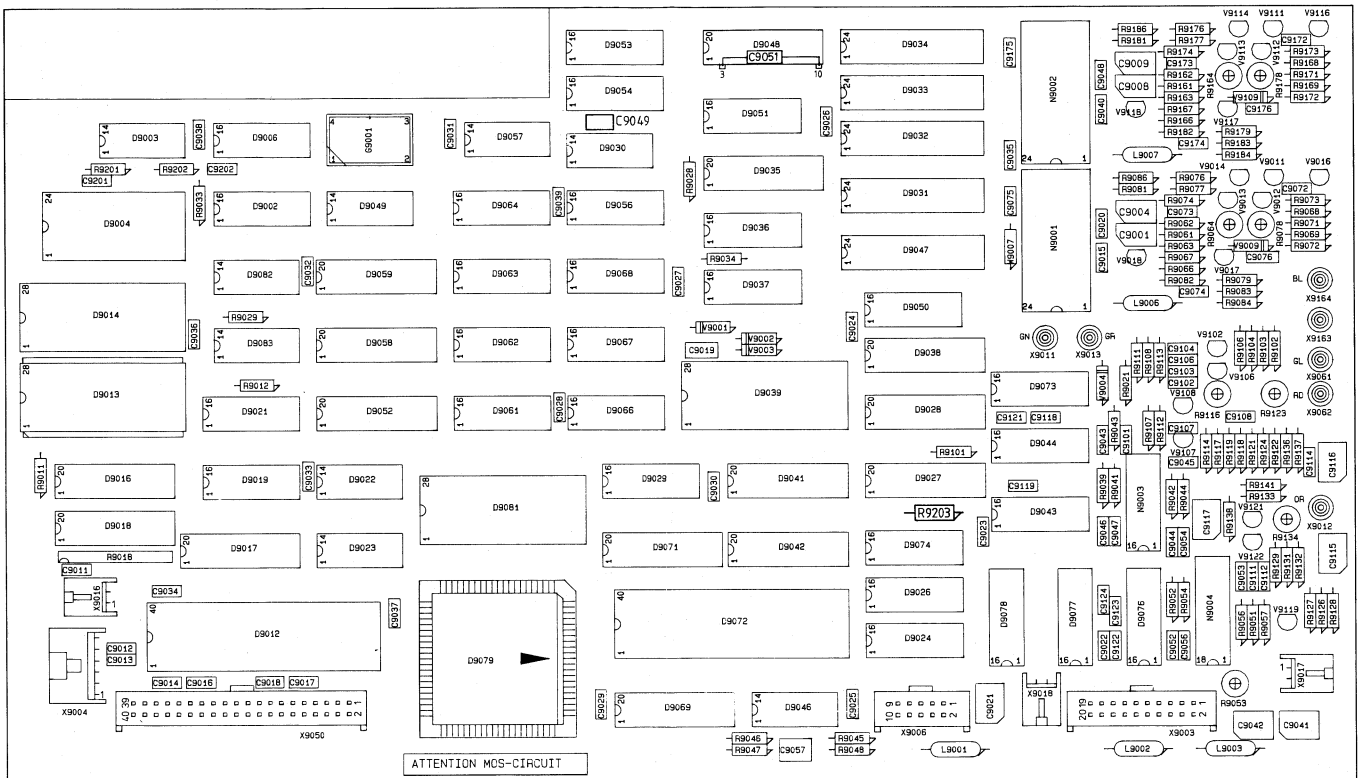
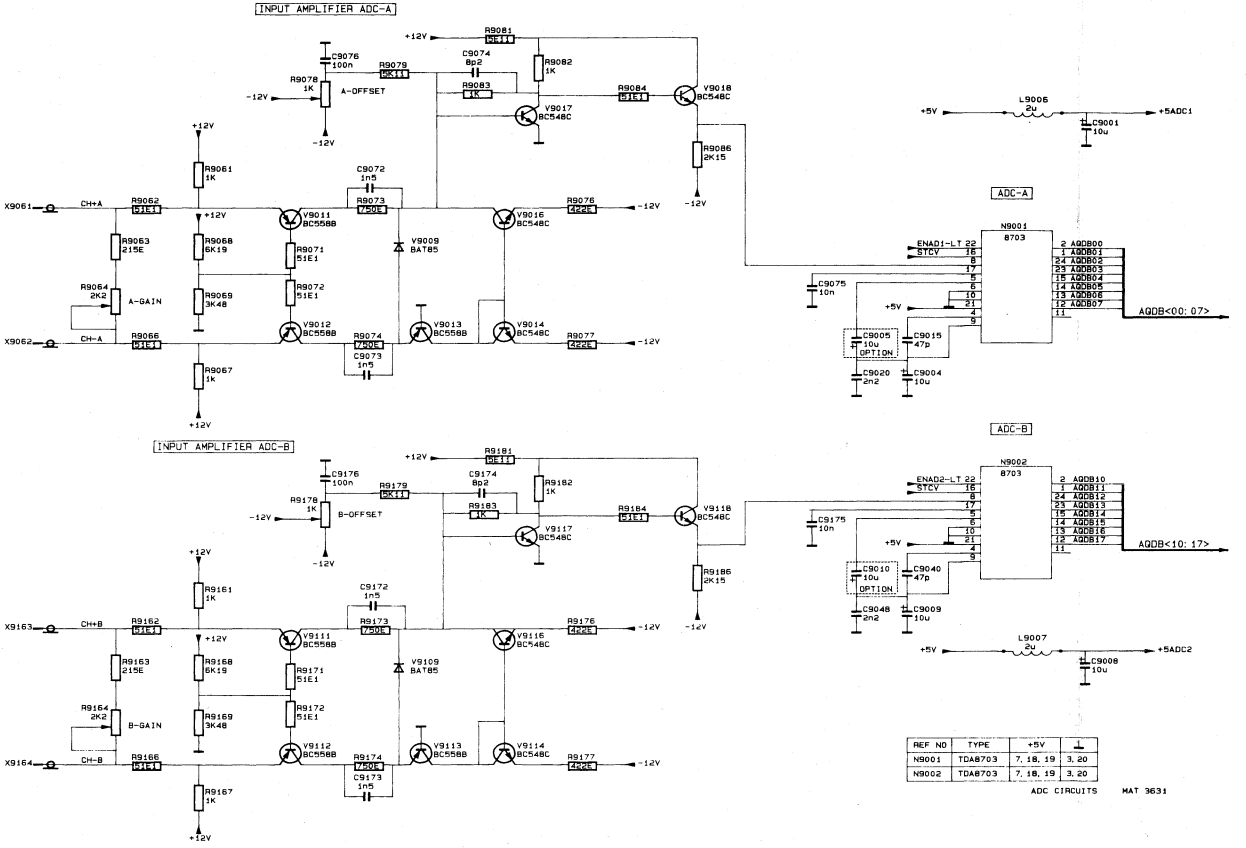


Figure 11.4 Digital unit, p.c.b. lay-out



REF ND	TYPE	+5V	⊥
N9001	TDA8703	7, 18, 19	3, 20
N9002	TDA8703	7, 18, 19	3, 20

Figure 11.5 Circuit diagram of input amplifiers and ADC circuit

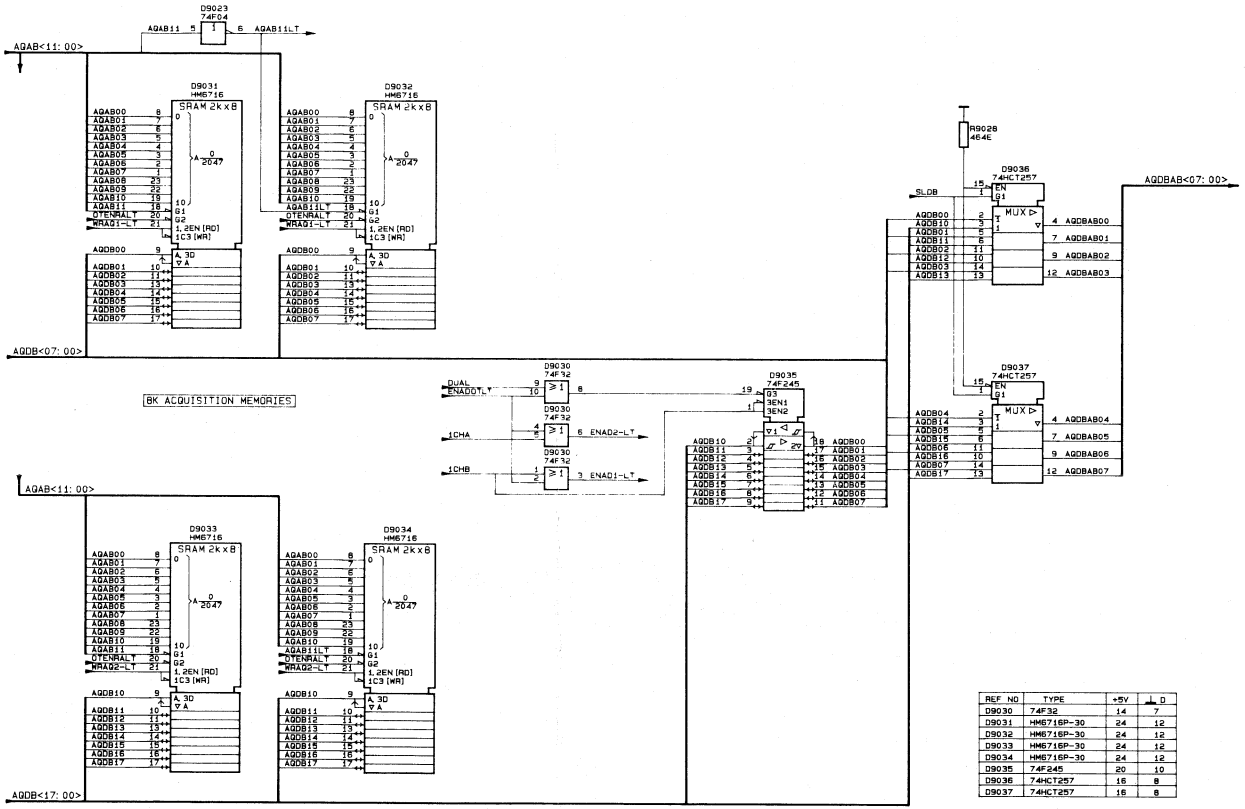


Figure 11.6 Circuit diagram of aquisition memories

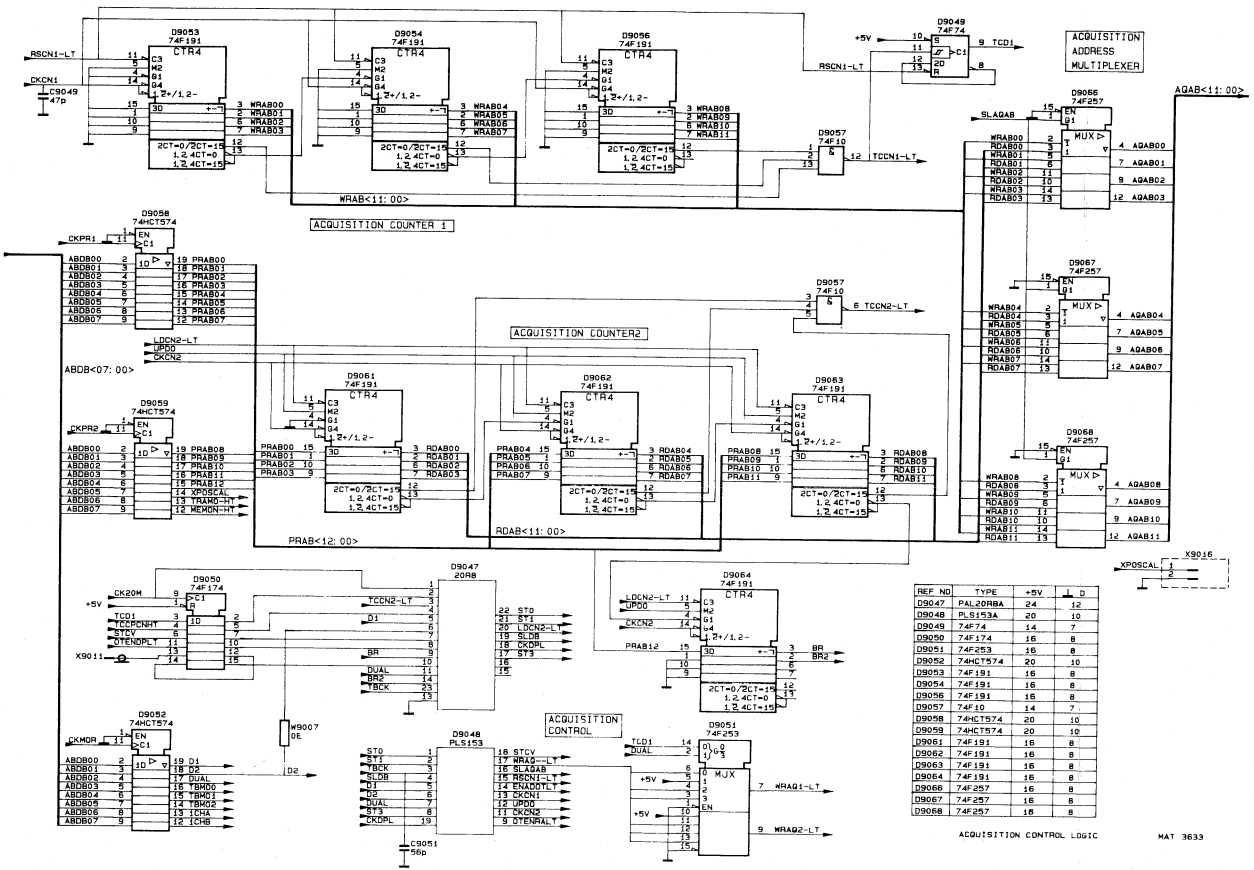
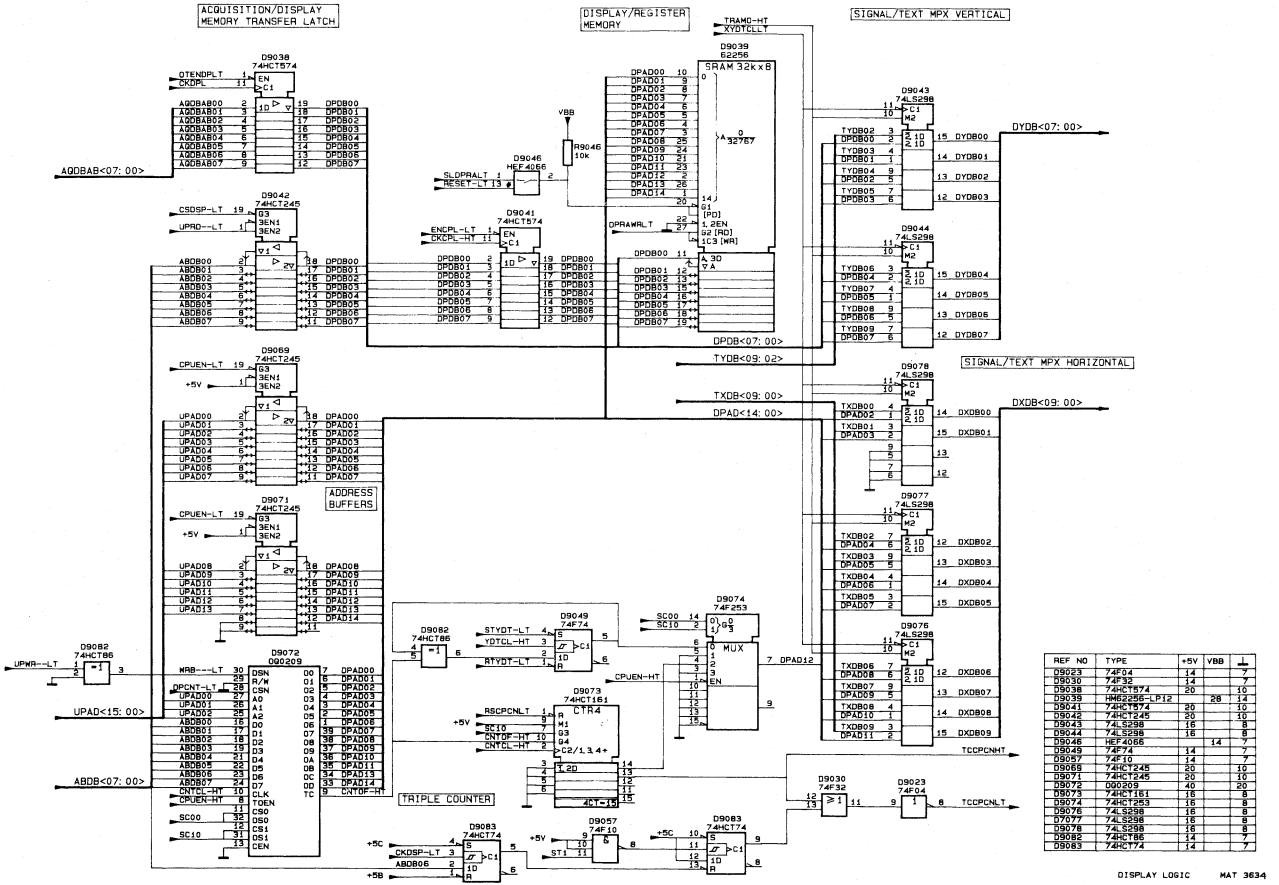
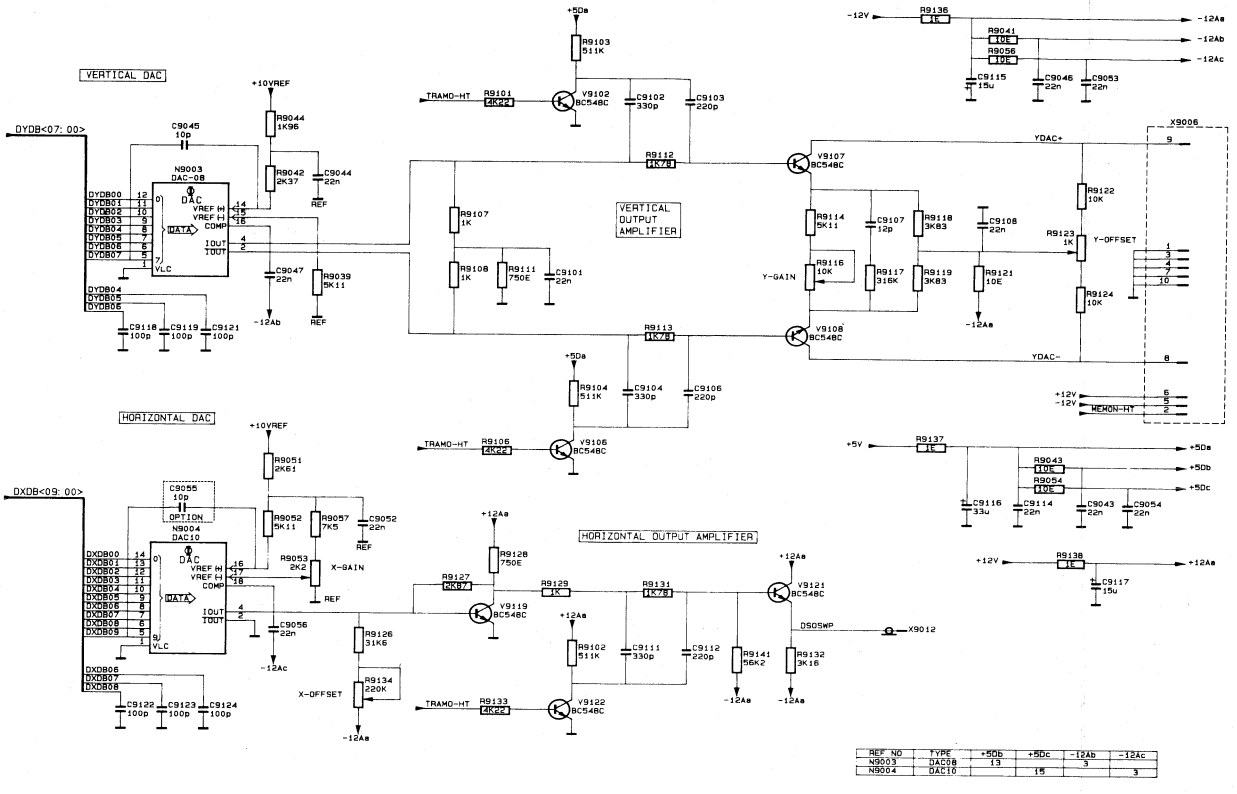


Figure 11.7 Circuit diagram of aquisition control logic



REF NO	TYPE	+5V	VBB	⏚
D9023	74F04	14		7
D9030	74F32	14		7
D9038	74HCT574	20		10
D9039	HM62256-LP12		28	14
D9041	74HCT574	20		10
D9042	74HCT245	20		10
D9043	74LS298	16		8
D9044	74LS298	16		8
D9046	HEF4066		14	7
D9049	74F74	14		7
D9057	74F10	14		7
D9069	74HCT245	20		10
D9071	74HCT245	20		10
D9072	000209	40		20
D9073	74HCT161	16		8
D9074	74HCT253	16		8
D9076	74LS298	16		8
D9077	74LS298	16		8
D9078	74LS298	16		8
D9082	74HCT86	14		7
D9083	74HCT74	14		7

Figure 11.8 Circuit diagram of display logic



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

Figure 11.9 Circuit diagram of DAC-circuits

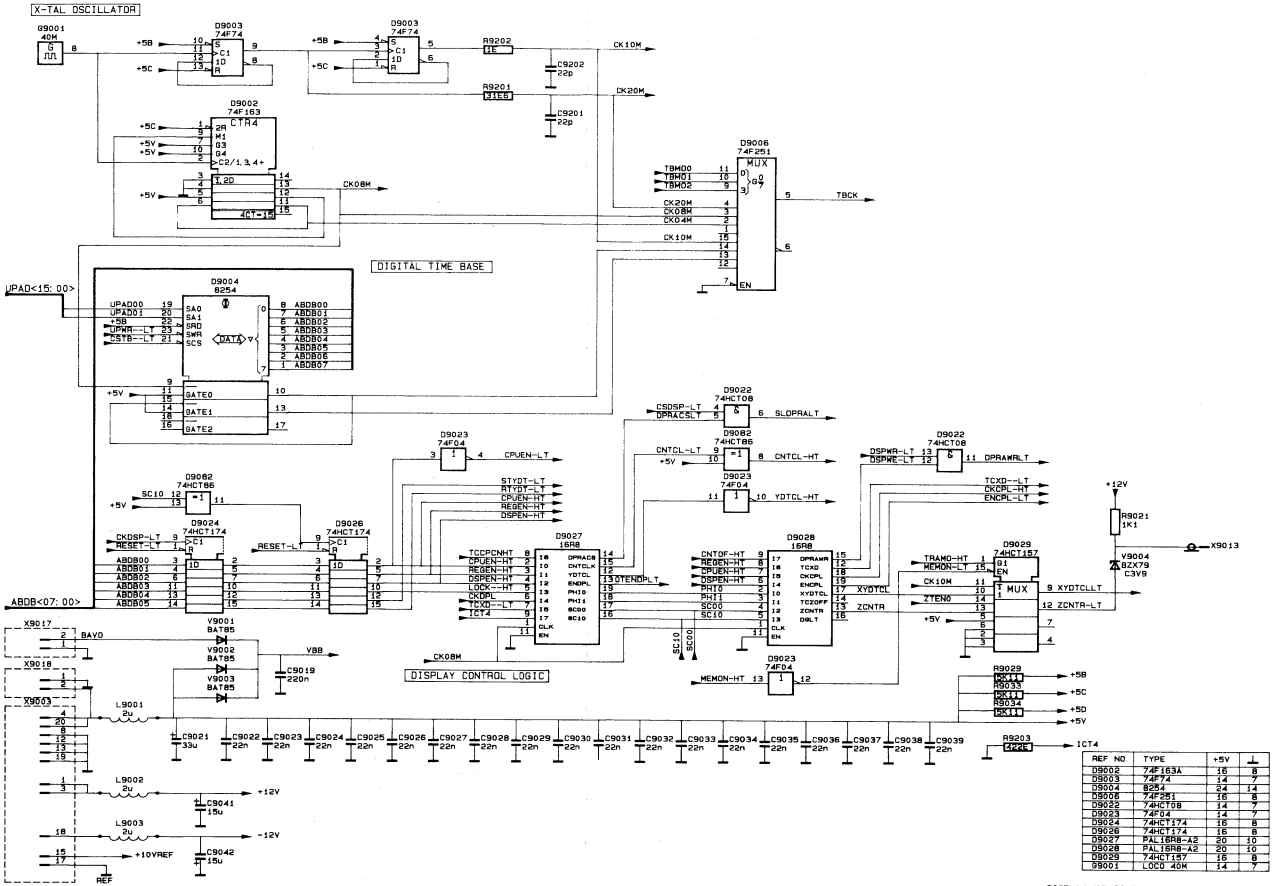
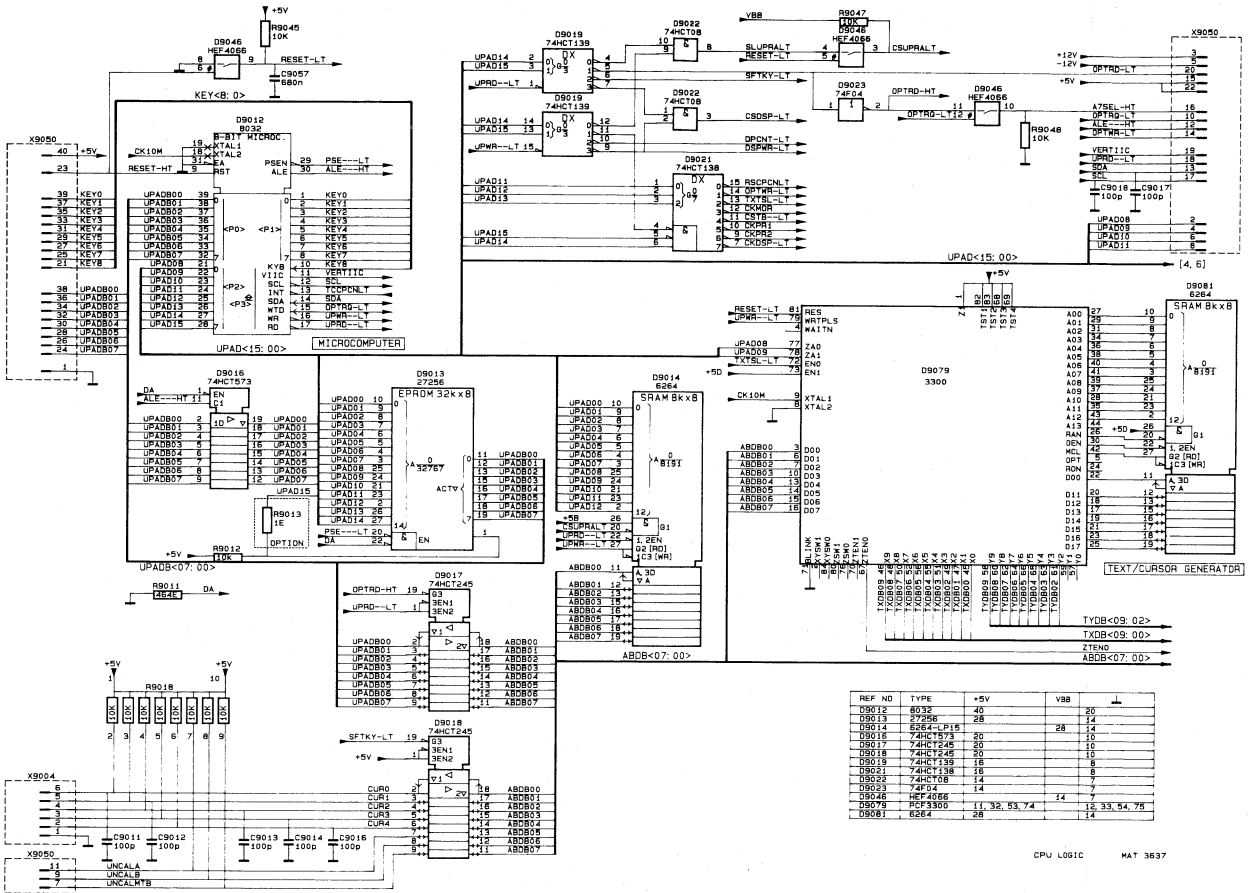


Figure 11.10 Circuit diagram of display and time base control



REF ND	TYPE	+5V	VBB	⏚
D9012	8032	40		20
D9013	27256	28		14
D9014	6264-LP15		28	14
D9016	74HCT573	20		10
D9017	74HCT245	20		10
D9018	74HCT245	20		10
D9019	74HCT139	16		8
D9021	74HCT138	16		8
D9022	74HCT08	14		7
D9023	74F04	14		7
D9046	HEF4066		14	7
D9079	PCF3300	11, 32, 53, 74		12, 33, 54, 75
D9081	6264	28		14

Figure 11.11 Circuit diagram of CPU logic

12. ADAPTATION UNIT (A16)

12.1 VERTICAL DISPLAY MODE SWITCH

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

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

12.2 REAL TIME MODE AMPLIFIER

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

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

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

The stage comprises the following real-time functions:

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

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

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

12.3 DIGITAL MEMORY AMPLIFIER

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

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

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

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

12.4 SIGNAL NAME LIST

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

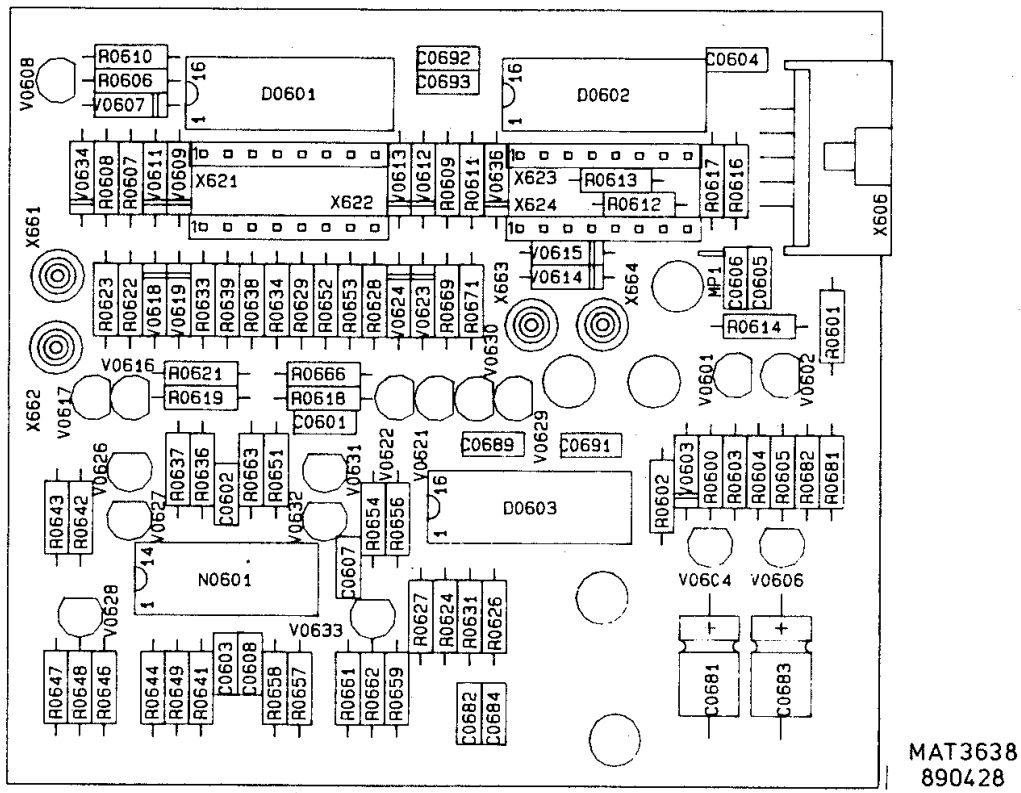


Figure 12.1 Adaptation unit, p.c.b. lay-out

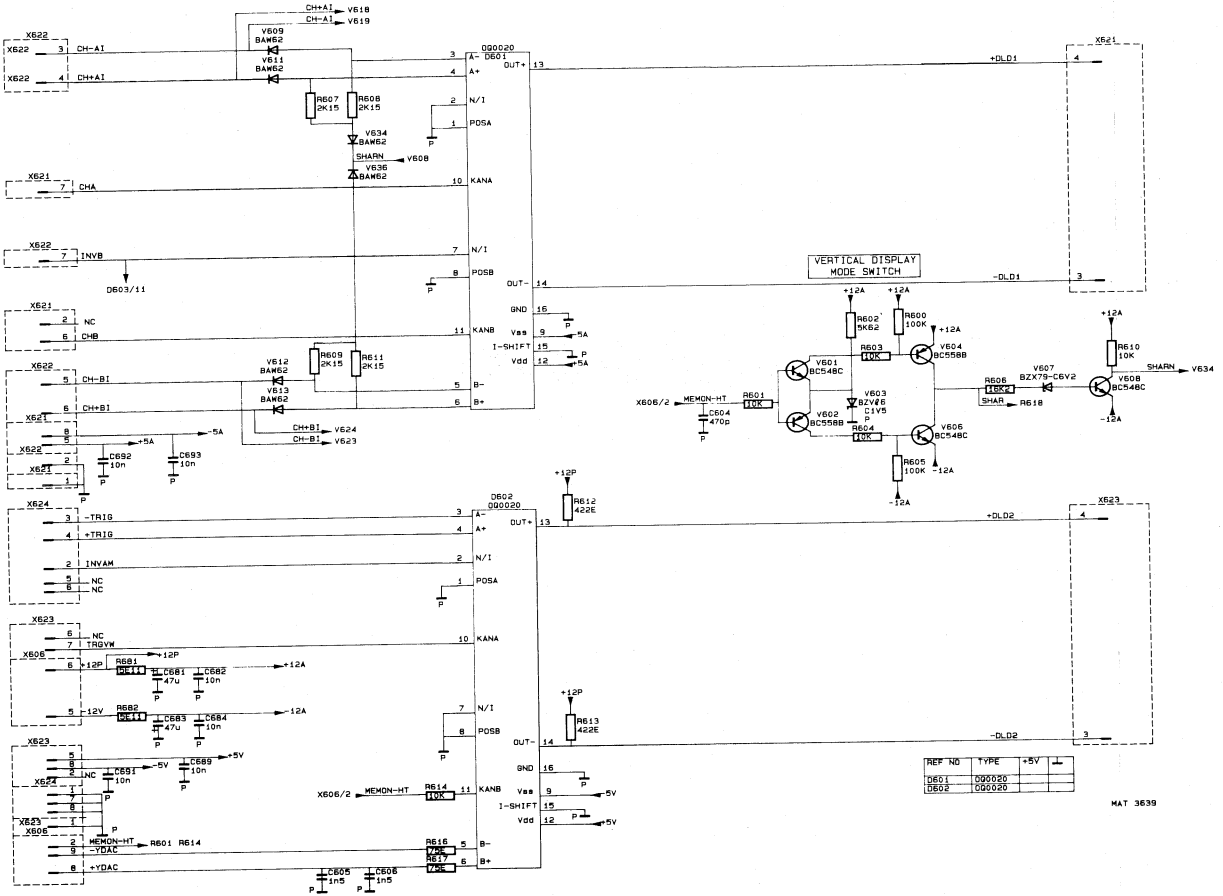


Figure 12.2 Circuit diagram of adaptation unit, section 1

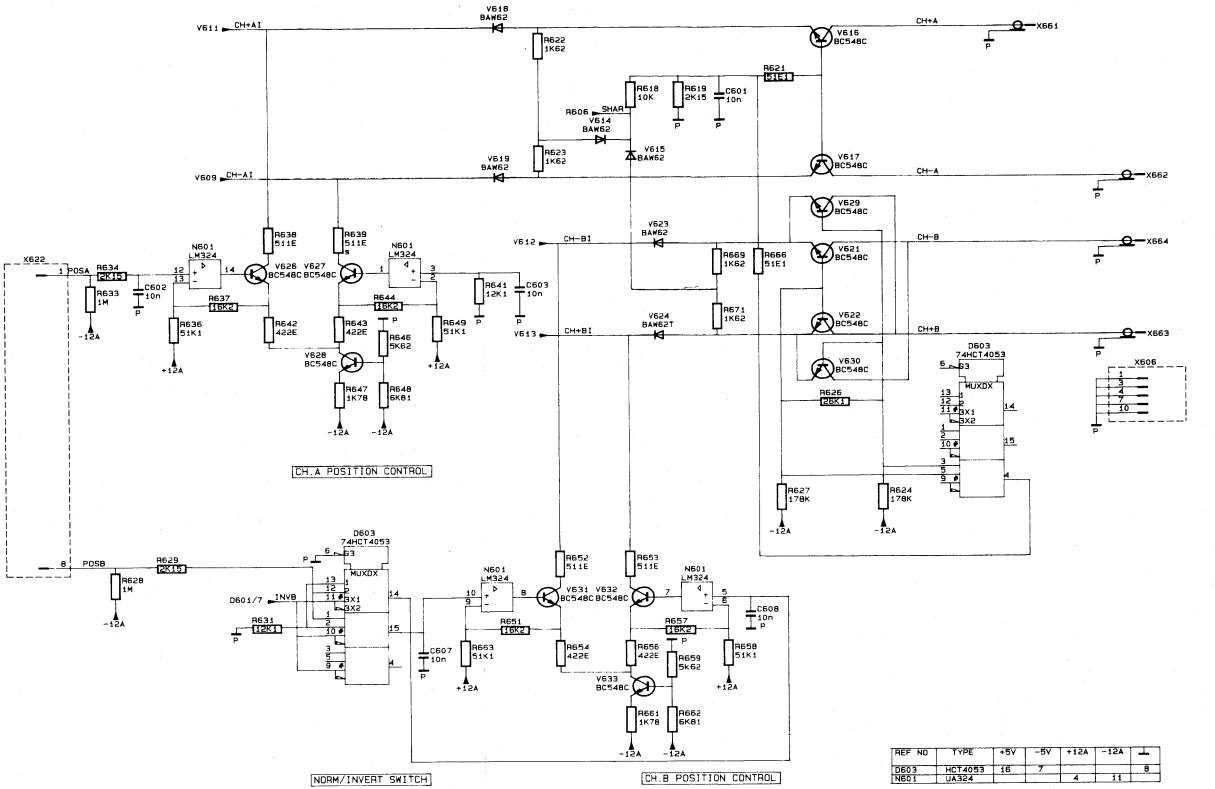


Figure 12.3 Circuit diagram of adaptation unit, section 2

13. PERFORMANCE CHECK

13.1 GENERAL INFORMATION

WARNING: Before switching-on, ensure that the instrument has been installed in accordance with the Installation Instructions outlined in Section 2 of the Operating 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 instrument's 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-focused, 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 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. Bear in mind thet the test equipment is properly terminated.
* 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.

13.2 PRELIMINARY SETTINGS

- Switch-on the instrument (no input signal).
- Check if all LCD segments are on for approx. 1 sec.
- Put the instrument in DIGITAL MEMORY off mode. The LCD text DIGITAL MEMORY is not visible then. All test steps are made in this instrument mode, unless otherwise mentioned.
- At the start of every check only AUTO SET must be pressed (after the input signal is applied).

13.3 RECOMMENDED TEST EQUIPMENT

The test equipment that must be used for this performance check is as given in section 15.2, except :

Trimming tool kit
Oscilloscope
Digital multimeter

13.4 CHECKING PROCEDURE

13.4.1		POWER SUPPLY
*	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 via a 10:1 probe - Press AUTO SET
	REQUIREMENTS	- Starts at any mains voltage between 100 V...240 V ac (r.m.s.) - Instrument performance does not change across 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	Local mains voltage 110, 220 or 240 V (r.m.s.).
	SETTINGS	Press POWER ON
	REQUIREMENTS	Consumes : 55 W
	MEASURING RESULTS	.....

13.4.2 VERTICAL DEFLECTION OR Y-AXIS

*	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%)	.....
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 A(B) fully anti-clockwise
	REQUIREMENTS	- Check if displayed amplitude <2 div (1:>2,5).
	MEASURING RESULTS	.....
*	SUBJECT	Input coupling (continued procedure of previous subject)
	SETTINGS AND REQUIREMENTS	- Turn VAR control A(B) fully clockwise into CAL. - Press GND; check if input signal is interrupted. - Press GND again and then AC/DC - Check if in DC position the signal shifts upwards compared wth the AC position
	MEASURING RESULTS	.....
*	SUBJECT	Frequency response (DIGITAL MEMORY off)
	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. across the complete bandwidth range ($\geq$ 50MHz) - 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. across the complete bandwidth range ($\geq$ 35MHz)
	MEASURING RESULTS	.....
*	SUBJECT	Frequency response (DIGITAL MEMORY on)
	TEST EQUIPMENT	Constant amplitude sine-wave generator (SG503)
	INPUT VOLTAGE	Constant amplitude sine-wave signal, 120 mV frequency 50 kHz...10 MHz to input A (B).
	SETTINGS AND REQUIREMENTS	- Set A (B) to 20 mV/div. - Apply 50 kHz sine-wave signal to A (B) - Press DIGITAL MEMORY in order to switch this function on: the text DIGITAL MEMORY becomes visible in the LCD - Adjust trace height to exactly 6 div.

		- Increase the frequency of the input signal up to 10 MHz. - Check if the vertical deflection is $\geq$ 4,2 div.across the complete bandwidth range (> 10MHz) - 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 10 MHz. - Check if the vertical deflection is $\geq$ 4,2 div. across the complete bandwidth range
	MEASURING RESULTS	.....
*	SUBJECT	Rise-Time (DIGITAL MEMORY off mode)
	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 $\leq$ 1 ns to input A (B) frequency: 1MHz.
	SETTINGS	- Set A(B) to 100 mV/div. - Press DIGITAL MEMORY in order to switch this function off. The text DIGITAL MEMORY disappears from the LCD - Press X 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.); * measured rise-time must be: 7,1 ns or less (1,4 subdiv. or less).
	MEASURING RESULTS	.....
*	SUBJECT	Noise
	TEST EQUIPMENT	-
	INPUT VOLTAGE	-
	SETTINGS	- Press A/B so that channel A and B are both on - Set channel A and B to 20 mV/div - Press ALT/CHOP for CHOP mode - Press AC/DC of both channels for DC input coupling - Press GND of both channels for grounded inputs
	REQUIREMENT	- Check if the amplitude of the noise on the traces is not more than 0,5 subdiv.
	MEASURING RESULTS	.....

*	SUBJECT	Vertical Dynamic range
	TEST EQUIPMENT	Constant amplitude sine-wave generator
	INPUT VOLTAGE	Sine-wave signal of 1 MHz, 2,4 Vpp to input A(B)
	SETTINGS	- Apply sine-wave signal of 1 MHz, 2,4 Vpp to input A(B). - Set A (B) to 100 mV/div. - Shift with the Y POS control the sine-wave of channel A(B) 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	- Apply sine-wave input signal to input A(B) - Press AUTO SET - Set channel A(B) to 0,5 V/div - Set the generator to a 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) - Press A/B twice so that both channels are displayed in ADD mode.
	REQUIREMENT	- Check if the trace height of the A-B signal is <0,08 div. Adjust the A and B VAR control(s) to minimise the displayed amplitude.
	MEASURING RESULTS	.....
*	SUBJECT	Visual Signal Delay
	TEST EQUIPMENT	Square wave calibration generator (PG506)
	INPUT VOLTAGE	Fast-rise input signal 1 MHz, $\leq$1 ns, 0,5 V to input A
	SETTINGS	- Apply fast-rise input signal to input A - Press AUTO SET - Put the A(B) VAR controls in the CAL position. - Set A to 100 mV/div. - Set MAIN TB to 50 ns/div. - Press X MAGN and turn X POS - Set INTENSITY fully clock-wise and TRIG LEVEL fully anti-clockwise.
	REQUIREMENT	- Check if visual signal delay is >15 ns
	MEASURING RESULTS	.....
	SETTINGS	- Put TRIG LEVEL and X POS back in mid position

*

SUBJECT — Base line jump

TEST EQUIPMENT —

INPUT VOLTAGE —

SETTINGS

Attenuator balance

- This check must be done in the service menu OFFS-A.
  To enter this menu proceed as follows:
- Press RESET 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 display does not jump more than 1 subdiv.

VAR balance

- Press mV of channel A UP-DOWN input sensitivity control.
- Check LCD display: "3.1" flashing.
- Rotate VAR control of channel A and B
- Check if display does 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 display does 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 that the display does not jump more than 1 subdiv.
- Press AUTO SET two times to leave the SERVICE MENU

MEASURING RESULTS .....

13.4.3		HORIZONTAL DEFLECTION OR X-AXIS
*	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 RESET 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^{o} is displayed.
	MEASURING RESULTS	.....
*	SUBJECT	Time coefficients
	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:
Note: in X MAGN x10 is the requirement valid for the +4 ... -4 div from the screen centre and excluding the first and last 50 ns.

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

TEST EQUIPMENT Time marker generator (TG501)

INPUT VOLTAGE Time marker signal 1 us to input A

SETTINGS
- Set TB to 0,2 us/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 us to 0,5 us; first marker on first graticule line and second marker on the third graticule line or closer to the first marker (2,5:1)

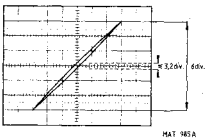
SETTINGS
- Set the TB VAR control fully clockwise
- Press X MAGN (magnifier on)
- Set the top of the second marker pulse exactly in the horizontal centre of the graticule
- Press X MAGN (magnifier off)

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	Square-wave calibration generator (PG 506)
	INPUT VOLTAGE	Square-wave 500mV trace height to input A
	SETTINGS	- Press X DEFL - Press A/B twice for only ch. B display - Set A to 100 mV/div - Select A as X DEFL source with TRIG or X SOURCE
	REQUIREMENT	- Check if a horizontal line of 5 div. is displayed (+or- 0,25 div)
	INPUT VOLTAGE	- Square-wave 500 mV to input EXT
	SETTINGS AND REQIREMENTS	- Select EXT DC with TRIG or X SOURCE - Press X DEFL - Select EXT DC as TRIG X SOURCE - Check if a horizontal line of 5 div. (+or- 0,25%) is displayed.
	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	- Apply a 50 kHz sine-wave signal to input A - Set channel A to 5 mV/div - Adjust the trace height to exactly 6 div. - Press X DEFL - Press A/B twice - Select A as horizontal deflection source with TRIG or X SOURCE - Adjust the input voltage for exactly 6 div. horizontal deflection - Increase the frequency of the input signal up to 2 MHz
	REQUIREMENTS	- Check if the trace width is > 4,2 div. across the complete bandwidth range.
	MEASURING RESULTS	.....
*	SUBJECT	Maximum phase shift between horizontal and vertical deflection.
	TEST EQUIPMENT	LF sine-wave generator
	INPUT VOLTAGE	Sine wave signal, 2 kHz...100 kHz, trace height 6 div to input A
	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 $<3^{o}$ (see figure below)



MEASURING RESULTS .....

13.4.4		TRIGGERING
*	SUBJECT	Trigger Sources and trigger coupling
	TEST EQUIPMENT	Square-wave generator
	INPUT VOLTAGE	Square-wave signal 2 kHz, 800 mV trace height to input A
	SETTINGS AND REQUIREMENTS	- Set the generator to a trace height of 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 (e.g. via a 10:1 attenuator probe). - Press A/B once so that Ch. A and B are both on. - Set B to 200 mV. - Select B as trigger source by pressing TRIG or X SOURCE twice (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 five times (A and B both selected as trigger source). - 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)

	SETTINGS AND REQUIREMENTS	- Set A(B) to 0,1 mV/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 TRIG COUPL once for DC mode - Press trigger slope ⎍ ⎏ - Check if the sine-wave signal is inverted and is triggered on the negative slope. - Press SLOPE once again - 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. - Use the A(B) Y POS to position the signal top and bottom in the CRT viewing area. - Set A(B) to 0,1 V/div - Check if NOT TRIG'D is visible in the LCD, if the LEVEL control is set in its extreme positions - 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)
	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. - Rotate TRIG LEVEL for a stable triggered display - Decrease amplitude of input signal - Operate TRIG LEVEL for a triggered display - Check if the signal is well-triggered at amplitudes $\geq$ 0,5 div. - Decrease the frequency of the input signal to 50 kHz - Check if the signal stays well triggered at amplitudes $\geq$ 0,5 div. - Increase the frequency of the input signal up to 50 MHz. - Decrease amplitude of input signal to approx 1 div. - Turn LEVEL - Check if the signal is well-triggered at amplitudes $\geq$ 1 div. - Increase the frequency of the input signal up to 100 MHz

		- Decrease amplitude to approx 3 div. - Check if the signal is well-triggered at amplitudes $\geq$ 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	.....

13.4.5 CURSORS

*	SUBJECT	Voltage cursor accuracy
	TEST EQUIPMENT	SQ. wave calibration generator PG 506
	SETTINGS	- Apply a sq. wave voltage of 1 Vpp to the ch. A input. - Set A to 200 mV/div. - Select DC input coupling for channel A(B) - Press DIGITAL MEMORY and then LOCK - Select CURSORS of the softkeys under the CRT - Select via softkey MODE: V-CURS ON, T-CURS OFF and V on (RATIO off). - Press RETURN. - Select V-CRTL and position the REFerence cursor exactly on the bottom of the cursor. - Position the "delta" cursor exactly on the top of the signal. - Press LOCK again so that the text LOCK disappears from the LCD. - Press RETURN once.
	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 TG 501
	SETTINGS	- Apply an 1 ms time marker signal to the ch. A input. - Set TB to 1 ms/DIV. - Press LOCK.

		- Select via softkey MODE: V-CURS OFF, T-CURS ON and T on (RATIO and PHase off). - Press RETURN. - Select T-CTRL and position the REFerence cursor exactly on the second time marker pulse. - Position the "delta" cursor exactly on the 10th time marker pulse.
	REQUIREMENT	Check for a time cursor read-out of 8.00 ms, + or - 0,0008 ms.
	MEASURING RESULTS	.....
	SETTINGS	- Press DIGITAL MEMORY so that this function becomes inactive.

13.4.6		AUXILIARY INPUTS AND OUTPUTS
*	SUBJECT	Z-MOD Sensitivity
	TEST EQUIPMENT	Square-wave generator
	INPUT VOLTAGE	Square-wave signal, 1 kHz, duty cycle 50%, amplitude 0..2,5Vpp to input A and Z-in (rear side)
	SETTINGS AND REQUIREMENTS	- Set TB to 0,5 ms/div. - Select DC for channel A input coupling - Set the trace of channel A in mid position - 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 us blanking and 500 us 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 (e.g. via a 10:1 attenuator probe.
	SETTINGS	- Press GND of channel A - Set the trace in the centre of the screen - Press GND 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 and with a bottom level of 0 volt.
	MEASURING RESULTS	.....

14. DISMANTLING THE INSTRUMENT

14.1 GENERAL INFORMATION

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

14.2 REMOVING THE TOP AND BOTTOM COVERS

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

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

14.3 ACCESS TO PARTS FOR THE CHECKING AND ADJUSTING PROCEDURES

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

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.

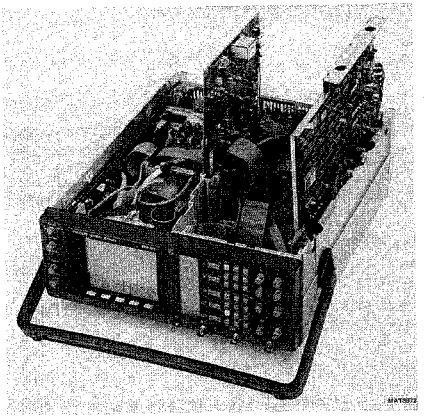


Figure 14.1 Access to all parts for adjusting the oscilloscope

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

15. ADJUSTING PROCEDURE

15.1 GENERAL INFORMATION

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

- Warming-up time under average conditions is 30 minutes.
- Where possible, instrument performance should be checked before any adjustment is made.
- All limits and tolerances given in this section are calibration guides, and should not be interpreted as instrument specifications unless they are also published in section 2.
- Tolerances given are for the instrument under test and do not include test equipment error.
- The most accurate display adjustments are made with a stable, well-focused low intensity display.
- All controls that are mentioned without item numbers are located on the outside of the instrument.

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.

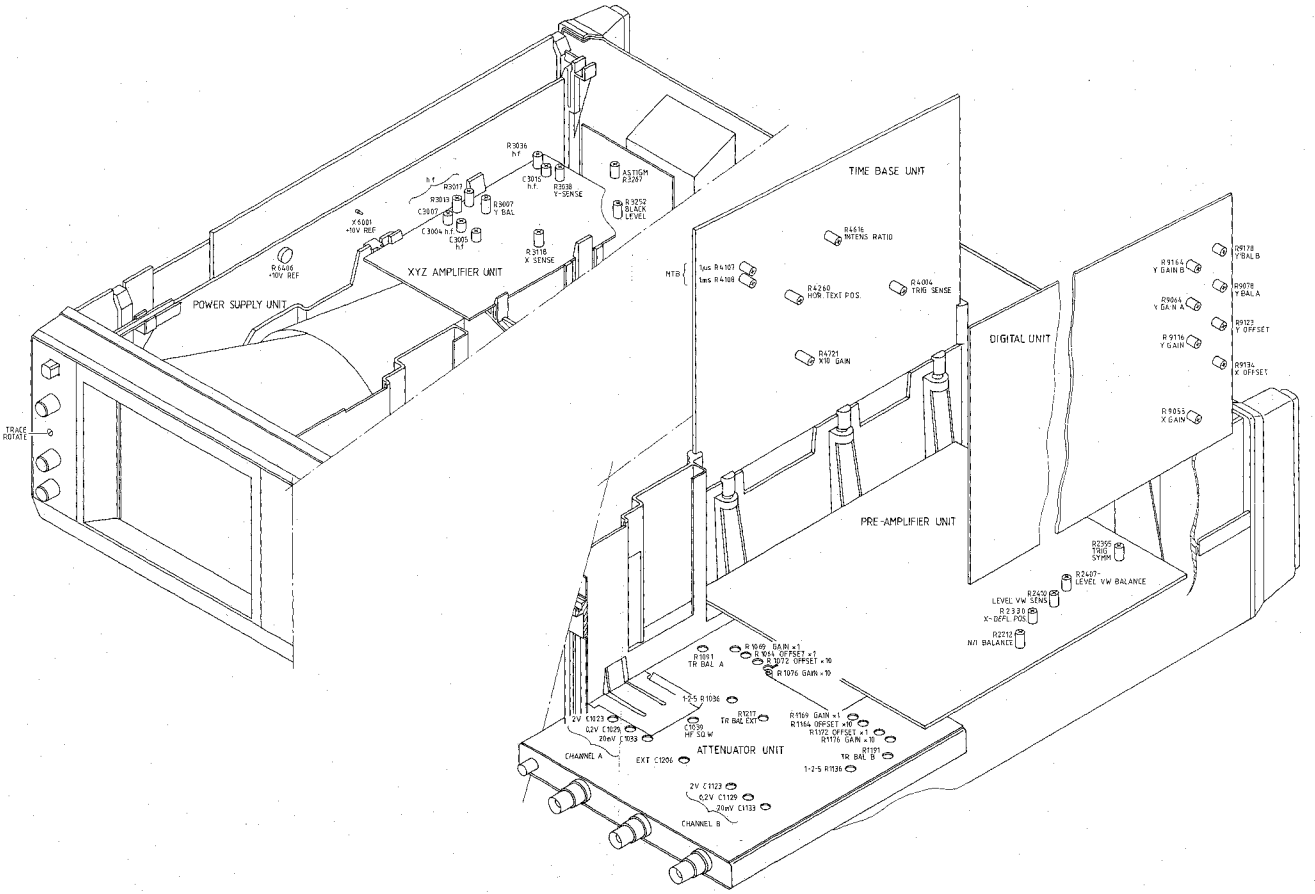


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Figure 15.1 Adjusting elements

15.2 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 Constant 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	Tektronix PG 506
Time-marker generator	Repetition rate: 0,5 s ... 0,05 /us	Tektronix TG 501
Digital multimeter	Wide voltage, current	Philips PM2524 with AC, DC and resistance ranges. High-voltage probe. Required: 0,1% accuracy ,PM9246
Oscilloscope	The bandwidth must be the same or higher than the bandwidth of the instrument under test.	Philips PM3055
Variable mains transformer	Well-insulated output voltage 90...264 Vac	Philips ord.number 2422 529 00005
Moving-iron meter		
Dummy probe 2:1	1 Megohm ±0,1 %//20 pF	
Cables, T-piece, 10:1 attenuator, terminations for the generators	Good quality BNC types for fast rise-time square-wave and high freq. sine-wave.	
Trimming tools		Philips 800NTX (ord. kitnumber 4822 310 50015)

15.3 SURVEY OF ADJUSTING ELEMENTS

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
POWER SUPPLY (see section 15.4.2)				
+10 V supply	R6406 X6001	power supply	digital voltm.	10 V (+,- 10 mV)
CRT DISPLAY (see section 15.4.3)				
pre adjustment	R4616	time base	-	mid position
black level	R3252	CRT socket	-	INTENS 10^{o} from c.c.w spot just invisible. line parr.
TRACE ROTATION	front	-		graticule
Astimatism	R3267	CRT socket	function generator 1 kHz/6 div. sine wave DIGITAL MEMORY on.	well defined trace + text
DISPLAY SECTION ADJUSTMENT OF DIGITAL MEMORY (see section 15.4.4)				
X-offset	R9134	dig. unit	service menu DIPLAY	correct X-pos.
Y-offset	R9123	dig. unit	service menu DISPLAY	correct Y-pos.
X-gain	R9053	dig. unit	service menu DISPLAY	10 div. X-defl.
Y-gain	R9116	dig. unit	service menu DISPLAY	6 div. Y-defl.
X-offset text	R4260	time base	service menu DISPAY	correct X-pos. of text

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
GAIN, LF S.Q. WAVE (see sections 15.4.5 and 15.4.6)				
EXT input	C1206	atten. unit	calibrated sq. wave: 0,5 V/ 1 kHz	dots at beginning + end of line same intensity
	R3118	XYZ ampl.	calibrated sq. wave: 0,5 V/ 1 kHz	5 div. horizontal
A input	R1069	atten. unit	calibrated sq. wave: 0,1 mV/ 1 kHz	5 div. vertical at A sens. 20 mV/div.
	C1033	atten. unit	calibrated sq. wave: 0,1 V/ 1 kHz	Straight pulse top at A sens. 20 mV/div.
	R3038	XYZ ampl.	calibrated sq. wave: 0,1 mV/ 1 kHz	5 div. vertical at A sens. 20 mV/div.
	R1076	atten. unit	calibrated sq. wave: 10 mV/ 1 kHz	5 div. vertical at A sens. 2 mV/div.
	C1029	atten. unit	calibrated sq. wave: 1 V/ 1 kHz	Straight pulse top at A sens. 0,2 V/div.
	C1023	atten. unit	calibrated sq. wave: 10 V/ 1 kHz	Straight pulse top at A sens. 2 V/div.
B input	C1133	atten. unit	calibrated sq. wave: 0,1 V/ 1 kHz	Straight pulse top at B sens. 20 mV/div.
	R1169	atten. unit	calibrated sq. wave: 0,1 V/ 1 kHz	5 div. vertical at B sens. 20 mV/div.
	R1176	atten. unit	calibrated sq. wave: 10 mV/ 1 kHz	5 div. vertical at B sens. 2 mV/div.

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
	C1129	atten. unit	calibrated sq. wave: 1 V/ 1 kHz	Straight pulse top at A sens. 0,2 V/div.
	C1123	atten. unit	calibrated sq. wave: 10 V/ 1 kHz	Straight pulse top at A sens. 2 V/div.
OFFSET (see section 15.4.7)				
1-2-5 bal. A	R1036	atten. unit	serv.menu: 3.0	minimise jump
1-2-5 bal. B	R1136	atten. unit	serv.menu: 3.0	minimise jump
VAR balance A	R1064	atten. unit	serv.menu: 3.1	Turn VAR jump
VAR balance B	R1164	atten. unit	serv.menu: 3.1	Turn VAR jump
1-10 balance A	R1072	atten. unit	serv.menu: 3.2	VAR CAL jump
1-10 balance B	R1172	atten. unit	serv.menu: 3.2	VAR CAL jump
Trig.bal. A	R1091	atten. unit	serv.menu: 3.3	VAR CAL jump
Trig.bal. B	R1191	atten. unit	serv.menu: 3.4	VAR CAL jump
Trig.bal. EXT	R1217	atten. unit	serv.menu: 3.5	VAR CAL jump
Norm.Inv. bal.	R2212	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
X-DEFLECTION AND TRIGGERING (see section 15.4.8)				
X-defl. offset	R2330	preamplifier	--	spot in horizontal mid of screen
Trigger sensitivity	(R2395)	preamplifier factory adj.	--	adjustment in "mid" position
	R4004	time base	sine-wave 0,4V/1kHz	triggered signal at + and - slope

Adjustment	Adjusting element(s)	Unit	Signal type, Generator, menu	Requirement
LEVEL preset	R2410	preamplifier	--	LEVEL pos. such that does not move when turning R2410
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 15.4.9)				
sweep speed: 1 ms/div.	R4108	time base	time markers: 1 ms	max. accuracy between 2nd and 10th graticule line
1 us/div.	R4107	time base	1 us	max. accuracy between 2nd and 10th graticule line
X MAGN and 0,1 ms/div.	R4721	time base	0,1 us	max. accuracy between 2nd and 10th graticule line
HF SQ. WAVE (see section 15.4.10)				
			fast-rise sq. wave:	
Pulse response channel B	R3017	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	R3013 C3007	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	R3036 C3004	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	C3016	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response
	C3005	XYZ-ampl.	100 mV/ 1 MHz	Optimal pulse response

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

15.4 ADJUSTING PROCEDURE

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

NOTE: Use always an insulated adjustment tool.

15.4.1 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.
- The adjustments are done in the memory off mode (text DIGITAL MEMORY not visible in LCD), unless it is otherwise indicated.
- It is advised to take good notice of the LCD where all currently active functions are indicated. This because of the fact that many front panel keys make sequential access possible to various modes.
- Take care to remove the input voltage after each section.
- All signal values are peak-to-peak values (pk-pk), unless otherwise indicated.

For better access to the adjusting elements on the time base unit and the power supply unit, proceed as indicated in section 14.3.

ATTENTION: Do not readjust potentiometer R2395, situated on the Pre-amplifier unit. However, if this potentiometer is inadvertently turned, proceed as indicated in section 15.4.8. under "trigger sensitivity".

15.4.2 Power supply adjustment

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

15.4.3 CRT display adjustment

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

Trace rotation:

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

Astigmatism:

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

15.4.4 Display section adjustment of digital memory.

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

- Adjust the X-offset with R9134 on the digital unit so that the waveform as indicated in the figure is obtained as much as possible.
- Adjust the Y-offset with R9123 on the digital unit so that the waveform as indicated in the figure is obtained as much as possible.
- Adjust the X-gain to 10 div with R9053 on the digital unit.
- Adjust the Y-gain to 6 div with R9116 on the digital unit.
- Adjust the X-offset of the text with R4260 on the time base so that the two squares are exactly in the horizontal mid of the screen.
- Press AUTO SET in order to leave the service menu.

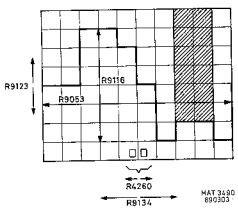

Figure 15.2 Display section adjustment

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

Adjustments located on attenuator unit, unless otherwise indicated.

Input EXT:

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

Input A:

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

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

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

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

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

15.4.7 Offset channel A(B)

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

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

- Press AUTO SET to leave the service menu.

15.4.8 X-deflection and triggering.

Adjustments on preamplifier unless otherwise noted.

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

Trigger sensitivity:

Important: R2395 is a factory-adjustment and must not be turned. If it is turned by mistake, you have to proceed as follows:
- Connect a digital voltmeter between the "connector side" of R4001 and R4002 on the time base unit. Refer to the p.c.b. lay-out in chapter 7 for the position of these resistors.
- Adjust R2395 so that the read-out of the voltmeter is 0 volt exactly

Now the adjustment of R4004:
- Press the X DEFL key (instrument goes back to normal time base mode)
- Put R2395 in its mid position.
- Apply a sinewave of 0,4 V/1 kHz to the channel A input.
- Opereate the trigger slope key / repeatedly. ****
- Adjust R4004 on the time base so that the signal is triggered in the two trigger slope positions.

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

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

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

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

15.4.9 Time base sweep speeds

Adjustments on time base unit.

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

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

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

15.4.10 HF sq.wave response channel B and A.

Adjustments on XYZ-amplifier.

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

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

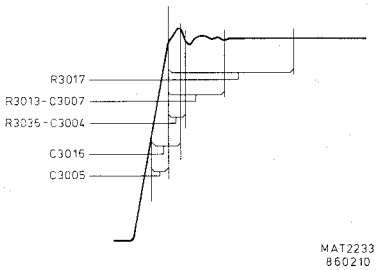

Figure 15.3 Square-wave response

- Press key A/B so that channel A is displayed.
- Move the generator signal from input B to input A.
- Select channel A as the TRIGger SOURCE.
- Select an input sensitivity of 20 mV/div for channel A.
- Center the signal with the channel A Y POS control.
- Make the pulse response of channel A as much as possible equal to that of channel B with R1039 on the attenuator unit.
- Check that the pulse via channel A has a rise-time of $\leq$ 7 ns and that pulse abberations are $\leq$ 0,2 div. peak-to-peak. Tilt must not exceed + or - 0,1 div.

15.4.11 Gain and offset in digital memory mode.

All adjustments are located on the digital unit.

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

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

16. CORRECTIVE MAINTENANCE

16.1 REPLACEMENTS

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

16.1.1 Standard parts

Electrical and mechanical replacement parts can be obtained through your local Philips 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.

16.1.2 Special parts

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

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

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

16.1.3 Transistors and Integrated Circuits

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

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

16.1.4 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.

16.1.5 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.

16.1.5.1 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.

16.1.5.2 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.

16.1.5.3 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.

16.1.5.4 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.

16.1.5.5 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

16.1.5.6 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.

16.1.5.7 Voltage surges

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

16.2 REMOVING THE UNITS AND MECHANICAL PARTS

NOTE: For installation, work in reversed sequence.

16.2.1 Attenuator unit (A1)

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

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

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

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

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

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

16.2.3 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 amongst other things the CRT socket and must be loosened first. For this, the CRT socket must be carefully removed from the CRT.

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

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

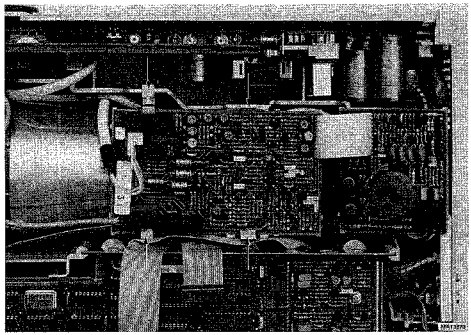

Figure 16.1 Clamping lips for XYZ-amplifier unit

16.2.4 Time-base unit (A4)

- Put the digital unit in upright position such as indicated in figure 16.4.
- Unlock the 3 plastic p.c.b. supports with a special tool that matches the diameter of the p.c.b. support (see section 16.6.2).
- The complete p.c.b. can be taken out of the instrument after having removed all flat cables. The time base can also be placed upright on the chassis: this is indicated in figure 16.4.

16.2.5 CRT control unit (A5)

- Remove the front unit (see section 16.2.7)
- Loosen the front profile (see section 16.2.1)
- Now the CRT control unit can be pulled out of the front profile after having removed the flat-cable and the CAL connector.

16.2.6 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. Moreover the use of a mains separation transformer is strongly recommended.

- Remove the extension shaft from the ON/OFF switch by pushing both ends together.
- Push both clamping lips that secure the power supply unit.
- Lift the power supply unit outside the instrument.
- Place the p.c.b. in the unit slider.

NOTES: - After the mentioned actions, the power supply unit can be measured under working conditions, provided that all cables are still connected to the unit.

- The flat cable to the CRT control unit can easily be removed now when having positioned the power supply unit like described.

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

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

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

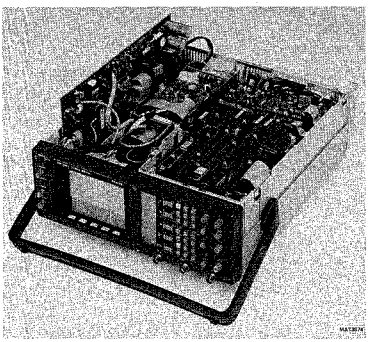

Figure 16.2 Power supply unit in service position.

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

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

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

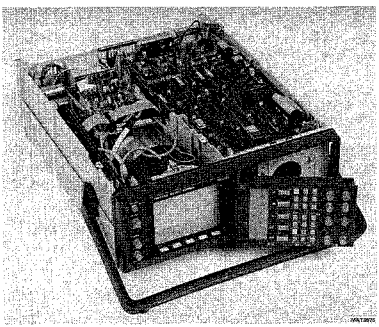

Figure 16.3 Measuring the front unit working condition

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

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

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

16.2.8 Digital unit A9

Measuring position and p.c.b. exchange:

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

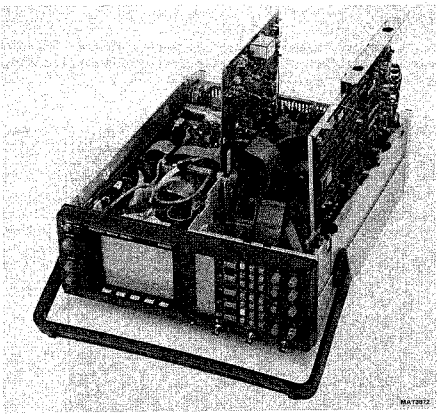

Figure 16.4 Measuring digital unit A9 and time base unit A4 in upright position for measuring in working condition.

16.2.9 Removing the delay-line cable

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

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

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

16.2.10 Replacement of CRT

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

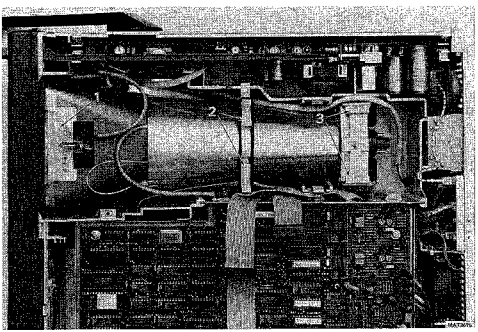

Figure 16.5 Removing the CRT

- Remove the XYZ-amplifier unit, see section 16.2.3.
- Remove the graticule lamp holder (1).
- Remove the bezel with the screen filter.
- Remove the two plastic pcb supports (2).
- Unlock the EHT-cable. Discharge the end of the cable to earth potential in order to prevent electric shock. This earth potential can be obtained via a measuring lead connected to the metal chassis plate at the rear panel of the oscilloscope.

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

- Push the two clamping lips that secure the CRT support (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.

16.3 SOLDERING TECHNIQUES

Working method:

- Carefully unsolder one after the other the soldering leads of the semi-conductor.
- 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 1mm 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.

16.4 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.

16.5 TROUBLE SHOOTING

16.5.1 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.

16.5.2 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 15. "Checking and Adjusting".
- Visually check the part of the oscilloscope in which the fault is suspected. In this way, it is possible to find faults such as bad soldering connections, bad interconnection plugs and wires, damaged components or transistors and IC's that are not correctly plugged into their sockets.
- Location of the circuit part in which the fault is suspected: the symptom often indicates this part of the circuit. If the power supply 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 collectorand 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 tace on the measuring oscilloscope screen.
  The outputs can easily be checked by a voltmeter or oscilloscope.

16.5.3 Power-up routine

Every time the instrument is switched-on an initialisation program is executed. By simply watching the LCD after switching on, it can be determined if the microcomputer related control part of the oscilloscope is functioning correctly.
Directly after switching on, the instrument´s internal serial control bus is checked and if everything is OK all segments in the LCD will light up. Passing this test means that the serial bus that controls the LCD and that puts the circuitry in the desired mode, functions correctly. This control bus is the so-called I2C bus and a general description of its configuration can be found in the explanation of the digital block diagram (where the control signals are generated) and the analog block diagram (where the control signals are setting the circuitry in the desired mode. The block diagram shows that the control signals are generated on the digital unit A9 and that the distribution occurs via the front unit A7.
After the test of the serial control bus, the RAM where the scope´s settings are stored is tested. These settings are compared with a sumcheck figure. If the test is succesfully passed, the settings from before switching-on are becoming active and thus also visible in the LCD. If the sumcheck test is not passed (e.g. if the memory back-up batteries are not installed or empty), the RAM is tested byte for byte. This is done by writing and reading 10101010 and 01010101 bit patterns in every memory location. If a fault is detected, the program keeps on trying to write and read into the defective memory address. This can be measured with an oscilloscope at the RAM´s chip enable input and at the read and write inputs (half the frequency).
If this test is passed the instrument starts up with default settings and the LCD is updated correspondingly.

16.5.4 Trouble-shooting the power supply

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

Supply voltabe	Output current	Dummy resistance and their service ordering numbers
+ 5 V	2,4 A	2,9E-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.

16.6 SPECIAL TOOLS

16.6.1 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:

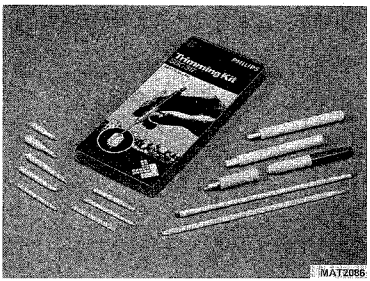

Figure 16.6 Trimming tool kit

16.6.2 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 16.2. The ordering number of this tool is 5322 535 91942

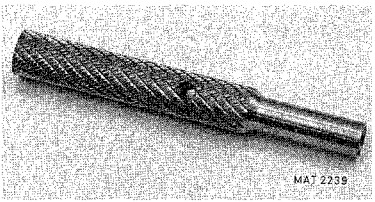

Figure 16.7 p.c.b. Snapper

16.7 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.

17. SAFETY INSPECTION AND TEST AFTER REPAIR AND MAINTENANCE IN THE PRIMARY CIRCUIT

17.1 GENERAL DIRECTIVES

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

17.2 SAFETY COMPONENTS

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

17.3 CHECKING THE PROTECTIVE EARTH CONNECTION

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

17.4 CHECKING THE INSULATION RESISTANCE

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

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

17.5 CHECKING THE LEAKAGE CURRENT

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

17.6 VOLTAGE TEST

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

Mechanical parts located at rear panel

Item	Qty	Ordering code	Description
31	2	5322 462 50324	Rear foot
--	1	5322 267 10004	BNC socket for Z-MOD
--	2	5322 502 12003	Screws for mains input socket
--	1	5322 321 21616	Line cable, European version
--	1	5322 321 10446	Line cable, USA version
--	1	5322 321 21617	Line cable, British version
--	1	5322 321 21618	Line cable, Swiss version
--	1	5322 321 21781	Line cable, Australean version
--	1	5322 219 81119	Mains input socket, incl. fuse holder
--	1	4822 253 30024	Fuse 1,6A (for mains input)

Mechanical parts located around the Cathode Ray Tube

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

Printed circuit boards

Item	Unit nr.	Ordering code	Description
36	A1	5322 216 51114	Attenuator unit
35	A2	5322 216 51196	Pre-amplifier unit
26	A3	5322 216 51117	XYZ-amplifier unit
33	A4	5322 216 51239	Time-base unit
14	A5	5322 216 51118	CRT-control unit
23	A6	5322 216 51195	Power supply unit
52	A7	5322 216 51233	Front unit
53	A8	5322 216 51207	LCD unit
32	A9	5322 216 51232	Digital unit A9
34	A15	5322 216 51204	Adaptation unit
4	A18	5322 216 51209	Unit with 5 pushbuttons under CRT screen

18.2 CABLES AND CONNECTORS

18.2.1 Flatcables and connectors

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

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

The following AMP-connectors are available:

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

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

18. PARTS LIST

(subject to alteration without notice)

18.1 MECHANICAL PARTS (Are indicated in figure 18.1)

Item	Qty	Ordering code	Description
1	1	5322 459 20503	Bezel
2	1	5322 414 20213	Positioning strip, plastic
3	1	5322 464 90484	Fixation strip
5	1	5322 480 30181	Contrast filter blue
6	1	5322 455 81083	Textfilm on bezel PM3335
6	1	5322 455 81084	Textfilm on bezel PM3337
7	1	5322 268 14052	CAL socket
8	1	4822 530 70296	Clamping spring for CAL socket
9	11	5322 414 10018	Control knob with spring
10	1	5322 464 90252	Front frame
11	1	5322 455 81026	Textfilm CRT unit
12	1	5322 455 81085	Textfilm for handle PM3335
13	1	5322 498 50219	Handle assembly
15	1	5322 414 60142	Power-on knob, green-brown
20	2	5322 492 63355	Spring for handle
21	1	5322 535 80735	Extension part for power-on switch
22	1	5322 447 91499	Upper cabinet
24	2	5322 462 10265	P.c.b. support for A3
27	2	5322 462 10264	P.c.b. guiding for A6
30	1	5322 464 90486	Chassis
37	6	5322 462 30304	P.c.b. support
38	1	5322 464 90249	Bottom cabinet
39	2	5322 464 90253	Attenuator cover
40	4	5322 462 50325	Bottom foot
41	3	5322 506 21188	BNC spacer ring
42	3	5322 532 41006	BNC extension bush
43	3	5322 267 10004	BNC socket
44	1	5322 464 90254	Front unit frame
45	1	5322 455 81086	Textfilm for front unit
46	23	5322 276 11856	Softkey brown
47	1	5322 276 12332	Softkey white
48	1	5322 276 11857	Softkey green
49	5	5322 277 10878	UP-DOWN key brown
50	2	5322 492 63354	Range indication spring
51	1	5322 450 60952	LCD window
54	1	5322 256 60289	Battery back-up holder
55	1	5322 361 10326	FAN assembly
56	2	5322 401 11278	Metal fastener for A9
57	2	5322 290 40257	Flat cable clamp
58	2	5322 256 64014	Battery holder
--	2	5322 255 40928	Heatsink for V3011 and V3012
--	2	5322 255 40059	Spacer for heatsink V3011, V3012
--	2	5322 401 10954	Delay line cable clamp

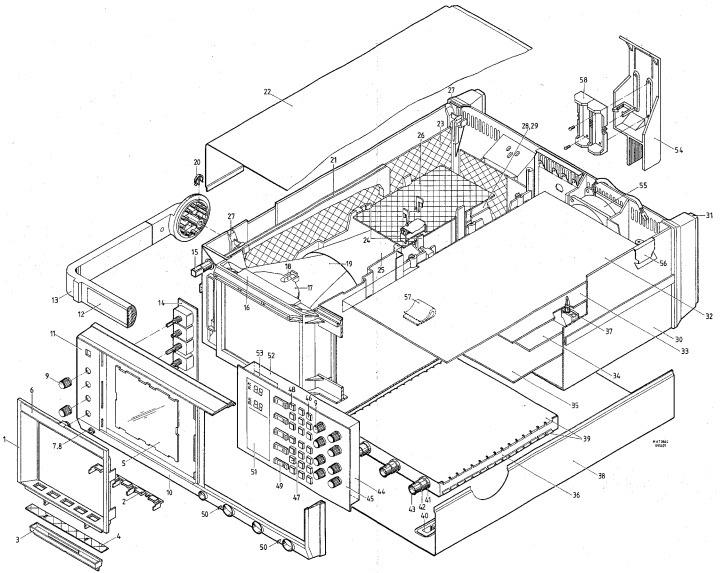

Figure 18.1 Exploded view

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

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

18.2.3 50 Ohm cables and connectors

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

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

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

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

18.2.4 Miscellaneous cables

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

18.2.5 Miscellaneous sockets and connectors

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

18.3 ELECTRICAL PARTS

18.3.1 CAPACITORS

POSNR	DESCRIPTION	ORDERING CODE
C 0601	-20+50% 10NF	4822 122 31414
C 0602	-20+50% 10NF	4822 122 31414
C 0603	-20+50% 10NF	4822 122 31414
C 0604	10% 470PF	4822 122 30354
C 0605	10% 1.5NF	4822 122 31169
C 0606	10% 1.5NF	4822 122 31169
C 0607	-20+50% 10NF	4822 122 31414
C 0608	-20+50% 10NF	4822 122 31414
C 0681	-10+50% 47UF	4822 124 20699
C 0682	-20+50% 10NF	4822 122 31414
C 0683	-10+50% 47UF	4822 124 20699
C 0684	-20+50% 10NF	4822 122 31414
C 0689	-20+50% 10NF	4822 122 31414
C 0691	-20+50% 10NF	4822 122 31414
C 0692	-20+50% 10NF	4822 122 31414
C 0693	-20+50% 10NF	4822 122 31414
C 1001	-20+50% 10NF	4822 122 31414
C 1002	400V 10% 22NF	5322 121 40308
C 1003	-20+50% 10NF	4822 122 31414
C 1006	-20+50% 10NF	4822 122 31414
C 1006	-20+50% 10NF	4822 122 31414
C 1007	0.25PF 1PF	5322 122 32775
C 1009	2% 33PF	5322 122 32072
C 1011	63V 10% 220NF	4822 121 42408
C 1012	63V 10% 220NF	4822 121 42408
C 1013	2% 15PF	4822 122 31823
C 1014	0.25PF 0.56PF	5322 122 32107
C 1016	0.25PF 3.3PF	5322 122 32549
C 1017	0.25PF 3.3PF	4822 122 31821
C 1018	0.25PF 2.2PF	5322 122 32894
C 1019	2% 33PF	5322 122 32072
C 1021	-20+50% 10NF	4822 122 31414
C 1022	2% 22PF	5322 122 32143
C 1023	7-10.0 PF MUR	5322 125 11013
C 1024	-20+50% 10NF	4822 122 31414
C 1026	0.25PF 3.3PF	5322 122 32549
C 1027	0.25PF 2.2PF	5322 122 32774
C 1028	2% 33PF	5322 122 32072
C 1029	7-10.0 PF MUR	5322 125 11013
C 1031	-20+50% 10NF	4822 122 31414
C 1032	2% 33PF	5322 122 32551
C 1033	7-10.0 PF MUR	5322 125 11013
C 1034	-20+50% 10NF	4822 122 31414
C 1035	-20+50% 10NF	4822 122 31414
C 1036	2% 39PF	4822 122 31069
C 1037	2% 22PF	5322 122 32143
C 1038	2% 100PF	4822 122 31516
C 1039	25-2.3 PF MUR	5322 125 11021
C 1040	2% 100PF	4822 122 31516
C 1041	63V 10% 100NF	5322 121 42492
C 1042	-20+50% 10NF	4822 122 31414
C 1043	-20+50% 10NF	4822 122 31414
C 1044	-20+50% 10NF	4822 122 31414
C 1045	-20+50% 10NF	4822 122 31414
C 1046	-10+50% 68UF	4822 124 20689
C 1047	0.25PF 4.7PF	4822 122 31822
C 1061	10% 470PF	4822 122 30354
C 1062	0.25PF 3.3PF	4822 122 31821
C 1063	2% 33PF	5322 122 32072
C 1064	10% 2.2NF	4822 122 30114
C 1066	-20+50% 1.5NF	4822 122 31416
C 1067	2% 150PF	4822 122 31413
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 1106	-20+50% 10NF	4822 122 31414
C 1106	-20+50% 10NF	4822 122 31414
C 1107	0.25PF 1PF	5322 122 32773
C 1109	2% 33PF	5322 122 32072
C 1111	63V 10% 220NF	4822 121 42408
C 1112	63V 10% 220NF	4822 121 42408
C 1113	2% 15PF	4822 122 31823
C 1114	0.25PF 0.56PF	5322 122 32107
C 1116	0.25PF 3.3PF	5322 122 32549
C 1117	0.25PF 3.3PF	4822 122 31821

POSNR	DESCRIPTION	ORDERING CODE
C 1118	0.25PF 2.7PF	5322 122 32894
C 1119	2% 33PF	5322 122 32072
C 1121	-20+50% 10NF	4822 122 31414
C 1122	2% 22PF	5322 122 32143
C 1123	7-10.0 PF MUR	5322 125 11013
C 1124	-20+50% 10NF	4822 122 31414
C 1126	0.25PF 3.3PF	5322 122 32549
C 1127	0.25PF 2.2PF	5322 122 32774
C 1128	2% 33PF	5322 122 32072
C 1129	7-10.0 PF MUR	5322 125 11013
C 1131	-20+50% 10NF	4822 122 31414
C 1132	2% 33PF	5322 122 32551
C 1133	7-10.0 PF MUR	5322 125 11013
C 1134	-20+50% 10NF	4822 122 31414
C 1135	-20+50% 10NF	4822 122 31414
C 1136	2% 39PF	4822 122 31069
C 1137	2% 22PF	5322 122 32143
C 1138	2% 180PF	4822 122 31516
C 1139	0.25PF 2.2PF	4822 122 31516
C 1140	2% 100PF	4822 122 31516
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 30354
C 1162	0.25PF 3.3PF	4822 122 31821
C 1163	2% 33PF	5322 122 32072
C 1164	10% 2.2NF	4822 122 30114
C 1166	-20+50% 10NF	4822 122 31414
C 1167	2% 150PF	4822 122 31413
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 3.3PF	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 31516
C 1213	0.25PF 1.8PF	5322 122 32315
C 1215	0.25PF 0.68PF	4822 122 31215
C 1216	2% 12PF	4822 122 31036
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 1425	-20+50% 10NF	4822 122 31414
C 1426	-10+50% 68UF	4822 124 20689
C 1427	-20+50% 10NF	4822 122 31414
C 1428	-20+50% 10NF	4822 122 31414
C 1429	-10+50% 68UF	4822 124 20689
C 1431	-20+50% 10NF	4822 122 31414
C 1432	-20+50% 10NF	4822 122 31414
C 1433	-10+50% 47UF	4822 124 20699
C 1434	-20+50% 10NF	4822 122 31414
C 1441	-20+50% 10NF	4822 122 31414
C 1442	-10+50% 68UF	4822 124 20689
C 1443	-20+50% 10NF	4822 122 31414
C 1444	-20+50% 10NF	4822 122 31414
C 1446	-10+50% 68UF	4822 124 20689
C 1447	-20+50% 10NF	4822 122 31414
C 2049	10% 1.5NF	4822 122 31169
C 2050	-20+50% 10NF	4822 122 31414
C 2051	10% 1.5NF	4822 122 31169
C 2169	10% 1.5NF	4822 122 31169
C 2150	-20+50% 10NF	4822 122 31414
C 2151	10% 1.5NF	4822 122 31169

POSNR	DESCRIPTION	ORDERING CODE
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	0.25PF 5.6PF	5322 122 32163
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% 1UF	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 20699
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% 1UF	4822 124 20689
C 2748	-20+50% 10NF	4822 122 31414
C 2751	-10+50% 47UF	4822 124 20699
C 2752	-20+50% 10NF	4822 122 31414
C 2753	-20+50% 10NF	4822 122 31414
C 2754	-20+50% 10NF	4822 122 31414
C 2771	-20+50% 10NF	4822 122 31414
C 2772	-10+50% 150UF	4822 124 20672
C 2773	-20+50% 10NF	4822 122 31414
C 2774	-10+50% 68UF	4822 124 20689
C 2776	-20+50% 10NF	4822 122 31414
C 2777	63V 10% 100NF	5322 121 42492
C 2781	-20+50% 10NF	4822 122 31414
C 3001	-20+50% 10NF	4822 122 31414
C 3002	10% 1.5NF	4822 122 31169
C 3003	10% 1.5NF	4822 122 31169
C 3004	7-10.0 PF MUR	5322 125 11013
C 3005	2-20PF MUR	5322 125 50296
C 3007	7-10.0 PF MUR	5322 125 11013
C 3008	0.25PF 8.2PF	4822 122 31052
C 3009	2% 12PF	4822 122 31056
C 3011	2% 68PF	4822 122 31349
C 3013	0.25PF 2.7PF	4822 122 31038
C 3014	0.25PF 2.7PF	4822 122 31038
C 3016	2-20PF MUR	5322 125 50296
C 3017	-20+50% 10NF	4822 122 31414
C 3018	0.25PF 5.6PF	5322 122 32163

POSNR	DESCRIPTION	ORDERING CODE
C 3021	-20+50% 10NF	4822 122 31414
C 3022	-20+50% 10NF	4822 122 31414
C 3101	10% 1.5NF	4822 122 31169
C 3102	10% 1.5NF	4822 122 31169
C 3103	7-10PF	5322 125 11013
C 3104	100V 10% 47NF	5322 121 42491
C 3105	-20+50% 10NF	4822 122 31414
C 3106	63V 10% 100NF	5322 121 42492
C 3107	0.25PF 2.7PF	4822 122 31038
C 3108	0.25PF 6.8PF	4822 122 31049
C 3109	63V 10% 100NF	5322 121 42492
C 3110	-20+50% 10NF	4822 122 31414
C 3111	-20+50% 10NF	4822 122 31414
C 3112	0.25PF 3.9PF	5322 122 32107
C 3113	0.25PF 0.82PF	4822 122 31214
C 3114	100V 10% 47NF	5322 121 42491
C 3116	63V 10% 100NF	5322 121 42492
C 3200	0.25PF 0.56PF	5322 122 32107
C 3201	0.25PF 0.56PF	5322 122 32107
C 3202	63V 10% 100NF	5322 121 42492
C 3205	63V 10% 100NF	5322 121 42492
C 3206	-20+50% 10NF	4822 122 31414
C 3206	63V 10% 100NF	5322 121 42492
C 3208	10% 470PF	4822 122 30034
C 3209	-10+10% 2.2NF	5322 122 33851
C 3211	-10+10% 2.2NF	5322 122 33851
C 3250	100V 10% 1NF	4822 121 41857
C 3251	63V 10% 220NF	4822 121 41908
C 3252	-10+10% 2.2NF	5322 122 33851
C 3255	-20+50% 10NF	4822 122 31414
C 3256	-20+50% 10NF	4822 122 31414
C 3256	0.25PF 0.56PF	5322 122 32107
C 3257	-20+50% 10NF	4822 122 31414
C 3258	-10+10% 2.2NF	5322 122 33851
C 3301	-20+50% 10NF	4822 122 31414
C 3302	-20+50% 10NF	4822 122 31414
C 3303	-10+50% 47UF	4822 124 20699
C 3304	-20+50% 10NF	4822 122 31414
C 3306	-20+50% 10NF	4822 122 31414
C 3307	-20+50% 10NF	4822 122 31414
C 3308	-20+50% 10NF	4822 122 31414
C 3309	-20+50% 10NF	4822 122 31414
C 3311	-20+50% 10NF	4822 122 31414
C 3312	-10+50% 47UF	4822 124 20699
C 3313	-20+50% 10NF	4822 122 31414
C 3314	-10+50% 15UF	4822 124 20729
C 3316	-20+50% 10NF	4822 122 31414
C 3317	-20+50% 10NF	4822 122 31414
C 3318	-20+50% 10NF	4822 122 31414
C 3319	-10+50% 15UF	4822 124 20729
C 3321	-20+50% 10NF	4822 122 31414
C 3322	-20+50% 10NF	4822 122 31414
C 3324	-20+50% 10NF	4822 122 31414
C 3326	-20+50% 10NF	4822 122 31414
C 4001	2% 100PF	4822 122 31316
C 4002	2% 100PF	4822 122 31316
C 4003	100V 10% 1NF	4822 121 41857
C 4004	10% 4.7NF	4822 122 31125
C 4005	10% 4.7NF	4822 122 31125
C 4006	-20+50% 10NF	4822 122 31414
C 4007	10% 470PF	4822 122 30034
C 4011	-20+50% 10NF	4822 122 31414
C 4028	2% 100PF	4822 122 31316
C 4029	2% 100PF	4822 122 31316
C 4101	-20+50% 10NF	4822 122 31414
C 4103	-20+50% 10NF	4822 122 31414
C 4105	63V 10% 100NF	5322 121 42492
C 4106	-10+50% 150UF	4822 124 20672
C 4107	63V 10% 100NF	5322 121 42492
C 4108	2% 100PF	4822 122 31316
C 4109	-20+50% 10NF	4822 122 31414
C 4110	63V 10% 470NF	5322 121 42979
C 4112	-20+50% 10NF	4822 122 31414
C 4113	630V 1% 1NF	4822 121 50591
C 4114	100V 10% 10NF	5322 121 41527
C 4116	10% 1.5NF	4822 122 31169
C 4117	2% 100PF	4822 122 31316
C 4118	-20+50% 10NF	4822 122 31414
C 4120	63V 10% 100NF	5322 121 42492
C 4122	63V 10% 100NF	5322 121 42492
C 4123	-10+50% 47UF	4822 124 20699
C 4124	-20+50% 10NF	4822 122 31414
C 4126	-10+50% 47UF	4822 124 20699
C 4260	63V 10% 100NF	5322 121 42492
C 4301	63V 10% 100NF	5322 121 42492
C 4302	-10+50% 4.7UF	4822 124 20726
C 4303	100V 10% 1NF	4822 121 41857
C 4304	2% 220PF	4822 122 30994
C 4306	-20+50% 10NF	4822 122 31414
C 4307	-20+50% 10NF	4822 122 31414

POSNR	DESCRIPTION	ORDERING CODE
C 4511	2% 100PF	4822 122 31416
C 4601	-20+50% 10NF	4822 122 31414
C 4602	-20+50% 10NF	4822 122 31414
C 4603	9.25PF 3.9PF	5322 122 36107
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	8.25PF 8.2PF	4822 122 31052
C 4603	8.25PF 8.2PF	4822 122 31052
C 4611	-20+50% 10NF	4822 122 31414
C 4612	-20+50% 10NF	4822 122 31414
C 4613	2% 1PF	4822 122 32185
C 4701	10% 1NF	4822 122 30027
C 4702	2% 220PF	4822 122 30994
C 4703	10% 1NF	4822 122 30027
C 4704	-20+50% 10NF	4822 122 31414
C 4801	-20+20% 2200UF	4822 124 21382
C 4806	-10+50% 150UF	4822 124 20672
C 4807	-20+50% 10NF	4822 122 31414
C 4808	-10+50% 68UF	4822 124 20689
C 4811	-20+50% 10NF	4822 122 31414
C 4815	-20+50% 10NF	4822 122 31414
C 4819	-20+50% 10NF	4822 122 31414
C 4820	-20+50% 10NF	4822 122 31414
C 4822	-20+50% 10NF	4822 122 31414
C 4825	-20+50% 10NF	4822 122 31414
C 4829	-20+50% 10NF	4822 122 31414
C 4831	-20+50% 10NF	4822 122 31414
C 4832	-10+50% 47UF	4822 124 20699
C 4833	-20+50% 10NF	4822 122 31414
C 4835	-20+50% 10NF	4822 122 31414
C 4836	-20+50% 10NF	4822 122 31414
C 4837	-10+50% 47UF	4822 124 20699
C 4839	2% 12PF	4822 122 31056
C 4888	-10+50% 47UF	4822 124 20699
C 4889	-10+50% 47UF	4822 124 20699
C 4891	-20+50% 10NF	4822 122 31414
C 4893	-20+50% 10NF	4822 122 31414
C 4895	-20+50% 10NF	4822 122 31414
C 4897	-20+50% 10NF	4822 122 31414
C 4898	-20+50% 10NF	4822 122 31414
C 4899	-20+50% 10NF	4822 122 31414
C 5001	-20+50% 10NF	4822 122 31414
C 5002	-20+50% 10NF	4822 122 31414
C 5003	-20+50% 10NF	4822 122 31414
C 5004	-20+50% 10NF	4822 122 31414
C 5006	-20+50% 10NF	4822 122 31414
C 6001	250V 10% 220NF	5322 121 44142
C 6002	MKT275 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 30092
C 6006	MKT275 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 43263
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% 47UF	4822 124 20699
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 6129	-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

POSNR	DESCRIPTION	ORDERING CODE
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 33081
C 6212	-10+10% 33PF	5322 122 33081
C 6213	10% 4.7NF	5322 122 31125
C 6214	20% 470PF	5322 122 30086
C 6215	100V 10% 100NF	5322 121 42578
C 6311	-20+50% 10NF	4822 122 31414
C 6312	-20+50% 10NF	4822 122 31414
C 6401	63V 10% 100NF	5322 121 42492
C 6402	-10+50% 68UF	4822 124 20689
C 6500	-10+50% 68UF	4822 124 20689
C 6501	-20+50% 10NF	4822 122 31414
C 6502	100V 10% 10NF	4822 121 41857
C 6503	2% 100PF	4822 122 31316
C 6506	2% 100PF	4822 122 31316
C 7001	63V 10% 220NF	4822 121 42408
C 7004	-20+50% 10NF	4822 122 31414
C 7005	63V 10% 100NF	5322 121 42492
C 7006	-20+50% 10NF	4822 122 31414
C 7007	63V 10% 100NF	5322 121 42492
C 7008	10% 680PF	4822 122 30053
C 7009	63V 10% 100NF	5322 121 42492
C 7011	-20+50% 10NF	4822 122 31414
C 7012	-20+50% 10NF	4822 122 31414
C 7013	-20+50% 10NF	4822 122 31414
C 7017	-20+50% 10NF	4822 122 31414
C 7018	-20+50% 10NF	4822 122 31414
C 7019	-20+50% 10NF	4822 122 31414
C 7021	63V 10% 100NF	5322 121 42492
C 7100	-20+50% 10NF	4822 122 31414
C 7101	-20+50% 10NF	4822 122 31414
C 7102	-20+50% 10NF	4822 122 31414
C 7103	-20+50% 10NF	4822 122 31414
C 7104	-10+50% 220UF	4822 124 20681
C 7106	-10+50% 220UF	4822 124 20681
C 9001	-20+20% 10UF	5322 124 21956
C 9004	-20+20% 10UF	5322 124 21956
C 9005	-20+20% 10UF	5322 124 21956
C 9008	-20+20% 10UF	5322 124 21956
C 9009	-20+20% 10UF	5322 124 21956
C 9010	-20+20% 10UF	5322 124 21956
C 9011	2% 100PF	4822 122 31316
C 9012	2% 100PF	4822 122 31316
C 9013	2% 100PF	4822 122 31316
C 9014	2% 100PF	4822 122 31316
C 9015	2% 47PF	4822 122 31072
C 9016	2% 100PF	4822 122 31316
C 9017	2% 100PF	4822 122 31316
C 9018	2% 100PF	4822 122 31316
C 9019	63V 10% 220NF	4822 121 42408
C 9020	10% 2.2NF	4822 122 30114
C 9021	-20+20% 33UF	5322 124 21957
C 9022	-20+80% 22NF	4822 122 30103
C 9023	-20+80% 22NF	4822 122 30103
C 9024	-20+80% 22NF	4822 122 30103
C 9025	-20+80% 22NF	4822 122 30103
C 9026	-20+80% 22NF	4822 122 30103
C 9027	-20+80% 22NF	4822 122 30103
C 9028	-20+80% 22NF	4822 122 30103
C 9029	-20+80% 22NF	4822 122 30103
C 9030	-20+80% 22NF	4822 122 30103
C 9031	-20+80% 22NF	4822 122 30103
C 9032	-20+80% 22NF	4822 122 30103
C 9033	-20+80% 22NF	4822 122 30103
C 9034	-20+80% 22NF	4822 122 30103
C 9035	-20+80% 22NF	4822 122 30103
C 9036	-20+80% 22NF	4822 122 30103
C 9037	-20+80% 22NF	4822 122 30103
C 9038	-20+80% 22NF	4822 122 30103
C 9039	-20+80% 22NF	4822 122 30103
C 9040	2% 47PF	4822 122 31072
C 9041	-20+20% 15UF	5322 124 21958
C 9042	-20+20% 15UF	5322 124 21958
C 9043	-20+80% 22NF	4822 122 30103
C 9044	-20+80% 22NF	4822 122 30103
C 9045	2% 16PF	4822 122 32185
C 9046	-20+80% 22NF	4822 122 30103
C 9047	-20+80% 22NF	4822 122 30103
C 9048	10% 2.2NF	4822 122 30114
C 9049	2% 47PF	4822 122 31072

POSNR	DESCRIPTION	ORDERING CODE
C 9051	2% 56PF	4822 122 32027
C 9052	-20+80% 22NF	4822 122 30103
C 9053	-20+80% 22NF	4822 122 30103
C 9054	-20+80% 22NF	4822 122 30103
C 9055	2% 10PF	4822 124 32185
C 9056	-20+80% 22NF	4822 122 30103
C 9057	63V 10% 680NF	5322 121 42498
C 9072	10% 1.5NF	4822 122 31169
C 9073	10% 1.5NF	4822 122 31169
C 9074	0.25PF 8.2PF	4822 122 31194
C 9075	100V 10% 10NF	4822 121 41857
C 9076	63V 10% 100NF	5322 121 42492
C 9101	-20+80% 22NF	4822 122 30103
C 9102	2% 330PF	4822 122 30094
C 9103	2% 220PF	4822 122 30094
C 9104	2% 330PF	4822 122 31353
C 9106	2% 220PF	4822 122 30094
C 9107	2% 12PF	4822 122 31196
C 9108	-20+80% 22NF	4822 122 30103
C 9111	2% 330PF	4822 122 31353
C 9112	2% 220PF	4822 122 30094
C 9114	-20+80% 22NF	4822 122 30103
C 9115	-20+20% 15UF	5322 124 21958
C 9116	-20+20% 33UF	5322 124 21957
C 9117	-20+20% 15UF	5322 124 21958
C 9118	2% 100PF	4822 122 31316
C 9119	2% 100PF	4822 122 31316
C 9121	2% 100PF	4822 122 31316
C 9122	2% 100PF	4822 122 31316
C 9123	2% 100PF	4822 122 31316
C 9124	2% 100PF	4822 122 31316
C 9172	10% 1.5NF	4822 122 31169
C 9173	10% 1.5NF	4822 122 31169
C 9174	0.25PF 8.2PF	4822 122 31194
C 9175	100V 10% 10NF	4822 121 41857
C 9176	63V 10% 100NF	5322 121 42492
C 9201	2% 22PF	5322 122 32143
C 9202	2% 22PF	5322 122 32143

18.3.2 RESISTORS

POSNR	DESCRIPTION	ORDERING CODE
R 0600	MRS25 1% 100K	4822 116 52973
R 0601	MRS25 1% 10K	4822 116 53022
R 0602	MRS25 1% 5K62	5322 116 53495
R 0603	MRS25 1% 10K	4822 116 53022
R 0604	MRS25 1% 10K	4822 116 53022
R 0605	MRS25 1% 100K	4822 116 52973
R 0606	MRS25 1% 16K2	5322 116 53589
R 0607	MRS25 1% 2K15	5322 116 53239
R 0608	MRS25 1% 2K15	5322 116 53239
R 0609	MRS25 1% 2K15	5322 116 53239
R 0610	MRS25 1% 10K	4822 116 53022
R 0611	MRS25 1% 2K15	5322 116 53239
R 0612	MRS25 1% 422E	5322 116 53592
R 0613	MRS25 1% 422E	5322 116 53592
R 0614	MRS25 1% 10K	4822 116 53022
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% 51E1	5322 116 55215
R 0622	MRS25 1% 1K62	5322 116 55257
R 0623	MRS25 1% 1K62	5322 116 55257
R 0624	MRS25 1% 178K	5322 116 55555
R 0626	MRS25 1% 26K1	5322 116 55261
R 0627	MRS25 1% 178K	5322 116 55555
R 0628	MRS25 1% 1M	4822 116 52843
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 55121
R 0637	MRS25 1% 16K2	5322 116 55589
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 55208
R 0648	MRS25 1% 6K81	5322 116 53252
R 0649	MRS25 1% 51K1	4822 116 55121
R 0651	MRS25 1% 16K2	5322 116 53589
R 0652	MRS25 1% 511E	5322 116 53135
R 0653	MRS25 1% 511E	5322 116 53135

POSNR	DESCRIPTION	ORDERING CODE
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 55121
R 0659	MRS25 1% 5K62	5322 116 53495
R 0661	MRS25 1% 1K78	5322 116 55208
R 0662	MRS25 1% 6K81	5322 116 53252
R 0663	MRS25 1% 51K1	4822 116 55121
R 0666	MRS25 1% 51E1	5322 116 55215
R 0669	MRS25 1% 1K62	5322 116 55257
R 0671	MRS25 1% 1K62	5322 116 55257
R 0681	MRS25 1% 5E11	4822 116 52999
R 0682	MRS25 1% 5E11	4822 116 52999
R 1001	MRS25 1% 1K	5322 116 53508
R 1002	MRS25 1% 42E2	5322 116 53515
R 1003	MRS25 1% 61E9	5322 116 55645
R 1004	1/4W .25% 10K1	5322 116 53404
R 1006	MRS25 1% 121E	4822 116 52959
R 1007	0.6W 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	0.6W 0.25% 750K	5322 116 53588
R 1013	1/4W .25% 1M	5322 116 53423
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 52911
R 1019	0.6W 0.25% 990K	5322 116 53415
R 1022	MRS25 1% 56E2	5322 116 53644
R 1023	VR25 10% 22M	5322 116 51785
R 1024	MRS25 1% 10E	4822 116 52891
R 1026	MRS25 1% 61E9	5322 116 55645
R 1027	VR25 10% 22M	5322 116 51785
R 1028	MRS25 1% 10E	4822 116 52891
R 1029	1/4W .25% 1M	5322 116 53398
R 1031	VR25 10% 22M	5322 116 51785
R 1032	MRS25 1% 10E	4822 116 52891
R 1033	VR25 10% 22M	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 20055
R 1037	MRS25 1% 100K	4822 116 52973
R 1038	VR25 10% 22M	5322 116 51785
R 1039	MRS25 1% 1K96	5322 116 53257
R 1040	MRS25 1% 287E	5322 116 55221
R 1041	MRS25 1% 1K96	5322 116 53257
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 55208
R 1053	1/4W .25% 250E	5322 116 53406
R 1054	MRS25 1% 100E	5322 116 53126
R 1055	MRS25 1% 1K78	5322 116 55208
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 55261
R 1066	0.3W 25% 10K	4822 105 10455
R 1066	MRS25 1% 16K2	5322 116 53589
R 1067	MRS25 1% 12K1	4822 116 52957
R 1068	MRS25 1% 100E	5322 116 53126
R 1069	0.3W 25% 100E	5322 105 20029
R 1071	MRS25 1% 26K1	5322 116 55261
R 1072	0.3W 25% 10K	4822 105 10455
R 1073	MRS25 1% 2K61	5322 116 53327
R 1074	MRS25 1% 1K62	5322 116 55257
R 1076	0.3W 25% 100E	5322 105 20029
R 1077	MRS25 1% 10E	4822 116 52891
R 1078	MRS25 1% 12K1	4822 116 52957
R 1079	MRS25 1% 1K62	5322 116 55257
R 1081	MRS25 1% 511E	5322 116 53135
R 1082	MRS25 1% 100K	4822 116 52973
R 1083	MRS25 1% 11K	4822 116 52907
R 1084	MRS25 1% 82K5	5322 116 53581
R 1086	MRS25 1% 12K1	4822 116 52957
R 1087	MRS25 1% 1M	4822 116 52843
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

POSNR	DESCRIPTION	ORDERING CODE
R 1094	MRS25 1% 100E	5322 116 55126
R 1096	MRS25 1% 100E	5322 116 55126
R 1097	MRS25 1% 100E	5322 116 55126
R 1098	MRS25 1% 1K21	4822 116 52956
R 1099	MRS25 1% 1K21	4822 116 52956
R 1101	MRS25 1% 1K	4822 116 52108
R 1102	MRS25 1% 42E2	5322 116 55315
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 51022
R 1109	MRS25 1% 21K5	5322 116 55241
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 51022
R 1116	MRS25 1% 21K5	5322 116 55241
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 55444
R 1123	VR25 10% 22M	5322 116 51785
R 1124	MRS25 1% 10E	4822 116 52891
R 1126	MRS25 1% 61E9	5322 116 53645
R 1127	VR25 10% 22M	5322 116 51785
R 1128	MRS25 1% 10E	4822 116 52891
R 1129	1/4W .25% 1M	5322 116 53398
R 1131	VR25 10% 22M	5322 116 51785
R 1132	MRS25 1% 10E	4822 116 52891
R 1133	VR25 10% 22M	5322 116 51785
R 1134	MRS25 1% 1M	4822 116 52845
R 1135	MRS25 1% 100K	5322 116 55126
R 1136	0.3W 25% 22K	5322 105 20035
R 1137	MRS25 1% 100K	4822 116 52973
R 1138	VR25 10% 22M	5322 116 51785
R 1139	MRS25 1% 196E	5322 116 55237
R 1140	MRS25 1% 287E	5322 116 55221
R 1141	MRS25 1% 196E	5322 116 55237
R 1143	MRS25 1% 10E	5322 116 55126
R 1144	MRS25 1% 825E	5322 116 53541
R 1145	MRS25 1% 100E	5322 116 55126
R 1146	MRS25 1% 911E	5322 116 55135
R 1147	MRS25 1% 261E	5322 116 55239
R 1148	MRS25 1% 5K11	5322 116 53494
R 1149	MRS25 1% 1K47	5322 116 53185
R 1150	MRS25 1% 100E	5322 116 55126
R 1151	MRS25 1% 681E	4822 116 55123
R 1152	MRS25 1% 187K	5322 116 55208
R 1153	1/4W .25% 250E	5322 116 53606
R 1154	MRS25 1% 100E	5322 116 55126
R 1155	MRS25 1% 1K78	5322 116 53208
R 1156	1/4W .25% 375E	5322 116 55407
R 1157	1/4W .25% 150E	5322 116 53599
R 1158	1/4W .25% 150E	5322 116 53599
R 1161	MRS25 1% 110E	4822 116 52906
R 1162	MRS25 1% 10E	4822 116 52891
R 1163	MRS25 1% 26K1	5322 116 55261
R 1164	0.3W 25% 10K	4822 105 10455
R 1166	MRS25 1% 16K2	5322 116 55389
R 1167	MRS25 1% 12K1	4822 116 52957
R 1168	MRS25 1% 10E	5322 116 55126
R 1169	0.3W 25% 100E	5322 105 20029
R 1171	MRS25 1% 26K1	5322 116 55261
R 1172	0.5W 25% 10K	4822 105 10455
R 1173	MRS25 1% 2K61	5322 116 55327
R 1174	MRS25 1% 1K62	5322 116 55257
R 1176	0.3W 25% 100E	5322 105 20029
R 1177	MRS25 1% 10E	4822 116 52891
R 1178	MRS25 1% 12K1	4822 116 52957
R 1179	MRS25 1% 1K62	5322 116 55257
R 1181	MRS25 1% 511E	5322 116 53155
R 1182	MRS25 1% 100K	4822 116 52973
R 1183	MRS25 1% 1K	4822 116 52907
R 1184	MRS25 1% 82K3	5322 116 53581
R 1186	MRS25 1% 12K1	4822 116 52957
R 1187	MRS25 1% 1M	4822 116 52843
R 1188	MRS25 1% 100E	5322 116 55126
R 1189	MRS25 1% 422E	5322 116 55392
R 1191	0.5W 25% 100E	5322 105 20029
R 1192	MRS25 1% 10E	4822 116 52891
R 1193	MRS25 1% 422E	5322 116 55392
R 1196	MRS25 1% 100E	5322 116 55126
R 1196	MRS25 1% 100E	5322 116 55126
R 1197	MRS25 1% 100E	5322 116 55126
R 1198	MRS25 1% 1K21	4822 116 52956
R 1199	MRS25 1% 1K21	4822 116 52956
R 1201	MRS25 1% 1K	4822 116 52108
R 1202	MRS25 1% 68E1	5322 116 55264
R 1203	0.4W 0.1% 1M	5322 116 51695

POSNR	DESCRIPTION	ORDERING CODE
R 1204	VR25 10% 22M	5322 116 51785
R 1206	MRS25 1% 1K96	5322 116 55237
R 1207	MRS25 1% 100E	5322 116 55126
R 1208	MRS25 1% 825E	5322 116 55541
R 1209	MRS25 1% 1M	4822 116 52843
R 1211	MRS25 1% 100E	5322 116 55126
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 55185
R 1221	MRS25 1% 681E	4822 116 55123
R 1222	MRS25 1% 2K87	5322 116 55213
R 1223	MRS25 1% 1K33	5322 116 55512
R 1226	MRS25 1% 1K	4822 116 53108
R 1226	MRS25 1% 5K11	5322 116 53494
R 1227	MRS25 1% 1K33	5322 116 55512
R 1228	MRS25 1% 100E	5322 116 55126
R 1229	MRS25 1% 750E	5322 116 55265
R 1231	MRS25 1% 750E	5322 116 55265
R 1232	MRS25 1% 82E5	5322 116 53538
R 1233	MRS25 1% 36E8	5322 116 55391
R 1234	MRS25 1% 100E	5322 116 55126
R 1236	MRS25 1% 162E	5322 116 55323
R 1237	MRS25 1% 2K61	5322 116 55327
R 1238	MRS25 1% 100E	5322 116 55126
R 1239	MRS25 1% 2K7	4822 116 53028
R 1401	MRS25 1% 5E11	4822 116 52999
R 1402	MRS25 1% 31E6	5322 116 54964
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% 31E6	5322 116 54964
R 1423	MRS25 1% 5E11	4822 116 52999
R 1424	MRS25 1% 5E11	4822 116 52999
R 1441	MRS25 1% 100E	5322 116 55126
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 55213
R 2004	MRS25 1% 51E1	5322 116 55213
R 2101	MRS25 1% 10E	4822 116 52891
R 2102	MRS25 1% 10E	4822 116 52891
R 2201	MRS25 1% 75K	5322 116 55266
R 2202	MRS25 1% 12K1	4822 116 52957
R 2203	MRS25 1% 215K	5322 116 55425
R 2204	MRS25 1% 10K	4822 116 53022
R 2205	MRS25 1% 2K15	5322 116 55239
R 2206	MRS25 1% 75K	5322 116 55266
R 2207	MRS25 1% 12K1	4822 116 52957
R 2208	MRS25 1% 215K	5322 116 55425
R 2209	MRS25 1% 10K	4822 116 53022
R 2210	MRS25 1% 2K15	5322 116 55239
R 2211	MRS25 1% 5K62	5322 116 53495
R 2212	0.3W 25% 10K	4822 105 10455
R 2213	MRS25 1% 23K7	5322 116 55537
R 2214	MRS25 1% 10K	4822 116 53022
R 2215	MRS25 1% 2K15	5322 116 55239
R 2216	MRS25 1% 5K62	5322 116 53495
R 2222	MRS25 1% 1K96	5322 116 55237
R 2225	MRS25 1% 23K7	5322 116 55537
R 2230	MRS25 1% 147E	5322 116 55369
R 2231	MRS25 1% 422E	5322 116 55392
R 2232	MRS25 1% 383E	5322 116 55332
R 2234	MRS25 1% 42E2	5322 116 55315
R 2236	MRS25 1% 681E	4822 116 55123
R 2237	MRS25 1% 383E	5322 116 55332
R 2239	MRS25 1% 348E	5322 116 55391
R 2241	MRS25 1% 1K	4822 116 53108
R 2242	MRS25 1% 383E	5322 116 55332
R 2243	MRS25 1% 681E	4822 116 55123
R 2244	MRS25 1% 42E2	5322 116 55315
R 2246	MRS25 1% 422E	5322 116 55392
R 2247	MRS25 1% 383E	5322 116 55332
R 2251	MRS25 1% 75E	5322 116 55339
R 2252	MRS25 1% 750E	5322 116 55265
R 2253	MRS25 1% 750E	5322 116 55265
R 2254	MRS25 1% 75E	5322 116 55339
R 2255	MRS25 1% 287E	5322 116 55221
R 2301	MRS25 1% 19K6	5322 116 55258
R 2302	MRS25 1% 19K6	5322 116 55258
R 2303	MRS25 1% 5K62	5322 116 53495
R 2304	MRS25 1% 5K62	5322 116 53495
R 2311	MRS25 1% 2K87	5322 116 55213
R 2315	MRS25 1% 100E	5322 116 55126
R 2316	MRS25 1% 100E	5322 116 55126
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

POSNR	DESCRIPTION	ORDERING CODE
R 2325	MRS25 1% 5K62	5322 116 53495
R 2326	MRS25 1% 2K87	5322 116 53513
R 2327	MRS25 1% 3K31	4822 116 53077
R 2328	MRS25 1% 2K87	5322 116 53513
R 2329	MRS25 1% 825E	5322 116 53341
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 53072
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 53341
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 2363	MRS25 1% 23K7	5322 116 53537
R 2366	MRS25 1% 10K	4822 116 53072
R 2367	MRS25 1% 16K2	5322 116 53589
R 2369	MRS25 1% 68K1	5322 116 53538
R 2371	MRS25 1% 422E	5322 116 53292
R 2372	MRS25 1% 511E	5322 116 53135
R 2373	MRS25 1% 75K	5322 116 53266
R 2374	MRS25 1% 511E	5322 116 53135
R 2375	MRS25 1% 23K7	5322 116 53537
R 2376	VR25 10% 22M	5322 116 51785
R 2377	VR25 10% 22M	5322 116 51785
R 2378	VR25 10% 22M	5322 116 51785
R 2379	VR25 10% 22M	5322 116 51785
R 2380	MRS25 1% 750E	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% 3K01	4822 116 53316
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 53237
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 52975
R 2431	MRS25 1% 100K	4822 116 52975
R 2432	MRS25 1% 100K	4822 116 52975
R 2433	MRS25 1% 100K	4822 116 52973
R 2434	MRS25 1% 10K	4822 116 53072
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 53292
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 53536
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% 5E11	4822 116 52999
R 2742	MRS25 1% 5E11	4822 116 52999
R 3001	MRS25 1% 147E	5322 116 53569
R 3002	MRS25 1% 316E	5322 116 53314
R 3003	MRS25 1% 1K47	5322 116 53183
R 3004	MRS25 1% 422E	5322 116 53292
R 3006	MRS25 1% 2K37	5322 116 53536
R 3007	0.3W 25% 2K2	5322 105 20035
R 3008	MRS25 1% 121E	4822 116 52955
R 3009	MRS25 1% 3K83	4822 116 53079
R 3011	MRS25 1% 121E	4822 116 52955
R 3012	MRS25 1% 316E	5322 116 53314
R 3013	0.3W 25% 10K	4822 105 10455
R 3014	MRS25 1% 2K87	5322 116 53513
R 3015	MRS25 1% 316E	5322 116 53314
R 3016	MRS25 1% 2K37	5322 116 53536
R 3017	0.3W 25% 22K	5322 105 20033
R 3018	MRS25 1% 8K25	5322 116 53267
R 3020	MRS25 1% 10E	4822 116 52891
R 3021	MRS25 1% 464E	5322 116 53232
R 3022	MRS25 1% 750E	5322 116 53265
R 3023	MRS25 1% 348E	5322 116 53391
R 3024	MRS25 1% 750E	5322 116 53265
R 3025	MRS25 1% 10E	4822 116 52891
R 3026	MRS25 1% 464E	5322 116 53232
R 3027	MRS25 1% 42E2	5322 116 53515
R 3028	MRS25 1% 42E2	5322 116 53515
R 3029	MRS25 1% 3K16	4822 116 53021
R 3031	MRS25 1% 402E	5322 116 53439
R 3032	MRS25 1% 31E6	5322 116 54964
R 3033	MRS25 1% 100E	5322 116 53126
R 3034	MRS25 1% 162E	5322 116 53523
R 3036	0.3W 25% 10E	5322 105 20029
R 3037	MRS25 1% 100E	5322 116 53126
R 3038	0.3W 25% 470E	5322 105 20028
R 3039	MRS25 1% 42E2	5322 116 53515
R 3041	MRS25 1% 31E6	5322 116 53514
R 3042	MRS25 1% 110E	4822 116 52906
R 3043	MRS25 1% 110E	4822 116 52906
R 3046	MRS25 1% 110E	4822 116 52906
R 3046	MRS25 1% 110E	4822 116 52906
R 3047	MRS25 1% 42E2	5322 116 53515
R 3048	MRS25 1% 42E2	5322 116 53515
R 3049	MRS25 1% 51K1	4822 116 53121
R 3050	MRS25 1% 42E2	5322 116 53515
R 3051	MRS25 1% 51K1	4822 116 53121
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 3101	MRS25 1% 3K62	5322 116 53495
R 3102	MRS25 1% 562E	5322 116 53214
R 3103	MRS25 1% 1K21	4822 116 53096
R 3106	MRS25 1% 6K81	5322 116 53252
R 3106	MRS25 1% 42E2	5322 116 53515
R 3107	MRS25 1% 2K87	5322 116 53513
R 3108	MRS25 1% 825E	5322 116 53341
R 3109	MRS25 1% 6K19	5322 116 53263
R 3110	MRS25 1% 42E2	5322 116 53515
R 3111	MRS25 1% 42E2	5322 116 53515
R 3112	MRS25 1% 7K5	4822 116 53028
R 3113	MRS25 1% 1K21	4822 116 52956
R 3114	MRS25 1% 5K62	5322 116 53495
R 3115	MRS25 1% 42E2	5322 116 53515
R 3116	MRS25 1% 562E	5322 116 53214
R 3117	MRS25 1% 4K64	5322 116 53212
R 3118	0.3W 25% 1K	5322 105 20032
R 3119	MRS25 1% 4K64	5322 116 53212

POSNR	DESCRIPTION	ORDERING CODE
R 3120	MRS25 1% 42E2	5322 116 53515
R 3121	MRS25 1% 15K4	5322 116 53254
R 3122	MRS25 1% 2K37	5322 116 53556
R 3124	MRS25 1% 619E	5322 116 53337
R 3125	MRS25 1% 26E1	5322 116 53723
R 3126	MRS25 1% 14K7	4822 116 53531
R 3127	MRS25 1% 1K53	5322 116 53512
R 3128	MRS25 1% 825E	5322 116 53541
R 3129	MRS25 1% 1K1	5322 116 53473
R 3130	MRS25 1% 26E1	5322 116 53723
R 3131	MRS25 1% 1K53	5322 116 53512
R 3132	MRS25 1% 825E	5322 116 53541
R 3133	MRS25 1% 6K19	5322 116 53263
R 3134	MRS25 1% 14K7	4822 116 53531
R 3136	MRS25 1% 1K	4822 116 53108
R 3137	MRS25 1% 15K4	5322 116 53254
R 3138	MRS25 1% 2K37	5322 116 53556
R 3139	MRS25 1% 619E	5322 116 53337
R 3141	MRS25 1% 316E	5322 116 53214
R 3142	MRS25 1% 316E	5322 116 53514
R 3143	MRS25 1% 10E	4822 116 52891
R 3144	MRS25 1% 10E	4822 116 52891
R 3147	0.3W 10% 3K3	5322 116 54234
R 3148	MRS25 1% 9K09	5322 116 53250
R 3149	MRS25 1% 511E	5322 116 53135
R 3200	MRS25 1% 6K81	5322 116 53252
R 3201	MRS25 1% 511	4822 116 52996
R 3202	MRS25 1% 100E	5322 116 53126
R 3203	MRS25 1% 14K7	5322 116 53589
R 3204	MRS25 1% 562E	5322 116 53214
R 3205	MRS25 1% 6K64	5322 116 53212
R 3206	MRS25 1% 4K64	5322 116 53212
R 3207	MRS25 1% 82K5	5322 116 53281
R 3208	MRS25 1% 7K5	4822 116 53228
R 3209	MRS25 1% 1K	4822 116 53108
R 3210	MRS25 1% 42E2	5322 116 53515
R 3211	MRS25 1% 18K	4822 116 53022
R 3212	MRS25 1% 1K47	5322 116 53183
R 3213	MRS25 1% 25K7	5322 116 53537
R 3214	MRS25 1% 316E	5322 116 53162
R 3215	MRS25 1% 6K64	5322 116 53212
R 3216	MRS25 1% 178K	5322 116 53555
R 3217	MRS25 1% 511E	5322 116 53135
R 3218	MRS25 1% 619	5322 116 53533
R 3219	MRS25 1% 1M	4822 116 52843
R 3221	MRS25 1% 100E	5322 116 53126
R 3222	MRS25 1% 100K	4822 116 50973
R 3223	MRS25 1% 38K5	4822 116 52926
R 3224	MRS25 1% 2K37	5322 116 53536
R 3226	MRS25 1% 10E	5322 116 53126
R 3250	MRS25 1% 2K37	5322 116 53536
R 3251	MRS25 1% 1M	4822 116 52843
R 3253	MRS25 1% 75K	5322 116 53266
R 3254	MRS25 1% 1M	4822 116 53108
R 3256	MRS25 1% 178K	5322 116 53555
R 3257	MRS25 1% 825K	5322 116 53541
R 3258	VR25 5% 3M3	4822 110 72201
R 3259	VR25 5% 3M3	4822 110 72201
R 3261	VR25 5% 3M3	4822 110 72201
R 3263	VR25 5% 3M3	4822 110 72201
R 3267	25% 47K	5322 105 20037
R 3268	MRS25 1% 681K	5322 116 53553
R 3269	MRS25 1% 15K4	5322 116 53254
R 3270	MRS25 1% 2K37	5322 116 53537
R 3271	MRS25 1% 14K7	4822 116 53531
R 3273	MRS25 1% 215K	5322 116 53525
R 3301	MRS25 1% 10E	4822 116 52891
R 3302	MRS25 1% 1E	4822 116 52976
R 3303	MRS25 1% 1M	4822 116 52999
R 3304	MRS25 1% 5E11	4822 116 52999
R 3306	MRS25 1% 2K87	5322 116 53513
R 3308	MRS25 1% 10E	4822 116 52891
R 3309	MRS25 1% 5E11	4822 116 52999
R 3311	MRS25 1% 5E11	4822 116 52999
R 3312	MRS25 1% 5E11	4822 116 52999
R 3313	MRS25 1% 10E	4822 116 52891
R 4001	MRS25 1% 8E11	5322 116 53213
R 4002	MRS25 1% 51E1	5322 116 53213
R 4003	MRS25 1% 2K61	5322 116 53327
R 4004	0.3W 25% 1K	5322 105 20032
R 4006	MRS25 1% 10K	4822 116 53022
R 4007	MRS25 1% 100E	5322 116 53126
R 4008	MRS25 1% 100E	5322 116 53126
R 4009	MRS25 1% 1K	4822 116 53108
R 4011	MRS25 1% 2K15	5322 116 53239
R 4012	MRS25 1% 100E	5322 116 53126
R 4013	MRS25 1% 100E	5322 116 53126
R 4014	MRS25 1% 909E	4822 116 53533
R 4016	MRS25 1% 909E	4822 116 53533
R 4017	MRS25 1% 100E	5322 116 53126

POSNR	DESCRIPTION	ORDERING CODE
R 4019	MRS25 1% 51E1	5322 116 53213
R 4021	MRS25 1% 1K47	5322 116 53183
R 4022	MRS25 1% 511E	5322 116 53135
R 4023	MRS25 1% 562E	5322 116 53214
R 4026	MRS25 1% 909E	4822 116 53533
R 4027	MRS25 1% 5K62	5322 116 53495
R 4028	MRS25 1% 1K	4822 116 53108
R 4029	MRS25 1% 2K37	5322 116 53536
R 4031	MRS25 1% 1M	4822 116 52843
R 4032	MRS25 1% 5K11	5322 116 53494
R 4033	MRS25 1% 2K61	5322 116 53327
R 4041	MRS25 1% 5K11	5322 116 53494
R 4042	MRS25 1% 3K16	4822 116 53021
R 4043	MRS25 1% 5K11	5322 116 53494
R 4044	MRS25 1% 681K	5322 116 53553
R 4046	MRS25 1% 10K	4822 116 53022
R 4047	MRS25 1% 12K1	4822 116 52937
R 4086	MRS25 1% 909E	4822 116 53533
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 52937
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% 900E	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 4128	MRS25 1% 17K8	5322 116 53255
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 4133	MRS25 1% 3K68	4822 116 53515
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% 20QE	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 4253	MRS25 1% 1K	4822 116 53108
R 4258	MRS25 1% 4K64	5322 116 53212
R 4259	MRS25 1% 4K64	5322 116 53212
R 4260	0.3W 25% 1K	5322 105 20032
R 4261	MRS25 1% 10K	4822 116 53022
R 4262	MRS25 1% 10K	4822 116 53022
R 4263	MRS25 1% 5K11	5322 116 53494
R 4265	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% 121K	5322 116 53241
R 4332	MRS25 1% 4K22	5322 116 53246
R 4334	MRS25 1% 2K15	5322 116 53239
R 4404	MRS25 1% 2K37	5322 116 53536
R 4411	MRS25 1% 2K37	5322 116 53536
R 4501	MRS25 1% 13K3	5322 116 53469
R 4502	MRS25 1% 4K22	5322 116 53246
R 4503	MRS25 1% 6K81	5322 116 53252
R 4504	MRS25 1% 21K5	5322 116 53539
R 4505	MRS25 1% 511E	5322 116 53135
R 4506	MRS25 1% 2K15	5322 116 53239
R 4507	MRS25 1% 750E	5322 116 53255
R 4508	MRS25 1% 11K	4822 116 52907
R 4509	MRS25 1% 2K15	5322 116 53239
R 4513	MRS25 1% 1K47	5322 116 53183
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 52531
R 4526	MRS25 1% 21K7	5322 116 53536
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 53115
R 4601	MRS25 1% 2K37	5322 116 53536
R 4602	MRS25 1% 26K1	5322 116 53261
R 4603	MRS25 1% 23K7	5322 116 53537
R 4604	MRS25 1% 110K	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% 10K	4822 116 53022
R 4614	MRS25 1% 51K1	4822 116 53121
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% 8K25	5322 116 53267
R 4620	MRS25 1% 7K5	4822 116 53028
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 53532
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 53263
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

POSNR	DESCRIPTION	ORDERING CODE
R 4809	MRS25 1% 5E11	4822 116 52999
R 4819	MRS25 1% 5E11	4822 116 52999
R 4829	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 4841	MRS25 1% 10K	4822 116 53022
R 4891	MRS25 1% 5E11	4822 116 52999
R 4893	MRS25 1% 5E11	4822 116 52999
R 4894	MRS25 1% 5E11	4822 116 52999
R 4901	MRS25 1% 562E	5322 116 53214
R 4906	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 30969
R 6002	MRS25 1% 383K	5322 116 53576
R 6003	MRS25 1% 383K	5322 116 53576
R 6004	MRS25 1% 316E	5322 116 53514
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 53514
R 6009	0.5W 10% 1K5	4822 116 30268
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% 215E	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 53532
R 6032	1/4W .25% 5K62	4822 117 52573
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% 464E	5322 116 53212
R 6137	MRS25 1% 316E	5322 116 53514
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% 511E	5322 116 53215
R 6208	MRS25 1% 464E	5322 116 53232
R 6209	MRS25 1% 4K64	5322 116 53212
R 6211	MRS25 1% 464E	5322 116 53232
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 53525

POSNR	DESCRIPTION			ORDERING CODE
R 6404	MRS25	1%	6K81	5322 116 53252
R 6406	MRS25	1%	26K1	5322 116 53261
R 6407	MRS25	1%	5K48	5322 116 53315
R 6408	MTP10	20%	10K	5322 160 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%	3K11	5322 116 53494
R 6504	MRS25	1%	1K6	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%	330E	5322 116 53408
R 6511	MRS25	1%	562E	5322 116 53214
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 7021	MRS25	1%	11K	4822 116 52907
R 7022	MRS25	1%	10K	4822 116 53022
R 7025	MRS25	1%	90K9	5322 116 53582
R 7024	MRS25	1%	1K	4822 116 53108
R 7025	MRS25	1%	51E1	5322 116 53213
R 7026	MRS25	1%	6K64	5322 116 53212
R 7027	MRS25	1%	3K83	4822 116 53079
R 7028	MRS25	1%	3K83	4822 116 53079
R 7029	MRS25	1%	1K	4822 116 53108
R 7031	MRS25	1%	1K	4822 116 53108
R 7032	MRS25	1%	75K	5322 116 53266
R 7033	MRS25	1%	5K11	5322 116 53494
R 7034	MRS25	1%	162E	5322 116 53523
R 7036	0.5W	10%	2K2	4822 116 30254
R 7037	MRS25	1%	1K1	5322 116 53473
R 7038	MRS25	1%	1M	4822 116 52845
R 7041	MRS25	1%	3K83	4822 116 53079
R 7042	MRS25	1%	3K83	4822 116 53079
R 7043	MRS25	1%	1M	4822 116 52845
R 7102	MRS25	1%	100E	5322 116 55126
R 8001	MCR18	1%	10K	4822 116 52969
R 9011	MRS25	1%	464E	5322 116 53232
R 9012	MRS25	1%	10K	4822 116 53022
R 9013	MRS25	1%	1E	4822 116 52976
R 9014	105-103		10K	5322 111 30473
R 9021	MRS25	1%	2K3	5322 116 53473
R 9028	MRS25	1%	464E	5322 116 53232
R 9029	MRS25	1%	5K11	5322 116 53494
R 9033	MRS25	1%	5K11	5322 116 53494
R 9034	MRS25	1%	5K11	5322 116 53494
R 9039	MRS25	1%	5K11	5322 116 53494
R 9941	MRS25	1%	10E	4822 116 52891
R 9942	MRS25	1%	2K37	5322 116 55536
R 9043	MRS25	1%	10E	4822 116 52891
R 9044	MRS25	1%	1K96	5322 116 55237
R 9045	MRS25	1%	10K	4822 116 53022
R 9046	MRS25	1%	10K	4822 116 53022
R 9047	MRS25	1%	10K	4822 116 53022
R 9048	MRS25	1%	10K	4822 116 53022
R 9051	MRS25	1%	2K61	5322 116 53327
R 9052	MRS25	1%	5K11	5322 116 53494
R 9053	0.3W	25%	2K2	5322 105 20033
R 9054	MRS25	1%	10E	4822 116 52891
R 9056	MRS25	1%	10E	4822 116 52891
R 9057	MRS25	1%	7K5	4822 116 53028
R 9061	MRS25	1%	1K	4822 116 53108
R 9062	MRS25	1%	51E1	5322 116 53213
R 9063	MRS25	1%	215E	5322 116 53325
R 9064	0.3W	25%	2K2	5322 105 20033
R 9066	MRS25	1%	51E1	5322 116 53213
R 9067	MRS25	1%	1K	4822 116 53108
R 9068	MRS25	1%	6K19	5322 116 53265
R 9069	MRS25	1%	3K48	4822 116 53515
R 9071	MRS25	1%	51E1	5322 116 53213
R 9072	MRS25	1%	51E1	5322 116 53213
R 9073	MRS25	1%	750E	5322 116 53265
R 9074	MRS25	1%	750E	5322 116 53265
R 9076	MRS25	1%	422E	5322 116 53592
R 9077	MRS25	1%	422E	5322 116 53592
R 9078	0.3W	25%	1K	5322 105 20032
R 9079	MRS25	1%	5K11	5322 116 53494
R 9081	MRS25	1%	5E11	4822 116 52999
R 9082	MRS25	1%	1K	4822 116 53108
R 9083	MRS25	1%	1K	4822 116 53108
R 9084	MRS25	1%	51E1	5322 116 53213
R 9086	MRS25	1%	2K15	5322 116 53239
R 9087	MRS25	1%	4K22	5322 116 53246
R 9102	MRS25	1%	511K	5322 116 53334

POSNR	DESCRIPTION			ORDERING CODE
R 9103	MRS25	1%	511K	5322 116 53334
R 9104	MRS25	1%	511K	5322 116 53334
R 9106	MRS25	1%	4K22	5322 116 53246
R 9107	MRS25	1%	1K	4822 116 53108
R 9108	MRS25	1%	1K	4822 116 53108
R 9111	MRS25	1%	750E	5322 116 53265
R 9112	MRS25	1%	1K78	5322 116 53208
R 9113	MRS25	1%	1K78	5322 116 53208
R 9115	MRS25	1%	5K11	5322 116 53494
R 9116	0.3W	25%	10K	4822 105 10455
R 9117	MRS25	1%	316K	4822 116 53058
R 9118	MRS25	1%	3K83	4822 116 53079
R 9119	MRS25	1%	3K83	4822 116 53079
R 9121	MRS25	1%	10E	4822 116 52891
R 9122	MRS25	1%	10K	4822 116 53022
R 9123	0.3W	25%	1K	5322 105 20032
R 9124	MRS25	1%	10K	4822 116 53022
R 9126	MRS25	1%	31K6	5322 116 53262
R 9127	MRS25	1%	2K87	5322 116 53513
R 9128	MRS25	1%	750E	5322 116 53265
R 9129	MRS25	1%	1K	4822 116 53108
R 9131	MRS25	1%	1K78	5322 116 53208
R 9132	MRS25	1%	3K16	4822 116 53021
R 9133	MRS25	1%	4K22	5322 116 53246
R 9134	0.3W	25%	220K	5322 105 20039
R 9136	MRS25	1%	1E	4822 116 52976
R 9137	MRS25	1%	1E	4822 116 52976
R 9138	MRS25	1%	1E	4822 116 52976
R 9141	MRS25	1%	56K2	5322 116 53222
R 9161	MRS25	1%	1K	4822 116 53108
R 9162	MRS25	1%	51E1	5322 116 53213
R 9163	MRS25	1%	215E	5322 116 53325
R 9164	0.3W	25%	2K2	5322 105 20033
R 9166	MRS25	1%	51E1	5322 116 53213
R 9167	MRS25	1%	1K	4822 116 53108
R 9168	MRS25	1%	6K19	5322 116 53265
R 9169	MRS25	1%	3K48	4822 116 53515
R 9171	MRS25	1%	51E1	5322 116 53213
R 9172	MRS25	1%	51E1	5322 116 53213
R 9173	MRS25	1%	750E	5322 116 53265
R 9176	MRS25	1%	750E	5322 116 53265
R 9176	MRS25	1%	422E	5322 116 53592
R 9177	MRS25	1%	422E	5322 116 53592
R 9178	0.3W	25%	1K	5322 105 20032
R 9179	MRS25	1%	5K11	5322 116 53494
R 9181	MRS25	1%	5E11	4822 116 52999
R 9182	MRS25	1%	1K	4822 116 53108
R 9183	MRS25	1%	1K	4822 116 53108
R 9184	MRS25	1%	51E1	5322 116 53213
R 9186	MRS25	1%	2K15	5322 116 53239
R 9201	MRS25	1%	31E6	5322 116 54964
R 9202	MRS25	1%	31E6	5322 116 54964
R 9203	MRS25	1%	422E	5322 116 53592
U 3262	YR25	5%	7M5	5322 116 60131

18.3.3 COILS

POSNR	DESCRIPTION		ORDERING CODE
L 1001	0.22UH	10% TDK	5322 157 55284
L 1101	0.22UH	10% TDK	5322 157 55284
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 55509
L 3002	2.2UH	10% TDK	5322 157 55509
L 3003	2.7UH	10% TDK	5322 157 55511
L 4101	2.0UH	TDK	4822 157 91797
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	TDK	4822 157 52259
L 6004	220UH	TDK	5322 157 53524
L 6006	220UH	TDK	5322 157 53524
L 6101	100UH	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	150H		5322 157 52539

POSNR	DESCRIPTION		ORDERING CODE
L 6201	82UH		4822 158 10563
L 6501	82UH		4822 158 10563
L 7101	150H		5322 157 52539
L 9001	2.0UH	TDK	4822 157 51757
L 9002	2.0UH	TDK	4822 157 51757
L 9003	2.0UH	TDK	4822 157 51757
L 9006	2.0UH	TDK	4822 157 51757
L 9007	2.0UH	TDK	4822 157 51757

18.3.4 SEMI-CONDUCTORS

POSNR	DESCRIPTION		ORDERING CODE
V 0601	BC548C	PEL	4822 130 44196
V 0602	BC558B	PEL	4822 130 44197
V 0603	BZV86-C1V4	PEL	4822 130 81423
V 0604	BC558B	PEL	4822 130 44197
V 0606	BC548C	PEL	4822 130 44196
V 0607	BZX79-C6V2	PEL	4822 130 34167
V 0608	BC548C	PEL	4822 130 44196
V 0609	BAW62	PEL	4822 130 30613
V 0611	BAW62	PEL	4822 130 30613
V 0612	BAW62	PEL	4822 130 30613
V 0613	BAW62	PEL	4822 130 30613
V 0614	BAW62	PEL	4822 130 30613
V 0615	BAW62	PEL	4822 130 30613
V 0616	BC548C	PEL	4822 130 44196
V 0617	BC548C	PEL	4822 130 44196
V 0618	BAW62	PEL	4822 130 30613
V 0619	BAW62	PEL	4822 130 30613
V 0621	BC548C	PEL	4822 130 44196
V 0622	BC548C	PEL	4822 130 44196
V 0623	BAW62	PEL	4822 130 30613
V 0624	BAW62	PEL	4822 130 30613
V 0626	BC548C	PEL	4822 130 44196
V 0627	BC548C	PEL	4822 130 44196
V 0628	BC548C	PEL	4822 130 44196
V 0629	BC548C	PEL	4822 130 44196
V 0630	BC548C	PEL	4822 130 44196
V 0631	BC548C	PEL	4822 130 44196
V 0632	BC548C	PEL	4822 130 44196
V 0633	BC548C	PEL	4822 130 44196
V 0636	BAW62	PEL	4822 130 30613
V 0638	BAW62	PEL	4822 130 30613
V 1000	BA483	PEL	4822 130 32656
V 1001	BF324	PEL	4822 130 41448
V 1002	BF324	PEL	4822 130 41448
V 1003	ON4401	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

POSNR	DESCRIPTION		ORDERING CODE
V 1119	BF199	PEL	4822 130 44154
V 1121	BF199	PEL	4822 130 44154
V 1122	BF324	PEL	4822 130 41448
V 1123	BZX79-C5V6	PEL	4822 130 34173
V 1124	BF370	PEL	4822 130 42589
V 1161	BAW62	PEL	4822 130 30613
V 1162	BAW62	PEL	4822 130 30613
V 1163	BF324	PEL	4822 130 41448
V 1164	BF324	PEL	4822 130 41448
V 1200	BZV86-C1V4	PEL	4822 130 81423
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 3002	BF324	PEL	4822 130 41448
V 3003	BC558B	PEL	4822 130 44197
V 3004	BF324	PEL	4822 130 41448
V 3006	BF324	PEL	4822 130 41448
V 3007	BC548C	PEL	4822 130 44196
V 3008	BF370	PEL	4822 130 42589
V 3009	BF370	PEL	4822 130 42589
V 3011	2N3866-01	PEL	5322 130 61799
V 3012	2N3866-01	PEL	5322 130 61799
V 3013	BZX79-B27	PEL	4822 130 34379
V 3014	BZX79-B27	PEL	4822 130 34379
V 3016	BAW62	PEL	4822 130 30613
V 3101	BF324	PEL	4822 130 41448
V 3102	BF324	PEL	4822 130 41448
V 3103	BF324	PEL	4822 130 41448
V 3104	BC558B	PEL	4822 130 44197
V 3106	BF324	PEL	4822 130 41448
V 3108	BF472	PEL	5322 130 42535
V 3109	BF370	PEL	4822 130 42589
V 3111	BF370	PEL	4822 130 42589
V 3112	2N5551	PEL	5322 130 44491
V 3113	BZX79-B5V6	PEL	4822 130 34173

POSNR	DESCRIPTION		ORDERING CODE
V 3114	2N5551	PEL	5322 130 44491
V 3116	BF472	PEL	5322 130 42535
V 3200	BF370	PEL	4822 130 42589
V 3201	BF370	PEL	4822 130 42589
V 3202	2N5401	PEL	5322 130 42536
V 3203	2N5551	PEL	5322 130 44491
V 3204	BF423	PEL	4822 130 41646
V 3205	BZX79-B5V6	PEL	4822 130 34173
V 3206	BAW62	PEL	4822 130 30613
V 3207	BC548C	PEL	4822 130 44196
V 3208	BF423	PEL	4822 130 41646
V 3209	BAW62	PEL	4822 130 30613
V 3211	BAW62	PEL	4822 130 30613
V 3212	BZX79-B68	PEL	4822 130 30844
V 3213	BC548C	PEL	4822 130 44196
V 3214	BAW62	PEL	4822 130 30613
V 3215	BAW62	PEL	4822 130 30613
V 3216	BZX79-C9V1	PEL	4822 130 30862
V 3217	BAW62	PEL	4822 130 30613
V 3251	BF423	PEL	4822 130 41646
V 3252	BZX79-C6V2	PEL	4822 130 34167
V 3253	BF423	PEL	4822 130 41646
V 3254	BF423	PEL	4822 130 41646
V 3256	BF423	PEL	4822 130 41646
V 3257	BAV21	PEL	4822 130 30842
V 3301	BZX79-C6V2	PEL	4822 130 34167
V 4001	BF199	PEL	4822 130 44154
V 4002	BF199	PEL	4822 130 44154
V 4003	BF324	PEL	4822 130 41448
V 4004	BF324	PEL	4822 130 41448
V 4005	BZX79-C6V2	PEL	4822 130 34167
V 4006	BAW62	PEL	4822 130 30613
V 4008	BYQ25X	PEL	5322 130 42051
V 4009	BC548C	PEL	4822 130 44196
V 4011	BC548C	PEL	4822 130 44196
V 4012	BC548C	PEL	4822 130 44196
V 4013	BZX79-C5V1	PEL	4822 130 34253
V 4014	BC548C	PEL	4822 130 44196
V 4016	BZX79-C3V6	PEL	5322 130 34834
V 4017	BAW62	PEL	4822 130 30613
V 4018	BC548C	PEL	4822 130 44196
V 4021	BC548C	PEL	4822 130 44196
V 4022	BAW62	PEL	4822 130 30613
V 4023	BC548C	PEL	4822 130 44196
V 4101	BC558B	PEL	4822 130 44197
V 4102	BAW62	PEL	4822 130 30613
V 4103	BAW62	PEL	4822 130 30613
V 4104	BC548C	PEL	4822 130 44196
V 4106	BAW62	PEL	4822 130 30613
V 4107	BC327	PEL	4822 130 40854
V 4108	BC548C	PEL	4822 130 44196
V 4109	BC558B	PEL	4822 130 44197
V 4110	BA483	PEL	4822 130 32656
V 4111	BC558B	PEL	4822 130 44197
V 4112	BSX20	PEL	4822 130 41705
V 4113	BZV86-C1V4	PEL	4822 130 81423
V 4114	BSX20	PEL	4822 130 41705
V 4115	BZX79-C6V2	PEL	4822 130 34167
V 4116	BAW62	PEL	4822 130 30613
V 4117	BC548C	PEL	4822 130 44196
V 4118	BC548C	PEL	4822 130 44196
V 4119	BF199	PEL	4822 130 44154
V 4120	BAW62	PEL	4822 130 30613
V 4121	BC548C	PEL	4822 130 44196
V 4122	BAW62	PEL	4822 130 30613
V 4123	BAW62	PEL	4822 130 30613
V 4216	BAW62	PEL	4822 130 30613
V 4217	BC548C	PEL	4822 130 44196
V 4300	BZX79-C6V2	PEL	4822 130 34167
V 4301	BC558B	PEL	4822 130 44197
V 4302	BC548C	PEL	4822 130 44196
V 4304	BC558B	PEL	4822 130 44197
V 4305	BZX79-C9V1	PEL	4822 130 30862
V 4306	BAW62	PEL	4822 130 30613
V 4307	BC548C	PEL	4822 130 44196
V 4308	BZV86-C1V4	PEL	4822 130 81423
V 4309	BC548C	PEL	4822 130 44196
V 4321	BAW62	PEL	4822 130 30613
V 4322	BC548C	PEL	4822 130 44196
V 4323	BC548C	PEL	4822 130 44196
V 4500	BAW62	PEL	4822 130 30613
V 4501	BC548C	PEL	4822 130 44196
V 4502	BC548C	PEL	4822 130 44196
V 4503	BC548C	PEL	4822 130 44196
V 4504	BC548C	PEL	4822 130 44196
V 4505	BAW62	PEL	4822 130 30613
V 4506	BC548C	PEL	4822 130 44196
V 4510	BC558B	PEL	4822 130 44197
V 4511	BC558B	PEL	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 4603	BAW62	PEL	4822 130 30613
V 4611	BF199	PEL	4822 130 44154
V 4612	BF199	PEL	4822 130 44154
V 4613	BAW62	PEL	4822 130 30613
V 4614	BAW62	PEL	4822 130 30613
V 4616	BC548C	PEL	4822 130 44196
V 4617	BAW62	PEL	4822 130 30613
V 4618	BAW62	PEL	4822 130 30613
V 4702	BF324	PEL	4822 130 41448
V 4703	BAW62	PEL	4822 130 30613
V 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 6001	BYV96E	PEL	5322 130 34979
V 6002	BYV96E	PEL	5322 130 34979
V 6003	BYV96E	PEL	5322 130 34979
V 6004	BYV96E	PEL	5322 130 34979
V 6007	BAX12	PEL	5322 130 34605
V 6008	BAX12	PEL	5322 130 34605
V 6009	BC337	PEL	4822 130 40855
V 6011	BAX12	PEL	5322 130 34605
V 6012	BZX79-C15	PEL	4822 130 34281
V 6013	BRY39	PEL	5322 130 40482
V 6014	BUK456-800B		5322 130 43926
V 6016	BYV27-150	PEL	4822 130 31628
V 6017	BYV96E	PEL	5322 130 34979
V 6018	BUW12A	PEL	5322 130 42114
V 6019	BYV26C	PEL	4822 130 32343
V 6021	BZX79-C3V0	PEL	4822 130 31881
V 6031	BZX79-C3V6	PEL	5322 130 34834
V 6101	MSR2445CT	MOT	5322 130 41179
V 6102	BYM95C	PEL	4822 130 41402
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	BZX78	PEL	5322 130 44278
V 6401	BZV11	PEL	5322 130 34294
V 6402	BAX12	PEL	5322 130 34605
V 6403	BC337	PEL	4822 130 40855
V 7001	BAW62	PEL	4822 130 30613
V 7002	BC548C	PEL	4822 130 44196
V 7101	BAW62	PEL	4822 130 30613
V 9001	BAT85	PEL	4822 130 31983
V 9002	BAT85	PEL	4822 130 31983
V 9003	BAT85	PEL	4822 130 31983

POSNR	DESCRIPTION		ORDERING CODE
V 9004	BZX79-C5V9	PEL	4822 130 31981
V 9009	BAT85	PEL	4822 130 31983
V 9011	BC558B	PEL	4822 130 44197
V 9012	BC558B	PEL	4822 130 44197
V 9013	BC558B	PEL	4822 130 44197
V 9014	BC548C	PEL	4822 130 44196
V 9016	BC548C	PEL	4822 130 44196
V 9017	BC548C	PEL	4822 130 44196
V 9018	BC548C	PEL	4822 130 44196
V 9162	BC548C	PEL	4822 130 44196
V 9106	BC548C	PEL	4822 130 44196
V 9107	BC548C	PEL	4822 130 44196
V 9108	BC548C	PEL	4822 130 44196
V 9109	BAT85	PEL	4822 130 31983
V 9111	BC558B	PEL	4822 130 44197
V 9112	BC558B	PEL	4822 130 44197
V 9113	BC558B	PEL	4822 130 44197
V 9114	BC548C	PEL	4822 130 44196
V 9116	BC548C	PEL	4822 130 44196
V 9117	BC548C	PEL	4822 130 44196
V 9118	BC548C	PEL	4822 130 44196
V 9119	BC548C	PEL	4822 130 44196
V 9121	BC548C	PEL	4822 130 44196
V 9122	BC548C	PEL	4822 130 44196

18.3.5 INTERGRATED CIRCUITS

POSNR	DESCRIPTION		ORDERING CODE
D 0601	PLIFIER		5322 209 80991
D 0602	PLIFIER		5322 209 80991
D 0603	C74NCT4053P	PEL	4822 209 71584
D 1001	TEA1017/N9	PEL	5322 209 60191
D 1101	TEA1617/N9	PEL	5322 209 60191
D 2205	ARRAY BQ 0127		4822 209 80992
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			5322 321 21597
D 6501	HEF4066BP	PEL	5322 209 10357
D 7002	HEF4053BP	PEL	5322 209 10576
D 7002	SN74LS38N		5322 209 85605
D 7003	PCF4HCT259P	PEL	5322 209 11119
D 7003	SN74LS259BN		5322 209 86007
D 7006	SN74LS244N	MOT	5322 209 86017
D 7006	SN74LS244N		5322 209 86017
D 8001	PCF8577T	PEL	5322 209 70024
D 8002	PCF8577T	PEL	5322 209 70024
D 8003	PCF8577T	PEL	5322 209 70024
D 9002	74F163APC	FSC	5322 209 85343
D 9003	74F74PC	FSC	5322 209 81474
D 9004	P8256	INT	5322 209 82406
D 9006	74F251APC	FSC	5322 209 81546
D 9012	P8032AH	INT	5322 209 11318
D 9013	PROM		5322 209 51682
D 9014	M6264ALP-12	HIT	5322 209 60192
D 9016	PCF4HCT573P	PEL	5322 209 11488
D 9017	PCF4HCT245P	PEL	5322 209 11117
D 9018	PCF4HCT245P	PEL	5322 209 11117
D 9019	PCF4HCT139P	PEL	5322 209 11112
D 9021	PCF4HCT138P	PEL	5322 209 11111
D 9022	PCF4HCT08P	PEL	5322 209 11265
D 9023	74F04PC	FSC	5322 209 81577
D 9024	PCF4HCT174P	PEL	5322 209 11478
D 9026	PCF4HCT174P	PEL	5322 209 11478
D 9027	PAL		5322 209 51683
D 9028	PAL		5322 209 51684
D 9029	PCF4HCT157P	PEL	5322 209 11263
D 9030	74F32PC	FSC	4822 209 82133
D 9031	HM6716P-30	HIT	5322 209 61135
D 9032	HM6716P-30	HIT	5322 209 61135
D 9033	HM6716P-30	HIT	5322 209 61135
D 9034	HM6716P-30	HIT	5322 209 61135
D 9035	74F259PC	FSC	5322 209 82169
D 9036	PCF4HCT257P	PEL	5322 209 11114
D 9037	PCF4HCT257P	PEL	5322 209 11114
D 9038	PCF4HCT574P	PEL	5322 209 11489
D 9039	M6226ALP-12	HIT	5322 209 72129
D 9041	PCF4HCT574P	PEL	5322 209 11489
D 9042	PCF4HCT245P	PEL	5322 209 11117
D 9043	N74LS298N	SIG	5322 209 85937

POSNR	DESCRIPTION		ORDERING CODE
D 9044	N74LS298N	SIG	5322 209 85937
D 9046	HEF4066BP	PEL	5322 209 10357
D 9047	PAL		5322 209 51685
D 9048	FPLA		5322 209 51686
D 9049	74F74PC	FSC	5322 209 81474
D 9050	74F174PC	FSC	5322 209 83326
D 9051	74F253PC	FSC	5322 209 81771
D 9052	PCF4HCT574P	PEL	5322 209 11489
D 9053	74F191PC	FSC	5322 209 81676
D 9054	74F191PC	FSC	5322 209 81676
D 9056	74F191PC	FSC	5322 209 81676
D 9057	74F18PC	FSC	5322 209 81681
D 9058	PCF4HCT574P	PEL	5322 209 11489
D 9059	PCF4HCT574P	PEL	5322 209 11489
D 9061	74F191PC	FSC	5322 209 81676
D 9062	74F191PC	FSC	5322 209 81676
D 9063	74F191PC	FSC	5322 209 81676
D 9064	74F191PC	FSC	5322 209 81676
D 9066	74F257APC	FSC	5322 209 71672
D 9067	74F257APC	FSC	5322 209 71672
D 9068	74F257APC	FSC	5322 209 71672
D 9069	PCF4HCT245P	PEL	5322 209 11117
D 9071	PCF4HCT245P	PEL	5322 209 11117
D 9073	PCF4HCT161P	PEL	5322 209 11476
D 9074	74F253PC	FSC	5322 209 81771
D 9076	N74LS298N	SIG	5322 209 85937
D 9077	N74LS298N	SIG	5322 209 85937
D 9078	N74LS298N	SIG	5322 209 85937
D 9081	M6264ALP-12	HIT	5322 209 60192
D 9082	PCF4HCT86P	PEL	5322 209 11473
D 9083	PCF4HCT74P	PEL	5322 209 11109
N 0601	LM324N	NSC	4822 209 80587
N 1091	OP-77GP	PMI	5322 130 60937
N 1101	OP-77GP	PMI	5322 130 60937
N 1201	LF356N	NSC	5322 209 86451
N 1301	LF356N		5322 209 86451
N 4101	LM324N	NSC	4822 209 80587
N 4101	LM324N		4822 209 80587
N 4102	OP-77GP	PMI	5322 130 60937
N 4103	TL084CP	T.I	5322 209 72464
N 4601	CA3102E	RCA	5322 209 72657
N 6001	LM358N	NSC	4822 209 70672
N 6002	LM358N	NSC	4822 209 70672
N 7001	LM339AN	NSC	5322 209 60188
N 9001	TDA8703-C1	PEL	5322 209 61133
N 9002	TDA8703-C1	PEL	5322 209 61133
N 9003	DAC-08EP	PMI	5322 209 11253
N 9004	DAC10FX	PMI	5322 209 71665

18.3.6 MISCELLANEOUS

E 0001	T13/4 28V 80MA		5322 134 40534
E 8001	60MA MSG9012		5322 134 40849
G 9001	RQ-0-50-40M S.R		5322 242 72575
N 6001	CNX35	PEL	5322 130 90137
H 8002	LFH1545-1	PEL	5322 209 60193
K 1001	DRELAIS IL 12 V		5322 280 20125
K 1002	DRELAIS IL 12 V		5322 280 20125
K 1003	DRELAIS IL 12 V		5322 280 20125
K 1004	DRELAIS IL 12 V		5322 280 20125
K 1006	DRELAIS IL 12 V		5322 280 20125
K 1007	DRELAIS IL 12 V		5322 280 20125
K 1008	DRELAIS IL 12 V		5322 280 20125
K 1101	DRELAIS IL 12 V		5322 280 20125
K 1102	DRELAIS IL 12 V		5322 280 20125
K 1103	DRELAIS IL 12 V		5322 280 20125
K 1104	DRELAIS IL 12 V		5322 280 20125
K 1106	DRELAIS IL 12 V		5322 280 20125
K 1107	DRELAIS IL 12 V		5322 280 20125
K 1108	DRELAIS IL 12 V		5322 280 20125
K 1201	DRELAIS IL 12 V		5322 280 20125
K 4101	DRELAIS IL 12 V		5322 280 20125
S 6001			5322 276 11859
S 7002	BR		5322 277 10878
S 7004	BR		5322 277 10878
S 7006	BR		5322 277 10878
S 7008	BR		5322 277 10878
S 7010	BR		5322 277 10878
S 7012			5322 276 11857
S 7013			5322 276 11856
S 7014			5322 276 11856
S 7015			5322 276 11856
S 7016			5322 276 11856
S 7017			5322 276 11856

POSNR	DESCRIPTION	ORDERING CODE
S 7018		5322 276 11856
S 7019		5322 276 11856
S 7020		5322 276 11856
S 7021		5322 276 11856
S 7022		5322 276 11856
S 7023		5322 276 11856
S 7024		5322 276 11856
S 7025		5322 276 11856
S 7026		5322 276 11856
S 7028		5322 276 11856
S 7029		5322 276 11856
S 7030		5322 276 11856
S 7031		5322 276 11856
S 7032		5322 276 11856
V 0001	D14-3720M PEL	5322 131 20169