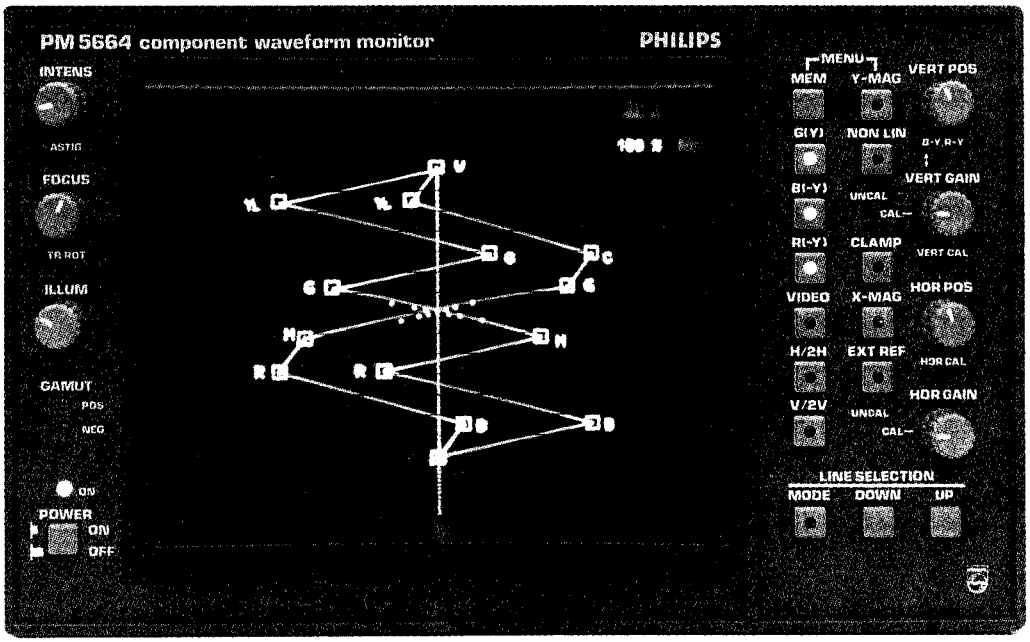
PHILIPS

Component waveform monitor
PM 5664

Service Manual



9499 495 00911
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Important

In correspondence concerning this instrument, please quote the full type and KU. number (serial number) as shown on the identification plate on the rear of the instrument.

Printed in Denmark

Contents

Subject index

1. Safety

Read this chapter carefully before installation and use of the instrument.

1.1 Introduction

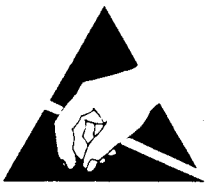
The instrument described in this manual is designed to be used by properly trained personnel only.
Adjustment, maintenance and repair of the exposed equipment are only to be carried out by qualified personnel who are aware of the hazards involved.

1.2 Safety Precautions

For the correct and safe use of the 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 applicable, are found throughout this manual. "Warning" and "caution" and/or warning symbols are marked on the instrument where necessary.

If covers are opened or parts are removed, except those parts to which access can be gained by hand, live parts may be exposed Accessible terminals may also be live.

The instrument must be disconnected from all power sources before performing any adjustment, replacement, maintenance, or repair which requires the instrument to be opened. If adjustment, maintenance, or repair of the opened instrument is unavoidable, it must only be carried out by a skilled person who is aware of the hazards involved.



ATTENTION

1.3 "Caution" and "Warning" Markings

"Caution"
Used to indicate that correct operation or maintenance is necessary to prevent damage to or destruction of equipment or other property.
"Warning"
Used to indicate a potential hazard that requires correct procedures or practices in order to prevent personal injury.

1.4 Impaired Safety Protection

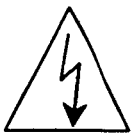
Whenever it is likely that safe operation is impair-ed, the instrument must be made inoperative and secured against unintended operation. The appropriate servicing authority must then be informed.
For example, safety is likely to be impaired if the instrument fails to perform the intended measurements or shows visible damage.

1.5 Electrostatic Sensitive Devices

All ICs and many other semi-conductors are susceptible to electrostatic discharges (ESD).
Careless handling during repair can reduce lifetime drastically.

When repairing, make sure that you are connected to the same potential as the mass of the set via a wrist wrap with resistance. Keep components and tools also at this potential.

1.6 Symbols

Symbol:	Color:	Explanation:
	Red	High voltage terminal: a terminal at which a voltage is or may be adjusted to 1000V or more (high voltage≥1000V).
	Black/Yellow	Live part.
	Black/Yellow	The operator must refer to an explanation in the manual to ensure that the instrument is not damaged during use.

2. Block diagram description

The PM 5664 consists of 8 (10) units.
These are:

Power Supply . . . . . Unit 1
CRT Board . . . . . Unit 1A
Illumination Panel . . . . . Unit 1B
CRT Control . . . . . Unit 2
Deflection Amplifiers . . . . . Unit 3
Signal Processor . . . . . Unit 4
Potentiometer Board . . . . . Unit 5
Keyboard . . . . . Unit 6
Control Unit . . . . . Unit 7
GBR Monitor Out . . . . . Unit 8

2.1 Main functions of the units

2.1.1 Power Supply

The Power Supply delivers various regulated and unregulated voltages used by other parts of the instrument. Also supplies the CRT with the necessary voltages like FOCUS, High Tension, and filament voltage.

2.1.2 CRT Control

The CRT Control unit contains 6 potentiometers used to control Intensity, Astigmatism, Focus, Trace Rotation, and Illumination.

2.1.3 Deflection Amplifiers

This unit contains amplifiers which amplify the horizontal and vertical signals to the proper level with respect to the deflection plates of the CRT.

2.1.4 Signal Processor

The three component signals from the input connectors are fed, each via a diferent amplifier, to the Reference switch, the Display matrix, the Format switch, the Monitor matrix, and the V- and H-selector.

If the input signals are in GBR mode, they are fed directly via the Format switch to the output buffers on unit 8. If the input signals are in YUV mode, they are converted into GBR mode by the Monitor matrix circuit.

The Display matrix works the opposite way. If the input signals are in YUV mode, they are fed directly to the V- and H-selectors, but if the input signals are in GBR mode, they are converted into YUV mode by the Display matrix circuit.

The Vertical Selector circuit selects the input for the Variable Gain circuit. The selected signal can be fed through the band-pass section of the Non-Linearity filter (selectable on front panel), the function of which is to remove chroma information and differentiate the luminance steps. The variable gain amplifier is controlled by the VERT GAIN potentiometer on the front panel. A "reference" signal is also added here by the graticule generator in the two TEST modes.

From the Variable Gain Amplifier the signal is fed to a polarity switch, which may invert the signal. Only the non-inverting is used in stardards instruments. Then a clamp pulse is added to the vertical signal (if selected). This clamp pulse provides also the clamp of the U and V component to the 50% level in YUV parade mode. The vertical signal is then fed either via the second part of the Non-Linearity filter (low-pass) or, if selected, through the Vertical Low-Pass filter (4th order filter). The filter switch is used to select one of these two filters.

The input signal to the vertical drive amplifier comes either from the Filter switch, the Graticule Generator (VGV), or in Bowtie mode via the H-SIGNAL switch. A DC voltage from the VERT POS potentiometer has also been added. The gain of the Vertical Drive amplifier depends on whether the instrument is in The Normal mode or Y-MAG (x5) has been selected. The vertical deflection sig-

nal is then fed via the Vertical Output Amplifier on unit 3 to the CRT.

The signal selected with the Horizontal selector is fed through a Variable Gain amplifier, a Polarity switch, and a Low-Pass filter, all similar to the circuits in the vertical signal path. In the buffer which comes after the Low-Pass filter DC voltage from the HOR POS potentiometer is added to the signal. This signal is used for horizontal deflection when the Vector or Star mode has been selected (X/Y-mode). If one of the waveform modes is selected, a sawtooth signal from the sawtooth generator is used. A horizontal line time pulse is used as clockpulse for the Sawtooth Generator. This is derived from the Sync Separator circuit via the Clamp Generator. The Sync Separator also contains an oscillator which provides a line "substitution" signal in case no external sync is provided. The Sawtooth Generator generates 6 different ramp signals depending on the selected display mode (V, 2V, H, 2H, Parade-H, Parade-V). The signal selection switch is controlled by the microprocessor (Unit 7).

The input signal to the Horizontal Drive Amplifier is comes either from the signal selection switch or from the Graticule Generator (HVG). The gain of the Horizontal Drive Amplifier dependes on whether the instrument is in normal mode or X-MAG (x5) has been selected. The horizontal deflection signal is then fed via the Horizontal Output Amplifier (Unit 3) to the CRT.

Finally, unit 4 contains a Calibration Generator which provides a 100kHz used in TEST mode to check the horizontal timing and vertical deflection. This signal is fed to the V-selector circuit, while a 12.5kHz signal derived from the 100kHz signal is fed to the Sync Separator as a horizontal timing pulse.

2.1.5 Potentiometer Board

The Potentiometer Board houses the potentiometers for adjustment of the horizontal and vertical gain, horizontal and vertical position, X- and Y-gain, and the position of the B-Y and R-Y signals in the PARADE display mode.

2.1.6 Keyboard

The Keyboard contains all the selectors on the front panel. The output of the keyboard is input to the Unit 7 Control Board.

2.1.7 Control Board

The Control Board contains a microcontroller to control the function of the instrument, an electronic graticule generator, and an amplifier for the external reference signal. The microcontroller provides various control signals to the other parts of the instrument, either by use of an I^2C bus or an 8-bit parallel databus line (for unit 4). Input to the microcontroller is line and field information, the keyboard, and the remote connector.

The Electronic Graticule Generator provides the electronic graticule and the menu text on the CRT display.

2.1.8 GBR Monitor Out

This unit contains the GBR video output buffers with clamp drivers for the PIX MONITOR OUTPUTs, a composite video amplifier for the monitor out, and a gamut detector.
The gamut detector determines whether the level of a primary color component exceeds 735mV (±5mV), or -35mV (±5mV): If it does, this will be indicated on the GAMUT LEDs and on the PIX MON OUTPUTS as a flickering area on the monitor screen displaying the error area.

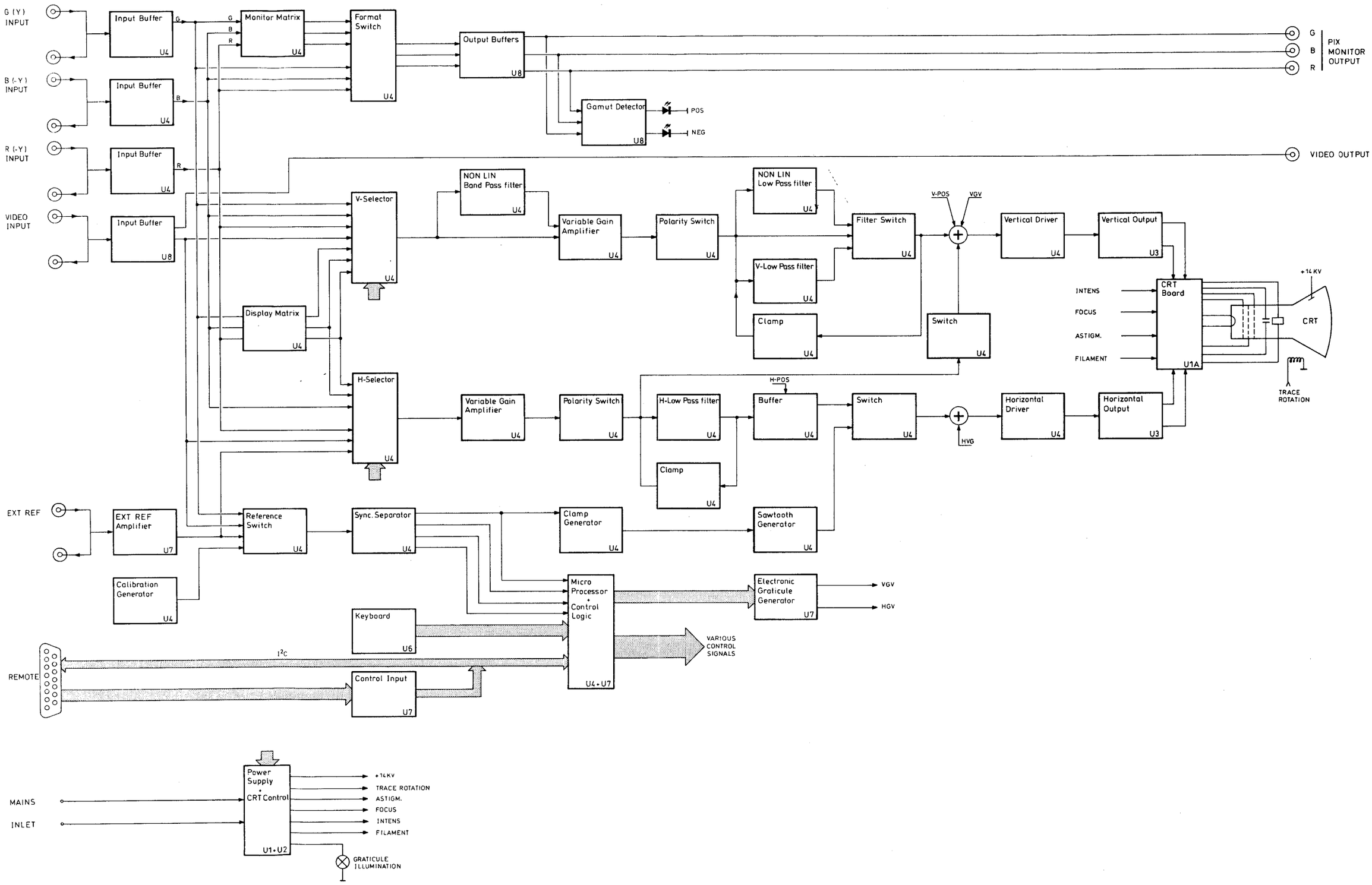


Fig. 2-1 Instrument block diagram

3. Access to units

General information

For the location of connectors on the various units, please see Figs. 4-1 and 4-2 (wiring diagrams).

3.1 Removing the Cover

- Remove the PM 5664 from the cover by unscrewing two screws "A" at the rear panel.
- Pull the instrument out of the cover.

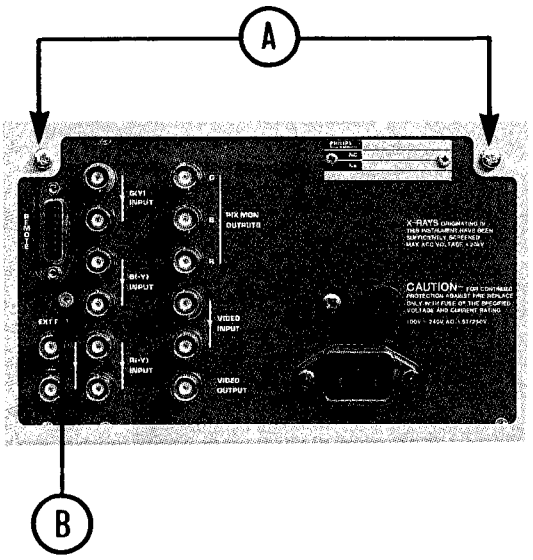


Fig. 3-1 Rear plate.

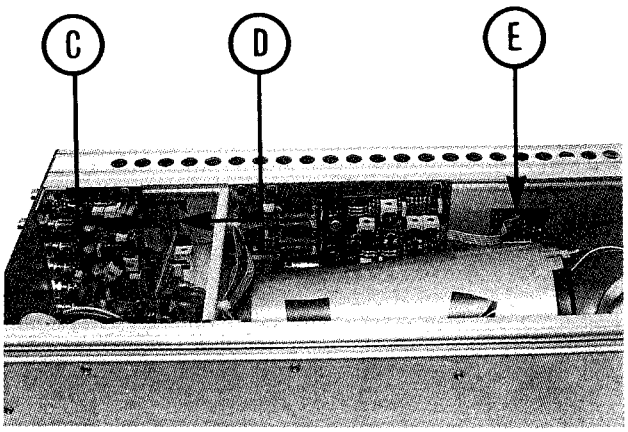


Fig. 3-2 View of connectors.

- Remove the screw "B" on the rear panel. Carefully pull the Signal board and the CPU unit out from the front of the instrument.

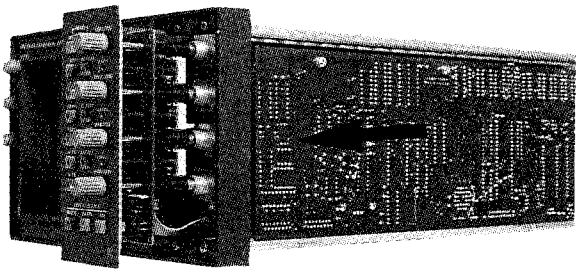


Fig. 3-3 Slid-out units.

- Access to the component side of the Signal board and the CPU unit is obtained by unscrewing the three screws "F" and open the two units carefully.

3.2 Access to and Removal of the Signal Processor (Unit 4) and Control Board (unit 7)

Access to the solder side of Unit 4:

- Remove flat cable connectors "C", "D", and "E" at the rear of Unit 4.

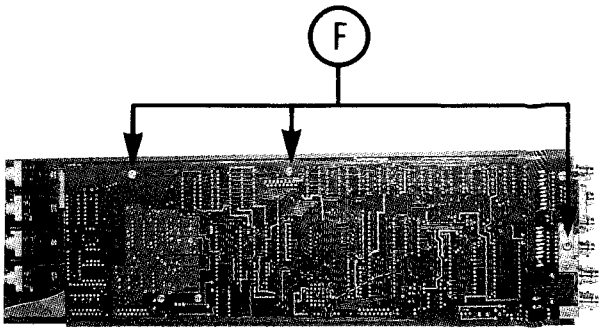


Fig. 3-4 Screws on CPU unit.

3.3 Access to and Removal of the Power Supply - Unit 1

- Turn the PM 5664 upside-down.
- Remove three screws "G" and lift the Power Supply unit out carefully.
- To get access to the solder side, the 10 screws holding the PCB onto the plate underneath must be removed.

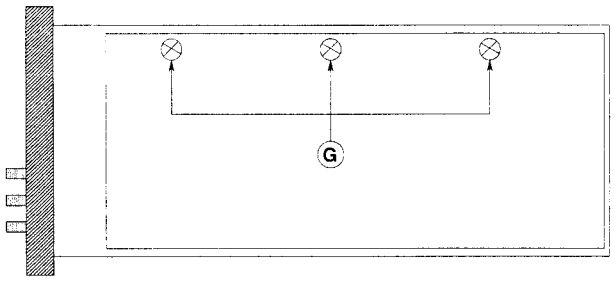


Fig. 3-5 Power Supply unit.

3.4 Access to and Removal of the CRT Control Unit - Unit 2

- Remove the three knobs "H" (*see Fig. 3-6*).
- Remove the "upper" unbracko screw which holds the PCB onto the frame of the instrument.
- Remove Unit 1 as described in paragraph 3.3 .
- Remove the "lower" unbracko screw which holds the PCB onto the frame of the instrument.
- Pull out the unit.

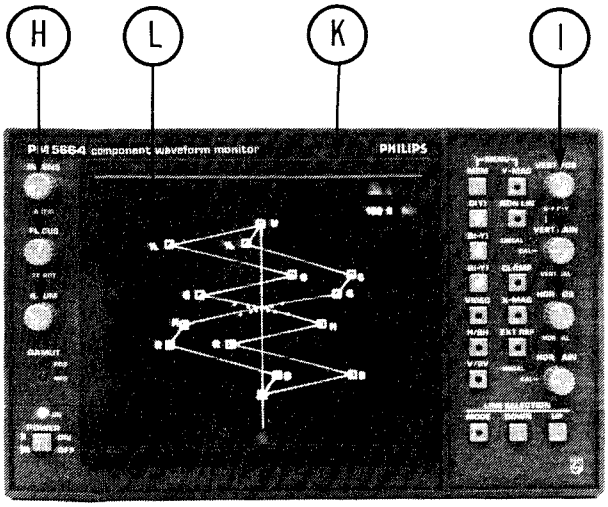


Fig. 3-6 Front of instrument.

3.5 Access to the Deflection Amplifier - Unit 3.

- Remove the plugs on connectors XE, XP, and XJ (*see Figs. 4-1/4-2*).
- Remove the unit by unscrewing the four screws holding the PCB onto the frame of the instrument.

3.6 Access to the Potentiometer Board - Unit 5 and the Keyboard - Unit 6

- Remove the Signal Board as decribed in section 3.2.
- Remove the plug on connector XP on the Keyboard panel.
- Remove the two screws "M".

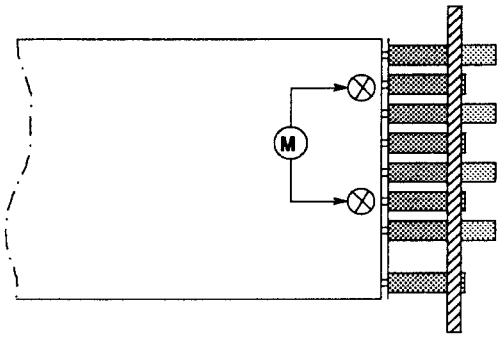


Fig. 3-7 Signal board, solder side.

- Remove the plug on connector XN on the Signal Board.
- For full access to the Keyboard, remove the 4 knobs marked "I" in Fig. 3-6 and the two screws marked "O" in Fig. 3-8.

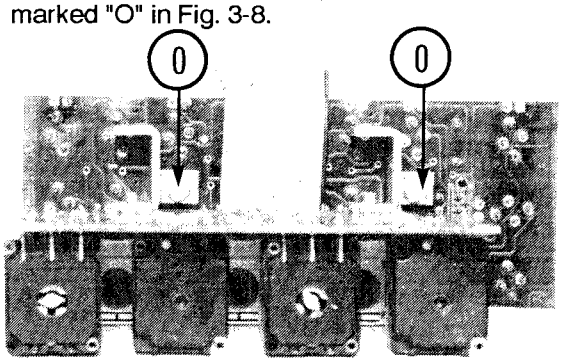


Fig. 3-8 Keyboard, solder side.

3.7 Access to the GBR Monitor Out Unit - Unit 8.

- Remove the plug on connector XK on Unit 8.
- Remove the unit by unscrewing the four screws holding the PCB onto the frame of the instrument.

3.8 CRT Replacement

- Remove the window marked "K" and the grey filter marked "L" in Fig. 3-6.
- Remove the plug from the connector on the Illumination panel.
- Disconnect the Power Supply as mentioned in section 3.3.
- Remove the H.T. supply socket mounted on the anode of the CRT.
- Discharge the anode on the CRT.
- Remove the plug from connector XE on the Deflection amplifier unit.
- Remove the plugs from connectors XG, XE, and XH on the CRT board.
- Remove the CRT board.
- Pull off the ground connection wire on the shielding.
- Unsolder the wire yellow and the red wire coming from the trace rotation coil on the Illumination panel (ST 1 and ST 2) (*see Fig. 3-9*).

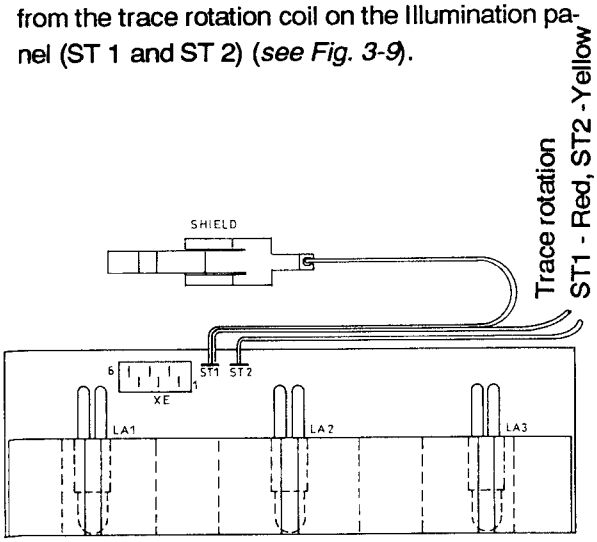


Fig. 3-9 Wiring Illumination panel

- Pull out the Illumination panel.
- Remove the plug on connector XP on the Deflection amplifier unit.
- Release four screws "P" holding the fixing plate in position inrespect to the CRT.

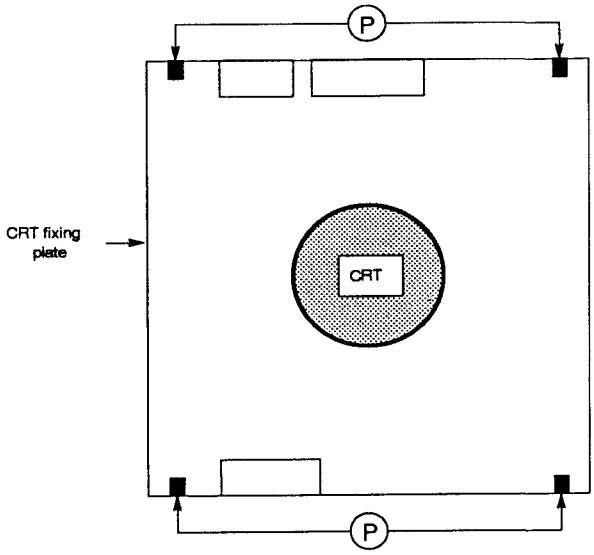


Fig. 3-10 CRT fixing plate

- Pull out towards the back and then flip out from the bottom the CRT-including shielding andrubber bushing towards the bottom.

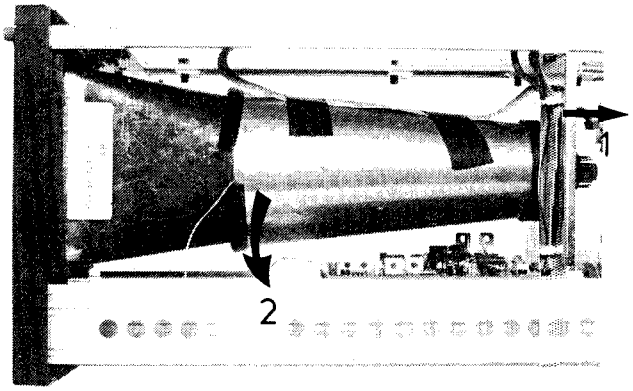


Fig. 3-11 CRT Removal.

- Pull the shielding off the CRT.

4. Wiring diagram

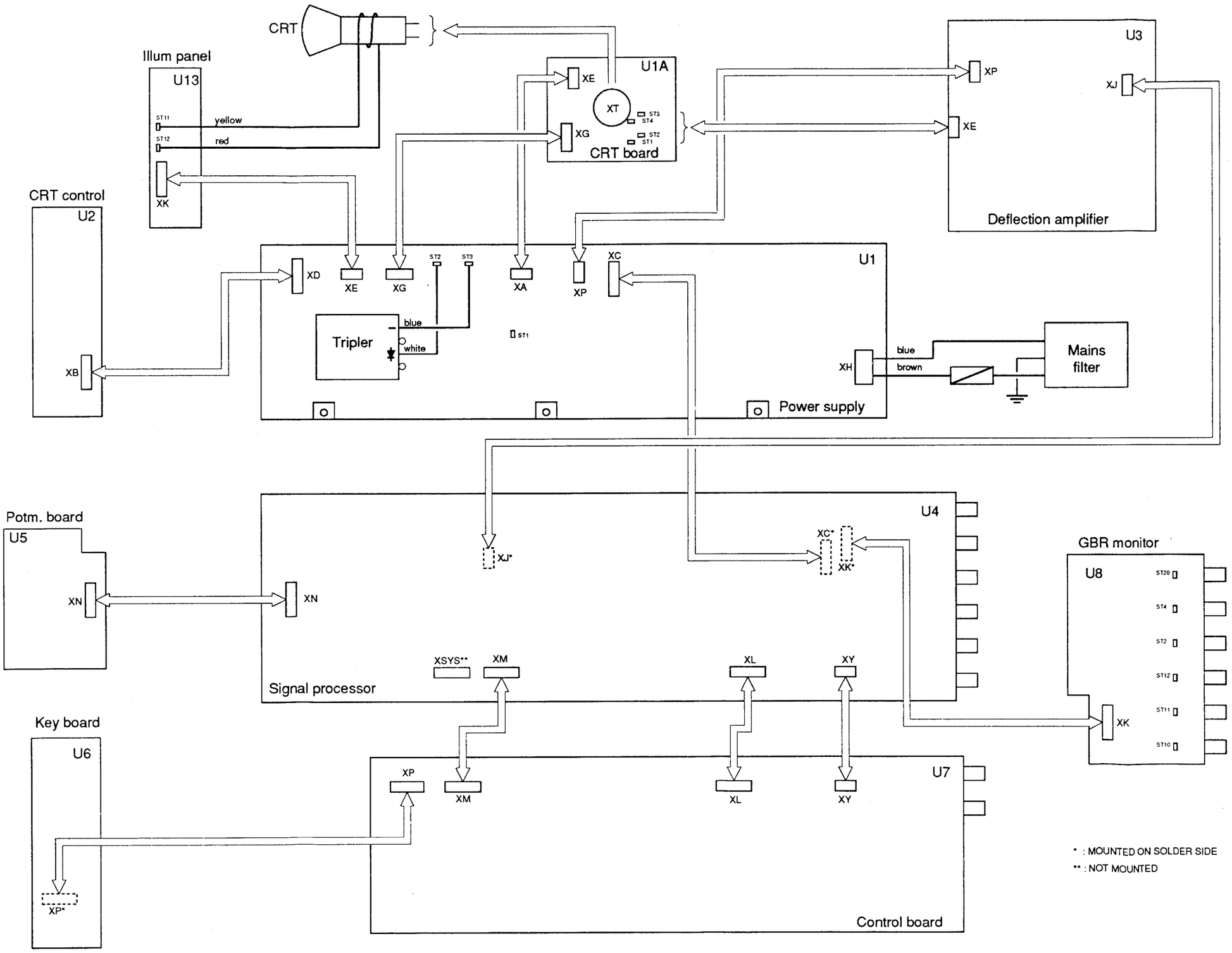
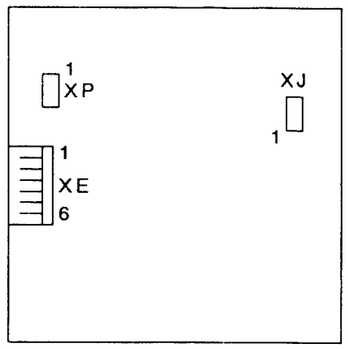
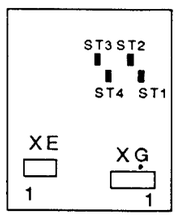


Fig. 4-1 Wiring diagram

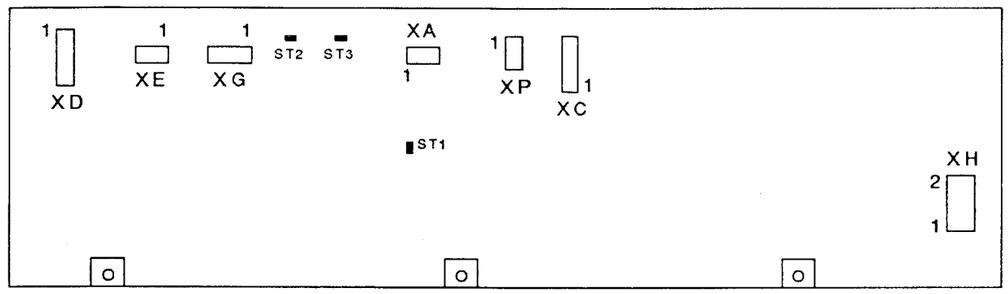
Unit 3 - Deflection ampl.



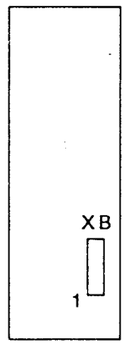
Unit 1A - CRT board



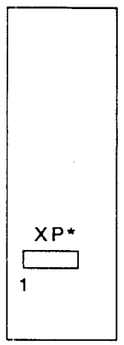
Unit 1 - Power supply



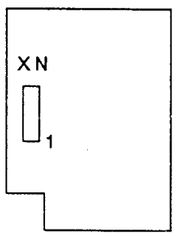
Unit 2
CRT control



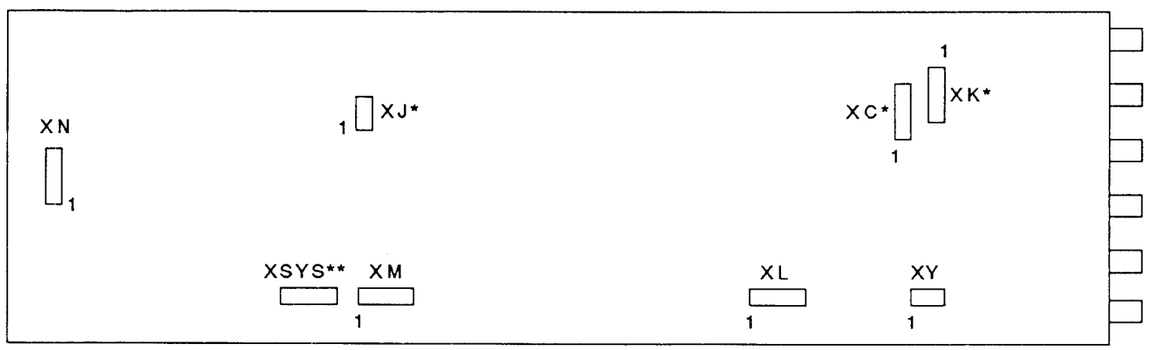
Unit 6
Key board



Unit 5
Potm. board

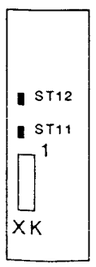


Unit 4 - Signal processor

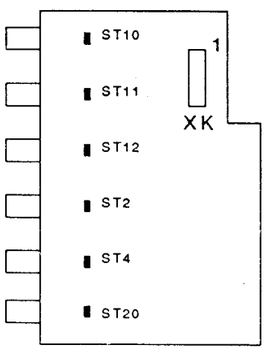


*: MOUNTED ON SOLDER SIDE
**: NOT MOUNTED

Illum panel



Unit 8 - GBR monitor



Unit 7 - Control board

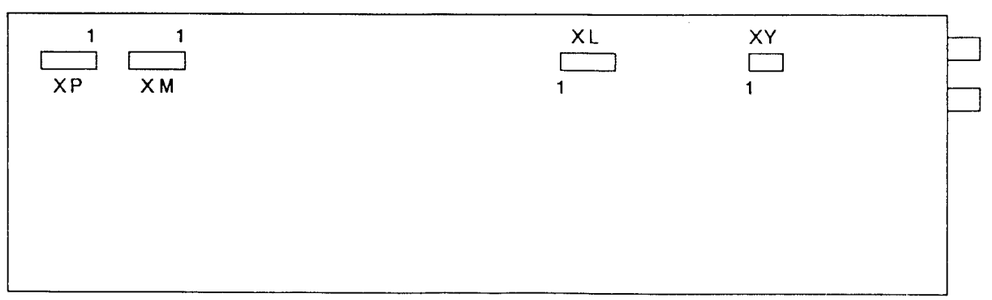


Fig. 4-2 Connector location

5. Power Supply - Unit 1

5.1 General Information

The Power Supply provides various regulated and unregulated voltages used by other parts of the instrument. The instrument may be powered by a mains voltage of 85-240V AC_{RMS}, 120-264V DC. The mains voltage primary is protected by a 1.5A (slow) fuse (F1) located at the rear of the instrument.

5.2 Circuit Description

5.2.1 Mains Rectifier

The mains voltage is rectified by the diode bridge (D1). The DC voltage is then smoothed by the choke L1 and capacitors C2 and C3. The DC voltage is then fed into the Converter circuit, which consists of a Switch controller, Converter switch, and dV/dt limiter.

5.2.2 Converter Circuit

The flyback converter consists of transistors Q2 and Q3 and their associated components. The converter frequency depends on the input voltage. For 110V AC it is approx. 35kHz and for 220V AC approx. 50kHz. These frequencies may vary, since the frequency also depends on the load connected to the power supply.

Transistors Q2 and Q3 conduct on the forward stroke and feed the current into pin 3-4 of T1. The voltage at R15-R16 increases with the current of T1. When the voltage at R13 exceeds approx.0.7V it will fire switch D11, which when switches Q2-Q3 off. The energy in T1 will during flyback time induce a voltage at the secondary windings which will be rectified and fed into the DC output capacitors. Also during flyback time, a voltage will be induced at pin 1-2 of T1. This voltage will recharge capacitor C4 via the path D10, D9, Q1, R6/R8, C4, and L2. When a certain value is reached, D11 is switched off. Q2-Q3 is then switched on and the sequence starts all over again. The signal at the gate of Q2 is a square wave signal received from the Voltage Stabilizer. The dV/dt limiter (L4, C12 and D14) serves to eliminate the switching spikes at the collector of Q3.

R3 is used to start up the power supply when the instrument is first switched on.

5.2.3 DC Output

The DC Output circuit rectifies the signal from T1. The DC voltages are smoothed by the capacitors. The +12V and -12V are regulated by V4 and V5. DC voltages for use in other parts of the instrument come from this circuit.

5.2.4 Voltage Control - Reference

The Voltage Reference circuit ensures an accurate 10V reference to the Voltage Control. The Voltage Control compares the reference voltage with the -15V output. If there is a change in the -15V supply (e.g. due to increasing load at any output) the output of V1-B will correct the output via the optocoupler and bring DC levels back to normal.

5.2.5 Optocoupler

The current through R7 is determined by the Optocoupler, this current also runs through R13. Together with the current from R14 they determine the intervals at which switch D11 is fired. When the output from the Power Supply decreases (e.g. due to increasing load) the current through R7 will decrease. The intervals at which D11 fires will be longer due to the smaller current contribution from R7. The energy in T1 will then increase and the output voltage will return to normal.

5.2.6 Voltage Protection

The Protection circuit is used to protect the Power Supply against too-low or too-high voltages at the outputs. With too high an output voltage at the +15V output, Q5 will switch on. D29 in the ±43V output will turn on and short-circuit the outputs. If one of the outputs short-circuites, the power supply will operate at a low frequency (approximately 2kHz). When the output voltages are too low, Q4-Q6 will also switch on D29 and short-circuit the output. R40/C21 ensures that a virtual short circuit of the output is ignored when the instrument is first switched on.

5.2.7 High Voltage Generator - Tripler

The output from the oscillator (Q8-Q9) is transformed by T2 and fed to the tripler. The frequency is controlled by T2 (approx. 65kHz). The amplitude is controlled by the output from V3-a via Q7. The control circuit receives a feedback (-2k6V) from the output and the reference voltage from V1-A. The H.T. supply also supplies the CRT with filament voltage. -2.6kV is fed to the Black Level circuit and the AC/DC converter on the CRT Board. The tripler supplies the CRT anode with +14kV.

5.2.8 Trace Rotation

The Trace Rotation circuit (Q10-Q11) determines the strength and direction of the current passed to the trace rotation coil wound around the neck of the CRT. The current is controlled by a front panel screwdriver operated potentiomet control.

5.2.9 Illumination Control

The Illumination circuit (V3-B, Q14) determines the amount of current passed to the Graticule Illumination lamps (LA1-3) of the CRT, and the amount of current is controlled by the ILLUM potentiometer on the front panel. Q13 controls whether the Illumination lamps are on or off.

5.2.10 Z-Amplifier

The intensity of the beam is controlled by the Z-Amplifier. An oscillator signal (Z-OSC), which controls the intensity, is led from the High-Voltage Generator to a limiter - circuit (Intensity - LF), which controls the peak-peak amplitude of the oscillator signal, depending on the setting of the intensity potentiometers.

The different modes (Vector, Waveform, Test, etc.) need different light - intensities at the same potentiometer setting. This is controlled by the analog switches V7, which connects different resistor values to the emitter of Q20 depending on the selected mode. and V8, which shifts, depending on the selected mode, between the MENU, INTENS, and ILLUM potentiometer to control the voltage at the base of Q20. The analog switches are controlled by three inputs (I0, I1, and I2) derived from the Signal Processor (Unit 4). These three lines make up the set-up shown in Table 5-1.

5.2.11 AC/DC Converter (Unit 1A)

The AC/DC converters (D43-D44) convert the oscillator signal a DC voltage which is fed to G1 on the CRT and thereby controls the intensity on the screen. The blanking pulses from the Z-Amplifier are fed directly to the AC/DC converter via C78. The negative pulses will switch off the beam.

5.2.12 Black Level (Unit 1A)

The black level circuit is used to ensure that the beam is switched off when the INTENS potentiometer is in minimum position. This is adjustable by means of R4 (use a trimmer with an isolated tip). Q1 determine the minimum current through transistors Q2-Q4 and thus the voltage on the cathode of the CRT.

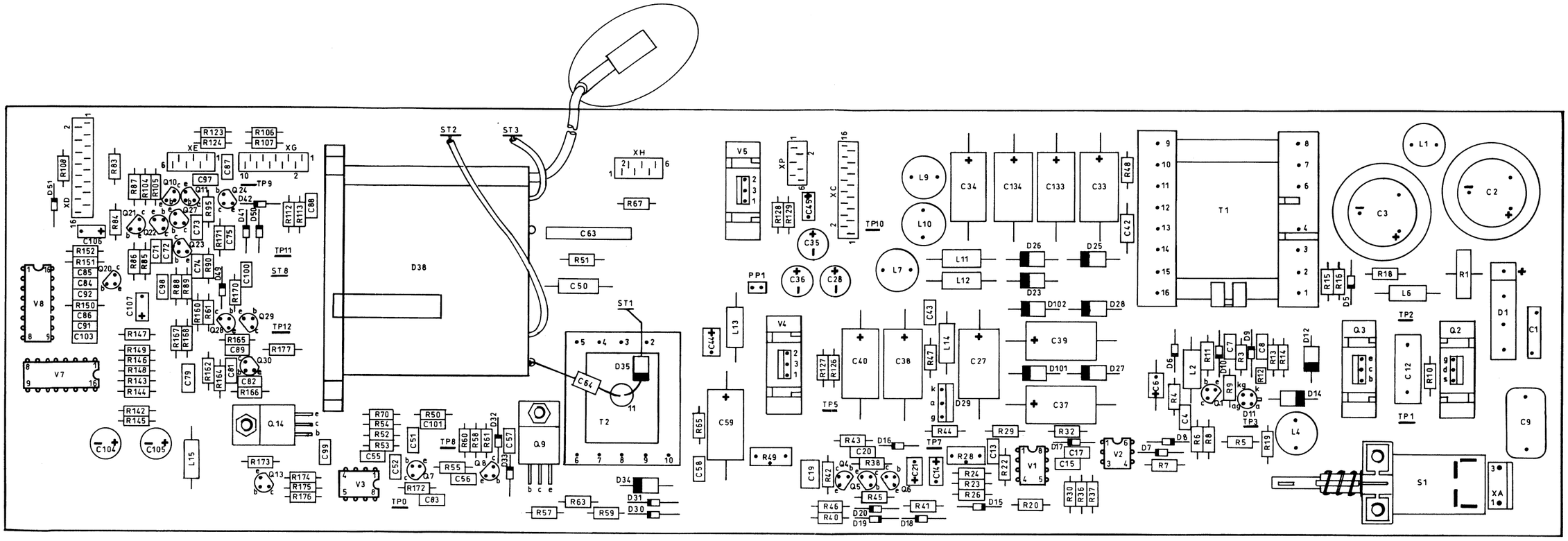
5.2.13 Focus Voltage Conversion

This circuit produces the focus voltage required by the CRT. The FOCUS potentiometer and the current through R107 determines the current through

transistors Q2, Q3, and Q4 and thus the G3 focus voltage to the CRT. When the intensity on the screen changes, the focus voltage must change too. To ensure stable focus, the output from the Z-Amplifier with information on the intensity is connected to the Focus circuit via the Dynamic Focus circuit.

I0	I1	I2	Potentiometer (V8)	Resistor (V7)	Function (Mode)
0	0	0	INTENS	R142	Waveform
0	0	1	INTENS	R143	Waveform, single line
0	1	0	R159/160	R144	Text, single line
0	1	1	MENU	R145	Menu text
1	0	0	ILLUM	R146	Text
1	0	1	ILLUM	R147	Graticule
1	1	0	ILLUM	R148	Dots
1	1	1	MENU	None	Blanking

Table 5-1.



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ATTENTION

Fig. 5-1 Component location, Power supply - unit 1

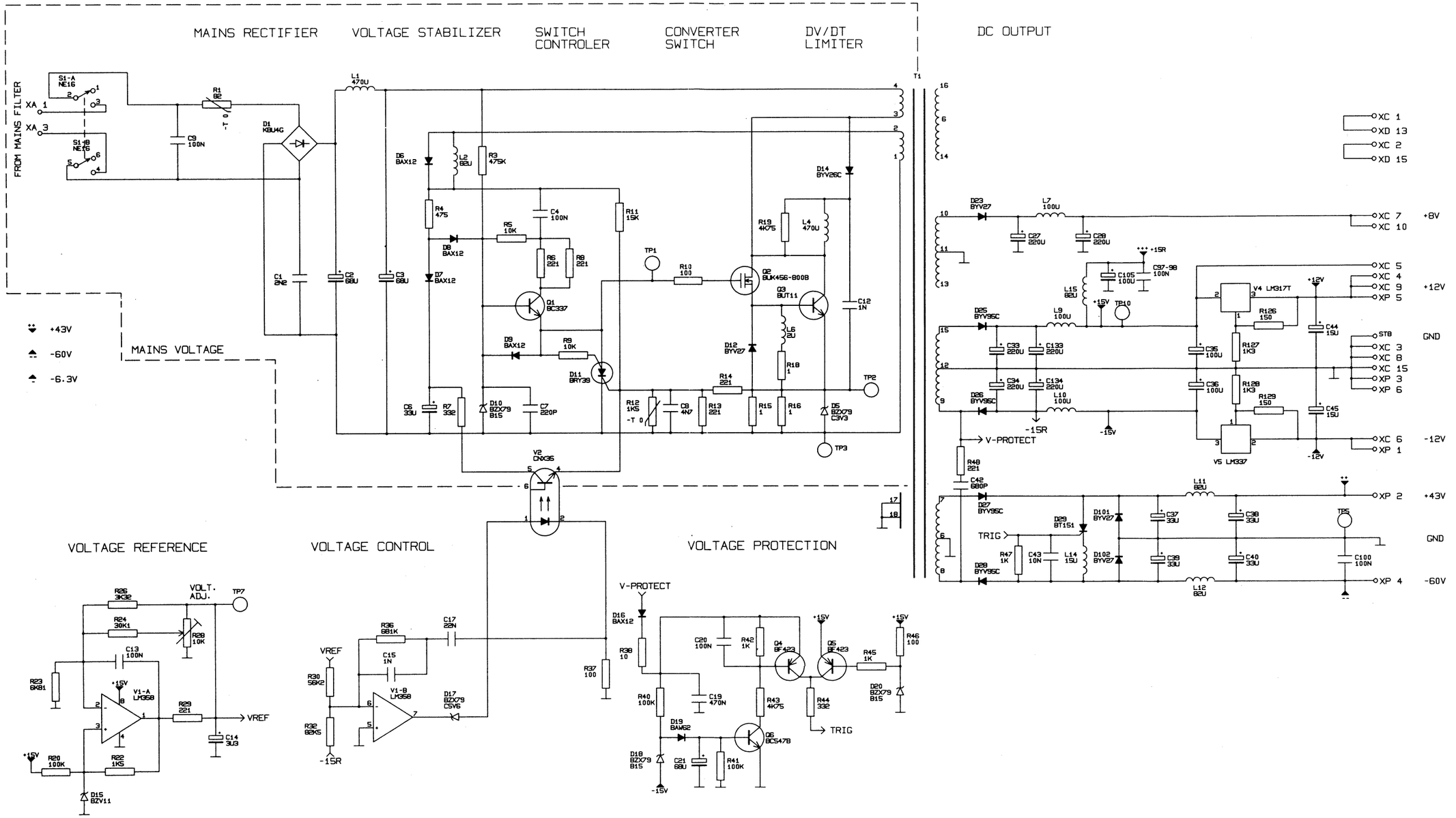


Fig. 5-2 Circuit diagram, Power supply - unit 1, sh.1

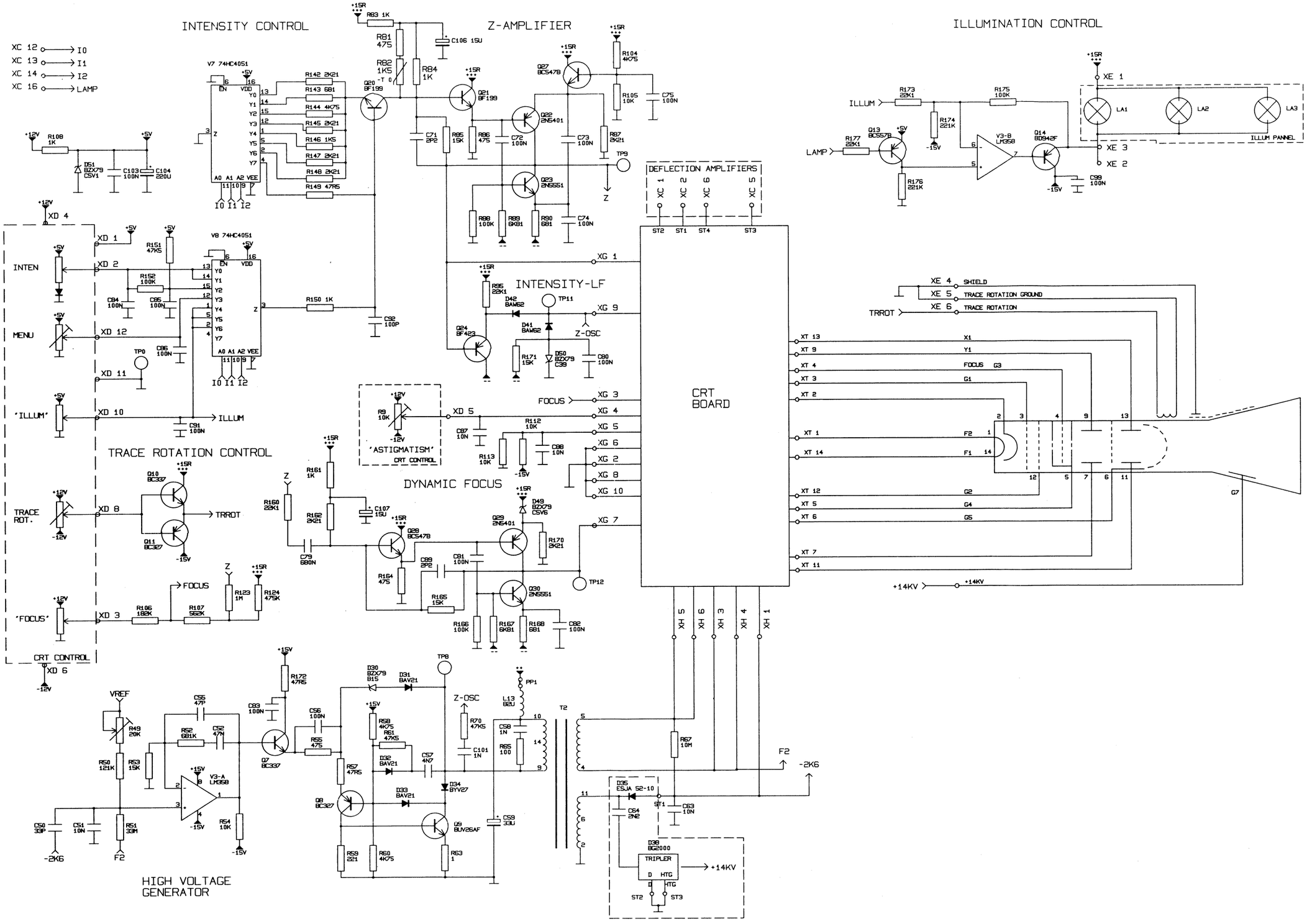
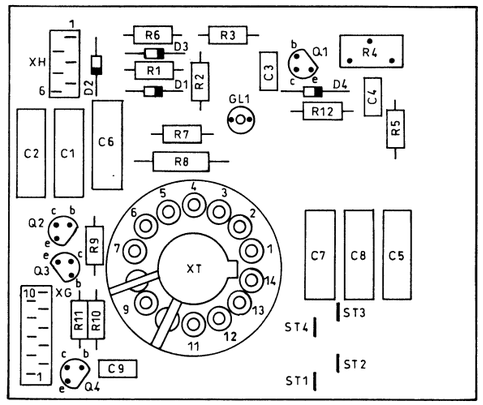
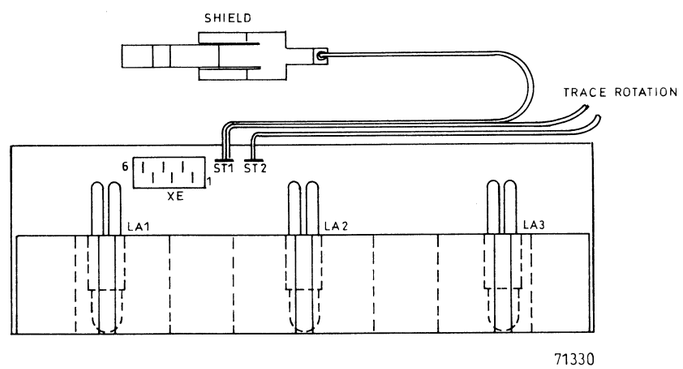


Fig. 5-3 Circuit diagram, Power supply - unit 1, sh.2



71570

Fig. 5-4 Component location, CRT board - unit 1A



71330

Fig. 5-5 Component location, Illum panel assy - unit 1B

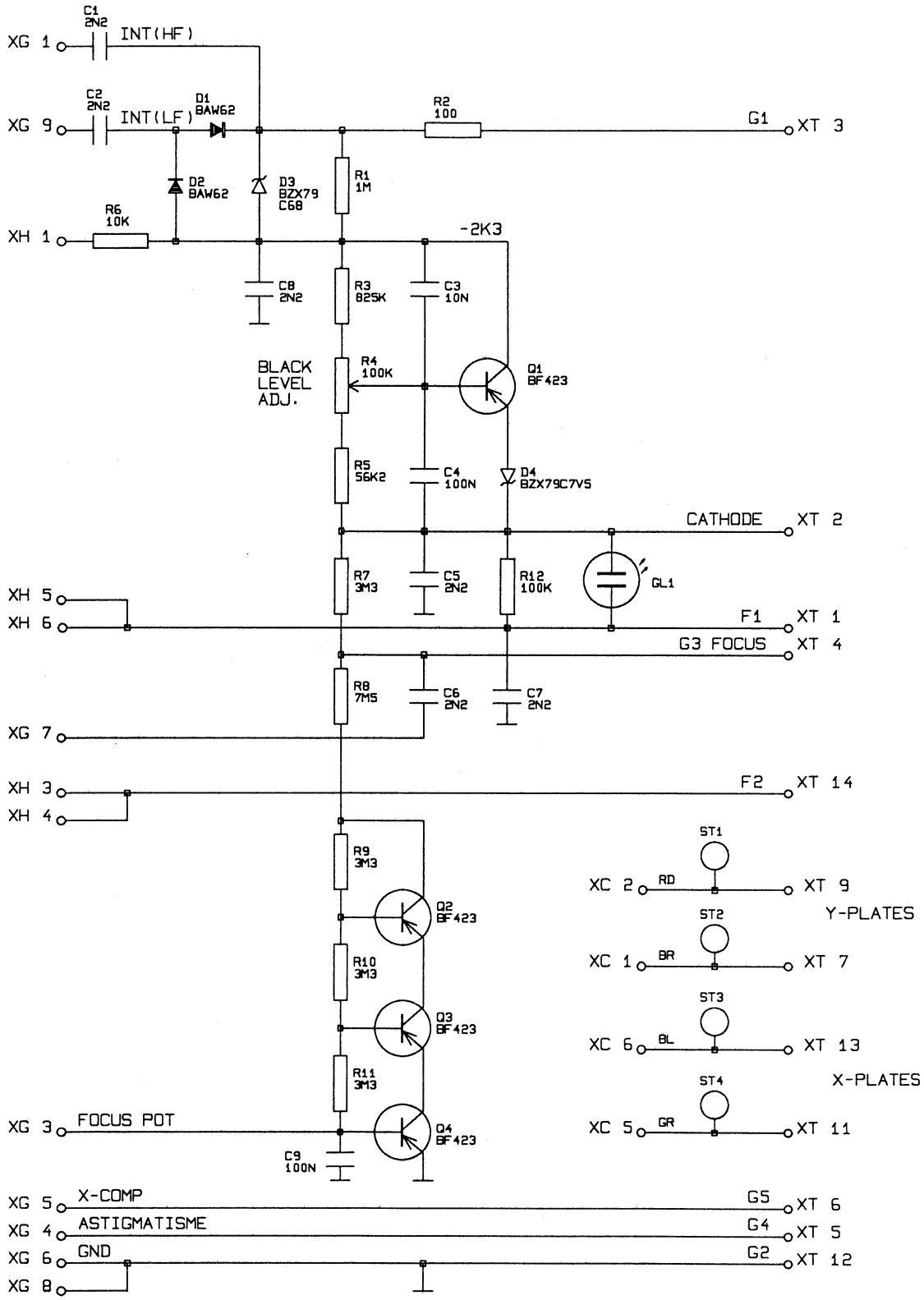


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Fig. 5-6 Circuit diagram, CRT board - unit 1A

6. CRT Control - Unit 2

The CRT Control unit consists of 6 potentiometers (of which 5 are accessible from the front of the instrument) and LEDs for ON and GAMUT indication. The potentiometers are used to control the Intensity, Astigmatism, Focus voltage of the CRT, Trace rotation, and the Illumination of the graticule light. The last potentiometer, which is not accessible from the front of the instrument, is used for adjustment of the MENU intensity.

Diode D1 reduces drift of the intensity.

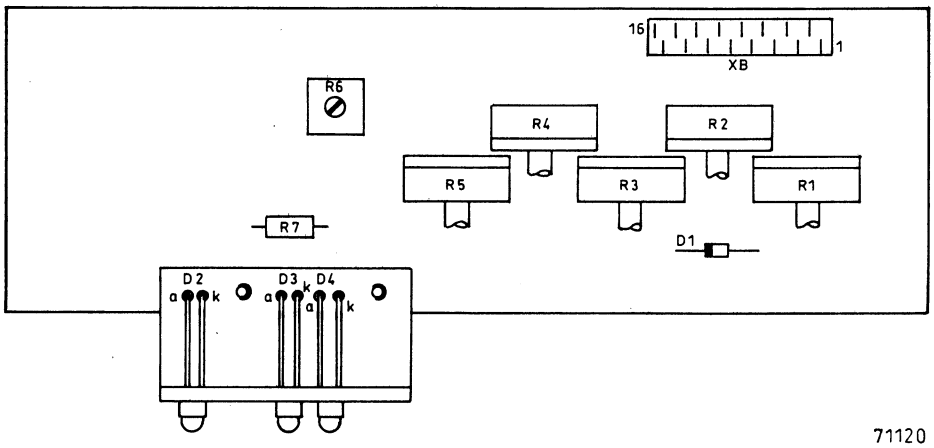

Fig. 6-1 Component location, CRT control - unit 2

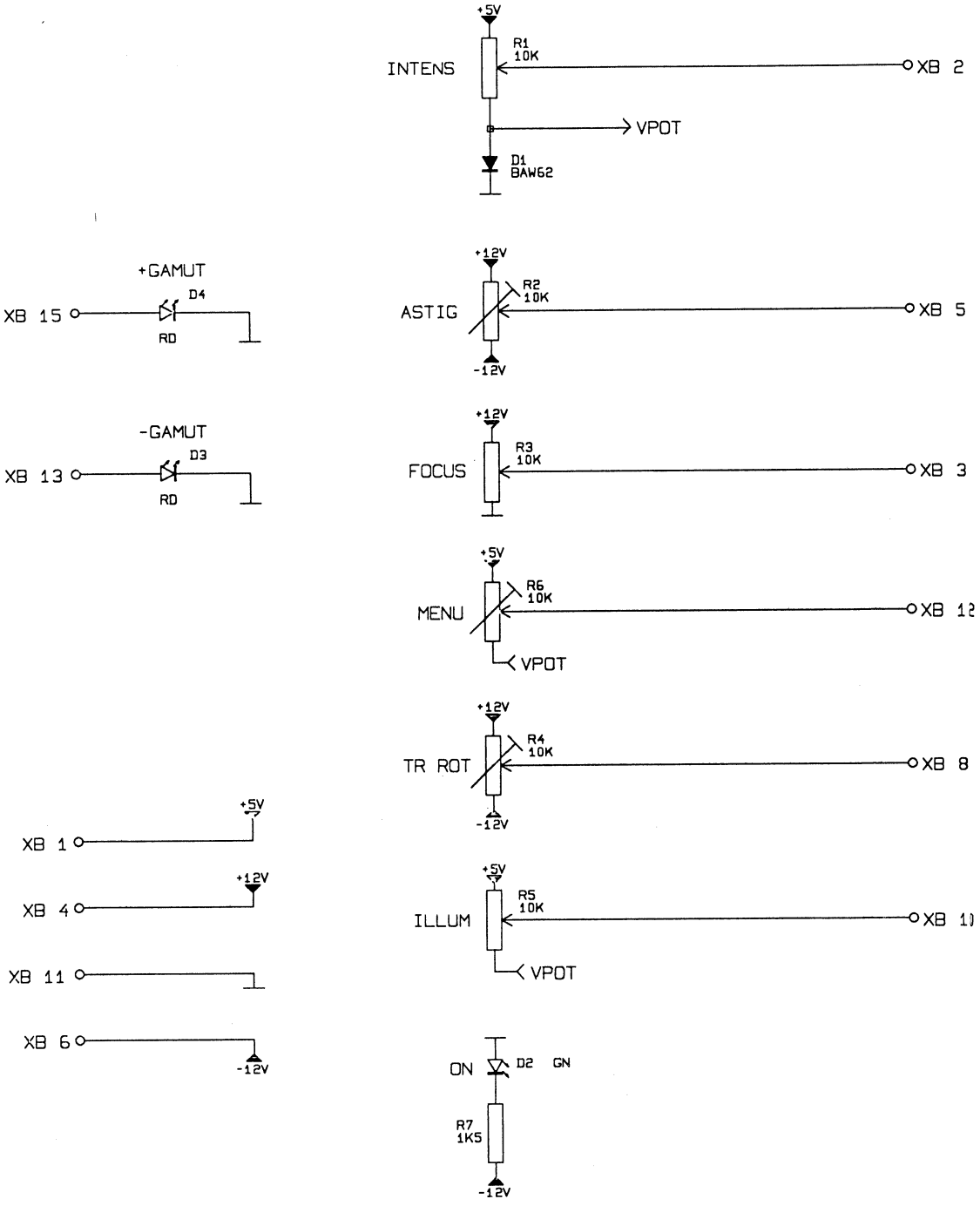

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Fig. 6-2 Circuit diagram, CRT control unit 2

7. Deflection Amplifiers - Unit 3

7.1 General Information

This unit contains the final amplifiers needed to supply the CRT plates with proper signal amplitudes.

7.2 Circuit Description

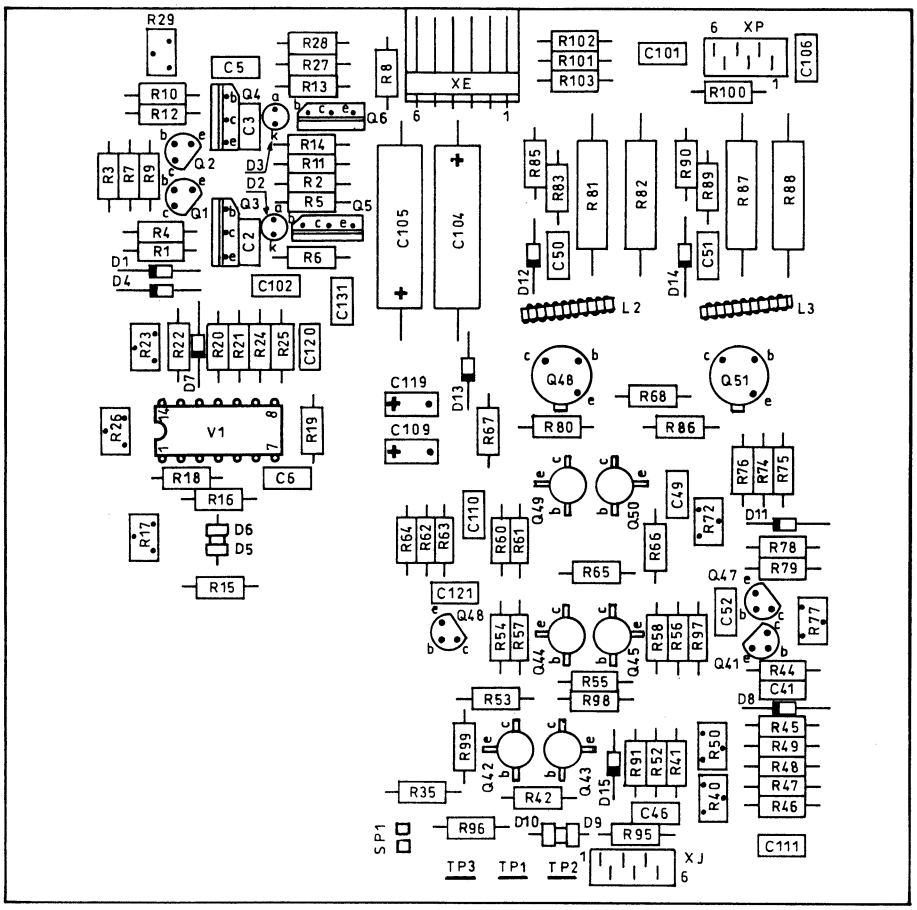
7.2.1 Horizontal Output Amplifier

The signal from the Unit 4 X-Driver enters the clipper circuit formed by the two double diodes D5 and D6, which limit the signal amplitude to approximately ±1V. Via gain control R17, the signal from the clipper enters the base of V1-b on the first differential amplifier V1-B/V1-C. V1-D controls the bias in the output stage, which at R23 is adjusted to approximately -14V at outputs XE5 and XE6 at 0V input. A balanced signal from the collectors of V1-B and V1-C is sent to the bases of Q1 and Q2, which together with Q3, Q4, Q5, and Q6 form a differential amplifier cascode-operated with its current source (Q5-Q6) at the collectors. The output is low-impedance due to the emitter output. R4/R19 and R12/R21 determines gain and D1-D4 functions as temperature compensation. D2 and D3 (LEDs) light up under normal operating conditions.

Due to minor deviations of the physical 90° relationship between the vertical and horizontal deflection plates of the CRT, it may be necessary to compensate by feeding a horizontal signal component to the Vertical amplifier, thereby eliminating the fault. Resistors R27-29, which feed this orthogonality signal to the Vertical Output amplifier, are only mounted in instruments, whose CRT needs this compensation.

7.2.2 Vertical Output Amplifier

The signal from the Unit 4 Y-Driver enters the clipper circuit formed by the two double diodes D9 and D10, which limit the amplitude of the signal to approximately ±1V. Via gain control R40, the signal from the clipper enters the base of Q43 of the first differential amplifier (Q42-Q43). The second differential amplifier consists of Q44 and Q45. Q41 and Q46 are current sources for these two differential amplifiers. A balanced signal from the collectors of Q44 and Q45 is fed to the two cascode-coupled output stages Q48-Q49 and Q50-Q51. Q47 controls the bias in the output stage, which on R77 is adjusted so that the voltage on the output XE1 and XE2 is approximately 0V at 0V input. The frequency response of the amplifier can be adjusted at R72/C54. The DC offset at the two outputs XE1 and XE2 can be adjusted by changing the DC balance (R50) in the First Differential amplifier.



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ATTENTION

Fig. 7-1 Component location, Deflection amplifiers - unit 3

HORIZONTAL OUTPUT AMPLIFIER

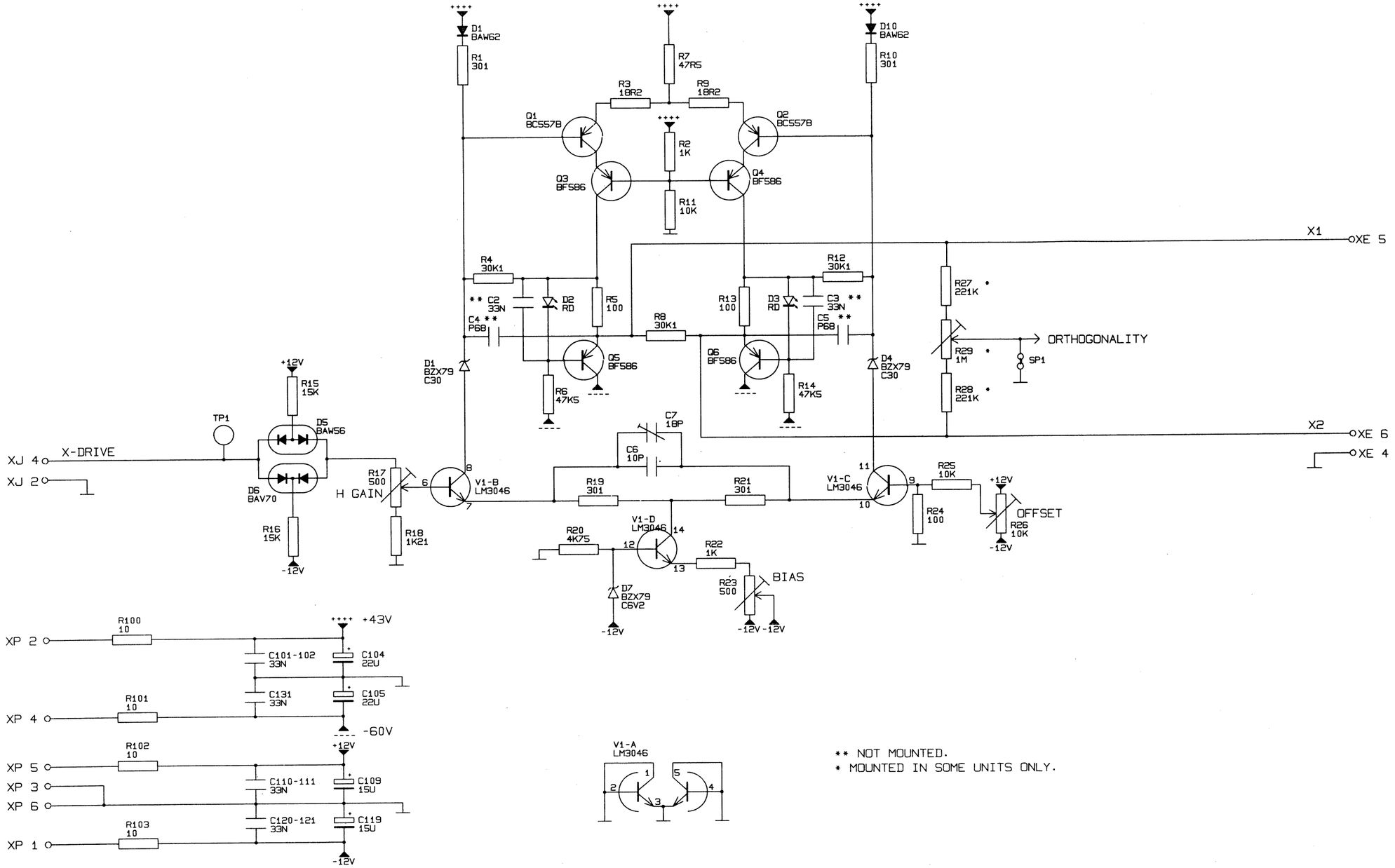
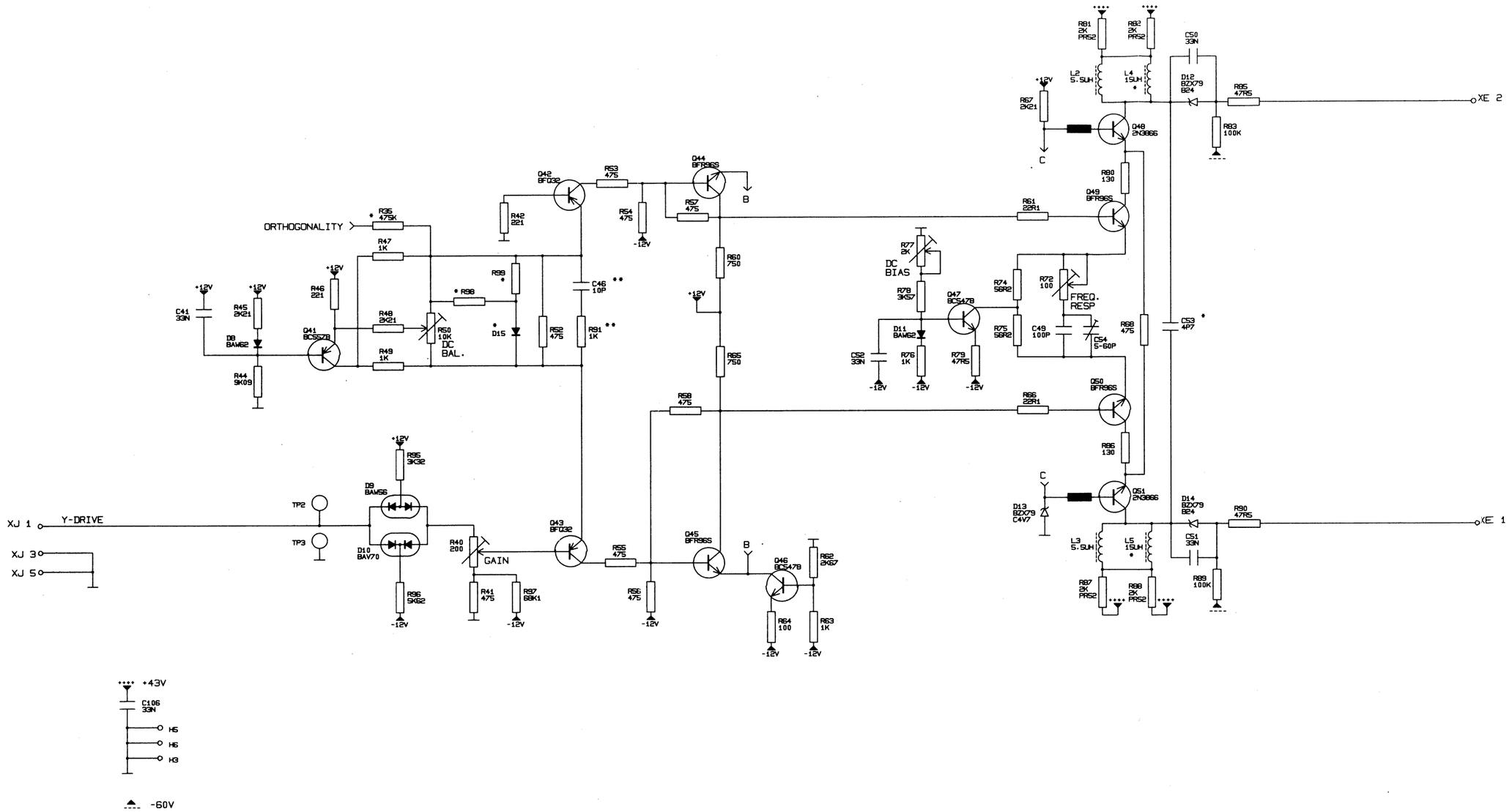


Fig. 7-2 Circuit diagram, Deflection amplifiers - unit 3 sh.1

VERTICAL OUTPUT AMPLIFIER



* MOUNTED IN SOME UNITS ONLY
** NOT MOUNTED

Fig. 7-3 Circuit diagram, Deflection board - unit 3, sht.2

8. Signal Processor - Unit 4

8.1 General Information

This unit is the heart of the instrument because it is here all the signal processing is done. This unit contains circuits for Waveform, Vector, and Test; the signal path through the circuits are controlled by the microprocessor on Unit 7. Furthermore the unit contains three looped-through inputs CH1, CH2 and CH3.

8.2 Circuit Description

8.2.1 Input Buffer

Since the three input buffers CH1, CH2, and CH3 are identical, only CH1 is described.

The input buffer is constructed as a Non-Inverting amplifier with a gain of one. At the input of the amplifier is an AC/DC switch, (Q1). When $\overline{AC}$ is high, Q1 short-circuits and the amplifier is DC-coupled. From the AC/DC switch the signal enters the base of one of the transistors in a differential stage (V1-A), in which V1-D is current generator. At R7 it is possible to adjust the current so that the DC offset on the buffer output is zero. V1-C ensures a high return loss when the instrument is switched off. The signal is then sent from the "second" collector of V1-A and via Q2 and the emitter follower V1-B to the display matrix and the monitor matrix.

8.2.2 Calibration Generator

The calibration generator is built around the IC V5. This counter is provided with a 6.4MHz X-tal oscillator. The 6.4MHz signal is reduced to 100kHz (TEST) and to 12.5kHz for the sync separator.

8.2.3 Sync Separator

The sync separator is constructed as a small subunit comprised of SMD components and considered one single component.

The sync separator receives its input from multiplexer V6.

The following signals are available to the Sync Separator:
- CH1 (CVS low),
- composite video (ERS low and CVS high),
- external sync signal ($\overline{\text{T-SEL}}$, ERS and CVS high), and
- 12.5kHz signal from the calibration generator ($\overline{\text{T-SEL}}$ low and ERS, CVS high).

Following signals are available from the Sync Separator:
- Composite sync (SYNC),
- a line-sequential sync (LINE),
- a field-sequential sync ($\overline{\text{FIELD}}$), and
- a frame-sequential square-wave signal (FIELD1).

8.2.4 Monitor Matrix

The monitor matrix circuit converts the input signals from the input buffers from YUV mode into GBR mode. If the input signals are G, B, and R, the matrix is by-passed by means of the multiplexer V8.

8.2.5 Display Matrix

The Display Matrix circuit converts the input signals from GBR mode into YUV mode. This is accomplished by a resistor array (R91) and the Operational amplifiers V9-A-C-D.

8.2.6 Vertical Selector

The Vertical Selector circuit selects the input to the Variable Gain circuit. The selected signal can be fed through the band-pass section of the Non-Linearity filter by means of the V206 switches ($\overline{NON}$ low).

8.2.7 Non-Linearity Filter

The Non-Linearity filter is divided into two parts:
- a band-pass section before the Variable Gain circuit and
- a low-pass section after it.

This is done to eliminate non-linearity errors deriving from the variable gain circuit.

The Non-Linearity filter, built up around the transistors Q214, Q215 and Q311, removes the chroma information and differentiates the luminance steps. The output from the filter is spikes expressing the amplitude of the luminance steps in the incoming video signal.

8.2.8 Variable Gain Vertical

The signal from the V-selector circuit is fed to the one part of a balanced input on the double-balanced modulator IC V202 (pin 4). It also enters the inverting amplifier Q211-Q213, which produces a balanced input for balanced modulator V202 (pin 1). The inverting amplifier has a gain of -1.0.

A "reference" signal, *Vertical Graticule Variable* (VGV), from the graticule generator can be added to the input signal via R270-R271 and V206-B. This is active in the two TEST modes in which you add a signal as reference (700mV or variable level).

The V-BAL potentiometer (R268) is adjusted so that the DC offset at the output of V202 is independent of the gain settings. The OFFSET ADJ. potentiometer is adjusted for minimum offset.

The gain of V202 can be controlled either by the V-CAL or the V-VAR GAIN potentiometer on the Potentiometer Board (Unit 5). When the V-VAR GAIN (VERT GAIN) is turned away from its left-most position, the "V-UNCAL" switch is closed due to its mechanical connection to the V-VAR GAIN potentiometer. When the V-UNCAL switch is closed, the microprocessor on Unit 7 switches V207-C to the V-VAR GAIN potentiometer via the VVE signal (*Vertical Variable Enable*).

From V207-C the control voltage is fed to pin 10 of modulator IC V202. A reference voltage (approx. 3.8V) is connected to pin 8. The DC voltage obtained across double-diode D201 is used to control the gain of the Vertical signal, so that maximum gain is obtained at approximately 100mV and minimum gain at 0mV.

R205/C201 and R285/C220 compensates for low-frequency (field) errors.

8.2.9 Polarity Switch and Buffer, Vertical

The polarity switch may invert the signal from the output of the balanced modulator V202. In standard instruments only the non-inverting function is used, which means that the VI signal at V207-B, pin 10 always is low, which again makes the switch activate Q201/Q204 by lowering the DC voltage at the base of the transistors to 6V (Off: 8V).

The current mirror Q205-Q206 converts the balanced signal to a single current flowing into the input of the current to voltage converting amplifier (Q207-Q209).

8.2.10 Multiple Clamp, Vertical

The input to the clamp is taken from the output of response switch V303 and fed to the non-inverting input of transconductance amplifier V205-D. The inverting input is connected to ground or - if the YUV parade signal is selected, in which the U and the V components are clamped to the 50% level - to the B(-Y), R(-Y) potentiometer on the Potentiometer Board (Unit 5).

When the *Clamp Pulse* (CP) from the Clamp Generator is fed via Q210 to the amplifier, the voltage difference between the inputs is detected. A correc-

tion voltage is then sent to one of the "clamp" capacitors via switch V204 and back through the switch and a voltage buffer (V208-C) to the input of the current to voltage converter (Q207-Q209). The switch switches between the three clamp capacitors C208-C210 (one for each input channel). This is controlled by the microprocessor on Unit 7 and synchronized to line shift. If "clamp" is not selected (off) the buffer (V208-C) is connected to ground through the switch.

8.2.11 Vertical-LP Filter

This filter consists of two second order low-pass blocks built around Q301/Q302 and a buffer amplifier (V208-D/Q305) with a gain of approximately 1.5. This makes it a 4th order filter of the Bessel type with less than 1% overshoot. The output of the buffer amplifier is fed to response switch V303.

8.2.12 Vertical Drive Amplifier

The input signal to the vertical drive amplifier comes either from the Graticule Generator via V301-C, response switch V303, or through the H-SIGNAL switch V207-a (Bowtie mode). When the graticule signal is selected, Q303 is switched in to eliminate "interference" from the response switch.

A DC voltage to control the vertical position is added from the Potentiometer Board via switch V509-B and a buffer amplifier (V506-A).

The Vertical Drive amplifier itself is a current-to-voltage amplifier, built around the transistor array (V304/Q304). This ensures low-temperature drift.

When transistor V304-C is switched on, the amplifier-gain is increased 5 times. C304 and C324 are used to adjust the frequency compensation in the x1 and x5 modes respectively.

8.2.13 Horizontal Selector, Variable Gain (H), Polarity Switch, Buffer, Multiple Clamp (H), and Horizontal LP-Filter.

For descriptions of the above-mentioned circuits, please see the descriptions for respective circuits in the vertical section (similar).

8.2.14 Time Base

The Time Base circuit delivers sawtooth signals for the horizontal drive amplifier with six different ramp rise-times. It consists of a current generator, 3 timing capacitors, a buffer amplifier and some control circuits.

The Current Generator is built around V501-A and Q505. The non-inverting input of V501-A is kept at a voltage determined by the resistors R509-512. The same voltage will be at the emitter of Q505. This voltage determines the current flowing from the collector of Q505 into the timing capacitors C505-506. In V mode, is C507 also acts as timing capacitor.

The linear charging of the timing capacitors makes the positive-going ramp of the sawtooth signal. The negative-going ramp is obtained when the transistor Q506 short-circuits timing capacitors (C505, C506, and C507).

The sawtooth signal is fed via a buffer amplifier (V501-B) to the response switch V503. The amplifier gain is set by the switch V502-B, depending on whether the field frequency of the incoming signal is 50Hz or 60Hz.

The Control circuit consist of two flip-flops and three gates. Input is line sync (H) from the free-run oscillator and the $\overline{\text{TBR}}$-signal from the microprocessor. $\overline{\text{TBR}}$ controls the start of the positive-going ramp of the sawtooth signal. It triggers V505-B, making pin 9 low for a period determined by R516 and C510. In this period transistor Q506 is switched on the gate V507-A, making the negative-going ramp.

The six ramp rise-times are partly obtained by changing the current from current generator Q503-Q504, and partly by switching in the tim-ing capacitor C507 with V502-C.

8.2.15 Horizontal Drive Amplifier

The input signal to the Horizontal Drive Amplifier either comes from the Graticule Generator via V301-B or from the Response switch V503. When the graticule signal is selected, transistor Q509 is switched on to short-circuit the signal from the Response switch.

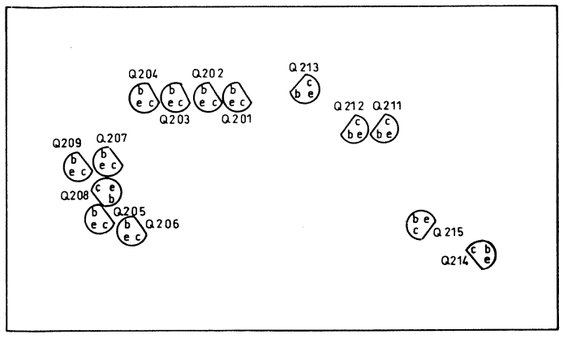
The amplifier, built around the transistors V504-A-B and Q504, is identical to the Vertical Drive Amplifier. When transistor V504-C is switched on, the gain is increased 5 times. C522 and C519 provides frequency compensation adjustment in the x1 mode and x5 modes respectlively.

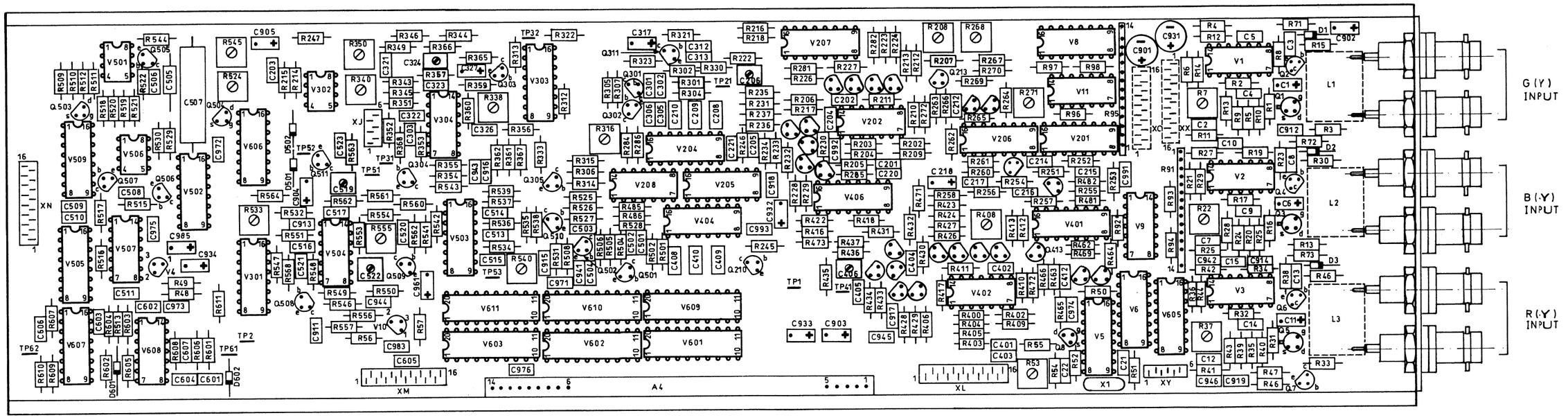
8.2.16 Microprocessor Interface

The Microprocessor Interface consists of a fast working port (V601-V603) whose inputs are connected to the microprocessor output port on unit 7, and a slow-working port V605-V606 connected to the I^2C bus coming from Unit 7. The fast signals are synchronized to the line signal by the latches V609-V611 and V608-D.

8.2.17 Free Run Oscillator and Clamp Generator

If line sync pulses from an external sync signal are present, the Free-Run Oscillator, built around V608-A, receives its input from the Sync Separator and works as an inverter. In case there is no external line sync it will start oscillating at a frequency of approximately 14kHz and thereby make a sync substitution signal. The output is delayed by the one-shot circuit V607-B so that it corresponds to the back porch of the line sync. The clamp pulses are generated by the one-shot V607-A, which again is controlled by V608-B-C. The clamp pulses are fed to both the Horizontal and Vertical Clamp circuits and the Video Output buffers.





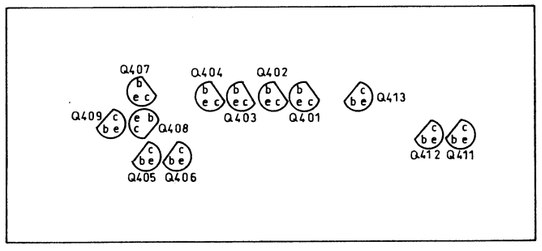


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Fig. 8-1 Component location, Signal processor - unit 4

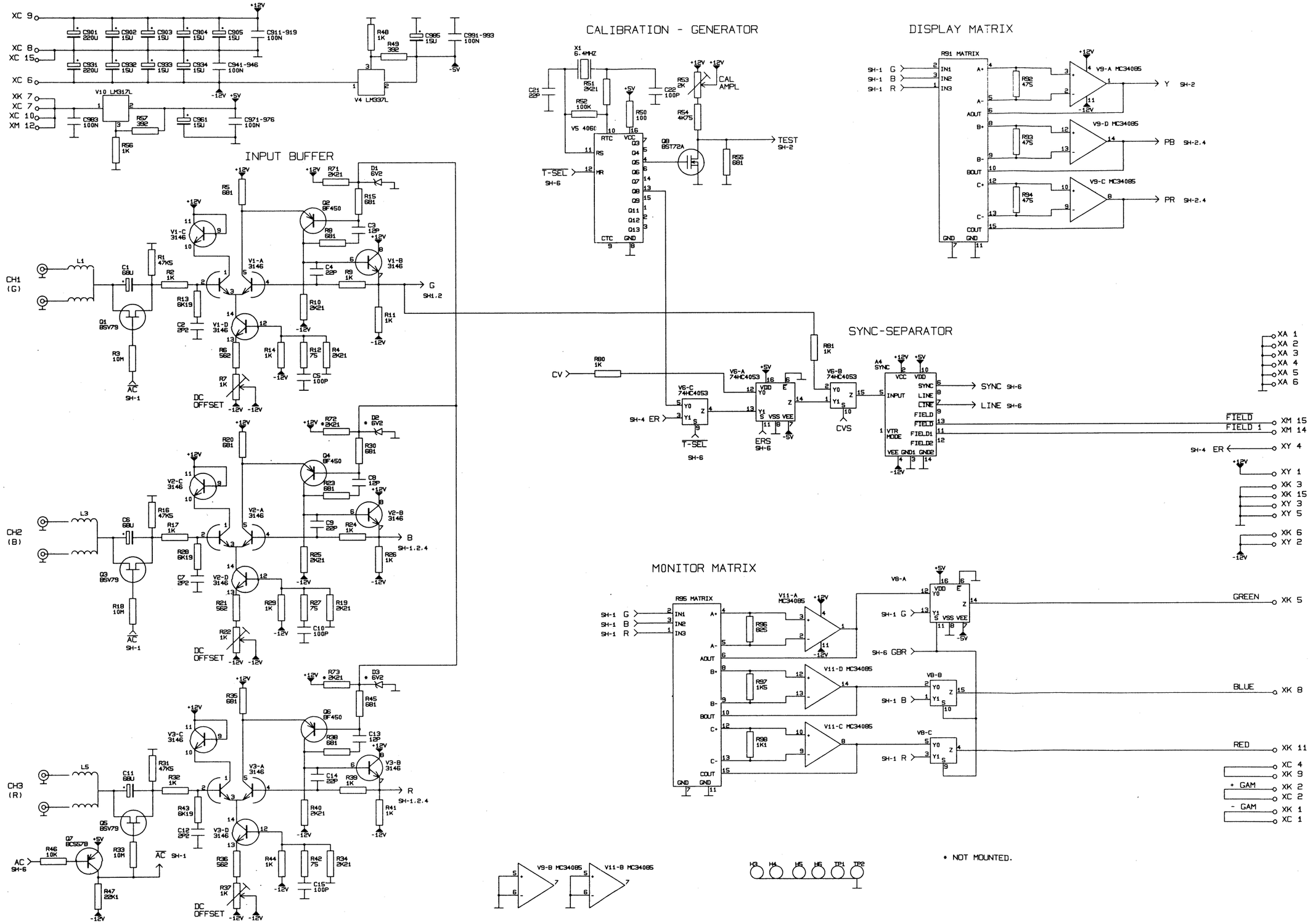


Fig. 8-2 Circuit diagram, Signal processor - unit 4, sh.1

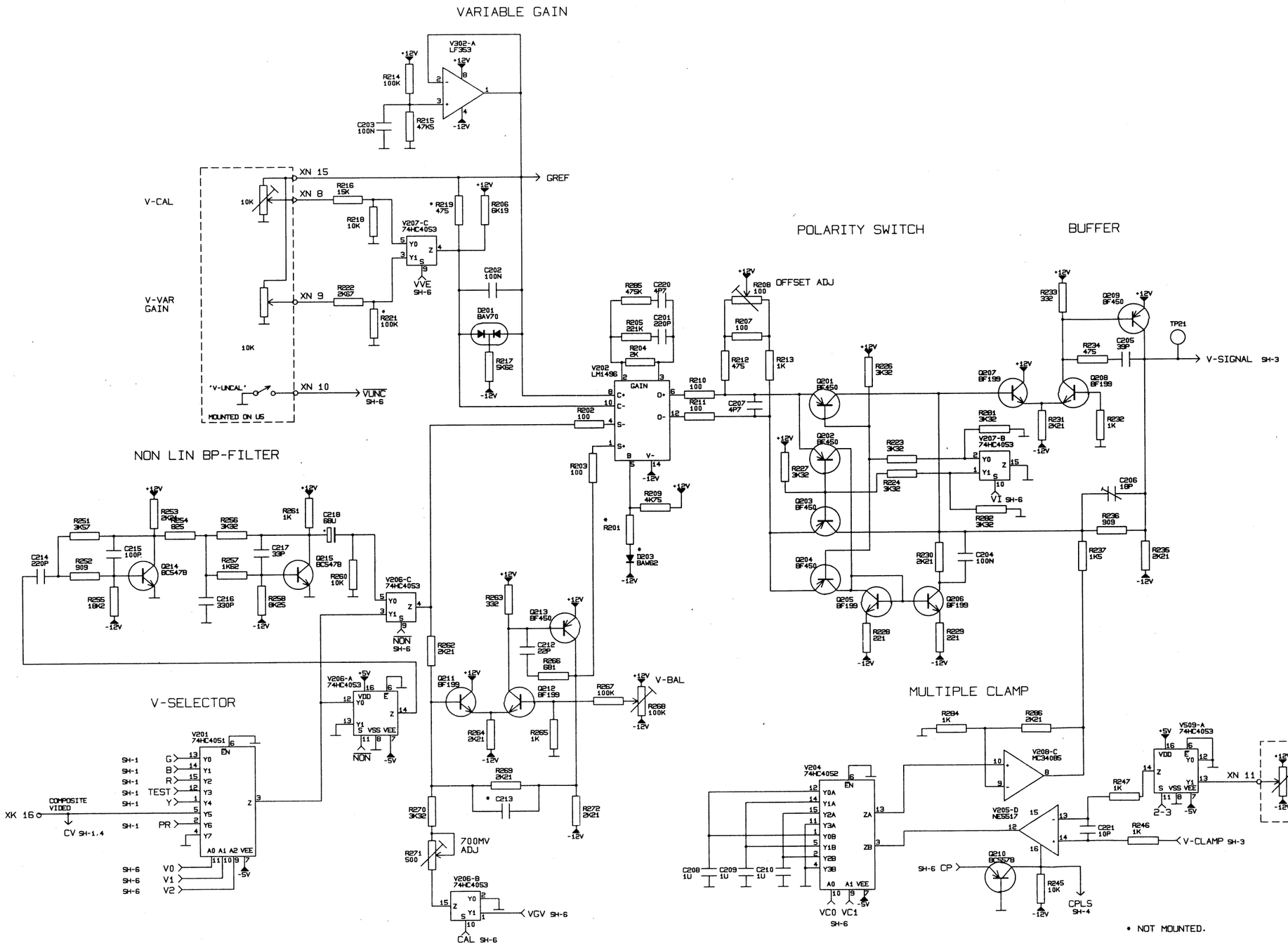


Fig. 8-3 Circuit diagram, Signal processor - unit 4, sh.2

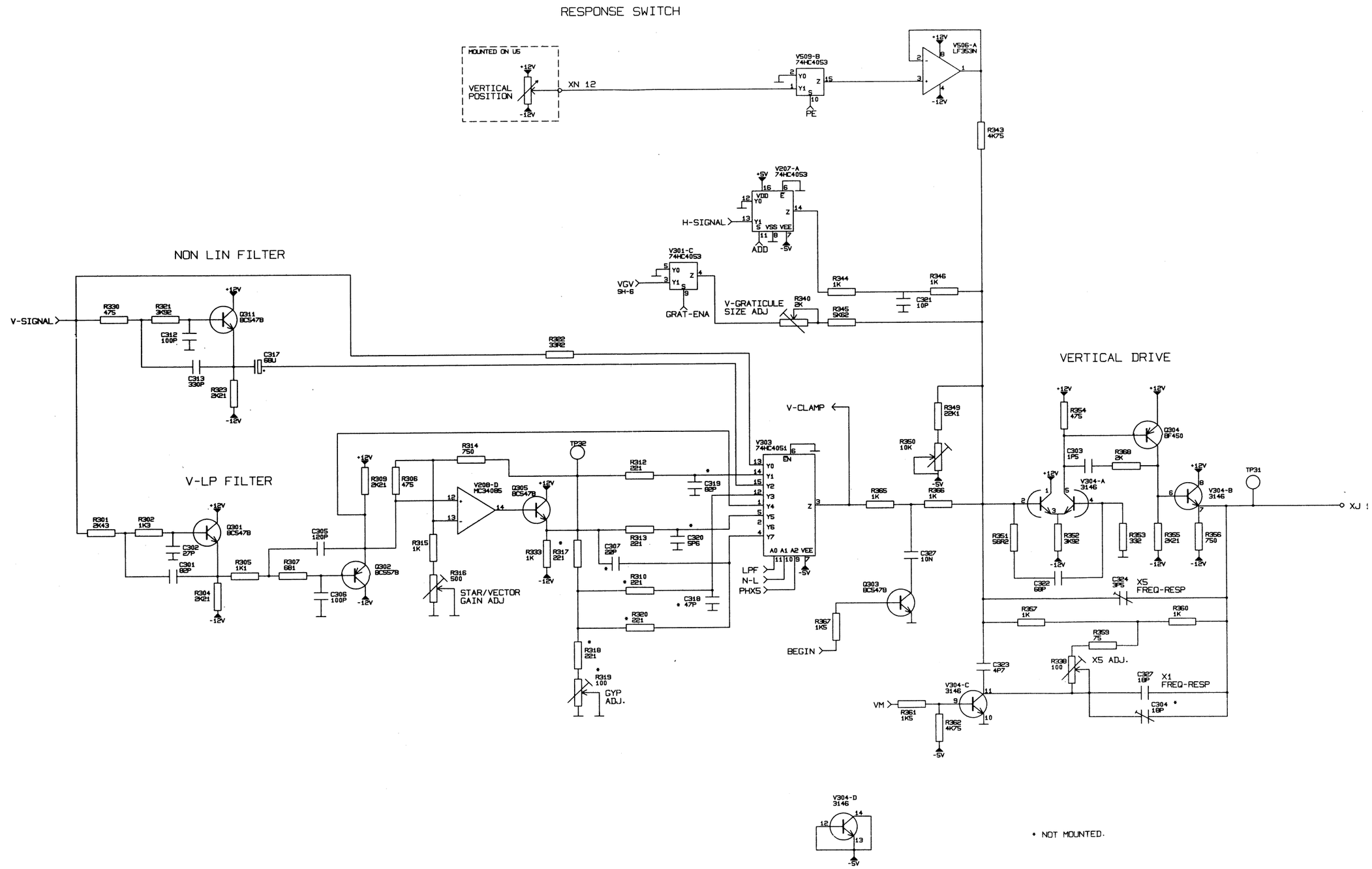


Fig. 8-4 Circuit diagram, Signal processor - unit 4, sh.3

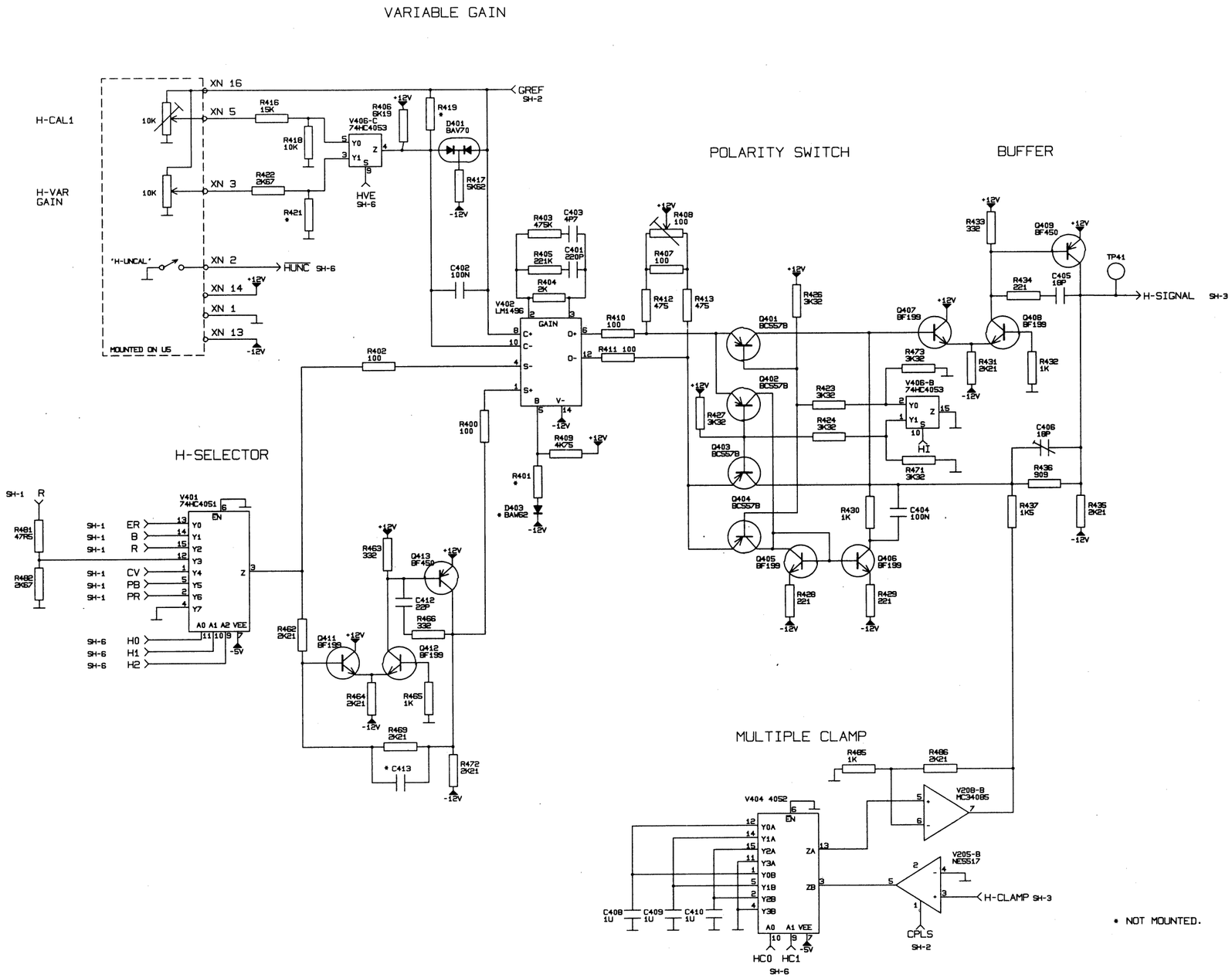


Fig. 8-5 Circuit diagram, Signal processor - unit 4, sh.4

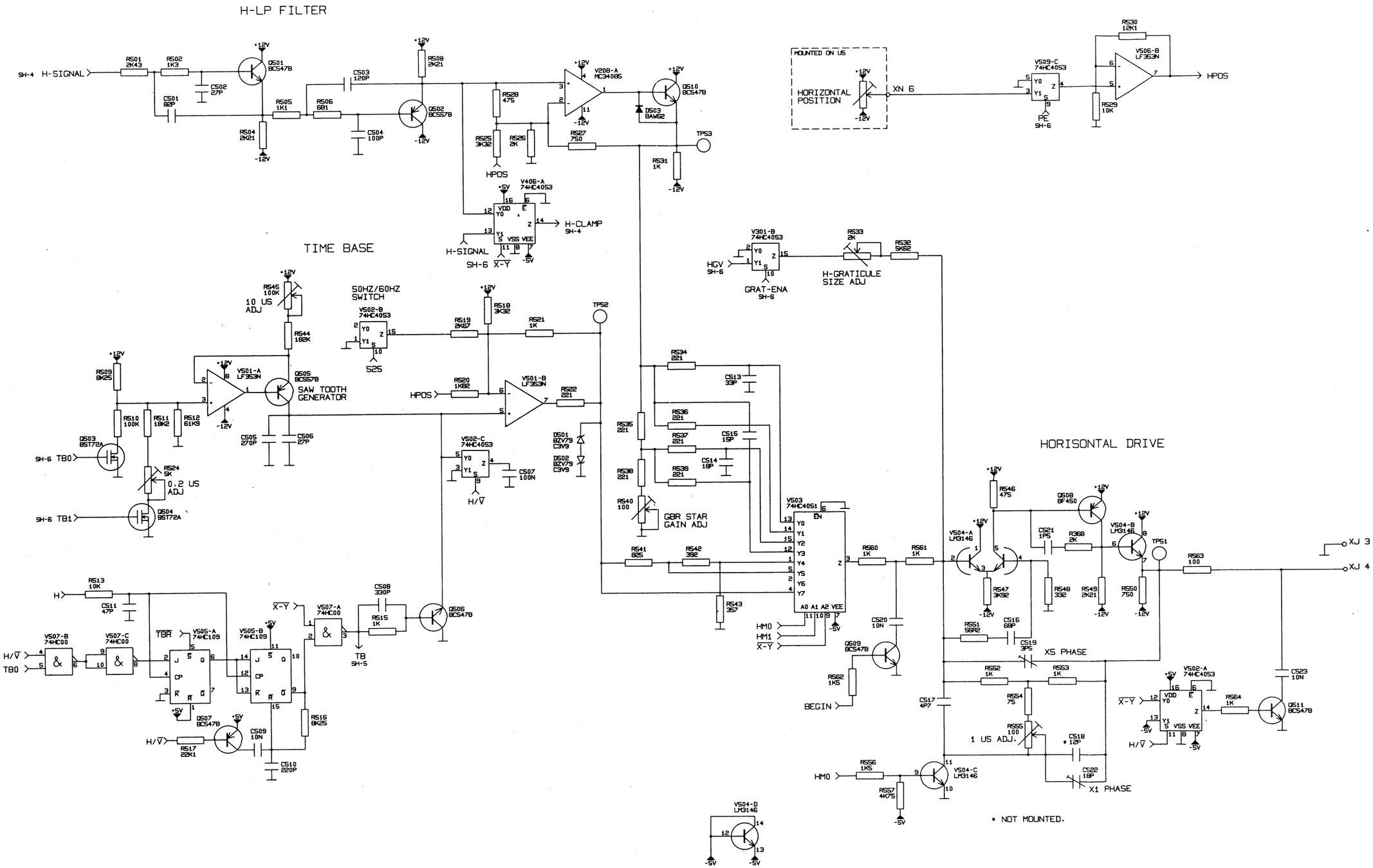
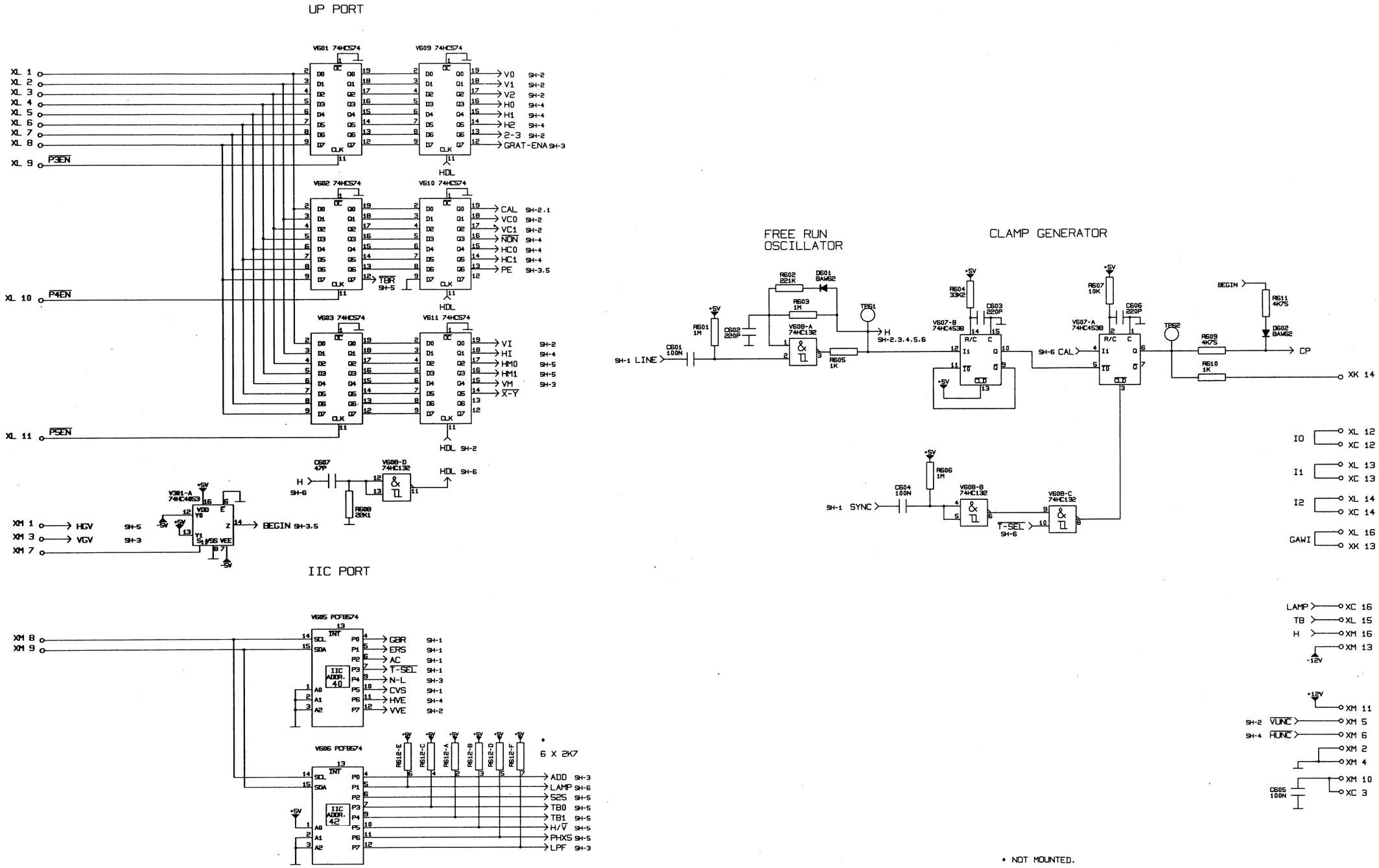


Fig. 8-6 Circuit diagram, Signal processor - unit 4, sh.5



• NOT MOUNTED.

Fig. 8-7 Circuit diagram, Signal processor - unit 4, sh 6

9. Potentiometer Board - Unit 5

The Potentiometer Board houses the potentio-meters for adjustment of the horizontal and vertical gain, horizontal and vertical position, X and Y gain, and the position of the B-Y and R-Y signal in the PARADE display mode.

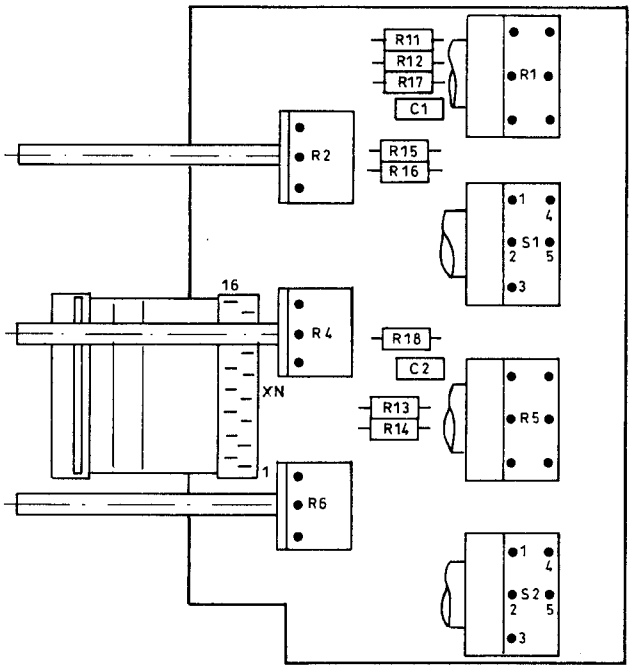


Fig. 9-1 Component location, Potmeter board - unit 5

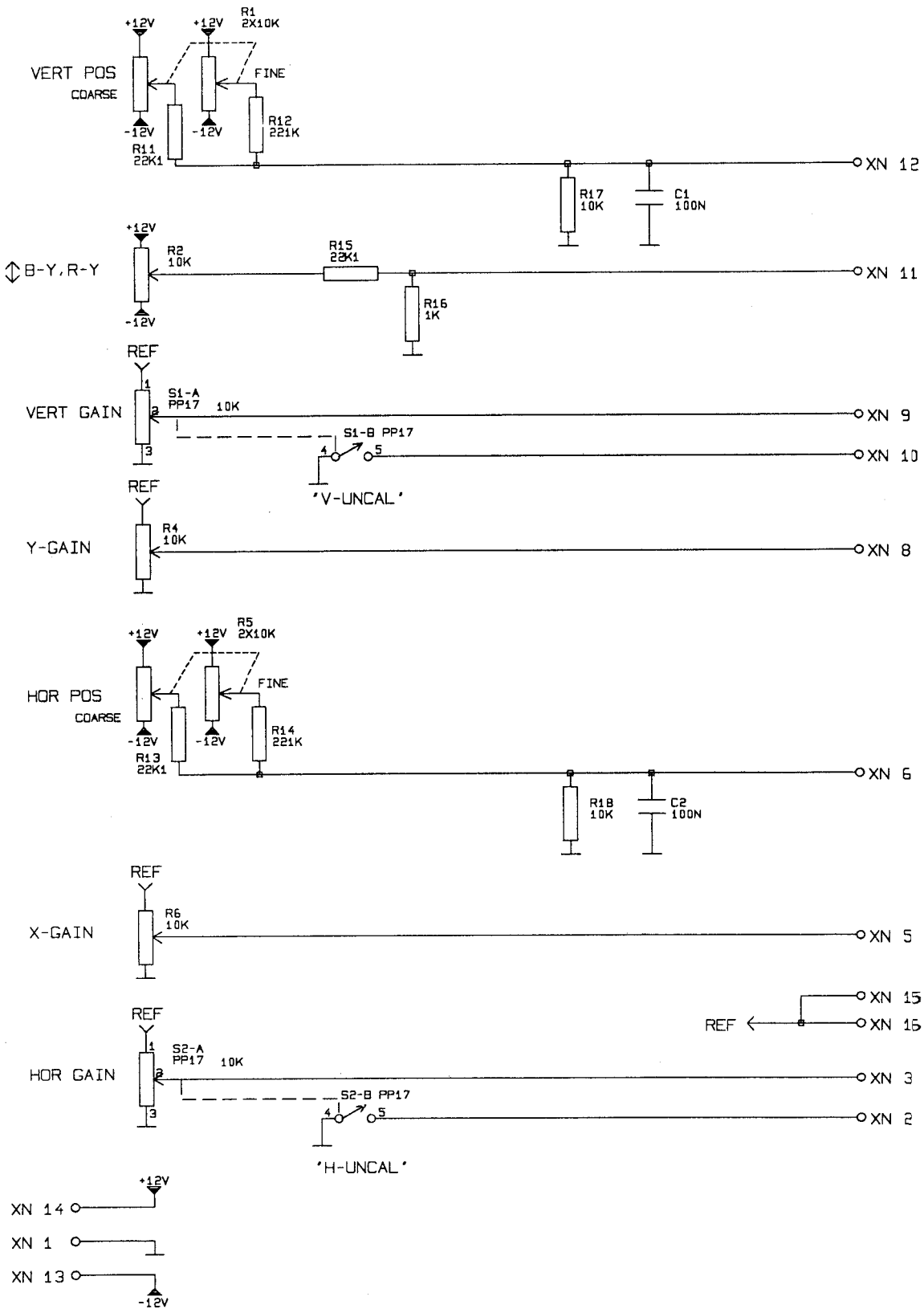


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Fig. 9-2 Circuit diagram, Potmeter board - Unit 5

10. Keyboard - Unit 6

The Keyboard is a 4 x 4 matrix.
The switches are provided with built-in LEDs.

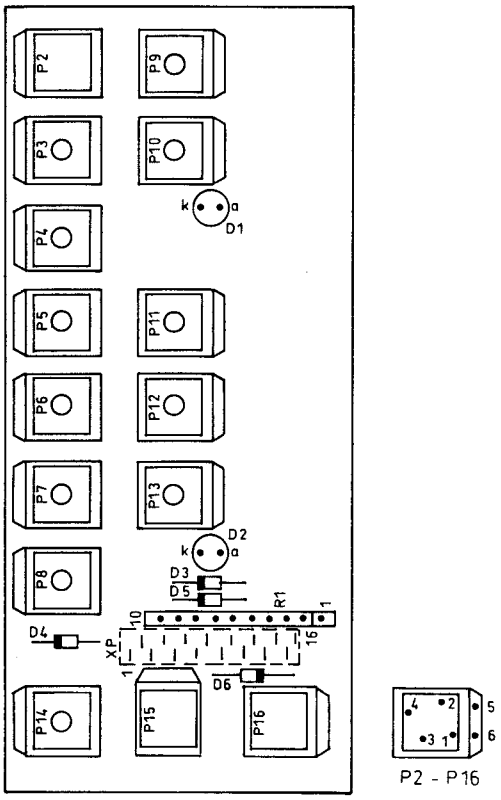

Fig. 10-1 Component location, Key board - unit 6

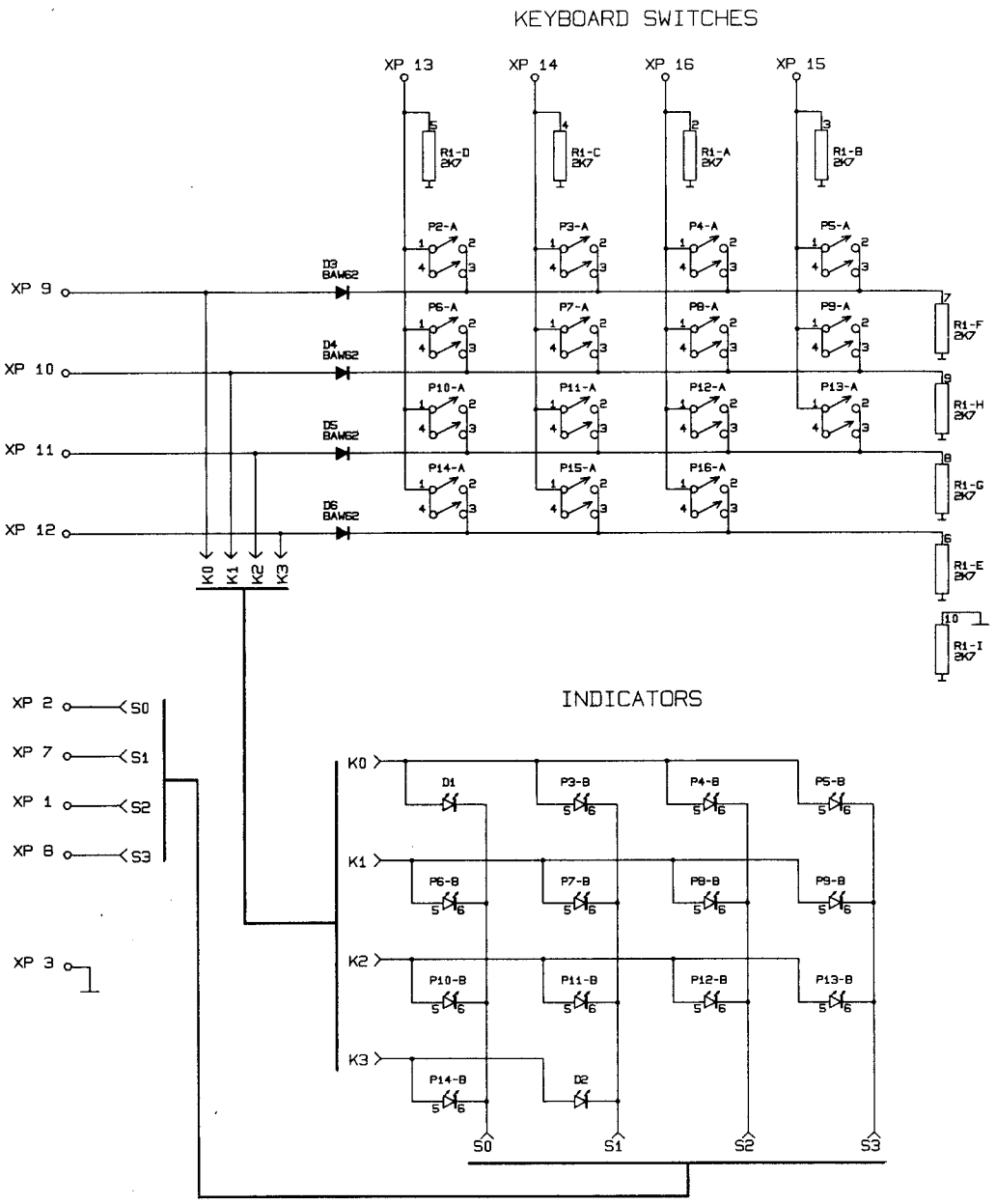

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Fig. 10-2 Circuit diagram, Key board - unit 6

11. Control Board - Unit 7

11.1 General Information

This unit contains a microcontroller which controls the function of the instrument and a graticule generator which controls the CRT display.

The circuit can be separated into a microprocessor circuit, a reset circuit, a control input circuit, an intensity control, a display/keyboard circuit and a graticule generator.

The unit also contains an amplifier for external reference signal.

11.2 Circuit Description

11.2.1 Microprocessor Circuit

The Microprocessor circuit is based on the microcontroller V103, which is used in a standard configuration with V104 as address latch, V101 as external RAM, V102 as external ROM, battery backup B101, and an address decoder, V109, for addressing the external ports.
From the input port V201 the microprocessor receives information on activation of the keyboard, the actual field (1st or 2nd), whether the variable gain is on or off, and whether the actual input video signal is a 625 or 525 line signal.

Other microprocessor input are reset, remote control input (via the I^2C bus), field interrupt, line counter input, ready flag from the graticule generator, and an I^2C bus.

The Graticule Generator and Intensity Control are both controlled by the microprocessor via the output port V303.

The clock signal from the Crystal Oscillator is buffered by transistor Q102 and fed to the Graticule Generator.

11.2.2 Reset Circuit

A Reset circuit with voltage sensor V105 is introduced to get a controlled power-up and power-down. If the supply voltage reaches the low level of 3.6V, determined by R104 and R105, the Voltage Sensor resets the microprocessor and blocks the RAM. This makes the battery backup take over the power supply of the RAM.

11.2.3 Remote Control Input

From the Control Input it is possible to activate the store and recall functions. The selection of function is sensed by the microprocessor when reading the I^2C port V107.

11.2.4 Intensity Control

The heart of the intensity control is the *Programmable Gate Array* (PGA), which is downloaded by the microprocessor when the monitor is turned on. The intensity of the CRT is decoded by V111, controlled by the microprocessor. V111 also filters the field information from the Sync Separator on Unit 4 to avoid triggering errors. The gamut window signal for the Gamut Detector (Unit 8) is also derived from V111.

11.2.5 Display/Keyboard Circuit

The keyboard switches and display indicator LEDs are located on Unit 6 and connected to Unit 7 through the connector XP. The switches and the LEDs are working in a matrix. Here the microprocessor activates the relevant switches for the selected set-up through V202 and Q201-204 and reads the switches in the "vertically direction" by means of V201. The relevant LEDs for the set-up are activat-ed in the "horizontally direction" by the LED scanning circuit V205 and in the "vertically direction" by V206 and the IC V203 driver. V207 is an oscillator/divider which provides the relevant scanning frequency.

11.2.6 Graticule Generator

The Electronic Graticule generator provides the electronic graticule and menu text on the CRT display. The system distinguishes between three kind of figures:
1. Graticules
2. Characters
3. Voltages

The idea is to generate the requested figure in small parts by creating a horizontal and vertical voltage sweep on the output of V308-A and B (HGV and VGV).

The generator receives its orders from the microprocessor via the port V308 and the control lines $\overline{\text{BEGIN}}$, $\overline{\text{LOADPOS}}$, and $\overline{\text{UPDATE}}$.

The END-signal is a reply message from the generator back to the microprocessor.

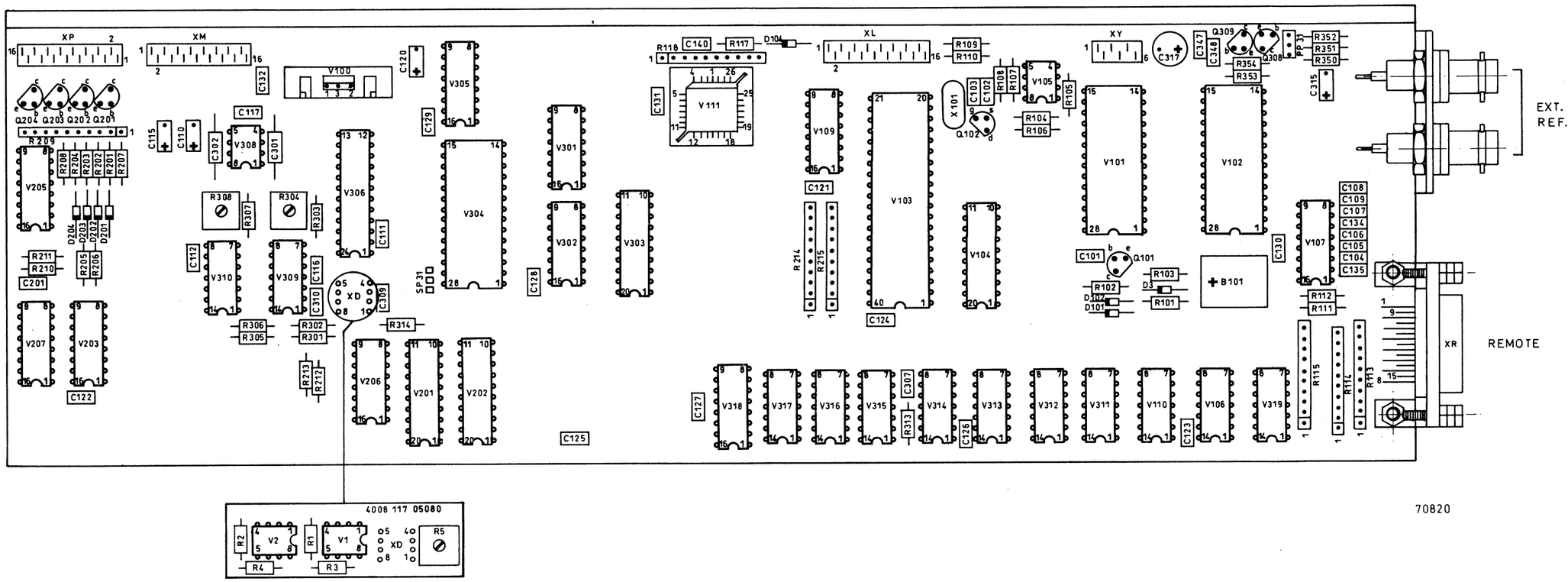
1. Graticules
A graticule is started when the CPU begins addressing the graticule memory V304 and the $\overline{\text{BEGIN}}$ signal goes low. This enables frequency divider V318 which via V315-D and V314-D drives the address counter V301-302. Data information is then transmitted from memory V304 to the *Digital-to Analog Converter* (DAC) V306 for each piece of line in the graticule. The DAC contains a 12-bit D/A converter for both horizontal as well as vertical data information. For each piece of line 4 byte is needed from the memory to load the double D/A converter. The DAC outputs are current outputs, but they are converted into voltages by the four opamps V1-A-B and V2-A-B. This voltage is sampled by V309 and V310, which then drive integrators V308-A and -B.

By feeding back HGV and VGV outputs to the input of the sample/hold amplifiers, the outputs will be proportional with the actual and the previous sample value. Thus it will take the same amount of time to draw the line-part in question, no matter what length it is. With R304 and R308 it is possible to adjust the horizontal shape and vertical shape respectically.

The D6-pulse through V316-B signals that a part of the graticule line should be blanked. The D7-pulse through V315-C and V317-B signals that the graticule "drawing" is finished by generating the $\overline{\text{END}}$-signal to the microprocessor.

2. Characters
When a character is drawn, the microprocessor starts by sending the $\overline{\text{LOADPOS}}$ pulse and the most significant bits to the DAC via V110-C-D and V305. This is to locate the position on the screen from which the charater is drawn. Then the microprocessor sends a $\overline{\text{BEGIN}}$ pulse and the memory V304 delivers the least significant bits to the DAC until the character is finished.

3. Voltages
Generation of a voltage is in general done the same way as generation of a character. Only the microprocessor sends an $\overline{\text{UPDATE}}$ pulse instead of the $\overline{\text{BEGIN}}$ pulse. The DAC values will then be sampled one time via V312-D, V316-A, V315-A-B and V106-F without starting the address counter V301. The voltage on the outputs HGV and VGV will then correspond to the input values.



ATTENTION

Fig. 11-1 Component location, Control board - unit 7

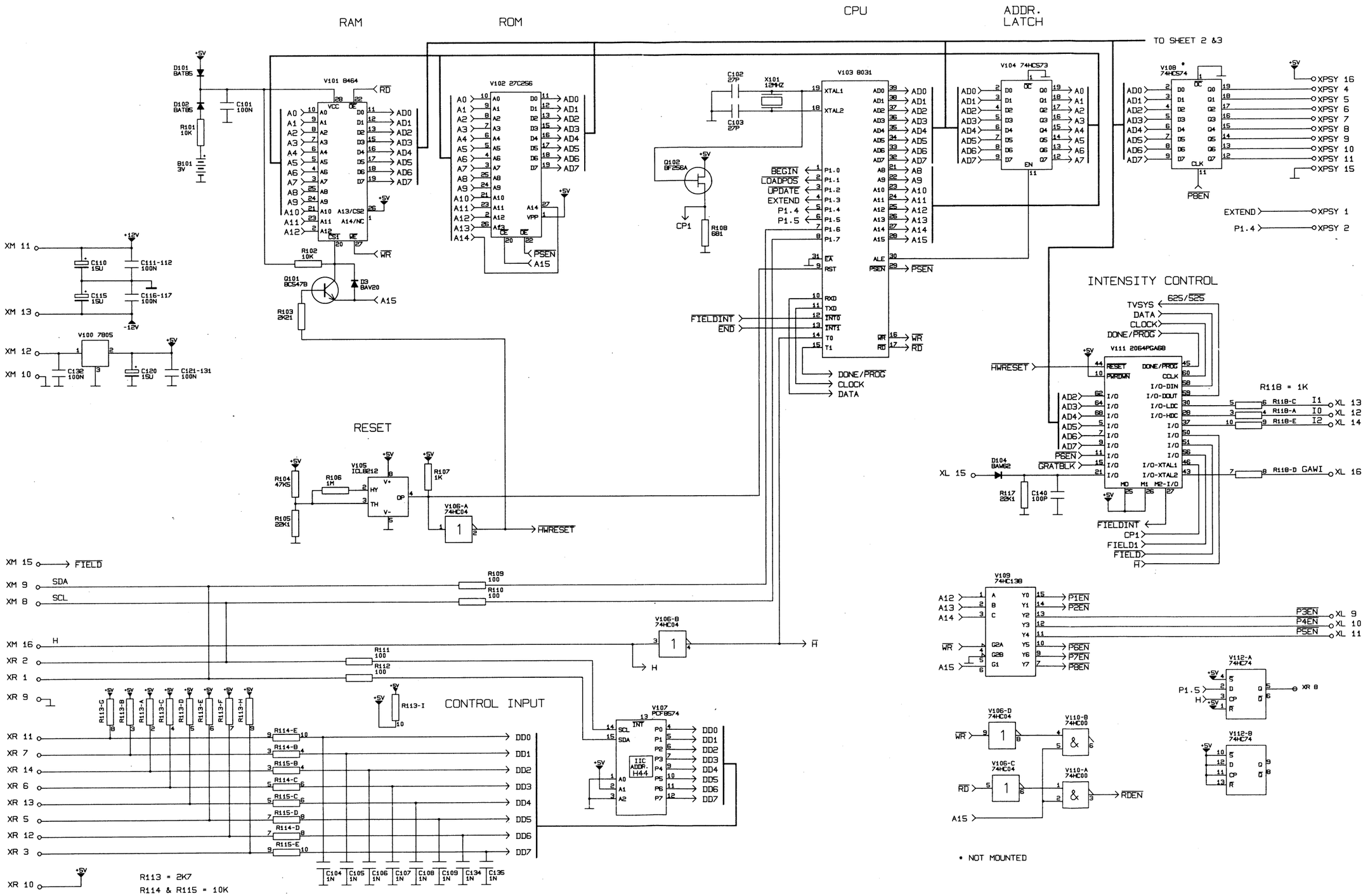


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Fig. 11-2 Circuit diagram, Control board - unit 7, sh.1

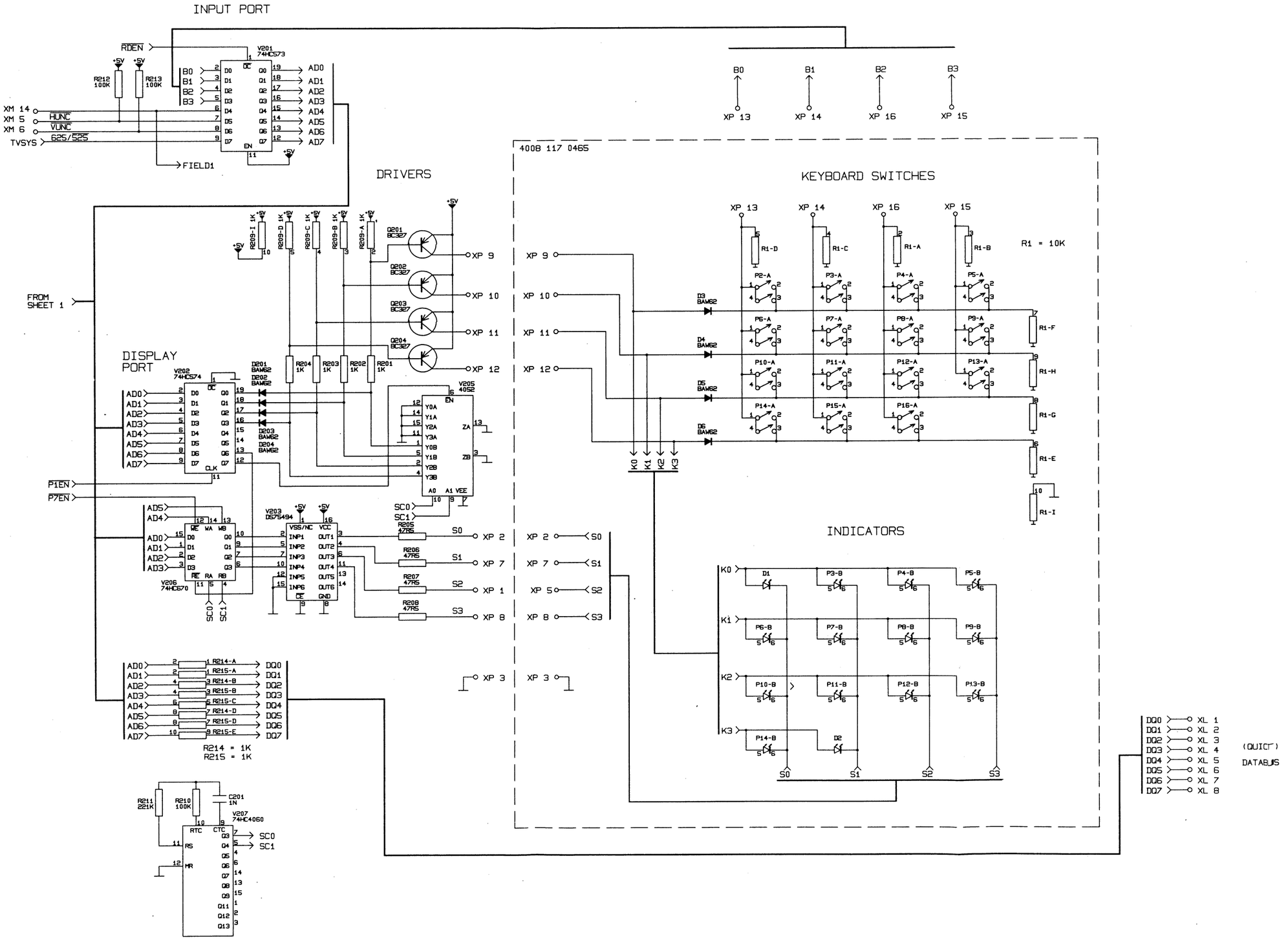


Fig. 11-3 Circuit diagram, Control board - unit 7, sh. 2

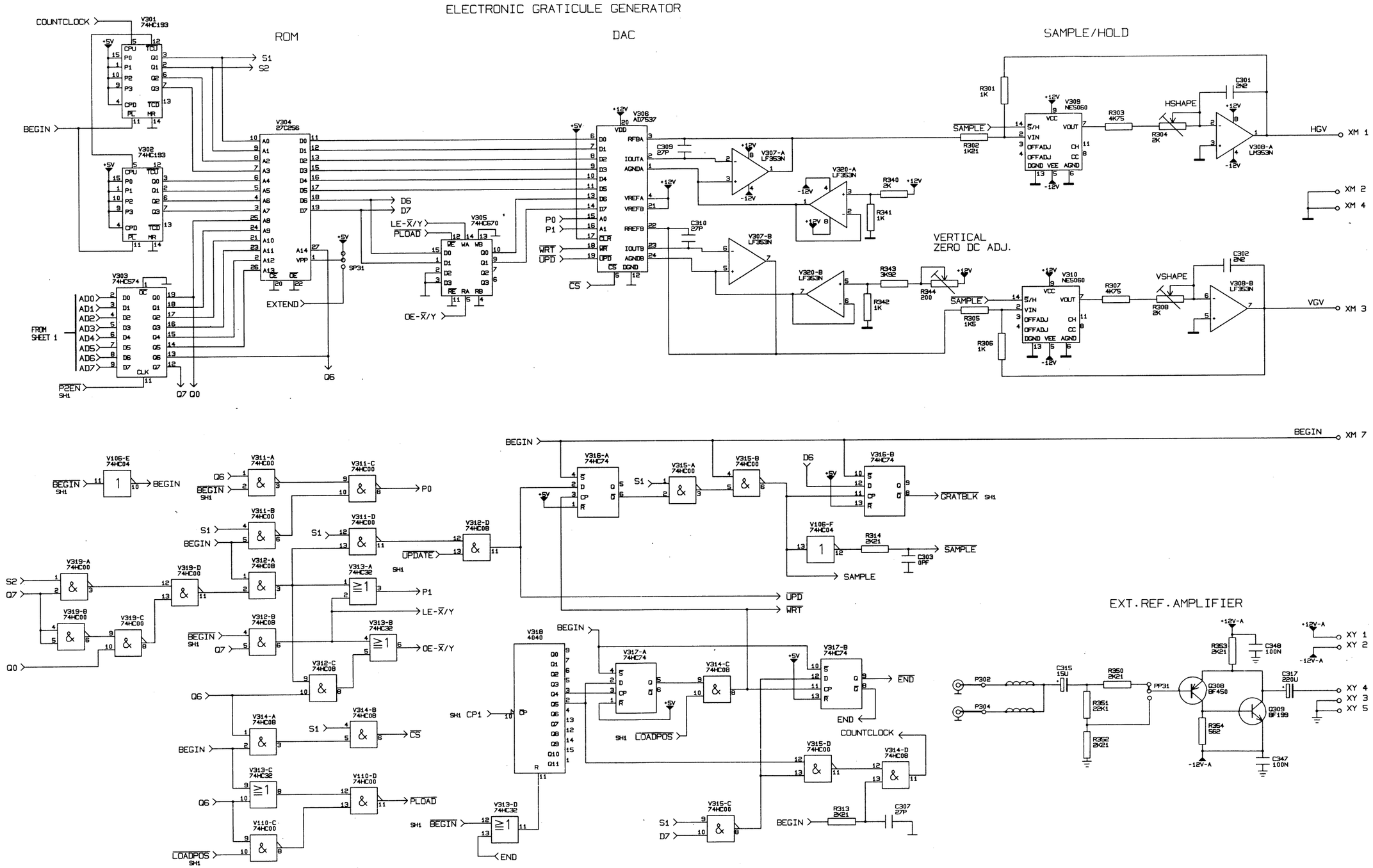


Fig. 11-4 Circuit diagram, Control board - unit 7, sh 3

12. GBR Monitor Out - Unit 8

12.1 General Information

This unit contains the GBR Video Output buffers with clamp drivers, a Composite Video Amplifier for the monitor out, and a Gamut Detector.

12.2 Circuit Description

12.2.1 GBR Video Buffers

Since the three video buffers are identical only the G-AMP circuit will be described.

The amplifier consists of three transistors (Q1, Q2, Q3) coupled as a Non-Inverting Amplifier where R3 and R7 determine the gain. The amplifier is feedback-clamped by the double *Operational Transconductance Amplifier* (OTA) V2-A and -B and the clamp capacitor C2. The output impedance is kept low by emitter follower Q3, and the output impedance is set to 75Ω by means of R4.

12.2.2 Composite Video Amplifier

The Composite Video Amplifier consists of three amplifiers:
- an INPUT amplifier,
- a MONITOR OUT amplifier, and
- a DISPLAYED COMPOSITE VIDEO amplifier.

All three amplifiers are Non-Inverting Amplifiers, and where the INPUT amplifier (Q15/Q17) and the DISPLAYED COMPOSITE VIDEO amplifier (Q16/Q19) both have a gain of 1, the MONITOR OUT amplifier (Q18/Q20) have a gain of approximately 2 (set by R55 and R56).

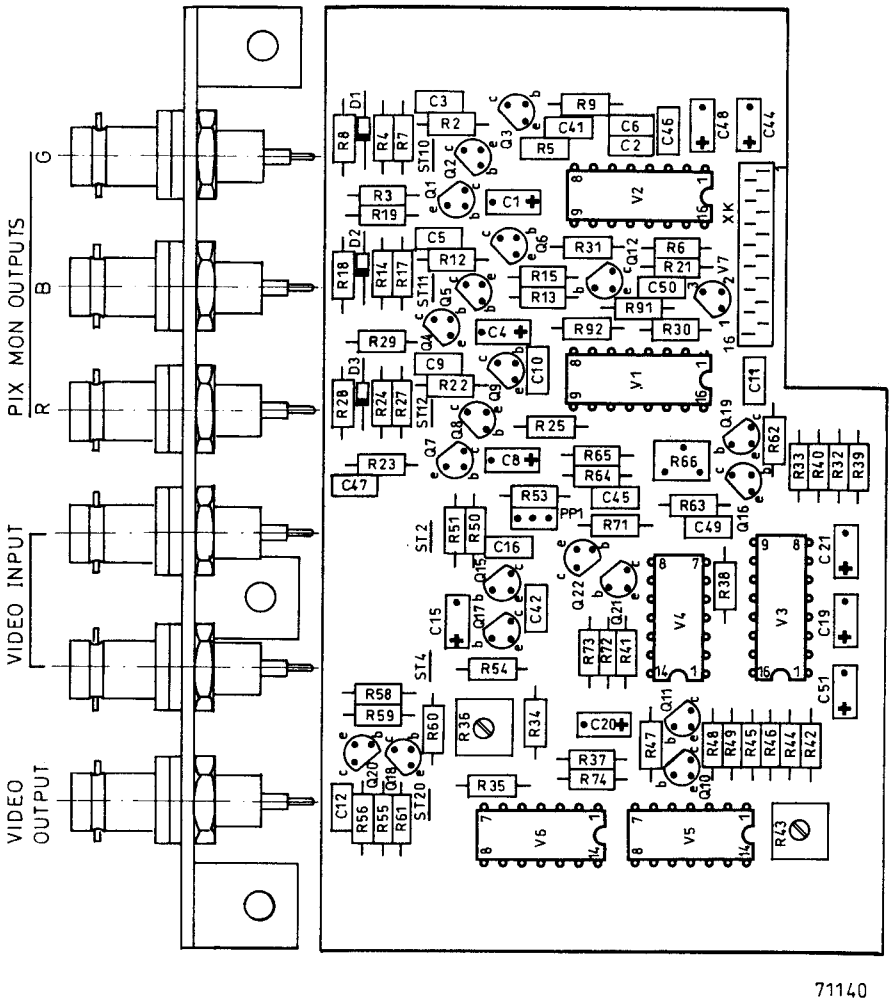
12.2.3 Gamut Detector

The main function of the Gamut Detector is to detect it if the level of a primary color component exceeds 735mV (±5mV), which makes the LED "POS" on unit 2 light-up, or -35mV (±5mV), which makes the LED "NEG" on unit 2 light-up. Also a level excess will be indicated on the PIX MON OUTPUTS as a flickering area on the monitor screen displaying the error area.

The Gamut Detector consists of a positive and a negative peak detector, a 2Hz generator, and two one-shot circuits.

The Positive Peak Detector is a comparator made as a Differential Amplifier where the transistors V6-A-B-C are coupled in parallel to one transistor. Q10 is introduced to increase the gain of the comparator. If one of the inputs G, B, or R exceeds the level adjusted by means of R36 (735mV), the collector of Q10 will go high and via gate V4-B trigger one-shot V3-A and the 2Hz generator V4-C. The one-shot circuit is introduced to make the gamut LED flash for a minimum period of 0.5 seconds. The 2Hz generator will make the error area flash on the PIX MON OUTPUTS.

The Negative Peak Detector is similar to the positive, except that the G, B, and R inputs here are connected to the emitters of the difference transistor V6-A-B-C.



ATTENTION

Fig. 12-1 Component location, GBR monitor out - unit 8

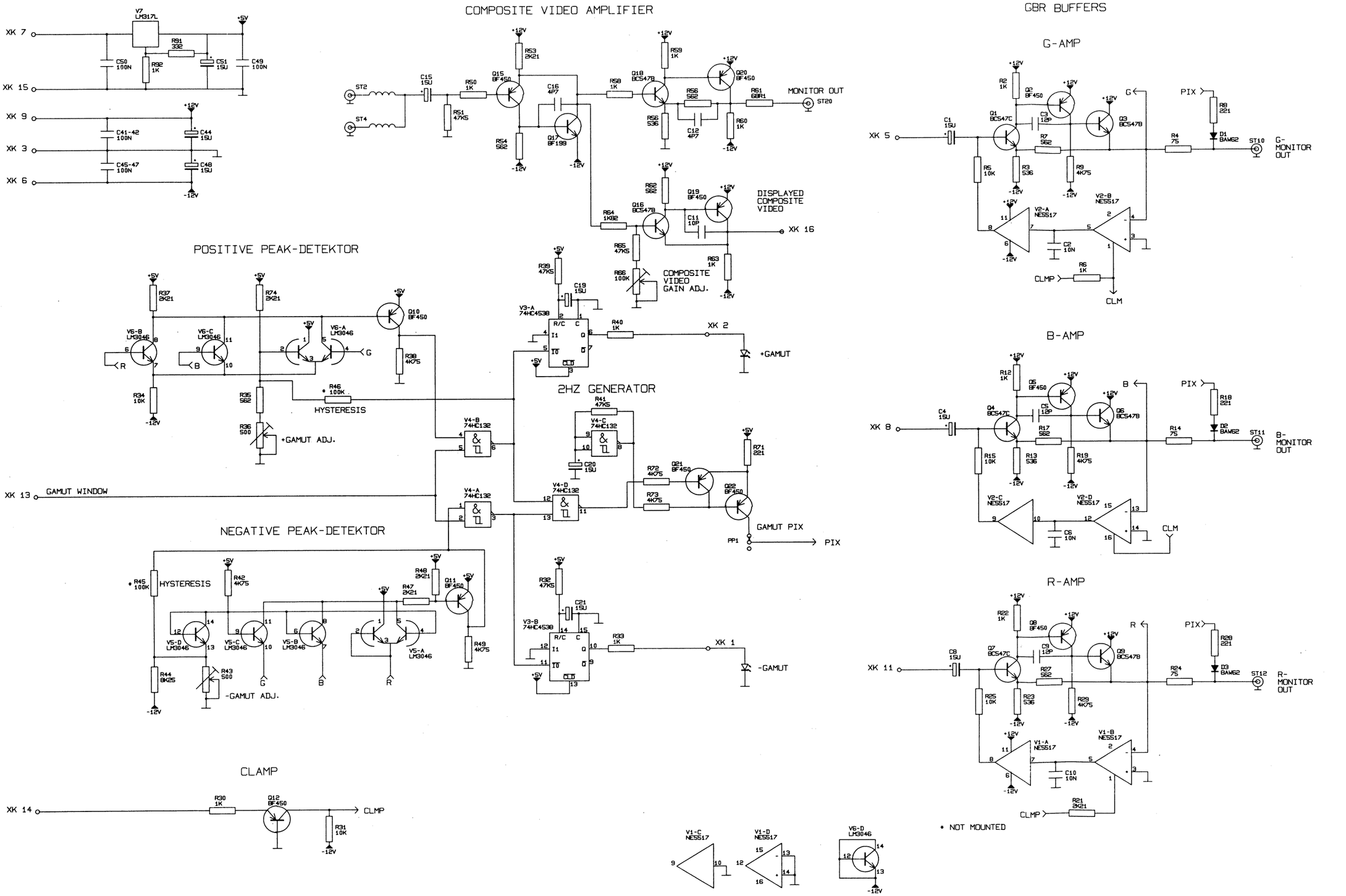


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Fig. 12-2 Circuit diagram, GBR monitor out - unit 8

13.

This chapter is reserved for later possible additions.

14. List of Mechanical Parts

Item	Description	Quantity	Ordering number
1	Power on knob, green	1	5322 414 60798
	Power on knob, brown		5322 414 30184
2	LED green ("ON)	1	4822 130 32472
3	LED red ("GAMUT","UNCAL")	4	4822 130 31274
4	Potentiometer, 10K	3	5322 101 20986
	Shaft for potentiometer	3	5322 535 92482
	Knob, grey	3	5322 414 40057
	Knob, brown		5322 414 30044
	Cap for knob, grey	3	5322 462 41699
	Cap for knob, brown		5322 414 70016
5	Potentiometer, 10k	2	5322 101 20986
	Shaft for potentiometer	3	5322 535 92482
6	Textplate left, grey	1	5322 455 71058
	Textplate left, brown		5322 455 71054
7	Window for grey version	1	5322 450 10053
	Window for brown version		5322 450 10052
8	Filter, grey	1	5322 480 30324
9	Cathode ray tube, version /00	1	5322 131 20239
	Cathode ray tube, version /20		5322 131 20241
10	Front frame, grey	1	5322 447 91972
	Front frame, brown		5322 447 91518
11	Push button	3	5322 276 12417
	Cap for pushbutton, grey	3	5322 414 30165
	Cap for pushbutton, brown		5322 414 60036
12	Push button with green LED	12	5322 276 12417
	Cap for pushbutton, grey	12	5322 414 30172
	Cap for pushbutton, brown		5322 414 60038
13	Text plate right, grey	1	5322 455 71059
	Text plate right, brown		5322 455 71053
14	Potentiometer, 2x10k	2	5322 101 30756
	Knob, grey	2	5322 414 30195
	Knob, brown		5322 414 30145
	Cap for knob, grey	2	5322 462 41699
	Cap for knob, brown		5322 414 70016
15	Potentiometer	3	5322 101 20986
	Shaft for potentiometer	3	5322 535 92482
16	Potentiometer with switch	2	5322 101 30755
	Knob, grey	2	5322 414 30195
	Knob, brown		5322 414 30145
	Cap for knob, grey	2	5322 462 41699
	Cap for knob, brown		5322 414 70016

Item	Description	Quantity	Ordering number
17	Fuseholder	1	5322 256 34102
	Cap for fuseholder	1	5322 462 44477
	Fuse 1.5A slow	1	4822 253 50049
18	Power line filter	1	5322 267 40784
19	Connector 15 pin sub-D	1	5322 267 51089
20	BNC coax socket	14	5322 267 10004
	Lamp for graticule, 28V 80mA	3	5322 134 41035

15. List of Electrical Parts

Standard resistors (MR25, 0.4W, 1% and CHIP0805, 1W, 0.5%) are found on the "List of standard resistors" at the rear of the manual.

Unit 1 - power supply

Number	Ordering number	Type
Integrated circuits		
V1.	4822 209 81472	LM358N
V2.	5322 130 90137	CNX35
V3.	4822 209 81472	LM358N
V4.	4822 209 80591	LM317T
V5.	5322 209 81236	LM337T
V7.	4822 209 71582	74HC4051P
V8.	4822 209 71582	74HC4051P
Transistors		
Q1.	4822 130 40855	BC337
Q2.	5322 130 43926	BUK456-800B
Q3.	4822 130 42229	BUT11
Q4.	4822 130 41646	BF423
Q5.	4822 130 41646	BF423
Q6.	4822 130 40959	BC547B
Q7.	4822 130 40855	BC337
Q8.	4822 130 40854	BC327
Q9.	5322 130 61092	BUV26AF
Q10.	4822 130 40855	BC337
Q11.	4822 130 40854	BC327
Q13.	4822 130 44568	BC557B
Q14.	4822 130 62679	BD942
Q20.	4822 130 44154	BF199
Q21.	4822 130 44154	BF199
Q22.	5322 130 42534	2N5401
Q23.	5322 130 44491	2N5551
Q24.	4822 130 41646	BF423
Q27.	4822 130 40959	BC547B
Q28.	4822 130 40959	BC547B
Q29.	5322 130 42534	2N5401
Q30.	5322 130 44491	2N5551
Diodes		
D1.	5322 130 81291	RECT. BRIDGE TYPE2
D5.	5322 130 31504	BZX79-C3V3
D6.	5322 130 34605	BAX12

Number	Ordering number	Type
D7.	5322 130 34605	BAX12
D8.	5322 130 34605	BAX12
D9.	5322 130 34605	BAX12
D10.	4822 130 34281	BZX79-B15
D11.	5322 130 40482	BRY39
D12.	4822 130 31628	BYV27-150
D14.	4822 130 32343	BYV26C
D15.	5322 130 34294	BZV11
D16.	5322 130 34605	BAX12
D17.	4822 130 34173	BZX79-C5V6
D18.	4822 130 34281	BZX79-B15
D19.	4822 130 30613	BAW62
D20.	4822 130 34281	BZX79-B15
D23.	4822 130 31628	BYV27-150
D25.	4822 130 41487	BYV95C
D26.	4822 130 41487	BYV95C
D27.	4822 130 41487	BYV95C
D28.	4822 130 41487	BYV95C
D29.	5322 130 24081	BT151
D30.	4822 130 34281	BZX79-B15
D31.	4822 130 30842	BAV21
D32.	4822 130 30842	BAV21
D33.	4822 130 30842	BAV21
D34.	4822 130 31628	BYV27-150
D35.	5322 130 32509	ESJA52-10
D38.	5322 130 32509	H.T. TRIPLER
D41.	4822 130 30613	BAW62
D42.	4822 130 30613	BAW62
D49.	4822 130 34173	BZX79-C5V6
D50.	4822 130 34145	BZX79-C39
D51.	5322 130 34233	BZX79-C5V1
D101.	4822 130 31628	BYV27-150
D102.	4822 130 31628	BYV27-150
Miscellaneous		
S1.	5322 276 11123	Mains switch
Transformers		
T1.	5322 148 60244	Switch transformer
T2.	5322 146 30592	Switch transformer

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Capacitors					
C1.	5322 122 33397	2N2	-20+80%	4kV	CERAMIC
C2.	5322 124 21938	68U	-20+20%	385V	ELECTROLYTIC
C3.	5322 124 21938	68U	-20+20%	385V	ELECTROLYTIC
C4.	5322 121 42386	100N	+/-10%	63V	FOIL
C6.	4822 124 20712	33U	-10+50%	40V	ELECTROLYTIC
C7.	5322 122 32056	220P	+/-2%	100V	CERAMIC
C8.	4822 122 30128	4N7	+/-10%	100V	CERAMIC
C9.	5322 122 50107	100NF	+/-20%	250V	PAPER
C12.	5322 121 42663	1N0	+/-5%	2000V	FILM
C13.	5322 121 42386	100N	+/-10%	63V	FOIL
C14.	4822 124 20947	3U3	+/-20%	16V	TANTAL
C15.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C17.	4822 121 41856	22N	+/-10%	100V	FOIL
C19.	5322 121 42979	470N	+/-10%	63V	FOIL
C20.	5322 121 42386	100N	+/-10%	63V	FOIL
C21.	5322 124 10455	68U	+/-20%	6.3V	TANTAL
C27.	4822 124 20704	220U	-10+50%	25V	ELECTROLYTIC
C28.	4822 124 40196	220U	+/-20%	16V	ELECTROLYTIC
C33.	4822 124 20704	220U	-10+50%	25V	ELECTROLYTIC
C34.	4822 124 20704	220U	-10+50%	25V	ELECTROLYTIC
C35.	5322 124 40852	100U	+/-20%	35V	ELECTROLYTIC
C36.	5322 124 40852	100U	+/-20%	35V	ELECTROLYTIC
C37.	4822 124 20745	33U	-10+50%	100V	ELECTROLYTIC
C38.	4822 124 20745	33U	-10+50%	100V	ELECTROLYTIC
C39.	4822 124 20745	33U	-10+50%	100V	ELECTROLYTIC
C40.	4822 124 20745	33U	-10+50%	100V	ELECTROLYTIC
C42.	5322 121 54061	680P	+/-1%	630V	POLYESTER
C43.	4822 121 41857	10N	+/-10%	100V	FOIL
C44.	4822 124 20977	15U	+/-20%	16V	TANTAL
C45.	4822 124 20977	15U	+/-20%	16V	TANTAL
C50.	5322 122 50106	33P	+/-10%	4kV	CERAMIC
C51.	4822 121 41857	10N	+/-10%	100V	FOIL
C52.	5322 121 42604	47N	+/-10%	63V	TANTAL
C55.	5322 122 32343	47P	+/-2%	100V	CERAMIC
C56.	5322 121 42386	100N	+/-10%	63V	FOIL
C57.	4822 122 30128	4N7	+/-10%	100V	CERAMIC
C58.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C59.	4822 124 20745	33U	-10+50%	100V	ELECTROLYTIC
C63.	5322 122 54009	10N	-20+50%	3kV	CERAMIC
C64.	5322 122 33397	2N2	-20+80%	4kV	CERAMIC
C71.	4822 122 31036	2P2	+/-P25	100V	CERAMIC
C72.	5322 121 42386	100N	+/-10%	63V	FOIL
C73.	5322 121 42386	100N	+/-10%	63V	FOIL
C74.	5322 121 42386	100N	+/-10%	63V	FOIL
C75.	5322 121 42386	100N	+/-10%	63V	FOIL
C79.	5322 121 42498	680N	+/-10%	63V	FOIL

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
C80.	5322 121 42386	100N	+/-10%	63V	FOIL
C81.	5322 121 42386	100N	+/-10%	63V	FOIL
C82.	5322 121 42386	100N	+/-10%	63V	FOIL
C83.	5322 121 42386	100N	+/-10%	63V	FOIL
C84.	5322 121 42386	100N	+/-10%	63V	FOIL
C85.	5322 121 42386	100N	+/-10%	63V	FOIL
C86.	5322 121 42386	100N	+/-10%	63V	FOIL
C87.	4822 121 41857	10N	+/-10%	100V	FOIL
C88.	4822 121 41857	10N	+/-10%	100V	FOIL
C89.	4822 122 31036	2P2	+/-P25	100V	CERAMIC
C91.	5322 121 42386	100N	+/-10%	63V	FOIL
C92.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C97.	5322 121 42386	100N	+/-10%	63V	FOIL
C98.	5322 121 42386	100N	+/-10%	63V	FOIL
C99.	5322 121 42386	100N	+/-10%	63V	FOIL
C100.	5322 121 42386	100N	+/-10%	63V	FOIL
C101.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C103.	5322 121 42386	100N	+/-10%	63V	FOIL
C104.	4822 124 40196	220U	+/-20%	16V	ELECTROLYTIC
C105.	5322 124 40852	100U	+/-20%	35V	ELECTROLYTIC
C106.	4822 124 20977	15U	+/-20%	16V	TANTAL
C107.	4822 124 20977	15U	+/-20%	16V	TANTAL
C133.	4822 124 20704	220U	-10+50%	25V	ELECTROLYTIC
C134.	4822 124 20704	220U	-10+50%	25V	ELECTROLYTIC
Resistors					
R1.	4822 116 30069	82R	20%	1.7A	NTC
R12.	4822 116 30248	1K5	5%	0.5W	NTC
R28.	5322 100 10967	10K	20%	0.5W	TRIMPOTM.
R49.	5322 103 10393	20K	20%	0.5W	TRIMPOTM.
R51.	4822 053 21336	33M	5%	0.5W	VR37
R67.	4822 053 20106	10M	5%	0.25W	VR25
R82.	4822 116 30248	1K5	5%	0.5W	NTC

Unit 1A - CRT board

Number	Ordering number	Type
Transistors		
Q1.	4822 130 41646	BF423
Q2.	4822 130 41646	BF423
Q3.	4822 130 41646	BF423
Q4.	4822 130 41646	BF423

Number	Ordering number	Tyoe
Diodes		
D1.	4822 130 30613	BAW62
D2.	4822 130 30613	BAW62
D3.	4822 130 30864	BZX79-C68
D4.	4822 130 30861	BZX79-C7V5
Miscellaneous		
GL1.	5322 134 20291	NEON LAMP

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Capacitors					
C1.	5322 122 33397	2N2	-20+80%	4kV	CERAMIC
C2.	5322 122 33397	2N2	-20+80%	4kV	CERAMIC
C3.	4822 121 41857	10N	+/-10%	100V	FOIL
C4.	5322 121 42386	100N	+/-10%	63V	FOIL
C5.	5322 122 33397	2N2	-20+80%	4kV	CERAMIC
C6.	5322 122 33397	2N2	-20+80%	4kV	CERAMIC
C7.	5322 122 33397	2N2	-20+80%	4kV	CERAMIC
C8.	5322 122 33397	2N2	-20+80%	4kV	CERAMIC
C9.	5322 121 42386	100N	+/-10%	63V	FOIL
Resistors					
R4.	5322 103 10321	100K	20%	0.5W	TRIMPOTM.
R7.	4822 053 20335	3M3	5%	0.25W	VR25
R8.	4822 053 21755	7M5	5%	0.5W	VR37
R9.	4822 053 20335	3M3	5%	0.25W	VR25
R10.	4822 053 20335	3M3	5%	0.25W	VR25
R11.	4822 053 20335	3M3	5%	0.25W	VR25

Unit 2 - CTR control

Number	Ordering number	Type
Diodes		
D1.	4822 130 30613	BAW62

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Resistors					
R6.	5322 103 10305	10K	20%	0.5W	TRIMPOTM.

Unit 3 - Deflection board

Number	Ordering number	Type
Integrated circuits		
V1.	5322 209 62806	LM3046
Transistors		
Q1.	4822 130 44568	BC557B
Q2.	4822 130 44568	BC557B
Q3.	5322 130 62681	BF586
Q4.	5322 130 62681	BF586
Q5.	5322 130 62681	BF586
Q6.	5322 130 62681	BF586
Q41.	4822 130 44568	BC557B
Q42.	5322 130 34954	BFQ32/02
Q43.	5322 130 34954	BFQ32/02
Q44.	5322 130 42244	BFR96S/02
Q45.	5322 130 42244	BFR96S/02
Q46.	4822 130 40959	BC547B
Q47.	4822 130 40959	BC547B
Q48.	5322 130 41799	2N3866/01
Q49.	5322 130 42244	BFR96S/02
Q50.	5322 130 42244	BFR96S/02
Q51.	5322 130 41799	2N3866/01
Diodes		
D1.	4822 130 34328	BZX79-C30
D2.	4822 130 31274	LED RED TLR124
D3.	4822 130 31274	LED RED TLR124
D4.	4822 130 34328	BZX79-C30
D5.	5322 130 30691	BAW56
D6.	5322 130 34331	BAV70
D7.	4822 130 34167	BZX79-C6V2
D8.	4822 130 30613	BAW62
D9.	5322 130 30691	BAW56
D10.	5322 130 34331	BAV70
D11.	4822 130 30613	BAW62
D12.	4822 130 34398	BZX79-B24
D13.	4822 130 34174	BZX79-C4V7
D14.	4822 130 34398	BZX79-B24

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Capacitors					
C2.	5322 121 42489	33N	+/-10%	100V	FOIL
C3.	5322 121 42489	33N	+/-10%	100V	FOIL
C4.	4822 122 31215	P68	+/-P25	100V	CERAMIC
C5.	4822 122 31215	P68	+/-P25	100V	CERAMIC
C6.	4822 122 31072	47P	+/-2%	100V	CERAMIC
C41.	5322 121 42489	33N	+/-10%	100V	FOIL
C46.	4822 122 32185	10P	+/-2%	100V	CERAMIC
C49.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C50.	5322 121 42489	33N	+/-10%	100V	FOIL
C51.	5322 121 42489	33N	+/-10%	100V	FOIL
C52.	5322 121 42489	33N	+/-10%	100V	FOIL
C101.	5322 121 42489	33N	+/-10%	100V	FOIL
C102.	5322 121 42489	33N	+/-10%	100V	FOIL
C104.	4822 124 20744	22U	-10+50%	100V	ELECTROLYTIC
C105.	4822 124 20744	22U	-10+50%	100V	ELECTROLYTIC
C106.	5322 121 42489	33N	+/-10%	100V	FOIL
C109.	4822 124 20977	15U	+/-20%	16V	TANTAL
C110.	5322 121 42489	33N	+/-10%	100V	FOIL
C111.	5322 121 42489	33N	+/-10%	100V	FOIL
C119.	4822 124 20977	15U	+/-20%	16V	TANTAL
C120.	5322 121 42489	33N	+/-10%	100V	FOIL
C121.	5322 121 42489	33N	+/-10%	100V	FOIL
C131.	5322 121 42489	33N	+/-10%	100V	FOIL
Resistors					
R17.	5322 103 10392	500R	20%	0.5W	TRIMPOTM.
R23.	5322 103 10392	500R	20%	0.5W	TRIMPOTM.
R26.	5322 100 10967	10K	20%	0.5W	TRIMPOTM.
R40.	5322 103 10322	200R	20%	0.5W	TRIMPOTM.
R50.	5322 100 10967	10K	20%	0.5W	TRIMPOTM.
R72.	5322 103 10324	100R	20%	0.5W	TRIMPOTM.
R77.	5322 101 10337	2K	20%	0.5W	TRIMPOTM.
R81.	5322 116 55205	2K0	5%	2.5W	PR52
R82.	5322 116 55205	2K0	5%	2.5W	PR52
R87.	5322 116 55205	2K0	5%	2.5W	PR52
R88.	5322 116 55205	2K0	5%	2.5W	PR52

Unit 4 - Signal processor

Number	Ordering number	Type
Integrated circuits		
V1.	5322 209 62806	LM3046
V2.	5322 209 62806	LM3046
V3.	5322 209 62806	LM3046
V4.	5322 209 83228	LM337LZ
V5.	5322 209 11196	74HC4060P
V6.	5322 209 11296	74HC4053P
V8.	5322 209 11296	74HC4053P
V9.	5322 209 63815	MC34085P
V10.	5322 209 82943	LM317LZ
V11.	5322 209 63815	MC34085P
V201.	4822 209 71582	74HC4051P
V202.	5322 209 85803	MC1496N
V204.	4822 209 60002	74HC4052P
V205.	4822 209 63807	NE5517N
V206.	5322 209 11296	74HC4053P
V207.	5322 209 11296	74HC4053P
V208.	5322 209 63815	MC34085P
V301.	5322 209 11296	74HC4053P
V302.	5322 209 81395	LF353N
V303.	4822 209 71582	74HC4051P
V304.	5322 209 62806	LM3046
V401.	4822 209 71582	74HC4051P
V402.	5322 209 85803	MC1496N
V404.	4822 209 60002	74HC4052P
V406.	5322 209 11296	74HC4053P
V501.	5322 209 81395	LF353N
V502.	5322 209 11296	74HC4053P
V503.	4822 209 71582	74HC4051P
V504.	5322 209 62806	LM3046
V505.	5322 209 11334	74HC109P
V506.	5322 209 81395	LF353N
V507.	5322 209 83218	74HC00P
V509.	5322 209 11296	74HC4053P
V601.	5322 209 11342	74HC574P
V602.	5322 209 11342	74HC574P
V603.	5322 209 11342	74HC574P
V605.	5322 209 10883	PCF8574P
V606.	5322 209 10883	PCF8574P
V607.	5322 209 11135	74HC4538P
V608.	5322 209 11194	74HC132P
V609.	5322 209 11342	74HC574P
V610.	5322 209 11342	74HC574P
V611.	5322 209 11342	74HC574P

Number	Ordering number	Type
Transistors		
Q1.	5322 130 44017	BSV79
Q2.	4822 130 44237	BF450
Q3.	5322 130 44017	BSV79
Q4.	4822 130 44237	BF450
Q5.	5322 130 44017	BSV79
Q6.	4822 130 44237	BF450
Q7.	4822 130 44568	BC557B
Q8.	5322 130 60803	BST72A
Q201.	4822 130 44237	BF450
Q202.	4822 130 44237	BF450
Q203.	4822 130 44237	BF450
Q204.	4822 130 44237	BF450
Q205.	4822 130 44154	BF199
Q206.	4822 130 44154	BF199
Q207.	4822 130 44154	BF199
Q208.	4822 130 44154	BF199
Q209.	4822 130 44237	BF450
Q201.	4822 130 44568	BC557B
Q211.	4822 130 44154	BF199
Q212.	4822 130 44154	BF199
Q213.	4822 130 44237	BF450
Q214.	4822 130 40959	BC547B
Q215.	4822 130 40959	BC547B
Q301.	4822 130 40959	BC547B
Q302.	4822 130 44568	BC557B
Q303.	4822 130 40959	BC547B
Q304.	4822 130 44237	BF450
Q305.	4822 130 40959	BC547B
Q311.	4822 130 40959	BC547B
Q401.	4822 130 44237	BF450
Q402.	4822 130 44237	BF450
Q403.	4822 130 44237	BF450
Q404.	4822 130 44237	BF450
Q405.	4822 130 44154	BF199
Q406.	4822 130 44154	BF199
Q407.	4822 130 44154	BF199
Q408.	4822 130 44154	BF199
Q409.	4822 130 44237	BF450
Q411.	4822 130 44154	BF199
Q412.	4822 130 44154	BF199
Q413.	4822 130 44237	BF450
Q501.	4822 130 40959	BC547B
Q502.	4822 130 44568	BC557B
Q503.	5322 130 60803	BST72A
Q504.	5322 130 60803	BST72A
Q505.	4822 130 44568	BC557B

Number	Ordering number	Type
Q506.	4822 130 40959	BC547B
Q507.	4822 130 44568	BC557B
Q508.	4822 130 44237	BF450
Q509.	4822 130 40959	BC547B
Q510.	4822 130 40959	BC547B
Q511.	4822 130 40959	BC547B
Diodes		
D1.	4822 130 34167	BZX79-C6V2
D201.	5322 130 34331	BAV70
D401.	5322 130 34331	BAV70
D501.	4822 130 31981	BZX79-C3V9
D502.	4822 130 31981	BZX79-C3V9
D601.	4822 130 30613	BAW62
D602.	4822 130 30613	BAW62
Crystals		
X1.	5322 242 72146	6.400000MHz
SMD		
A4.	5322 216 61575	Sync separator

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Capacitors					
C1.	5322 124 10455	68U	+/-20%	6.3V	TANTAL
C2.	4822 122 31036	2P2	+/-P25	100V	CERAMIC
C3.	4822 122 31056	12P	+/-2%	100V	CERAMIC
C4.	5322 122 32143	22P	+/-2%	100V	CERAMIC
C5.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C6.	5322 124 10455	68U	+/-20%	6.3V	TANTAL
C7.	4822 122 31036	2P2	+/-P25	100V	CERAMIC
C8.	4822 122 31056	12P	+/-2%	100V	CERAMIC
C9.	5322 122 32143	22P	+/-2%	100V	CERAMIC
C10.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C11.	5322 124 10455	68U	+/-20%	6.3V	TANTAL
C12.	4822 122 31036	2P2	+/-P25	100V	CERAMIC
C13.	4822 122 31056	12P	+/-2%	100V	CERAMIC
C14.	5322 122 32143	22P	+/-2%	100V	CERAMIC
C15.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C21.	5322 122 32143	22P	+/-2%	100V	CERAMIC
C22.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C201.	5322 122 32056	220P	+/-2%	100V	CERAMIC
C202.	5322 121 42386	100N	+/-10%	63V	FOIL

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
C203.	5322 121 42386	100N	+/-10%	63V	FOIL
C204.	5322 121 42386	100N	+/-10%	63V	FOIL
C205.	4822 122 31069	39P	+/-2%	100V	CERAMIC
C206.	5322 125 50051	2P0-18P			TRIMMER
C207.	4822 122 31822	4P7	+/-P25	100V	CERAMIC
C208.	5322 121 42114	1U0	+/-5%	63V	FOIL
C209.	5322 121 42114	1U0	+/-5%	63V	FOIL
C210.	5322 121 42114	1U0	+/-5%	63V	FOIL
C212.	5322 122 32143	22P	+/-2%	100V	CERAMIC
C214.	5322 122 32056	220P	+/-2%	100V	CERAMIC
C215.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C216.	4822 122 31353	330P	+/-2%	100V	CERAMIC
C217.	5322 122 32072	33P	+/-2%	100V	CERAMIC
C218.	5322 124 10455	68U	+/-20%	6.3V	TANTAL
C220.	4822 122 31822	4P7	+/-P25	100V	CERAMIC
C221.	4822 122 32185	10P	+/-2%	100V	CERAMIC
C301.	4822 122 31237	82P	+/-2%	100V	CERAMIC
C302.	4822 122 30045	27P	+/-2%	100V	CERAMIC
C303.	5322 122 32101	1P5	+/-P25	100V	CERAMIC
C305.	4822 122 31348	120P	+/-2%	100V	CERAMIC
C306.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C312.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C313.	4822 122 31353	330P	+/-2%	100V	CERAMIC
C317.	5322 124 10455	68U	+/-20%	6.3V	TANTAL
C321.	4822 122 32185	10P	+/-2%	100V	CERAMIC
C322.	4822 122 31349	68P	+/-2%	100V	CERAMIC
C323.	4822 122 31822	4P7	+/-P25	100V	CERAMIC
C324.	5322 125 50048	1P0-3P5			TRIMMER
C326.	4822 122 31061	18P	+/-2%	100V	CERAMIC
C327.	4822 121 41857	10N	+/-10%	100V	FOIL
C401.	5322 122 32056	220P	+/-2%	100V	CERAMIC
C402.	5322 121 42386	100N	+/-10%	63V	FOIL
C403.	4822 122 31822	4P7	+/-P25	100V	CERAMIC
C404.	5322 121 42386	100N	+/-10%	63V	FOIL
C405.	4822 122 31061	18P	+/-2%	100V	CERAMIC
C406.	5322 125 50051	2P0-18P			TRIMMER
C408.	5322 121 42114	1U0	+/-5%	63V	FOIL
C409.	5322 121 42114	1U0	+/-5%	63V	FOIL
C410.	5322 121 42114	1U0	+/-5%	63V	FOIL
C412.	5322 122 32143	22P	+/-2%	100V	CERAMIC
C501.	4822 122 31237	82P	+/-2%	100V	CERAMIC
C502.	4822 122 30045	27P	+/-2%	100V	CERAMIC
C503.	4822 122 31348	120P	+/-2%	100V	CERAMIC
C504.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C505.	5322 121 54047	270P	+/-1%	630V	POLYESTER
C506.	4822 122 30045	27P	+/-2%	100V	CERAMIC
C507.	5322 121 54124	100N	+/-1%	63V	POLYESTER

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
C508.	4822 122 31353	330P	+/-2%	100V	CERAMIC
C509.	4822 121 41857	10N	+/-10%	100V	FOIL
C510.	5322 122 32056	220P	+/-2%	100V	CERAMIC
C511.	4822 122 31072	47P	+/-2%	100V	CERAMIC
C513.	5322 122 32072	33P	+/-2%	100V	CERAMIC
C514.	4822 122 31061	18P	+/-2%	100V	CERAMIC
C515.	4822 122 31823	15P	+/-2%	100V	CERAMIC
C516.	4822 122 31349	68P	+/-2%	100V	CERAMIC
C517.	4822 122 31822	4P7	+/-P25	100V	CERAMIC
C519.	5322 125 50048	1P0-3P5			TRIMMER
C520.	4822 121 41857	10N	+/-10%	100V	FOIL
C521.	5322 122 32101	1P5	+/-P25	100V	CERAMIC
C522.	5322 125 50051	2P0-18P			TRIMMER
C523.	4822 121 41857	10N	+/-10%	100V	FOIL
C601.	5322 121 42386	100N	+/-10%	63V	FOIL
C602.	5322 122 32056	220P	+/-2%	100V	CERAMIC
C603.	5322 122 32056	220P	+/-2%	100V	CERAMIC
C604.	5322 121 42386	100N	+/-10%	63V	FOIL
C605.	5322 121 42386	100N	+/-10%	63V	FOIL
C606.	5322 122 32056	220P	+/-2%	100V	CERAMIC
C607.	4822 122 31072	47P	+/-2%	100V	CERAMIC
C901.	4822 124 40196	220U	+/-20%	16V	ELECTROLYTIC
C902.	4822 124 20977	15U	+/-20%	16V	TANTAL
C903.	4822 124 20977	15U	+/-20%	16V	TANTAL
C904.	4822 124 20977	15U	+/-20%	16V	TANTAL
C905.	4822 124 20977	15U	+/-20%	16V	TANTAL
C911.	5322 121 42386	100N	+/-10%	63V	FOIL
C912.	5322 121 42386	100N	+/-10%	63V	FOIL
C913.	5322 121 42386	100N	+/-10%	63V	FOIL
C914.	5322 121 42386	100N	+/-10%	63V	FOIL
C915.	5322 121 42386	100N	+/-10%	63V	FOIL
C916.	5322 121 42386	100N	+/-10%	63V	FOIL
C917.	5322 121 42386	100N	+/-10%	63V	FOIL
C918.	5322 121 42386	100N	+/-10%	63V	FOIL
C919.	5322 121 42386	100N	+/-10%	63V	FOIL
C931.	4822 124 40196	220U	+/-20%	16V	ELECTROLYTIC
C932.	4822 124 20977	15U	+/-20%	16V	TANTAL
C933.	4822 124 20977	15U	+/-20%	16V	TANTAL
C934.	4822 124 20977	15U	+/-20%	16V	TANTAL
C941.	5322 121 42386	100N	+/-10%	63V	FOIL
C942.	5322 121 42386	100N	+/-10%	63V	FOIL
C943.	5322 121 42386	100N	+/-10%	63V	FOIL
C944.	5322 121 42386	100N	+/-10%	63V	FOIL
C945.	5322 121 42386	100N	+/-10%	63V	FOIL
C946.	5322 121 42386	100N	+/-10%	63V	FOIL
C961.	4822 124 20977	15U	+/-20%	16V	TANTAL
C971.	5322 121 42386	100N	+/-10%	63V	FOIL

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
C972.	5322 121 42386	100N	+/-10%	63V	FOIL
C973.	5322 121 42386	100N	+/-10%	63V	FOIL
C974.	5322 121 42386	100N	+/-10%	63V	FOIL
C975.	5322 121 42386	100N	+/-10%	63V	FOIL
C976.	5322 121 42386	100N	+/-10%	63V	FOIL
C983.	5322 121 42386	100N	+/-10%	63V	FOIL
C985.	4822 124 20977	15U	+/-20%	16V	TANTAL
C991.	5322 121 42386	100N	+/-10%	63V	FOIL
C992.	5322 121 42386	100N	+/-10%	63V	FOIL
C993.	5322 121 42386	100N	+/-10%	63V	FOIL
Resistors					
R3.	4822 053 20106	10M	5%	0.25W	VR25
R7.	5322 103 10316	1K	20%	0.5W	TRIMPOTM.
R18.	4822 053 20106	10M	5%	0.25W	VR25
R22.	5322 103 10316	1K	20%	0.5W	TRIMPOTM.
R33.	4822 053 20106	10M	5%	0.25W	VR25
R37.	5322 103 10316	1K	20%	0.5W	TRIMPOTM.
R53.	5322 100 11082	2K	20%	0.5W	TRIMPOTM.
R91.	5322 111 91998				MATRIX GBR YUV
R95.	5322 111 91959				MATRIX EBU YUV
R95.	5322 111 91958				MATRIX BET. YUV
R208.	5322 103 10323	100R	20%	0.5W	TRIMPOTM.
R268.	5322 103 10314	100K	20%	0.5W	TRIMPOTM.
R271.	5322 103 10317	500R	20%	0.5W	TRIMPOTM.
R316.	5322 103 10317	500R	20%	0.5W	TRIMPOTM.
R338.	5322 103 10323	100R	20%	0.5W	TRIMPOTM.
R340.	5322 100 11082	2K	20%	0.5W	TRIMPOTM.
R350.	5322 103 10305	10K	20%	0.5W	TRIMPOTM.
R408.	5322 103 10323	100R	20%	0.5W	TRIMPOTM.
R524.	5322 103 10318	5K	20%	0.5W	TRIMPOTM.
R533.	5322 100 11082	2K	20%	0.5W	TRIMPOTM.
R540.	5322 103 10323	100R	20%	0.5W	TRIMPOTM.
R545.	5322 103 10314	100K	20%	0.5W	TRIMPOTM.
R555.	5322 103 10323	100R	20%	0.5W	TRIMPOTM.

Unit 5 - Potmeter board

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Capacitors					
C1.	5322 121 42386	100N	+/-10%	63V	FOIL
C2.	5322 121 42386	100N	+/-10%	63V	FOIL

Unit 6 - Keyboard

Number	Ordering number	Type
Diodes		
D3.	4822 130 30613	BAW62
D4.	4822 130 30613	BAW62
D5.	4822 130 30613	BAW62
D6.	4822 130 30613	BAW62

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Resistors					
R1.	5322 111 91609	9x2K7	2%		NETWORK

Unit 7 - Control board

Number	Ordering number	Type
Integrated circuits		
V1.	5322 209 81395	LF353N
V2.	5322 209 81395	LF353N
V100.	5322 209 86445	7805UC
V101.	5322 209 11744	8464-15L
V102.	5322 209 63814	PROG. PROM
V103.	4822 209 72639	MAB8031AH-12P
V104.	5322 209 83271	74HC573P
V105.	5322 209 81775	ICL8212CPA
V106.	4822 209 70194	74HC04P
V107.	5322 209 10883	PCF8574P
V109.	5322 209 11335	74HC138P
V110.	5322 209 83218	74HC00P
V111.	5322 209 63814	AM2064
V201.	5322 209 83271	74HC573P
V202.	5322 209 11342	74HC574P
V203.	5322 209 50719	75494
V205.	4822 209 10263	HEF4052BP
V206.	4822 209 11583	74HC670P
V207.	5322 209 11196	74HC4060P
V301.	4822 209 63808	74HC193P
V302.	4822 209 63808	74HC193P
V303.	5322 209 11342	74HC574P

Number	Ordering number	Type
V304.	5322 209 52047	PROG. PROM (GRATICULE)
V305.	4822 209 11583	74HC670P
V306.	5322 209 63816	AD7537JN
V308.	5322 209 81395	LF353N
V309.	5322 209 63817	NE5060F
V310.	5322 209 63817	NE5060F
V311.	5322 209 83218	74HC00P
V312.	5322 209 11322	74HC08P
V313.	5322 209 70961	74HC32P
V314.	5322 209 11322	74HC08P
V315.	5322 209 83218	74HC00P
V316.	5322 209 82575	74HC74P
V317.	5322 209 82575	74HC74P
V318.	5322 209 11365	74HC4040P
V319.	5322 209 83218	74HC00P
Transistors		
Q101.	4822 130 40959	BC547B
Q102.	5322 130 44418	BF256A
Q201.	4822 130 41246	BC327-25
Q202.	4822 130 41246	BC327-25
Q203.	4822 130 41246	BC327-25
Q204.	4822 130 41246	BC327-25
Q308.	4822 130 44237	BF450
Q309.	4822 130 44154	BF199
Diodes		
D3.	4822 130 34189	BAV20
D101.	4822 130 31983	BAT85
D102.	4822 130 31983	BAT85
D104.	4822 130 30613	BAW62
D201.	4822 130 30613	BAW62
D202.	4822 130 30613	BAW62
D203.	4822 130 30613	BAW62
D204.	4822 130 30613	BAW62
Crystals		
X101.	4822 242 71663	12.000000MHz
Miscellaneous		
B101.	5322 138 10262	Battery

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Capacitors					
C101.	5322 121 42386	100N	+/-10%	63V	FOIL
C102.	4822 122 30045	27P	+/-2%	100V	CERAMIC
C103.	4822 122 30045	27P	+/-2%	100V	CERAMIC
C104.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C105.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C106.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C107.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C108.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C109.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C110.	4822 124 20977	15U	+/-20%	16V	TANTAL
C111.	5322 121 42386	100N	+/-10%	63V	FOIL
C112.	5322 121 42386	100N	+/-10%	63V	FOIL
C115.	4822 124 20977	15U	+/-20%	16V	TANTAL
C116.	5322 121 42386	100N	+/-10%	63V	FOIL
C117.	5322 121 42386	100N	+/-10%	63V	FOIL
C120.	4822 124 20977	15U	+/-20%	16V	TANTAL
C121.	5322 121 42386	100N	+/-10%	63V	FOIL
C122.	5322 121 42386	100N	+/-10%	63V	FOIL
C123.	5322 121 42386	100N	+/-10%	63V	FOIL
C124.	5322 121 42386	100N	+/-10%	63V	FOIL
C125.	5322 121 42386	100N	+/-10%	63V	FOIL
C126.	5322 121 42386	100N	+/-10%	63V	FOIL
C127.	5322 121 42386	100N	+/-10%	63V	FOIL
C128.	5322 121 42386	100N	+/-10%	63V	FOIL
C129.	5322 121 42386	100N	+/-10%	63V	FOIL
C130.	5322 121 42386	100N	+/-10%	63V	FOIL
C131.	5322 121 42386	100N	+/-10%	63V	FOIL
C132.	5322 121 42386	100N	+/-10%	63V	FOIL
C134.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C135.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C140.	4822 122 31316	100P	+/-2%	100V	CERAMIC
C201.	5322 122 32331	1N0	+/-10%	100V	CERAMIC
C301.	5322 121 54071	2N2	+/-1%	250V	POLYESTER
C302.	5322 121 54071	2N2	+/-1%	250V	POLYESTER
C307.	4822 122 30045	27P	+/-2%	100V	CERAMIC
C309.	4822 122 30045	27P	+/-2%	100V	CERAMIC
C310.	4822 122 30045	27P	+/-2%	100V	CERAMIC
C315.	4822 124 20977	15U	+/-20%	16V	TANTAL
C317.	4822 124 40196	220U	+/-20%	16V	ELECTROLYTIC
C347.	5322 121 42386	100N	+/-10%	63V	FOIL
C348.	5322 121 42386	100N	+/-10%	63V	FOIL
Resistors					
R5.	5322 103 10306	200R	20%	0.5W	TRIMPOTM.
R113.	5322 111 91609	9x2K7	2%		NETWORK
R114.	5322 111 91599	5x10K	2%		NETWORK

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
R115.	5322 111 91599	5x10K	2%		NETWORK
R118.	4822 111 91953	5x1K	2%		NETWORK
R209.	5322 111 90454	9x1K0	2%		NETWORK
R214.	4822 111 91953	5x1K	2%		NETWORK
R215.	4822 111 91953	5x1K	2%		NETWORK
R304.	5322 100 11082	2K	20%	0.5W	TRIMPOTM.
R308.	5322 100 11082	2K	20%	0.5W	TRIMPOTM.

Unit 8 - GBR monitor

Number	Ordering number	Type
Integrated circuits		
V1.	4822 209 63807	NE5517N
V2.	4822 209 63807	NE5517N
V3.	5322 209 11135	74HC4538P
V4.	5322 209 11194	74HC132P
V5.	5322 209 62806	LM3046
V6.	5322 209 62806	LM3046
V7.	5322 209 82943	LM317LZ
Transistors		
Q1.	4822 130 40959	BC547B
Q2.	4822 130 44237	BF450
Q3.	4822 130 40959	BC547B
Q4.	4822 130 40959	BC547B
Q5.	4822 130 44237	BF450
Q6.	4822 130 40959	BC547B
Q7.	4822 130 40959	BC547B
Q8.	4822 130 44237	BF450
Q9.	4822 130 40959	BC547B
Q10.	4822 130 44237	BF450
Q11.	4822 130 44237	BF450
Q12.	4822 130 44237	BF450
Q15.	4822 130 44237	BF450
Q16.	4822 130 40959	BC547B
Q17.	4822 130 44154	BF199
Q18.	4822 130 40959	BC547B
Q19.	4822 130 44237	BF450
Q20.	4822 130 44237	BF450
Q21.	4822 130 44237	BF450
Q22.	4822 130 44237	BF450

Number	Ordering number	Type
Diodes		
D1.	4822 130 30613	BAW62
D2.	4822 130 30613	BAW62
D3.	4822 130 30613	BAW62

Number	Ordering number	Value	Tol(%)	Volt/Watt	Description
Capacitors					
C1.	4822 124 20977	15U	+/-20%	16V	TANTAL
C2.	4822 121 41857	10N	+/-10%	100V	FOIL
C3.	4822 122 31056	12P	+/-2%	100V	CERAMIC
C4.	4822 124 20977	15U	+/-20%	16V	TANTAL
C5.	4822 122 31056	12P	+/-2%	100V	CERAMIC
C6.	4822 121 41857	10N	+/-10%	100V	FOIL
C8.	4822 124 20977	15U	+/-20%	16V	TANTAL
C9.	4822 122 31056	12P	+/-2%	100V	CERAMIC
C10.	4822 121 41857	10N	+/-10%	100V	FOIL
C11.	4822 122 32185	10P	+/-2%	100V	CERAMIC
C12.	4822 122 31822	4P7	+/-P25	100V	CERAMIC
C15.	4822 124 20977	15U	+/-20%	16V	TANTAL
C16.	4822 122 31822	4P7	+/-P25	100V	CERAMIC
C19.	4822 124 20977	15U	+/-20%	16V	TANTAL
C20.	4822 124 20977	15U	+/-20%	16V	TANTAL
C21.	4822 124 20977	15U	+/-20%	16V	TANTAL
C41.	5322 121 42386	100N	+/-10%	63V	FOIL
C42.	5322 121 42386	100N	+/-10%	63V	FOIL
C44.	4822 124 20977	15U	+/-20%	16V	TANTAL
C45.	5322 121 42386	100N	+/-10%	63V	FOIL
C46.	5322 121 42386	100N	+/-10%	63V	FOIL
C47.	5322 121 42386	100N	+/-10%	63V	FOIL
C48.	4822 124 20977	15U	+/-20%	16V	TANTAL
C49.	5322 121 42386	100N	+/-10%	63V	FOIL
C50.	5322 121 42386	100N	+/-10%	63V	FOIL
C51.	4822 124 20977	15U	+/-20%	16V	TANTAL
Resistors					
R36.	5322 103 10317	500R	20%	0.5W	TRIMPOTM.
R43.	5322 103 10317	500R	20%	0.5W	TRIMPOTM.
R66.	5322 103 10321	100K	20%	0.5W	TRIMPOTM.

List of standard resistors

MR25 = 0.4W, 1%,
METAL FILM RESISTOR

Type	Value	Ordering number
MR25	10	5322 116 50452
MR25	11	5322 116 54058
MR25	12.1	5322 116 54069
MR25	13	5322 116 54082
MR25	15	5322 116 51221
MR25	16.2	5322 116 54431
MR25	18.2	5322 116 54083
MR25	20	5322 116 51048
MR25	22.1	5322 116 50983
MR25	24.3	5322 116 54435
MR25	26.7	5322 116 54087
MR25	30.1	5322 116 50804
MR25	33.2	5322 116 50527
MR25	35.7	5322 116 54439
MR25	39.2	5322 116 54087
MR25	43.2	5322 116 50519
MR25	47.5	5322 116 50952
MR25	51.1	5322 116 54442
MR25	56.2	5322 116 54446
MR25	61.9	5322 116 54451
MR25	68.1	5322 116 54455
MR25	75	5322 116 54459
MR25	82.5	5322 116 54462
MR25	90.9	5322 116 54466
MR25	100	5322 116 55549
MR25	110	5322 116 54474
MR25	130	5322 116 54481
MR25	150	5322 116 54486
MR25	162	5322 116 50417
MR25	182	5322 116 54493
MR25	200	5322 116 54496
MR25	221	4822 116 51223
MR25	267	5322 116 54503
MR25	301	5322 116 55366
MR25	332	4822 116 51226
MR25	357	5322 116 50603
MR25	392	5322 116 54006
MR25	432	5322 116 54522
MR25	475	5322 116 54007
MR25	511	4822 116 51282
MR25	562	4822 116 51231
MR25	619	4822 116 51232
MR25	681	4822 116 51233
MR25	750	4822 116 51234
MR25	825	5322 116 54541
MR25	909	5322 116 55278
MR25	1K	4822 116 51235
MR25	1.10K	4822 116 51236
MR25	1.21K	5322 116 54557
MR25	1.30K	5322 116 50526
MR25	1.50K	4822 116 51239
MR25	1.62K	5322 116 55359
MR25	1.82K	5322 116 54568
MR25	2K	5322 116 54572
MR25	2.21K	4822 116 51245
MR25	2.43K	5322 116 54004
MR25	2.67K	5322 116 54578
MR25	3.01K	4822 116 51246
MR25	3.32K	5322 116 54005
MR25	3.57K	5322 116 54586
MR25	3.92K	5322 116 54591
MR25	4.32K	5322 116 54594
MR25	4.75K	5322 116 54008
MR25	5.11K	5322 116 54595
MR25	5.62K	4822 116 51281
MR25	6.19K	5322 116 55426
MR25	6.81K	4822 116 51252
MR25	7.50K	5322 116 54608
MR25	8.25K	5322 116 54558
MR25	9.09K	4822 116 51284

Type	Value	Ordering number
MR25	10K	4822 116 51253
MR25	11K	5322 116 54623
MR25	12.1K	5322 116 50572
MR25	13K	5322 116 50522
MR25	15K	4822 116 51255
MR25	16.2K	5322 116 55361
MR25	18.2K	5322 116 54638
MR25	20K	5322 116 54642
MR25	22.1K	4822 116 51257
MR25	24.3K	5322 116 54647
MR25	26.7K	5322 116 54652
MR25	30.1K	5322 116 54655
MR25	33.2K	4822 116 51259
MR25	35.7K	5322 116 54662
MR25	39.2K	4822 116 51262
MR25	43.2K	5322 116 54667
MR25	47.5K	5322 116 54671
MR25	51.1K	5322 116 50672
MR25	56.2K	4822 116 51264
MR25	61.9K	5322 116 50672
MR25	68.1K	4822 116 51266
MR25	75K	4822 116 51267
MR25	82.5K	5322 116 55374
MR25	90.9K	5322 116 54694
MR25	100K	4822 116 51268
MR25	110K	5322 116 54701
MR25	121K	5322 116 54704
MR25	130K	5322 116 54707
MR25	150K	4822 116 51269
MR25	162K	5322 116 54716
MR25	182K	5322 116 54722
MR25	200K	4822 116 51266
MR25	221K	4822 116 51272
MR25	243K	5322 116 54733
MR25	267K	4822 116 54737
MR25	301K	5322 116 54743
MR25	332K	4822 116 51184
MR25	357K	5322 116 51767
MR25	392K	5322 116 51768
MR25	432K	5322 116 51769
MR25	475K	4822 116 51275
MR25	511K	5322 116 55258
MR25	562K	4822 116 51169
MR25	619K	5322 116 55315
MR25	681K	5322 116 55284
MR25	750K	5322 116 55532
MR25	825K	5322 116 51398
MR25	909K	5322 116 55533
MR25	1M	5322 116 55535

SMD resistors

Type 0805 = 1W, 0.5%,
CHIP

Type	Value	Ordering number
0805	2R2	4822 116 90466
0805	2R7	5322 116 82067
0805	3R3	4822 116 90469
0805	3R9	4822 116 82062
0805	4R7	4822 116 90462
0805	5R6	5322 116 82068
0805	6R8	5322 116 82069
0805	8R2	5322 116 82071
0805	10R	4822 116 90457
0805	12R	5322 116 82066
0805	15R	4822 116 81118
0805	18R	5322 116 81929
0805	22R	4822 116 90467
0805	27R	4822 116 90468
0805	33R	4822 116 90471
0805	39R	4822 111 91653
0805	47R	4822 111 91652
0805	56R	4822 116 90451
0805	68R	4822 116 80887
0805	82R	4822 111 91507
0805	100R	4822 116 90441
0805	120R	4822 116 81026
0805	150R	4822 116 80879
0805	180R	4822 116 90438
0805	220R	4822 116 90339
0805	270R	4822 116 80882
0805	330R	4822 111 91501
0805	390R	4822 116 81029
0805	470R	4822 116 90446
0805	560R	4822 111 91533
0805	680R	4822 116 90463
0805	820R	4822 116 81034
0805	1K0	4822 111 91516
0805	1K2	4822 116 80877
0805	1K5	4822 116 90458
0805	1K8	4822 116 81383
0805	2K2	4822 111 91522
0805	2K7	4822 111 91449
0805	3K3	4822 111 91526
0805	3K9	4822 111 91527
0805	4K7	4822 111 91532
0805	5K6	4822 111 91534
0805	6K8	4822 116 90464
0805	8K2	4822 111 91655
0805	10K	4822 111 91517
0805	12K	4822 116 81382
0805	15K	4822 111 91498
0805	18K	4822 111 91521
0805	22K	4822 111 91523
0805	27K	4822 116 90342
0805	33K	4822 116 81017
0805	39K	4822 116 90445
0805	47K	4822 111 91661
0805	56K	4822 111 91535
0805	68K	4822 116 90347
0805	82K	4822 116 81389
0805	100K	4822 111 91518
0805	120K	4822 116 90442
0805	150K	4822 116 90459
0805	180K	4822 116 90443
0805	220K	4822 116 80881
0805	270K	4822 116 81028
0805	330K	4822 116 90345
0805	390K	4822 111 91529
0805	470K	4822 116 90447
0805	560K	4822 116 80925
0805	680K	4822 116 81032
0805	820K	4822 116 90348