

## Errata

**Title & Document Type:** 1220A/21A Oscilloscope Operating and Service Manual

**Manual Part Number:** 01220-90001

**Revision Date:** February 1974

### About this Manual

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### HP References in this Manual

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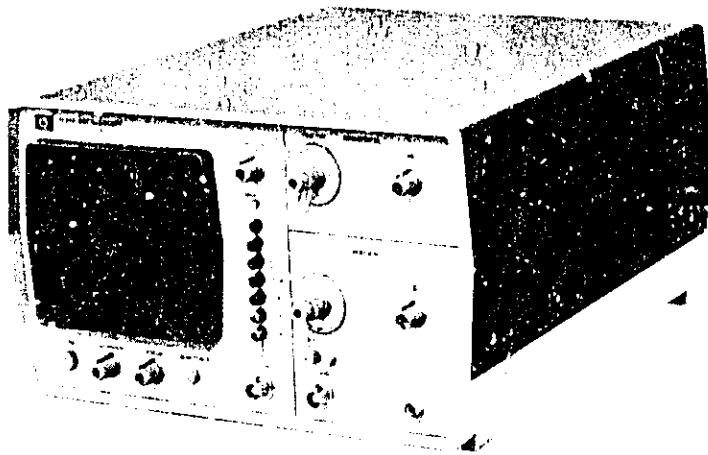
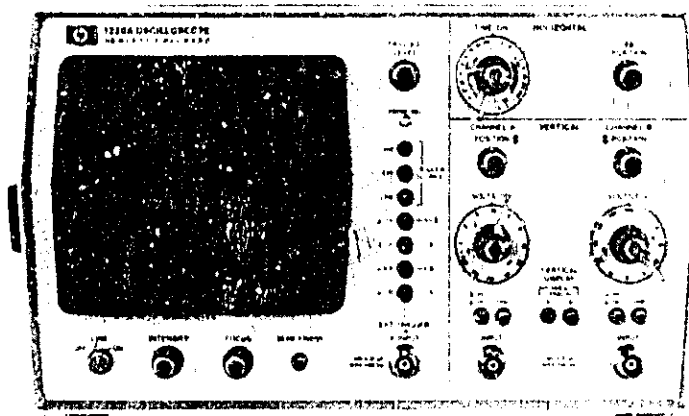
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Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.



**Agilent Technologies**

# OSCILLOSCOPE 1220 A AND 1221 A



HEWLETT *hp* PACKARD

### CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the US National Bureau of Standards to the extent allowed by the Bureau's calibration facilities or to the calibration facilities of other International Standards Organization Members.

### WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

For any assistance contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

### PREFACE

One copy of this manual is supplied with each instrument. Additional copies may be purchased from the local Hewlett-Packard Sales and Service Office. Specify the instrument model number and serial number. A microfiche version of this manual is available under part number 01220-977501.

Reference should be made to the manual change sheets supplied with the manual for errata and technical changes.

Technical changes are indicated by the prefix (the first five characters) of the serial number which appears on the rear panel of the instrument; the serial number prefix of the instrument to which this manual applies directly is:

**1322G**

for serial number 06 381 on for Model 1220(A)  
and 06 321 on for Model 1221(A)

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1-1 Your new Hewlett-Packard Model 1220A or 1221A Oscilloscope is produced using the same construction and design techniques used to achieve laboratory instrument measurement accuracy. You can rely on this instrument for long, dependable, accurate operation wherever you use it and whatever the conditions under which you use it.

1-2 Special effort has gone into the design of your Oscilloscope to make it easy to use. Front panel controls are separated into logical groupings; each group is identified, and so is each control in the group. Latching pushbuttons are used to make it easy to change modes of operation, with ample finger-space allowed.

1-3 Controls and connectors less frequently used are placed on the rear panel: Line voltage selector switches; fuse holder; Z-input (intensity modulation); power source for camera adapter; and convenient ground connector.

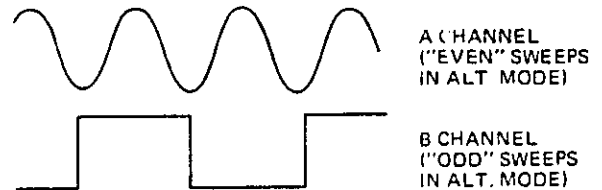
1-4 Easy servicing is ensured by the use of only four circuit modules: Trigger circuit board (horizontal or sweep circuits); Amplifier circuit board (vertical circuits); High Voltage circuit; Heat Sink Assembly (primary power input). All assemblies are removable for servicing, as is the CRT (cathode-ray tube). Full instructions for assembly removal are provided in the Maintenance section.

1-5 Specifications are shown in Table 1-1. Vertical deflection sensitivities, horizontal sweep speeds, risetime, and bandwidth response are ample for tests required in servicing black-and-white or color television receivers, AM or FM radio receivers, tape recorders, or any other electronic equipment of similar nature. Synchronization is possible from TV line or frame.

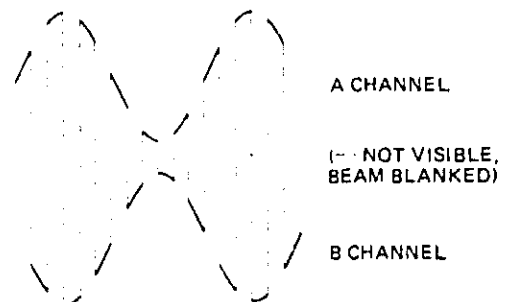
In addition, the 1220A allows two signals to be compared. The affect of a dual trace display being achieved by automatic 'alternate' and 'chop' switching. Briefly, here is a description of how this works:

Alternate display mode shows a display of each vertical channel input signal on alternate sweeps. Let's suppose a sine wave is

applied to Channel A input and a square wave to Channel B input. The first sweep will display the sine wave, the next sweep will display the square wave, the next displays the sine wave, and so on. Notice that this display mode is automatically selected in sweep speeds of  $0.1\mu\text{s}/\text{cm}$  to  $500\mu\text{s}/\text{cm}$ .



Chop mode is effective at sweep speeds below  $1\text{ms}/\text{cm}$  and the display is developed by the sweep circuits switching from one input to the other very rapidly. Persistence of the CRT phosphor glow and visual persistence of the viewer build a continuous display of both channels. This phenomenon is illustrated in the following diagram (in this case two sine waves are applied).



These two methods of display are automatically chosen when you select sweep speed and make it possible for you to see two complete signals simultaneously without undesirable flicker

1-6 Note that the terms "sweep" and "trigger" are two entirely different things. "Sweep" refers to the constant rate of travel of the beam, or trace horizontally across the display area. It is governed directly by the setting of the horizontal TIME/DIV control. "Trigger" determines the timing of the start of each sweep and does not necessarily occur at regular intervals.

1-7 Items supplied with your Oscilloscope are:

**Power Cable:** 3-wire, removable. Cable plugs are provided for receptacles commonly found in your area.

**Fuses:** One 0.5 ampere fuse for 100/120V operation.  
One 0.25 ampere fuse for 220/240V operation.

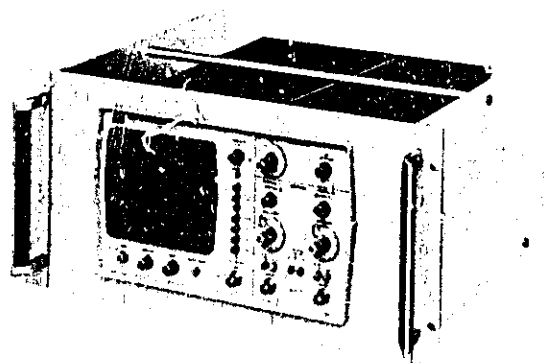
**Light Filter:** Blue.

**Operating and Service Manual.**

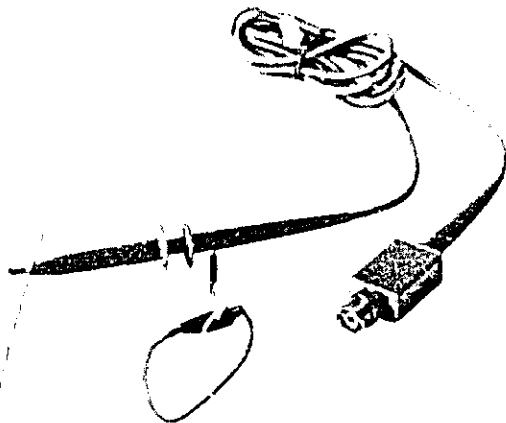
Operating Instructions in German, French and Italian, part number 01220-90002

Other accessories available:

**Rack Mount Kit:** 8 3/4-in. x 19-inch, HP Model 10119A.



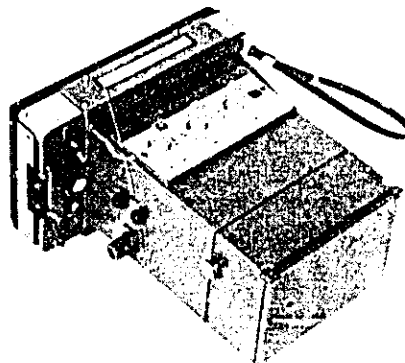
**Attenuator Probe:** compensating, 10:1 attenuation ratio, HP Model 10013A;



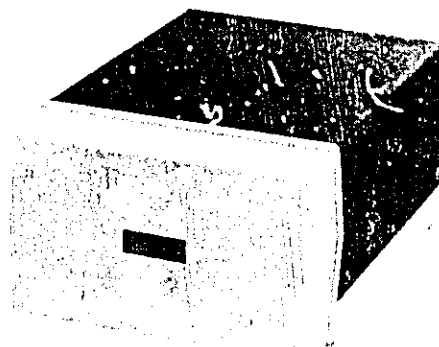
**BNC/Banana Plug Adapter:** HP Model 10110A.

**Camera:** HP Model 123A (requires Camera Adapter).

**Camera Adapter:** HP Model 10373A.



**Front Panel Cover:** with accessory storage compartment, HP Model 10117A.



**Viewing Hood:** HP Model 10116A.



Table 1-1. Specifications

**Modes of Operation (1220A only)**

channel A; channel B; channels A and B displayed alternately on successive sweeps (alt); triggering by A channel; channels A and B displayed by switching between channels at approx. 200kHz rate with blanking during switching (chop); automatic selection of alternate or chop mode.

Chop: at sweep speeds from 0.5sec/div to 1ms/div;

Alt: 0.5ms/div to .1 $\mu$ s/div.

**VERTICAL AMPLIFIERS**

(1220A - 2-channel, 1221A - 1-channel)

**BANDWIDTH**

(50kHz, 50 $\Omega$  source reference signal giving 6cm vertical deflection)

DC-coupled: dc to 15 MHz (-3dB)

AC-coupled: approx. 2 Hz to 15 MHz (-3dB)

Risetime: approx. 23ns

**DEFLECTION FACTOR**

Ranges: from 2mV/div to 10V/div (12 ranges) in 1, 2, 5 sequence.  $\pm$  3% accuracy with vernier in calibrated position on 10mV/cm to 10V/div ranges.  $\pm$  5% accuracy on 2mV/div and 5mV/div ranges.

Vernier: continuously variable between all ranges, extends maximum deflection factor to at least 25V/div.

**INPUTS**

Input RC: 1 megohm shunted by approx. 30pF.

Input coupling: AC, DC or GND selectable. GND position disconnects signal input and grounds amplifier input.

Maximum Input:  $\pm$  400V (dc + pk ac).

**TIME BASE****SWEEP**

Ranges: from 0.1 $\mu$ sec/div to 0.5sec/div (21 ranges) in 1, 2, 5 sequence.  $\pm$  4% accuracy with Expander in calibrated position.

Expander: expands sweep continuously min. 10 times. Usable max. sweep speed is approx. 20ns.

**SWEEP MODE**

Sweep is triggered by internal or external signal. Bright baseline displayed in absence of input signal.

**TRIGGERING**

Internal: approx. 2 Hz to 15 MHz on signals causing 1 div. or more vertical deflection.

External: approx. 2 Hz to 15 MHz on signals 0.1Vpp or more.

External Input RC: approx. 1 megohm shunted by approx. 30pF.

Line: triggers on line frequency.

TV Sync: Separator for positive or negative video, 1 div. min. video signal to trigger. Time/div switch selects automatic frame (0.5 s/div to 100 $\mu$ s/div) or automatic line (50 $\mu$ s/div to 0.1 $\mu$ s/div) trigger. Usable also as a low pass filter.

**LEVEL AND SLOPE**

Internal: at any point on the positive or negative slope of the displayed waveform.

External: continuously variable from +0.5V to -0.5V on each slope of the trigger waveform (with 20dB-Attenuator: +5V to -5V).

**EXTERNAL HORIZONTAL INPUT**

Bandwidth: dc to 1 MHz

**Deflection Factor.**

Expander	X-Mode Attenuator	Deflect. Fact.
CW	1:1	100mV/div
Cal.	1:1	1V/div
Cal.	1:10	10V/div

Continuous adjustment between ranges by Expander.

Table 1-1. Specifications (cont'd)

Input RC: 1 megohm shunted by approx. 30pF

X-Y Phase Shift: less than 3 $^{\circ}$  at 100KHz.

**CATHODE-RAY TUBE**

TYPE: mono-accelerator, 2kV accelerating potential, P31 Phosphor

Graticule: 8 x 10 cm internal graticule; 0.2 div sub-division; on major axes.

Beam Finder: returns trace to CRT screen regardless of setting of horizontal and vertical controls.

Intensity Modulation: +5V (TTL compatible) 2 Hz to 1 MHz blanks trace of any intensity.

Maximum Input: 7V RMS

Input Resistance: approx. 1.5k $\Omega$

**GENERAL**

Probe Adjust: approx. 0.5 V pp, 2 kHz square wave for adjusting probe compensation.

Power Requirements: 100, 120, 220, 240V + 5, -10% 48 to 66 Hz. Approx. 40W

**Weight:**

1220A: net 16 lbs (7.3 kg);

shipping 21 lbs (9.5 kg)

1221A: net 15 1/2 lbs (7 kg);

shipping 20 1/2 lbs (9.2 kg)

**Dimensions:**

Height 170 mm (7.1 in.)

Width 311.2 mm (12.7 in.)

Depth 412.8 mm (16.1 in.)

**ENVIRONMENTAL SPECIFICATIONS**

Temperature: Nonoperating -40 to +70 $^{\circ}$ C. Operating 0 to +45 $^{\circ}$ C within specs.

Humidity: to 95% relative humidity at 40 $^{\circ}$ C.

Vibration: vibrated in three planes for 15 min. each with 0.25 mm (0.010 inch) excursion, 10 to 55 Hz.

Altitude: to 4600 m (15000 ft.)

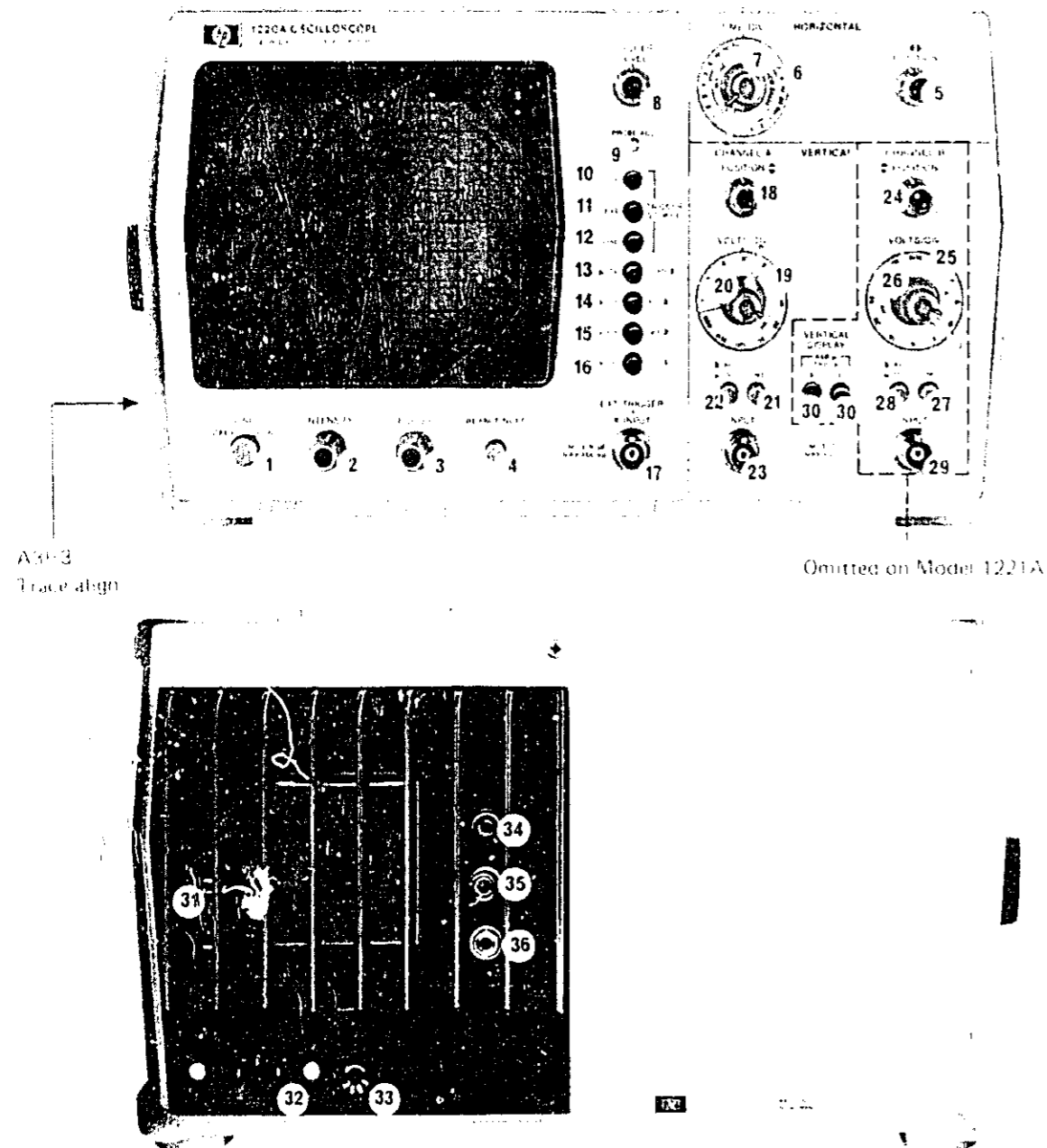
Accessories furnished: 1 power cord, 1 blue light filter, fuses for 100/120 V operation and 220/240 V operation, 1 operating and service manual, operating instructions in French, German and Italian.

**OPTIONS**

Option 007: CRT with P7 phosphor instead of P31 phosphor.

Option 020: Front Panel in German

Option 021: Front Panel in French



Initial Settings as above. Controls 1, 10 and 30A are pressed and other pushbuttons are released

**1** LINE. Applies primary power to the instrument.  
**2** INTENSITY. Controls brightness of the display.  
**CAUTION.** A trace or spot of too high intensity may burn the phosphor inside the CRT face. See INTENSITY LIMIT adjustment in Section 3.

**3** FOCUS. Controls sharpness and clarity of the display. An interior adjustment ensures proper focus of all parts of the trace. See ASTIGMATISM adjustment in Section 3.

**4** BEAM FINDER. Brings beam or trace into viewing area of CRT. When pressed,

this pushbutton reduces amplifier gain to a level where trace cannot be deflected offscreen. By watching the viewing area as you press this button, you will be able to tell which other controls must be adjusted to bring the trace back on screen (i.e. POSITION controls).

**5** HORIZONTAL POSITION. Adjust the movement of the trace from side to side

Figure 2-1. Controls and Connectors

on the viewing area. When the expander is being used, this control makes it possible for you to view either end of the expanded trace, or any point between.

**6** HORIZONTAL TIME DIV. With expander in the calibrated position (fully counterclockwise), markings on this dial indicate the amount of time it takes for a spot on the CRT to travel one horizontal division. This time ranges from 0.1  $\mu$ sec to 0.5sec. Note also that the setting of this control governs the type of display (alternate or chop) in Model 1220A.

**7** EXPANDER. To effect the expansion of a horizontal scan (center). Clockwise rotation allows the trace to be stretched by factors up to 10. This has many applications when a particular point on a wave form is of interest. With the expander out of detent position, sweep speed does not relate directly to the TIME DIV. switch markings.

**8** TRIGGER LEVEL. This control enables the operator to start the sweep at any desired amplitude level on the applied signal.

**9** PROBE ADJ. At this point, an externally generated square wave is brought to the front panel where it may be used to compensate low capacity divider probes by attaching the probe tip to this point and connecting the probe to a vertical amplifier; the probe compensator may be adjusted to match the oscilloscope input.

**10** INT. This pushbutton is pressed to select an internally generated sync signal to trigger the sweep. Pressing this pushbutton releases EXT **11** and LINE **12**.

**11** EXT. When pressed this pushbutton allows the Model 1220A/1221A to trigger on an external sync signal applied to EXT TRIGGER INPUT **17**. Pressing this pushbutton releases INT **10** and LINE **12**.

**12** LINE. Pressing this pushbutton allows the sweep circuit to trigger on a line power supply frequency. The known power source frequency may be used as a handy reference for investigating interference problems.

**13** TV NORM. In the NORM position (retracted) this pushbutton disables the TV Sync Separator circuit and the instrument operates in the normal mode. When pressed to the TV position, the TV Sync Separator is enabled and the

coeff. scope triggers on the frame (Housed or slower or line (faster or faster) sync of a video signal applied to the EXT TRIGGER INPUT **17** or to a CHANNEL A **23** or CHANNEL B **29** INPUT.

**14** When released, oscilloscope will trigger on positive going edge of applied signal. When pressed, the negative going edge will cause the trigger.

**15** X-Y SWP. Sweep. Set to the SWP position (retracted), the dual-trace operation in the normal mode. Set to X-Y position, the oscilloscope deflects horizontally by an amount proportional to the amplitude of the signal applied to **17**.

**16** EXT. TRIGGER. EXT. TRIGGER applied to **17** may be attenuated by a factor of 10 when the pushbutton is in the pressed position. Release the pushbutton to return to a 1:1 amplitude ratio.

**17** EXT. TRIGGER. X-Y SWP. A blank display (an external probe may be applied to this input to deflect the beam along the X-axis) is obtained when the hand is moved up and down the sweep.

**18** CHANNEL A VOL. TRIG. Horizontal (retracted) clockwise rotation of this dial makes up and down the wave so that makes the trace down.

**19** CHANNEL A VOLTS DIV. This dial indicates the voltage of the input signal in the exactly what input voltage is. It will deflect the beam vertically one division on the grid scale when the vertical **20** is calibrated position (fully counterclockwise) set. For example, if you apply a 200mV amplitude signal to CHANNEL A INPUT **23** and the VOLTS DIV switch is set to 100mV, the beam will be deflected vertically two divisions.

**20** CHANNEL A gain (center). This control gives continuous variation within calibrated settings on control **19** and is useful in making voltage comparisons.

**21** CHANNEL A GND. When this pushbutton is pressed, CHANNEL A amplifier is grounded and any signal applied to CHANNEL A INPUT **23** is disconnected. Automatic trace is automatically applied to the CRT. This pushbutton is helpful in establishing a zero volt level.

**22** CHANNEL A AC/DC. Determines whether the input signal is connected to the preamplifier capacitively (AC) or directly (DC). When the signal is direct

coupled (DC), the instrument has band width response from 0 to 15 MHz (capacitively coupled). With the band width response from 2 MHz to 15 MHz.

**23** CHANNEL A INPUT.

**24-29** Channel controls (see controls **18-23**).

**30** DUAL/AC DISPLAY. When two or more input signals are applied (line to Channel A, line to Channel B), these pushbuttons determine which channel will be displayed on the CRT. When DUAL/AC DISPLAY A is pressed, the Channel A input signal is displayed, or Channel B when B is pressed. When both pushbuttons are pressed, both vertical signals are displayed at the same time. Pushbutton **18-29** position in the top row (one above the other) will cause a portion of the two signals (just those indicated) the signal at channel A is only selected is the top row. This allows the operator to compare the input between the two signals.

**31** See Page 2-1.

**32** REAR PANEL SELECT SWITCHES. These switches select the external source of the signal to accept the primary channel sweep signal. The SWITCHES will be in the position marked for the probe which is currently used.

**33** Rear Panel Power Receptacle. A three pin receptacle to provide power (ground through the power cable for use of the power).

**34** Rear Panel Fuse Holder. An optional 500mA fuse (1/2 amp) is provided (rated for use of current over load). A 1/2 Ampere slow blow fuse must be used when operating from 100V-120V power source. A 0.25 Ampere fuse is used when operating from 220V-240V power source.

**35** Rear Panel Z. A banana jack that permits intensity modulation (Z-axis) voltages to be applied. A 10V signal applied to the Z input will blank a trace of any intensity. This feature is helpful in determining signal frequencies, and because it is TTL (transistor-resistor logic) compatible, computerized signals may also be used as blanking input. Maximum input at this jack is 7 V rms RMS.

**36** Rear Panel 12V. This connector provides a convenient ground point for test instruments being used for adjustment or performance checks.

**36** Rear Panel 12V.

Figure 2-1. Controls and Connectors

## 2-1 GENERAL

2-2 Now that you have been introduced to your new oscilloscope, let's put it to work. First, we will tell you a few things you should do before you turn the instrument on. These things protect you and the instrument.

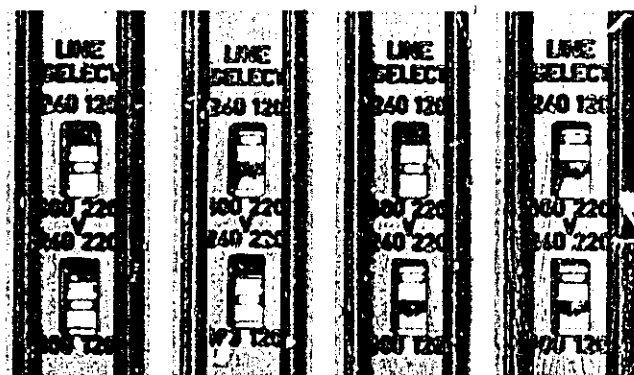
Then, we will tell you how to put the instrument into operation. Until you are completely familiar with your oscilloscope, we recommend that you perform this turn on procedure each time you use the instrument.

Notice that in most of these procedures, we are letting the oscilloscope handle all the triggering problems. At the end of this section there is a more complete discussion of triggering information.

## 2-3 BEFORE INITIAL TURN-ON:

2-4 Check the fuse in the fuse-holder 33 on the rear panel. If you intend to use 100V or 120V power source, the fuse should be .5 ampere slow-blow. For a power source of 220V or 240V, the fuse should be .25 ampere slow-blow.

2-5 Check the LINE SELECTOR switches 31 on the rear panel. Correct line voltage is very important. If trace modulation is apparent, refer to paragraph 3-66 and table 4-2.02.



for  
100V

for  
120V

for  
220V

for  
240V

2-6 The power cord supplied with your oscilloscope is a three-wire cord with a ground terminal. Used in a power outlet with a ground terminal, the operator is protected against shock. If you are using a power outlet that does not have a ground terminal, use an appropriate adapter and fasten the ground lead to an external ground. In this way you retain the operator protection features.

## 2-7 INITIAL TURN-ON PROCEDURE

2-8 First, set front panel controls as indicated in figure 2-1 so that when you apply power you will achieve a display on the viewing area. Now that all the button-pushing and knob-turning is done, rotate the INTENSITY control 2 slowly clockwise, if necessary, until a trace appears on the viewing area of the CRT. If trace is not horizontal, adjust potentiometer A3 R3 (accessible through hole in side of case). Local magnetic field affects this setting. If trace modulation is apparent, check setting of the LINE SELECT switches. Set X-Y/SWEEP control 15 to X-Y and rotate the FOCUS control 3 as necessary to get the smallest, sharpest, dot possible.

To display a full-width line, set the X-Y/SWEEP push-button 15 back to SWEEP position.

2-9 These basic control settings can be used in the following measurement procedure unless some other setting is specified.

## 2-10 TO DISPLAY A SIGNAL

2-11 Now that we have the instrument operating, let's apply an external signal. Once again there is some control manipulation needed to prepare the oscilloscope to respond properly and accurately.

2-12 Apply a sine wave of 10V amplitude and 1kHz frequency to CHANNEL A INPUT connector 23. You should see a sine wave display on the viewing area approximately centered on the CRT screen. HORIZON-

TAL POSITION 5 and CHANNEL A POSITION 18 may be used to position the trace to any convenient location.

2-13 The trace you are displaying may drift or move across the display area. This action makes accurate measurement difficult. The display can be stabilized by changing the setting of TRIGGER LEVEL control 8.

## 2-14 PEAK-TO-PEAK VOLTAGE MEASUREMENTS

2-15 Because we now have a sine wave display, this is a good place to practice making peak-to-peak measurements:

Set CHANNEL A VOLTS/DIV 19 until you have a waveform at least three divisions high. Select a TIME/DIV 6 setting that will display two or three complete cycles of the waveform.

Use the CHANNEL A POSITION control 18 to position the negative peaks of the waveform on a horizontal graticule line near the bottom of the graticule. Use the HORIZONTAL POSITION control 5 to position a positive peak of the waveform on the center vertical graticule line. Positioning the waveform this way enables you to use the small divisions on the vertical center-line more accurately.

Count the number of vertical divisions from the most negative portion of the display to the most positive portion (estimate to the nearest tenth of a division).

Multiply this number of divisions by the VOLTS/DIV control 19 setting. For example:

$$\begin{aligned} \text{Number of divisions} &= 5.2 \\ \text{VOLTS/DIV setting} &= 0.1\text{V} \\ 5.2 \times .1 &= 0.52\text{V peak-to-peak} \end{aligned}$$

If you are applying the external signal through a divider probe, you must also multiply by the probe factor. For example:

$$\begin{aligned} \text{Probe attenuation ratio} &= 10:1 \\ \text{Probe factor} &= 10 \end{aligned}$$

therefore, from previous paragraphs,  
 $5.2 \times .1 \times 10 = 5.2\text{ V peak-to-peak}$

## 2-16 DC VOLTAGE MEASUREMENTS

2-17 Apply the external signal to CHANNEL A INPUT 23, press CHANNEL A GND pushbutton 21 and

AC/DC button 22. Use the CHANNEL A POSITION control 18 to locate the trace on a convenient horizontal graticule line. Reference for positive dc voltages should be below the center horizontal graticule line; reference for negative dc voltages should be above the horizontal graticule line. Do not change CHANNEL A POSITION control until measurements are complete. Release GND pushbutton 21:

Apply the signal to be measured (square wave, pulse train, etc.) to CHANNEL A INPUT 23.

Adjust CHANNEL A VOLTS/DIV switch 19 until the point of the signal to be measured is as many divisions as possible from the selected zero-volt reference line to make measurement easier and more accurate.

Now, use the HORIZONTAL POSITION control 5 to move the point to be measured until it rests on the center vertical graticule line.

Count the number of vertical divisions between the zero-volt reference line and the point to be measured (estimate to the nearest tenth of a division).

Multiply the number of divisions by the VOLTS/DIV setting and by the probe factor if any. For example:

$$\begin{aligned} \text{Number of divisions} &= 6.4 \\ \text{VOLTS/DIV setting} &= .05\text{V} \\ \text{Probe factor (10:1 probe)} &= 10 \\ 6.4 \times .05\text{V} \times 10 &= 3.2\text{ Volts} \end{aligned}$$

## 2-18 TIME INTERVAL MEASUREMENTS

2-19 First, display the signal as described in an earlier paragraph, and set the HORIZONTAL TIME/DIV control 6 and TRIGGER LEVEL control 8 to obtain a stable display.

Use the HORIZONTAL POSITION control 5 to position one measurement point on the signal at a vertical graticule line. Then use the CHANNEL A POSITION control 18 to position the other measurement point on the center horizontal graticule line.

Count horizontal divisions to the nearest tenth between the two measurement points. Then multiply this number of divisions by the TIME/DIV control 6 setting. For example:

$$\begin{aligned} \text{Number of divisions counted} &= 6.4 \\ \text{TIME/DIV control setting} &= 0.5\mu\text{sec} \\ 6.4 \times 0.5\mu\text{sec} &= 3.2\mu\text{sec} \end{aligned}$$

## 2-20 FREQUENCY CALCULATION

2-21 Use the same procedure described for measuring the time between two points on a signal. For this calculation, use the beginning point and end point of one cycle of the signal as the measuring points.

After finding the time between these points, use this formula to calculate signal frequency:

$$\frac{1}{\text{time in seconds}}$$

Substituting numbers from the previous procedure as an example, we get the following result:

$$\frac{1}{3.2\mu\text{sec}} = \frac{1}{3.2 \times 10^{-6}\text{sec}} = 0.3125 \times 10^6 \text{ Hz}$$

or approximately 310kHz.

## 2-22 DC OFFSET MEASUREMENT

2-23 Apply signal to be measured to CHANNEL A INPUT 23; use CHANNEL A POSITION control 18 to place negative peak of signal on the center horizontal graticule line.

Release CHANNEL A AC/DC pushbutton 22 (AC position) and note trace shift.

Count the number of divisions between center horizontal graticule line and position of negative peak of signal. Multiply this number by the CHANNEL A VOLTS/DIV setting to get DC offset voltage. For example:

$$\begin{aligned} \text{Divisions of trace shift} &= 1.6 \\ \text{Setting of A VOLTS/DIV} &= 5\text{mV} \\ 1.6 \times 5\text{mV} &= 8\text{mV DC offset voltage} \end{aligned}$$

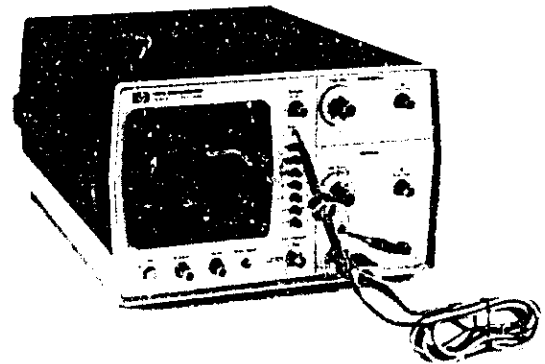
## 2-24 PROBE COMPENSATION

2-25 Your oscilloscope provides high input impedance and low input capacitance. These factors avoid changing the operating characteristics of the circuit you are examining. However, when a probe is used to feed signals from the circuit into the oscilloscope, the probe output must match the oscilloscope input.

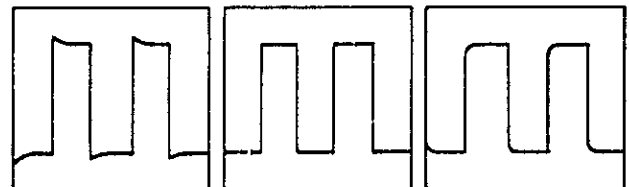
2-26 A probe such as the HP Model 10013A Divider Probe provides the required compensation adjustment in the form of a screwdriver adjustment in the

body of the probe. The oscilloscope PROBE ADJ 9 provides a 2kHz, .5 Volt peak-to-peak square wave output which can be used for probe compensation.

2-27 Clip the probe input to the PROBE ADJ 9 connector 9 and attach the probe cable to the CHANNEL A INPUT 23. Use HORIZONTAL TIME/DIV control 6 and CHANNEL A VOLTS/DIV 19 settings that will display at least two full square wave cycles large enough to read easily.



Rotate compensation adjustment on the probe body as you watch the square wave display.



Over-compensated

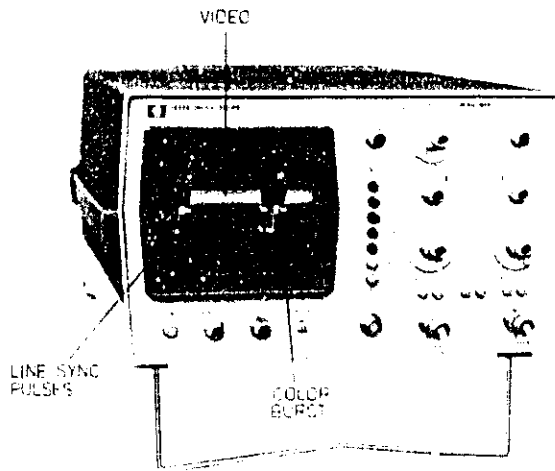
Correctly adjusted

Under-compensated

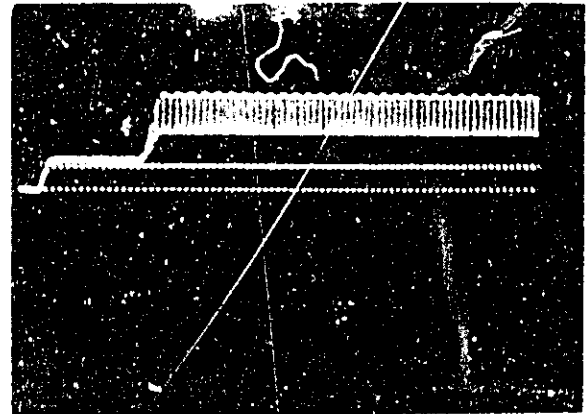
## 2-26 TV SIGNALS

2-29 To observe a composite or sync-only signal, apply the signal to CHANNEL A INPUT connector as described in an earlier paragraph, but change the NORM/TV pushbutton 13 to the TV setting.

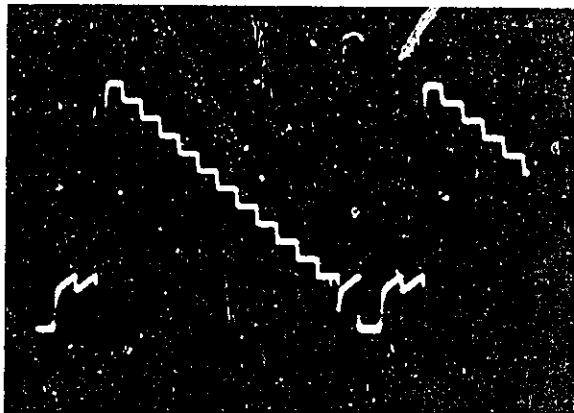
If you wish to observe individual lines of picture signal, use a TIME/DIV control 6 setting in the TV LINE range (typically 2μsec), the oscilloscope will then trigger on each line sync pulse.



Pattern generator color TV signal, line trigger

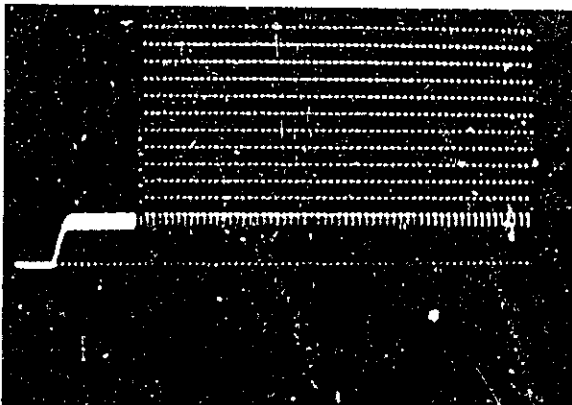


Color bar signal frame trigger 0.5ms/div



Staircase Signal, line trigger 10µs/div

To observe video field, use a TIME/DIV control 6 setting in the TV FRAME range (typically 5msec), the oscilloscope will then trigger on each frame pulse.



Color Staircase signal, frame trigger 0.5ms/div

## 2-30 TIME DIFFERENCE MEASUREMENTS

2-3 This description of time-difference measurements applies directly to the HP Model 1220A Oscilloscope. Measurement also applies to signals that are referenced to a common source. For example, two points in a horizontal circuit that are referenced to a common oscillator.

Display one signal on CHANNEL A INPUT 23 and the other signal on CHANNEL B INPUT 29

Adjust TIME/DIV control 6 so that the two points to be measured are at least four divisions apart, and readjust TRIGGER LEVEL control 8 as necessary to stabilize the display.

Use the HORIZONTAL POSITION control 5 to position the first measurement point on a convenient vertical graticule line. Then use the appropriate VERTICAL POSITION control 18 / 24 to position the second measurement point on the center horizontal graticule line.

Count the horizontal divisions between the two measurement points (to the nearest tenth of a division) and multiply this number by the TIME/DIV switch setting. For example:

Number of divisions = 6.5  
 TIME/DIV setting = 5msec  
 $6.5 \times 5\text{msec} = 32.5\text{nsec} = \text{time between points.}$

**2-32 PHASE DIFFERENCE MEASUREMENTS**

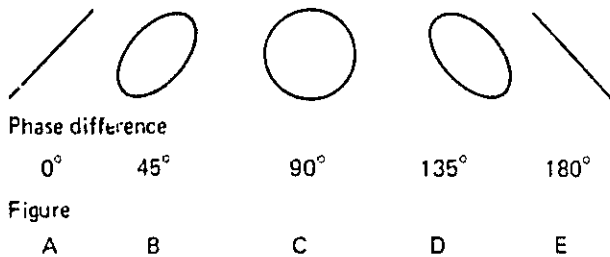
2-33 Phase difference measurements can be made between two signals of the same frequency by applying one signal to the vertical deflection amplifier and the other to the horizontal amplifier. Start by making the following control settings:

- X-Y/SWEEP 15 to X-Y position
- CHANNEL AC/DC 22 to AC position
- VERTICAL DISPLAY 30 to A only

Now, apply the first signal to CHANNEL A INPUT 23 and by using CHANNEL A VOLTS/DIV 19, POSITION 18, and vernier 20, obtain two dots separated by exactly 8 vertical divisions. Use HORIZONTAL POSITION 5 to set these dots on the center vertical graticule line, and press CHANNEL A GND 21 to remove the channel A display while you set up the horizontal display.

Apply the second signal to the X INPUT connector 19. Now use EXPANDER 7 and CHANNEL A POSITION 18 to display two dots 8 divisions apart on the center horizontal graticule line.

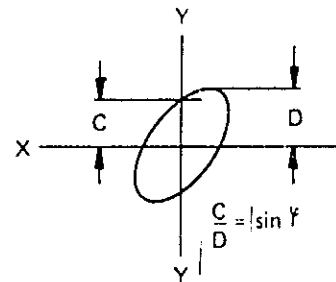
Release the CHANNEL A GND pushbutton 21 and observe the display on the CRT. The following sketch indicates a few possibilities:



2-34 An ellipse formed between 0° and 45° will slant in the same direction as figure B, but will have a narrower opening. An ellipse formed between 45° and 90° will have the same slant, but a larger opening.

Determining the actual phase relationship involves some further calculation that looks more complex than it really is. Move the ellipse until it is centered at the intersection of the center vertical and horizontal graticule lines. Measure the distances C and D as shown below and substitute these distances in the formula given to obtain the sine of the phase angle. Look up this sine in a table

of sines to find the phase angle. If the ellipse indicates an angle between 90° and 180°, calculate the sine as described above and subtract the resulting angle from 180° to obtain the true value.



**2-35 TRIGGERED SWEEP SUMMARY**

2-36 Older oscilloscopes had a free-running sawtooth sweep ramp generator. This sawtooth ramp deflected the applied signals at a set speed across the face of the CRT, but there was no adequate control over blanking during retrace, and the applied signal would start at some random point for each trace.

2-37 The HP Model 1220A/1221A Oscilloscopes have what is called Triggered Sweep. Basically, this means that no sawtooth ramp voltage is generated in the horizontal sweep circuit until a vertical input signal is applied. Other refinements have been added, too.

2-38 What advantages do you derive from this type of operation?

The CRT screen does not show a spot while waiting for the next vertical pulse to be applied

Through the use of the associated TRIGGER LEVEL control 8, you can trigger the sweep at any point.

No portion of the retrace signal is visible on the CRT to cause confusion at a critical point in measurement. This is accomplished by having the ramp generator apply a blanking signal to the horizontal output at the same time that retrace is started. As soon as retrace is complete, the blanking signal is removed.

Very slow sweep speeds are obtainable without using any external components to modify the sweep oscillator and ramp generator. The HP Model 1220A/1221A Oscilloscopes are capable of sweeps as slow as 0.5 seconds per division.

When no vertical signal is applied, the instrument automatically displays a bright line

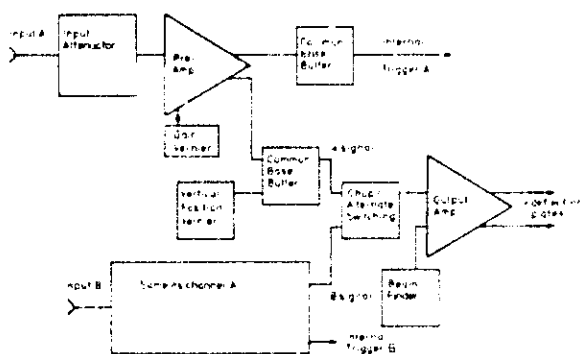
continuous trace. This capability can be of great help in setting up a zero-volt reference line for measurement purposes.

#### 2-39 TV Sync Separator as Low Pass Filter

2-40 If triggering from a noisy or complex source, the TV sync separator can be used to reject components above 20kHz.



### 3-1 VERTICAL CHANNEL(S) (Figure 5-3)



### 3-2 Input Attenuator

3-3 The input attenuator divides the input signal by 1, 10 or 100.

### 3-4 Preamplifier

3-5 The preamplifier is a 3 stage differential amplifier with switched gain control and input protection. CR101 and CR102 limit excessive signal swings from the input attenuator to  $\pm 4.1V$  (approx.) as defined by zener diodes CR104 and CR105. The signal is applied to the first differential amplifier stage (U101b, U101d) via a source follower (Q101a) and emitter follower (U101c).

3-6 Ranging is achieved, in conjunction with the input attenuator, by selecting different emitter current paths in the first and third preamplifier stages. In the first stage this is effected by the differential switch, Q103/Q104, under control of the VOLTS/DIV switch. In the 2mV, 5mV and 10mV positions the switch connects the potential from the junction of R182/R183 to the base of Q104. Q103 cuts off causing Q104 to route the emitter current via R125 and R126. In the other

positions (above 10mV) Q103 conducting draws the emitter current via R123 and R124. In this case the amplification is one tenth (1/10) of that selected in the 2mV, 5mV and 10mV positions. In the last preamplifier stage, gain is controlled in precisely the same manner by U102b, (X1), U102a (X2) and U102e (X5). Fine control is achieved by VERNIER R149 in the second preamplifier stage while overall gain of the complete Y channel is adjusted by R162 (when the fine VERNIER is in the CAL Position). Balance potentiometers R114, R148 and R175 are adjusted so that the trace does not move when switching from one range to another.

### 3-7 Common Base Stages (Q110)

3-8 For internal triggering purposes, one output of the preamplifier is buffered to the trigger circuits by common base stage Q110. The other output is buffered to the chopper circuit via common base stage Q109. At this stage the signal is offset by a current derived from the vertical position vernier (R159).

### 3-9 Chopper

3-10 The chopper circuit (CR301-CR304) is controlled by the Chop-Alt Control Flip-Flop. During Channel A operation CR303 conducts causing CR304 to cut off and block the channel B signal. At the same time CR301 is cut off enabling CR302 to pass the channel A signal to the output amplifier. During Channel B operation the situation is reversed so that only Channel B signal is displayed.

3-11 When both channels are to be displayed in the chopped mode of operation (when Time/Div switch is in 1ms to 0.5 $\mu$ s range) the chopper circuit switches between channels A and B so that both channels are displayed during the same sweep. When both channels are to be displayed in the alternate sweep mode (.5ms to .1 $\mu$ s) the chopper circuit alternately selects channel A on one sweep and channel B on the next.

### 3-12 Output Amplifier

3-13 The signal from the chopper circuit is applied to the current amplifier Q301/Q302 which in turn drives the Vertical Output Amplifier. The output amplifier comprises a differential input stage which drives two identical negative feedback amplifiers.

3-14 The differential input stage comprises U301a, U301b, U301c and U301d. U301a and U301b are connected as back-to-back diodes (joined at the cathodes) and linearize the essentially logarithmic characteristic of the differential amplifier at high signal levels. At low signal levels the characteristics requires no linearization.

3-15 Diodes CR305 and CR306 prevent the amplifier from going into saturation when excessive signals are applied or when the vertical position vernier is at one of its extremes.

3-16 The BEAM FINDER switch, when pressed, disconnects R312 from the emitter circuit of the differential input stage. This reduces the overall gain of the output stage (and consequently reduces the deflection) so that the trace is always displayed regardless of the position of the vertical position vernier. This does not affect the intensity.

3-17 The final output comprises two identical amplifier stages. For convenience only the left hand channel (Q411, Q409, Q407, Q405, Q403 and Q401) is described. Q407 and Q405 form a cascode amplifier with negative feedback supplied to driver stage Q409/Q411 through R416 and R418. Q401 and Q403, connected in series comprise a driven (by C405) current source. The steady state current level is established by R401 while extra current needed by fast transients is supplied by C401. High frequency components of the deflection signal are coupled to the current source via C405.

### 3-18 HORIZONTAL CHANNEL

3-19 There are two basic modes of operation of the horizontal deflection circuits,

as an amplifier (in the X-Y mode)  
or,

as a synchronous reference source for the horizontal axis of the display.

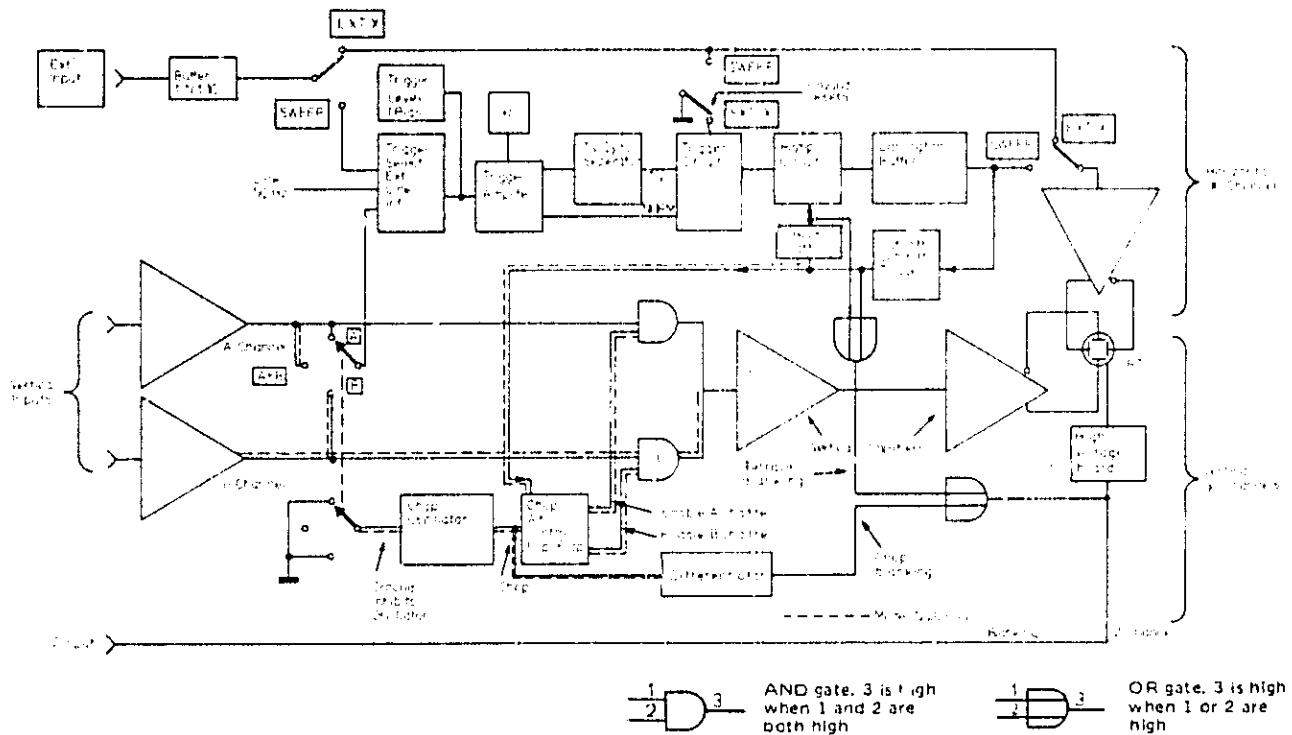
In the EXT DEFL mode, the external input is applied to the horizontal Output Amplifier via the Ext Input Buffer. The rest of the circuitry is disabled.

3-20 When used as a synchronous, time related, horizontal reference source, the horizontal deflection circuit requires a trigger signal. The Trigger Selector Switches select the source of the trigger signal from either the Ext Input (EXT mode), the power supply (LINE trigger) or from the A or B channel preamplifiers (INT mode). The trigger signal is then summed with the output of the trigger LEVEL vernier and applied to the Trigger Amplifier so that triggering occurs when the trigger signal passes the threshold of the Trigger Circuit. By shifting the signal with the LEVEL vernier, the point, on the trigger signal waveform, at which triggering is to occur can be varied.

The +/- switch applies the trigger signal to either the non-inverting or inverting input of the Trigger Amplifier, so that the slope (positive or negative), on which triggering is to occur, can be defined.

Alternatively, in the TV mode, the output from the Trigger Amplifier is applied to the TV Sync Separator. This circuit separates Field and Line sync pulses from a composite video signal and, depending on the sweep speed selected, applies either Frame (Field Rate) or Line sync pulses to the Trigger Circuit.

3-21 On receipt of a signal from the sync separator or the Trigger Amplifier, the Trigger Circuit enables the Ramp Generator and causes the Blanking Circuit to remove the blanking signal so that a trace is displayed. The ramp is applied simultaneously to the horizontal Amplifier and the Cut-Off Schmitt Trigger (C.O.S.T.) via the Sweep Output Buffer. The Sweep Length Adjust vernier attenuates the ramp. When the attenuated ramp reaches the threshold of the C.O.S.T., the C.O.S.T. resets the Trigger Circuit and starts the Hold-Off circuit. Resetting the Trigger Circuit disables the Ramp Generator which causes the C.O.S.T. to be reset. However, because the Ramp Generator takes a finite time (proportional to the ramp time) to be completely reset, the Hold-Off circuit keeps the Trigger Circuit reset until the Ramp Generator is completely reset. This prevents premature starting of a new ramp by another trigger signal. If, by 500ms after the last trigger was received, no new trigger signal occurs the Trigger Circuit automatically starts a new ramp so that a trace is still generated.



3-22 When both channels A and B are to be displayed simultaneously, the sweep speed determines which method of display (chop or alternate) is to be used. At sweep speeds of 0.5ms and faster, A and B are displayed on alternate sweeps. This is achieved by the Chop-Alt Control Flip-Flop being clocked after every sweep by the C.O.S.T. Thus, during one sweep, channel A signal passes through the switch and, during the next sweep, channel B signal passes. At sweep speeds of 1ms and longer, the Chop Oscillator drives the Chop-Alt Control Flip-Flop (at approx. 200kHz) so that during each sweep both signals are passed by the Chopper at alternate 5µs intervals. During single trace operation the Chop-Alt Control Flip-Flop is held in the Preset (A displayed) or Clear (B displayed) state by the A B display switches.

3-23 Detailed Description (figure 5-4)

3-24 Ext Input Buffer

3-25 The buffer comprises source follower Q1, which provides high input impedances, and emitter follower Q2, which provides low output impedance for driving the horizontal amplifier or trigger amplifier.

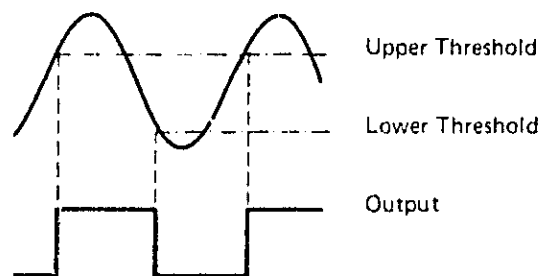
3-26 Trigger Switches

3-27 The trigger switches select the source of the trigger signal. When EXT (external trigger) is selected, the signal from the Ext Input Buffer is applied to the

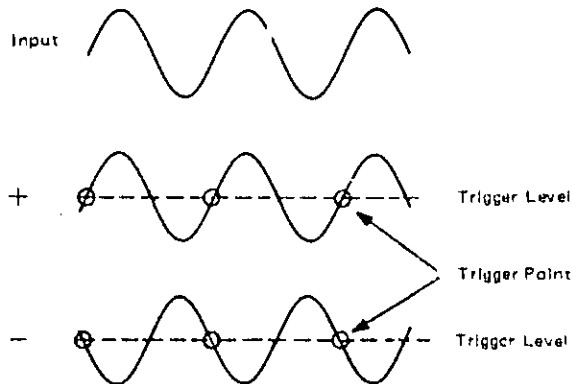
Trigger Amplifier. When LINE trigger is selected, the switch connects the line frequency signal (from the +5V secondary winding of the power supply) to the Trigger Amplifier. When LINE is not selected (i.e. when another trigger mode is selected) the line frequency signal is grounded, via R1, so that it cannot be a source of a line frequency interference. Similarly, when EXT triggering (triggering from the signal of either channel A or B) is not selected, the signal from the EXT INPUT BUFFER is grounded through R10.

3-28 Trigger Amplifier

3-29 The trigger signal is ac coupled, via C27, to the trigger amplifier which comprises Q3, Q4, Q5, Q6 and Q7. At the input, the signal is offset by the TRIGGER LEVEL vernier (R20) so that the output signal is shifted relative to the threshold level of the Input Schmitt Trigger MC7a in the Trigger Circuit. This permits the Schmitt Trigger to be triggered from various amplitude levels of the trigger input signal:



While this defines the trigger level, the +/- switch of S2 selects the input (inverting via Q6 or non-inverting via Q3) to which the signal is applied so that the slope on which the threshold level is relevant can be defined. The two controls define precise points on the trigger waveform.



R66 is a symmetry control which is adjusted so that the dc level of the output of the amplifier is the same for inverting and non-inverting operation.

3-30 When the TV/NORM switch is in the TV position, the trigger signal is taken from Q4 collector and applied to the TV Sync Separator. Q7 is cut off to prevent the (unprocessed video) signal from reaching the Trigger Circuit and to enable the Trigger Circuit.

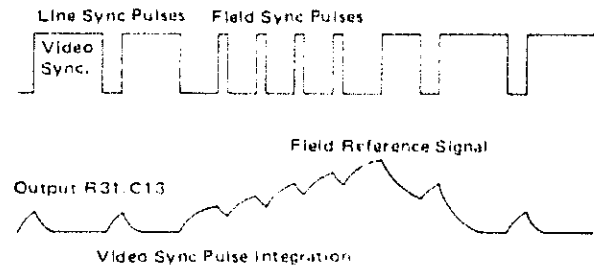
### 3-31 TV Sync Separator

3-32 The sync separator separates the Field and Line sync pulses of a composite video signal and outputs either Line sync pulses or the Frame (Field Rate) signal to the Trigger circuit.

C11 and R29 filter the video portion of the signal to produce a mean dc level. Thus, when a sync pulse occurs it is superimposed on this dc level and turns on Q8 so that only sync pulses reach the sync separator.

When the sweep speed is set in the range  $0.1\mu\text{s}$  to  $50\mu\text{s}/\text{div}$ , Flip-Flop MC8 is held in the Preset state and only the Line Circuit provides an output. In the Line Circuit Q10, MC2b and R37 are connected as a Schmitt trigger so that sync pulses are only re-shaped. When the sweep speed is set to sweeps longer than  $0.1\text{ms}/\text{div}$  the OV is removed from the Preset input of MC8b and the

Frame circuit is enabled. This signal is integrated by R31/C13 and applied to Clock Input of MC8b via the Schmitt Trigger comprising Q9/MC2a and R33.



Only when the field sync pulses occur does the Integrator output reach a level sufficient to clock MC8b. Because MC8b divides the Field sync pulses by a factor of 2, triggering occurs on alternate field sync pulses. When Frame circuit operation is selected, the LINE circuit output is always high (+5V) so that MC4a is enabled and inverts the Frame signal from MC8b. In the Line mode MC8b in the preset state (Q output High) enables MC4a so that the line sync pulses are inverted by MC4a.

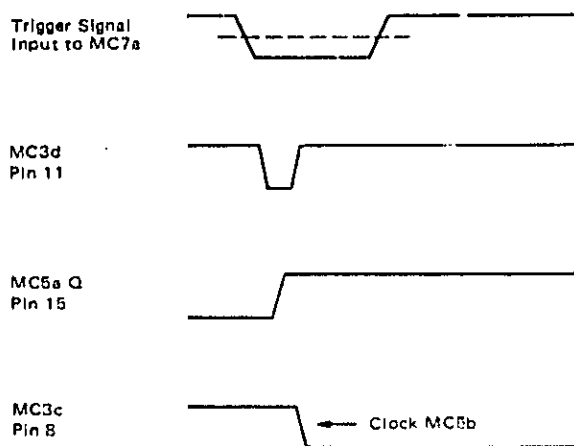
### 3-33 Trigger Circuit

3-34 On a negative transition from either the Trigger Amplifier or the Sync Separator, Input Schmitt Trigger MC7a output (pin 6) goes high. This is immediately present at MC3 pin 13 causing MC3 pin 11 to go low. (Because MC13 pin 12 is, at this moment, still high due to the propagation delay of MC1 a, b, c). The low-to-high transition from MC7a pin 6:

Clocks MC5A (Q goes high and enables MC3c).

Clocks MC6a (this enables MC2d and hence MC7a hold-off).

After the propagation delay times of MC1a, MC1b and MC1c, a high-to-low transition occurs at MC1c pin 6 causing MC3d pin 11 to go high. This positive transition is inverted by MC3c (enabled by MC5a Q output) to clock MC5b so that MC5b Q output goes high and Q goes low. MC5b Q output low enables the Ramp Generator and causes the blanking circuits to remove the blanking signal MC5b Q output high causes a low at MC2d pin 11 (MC2d enabled by Q output of MC6) which holds off the input Schmitt trigger MC7a.



### 3-35 Ramp Generator

3-36 The ramp generator comprises a constant current source (Q11, CR6 to CR7, R42 and one of R88 to R95) which charges a selected capacitor (C28 and C29 or C30, C31 or C32). The output voltage increases linearly with time at a rate proportional to the value of the capacitor and the charging current. The circuit is controlled by Q12 which is in turn controlled by the Trigger Circuit. When Q12 is conducting (between sweep) the selected capacitor is discharged and the current from the current source flows to ground through Q12. When Q12 is cut off (during sweep) the current source charges the selected capacitor.

3-37 When the ramp is completed a negative transition from the Cut-Off Schmitt Trigger MC7b clears MC5b so that the Ramp Generator is disabled and the hold-down at the input of the input Schmitt Trigger MC7a is removed. However, to prevent premature triggering, the Hold-Off circuit keeps MC5a and MC5b in the clear state (pins 3 & 8 low) until the Ramp Generator is fully reset. When the Hold-Off signal is removed the next trigger can restart the sequence. If no trigger is received within 500ms (approx.) of the last trigger, the Bright Line Auto monostable MC6 returns to its stable state (Q output low,  $\bar{Q}$  output high) and sets MC5b to its preset (Q high,  $\bar{Q}$  low) via MC3a. Thus, the Ramp Generator is enabled and a sweep occurs although it is asynchronous. At the end of this sweep, if no new trigger has been received then the end of Hold-Off presets MC5b so that another sweep is started. Thus, until MC6 is set to its quasi-stable state by a new trigger, continuous sweeps occur with minimum time between them. In the normal mode of operation (i.e. when trigger pulses are applied), MC6 is always in its quasi-stable state because it is a retriggerable mono-stable.

### 3-38 Sweep Output

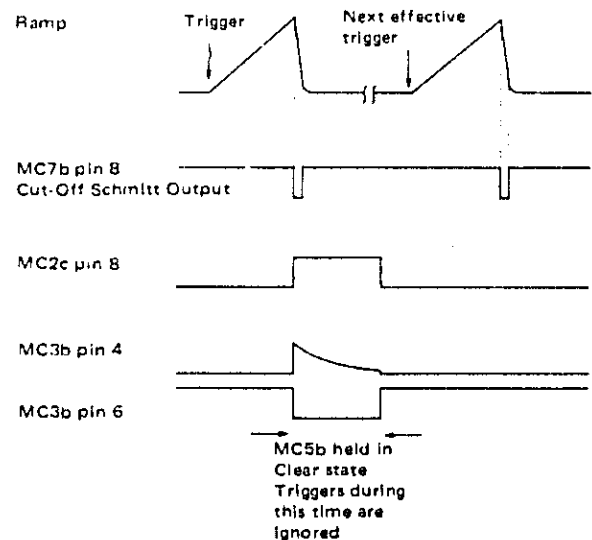
3-39 The sweep output circuit comprises Q13 and Q14 connected as a Darlington pair to provide high input impedance, low output impedance and high current gain. The Sweep Output Circuit buffers the ramp to the Horizontal Output Amplifier and the Sweep Length Adjust vernier.

### 3-40 Sweep Length Adjust

3-41 When the ramp signal at MC7b pin 9 reaches the threshold level of the Cut-Off Schmitt Trigger, MC7b switches so that the Trigger Circuit is reset and the Hold Off circuit is enabled. The point in time (and hence the length of the sweep) at which the threshold level is reached is adjusted by R98.

### 3-42 Hold-Off Circuit

3-43 The Hold-Off circuit is a monostable which holds the Trigger Circuit off while the ramp generator capacitor is discharged. This is to prevent premature starting of a sweep. The monostable consists of MC2c, either C33, C34, C35 or C36, R46 and MC3b. When the output of the cut-off Schmitt Trigger goes low, MC2c output goes high. The loop MC2c/MC3b retains this status for an interval so that MC5b is held in the clear state. This interval permits complete discharge of the ramp capacitor.



**3-44 Horizontal Output Amplifier**

3-45 The horizontal output amplifier is very similar to the vertical deflection amplifier. The differential input stage Q15 and Q16 provides gain adjustment and horizontal position control (R105). When Beam Find is pressed the gain of the amplifier is reduced (because of R64) so that the sweep is shortened and can also always be seen on the display regardless of the position of the horizontal position vernier R105. The output stage comprises two identical channels as in the vertical deflection section.

**3-46 Chop Oscillator**

3-47 The chop oscillator comprises MC4b and MC4c connected as a free running multivibrator. The oscillator, which runs at approximately 200kHz is disabled in the single channel display mode and at sweep speeds faster than 0.1ms/div. The oscillator is also disabled between sweeps (by Q output of MC5b).

**3-48 Chop-Alt Control Flip-Flop**

3-49 In the chop mode (sweep speeds of 1ms and longer) with dual trace operation selected, the Chop-Alt Control Flip-Flop (MC8a) is clocked by the Chop Oscillator via MC4d. In the Alternate mode (sweep speeds of 0.5ms and faster) with dual trace operation selected, the Chop-Alt Control Flip-Flop is clocked at the end of each sweep by the signal from the Cut-Off Schmitt Trigger.

In single trace modes, the Flip-Flop is held in either the Preset (Channel A display) or the Clear (Channel B display) state.

**3-50 Blanking**

3-51 The purpose of the blanking circuit is:  
to suppress retrace,  
to suppress trace during switching in chop operation,  
to provide a Z-input  
(for trace modulation e.g. time markers).

Retrace is suppressed by the Q output of MC5b (which goes low at end of each sweep) via CR16 and MC4d. The connection via CR5 direct to the C.O.S.T. ensures that blanking takes place immediately sweep ends.

In chop operation, the differentiated chop oscillator signal (C45, R96, R99), provides blanking during switching from one channel to the other.

Z input and the output of MC4d are fed over similar shaping networks to the blanking amplifier on A3.

**3-52 Blanking Amplifier (figure 5-2)**

3-53 The blanking amplifier Q2/Q4 is an inverting amplifier which drives the grid of the CRT, via C6, to cut off the electron beam during trace return (between sweeps), during chop mode operation (between chops) and under control of the Z axis input. Q2 acts as a current source load at low frequencies and as an active "pull-up" at high frequencies. Commutating capacitor C8 and decoupling capacitor C7 improve the high frequency response. CR18 and CR1 clamp the output at approximately 32V when no blanking signal is present. C6 differentiates the blanking pulse and isolates the amplifier from the high grid voltage.

**3-54 Power Supplies (figure 5-2)****3-55 +5V Supply**

3-56 The output of the 12V ac secondary of T1 is rectified by bridge rectifier CR13-CR16 and regulated by MC3.

**3-57 +210V Supply**

3-58 The +210V supply is an unregulated 115V supply which is offset by 95V at the junction of CR3/CR4 of bridge rectifier CR1-CR4.

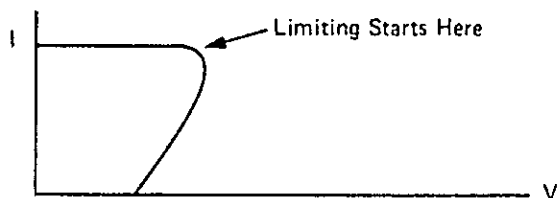
**3-59 +95V Supply**

3-60 The +95V supply is a fully regulated, current limiting supply. A sample of the output voltage (at pin 4 of MC1) is compared with a reference voltage (at pin 5 of MC1). A difference between these two potentials causes an error output from pin 9 of MC1 which controls series regulator transistor Q1. When the output voltage falls the error voltage causes Q1 to conduct more and supply more current to the load with a consequent increase in output voltage.

When the output voltage rises the error signal tends to cut off Q1 to reduce the output current and effect a lowering of the output voltage.

Current limiting is achieved by R4 and a cut-off transistor in MC1. As the current output increases, the voltage dropped across R4 increases. Pins 2 and 3 of MC1 are the base and emitter connections (respectively) of the cut-off transistor.

When the potential dropped across R4 is sufficient to cause this transistor to conduct, it removes the error signal from Q1 causing the output current to fall. R5 and R6, in conjunction with R4, give a "foldback" characteristic to the supply. That is, when the current limit is reached the output voltage also falls to a low value (see characteristic).



#### Foldback Current Limiting

#### 3-61 +12V Supply

3-62 The +12V supply is also a series regulated, current limited supply which operates in similar fashion to the +95V supply. The reference voltage, with which the output sample is compared, is derived from the +95V supply.

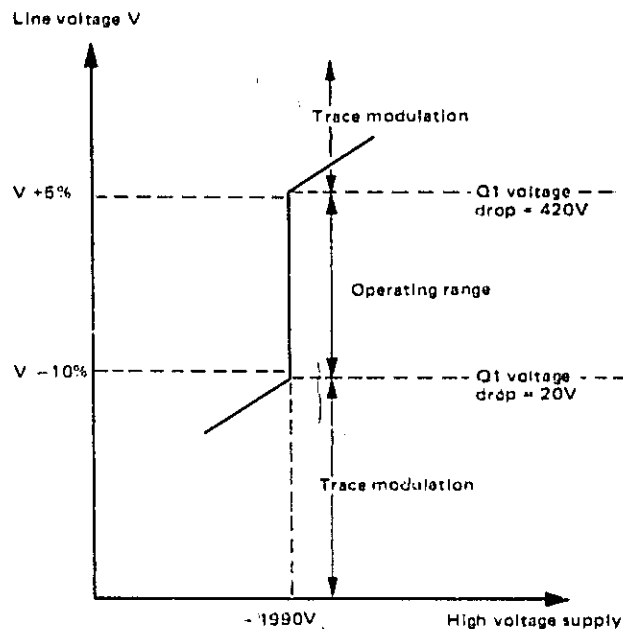
#### 3-63 -12V Supply

3-64 The -12V supply is also a series regulated, current protected supply. However, the sample of the output voltage is derived from both the +12V and -12V output, so that the difference between the +12V and -12V supply is always constant. When current through R20 causes a voltage drop across it, sufficient to turn-on Q4, Q4 takes all the current from MC4 causing the output current to fall.

#### 3-65 High Voltage Supply

3-66 The voltage from the 1600V secondary of T1 is rectified (CR14-17), applied across capacitor A3C1 regulated by A3Q1, applied to the intensity network and the CRT heater. To regulate, a portion of the .V. supply is compared with the +95V supply. The resulting A3MC1 output controls the emitter/collector resistance of A3Q1

so that the voltage dropped across the transistor compensates for high voltage supply fluctuations. A zener diode chain is connected across collector and emitter so that the transistor's breakdown potential is not reached. The characteristic of this arrangement is :



The horizontal position of the characteristic, and consequently the level of the high voltage supply, is adjusted by R30. The vertical position is set by R1 so that proper regulation occurs in the range +5%, -10% of the selected line voltage. If the line voltage goes outside this range, regulation will cease and ripple - causing trace modulation - will be apparent. Consequently, in districts where the line voltage excursions lie outside one of the regulator limits, R1 should be adjusted so that the characteristic brackets these excursions rather than the nominal 110, 120, 220 or 240 volts, +5%, -10%.

#### 3-67 Probe Adjust Supply (figure 5-4)

3-68 MC1d and MC1e operate as a free running multivibrator the output of which is buffered to Probe Adjust Connector via MC1f.

**4-1 PREVENTIVE MAINTENANCE**

4-2 If carried out regularly (quarterly or half-yearly), the short time spent on preventive maintenance will be adequately repaid because the inherent reliability and accuracy of the oscilloscope will be maximized.

**4-3 Mechanical Inspection**

4-4 Check that all fittings, connectors and boards are firmly in place. Check that wiring and cables — especially these of power supply and high voltage — are in good condition.

4-5 Ensure CRT socket is fitted firmly. Make sure that the securing screws of the heat sink assembly are tight so that there is good thermal contact between heatsink and power transistors, verify that electrical insulating sheet (with silicone grease) is between transistor and heatsink.

**WARNING**

**VOLTAGES DANGEROUS TO LIFE**

High voltages are used in this instrument. Switch off, disconnect from supply and wait for a few minutes before removing covers.

**4-6 Lubrication and Cleaning**

4-7 Remove dust from interior. If rotary switches become noisy, clean with aerosol degreaser (part number 8500-0232), allow to dry, then lubricate with Fiektrolube 2A aerosol spray (part number 6040-0300). Avoid cleaners with a grease or oil content.

**4-8 Adjustment**

4-9 Perform the adjustment procedure (table 4-2).

**WARNING**

**VOLTAGES DANGEROUS TO LIFE**

Exercise caution when operating the oscilloscope without covers.

**4-10 Performance Check**

4-11 Carry out the performance checks in tables 4-3.

**4-12 TEST INSTRUMENTS**

4-13 Refer to table 4-4.

**4-14 SERVICING**

4-15 When a fault is evident it is necessary to localize the cause (see below), effect the repair (see 'Removal of assemblies' and 'Repairing circuit boards', readjust (table 4-2) and to verify performance (table 4-3). The following paragraphs outline a possible approach to troubleshooting using a minimum of test equipment.

**4-16 TROUBLESHOOTING**

Before commencing troubleshooting, make sure that an apparent fault is not caused by incorrect supply, fuses or control settings. In the following paragraphs, reference should be made to the circuit diagrams (Section 5) and the voltages and waveforms thereon.

**4-17 Low Voltage Power Supply**

**NOTE**

All low-voltage power supplies contain short-protection circuits. If any supply shows an unusually low voltage reading it may indicate a short in any circuit using that supply.



**4-18 +95V Supply**

4-19 Measure +95 volt output test point. If this voltage is wrong, check rectifier output voltage. If rectifier output is wrong, suspect rectifier transformer winding, or bad A2C3/R13.

Measure voltage to pin 11 of A2MC1 to be sure it is 20V higher than voltage at A2 +95V Test Point. If it is not, suspect A2CR21 or 210V supply. Measure voltage at base of A1Q1; it should be more positive than emitter voltage (up to 0.6V). If not, and voltage at pin 11 MC1 is right, check components in voltage divider A2R7/R8/R9/R10/R11. If these are ok, trouble is in A1MC1 or A2Q1.

**4-20 +12V Supply**

4-21 If voltage at A2 +12V test point is wrong, check output of +12V supply rectifier. If rectifier output satisfactory, check voltages at A2MC2 pin 3. If wrong, check +95V input and components associated with A2MC2 pin 3.

If voltage at A2MC2 pin 3 is satisfactory, check voltage at the base of A2Q2. If it is not more positive than the emitter voltage, either A2MC2 or R17/R27 may be faulty.

**4-22 -12V Supply**

4-23 Measure voltage on one side of rectifier output, then the other side. Note this voltage difference to be more than 16 volts. Check accuracy of voltage at Pin 3 MC4 voltage divider.

If these are in order, check A2Q3/Q4. If satisfactory, replace A2MC4.

**4-24 +210V Supply**

4-25 If rectifier output and +95 volt supply are correct, check components A2R1, R2, R3, etc. and load.

**4-26 +5V Supply**

4-27 If rectifier output is correct, check A2MC3, C9, C10 and load.

**4-28 High Voltage Power Supply**

Voltages in this circuit are dangerous to life. Use extreme caution. Remove shield only to gain access. Replace shield immediately afterwards.

4-29 Circuit theory will be your best guide in checking this circuit. See paragraph 3-65.

An indication of too high a voltage at A2TP1 (+450V or higher) and a low voltage at A3TP2 (-1700 to -1300V) can be due to an open High Voltage Regulator, A3Q1. To check this possibility, measure the voltage at the junction of MC1 pin 6. If the voltage reading is not +0.8V or greater, there is likelihood of a fault in the voltage regulator MC1 or A3R11/R12/R13/R14/R15/R17/R18/R4/CR12.

The Trace Align circuit is straight forward. If the power supplies and potentiometer A3R3 are in order, there is trouble in the Trace Align coil on the neck of the CRT.

Astigmatism failure is equally easy to check. If the power supply to A3R2 is ok and A3C9 is good, trouble in the CRT may be assumed after checking the CRT socket connections (CAUTION!).

**4-30 Vertical Amplifier Circuits**

4-31 Troubleshooting the Vertical Amplifier Circuits starts by attempting to localize the trouble into the Attenuator, Preamplifier Circuits or Output Amplifier Circuit. A few simple front panel control operations may help.

4-32 Turn the instrument on and display a trace or spot. Make these checks on both channels of Model 1220A:

Does the vertical POSITION control 18, 24 move the trace outside the viewing area both top and bottom? If only one trace POSITION control is working correctly, probably the other channel preamplifier is wrong. If neither channel is working correctly, the output amplifier is probably wrong.

Position the trace or dot on a convenient horizontal line. If display shifts up or down, when VOLTS/DIV switch 19 is rotated, the preamplifiers are not symmetrical.

Using a 10:1 divider probe to apply PROBE ADJ signal 9 to CHANNEL A INPUT 23, can the square wave be compensated by the probe? If it can, the attenuator is probably correctly compensated.

4-33 If any of these checks give a fault indication, there is either a problem of unbalanced amplifiers or a faulty circuit. Check first to be sure that A2 board 12V supplies are in order.

4-34 To eliminate the possibility of an unbalanced condition, or wrong gain we recommend that you perform the Calibration Adjustment procedures for the vertical and attenuator circuits. This may eliminate extensive troubleshooting.

4-35 If, after completing the adjustment procedures, the problem still exists, determine which vertical circuit is causing the trouble (if, in Model 1220A, both channels are faulty, fault must lie in common parts) and verify the voltages at test point A2TP1, at the output of the X1, X10 Preamplifier (TP3 in Model 1220A), and A2TP2 at the output of X1, X2, X5 Preamplifier. Noise may be caused if ground bonding screw (paragraph 4-74) is loose.

4-36 **To Troubleshoot with a Monitor Oscilloscope**

4-37 Initial settings (fig. 2-1) except:

- 6 to 0.2 msec/div
- 19 to 100 mV/div
- 22 to AC

Apply PROBE ADJ. 9 signal direct to INPUT 23.

Set monitor oscilloscope with same control settings except 20mV/div on the VOLTS/DIV switch. Use a 10:1 divider probe to monitor the output at A2TP1 (A2TP3 for Channel B in Model 1220A).

4-38 The monitored waveform should be a square wave of approximately 1.7 vertical divisions peak-to-peak. If it is, you may assume the Attenuator and X1, X10 Preamplifier are working as they should.

4-39 To eliminate Attenuator or Preamplifier, leave all control settings the same and monitor the output at A2TP2. The waveform should be a square wave of approximately 2.8 vertical divisions peak-to-peak. If the waveform is incorrect, troubleshoot the X1, X2, X5 Preamplifier (or the Chop-Alt Control on board A3 in Model 1220A.)

4-40 **To Troubleshoot with a Voltmeter**

4-41 A look at the A2 Amplifier Board schematic shows that each section is a symmetrical amplifier. It also shows voltages at certain representative points in

each section. These voltages are measured with no input to the instrument, with the appropriate VOLTS/DIV switch set to 100mV position, and with CHANNEL A (or B) GND pushbutton 21/27 pressed to avoid transient input.

4-42 Check these representative voltages in your instrument as shown on the schematic. Other voltages at unmarked corresponding points in the circuit should be symmetrical whatever the value. For example, the voltage you measure at the emitters of A2Q103/Q104 should be -6.5 V; the voltages at pin 2 and pin 12 of A2U101 should be symmetrical whatever the value.

4-43 When a point is found where voltages are incorrect or unsymmetrical, this is a point where you can begin looking for components that have changed value, transistors that are leaky or breaking down, diodes that are faulty, etc.

4-44 If you are troubleshooting in the Output Amplifier and are not sure if A2Q301/2 is at fault, place a short across A2CR306 while making voltage level and symmetry measurements. Be sure to remove this short when troubleshooting is completed.

4-45 **Troubleshooting Tips**

4-46 Amplifier symmetry in the X1, X10 Preamplifier can be determined by checking voltages at collectors of A2Q107a/Q107b. If voltages of proper amplitude and symmetry are obtained here with Channel A vernier 20 in Cal detent, you may be reasonably sure the entire amplifier is symmetrical. (Check A2Q207a/Q207b in Model 1220A Channel B).

4-47 Don't overlook A2U102 (A2U202 in Channel B) transistors connected to pins 1, 2, 3, 4, 5, 12, 13, 14. These transistors serve as Current Sources for both Preamplifiers and must be operating properly to ensure correct Preamplifier operation.

4-48 Note variable capacitors A1C420/C421. These capacitors are solely for pulse response. They consist only of short lengths of isolated wire near the cases of transistors A1Q409/Q410. Do not change adjustment when checking voltage values and symmetry.

4-49 **Horizontal Circuits**

4-50 **No Horizontal Deflection and Defective Sweep**

4-51 The easiest way to start troubleshooting these circuits is by checking the condition of the Hori-

zontal Output Amplifier. Set X-Y/SWP pushbutton 15 to X-Y position. Connect PROBE ADJ 7 to CHANNEL A INPUT 23. It may be necessary to adjust INTENSITY 2 and horizontal POSITION 5 to bring two dots into view at center.

4-52 Rotate horizontal POSITION 5 from extreme cw position to extreme ccw position and observe that dots disappear off the screen to the right and left respectively. Return POSITION control 5 to midrange position. Now, rotate expand control 7 to extreme cw position and note dots are approximately 6 divisions apart.

4-53 If these conditions are met, the Horizontal Output Amplifier is working properly. However, if these conditions are not met, it is necessary to troubleshoot the Output Amplifier as follows:

Monitor voltages at the emitters of A1Q15/Q16. Adjust POSITION control 5 until these voltages are equal.

Monitor voltages at collectors of A1Q19/Q20. Verify that they are symmetrical. If not satisfactory check current sources Q21 to Q24.

4-54 No Sweep

4-55 Check A1TP4 and A1MC5b pin 10 waveforms. If the latter is low, the ramp should function.

4-56 Sweep on Auto Mode Only

NOTE... Some combinations of low frequency input and very low sweep speeds may produce random triggering. This is because the signal frequency approaches the operating time of the ramp switch and the automatic bright line circuit. If your application requires frequent use under these conditions, the hold-off can be lengthened by increasing the value of C14.

4-57 Confirm trigger is available at A1TP2. Check MC7a pins 4 and 5 are high, if so, check trigger output (pin 6). If MC7a satisfactory, check inverters MC1a/b/c and verify that MC3d pin 11 delivers a narrow (about 25ns) pulse.

4-58 Logic can also be verified by setting control 15 to X-Y, when MC5b and MC6a will be cleared. Note, however, that MC5b is preset at the same time and that pins 11 and 10 will, therefore, both be high.

4-59 Set X-Y/SWP 15 to X-Y. Start at A1TP2 and while monitoring voltage, rotate TRIGGER LEVEL control 8 from 3 o'clock position back to 9 o'clock position. Voltage at A1TP2 should go from approximately +2.8V to approximately +0.1V. Then monitor voltage at A1MC7a pins 4 and 5 which should be high. Monitor A1MC7a pin 6 while rotating TRIGGER LEVEL from 3 o'clock position to 9 o'clock position; the MC state should be low and then high respectively. Follow change of state thorough MC1a, b and c.

4-60 Double Trigger

4-61 If sweep double triggers, check that a narrow negative pulse appears at MC3d pin 11.

4-62 No Auto Sweep

4-63 Check A1 MC3a, A1MC5b and the monostable A1MC6. Using a voltmeter, do not apply any signals to oscilloscope. Note that onto sweep can be disabled if TRIGGER LEVEL 8 is centered (symptom: faint or flickering trace).

4-64 If no Trigger in EXT Trigger Mode but INT is working

4-65 In this condition, it is most likely that the Ext Input Buffer Amplifier is not working. This circuit can be corrected by normal troubleshooting of the components.

4-66 If no Trigger in TV Mode

4-67 If triggering is possible in INT, EXT and LINE, apply a TV signal to input 23 and set amplitude for a 3-div. deflection. With control 6 set to 50 $\mu$ SEC/DIV, line sync pulses should be present at MC2b pin 6 and inverted at TP3. MC8Q should be high. With control 6 set to 0.1m SEC/DIV, MC2a pin 3 output should clock MC8.

4-68 If no Trigger in INT Mode

4-69 Check first to see if EXT, LINE and TV Modes are triggering. If they are, check A2Q110, CR110, CR113, A1CR 213, Q210.

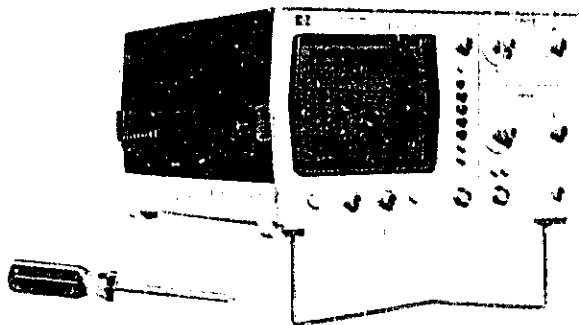
4-70 If no Triggering in LINE Mode

4-71 Check first that INT, EXT and TV are working. If they are, check +8V trigger pulse from A2R12 and power supply circuit.

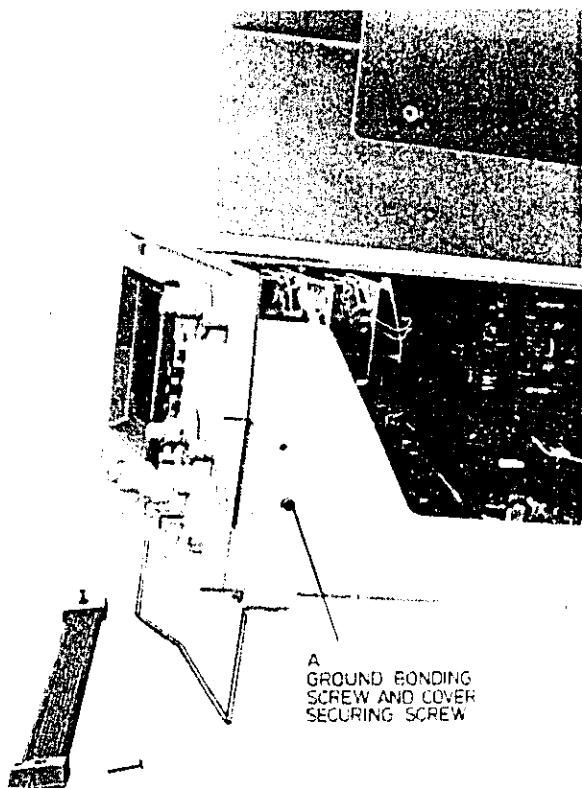
**4-72 REMOVAL OF ASSEMBLIES**

**4-73 Cover**

4-74 Unplug power cord. Remove the four screws from the sides of the instrument and lift the cover off.

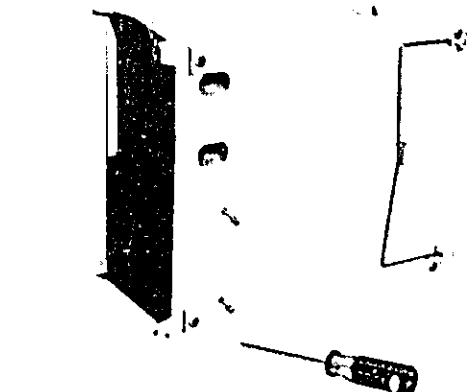


Note that it is important to replace screw A (see figure below) when operating the instrument without the cover. This screw connects interior metalizing of cabinet with the internal grounding system.

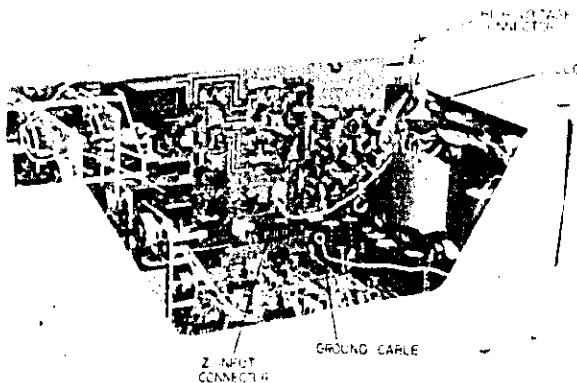


**4-75 Heat Sink Assembly**

4-76 Remove the two heat sink screws from the underside of the case. See figure top right.



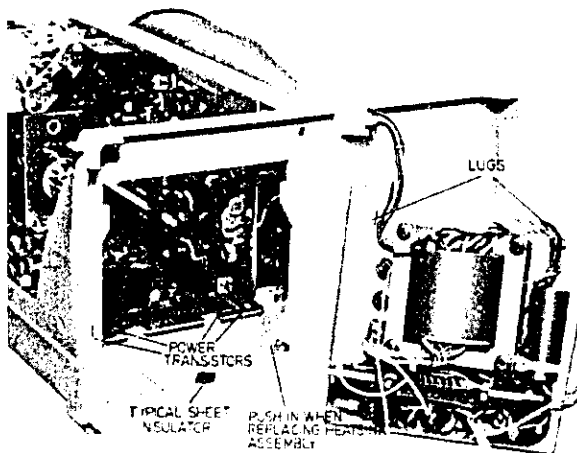
Disconnect the high voltage connector, the Z input connector and the ground cable. Lift the assembly to disengage the lugs and pull it out through the rear panel.



To replace assembly.

ensure sheet insulators are in place over power transistors and that silicon grease is applied generously to their surfaces.

To ensure line switch actuating pin does not foul heat sink assembly, release LINE push-button by pressing against actuating pin and, at the same time, releasing the LINE button 1, pull and turn button through 90 degrees so that it stays out.



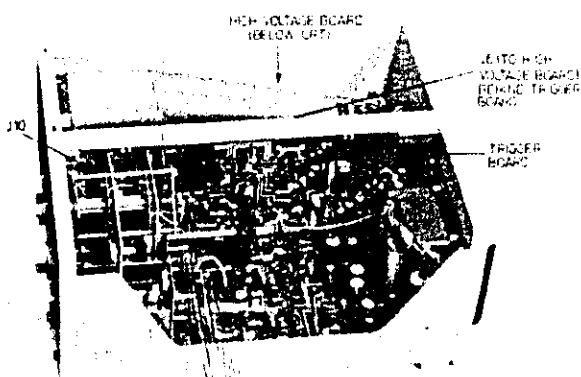
Replace heat sink assembly.

Replace screws. Tighten to ensure good thermal contact.

Release LINE button by turning; check operation.

#### 4-77 Circuit Boards

4-78 Remove the heat sink assembly. Disconnect connectors J6 and J10. Remove all knobs in the HORIZONTAL and VERTICAL panels (note, set screws have socket heads). Remove rings from all three BNC connectors. Remove the two screws from the top edge of the trigger board and ease away from rail. Taking care not to damage pins on rear of trigger board, pull the boards toward the rear, unplug the trigger board from the amplifier board and lift them out, individually.



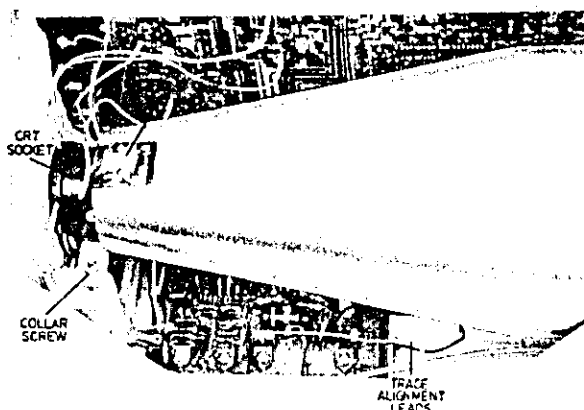
#### 4-79 Cathode Ray Tube (CRT)



IMPLOSION HAZARD. Handle CRT carefully

4-80 To remove CRT (with shield) from the instrument:

- Disconnect the trace alignment leads.
- Disconnect the leads from the trigger boards.
- Remove CRT collar screws.
- Lever collar base away from mounting.
- Lift rear of CRT, remove CRT socket and lift away from instrument.



To replace CRT and shield, reverse this procedure. If the CRT is to be replaced by a new tube, remove CRT and shield as above then;

Mark the orientation of CRT base and CRT collar on the shield using a pencil.

Slacken circle clip.

Pull off collar and circle clip.

Remove rubber ring at face of CRT.

Pull CRT out from shield.

Ensure that a flat rubber ring is fitted to neck of new CRT near base.

Insert new CRT into shield.

Align CRT base spigot with mark on shield.

Fit rubber ring at face of CRT.

Place CRT and shield face down on a smooth surface.

Push down on CRT base for firm fit into rubber ring at face.

Fit collar and circle clip on neck of tube over rubber ring. Align collar with mark on shield and push towards CRT face so that the shield is firmly clamped.



Clamp collar, taking care not to overtighten the circle clip. Preferably use a torque screwdriver set to 0.11 kg-m (10 in-lb).

#### 4-81 Attenuator Assembly

4-82 The attenuator shield is soldered to the printed circuit board at two points. If the shield is removed in the process of servicing the switch assembly, replace the shield making sure both points are solidly soldered to the board before performing any further checks or adjustments.

#### 4-83 ACCESS TO REAR OF TRIGGER BOARD

4-84 When troubleshooting trigger amplifier, access to the printed track can be made by removing CRT collar screws, easing the CRT backwards and then swinging the screen end of the CRT away from the trigger board.

 **WARNING** 

IMPLOSION HAZARD. Handle CRT carefully. DANGEROUS VOLTAGES. Switch off and disconnect oscilloscope from supply before moving CRT. Use special caution when operating instrument with CRT displaced.

Alternatively, extender board (part number 5060-0049) is available. This fits in place of trigger board which can then be operated in a position vertically above its usual position.

#### 4-85 REPAIRING CIRCUIT BOARDS

4-86 This instrument uses etched circuit boards with plated-through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components, such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information.

#### 4-87 Semiconductor Removal and Replacement

4-88 When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as used for the original part. Refer to figure 5-2 for the power transistors.

#### 4-89 Integrated Circuit Replacement

##### CAUTION

To avoid damaging integrated circuits when removing or replacing them, carry out the following procedure carefully.

4-90 Soldered integrated circuits can be removed with soldering irons which simultaneously heat all connections. Soldering irons with built-in desoldering tools also facilitate quick removal.

Use the following procedure for removing an integrated circuit with a standard soldering iron.

Heat lead solder joint. Use small tip.

When solder is fluid, remove with desoldering tool.

Repeat for each lead until all leads are free.

Grasp each lead with long-nosed pliers and check that it is mechanically free from circuit board.

When all leads are free, carefully remove integrated circuit. Dual in-line type can be removed by gently gripping top and bottom with long-nosed pliers and rolling circuit out.

Use desoldering tool or toothpick to remove all remaining solder from circuit board holes.

##### CAUTION

Be careful not to damage the integrated circuit with excessive heat. Work quickly.

Insert replacement integrated circuit into circuit board and solder in place.

4-91 When replacing an integrated circuit, note the mark or notch used for orientation. The component-identification photographs and the integrated circuit pin-location diagrams in this manual show the correct orientation.

#### 4-92 Transistor Heat Sink Removal

4-93 Carefully pull away from transistor body.

##### CAUTION

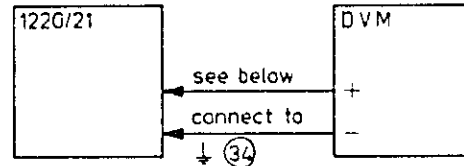
When replacing heat sinks, support the bottom of the transistors to avoid lead damage caused by downward pressure.

## ADJUSTMENTS

Table 4-1. Test Instruments Required

Instrument or Accessories	Brief Specification
Voltmeter Calibrator	10mV - 50V p-p $\pm 0.2\%$ 0 - 60 MHz
Square Wave Generator	1 kHz - 1 MHz Risetime < 5nsec
Oscillator*	50 kHz - 15 MHz
Time Mark Generator	Pulse range from 0.1 $\mu$ sec - 0.5 msec $\pm 1\%$
Digital Voltmeter	0.1V - 100V $\pm 0.1\%$
DC-Volt-Ohm- Meter	1mV - 300V 1 $\Omega$ - 10 M $\Omega$
Oscilloscope	5mV - 10 $\pm 3\%$ 35 MHz - 60 MHz
TV Pattern Generator	TV Signals to local standard
Male BNC to Male BNC cable	50 $\Omega$
BNC TEE 1 male 2 female	50 $\Omega$
50 $\Omega$ Feedthrough Termination	50 $\Omega$
1000:1 High Voltage Divider	$\pm 2\%$
Trimmer Capacitor	9-35pF
Resistor	1M $\Omega \pm 1\%$
Variable transformer	100 - 250V, 50/60 Hz > 50VA
AC Voltmeter	150, 300V, 50/60 Hz, 1%

Table 4-2.01. Adjustment Procedure: Low Voltage Power Supply



Initial control settings as figure 2-1

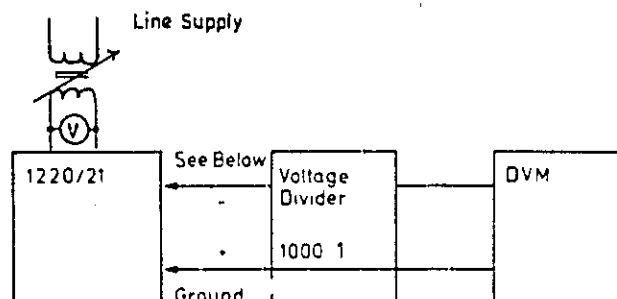
The +95V supply is an adjustable reference for the  $\pm 12$  Volt supplies, and the +210 Volt supply. It is normally adjusted to produce highest accuracy on the +12 Volt supply.

STEP	ACTION	RESULT
1	Connect Digital Voltmeter - (or $\downarrow$ ) lead to the jack 34 on Model 1220A/1221A rear panel.	
2	Connect Digital Voltmeter + lead to +12V test point on A2.	
3	Adjust A2R10 until +12V supply gives reading of	+12V $\pm 0.05$ V
4	Transfer Digital Voltmeter to +5V test point on A2	+5V $\pm 0.25$ V
5	Transfer Digital Voltmeter to -12V test point on A2	-12V $\pm 0.3$ V
6	Transfer Digital Voltmeter to +95V test point on A2	+95V $\pm 2$ V
7	Change Digital Voltmeter range, if necessary, and connect to +210V test point on A2.	+210V $\pm 20$ V
8	Disconnect Digital Voltmeter.	

\*An a.c. voltmeter (100mV  $\pm 1\%$ , to 20 MHz) will be needed if available oscillator is uncalibrated.

## ADJUSTMENTS

Table 4-2.02. Adjustment Procedure: High Voltage Supply



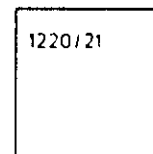
Initial control settings as figure 2-1

For this check, the line voltage must be within 1% of the nominal voltage set on the line voltage selectors 31.

STEP	ACTION	RESULT
1	Set LINE SELECTOR 31 to 220V.	
2	Set TIME/DIV 6 to 5ms	
3	Set A3R1 so that no trace modulation is apparent.	
4	Set variable transformer for a reading of 220V.	
5	Connect 1:1000 voltage divider to A3TP2	
6	Adjust A3R30 for a DVM reading of $1.96V \pm 5mV$ .	
7	Set variable transformer for a reading of 198V on the voltmeter.	
8	Set A3R1 so that no trace modulation is apparent.	
9	Set variable transformer for a reading of 232V.	
10	Check that no trace modulation is apparent. If necessary, readjust A3R1 and repeat steps 7, 8, 9 and 10.	
11	Repeat steps 4, 5 and 6.	
12	Disconnect variable transformer, set LINE SELECTOR to appropriate line voltage.	

NOTE. This procedure may need to be modified if line voltage lies outside 100, 110, 220 or 240V +5%, -10%. Refer to paragraph 3-66.

Table 4-2.03. Adjustment Procedure: Intensity Limit, Astigmatism Trace Alignments



Initial control settings as figure 2-1

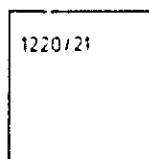
STEP	ACTION
1	Set X-Y/SWEEP pushbutton 15 to X-Y position to disable automatic bright-line sweep.
2	Center beam using POSITION controls 5 / 18.
3	Rotate INTENSITY 2 to 10 o'clock position.
4	Adjust Intensity Limit adjust A3R4 so beam is just extinguished.
5	Adjust INTENSITY 2 to obtain normal spot brightness.
6	Adjust Astigmatism adjustment A3R2 and Focus 3 to get a sharp, round dot.
7	Set X-Y/SWEEP pushbutton 15 to SWEEP position.
8	Adjust Trace Align adjustment A3R3 so that trace is parallel with horizontal graticule lines. Local magnetic field affects this setting.
9	Replace safety cover on high voltage board.

Test and Adjustment Points are indicated on Figure 4-1, Page 4-15



## ADJUSTMENTS

Table 4-2.04 Adjustment Procedure: Vertical Pre-amplifier Balance



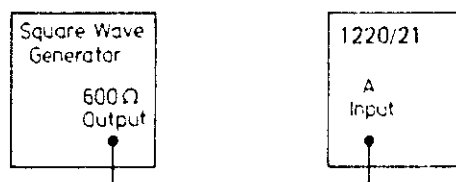
Initial control settings as figure 2-1

## STEP ACTION

NOTE: Use CHANNEL A on Model 1220A. Use VERTICAL on Model 1221A.

- 1 Press GND pushbutton 21 (VERTICAL DISPLAY A on Model 1220A).
- 2 Set VOLTS/DIV switch 19 to 20mV position and use POSITION control 18 to set trace on center horizontal graticule line.
- 3 Set VOLTS/DIV switch 19 to 2mV position and adjust X1/X10 adjustment A2R114 until trace is re-centered.
- 4 Repeat steps 2 and 3 until no trace shift occurs when VOLTS/DIV switch 19 is moved from 20mV to 2mV position.
- 5 Set VOLTS/DIV switch 19 to 100mV position and use POSITION control 18 to set trace on center horizontal graticule line.
- 6 Set VOLTS/DIV switch 19 to 50 mV position and adjust X1/X2 adjustment A2R148 until trace is positioned on center horizontal graticule line.
- 7 Repeat steps 5 and 6 until no trace shift occurs when VOLTS/DIV switch 19 is moved from 100mV to 50mV settings.
- 8 Set VOLTS/DIV switch 19 to 100mV and use POSITION control 18 to set trace on center horizontal graticule line.
- 9 Set VOLTS/DIV switch 19 to 20mV position and adjust X1/X5 adjustment A2R175 until trace is re-centered.
- 10 Repeat steps 1 through 9 for CHANNEL B on Model 1220A.

Table 4-2.05 Adjustment Procedure: Compensation of Vertical Attenuator(s)



Initial control settings as figure 2-1

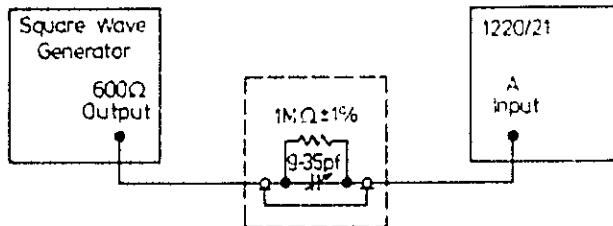
## STEP ACTION

NOTE: These adjustments are necessary only if repairs have been made to the attenuator assembly.

- 1 Set Model 1220A/Model 1221A VOLTS/DIV switch 19 to 0.2V setting and HORIZONTAL TIME/DIV switch 6 to 20μsec setting.
- 2 Set Square Wave Generator controls for 10kHz output with sufficient amplitude to produce 6 divisions of vertical deflection.
- 3 Adjust A2C102 compensation adjustment to achieve squarest corners on the displayed waveform.
- 4 Set CHANNEL A VOLTS/DIV switch 19 to 2V settings and adjust Square Wave Generator output for 6 divisions of vertical display.
- 5 Adjust A2C105 compensation adjustment to achieve squarest corners on displayed waveform.
- 6 Repeat steps 1 through 5 on Channel B attenuator for Model 1220A.

## ADJUSTMENTS

Table 4-2.06. Adjustment Procedure: Input Capacitance



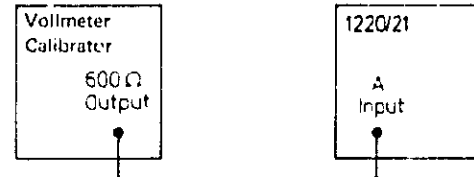
Initial control settings as figure 2-1

NOTE: This procedure is only necessary when repairs have been made to the attenuator. The input capacitance can be measured directly at the vertical channel INPUT connector 23 29 by using an LC Meter. The following procedure is to be used only if an LC Meter is not available. A shield, as indicated by the dotted line in the above drawing, should be used to keep stray capacitance from affecting measurements.

## STEP ACTION

- 1 Set HORIZONTAL TIME/DIV switch 6 to 20 $\mu$ sec setting, CHANNEL A VOLTS/DIV switch 19 to 2mV setting. Set Square Wave Generator for 1kHz signal.
- 2 Adjust Square Wave Generator amplitude to produce 6 divisions vertical deflection, and adjust 9-35pf trimmer to give squarest corner on waveform.
- 3 Set VOLTS/DIV switch 19 to 0.2V setting and set Square Wave Generator to produce 6 divisions vertical deflection.
- 4 Adjust Input Capacitor A2C103 for best possible waveform.
- 5 Set VOLTS/DIV switch 19 to 2V setting and adjust Square Wave Generator to produce 6 divisions vertical deflection.
- 6 Adjust Input Capacitor A2C106 for best possible waveform.
- 7 Repeat steps 1 through 6 for CHANNEL B. Use VOLTS/DIV switch 25 and Input Capacitors A2C203 and A2C206.

Table 4-2.07. Adjustment Procedure: Vertical Gain



Initial control settings as figure 2-1

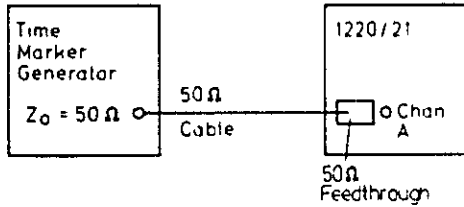
NOTE: During this procedure, be sure vertical verniers 20 / 26 are in full counterclockwise (detent) position.

## STEP ACTION

- 1 Set CHANNEL A VOLTS/DIV switch 19 to 100mV setting and HORIZONTAL TIME/DIV switch 6 to 1msec setting.
- 2 Set Oscillator for 400kHz at exactly 500mV p-p amplitude.
- 3 Adjust Vertical Gain adjustment A2R162 for exactly 5 divisions of vertical deflection. This ensures 3% accuracy in the vertical amplifier.
- 4 Repeat steps 1 through 3 on CHANNEL B for Model 1220A. Set VERTICAL VOLTS/DIV switch 25, and adjust A2R262 for Channel B.

ADJUSTMENTS

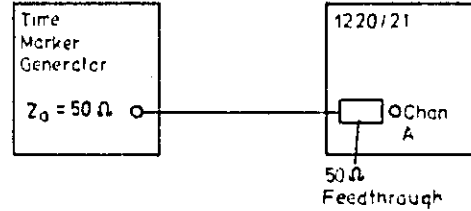
Table 4-2.08. Adjustment Procedure: Sweep Speed



Initial settings as figure 2-1

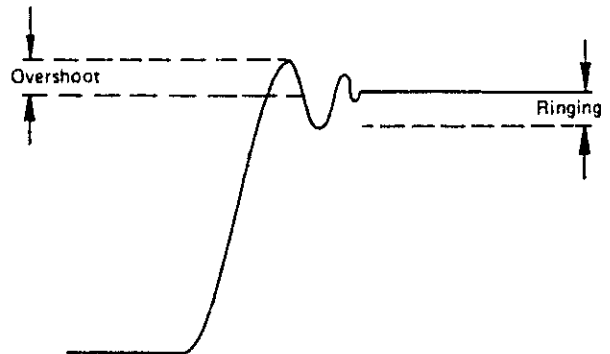
- | STEP | ACTION   |
|------|--|
| 1    | Set generator for a 1ms marker interval.   |
| 2    | Adjust A1R97 so that markers lie on vertical graticule lines (use POSITION control 5 to align first marker with edge of graticule).                                |
| 3    | Set generator for a 0.2μs marker interval and oscilloscope sweep to 0.2μs/div.   |
| 4    | Adjust A1C28 so that time markers again co-incide with vertical lines of graticule.  |
| 5    | Set calibrator in turn to 0.1μs and 0.5μs and verify sweep calibration for corresponding oscilloscope settings. If necessary, re-adjust A1C28 for best compromise. |

Table 4-2.09. Calibration Procedure: Pulse Response



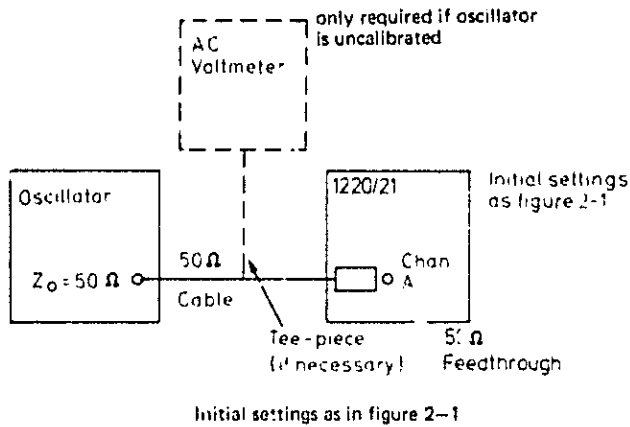
Initial settings as in figure 2-1

- | STEP | ACTION   | RESULT |
|------|--|--------|
| 1    | Set attenuator to 100mV/div. Set sweep to 0.1μs/div. Set generator for 1 MHz square wave, adjust output amplitude for a 6-division vertical display on the oscilloscope. |        |
| 2    | Adjust A1C420 and C421 for optimum pulse response in terms of ringing, overshoot and rise time   |        |



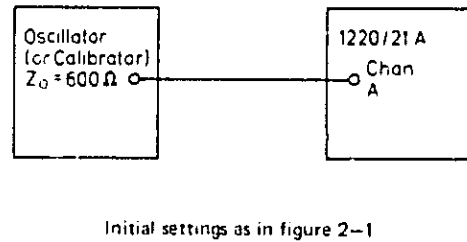
ADJUSTMENTS

Table 4-2.10. Adjustment Procedure: Bandwidth

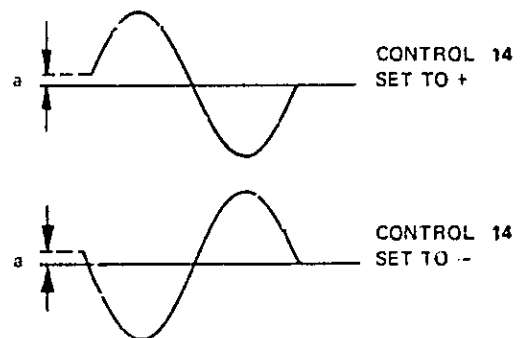


- | STEP | ACTION  |
|------|---|
| 1    | Set oscillator to 50 kHz at an output which produces a vertical deflection of 6 divisions.                              |
| 2    | Set oscillator to 15 MHz at the same amplitude. Adjust A1C420/C421 to obtain a vertical deflection $\geq 4.3$ divisions |
| 3    | Optimize adjustment by repeating previous table.  |

Table 4-2.11. Adjustment Procedure: Trigger Amplifier Balance



- | STEP | ACTION  |
|------|---|
| 1    | Remove connector J10 (between A1 and front panel) so that TRIGGER LEVEL control 8 is inoperative. |
| 2    | Set oscilloscope sweep to 0.1ms/div, sensitivity to 100mV/div, and +/- 14 to +.                   |
| 3    | Set generator for 1 kHz sinewave at 600mV p-p.  |
| 4    | Adjust A1R66 so that both start at the same point.  |

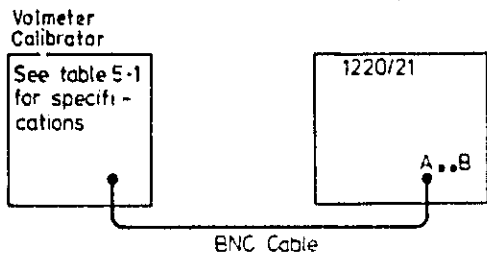


- |   |                |
|---|----------------|
| 5 | Reconnect J10. |
|---|----------------|

End of Adjustment Procedure

PERFORMANCE TESTS

Table 4-3.01. Performance Test: Vertical Sensitivity

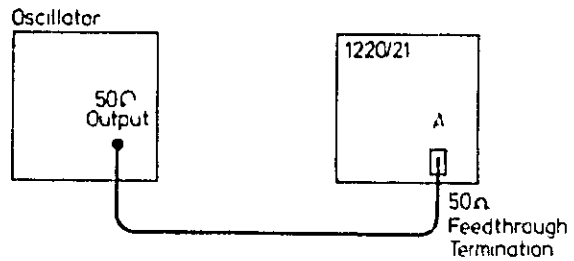


Initial control settings as figure 2-1

VOLTMETER CALIBRATOR	1220A/1221A VOLTS/DIV	RESULTS
50Vpp	10V	5 div
30Vpp	5V	6 div
10Vpp	2V	5 div
5Vpp	1V	5 div
3Vpp	.5V	6 div
1Vpp	.2V	5 div
.5Vpp	.1V	5 div
.3Vpp	50mV	6 div
.1Vpp	20mV	5 div
50mVpp	10mV	5 div
30mVpp	5mV	6 div
10mVpp	2mV	5 div

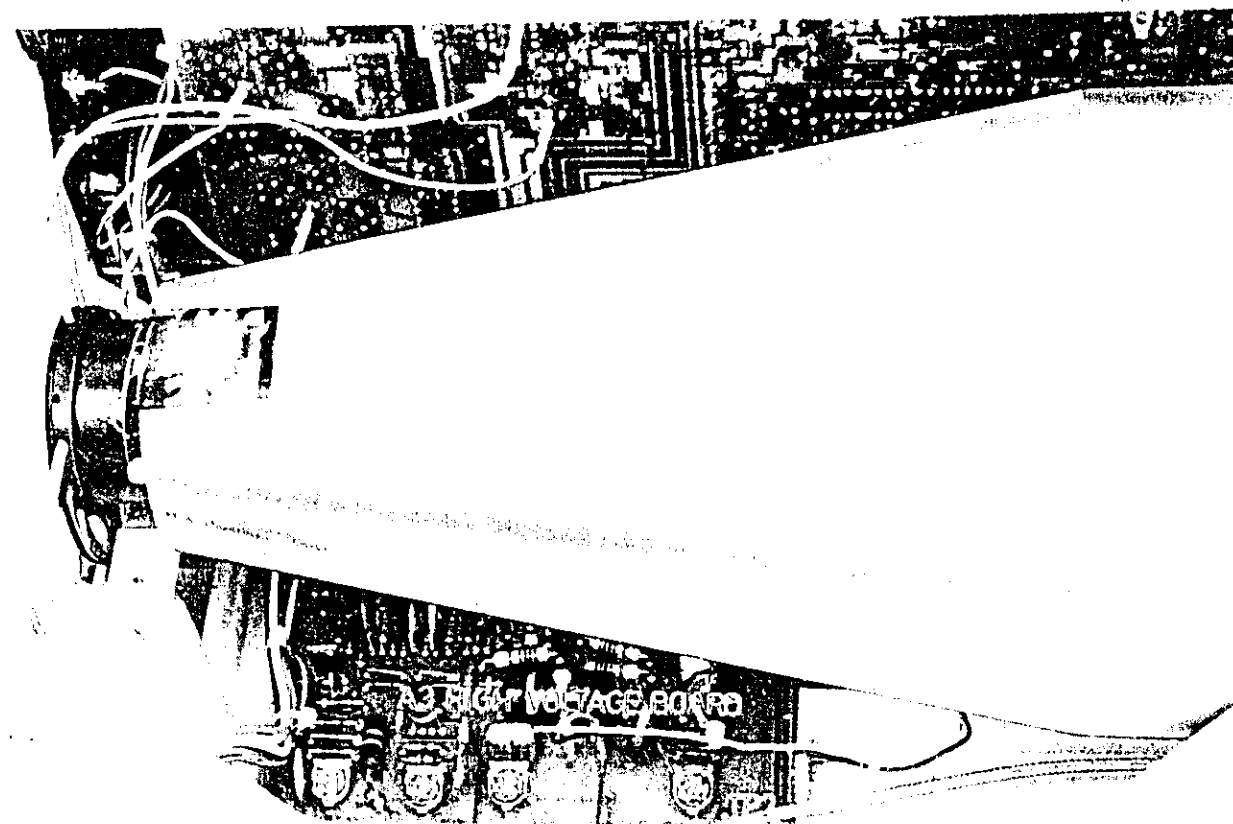
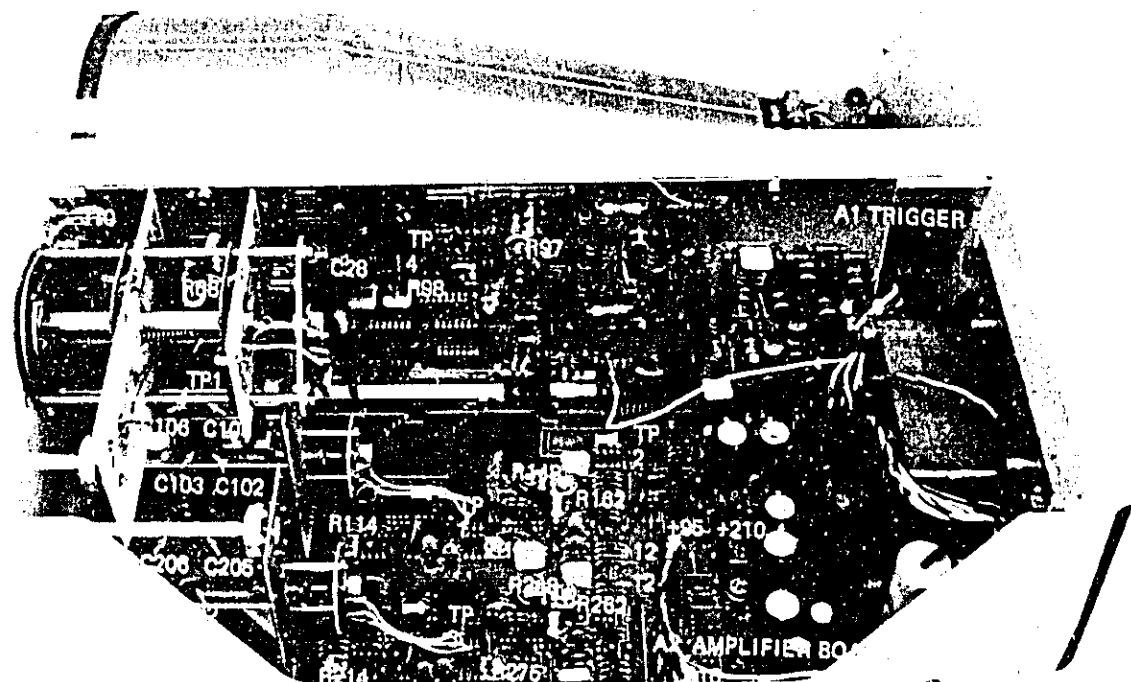
Transfer Input to channel B, select channel B and repeat above tests.

Table 4-3.02. Performance Test: Internal Trigger Sensitivity



Initial control settings as figure 2-1 except: VOLTS/DIV (19) .1V  
TIME/DIV (6) .1us

- | STEP | ACTION   |
|------|--|
| 1    | Set oscillator frequency to 15 MHz.  |
| 2    | Set oscillator amplitude for a 1220A, 1221A display of 2 div.  |
| 3    | Adjust the 1220A/1221A TRIGGER LEVEL to obtain a stable display.                                       |
| 4    | Depress the "+/-" button 14 for negative triggering; display should change polarity and remain stable. |



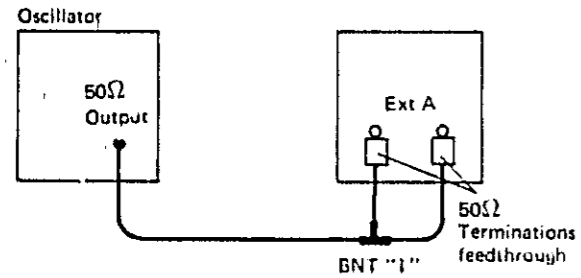
**⚡ WARNING ⚡**  
**VOLTAGES DANGEROUS TO LIFE**

Adjustments with protective cover removed  
Use extreme caution when final testing is done  
with this cover removed.

Figure 4-3. Location of Calibration Controls

PERFORMANCE TESTS

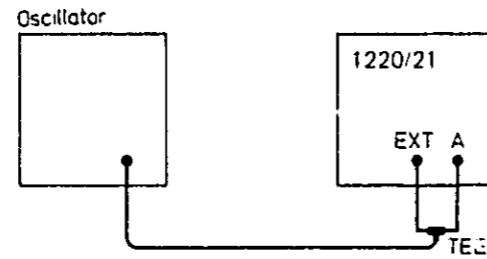
Table 4-3.03 Performance Test: External Trigger Sensitivity



STEP ACTION

- 1 Set oscillator amplitude for a 1220A/1221A display of 1 div.
- 2 Depress the EXT button 11 for external triggering and adjust the 1220A/1221A LEVEL control B to obtain a stable display.
- 3 Release the "+/-" button 14 for positive triggering; display should change polarity and remain stable.

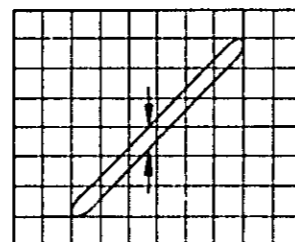
Table 4-3.04. Performance Test: Phase Shift Check



Initial control settings as figure 2-1 except:  
X-Y/SWP pressed

STEP ACTION

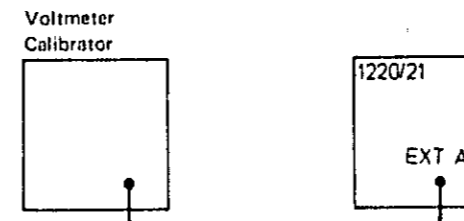
- 1 Set oscillator to 100kHz.
- 2 Set ampl. for a 6 div. deflection horizontal and vertical.
- 3 Phase shift should be < 0.2div.
- 4 Repeat for channel B.
- 5 Check that results of table 4-2.10 are met.



< 0.2 div

PERFORMANCE TESTS

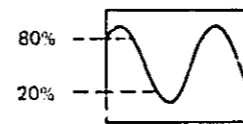
Table 4-3.05 Performance Test: Trigger Level and Polarity Controls Check



Initial control settings as figure 2-1 except:  
VOLTS/DIV 0.1V

STEP ACTION

- 1 Set calibrator amplitude to 0.6Vpp at 400 Hz.
- 2 Set 1220A/1221A TIME/DIV switch to 1ms.
- 3 Set TRIGGER LEVEL slowly ccw and cw. Trigger point should shift from 20% to 80% of positive slope.



- 4 Depress the "+/-" switch for negative triggering. Repeat step 3 for negative slope.

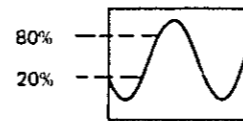
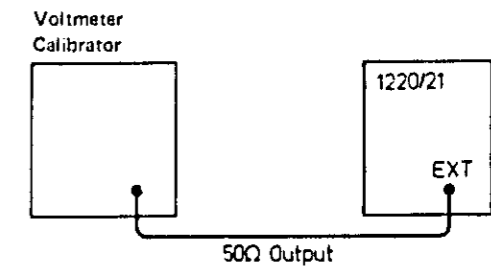


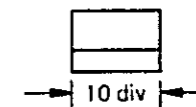
Table 4-3.06. Performance Test: Deflection Check



Initial control settings as figure 2-1 except:  
X-Y/SWP pressed

STEP ACTION

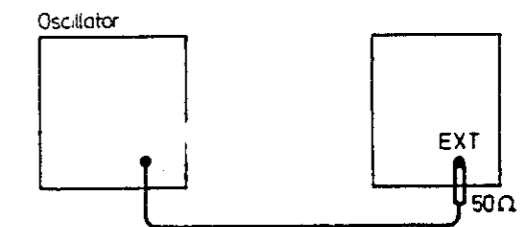
- 1 Set calibrator amplitude to 10Vpp. The horizontal trace should be 10 divisions, ± 0.5 division.



- 2 Depress the 1:10 switch. The horizontal trace should be 1 division, ± 1 division.



Table 4-3.07 Performance Test: Horizontal Bandwidth Check



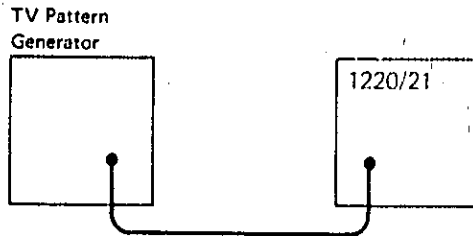
Initial control settings as figure 2-1 except:  
X-Y/SWP pressed

- 1 Set Signal Source to 50kHz
- 2 Adjust source for 10 div. on 1220A/1221A
- 3 Observe meter reading
- 4 Set source to 1 MHz
- 5 Amplitude check
- 6 Display should be ≥ 7.1 div.

← Tables 4-3.03 and 4-3.04

PERFORMANCE TESTS

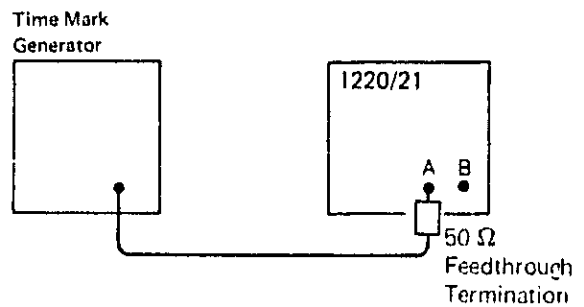
Table 4-3.08. Performance Test: TV Sync Separator Check



Initial control settings as figure 2-1 except:  
 VOLTS/DIV 100mV/div  
 TIME/DIV .2ms  
 TV-NORM pressed

- | STEP | ACTION   |
|------|--|
| 1    | Set the TV pattern generator to produce a signal.  |
| 2    | Select correct signal polarity.  |
| 3    | Adjust generator amplitude for a display of 3 divisions. 1220A/1221A should trigger on frame pulses. |
| 4    | Switch the TIME/DIV switch to 10μs. The 1220A/1221A should trigger on line pulses.                   |

Table 4-3.09. Performance Test: Sweep Accuracy Check

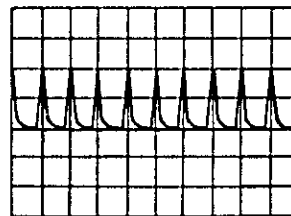


Initial control settings as figure 2-1 except:  
 VOLTS/DIV 0.1V

TIME MARK INTERVAL	1220A/1221A TIME/DIV SETTING
--------------------	------------------------------

- |                  |     |
|------------------|-----|
| .1μ              | .1μ |
| .2μ              | .2μ |
| .5μ              | .5μ |
| and so on to .5s |     |

The first time mark should appear at the left edge of the graticule in each setting; the 11<sup>th</sup> mark should occur within 0.4 div. of the right edge of the graticule.



Set sweep to 1ms/div  
 Time marker 1msec  
 11 markers should appear

Turn sweep expander fully Cw  
 Time interval should be equal or greater than 10 div.



DIAGRAMS AND REPLACEABLE PARTS

Table 5-1. Abbreviations

A = Ampere, Assembly	FLM = Film	PCAR = Polycarbonate
AL = Aluminium	FET = Field Effect Transistor	POLYS = Polystyrene
AMP = Amplifier	GE = Germanium	POLYE = Polyester
AY = Assembly	HC = Hot Carrier	Q = Transistor
BD = Board	IC = Integrated Circuit	R = Resistor
C = Capacitor	J = Connector	REG = Regulator
CAR = Carbon	J-FET = Junction-Field Effect Transistor	S, SW = Switch
CER = Ceramic	K = Kilohms	SI = Silicon
CMT = Cermet	L = Inductor	SKT = Socket
CPLR = Coupler	LIN = Linear	SLTD = Selected
CONN = Connector	LOG = Logarithmic	T = Transformer
CONT = Contact	M = Megohm	TAN = Tantalum
COMP = Composition	MC = Micro-circuit (e.g. packaged gates, inverters, flip-flops)	U = Micro ( $1 \times 10^{-6}$ ), packaged transistors
CP = Diode	MET = Metal or Metalized	V = Volts, Electronic tubes
DIG = Digital	MIC = Mica	VAR = Variable Value (maximum value shown)
EY = Electrolytic	M.P. = Mechanical part	W = Watts, Cable assembly, working
F = Fuse, Fixed Value, Farad	N = Negative	X = Socket
	n, N = nano ( $1 \times 10^{-9}$ )	Z = Zener
	OP = Operational	

Table 5-2. Circuit Diagram Symbols

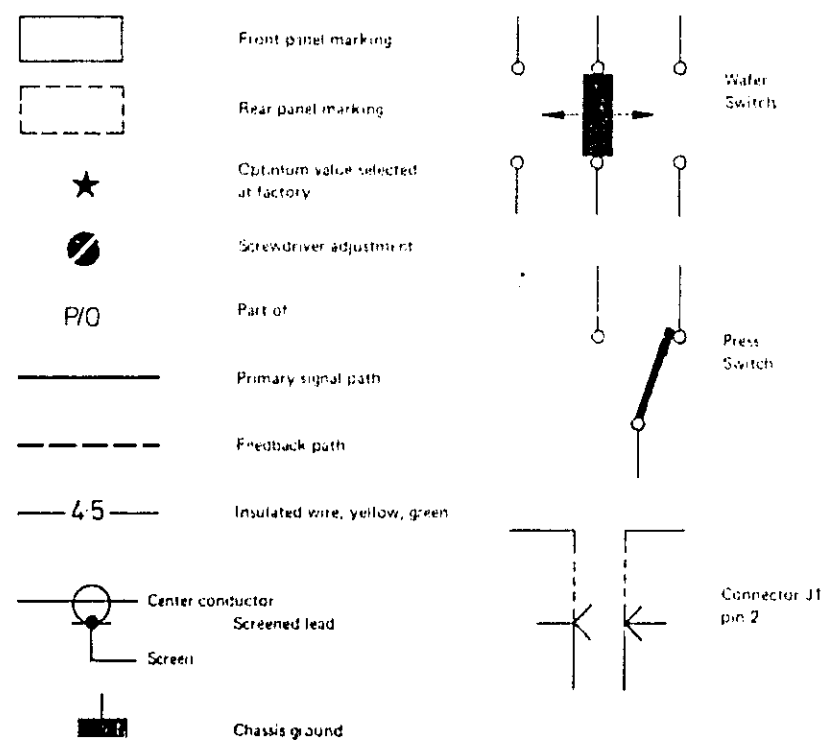
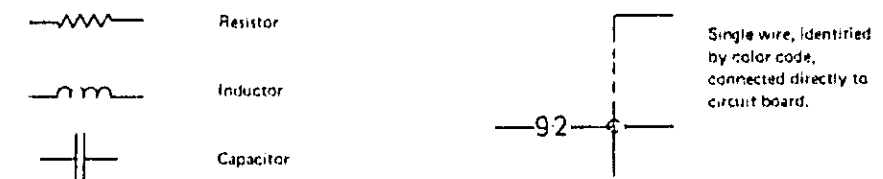
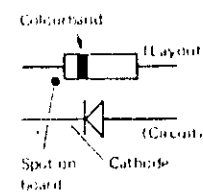
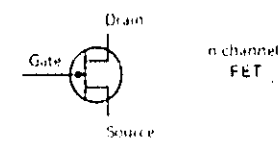
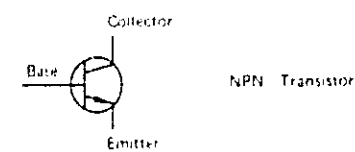
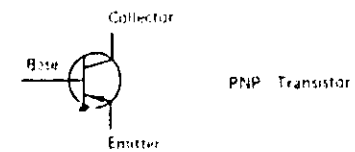
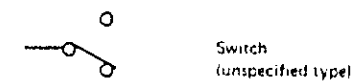


Table 5-2. Circuit Diagram Symbols (cont'd).



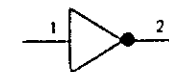
Unless otherwise indicated:  
capacitance in microfarads  
inductance in microhenries  
resistance in ohms.



NAND gate 3 is low (logical 0) when 1 and 2 are both high (logical 1)

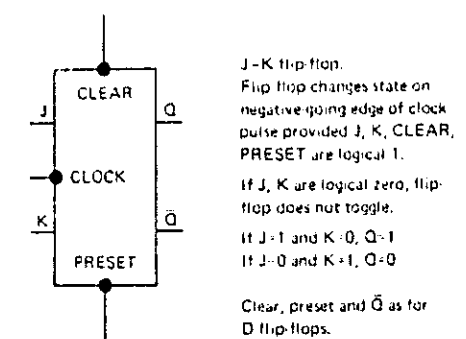
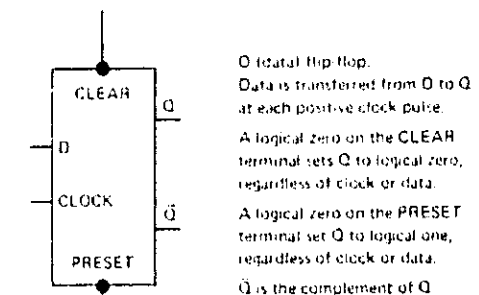
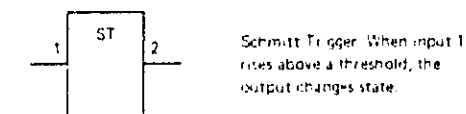
NAND gate 3 is low conditions.

Terminal	1	2	3
logic state	1	1	0
	1	0	1
	0	1	1
	0	0	1



Color Code

0	Black
1	Brown
2	Red
3	Orange
4	Yellow
5	Green
6	Blue
7	Violet
8	Gray
9	White



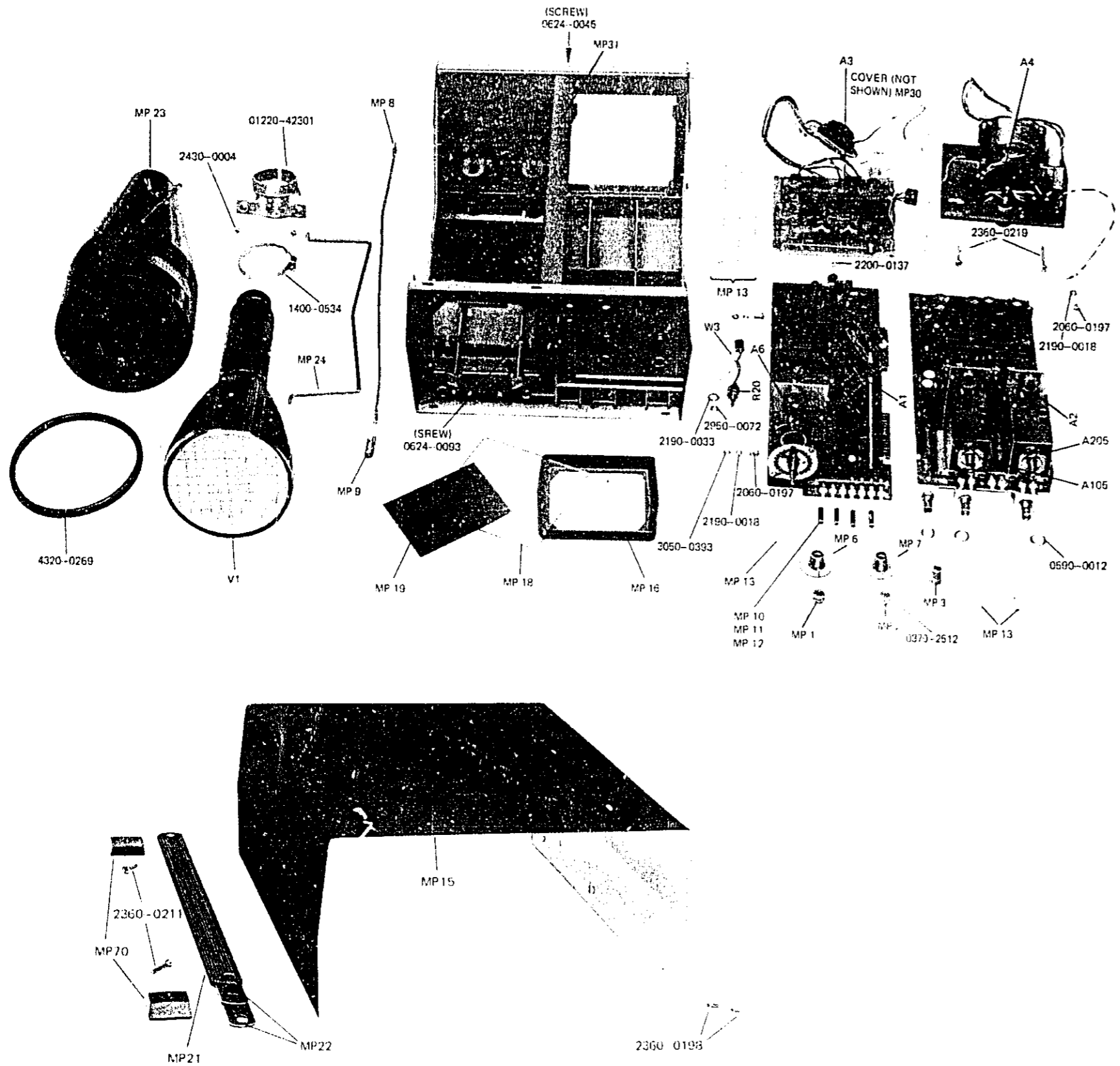


Table 5-3. Replaceable Parts

This list applies to all models 1220A/21A, standard and options 020 (German) and 021 (French). Parts particular to one version are indicated by the name of that version appearing in the Description column.

Component Referencing

The instrument consists of a number of assemblies (A1, A2, etc) mounted in a frame (main assembly). Components mounted on an assembly take the assembly number in addition to a component number. Thus the reference designator A1Q3 means transistor 3 on assembly A1. Components mounted directly on the main assembly take no assembly reference.

Main Assembly

REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION
A1	01220-00901	RD AY TRIGGER - 1220A
A1	01221-00901	RD AY TRIGGER - 1221A
A2	01220-00904	RD AY AMPLIFIER - 1220A
A2	01221-00904	RD AY AMPLIFIER - 1221A
A3	01220-00907	RD AY HV - 1220A
A4	01220-01901	HEAT SINK AY
F1	2190-0201	FUSE 250V 25A 1P
F2	2190-0202	FUSE 100V
F3	1200-01901	BATTERY
MP1	0350-0004	KNOB POWER OFF
MP2	0350-0005	KNOB POWER ON
MP3	0350-0006	KNOB FUNCTION
MP4	0350-0512	KNOB CONVERTER
MP5	0400-0001	MURKREFT
MP6	01220-02401	KNOB AY TRIGGER
MP7	01220-02402	KNOB AY TRIGGER
MP8	01220-02403	KNOB AY TRIGGER
MP9	01220-02404	KNOB AY TRIGGER
MP10	0340-0276	WHEEL W/STOP
MP11	01220-02801	KNOB POWER
MP12	0340-0277	KNOB FOCUS
MP13	0340-0278	KNOB FOCUS
MP14	0340-0279	KNOB FOCUS
MP15	0340-0280	KNOB FOCUS
MP16	0340-0281	KNOB FOCUS
MP17	0340-0282	KNOB FOCUS
MP18	0340-0283	KNOB FOCUS
MP19	0340-0284	KNOB FOCUS
MP20	0340-0285	KNOB FOCUS
MP21	0340-0286	KNOB FOCUS
MP22	0340-0287	KNOB FOCUS
MP23	0340-0288	KNOB FOCUS
MP24	0340-0289	KNOB FOCUS
MP25	0340-0290	KNOB FOCUS
MP26	0340-0291	KNOB FOCUS
MP27	0340-0292	KNOB FOCUS
MP28	0340-0293	KNOB FOCUS
MP29	0340-0294	KNOB FOCUS
MP30	0340-0295	KNOB FOCUS
MP31	0340-0296	KNOB FOCUS
MP32	0340-0297	KNOB FOCUS
MP33	0340-0298	KNOB FOCUS
MP34	0340-0299	KNOB FOCUS
MP35	0340-0300	KNOB FOCUS
MP36	0340-0301	KNOB FOCUS
MP37	0340-0302	KNOB FOCUS
MP38	0340-0303	KNOB FOCUS
MP39	0340-0304	KNOB FOCUS
MP40	0340-0305	KNOB FOCUS
MP41	0340-0306	KNOB FOCUS
MP42	0340-0307	KNOB FOCUS
MP43	0340-0308	KNOB FOCUS
MP44	0340-0309	KNOB FOCUS
MP45	0340-0310	KNOB FOCUS
MP46	0340-0311	KNOB FOCUS
MP47	0340-0312	KNOB FOCUS
MP48	0340-0313	KNOB FOCUS
MP49	0340-0314	KNOB FOCUS
MP50	0340-0315	KNOB FOCUS
MP51	0340-0316	KNOB FOCUS
MP52	0340-0317	KNOB FOCUS
MP53	0340-0318	KNOB FOCUS
MP54	0340-0319	KNOB FOCUS
MP55	0340-0320	KNOB FOCUS
MP56	0340-0321	KNOB FOCUS
MP57	0340-0322	KNOB FOCUS
MP58	0340-0323	KNOB FOCUS
MP59	0340-0324	KNOB FOCUS
MP60	0340-0325	KNOB FOCUS
MP61	0340-0326	KNOB FOCUS
MP62	0340-0327	KNOB FOCUS
MP63	0340-0328	KNOB FOCUS
MP64	0340-0329	KNOB FOCUS
MP65	0340-0330	KNOB FOCUS
MP66	0340-0331	KNOB FOCUS
MP67	0340-0332	KNOB FOCUS
MP68	0340-0333	KNOB FOCUS
MP69	0340-0334	KNOB FOCUS
MP70	0340-0335	KNOB FOCUS
MP71	0340-0336	KNOB FOCUS
MP72	0340-0337	KNOB FOCUS
MP73	0340-0338	KNOB FOCUS
MP74	0340-0339	KNOB FOCUS
MP75	0340-0340	KNOB FOCUS
MP76	0340-0341	KNOB FOCUS
MP77	0340-0342	KNOB FOCUS
MP78	0340-0343	KNOB FOCUS
MP79	0340-0344	KNOB FOCUS
MP80	0340-0345	KNOB FOCUS
MP81	0340-0346	KNOB FOCUS
MP82	0340-0347	KNOB FOCUS
MP83	0340-0348	KNOB FOCUS
MP84	0340-0349	KNOB FOCUS
MP85	0340-0350	KNOB FOCUS
MP86	0340-0351	KNOB FOCUS
MP87	0340-0352	KNOB FOCUS
MP88	0340-0353	KNOB FOCUS
MP89	0340-0354	KNOB FOCUS
MP90	0340-0355	KNOB FOCUS
MP91	0340-0356	KNOB FOCUS
MP92	0340-0357	KNOB FOCUS
MP93	0340-0358	KNOB FOCUS
MP94	0340-0359	KNOB FOCUS
MP95	0340-0360	KNOB FOCUS
MP96	0340-0361	KNOB FOCUS
MP97	0340-0362	KNOB FOCUS
MP98	0340-0363	KNOB FOCUS
MP99	0340-0364	KNOB FOCUS
MP100	0340-0365	KNOB FOCUS

Figure 5-1. Parts identification for main assembly





Table 5-3. Replaceable Parts (cont'd)

Assembly A3-High Voltage Board

REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION
A2	R121	0757-0273 R-F 3.01K +-1% 1/8W MET FLM
A2	R122	0757-0273 R-F 3.01K +-1% 1/8W MET FLM
A2	R123	0757-0420 R-F 750 +-1% 1/8W MET FLM
A2	R124	0757-0420 R-F 750 +-1% 1/8W MET FLM
A2	R125	0698-4384 R-F 54.0 +-1% 1/8W MET FLM
A2	R126	0698-4384 R-F 54.0 +-1% 1/8W MET FLM
A2	R127	0757-0407 R-F 200 +-1% 1/8W MET FLM
A2	R128	0757-0407 R-F 200 +-1% 1/8W MET FLM
A2	R129	0757-0419 R-F 681 +-1% 1/8W MET FLM
A2	R130	0757-0465 R-F 100K +-1% 1/8W MET FLM
A2	R131	0757-0465 R-F 100K +-1% 1/8W MET FLM
A2	R132	0757-0346 R-F 10 +-1% 1/8W MET FLM
A2	R133	0757-0346 R-F 10 +-1% 1/8W MET FLM
A2	R135	0757-0437 R-F 4.75K +-1% 1/8W MET FLM
A2	R136	0757-0437 R-F 4.75K +-1% 1/8W MET FLM
A2	R138	0757-0280 R-F 1K +-1% 1/8W MET FLM
A2	R139	0757-0280 R-F 1K +-1% 1/8W MET FLM
A2	R140	0757-0317 R-F 1.33K +-1% 1/8W MET FLM
A2	R141	0757-0317 R-F 1.33K +-1% 1/8W MET FLM
A2	R142	0698-3268 R-F 11.5K +-1% 1/8W MET FLM
A2	R143	0757-0454 R-F 33.2K +-1% 1/8W MET FLM
A2	R144	0757-0280 R-F 1K +-1% 1/8W MET FLM
A2	R145	0757-0280 R-F 1K +-1% 1/8W MET FLM
A2	R146	0698-3447 R-F 422 +-1% 1/8W MET FLM
A2	R147	0757-0410 R-F 301 +-1% 1/8W MET FLM
A2	R148	2100-2740 R-VAR 22K 1/2W CER MET
A2A105	R149	2100-0590 R-VAR 500 10% LIN
A2	R150	0698-3510 R-F 453 +-1% 1/8W
A2	R151	0757-0273 R-F 3.01K +-1% 1/8W MET FLM
A2	R152	0757-0273 R-F 3.01K +-1% 1/8W MET FLM
A2	R153	0698-3510 R-F 453 +-1% 1/8W
A2	R154	0757-0273 R-F 3.01K +-1% 1/8W MET FLM
A2	R155	0757-0273 R-F 3.01K +-1% 1/8W MET FLM
A2A105	R159	2100-0593 R-VAR 10K 20% LIN (1220A)
A2	R160	0757-0434 R-F 3.65K +-1% 1/8W MET FLM
A2	R162	2100-2797 R-VAR 4.7K 1/2W CER MET
A2	R163	0757-0280 R-F 1K +-1% 1/8W MET FLM
A2	R165	0698-3530 R-F 470 +-5% 1/8W MET FLM
A2	R166	0698-3530 R-F 470 +-5% 1/8W MET FLM
A2	R167	0698-3252 R-F 450 +-1% 1/8W MET FLM
A2	R168	0698-3252 R-F 450 +-1% 1/8W MET FLM
A2	R169	0698-4402 R-F 97.6 +-1% 1/8W MET FLM
A2	R170	0698-4402 R-F 97.6 +-1% 1/8W MET FLM
A2	R171	0698-3447 R-F 422 +-1% 1/8W MET FLM
A2	R172	0698-3447 R-F 422 +-1% 1/8W MET FLM
A2	R173	0757-0407 R-F 200 +-1% 1/8W MET FLM
A2	R174	0757-0442 R-F 10K +-1% 1/8W MET FLM
A2	R175	2100-2740 R-VAR 22K 1/2W CER MET
A2	R176	0757-0465 R-F 100K +-1% 1/8W MET FLM

REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION
A2	R177	0757-0465 R-F 100K +-1% 1/8W MET FLM
A2	R173	0757-0465 R-F 100K +-1% 1/8W MET FLM
A2	R179	0757-0440 R-F 20K +-1% 1/8W MET FLM
A2	R180	0757-0346 R-F 10 +-1% 1/8W MET FLM
A2	R181	0757-0346 R-F 10 +-1% 1/8W MET FLM
A2	R182	0757-0427 R-F 1.5K +-1% 1/8W MET FLM
A2	R183	0757-0427 R-F 1.5K +-1% 1/8W MET FLM
A2	R184	0757-0407 R-F 200 +-1% 1/8W MET FLM
A2	R185	0757-0407 R-F 200 +-1% 1/8W MET FLM
A2	R301	0757-0421 R-F 825 +-1% 1/8W MET FLM
A2	R302	0757-0437 R-F 4.75K +-1% 1/8W MET FLM
A2	R303	0757-0280 R-F 1K +-1% 1/8W MET FLM
A2	R304	0757-0453 R-F 30.1K +-1% 1/8W MET FLM
A2	R305	0757-0420 R-F 750 +-1% 1/8W MET FLM
A2	R306	0757-0384 R-F 20 +-1% 1/8W MET FLM
A2	R307	0757-0384 R-F 20 +-1% 1/8W MET FLM
A2	R308	0698-3262 R-F 40.2 +-1% 1/8W MET FLM
A2	R309	0698-3262 R-F 40.2 +-1% 1/8W MET FLM
A2	R310	0757-0417 R-F 562 +-1% 1/8W MET FLM
A2	R311	0698-3151 R-F 2.87K +-1% 1/8W MET FLM
A2	R312	0698-3151 R-F 2.87K +-1% 1/8W MET FLM
A2	R313	0698-3151 R-F 2.87K +-1% 1/8W MET FLM
A2	R314	0698-4435 R-F 2.49K +-1% 1/8W MET FLM
A2	R315	0757-0384 R-F 20 +-1% 1/8W MET FLM
A2	R601	0757-0054 R-F 900K +-1% 1/2W MET FLM
A2	R602	0757-0465 R-F 100K +-1% 1/8W MET FLM
A2	R603	0757-0401 R-F 100 +-1% 1/8W MET FLM
A2	S4	3101-0560 SWITCH-PUSHBUTTON
A2	U101	1821-0001 TRANSISTOR ARRAY CA3046
A2	U102	1821-0001 TRANSISTOR ARRAY CA3046
A2	U301	1821-0001 TRANSISTOR ARRAY CA3046

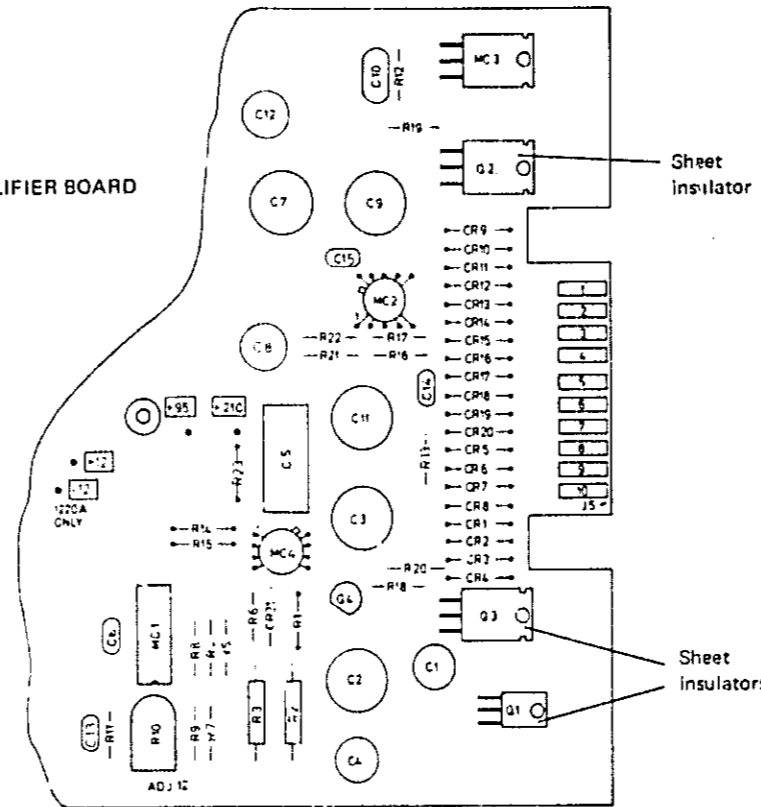
REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION
A3	C1	01220-66507 BO AY HIGH VOLTAGE
A3	C2	0160-4044 C-F 220NF +-20% 30V DC POLYE
A3	C3	0160-2930 C-F 10NF +80 -20% 100VDC CERA
A3	C3	0160-2913 C-F 10NF +85 -20% 500VDC CERA
A3	C4	0160-4042 C-F 15NF +-20% 300 VDC POLYE
A3	C5	0160-3720 C-F 100NF +-10% 16VDC MET POLYC
A3	C6	0160-4042 C-F 15NF +-20% 3000VDC POLYE
A3	C7	0160-3208 C-F 25NF +80 -20% 100VDC CER
A3	C8	0160-3208 C-F 25NF +80 -20% 100VDC CER
A3	C9	0160-2930 C-F 10NF +80 -20% 100VDC CER
A3	C11	0170-0085 C-F .1UF +-20% 50V POLYE
A3	C12	0160-2902 C-F 10NF +-20% 500VDC CER
A3	C13	0170-0085 C-F .1UF +-20% 50V POLYE
A3	C15	0160-0151 C-F 4.7NF +80 -20% 4000WVDC
A3	C18	0160-2959 C-F 1NF -20 +80% 1KVDC CER
A3	CR1	1902-3290 DIODE-Z 31.6V 5% 0.4W
A3	CR2	1902-0586 DIODE-Z 150V 5% 1.0W
A3	CR3	1902-0586 DIODE-Z 150V 5% 1.0W
A3	CR4	1902-0586 DIODE-Z 150V 5% 1.0W
A3	CR5	1901-0050 DIODE SI 30V 50mA
A3	CR6	1901-0050 DIODE SI 30V 50mA
A3	CR6	1901-0586 DIODE SI 1N4007
A3	CR9	1901-0050 DIODE SI 30V 50mA
A3	CR10	1901-3082 DIODE-Z 4.64V 5% 0.4W
A3	CR11	1902-0243 DIODE-Z 30.1V 5% 0.4W
A3	CR12	1902-3304 DIODE-Z 35.7V .4W
A3	CR13	1902-3357 DIODE-Z 56.2V 4W
A3	CR14	1901-0489 DIODE SI 2.5KV 25A
A3	CR15	1901-0489 DIODE SI 2.5KV 25A
A3	CR16	1901-0489 DIODE SI 2.5KV .25A
A3	CR17	1901-0489 DIODE SI 2.5KV .25A
A3	CR18	1901-0033 DIODE SI 1N485E
A3	CR19	1901-0050 DIODE SI
A3	J7	1251-2496 BODY R&P 5 CONNECTOR
A3	MC1	1820-0203 IC OP AMP UA741
A3	MP1	1251-0571 CONNECTOR
A3	Q1	1854-0622 TRANSISTOR SI NPN
A3	Q2	1853-0036 TRANSISTOR SI PNP 2N3906
A3	Q4	1854-0215 TRANSISTOR SI NPN 2N3904

REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION
A3	R1	2100-2784 R-VAR 470K 20% 0.5W LIN
A3	R2	2100-2782 R-VAR 100K 20% 0.5W LIN
A3	R3	2100-2789 R-VAR 10K 20% .5W LIN
A3	R4	2100-2782 R-VAR 100K 20% 0.5W LIN
A3	R5	2100-0594 R-VAR 5M 30% 2W LIN CF
A3	R6	2100-0595 R-VAR 2.5M 30% 2W LIN CF
A3	R7	0757-0280 R-F 1K 1% .125W F MET FLM
A3	R8	0757-0416 R-F 511 1% .125W MET FLM
A3	R9	0757-0468 R-F 130K 1% .125W MET FLM
A3	R10	0698-3452 R-F 147K 1% .125W MET FLM
A3	R11	0757-0052 R-F 500K 1% 1/2W MET FLM
A3	R12	0757-0052 R-F 500K 1% 1/2W MET FLM
A3	R13	0757-0052 R-F 500K 1% 1/2W MET FLM
A3	R14	0757-0052 R-F 500K 1% 1/2W MET FLM
A3	R15	0757-0052 R-F 500K 1% 1/2W MET FLM
A3	R16	0698-3455 R-F 261K 1% 1/8W MET FLM
A3	R17	0698-6038 R-F 560K 1% 1/2W MET FLM
A3	R18	0698-4522 R-F 165K 1% 1/8W MET FLM
A3	R19	0690-1061 R-F 10M 10% 1W CAR COMP
A3	R20	0757-0394 R-F 511 1% 1/8W MET FLM
A3	R21	0683-2265 R-F 22M 5% 1/4W CAR COMP
A3	R22	0757-0346 R-F 10 1% 1/8W MET FLM
A3	R23	0757-0403 R-F 121 1% 1/8W MET FLM
A3	R24	0757-0449 R-F 20K 1% 1/8W MET FLM
A3	R25	0757-0442 R-F 10K 1% 1/8W MET FLM
A3	R26	0757-0449 R-F 20K 1% 1/8W MET FLM
A3	R27	0757-0433 R-F 3.32K 1% MET FLM
A3	R28	0698-3496 R-F 866 1% 1/8W MET FLM
A3	R29	0757-0433 R-F 3.32K 1% MET FLM
A3	R30	2100-2740 R-VAR 22K 20% 0.5W LIN CF
A3	R31	0758-0057 R-F 5.6K 5% 1/2W
A3	R32	0757-0384 R-F 20 1%
A3	R33	0686-1025 R-F 1K 5% 1/2W
A3	R34	0686-1015 R-F 100 5%
A3	R35	0686-4735 R-F 47K 5% 1/2W
A3	R36	0686-4735 R-F 47K 5% 1/2W
A3	R37	0757-0457 R-F 47.5K 1%
A3	S6	3101-1734 SWITCH ASSY
A3	W1	01220-61601 CABLE
A3	W2	01220-61602 CABLE

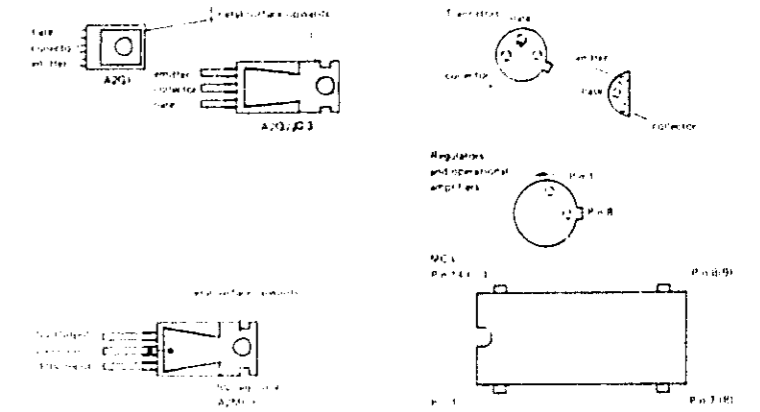
Assembly A4—Heat Sink Assembly

REFERENCE DESIGNATOR	HP PART NUMBER	DESCRIPTION
A4	01220-61101	HEAT SINK ASSEMBLY
A4	C1	0150-4026 C-F .2UF 20% 25WDC
A4	F1	1400-0084 FUSE HOLDER
A4	J1	1251-2357 CONN PWR AC RECEPTACLE
A4	J2	1251-0406 JACK TELE 2
A4	J3	1251-0229 BODY BANANA
A4	J4	1510-0038 BDG POST .812 LG
A4	MP1	01220-44102 COVER POWER SWITCH
A4	MP2	01220-47403 PUSH BUTTON SHRR
A4	S1	3101-0556 SW LINE, 1 STAT
A4	S5	3101-1609 SW DPDT, DUAL
A4	T1	01220-61103 TRANSFORMER ASSEMBLY
A4	X1	1251-0166 CONN-PC 10CONT
A4	X2	1251-2495 CONN (PART OF T1 ASSEMBLY)
A4	X3	1251-2990 CONT R&P CONN

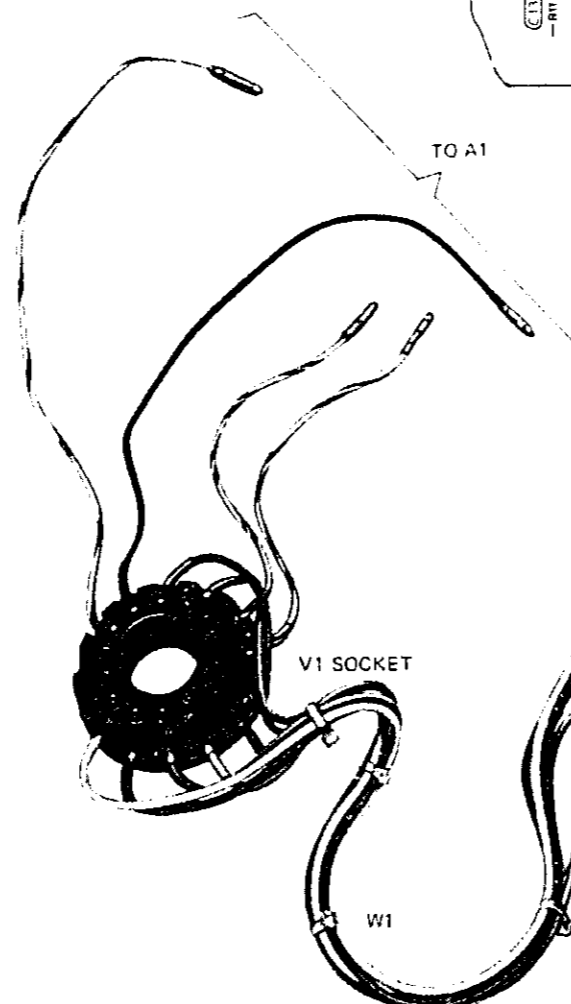
Part of A2 AMPLIFIER BOARD



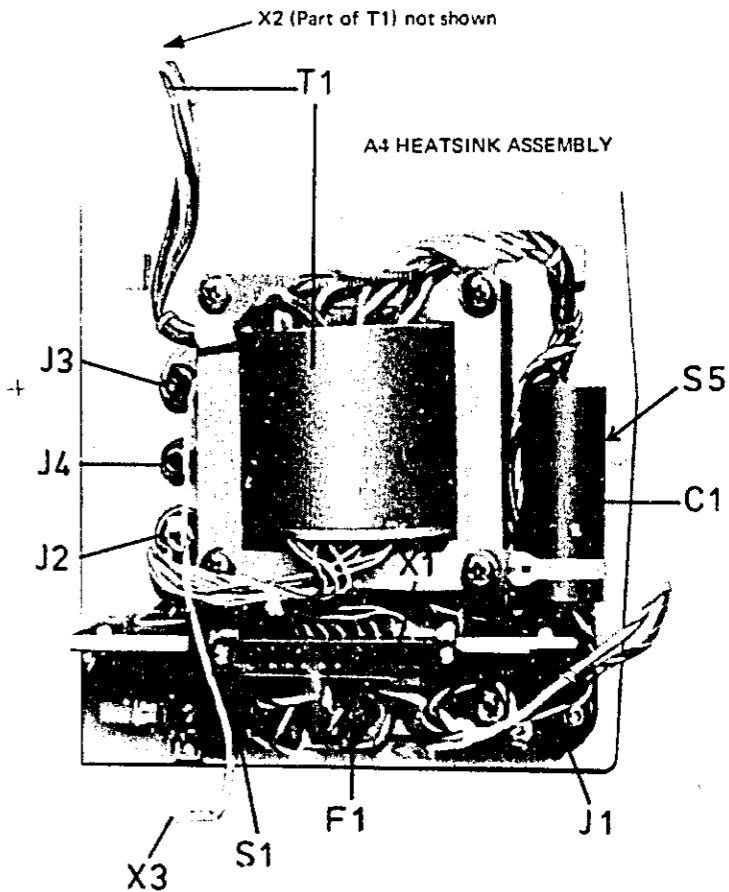
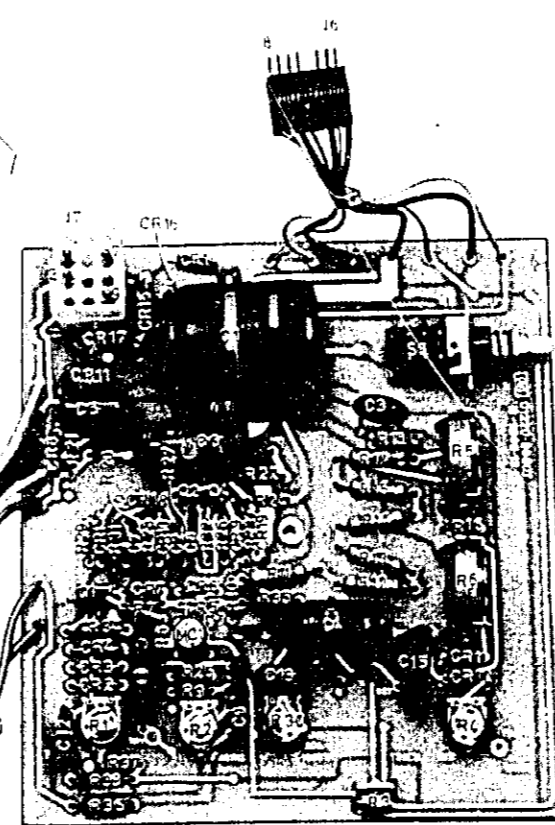
COMPONENTS ARE AS SEEN FROM TOP. ○ REPRESENTS LOCATION OF PIN ON OTHER SIDE



NOTE: Sheet insulators are fixed to power transistors, and power transistors to board, with a cyanoacrylate adhesive. Do not use ordinary adhesive; if too thick a layer is produced, heat dissipation is adversely affected.



A3 HIGH VOLTAGE BOARD



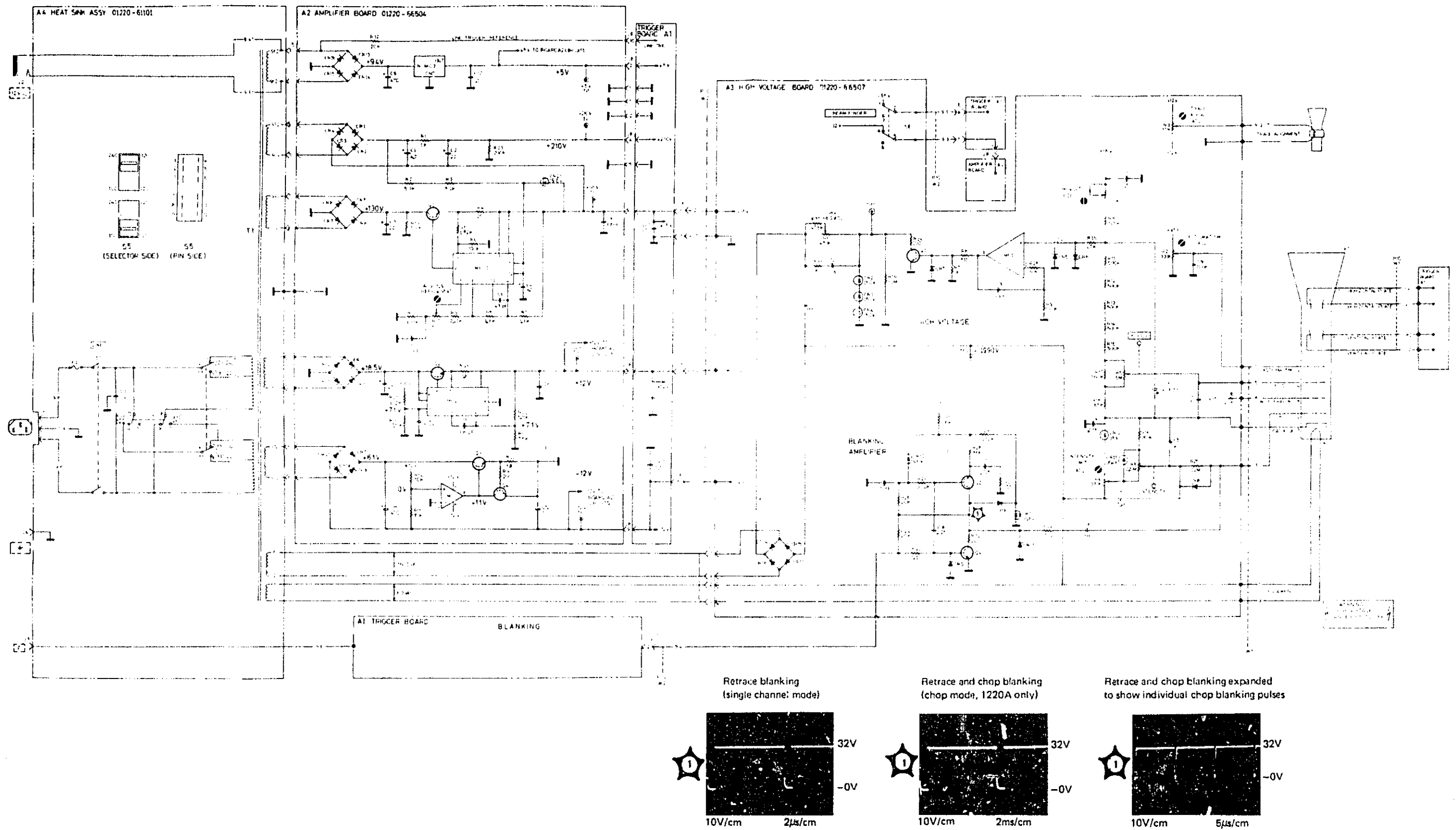
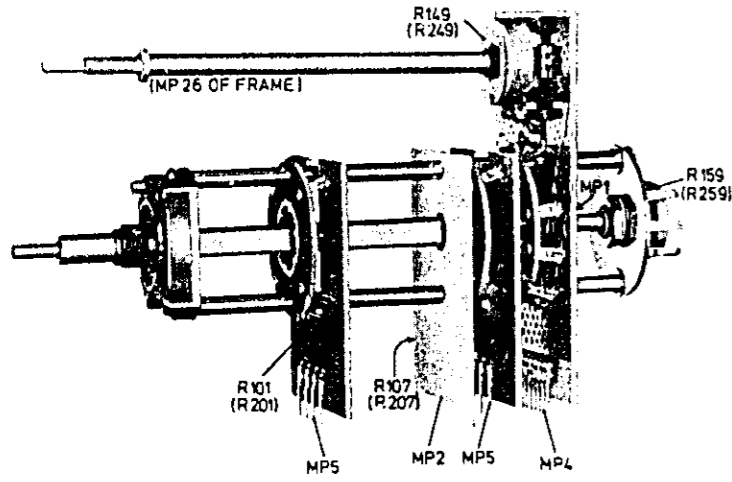
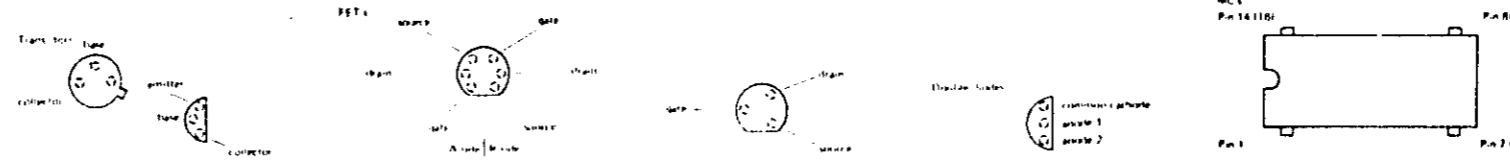


Figure 5-2. Power Supplies. (Assemblies A3, A4 and part A2)

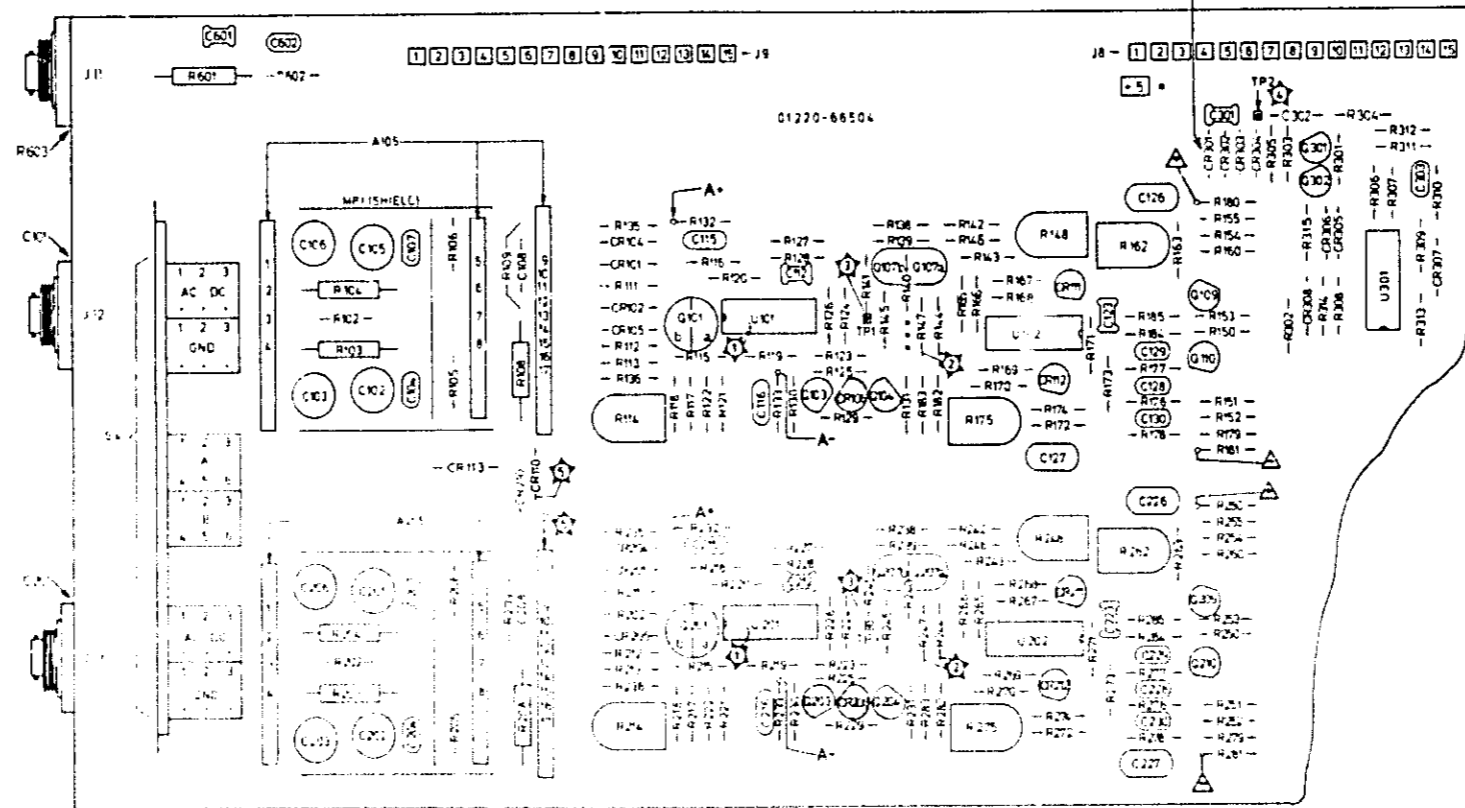
A2 A105 (205) VOLTS/DIV SWITCH ASSEMBLY



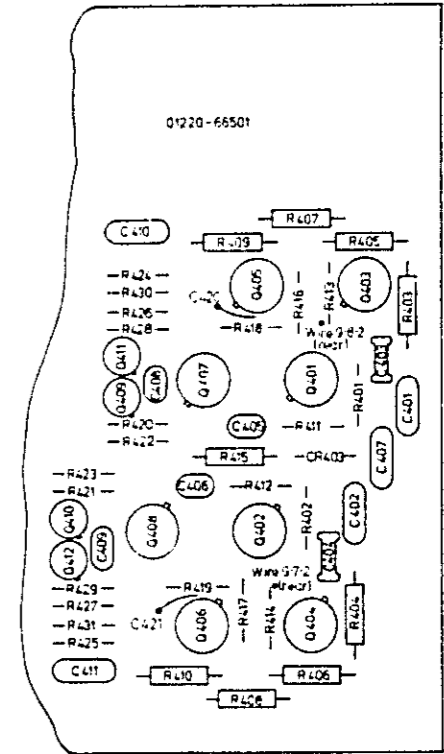
COMPONENTS AS SEEN FROM TOP. ⊙ Represents location of pin on other side



A2 AMPLIFIER BOARD



PART OF A1 TRIGGER BOARD



- R101, 103, 104, 106, 106, 108, 109, 202, 203, 204, 205, 206, 208, 208, 601, 602, 603.
- C101, 102, 103, 104, 106, 106, 107, 108, 201, 202, 203, 204, 205, 206, 207, 208, 601, 602
- CR110, 113, 210.

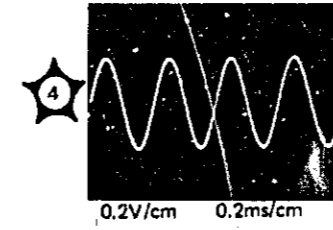
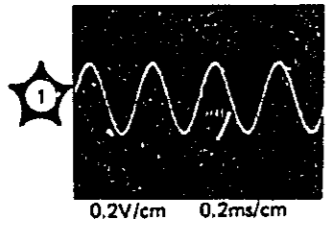
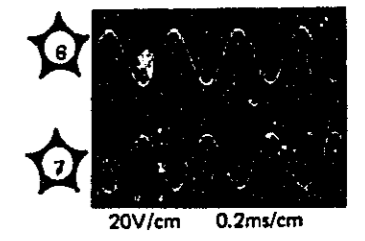
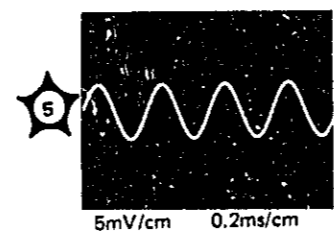
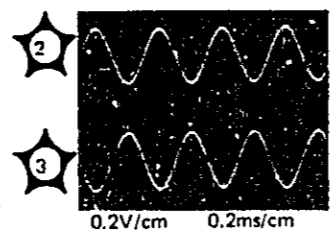
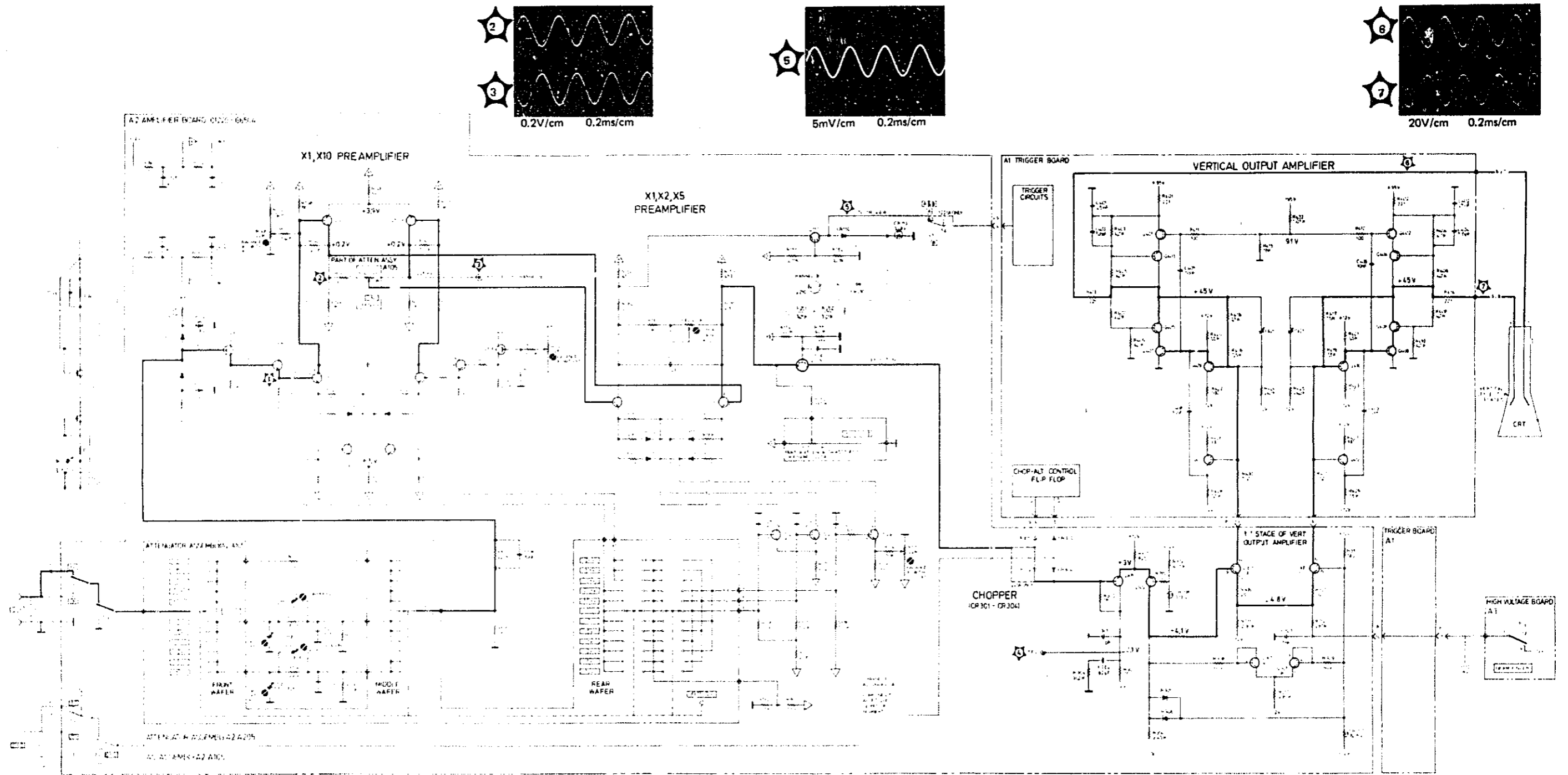
- R111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 134, 135, 136, 141, 202, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 232, 233, 234, 235, 236, 241.
- C11, 115, 116, 212, 215, 216.
- CR101, 102, 104, 106, 106, 201, 204, 205, 206
- Q101, 201.
- U101, 201.

- R131, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 162, 163, 165, 166, 167, 168, 169, 170, 172, 173, 174, 175, 176, 177, 178, 182, 183, 184, 185, 231, 238, 239, 240, 242, 243, 244, 246, 247, 248, 267, 263, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 282, 283, 284, 285.
- C123, 126, 127, 128, 129, 130, 23, 226, 227, 228, 229, 230.
- CR111, 112, 211, 212.
- Q104, 107, 204, 207.
- U102, 202.

- R150, 151, 152, 153, 154, 155, 160, 179, 180, 181, 250, 251, 252, 253, 254, 260, 279, 280, 281, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315.
- C301, 302, 303.
- CR301, 302, 303, 304, 305, 306, 307, 308
- Q109, 110, 208, 210, 301, 302.
- U301.

- R401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 419, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431.
- C401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 420, 421.
- CR403
- Q401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412.
- U401.





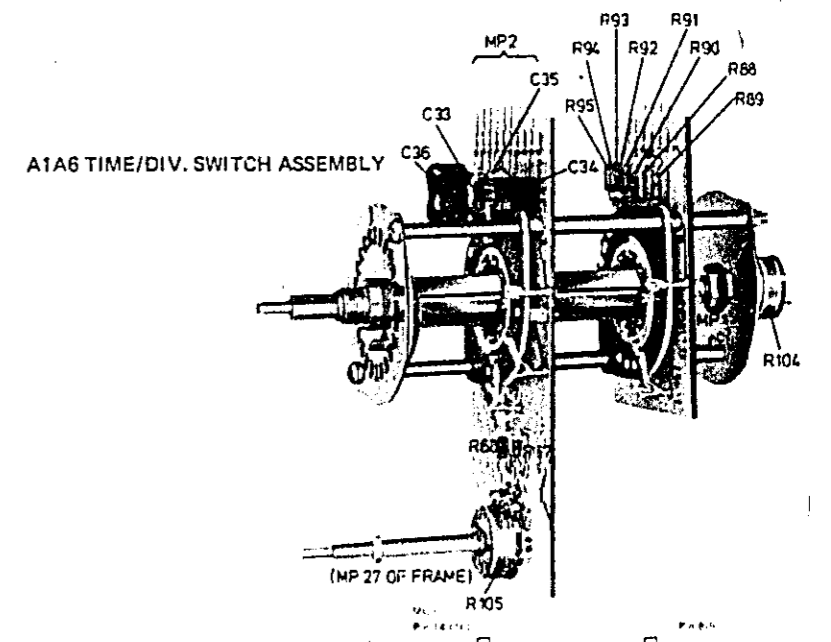
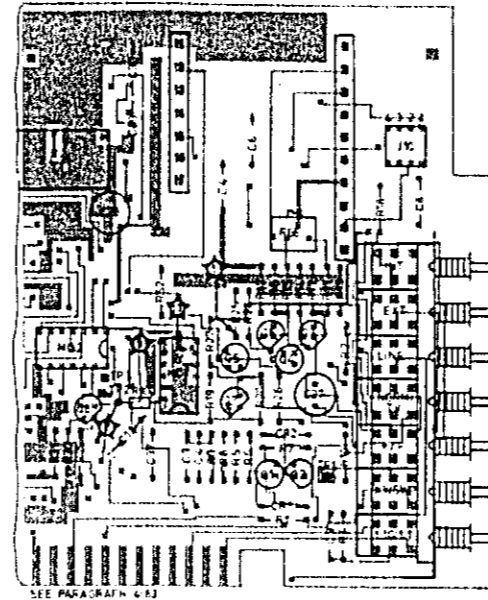
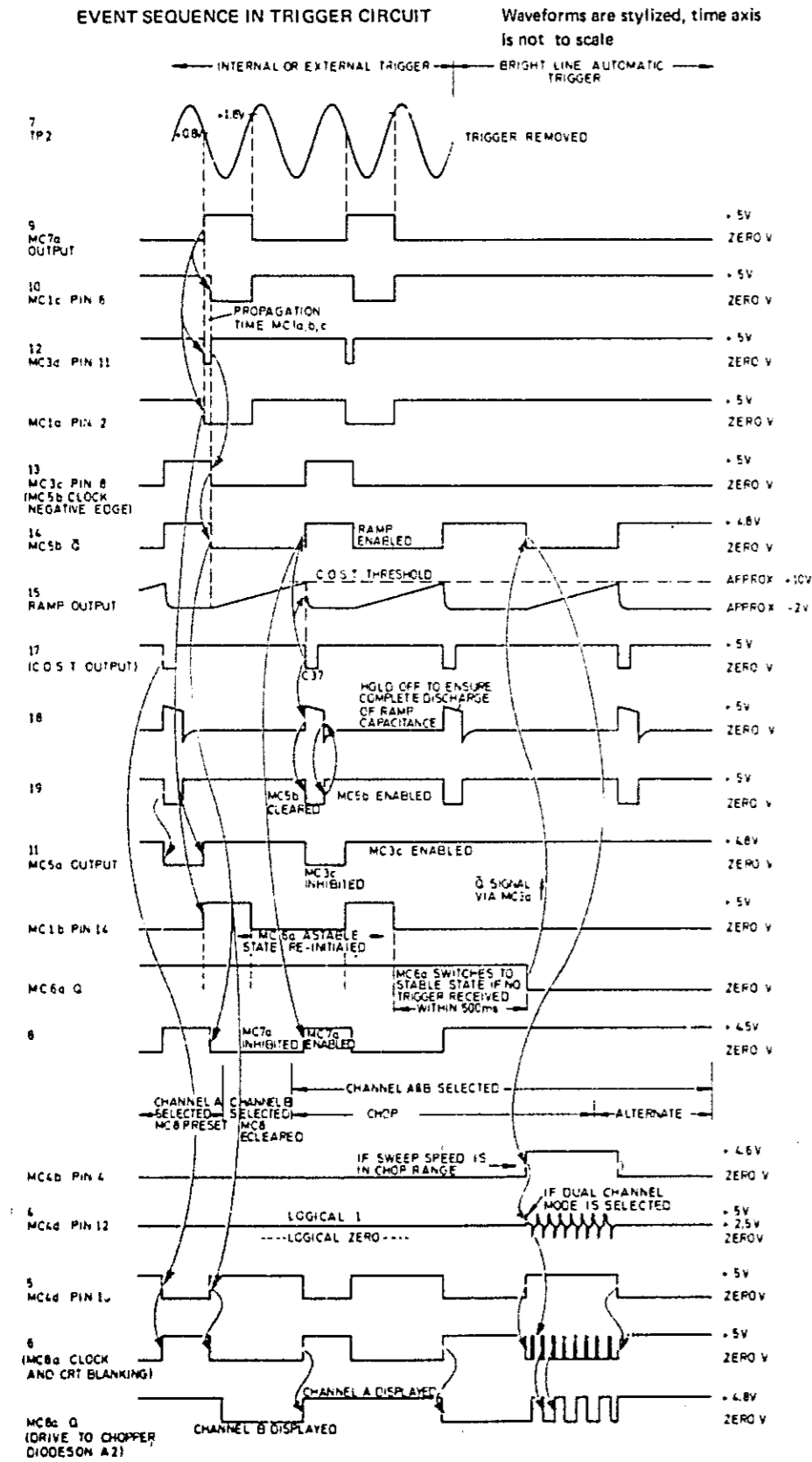
**WAVEFORM NOTES**  
 Input Signal: 2kHz, 0.6V<sub>p-p</sub> sine wave  
 Control settings  
 as figure 2-1, except:

VOLTS/DIV 19/25	100mV
TIME/DIV 6	0.2ms

**MONITOR SCOPE**  
 See values below waveforms.

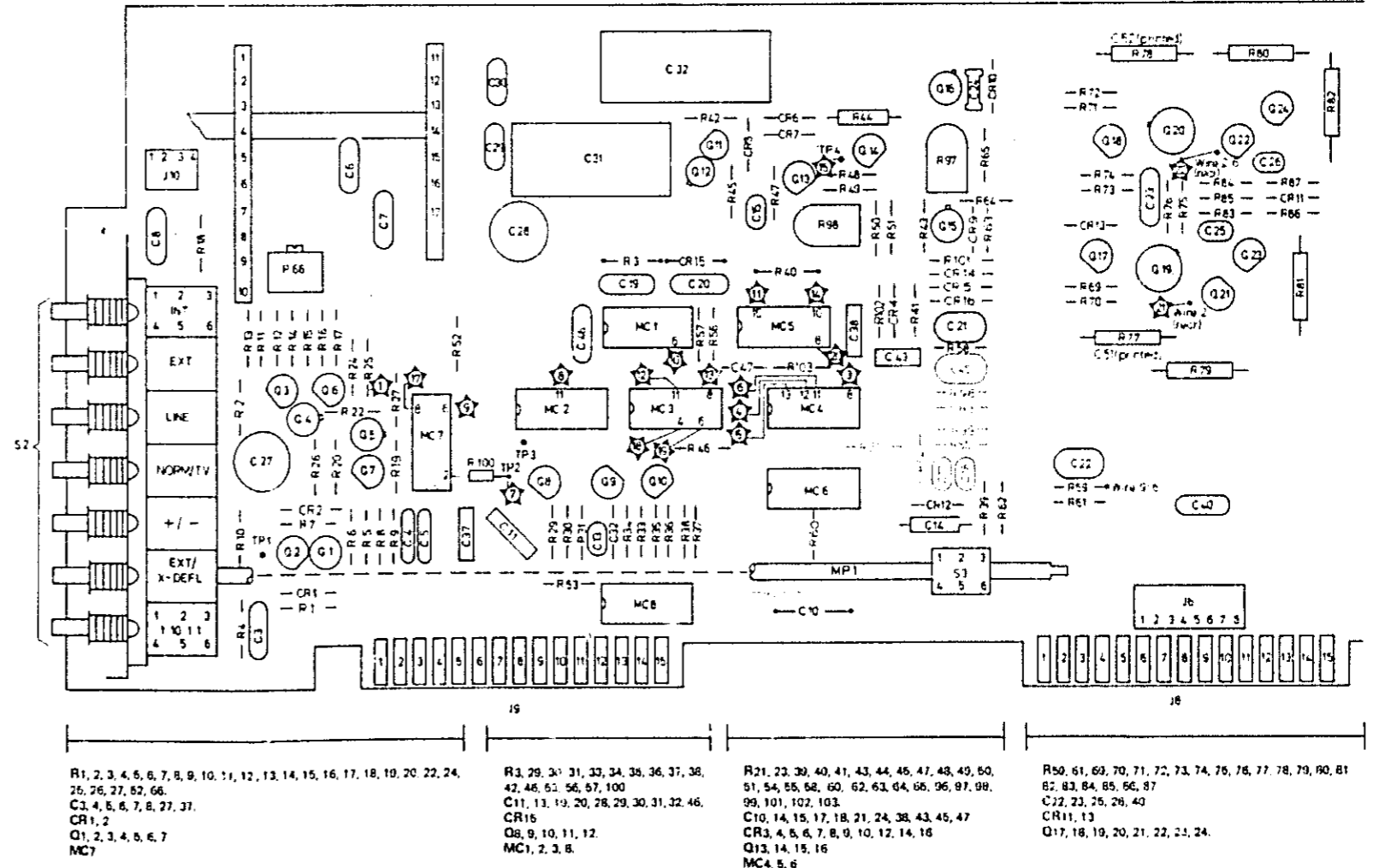
Figure 5-3. Vertical Channels  
 (Assemblies A105 (205), part A1, part A2)

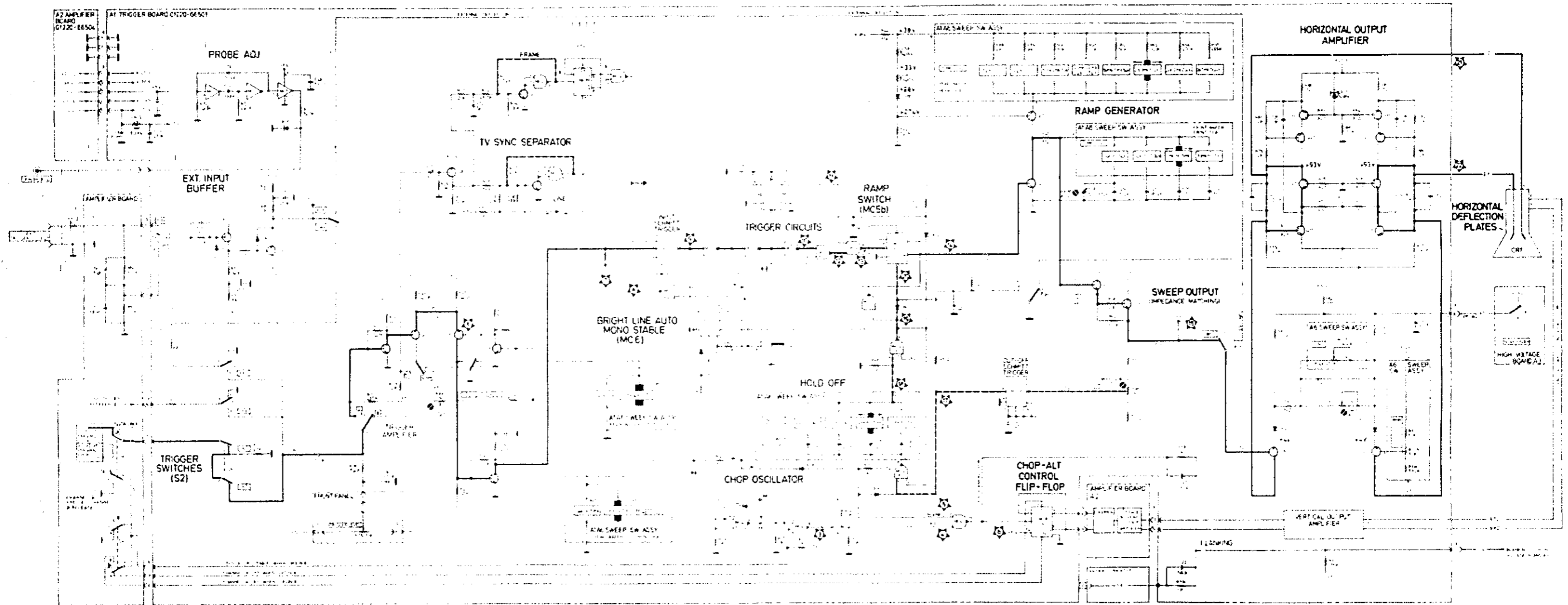
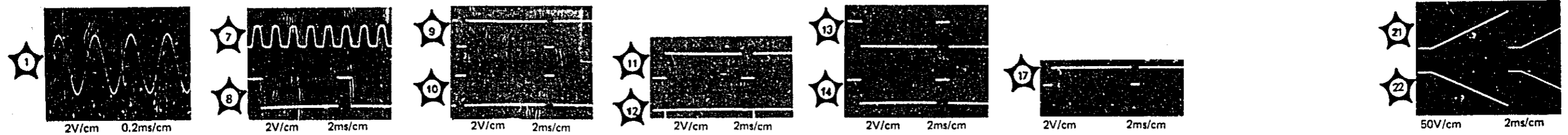
A1 TRIGGER BOARD (PART REAR VIEW)



COMPONENTS ARE AS SEEN FROM TOP, Q REPRESENTS LOCATION OF PIN ON OTHER SIDE

A1 TRIGGER BOARD

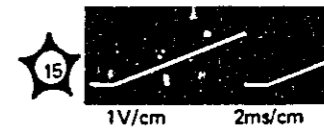
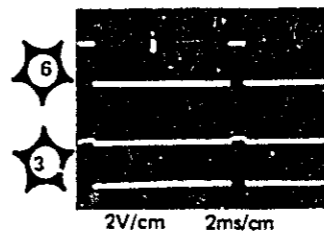
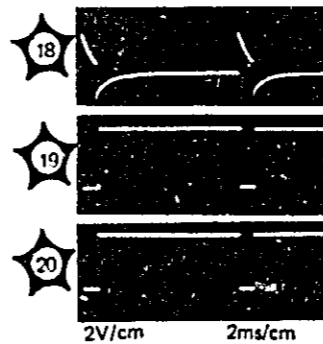
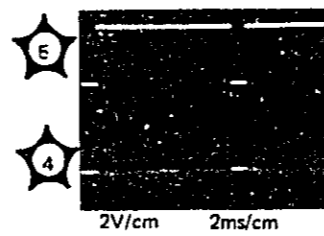
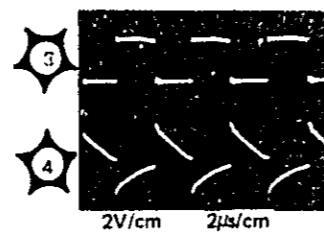




**WAVEFORM NOTES**  
 Input Signal: 2kHz, 0.6Vp-p sine wave  
 Control settings as figure 2-1 except:

VOLTS/DIV 19/25 100mV  
 TIME/DIV 6 1ms

**MONITOR SCOPE**  
 See values below waveforms



V<sub>CC</sub> and GND connections

	V <sub>CC</sub>	GND
MC1 to 4	14	7
MC5	5	13
MC6 to 8	14	7

Figure 5-4. Horizontal Channel (Assemblies A1 and A6)

## CATHODE-RAY TUBE WARRANTY

The cathode-ray tube (CRT) supplied in your Hewlett-Packard Oscilloscope and replacement CRT's purchased from hp are warranted by the Hewlett-Packard Company against electrical failure for a period of one year from the date of sale. Broken tubes and tubes with phosphor or mesh burns are not included under this warranty. If the CRT is broken when received, a claim should be made with the responsible carrier.

Your nearest Hewlett-Packard Sales/Service Office (listed at rear of instrument manual) maintains a stock of replacement tubes and will assist in processing the warranty claim.

We would like to evaluate every defective CRT. This engineering evaluation helps us to provide a better product for you. Please fill out the CRT Failure Report on the reverse side of this sheet and return it with the defective CRT to:

Hewlett-Packard Company  
1900 Garden of the Gods Road  
Colorado Springs, Colorado 80907

Attention: CRT QA

To avoid damage to the tube while in shipment, please follow the shipping instructions below; warranty credit is not allowed on broken tubes.

### SHIPPING INSTRUCTIONS

It is preferable that the defective CRT be returned in the replacement CRT carton. If the carton or packaging material is not available, pack the CRT according to the instructions below:

1. Carefully wrap the tube in 1/4 inch thick cotton batting or other soft padding material.
2. Wrap the above in heavy kraft paper.
3. Pack wrapped tube in a rigid container which is at least 4 inches larger than the tube in each dimension.
4. Surround the tube with at least 4 inches of packed excelsior or similar shock absorbing material; be sure the packing is tight all around the tube.

Thank you,  
CRT Department

CATHODE-RAY TUBE FAILURE REPORT

DATE \_\_\_\_\_

FROM:

NAME \_\_\_\_\_

COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

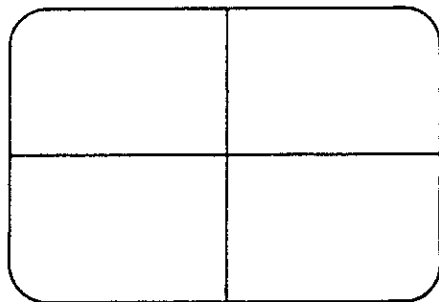
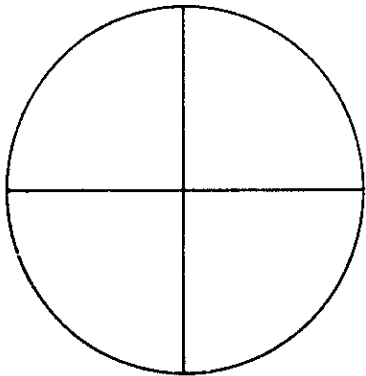
1. hp INSTRUMENT MODEL NO. \_\_\_\_\_

2. hp INSTRUMENT SERIAL NO. \_\_\_\_\_

3. CRT SERIAL NO \_\_\_\_\_

4. Please describe the failure and , if possible, show the trouble on the appropriate CRT face below.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



5. Is the CRT within warranty? Yes \_\_\_\_\_ No \_\_\_\_\_

6. hp Sales/Service Office \_\_\_\_\_ Repair Order No. \_\_\_\_\_

PLEASE TEAR AWAY

# MANUAL CHANGES

Model Number	1220/21A
Date Printed:	Feb. 74
Part Number	01220-90001

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

1220A		1221A	
Serial Prefix	Make Changes	Serial Prefix	Make Change
1322G01416	1	1322G00311	1
1322G01516*	1, 2	1322G00341	1, 2
1322G01916	1-4	1322G00371	1-3
1444G02216	1-6	1322G00461	1-4
1444G02516 - 1444G02715	1-7	1322G00721	1-4 and 6
1444G02716 - 1444G02815	1-8	1453G00701 - 1453G00600	1-6 and 8, 9
1444G02316 - 1444G03015	1-9	1453G00831 - 1453G00910	1-6 and 8, 9, 10
1444G03016 - 1444G03115	1-10	1546G00311 - 1546G00330	1-11
1543G03116 - 1543G03335		1612G00331 - 1612G00950	1-13
1543G03336 - 1543G03455	1-12	1612G00951 - 1612G01010	1-14
1611G03456 - 1611G03505	1-13	1612G01011 onwards	1-15
1611G03506 onwards	1-14		

\* Some serial numbers above -G01859 may incorporate Change 5. Refer to page 4.

## ERRATA

Page 5-2 Add to / change parts list

MP31	01220-24701	Spacer
MP32	5040-1125	Housing
V1	5033-3353	CRT (P-31)
V1	5033-3833	CRT (P-7)

Page 5-2 Parts List

A1C403/404	Delete
A1C407	0160-2903
A1Q15	1853-0089
A1Q16	1853-0089

Page 5-4 Parts List

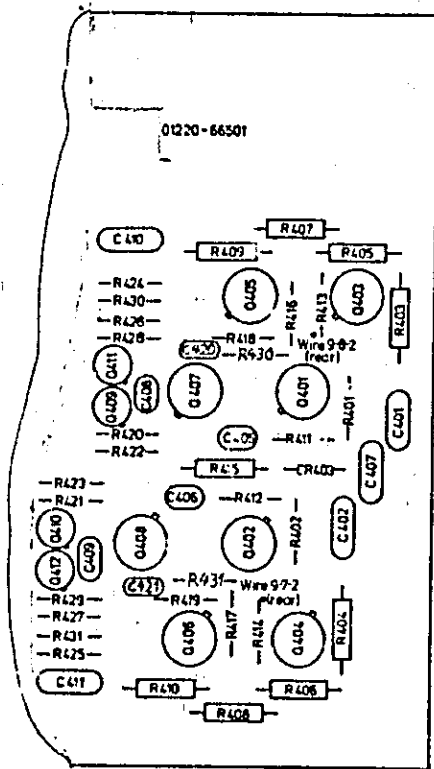
A2A105/205	3103-0550	INS CAP } FOR HEAT SINS } Q107/207
A2MP6	0340-0530	
A2MP7	1205-0277	

Page 5-5 Parts List

A3R22	0636-6015	R-F 100 53/
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Figure A2A105 (205) SWITCH ASSEMBLY  
Transpose annotation R149 (249) with R159 (259).

PART OF A1 TRIGGER BOARD



A1 TRIGGER BOARD

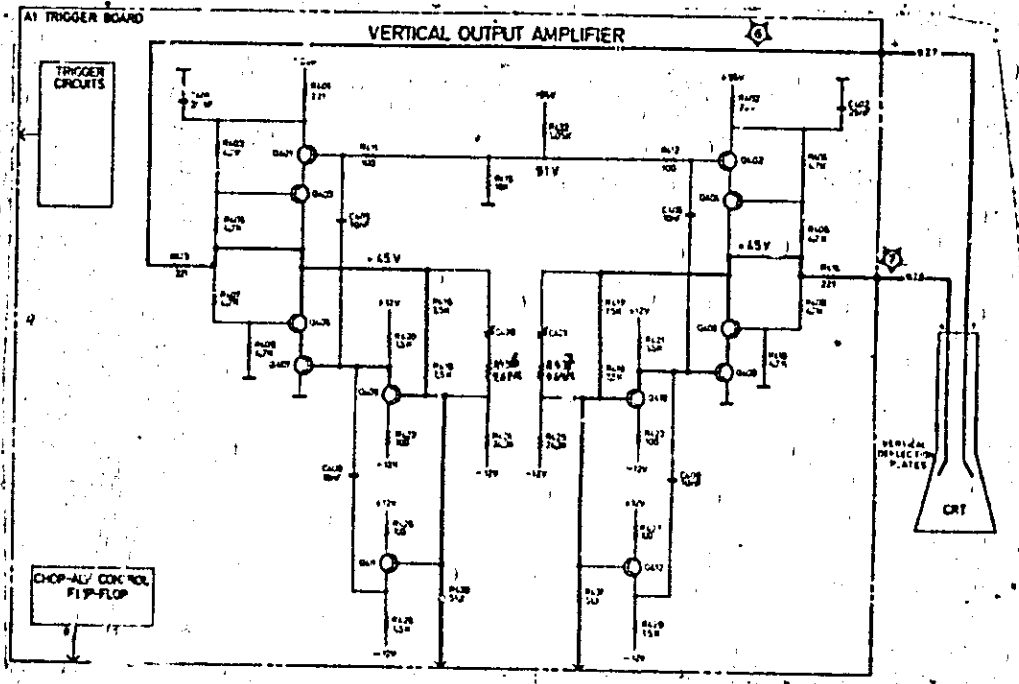


DIAGRAM 1

## CHANGE 1

Board Assembly Amplifier (A2) add:

C132/133	0160-2940	C-F 470 P
from base 0103/104 to ground,		
change:		
Q101	1855-0211	XSTR FET

Board Assembly HV (A3), change:

R1	2100-2782	R-VAR 100K
R37	0698-7764	R-F 18K

## CHANGE 2

Board Assembly Trigger (A1) (see attached diagram 1):  
Delete capacitors C403, C404, C420, C421

Add	C420, C421	0121-0168	C-VAR .25 - 1.5pF
	R436, R437	0698-3155	R-F 4.84K

Board Assembly Amplifier (A2):

Delete	C301		
Change	C123, 223	0121-0175	C-VAR 2-22pF

## CHANGE 3

Board Assembly Trigger (A1):

Change	Q15, 16	1853-0089	TRANSISTOR SI PNP
--------	---------	-----------	-------------------

## CHANGE 4

Heat Sink Assembly (A4)

Delete	MP1		
Change	S1	3101-1720	SWITCH LINE

Board Assembly Trigger (A1)

Change	C407	0160-2903	C-F 50nF, 500V
--------	------	-----------	----------------

## CHANGE 5

Board Assembly HV (A3)

Change	R15	0757-0478	R-F 301K 1%
Change	R18	0757-0478	R-F 385K 1%
Change	V1	2090-0032/3	CRT (P-31) / (P-7)
Change	W1	01220-61606	Cable CRT
Add		1400-0265	Camp

Board Assembly Amplifier (A2)

Add	R12, R179	0757-0449	R-F 20K 1%
-----	-----------	-----------	------------

Heat Sink Assembly (A4)

Add	MP3	2950-0131	Nylon nut
-----	-----	-----------	-----------

## CHANGE 6

Main Assembly

Change	MP18	01220-24101	Safety plate (transparent to UV)
--------	------	-------------	-------------------------------------

## CHANGE 6 (continued)

List of serial number suffixes, to which change 6 applies:

-G1626	-G2101	-G2157
-G1622	-G2103	-G2158
-G1848	-G2104	-G2159
-G1859	-G2106	-G2160
-G1861	-G2110	-G2162
-G1872	-G2111	-G2163
-G1875	-G2113	-G2164
-G2002	-G2116	-G2165
-G2008	-G2118	-G2166
-G2009	-G2119	-G2167
-G2016	-G2120	-G2168
-G2026	-G2121	-G2169
-G2030	-G2122	-G2170
-G2033	-G2123	-G2173
-G2044	-G2124	-G2178
-G2045	-G2125	-G2179
-G2047	-G2126	-G2182
-G2058	-G2127	-G2183
-G2057	-G2129	-G2185
-G2063	-G2130	-G2186
-G2066	-G2131	-G2188
-G2067	-G2132	-G2189
-G0268	-G2135	-G2190
-G2070	-G2136	-G2196
-G2074	-G2138	-G2198
-G2080	-G2140	-G2199
-G2081	-G2141	-G2201
-G2082	-G2142	-G2202
-G2083	-G2143	-G2204
-G2084	-G2144	-G2205
-G2085	-G2145	-G2207
-G2088	-G2149	-G2208
-G2090	-G2151	
-G2091	-G2152	
-G2096	-G2154	
-G2097	-G2156	

## CHANGE 7

Board Assembly Amplifier (A2)

On page 5-4, delete part number 1001-0033 for CR5, 6, 7 and 8, and add new part number 1901-0159.



Model 1220/21A

**CHANGE 8**

Board Assembly HV (A3)

On Page 5-5, Table 5-3, delete part number 01220-61601 for W1 and add new part number 01220-61608

Heat Sink Assembly (A4)

On Page 5-6, A4 Parts List

Add	MP3	1400-0290	Bracket
Add	MP4	2360-0113	Scr. mch 6-32
Add	MP5	3050-0307	Wash Brs 5/32

**CHANGE 9**

On Page 5-2, Table 5-3, delete following:

F1	2110-0201	FUSE 250V .25A SB
F1	2110-0202	FUSE 250V .25A SB

and add:

F1	2110-0044	FUSE 250V .3A SB
F1	2110-0016	FUSE 250V .6A SB

**CHANGE 10**

On Pages 5-2 and 5-4, Table 5-3:

Change

A2 01220-66509 (1220A only)

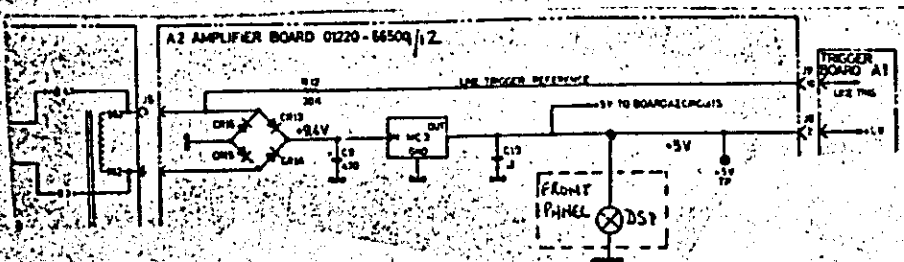
On Page 5-2, Table 5-3:

Add

DS1	2140-0348	LAMP IND.
MP35	1450-0404	LENS PILOT LIGHT
MP38	01183-67701	BASE PILOT LIGHT

On Page 5-7, Figure 5-2

Change as follows:



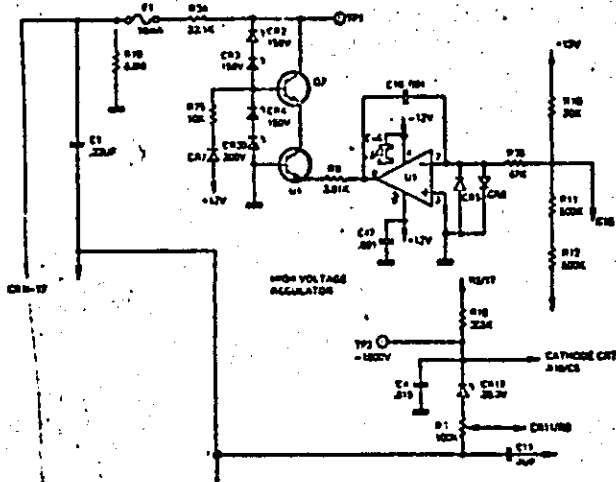
Board Assembly A3, Table 5-3:

Delete following parts: C46, C47, CR12, CR30, Q1, Q7, R10, R19, R34, MC1

Add the following:

A3C46	0160-3456	1000pF
A3C47	0160-3456	1000pF
A3CR12	1902-3311	DIODE 2MR 78.3V
A3CR30	1902-0669	DIODE 2MR 200V
A3Q1	1854-0079	
A3Q7	1854-0074	
A3R10	0698-6943	20Kohm
A3R19	0693-6851	6.8Mohm
A3R34	0757-0846	22.1K ohm
A3U1	1826-0043	
A3F1	2110-0066	FUSE .01A

Change Figure 5-2, Schematic as follows:



CHANGE 12

Board Assembly A1, On Table 5-3, Schematic 5-4.

Change C14 to 33pF Part No. 0180-0229

On Page 1-3, Change Internal and external triggering specification to read approx. 10 Hz to 15 MHz.

To A2 Parts List, Page 5-4

Add	MP10	01222-23201	Collar
	MP11	01222-09101	Spring
	MP12	0890-0807	Tubing (Transistors Q101, Q201)

CHANGE 13

For the 1221:

In Table 5-3, delete R159 and MP27 from Main Assy			
add R159 Pot-Cable Assy	01220-63401	to	Main Assy.
delete A1A6R105			
add R105 Pot-Cable Assy	01220-63401	to	Main Assy.

For the 1220:

In Table 5-3, delete A2A105 R159 and A1A6 R105			
add R159 Pot-Cable Assy	01220-63401	to	Main Assy
R105 Pot-Cable Assy	01220-63401	to	Main Assy
delete MP25 and MP27 from Main Assy			

For both 1220 and 1221:

In Table 5-3, delete A1Q21, A1Q22, A1Q23, A1Q24	1853-0355
add A1Q21, A1Q22, A1Q23, A1Q24	1853-0038

CHANGE 14

On Table 5-3, Assembly A1

Change Q11 1853-0068 XSTR PNP S1

CHANGE 15 (1221 only)

On Pages 5-2 and 5-4, Table 5-3,

Change A2 01220-66612

On Page 5-6, Table 5-3

Delete J2 1261-0406

# MANUAL CHANGES

Manual for Model Number	1220/21A
Manual printed on	February 74
Manual Part Number	01220-90001

Make all ERRATA corrections.

Check the following table for your instrument serial prefix/serial number and make the listed changes to your manual.

► New Item

Serial Prefix or Serial Number	Manual Changes	Serial Prefix or Serial Number	Manual Changes
<u>1220A</u>		<u>1221A</u>	
1611G 03956 onwards <sup>1)</sup>	1	1647G 1101- 1647G01115 <sup>1)</sup>	1
1645G 04066 onwards	1,4	1703G 01116-1703G01130	1,2
1704G 04126 onwards	1,3,4	1704G01131 onwards	1,2,3
1704G04186 onwards	6 1,3,4,5	1704G 01151 onwards	1 to 4
1704G04236 onwards	1 to 6	1704G 01161 onwards	1 to 5
1704G04261 onwards	1 to 7	1704G 01261 onwards	1 to 6
		1704G01276 onwards	1 to 7

### IMPORTANT NOTICES

1) Manual Change 1 and supplement summarize all changes effective at serial numbers 1611G03956 (1220A) and 1647G1101 (1221A). For precise information for lower serial numbers, enquire at your local Sales and Service office.

For serial numbers with an 'A' prefix, refer to manual 01220-90901

Model 1220/21A

### ERRATA

Page 5-2. Add to/change parts list

MP31	01220-24701
MP32	5040-1125
V1	2090-0032
V1	2090-0033

SPACER HOUSING  
CRT (P-31)  
CRT (P-7)

Page 5-2. Parts List

A1C403/404	Delete
A1C407	0160-2903
A1Q15	1853-0089
A1Q16	1853-0089

Page 5-4. Parts List

A2A105/205	3100-0550
A2MP6	0340-0530
A2MP7	1205-0277

INS CAP FOR  
HEAT SINK Q107/207

Page 5-5. Parts List

A3R22	0686-1015	R-F 100 5%
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Figure A2A105 (205) SWITCH ASSEMBLY

Transpose annotation R149 (249) with R159 (259).

Table 1-1. Triggering bandwidth, internal and external: 10 Hz to 15 MHz.

Page 5-2. Add:

W1	8120-1692
W1	8120-1369
W1	8120-1703
W1	8120-1521

PWR CORD SET SCHUKO  
PWR CORD SET AUSTR. S  
PWR CORD SET BS  
PWR CORD SET NEMA

MODEL 1220/21A

MANUAL CHANGE 1

Substitute Fig. 5-1 and Service Sheets with those in the attached supplement and change the parts list as follows:

MAINFRAME

On Page 1-3, change internal and external triggering specification to read ..... approx. 10 Hz to 15 MHz.

On Page 2-0, delete control 36, rear panel 12V jack.  
Delete 2nd sentence of paragraph 2-5.  
Delete Table 4-2.02.

Change Table 5-3 as follows:  
For the 1221:

delete R159 and MP27 from Main Assy			
add R159 Pot-Cable Assy	01220-63401	to	Main Assy
delete A1A6R105			
add R105 Pot-Cable Assy	01220-63401	to	Main Assy.

For the 1220:

delete A2A105 R159 and A1A6 R105			
add R159 Pot-Cable Assy	01220-63401	to	Main Assy
add R105 Pot-Cable Assy	01220-63401	to	Main Assy.
delete MP26 and MP27 from Main Assy.			

For both 1220 and 1221:

delete A1Q21, A1Q22, A1Q23, A1Q24	1853-0355		
add A1Q21, A1Q22, A1Q23, A1Q24	1853-0038		
delete MP8, 9			
add W8	01220-61609		CABLE AY POWER
add MP9	5040-9302		KNOB SW PBTN
add W38	01220-61608		CABLE AY POWER SWITCH
change A2	01220-66509		(1220A only)
change A2	01220-66512		(1221A only)
change MP18	5000-8895		SAFETY PLATE
delete F1	2110-0201		FUSE 250V .25A SB
delete F1	2110-0202		FUSE 250V .25A SB
add F1	2110-0044		FUSE 250V .3A SB
add F1	2110-0016		FUSE 250V .6A SB
add DS1	2140-0346		LAMP IND.
add MP35	1450-0404		LENS PILOT LIGHT
add MP36	00123-67701		BASE PILOT LIGHT
delete J2	1251-0406		
change MP6	01223-67401		KNOB AY VOLTS/DIV

MODEL 1220/21A

MANUAL CHANGE 1 (cont'd)

ASSEMBLY 1

Change	C1 to 33uF	0160-0229	
change	A1C3	0160-2913	1.8nF
add	A1CR24	1901-0376	
add	A1R114	0757-0283	2K 1% .125W
add	A1R115	0757-0283	2K 1% .125W
change	A1Q11	1853-0066	XSTR PNP S1
change	A1Q15, 16	1853-0089	TRANSISTOR SI PNP
change	A1C407	0160-2903	C-F 50nF 500V
	delete capacitors C403, C404, C420, C421		
add	A1C420, C421	0121-0168	C-VAR .25 - 1.5pF
add	A1R436, R437	0698-3155	R-F 4.64K

ASSEMBLY 2

change	A2	01220-66509	(1220A only)
change	A2	01220-66512	(1221A only)
add	A2C132/133	0160-2940	C-F 470P
change	A2Q101	1855-0211	XSTR FET
delete	A2C301		
change	A2C123, 223	0121-0475	C-VAR 2-22pF
change	A2CR5, 6, 7, 8	1901-0159	
add	A2MP10	01222-23201	COLLAR
add	A2MP11	01222-09101	SPRING
add	A2MP12	0890-0807	TUBING (TRANSISTORS Q101, Q201)
add	A2R12, R179	0757-0449	R-F 20K 1%
add	A2U5	1820-1197	IC SN 74LS00N TTL QUAD NAND

ASSEMBLY 3

Delete following parts: C46, C47, CR12, CR30, Q1, Q7, R10, R19, R34, MC1/ On A3

add	A3C46	0160-3456	1000pF
add	A3C47	0160-3456	1000pF
add	A3CR12	1902-3311	DIODE ZNR 38.3V
add	A3CR30	1902-0669	DIODE ZNR 200V
add	A3Q1	1854-0079	
add	A3Q7	1854-0044	
add	A3R10	0698-6943	20K OHM
add	A3R19	0693-6851	6.8M OHM
add	A3R34	0757-0846	22.1K OHM
add	A3U1	1826-0043	
add	A3F1	2110-0066	FUSE .01A
add	A3R1	2100-2782	R-VAR 100K
add	A3R37	0698-7764	R-F 18K
change	A3R15	0757-0476	R-F 301K 1%
change	A3R18	0757-0478	R-F 365K 1%

MODEL 1220/21A

MANUAL CHANGE 1 (cont'd)

	change add	A3W1 A3MP	01220-61606 1400-0265	CABLE CRT CLAMP
ASSEMBLY 4				
	change delete	A3W1 A4MP1	01220-61606	
	change add	A4S1 MP2	3101-1720 2950-0131	SWITCH LINE NYLON NUT.
	add	MP3	1400-0290	BRACKET
	add	MP4	2360-0113	SCR.MCH 6-3
	add	MP5	3050-0307	WASH BRS 5/

ASSEMBLY 2

change the following parts:

A2Q1	1854-0330	XSTR SI NPN
A2R10	2100-0558	R-VAR 500 1
A2R114, 148, 175 and 1220A only:		
R214, 248, 275	2100-0558	R-VAR 20K
A2R162 and 1220A only:		
R262	2100-3252	R-VAR 5K

MODEL 1220/21A

MANUAL CHANGE 2

For the 1221

change VI	2090-0034	CRT (P-7)
change VI	2090-0031	CRT (P-31)

MANUAL CHANGE 3

For the 1221

change A3 Part No. to 01222-66515  
change A3 R5 2100-3606 R-VAR 4.7M.  
change A3 R6 2100-3605 R-VAR 2.2M.

MANUAL CHANGE 4

change parts list and schematic:

A2	R165/6 265/6	0757-0415	R-F	475	1%
A2	R169/70 269/70	0698-5196	R-F	96.25	0.25%
A2	Q101/201	1855-0213	XSTR	DUAL	2N5912

MANUAL CHANGE 5

change parts list and schematic:

A3	R15	0757-0478	R-F	365K
A3	R18	0757-0476	R-F	301K

MANUAL CHANGE 6

change parts list and schematic:

A2 C131 0160-3456 C-F 1000pF

(for 1220 only) A2 C231 0160-3456 C-F 1000pF

change parts list and schematic:

A2 A105 01220-61905 BD AY SWITCH

consisting of - A105 MP1 3130-0038 CPLR SW  
A105 MP2 01220-00602 SHIELD  
A105 MP3 01220-00603 BRACKET  
A105 MP4 1251-0680 CONTACT STRIP  
A105 MP5 1251-0681 CONTACT STRIP  
A105 R101 0757-0386 R-F 24.3  
A105 R107 0757-0393 R-F 47.5  
A105 R149 2100-0590 R-VAR 500

(for 1220 only) change A2A205 as above for A2A105  
change parts list and schematic:

A1 A6 01220-61906 SWITCH-TIME BASE

consisting of - A6 MP1 3130-0038 COPLR SW  
A6 MP2 1251-0683 CONTACT STRIP  
A6 MP3 1251-0700 CONN STRIP  
A6 C33 0160-2218 C-F .001 UF  
A6 C34 0160-3996 C-F .27UF  
A6 C35 0180-1745 C-F 1.5 UF  
A6 C36 0180-0229 C-F 33UF  
A6 R68 0757-0200 R-F 5.62K  
A6 R67 0757-0424 R-F 1.1K  
A6 R89 0698-6755 R-F 8K  
A6 R90 0698-6871 R-F 10K  
A6 R91 0698-6885 R-F 20K  
A6 R92 0698-5573 R-F 62.5K  
A6 R93 0698-6770 R-F 100K  
A6 R94 0698-6217 R-F 200K  
A6 R95 0698-8312 R-F 499K  
A6 R104 2100-0591 R-VAR 25K  
A6 R88 0698-5323 R-F 4K

MANUAL CHANGE 7

change parts list:

A3P1 2110-0420 FUSE .032A 250V

change parts list and schematic

A2 A105(A205) R149 2100-3735 R-VAR 25K

A1 A6 R104 2100-3736 R-VAR 25K

# HP MANUAL CHANGES

MODELS 1220A AND 1221A  
OSCILLOSCOPE

Manual Serials Prefixed: 1322G  
Manual Printed: Feb. 1974

Make all changes listed below as Errata. Check the following table for your instrument serial prefix and/or serial number and make listed change(s) to the manual:

Serial Prefix or Number	Make Changes	Serial Prefix or Number	Make Changes
1416A	1		
1341A	1		
1516A	1, 2		

## ERRATA

Insert SAFETY SUMMARY sheet (attached to this manual changes sheet) in front of operating and service manual.

Page 1-3, table 1-1,

TRIGGERING, Internal and External:

Change approx. 2 Hz to read approx. 10 Hz.

Page 4-11,

Add: the following adjustment procedure as the last procedure on the page:

Table 4-2.075. Adjustment Procedure: Vertical Gain

STEP	ACTION
1	Set HORIZONTAL TIME/DIV 6 to 0.1 ms setting.
2	Set EXPANDER 7 to calibrated detent.
3	Set X-Y/SWP 15 to SWP.
4	Press INT TRIGGER SOURCE 10 pushbutton.
5	Adjust HORIZONTAL POSITION 5 control to start sweep at left-hand vertical graticule line.
6	Adjust sweep length A1R98 for a 10-division sweep length.
7	Readjust HORIZONTAL POSITION 5 control to move sweep one division to the left.
8	Readjust sweep length A1R98 to extend the sweep exactly to the right-hand vertical graticule line.

Page 4-14, table 4-3.01,

Use 1000:1 attenuator (typically 999K and 1K resistors) between Voltmeter Calibrator and 1220/21 for testing the most sensitive ranges.

Increase Voltmeter Calibrator output by X1000 when using 1000:1 attenuator.

Page 4-16, table 4-3.06, step 1,

10 divisions,  $\pm 0.5$  division:

Change to read 10 divisions, (+0, -1) division.

Page 5-2, Replaceable Parts,

L1: Change to HP Part No. 01220-67721, COIL AY ALIGN.

Delete: MP10, MP11, and MP12.

Add: MP14, HP Part No. 01220-00221, PANEL FRONT (1220A) (AMERICAN) DOES NOT INCLUDE PROBE ADJ SHAFT. ORDER SEPARATELY HP PART NO. 0360-1646.

MP15: Change to HP Part No. 01220-04121, COVER:HOUSING.

MP18: Change HP Part No. to 01220-24101.

MP19: Add to Description, EXCEPT OPTION 007.

Add: MP19, HP Part No. 4114-0552, FILTER AMBER OPTION 007 ONLY.

Δ MP24: Change HP Part No. to 1460-1406.

V1: Change description to CRT (P-31).

Add: V1, HP Part No. 5083-3833, CRT (P-7) OPTION 007.

W1: Change to HP Part No. 8120-1538, PWR CORD.

7 April 1975

Δ = Latest additions to this change sheet.

This change sheet supersedes all prior change sheets for this manual.

Supplement A for  
01220-90001

ERRATA (Cont'd)

Page 5-2, Replaceable Parts (Cont'd),

Add: W2, HP Part No. 01220-61622, CABLE AY LOW VOLTAGE.

W3: Change to HP Part No. 01220-61623, CABLE AY TRIGGER LEVEL POT.

Add: W4, HP Part No. 01220-61621, CABLE AY CRT.

Page 5-3, Replaceable Parts,

A1C6: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

A1C7: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

A1C8: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

A1C14: Change to HP Part No. 0180 0229, C:FXD ELECT 33 UF 10% 10 VDCW.

A1C19: Change to HP Part No. 0160-0168, C-F 0.1 UF 10% 200 VDC MY.

A1C20: Change to HP Part No. 0160-0168, C-F 0.1 UF 10% 200 VDC MY.

A1C40: Change to HP Part No. 0160-2903, C-F 0.05 UF 20% 500 VDC CER.

Delete: A1C45.

A1C46: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

A1C401: Change to HP Part No. 0160-2903, C-F 0.05 UF 20% 500 VDC CER.

A1C402: Change to HP Part No. 0160-2903, C-F 0.05 UF 20% 500 VDC CER.

A1C407: Change to HP Part No. 0160-2903, C-F 50 NF 20% 500 VDC CER.

A1C410: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

A1C411: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

Add: A1MP11, HP Part No. 5040-1127, KNOB PBTN GREEN.

Add: A1MP12, HP Part No. 5040-1128, KNOB PBTN BLUE.

A1R20: Change to HP Part No. 0757-0949, R-F 11K +-2% 1/8W FLM.

Δ A1R66: Change to HP Part No. 2100-1984, R-VAR 100 10% .5W LIN CERMET.

Page 5-4, Replaceable Parts,

Δ A1R97: Change to HP Part No. 2100-2216, R-VAR 5K + -10% 1/2W.

Δ A1R98: Change to HP Part No. 2100-1986, R-VAR 1K +-10% 1/2W.

A1A6R105: Change HP Part No. to 5080-9698.

A2C8: In description, change 16VDC to read 25VDC.

A2C10: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

A2C12: In description, change 16VDC to read 25VDC.

A2C126: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

A2C127: Change to HP Part No. 0160-3443, C-F 0.1 UF +80-20% 50 VDC CER.

Page 5-4, Replaceable Parts (Cont'd),

Add: A2C131, HP Part No. 0140-0196, C-F 150 PF 300V MIC.

Add: A2C132, HP Part No. 0160-3447, C-F 470 PF 10% 1KV DC CERA.

Add: A2C133, HP Part No. 0160-3447, C-F 470 PF 10% 1KV DC CERA.

A2C602: Change to HP Part No. 0140-0195, C-F 130 PF 5% 300 VDCW MIC.

Add: A2MP10, HP Part No. 5040-1126, KNOB PBTN GRAY.

Add: A2MP12, HP Part No. 5040-1128, KNOB PBTN BLUE.

Add: A2M213, HP Part No. 0340-0530, INSULATOR-HEAT ON A2Q107 AND A2Q207.

Δ Add: A2MP14, HP Part No. 0340-0473, HEAT SINK.

A2Q101: Change to HP Part No. 1855-0211, TRANSISTOR FET DUAL SI N-CHANNEL DEPLETION.

A2R5: In description, show 1.82 as 1.82K.

Δ A2R10: Change to HP Part No. 2100-1788, R-VAR 500 10% .5W LIN CERMET.

Δ A2R114: Change to HP Part No. 2100-2030, R-VAR 20K 10% .5W LIN CERMET.

Page 5-5, Replaceable Parts,

Δ A2R148: Change to HP Part No. 2100-2030, R-VAR 20K 10% .5W LIN CERMET.

Δ A2R162: Change to HP Part No. 2100-2216, R-VAR 5K 10% .5W LIN CERMET.

Δ A2R175: Change to HP Part No. 2100-2030, R-VAR 20K 10% .5W LIN CERMET.

A3C1: Change to HP Part No. 0160-4280, C-F 220NF 4000VDC POLYE.

A3C3: Change to HP Part No. 0160-2902, C-F .01UF 20% 1000VDCW CER.

A3C11: Change to HP Part No. 0160-0168, C-F .1UF +-10% 200VDC POLYE.

A3C13: Change to HP Part No. 0160-0168, C-F .1UF +-10% 200VDC POLYE.

Add: A3C16, HP Part No. 0160-3443, C-F 0.1UF +80-20% 50VDC CER.

Add: A3C17, HP Part No. 0160-3443, C-F 0.1UF +80-20% 50VDC CER.

Delete: A3CR13.

Add: A3CR20, HP Part No. 1901-0040, DIODE SI 30V .05A.

Δ A3R1: Change to HP Part No. 2100-2655, R-VAR 100K 10% .5W LIN CERMET.

Δ A3R2: Change to HP Part No. 2100-2655, R-VAR 100K 10% .5W LIN CERMET.

Δ A3R3: Change to HP Part No. 2100-3274, R-VAR 10K 10% .5W LIN CERMET.

Δ A3R4: Change to HP Part No. 2100-2655, R-VAR 100K 10% .5W LIN CERMET.

A3R22: Change to HP Part No. 0687-1011, R-F 100 10% 0.5W COMP.

Δ A3R30: Change to HP Part No. 2100-2030, R-VAR 20K 10% .5W LIN CERMET.



ERRATA (Cont'd)

Page 5-5, Replaceable Parts (Cont'd),

- A3R34: Change to HP Part No. 0687-1011, R-F 100 10% 0.5W C.W.P.
- A3R35: Change to HP Part No. 0757-0768, R-F 47.5K 1% 1/4W MET FLM.
- A3R36: Change to HP Part No. 0757-0768, R-F 47.5K 1% 1/4W MET FLM.
- A3R37: Change to HP Part No. 0683-2035, R-F 20K +-5% 1/4W.

Page 5-6, Replaceable Parts,

- A4J4: Change to HP Part No. 1251-0463, CONN:FEMALE BANANA BLACK.
- A4T1: Change description to NSR:PART OF A4.

Page 5-6,

- W1 (bottom-center of page): Change reference designator to W4.

Page 5-7, Schematic,

- Add: A3CR20 from +12V input (cathode) to ground (anode).
- Add: A3C16 (0.1 UF) from +12V terminal to ground on assembly A3.
- Add: A3C17 (0.1 UF) from -12V terminal to ground on assembly A3.
- MC1: Change reference designator of associated capacitor from A3C16 to A3C18.
- A3R35: Change value to 47.5K.
- A3R36: Change value to 47.5K.
- Δ A2R10: Change value to 500.
- Δ A3R30: Change value to 20K.
- A3R1: Change value to 100K.
- A3R2: Change ground on bottom of symbol to -12V.
- A3C3: Change value to .01UF.
- A3CR8: Change to zener symbol. Show value of 150V.
- A3CR11 (near J7): Change reference designator to A3C11.

Page 5-7, Schematic (Cont'd),

- A3R37: Change value to 20K.
  - W1 (between V1 and A1): Change designator to W4.
  - Wire color 5 from A3 to V1: Change color to 95.
  - A3R2: Show connected to -12V instead of ground. Increases astigmatism adjustment range.
- Page 5-8, A2A105 (205) VOLTS/DIV SWITCH ASSEMBLY,
- R159: Change reference designator to R149.
  - R259: Change reference designator to R249.
  - R149: Change reference designator to R159.
  - R249: Change reference designator to R259.

Page 5-9, Schematic,

- Add: A2C132 (470 PF) from base of A2Q103 to ground.
  - A1C420 and A1C421: Indicate 18-gage wire beside symbols.
  - A1C401: Change value to 50 nF.
  - A1C402: Change value to 50 nF.
  - Add: A2C133 (470 PF) from base of A2Q104 to ground.
  - A2R310: Where +12V is connected, show instead that connection is to chassis ground.
  - Δ A2R114: Change value to 20K.
  - Δ A2R148: Change value to 20K.
  - Δ A2R175: Change value to 20K.
  - Δ A2R162: Change value to 5K.
- Page 5-10, Component Layout,
- Delete: A1C45. Replace with black jumper wire.
- Page 5-11, Schematic,
- A1R20: Change value to 11K.
  - Delete: A1C45. Replace with black jumper wire.
  - A1, pin 13 (to A6R104): Change pin no. to 14.
  - A1, pin 14 (to A6R104): Change pin no. to 13.
  - A1C14: Change value to 33 UF.
  - A1C40: Change value to 50 nF.
  - Δ A1R97: Change value to 5K.

CHANGE 1

Page 5-2, Replaceable Parts,

- A1 (1220A only): Change HP Part No. to 01220-66531.
  - A2 (1220A only): Change HP Part No. to 01220-66530.
  - A3: Change HP Part No. to 01220-66527.
  - A4: Change HP Part No. to 01220-61121.
  - Add: MP32, HP Part No. 01220-00621, SHIELD ATTENUATOR (FORMERLY A2MP1, MODIFIED).
- Page 5-3, Replaceable Parts,
- A1 (1220A only): Change HP Part No. to 01220-66531.
  - Δ Add: A1A1, HP Part No. 01220-66511, BOARD ASSEMBLY TRIGGER WITHOUT SWITCH.
  - Δ A1A6: Change HP Part No. to 01220-61902.

Page 5-3, Replaceable Parts (Cont'd),

- Δ Add: A1A6A1, HP Part No. 01220-66523, BD AY FRONT, INCLUDES A1A6C33 THRU A1A6C36, A1A6R67, A1A6R68, A1A6R105, AND ASSOCIATED SWITCH WAFER.
  - Δ Add: A1A6A2, HP Part No. 01220-66523, BD AY REAR, INCLUDES A1A6R88 THRU A1A6R95 AND ASSOCIATED SWITCH WAFER.
  - Δ Add: A1A6MP4, HP Part No. 01220-00624, BRACKET.
- Page 5-4, Replaceable Parts,
- Add: A1A6R95, HP Part No. 0698-3263, R-F 500K +-1% 1/8W FLM.
  - A2 (1220A only): Change HP Part No. to 01220-66530.
  - Δ Add: A2A1, HP Part No. 01220-66510, BOARD ASSEMBLY AMPL WITHOUT SWITCHES.

**CHANGE 1 (Cont'd)**

Page 5-4, Replaceable Parts (Cont'd),

- Δ A2A105: Change to HP Part No. 01220-61901, BD AY SWITCH.
- Δ Add: A2A105A1, HP Part No. 01220-66528, BD AY FRONT, INCLUDES A2A105MP5, A2A105R101, AND ASSOCIATED SWITCH WAFER.
- Δ Add: A2A105A2, HP Part No. 01220-66526, BD AY MDL, INCLUDES A2A105MP5, A2A105R107, AND ASSOCIATED SWITCH WAFER.

Page 5-4, Replaceable Parts (Cont'd),

- Δ Adj. A2A105A3, HP Part No. 01220-66525, BD AY REAR, INCLUDES A2A105MP4, A2A105R159, AND ASSOCIATED SWITCH WAFER.
- Δ A2A205: Change to HP Part No. 01220-61901, BD AY SWITCH.
- Page 5-5, Replaceable Parts,  
Delete: A3W1 and A3W2.  
A3: Change HP Part No. to 01220-66527.
- Δ Page 5-11, Schematic,  
A1A6R95: Change value to 500K.

**Δ CHANGE 2**

Page 5-2, table 5-3,

- A4: Change HP Part No. to 01220-61122.
- Delete: MP8 and MP9.
- MP14 (01220-00221): Change HP Part No. to 01220-00222.
- Delete: MP26 and MP27.
- Add: R105, HP Part No. 2100-2488, R-VAR 10K 20% 0.5W LIN (FORMERLY A1A6R105).
- Add: R159, HP Part No. 2100-2488, R-VAR 10K 20% 0.5W LIN (FORMERLY A2A105R159).
- Add: R259, HP Part No. 2100-2488, R-VAR 10K 20% 0.5W LIN (FORMERLY A2A205R259).
- Add: W5, HP Part No. 01220-61624, CBL AY PWR SW, INCLUDES W5S1, HP Part No. 3101-1732.

Page 5-3, table 5-3,

- A1A6: Change HP Part No. to 01220-61904.
- A1A6A1: Change to HP Part No. 01220-66533, BD AY FRONT, INCLUDES A1A6C33 THRU A1A6C36, A1A6R67, A1A6R68, AND ASSOCIATED SWITCH WAFER.

Page 5-4, table 5-3,

- Delete: A1A6R105.
- A2A105: Change HP Part No. to 01220-61903.
- A2A205: Change HP Part No. to 01220-61903.
- A2A105A3: Change to HP Part No. 01220-66532, BD AY REAR, INCLUDES A2A105MP4, AND ASSOCIATED SWITCH WAFER.

Page 5-5, table 5-3,

- Delete: A2A105R159.

Page 5-6, Assembly A4 table,

- A4: Change HP Part No. to 01220-61122.
- Delete: A4C1, A4MP2, and A4S1.
- Add: A4W1, HP Part No. 01220-61626, CABLE ASSY:PWR MODULE.

Page 5-7, figure 5-2,

- Delete: A4C1.
- A4S1: Change reference designator to W5S1.

Page 5-9, figure 5-3,

- R159: Delete note which says part of A2A105 (A205).

Page 5-11, figure 5-4,

- R105: Show as a main assembly part instead of part of A1A6.

## **SAFETY SUMMARY**

*The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violate safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.*

### **GROUND THE INSTRUMENT,**

*To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The instrument power jack and the power cable mating plug meet International Electrotechnical Commission (IEC) safety standards.*

### **DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.**

*Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.*

### **KEEP AWAY FROM LIVE CIRCUITS.**

*Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them. Use a nonmetallic adjusting tool throughout the instrument.*

### **DO NOT SERVICE OR ADJUST ALONE.**

*Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present. Use extreme caution when servicing the high voltage section because voltages dangerous to life are present.*

### **USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.**

*Breakage of the cathode-ray tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.*

### **DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.**

*Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.*

### **DANGEROUS PROCEDURE WARNINGS.**

*Warnings, such as the example below, are provided throughout this manual. Instructions contained in the warnings are for your protection and must be observed.*



**WARNING**



*Dangerous voltages, capable of causing death, are present in this instrument.  
Use extreme caution when handling, testing, and adjusting.*