Errata

Title & Document Type: **1223A Storage Oscilloscope Operating and Service Manual**

Manual Part Number: **01223-90003**

Revision Date: **August 1979**

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HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

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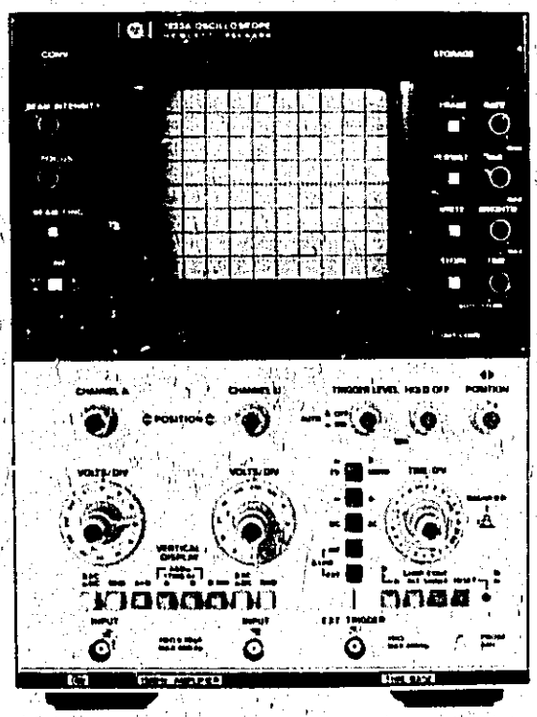
Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

OPERATING AND SERVICE MANUAL

1223A STORAGE OSCILLOSCOPE



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OPERATING AND SERVICE MANUAL

1223A STORAGE OSCILLOSCOPE

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers up to 1533G00286. Any changes made in instruments having serial numbers higher than the above number will be found in a "Manual Changes" supplement supplied with this manual. Be sure to examine this supplement for any changes which apply to your instrument and record these changes in the manual.

D-7030 BÖBLINGEN, HERRENBERGER STR. 110
FEDERAL REPUBLIC OF GERMANY

MANUAL PART NO. 01223-90003
Microfiche Part No. 01223-95003

PRINTED: AUG. 1979

SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this product.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by HP. However, warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within the HP service travel area. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

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

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 violates 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.

GENERAL – This is a Safety Class I instrument (provided with terminal for protective earthing) and has been manufactured and tested according to international safety standards.

OPERATION – BEFORE APPLYING POWER comply with the installation section. Additionally, the following shall be observed:

Do not remove instrument covers when operating.

Before the instrument is switched on, all protective earth terminals, extension cords, auto-transformers and devices connected to it should be connected to a protective earth via a ground socket. Any interruption of the protective earth grounding will cause a potential shock hazard that could result in serious personal injury. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation is present. Do not replace components with power cable connected.

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.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

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.

SAFETY SYMBOLS

The apparatus will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the apparatus against damage.

Indicates dangerous voltages.

Earth terminal

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice or the like, which, if not correctly performed or adhered to, could result in injury or loss of life. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the equipment. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

WARNING

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

CONTENTS

CONTENTS

TABLES

ILLUSTRATIONS

SERVICE SHEETS

APPENDIX 1

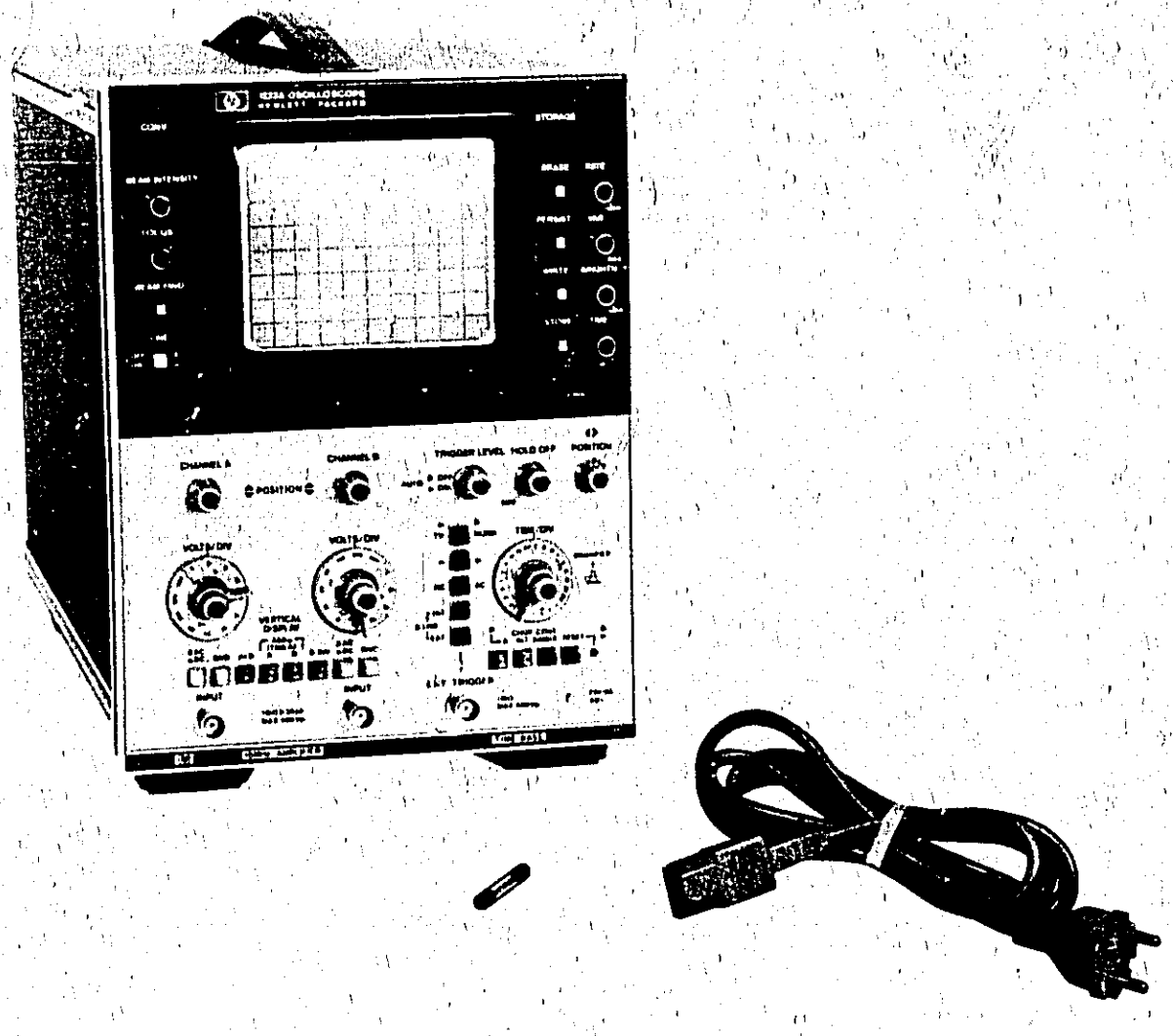


Figure 1–1. Accessories Supplied

SECTION I
GENERAL INFORMATION

1–1 INTRODUCTION

1–2 This Operating and Service Manual contains information required to install, operate, test, adjust and service the Hewlett-Packard Model 1223A. Figure 1–1 shows the mainframe and accessories supplied. This section covers instrument identification, description, accessories, specifications, and other basic information.

1–3 A microfiche version of this manual is available on 4 x 6 inch microfilm transparencies (order number on title page). Each microfilm contains up to 60 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1–4 SPECIFICATIONS

1–5 Instrument specifications are listed in Table 1–2. These specifications are the performance standards or limits against which the instrument is tested.

1–6 SAFETY CONSIDERATIONS

1–7 The Model 1223A is a Safety Class 1 instrument (it has an exposed metal chassis that is directly connected to earth via the power supply cable).

1–8 This operating and service manual contains information, cautions, and warnings which must be followed by the user to ensure safe operation and to maintain the instrument in a safe condition.

1–9 INSTRUMENTS COVERED BY MANUAL

1–10 Attached to the rear of this instrument is a serial number plate (Figure 1–2). The first four digits of the serial number only change when there is a significant change to the instrument. The last five digits are assigned to instruments sequentially. The contents of this manual apply directly to the instrument serial number quoted on the title page. For instruments with lower serial numbers, refer to the backdating information in Section 8 of this manual. For instruments with higher serial numbers, refer to the Manual Change sheets at the end of this manual. In addition to change information, the Manual Change sheets may contain information for correcting errors in the manual. To keep this manual as up-to-date and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Change supplement. The supplement for this manual is identified with this manual's print date and part number, both of which appear on this manual's title page. Complimentary copies of the supplement are available from Hewlett-Packard.

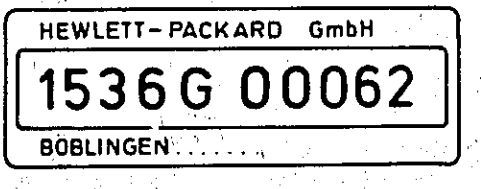


Figure 1–2. Serial Number Plate

1–11 DESCRIPTION

1–12 The 1223A is a dual channel, 15 MHz storage oscilloscope operating in two main modes of operation—conventional mode and store mode. Conventional features of the 1223A include 2mV/cm to 10V/cm deflection factors over the full bandwidth; X-Y display capability; calibrated sweep times from 100ns/cm to 2s/cm; sweep magnifier to expand display up to ten times; variable trigger hold-off; ac or dc trigger coupling; and TV sync separator. Store features include variable store time; variable persistence; variable auto-erase rate; brightness and autostore.

1–13 ACCESSORIES SUPPLIED

1–14 The 1223A is supplied complete with the following items (see Figure 1–1).

ITEM	HP PART NUMBER
400 mA Fuse for 230V operation	2110–0340
800 mA Fuse for 115V operation	2110–0020
Power Cable	see Figure 1–3

1–15 ACCESSORIES AVAILABLE

1–16 Accessories available are listed as follows:

Model 10013A 10:1 Divider Probe
Model 197A Camera
Model 10376A Adapter (for 197A)
Model 123A Camera
Model 16491A Adapter (for 123A)
Model 1230A Logic Trigger
Model 10173A RFI Metal Mesh Contrast Screen
Rack Mount Capabilities: for optimum rack mount solution – contact local HP office.

1–17 RECOMMENDED TEST EQUIPMENT

1–20 Equipment required to maintain the model 1223A is listed in Table 1–1. Other equipment can be substituted if it meets or exceeds the critical specifications listed in the table.

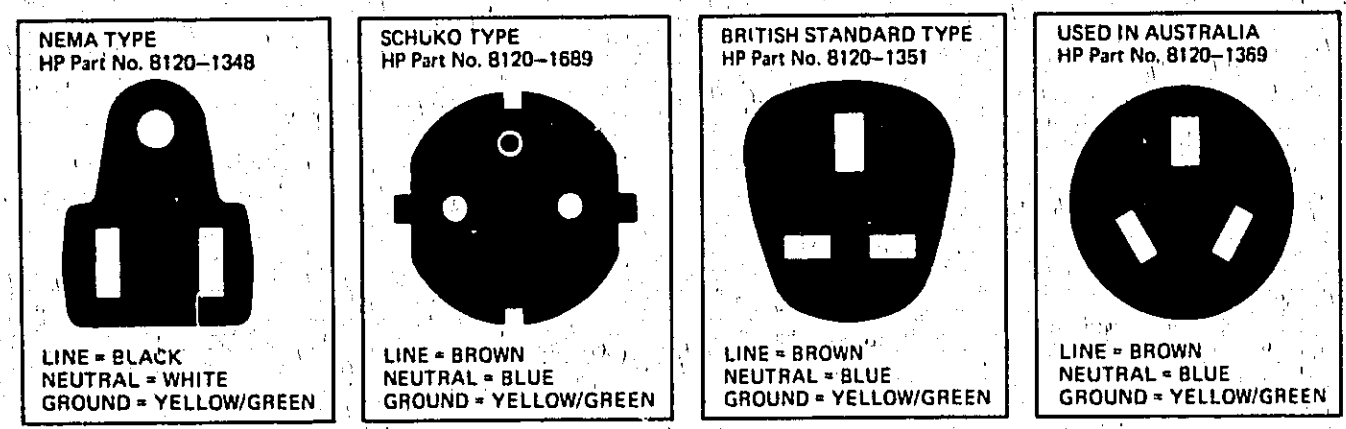


Figure 1–3. Power Cables Available: Plug Identification

Table 1–1. Recommended Test Equipment

INSTRUMENT TYPE	RECOMMENDED MODEL	REQUIRED CHARACTERISTICS	REQUIRED FOR
Voltmeter Calibrator	HP 738 BR	10mV – 50VPP 0.1%	PA
Time Mark Gen.	HP 226A	Time marks: 0.1μs –0.5s	PA
LCR Meter	HP 4332A		A
TV Signal Generator			P
Digital Voltmeter	HP 3465A/B	DC 1mV – 300V AC 300V	A
Oscillator	Tektronix 191	50 KHz – 15 MHz	PA
50 Ohm feedthrough	HP 10100C		PA
Square Wave Gen.	HP 211B	Risetime 5ns	A
BNC Tee	HP P/N 1250–0781		PA
9–in. BNC Cable	HP 10502A	BNC–BNC	PA
44–in. BNC Cable	HP 10501A	BNC–BNC	PA
Cable assembly	HP 11001A	dual banana BNC	PA
Adapter BNC	1250–0080	BNC female-female	PA
Variable Transformer	ET–3048	100–250V 50/60Hz 50VA	A
1000: 1 HV Probe	ET 4207		A

NOTE: P = Performance Check
A = Adjustment

Table 1–2. Specifications

MODES OF OPERATION

■ Variable Persistence ■ Write ■ Store ■ Auto Store
■ Conventional

DISPLAY MODES

Channel A
Channel B
Channel A + B
Channel B INV(erted)
Channels A & B: CHOP (switching between channels at approximately 300 kHz rate with blanking during switching)
ALT (A and B displayed alternately on successive sweeps).

VERTICAL AMPLIFIERS

BANDWIDTH: 15 MHz (3 dB down from 50 kHz, 6 div reference signal from a terminated 50 ohm source).
DC-Coupled: dc to 15 MHz.
AC-Coupled: 2 Hz to 15 MHz.
Rise Time: 23 ns (measured from 10% to 90% points of 6 div input step from a terminated 50 ohm source).

INPUT RC (typical): ac and dc; 1 megohm shunted by 30 pF.
Ground position disconnects input connector and grounds amplifier input.

DELAY LINE: allows entire leading edge of signal to be seen.

DEFLECTION FACTOR

Ranges: 2mV/div to 10V/div (12 calibrated positions) in 1, 2, 5 sequence.
±3% accuracy with vernier in calibrated position (10 mV/div to 10V/div ranges),
±5% accuracy on 2 mv/div and 5 mv/div ranges (with verniers in calibrated setting).
Vernier: continuously variable between all ranges; extends maximum deflection factor to at least 25 V/div.
Maximum Input Voltage: 400 V (dc or ac peak)

Calibrated X–Y Operation (B → A)

X-input signal via channel A
Y-input signal via channel B
Bandwidth: 1 MHz
Accuracy: ±5% (2 mV/div to 5 mV/div ranges),
±3% (10 mV/div to 10 V/div ranges),
X-Y Phase Shift: Less than 3° at 100 kHz

COMMON MODE REJECTION: Typically > 30 dB up to 1 MHz.

TIME BASE

Sweep Ranges: 0.1μs/div to 2 s/div (22 ranges in 1, 2, 5 sequence).
Accuracy: ± 4% over full screen with Magnifier control calibrated setting.
Magnifier: Continuously expands sweep at least 10 times. Maximum usable sweep speed 100 ns/div.

TRIGGERING

TRIGGER MODES

Internal: dc to 15 MHz on signals causing 1 division or more vertical deflection. Sweep is triggered on:
channel selected for display,
channel A in A & B mode,
composite signal in A + B mode.
External: dc to 15 MHz on signals of 100 mV p–p or more.
External Input R: approx. 1 megohm.
Line: triggers on line frequency.
TV Sync: separator for + or – video; requires 1 cm of video signal to trigger; automatic frame (2 s/div to 100 μs/div) and line (50μs/div to 0.1μs/div) select. Usable also as low-pass filter (attenuates signals above 8 KHz).
AUTO(matic) OFF: sweep is triggered by internal or external signal.
AUTO(matic) ON: bright baseline displayed if trigger signal is absent for longer than 500 ms.
SINGLE: sweep is triggered only once.
RESET: pushbutton arms sweep and lights indicator.
TRIGGER HOLD-OFF: time between sweeps continuously variable up to 10 times. Enables triggering on complex signals without loss of time base calibration.

TRIGGER COUPLING: ac, dc. Ac attenuates signals below 10 Hz.

LEVEL AND SLOPE

Internal: at any point on maximum 12 divisions displayed waveforms.
External: continuously variable form +1V to –1V on either slope of trigger signal.

STORAGE/ERASE MODES

VAR. PERSISTENCE: Persistence continuously variable from 0.1s to more than 1 min.

WRITE: Writing speed can be varied with BRIGHTN(ess) control from 20 div/ms to more than 200 div/ms for the full 8X10 division display area. 1000 div/ms can be achieved on an area of 6X8 divisions.

STORE: Storage time adjustable with the STORE TIME control for minimum 10 seconds up to typically 4 hours depending on BRIGHTN(ess) control setting. (Max. store time is achieved with min. BRIGHTN(ess) and max. STORE TIME settings.)

AUTO STORE: in trigger mode SINGLE, instrument ready to catch and store a single event for a cumulative time of at least 2 hours, typically 4 hours.

ERASE: Manual ERASE pushbutton and AUTOMATIC ERASE control. In AUTO ERASE mode, time between erasure cycles is variable from 1s to 1 min.
REMOTE ERASE is activated by grounding the rear panel REMOTE ERASE INPUT (or connecting to TTL low level).
Max. input Voltage: –1V peak to +15V peak.
REMOTE ERASE and MANUAL ERASE overrides auto erase cycle.

CATHODE RAY TUBE AND CONTROLS

TYPE: post-accelerator storage tube, 8.5 kV accelerating potential; aluminized P-31 phosphor (approx. 40μs natural persistence).

Table 1–2. Specifications (cont'd.)

GRATICULE: 8X10 division (1 div. = 9.6 mm sq.) internal graticule with 5 subdivisions per division on major horizontal and vertical axes. Additionally, 10% and 90% lines for both 6- and 8-division screen heights.

Z-AXIS INPUT (Intensity Modulation)
TTL Low Level or grounding the input blanks trace of any intensity. Usable up to 1 MHz.

Max Input Voltage: –1V peak to +15V peak, from source capable of sinking 2.5 mA.

GENERAL

PROBE ADJUST: typically 600 mV p-p, 2 kHz square wave for adjusting probe compensation.

BEAM FINDER: returns trace to CRT screen regardless of settings of horizontal and vertical controls.

ENVIRONMENT SPECIFICATIONS

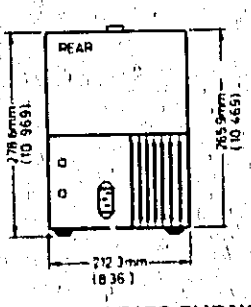
Temperature: Non-operating –40 to +75°C
Operating 0 to 55°C within specs.
Humidity: to 95% rel. humidity at 40°C.
Altitude: to 4600m (15000 ft).
Vibration: vibrated in three planes for 15 min. each with .25mm (.01 inch) excursions, 10 to 55 Hz.

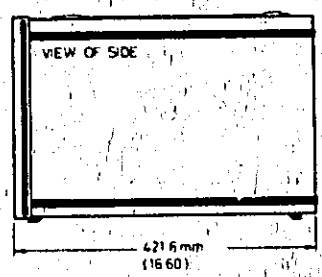
POWER REQUIREMENTS

100/120/220/240V AC, +5% –10%, 48-66 Hz. 70VA.

Data subject to change

WEIGHT: Net 11.75kg /25 3/4 lb); shipping 15kg (32 lb).
DIMENSIONS: NOTES: 1. Dimensions are for general information only. If dimensions are required for building special enclosures, contact your HP field engineer.
2. Dimensions are in millimeters and (inches).





ACCESSORIES FURNISHED: one blue light filter, one power cord, fuses for 100V, 120V operation and 220V, 240V operation, and one Operating and Service Manual.

ACCESSORIES AVAILABLE: Model 10013A 10:1 Attenuator Probe, Model 1230A Logic Trigger, Model 197A Camera, Model 10376A Camera Adapter for 197A Camera, Model 123A Camera, Model 16491A Camera Adapter for 123A Camera, Model 10173A RFI Metal Mesh Contrast Screen, Rack Mount Capabilities: for optimum rack mount solution – contact local HP Office.

Specifications describe the instrument's warranted performance. Supplement characteristics – identified by the word "typical" are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

SECTION II
INSTALLATION

2–1 INTRODUCTION

2–2 This section provides installation instructions for the Model 1223A Storage Oscilloscope and its accessories. It also includes information about initial inspection and damage claims, preparation for use, and packaging, storage and shipment.

2–3 INITIAL INSPECTION

2–4 Inspect the shipping container for damage. If the container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1–1 plus any accessories that were ordered with the instrument. Procedures for checking the electrical operation are given in Section 3. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the operator's checks, notify the nearest Hewlett-Packard Sales/Service office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for carrier's inspection. The HP office will arrange for repair or replacement without waiting for settlement.

2–5 PREPARATION FOR USE

2–6 Power Requirements

2–7 The 1223A requires a power source of 110 V, 120 V, 220 V or 240 V, +5 %, −10 % at a frequency of 48 to 66 Hz single phase. The maximum power consumption is 88 VA.

2–8 Power Cable

2–9 In accordance with international safety standards, this instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable shipped with each instrument depends on the country of destination. Refer to Figure 1–3 for the part number of the power cords available.

2–10 If the plug on the cable supplied does not fit your power outlet, then cut the cable at the plug end and connect a suitable plug. The plug should meet local safety requirements and include the following features:

Minimum current rating of 2A
Ground connection
Cable clamp.

The colour coding used in the cable will depend on the cable supplied (see Figure 1–3).

2–11 **Line Voltage Selection**

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT make sure that the instrument is set to the local line voltage.

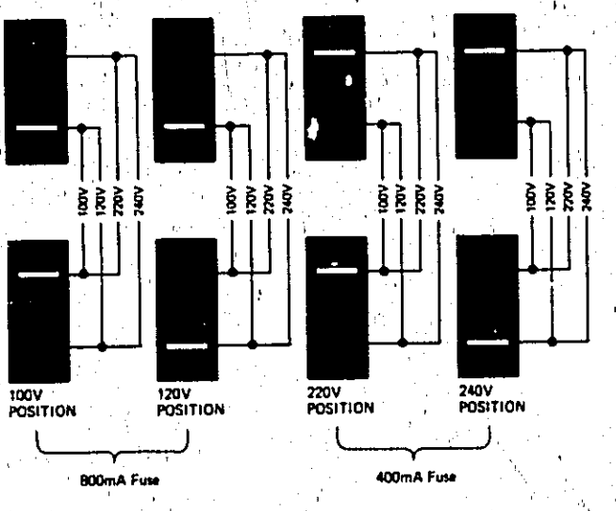


Figure 2–1. Line Voltage and Fuse Selection

2–12 Figure 2–1 provides instruction for line voltage and fuse selection.

WARNING

To avoid the possibility of injury or death, the following precautions must be followed before the instrument is switched on:

a. If this instrument is to be energized via an autotransformer for voltage reduction, make sure that the common terminal is connected to the grounded pole of the power source.

b. The power cable plug shall only be inserted into a socket outlet provided with a protective ground contact. The protective action must not be negated by the use of an extension cord without a protective conductor.

c. Before switching on the instrument, the protective ground terminal of the instrument must be connected to a protective conductor of the power cable. This is verified by checking that the resistance between the instrument chassis and the front panels of all modules in the instrument and the ground pin of the power cable plug is zero ohms.

2–13 Operating Environment

2–14 The 1223A will operate within specifications when the ambient temperature is between 0°C and 55°C.

2–15 STORAGE AND SHIPMENT

2–16 The 1223A can be stored or shipped at temperatures between −40°C and 75°C. The instrument should be protected from temperature extremes which cause condensation within the instrument.

2–17 If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office, attach a tag showing owner, return address, model number and full serial number and the type of service required. The original shipping carton and packaging material may be re-usable but the Hewlett-Packard Sales/Service office will also provide information and recommendations on materials to be used if the original packing is not available or re-usable. General instructions for re-packing are as follows:

1. Wrap instrument in heavy paper or plastic.

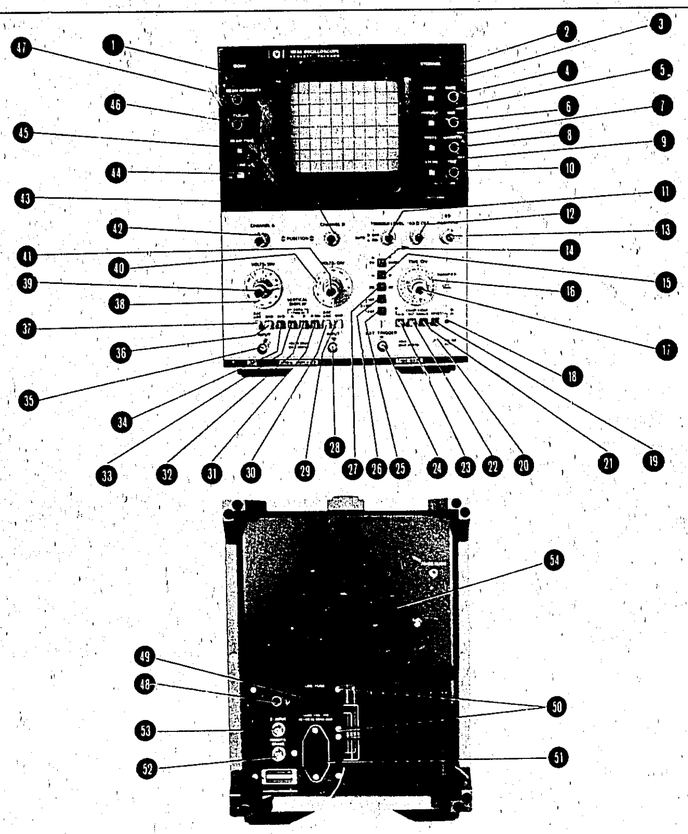
2. Use strong shipping container. A double wall carton made of 350-pound test material is adequate.

3. Use enough shock-absorbing material (3 to 4-inch layer) around all sides of instrument to provide firm cushion and prevent movement inside container. Protect control panel with cardboard.

4. Seal shipping container securely.

5. Mark shipping container FRAGILE to encourage careful handling.

6. In any correspondence, refer to instrument by model number and serial number.



1 **CONV LED INDICATOR.** Indicates that oscilloscope is in conventional mode of operation i.e. PERSIST, WRITE and STORE are released.

2 **STORAGE LED INDICATOR.** Indicates that oscilloscope is in storage mode of operation i.e. PERSIST, WRITE or STORE pushbutton depressed.

3 **ERASE.** Pressing this pushbutton erases the written display in PERSIST and WRITE modes; also sets the sweep to zero and arms the trigger.

4 **RATE.** In MAN detent position, erasure can only occur either by pressing the ERASE pushbutton (3) or applying a signal to the rear panel connector (52). All other positions provide a continuously variable erase rate.

5 **PERSIST.** Pressing this pushbutton enables the duration of the trace to be varied continuously.

6 **VAR.** Increases (cw) or decreases (ccw) the duration of the trace.

7 **WRITE.** Selects write mode of operation. In this mode the brightness can be varied continuously with maximum persistance.

8 **BRIGHTNESS.** Increases (cw) or decreases (ccw) the brightness of the trace in WRITE mode.

9 **STORE.** Pressing this pushbutton stores the written display for a time determined by TIME vernier (10).

10 **TIME.** Provides continuous control of the signal store time. In fully detent position, AUTO STORE selected i. e. scope ready to receive and store a single event for up to two hours. To ensure that no signal is present at the input before selecting AUTO STORE, the operator should:
a) ground the channel amplifier via (29) or (36) and position the trace as necessary via (13), (42) and (43)
b) select SINGLE at (21)
c) select AUTO OFF at (11)
d) press ERASE pushbutton (3).

11 **TRIGGER LEVEL.** Selects amplitude point on trigger signal that starts the sweep. Pressing this control enables the automatic baseline; pulling this control switches over to normal trigger.

12 **HOLD OFF.** Provides continuous control of time between sweeps.

13 **POSITION.** Controls horizontal position of display.

14 **TV/NORM.** In NORM position, TV Sync separator circuit is disabled and instrument triggers on normal signals. In TV position, TV Sync Separator is enabled and oscilloscope triggers on the frame (100 us or slower) or the line (50us or faster) sync of a video signal applied to channel A or channel B INPUT (28) or (35) connector.

15 **–/+.** Selects negative or positive slope of trigger signal to start the sweep.

16 **TIME/DIV.** Controls sweep speed. With expander control in calibrated position, dial setting of this control indicates the time it takes for a spot on the CRT to move one horizontal division. Setting of this control also determines TV SYNC LINE or FRAME lock.

17 **EXPANDER.** Clockwise rotation of this control expands the trace up to a factor of 10. Sweep speeds established by TIME/DIV control settings are no longer calibrated with this control out of CAL detent.

18 **RESET LED INDICATOR.** Lights when trigger is armed.

19 **RESET.** Pusbutton to arm the trigger circuit in single mode.

20 **PROBE ADJ.** Provides approximately 2 kHz, approximately 0.5V square wave for divider probe compensation.

21 **CONT/SINGLE.** In SINGLE, sweep triggered only once, must be reset (via (19)) manually; in CONT, sweep cycles continuously with AUTO ON selected.

22 **CHOP/ALT.** Position CHOP presents separate display of each input. Both inputs are displayed during the same sweep by switching between each channel at approximately 300 kHz rate. This position should be used to display low frequency signals. Position ALT displays each channel on alternate sweeps. This position should be used to display high frequency signals.

23 **B→A.** Provides X–Y display capability. Channel B input signal provides vertical deflection and channel A input signal provides horizontal deflection.

24 **EXT TRIGGER.** BNC connector for external input trigger signal.

25 **EXT.** Pressing this pushbutton selects external sync signal applied to EXT TRIGGER connector (24) to trigger the sweep. When this pushbutton and INT pushbutton (26) are simultaneously released, then line power supply frequency automatically selected to trigger the sweep.

26 **INT.** Pressing this pushbutton selects an internally generated sync signal to trigger the sweep.

27 **DC/AC.** In DC, couples external trigger signal directly. In AC, capacitively couples external trigger signal.

28 **INPUT.** BNC connector for channel B input.

29 **GND.** When pressed, this pushbutton disconnects the input signal applied to channel B and grounds the input to channel B vertical preamplifier.

30 **AD/DC.** Selects capacitive (AC) or direct (DC) coupling of the input signal to channel B vertical preamplifier.

31 **B INV.** When pressed, inverts the polarity of channel B input signal. Can be used for A–B operation.

32 **B (VERTICAL DISPLAY).** Selects input signal applied to channel B to be displayed on CRT. When A (33) also selected, then internal triggering occurs on input signal applied to channel A.

33 **A (VERTICAL DISPLAY).** Selects input signal applied to channel A to be displayed on CRT.

34 **A+B.** When pressed presents algebraic addition (A+B) of input signals applied to channel A and channel B.

35 **INPUT.** BNC connector for channel A input.

36 **GND.** When pressed, this pushbutton disconnects the input signal applied to channel A, and grounds the input to channel A vertical preamplifier.

37 **AD/DC.** Selects capacitive (AC) or direct (DC) coupling of input signal to channel A vertical preamplifier.

38 **VOLTS/DIV.** Selects channel A vertical deflection factor necessary for calibrated measurements when vernier (39) is in CAL detent. Dial settings indicate voltage amplitude required for one division of vertical deflection.

39 **VERNIER.** Provides continuous adjustment of volts/div between calibrated positions of VOLTS/DIV control (38).

40 **VOLTS/DIV.** Selects channel B vertical deflection factor necessary for calibrated measurements when vernier (41) is in CAL detent. Dial settings indicate voltage amplitude required for one division of vertical deflection.

41 **VERNIER.** Provides continuous adjustments of volts/div between calibrated positions of VOLTS/DIV control (40).

42 **CHANNEL A POSITION.** Controls vertical position of channel A display.

43 **CHANNEL B POSITION.** Controls vertical position of channel B display.

44 **LINE.** Applies primary ac power to the instrument.

45 **BEAM FINDER.** Returns display to viewing area of the CRT regardless of settings of vertical and horizontal controls.

46 **FOCUS.** Controls sharpness and clarity of beam.

47 **INTENSITY.** Controls brightness of the beam.

48 **REAR PANEL ⏚.** This connector provides a convenient ground point for test instruments being used for adjustment or performance checks.

49 **REAR PANEL FUSE HOLDER.** Accepts standard fuses to provide instrument protection in case of current over-load. An 800 mA slow-blow fuse must be used when operating from 110 V/120 V power source. A 400 mA fuse is used when operating from 220 V/240 V power source.

50 **REAR PANEL LINE SELECT SWITCHES.** These switches connect the internal power transformer to accept the primary power source voltage. BOTH SWITCHES must be set to the position marked for the power source you are using.

51 **REAR PANEL POWER RECEPTACLE.** A three-prong receptacle to provide chassis ground through the power cable for operator protection.

52 **REAR PANEL REMOTE ERASE.** BNC connector for permitting erase signals to be applied. Contact with ground will activate a single erase cycle.

53 **REAR PANEL Z:** A banana jack that permits intensity modulation (Z-axis) voltages to be applied. A +5V signal applied to the Z input will blank a trace of any intensity.

54 **TRACE ALIGN.** Local magnetic field compensation. Adjust for horizontal baseline.

Figure 3–1. Front and Rear Panel Controls, Connectors, and Indicators.

SECTION III
OPERATION

3–1 INTRODUCTION

3–2 This operating section explains the functions of the controls and indicators of the Model 1223A Storage Oscilloscope. Front and rear panel controls and connectors are identified and briefly described in Figure 3–1. A more detailed description of the control and connector functions is given in the following paragraphs. Also included in this section is an Operator's Check, to enable the operator to make quick evaluation of the instrument's main functions, and Operator Maintenance information.

3–3 SPECIAL OPERATING CONSIDERATIONS

3–4 Prior to operating the Model 1223A, the operator should familiarise himself with the controls and connectors by reading this section in its entirety.

CAUTION

To reduce the risk of CRT burns, follow the operating instructions carefully.

3–5 The following steps must be taken before applying power to the Model 1223A.

a) Read the safety summary at the front of this manual.

b) Be sure the power selector switches are set properly for the power source being used to avoid instrument damage.

CAUTION

Do not change the LINE SELECTOR Switch setting with the instrument on or with power connected to the rear panel.

3–6 PREOPERATIONAL ADJUSTMENTS

3–7 INITIAL TURN-ON

3–8 To place the Model 1223A into operation, perform the following steps:

a) Press TRIGGER LEVEL to AUTO ON and set control to mid-range.

b) Press INT pushbutton.

c) Press VERTICAL DISPLAY A pushbutton.

NOTE

All other pushbuttons are released.

d) Set channel A and channel B vertical POSITION controls to mid-range.

e) Set horizontal POSITION control to mid-range.

f) Set channel A and channel B VOLT/DIV switches to 5V, and set verniers to CAL detent.

g) Set TIME/DIV switch to 1ms and set vernier to CAL detent.

h) Set FOCUS control to mid-range.

i) Set INTENSITY control to mid-range.

j) Set HOLD OFF fully CCW.

k) Check that AUTO STORE is not selected.

l) Apply operating power and allow one hour's warm-up time for accurate measurements within the specified operating environment.

3–9 OPERATOR'S PERFORMANCE CHECK

3–10 The operation of the Model 1223A can be checked without use of additional test equipment. These operating tests will functionally check each of the display modes and the front-panel controls. To check the specifications listed in Table 1–2, refer to SECTION IV for performance checks. The operation check must be performed in the sequence given. Do not attempt to start a procedure in mid-sequence, because succeeding steps depend on control settings and results of previous steps. If any of the results are unobtainable, refer to SECTIONS IV and V, Performance Checks and Adjustments respectively.
The following procedure begins by assuming the control settings from the end of the turn-on procedure (para. 3.8.)

a) Depress BEAM FINDER pushbutton and operate INTENSITY control to bring baseline into view.

b) Operate POSITION controls to centre baseline.

c) Switch TIME/DIV control through all ranges and check that auto baseline is always visible.

d) Press VERTICAL DISPLAY A and B pushbuttons simultaneously.

e) Switch from CHOP to ALT and check that two traces remain visible. (Depending on TIME/DIV setting, the traces may appear as dotted lines in CHOP mode.)
f) Press CONT/SINGLE pushbutton. No display should be visible on-screen.
g) Press RESET. One sweep should occur with the RESET LED lighting during the sweep (although only visible at lower sweep speeds).
h) Set TIME/DIV to .1s.
i) Press RESET and adjust INTENSITY control for normal brightness.
j) Set VAR. control CCW.
k) Press PERSIST. pushbutton. The screen should be evenly flooded light green.
l) Press ERASE pushbutton.
m) Slowly turn VAR CW in small increments — pressing ERASE after each increment. The spot tail should become longer and the screen become darker.

NOTE

If spot blooms, then reduce INTENSITY.

n) Press ERASE pushbutton. The baseline should be written and remain on-screen for minimum 1 minute.
o) Press WRITE pushbutton.
p) Press ERASE pushbutton. The baseline should be written.
q) Set TIME fully CW (not to AUTO STORE detent).
r) Press STORE pushbutton. No baseline should be visible.
s) Turn TIME slowly CCW. Baseline should become visible and then brighter.
t) Set TIME to AUTO STORE detent, and press WRITE pushbutton. The screen should be dark and no signal visible.
u) Slightly adjust channel A vertical POSITION control.
v) Press RESET pushbutton. The spot should be visible for one sweep.
w) Turn TIME out of AUTO STORE detent. Two baselines should be visible with normal brightness.

3–11 CONVENTIONAL MODE OF OPERATION

3–12 Selection of this mode disables the storage controls (ERASE, PERSIST, WRITE and STORE) of the instrument. It will now function as a conventional general-purpose oscilloscope. (Switching from a storage mode to conventional mode is accomplished by gently pressing the PERSIST, WRITE, or STORE pushbuttons until the depressed pushbutton is released).

3–13 VERTICAL DISPLAY

3–14 These pushbuttons select the type of vertical display. Input signals may be displayed either singly or simultaneously as explained in the following.

3–15 Pushbutton A displays channel A input signal.

3–16 Pushbutton B displays channel B input signal.

3–17 Pushbuttons A and B (A&B) together display channel A and channel B input signals simultaneously.

3–18 Pushbutton A+B displays the algebraic sum of channel A and channel B input signals.

3–19 Pushbutton B INV displays in inverse polarity, the channel B input signal. B INV with A+B displays the difference between A and B input signals.

3–20 INPUT COUPLING

3–21 The AC/DC pushbuttons (located above INPUT BNC connectors) selected either capacitive (AC) or direct (DC) coupling of the input signal to the vertical amplifiers. The pushbuttons should be in DC position when viewing long duration pulses or dc levels of waveforms. AC should be selected when viewing ac waveforms having large dc levels.

3–22 The GND pushbutton is used to disconnect the signal source from the amplifier input and at the same time ground the amplifier input. This pushbutton can be used to establish a reference.

3–23 TRIGGER HOLD OFF

3–24 This control varies the time between sweeps up to 10 times. It is particularly useful for stable triggering on complex signals.

3–25 TRIGGER LEVEL

3–26 This control selects the point on the trigger signal that starts the sweep. Triggering point is adjustable at any level on the displayed waveform (maximum 10 divisions) if INT trigger selected. If EXT trigger selected, the trigger point is adjustable between +1V and −1V on either slope of the trigger signal.

3–27 An additional function of this control is selection of AUTO ON/AUTO OFF. AUTO ON selection enables the automatic baseline and is normally used in conjunction with the input GND pushbutton for establishing a reference line. AUTO OFF selection is for normal triggering, especially at low frequencies.

3–28 TRIGGER COUPLING

3–29 Direct coupling (DC) is normally used for trigger signals from dc to 10 Hz. Capacitive coupling (AC) is normally used for ac trigger signals over 10 Hz. If AC is selected for trigger signals below 10 Hz, then the trigger signal is attenuated.

3–30 CHOP/ALT

3–31 This pushbutton is only functional when both VERTICAL DISPLAY pushbuttons A and B are depressed. In CHOP mode, both channel A and B inputs are displayed during same sweep by switching between each channel at 300 KHz rate. This mode should be used to display low frequency signals. Position ALT displays each channel on alternate sweeps and should be used to display high frequency signals.

3–32 TV/NORM

3–33 This pushbutton provides a convenient means of viewing TV signals. When TV selected, the oscilloscope will trigger on the line or frame signal depending on the setting of the TIME/DIV switch. In the .1μs–50μs range, triggering is on the line signal. In the 100μs–.5s range, triggering is on each frame pulse.

3–34 A special use of the TV position is when the TV sync separator is needed as a low-pass filter. If triggering from a noisy or complex source, the TV sync separator can be used to reject components above 20 KHz.

NOTE

If line pulses are negative with respect to video information, then –/+ switch should be in – position for optimum display. Similarly + should be selected when line pulses are positive with respect to video information.

3–35 If NORM selected, then the instrument triggers over the full trigger frequency range.

3–36 BEAM FINDER

3–37 Pushing this pushbutton reduces amplifier gain enough to return the beam to the viewing area. This enables the operator to locate the beam and determine the action necessary to centre a display via the POSITION controls. When centered properly, the beam remains on the CRT when the pushbutton is released.

CAUTION

If no beam is visible when BEAM FINDER is pressed, carefully adjust INTENSITY until a beam is observed.

3–38 STORAGE MODE OF OPERATION

3–39 Storage mode of operation is selected by pressing one of PERSIST, WRITE or STORE pushbuttons. These pushbuttons are mechanically interlocked so that only one can be engaged at any one time.

CAUTION

When not actively using the 1223A or when auto baseline is displayed for long periods, switch to PERSIST mode with minimum persistence (VAR control CCW). This eliminates the possibility of burning the mesh because the signal is being continually erased; also, any irregulatities in control settings can be quickly distinguished in this mode.

3–40 PERSIST

3–41 The use of variable persistence mode is primarily for elimination of flicker at low frequency operation, thus enabling the operator to view a stable continuous trace.

3–42 The VAR control provides a means of controlling the CRT trace decay-rate. Using this capability, slow moving signals can be made to create a full trace pattern by adjusting decay-rate to the appearance of the next trace, thereby eliminating flicker.

3–43 Having found the optimum persistence (decay-rate) setting, the operator can view for longer periods of time by:

a) pressing WRITE pushbutton

then

b) pressing ERASE pushbutton (RATE control in MAN detent position) thus enabling the signal to be written again with maximum persistence

then

c) pressing STORE pushbutton. The signal can now be viewed for up to 2 hours.

On returning to PERSIST mode, no re-adjustment of the VAR control is necessary.

3–44 WRITE

3–45 The WRITE mode is primarily for writing the single-shot event, and as such, the CONT/SINGLE pushbutton is normally set to SINGLE in this mode.

CAUTION

Before switching to WRITE mode with CONT selected, ensure that INTENSITY control is adjusted for low intensity.

3–46 In this mode, a signal is automatically written with maximum persistence (over 1 minute) and the VAR persistence control is disabled.

3–47 The BRIGHTNESS control provides a means of controlling the write-rate (from 20 div/ms to over 200 div/ms). The setting of this control determines the speed of the single-shot event that can be clearly displayed.

3–48 If the operator has approximate knowledge of the pulse parameters of the single-shot event, then an optimum display can be obtained by first simulating the event, using a pulse generator, and then adjusting the INTENSITY and BRIGHTNESS control as required.

3–49 Once an optimum display of the event is obtained the operator can view for longer periods either by:

a) pressing STORE pushbutton, in which case the display remains on-screen for up to at least 2 hours, depending on the settings of the STORE TIME and BRIGHTNESS controls.

or

b) selecting AUTO STORE by the TIME control which causes the signal to be stored but not displayed. Turning the TIME control out of the AUTO STORE detent then makes the signal visible for a time determined by the settings of the TIME and BRIGHTNESS controls. In this case the total storage time (visible and non-visible) does not exceed 2 hours.

3–50 Multi-signal comparisons can be conveniently made in WRITE mode by:

a) Setting TIME/DIV control as required.
b) Select VERTICAL DISPLAY A.
c) Set VOLT/DIV switch for channel A as required.
d) Set CONT/SINGLE to CONT.
e) Apply signal to channel A INPUT.
f) Adjust POSITION controls to locate trace in the top half of the screen.
g) Set CONT/SINGLE to SINGLE.
h) Apply signal to channel A INPUT.
i) Adjust vertical POSITION control such that second signal can be written without overwriting the signal written in step "h".
j) Press RESET pushbutton.
k) Apply second signal to channel A INPUT.
l) Repeat steps i to k for as many times as trace can be written without overwriting the previous trace.
m) For longer view times, switch to STORE mode as described in para. 3–49.

3–51 STORE

3–52 The STORE mode enables the operator to view, for extended periods of time, a signal already written in WRITE mode. By selecting this mode, the operator disables the channel A and B INPUTS, and also disables the ERASE function.

3–53 The time for which a signal can be stored is determined by the settings of the TIME and BRIGHTNESS. Whilst in STORE mode, these controls can be adjusted for optimum display/store-time. (Refer to Table 1–2 for exact specifications of store-time.)

3–54 AUTO STORE

3–55 The AUTO STORE mode only functions when the WRITE pushbutton is depressed, and enables the oscilloscope to automatically store (non-visible) a single-shot event.

3–56 In this mode, the ERASE function is disabled.

3–57 Although AUTO STORE mode can be selected after the single-shot event is written on-screen (as described in para. 3–49), it is normally selected prior to the event occurring. In this case, the operator should ensure that the expected signal can be written on the CRT i.e. INTENSITY and BRIGHTNESS are properly set. This can be done by switching out of AUTO STORE to WRITE mode, then simulating the expected signal using a signal generator. Having determined the optimum settings of the INTENSITY and BRIGHTNESS controls, the operator should clear the CRT screen prior to returning to AUTO STORE. The following procedure ensures that this is done:

a) Press GND pushbutton(s) of the channel(s) being used.
b) Select AUTO OFF at the TRIGGER LEVEL control.

c) Press ERASE pushbutton. Note that RESET LED lights.
d) Set TIME control to AUTO STORE detent.
e) Release GND pushbutton(s).

When the event is captured and stored, the RESET LED is extinguished.

3–58 ERASE

3–59 The erase cycle removes the written display and only functions in WRITE and PERSISTENCE modes.

3–60 When the VAR control is set to MAN detent, erasure occurs either when the ERASE pushbutton is depressed or when the rear panel REMOTE ERASE input is connected to ground. In both cases the sweep is set to zero independent of beam position.

NOTE

A single remote erasure is initiated by a negative going edge to ground. Should the REMOTE ERASE input remain connected to ground, the front panel erase controls are disabled and no further erasure can occur until the REMOTE ERASE input goes positive again.

3–61 All other positions of the VAR control (other than MAN detent) provide a continuously variable, automatic erasure rate.

3–62 Each erasure, whether automatic, manual or remote, causes the sweep to be set to zero and the trigger to be armed. Because of this timing relationship between erasure and sweep circuitry, a start reference point (end of sweep) needs to be established when SINGLE sweep selected, AUTO OFF selected, and switching from MAN erase to auto erase. This is accomplished either by:

a) Pressing ERASE pushbutton after going to auto-erase. This sets the sweep to zero and arms the trigger. The next trigger initiates a sweep and the auto erasure proceeds at the end of that sweep.

or

b) Pressing RESET pushbutton after going to auto erase. This also arms the trigger. The next trigger then initiates a sweep and the auto erasure proceeds at the end of that sweep.

3–63 If switching from MAN erase to auto erase when in SINGLE sweep and AUTO ON selected, then no trigger signal need be applied after pressing ERASE or RESET pushbutton.

3–64 CONT/SINGLE

3–65 This pushbutton enables selection of continuous sweep or single sweep operation. The CONT position is normally used for PERSIST and CONV modes of operation; the SINGLE position is normally used for WRITE and AUTO STORE modes of operation.

3–66 When CONT is selected together with AUTO ON, then baseline is always displayed. A channel input signal of approx. 2Hz or higher overrides auto operation and produces a stable display, although adjustment of TRIGGER LEVEL control may be necessary. If AUTO OFF selected, a trigger signal (to channel INPUT or EXTERNAL INPUT) is always needed to generate a sweep.

3–67 When SINGLE is selected, one sweep occurs and the trigger circuitry must be armed by operation of the RESET pushbutton before another sweep can occur. Indication that the trigger circuit is armed is then given by an illuminated RESET LED (light emitting diode). Also in SINGLE selection, repetitive operation of the RESET pushbutton integrates the signal display up to a convenient brightness.

3–68 RESET

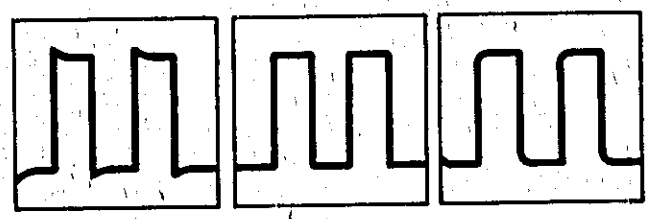
3–69 The RESET pushbutton is for arming the trigger when in single sweep operation. Indication of an armed trigger is given by an illuminated LED.

3–70 PROBE COMPENSATION

3–71 The Model 1223A provides high input impedance and low input capacitance. However, when a probe is used to feed signals from the circuit into the oscilloscope, the probe output must match the oscilloscope input.

3–72 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 provides an approximate 2 KHz and approximately 0.6V p-p square wave output, which can be used as follows for probe compensation:

a) Connect the probe input to the PROBE ADJ output, and attach probe cable to channel A INPUT.
b) Adjust TIME/DIV and channel A VOLTS/DIV controls such that 2 full square wave cycles are easily visible.
c) Adjust the probe for the correct square wave display shown in Figure 3–2.



Over-compensated | Correctly adjusted | Under-compensated

Figure 3–2. Probe Compensation.

3–73 OPERATOR'S MAINTENANCE

3–74 The only maintenance the operator should normally perform is replacement of the primary power fuse located on the rear Heat Sink Assembly A1. For instructions on how to change the fuse, refer to SECTION II, Line Voltage Selection.

CAUTION

Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

SECTION IV
PERFORMANCE TESTS

4–1 INTRODUCTION

4–2 The procedures in this section test the electrical performance of the oscilloscope using the specifications of Table 1–2 as performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in Section III under operator's checks.

4–3 EQUIPMENT REQUIRED

4–4 Equipment required for the performance tests is listed in Table 1–1, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model(s).

4–5 TEST RECORD

4–6 Results of the performance tests may be tabulated on the Test Record at the end of the test procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance, troubleshooting, and after repairs or adjustments.

4–7 PERFORMANCE TESTS

4–8 The performance tests given in this section are suitable for incoming inspection, troubleshooting, or preventive maintenance. During any performance test, all shields and connecting hardware must be in place. The tests are designed to verify the published instrument specifications, perform the tests in the order given and record the data on the test card and/or in the data spaces provided at the end of each procedure.

NOTE

The oscilloscope must have a warmup time of 1 hour and the line voltage must be within +5%, −10% of nominal if the performance tests are to be considered valid.

4–9 Each test is arranged so that the specification is written as it appears in Table 1–2. Next, a description of the test and any special instructions or problem areas are included. Each test that requires test equipment has a setup drawing and a list of the required equipment. The initial steps of each procedure give control settings required for that particular test.

PERFORMANCE TESTS

4–10 CHOP/ALTERNATE AND BEAMFINDER TESTS

SPECIFICATIONS:

Beamfinder returns trace to CRT screen regardless of settings of horizontal and vertical POSITION controls.

PROCEDURE:

1. Set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL	
CHANNEL A(B) POSITION ▲▼	as required	
VOLTS/DIV	1V/DIV	(1V/DIV)
VERNIER	CAL	(CAL)
INPUT COUPLING	AC	(AC)
VERTICAL DISPLAY	A & B'	
TRIGGER LEVEL	AUTO ON	
TRIGGER MODE	INT/ +/ NORM/ AC	
B▲ ▶A	OFF	
CHOP ALT	CHOP	
CONT SINGLE	CONT	
POSITION ◀▶	as required	
HOLD OFF	CCW	
TIME/DIV	10ms/DIV	
MAGNIFIER	CAL position	

2. Set TRIGGER LEVEL control for free-run and adjust vertical controls so that two traces are visible on-screen (CHOP mode).

3. Press CHOP/ALT pushbutton. Both traces should be visible alternately on-screen (ALT Mode).

4. Release CHOP/ALT pushbutton.

5. Turn CHANNEL A POSITION control CW, CHANNEL B POSITION control CCW and horizontal POSITION control CW. Both traces should be off-screen.

6. Press BEAM FINDER pushbutton. Both traces (dots) should return to the CRT screen.

PERFORMANCE TESTS

4–11 CHANNEL A/CHANNEL B INPUT COUPLING AND AUTO ON-OFF BLANKING TESTS

SPECIFICATIONS:

AC, DC, or GND. Ground position disconnects input connector and grounds amplifier input.
In AUTO OFF and no input signals applied – no display.

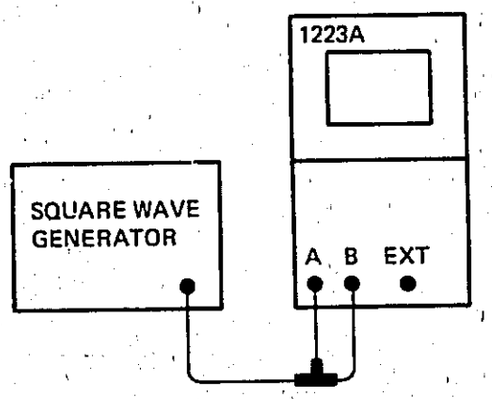


Figure 4–1. Input Coupling and Auto On-Off Blanking Test Setup.

EQUIPMENT:

Squarewave Generator.
BNC Tee.

PROCEDURE:

1. Set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL	
CHANNEL A(B) POSITION ▲▼	Trace centered	(Trace centered)
VOLTS/DIV	1V/DIV	(1V/DIV)
VERNIER	CAL	(CAL)
INPUT COUPLING	DC	(DC)
VERTICAL DISPLAY	CHANNEL A	
TRIGGER LEVEL	AUTO OFF	
TRIGGER MODE	INT/+/NORM/AC	
B ▲▶ A	OFF	
CHOP ALT	CHOP	
CONT SINGLE	CONT	
POSITION ◀▶	as required	
HOLD OFF	CCW	
TIME/DIV	20ms/DIV	
MAGNIFIER	CAL position	

2. Connect the Squarewave Generator to the 1223A as shown in Figure 4–1.

PERFORMANCE TESTS

3. Set the Squarewave Generator controls so that a 10Hz squarewave is applied to CHANNEL A and CHANNEL B inputs and amplitude is adjusted for a 6 division vertical display.

4. Adjust TRIGGER LEVEL control in AUTO OFF for a stable display.

5. Release input coupling AC/DC pushbutton. The displayed squarewave should be differentiated.

6. Press CHANNEL A GND pushbutton and check that the display is completely blanked.

7. Switch TRIGGER LEVEL to AUTO ON. The auto baseline should be displayed.

8. Release CHANNEL A DISPLAY pushbutton, press CHANNEL B DISPLAY pushbutton, and repeat steps 3–6 for channel B.

PERFORMANCE TESTS

4–12 DEFLECTION FACTOR VERNIER AND X-AXIS CALIBRATION TESTS

SPECIFICATIONS:

2mV/DIV to 5mV/DIV Range ± 5%
10mV/DIV to 10V/DIV Range ± 3%
VERNIER: Continuously variable between all ranges; extends maximum deflection factor to at least 25V/cm.

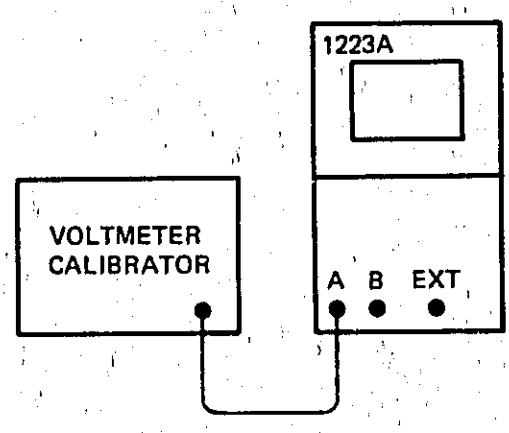


Figure 4–2. Test Setup for Deflection Factor/Vernier/X-Axis Calibration.

EQUIPMENT:

Voltmeter Calibrator.

PROCEDURE:

1. Connect the Voltmeter Calibrator to the 1223A as shown in Figure 4–2, and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL	
CHANNEL A(B) POSITION ▲▼	trace centered	(trace centered)
VOLTS/DIV	as required	
VERNIER	CAL	(CAL)
INPUT COUPLING	AC	(AC)
VERTICAL DISPLAY	CHANNEL A	
TRIGGER LEVEL	as required	
TRIGGER MODE	INT/+/NORM/AC	
B ▲└▶A	OFF	
CHOP ALT	CHOP	
CONT SINGLE	CONT	
POSITION ◀▶	midrange	
HOLD OFF	CCW	
TIME/DIV	as required	
MAGNIFIER	CAL position	

2. Check all VOLT/DIV ranges for specifications.

PERFORMANCE TESTS

3. Press B↕A pushbutton and check horizontal deflection factor in X–Y mode meets the same specifications given for the vertical deflection.

4. Release B↕A pushbutton.

5. Connect Voltmeter Calibrator to channel B, and press CHANNEL B DISPLAY pushbutton.

6. Check all VOLT/DIV ranges for specifications.

7. Reconnect the Voltmeter CALIBRATOR to channel A and press CHANNEL A DISPLAY pushbutton.

8. Set 1223A VOLTS/DIV switch to 100mV/DIV and set Voltmeter Calibrator controls for a 1V p–p output signal.

9. Rotate VERNIER CCW. The display signal should decrease to approximately 4 divisions.

10. Repeat steps 7–9 for Channel B.

11. Reset VERNIERS to CAL position.

PERFORMANCE TESTS

4–13 A+B MODE; B INV COMMON MODE REJECTION TESTS

SPECIFICATIONS:

Common mode rejection > 30dB up to 1MHz.

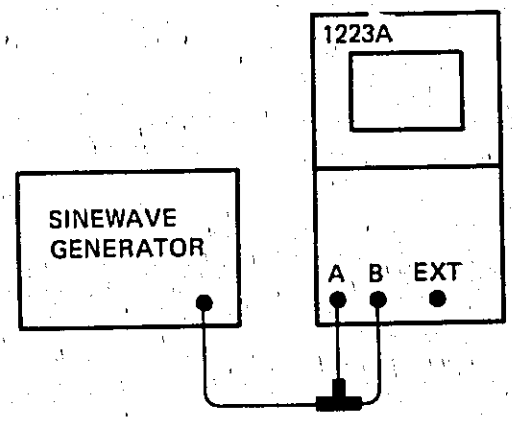


Figure 4–3. A+B Mode and B Inv Common Mode Rejection Test Setup.

EQUIPMENT:

Sinewave Generator.
BNC Tee.

PROCEDURE:

1. Connect Sinewave Generator to the 1223A as shown in Figure 4–3 and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL	
CHANNEL A(B) POSITION ▲▼	centered	(centered)
VOLTS/DIV	100mV/DIV	(100mV/DIV)
VERNIER	CAL	(CAL)
INPUT COUPLING	AC	(AC)
VERTICAL DISPLAY	A&B	
TRIGGER LEVEL	as required	
TRIGGER MODE	INT/+/NORM/AC	
B↕A	OFF	
CHOP ALT	CHOP	
CONT SINGLE	CONT	
POSITION ◄►	as required	
HOLD OFF	CCW	
TIME/DIV	0.2 us/DIV	
MAGNIFIER	CAL position	

2. Keep GND pushbuttons for channel A and channel B depressed and centre both traces exactly.

PERFORMANCE TESTS

3. Release GND pushbuttons and set Sinewave Generator Controls for a 1MHz sinewave output to both channels.

4. Adjust sinewave amplitude for a vertical deflection of 4 divisions.

5. Press A+B pushbutton. The vertical display should be 8 divisions ± 0.6% (0.48 divisions).

6. Set VOLT/DIV switches for channel A and channel B to 50mV/DIV.

7. Press B INV pushbutton (both A+B and B INV now depressed). The remaining ac signal should be less than 0.25 divisions (0.25 divisions equivalent to 30 dB).

PERFORMANCE TESTS

4–14 VERTICAL BANDWIDTH TEST

SPECIFICATIONS:

3dB down from a 50kHz, 6 division reference signal from a terminated 50Ω source at 15MHz.

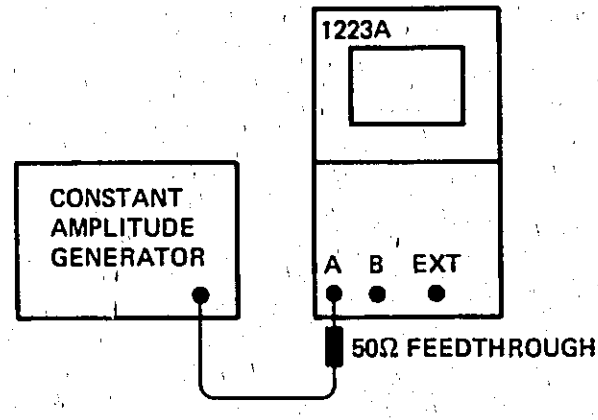


Figure 4–4. Vertical Bandwidth Test Setup.

EQUIPMENT:

Constant Amplitude Generator
50 Feedthrough

PROCEDURE:

1. Connect the Constant Amplitude Generator to the 1223A as shown in Figure 4–4 and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL	
CHANNEL A(B) POSITION ▲▼	centered	(centered)
VOLTS/DIV	5mV/DIV	(5mV/DIV)
VERNIER	CAL	(CAL)
INPUTS COUPLING	AC	(AC)
VERTICAL DISPLAY	CHANNEL A	
TRIGGER LEVEL	as required	
TRIGGER MODE	INT/+/NORM/AC	
B ▲ ▶A	OFF	
CHOP ALT	CHOP	
CONT SINGLE	CONT	
POSITION ◀▶	as required	
HOLD OFF	CCW	
TIME/DIV	0.1ms/DIV	
MAGNIFIER	CAL position	

2. Set the Constant Amplitude Generator controls for a 50 kHz sinewave output to channel A.

3. Adjust sinewave amplitude for exactly 6 divisions vertical deflection.

PERFORMANCE TESTS

4. Change sinewave frequency to 15MHz. The vertical deflection should now be > 4.3 divisions.

5. Press CHANNEL B DISPLAY pushbutton, and connect Constant Amplitude Generator to channel B INPUT.

6. Repeat steps 2–4 for channel B.

PERFORMANCE TESTS

4–15 SWEEP RANGES AND MAGNIFIER TESTS

SPECIFICATIONS:

From 100ns/DIV to 2s/DIV within 4% accuracy over full scale, with MAGNIFIER in calibrated position. MAGNIFIER continuously expands sweep at least 10 times. Maximum usable sweep speed 10ns/DIV.

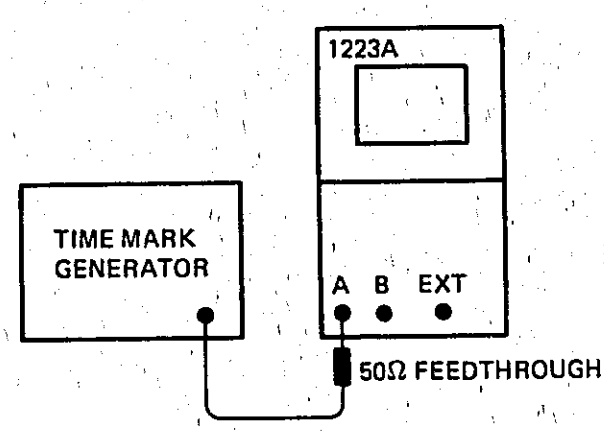


Figure 4–5. Sweep Ranges and Magnifier Test Setup.

EQUIPMENT:

Time Mark Generator
50Ω Feedthrough

PROCEDURE:

1. Connect the Time Mark Generator to the 1223A as shown in Figure 4–5 and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL
CHANNEL A(B) POSITION ▲▼	centered
VOLTS/DIV	as required
VERNIER	CAL
INPUT COUPLING	AC
VERTICAL DISPLAY	CHANNEL A
TRIGGER LEVEL	AUTO OFF, as required
TRIGGER MODE	INT/+/NORM/AC
B▲▶A	OFF
CHOP ALT	CHOP
CONT SINGLE	CONT
POSITION◀▶	as required
HOLF OFF	CCW
TIME/DIV	as required
MAGNIFIER	CAL position

2. Set the Time Mark Generator and 1223A TIME/DIV switch to 0.1 us.

PERFORMANCE TESTS

3. Adjust the horizontal POSITION control so that the first time mark corresponds exactly to the extreme left vertical graticule line.

4. Check that the eleventh time mark corresponds to within ± 4% of the extreme right vertical graticule line.

5. Adjusting the Time Mark Generator controls accordingly, check all other sweep ranges for specifications.

NOTE

Use PERSISTENCE MODE at lower sweep speed.

6. Set MAGNIFIER to CW position and check that sweep is expanded at least x10.

7. Set MAGNIFIER control back to CAL position.

PERFORMANCE TESTS

4–16 TRIGGER MODES (Slope; AC/DC Coupling; INT/EXT Trigger Source) AND AUTOBASELINE

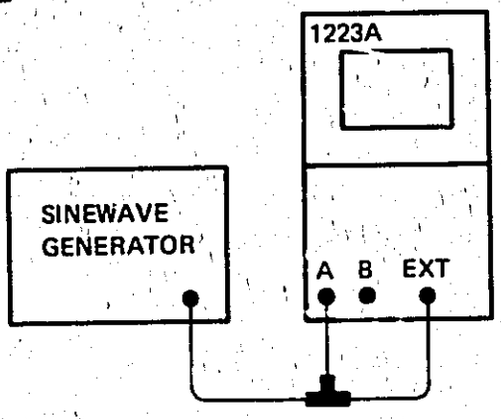


Figure 4–6. Trigger Modes Test Setup.

EQUIPMENT:

Sinewave Generator.
BNC Tee.

PROCEDURE:

1. Connect the Sinewave Generator to the 1223A as shown in Figure 4–6, and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL	
CHANNEL A(B) POSITION ▲▼	centered	(centered)
VOLTS/DIV	100mV/DIV	(100mV/DIV)
VERNIER	CAL	(CAL)
INPUT COUPLING	AC	(AC)
VERTICAL DISPLAY	CHANNEL A	
TRIGGER LEVEL	CCW, AUTO (BASELINE) ON	
TRIGGER MODE	INT/+/NORM/AC	
B ▲▷ A	OFF	
CHOP ALT	CHOP	
CONT SINGLE	CONT	
POSITION ◄►	as required	
HOLD OFF	CCW	
TIME/DIV	0.2 ms/DIV	
MAGNIFIER	CAL position	

2. With Sinewave Generator disconnected, verify that baseline is displayed.
3. Connect Sinewave Generator and set for a 1kHz output signal. Adjust for a vertical deflection of 2 divisions. Verify that display triggers.
4. Switch AUTO (baseline) off, center display and set TRIGGER level control to mid-range.
5. Press +/– (slope) pushbutton and AC/DC (trigger coupling) pushbutton. The display should remain stable.

PERFORMANCE TESTS

6. Switch to EXT trigger.

7. Release +/– (slope) and AC/DC (trigger coupling) pushbuttons checking that the display remains stable.

8. Switch to INT. trigger.

9. Check that when DISPLAY MODE A, A&B, or A&B INV selected, the 1223A triggers on channel A.

10. Check that when DISPLAY MODE B or B INV selected, the 1223A triggers on channel B.

11. Check that when DISPLAY MODE A+B or A+B B INV selected, the 1223A triggers on the composite signal for positive and negative slope, and AC and DC trigger coupling.

PERFORMANCE TESTS

4–17 LOW FREQUENCY AND HIGH FREQUENCY TRIGGER TESTS

SPECIFICATIONS:

Triggers on signals from 0 to 15 MHz causing 1 division or more vertical deflection in INT trigger mode, or on signals of 100mV p-p or more in EXT trigger mode.

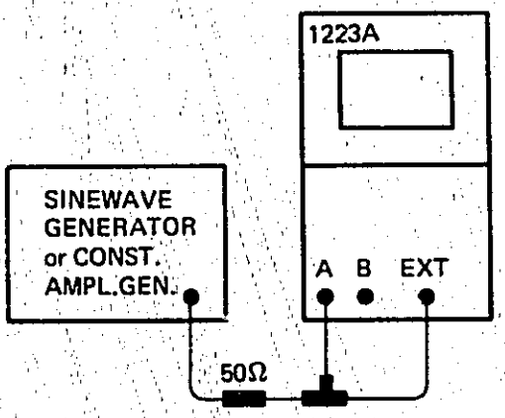


Figure 4–7. Low Frequency/High Frequency Trigger Test Setup.

EQUIPMENT:

Sinewave Generator (or Constant Amplitude Generator).
BNC Tee.
50Ω Feedthrough.

PROCEDURE:

1. Connect the Sinewave Generator to the 1223A as shown in Figure 4–7 and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL
CHANNEL A(B) POSITION ▲▼	centered
VOLTS/DIV	100mV/DIV
VERNIER	CAL
INPUT COUPLING	AC
VERTICAL DISPLAY	CHANNEL A
TRIGGER LEVEL	AUTO OFF/ON, as required
TRIGGER MODE	INT/+/NORM/AC
B▲└▶A	OFF
CHOP ALT	CHOP
CONT SINGLE	CONT
POSITION ◀▶	as required
HOLD OFF	CCW
TIME/DIV	as required
MAGNIFIER	CAL position

PERFORMANCE TESTS

2. Adjust Sinewave Generator controls for a 10Hz output 1 division vertical deflection.

3. Check that stable triggering can be achieved with the TRIGGER LEVEL control in INT and EXT trigger modes.

4. Adjust sinewave frequency for 15 MHz output.

5. Repeat step 3.

PERFORMANCE TESTS

4–18 TV TRIGGER TEST

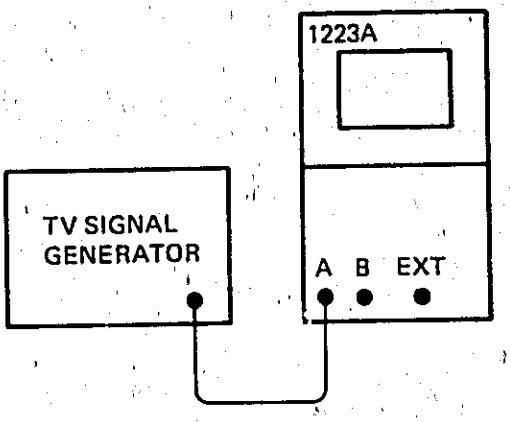


Figure 4–8. TV Trigger Test Setup.

EQUIPMENT:

TV Signal Generator.

PROCEDURE:

1. Connect the TV Signal Generator to the 1223A as shown in Figure 4–8 and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL
CHANNEL A(B) POSITION ▲▼	as required
VOLTS/DIV	as required
VERNIER	CAL
INPUT COUPLING	AC
VERTICAL DISPLAY	CHANNEL A
TRIGGER LEVEL	midrange
TRIGGER MODE	INT/–/AC/TV
B ▲ ▶ A	OFF
CHOP ALT	Chop
CONT SINGLE	Cont
POSITION ◀▶	as required
HOLD OFF	CCW
TIME/DIV	2ms/Div
MAGNIFIER	CAL position

2. Apply a video signal to the 1223A channel A.

3. Achieve a stable display, if necessary by changing to + slope and adjusting TRIGGER LEVEL control.

4. Set TIME/DIV to 20us/DIV and check that there is stable triggering on a TV line signal.

PERFORMANCE TESTS

4–19 PROBE ADJUST AND LINE SYNC TESTS

SPECIFICATIONS:

Probe adjust output approximately 0.6V, 2KHz.

EQUIPMENT:

10:1 Divider Probe.

PROCEDURE:

1. Set 1223A controls as follows:

OPERATING MODE	CONVENTIONAL
CHANNEL A(B) POSITION ▲▼	as required
VOLTS/CIV	10mV/DIV
VERNIER	CAL
INPUT COUPLING	AC
VERTICAL DISPLAY	CHANNEL A
TRIGGER LEVEL	as required
TRIGGER MODE	INT/+/NORM/AC
B▲└▶A	OFF
CHOP ALT	CHOP
CONT SINGLE	CONT
POSITION◀▶	as required
HOLD OFF	CCW
TIME/DIV	0.1ms/DIV
MAGNIFIER	CAL position

2. Connect 10:1 Divider Probe BNC connector to channel A INPUT, and clip Divider Probe tip to PROBE ADJ. output.

3. Adjust TRIGGER LEVEL control to give a stable display. Compensate probe for optimum square wave, checking frequency and amplitude.

4. Connect Divider Probe tip to ac line.

5. Adjust VOLTS/DIV and TIME/DIV switches to display a waveform within the screen.

6. Select LINE trigger and check that 1223A triggers correctly.

PERFORMANCE TESTS

4–20 X–Y PHASE SHIFT AND X–AXIS BANDWIDTH TESTS

SPECIFICATIONS:

X-axis bandwidth 1 MHz.
X-Y phase shift – less than 3° at 100 KHz.

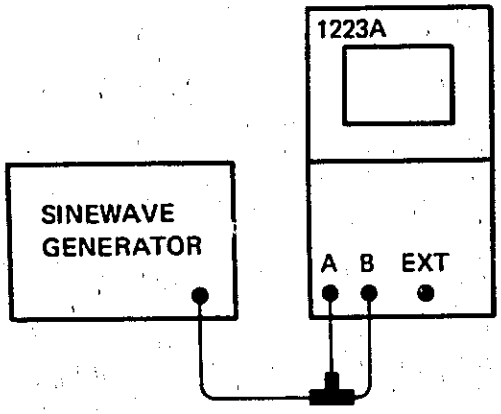


Figure 4–9. X–Y Phase Shift and X-Axis Bandwidth Test Setup.

EQUIPMENT:

Sinewave Generator.
BNC Tee.

PROCEDURE:

1. Connect Sinewave Generator to 1223 as shown in Figure 4–9 and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL	
CHANNEL A(B) POSITION ▲▼	as required	
VOLTS/DIV	100mV/DIV	(100mV/DIV)
VERNIER	CAL	(CAL)
INPUT COUPLING	AC	(AC)
VERTICAL DISPLAY	CHANNEL A	
TRIGGER LEVEL	as required	
TRIGGER MODE	INT/+/NORM/AC	
B▲ ▶A	as required	
CHOP ALT	CHOP	
CONT SINGLE	CONT	
POSITION◀▶	as required	
HOLD OFF	CCW	
TIME/DIV	as required	
MAGNIFIER	CAL position	

2. Set Sinewave Generator for 100 KHz output and adjust amplitude for exactly 8 division vertical display.

PERFORMANCE TESTS

3. Press B↑↳A pushbutton. A 45° shifted ellipse should appear within 8x8 divisions on the screen. (If necessary, centre the ellipse with vertical POSITION controls). Check that the ellipse width, measured along the centre horizontal line is < 0.4 divisions.

4. Release the B↑↳A pushbutton.

5. Set the sinewave Generator output to 1MHz and adjust sinewave amplitude for a 6 division vertical deflection.

6. Press channel B GND and B↑↳A pushbuttons. Check that the horizontal trace is > 4.3 division.

7. Release channel B GND and B↑↳A pushbuttons.

PERFORMANCE TESTS

4–21 INTENSITY MODULATION TEST

SPECIFICATIONS:

Grounding the input with a repetition rate up to 1MHz blanks trace of any intensity.

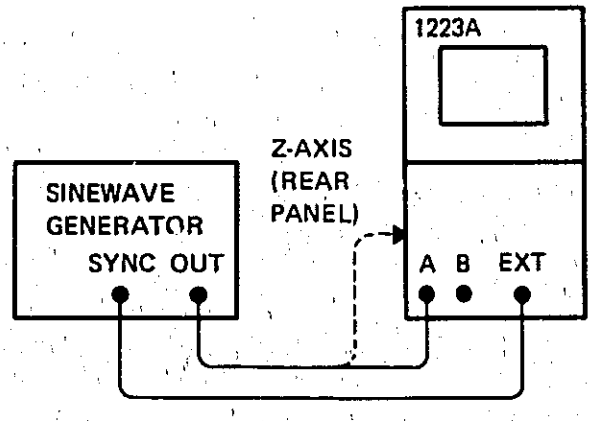


Figure 4–10. Intensity Modulation Test Setup.

EQUIPMENT:

Sinewave Generator.

PROCEDURE:

1. Connect the Sinewave Generator to the 1233A as shown in Figure 4–10 and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL
CHANNEL A(B) POSITION ▲▼	trace centered
VOLTS/DIV	1V/DIV
VERNIER	CAL position
INPUT COUPLING	AC
VERTICAL DISPLAY	CHANNEL A
TRIGGER LEVEL	AUTO ON free run
TRIGGER MODE	EXT/+/NORM./AC
B↑↳A	OFF
CHOP ALT	CHOP
CONT SINGLE	CONT
POSITION ◀▶	as required
HOLD OFF	CCW
TIME/DIV	1us/DIV
MAGNIFIER	CAL position

2. Set Sinewave Generator controls for 1 MHz output and 4 division vertical deflection.

PERFORMANCE TESTS

3. Press channel A GND pushbutton.

4. Short Z INPUT, on the rear heatsink, to ground. The baseline should be blanked.

5. Disconnect BNC cable from CHANNEL A INPUT and connect it to the Z INPUT. The display should show an interrupted horizontal trace.

PERFORMANCE TESTS

4–22 VARIABLE PERSISTENCE TEST

SPECIFICATION:

Continuously variable from less than 0.1s to more than 1 minute.

PROCEDURE:

1. Set the 1223A controls as follows:

OPERATING MODE	STORAGE (PERSISTENCE)
CHANNEL A(B) POSITION ▲▼	as required
VOLTS/DIV	100mV/DIV
VERNIER	CAL
INPUT COUPLING	AC/GND pressed
VERTICAL DISPLAY	CHANNEL A
TRIGGER LEVEL	AUTO ON, free run
TRIGGER MODE	INT/+/NORM/AC
B ▲ ▶A	OFF
CHOP ALT	CHOP
CONT SINGLE	CONT
POSITION ◀▶	as required
HOLD OFF	CCW
TIME/DIV	0.1s/DIV
MAGNIFIER	CAL position
INTENSITY	10 o'clock position

2. Set VAR PERSIST control to ccw position and adjust INTENSITY control so that the moving spot has a normal brightness.

3. Turn the VAR PERSIST control slowly clockwise and note that the spot-tail becomes longer.

4. Set VAR PERSIST control to CW position, CONT/SINGLE to SINGLE and ERASE RATE to MAN position.

5. Press ERASE pushbutton. After erasure, a baseline should be written and remain on-screen without fading for more than 1 minute.

NOTE

If trace blooms reduce INTENSITY

PERFORMANCE TESTS

4–23 BRIGHTNESS AND STORE TIME TESTS

SPECIFICATIONS:

With BRIGHTNESS control set to CCW position (20 DIV/ms), and minimum (CCW) setting of STORE TIME control, storage time is a minimum of 1 minute increasing up to typically 4 hours with reduced brightness. With BRIGHTNESS in CW position, the store time decreases to 15 seconds minimum.

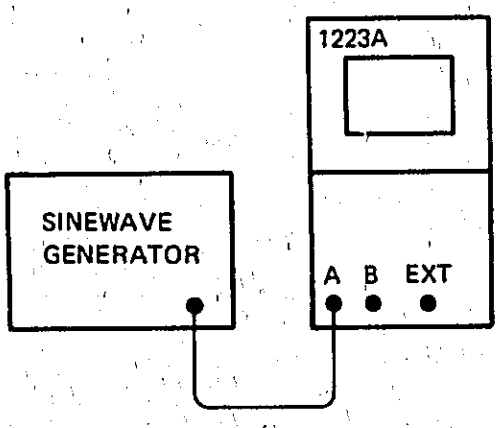


Figure 4–11. Writing Speed and Store Time Test Setup.

EQUIPMENT:

Sinewave Generator.

PROCEDURE:

1. Connect the Sinewave Generator to the 1223A as shown in figure 4–11 and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL
CHANNEL A(B) POSITION ▲▼	trace centered
VOLTS/DIV	1V/DIV
VERNIER	CAL position
INPUT COUPLING	AC
VERTICAL DISPLAY	CHANNEL A
TRIGGER LEVEL	AUTO OFF, as required
TRIGGER MODE	INT/+/NORM/AC
B▲▶A	OFF
CHOP ALT	CHOP
CONT SINGLE	CONT
POSITION◀▶	trace centered
HOLD OFF	CCW
TIME/DIV	0.1ms/DIV
MAGNIFIER	CAL position

2. Set Sinewave Generator controls for a 4KHz output and an 8 division vertical deflection.

3. Switch VOLTS/DIV switch from 1V/DIV to 100mV/DIV.

PERFORMANCE TESTS

4. Press CONT/SINGLE and WRITE pushbuttons.

5. Turn INTENSITY control and BRIGHTNESS control fully CW.

6. Turn ERASE RATE control to MAN position.

7. Check that STORE TIME control is in CCW position (minimum store time).

8. Press ERASE pushbutton.

9. Press STORE pushbutton. The vertical lines stored on-screen should be visible for a minimum of 15 seconds within an area of 6x8 divisions.

10. Repeat steps 1 to 9 with Sinewave Generator set to 80Hz output, TIME/DIV switch set to 10ms/DIV, BRIGHTNESS control fully CCW, and WRITE pushbutton pressed.

11. Check that the view time is now more than one minute.

12. Check that when turning STORE TIME control cw, brightness decreases and store time increases up to typically 4 hours (STORE TIME control fully cw).

PERFORMANCE TESTS

4–24 AUTO STORE TEST

NOTE

AUTO STORE can only be used in SINGLE mode

SPECIFICATIONS:

Instrument ready to catch and store a single event for at least 2 hours (typ. 4 hours).

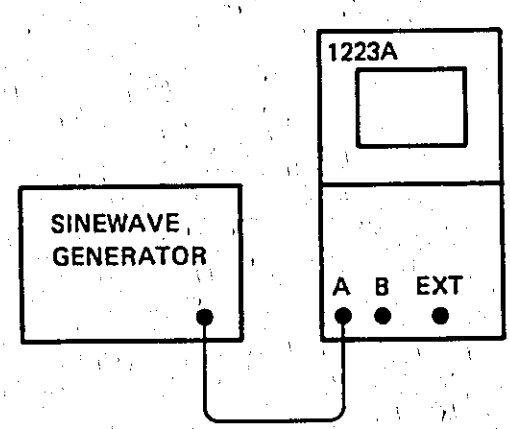


Figure 4–12. Auto Store Test Setup.

EQUIPMENT:

Sinewave Generator.

PROCEDURE:

1. Connect the Sinewave Generator to the 1223A as shown in Figure 4–12, and set the 1223A controls as follows:

OPERATING MODE	CONVENTIONAL
CHANNEL A(B) POSITION ▲▼	trace centered
VOLTS/DIV	1V/DIV
VERNIER	CAL position
INPUT COUPLING	AC
VERTICAL DISPLAY	CHANNEL A
TRIGGER LEVEL	AUTO OFF, as required
TRIGGER MODE	INT/+/NORM/AC
B▲ ▶A	OFF
CHOP ALT	CHOP
CONT SINGLE	CONT
POSITION ◀▶	as required
HOLD OFF	CCW
TIME/DIV	10ms/DIV
MAGNIFIER	CAL position

STORE TIME control out of AUTO STORE position

Table 4–1. Performance Test Record

Hewlett-Packard
Model 1223A
Storage Oscilloscope
Serial No. _____

Tested By _____

Date _____

CONVENTIONAL MODE

Para. No.	Test Description	Results Min	Actual	Max
4–10	Chop/Alt, Beam Find			
2	Two traces visible	–	Yes/no	–
3	Traces visible alternately	–	Yes/no	–
6	Both traces return to screen	–	Yes/no	–
4–11	Input coupling, auto on/off blanking		Channel A / B	
5	Display differentiated	–	Yes/no Yes/no	–
6	Display blanked	–	Yes/no Yes/no	–
7	Auto baseline	–	Yes/no Yes/No	–
4–12	Vertical and Y deflection calibration, vernier check.		Channel A / Y / B	
2, 3, 6	2 mV Range Verniers set to CAL	–5 %		+5 %
	5 mV Range	–5 %		+5 %
	10 mV Range	–3 %		+3 %
	20 mV Range	–3 %		+3 %
	50 mV Range	–3 %		+3 %
	100 mV Range	–3 %		+3 %
	500 mV Range	–3 %		+3 %
	1 V Range	–3 %		+3 %
	2 V Range	–3 %		+3 %
	5 V Range	–3 %		+3 %
	10 V Range	–3 %		+3 %
9	100 mV Range Verniers CCW	Approx 4 divisions		Approx 4 divisions
4–13	A+B mode, common mode rejection Vertical deflection			
5	A+B	7.52 div		8.48 div
7	A+B with B INV	–		0.25 div
4–14	Vertical bandwidth		Channel A / B	
4	Vertical deflection	4.3 div		–

Table 4–1. Performance Test Record

Para. No.	Test Description	Results Min	Actual	Max
4–15	Sweep ranges and magnifier			
	Position of eleventh pulse			
4	0.1 µs Range	9.6		10.4
5	0.2 µs Range			
	0.5 µs Range			
	1 µs Range			
	2 µs Range			
	5 µs Range			
	10 µs Range			
	20 µs Range			
	60 µs Range			
	0.1 ms Range			
	0.2 ms Range			
	0.5 ms Range			
	1 ms Range			
	2 ms Range			
	5 ms Range			
	10 ms Range			
	20 ms Range			
	50 ms Range			
	0.1 s Range			
	0.2 s Range			
	0.5 s Range			
	1 s Range			
	2 s Range			
6	Magnifier cw			
	Sweep expansion	x10		
4–16	Trigger modes			
2	Autobaseline with no signal		Yes/no	
3	Autobaseline triggers		Yes/no	
5	Display stable (+/– switching)		Yes/no	
5	Display stable (AC/DC switching)		Yes/no	
6	As 5 but with EXT trigger		Yes/no	
9	A, A & B, A & B with B INV triggers from channel A		Yes/no	
10	B, B INV, triggers from channel B		Yes/no	
11	A+B, A+B with B INV triggers from composite		Yes/no	
4–17	LF/HF Trigger			
3	Stable INT trigger		Yes/no	
	Stable EXT trigger		Yes/no	
6	Stable INT trigger		Yes/no	
	Stable EXT trigger		Yes/no	
4–18	TV Trigger			
3	Stable display (frame)		Yes/no	
4	Stable display (TV line)		Yes/no	

Table 4–1. Performance Test Record

Para. No.	Test Description	Results		
		Min	Actual	Max
4–19	Line Sync			
6	Stable display (line)		Yes/no	
4–20	X–Y Phase shift, bandwidth			
3	45° elipse		Yes/no	
	Elipse width	–		0.4 div
6	Horizontal trace	4.3 div	Yes/no	
4–21	Intensity modulation			
4	Baseline blanked		Yes/no	
5	Interrupted horizontal trace		Yes/no	
STORAGE MODE				
4–22	Variable persistence			
5	Persistence	1 min		–
4–23	Brightness and store			
9	View time	15 s		
11	View time	1 min		
12	Store time	2 h		4 h (typ)
4–24	Auto store			
7	Reset button/lamp		Yes/no	
8	Normal intenstiy		Yes/no	
9	Store time	2 h		4 h (typ)
4–25	Erase			
4	Remote erase		Yes/no	
5	Manual erase		Yes/no	
6	Min auto erase time	–		1 s
	Max auto erase time	1 min		–
7	Manual erase overrides auto erase		Yes/no	
9	RESET lamp goes out after one sweep		Yes/no	
11	ERASE button arms and lights RESET lamp		Yes/no	
12	RESET lamp stays on until trigger occurs		Yes/no	

SECTION V
ADJUSTMENTS

5–1 INTRODUCTION

5–2 This section describes the adjustments which will return the Oscilloscope to peak operating condition after repairs are completed.

5–3 If the adjustments are to be considered valid, the Oscilloscope must have a one hour warmup and the line voltage must be within +5 to −10% of nominal.

5–4 SAFETY CONSIDERATIONS

5–5 Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition (see Sections II and III). Service and adjustments should be performed only by qualified service personnel.

WARNING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

5–6 Any adjustment, maintenance, and repair of the opened instrument with voltage applied should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

5–7 Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

5–8 Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the shortcircuiting of fuseholders must be avoided.

5–9 Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and secured against any unintended operation.

WARNING

Adjustments described herein are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

5–10 EQUIPMENT REQUIRED

5–11 The test equipment required for the adjustment procedures is listed in Table 1–1, Recommended Test Equipment. The critical specifications of substitute test instruments must meet or exceed the standards listed in the table if the Oscilloscope is to meet the standards set forth in Table 1–2, Specifications.

5–12 ADJUSTMENT LOCATIONS

5–13 Figure 5–1 at the end of this section shows the locations of adjustment points.

ADJUSTMENTS

CAUTION

Before adjusting Voltages turn INTENSITY CCW

5–14 LOW VOLTAGE POWER SUPPLY ADJUSTMENT

WARNING

High voltages dangerous to life.

EQUIPMENT:

4 digit Digital Voltmeter
Variable Transformer
Test Leads.

NOTES

1. *Ensure that the Line Selector Switch on the heat sink assembly is set to the correct line voltage.*
2. *Input current at 220V is approx. 200 mA*

PROCEDURE:

1. Adjust A1 A100 R16 for – 12V. 01V at the 12V test point.
2. Check the other supply voltages for specifications:

+ 12V	± 300 mV
+ 5 V	± 250 mV
+ 12,6V	+ 1 V – 0.3V
+ 100V	± 1,5V
+ 156V	± 5V

5–15 HIGH VOLTAGE SUPPLY ADJUSTMENT

WARNING

High voltages dangerous to life.

EQUIPMENT:

4-digit Digital Voltmeter
1000:1 Divider Probe

4-digit Digital Voltmeter
1000:1 Divider Probe

PROCEDURE:

1. Monitor high voltage with 1000:1 Divider Probe at A5 R12 and adjust A5R14 for –2460V ± 5V.

NOTE

Testpoint on A5 R12 can be reached through the access hole.

2. Press BEAM FINDER. High Voltage should not change more than 20V.

5–16 COLLIMATOR ADJUSTMENT

PROCEDURE:

1. Press ERSIST pushbutton and turn VAR. Persistence Control to minimum persistence (CCW)
2. Set flood gun grid adjust, A6 R15, to midrange
3. Adjust A6 R47 (Collimator) so that both flood gun patterns just reach the edge of the aluminium ring on the CRT.

5–17 INTENSITY LIMIT ADJUSTMENT

CAUTION

Be extremely careful so as not to burn the mesh. (Turn INTENSITY CCW)

NOTE

ERASE after each adjustment

PROCEDURE:

1. Press WRITE pushbutton, turn BRIGHTNESS potentiometer to max. (CW) and STORE TIME control CCW
2. Turn A6 R40 to CW position.
3. Turn Intensity Limit potentiometer A5 R24 fully CCW.
4. Turn INTENSITY control CW.
5. Press CONT-SINGLE pushbutton to SINGLE.
6. Turn TRIGGER LEVEL control CCW and switch to AUTO OFF.
7. Slowly adjust Intensity Limit A5 R24 in small increments until a dot just appears.
8. With FOCUS Control and astigmatism potentiometer A5 R41 adjust the dot to be as small and round as possible.
9. Adjust Intensity Limit A5 R24 CCW until the dot just disappears.

5–18 ASTIGMATISM AND FOCUS ADJUSTMENT

EQUIPMENT:

Sinewave Generator

PROCEDURE:

1. Switch 1223A to CONVENTIONAL Mode
2. Set TIME/DIV Control to 1ms/DIV and apply a 1 kHz sinewave signal for a vertical deflection of 6 divisions.
3. Adjust INTENSITY control to obtain normal trace brightness.
4. Trigger for a stable display and adjust Astigmatism potentiometer A5 R41 and FOCUS Control for an optimum sharp trace.
5. Recheck INTENSITY LIMIT ADJUSTMENT. Readjust if necessary.

5–19 TRACE ALIGN

PROCEDURE:

1. Press GND pushbuttons on channel A and channel B inputs.
2. Set CONT. SINGLE pushbutton to CONT.
3. Press TRIGGER LEVEL control and adjust it for free run.
4. Adjust INTENSITY to a medium trace brightness, and set trace to the center horizontal graticule line via the vertical and horizontal POSITION controls.
5. Adjust Trace Align R38 so that the trace is parallel with the horizontal graticule line.

5–20 VERT. PATTERN ADJUSTMENT

EQUIPMENT:

Sinewave Generator

PROCEDURE:

1. Press B ↑→ A pushbutton and apply a 1 kHz sinewave signal to channel B input to get a vertical deflection of 8 divisions.
2. Position the trace with the Channel A POSITION control to the left vertical graticule line.
3. Adjust pattern potentiometer A5 R42 so that the trace is parallel to the left vertical graticule line.
4. Move trace to the right graticule line and optimize adjustment if necessary.

5–21 TRIGGER BALANCE ADJUSTMENT

EQUIPMENT:

Sinewave Generator
2 50 Ω cables BNC to BNC
1 BNC TEE

PROCEDURE:

1. Set VOLTS/DIV Switch of CHANNEL A to 20 mV/Div and apply a 1 kHz sinewave signal to CHANNEL A and EXT TRIGGER Input.
2. Adjust the sinewave generator to get a vertical display of 8 divisions.
3. Set TIME/DIV switch to 0.1 ms/DIV and press INT TRIGGER pushbutton.
4. Adjust TRIGGER LEVEL Control for a stable display.
5. Centre the signal with the vertical POSITION control.
6. Switch from + to – trigger slope and adjust A3 R66 so that the sweep starts at the same point on the screen.
7. With the TRIGGER LEVEL control, adjust trigger point to the center horizontal graticule line.
8. Switch CHANNEL A Input to 100 mV/DIV, and adjust A3 R5 so that the trigger starts at the same point when switching trigger coupling from AC to DC.
9. Press EXT TRIGGER and adjust A2 R6 for the same trigger point with AC and DC coupling.
10. Select A+B mode; set trigger coupling to AC; set CHANNEL B VOLTS/DIV switch to 100mV/DIV; and adjust CHANNEL B POSITION control to center signal on screen. Adjust A3R72 for the same trigger point with AC and DC trigger coupling.
11. Select LINE Trigger and apply an AC line signal to CHANNEL A.
12. Adjust display for 2 divisions.
13. Press AC–DC Trigger Input Coupling and adjust A3R4 so that the sweep starts at the same point.

5–22 SWEEP TIME ADJUSTMENT

EQUIPMENT:

Time Mark Generator
50 Ω Feedthrough
50 Ω Cable BNC–BNC

PROCEDURE:

1. Connect the 50 Ω terminated time marker to CHANNEL A Input and adjust display for approx. 2 divisions.
2. Switch Time Marker and TIME/DIV Switch to 1 ms.
3. Adjust A2 R97 so that 11 Time Marks correspond to the vertical graticule lines.
4. Switch Time Marker and TIME/DIV control to .2μs and repeat step 3 using A2C28 as adjustment point in the same way.
5. Switch Time Marker and TIME/DIV control to 1s and repeat step 3 using A9 R/7* as adjustment point (NOTE: for this range use VAR, PERSISTENCE).
6. Check that all Sweep Ranges are within the specifications of ± 3% and if necessary, optimize adjustments 3 to 5.

* *Later models: use R19 (1s) and R20 (2s)*

5–23 SWEEP LENGTH ADJUSTMENT

EQUIPMENT:

Time Mark Generator
50 Ω Feedthrough
50 Ω Cable BNC–BNC

PROCEDURE:

1. Set Time Marker and 1223A TIME/DIV switch to 1 ms.

2. Set the first Time Mark to the left graticule line.
3. With HOR. POSITION control shift the second Time Mark to the left graticule line and adjust A2 R98 for a sweep length of 10 divisions (total sweep length is 11 divisions minus 0.2 division).

5–24 BALANCE ADJUSTMENT (Channel A and B)

NOTES

1. *Reference designators in brackets are for CHANNEL B*
2. *Ensure that the VOLT/DIV Verniers are in CAL (detent) position.*

PROCEDURE:

1. Press Input GND button and set VOLT/DIV to 100 mV/DIV.
2. Adjust TRIGGER LEVEL control so that the baseline is displayed.
3. Center trace and switch alternately from 20 mV/DIV to 2 mV/DIV. Adjust A2 R114 (A2 R214) until the trace no longer shifts.
4. Center trace in the 100 mV/DIV range and switch alternately tothe 50 mV/DIV range. Adjust A2 R148 (A2 R248) for no trace shift.
5. Adjust A2 R175 (A2 R275) for no trace shift when switching from 100 mV/DIV to 20 mV/DIV.
6. Check all ranges for trace shift $<$ .4 DIV. Repeat steps 1–5 if necessary.

5–25 CHANNEL B INV BALANCE ADJUSTMENT

PROCEDURE:

1. Depress GND for CHANNEL B. Switch CHANNEL B to 2 mV/DIV and adjust A2 R237 for no trace shift while switching from B INV to B normal. Recheck and readjust DC balance channel B.

5–26 A + B BALANCE ADJUSTMENT

PROCEDURE:

1. Depress GND pushbuttons for CHANNEL A and CHANNEL B. Set CHANNEL A and B to 2 mV/DIV. Press CHANNEL A and CHANNEL B button and center both traces exactly with the VERT. POSITION controls.
2. Press A+B button and center trace by adjusting A2 R320.

5–27 ATTENUATOR COMPENSATION ADJUSTMENT (CHANNEL A)

EQUIPMENT:

Square Wave Generator
BNC Cable.

NOTE

This procedure should be repeated for channel B, the adjustment points for channel B being given in parenthesis.

PROCEDURE:

1. Set TIME/DIV switch to .2 ms/DIV.
2. Switch VOLTS/DIV to 200 mV/DIV and apply a 1kHz squarewave for a vertical deflection of 6 divisions.
3. Adjust A2 C102 (A2 C202) for a proper square wave response.
4. Set VOLTS/DIV switch to 2V and apply a 1kHz squarewave signal for a vertical deflection of 6 divisions. (use 600 Ω output on the square wave generator).
5. Adjust A2 C105 (A2 C205) for proper square wave response.

5–28 INPUT RC ADJUSTMENT (CHANNEL A)

EQUIPMENT:

Capacitance Meter (Ranges 30pF and 100pF)

NOTE

This procedure should be repeated for channel B, the adjustment points for channel B being given in parenthesis.

PROCEDURE:

1. Switch vertical attenuator to 2 mV/DIV.
2. Connect LC Meter to the input and note indicated input capacitance.
3. Switch to 200 mV/DIV and adjust A2 C103 (A2 C203) to the same values as in 2.
4. Switch to 2V/DIV and adjust A2 C106 (A2 C206) to the same value as in 2.

5–29 VERTICAL GAIN ADJUSTMENT

EQUIPMENT:

Voltmeter Calibrator
BNC TEE
BNC Cable

PROCEDURE:

1. Set VOLTS/DIV Switches for CHANNEL A and CHANNEL B to 100 mV/DIV and ensure that Verniers are in CAL position.
2. Set potentiometers A2 R162 and A2 R262 to mid-range position.
3. Apply a 600 mVpp sinewave signal to CHANNEL A and CHANNEL B inputs.
4. Switch to CHANNEL A and adjust amplitude via A2 R301, to exactly 6 Divisions.
5. Press A+B and B INV pushbuttons, and adjust A2 R262 for minimum vertical display.
6. Check that all ranges are within specifications. (2mV/DIV to 5mV/DIV ± 5%; 10mV/DIV to 10V/DIV ± 3%).

5–30 PULSE RESPONSE AND BANDWIDTH

EQUIPMENT:

Squarewave Generator
50 Ω Feedthrough
BNC Cable.
Constant Amplitude Generator

PROCEDURE:

1. Set input attenuators to 5 mV/DIV and TIME BASE to 0.1 µs/DIV.
2. Connect terminated squarewave generator to CHANNEL A and apply a 1 MHz squarewave.
3. Adjust amplitude for a display of 6 divisions.
4. With A6 C418, A6 C419 and A2 C123, adjust for pulse response within 0.4 DIV overshoot and undershoot.
5. Adjust CHANNEL B with A2 C223 for the same pulse response as given in step 4.
6. Apply a 6 division 50 kHz sinewave signal to CHANNEL A.
7. Switch constant Amplitude Generator to 15.5 MHz and adjust A2 C123 for a vertical display of 4.3 Divisions.
8. Repeat step 7 for CHANNEL B, adjusting via A2 C223.

5–31 EXT HORIZONTAL INPUT ADJUSTMENT

EQUIPMENT:

Voltmeter Calibrator

PROCEDURE:

1. Set CHANNEL A attenuator to 100 mV/DIV (Vernier in CAL position).
2. Press switch B↑A and apply a 1V sinewave signal to CHANNEL A.
3. Adjust A2 R409 for a 10 Division display.
4. Press CHANNEL A GND button, set CHANNEL A VERT POSITION control to midrange and center the spot with A2 R408. Repeat steps 1 to 3.
5. Switch B↑A out.

5–32 BRIGHTNESS AND FLOOD GUN GRID ADJUST

EQUIPMENT:

Sinewave Generator.

PROCEDURE:

1. Set the CHANNEL A attenuator to 1V/DIV, and apply a 4 kHz sinewave signal for a display of 8 divisions in CONVENTIONAL mode. Set TIME/DIV switch to 0.1ms/DIV.
2. Switch to 100 mV/DIV.
3. Press WRITE button and set BRIGHTNESS control fully CW.
4. Press CONT SINGLE button and turn INTENSITY control CW.
5. Press ERASE and adjust A6 R40 so that the signal is visible within a reduced area of 6 x 8 divisions.

NOTE

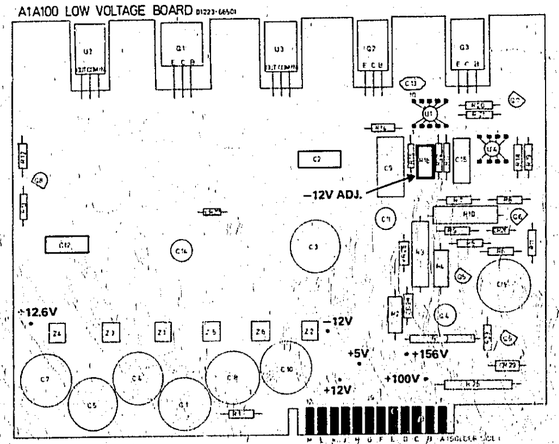
ERASE after each adjustment

6. Adjust A6 R15 to obtain the best compromise between light and dark background illumination over the display area.

NOTE

ERASE after each adjustment

7. Press ERASE and check that the signal is visible for at least 15 seconds. If the trace becomes non-viewable due to fade positive, readjust A6 R40 for a slightly darker screen.



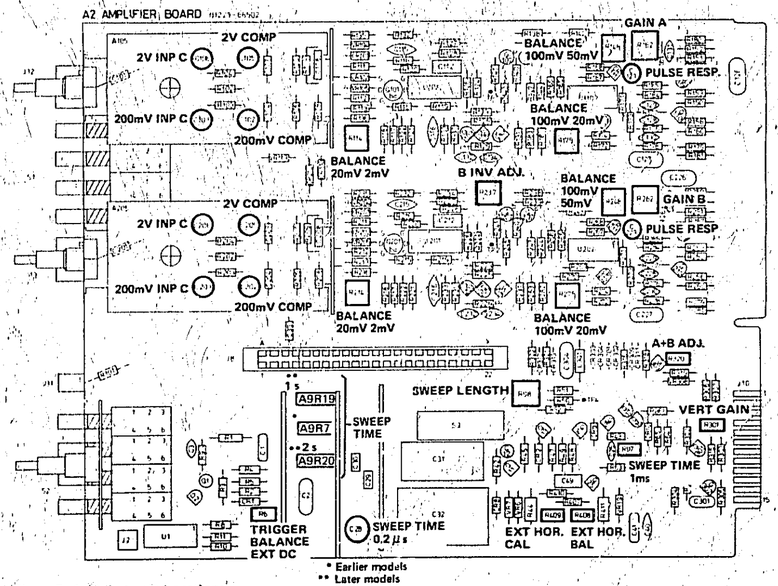
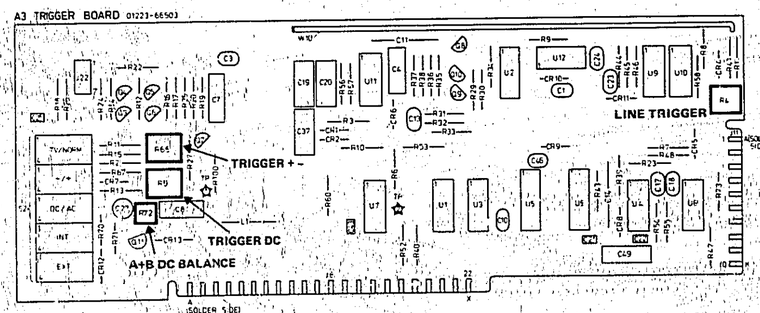
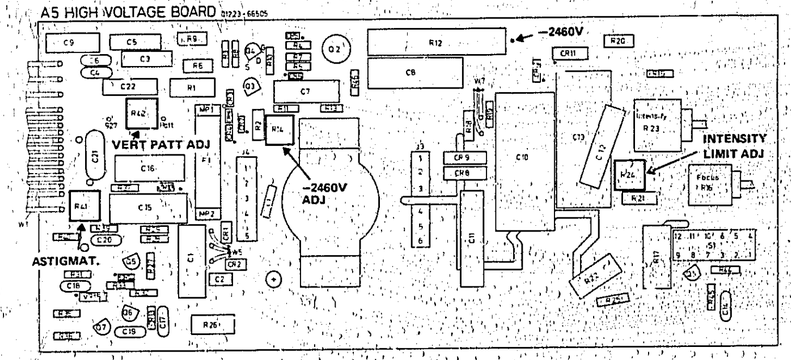
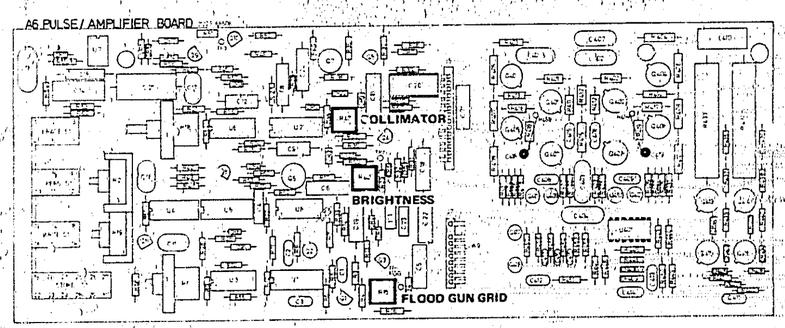


Figure 5–1. Adjustment Locations







SECTION VI
REPLACEABLE PARTS

6–1 INTRODUCTION

6–2 This section contains information for ordering parts. Table 6–1 lists abbreviations used in the parts lists and elsewhere in the manual. Table 6–2 lists all replaceable parts in reference designator order. Table 6–3 contains the names and addresses that correspond to the manufacturer code numbers.

6–3 ABBREVIATIONS

6–4 Table 6–1 lists abbreviations used in the parts lists, schematics and elsewhere in the manual. In some cases two forms of the abbreviation are used, one all in capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts lists are always all capitals. However, in the schematics and other parts of the manual, the same abbreviations may have upper and lower case letters.

6–5 REPLACEABLE PARTS

6–6 Table 6–2 is the list of replaceable parts and is organised as follows:

a. Mainframe (chassis) parts in alphanumerical order by reference designation
b. Electrical assemblies and their components in alpha-numerical order by reference designation.

Reference designators are of the form A5R9 i. e. resistor 9 on assembly 5.

6–7 The information given for each part consists of the following:

a. The Hewlett-Packard part number.
b. Part number check digit (CD).
c. The total quantity (Qty) in the major assembly (A1, A2, etc).
d. The description of the part.
e. A typical manufacturer of the part in a five-digit code.
f. The manufacturers' code number for the part.

6–8 ORDERING INFORMATION

6–9 To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number (with the check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office (list of Sales/Service offices at the rear of this manual). The check digit will ensure accurate and timely processing of your order.

6–10 To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required, address the order to the nearest Hewlett-Packard office.

Table 6–1. Reference Designators and Abbreviations

REFERENCE DESIGNATIONS

A . . . . . assembly
AT . . . attenuator; isolator; termination
B . . . . . fan; motor
BT . . . . . battery
C . . . . . capacitor
CP . . . . . coupler
CR . . . . . diode; diode thyristor; varactor
DC . . . directional coupler
DL . . . . . delay line
DS . . . . . annunciator; signaling device (audible or visual); lamp; LED
E . . . . . miscellaneous electrical part
F . . . . . fuse
FL . . . . . filter
H . . . . . hardware
HY . . . . . circulator
J . . . . electrical connector (stationary portion); jack
K . . . . . relay
L . . . . . coil; inductor
M . . . . . meter
MP . . . . . miscellaneous mechanical part
P . . . . electrical connector (movable portion); plug
Q . . . . . transistor; SCR; triode thyristor
R . . . . . resistor
RT . . . . . thermistor
S . . . . . switch
T . . . . . transformer
TB . . . . . terminal board
TC . . . . . thermocouple
TP . . . . . test point
U . . . . integrated circuit; microcircuit
V . . . . . electron tube
VR . . . . voltage regulator; breakdown diode
W . . . . cable; transmission path; wire
X . . . . . socket
Y . . . . crystal unit (piezoelectric or quartz)
Z . . . . tuned cavity; tuned circuit

ABBREVIATIONS

A . . . . . ampere
ac . . . . alternating current
ACCESS . . . . . accessory
ADJ . . . . . adjustment
A/D . . . . analog-to-digital
AF . . . . audio frequency
AFC . . . . . automatic frequency control
AGC . . . . . automatic gain control
AL . . . . . aluminum
ALC . . . . automatic level control
AM . . . amplitude modulation
AMPL . . . . . amplifier
APC . . . . automatic phase control
ASSY . . . . . assembly
AUX . . . . . auxiliary
avg . . . . . average
AWG . . . . . American wire gauge
BAL . . . . . balance
BCD . . . . . binary coded decimal
BD . . . . . board
BE CU . . . . . beryllium copper
BFO . . . . beat frequency oscillator
BH . . . . . binder head
BKDN . . . . . breakdown
BP . . . . . bandpass
BPF . . . . . bandpass filter
BRS . . . . . brass
BWO . . . . backward-wave oscillator
CAL . . . . . calibrate
ccw . . . . counter-clockwise
CER . . . . . ceramic
CHAN . . . . . channel
cm . . . . . centimeter
CMO . . cabinet mount only
COAX . . . . . coaxial
COEF . . . . . coefficient
COM . . . . . common
COMP . . . . composition
COMPL . . . . . complete
CONN . . . . . connector
CP . . . . . cadmium plate
CRT . . . cathode-ray tube
CTL . . . . complementary transistor logic
CW . . . . continuous wave
cw . . . . . clockwise
cm . . . . . centimeter
D/A . . . . digital-to-analog
dB . . . . . decibel
dBm . . . . decibel referred to 1 mW
dc . . . . . direct current
deg . . degree (temperature interval or difference)
. . ° . . . degree (plane angle)
°C . . . . . degree Celsius (centigrade)
°F . . . . degree Fahrenheit
°K . . . . . degree Kelvin
DEPC . . deposited carbon
DET . . . . . detector
diam . . . . . diameter
DIA . . . diameter (used in parts list)
DIFF AMPL . . . differential amplifier
div . . . . . division
DPDT . . . . . double-pole, double-throw
DR . . . . . drive
DSB . . . . double sideband
DTL . . . . diode transistor logic
DVM . . . digital voltmeter
ECL . . . . emitter coupled logic
EMF . . electromotive force
EDP . . . . electronic data processing
ELECT . . . . . electrolytic
ENCAP . . . . encapsulated
EXT . . . . . external
F . . . . . farad
FET . . . . . field-effect transistor
F/F . . . . . flip-flop
FH . . . . . flat head
FIL H . . . . . fillister head
FM . frequency modulation
FP . . . . . front panel
FREQ . . . . . frequency
FXD . . . . . fixed
g . . . . . gram
GE . . . . . germanium
GHz . . . . . gigahertz
GL . . . . . glass
GRD . . . . . ground(ed)
H . . . . . henry
h . . . . . hour
HET . . . . . heterodyne
HEX . . . . . hexagonal
HD . . . . . head
HDW . . . . . hardware
HF . . . . . high frequency
HG . . . . . mercury
HI . . . . . high
HP . . . . . Hewlett Packard
HPF . . . . . high pass filter
HR . . . . . hour (used in parts list)
HV . . . . . high voltage
Hz . . . . . Hertz
IC . . . . . integrated circuit
ID . . . . . inside diameter
IF . . . . . intermediate frequency
IMPG . . . . . impregnated
in . . . . . inch
INCD . . . . . incandescent
INCL . . . . . include(s)
INP . . . . . input
INS . . . . . insulation
INT . . . . . internal
kg . . . . . kilogram
kHz . . . . . kilohertz
kΩ . . . . . kilohm
kV . . . . . kilovolt
lb . . . . . pound
LC . . . . . inductance capacitance
LED . . light emitting diode
LF . . . . . low frequency
LG . . . . . long
LH . . . . . left hand
LIM . . . . . limit
LIN . . . . linear taper (used in parts list)
lin . . . . . linear
LK WASH . . . lock washer
LO . . . low; local oscillator
LOG . . . logarithmic taper (used in parts list)
log . . . . . logarithm(ic)
LPF . . . . . low pass filter
LV . . . . . low voltage
m . . . . . meter (distance)
mA . . . . . milliampere
MAX . . . . . maximum
MΩ . . . . . megohm
MEG . . . meg (10^6) (used in parts list)
MET FLM . . . . metal film
MET OX . . . metallic oxide
MF . . . medium frequency; microfarad (used in parts list)
MFR . . . . . manufacturer
mg . . . . . milligram
MHz . . . . . megahertz
mH . . . . . millihenry
mho . . . . . mho
MIN . . . . . minimum
min . . . . . minute (time) . . . . . minute (plane angle)
MINAT . . . . . miniature
mm . . . . . millimeter
MOD . . . . . modulator
MOM . . . . . momentary
MOS . . . . . metal oxide semiconductor
ms . . . . . millisecond
MTG . . . . . mounting
MTR . . . meter (indicating device)
mV . . . . . millivolt
mVac . . . . . millivolt, ac
mVdc . . . . millivolt, dc
mVpk . . . . millivolt, peak
mVp-p . . . millivolt, peak to peak
mVrms . . . . millivolt, rms
mW . . . . . milliwatt
MUX . . . . . multiplex
MY . . . . . mylar
µA . . . . . microampere
µF . . . . . microfarad
µH . . . . . microhenry
µmho . . . . . micromho
µs . . . . . microsecond
µV . . . . . microvolt
µVac . . . . microvolt, ac
µVdc . . . . microvolt, dc
µVp-p . . . microvolt, peak to peak
µVrms . . . . microvolt, rms
µW . . . . . microwatt
nA . . . . . nanoampere
NC . . . . . no connection
N/C . . . . normally closed
NE . . . . . neon
NEG . . . . . negative
nF . . . . . nanofarad
NI PL . . . . . nickel plate
N/O . . . . normally open
NOM . . . . . nominal

NOTE

All abbreviations in the parts list will be in upper case.

Table 6–1. Reference Designators and Abbreviations (cont'd)

NORM . . . . . normal
NPN . . negative-positive negative
NPO . . . negative-positive zero (zero temperature coefficient)
NRFR . not recommended for field replacement
NSR . . . . not separately replaceable
ns . . . . . nanosecond
nW . . . . . nanowatt
OBD . order by description
OD . . . . outside diameter
OH . . . . oval head
OP AMPL . . . operational amplifier
OPT . . . . . option
OSC . . . . . oscillator
OX . . . . . oxide
oz . . . . . ounce
Ω . . . . . ohm
P . . . peak (used in parts list)
PAM . . . pulse amplitude modulation
PC . . . . . printed circuit
PCM . . pulse-code modulation; pulse-count modulation
PDM . . . pulse duration modulation
pF . . . . . picofarad
PH BRZ . phosphor bronze
PHL . . . . . Phillips
PIN . . . positive-intrinsic-negative
PIV . . . . . peak inverse voltage
pk . . . . . peak
PL . . . . . phase lock
PLO . . . . phase lock oscillator
PM . . . . phase modulation
PNP . . . positive-negative-positive
P/O . . . . . part of
POLY . . . . polystyrene
PORC . . . . porcelain
POS . . positive; position(s) (used in parts list)
POSN . . . . position
POT . . . . potentiometer
p-p . . . . . peak-to-peak
PP . . . . peak to peak (used in parts list)
PPM . . . pulse position modulation
PREAMPL . . preamplifier
PRF . . . pulse repetition frequency
PRR . . . pulse repetition rate
ps . . . . . picosecond
PT . . . . . point
PTM . . . . pulse time modulation
PWM . . . pulse-width modulation
PWV . . . peak working voltage
RC . . resistance-capacitance
RECT . . . . rectifier
REF . . . . reference
REG . . . . regulated
REPL . . . replaceable
RF . . . radio frequency
RFI . . . radio frequency interference
RH . . . round head; right hand
RLC . . . . resistance-inductance-capacitance
RMO . . rack mount only
rms . . . root mean square
RND . . . . round
ROM . . read only memory
R&P . . . rack and panel
RWV . . . reverse working voltage
S . . . scattering parameter
s . . . . . second (time)
" . . . second (plane angle)
S B . . . slow blow (fuse) (used in parts list)
SCR . . . silicon controlled rectifier, screw
SE . . . . . selenium
SECT . . . . sections
SEMICON . . . semiconductor
SHF . . . superhigh frequency
SI . . . . . silicon
SIL . . . . . silver
SL . . . . . slide
SNR . . signal-to-noise ratio
SPDT . . . . single-pole, double-throw
SPG . . . . . spring
SR . . . . . split ring
SPST . . . . single-pole, single-throw
SSB . . . single sideband
SST . . . . stainless steel
STL . . . . . steel
SQ . . . . . square
SWR . . standing wave ratio
SYNC . . . . synchronize
T . . timed (slow-blow fuse)
TA . . . . . tantalum
TC . . . temperature compensating
TD . . . . . time delay
TERM . . . . terminal
TFT . . thin film transistor
TGL . . . . . toggle
THD . . . . . thread
THRU . . . . through
TI . . . . . titanium
TOL . . . . . tolerance
TRIM . . . . . trimmer
TSTR . . . . transistor
TTL . . transistor transistor logic
TV . . . . . television
TVI . television interference
TWT . . traveling wave tube
U . . . micro (10⁻⁶) (used in parts list)
UF . . microfarac (used in parts list)
UHF . . ultrahigh frequency
UNREG . . . unregulated
V . . . . . volt
VA . . . . . voltampere
Vac . . . . . volts, ac
VAR . . . . . variable
VCO . . voltage controlled oscillator
Vdc . . . . . volts, dc
VDCW . . volts, dc, working (used in parts list)
V(F) . . . . volts, filtered
VFO . . variable frequency oscillator
VHF . . . very high frequency
Vpk . . . . . volts, peak
Vp-p . . volts, peak-to-peak
Vrms . . . . . volts, rms
VSWR . . . voltage standing wave ratio
VTO . . . . voltage-tuned oscillator
VTVM . . . Vacuum tube voltmeter
V(X) . . . . volts, switched
W . . . . . watt
W . . . . . with
WIV . . . working inverse voltage
WW . . . . . wirewound
W/O . . . . . without
YIG . . yttrium iron garnet
Z_0 . . . characteristic impedance

MULTIPLIERS

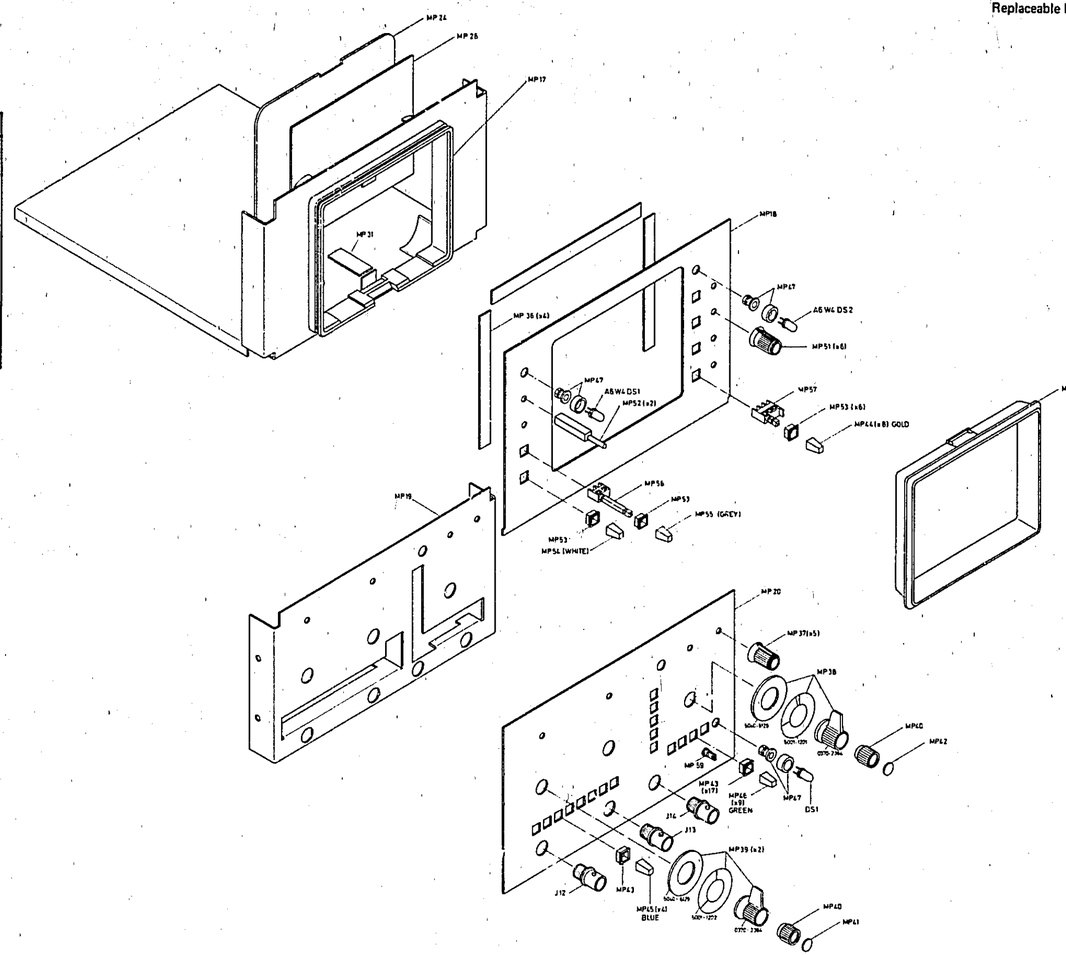
Abbreviation	Prefix	Multiple
T	tera	10^{12}
G	giga	10^{9}
M	mega	10^{6}
k	kilo	10^{3}
da	deka	10
d	deci	10^{-1}
c	centi	10^{-2}
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}
f	femto	10^{-15}
a	atto	10^{-18}

NOTE

All abbreviations in the parts list will be in upper case.

Table 6–2. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS		ZIP CODE
02546	VOLVO GMBH	HAMBURG	GM	
05120	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
01929	ICA CORP SOLID STATE DIV	SOMERVILLE	NJ	08876
02568	GE CO SEMICONDUCTOR PROD DEPT	SYRACUSE	NY	13201
03508	KDI PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
05245	ERIE COMPONENTS	SAINT-HALO	FR	
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW	CA	94042
14936	GENERAL INSTR CORP SEMICON PROD GP	HICKSVILLE	NY	11802
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON	NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
32997	HOUGHS INC PAYMENT PROD DIV	RIVERSIDE	CA	92507
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC	CT	06226
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE	PA	16512
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA	PA	19108
75915	LITTELFUSE INC	DES PLAINES	IL	60016
91637	DALE ELECTRONICS INC	COLUMBUS	NE	68601



Continued overleaf

Figure 6–1. Parts Identfication for Main Assembly

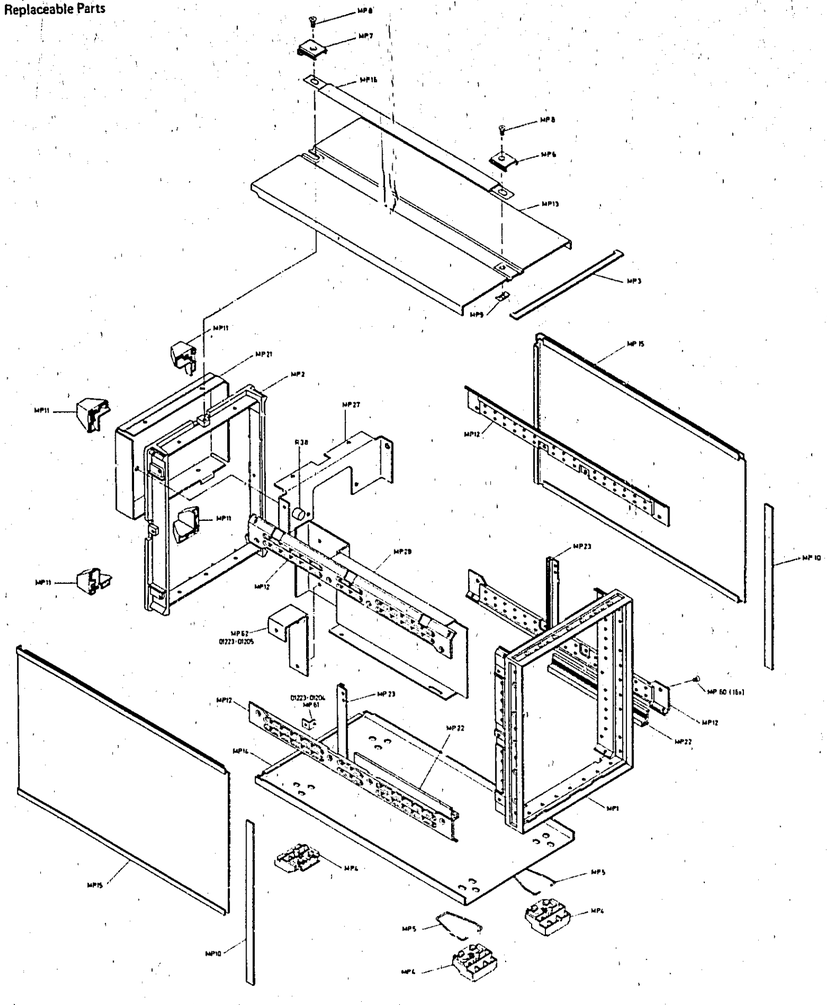


Figure 6–1. Parts Identification for Main Assembly (cont d)

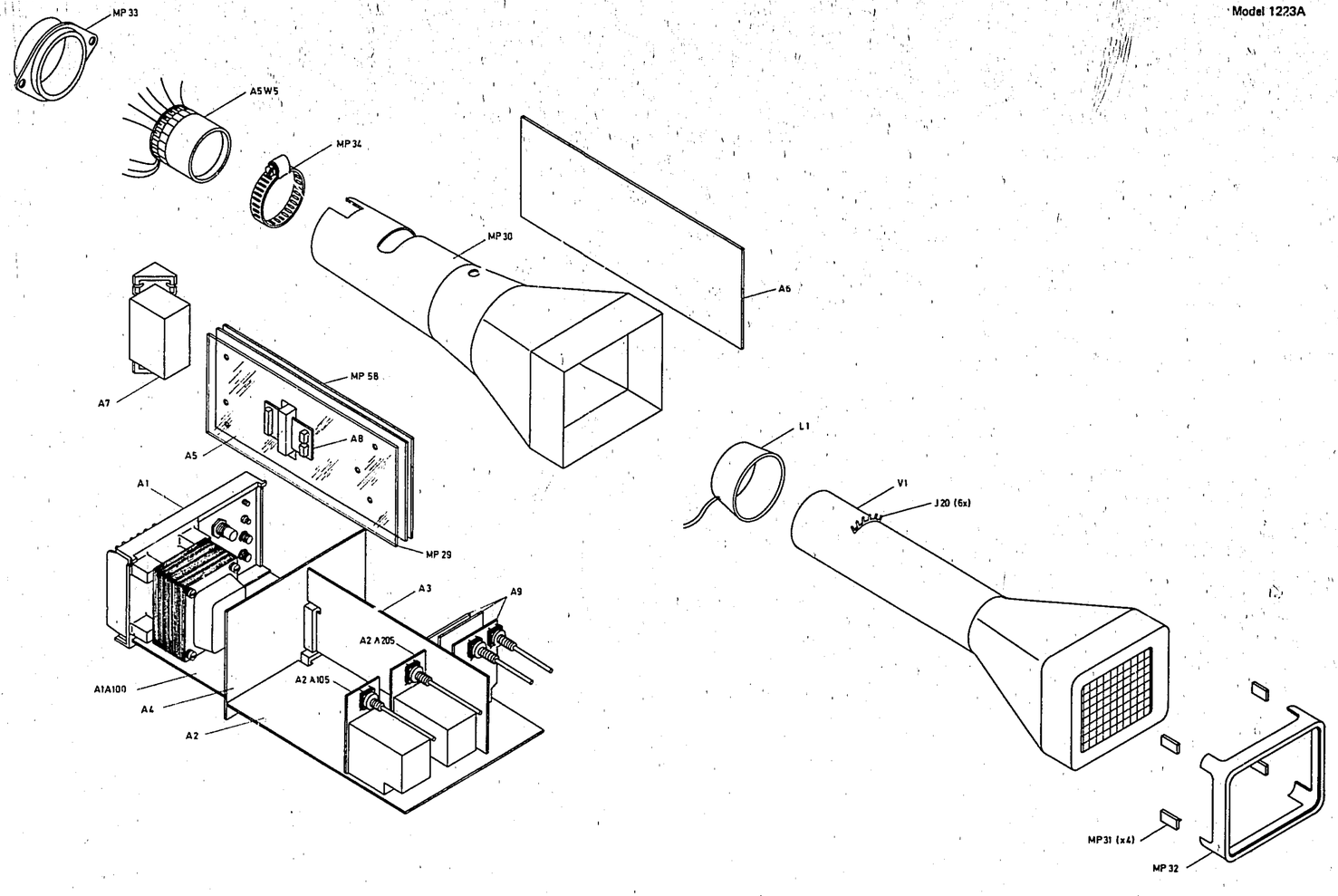


Figure 6–1. Parts Identification for Main Assembly (cont'd)

Table 6–3. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	01223-66101	7		LOW VOLTAGE POWER SUPPLY MODULE	28480	01223-66101
A2	01223-66502	2		AMPLIFIER BOARD ASSEMBLY	28480	01223-66502
A3	01223-66503	3		TRIGGER BOARD ASSEMBLY	28480	01223-66503
A4	01223-66504	4		MOTHER BOARD ASSEMBLY	28480	01223-66504
A5	01223-66505	5		HIGH VOLTAGE BOARD ASSEMBLY	28480	01223-66505
A6	01223-66506	6		PULSE/AMPLIFIER BOARD ASSEMBLY	28480	01223-66506
A7	0960-0462	4	1	HIGH VOLTAGE MULTIPLIER	28480	0960-0462
DS1	1990-0487	0	1	LED YEL MIN	28480	1990-0487
F1	2110-0020	1	1	FUSE .8A 250V SLO-BLO 1.25X.25 UL	75915	313.800
L1	5060-0435	8	1	COIL ALIGNMENT	28480	5060-0435
MP1	5020-8821	8	1	FRAME, FRONT	28480	5020-8821
MP2	01223-20501	5	1	FRAME, REAR	28480	01223-20501
MP3	5040-7203	0	1	TRIM STRIP	28480	5040-7203
MP4	5040-7201	8	1	FOOT(STANDARD)	28480	5040-7201
MP5	1460-1345	5	1	TILT STAND BST	28480	1460-1345
MP6	5040-7219	8	1	STRAP, HANDLE, CAP-FRONT	28480	5040-7219
MP7	5040-7220	1	1	STRAP, HANDLE, CAP-REAR	28480	5040-7220
MP8	2680-0172	1	1	SCREW-MACH 10-32 .375-IN-LG 100 DEG	28480	2680-0172
MP9	0590-0639	2	1	NUT-SHMET-FLT 10-32-THD 3TL	28480	0590-0639
MP10	5001-0442	3	1	TRIM, SIDE	28480	5001-0442
MP11	5040-7221	2	1	FOOT, REAR	28480	5040-7221
MP12	5020-8836	5	1	CORNER STRUT, 15	28480	5020-8836
MP13	5001-0430	9	1	COVER, TOP	28480	5001-0430
MP14	5060-9842	9	1	COVER, BOTTOM	28480	5060-9842
MP15	01223-04101	7	1	COVER, SIDE	28480	01223-04101
MP16	5060-9803	2	1	STRAP, HANDLE	28480	5060-9803
MP17	01223-00205	4	1	PANEL, SUB-CRT	28480	01223-00205
MP18	01223-00204	3	1	PANEL, FRONT-CRT	28480	01223-00204
MP19	01223-00203	2	1	PANEL, SUB X-Y	28480	01223-00203
MP20	01223-00202	1	1	PANEL, FRONT X-Y	28480	01223-00202
MP21	01223-00201	0	1	PANEL, REAR	28480	01223-00201
MP22	01223-23102	8	1	GUIDE, X-Y BOARD	28480	01223-23102
MP23	01223-23101	7	1	GUIDE, MOTHER BOARD	28480	01223-23101
MP24	01740-20601	2	1	SHIELD, SAFETY CRT	28480	01740-20601
MP25	5040-0521	1	1	BEZEL	28480	5040-0521
MP26	01740-02701	5	1	FILTER, LIGHT BLUE	28480	01740-02701
MP27	01223-01201	2	1	BRACKET, CRT	28480	01223-01201
MP28	01223-01202	3	1	BRACKET, M.V.	28480	01223-01202
MP29	01223-44101	1	1	COVER, PLASTIC, M.V.	28480	01223-44101
MP30	01220-0204	0	1	SHIELD, CRT	28480	01220-0204
MP31	0460-0852	4	1		28480	0460-0852
MP32	5060-0443	6	1	LIGHT MASK	28480	5060-0443
MP33	1400-0798	4	1	HOLDER, CRT	28480	1400-0798
MP34	1400-0026	1	1	CLAMP-HOSE 2-2.625-DIA .5-WD BST	28480	1400-0026
MP35	0400-0601	7	1	GROMMET-CHAN PLAIN .56-IN-GRV-OD	28480	0400-0601
MP36	0460-0919	6	1	TAPE INDL .25-IN-W .031-IN-T POLYU-FM	28480	0460-0919
MP37	0370-1005	2	1	KNOB-BASE-PTR 3/8 JGK .125-IN-ID	28480	0370-1005
MP38	01223-67402	3	1	KNOB ASSEMBLY, TIME/DIV	28480	01223-67402
MP39	01223-67401	2	1	KNOB ASSEMBLY, VOLTS/DIV	28480	01223-67401
MP40	0370-2512	8	1	KNOB(CNCTRC 9ND	28480	0370-2512
MP41	0350-0824	9	1	DECAL-KB CAP 3/8 IN-SER	28480	0350-0824
MP42	0350-0975	1	1	KNOB, DECAL	28480	0350-0975
MP43	0370-0606	7	1	BEZEL-PUSHBUTTON 0.330-IN SQ; JADE GRAY	28480	0370-0606
MP44	0370-0684	1	1	PUSHBUTTON 0.230 IN SQ; 0.425 IN HGT	28480	0370-0684
MP45	0370-0671	6	1	PUSHBUTTON 0.230 IN SQ; 0.425 IN HGT	28480	0370-0671
MP46	0370-2630	1	1	PUSHBUTTON 0.230 IN SQ; 0.425IN HGT	28480	0370-2630
MP47	5002-4707	1	1	CLIP	28480	5002-4707
MP48	0400-0002	2	1	GROMMET-RND .188-IN-ID .312-IN-GRV-OD	28480	0400-0002
MP49	0400-0009	9	1	GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
MP50	0400-0010	2	1	GROMMET-RND .25-IN-ID .375-IN-GRV-OD	28480	0400-0010
MP51	0370-1007	4	1	KNOB-BASE-PTR 3/8 DBP .125-IN-ID	28480	0370-1007
MP52	01223-43201	0	1	COUPLER, M.V.	28480	01223-43201
MP53	0370-0607	8	1	BEZEL-PUSHBUTTON 0.330-IN SQ; OLIVE	28480	0370-0607
MP54	0370-2631	2	1	PUSHBUTTON 0.230 IN SQ; 0.425IN HGT	28480	0370-2631
MP55	0370-0604	5	1	PUSHBUTTON 0.230 IN SQ10.425 IN HGT	28480	0370-0604
MP56	5040-7675	0	1	PUSH ROD, SWITCH	28480	5040-7675
MP57	5040-9301	3	1	PUSH ROD, SWITCH	28480	5040-9301
MP58	01223-05401	2	1	INSULATOR, M.V.	28480	01223-05401
MP59	0360-1646	6	1	TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	28480	0360-1646
MP60	2510-0192	6	1	SCREW-MACH 8-32 .25-IN-LG 100 DEG	28480	2510-0192
Q1	1854-0456	2	1	TRANSISTOR NPN SI PD=65W FT=3MHZ	01295	TIP41A
R10	2100-2988	3	1	RESISTOR-VAR CONTROL CCP 10K 10% LIN	28480	2100-2988

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
V1	5083-2510	2	1	CRT	28480	5083-2510
W1	8120-1692	2	1	CABLE ASSY 3-CNDCT MGP-JKT	28480	8120-1692
W2	01223-61602	3	1	CABLE ASSEMBLY, TRIGGER	28480	01223-61602
W3	01223-61603	4	1	CABLE ASSEMBLY, POWER SWITCH	28480	01223-61603
W5	01223-61605	6	1	CABLE ASSEMBLY, CRT I	28480	01223-61605

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	01223-61101	7	2	LOW VOLTAGE POWER SUPPLY MODULE	28480	01223-61101
A1A1	01223-66501	1	2	LOW VOLTAGE POWER SUPPLY ASSEMBLY	28480	01223-66501
A1F1	2110-0380	8	2	FUSE .4A 250V SLO-BLO 1.25X.25 UL	75915	313.400
A1FL10	9135-0035	7	1	FILTER-LINE WIRE-TERMS	28480	9135-0035
A1J1	1250-0083	1	4	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A1J1R	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A1HP1	0050-0594	4	1	HEAT SINK	2P4P0	0050-0594
A1HP2	01223-00206	5	1	PANEL, HEAT SINK	28480	01223-00206
	1510-0038	F	1	BINDING POST ASSY SGL THD-STUD	28480	1510-0038
A1Q1	1854-0573	4	1	TRANSISTOR NPN SI TO-220AB PD=30W	04713	MJE3738
A1Q2	1854-0402	8	2	TRANSISTOR NPN SI PD=30W FT=3MHZ	28480	1854-0402
A1Q3	1854-0402	8		TRANSISTOR NPN SI PD=30W FT=3MHZ	28480	1854-0402
A1S1	3101-2298	1	2	SWITCH-SL DPDT STD 5A 250VAC SLDR-LUG	28480	3101-2298
A1S2	3101-2298	1		SWITCH-SL DPDT STD 5A 250VAC SLDR-LUG	28480	3101-2298
A1T1	01223-61102	8	1	TRANSFORMER, POWER	28480	01223-61102
A1U2	1826-0122	0	2	IC 7805 V RGLTR TO-220	07263	7805UC
A1U3	1826-0122	0		IC 7805 V RGLTR TO-220	07263	7805UC
A1W8	01223-61608	9	1	CABLE ASSEMBLY, ER	28480	01223-61608
A1XF1	1400-0090	9	1	WASHER;RUBBER 5/8" OD	00000	OBD
A1XF1	2110-0465	8	1	FUSEHOLDER CAP EXTR PST; BAYONET; 20A	28480	2110-0465
A1XF1	2110-0467	0	1	NUT-HEX 1/2-28 THD 0.688 A/F	75915	903-070
A1XF1	2110-0470	5	1	FUSEHOLDER BODY EXTR PST; BAYONET; THD	75915	305003-010
A2	01223-66502	2	2	AMPLIFIER BOARD ASSEMBLY	28480	01223-66502
A2A4	01223-61901	5	2	SWITCH ASSEMBLY, TIME	28480	01223-61901
A2A105	01223-61902	6	3	SWITCH ASSEMBLY, VOLT	28480	01223-61902
A2A205	01223-61902	6		SWITCH ASSEMBLY, VOLT	28480	01223-61902
A2C1	0160-3097	1	2	CAPACITOR-FXD .47UF +80-20% 50VDC CER	28480	0160-3097
A2C2	0160-4213	5	9	CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A2C3	0160-3456	6	21	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C4	0160-3558	9	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A2C25	0160-2055	9	10	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C28	0121-0476	2	1	CAPACITOR-V TRMR-POLYP 5.5-65PF 100V	02540	2222 808 32859
A2C29	0180-0196	3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300MVICR
A2C30	0160-3935	6	1	CAPACITOR-FXD 950PF +-1% 100VDC MICA	28480	0160-3935
A2C31	0160-3255	3	1	CAPACITOR-FXD .1UF +-1% 250VDC POLYSTY	28480	0160-3255
A2C32	0160-0599	2	1	CAPACITOR-FXD 10UF +-2% 63VDC MET-POLYC	28480	0160-0599
A2C33	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A2C40	0160-2628	2	8	CAPACITOR-FXD .03UF +-20% 500VDC CER	28480	0160-2628
A2C41	0160-3097	1		CAPACITOR-FXD .47UF +80-20% 50VDC CER	28480	0160-3097
A2C49	0160-2249	3	1	CAPACITOR-FXD 4.7PF +-.25PF 500VDC CER	28480	0160-2249
A2C101	0160-3581	8	2	CAPACITOR-FXD .1UF +-20% 63VDC	05994	0071-460
A2C102	0121-0496	6	4	CAPACITOR-V TRMR-CER 2-8PF 200V PC-MTG	72982	538-004A2-8
A2C103	0121-0497	7	4	CAPACITOR-V TRMR-CER 5.5-18PF 200V	72982	538-004A5.5-18
A2C104	0180-0191	8	2	CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300MVICR
A2C105	0121-0496	6		CAPACITOR-V TRMR-CER 2-8PF 200V PC-MTG	72982	538-004A2-8
A2C106	0121-0497	7		CAPACITOR-V TRMR-CER 5.5-18PF 200V	72982	538-004A5.5-18
A2C107	0160-2940	1	6	CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0160-2940
A2C108	0160-3226	8	2	CAPACITOR-FXD .01UF +-10% 400VDC	28480	0160-3226
A2C112	0150-0059	8	2	CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0150-0059
A2C115	0160-2628	2		CAPACITOR-FXD .03UF +-20% 500VDC CER	28480	0160-2628
A2C116	0160-2628	2		CAPACITOR-FXD .03UF +-20% 500VDC CER	28480	0160-2628
A2C125	0121-0475	1	2	CAPACITOR-V TRMR-POLYP 2-22PF 100V	02540	2222 808 11229
A2C126	0160-4213	5		CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A2C127	0150-0121	5	4	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A2C128	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C129	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C130	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C131	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C132	0160-3455	5	4	CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A2C134	0160-3455	5		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A2C201	0160-3581	8		CAPACITOR-FXD .1UF +-20% 63VDC	05994	0071-460
A2C202	0121-0496	6		CAPACITOR-V TRMR-CER 2-8PF 200V PC-MTG	72982	538-004A2-8
A2C203	0121-0497	7		CAPACITOR-V TRMR-CER 5.5-18PF 200V	72982	538-004A5.5-18
A2C204	0180-0191	8		CAPACITOR-FXD 56PF +-5% 300VDC MICA	72136	DM15E560J0300MVICR
A2C205	0121-0496	6		CAPACITOR-V TRMR-CER 2-8PF 200V PC-MTG	72982	538-004A2-8
A2C206	0121-0497	7		CAPACITOR-V TRMR-CER 5.5-18PF 200V	72982	538-004A5.5-18

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2C207	0140-2940	1		CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0140-2940
A2C208	0140-3226	8		CAPACITOR-FXD .01UF +-10% 400VDC	28480	0140-3226
A2C212	0150-0059	F		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0150-0059
A2C215	0160-2628	2		CAPACITOR-FXD .03UF +-20% 500VDC CER	28480	0160-2628
A2C216	0160-2628	2		CAPACITOR-FXD .03UF +-20% 500VDC CER	28480	0160-2628
A2C223	0121-0475	1		CAPACITOR-V TRMR-POLYE 2-22PF 100V	02940	2222 808 11229
A2C226	0160-4213	5		CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A2C227	0160-4213	5		CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A2C228	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C229	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C230	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C231	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A2C232	0160-3455	5		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A2C234	0160-3455	5		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3455
A2C301	0140-0193	0	1	CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WVICR
A2C304	0150-0121	5		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0150-0121
A2C305	0180-0374	3	6	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A2C306	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A2CR1	1901-0376	6	7	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR2	1901-0040	1	45	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR3	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR4	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR101	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR102	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR106	1901-0358	4	6	DIODE-DUAL 50V VF DIFF=3MV	04713	MSD6101
A2CR110	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR111	1901-0358	4		DIODE-DUAL 50V VF DIFF=3MV	04713	MSD6101
A2CR112	1901-0358	4		DIODE-DUAL 50V VF DIFF=3MV	04713	MSD6101
A2CR201	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR202	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A2CR206	1901-0358	4		DIODE-DUAL 50V VF DIFF=3MV	04713	MSD6101
A2CR210	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR211	1901-0358	4		DIODE-DUAL 50V VF DIFF=3MV	04713	MSD6101
A2CR212	1901-0358	4		DIODE-DUAL 50V VF DIFF=3MV	04713	MSD6101
A2CR301	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR302	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR303	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR308	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR309	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR311	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR312	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR313	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2J2	1251-4267	3	1	CONNECTOR 3-PIN F P POST TYPE	28480	1251-4267
A2J8	1251-1365	6	1	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROW	28480	1251-1365
A2J11	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A2J12	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A2J13	1250-0083	1		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0083
A2L301	9140-0114	4	1	COIL-MLD 10UH 10% Q=55 .155DX.375LG-NOM	28480	9140-0114
A2Q1	1855-0356	3	1	TRANSISTOR J-FET N-CHAN D-MODE TO-18 SI	28480	1855-0356
A2Q2	1854-0215	1	18	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q11	1853-0066	8	1	TRANSISTOR PNP SI TO-92 PD=625MW	28480	1853-0066
A2Q12	1854-0005	7	1	TRANSISTOR NPN 2N708 SI TO-18 PD=360MW	04713	2N708
A2Q13	1854-0392	5	1	TRANSISTOR NPN SI PD=310MW FT=50MHZ	04713	2N5088
A2Q14	1854-0071	7	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2Q15	1853-0099	5	2	TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A2Q16	1853-0099	5		TRANSISTOR PNP 2N4917 SI PD=200MW	07263	2N4917
A2Q17	1853-0036	2	12	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q25	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q101	1855-0213	1	2	TRANSISTOR-JFET DUAL N-CHAN D-MODE TO-78	28480	1855-0213
A2Q103	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q104	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q107	5080-1081	4	2	TRANSISTOR, PAIR, SELECTED	28480	5080-1081
A2Q109	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q110	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q201	1855-0213	1		TRANSISTOR-JFET DUAL N-CHAN D-MODE TO-78	28480	1855-0213
A2Q203	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q204	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2Q207	5080-1081	4		TRANSISTOR, PAIR, SELECTED	28480	5080-1081
A2Q209	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q210	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q301	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q302	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2Q303	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R1	0698-1055	1	1	RESISTOR 1M 5% .5W CC TC=0+1000	01121	EB1055
A2R2	0698-3250	5	2	RESISTOR 5.36K 1% .125W F TC=0+-100	24546	C4-1/8-TC-5361-F
A2R3	0757-0280	3	27	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R4	0698-4433	0	2	RESISTOR 2.26K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2261-F
A2R5	0698-3202	9	1	RESISTOR 1.74K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1741-F
A2R6	2100-3273	1	2	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A2R7	0698-4132	4	1	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A2R8	0757-0475	8	1	RESISTOR 274K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2743-F
A2R10	0757-0442	9	25	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R12	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2R13	0757-0410	1	5	RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A2R14	0757-0280	6	2	RESISTOR 10K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1002-F
A2R15	0757-0394	0	8	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2R17	0757-0401	0	15	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R18	0757-0407	6	15	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R19	0757-0453	2	1	RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A2R20	0757-0427	0	11	RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2R21	0757-0430	5	1	RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
A2R22	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R23	0698-3499	6	2	RESISTOR 40.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4022-F
A2R24	0757-0123	3	2	RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A2R25	0698-3499	6		RESISTOR 40.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4022-F
A2R26	0757-0463	8	2	RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A2R27	2100-3274	2	5	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A2R28	2100-3352	7	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A2R101	0757-0198	2	2	RESISTOR 100 1% .5W F TC=0+-100	28480	0757-0198
A2R102	0698-3431	6	2	RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
A2R103	0757-0054	9	2	RESISTOR 900K 1% .5W F TC=0+-100	28480	0757-0054
A2R104	0757-0057	2	2	RESISTOR 990K 1% .5W F TC=0+-100	28480	0757-0057
A2R105	0698-5470	7	2	RESISTOR 111K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1113-F
A2R106	0698-3109	5	2	RESISTOR 10.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1012-F
A2R108	0757-0059	4	2	RESISTOR 1M 1% .5W F TC=0+-100	28480	0757-0059
A2R109	0698-2245	3	2	RESISTOR 220K 5% .5W CC TC=0+882	01121	EB2245
A2R111	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R112	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R113	C.57-0124	4	2	RESISTOR 39.2K 1% .125W F TC=0+-100	28480	0757-0124
A2R114	2100-3353	8	6	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-V46-203
A2R115	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2R116	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2R117	0698-0085	0	4	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A2R118	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A2R119	0757-0346	2	11	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R120	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R121	0757-0273	4	8	RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2R122	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2R123	0757-0420	3	4	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A2R124	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A2R125	0698-4384	C	4	RESISTOR 54.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-54R9-F
A2R126	0698-4384	0		RESISTOR 54.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-54R9-F
A2R127	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R128	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R129	0757-0419	0	2	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A2R130	0757-0465	6	18	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R131	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R132	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R133	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R135	0757-0437	2	4	RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A2R136	0757-0437	2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A2R138	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R139	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R140	0757-0317	7	4	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A2R141	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A2R142	0698-3268	7	2	RESISTOR 11.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1152-F
A2R143	0757-0458	3	2	RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A2R144	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R145	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R146	0698-3447	4	6	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R147	0757-0410	1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A2R148	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-V46-203
A2R150	0698-4455	6	2	RESISTOR 536 1% .125W F TC=0+-100	24546	C4-1/8-T0-536R-F
A2R151	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2R152	0698-4469	2	2	RESISTOR 1.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1151-F
A2R153	0698-4454	7	2	RESISTOR 549 1% .125W F TC=0+-100	24546	C4-1/8-T0-549R-F
A2R156	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R157	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R160	0757-0273	8		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2R162	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A2R163	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R165	0757-0415	6	4	RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A2R166	0757-0415	6		RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A2R167	0698-3252	9	4	RESISTOR 450 1% .125W F TC=0+-50	28480	0698-3252
A2R168	0698-3252	9		RESISTOR 450 1% .125W F TC=0+-50	28480	0698-3252
A2R169	0698-5196	6	4	RESISTOR 96.25 .25% .125W F TC=0+-100	03888	PME55-1/8-T0-96R25-C
A2R170	0698-5196	6		RESISTOR 96.25 .25% .125W F TC=0+-100	03888	PME55-1/8-T0-96R25-C
A2R171	0698-3447	6		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R172	0698-3447	6		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R173	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R174	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R175	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-Y46-203
A2R176	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R177	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R178	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R179	0757-0469	6	12	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2R180	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R181	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R182	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2R183	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2R184	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R185	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R202	0698-3431	6		RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
A2R203	0757-0054	9		RESISTOR 900K 1% .5W F TC=0+-100	28480	0757-0054
A2R204	0757-0053	2		RESISTOR 990K 1% .5W F TC=0+-100	28480	0757-0057
A2R205	0698-5870	7		RESISTOR 111K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1113-F
A2R206	0698-3160	5		RESISTOR 10.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1012-F
A2R208	0757-0059	0		RESISTOR 1M 1% .5W F TC=0+-100	28480	0757-0059
A2R209	0686-2245	2		RESISTOR 220M 5% .5W CC TC=0+850	01121	EB2245
A2R211	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R212	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R213	0757-0124	4		RESISTOR 39.2K 1% .125W F TC=0+-100	28480	0757-0124
A2R214	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-Y46-203
A2R215	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2R216	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2R217	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A2R218	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A2R219	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R220	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R221	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2R222	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2R223	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A2R224	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A2R225	0698-4388	0		RESISTOR 54.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-54R9-F
A2R226	0698-4388	0		RESISTOR 54.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-54R9-F
A2R227	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R228	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R229	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A2R230	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R231	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R232	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R233	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R234	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A2R235	0757-0437	2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A2R236	0757-0437	2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A2R237	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A2R238	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R239	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R240	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A2R241	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A2R242	0698-1269	7		RESISTOR 11.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1152-F
A2R243	0757-0454	3		RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A2R244	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R245	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R246	0698-3447	6		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R247	0757-0410	1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A2R248	2100-3353	8		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-Y46-203
A2R250	0698-0455	6		RESISTOR 536 1% .125W F TC=0+-100	24546	C4-1/8-T0-536R-F
A2R251	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2R252	0698-0469	2		RESISTOR 1.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1151-F
A2R253	0698-0456	7		RESISTOR 549 1% .125W F TC=0+-100	24546	C4-1/8-T0-549R-F
A2R254	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2R257	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2R259	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2R262	2100-3274	7		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A2R263	0757-0288	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R265	0757-0415	6		RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A2R266	0757-0415	6		RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A2R267	0698-3252	9		RESISTOR 450 1% .125W F TC=0+-50	28480	0698-3252
A2R268	0698-3252	9		RESISTOR 450 1% .125W F TC=0+-50	28480	0698-3252
A2R269	0698-5196	4		RESISTOR 9k.25 .25% .125W F TC=0+-100	03688	PME55-1/8-T0-9kR25-C
A2R270	0698-5196	4		RESISTOR 9k.25 .25% .125W F TC=0+-100	03688	PME55-1/8-T0-9kR25-C
A2R271	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R272	0698-3447	4		RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A2R273	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R274	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2R275	2100-3353	6		RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-Y46-203
A2R276	0757-0465	7		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R277	0757-0465	7		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R278	0757-0465	7		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2R279	0757-0449	5		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2R280	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R281	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2R282	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2R283	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2R284	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R285	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2R301	2100-3349	2	1	RESISTOR-TRMR 100 10% C SIDE-ADJ 1-TRN	28480	2100-3349
A2R302	0757-0410	1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A2R303	0757-0410	1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A2R304	0757-0422	5	2	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A2R305	0757-0422	5		RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A2R306	0698-4429	4	3	RESISTOR 1.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1871-F
A2R307	0698-4429	4		RESISTOR 1.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1871-F
A2R308	0698-4360	7	1	RESISTOR 15.4 1% .125W F TC=0+-100	03688	PME55-1/8-T0-15R4-F
A2R309	0698-4401	2	1	RESISTOR 95.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-95R3-F
A2R310	0698-4381	7	1	RESISTOR 48.7 1% .125W F TC=0+-100	24546	C4-1/8-T0-48R7-F
A2R315	0757-0394	8	6	RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A2R316	0757-0409	8	1	RESISTOR 274 1% .125W F TC=0+-100	24546	C4-1/8-T0-274R-F
A2R318	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2R319	0698-0044	9	1	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A2R320	2100-3351	6	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A2R321	0698-3558	8	2	RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A2R322	0698-3558	8		RESISTOR 4.02K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4021-F
A2R407	0698-3704	2	1	RESISTOR 715 1% .125W F TC=0+-100	24546	C4-1/8-T0-715R-F
A2R408	2100-3350	5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A2R409	2100-3207	1	2	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	28480	2100-3207
A2R410	0698-3256	5		RESISTOR 5.36K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5361-F
A2R411	0757-0760	4	1	RESISTOR 20K 1% .25W F TC=0+-100	24546	C5-1/4-T0-2002-F
A2S1	01222-61901	6	1	SWITCH ASSEMBLY, PUSHBUTTON	28480	01222-61901
A2S2	3101-2047	8	1	SWITCH-PB 6-STATION 10MM C-C SPACING	28480	3101-2047
A2S3	3101-1930	6	2	SWITCH, PUSHBUTTON 4POT 115V	28480	3101-1930
A2U1	1820-1147	0	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A2U101	1821-0002	5	2	TRANSISTOR ARRAY	01928	CA3045
A2U102	1821-0002	5		TRANSISTOR ARRAY	01928	CA3045
A2U201	1821-0002	5		TRANSISTOR ARRAY	01928	CA3045
A2U202	1821-0002	5		TRANSISTOR ARRAY	01928	CA3045
A2VR6	1902-3092	1	2	DIODE-ZNR 4.99V 2% DO-7 PD=.4W TC=-.012%	28480	1902-3092
A2VR7	1902-3092	1		DIODE-ZNR 4.99V 2% DO-7 PD=.4W TC=-.012%	28480	1902-3092
A2VR19	1902-0084	1	1	DIODE-ZNR 7.5V 5% DO-7 PD=.4W TC=+.05%	28480	1902-0084
A2VR104	1902-3048	7	5	DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	28480	1902-3048
A2VR105	1902-3048	7		DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	28480	1902-3048
A2VR113	1902-3048	7		DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	28480	1902-3048
A2VR204	1902-3048	7		DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	28480	1902-3048
A2VR205	1902-3048	7		DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	28480	1902-3048
A2VR308	1902-0126	6	1	DIODE-ZNR 2.61V 5% DO-7 PD=.4W TC=-.072%	28480	1902-0126
A3	01223-60503	3	2	TRIGGER BOARD ASSEMBLY	28480	01223-60503
A3C1	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3C3	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3C4	0160-0174	9	6	CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C7	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C8	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C11	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A3C13	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3C14	0180-3229	7	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X901082
A3C17	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3C18	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3C19	0160-4213	5		CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A3C20	0160-4213	5		CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A3C21	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C22	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C23	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3C24	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A3C25	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C27	0180-2739	8	1	CAPACITOR-FXD 47UF+50-10% 10VDC AL	28480	0180-2739
A3C37	0160-4213	5		CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A3C43	0160-3558	9		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-3558
A3C46	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C49	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A3CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR5	1901-0535	9	7	DIODE-SCHOTTKY	28480	1901-0535
A3CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR11	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
A3CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3J22	1251-3714	3	1	CONNECTOR 7-PIN F POST TYPE	28480	1251-3714
A3L1	9100-1657	8	1	COIL-MLD 1.5MH 5% Q=65 .215DX.58LG-NOM	28480	9100-1657
A3Q1	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q2	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q5	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q6	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q7	1854-0296	8	1	TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
A3Q8	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q9	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q10	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q11	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3R1	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R2	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A3R3	0683-5145	2	1	RESISTOR 510K 5% .25W FC TC=-800/+900	01121	CB5145
A3R4	0757-0283	6	9	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R6	2100-3252	F	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	28480	2100-3252
A3R5	2100-3212	8	2	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A3R6	0698-3439	4	1	RESISTOR 178 1% .125W F TC=0+-100	24546	C4-1/8-T0-178R-F
A3R7	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R8	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R9	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R10	0698-3445	2	1	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A3R11	0698-3150	6	2	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3R12	0757-0274	5	5	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3R13	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3R14	0698-4453	4	2	RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A3R15	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3R16	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3R17	0698-4453	4		RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A3R18	0757-0443	0	1	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3R19	0757-0431	6	6	RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A3R20	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3R22	0757-0398	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R23	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R24	0698-4439	6	2	RESISTOR 3.24K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3241-F
A3R25	0698-4439	6		RESISTOR 3.24K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3241-F
A3R26	0757-0424	7	2	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A3R27	0757-0440	7	7	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3R29	0683-1055	5	2	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A3R30	0757-0444	1	7	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A3R31	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A3R32	0698-4486	5	1	RESISTOR 45.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4532-F
A3R33	0698-4485	4	1	RESISTOR 37.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3742-F
A3R34	0757-0468	9	1	RESISTOR 130K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1303-F
A3R35	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A3R36	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A3R37	0757-0457	6	3	RESISTOR 47.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4752-F
A3R38	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R39	0757-0457	6		RESISTOR 47.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4752-F
A3R40	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R41	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R43	0698-3278	0	1	RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A3R44	0698-4086	9	2	RESISTOR 22.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-22R6-F
A3R45	0698-4086	9		RESISTOR 22.6 1% .125W F TC=0+-100	03888	PME55-1/8-T0-22R6-F
A3R47	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R48	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R52	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R53	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R54	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R55	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R56	0757-0431	6		RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A3R57	0757-0431	6		RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A3R58	0698-3151	7	7	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A3R60	0698-4471	6	1	RESISTOR 7.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7151-F
A3R66	2100-0568	1	1	RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A3R67	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A3R70	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A3R71	0698-4433	0		RESISTOR 2.26K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2261-F
A3R72	2100-3212	A		RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-32 2
A3R73	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A3R100	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3S1	3101-1930	6		SWITCH-PB 4POT .4A 115VAC	28480	3101-1930
A3S2	3101-2048	9	1	SWITCH-PB 5-STATION 10MM C-C SPACING	28480	3101-2048
A3U1	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A3U2	1820-0054	5	1	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A3U3	1820-0681	4	1	IC GATE TTL S NAND QUAD 2-INP	01295	SN74S00N
A3U4	1820-0685	8	2	IC GATE TTL S NAND TPL 3-INP	01295	SN74S10N
A3U5	1820-0629	0	1	IC FF TTL S J-K NEG-EDGE-TRIG	01295	SN74S112N
A3U6	1820-0579	9	1	IC MV TTL MONOSTBL RETRIG DUAL	01295	SN74123N
A3U7	1820-0537	9	1	IC SCHMITT-TRIG TTL NAND DUAL 4-INP	01295	SN7413N
A3U8	1820-1112	3	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A3U9	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A3U10	1820-0328	6	1	IC GATE TTL NOR QUAD 2-INP	01295	SN7402N
A3U11	1820-0174	0	1	IC INV TTL HEX	01295	SN7404N
A3U12	1820-0845	8		IC GATE TTL S NAND TPL 3-INP	01295	SN74S10N
A3W10	01223-61610	3	1	CABLE ASSEMBLY, TRIGGER	28480	01223-61610
A4	01223-66504	4	2	MOTHER BOARD ASSEMBLY	28480	01223-66504
A4DL1	8120-1171	2	1	COIL-DELAY LINE,162 +-9NS,175 +-8 OHM	28480	8120-1171
A4J5	1251-3705	8	2	CONNECTOR 20-PIN F METRIC CIS	28480	1251-3705
A4J6	1251-3705	8		CONNECTOR 20-PIN F METRIC CIS	28480	1251-3705
A4J7	1251-3708	5	1	CONNECTOR 10-PIN F METRIC CIS	28480	1251-3708
A4J9	1251-1626	2	1	CONNECTOR-PC EDGE 12-CONT/ROW 2-ROWS	28480	1251-1626
A4J10	1251-1633	1	1	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-1633
A4J11	1251-2034	8	1	CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS	28480	1251-2034
A4R1	0757-0399	5	2	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A4R2	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A4R3	0698-6328	2	1	RESISTOR 187 1% .125W F TC=0+-100	24546	C4-1/8-T0-187R-F
	1400-0704	2	1	CABLE CLAMP-NYLON .188-.25-DIA .375-WD	28480	1400-0704
A5	01223-66505	5	2	HIGH VOLTAGE BOARD ASSEMBLY	28480	01223-66505
A5A8	01223-61103	9	1	TRANSFORMER ASSEMBLY, HIGH VOLTAGE	28480	01223-61103
A5C1	0180-0097	7	1	CAPACITOR-FXD 47UF+-10% 35VDC TA	56289	150D476X9035B2
A5C2	0160-0170	5	1	CAPACITOR-FXD .22UF +80-20% 25VDC CER	28480	0160-0170
A5C3	0180-0100	3	2	CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A5C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C5	0180-0100	3		CAPACITOR-FXD 4.7UF+-10% 35VDC TA	56289	150D475X9035B2
A5C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C7	0160-0165	8	2	CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A5C8	0160-4079	1	1	CAPACITOR-FXD 1500PF +-20% 4KVDC	28480	0160-4079
A5C9	0160-3720	7	9	CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-3720
A5C10	0160-4024	6	1	CAPACITOR-FXD .1UF +-20% 4KVDC MET-POLYE	56289	430P104040
A5C11	0160-0543	6	1	CAPACITOR-FXD 4700PF +-20% 4KVDC	28480	0160-0543
A5C12	0160-0544	7	1	CAPACITOR-FXD .022UF +-20% 4KVDC	28480	0160-0544
A5C13	0160-0584	5	1	CAPACITOR-FXD .0068UF +-20% 4KVDC	56289	430P683040
A5C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C15	0180-0089	7	1	CAPACITOR-FXD 100UF+50-10% 15VDC AL	56289	30D106F150DD2
A5C16	0160-0165	8		CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A5C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C18	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A5C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5C21	0160-3731	0	1	CAPACITOR-FXD .01UF +-20% 1KVDC CER	28480	0160-3731
A5C22	0160-3720	7		CAPACITOR-FXD .1UF +-10% 160VDC	28480	0160-3720
A5C24	0160-3443	1	1	CAPACITOR-FXD .1UF +80-20% 50V°C CER	28480	0160-3443
A5CR1	1901-0731	7	4	DIODE-PWR RECT 400V 1A	28480	1901-0731
A5CR2	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A5CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR6	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR7	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5CR8	1901-0683	8	2	DIODE-HV RECT 10KV 5MA 250NS	28480	1901-0683
A5CR9	1901-0683	8		DIODE-HV RECT 10KV 5MA 250NS	28480	1901-0683
A5CR10	1901-1065	2	1	DIODE-PWR RECT 1N4936 400V 1A 200NS	14936	1N4936
A5CR11	1901-0490	5	1	DIODE-HV RECT 3KV 250MA	28480	1901-0490
A5CR12	1901-0096	7	2	DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
A5CR13	1901-0050	3	6	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A5CR14	1901-0518	8	3	DIODE-SCHOTTKY	28480	1901-0518
A5CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A5F1	2110-0269	0	1	FUSEHOLDER-CLIP TYPE,250-FUSE	28480	2110-0269
A5F1	2110-0340	8		FUSE .4A 250V SLO-SLO 1.25X.25 UL	75915	313.400
A5F1	2110-0201	0	1	FUSE .75A 250V SLO-SLO 1.25X.25 UL	75915	313.250
A5L1	9140-0179	1	1	COIL-MLD 22UH 10% Q=75 .155DX.375LG-NOM	28480	9140-0179
A5MP2	1400-0031	8	1	CLAMP-CABLE .375-DIA .5-WD NYL	28480	1400-0031
A5Q1	1854-0478	4	7	TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A5Q2	1853-0034	0	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A5Q3	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A5Q4	1855-0057	1	1	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0057
A5Q5	1853-0316	9	3	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A5Q6	1854-0478	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A5Q7	1853-0281	9	3	TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A5R1	0811-1671	4	1	RESISTOR 2.7 5% 2W PW TC=0+-400	75042	BWH2-2R7-J
A5R2	0757-0178	8	1	RESISTOR 100 1% .25W F TC=0+-100	24546	C5-1/4-T0-101-F
A5R3	0698-4487	4	1	RESISTOR 25.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2552-F
A5R4	0757-0727	3	1	RESISTOR 562 1% .25W F TC=0+-100	24546	C5-1/4-T0-562R-F
A5R5	0698-3155	1	3	RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A5R6	0699-0002	3	2	RESISTOR 6.8 10% .5W CC TC=0+-412	01121	EB6BG1
A5R7	0698-3492	9	1	RESISTOR 2.67K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2671-F
A5R8	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2612-F
A5R9	0699-0002	3		RESISTOR 6.8 10% .5W CC TC=0+412	01121	EB6BG1
A5R10	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R11	0686-1025	5	1	RESISTOR 1K 5% .5W CC TC=0+447	01121	EB1025
A5R12	0698-8018	5	1	RESISTOR 30M 1% 3W C TC=0+-100	03888	PVC175-3-T0-3000-F
A5R13	0683-1055	5		RESISTOR 1M 5% .25W FC TC=800/+900	01121	CB1055
A5R14	2100-3213	9	2	RESISTOR-TRMR 200K 10% C TOP-ADJ 1-TRN	28480	2100-3213
A5R15	0683-2755	8	1	RESISTOR 2.7M 5% .25W FC TC=-900/+1100	01121	CB2755
A5R16	2100-3520	1	1	RESISTOR-VARIABLE 1.5M +-20% LIN; CC	28480	2100-3520
A5R17	0698-5353	5	2	RESISTOR 8.25M 5% 1W C TC=0+-200	28480	0698-5353
A5R18	0687-3331	2	1	RESISTOR 33K 10% .5W CC TC=0+785	01121	EB3331
A5R19	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R20	0687-2221	7	1	RESISTOR 2.2K 10% .5W CC TC=0+647	01121	EB2221
A5R21	0757-0388	0	1	RESISTOR 1K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1004-F
A5R22	0698-8827	0	1	RESISTOR 20M 10% 1W C TC=0+-250	28480	0698-8827
A5R23	2100-3521	2	1	RESISTOR-VARIABLE 500K +-20% LIN; CC	28480	2100-3521
A5R24	2100-0569	9	1	RESISTOR-TRMR 1M 20% C TOP-ADJ 1-TRN	28480	2100-0569
A5R25	0757-0394	6	1	RESISTOR 10K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1002-F
A5R26	0690-1011	6	1	RESISTOR 100 10% 1W CC TC=0+529	01121	GB1011
A5R27	0757-0344	9	1	RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A5R28	0757-0742	9	1	RESISTOR 8.19K 1% .25W F TC=0+-100	24546	C5-1/4-T0-8191-F
A5R29	0757-0442	0	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R30	0757-0447	5	1	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A5R31	0757-0442	0	1	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R32	0757-0344	9	1	RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A5R33	0757-0442	0	1	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A5R34	0698-5353	5	1	RESISTOR 8.25M 5% 1W C TC=0+-200	28480	0698-5353
A5R35	0757-0920	7	3	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A5R36	0757-0388	5	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R37	0757-0280	5	1	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A5R38	0698-3228	9	1	RESISTOR 49.9K 1% .125W F TC=0+-100	28480	0698-3228
A5R40	0757-0442	0		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A5R41	2100-0580	7	1	RESISTOR-TRMR 500K 10% C TOP-ADJ 1-TRN	28480	2100-0580
A5R42	2100-3213	9		RESISTOR-TRMR 200K 10% C TOP-ADJ 1-TRN	28480	2100-3213
A5R44	0757-0465	6	1	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A5R45	0698-4492	1	1	RESISTOR 44.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4422-F
A5R46	0698-7843	7	1	RESISTOR 178K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5S1	3101-2103	7	1	SWITCH-PB 4PDT NON .05A 115VAC	28480	3101-2103
A5TP1	1251-0206	2	2	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ PKD	28480	1251-0206
A5TP2	1251-0206	2		CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ PKD	28480	1251-0206
A5VR15	1902-3290	1	1	DIODE-ZNR 11.8V 5% DO-7 PD=.4W TC=+.074%	28480	1902-3290
A5W1	01223-61601	2	1	CABLE ASSEMBLY, HIGH VOLTAGE	28480	01223-61601
A5W2	01223-61612	5	1	CABLE ASSEMBLY, TRANSISTOR	28480	01223-61612
A6	01223-66506	6	2	PULSE/AMPLIFIER BOARD ASSEMBLY	28480	01223-66506
A6C1	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A6C2	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A6C3	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A6C4	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A6C5	0160-3720	7		CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-3720
A6C6	0160-3720	7		CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-3720
A6C8	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A6C9	0180-0374	3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A6C10	0160-3720	7		CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-3720
A6C11	0160-2940	1		CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0160-2940
A6C12	0180-0228	6	5	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A6C13	0160-3456	6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3456
A6C14	0160-3720	7		CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-3720
A6C15	0180-1746	5	1	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A6C16	0160-2940	1		CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0160-2940
A6C17	0160-2940	1		CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0160-2940
A6C18	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A6C19	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A6C20	0180-0558	5	1	CAPACITOR-FXD 470UF+-20% 10VDC TA	56289	150D477X0010B2
A6C21	0180-2647	7	1	CAPACITOR-FXD 68UF+-20% 50VDC TA	28480	0180-2647
A6C22	0160-3720	7		CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-3720
A6C23	0160-0174	9		CAPACITOR-FXD .47UF +80-20% 25VDC CER	28480	0160-0174
A6C24	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A6C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C401	0160-2628	2		CAPACITOR-FXD .03UF +-20% 500VDC CER	28480	0160-2628
A6C402	0160-2628	2		CAPACITOR-FXD .03UF +-20% 500VDC CER	28480	0160-2628
A6C403	0160-4213	5		CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A6C404	0160-4213	5		CAPACITOR-FXD .1UF +-20% 50VDC POLYE	28480	0160-4213
A6C405	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C406	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C407	0160-2628	2		CAPACITOR-FXD .03UF +-20% 500VDC CER	28480	0160-2628
A6C408	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C409	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C410	0160-3720	7		CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-3720
A6C411	0160-3720	7		CAPACITOR-FXD .1UF +-10% 100VDC	28480	0160-3720
A6C411	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C412	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C413	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C414	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A6C415	0160-2940	1		CAPACITOR-FXD 470PF +-5% 300VDC MICA	28480	0160-2940
A6C416	0140-0192	9	1	CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J300WV1CR
A6C417	0160-2307	8	1	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-2307
A6C418	0121-0168	9	2	CAPACITOR-V TRMR-PSTN .2-1.5PF 600V	28480	0121-0168
A6C419	0121-0168	9		CAPACITOR-V TRMR-PSTN .2-1.5PF 600V	28480	0121-0168
A6C420	0180-1704	5	1	CAPACITOR-FXD 47UF+-10% 6VDC TA	56289	150D476X9006B2
A6CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR4	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR5	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR6	1901-0033	2	2	DIODE-GEN PRP 180V 200MA DO-7	28480	1901-0033
A6CR7	1901-0731	7		DIODE-PWR RECT 400V 1A	28480	1901-0731
A6CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR9	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR10	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR12	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
A6CR13	1901-1068	5	1	DIODE-SCHOTTKY	28480	1901-1068
A6CR14	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR15	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR17	1901-0096	7		DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
A6CR18	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR19	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR22	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A6CR23	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050

Table 6-3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6CR401	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A6CR402	1901-0518	8		DIODE-SCHOTTKY	28480	1901-0518
A6CR403	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR404	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A6CR405	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
A6CR406	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
A6CR407	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
A6CR409	1901-0535	9		DIODE-SCHOTTKY	28480	1901-0535
A6Q1	1853-0281	9		TRANSISTOR PNP 2N2907A SI TO-18 PD=400MW	04713	2N2907A
A6Q2	1855-0010	6	1	TRANSISTOR-UJT P CH N 2N2646	03508	2N2646
A6Q3	1853-0336	5	3	TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A6Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A6Q5	1853-0336	5		TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A6Q6	1853-0336	5		TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A6Q7	1854-0621	3	1	TRANSISTOR NPN SI TO-39 PD=800MW	01295	GF258
A6Q8	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A6Q9	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A6Q10	1854-0474	4		TRANSISTOR NPN SI PD=310MW FT=100MHZ	04713	2N5551
A6Q11	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A6Q12	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A6Q13	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A6Q401	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A6Q402	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A6Q403	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A6Q404	1853-0314	9		TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A6Q405	1854-0637	1	8	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q406	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q407	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q408	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q409	1853-0218	2	2	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0218
A6Q410	1853-0218	2		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0218
A6Q411	854-0385	8	2	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q412	854-0385	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A6Q413	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q414	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q415	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q416	1854-0637	1		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	01295	2N2219A
A6Q417	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A6Q418	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A6R1	2100-3517	6	2	RESISTOR-VARIABLE 2K 5% +-20% LIN	28480	2100-3517
A6R2	2100-3518	7	1	RESISTOR-VARIABLE 5K +-20% LIN; CC	28480	2100-3518
A6R3	0757-0123	3		RESISTOR 34.8K 1% .125W F TC=0+-100	28480	0757-0123
A6R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R5	0698-3540	8	1	RESISTOR 15.8K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1582-F
A6R6	0757-0477	0	1	RESISTOR 332K 1% .125W F TC=0+-100	19701	MFMC1/8-T0-3323-F
A6R7	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A6R8	0757-0807	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A6R9	0757-0442	8		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R10	0757-0442	8		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R11	0698-3228	9		RESISTOR 49.9K 1% .125W F TC=0+-100	28480	0698-3228
A6R12	0698-3448	2	1	RESISTOR 102K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1023-F
A6R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R14	0698-3259	6	1	RESISTOR 7.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7871-F
A6R15	2100-0558	9	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
A6R16	0757-0463	4		RESISTOR 82.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8252-F
A6R17	0757-0457	6		RESISTOR 47.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4752-F
A6R18	2100-3517	6		RESISTOR-VARIABLE 2K 5% +-20% LIN	28480	2100-3517
A6R19	2100-3519	8	1	RESISTOR-VARIABLE 2K +-20% LIN; CC	28480	2100-3519
A6R20	0757-0442	8		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A6R21	0698-3572	8	1	RESISTOR 60.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6042-F
A6R22	0757-0413	4	2	RESISTOR 392 1% .125W F TC=0+-100	24546	C4-1/8-T0-3920-F
A6R23	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R24	0698-3452	1	1	RESISTOR 147K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1473-F
A6R25	0757-0413	4		RESISTOR 392 1% .125W F TC=0+-100	24546	C4-1/8-T0-3920-F
A6R26	0757-0431	6		RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A6R27	0757-0431	6		RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A6R28	0698-4429	4		RESISTOR 1.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1871-F
A6R29	0698-4014	3	1	RESISTOR 787 1% .125W F TC=0+-100	24546	C4-1/8-T0-7870-F
A6R30	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R31	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R32	0698-4499	8	1	RESISTOR 54.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5492-F
A6R33	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A6R34	0757-0434	9	1	RESISTOR 3.65K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3651-F
A6R35	0698-4516	0	1	RESISTOR 113K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1133-F

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6R39	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R3A	0757-0476	9	F	RESISTOR 301K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3013-F
A6R3B	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R3C	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R3D	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R40	2100-0567	0	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A6R41	0698-3442	9	2	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A6R42	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A6R43	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A6R44	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R45	0757-0472	5	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A6R46	0698-3228	9		RESISTOR 68.9K 1% .125W F TC=0+-100	28480	0698-3228
A6R47	2100-3253	7	1	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A6R48	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R49	0698-4508	0	1	RESISTOR 78.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7872-F
A6R50	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A6R51	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A6R52	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R53	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R54	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R55	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R56	0698-4492	1	1	RESISTOR 32.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3242-F
A6R57	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R58	0698-4488	3	1	RESISTOR 24.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2492-F
A6R59	0698-3226	7	2	RESISTOR 6.49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6491-F
A6R60	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R61	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R62	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R63	0757-0476	9		RESISTOR 301K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3013-F
A6R64	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A6R65	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A6R66	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A6R67	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A6R68	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R69	0757-0452	1	1	RESISTOR 27.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2742-F
A6R70	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R71	0757-0449	6		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A6R801	0698-3488	3	2	RESISTOR 442 1% .125W F TC=0+-100	24546	C4-1/8-T0-442R-F
A6R802	0698-3488	3		RESISTOR 442 1% .125W F TC=0+-100	24546	C4-1/8-T0-442R-F
A6R803	0757-0746	6	8	RESISTOR 4.75K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4751-F
A6R804	0757-0746	6		RESISTOR 4.75K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4751-F
A6R805	0757-0746	6		RESISTOR 4.75K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4751-F
A6R806	0757-0746	6		RESISTOR 4.75K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4751-F
A6R807	0757-0746	6		RESISTOR 4.75K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4751-F
A6R808	0757-0746	6		RESISTOR 4.75K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4751-F
A6R809	0757-0746	6		RESISTOR 4.75K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4751-F
A6R810	0757-0746	6		RESISTOR 4.75K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4751-F
A6R811	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R812	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R813	0757-0282	5	6	RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A6R814	0757-0282	5		RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A6R815	0757-0756	1	1	RESISTOR 18.2K 1% .25W F TC=0+-100	24546	C5-1/4-T0-1822-F
A6R816	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R817	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R818	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R819	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A6R820	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A6R821	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A6R822	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R823	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R824	0757-0451	0	2	RESISTOR 24.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2432-F
A6R825	0757-0451	0		RESISTOR 24.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2432-F
A6R826	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R827	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A6R828	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A6R829	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A6R830	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6R831	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A6R832	0698-4432	9	1	RESISTOR 2.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2101-F
A6R833	0773-0022	5	2	RESISTOR 3K 5% 5W MO TC=0+-250	27167	FP5-5-250-3001-J
A6R834	0773-0022	5		RESISTOR 3K 5% 5W MO TC=0+-250	27167	FP5-5-250-3001-J
A6R835	0757-0282	5		RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A6R836	0757-0282	5		RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A6R837	0698-3156	2	4	RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A6R838	0698-3156	2		RESISTOR 14.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F

Table 6–3. Replaceable Parts (cont'd)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6R839	0698-3156	2		RESISTOR 10,7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A6R840	0698-3156	2		RESISTOR 10,7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1472-F
A6R841	0698-4492	3	3	RESISTOR 1,69K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1691-F
A6R842	0698-4492	3		RESISTOR 1,69K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1691-F
A6R843	0757-0784	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MFAC1/8-T0-20R0-F
A6R844	0757-0784	8		RESISTOR 20 1% .125W F TC=0+-100	19701	MFAC1/8-T0-20R0-F
A6R845	0757-0393	6	2	RESISTOR 42,2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A6R846	0757-0393	6		RESISTOR 42,2 1% .125W F TC=0+-100	24546	C4-1/8-T0-42R2-F
A6R847	0698-4435	2	2	RESISTOR 2,49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2491-F
A6R848	0698-3151	7		RESISTOR 2,87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A6R849	0698-3151	7		RESISTOR 2,87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A6R850	0698-3151	7		RESISTOR 2,87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A6R851	0698-4435	2		RESISTOR 2,49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2491-F
A6R852	0698-3151	7		RESISTOR 2,87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A6R853	0698-3151	7		RESISTOR 2,87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A6R854	0698-3226	7		RESISTOR 6,49K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6491-F
A6R855	0757-0273	8		RESISTOR 3,01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A6R856	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R857	0757-0417	8	1	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A6R858	0698-4489	0	1	RESISTOR 127 1% .125W F TC=0+-100	24546	C4-1/8-T0-127R-F
A6R859	0698-3155	1		RESISTOR 4,64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R860	0698-3155	1		RESISTOR 4,64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A6R861	0757-0290	5	1	RESISTOR 6,19K 1% .125W F TC=0+-100	19701	MFAC1/8-T0-6191-F
A6S1	3101-2049	0	1	SWITCH-PB 4-STATION 20MM C-C SPACING	28480	3101-2049
A6U1	1820-1750	0	2	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN54LS123J
A6U2	1820-1750	0		IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN54LS123J
A6U3	1820-1879	4	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN54LS00J
A6U4	1820-1273	2	1	IC BFR TTL LS NOR QUAD 2-INP	01295	SN74LS28N
A6U5	1820-1878	3	1	IC GATE TTL NOR DUAL 4-INP	01295	SN5423J
A6U6	1820-1092	3	1	IC MV TTL MONOSTBL	01295	SN54121J
A6U7	1826-0400	7	1	IC TIMER TTL	04713	MC1555G
A6U8	1820-1880	7	1	IC GATE TTL LS NOR TPL 3-INP	01295	SN54LS27J
A6U401	1821-0002	5		TRANSISTOR ARRAY	01928	CA3045
A6VR1	1902-3326	4	1	DIODE-ZNR 43 V 5% DO-7 PD=.4W TC=+.08%	28480	1902-3326
A6VR807	1902-3105	7	1	DIODE-ZNR 5.62V 2% DO-7 PD=.4W TC=+.016%	28480	1902-3105
A6W4	01223-61604	5	1	CABLE ASSEMBLY, LED	28480	01223-61604
A6W4DS1	1990-0521	4	2	LED GREEN	28480	1990-0521
A6W4DS2	1990-0521	4		LED GREEN	28480	1990-0521
A6W6	01223-61606	7	1	CABLE ASSEMBLY, PULSE	28480	01223-61606
A6W9	01223-61609	0	1	CABLE ASSEMBLY, X-Y SIGN	28480	01223-61609
A6W11	01223-61611	4	1	CABLE ASSEMBLY, IMPL	28480	01223-61611
A9	01223-61901	5		SWITCH ASSEMBLY, TIME	28480	01223-61901
A9C1	0180-0228	6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A9C2	0180-0291	3	1	CAPACITOR-FXD 1UF+-10% 35VDC TA	56289	150D105X9035A2
A9C3	0160-3715	0	1	CAPACITOR-FXD .015UF +-10% 250VDC	28480	0160-3715
A9C4	0160-2212	0	1	CAPACITOR-FXD 560PF +-5% 300VDC MICA	28480	0160-2212
A9CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9MP1	01220-00604	4	1	BRACKET	28480	01220-00604
A9MP4	3130-0038	4	2	COUPLER-SWITCH "U" SHAPED) .0450 +-.0005	28480	3130-0038
A9Q1	1854-0023	9	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0023
A9R1	0757-0424	7		RESISTOR 1,1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A9R2	0757-0200	7		RESISTOR 5,62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A9R3	2100-3512	1	1	RESISTOR-VAR CONTROL CC 10K 20%	28480	2100-3512
A9R4	2100-3513	2	1	RESISTOR-VAR CONTROL CC 50K 20%	28480	2100-3513
A9R5	0698-6770	2	2	RESISTOR 100K .5% .125W F TC=0+-50	28480	0698-6770
A9R6	0698-6217	2	2	RESISTOR 200K .5% .125W F TC=0+-100	28480	0698-6217
A9R8	0698-4428	3		RESISTOR 1,69K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1691-F
A9R9	0698-3510	2	1	RESISTOR 453 1% .125W F TC=0+-100	24546	C4-1/8-T0-453R-F
A9R10	0698-6755	3	1	RESISTOR 8K .5% .125W F TC=0+-50	24546	HC4-1/8-T2-8001-D
A9R11	0698-7049	0	1	RESISTOR 3,92K .5% .125W F TC=0+-50	19701	MFAC1/8-T2-3921-D
A9R12	0698-6321	9	1	RESISTOR 9,9K .1% .125W F TC=0+-25	03888	PME55-1/8-T9-9901-B
A9R13	0698-6885	0	1	RESISTOR 20K .5% .125W F TC=0+-50	28480	0698-6885
A9R14	0698-5573	1	1	RESISTOR 50K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5002-D
A9R15	0698-6770	2		RESISTOR 100K .5% .125W F TC=0+-50	28480	0698-6770
A9R16	0698-6217	2		RESISTOR 200K .5% .125W F TC=0+-100	28480	0698-6217
A9R17	0698-6628	9	1	RESISTOR 500K .1% .125W F TC=0+-25	91637	MFF-1/8-T9-5003-B
A9R18	2100-3736	1	1	RESISTOR-VAR CONTROL CC 25K 20% 10CCW	28480	2100-3736
A9R19	2100-3207	1		RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	28480	2100-3207
A9R20	2100-3274	2		RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A100	01223-66501	1		LOW VOLTAGE POWER SUPPLY ASSEMBLY	28480	01223-66501

SECTION VII
BACKDATING/UPDATING

7–1 GENERAL

7–2 Backdating/Updating information is contained in the Service Sheets.

SECTION VIII
SERVICE

8–1 INTRODUCTION

8–2 This section contains component layouts, schematic diagrams, principles of operation and service information. These are organized as 'Service Sheets', which are identified by a large number within a square in the lower corners. Service Sheet 0 contains information for the instrument as a whole, and assists troubleshooting to board level. Other service sheets concern specific boards, see Tables 8–1 and 8–2. Schematic Diagram symbols are summarized in Table 8–3. Diagnostic test procedures are summarized under § 8–11.

Table 8–1. Index to Assemblies

	Service Sheet
Block diagram	0
A1, A1A100 Low Voltage Supply	1
A2, A2A105, A2A205, A2A9 Channel Amplifier	3, 4, 5
A3 Trigger Board	4
A4 Mother Board	5
A5, A5A8 High Voltage Supply	2
A6 Pulse/Amplifier Board	5, 6, 7
A7 High Voltage Multiplier	2
A8 High Voltage Transformer	2
A9 Time Base Board	4, 5
V1 CRT	6A
Mainframe	Figure 6–1

8–3 SAFETY CONSIDERATIONS

8–4 Although this instrument has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to ensure safe operation and to retain the instrument in safe condition (see Sections II and III). Service and adjustments should be performed only by qualified service personnel. After repair, the After Service Safety Check (§ 8–27) must be performed.

WARNING

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnection of the protective earth terminal is likely to make the instrument dangerous. Intentional interruption is prohibited.

8–5 Any adjustment, maintenance, and repair of the opened instrument with voltage applied should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

8–6 Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

8–7 Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the shortcircuiting of fuseholders must be avoided.

8–8 Whenever it is likely that the protection offered by the fuses has been impaired, the instrument must be made inoperative and secured against any unintended operation.

WARNING

Adjustments described herein are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

8–9 PRINCIPLES OF OPERATION

8–10 A description how the instrument works in general is contained in Service Sheet 0. More detailed circuit descriptions are contained in subsequent service sheets. The symbology used in block and circuit diagrams is explained in Table 8–3.

8–11 RECOMMENDED TEST EQUIPMENT

8–12 Refer to Table 1–1.

8–13 REPAIR

8–14 Any necessary repair procedures are described on the appropriate service sheet. Board layouts include a component locator (grid reference with index). Mainframe structure and components are illustrated in Figure 6–1. Reference designators and abbreviations are listed in Table 6–1.

8–15 Service Aids

8–16 25-pin extender boards are available under HP part number 5061–2160.

8–17 After-Service Safety Check

8–18 Execute the following checks when servicing is completed.

8–19 Disconnect power cord from line. Visually inspect interior of instrument for any sign of abnormal internall generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine cause and remedy.

8–20 Check cabinet/ground pin continuity in accordance with IEC/VDE. Flex the power cord while making the measurement to detect any intermittent discontinuity. Check internal ground connections on boards and frame. Also check resistance of any front or rear panel ground terminals marked ⏚.

8–21 Check cabinet/line isolation in accordance with IEC/VDE. Replace any component which results in a failure or refer to production Memo or Service Note issued by product division for alternate action.

8–22 Check line fuse to verify that the proper value is installed.

8–23 Check that safety covers are installed (Figure 6–1. MP29, 24).

8–24 Check that all cables inside are properly connected. Check that all boards and the heatsink on the chassis are properly connected.

8–25 Inform Hewlett-Packard (internally, the responsible product division) of any repeated failures in the above tests or any other safety features.

Table 8–2. Service Sheet Index

Service Sheet	Assembly	Function
0		Block Diagram, CRT connections
1	A1, A1A100	Low Voltage supply
2	A5, A7, A8	High Voltage supply
3	A2, A2A105, A2A205	Channel A/B amplifiers
4	A2, A3	Trigger circuits
5	A2, A4, A6, A9	Trigger circuits, deflection amplifiers, mother board
6	A6	Storage logic

Table 8–3. Schematic Diagram Notes (1 of 2)

The following symbols conform, as far as possible, with ANSI Y 32.2, IEEE No. 315 and ANSI Y32.14 (for the logic symbols). These standards should be consulted when further informations is required.

General

Units

Resistance values are in ohms, capacitance values in microfarads and inductance values in microhenries unless otherwise noted.

P/O — Part of

✳ — Asterisk denotes a factory selected value. The value shown is the nominal value.

Encloses front panel nomenclature.

Encloses rear panel nomenclature.

Heavy line indicates signal path.

Heavy dashed line indicates primary feedback path.

947 — Wire colour code. Same as resistor colour code. First number is wire body colour.

Wire or plug used as link.

Test point in a circuit. Point may/may not be identified on P.C. board.

Used with trimmer potentiometers or capacitors to indicate screwdriver adjustment.

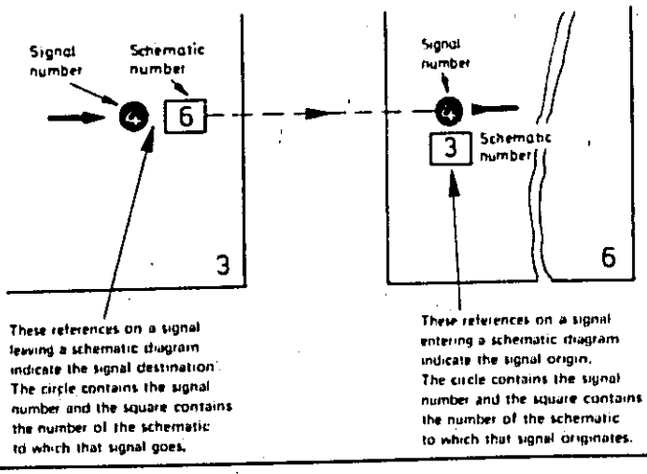
Direct connection to earth.

Ground connection to instrument chassis or frame.

Used when a number of common-return connections are at the same potential. If there is more than one such system in the same circuit, numbers are written in the triangles, so that all connections with the same potential have the same number.

xV — Specific potential difference with respect to a potential reference level, eg. +10 V

Schematic Referencing



These references on a signal leaving a schematic diagram indicate the signal destination. The circle contains the signal number and the square contains the number of the schematic to which that signal goes.

These references on a signal entering a schematic diagram indicate the signal origin. The circle contains the signal number and the square contains the number of the schematic to which that signal originates.

Components

Normally open toggle switch. Circles (O) are used for the contacts to indicate a locking type switch.

Spring return, 2-position transfer switch. Triangle (▲) are used for the contacts to indicate a non locking type switch.

2-position, 2-pole slide switch.

Air cored inductor.

Air cored transformer. The dot (●) is used, when necessary, to indicate instantaneous polarity.

Iron core

Ferrite core

bead — Ferrite bead

Varactor diode

Multi junction diode

Diode

Zener diode

Schottky diode

Light Emitting Diode (LED)

Photodiode

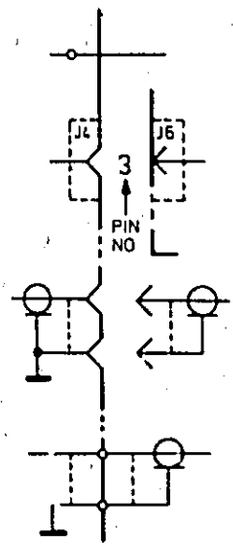
Fuse

Neon

Filament lamp

Table 8–3. Schematic Diagram Notes (2 of 2)

Terminals and Connectors



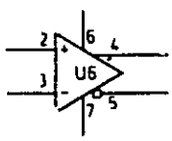
Soldered connection.

Example of fixed male and female connectors with plug and socket and contact designators, eg. P.C. board edge connector and socket.

example of bulkhead mounted coaxial socket with free coaxial plug and cable.

example of coaxial cable with termination soldered to P.C. board.

Analog Symbols



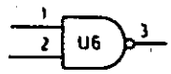
Operational amplifier

Voltage source

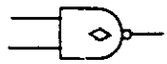
Current source

Logic Symbols

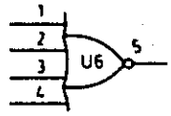
Positive logic is used unless otherwise specified.



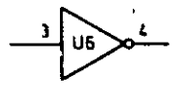
2-input NAND gate



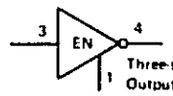
open collector



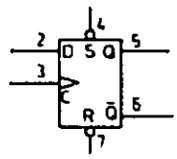
4-input NOR gate



Inverter

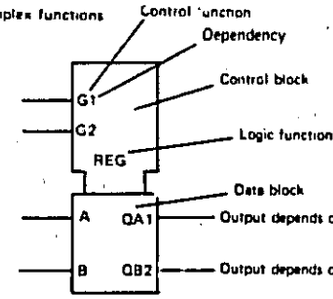


Three-state device. Output is high-impedance when EN is false, irrespective of input. Normal operation when EN is true.

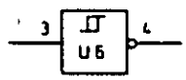


Flip-flop

Complex functions



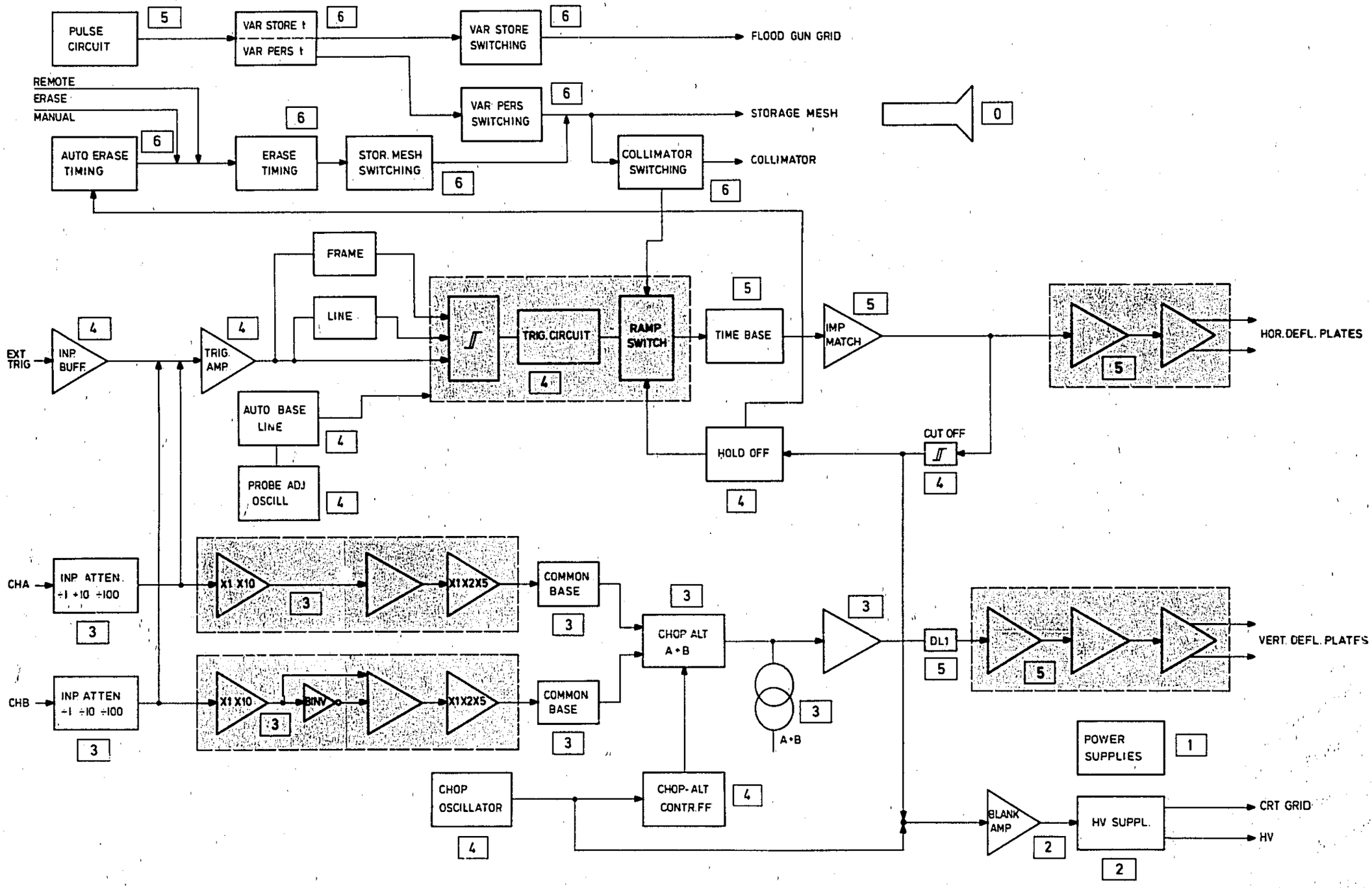
Control functions:
G-gate, C-clock EN-3-state, R-reset (Q low) S-set (Q high), ↑ (↓)-count up (down) → shift, > edge-triggered.
Logic functions:
REG-register, SEL-selector CNTR-counter, (DE)MUX-(de)multiplexer



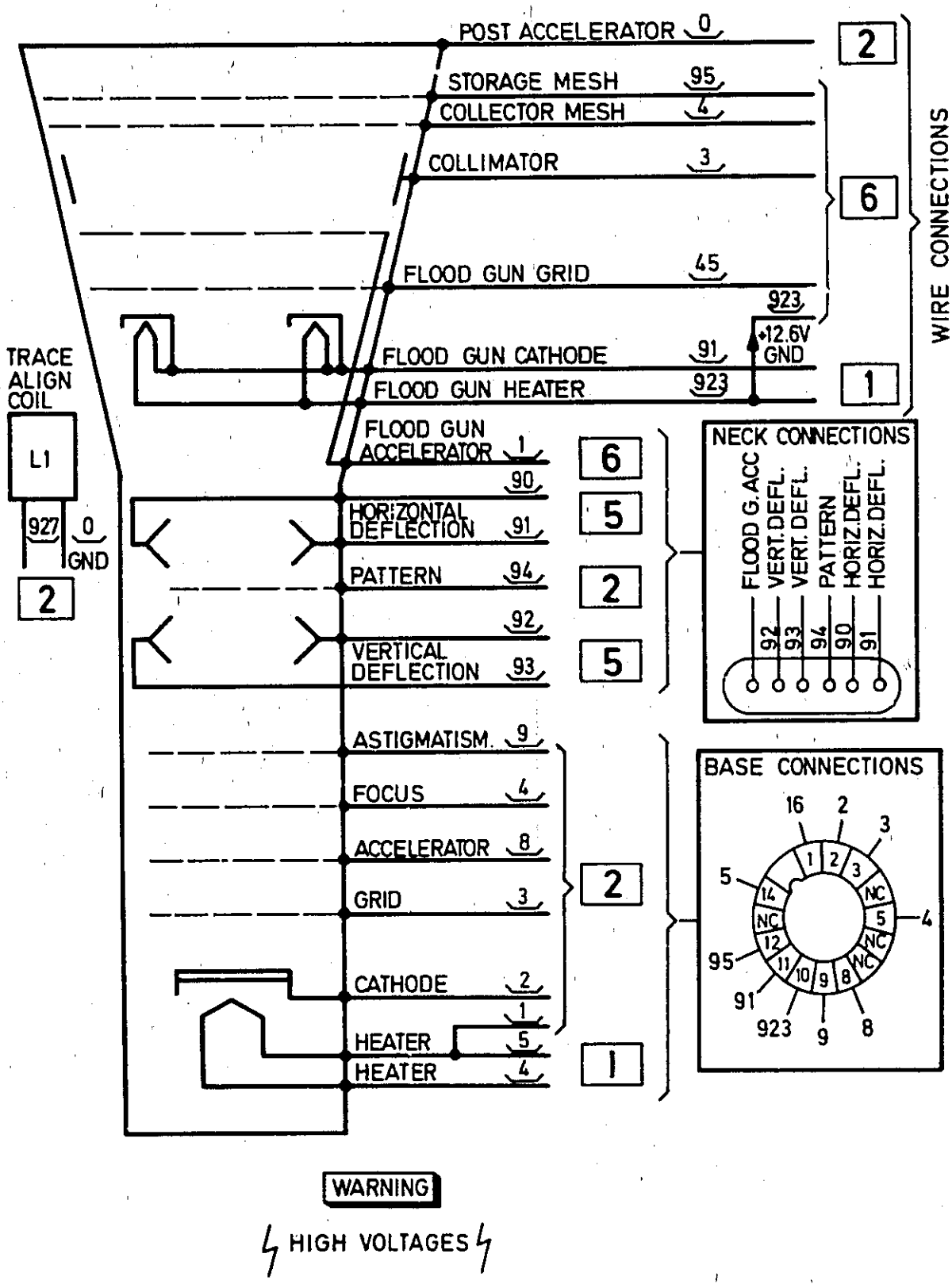
Schmitt trigger

Wired AND connection

Wired OR connection

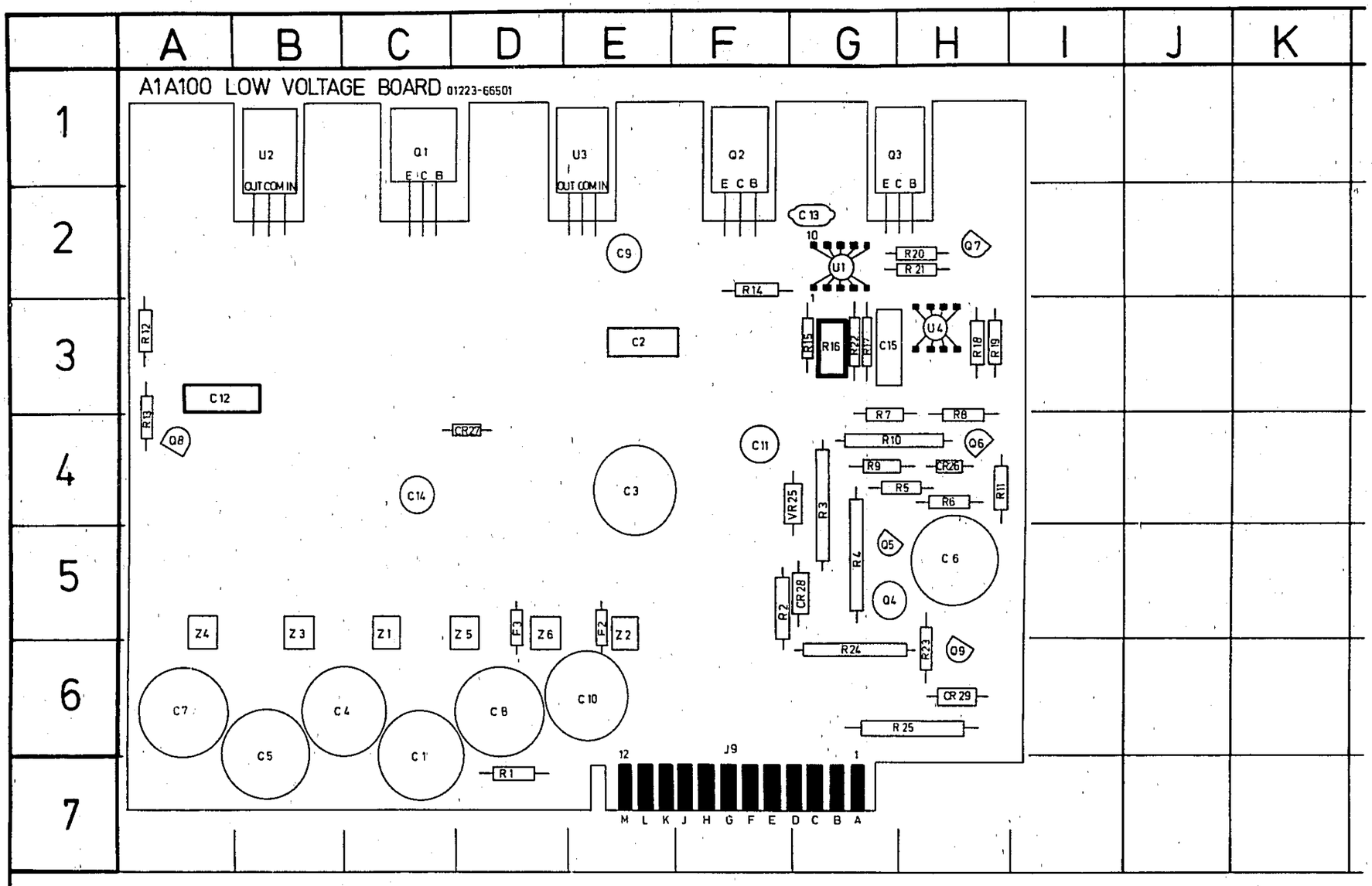


0 BLOCK DIAGRAM



WARNING

HIGH VOLTAGES



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C6/7	U1	G2
C2	E3	U2	B1
C3	E4	U3	E1
C4	B6	U4	H3
C5	B6/7	VR25	F4
C6	A5	Z1	C5
C7	A6	Z2	[illegible]5
C8	D6	Z3	[illegible]5
C9	E2	Z4	[illegible]5
C10	D/E6	Z5	[illegible]/D5
C11	F4	Z6	D5
C12	A3–4		
C13	G2		
C14	C4		
C15	G3		
CR26	H4		
CR27	C/D4		
CR28	F/G5		
CR29	H6		
F2	E5		
F3	D5		
Q1	C1		
Q2	F1		
Q3	G/H1		
Q4	G5		
Q5	G5		
Q6	H4		
Q7	H2		
Q8	A3		
Q9	H5/6		
R1	D7		
R2	F5		
R3	G4/5		
R4	G4/5		
R5	G/H4		
R6	H4		
R7	G/H3		
R8	H3		
F9	G4		
R10	G/H4		
R11	H4		
R12	A3		
R13	A3/4		
R14	F3		
R15	G3		
R16	G3		
R17	G3		
R18	H3		
R19	H3		
R20	H2		
R21	H2		
R22	G3		
R23	H5/6		
R24	G5/6		
R25	G/H6		

8–1–1 LOW VOLTAGE SUPPLY

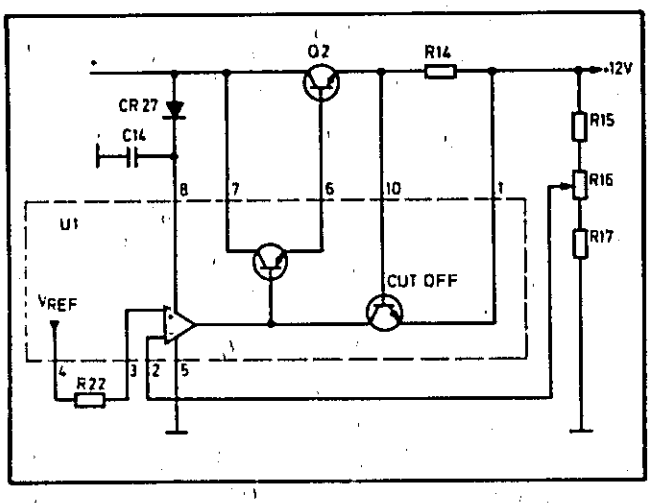
8–1–2 The Low Voltage power supply provides +5 V, +156 V, +100 V, +12.6 V, +12 V and −12 V. All supplies are regulated. The +156 V, +100 V, +12.6 V and −12 V supplies are referenced to the +12 V supply.

8–1–3 +5 V Supply

8–1–4 The output of the 7 V ac secondary of AIT1 is rectified by Z1 and regulated by U3.

8–1–5 +12 V Supply

8–1–6 The 12 V power supply is a fully regulated current limiting supply. A sample of the output voltage is applied to U1 pin 2 inverting input and is compared with an internal reference voltage coming from pin 4 via R22 to the non-inverting input pin 3. The difference between these two voltages causes an error output from pin 6 which is applied to the series-regulator Q2. When the output voltage decreases, the error voltage causes Q2 to conduct more and supply more current to the load. When the output voltage increases, the error voltage tends to cut off Q2 thus reducing the output current and lowering the output voltage.



Current limiting is accomplished by R14 and a cut-off transistor in U1. As the current output of Q2 increases, the voltage drop across R14 increases. When the voltage drop across R14 is sufficient to cause the cut-off transistor to conduct (U1 pin 10 and pin 1), it removes the error signal from the base of Q2 causing the output current to decrease, thereby reducing the output voltage. CR27 and C14 reduce ripple.

8–1–7 −12 V Supply

8–1–8 The −12 V supply is also a series regulated, current limiting supply. A sample of the −12 V is compared with a sample of the +12 V reference supply. When the −12 V supply increases, less current is supplied from U4b pin 7 to the base of Q3 and the current through Q3 is reduced. If more current is required from the −12 V load, the −12 V level decreases. This causes the output current of U4b pin 7 to increase and Q3 to deliver more current. The current through Q3 may increase until the voltage drop across R21 is sufficient to switch on Q7. The output current of U4b pin 7 is thus fed to ground and current limiting starts.

8–1–9 +12.6 V Supply

8–1–10 The +12.6 V supply uses a precision 5 V voltage regulator (U2) hooked up to +7.6 V on the emitter of Q8. U2 has an internal current limiter.

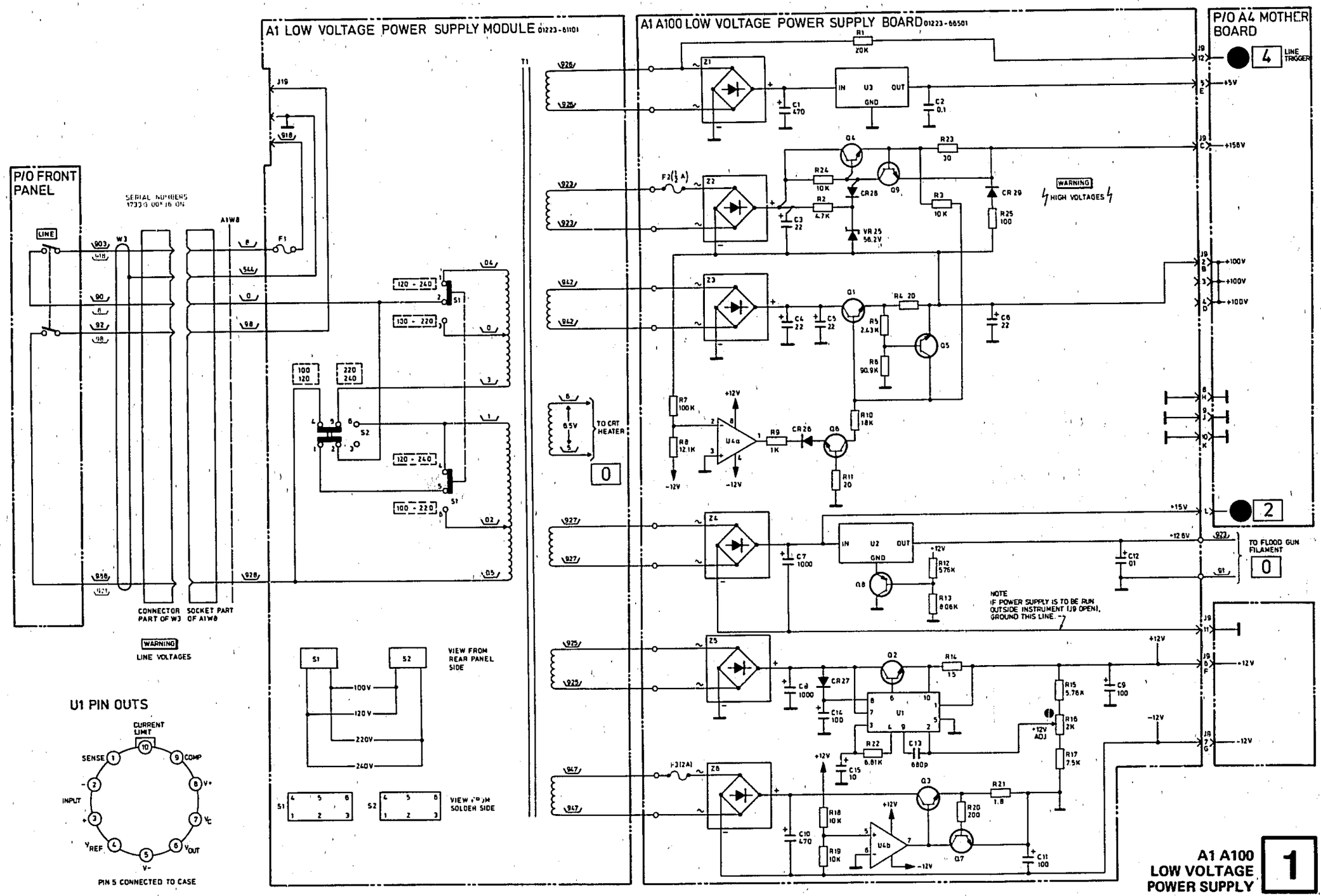
NOTE: The negative side of C7 must be grounded when operating the power supply separately for trouble shooting.

8–1–11 +100 V Supply

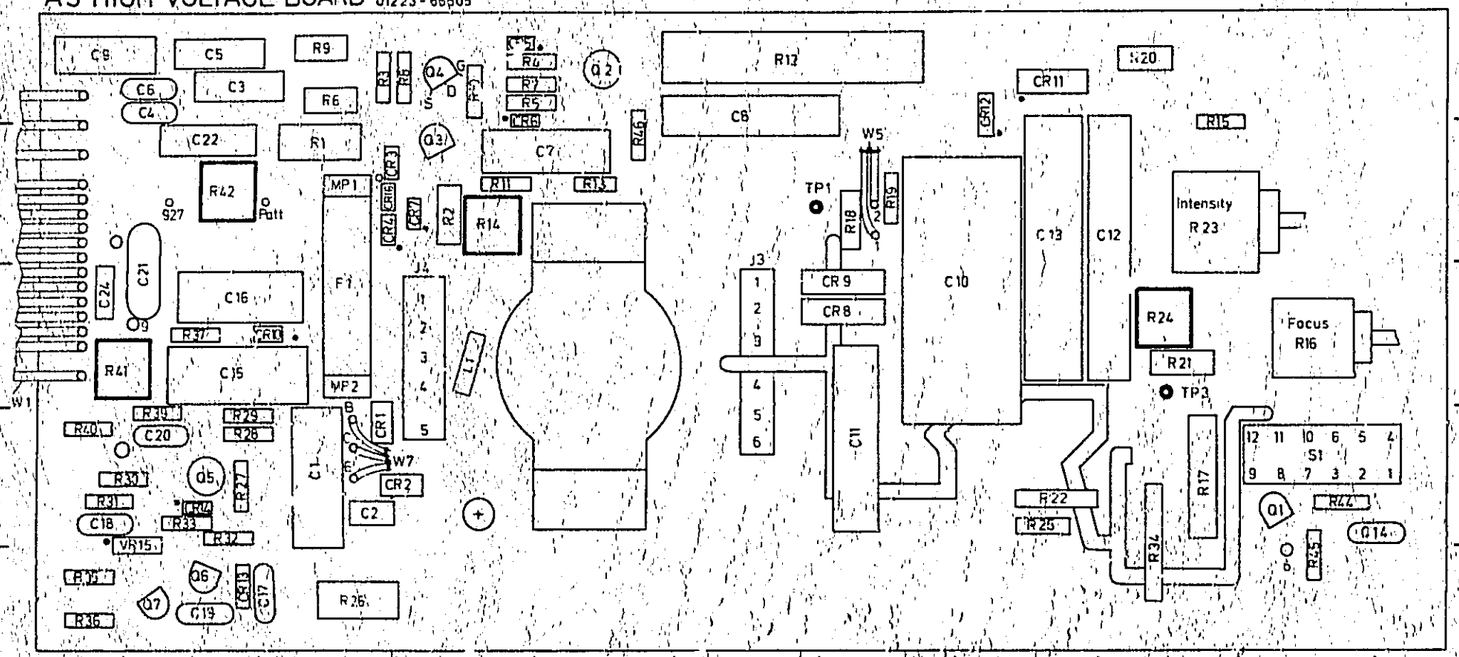
8–1–12 A sample of the +100 V output voltage is fed via R7 to the inverting input of U4a and compared with the stabilized −12 V. The error voltage causes Q1 (via Q6) conduction to vary according to the load. Current limiting is accomplished by Q5. If the voltage drop across R4 is sufficient, Q5 turns on, the base current of Q1 goes down and Q1 cuts off. R4 and R5, in conjunction with R6, give a "foldback" characteristic to the supply.

8–1–13 +156 V Supply

8–1–14 The +156 V supply is a +56 V regulated, current limited supply hooked up to the +100 V supply. The base current of Q4 is supplied via R24 and the base voltage stabilized to approx. 56.8 V by VR25 and CR28. Current limiting is accomplished by Q9 and R23. If the +156 V supply is shorted, CR29 conducts and activates Q5 (current limiter and foldback of the +100 V supply). R3 is used to start the +100 V supply during switch on and works as a load for the 156 V supply when the power supply assembly is operated separately for trouble-shooting.


A1 LOW VOLTAGE POWER SUPPLY MODULE 01223-61101
A1 A100 LOW VOLTAGE POWER SUPPLY BOARD 01223-66501
P/O A4 MOTHER BOARD
P/O FRONT PANEL
SERIAL NUMBERS
LINE
F1
A1W8
W3
J19
T1
120 - 240
100 - 220
100 120
220 240
S1
S2
TO CRT HEATER
6.5V
0
CONNECTOR PART OF W3
SOCKET PART OF A1W8
WARNING
LINE VOLTAGES
VIEW FROM REAR PANEL SIDE
100V
120V
220V
240V
VIEW FROM SOLDER SIDE
U1 PIN OUTS
CURRENT LIMIT
SENSE
COMP
INPUT
V+
VC
VREF
VOUT
V-
PIN 5 CONNECTED TO CASE
F2(½A)
F3(2A)
R1 20K
C1 470
C2 0.1
U3
IN
OUT
GND
Q4
R23 30
R24 10K
R2 4.7K
C3 22
CR28
Q9
R3 10K
CR 29
R25 100
VR 25 56.2V
WARNING
HIGH VOLTAGES
C4 22
C5 22
Q1
R4 20
R5 2.43K
R6 90.9K
Q5
C6 22
R7 100K
R8 12.1K
U4a
R9 1K
CR26
Q6
R10 18K
R11 20
+5V
+15V
+156V
+100V
+12V
-12V
+12.6V
TO FLOOD GUN FILAMENT
NOTE
IF POWER SUPPLY IS TO BE RUN OUTSIDE INSTRUMENT TJ9 OPEN, GROUND THIS LINE.
R12 576K
R13 806K
Q8
C7 1000
U2
C12 01
Q2
R14 15
C8 1000
CR27
C14 100
U1
R15 5.76K
R16 2K
+12V ADJ
R17 7.5K
C9 100
R22 6.81K
C13 680p
C15 10
Q3
R21 1.8
R18 10K
R19 10K
U4b
R20 200
Q7
C10 470
C11 100
LINE TRIGGER
A1 A100 LOW VOLTAGE POWER SUPPLY
1

A5 HIGH VOLTAGE BOARD 01223-66505



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C4	C19	B5	CR14	B4	R7	D/E1	R25	H4	R44	J4
C2	C4	C20	B4	F1	C3	R8	D1	R26	C5	R45	J4/5
C3	B1	C21	B2/3	J1	B/C3	R9	C1	R27	B4	R46	E2
C4	B1	C22	B2	MP1	Q2	R10	D1	R28	B/C4	R47	D3
C5	B1	C24	A3	MP2	C3	R11	D2	R29	B/C4	S1	J4
C6	B1	CR1	C4	Q1	J4	R12	F/G1	R30	A4	VR15	A/B4
C7	D/E2	CR2	C/C4	Q2	E1	R13	E2	R31	A4	W1	A1-3
C8	F2	CR3	C2	Q3	D2	R14	D2	R32	B4	W3	C4
C9	A1	C14	C2	Q4	D1	R15	I2	R33	B4	W7	G2
C10	G/H2/3	CR5	D1	Q5	B4	R16	J3	R34	J5		
C11	G4	CR6	D2	Q6	B5	R17	I4	R35	A5		
C12	H/I2/3	CR7	D2	Q7	B5	R18	G2	R36	A5		
C13	H/I2/3	CR8	F/G2	R1	C2	R19	G2	R37	J3		
C14	J4	CR9	F/G3	R3	D2	R20	I1				
C15	B/C3	CR10	C3	R3	C1	R21	I3	R39	B4		
C16	B/C3	CR11	H1	R4	D/E1	R22	H/I4	R40	A4		
C17	C5	CR12	I2	R5	D/E1	R23	I2	R41	A/B3		
C18	A4	CR13	B5	R6	C1	R24	I3	R42	H2		

8–2–1 HIGH VOLTAGE SUPPLY

8–2–2 High Voltage Oscillator

8–2–3 The high voltage oscillator consists of Q1, A8 HV Transformer Assembly and a regulation circuit. When the instrument is turned on, a +15 V unregulated supply is applied to Q1 turning it on. As a current flows through primary winding A1, a voltage is induced in the second primary winding 2. This voltage is applied via CR1 to the base of Q1 as positive feedback. When conduction through Q1 reaches saturation, the magnetic field developed in winding 1 starts to collapse. This induces a reverse voltage in winding 2 causing reduced conduction of Q1. With varying conduction of Q1, the circuit oscillates at a rate determined by the inductance and capacitance of the oscillator circuit. The magnitude of the oscillations, and consequently the output of the HV supply, is controlled by a regulation circuit.

8–2–4 High Voltage Regulator

8–2–5 Part of the −2460 V generated by secondary winding 4 and rectified by CR8 is used as a reference voltage and applied to the gate of Q4. This voltage is reduced by resistor network R12/R46/R13/R14, amplified by Q4/Q3/Q2 and applied through winding 2 and CR1 to the base of Q1. Depending on the reference (cathode) voltage, Q1 changes the oscillator amplitude to stabilize the reference voltage. The cathode voltage (reference) can be adjusted by R14 (HIGH VOLTAGE ADJ.) which influences the feedback voltage to Q4.

8–2–6 High Voltage Rectifiers

8–2–7 The CRT cathode voltage is developed by winding 4, rectified by CR8 and filtered by C11, R18 and C10. R19 couples one end of the CRT heater to the cathode. The focus voltage is derived by the divider chain R15, R17, R34 and adjusted by R16.

8–2–8 Winding 4 also provides ac energy for a high voltage tripler which develops the post accelerator voltage.

8–2–9 The CRT grid voltage is developed by winding 3 and rectified by CR9. Smoothing, intensity adjustment and maximum intensity limit setting are carried out by C13, R23 and R24. To blank the CRT beam, the junction R25/C12 (the 'earthy end' of the grid voltage supply) is referenced to zero volts by the blanking amplifier. To turn the beam on, this level is changed to approx. +33.5 V. Thus the grid voltage is approx. −2510 V (i.e. −2543 + 33.5 V) for beam on and approx. −2543 V for blanking. R20, CR11 and CR12 prevent the grid from becoming more positive than the cathode.

8–2–10 A −130 V supply for the astigmatism adjustment and the pulse amplifier board is derived from winding 5, rectified by CR10 and filtered by C16, R37 and C15.

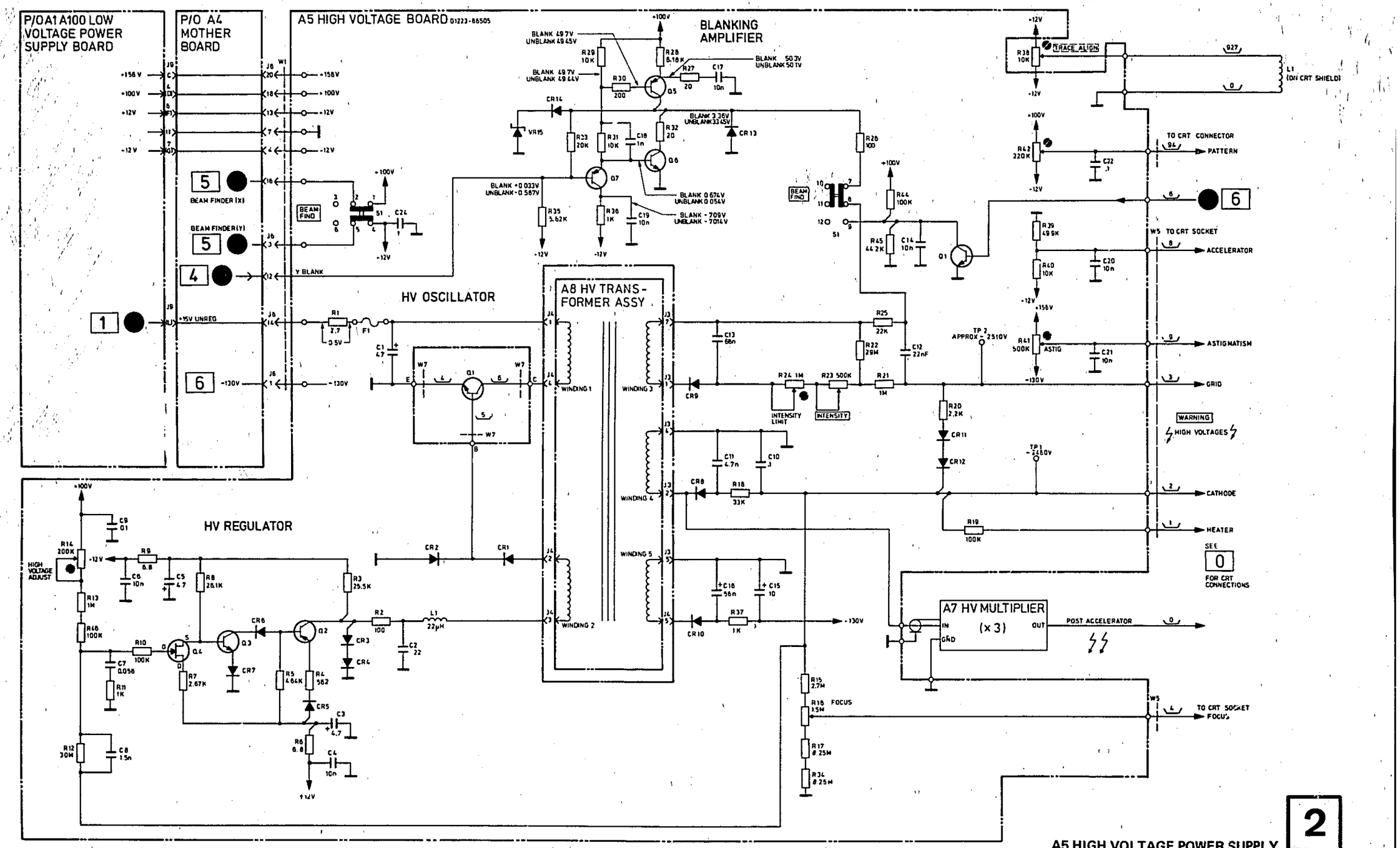
8–2–11 Blanking Amplifier

8–2–12 The blanking amplifier (Q5, Q6, Q7) suppresses the CRT beam by pulling the CRT grid voltage from −2510 to −2543 V. The amplifier is driven via A3R58 by A3U12 pin 8 (Service Sheet 4) which switches to a high level:

during retrace,
during switching in chop operation,
and when the Z input is pulled low.

8–2–13 In the beam-on condition, A3U2 pin 8 is low and Q7 base is at approx. −0.6 V. Consequently, Q7 conducts, and its approx. +0.05 V emitter voltage cuts Q6 off. Q5's current therefore flows through CR14 and VR15, setting up approx. 33.5 V at the collector. This is applied via R26 to the 'earthy end' of the CRT grid power supply so that the beam-on grid potential of approx. −2510 V (i.e. −2510 V + 33.5 V) is achieved.

8–2–14 When A3U2 pin 8 goes high, A3R41 and A3CR4 apply +5.6 V to A3R58, and Q7 base rises to approx. +0.03 V. Q7 turns off and Q6 conducts Q5's current to ground. Consequently, the CR14/VR15 voltage collapses, the Q5 collector falls from +33.5 V to near-zero, and the CRT grid voltage is pulled from −2510 V to −2543 V for the beam-off condition.



A5 HIGH VOLTAGE POWER SUPPLY

2

A2 AMPLIFIER BOARD 01223-66502

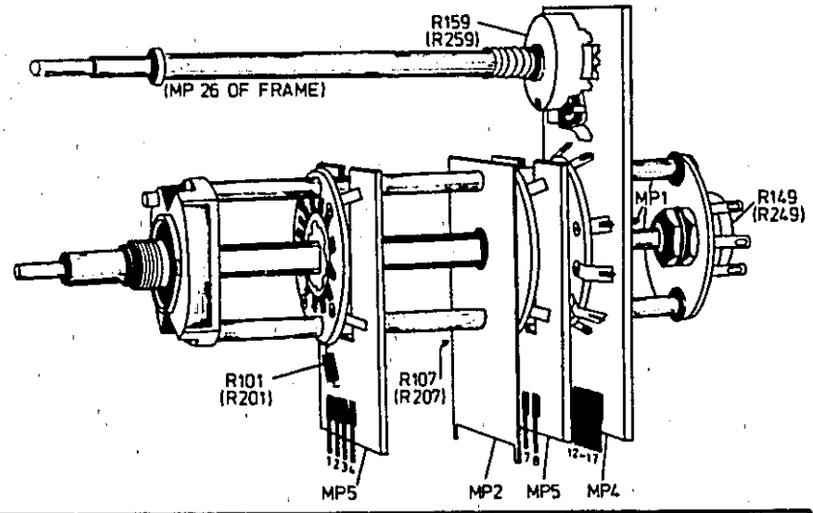
REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D7	C231	J3
C2	E7/8	C232	G5
C3	C7	C234	G5
C4	D6	C301	J7
C25	I7	C304	H5/6
C28	E8	CR1	D8
C29	F7	CR2	C7
C30	E7	CR3	H7
C31	F/G7	CR8	G8
C32	F/G8	CR9	I6/7
C33	D5	CR10	J6/7
C40	J8	CR101	E/F1
C41	I8	CR102	E/F2
C49	H/I7	CR106	G2
C101	B2	CR110	E3
C102	D2	CR111	I2
C103	C2	CR112	I2
C104	D2	CR201	E/F4
C105	D1	CR202	E/F4
C106	C1	CR206	G5
C107	D2	CR210	E3
C108	E2	CR211	I4
C112	G1	CR212	I4
C115	F1	CR301	I5/6
C116	G2	CR302	I5/6
C123	I2	CR303	I5/6
C126	K2	CR304	I5/6
C127	J3	CR309	I5/6
C128	J2	CR311	I5/6
C129	J2	CR312	H5/6
C130	J2	CR313	H5/6
C131	J1	J2	B8
C132	G3	J8	D6
C134	G3	J11	A6
C201	B4	J12	A2
C202	D5	J13	A4
C203	C5	L301	I5/6
C204	D4/5	Q1	C7
C205	D4	Q2	C7
C206	C4	Q11	H7
C207	D4	Q12	H7
C208	E4	Q13	H6
C212	G4	Q14	I7
C215	F3	Q15	I6
C216	G5	Q16	I6
C223	I4	Q17	I6
C226	J3	Q25	I7
C227	J5	Q101	F2
C228	J4	Q103	G2
C229	J4	Q104	G2
C230	J5	Q107	H1

TO DS1 ON FRONT PANEL

SERIAL NUMBERS
1727G 00486 ON

A2 A105 (205) VOLTS/DIV SWITCH ASSEMBLY

01223-61902



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
Q109	J2	R102	C/D2	R144	H2	R205	E 4/5	R245	H4	R305	K7
Q110	J2	R103	C/D2	R145	G/H2	R206	E4	R246	I3	R306	J6
Q201	F4	R104	C/D2	R146	H/I1	R208	E4/5	R247	H4	R307	K6
Q203	G5	R105	D/E2	R147	H2	R209	E4	R248	I3	R308	J7
Q204	G/H5	R106	D/E2	R148	I1	R211	E/F4	R250	J4	R315	K7
Q207	H4	R108	E2	R150	J2	R212	E/F4	R251	J3	R316	I5/6
Q209	J4	R109	E2	R151	J1	R213	E/F4	R252	J3	R318	J5/6
Q210	J4	R111	E/F1	R152	J1	R214	E5	R253	J4	R319	J6
Q301	J7	R112	E/F2	R153	J2	R215	F4	R256	J4	R320	J5/6
Q302	J/K7	R113	E/F2	R156	J2	R216	F4	R257	J4	R321	H5/6
Q303	J6	R114	E2	R157	J1	R217	F5	R260	J5	R322	H5/6
R1	C/D7	R115	F2	R160	J2	R218	F5	R262	J3	R407	H/I7/8
R2	D7	R116	F1	R162	J1	R219	G4	R263	J3/4	R408	I8
R3	C7	R117	F2	R163	J1	R220	F4	R265	H4	R409	H8
R4	D7	R118	F2	R165	H2	R221	F5	R266	H4	R410	H7
R5	D7	R119	G2	R166	H2	R222	F5	R267	I4	R411	I8
R6	D8	R120	F1	R167	I2	R223	G4	R268	I4	S1	A3
R7	E6	R121	F2	R168	I1	R224	G4	R269	I4	S2	A7
R8	C8	R122	F2	R169	I2	R225	G4	R270	H/I4	S3	F/G6
R9	C7	R123	G2	R170	H2	R226	G4	R271	I4	U1	B/C8
R10	C8	R124	G2	R171	I2	R227	G3	R272	I5	U101	F/G2
R11	C8	R125	G2	R172	I2	R228	G3	R273	I4	U102	I2
R42	G7	R126	G2	R173	I2	R229	G5	R274	I5	U201	F/G4
R43	I7	R127	G1	R174	I2	R230	G5	R275	H/I5	U202	I4
R44	H8	R128	G1	R175	H2	R231	H5	R276	J4	VR6	H8
R45	H7	R129	G3	R176	J2	R232	F3	R277	J4	VR7	H8
R47	H7	R130	G2	R177	J2	R233	G5	R278	J5	VR19	I7/8
R48	I7	R131	H2	R178	J3	R234	G3	R279	J5	VR104	E/F1
R49	H7	R132	F1	R179	J3	R235	E/F3	R280	J3	VR105	E/F2
R50	H6	R133	G2	R180	J1	R236	E/F4	R281	J5	VR113	D3
R51	H6	R135	E/F1	R181	J3	R237	G3	R282	H5	VR204	E/F3
R62	H6	R136	E/F2	R182	H2	R238	H3	R283	H5	VR205	E/F4
R63	I7	R138	H1	R183	H2	R239	H3	R284	J4	VR308	J6
R64	J7	R139	H1	R184	J2	R240	H4	R285	J4	C305	K5
R65	J7	R140	H1	R185	J2	R241	G4	R301	J/K6	C306	J7
R66	J6	R141	G2	R202	C/D4	R242	I3	R302	J7	R309	K5
R97	I7	R142	H/I1	R203	C/D4	R243	H/I4	R303	K7	R310	J8
R98	H6	R143	H/I1	R204	C/D4	R244	H4	R304	J7		
R101	B6										

8–3–1 CHANNEL A AND B AMPLIFIERS

8–3–2 Input Attenuator

8–3–3 The input impedance on all ranges of the VOLT/DIV switch is one megohm shunted by a capacitance of approx 30 pF. The attenuator divides the input signal by 1 in the 2 mV/DIV to 100 mV/DIV ranges. The .2 V/DIV to 1 V/DIV ranges are divided by 100. Frequency compensation maintains the same ratios at high frequencies.

8–3–4 Preamplifier

8–3–5 The preamplifier is a three-stage differential amplifier with switched gain control and input protection. Diodes CR101/VR104 and CR102/VR105 limit excessive signal swings from the attenuator to approximately ± 4.2 V.
The signal is applied to the first differential amplifier stage at pin 6 of U101 b/d via source-follower Q101 and emitter-follower U101C. In conjunction with the input attenuator, ranging is accomplished by selecing different emitter current paths in the first and the third preamplifier stage. In the first stage, this is effected by switches Q103 and Q104 and in the third stage by U102b, U102a and U102e. Example: In the 2 mV, 5 mV and 10 mV positions, the VOLTS/DIV switch connects the voltage from the junction of R182 and R183 (approx −6 V) to the base of Q104. Q103 is cut off and Q104 routes the emitter base current of U101b and U101d through CR106a R125 and CR106b R126 respectively. In ranges 20 mV to 10 V, Q104 is switched off and Q103 conducts. The following table shows which switches are active (conducting) in the different VOLT/DIV ranges.

8–3–6 When switching the gain of the first differential amplifier stage a small unbalance may occur. This is compensated by adjusting R114. The second preamplifier is balanced by adjusting R148. The output amplitude of the second stage can be reduced by VERNIER R149 which can be set from the front panel. Overall gain for channel A is adjusted by R162 which is part of the third preamplifier stage. R175 is used to adjust the balance of the third stage.

8–3–7 Channel B is equivalent to channel A except for the connections from the first to the second preamplifier stage. When B INV is selected, the signal is inverted by reversing the input of the second preamplifier stage (Service Sheet 3A). Balance for channel B and B INV is adjusted with A2 R237.

8–3–8 Common base stages Q110 and Q109

8–3–9 For internal triggering, one output of the third preamplifier stage is buffered by common base stage Q110 and fed to the sweep circuits. The other output is buffered by the common base stage Q109 and applied to the CHOP/ALT control circuit. In this stage, the signal can be offset by a current derived from the vertical position potentiometer R159.

8–3–10 Chop/Alt Control

8–3–11 The CHOP/ALT control switch consists of CR301, CR302, CR303 and CR304. The diodes are biased by the CHOP/ALT control flip-flop A3U8a (Service Sheet 4). During channel A operation, A3U8a

INPUT DIVISION FACTOR	VOLT/DIV RANGE	Q103 X1	Q104 X10	U102b X1	U102a X2	U102e X5
1	2 mV		●			●
	5 mV		●		●	
	10 mV		●	●		
	20 mV	●				●
	50 mV	●			●	
	.1 V	●		●		
10	.2 V	●				●
	.5 V	●			●	
	1 V	●		●		
100	2 V	●				●
	5 V	●			●	
	10 V	●		●		

● = ACTIVE (conducting)

$\overline{Q}$ output is low. This causes CR303 to conduct and CR304 to cut off and thus blocks the channel B signal. As Q output of A3U8a is high, CR301 is reverse biased (cut off). CR302 conducts allowing the channel A signal to pass. During channel B operation, the situation is reversed so that only the B signal is displayed. R322/CR312 and R321/CR113 make the low-high transition of A3U8a outputs faster in CHOP or ALTERNATE modes.

8–3–12 Current Source Q303

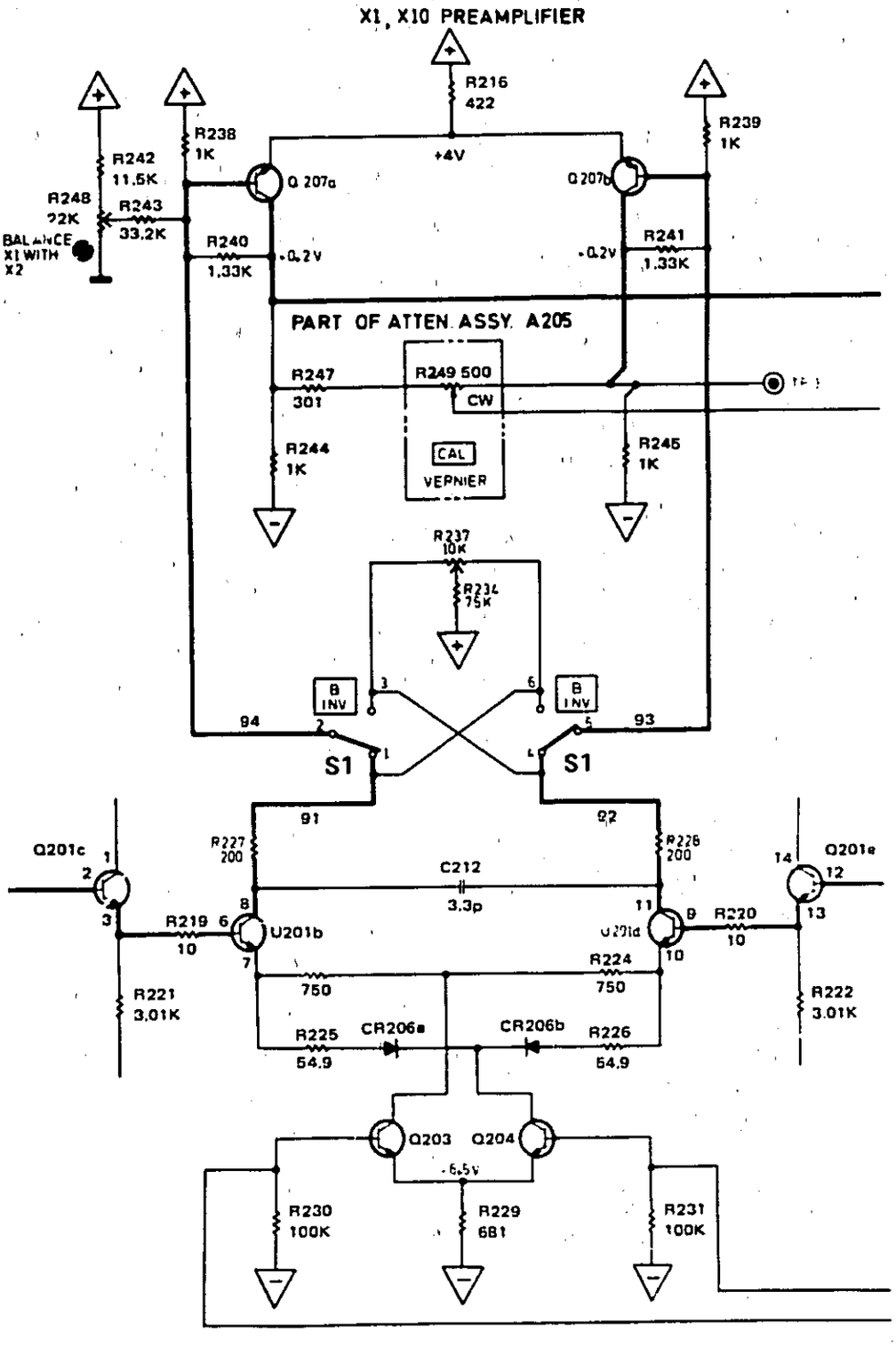
8–3–13 When A+B mode is selected, Preset and Clear of A3U8a are low, causing Q and $\overline{Q}$ outputs to go high. CR301 and CR303 are cut off. By switching ground to the junction of R316 and CR309, Q303 is enabled. Q303 compensates the larger currents which would otherwise be produced by the sources at the outputs of channel A and channel B amplifiers. CR302 and CR304 are forward biased. With both diodes conducting, a composite signal (algebraic addition of both channel signals) is applied to the vertical output amplifier via the delay line driver.

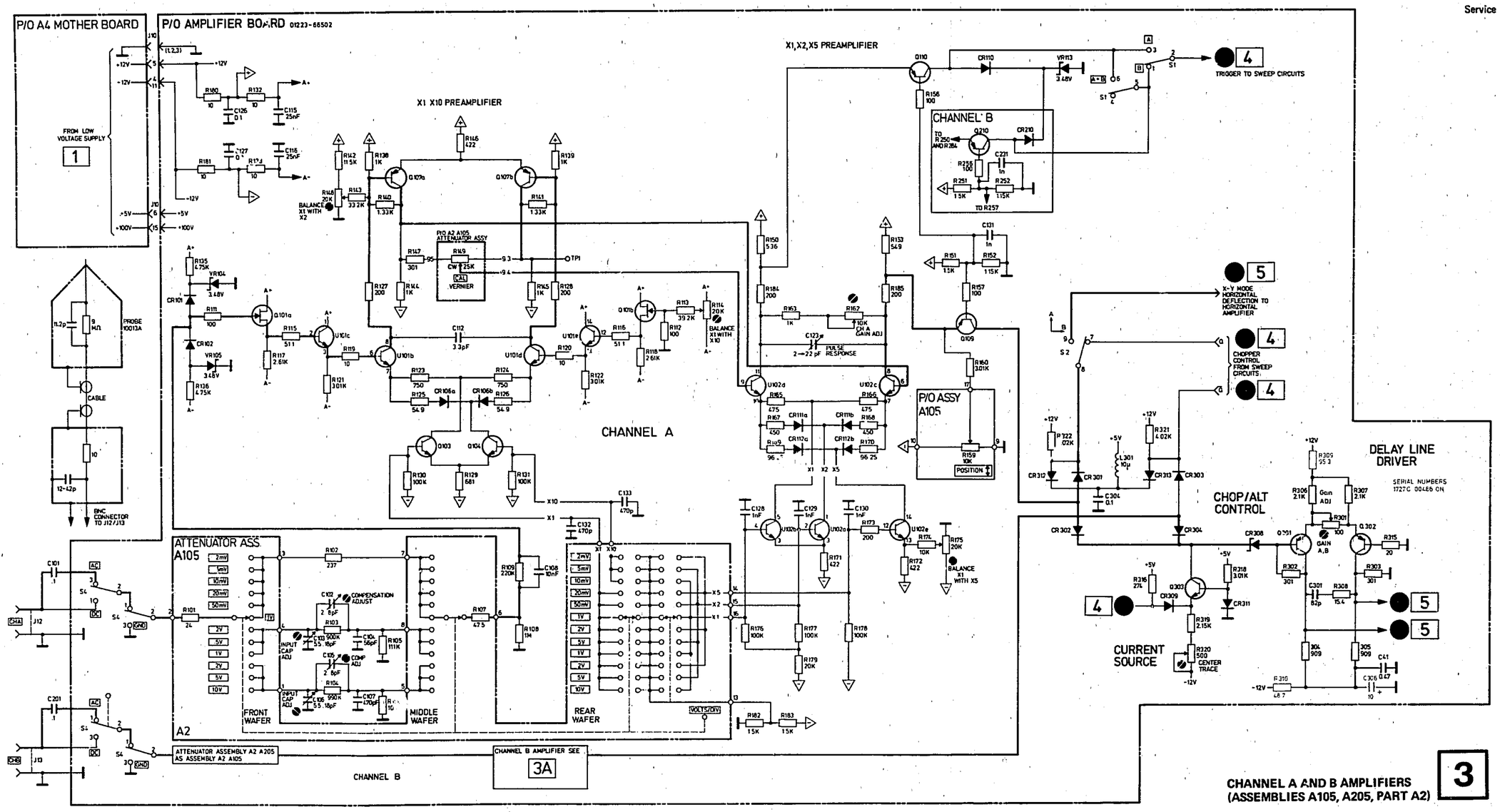
8–3–14 Delay-Line Driver

8–3–15 The signal from the CHOP/ALT control circuit is applied to the delay-line driver Q301 and Q302. The signal is then delayed by approx 160 ns and applied to the differential amplifier Q417 and Q418. Two transistors within U401 form a differential amplifier. The gain characteristics over the full voltage range are linearized by using the emitter base diodes of two transistors in U401. When differential amplifier U401 is in saturation, CR408 or CR409 start limiting.

CHANNEL B AMPLIFIER

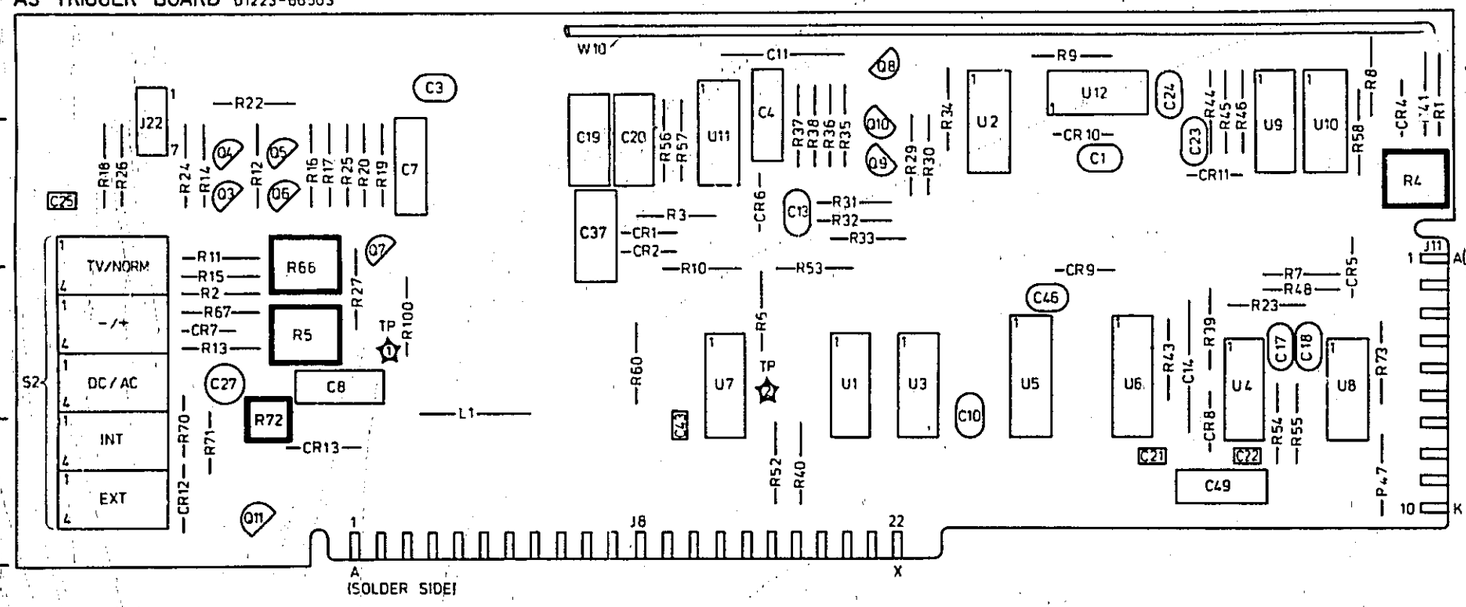
NOTE: The only difference, functionally, between CHANNEL A and CHANNEL B amplifiers is the inclusion of the B INV switch, as shown below. Everything else is identical, CHANNEL A utilising 100 series reference designators, CHANNEL B utilising 200 series reference designators.



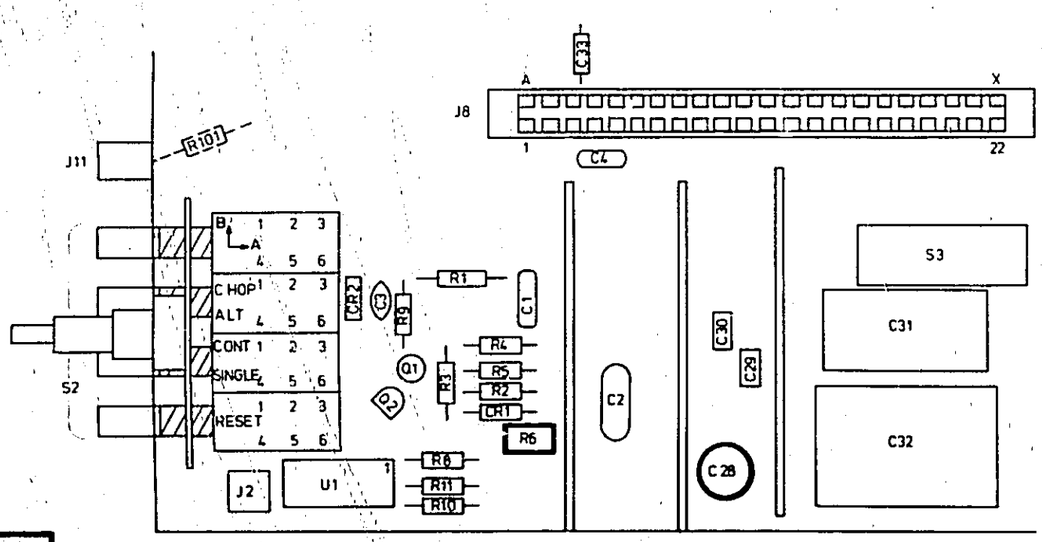


CHANNEL A AND B AMPLIFIERS (ASSEMBLIES A105, A205, PART A2) **3**

A3 TRIGGER BOARD 01223-66503



P/O A2 AMPLIFIER BOARD Complete Layout on Service Sheet 3



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C3	C/D1	C49	I4	Q9	G2	R19	C2	R43	I3	S2	A3
C4	F1/2	CR1	E2	Q10	G2	R20	C2	R44	I1/2	U1	F3
C7	C2	CR2	E2	Q11	B4	R22	B1	R45	I1/2	U2	G1/2
C8	C3	CR4	J1/2	R1	J1/2	R23	I3	R46	I1/2	U3	G3
C10	G3	CR5	J2/3	R2	B3	R24	B2	R47	J4	U4	I3
C11	F1	CR6	F2	R3	E2	R25	C2	R48	I3	U5	H3
C13	F2	CR7	B3	R4	J2	R26	A2	R52	F4	U6	H3
C14	I3	CR8	I4	R5	C3	R27	C3	R53	F3	U7	E/F3
C17	I3	CR9	H3	R6	F3	R29	G2	R54	I3/4	U8	J3
C18	I/J3	CR10	H2	R7	I3	R30	G2	R55	I3/4	U9	I1/2
C19	E2	CR11	I2	R8	J1	R31	F2	R56	E2	U10	J1/2
C20	E2	CR12	B4	R9	H1	R32	F2	R57	E2	U11	E/F1/2
C21	H4	CR13	C4	R10	E3	R33	F/G2	R58	J1/2	U12	H1
C22	I4	J22	B1/2	R11	B2	R34	G1/2	R60	E3		
C23	I2	L1	D3	R12	B2	R35	F1/2	R66	C2/3		
C24	I1	Q3	B2	R13	B3	R36	F1/2	R67	B3		
C25	A2	Q4	B2	R14	B2	R37	F1/2	R70	B3/4		
C27	B3	Q5	C2	R15	B3	R38	F1/2	R71	B4		
C37	E2	Q6	C2	R16	C2	R39	I3	R72	B3/4		
C43	E4	Q7	C2	R17	C2	R40	F4	R73	J3		

4

8–4–1 HORIZONTAL SECTION – TRIGGER CIRCUITS

8–4–2 X-Y Operation

8–4–3 There are two basic modes of operation of the horizontal deflection circuits: X-Y operation and normal sweep operation. In X-Y operation, an external signal, applied to the channel A input is processed as a vertical signal up to the CHOP/ALT control switch (CR301 to CR304, Service Sheet 3). With the $\frac{B}{A}$ pushbutton depressed, the channel A signal is fed via the amplifier A2Q25 (Service Sheet 5) to the horizontal output stage. With the same switch, input A of Schmitt trigger A3U7a (Service Sheet 4, center) is set to low. This disables the trigger and sweep circuitry. The channel B signal is used for vertical deflection.

8–4–4 Sweep Operation

8–4–5 External Trigger Input Buffer

8–4–6 Source follower A2Q1 provides a high input impedance for the ext trigger input. Diodes CR1 and CR2 protect the input of the FET. From the source of Q1, the external trigger signal is fed to the trigger amplifier.

8–4–7 Trigger Amplifier

8–4–8 The trigger signal is dc or, through C27, ac coupled to the trigger amplifier Q3, Q4, Q5, Q6 and Q7. At the input of the trigger amplifier, the signal is offset by the TRIGGER LEVEL control R20 so that the output signal from the trigger amplifier relates to the threshold of the input Schmitt trigger U7 a input B. The +/– switch S2 selects the slope on which the threshold level is defined. R66 is adjusted so that the dc level of the trigger amplifier is the same for inverting (–) or non-inverting (+) operation.

8–4–9 TV Sync Separator

8–4–10 The TV Sync Separator separates the frame and line sync pulses of a composite video signal. It outputs either line sync pulses or a frame sync signal to the trigger circuit. Frame sync is automatically selected with time base switch settings 100 µs to 0.5 s. A high level is applied from R53 to the preset input of U8b. The line trigger path is disabled. Q10 conducts and the output of U11 pin 10 is high. C11 and R29 filter out the video portion of the TV signal so that, when a sync pulse occurs, U8 switches on and only the sync pulses reach the TV separator. With frame sync selected, the sync pulses are integrated by R31 and C13. Line sync pulse cannot charge C13 and consequently the threshold level of Schmitt trigger Q9/U11 is not reached. When the field (frame) sync pulse occurs, Q9 is switched on, U11 pin 10 goes high and clocks U8b. The Q output signal is applied via U2b to the trigger circuit. Flip-flop U8b divides the field trigger pulses so that the sweep is triggered only on odd or only on even field numbers.

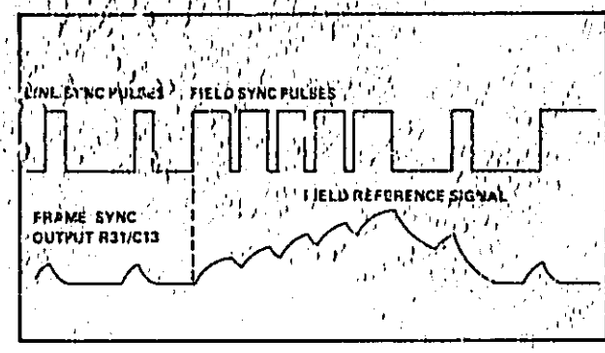


Figure 8–4–1. TV Sync Separation

8–4–11 TV line trigger is automatically selected with sweep ranges 1 µs to 50 µs, the Frame Trigger circuit being disabled by a low on the preset input U8b. The low is also applied to the junction of R53/R36 so that the line trigger circuit is enabled. Line trigger pulses cause Q8 to conduct. Pulses are shaped by Q10/U11 and fed via U2 to the input Schmitt trigger U7a.

8–4–12 Trigger Circuit

8–4–13 Trigger signals are applied to Schmitt trigger U7a either from the trigger amplifier to input B or from the TV sync separator to input C. Input D is used to disable U7a during sweep and input A is used to disable the Schmitt trigger when A versus B mode is selected. To accept a trigger signal from the trigger amplifier (input B), inputs A, C and D must be high. Schmitt trigger U7a switches on both transitions of the input signal, but only the negative transition is used for triggering. When a positive transition appears at input B of U7a, the output at pin 6 goes low and is inverted by U1a. This low to high transition cannot clock U5a and output Q says low with U3b disabled.

8–4–14 When a negative transition at the B or C input of U7a (either from the trigger amplifier or from the TV sync separator) the output at pin 6 goes high. Approx 30 ns later (caused by the propagation delay of U1a/b/c) U3 pin 5 goes low. The output signal of U7a (high) is immediately present at U3 pin 4 and, as U3 pin 5 is still high,

U3 pin 6 goes low. U3 pin 6 goes high again when the delayed signal at U3 pin 5 goes low. Besides this signal flow, the U7a output signal, inverted by U1a, clocks the high J input of U5a to the Q output which enables U3b. When U3 pin 6 goes high, U3 pin 8 goes low and clocks U5b. The $\overline{Q}$ of U5b goes low and A2Q12 (Service Sheet 5) is switched off. This allows the time base capacitor to be charged and a ramp (sweep) is generated. The Q output of U5b is fed via U4a, U2b and U12a to the blanking amplifier. To prevent a new trigger signal from being accepted during a sweep, U5b Q also pulls U2a pin 8 low so that U7a is inhibited.

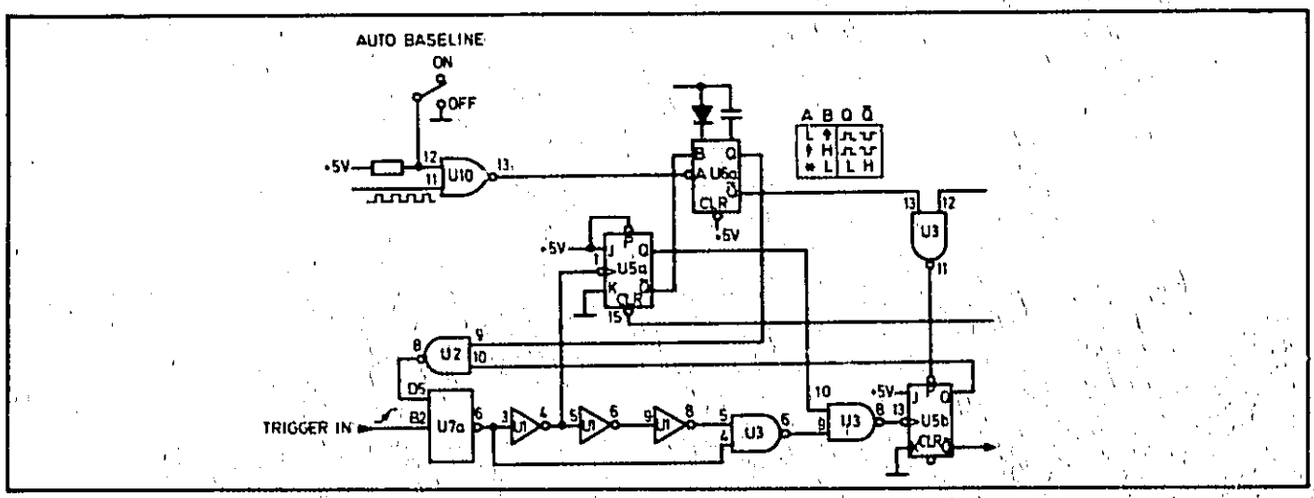
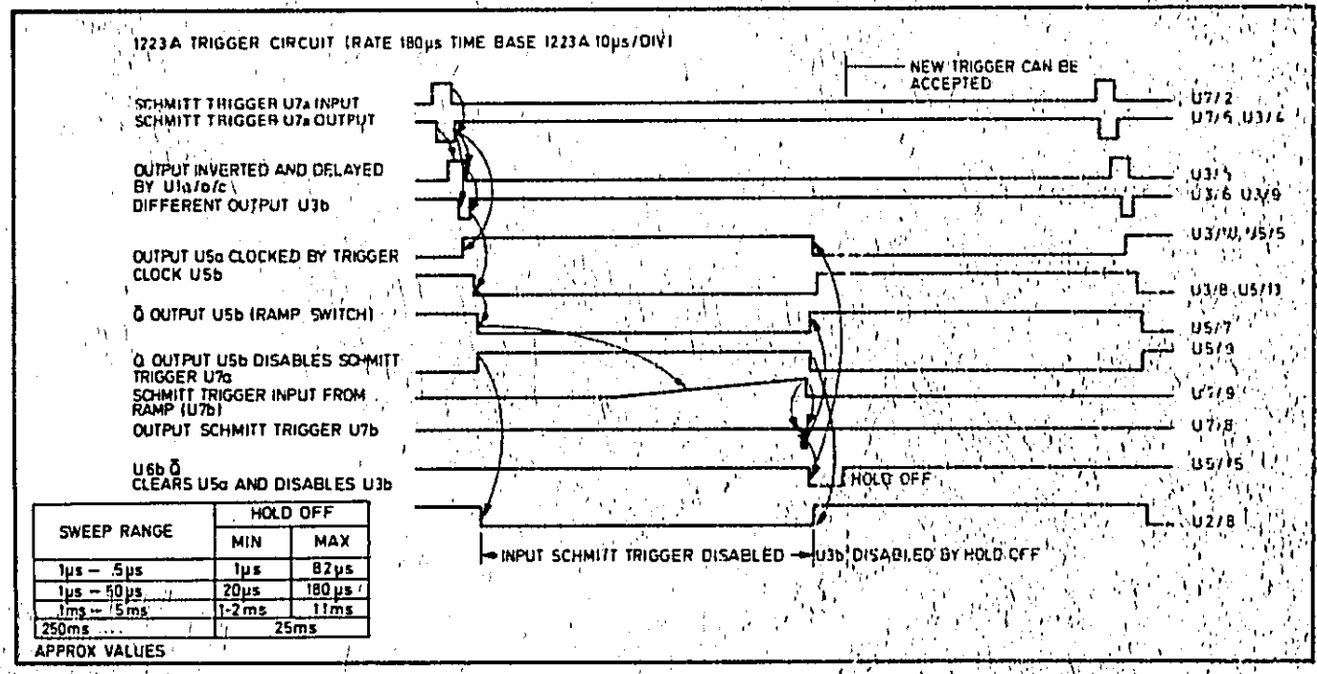


Figure 8–4–2. Trigger Circuit

8–4–15 Reset and Hold-Off Circuit

8–4–16 When A2 Q12 (Service Sheet 5) is switched off by U5b $\overline{Q}$, the voltage on the ramp capacitor (C28–32) increases. This signal is amplified by emitter followers A2 Q13 and Q14. When, depending on the sweep length adjustment (A2R98), the threshold level of A3U7b (Service Sheet 4) is reached, ouput U7b pin 8 goes low. This clears U5b via U12a and U10a. U5b $\overline{Q}$ goes high and switches A2 Q12 back on. This allows the ramp capacitor to discharge. The low Q of U5b sets U2a pin 8 high, enables Schmitt trigger U7a and blanks the trance during reset.

8–4–17 The reset signal from U7b pin 8 also starts the hold-off timer U6b. U6b $\overline{Q}$ goes low for a time determined by the hold-off capacitors (A9C1–C4) and the vernier setting (A9R4). The low from U6b $\overline{Q}$ is inverted by U12b and U10b which clears flip-flop U5a. Although U7a has been enbaled by the reset from U7b pin 8, no trigger can occur because U3b pin 10 is held low by U5a Q which disables U3b.



SWEEP RANGE	HOLD OFF	
	MIN	MAX
1µs – 5µs	1µs	82µs
10µs – 50µs	20µs	180µs
1ms – 5ms	1-2ms	11ms
250ms	25ms	

APPROX VALUES

Figure 8–4–3. Hold-Off Timing

8–4–18 Auto Baseline

8–4–19 Auto Baseline Off

8–4–20 When the trigger level vernier knob on the front panel is pulled out, auto baseline is switched off. A square wave from the probe adjust oscillator is applied through U10 to the U6a A-input. As long as no trigger signal appears at U7a, U5a $\overline{Q}$ and the B input of U6a are high. The pulses at the A input of U6a cause Q to stay high all the time until a trigger pulse appears. U6a $\overline{Q}$ is low and disables U3, so that no signal can start a sweep at the preset of U5b. When a trigger signal appears, U5a Q goes low. A low at the B input of U6a sets Q low and $\overline{Q}$ high, independent of the signal applied to the A input. After the trigger circuit has been reset at the end of the sweep and hold off period, it waits for a new trigger.

8–4–21 Auto Baseline On

8–4–22 When the trigger level vernier knob is depressed, auto baseline is enabled if no trigger appears within approx 500 ms. In this setting, A input of U6a is set to low. If a trigger appears, U5a $\overline{Q}$ goes low. This cause U6a $\overline{Q}$ to go high and Q to go low. At the end of the hold-off time, U5d is cleared which causes a positive transition to the B input of U6a. U6a Q goes high for the time determined by C14 (500 ms). If no trigger appears, U6a goes back to its stable state ($\overline{Q}$ = high). The high from U6a $\overline{Q}$ presets U5b via U3. U5b $\overline{Q}$ goes low and starts a sweep. When the sweep length is detected, U7b pin 8 clears U5b via U12a and U10a and stops the ramp generation. The reset from U7b pin 8 starts U6b. The low from U6b $\overline{Q}$ is inverted by U12b, U10b and U3 and sets the preset input of U5b high. After the hold off time, U6b switches back to its stable state. $\overline{Q}$ goes high and pulls preset of U5b low which starts a new sweep.

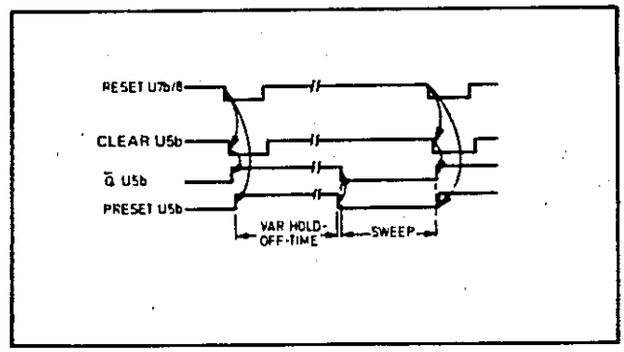
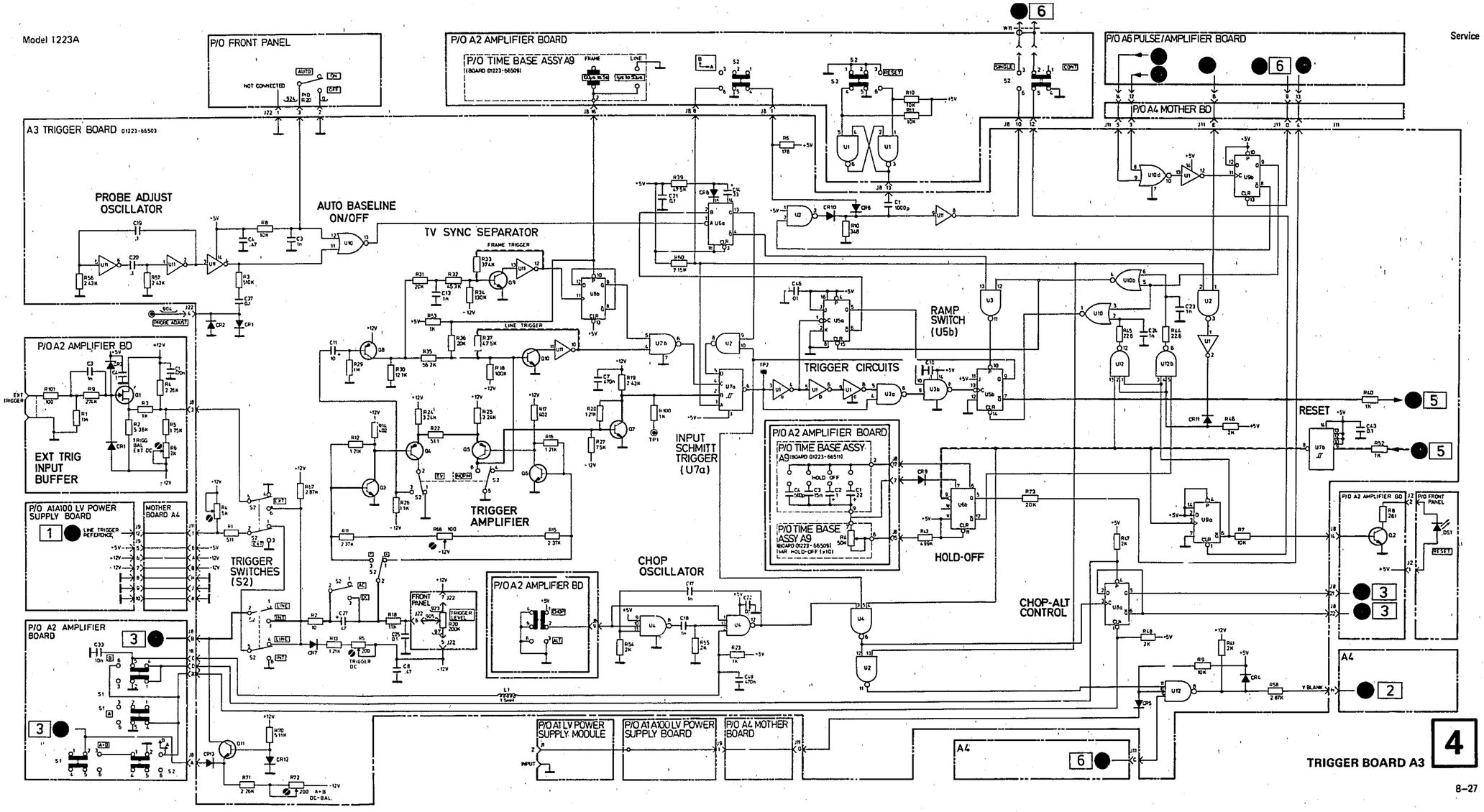
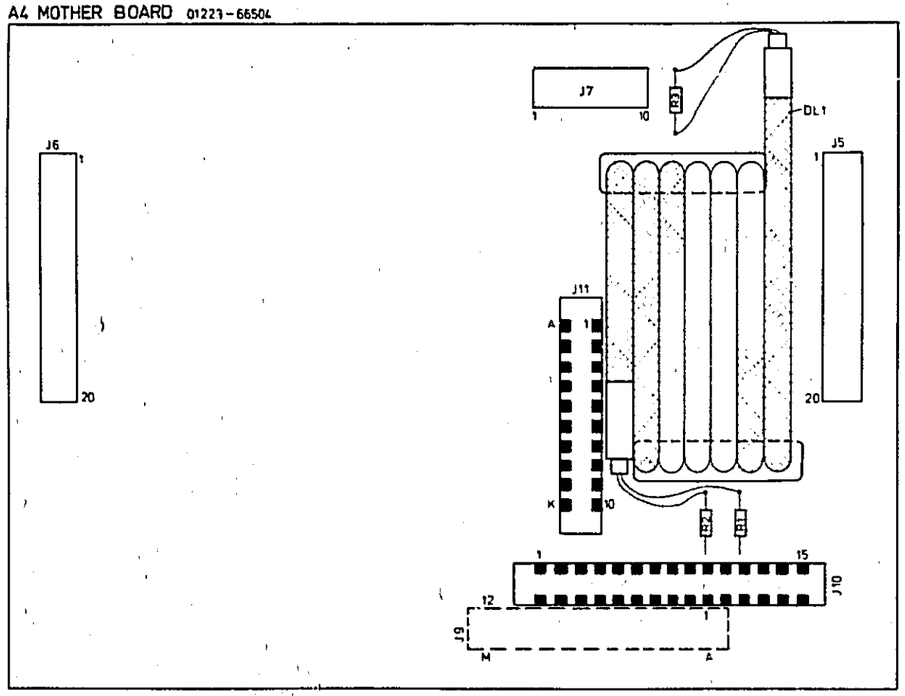


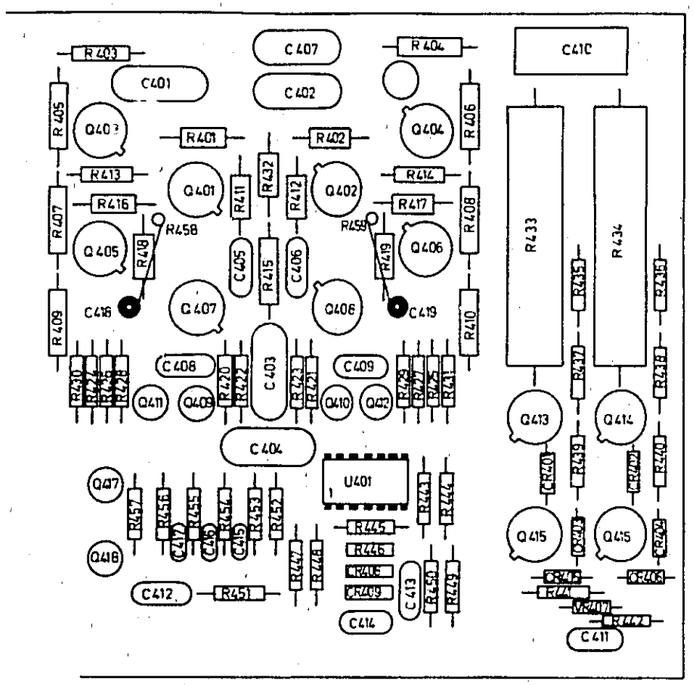
Figure 8–4–4. Auto baseline timing

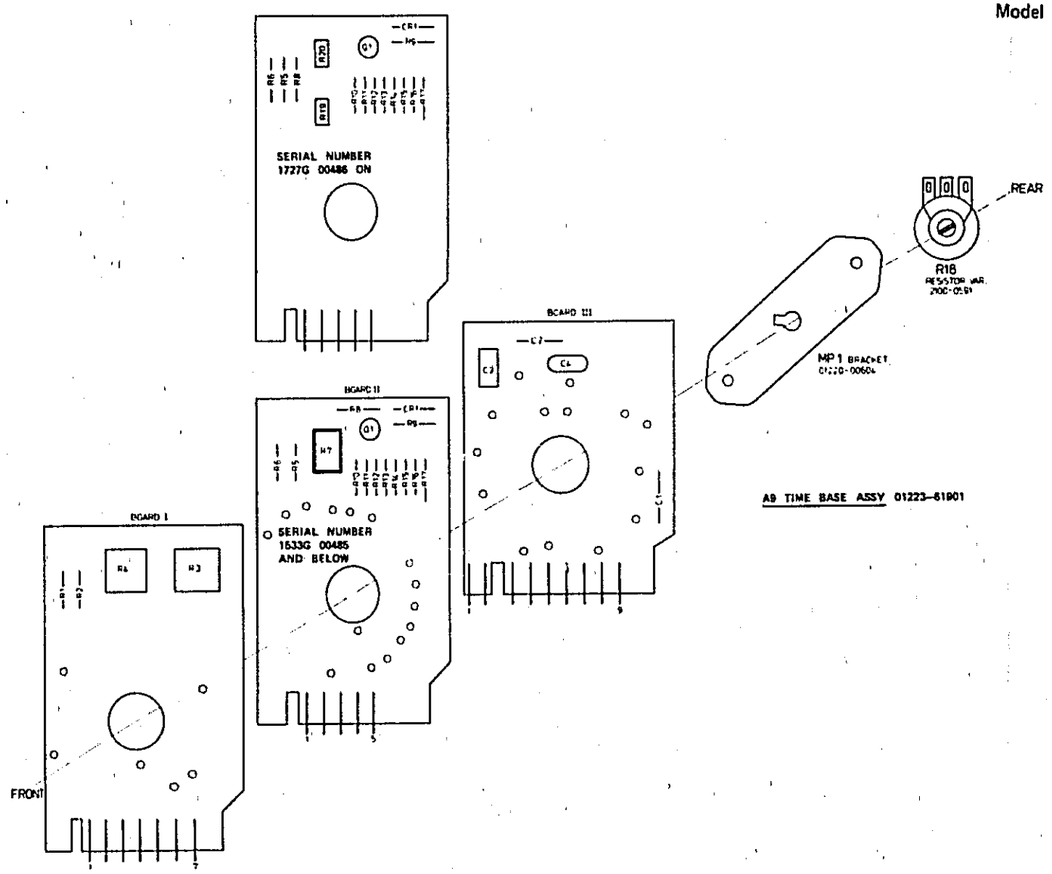

P/O FRONT PANEL
P/O A2 AMPLIFIER BOARD
P/O TIME BASE ASSY A9
P/O A6 PULSE/AMPLIFIER BOARD
P/O A4 MOTHER BD
A3 TRIGGER BOARD 01223-66503
PROBE ADJUST OSCILLATOR
AUTO BASELINE ON/OFF
TV SYNC SEPARATOR
RAMP SWITCH (U5b)
TRIGGER CIRCUITS
RESET
P/O A2 AMPLIFIER BD
EXT TRIG INPUT BUFFER
INPUT SCHMITT TRIGGER (U7a)
TRIGGER AMPLIFIER
TRIGGER SWITCHES (S2)
CHOP OSCILLATOR
HOLD-OFF
CHOP-ALT CONTROL
P/O A1A100 LV POWER SUPPLY BOARD
MOTHER BOARD A4
P/O A2 AMPLIFIER BOARD
P/O A1 LV POWER SUPPLY MODULE
P/O A1A100 LV POWER SUPPLY BOARD
P/O A4 MOTHER BOARD
A4
P/O FRONT PANEL
A4
TRIGGER BOARD A3
4

A4 MOTHER BOARD 01223-66504

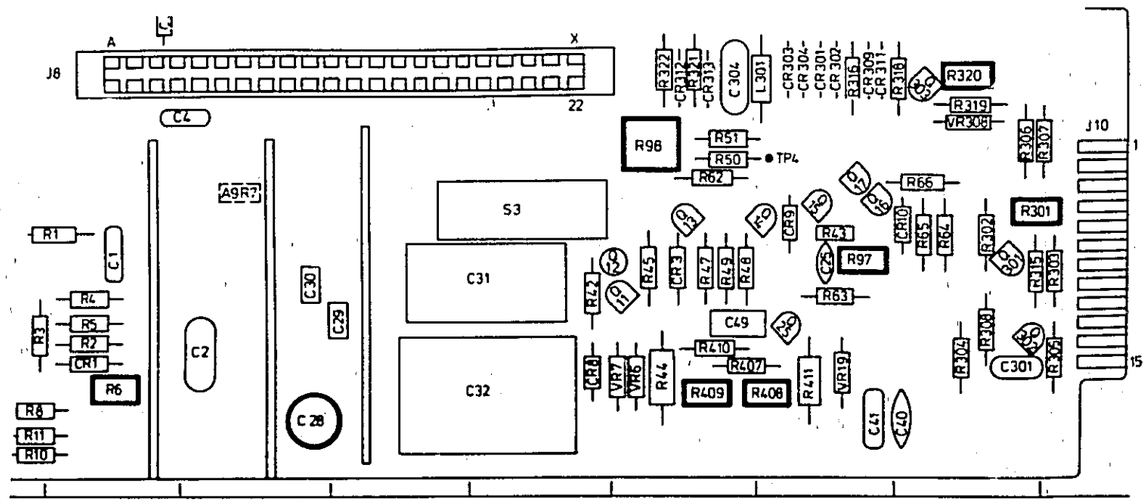


P/O A6 PULSE/AMPLIFIER BOARD Complete Layout on Service Sheet 6





P/O A2 AMPLIFIER BOARD Complete Layout on Service Sheet 3



5

8–5–1 HORIZONTAL SECTION – RAMP GENERATOR; DEFLECTION AMPLIFIER

8–5–2 Ramp Generator

8–5–3 The ramp generator consists of Q11, Q12, ramp capacitors and resistors. Q11 works as a constant current source where the current can be determined by R10 to R17 timebase resistors. Q12 works as a switch which is activated by signal 19 (Service Sheet 4, A3 U5b $\overline{Q}$ output). Before a sweep starts, A3 U5b $\overline{Q}$ is high and A2 Q12 conducts. The current from the 100 V supply is fed through R44 to the selected time base resistor thence via Q11 and Q12 to ground. Ramp capacitors are not charged. When Signal 19 goes low, Q12 cuts off and the selected ramp capacitor charges. For 1 s/div and 2 s/div sweep speeds, the adjustable current source (A9 Q1) improves adjustment accuracy for these slow sweep ranges.

8–5–4 Impedance Matching

8–5–5 The increasing voltage from the ramp capacitor is amplified by Darlington pair Q13 and Q14 (used because of high input impedance and high current gain). The voltage level of the ramp is sensed from the emitter path of Q14. The setting of R98 (sweep length adjust) determines the ramp level at which the Schmitt trigger A3 U7b (Service Sheet 4) clears A3 U5b. A clear pulse at A3 U5b sets $\overline{Q}$ output back to high which causes A2 Q12 to conduct. The ramp capacitor is now discharged through Q12.

8–5–6 Sweep/X-Y Operation

8–5–7 In sweep operation, Q14 output is switched to the horizontal deflection amplifier. In X-Y operation, the channel A signal, amplified by Q25, is applied instead. Gain and dc level adjustments in the Q25 circuit allow the X-amplitude and shift to be calibrated independently of normal sweep.

8–5–8 Horizontal Amplifier

8–5–9 The ramp signal is amplified by differential amplifier Q15 and Q16. Q17 supplies an offset current to the base of Q16 which is controlled by R3 POSITION CONTROL. The following figure shows a simplified schematic of the left half of the output amplifier. Q415 works as an amplifier stage with current feedback via R437 and CR403 to the base of Q415. CR401, a Schottky diode with approx 0.4 V forward voltage drop, prevents Q415 going into saturation when a positive input signal appears. CR403 is used to lift up the clamp voltage of CR401 by approx 0.7 V. If the input signal becomes too negative, no more current is supplied to the base of Q415 and the transistor cuts off. CR405 clamps Q415 base approx 150 mV more positive than its emitter. To reduce the emitter-collector voltage by one half, base stage Q413 is added in series to Q415, as shown in the schematic.

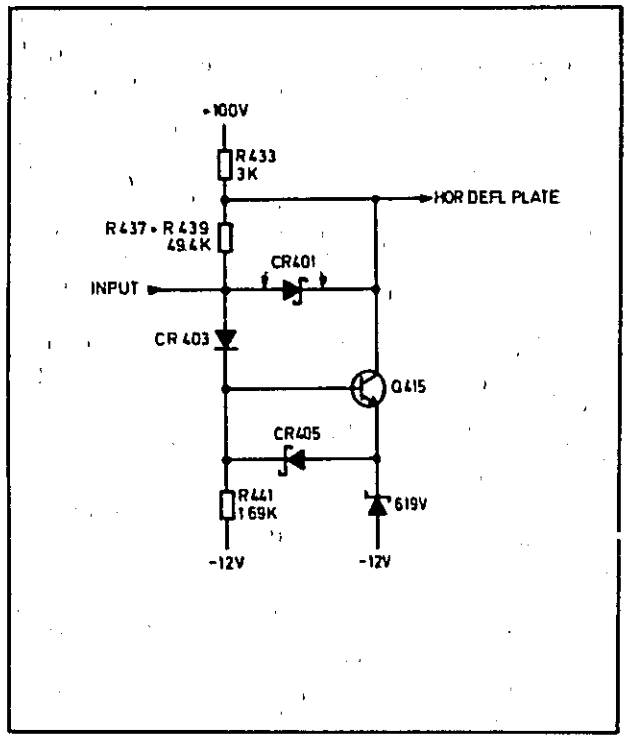
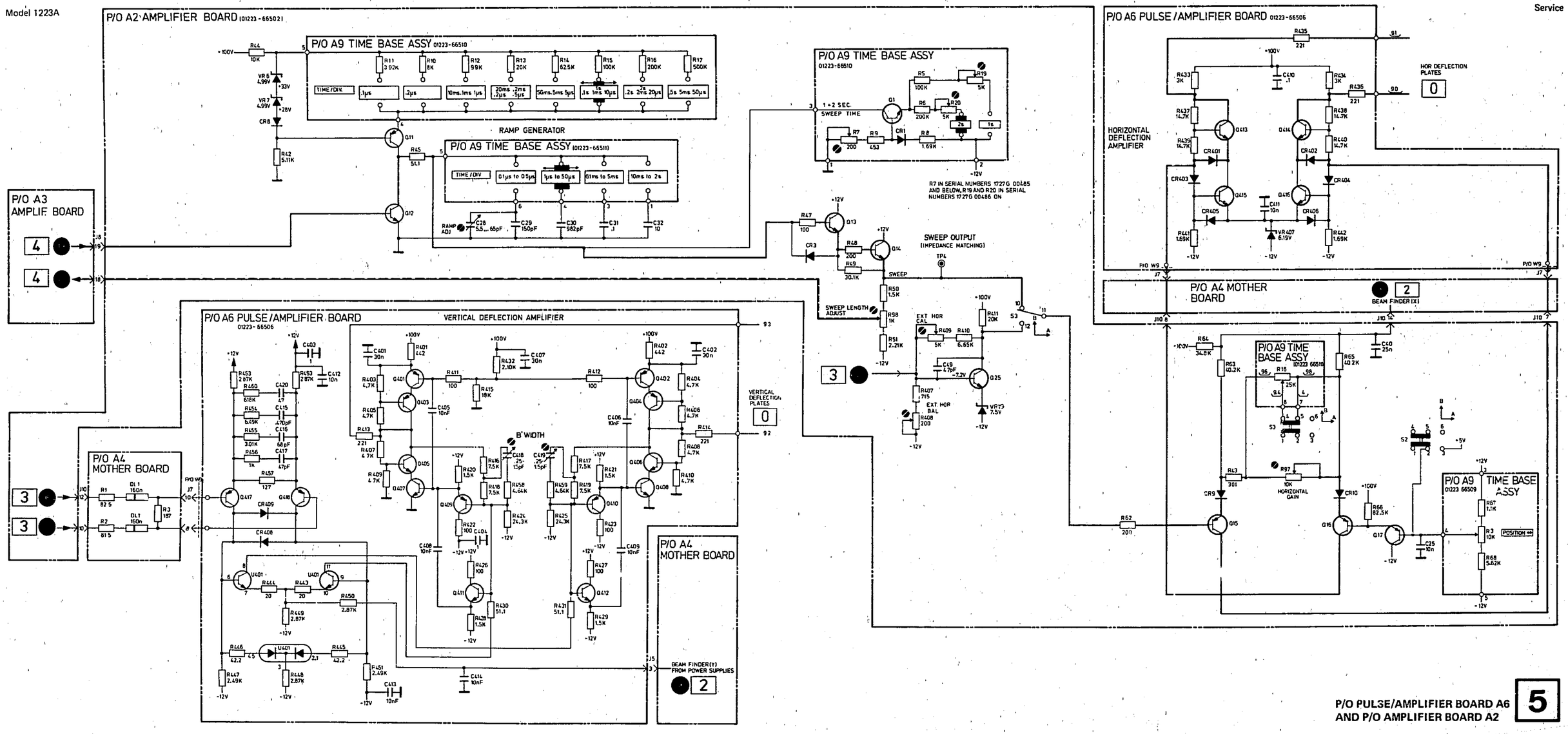


Figure 8–5–1. Simplified Horizontal Deflection Amplifier

8–5–10 VERTICAL OUTPUT AMPLIFIER

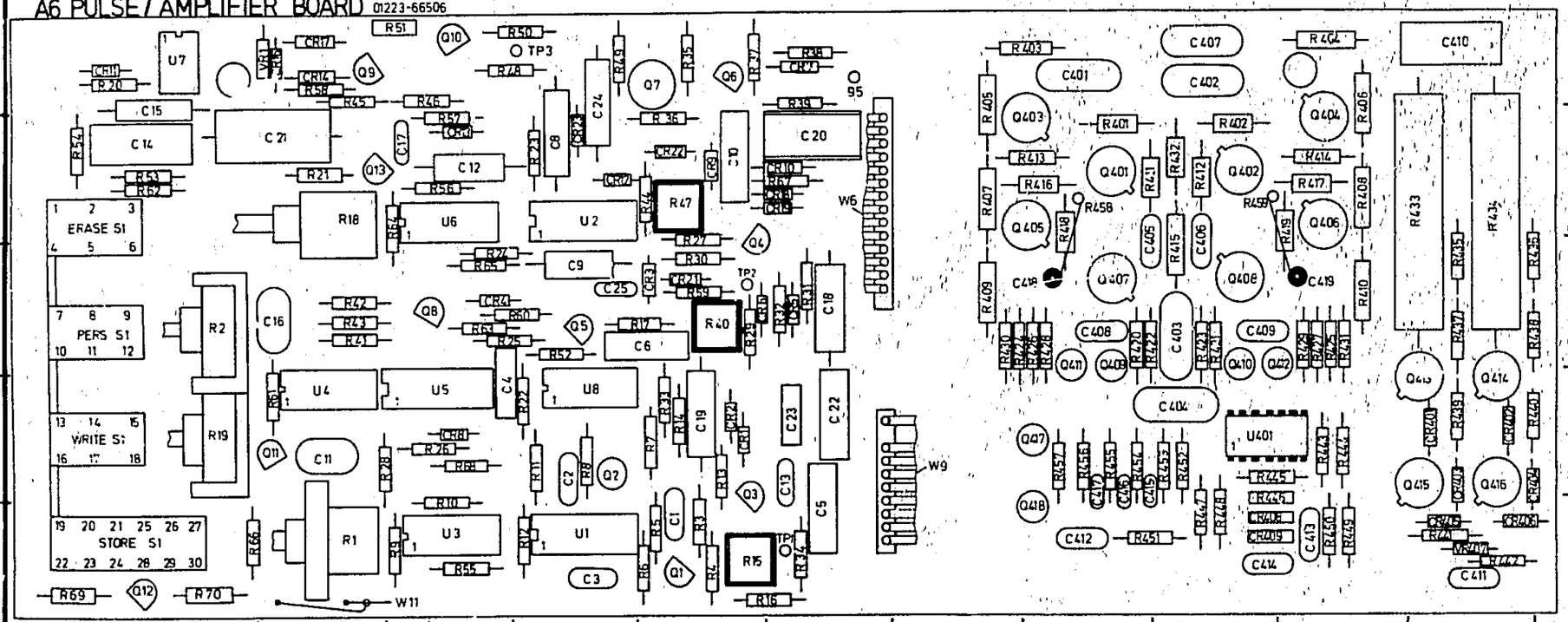
8–5–11 The end stage is comprised of two identical amplifiers. Q407 and Q405 form a cascode amplifier with negative feedback from the collector of Q405 to the base of Q409. Under static conditions, Q401 and Q403 work as a current source which is driven by Q405. In this case dc biasing of the output stage is controlled by Q409. The current, approx 25 mA, through Q401, Q403, Q405 and Q407 is determined by R401.

8–5–12 When ac is applied to the output amplifier, Q401/Q403 together with Q405/Q407 work as a push-pull amplifier. The input signal for stage Q401/Q403 is applied to the base of Q401 via C405. Q411 drives the relatively high input impedance caused by the high voltage variation necessary to drive the CRT.



P/O PULSE/AMPLIFIER BOARD A6 AND P/O AMPLIFIER BOARD A2 **5**

A6 PULSE / AMPLIFIER BOARD 01223-66506



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C1	F5	C20	G2	C414	J5	CR14	C1	Q3	F4	Q411	I3	R12	E5	R31	G3	R50	E1	R401	I2	R420	I3	R439	L4	R458	J2
C2	E4	C21	B/C2	C415	I4	CR16	C1	Q4	F/G2/3	Q412	J3	R13	F4	R32	G3	R51	D1	R402	J2	R421	J3	R440	L4	R459	J2
C3	E5	C22	G4	C416	I4	CR17	C1	Q5	E3	Q413	L3	R14	F4	R33	F4	R52	E3	R403	H/I1	R422	I3	R441	L5	S1	A/B
C4	D/E3/4	C23	G4	C417	I4	CR18	G2	Q6	F1	Q414	L3	R15	F/G5	R34	G5	R53	B2	R404	K1	R423	J3	R442	L5	U1	E5
C5	G4/5	C24	E1/2	C418	H3	CR19	G2	Q7	F1	Q415	L4	R16	F/G5	R35	F1	R54	A2	R405	H1/2	R424	H3	R443	K4	U2	E2
C6	E/F3	C25	F/F3	C419	K3	CR21	F3	Q8	D3	Q416	L4	R17	E/F3	R36	F2	R55	D5	R406	K1/2	R425	K3	R444	K4	U3	D5
C7	H2	C401	I1	CR1	F4	CR22	F2	Q9	C1	Q417	H4	R18	C2	R37	F1	R56	D2	R407	H2	R426	H3	R445	J4	U4	C4
C8	E2	C402	J1	CR2	F4	CR23	E2	Q10	D1	Q418	H4	R19	B4	R38	G1	R57	D2	R408	K2	R427	K3	R446	J4	U5	D4
C9	E3	C403	J3	CR3	F3	CR401	L4	Q11	C4	R1	C5	R20	A1	R39	G1	R58	C1	R409	H3	R428	I3	R447	J4	U6	D2
C10	F2	C404	J4	CR4	D3	CR402	L4	Q12	A/B5	R2	B3	R21	C2	R40	F3	R59	F3	R410	K3	R429	K3	R448	J4	U7	B1
C11	C4	C405	I2	CR5	G3	CR403	L4	Q13	C/D2	R3	F5	R22	E4	R41	C3	R60	D/E3	R411	I2	R430	H3	R449	K5	U8	E3/4
C12	D2	C406	J2/3	CR6	G3	CR404	L4	Q401	I2	R4	F5	R23	E2	R42	C3	R61	C3/4	R412	J2	R431	K3	R450	K5	U401	J4
C13	G5	C407	J1	CR7	G1	CR405	L4/5	Q402	J2	R5	F5	R24	D3	R43	C3	R62	B2	R413	H2	R432	J2	R451	I5	VR1	C1
C14	A/B2	C408	I3	CR8	D4	CR406	L51	Q403	H7/2	R6	F5	R25	D/E3	R44	F2	R63	D3	R414	K2	R433	L2	R452	J4	VR407	L51
C15	B1	C409	J3	CR9	F2	CR408	J5	Q404	K1/2	R7	F4	R26	[illegible]	R45	C1	R64	D2	R415	J2/3	R434	L2	R453	I4		
C16	C3	C410	L1	CR10	G2	CR409	J5	Q405	H2	R8	E4	R27	F3	R46	D1	R65	D3	R416	H2	R435	L2/3	R454	I4		
C17	D2	C411	L5	CR11	A1	L1	G4	Q406	K2	R9	D5	R28	D4	R47	F2	R66	B5	R417	K2	R436	L2/3	R455	I4		
C18	G3	C412	I5	CR12	E2	Q1	F5	Q407	I3	R10	D4	R29	F3	R48	D/E1	R67	G2	R418	I2	R437	L3	R456	I4		
C19	F4	C413	K5	CR13	D2	Q2	E4	Q408	J3	R11	E4	R30	F3	R49	E1	R68	D4	R419	J2	R438	L3	R457	I4		
								Q409	I3							R69	A5								
								C41	J3							R70	B5								

8–6–1 VARIABLE PERSISTENCE AND STORAGE

8–6–2 Pulse Circuit

8–6–3 To achieve variable persistence and storage, the pulse circuit is used to apply various voltage levels and pulses to certain elements in the CRT. Mode selection is made by switch S1 which controls circuitry on board assembly A6. The pulse generator consists of Q1, C1 and Q2, where Q1 works as a variable current source. The current through Q1 is determined by the setting of R2 in VAR PERS mode and by R1 in the VAR STORE mode. The current through Q1 charges C1 until the critical voltage at the gate of Q2 is reached. Q2 then switches through and discharges C1 via R8. This causes a fast positive voltage peak across R8. After a short time C1 is discharged, Q2 stops conducting and a new cycle starts. The frequency can be varied between 0 and approx 29 kHz in VAR PERS and VAR STORE modes, as measured at the junction of R8 and Q2.

8–6–4 Var. Persistence Mode

8–6–5 Variable persistence is achieved by pulsing the storage mesh of the CRT. This has the same effect as erasing the signal written on the storage mesh. However, complete erasure depends on the number of pulses applied in a certain time. Thus, with VAR PERS potentiometer in MAX position we have the same conditions as in WRITE mode and no pulses are applied to the storage mesh. As the setting is decreased, the number of pulses increases, and the persistence decreases.

8–6–6 When VAR PERS is selected, part of the voltage from VAR PERS potentiometer R2 is applied to the emitter of Q1 and starts the pulse generator. These pulses trigger the dual timer U1. Depending on the time constants R12/C3 and R11/C2, pulses at output U1a $\overline{Q}$ have a width of approx 200 µs and at U1b $\overline{Q}$ approx. 17 µs. As U3 pin 13 is pulled low by S1 STORE switch (released), no pulses from U1a $\overline{Q}$ can be applied to the flood gun grid. Q3 is conducting and the flood gun grid can be adjusted with R15.

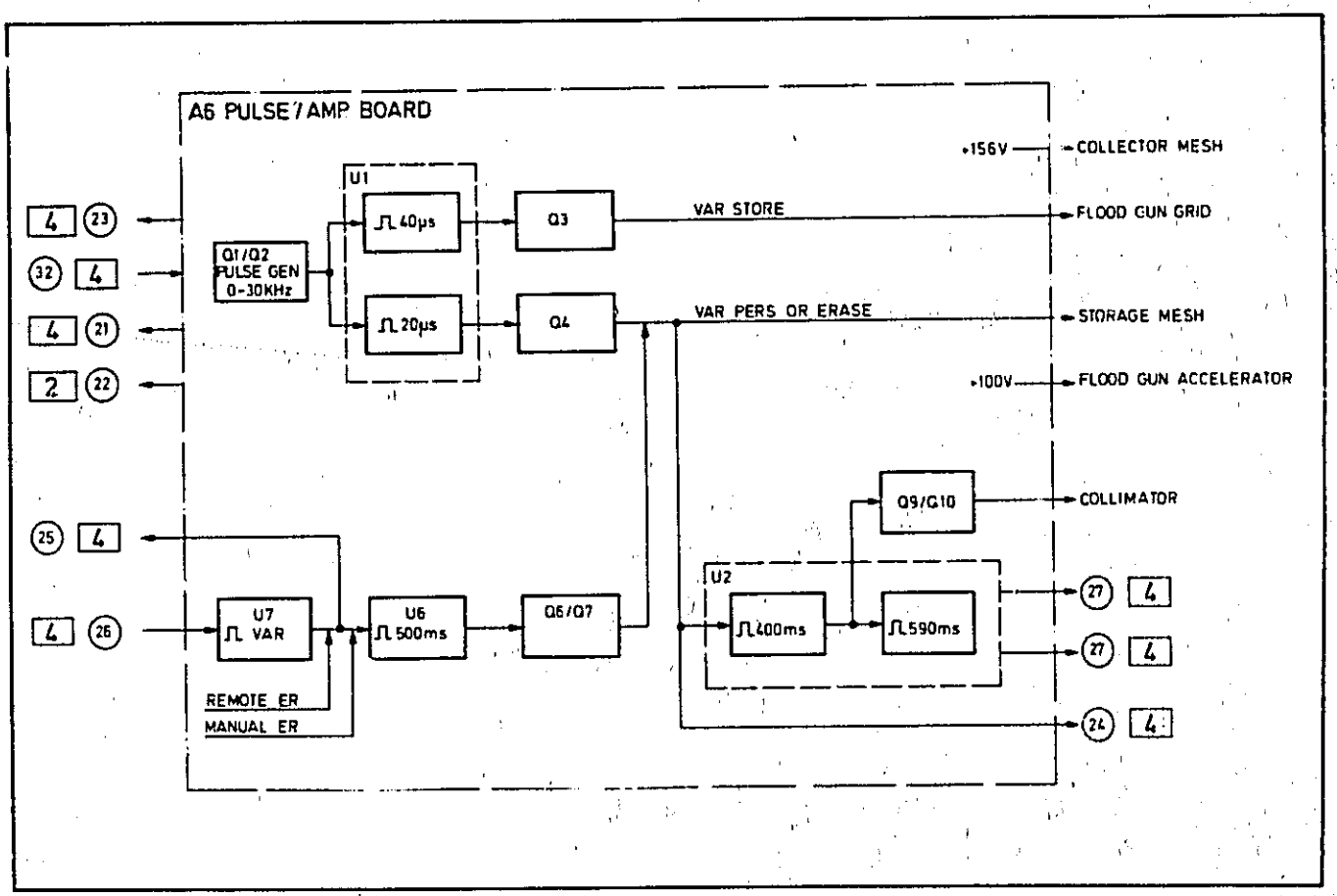


Figure 8–6–1. Storage Control

8–6–7 The pulses from U1b $\overline{Q}$ are fed via U5a, U8a, CR3 and R27 to the base of Q4. The offset level at the collector of Q4 is determined by network R29, R30, CR21, R59 and R40 (Brightn. Adj.). Diode CR5 is forward biased and the pulses can be applied to the storage mesh. Persistence decreases with increasing number of pulses. U8b pin 6 is low and consequently the brightness potentiometer R19 has no influence.

8–6–8 Erase Cycle

8–6–9 The erase cycle is initiated by a negative transition at pin 3 or pin 4 of timer A6U6. The negative transition may be generated externally (rear panel REMOTE ERASE connector), manually in write and variable persistence modes, or automatically.

8–6–10 In auto erase, the positive pulse available from the hold-off monostable (A3U6, Q output, Service Sheet 4) at the end of each sweep is inverted by A6Q13. The resulting negative pulse triggers the variable timer U7 which defines the pause between end of sweep and commencement of the erase cycle. U7's positive, variable width, output pulse:

- clears A3U5a and, in single shot mode, A3U9a (see signal 25, Service Sheet 4, A3U10d, A3U9b),
- is differentiated so that the negative going trailing edge provides a negative transition to trigger A6U6 at pin 4.

8–6–11 When A6U6 is triggered, it produces a positive pulse at the Q output of 500 ms width ($\approx 0.7 C_{12} R_{56}$). This pulse turns on Q7, and Q6 switches the +156 V supply via R38 to the tube's storage mesh, thus erasing the stored information.

8–6–12 For control purposes, a portion of the storage mesh signal is taken from the junction of R32/R33. This signal (a 500 ms positive pulse):

- blanks the trace during erasure (U3b pulls signal 27 low),
- clears A3U5a and presets U3U5b (see signal 24, A3U9b, A3U10b, A3U3d, Service Sheet 4), also clears A3U9a if SINGLE selected,
- triggers A6U2a at the end of the 500 ms pulse (trailing edge, negative transition).

8–6–13 When A6U2a is triggered, the output (Q) goes high for about 400 ms. This positive pulse:

- holds blanking signal 27 low,
- holds A6U5a output low,
- triggers A6U2b on the trailing edge.

Additionally, the complement (negative) pulse from output $\overline{Q}$ cuts off Q9. Q10 then lifts the collimator by about 70 V.

8–6–14 On being triggered by the U2a pulse trailing edge, U2b produces a 600 ms positive pulse (Q) which:

- holds blanking signal 27 low,
- switches the storage mesh to about +13 V (by switching on U8a in additional to U8b when persistence is selected, and by switching on U8b in additional to U8a when store or write are selected).

The pulse complement from the $\overline{Q}$ output is differentiated (C16/R28) so that the trailing edge clears A3U9b (signal 23, Service Sheet 4).

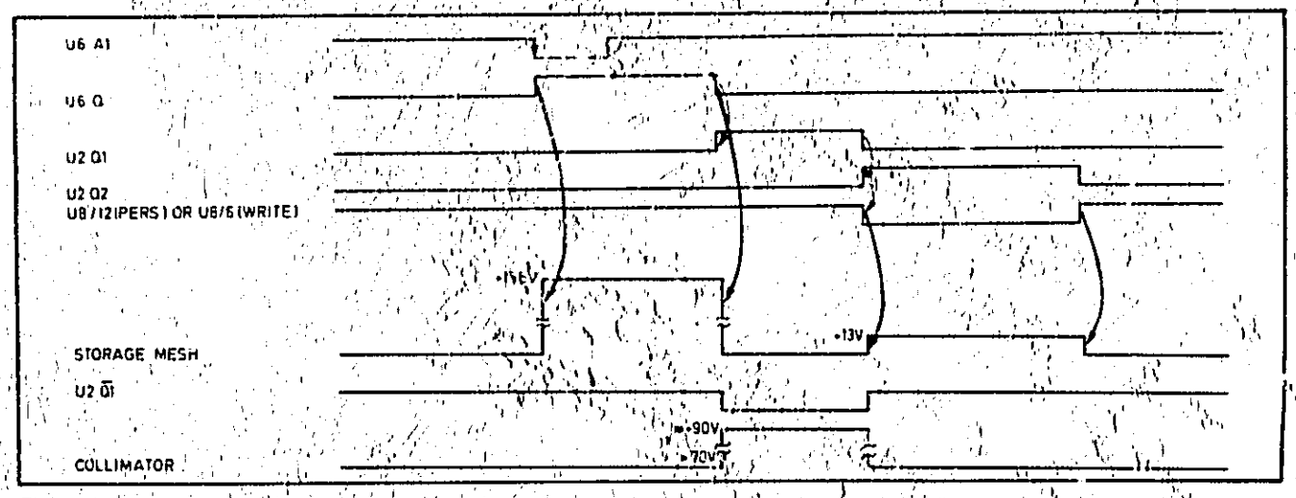


Figure 8–6–2. Erase Cycle

8–6–15 Write Mode

8–6–16 With Write Mode selected, pulse generator Q1/Q2 is disabled and U3 a pin 13 is set low via the store switch. Q3 is conducting and the flood gun grid is held at approx −8 V, depending on R15 setting. The collimator voltage is approx +70 V. As all inputs of U8b are low, U8b pin 6 is high and enables the brightness vernier. With the brightness vernier, the voltage at the storage mesh can be varied from approx +4 V to +7.5 volts. U8a pin 12 is held low because a high level is derived from R53 via the store switch.

8–6–17 Store Mode (Variable Store and Time)

8–6–18 When the store mode is selected (but not AUTO STORE), flip flop U3c/d is set (U3d pin 3 low) and a low (Signal 21) is applied to A3U2 pin 1 on the trigger board (Service Sheet 4). Consequently A3U5a and A3U5b are cleared and the trigger circuit and sweep are disabled. On Service Sheet 6, U8a pin 13 is high, causing a low at U8a pin 12. U8b pins 3, 4, 5 are low, U8b pin 6 high, enabling the brightness vernier. Thus, the storage mesh voltage can be varied between approx. +4 to +7.5 V, influencing the store time.

8–6–19 In store mode, pulse generator Q1/Q2 is enabled. Depending on the setting of VAR. STORE control R1, the frequency can be varied between 0 and approx 29 kHz. U1b $\overline{Q}$ output has no influence on the storage mesh, because a high at U5a pin 10 disables this signal.

8–6–20 U1a $\overline{Q}$ output signal is applied to the base of Q3 through U3a and U3b. When Q3 is cut off (no pulses from U1a $\overline{Q}$) the flood gun grid is switched to approx −110 V and cuts the flood guns off. Negative pulses at base of Q3 cause Q3 to conduct. This allows the flood gun electrons to strike the storage mesh. Maximum store time can be achieved with flood gun grid set to −110 V and with storage mesh at +7.5 V.

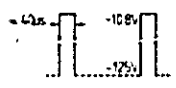
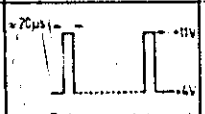
8–6–21 The erase cycle is disabled because the +5 V level derived from R62 is applied to U4 pin 12. U4 pin 13 is thus low and prevents U6 from switching Q7.

8–6–22 Auto Store Mode

8–6–23 Auto Store Mode works with write mode and single sweep to capture a single event and to achieve max store time. In Single Mode the sweep is armed during an erase cycle. As long as only write is selected, Q3 conducts and provides approx 7.8 V at the flood gun grid.

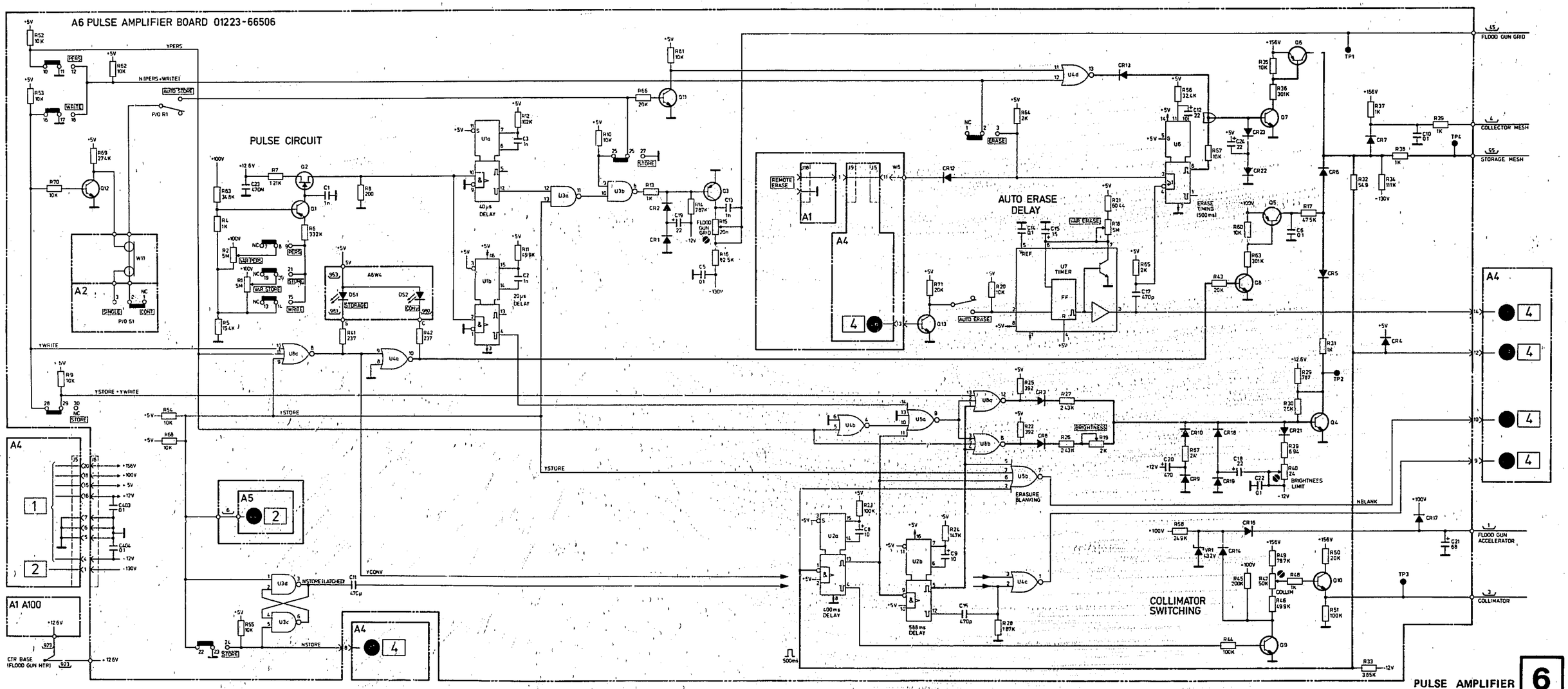
8–6–24 In Write Mode, a +5 V level is applied to the base of Q12. The collector of Q12 shows a low level which, when Single is selected and the auto store switch is closed, is applied to U3 pin 9 via the released STORE switch. U3b pin 8 goes high and cuts Q3 off. The −130 V supply is now applied to the flood gun grid through R16, and the flood guns are completely switched off (max store time). The signal can now be written on the storage mesh as in Write Mode; the written signal, however, is not visible, because the flood guns are switched off. When switching out of Auto Store the instrument reverts to Write Mode.

8–6–25 Auto Store is only possible with Single Mode. This is to avoid storage mesh damage which may occur if the trace strikes an undischarged storage mesh.

ELECTRODE (WIRE COLOR)	MODE SELECTED					
	CONVENTIONAL	VAR. PERSISTENCE	WRITE	VAR. STORE	AUTO STORE	NOTES
FLOOD GUN GRID (40)	-10.8 Vdc	-10.8 Vdc	-10.8 Vdc	 Pulse period depends on VAR STORE setting	-125 V dc	In VAR STORE mode with VERNIER ccw -10.8 V dc with VERNIER cw -125 Vdc
FLOOD GUN ACCELERATOR (1)	+44.3 Vdc	+44.3 Vdc	+44.3 Vdc	+44.3 Vdc	+44.3 Vdc	
COLLIMATOR (3)	+78.6 Vdc	+78.6 Vdc	+78.6 Vdc	+78.6 Vdc	+78.6 Vdc	
COLLECTOR MESH (4)	+156 Vdc	+156 Vdc	+156 Vdc	+156 Vdc	+156 Vdc	
STORAGE MESH (95)	-41.2 Vdc	 Pulse period depends on VAR. PERS. setting	+3.0 Vdc to +7.5 Vdc depending on BRIGHTNESS setting	+4.3 Vdc to +.75 Vdc depending on BRIGHTNESS setting	+4.0 Vdc to +7.5 Vdc depending on BRIGHTNESS setting	In VAR PERS mode VERNIER cw ≈ + 4 Vdc

Approx. values

Figure 8–6–3. Summary of Tube Operating Voltages



PULSE AMPLIFIER BOARD A6 **6**

HEWLETT hp PACKARD

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 the country of manufacture (see rear panel):

Hewlett-Packard GmbH
(Abt.: Incoming Inspection)
703 BÖBLINGEN
Herrenberger Str. 110
Attention: CRT QA

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

HEWLETT hp PACKARD

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.

_____

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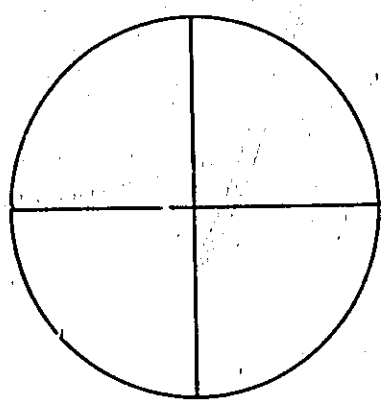

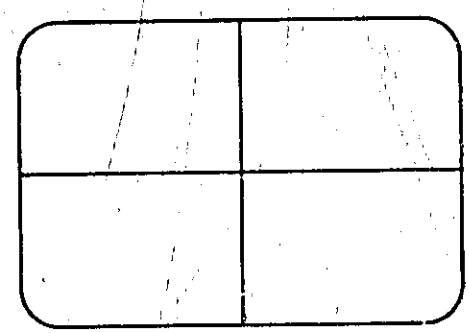

5. Is the CRT within warranty ? Yes _____ No _____
6. hp Sales/Service Office _____ Repair Order No. _____

PLEASE TEAR AWAY