### **Errata**

Title & Document Type: 1702A Oscilloscope Operating and Service Manual

Manual Part Number: 01702-90904

**Revision Date: February 1974** 

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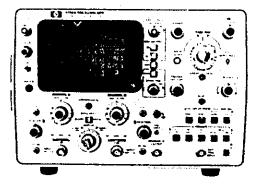
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# 1702A OSCILLOSCOPE



HEWLETT hp PACKARD



### OPERATING AND SERVICE MANUAL

# MODEL 1702A OSCILLOSCOPE

SERIALS PREFIXED: 1406A

Refer to Section VII for instruments with the following serial prefix numbers: 1150A, 1226A, 1230A, 1232A, 1325A, 1331A, and 1342A.

Refer to Section VII for instruments with the following standard options: 001 and 002.

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION 1900 G ARDEN OF THE GODS ROAD, COLORADO SPRINGS, COLORADO, U.S.A.

Manual Part Number 01702-90904. Microfiche Part Number 01702-90804.

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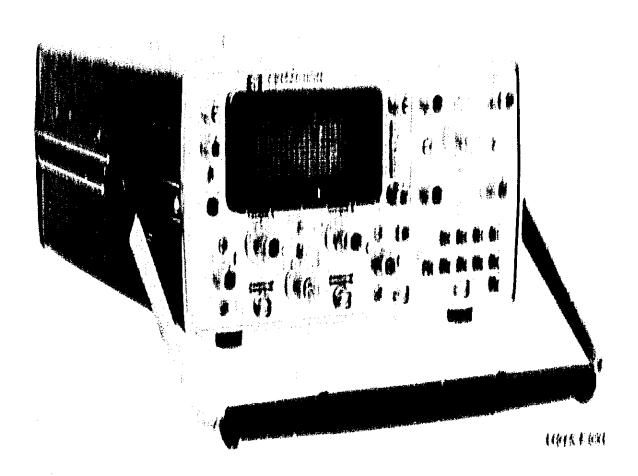
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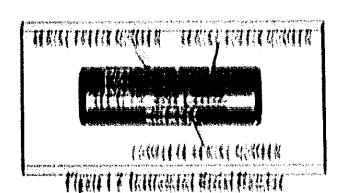
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### Battery (optional)

OPERATING TIME: up to 4 hours in Model 1703A.

RECHARGE TIME: 14 hr minimum, with power switch off, if not operated after power indicator flashes.

LOW BATTERY INDICATOR: power light flashes to indicate that batteries are discharged and further operation may damage battery.

RECHARGING: batteries are recharging whenever POWER MODE switch is set to AC with power applied. With POWER switch off, full charge is applied. With POWER switch ON, trickle charge is applied.

### WEIGHT

Without Panel Cover: net, 24 lb (11 kg); shipping, 35 lb (15.9 kg).

With Panel Cover and Accessories: net, 27 lb (12.3 kg), shipping, 38 lb (17.2 kg).

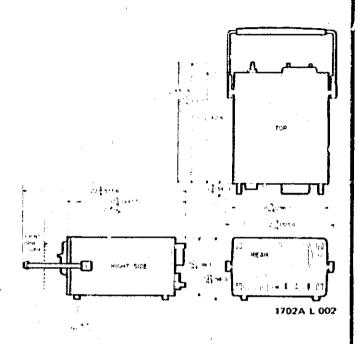
With Panel Cover, Accessories, and Battery Pack: net, 35 lb (16 kg); shipping, 46 lb (20.9 kg).

ENVIRONMENT (Oscilloscope operates within specifications over following ranges):

temperature 0°C to +55°C; humidity, to 95% relative humidity to 40°C; alti-

tude, to 15,000 ft; vibration, vibrated in three planes for 15 min each with 0.010 inch excursion, 10 to 55 Hz.

**DIMENSIONS:** refer to outline drawing.



ACCESSORIES FURNISHED: blue contrast filter, Model 10115A; front panel storage cover, Model 10101B; two Model 10006B probes, one dc power plug HP Part No. 1251-2614 for assembling dc power cord; one ac power cord with right angle plug.

### **SECTION II**

### INSTALLATION

### 2-1. INTRODUCTION.

2-2. This section contains instructions for performing an initial inspection of the Model 1702A. Installation procedures and precautions are presented in step-by-step order. The procedures for making a claim for warranty repairs and for repacking the instrument for shipment are also described in this section.

### 2-3. INITIAL INSPECTION.

- 2-4. The instrument was inspected mechanically and electrically before shipment. Upon receipt, inspect it for damage that may have occurred in transit. Check for broken knobs, bent or broken connectors, and dents or scratches. If damage is found, refer to the claims paragraph in this section. Retain the packing material for possible future use.
- 2-5. Check electrical performance of the instrument immediately after receipt. Refer to Section V for the performance check procedure. The performance check will determine whether or not the instrument is operating within the specifications listed in table 1-1. Initial performance and accuracy of the instrument are certified as stated in the front of this manual. If the instrument does not operate as specified, refer to the claims paragraph in this section.



Voltages are present inside the instrument when the POWER switch is off and ac power cord connected.

### 2-6. PREPARATION FOR USE.

### 2-7. POWER REQUIREMENTS.

- 2-8. The Model 1702A can operate either from an ac or dc power source. For ac operation, the Model 1702A requires 115- or 230-volt ±20%, single phase, 48- to 440-Hz source that can deliver 50 volt-amperes.
- 2-9. A slide switch inside the rear panel module (figure 2-1), on the rear panel, determines 145or 230-volt operation. To check or change the position of this slide switch, proceed as follows:
- a. Turn instrument off and remove power cord from rear panel.
  - b. Move plastic cover to left (figure 2-1).

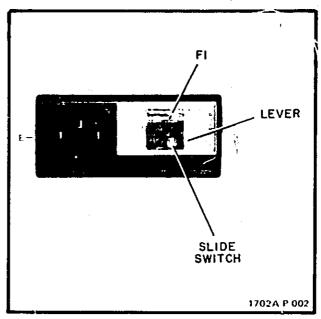


Figure 2-1. Rear Panel Power Module

- c. Pull out lever under fuse. This removes fuse (0.5AT for 115V operation) from instrument.
- d. Check to see that slide switch (figure 2-1) is to right for 115V operation.
- e. For 230V operation, move slide switch to left and install 0.25 AT fuse.
- 2-10. For dc operation, the Model 1702A requires from 11.5 to 36 volts, 25 watts maximum. The instrument can also be operated from a battery pack. Depending on the power mode of operation, the POWER MODE switch (on rear panel) should be set to one of three positions: DC LINE, INTERNAL BATTERY, or AC LINE to change POWER MODE switch proceed as follows:



Do not change POWER MODE switch setting with instrument on or AC or DC voltage applied to te instrument.

- a. Turn instrument off.
- b. Disconnect AC or DC power cord from rear panel.
- c. Set POWER switch (on rear panel) to desired position.
  - d. Connect AC or DC power cord.

### 2-11. THREE-CONDUCTOR AC POWER CABLE.

2-12. For the protection of operating personnel, Hewlett-Packard Company recommends that the instrument panel and cabinet be grounded. This instrument is equipped with a three-conductor, ac power cable that, when connected to an appropriate receptacle, grounds the instrument through the offset pin. The power jack and mating plug of the power cord meet International Electro-technical Commission (IEC) safety standards. To preserve this protection feature when operating from a two-contact outlet, use a three-conductor to two-conductor adapter, and connect the adapter wire to ground at the power outlet.

### 2-13. DC PLUG.

2-14. A dc plug is provided for operating from a dc line. The cable used for the dc power cord must be able to carry 2.5A of current with a voltage loss of less than IV.

### 2-15. BATTERY INSTALLATION.

2-16. To install the battery pack in Model 1702A, proceed as follows:



Read operating note on battery pack before installation.

- a. Turn instrument off and remove power cord from rear of instrument.
- b. Set POWER MODE switch to INTERNAL BATTERY position.
- c. Turn instrument on its top and loosen fasteners holding bottom cover.
  - d. Remove bottom cover.
- e. Place battery pack in instrument as shown in figure 2-2.
  - f. Tighten battery screws in place (figure 2-2).
- g. Connect P1 to battery J1 as shown in figure 2-2.
- h. Replace bottom cover and tighten fasteners.
  - i. Turn instrument right side up.
- j. Turn instrument on and observe power light. If power light is on, resume normal operation.



If power light is flashing, buttery is discharged. Damage to the battery may result if operated in this condition. Refer to Section III for battery recharging operation.

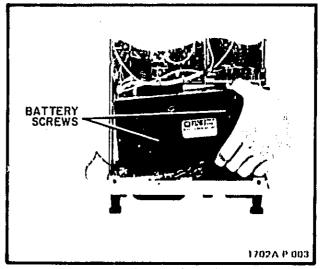


Figure 2-2. Battery Installation

### 2-17. CLAIMS.

2-18. The warranty statement applicable to this instrument is printed in the front of this manual. Refer to the rear of this manual for the CRT warranty statement. If physical damage is found or if operation is not as specified when the instrument is received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately (refer to the list in back of this manual for addresses). The HP Sales/Service Office will arrange for repair or replacement without waiting for settlement of the claim with the carrier.

### 2-19. REPACKING FOR SHIPMENT.

2-20. If the Model 1702A is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner twith address), complete instrument serial number, and a description of the service required.

2-21. Use the original shipping carton and packing material. If the original packing material is not available, the HP Sales/Service Office will provide information and recommendations on materials to be used. Materials used for shipping an instrument normally include the following:

- a. A double-walled carton; refer to table 2-1 for test strength required.
- b. Heavy paper or sheets of cardboard to protect all instrument surfaces; use a non-abrasive material such as polygrethane or cushioned paper such as Kimpak around projecting parts.
- e. At least 4 inches of tightly-packed, industry-approved, shock-absorbing material such as extra-firm polyurethane foam.
- d. Heavy-duty shipping tape for securing outside of carton.

Table 24. Shipping Carton Test Strength

Gross Weight (lb)	Carton Test Strength (lb)		
up to 10	200		
10 to 30	275		
30 to 120	350		
120 to 140	500		
140 to 160	600		

### 2-22. CRT REPACKING FOR SHIPMENT.

2-23. When the CRT is shipped to a Hewlett-Packard Sales/Service Office, be sure to follow the procedure listed below.

# ECAUTION :

When packing the CRT, never place a storage tube face down. This will place charged material on the storage mesh.

a. Place cardboard on sides and lattom of shipping carton as shown in figure 23).

- b. Place label on top of carton saying, THIS SIDE UP.
- e. If packing materials for shipping storage tubes are not available, contact Hewlett-Packard Company, Colorado Springs Division, 1999 Garden of the Gods Road, Colorado Springs, Colorado U.S.A.
- d. Follow CRT shipping instructions as outlined on Cathodoray Tube Warrinty in front of this manual.

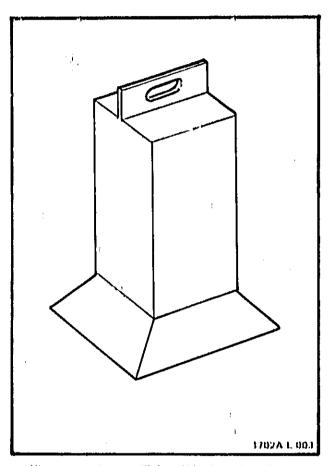
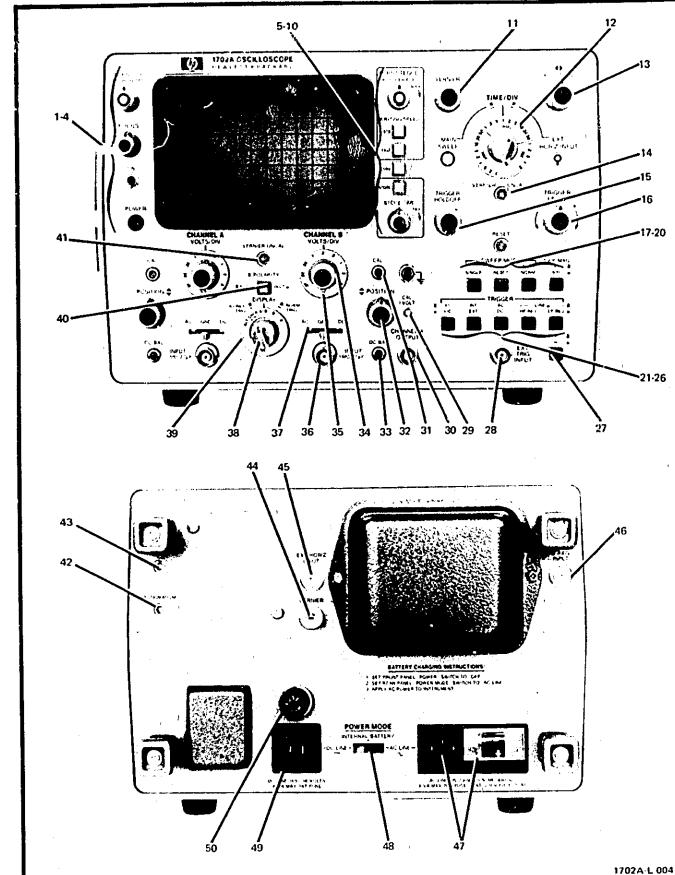


Figure 2-3, Storage Tube, Shipping Container



- 1. INTENSITY. Controls brightness of display.
- 2. PUSH:BEAM. Returns display to viewing
- 3. FOCUS. Controls sharpness of display.
- POWER-ON. Toggle switch with indicator light for turning oscilloscope off and on. Light flashes when optional battery is discharged.
- PERSISTENCE, Controls endurance time of displayed signal.
- 6. PUSHERASE. Removes stored or written displays.
- 7. WRITING SPEED.
- a. STD. Operates CRT at normal writing rate with variable persistence.
- b. FAST, Operates CRT at maximum writing rate with variable persistence.
- 8. CONV. Selects operation as standard oscilloscope. Note intensity level (paragraph 3-25).
- STORE. Retains displayed signal at reduced intensity.
- STORE TIME. Determines length of time that signal can be stored.
- 11. VERNIER. Provides continuous control of sweep time between calibrated positions of TIME/DIV control.
- 12. TIME DIV. Controls sweep time.
- 13. HORIZONTAL POSITION. Controls course and fine horizontal position of display.
- 14. VERNIER UNCAL, Lights when VERNIER is not in CAL position.

- 15. TRIGGER HOLDOFF (NORM). Provides continuous control of time between sweeps. NORM holdoff time is minimum.
- TRIGGER LEVEL. Selects amplitude point on trigger signal that starts sweep.
- 17. SINGLE. Selects single sweep operation.
- 18. RESET. Resets sweep in SINGLE sweep
- 19. AUTO/NORM.
  - a. AUTO. Automatic sweep in absence of trigger signal or triggered sweep by applying trigger signal above 40 Hz.
  - NORM, Sweep is triggered only by applying trigger signal.
- 20. SWP MAG. In X10 position, sweep is magnified 10 times.
- 21. ±1/±10. Attenuates external trigger signals by factor of 10; increasing external trigger range to ±12V.
- 22. INT/EXT. Selects trigger internal or external sweep triggering.
- 23. AC/DC, Selects trigger signal coupling.
- 24. HF REJ. Attenuates trigger signals above 30 kHz.
- 25. LF REJ. Attenuates trigger signals below 15 kHz.
- 26. LINE. Instrument triggers internally on line frequency.
- 27. slope. Selects slope of trigger that starts sweep.
- 28. EXT TRIG INPUT. External trigger input

- 29. CAL 1 VOLT. Calibrator 1-kHz, 1-volt ± 1% signal.
- 30. CHANNEL A OUTPUT. Channel A output jack.
- 31. channel B CAL. Adjust to calibrate amplifier with CHANNEL B VOLTS/DIV settings.
- 32. channel B POSITION, Controls vertical position of display.
- 33. channel B DC BAL. Adjust to minimize vertical shift of trace when channel B vernier is rotated.
- 34. CHANNEL B VOLTS/DIV. Selects vertical deflection factor necessary for calibrated measurements.
- 35. channel B vernier (CAL). Provides continuous adjustment of VOLTS/DIV between calibrated positions of CHANNELB VOLTS/DIV control.
- 36. channel B INPUT. BNC input connector.
- 37. channel B coupling (AC-GND-DC). Selects capacitive (AC) or direct (DC) coupling of input signal, or grounds input amplifier stage while disconnecting input.
- 38. trig. Selects internal triggering mode.
  - a. A ONLY TRIG. Instrument triggers on signal applied to channel A.
  - b. NORM TRIG. Instrument triggers on displayed signal except in DISPLAY ALT mode. In DISPLAY ALT mode, instrument should trigger on composite sync and LF REJ trigger coupling should be used to ensure proper triggering.
- DISPLAY. Selects type of display; either single channel, dual channel, alternate or chop mode.

- 40. B POLARITY, Selects polarity of channel B display (NORM/INVT).
- 41. VERNIER UNCAL, Lights when either channel A or channel B vernier is not in CAL position.
- 42. ASTIGMATISM. Adjusts roundness of writing spot.
- 43. TRACE ALIGN. Adjust to align trace with horizontal graticule line.
- 44. VERNIER. Permits 10:1 horizontal gain ratio.
- 45. EXT HORIZ INPUT, Input to external horizontal amplifier.
- 46. Z-AXIS INPUT, Z-axis input connector,
- 47. AC LINE, Power input from ac line, Power module contains ac line fuse (0.50 AT for 115V operation; 0.25 AT for 230V operation) and line selector switch.
- 48. POWER MODE, Selects DC LINE, INTERNAL BATTERY or AC LINE operation.
- 49. DC LINE. Power input for dc line operation.
- 50. fuse. 2-amp, slow-blow fuse in circuit for ac and external battery modes of operation. Use 3-amp, slow-blow fuse for dc line operation.

### BECTION III OPERATION

### 3-1. INTRODUCTION.

32. This section provides general operating instructions and applications information for the Model 1702A. Front and rear panel controls and connectors are identified and briefly described in figure 34. General operating instructions are provided in figures 33 through 3-7 and operational adjustments are detailed in figure 3-8.

# 3-3, SPECIAL OPERATING CONSIDER-ATIONS.

34. Prior to operating the Model 1702A, the operator must have a thorough understanding of instrument operation and control functions. This section should be read in its entirety before attempting to operate the instrument.

# EAUTION)

This instrument contains a new burnresistant CRP. Althrough CRP burns are greatly reduced, high intensity settings white in the conventional mode will burn the CRP, Observe all operating contions.

3-5. To apply power to Model 1702A perform initial turn-on procedure paragraph 3-85.

### 3-6. CONTROLS AND CONNECTORS.

34-7. The locations of operating controls and connectors are shown in figure 341 together with a brief explanation of their functions. Additional information regarding some of these controls and connectors is provided below.

### 3-8, FOCUS,

- 3-9. This control provides uniform focus of the trace over the entire CRT screen. To adjust:
  - a. Set WRITING SPEED to STD.
  - b. Center low-intensity spot on CRP screen.
- c. Adjust FOCUS control for small round, sharpley focused spot.

### 8-10. PUBLIDRAM.

ittl. Presing this pushbutton reduces amplifier pain enough to return the beam to the viewing area. This enables the operator to locate the beam and determine the action necessary to center a display texamples; reduce input signal amplitude; change coupling, adjust deflection factor, tripper level, de balance or position controls). When centered properly, the beam remains on the CRP when the pushbutton is released.

### Note

The beam find function is dependent on the setting of the intensity. If no beam is visible when the PUSH: INEAM control is engaged increase the INTENSITY setting until a beam is observed.

### 3-12. THACE ALIGN.

1441. The TRACE ALIGN adjustment compensates for external magnetic fields that may affect alignment of the horizontal trace with the graticule. The alignment should be checked when the instrument is moved to a new location and adjustment made whenever necessary.

### 3-14, CAL I VOLT.

3-15. The Evolt, Editz calibrator square wave output can be used for vertical sensitivity calibration and for divider probe compensation. The amplitude accuracy is +1% and frequency accuracy is +40%.

### D-16. COUPLING,

3-17. This lever switch selects either capacitive (AC) or direct (DC) coupling of the input signal to the vertical amplifiers, or it grounds (GND) the vertical amplifier input stage while disconnecting the input signal. The switch should be set to DC when viewing long duration pulses or de levels of waveforms, AC should be selected when viewing newaveforms having large de levels. GND position is used to disconnect the signal source from the amplifier input and at the same time ground the amplifier input. The GND position can be used to establish a reference.

### BIBL DISPLAY.

- it till. This control selects the type of vertical display Input signals may be displayed either simply of sim ultaneously as explained below
- tight. Projition A droplay or hound A input offinal
- 30). Pasipar Kalisplays channel Himput shrod
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- it is the property of the property represents the play of the play
- Ag). Position ALT displays each channel on afterunte sweeps. This mode should to used to display high frequency shinols.

### 8-95. PERSISTENCE AND INTENSITY:

did. The remards determine the viewing time of a shoot lessy displayed. The INTERSTY control sets the trace topplation on it to written. The IRRISTY BNCB control is used to entitled the desired durition of signal viewing without rewriting. It recomplishes this by varying the rate that the displayed signal is grand.

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ist)). Refertion of the operation mode deadles the variable persistence and storage teathers of the metric ment to will now fonction as a conventional, penetal purpose as the operational persons allow operational PERSISTENCE control does not function to this mode. Always adjust the INTENSITY in spiral mode, with intomuon persistence, for no blooming, then switch to conv. Do not increase intensity beyond this level while in the conv. mode.

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1512. In order to retain whatever is visible on the CPP, enjoye the STOIRS pushbatton. The signal will be stored at reduced intensity resulting in 54 storage time president than 1 br. The INTENSITY, PRINTSPENCE, FOR US, PUSH-ERASIS, and HOIS IZONTAL, POSPTION controls do not affect the presentation in the store mode.

it is the amonphicaline, it may be desired to show need appropriate a "life to possible through proper manipolational the Philips 1876 Band Perfect IV controls simply obtain the desired multiple trace display in the old male. Then enume the STORE postunition

### 9:34: STORE TIME:

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### 3540: U POLABITY:

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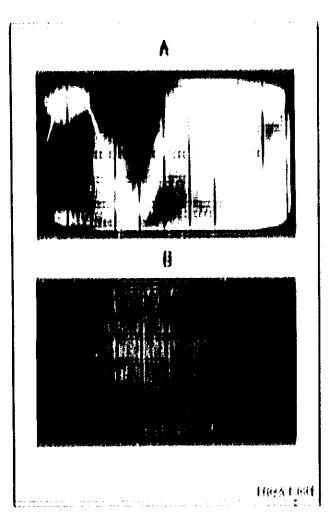
# 3:60: OPERATING CONSIDERATIONS:

### 3-61 - OFFINITIONS

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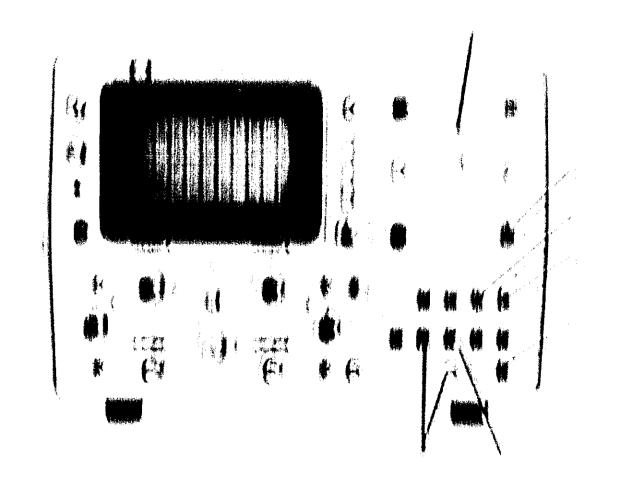
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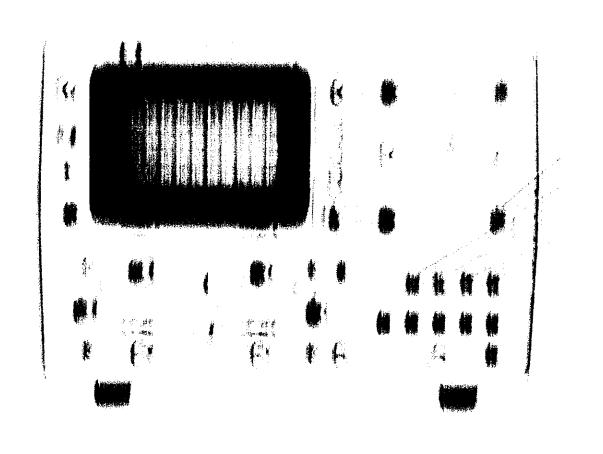
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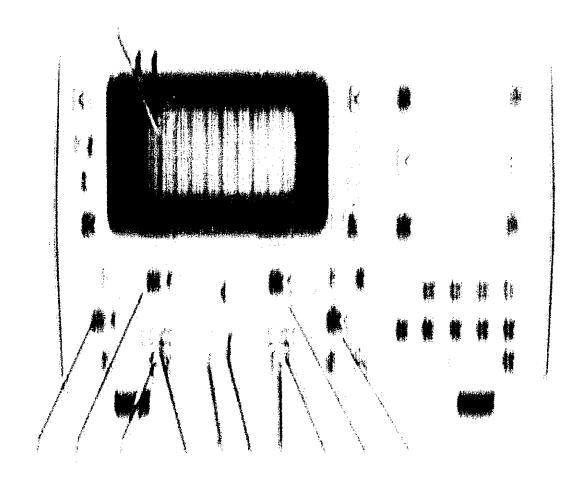
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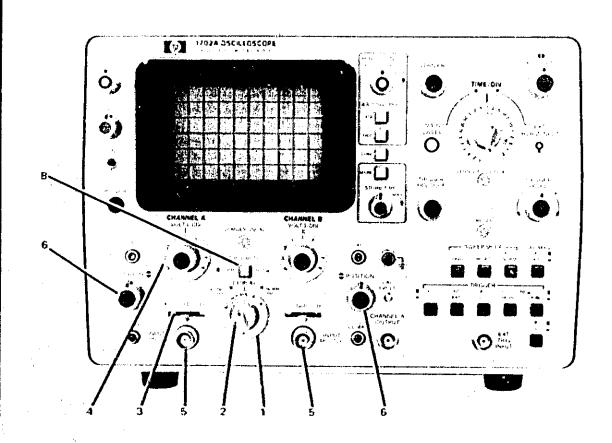
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# (CAUTION)

Do not allow trace to bloom. Do not allow unattended instrument to operate in CONV for extended periods of time.

### A + B OPERATION

- L. Set DISPLAY to A + B.
- 2. Set trig to NORM TRIG or A ONLY TRIG as desired.
- 3. Set channel A coupling to AC or DC.
- 4. Set CHANNELA VOLTS DIV to desired range.

- 5. Connect desired vertical signals to channel A and channel B INPUT connectors.
- Adjust channel A POSITION and channel B POSITION controls for desired display on screen.

### Note

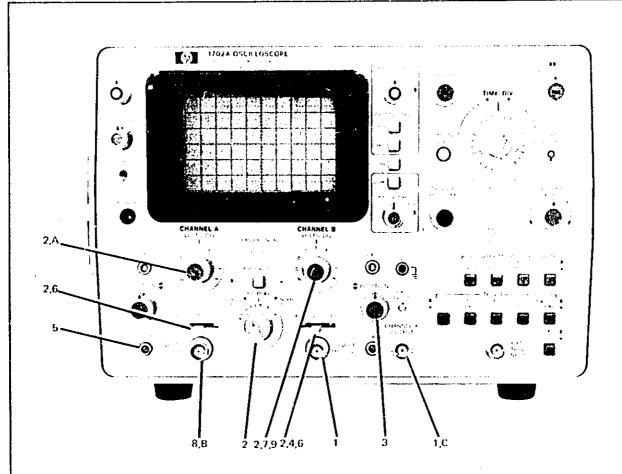
In the A + B mode, only one trace is observed. This trace is the sum of A + B and either channel POSITION control will vary the vertical position display.

### A -- B OPERATION

- A. Repeat steps 1 and 2 of A + B operation.
- B. Set B POLARITY pushbutton to INVT.
- C. Repeat steps 3 through 6 of A \* B operation.

1702A P 008

Figure 3-6. A + B and A — B Operation



### CASCADED OPERATION, CHANNEL A OUTPUT

- 1. Connect CHANNEL A OUTPUT to channel B INPUT with BNC cable.
- Set vertical controls as follows:

DISPLAY	. B
channel A VOLTS/DIV	0.1
channel B VOLTS/DIV	.01
channel A coupling	GND
channel B coupling	

- 3. Center trace with channel B POSITION control.
- 4. Set channel B coupling DC.
- 5. Center trace with channel A DC BAL control.

- Set channel A and channel B coupling to desired position.
- 7. Set channel B VOLTS DIV to desired range.
- 8. Connect signal to channel A INPUT.
- 9. Sensitivity of vertical amplifier (as read on channel BVOLTS/DIV switch) will be increased by a factor of 10.

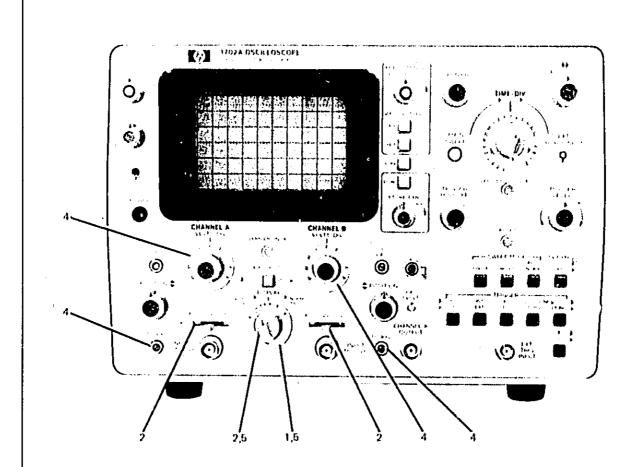
### INDEPENDENT OPERATION, CHANNEL A OUTPUT

- A. Set channel A VOLTS/DIV to desired range.
- B. Connect desired signal to channel A INPUT.
- C. Take amplified signal from CHANNELA OUT-PUT.

1702A P 009

Figure 3-7. Channel A Cascaded and Independent Operation

Model 1702A Operation



# EXAUTION 3

Do not allow trace to bloom. Do not allow unattended instrument to operate in CONV for expanded periods of time.

### DC BALANCE ADJUST

- 1. Set DISPLAY to A.
- 2. Set channel A coupling to GND.

- 3. Obtain baseline per figure 3-3, AUTO opera-
- 4. Adjust channel A DC BAL until vertical trace does not shift when turning channel A vernier from CAL to maximum attenuation.

### Note

If trace is not on CRT screen, press PUSII:BEAM pushbutton and adjust channel A DC BAL until trace remains on screen.

5. Repeat steps 1 through 4 for channel B.

1702A P 010

Figure 3-8. Amplifier Balance Adiust

### **SECTION IV**

### PRINCIPLES OF OPERATION

### 4-1. INTRODUCTION.

4-2. This section contains an overall explanation of circuit theory. Refer to the overall block diagram in Section VIII while reading the theory.

# 4-3. VARIABLE PERSISTENCE AND STORAGE.

- 4-4. This section deals with basic theory of operation to aid in the understanding of storage concepts.
- 4-5. The storage CRT consists mainly of a conventional write gun with associated deflection plates and an aluminized phosphor viewing screen. In addition, it contains flood guns, flood beam shaping and accelerating grids, a collector mesh, and storage mesh. A schematic drawing of this CRT is shown in figure 4-1. The write gun functions as a conventional, electrostatic deflection gun. Elements which provide storage and variable persistance are located between the write gun and phosphor.
- 4-6. The flood guns are located physically just outside the horizontal deflection plates and emit a cloud of electrons from their cathodes. This cloud of electrons is shaped and accelerated toward the viewing area by the collimator (the coating on the inside of the funnel section of the glass) and the col-

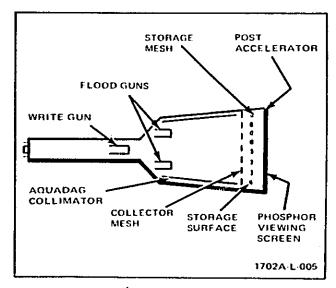


Figure 4-1. Simplified CRT Construction

lector mesh. The potential on the storage mesh and storage surface exerts further control on the flood of electrons as they arrive at the storage surface, where storage of information takes place.

- 4-7. The secondary emission ratio curve shown in figure 4-2 is the basis for storage of information on the storage surface. The point where the number of electrons leaving the storage surface is the same as the number of electrons arriving is called "first crossover" point. When more electrons are leaving than arriving, the storage surface potential rises; when more electrons are arriving then leaving, the storage surface potential decreases.
- 4-8. Figure 4-3 graphically presents the action of the storage mesh and storage surface potentials during the erase cycle. When the PUSH:ERASE control is pressed, the storage mesh and storage surface are brought to the same potential as the collector mesh, +160 volts. After approximately 100 ms, both storage mesh and storage surface are decreased to a potential of approximately +10 volts and held there for about 400 ms.
- 4.9. Flood gun electrons that have a potential close to 0 volt will be attracted to the +10 volts. These flood gun electrons then discharge the storage surface, because the potential is below first crossover (figure 4-2), and bring the entire storage surface to 0 volt. At the end of 400 ms, the storage mesh potential

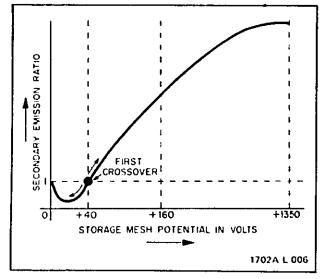


Figure 4-2. Secondary Emission Ratio

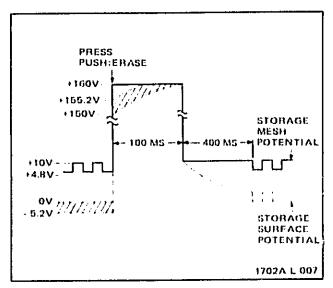


Figure 4-3, Erase Cycle

is decreased to +4.8 volts. The storage surface will follow, due to capacitive coupling, and becomes +5.2 volts.

4-10. Write gun electrons (with much higher than first crossover energy) charge the storage surface in a positive direction only in areas where they strike the storage surface. Flood gun electrons pass through these areas and are pulled to the viewing areas by the high post-accelerator potential.

4-11. The method of obtaining variable persistence is represented in figure 4-4. After the erase cycle, the unwritten storage surface is approximately —5.2 volts. Those areas of the storage surface struck by the write gun electrons become charged to near 0 volt. The written areas are clamped near 0 volt by flood gun electrons. When erase pulses are applied to the

storage mesh, the storage surface is capacitively increased to 5.2 volts for the duration of the pulse. While at this potential, the storage surface written areas tabout 5.2 volts) attract and capture flood gun electrons. This tends to lower the potential of written areas because it discharges the capacitor terented by the dielectric material) toward 0 volt. When the storage mesh returns to its normal level, the storage surface drops to 5.2 volts. The unwritten areas of the storage surface return to the -5.2 volt potential and written areas return to a slightly negative potential. somewhat lower tmore negative) then their initial value. This decrease in potential reduces the ability of the post-accelerator potential to reach through and capture flood gun electrons, and trace brightness is slightly reduced.

4-12. A train of erase pulses gradually erases the written trace as shown in figure 4-4. The repetition rate of the erase pulses varies the persistence of the written trace. While the storage mesh is pulsed positive, flood gun electrons are allowed through to the phosphor viewing screen at all areas on the storage surface, causing a light background glow under som conditions.

4-13. When the storage mesh potential is reduced to about —40 volts, in the conv mode, it nots as a control grid to flood gun electrons, repelling them from the phosphor. It has little effect on the write gun electrons, allowing them to pass through to the viewing area.

4-14. However, some of the write gun electrons strike the storage surface and drive it in a positive direction. At high intensity settings, this change in potential is very rapid. The energy from this sudden change is converted into heat in the storage sufrace and may burn the dielectric material. In storage modes of operation, this burning action is visible as trace blooming.

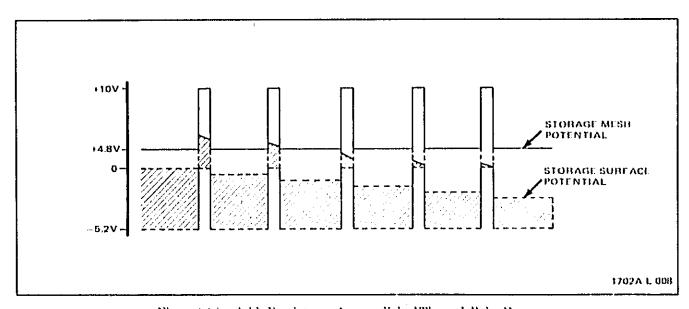


Figure 4-4. variable Persistence Accomplished Through Pulse Ernse

However, trace blooming is not visible during convoperation. Therefore the intensity level should be set just below the blooming point in the std mode before switching to the conv mode of operation.

4-16. Pade positive of the storage surface teausing the entire viewing area to be illuminated) limits the viewing time of a persisting trace. This effect is caused primarily by flood gan electrons ionizing the residual gas molecules. Pade positive is reduced by turning off the flood gun, except for a brief period during use in the storage mode. These turnent periods occur frequently at the minimum end of the STORE TIME control (fully cew) and produce a trace near normal intensity. No turneon periods occur on the maximum end of the STORE TIME control (fully ew) and the trace is not visible.

### 4-16. GENERAL THEORY.

4-17. An overall explanation of circuit operation based on block diagrams (schematics 1 and 2) is presented to generate a basic understanding of the instrument. For simplicity, the block diagrams are drawn for function and do not show all circuit details.

### Note

For circuit theory, a logic high (1) is a more positive voltage and logic low (0) is less positive voltage.

448. This instrument consists of a CRP, storage circuit, line rectifier, gate assembly, external horizontal amplifier, and three modules. The modules are as follows; (1) vertical amplifier module containing attenuators, vertical preamplifier, delay line, vertical output amplifier, and channel A output amplifier; (2) a horizontal amplifier module containing trigger assembly, horizontal mother board, main and delayed integrators, main and delayed sweep time assemblies, holdoff and comparator assembly, horizontal mode assembly, horizontal preamplifier, and horizontal output amplifier; and (3) power supply module containing low voltage mother board, low voltage converter, low voltage rectifier and filter, high voltage oscillator, and high voltage multiplier.

### 4-19. INPUT ATTENUATOR, (See schematic 1.)

4-20. The attenuators are compensated voltagedivider types. They provide division ratios of 4, 2, 5 10 and 100, giving nine separate sensitivities. Each decade input sensitivity range has an input capacitance adjustment and an attenuator compensation adjustment. Coupling (AC, GND, and DC) is also controlled in the attenuator stages.

### 4-21. VERTICAL PREAMPLIFIER.

4-22. The vertical preamplifier provides amplification to the input signals for drive to the vertical output amplifier. Channel A syne and composite syne signals originate in the vertical preamplifier. The syne signals are applied to the trigger assembly for internal triggering. Channel switching, chop operation, and display mode are also accomplished in the vertical preamplifier (schematic 7).

### 4-23. DELAY LINE,

4-24. The delay line provides approximately 400 ns delay to the vertical signal, allowing the horizontal circuits sufficient time to react to the trigger signal so that the event caused by the trigger can be observed on the fastest sweep.

### 4-25. VENTICAL OUTPUT AMPLIFIEN.

426. The vertical output amplifier provides drive to the CRP vertical deflection plates.

### 4-27. CHANNEL A OUTPUT AMPLIFIER.

1-28. The channel A output amplifier provides a gain of 10 to the channel A signal twith channel A VOLTS/DIV set to .01). With the CHANNEL, A OUTPUT connected to the channel B INPUT, the Model 1702A vertical sensitivity can be extended to 1 mV div.

### 1-20. TRIGGER CIRCUITS.

430. The trigger assembly provides the main trigger signal to the integrator. Prigger modes are selectable in this assembly. The tripper cirucit provides two outputs to the integrator (schematic 1). One output is the trigger that is generated by the current switch. The output of the current switch is controlled by the inputs to the set-trigger gates. One input to the set-trigger gate is the trigger signal and other input is the reset signal from the integrator. When the reset signal is high, the set-trigger gates are inoperative and no trigger signal is generated. When the reset signal is low, the set-trigger gates are operational and a trigger signal will be generated if there is an internal or external trigger input. The other output is the brightline auto level which is provides only in the auto mode.

### 4-31. INTEGRATOR.

432. The integrator initiates a horizontal sweep from the trigger laput. When the trigger signal is applied to the input amplifier, the Miller integrator activates and produces the horizontal sweep ramp. The Miller integrator is connected to the sweep timing components (schematic 12). The FIME DIV switch controls the ramp output from the Miller integrator. The output of the Miller integrator is amplified and applied to the horizontal amplifier circuits,

433. The horizontal sweep is also compared to a 12volt reference by the ramp comparator which drives the integrator set-reset multivibrator. The set-reset multivibrator, in conjunction with the holdest circuit, controls the amplitude and that appears of the sweep ramp. When the sweep ramp reaches 12 volts, the ramp comparator turns on and resets the trigger set trigger gates to a logic high the The signal from the holdest amplifier determines the holdest time of the circuits and sets the trigger set-trigger gates to a logic box (the form new sweep.

431. When the bright-line auto circuit is next, the set-reset multivibrator provides a ground for the bright-line auto level and terminates the sweep. This allows the sweep signal to return to its starting point.

133. At the same time that the ramp is generated, the alt amplifier provides an output to the vertical preamplifier d.K. flip flop for alt operations.

### 4-86. HOLDOFF.

day, The holdest establishes the time interval between tripper points. The time interval is adjusted by the TRRICER ROLDEP control A signal from the integrator set-reset multivibrator activates the holdest circuit. When the holdest amplifier RC circuits and the TRRICER ROLDEP control, is generated. When this ramp reaches a predetermined level, it activates the integrator set-reset multivibrator. The set-reset multivibrator then sets the tripper set-tripper gates low for new sweep.

### A-80, TIMING BEOUENGE

\$40. Pigure to is an illustration representing the time relationship between the trigger and sweep timing circuits. Waveform A represents the input signal to the vertical circuits and the integral syne signal. Waveform B responsents the integrator setteset multivibrator output. Waveform C represents the input to the trigger set trigger gates and waveform D represents the output! Waveform B represents the main integrator output! Waveform P represents the finant to the holdest amplither.

1-10. At  $T_{\rm pt}$  the multivibrator autput is high, holding the settrigger pates high, preventing a sweep signal. At  $T_{\rm p}$  the holdest time is completed and the multivibrator output nees low, activating the settrager pates. At  $T_{\rm sp}$  the trigger shand nees how, activating the settinger gates output poss low, activating the integrator which produces a horizontal sweep signal.

I the At T., the sweep is terminated and the set-reset multivitation output goes high. When the set reset multivitation nees high, the holdest time signal starts and the set tripper gutes are locked high, preventing a sweep. At the completion of holdest time, the sequence is repeated.

### AMP, BAT HOME INPUTA

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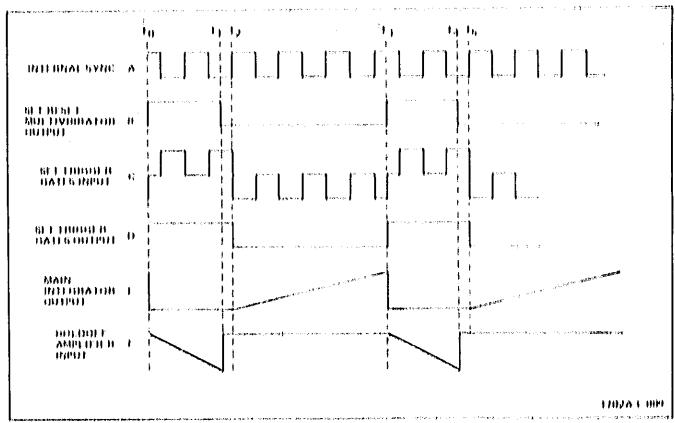


Figure 4.5. Timing Sequence

ation. In the EST HEIRIZ IMPLYF mode, the blanking signal is grounded and the output from the external horizontal amplifier is connected to the horizontal preamplifier.

# A:AA, LOW VOLTAGE POWER BUPPLY, (BUB BEHU! MHHO P.)

- The The low voltage power supply operates from three different power sources. The sources are as they followed power motion the fine the line is applied to the fugut power motion which is selectable for 115 or 300 volt operation and has an as the protection fuse. The ac input is applied to a step down power transformer.
- 1-16. The line rectifier rectities and filters the power transformer accompan of approximately 30 yallo Tills yallago is applied to the yallago regulator and a ripple filter which filters and the 190 hears apple
- 4.1% The voltage regulator output is applied to the low voltage converter. This stage converts the input de power to useable output de of different voltage levels. The low voltage converter is allotes between 40 kHz and 15 kHz, depending upon the input voltage and the output power.
- I to The voltage coupled from the converter to the low voltage restator to differed and applied to the low voltage methor board which provides low voltage distribution to the power supply module. A portional time 15 and 12 to voltage for both to the low voltage regulator which determines the trequency and that eyels at the converter for output voltage regulation.
- 4 M. The Altered voltages from the low valuage mother loaded are complet to the gate board. The gate board provides Altering, tase protection and distribution of the low voltage supplies to the rest of the Aload 1709A elecute

#### A-BO, HIGH VOLTAGE POWER BUPPLY.

A/A). The high voltage power supply consists of the high voltage oscillator, power transformer, rectifying networks, and high voltage multiplies. When the instrument is time on, the high voltage oscillator activates, coupling voltages from pure 1 and 2 into the secondary place 6 and 7, 5, 8, and 0. Pure 11 and 10 are connected to Diaments at the CIC. The secondary voltage at pin 7 is connected through a certifying dools to the control prid at the CIC. Fur 8 of the secondary is connected through a rectifying dools to the control prid at the CIC. Fur 8 of the secondary is connected through a rectifying dools to the dools have a through a restaure 18 connected from this disable buck through a restaure divider network, controlling the current source. The current source controls the oscillator amplitude and thus the high voltage oscillator output. The CIC voltages are negative, except for the post-precionator voltage.

the The Off enthule value is led but but the incent source. If the enthule value because more negative, less entent is supplied to the little valoperated contlator. With less entent supplied, the implitude of the be oscillator output is reduced and the enthule value will exture be meaned possibly value. If the enthule value becomes less negative, most entent is supplied to the by oscillator. The output amplitude max increases and the enthule value and to reduce to its manual question value. A 1874 by peak to peak values is present at pur it of the high value templomer. This value is applied to the high value multiplier entent where it is multiplied by 1. The value? output to applied to the

### 4:53 GATE AMPLIFIER.

151 The pate amplifier has four inputs one input is team the INTENSITY control, another input is the hardportal made blanking input, a third input to the section peramphilise loop blanking input sand tourth input is team the SANIS INTENT All of these inputs control the infonsity of Saxis of the CIFE The output team the pate amplifier to the CIFE prof increases of the reases the intensity of the theology.

## 4:55: STORAGE GIRGUITE:

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િશ્ક માં લીઇ કે લાકાલમાં લીઇ કે હો નિર્દેશ માણના છું માના મામલે લેવા માના કરવાઓ છી કે હોઇ નેલા કે હો લીઇ જે દાનમાં મેના પાલીઇ પાલી માના કે માણના છું એ જોડીએ તેવું તેવા કરવાઓ પાલી કે હોઇ માણે કે હો લીઇ કે પાલીએ ના તાલુકા કરે તે મારા મામલું કું કર્યો તેવા જે સામ કે આપ્યાનો મામ માના મામલે હોઇ હિલ્લા કે હો લીઇ કે નામ કર્યો કરે હોઇ નામ માના વાલા માના મામ હિલ્લા કે હો લીઇ કે નામ કર્યો કરે હોઇ

દેશના નિયમ જ દેશિક પાકના મુક્કાન કરો છે. કે કે કે માટે કે માર્ચિક કરો કરતા કરતા છે. માટે કે માટે કે માટે કે મા માત્ર મુખ્ય જ દેશિયા છે. માત્ર કે જે પાકન કે માત્ર કે માત્ય કે માત્ર કે

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provided to the CKT control grid through A3A4CR7 by the gate assembly. The blanking input completely blanks the CKT. As a less negative voltage is applied to the grid circuit the trace intensity becomes brighter. As more negative voltage is applied, the trace intensity decreases until it is blanked.

4-163. The sine wave signal produced by high oscillator A3Q1 is stepped up by the high voltage transformer, A3A4A1T1, producing a peak-to-peak voltage of approximately 1750 volts between pins 9 and 5. This signal is applied to high voltage multiplier circuit A5, which is a quadrupler circuit. The multiplier assembly rectifies the input voltage, inverts it, and multiplies it to approximately +7000 volts to drive the CRT post accelerator.

#### 4-164. LOW VOLTAGE POWER SUPPLY.

4-165. Schematic 18 contains the power module, line rectifier, part of the low voltage mother board and part of the A4 gate assembly. The A1 power module provides ac input power to the Model 1702A. The A2 line rectifier rectifies the incoming ac and provides some filtering. The trickle charge circuit for the battery is also contained on this board. The A3A1 low voltage mother board provides voltage regulation, filtering, and full charge current to the battery. The A4 gate assembly has the light driver for the scale illumination circuits and the low battery indicator circuit.

4-166. A1F1 is the ac input fuse. A1S1 provides selection between 115- and 230-volt operation. The ac input is applied to T1 which is a 3:1 stepdown transformer.

4-167. Z1 rectifies the incoming signal. A2C1 and A2C2 are ripple filter capacitors. A2R1 and A2CR1 provides a trickle charge of 40 milliamperes to the battery in AC LINE operation. A2R3, A2R4 and A2C3 provide the line sync signal. A3A1Q1 and A3Q2 form a series voltage regulator. A3A1R1 provides current to A3A1VR1 which sets the base reference voltage of A3A1Q1. A3A1R4 provides current limiting, A3A4CR1 is a protection diode for A3A4Q1 and A3Q2, A3A1C1 and A3A1R3 form a ripple filter. A3A1R5 and A3A1CR2 form the full charge circuit for the battery. When the instrument is off, approximately 400 milliamperes is applied to charge the battery. This charging current is always applied with the POWER MODE switch in AC LINE, the ac power connected and the instrument POWER switch set

4-168. POWER MODE switch S2, provides selection for AC LINE, INTERNAL BATTERY or DC LINE. S1 provides for power on or power off. F1 is in the line during all modes of operation. J2 provides for DC LINE input. This input should be limited between 11.5 to 36 volts, 18 watts maximum.

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4-169. A4Q2 and associated circuitry form the light driver network. When the instrument is operated in any mode except INTERNAL BATTERY the circuit is off. Current flows through A4R30, A4CR12 and DS1 when the instrument is turned on. When the instrument is operated in INTERNAL BATTERY and the battery voltage drops below 22.5 volts, A4Q2 turns on. DS1, A4R29 and A4C13 form a relaxation oscillator which causes DS1 to flash. This is an indication that the battery is discharged and further operation may damage the battery.

4-170. Schematic 19 contains the low voltage converter protection circuits and the low voltage converter assembly. The protection circuit protects the instrument in the event that the regulator fails, the dc line input is more than 40 volts, or the polarity of the dc input is reverse.

4-171. The A3A2 low voltage converter assembly changes the input de voltage to usable de voltages of different levels. The low voltage converter assembly also contains the regulator network which controls the converter output.

4-172. A3A1CR3 protects the instrument again—tade voltage connected with the wrong polarity. If the wrong polarity is connected, A3A1CR3 turns on and the line fuse F1 (schematic 18) opens. If a dc input over 40 volts is connected, A3A1VR3 conducts which turns on A3A1SCR1 and opens F1 (schematic 18).

4-173. If the regulated +15-volt supply goes above approximately 20 volts, bidirectional diode A3A1CR5 turns on. A3A1CR5, A3A1C2 and A3A1R9 form a relaxation oscillator whose output is coupled across A3A1T1, rectified by A3A1CR4 and filtered by A3A1CR3. This rectified voltage turns A3A1SCR1 on, opening line fuse F1.

4-174. A3A2Q2 with associated circuitry form the low voltage converter. This circuit changes the incoming de voltage to useable de voltages of different magnitudes, A3A2R2 and A3A2VR2 form a voltage source charging A3A2C7 through A3A2R6, A3A2C7 charges to the peak-point emitter voltage of the unijunction transistor A3A2Q1. At this voltage, A3A2Q1 conducts supplying current thru A3A2R12 to the base of A3A2Q2 (figure 4-1). This current turns on A3A2-Q2 allowing current to flow in the primary windings of A3A2T1 and A3A2T1 (schematic 19). As the current in these windings increases, primary winding 1 and 2 (A3A2T1) induce voltage into pins 3 and 4, such that A3A2Q2 conducts harder. The primary current continues to increase until the core (A3A2T1) saturates. At this point there is no longer magnetic coupling in A3A2T1 and A3A2Q2 turns off. When A3A2Q2 turns off, an open circuit condition on pins 1 and 2 of A3A3T1 (schematic 20) exists and the energy stored in the primary windings of A3A3T1 causes a fly back voltage to appear on the secondaries

- of A3A3T1. This allows the secondary circuits to conduct, charging the capacitors to the required dc voltages.
- 4-175. A fly back voltage also appears in the secondary windings A3A2T1 pins 3 and 4. This fly back voltage turns on A3A2CR4 charging A3A2C8. When all the energy has left the core, the cycle is repeated with A3A2C8 aiding the turn on of A3A2Q2. The magnetic field in the transformers provide drive for the rest of the operation.
- 4-176. A3A2VR3 is a protection diode protecting A3A2Q2 from emitter-to-collector breakdown, A3A2-C1 and A3A2C2 isolate the power supply from ground. Unijunction transistor A3A2Q1 fres only when the instrument is first turned on, A3A2CR5 provides a discharge path for A3A2C7 preventing A3A2Q1 from being turned on again.
- 4-177. The low voltage regulator controls the duty cycle of the low voltage converter thus controlling the output voltage. Current into or out of pin 5 of A3A2T1 increases or decreases the duty cycle of the low voltage converter. An increase in current flow from pin 5 decreases the conduction time of A3A2Q2 which lowers the output voltage from the low voltage rectifier and filter network.
- 4-178. The regulated +15 volts is applied to pin 3 of the low voltage converter assembly. The regulated -15 volts is applied to pin 10. The -15 volts turns on reference diode A3A2VR1. The +15 volts is compared to the voltage reference through A3A2R3 and A3A2R4. The different current, which results in a small voltage variation, is applied to operational amplifier A3A2U1 which is connected in the inverting mode. If the voltage at pin 2 increases, the output at pin 6 decreases. When the output of pin 6 decreases,

- A3A2Q4 turns on harder, drawing current through pins 6 and 5 of the transformer. This increase in dc current from pin 5 of A3A2T1 lowers the output voltage.
- 4-179. If +15 volts decreases, the voltage applied to pin 2 decreases causing an increase at the output of A3A2U1. When the voltage increases, A3A2Q3 turns on providing more current into pin 5 and 6 of A3A2T1. The increase in dc current into pin 5 increases the conduction time of A3A2Q2 causing the output voltage to increase.
- 4-180. A3A2CR1 and A3A2CR2 protect A3A2U1 input. A3A2C10, A3A2R13 and A3A2C12 provides frequency compensation. A3A2U1 operates open loop dc and closed loop ac. The closed loop feedback is provided by A3A2C13 and A3A2R14.
- 4-181. Schematic 20 contains the low voltage rectifier and filter networks, the low voltage mother board filter networks and the fuse protection circuits for the low voltage power supply.
- 4-182. A3A3CR1 through A3A3CR8 provides rectification of the input signal from the low voltage converter (schematic 19). A3A3C1 through A3A3C10 provide appropriate filtering.
- 4-183. A3A1C4 through A3A1C6 and A3A1C8 through A3A1C11 provide further filtering to the low voltage power supplies. A3A1R10 through A3A1R18 and A3A1R20 are bleeder resistors that discharge the capacitors on the low voltage rectifier and filter and the low voltage mother board.
- 4-184. The A4 gate assembly provides fuse protection, filtering, and distribution of the low voltage to the horizontal module and the vertical module.

Table 5-1. Recommend Test Equipment

Instrument Type	Recommended Model	Required Characteristics	Required For
Voltmeter Cal- ibrator	HP Model H01- 738BR	Voltage: 5 mV to 100V Accuracy: to 0.1%	P,A
Oscillator	HP Model 204C	Frequency: 100 kHz Voltage Output: 15 mV	<b>A</b>
Time-mark Generator	HP Model 226A	Time Marks: 0.1 usec to 2 sec in 1, 2, 5 sequence	Р, А
Square-wave Generator	HP Model 211B	Frequency: 100 kHz Risetime: <5 ns	P
Multifunction Digital Volt- meter	HP Model 3439A with 3444A	Voltage Range: 1000V Accuracy: ±0.1% Resistance Range: 10 megohms Accuracy: ±0.1%	P, A, T
VHF Signal Generator	HP Model 608E	Frequency: 50 kHz to 75 MHz Voltage Output: 50 mV to 5V p-p	P
LC Meter	HP Model 4332A	Range: 30 pF	A
50-ohm Feed- through Termi- nation	HP Model 10100C	Resistance: 50 ohms	P, A
50-ohm BNC Cable (1)	RG 213	50-ohms	P, A
BNC Cable (2)	HP Model 10501A Cable Assembly	44 in.	P, A
BNC Cable (2)	HP Model 10502A Cable Assembly	9 in.	P, A
Banana Jack to BNC Adapter	HP Model 10110A	Banana Jack to BNC	P, A
BNC to Binding Post Adapter	HP Model 10111A	BNC to Binding Post	P, A
Test Leads	HP Model 11002A	Test Leads	P, A, T
RF Millivolt- meter	HP Model 411A	Range: 35 mV Accuracy: ±3%	; <b>P</b>
10:1 Divider Probe	HP Model 10006B	Divide Ratio: 10:1	<b>A</b>
1000:1 Divider Probe	HP Model K05- 3440A	Divide Ratio: 1000:1	A
Monitor Oscillo- scope	HP Model 180A, 1801A and 1820A	Bandwidth: 50 MHz	<b>A,T</b>
Screwdriver	HP Part No. 8710-0900	Pozidrive	A, T
Service Kit	HP Part No. 01701-68701	Extender Boards and Board Puller	P, A, T

Note 1. P = Performance Check, A = Adjustment Procedure, T = Troubleshooting. 5-0

#### **SECTION V**

#### PERFORMANCE CHECK AND ADJUSTMENTS

#### 5-1. INTRODUCTION.

5-2. This section contains step-by-step procedure for checking the instrument specifications as given in table 1-1 of this manual. The performance check procedure gives troubleshooting suggestions in case the instrument fails to meet any specification tested. A table (performance check record) is provided at the end of the performance check for recording the measurements obtained in the first running of the procedure. This record may be used to compare measurements taken at later dates with the original. The procedures for making all internal adjustments are covered in paragraphs 5-98 through 5-209. A photograph showing the locations of all internal adjustment controls is presented in figure 5-15.

## 5-3. TEST EQUIPMENT.

5-4. Test equipment required for procedures in this section is listed in table 5-1. Test equipment equivalent to that recommended may be substituted, provided it meets the required characteristics listed in the table. For best results, use recently calibrated test equipment.

#### 5-5. PERFORMANCE CHECK.

- 5-6. The following subparagraphs describe procedures to determine whether or not the instrument is operating within the specifications of table 1-1. This check can be used as part of an incoming inspection, as a periodic operational test, or to check calibration after repairs or adjustments have been made. Any one of the following checks can be made separately if desired.
- 5-7. The first time the performance check is made, enter the results on the performance check record at the end of the procedure. Remove the record from the manual and file it for future reference. Be sure to include the instrument serial number on the record for identification.

#### 5-8. FRONT PANEL ADJUSTMENTS.

5.9. Set the instrument up and perform initial adjustments outlined in Section III before proceeding with the performance checks or adjustment procedures.

#### 5-10. FRONT PANEL SETTINGS.

5-11. Begin each performance test and adjustment procedure with the control settings listed below. If a control is to be set to another position, it will be listed in the procedures. After the completion of each performance check or adjustment procedure, the controls should be set back to the original front panel settings.

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channel A POSITION as required	
DISPLAY	
trig NORM TRIC	3
CHANNEL B VOLTS/DIV	
channel B coupling AG	
channel B vernier CA	
channel B POSITION ns required	
B POLARITY NORM	
HORIZONTAL POSITION as required	
VERNIER CAI	
TIME/DIV 5 uSEC	
AUTO/NORM AUTO	
INT/EXT IN'	
AC/DC	
slope	
TRIGGER LEVEL as required	
TRIGGER HOLDOFF NORM	
SWP MAG X	Ì

#### 5-12. PERFORMANCE TESTS.

#### 5-13. DEFLECTION FACTOR.

Table 5-2. Deflection Factor Accuracy

Voltmeter Calibrator Settings (volts p-p)	VOLTS/DIV Settings	Vertical Display (div)
0.1	.02	5 ±0,15
0.3	,05	6 ±0,18
0.5	.1	5 ±0,15
1.	,2 '	5 ±0,15
3	.5	6±0,18
5	1	5 ±0,15
10	2	5±0.15
30	5.	6,±0.18
		l

5-14. Specification. Ranges: from 10 mV/div to 5 V/div (0 ranges) in 1, 2, 5 sequence. Accuracy: +3% with vernier in CAL position. Vernier: continuously variable between all ranges, extends maximum deflection factor to at least 12.5 volts/div. vernier uncal light indicates when vernier is not in CAL position.

5-15. Description. The deflection factor is checked by applying a 400-Hz, voltage-calibrated signal to the input. The display signal is compared against the voltage standard.

## 5-16. Equipment.

- a. Voltmeter Calibrator.
- b. Banana Jack to BNC Adapter.
- e. BNC Cable, 44 in.

#### 5-17. Procedure.

n. Connect instruments as shown in figure 5-1.

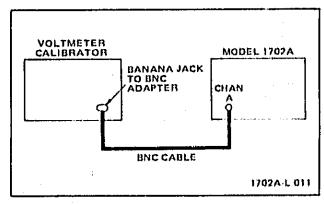


Figure 5-1. Deflection Factor Test Setup

- b. Set Model 1702A TIME/DIV to .5 mSEC.
- e. Set voltmeter calibrator controls for 50-mV p-p output signal.
- d. Observe CRT. Display should be 5 vertical div 23%.
- e. Observe vertical deflection factors specified in table 5-2.
  - f. Set voltmeter calibrator output for 30V.
  - g. Set CHANNEL A VOLTS/DIV to 5.
- h. Rotate channel A vernier control fully cew, VERNIER UNCAL light turns on, Display reduction should be equal to or less than 2.4 div.

- Rotate channel A vernier control fully ew into CAL detent.
- Connect voltmeter calibrator output to channel B4NPUT.
  - k. Set DISPLAY to B.
  - 1. Repeat steps b through I for channel B.
  - m. Remove test equipment.
- n. To return to initial settings, set Model 1702A controls as follows:

 d. Refer to schematic 3 if any deflection factor is not within specifications.

#### 5-18. CALIBRATOR.

5-19. Specification, Type: 1-kHz + 10% square wave, Voltage: 1V p-p +1%.

5-20. Description. The frequency is checked by the Model 1702A. The calibrator amplitude is checked by comparing the calibrator amplitude against a known 0.1%, IV p-p signal.

#### 5-21. Equipment,

- a. Voltmeter Calibrator.
- b. Banana Jack to BNC Adapter.
- e. BNC Cable, 44 in.
- d. Test Lend.

#### 5-22. Procedure.

n. Connect instruments as shown in figure 5-2.

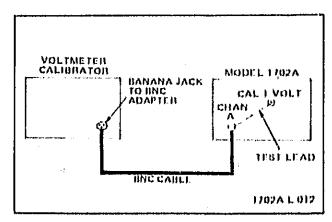


Figure 5-2. Calibrator Test Setup

b. Bet Model 1702A controls as follows:

CHANNEL A VOLTS/DIV	
channel A coupling	1)()
TIME DIV 2 mt	));(;

- e. Set voltmeter enlibrator controls for IV p-p output signal.
- d. Adjust channel A vernier so display is exactly 6 div of vertical amplitude.
  - e. Disconnect volumeter calibrator.
- f. Connect CAL I VOLT output to channel A INPLIT with test lend, Display should be 6 div of vertical amplitude +0.08 div and 1 kHz +10%.
  - g. Remove test lend.
- h. To return to initial settings, set Model 1702A controls as follows:

CHANNEL A VOLTBIDIV		
channel A vernier		
TIME/DIV	nBBC	

1. Refer to paragraph :5:171 and schematic 19 if test limits are incorrect.

#### 5-23. RIBETIME.

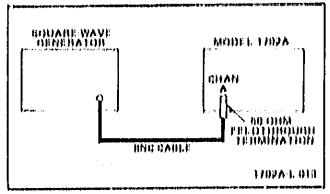
- 5-24. Specification. Risetime is less than 10 ns; direct or with Model 10000B Probe. Risetime is measured from 10% to 00% with 6-div input step from a terminated 50-ohm source.
- 5.25. Description. A 100-kHz signal, with a risetime of less than 5 ns, is applied to the vertical input of the instrument. The risetime displayed on the CRT is then checked to see that it is less than 10 ns. This measurement is made direct but may be made with Model 10006B Probe.

## 5-26. Equipment.

- n. Square-wave Concrator.
- b. 50-olim Feedthrough Termination.
- e. BNC Cable, 44 in.

#### 5-27. Procedure.

- a. Connect instruments as shown in figure 6-8.
- b. Bet TIME/DIV to A uSEC.
- e. Bet square-wave generator controls for 60-mV, 160-kHz output signal.



Pigure 5-3. Risetime Test Setup

- il. Adjust HORIZONTAL POSITION control so risotime portion of signal is in center of CRT.
  - e. Set SWP MAG to \$10.
- f. Mensure pulse risatime between 10% and 00% points (dotted lines on CRP), Risotime should be less than 10 as.
- g. Connect square-wave generator output to channel B INPUP.
  - h. BelDBPLAY to B.
- I. Report steps b through f for channal B risetime.
  - L' Remove test equipment:
- k. To return to initial settings, set Model 1702A controls as follows:

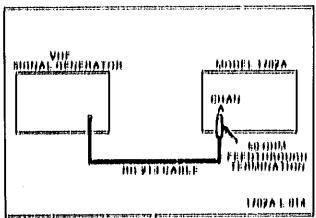
. 777,14810	<b>FF</b>	• • •			***	 		٨
TIME/DIV	FFI	<b>.</b>	H	, , , ,	* * * *	 ,,,,	אוו מ	(KC
BWP MAG.						 		XI

1. Refer to paragraph 5:186 and schematics 0, 4, 5, and 6 if risetime specifications are not met

## 5-20, BANDWIDTH.

5-20. Specification, (Direct or with Model 1000813 Probe, 3-413 down from 60-kHz, 6-44v reference signal from a terminated 60-ahm source.) DC coupled: de to 35 MHz, AC coupled: 10 Hz to 35 MHz.

5:30. Description. To cheek bandwidth, a constantamplitude signal generator is used to apply a 4-div, 50-kHz reference signal to the Model 1702A input. The constant-amplitude signal generator frequency is increased to 55 MHz. The signal amplitude displayed on the CRT must always be equal to or greater than 4.3 div to meet bandwidth specifications. This measurement is made direct but may be made with Model 10008B Probe.



Pigure 5-4. Handwidth Test Hetup

## Asth. Rquipment.

- a. VIIP Bland Cenerator.
- b. RO WHI Cable.
- e, Mohn Peelthrough Termination.

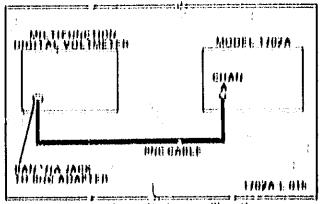
## Sap. Procedure.

- n. Connect Instruments as shown in Naire
- b. Bet VIIP signal generator controls for 60-mV, kHz output signal.
  - e. Adjust PRICIOSIC LEVEL for stable display.
- d. Adjust VIIP signal generator voltage vernier for fedly vertical display.
- e. But VIII? generator controls for frequency output of 86 MIIs. Vertical display on CRT should be equal to or greater than 4.8 div.
  - 6 Connect VIII sland generator to channel B.
  - as Ret DIRPLAY to Be
  - h. Repeat steps b through a for channel H.
  - L. Remove test equipment.
- ). Po return to initial settings, set DIMPLAY to A.
- k. Refer to schematics A through 7 if either channel does not meet bandwidth specification.

#### 6.89. INPUT HEBISTANCE.

Ast, Specification. This input is 1 megolim 19% shunted by approximately 87 pP.

- 5:35. Description: The Input resistance is measured with an obminator to verify resistance.
- 3:36 Ramment.
  - a. Maltifunction Digital Voltacias
  - by HNO Cable of the
  - e. Henana daek to ENC Adapter.



Pigure &&, Input Redstance Pest Boton

#### Sah Procedure

- a. Connect instruments as shown in figure 6-6.
- h. Bot Model 1708A controls us follows:

channel A coupling correspondence of the

e. But multifunction digital volumeter controls to measure 10 meaohins.

## Note

the a digital volumeter range having an output voltage less than 0.6% "file input elemit is protected against voltages in excess of 0.6% and will give a lawer resistance reading if this voltage is excended.

- र Connect HNC cable to channel A INPUP. Multifunction digital voltmeter should indicate 1 megohin १२%
- e, Cheek all CHANNEL A VOLZEZIAV ranges per tuble 6:0.
- f. Move HNC cable from channel A to channel H. Muniforetton digital voltmeter should indicate I menolin 19%.
- The Cheek all CHANNEL B VOLZA DIV ranges per table 60.

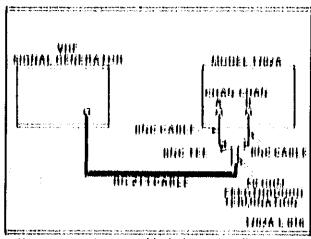
Table 6:16 Input Resistance

VOLATA DIV Bellinji	Alin	Actual	Mus

## Traillemove test equipment

t. To ceture to initial settings, set blodel 1709A controls as follows:

). Notes to retromption it and it input resistance repetition in not met:



Phone 6 6. Common Made Refection Text Belop

### 6:08. GOMMON MODE REJECTION RATIO (GMRR).

3 db. Aperthention: Proppensy: do to 1 MHz: CMIRIG at logic 40 dB on 10 are diversing at least 30 dB on all other ranges with vernions set for optimism pojection: Common mode shand amplitude equal to 30 dive

3-10 Description. This measurement is made by applying distinct signals to channel A and channel to channel A and channel to channel A and channel to channel A to the CRF will to the common made sharely.

## 3 II - Faraganent

- a: VIII Shanal Clemerator:
- h. HMF Cable Uh:
- is Milli Per
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#### à 19 - Procedore

- a. Connect instruments as shown in livery left,
- TO BELLHARRING VOLUE OF THE
- e: Bet VIII shead generator controls tor AG ktts: 0.8V psp shead an Shewed on Stadel 1708A CRY:
  - de Bet HBPlaY awith to Adla
  - o 861 CHANNEL A VOLUBATION OF THE
- 1. But It PHAMPPY to INVESTINATELY about to the Head Off dix.
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- to the all other settent negativity compensive the property of the property of
  - t. Hermove feat emilpment.
- j. To return to initial settings, set Model 1769A controls as follows:

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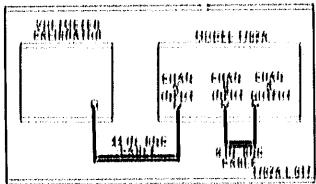
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- à 11. Specification. Amplifier main shall be to ets.
- is the American Character that he connecting channel A COPPEPP to channel It INPEPP, incerting a language compiler to the channel A INCOPP and observing CHE defection;

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- a. Valimeter Calibratia
- h: HHAT Cable: 14 in.
- e HNE Public # In:



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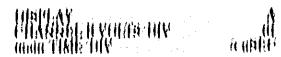
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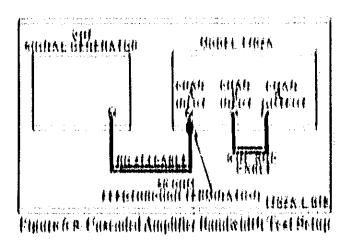
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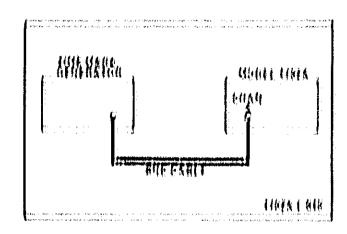
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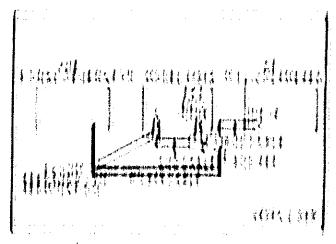
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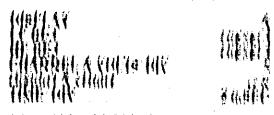
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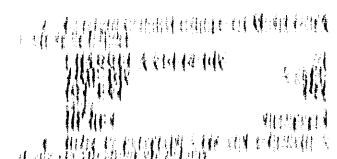
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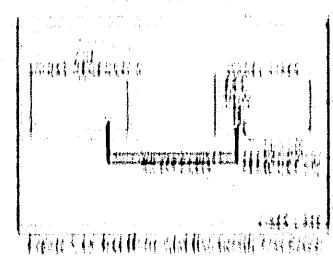


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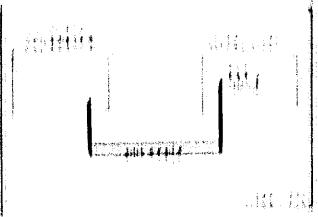
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## PERFORMANCE CHECK RECORD

Instrument Serial Number	Date			
Check	Specification	Measured		
DEFLECTION FACTOR	1.	Chan Chan A B		
.01 VOLTS/DIV .02 VOLTS/DIV .05 VOLTS/DIV .1 VOLTS/DIV .2 VOLTS/DIV .5 VOLTS/DIV 1 VOLTS/DIV 2 VOLTS/DIV 5 VOLTS/DIV 5 VOLTS/DIV	5 div ±0.15 div 5 div ±0.15 div 6 div ±0.18 div 5 div ±0.15 div 5 div ±0.15 div 6 div ±0.18 div 6 div ±0.18 div 5 div ±0.15 div 6 div ±0.15 div 6 div ±0.18 div			
Channel A Vernier Channel B Vernier	<2.4 div <2.4 div			
Calibrator Amplitude Calibrator Frequency	6 div ±0.06 div 1 kHz ±10%			
RISETIME				
Channel A Risetime Channel B Risetime	<10 ns <10 ns			
SANDWIDTH				
Channel A Bandwidth Channel B Bandwidth	>4.3 div >4.3 div			
INPUT RESISTANCE				
Channel A Resistance				
.0f VOLTS/DIV .02 VOLTS/DIV .06 VOLTS/DIV .1 VOLTS/DIV .2 VOLTS/DIV .5 VOLTS/DIV 1 VOLTS/DIV 2 5 VOLTS/DIV	1±0.02 megohm			
	•			

## PERFORMANCE CHECK RECORD

mstrument Serial lyumber	Dat	
Check	Specification	Measured
Channel B Resistance  .01 VOLTS/DIV .02 VOLTS/DIV .05 VOLTS/DIV .1 VOLTS/DIV .2 VOLTS/DIV .5 VOLTS/DIV 1 VOLTS/DIV 2 VOLTS/DIV 2 VOLTS/DIV 5 YOLTS/DIV	1±0.02 megohm	
COMMON MODE REJECTION RATIO (CMRR)  CMRR (50 kHz/0.01 volts/div)  CMRR (1 MHz/0.01 volts/div)	<0.3 div <0.3 div	
CASCADED AMPLIFIER GAIN	5.0 ±0.15 div	
CASCADED AMPLIFIER BANDWIDTH	>4.3 div	
.1 uSEC .2 uSEC .5 uSEC 1 uSEC 2 uSEC 5 uSEC 10 uSEC 20 uSEC 20 uSEC .1 mSEC .2 mSEC .1 mSEC .2 mSEC .5 mSEC 1 mSEC 2 mSEC .5 mSEC .1 sEC .2 SEC .3 SEC .3 SEC .3 SEC .3 SEC	11 in 10 div ±0.3 div 11 in 10 div ±0.3 div	

## PERFORMANCE'CHECK RECORD

Instrument Serial Number	Date	9.
Check	Specification	Mensured
Main Vernier Check SWP MAG (X10) Check	×2 div 10 div ±0,5 div	
TRIGGERING		
Internal Triggering (35 MHz) External Triggering (35 MHz) Chop Triggering (400 kHz) Line Triggering	<b>&gt;</b> >> >> >> >> >> >> >> >> >> >> >> >> >	
TRIGGER LEVEL RANGE AND POLARITY		
Int Trigger Level (+) Int Trigger Level (—) Ext Trigger Level (+) Ext Trigger Level (—)	√ √ −1,2V to +1,2V −1,2V to +1,2V	
EXT HORIZONTAL BANDWIDTH	≥7,2 div	
EXT HORIZONTAL DEFLECTION FACTOR X1 X10	10 ±0,5 dly 10 ±0,5 dly	
VARIABLE PERSISTENCE		
Minimum Persistence Maximum Persistence	<1 div >1 min	
STANDARD WRITING SPEED Visible Trace	≥1 min.	
STANDARD STORE TIME	:	
Visible Trace	≥1 hr .	
FAST WRITING SPEED		· · · · · · · · · · · · · · · · · · ·
Visible Trace	≥15 sec	
MAX STORE TIME		
Visible Trace	>5 min.	
·		

## 5-98. ADJUSTMENTS

5.00. The following paragraphs describe procedures to calibrate the instrument so that it will perform as specified in table 1-1. The entire adjustment procedure can be done in sequence, or any separate adjustment can be calibrated by following the steps outlined in the appropriate paragraph. The locations of adjustment controls are shown in a photograph included at the end of the section on a followingo,

5-100. Use a nonmetallic screwdriver and recently calibrated test equipment with characteristics as specified in table 5-1. After adjustments are complete, check instrument performance by doing the performance check procedure at the beginning of this section.

5-101. Set Model 1702A front punel controls to those positions given in purpgraph 5-10, Remove top and bottom covers.

## 5-102. ADJUSTMENT PROCEDURES,

## 5-103, LOW VOLTAGE POWER BUPPLY ADJUST.

δ-104. Reference. Schematics 18, 19, and 20 figures 5-15, 8-08, 8-30, and 8-40.

5-105. Description. The +15V is the only regulated voltage in this instrument. The rest of the voltages in this instrument are referenced to +15V. The voltage accuracy is set by using a digital voltage recurrence to monitor the +15V.

5-106. Equipment.

- n. Digital Voltmeter.
- b. Test Lends.

5-107. Procedure.

n. Connect digital voltmeter to XA4 (gate) pin : 6,

#### WARNING

Power is present in the line rectifier (A2) and low voltage mother board (A3A1) when POWER-ON switch is off,

- b. Turn instrument on.
- e. Adjust ABA2RB, LOW VOLTAGE ADJ, for voltmeter indication of +15V +10 mV.
- d. Check rest of low voltage power supply output voltages as shown in table 5-5.

Table 5-5, Power Bupply Voltage Limits

Bupply	Pest Point	Limits
-10V 10V 0V 00V 00V 100V	8A4 Pin 8 8A4 Pin 8 8A4 Pin 10 8A4 Pin 8 8A4 Pin 12 8A4 Pin 6 8A4 Pin 2	-11,88V -15,01V 14,6 V16,76V -6 1 V6,8 V -67 V -68 V 17 V68 V -180 V -180 V -150 V -180 V

#### 5-100. HIGH VOLTAGE POWER BUPPLY ADJUST.

5-100, References Schematic 17, Ogures 6-16 and 8-36.

5-110. Description. The high voltage is adjusted to \$\to\$ 1950V by comparing it against a known calibrated voltage standard.

- 3-111. Raninment.
  - a. Digital Voltmeter.
  - b. Volumeter Calibrator.
  - e. 1000:1 Divider Probe.
- 3-119. Procedure.
  - a. Turn power off.
  - b. Remove All power supply module cover.
  - e. Turn instrument on.
- d. Connect digital volumeter through 1000) divider probe to volumeter calibrator,
  - e. Set volumeter calibrator to -- 100-volt autput.
  - 1. Note volumeter indication.
  - B. Multiply indication in step f by 13.5.
- h. Monitor high voltage on red wire (2) from ABA4 using 1000:1 divider probe and digital voltameter.
- 5. Adjust ABA-IRI, HIGH VOLTAGE ADJ, for value calculated in step g.
  - J. Turn instrument off.
- k. Disconnect test equipment and replace All power supply module cover.

). Check high voltage power supply circuits on schematic 17 if adjustment connect be made.

### 6-118. INTENBITY LIMIT ADJUST.

5:11-6. Reference: Rehematics 14 and 17. Approx 5-15 and 8-86.

5:775. Description: The intensity limit adjustment is set so the front panel INTENSITY control has complete runge. This range is from extinguished to complete brightness.

## &116. Raupment.

- a. Manitor Ozeilloscope.
- b. 10d Divider Probe-

## #11% Procedures

- n. Bet Model 1709A TIME DIV to 1 march
- b. Obtain free-running trace (figure 6-8).
- e. Connect menitor escilloscope to unto entiput type (alor 1) with 10% divides proba-
- a). But inposting fusellloscope controls 19 down
- o. But INTENSITY control for 10V pap signal as viewed on monitor useffloscope.
- f. Adjust AdA-Orto, INTENSITY LIMIT ADJ. mult trace is just explanatished.
- g. Turn INTENSITY control ew and verify trace be visible.
  - h. Disconnect test equipment.
  - L Het Model 1708A TIME/DIV to 5 988C
- j. Check high voltage power supply circuit on schematic 17 if adjustment cannot be made.

## 17 THE TIME ALIGNMENT ADJUSTMENT.

6-110. References Behommtle 1-1, figures 6-15 and 8-01.

5-140. Description. The internal orth adjust is set to align the trace on the Yeasis.

#### 5-191. Ranipment.

- n. OseMator.
- b, BNG cable, 44 Inc

#### Note

Make sure the herizontal trace is properly aligned before proceeding with this adjustment:

## 8:199. Procedure.

- n. Connect escitlator set for 10/8417, 0/417 out: put to channel A INPOP.
  - b. Bet eweep display to BNP HORE INPUP.
- e. Adjum HOMKONYAL PORTTON until vers Heal line is centered on CNV sersen.
- d. Adjust A41895, orth adjust, until vertleal line is allumed on major Yests uraffeale.
  - e. Disconnect oscillator.
  - 6. Het sweep display to MAIN BWBBIS
- g. Refer to sechemate 14 it adjustment connective made.

## 6-188, PATTERN ADJUBTA

3-197. References Behemmile : 177. and throes.

A IPA. The expirion. The CRP grammity is sol for militarian barvelling or pineushionings.

## & DB. Bandanent.

- a: Oadlatur.
- h, AMC arble Him

#### 4:10% Procedures

#### None

Make one trace align (paragraph 1997) to properly set before performing this adjustment.

n. Het Madel 1709A controls as follows:

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THIANNEL.	A	V١	١	t.	m	Η.	ļ	ì	ľ	٧.	,			, .		,			1 6		1 1 1

- b, Connect oscillator output to channel  $\lambda$  INPUT.
- e. But oscillator controls for 1004112 output sland.
- d. Adjust oscillator amplitude control for 5.4: div display on CRP.

- p. Adjust INTHINBITY control for marmal view:
  - 6. Ungage CONV purblatten:
- it. Adjust A 11897, pattern ad), for loot compromise between distortion of vertical and horizontal edges of CRT display:
  - h: Meconnect test equipment:
- l. To return to initial settings, set Model 1763A controls as follows:

# CHANNELA VOLTE DIVERSO E ECONOMICE TO MERCE

J. Refer to echemotic 17 if adjustment connat be apply:

6 IPB, GATE AMPLIFIER RESPONSE ADJUST,

3:140 Neferences Schematic 11, Appres 6:15 and 8:01:

8:180. Description: The pate amplifier is adjusted for optimism response:

- Add Ryapment
  - a. Monttor Oxelloxcope.
  - b. 10:1 Divider Probe-
- & 139. Procedure.
  - ne But PINIBADIN to LUBBUS
- b. Connect 10st divider probation monitor archimeopa to wire (1) on Al puta may.
  - e. Het montor oxcilloscope controls as follows:

coupling econociosense, and other econociosense and other econociosenses and display

- d. Adjust INTRNSTTY control for 2014 amplitude pulse as displayed on oscilloscope.
- o. Adjust A109, and response oil, for fusion is the function of partition of the contract of t
  - f. Meconnect test equipment:
  - n. Hot TIMBADIN to 6 upikes
  - ha Refehannel A coupling to Ath
- to Hefer to schematic 11 if adjustment cannot be made.

- 6:133: POSITION OBNITERING ADJUST:
- 6: little Melecence: Behematics to be to and Tethjures belond to the
- & 166 the common internal controls are adjusted to contex the display. This adjustment varies the amplifier de reference, thus establishing position.

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- OF BELLIEPHAY TO BE
- h. Center channel B POSPTION controls
- e. Adjust A&Adltli, it for contestint adj. for no vertical trace while as it little dill's wellen in changed from Nethol to INV's.
- d: Adjust A&A HEION, B pol but oill, to center trace vertically.
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  - 1. Center channel A POBITION control.
- ps: Adjust ASA Hells A pos conteción adju to center trace voltanty:
  - ha Bet HERPLAN to A + Ha
  - to Adjust ABA (1800), A + 18 but, to center traces
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- It: Refer to echemotics to be and 7 if adjusts ment cannot be made:
- 6:10% TRIOGER AMPLIFIER BALANCE AND DO
- 4: 148, Reference: Behematics 1 and 6: Appires 6: 16 and 8:18:
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- n. Adjust channel A 19,18141118 to center discipline.
- H. Adjust Alea the composite sepe adjounted seem toppers at some point as the step t.
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  - 1. The anned lest equipment:
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- g To return to initial settings, set blook tings, english six follows:

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#### Note

If display fades positive too fast, adjust ASRIG. FAST ERASE, cw slightly and repeat steps as through dd. If display is: not stored over entire area, adjust ASRIG. FAST ESIASE, cow slightly and repeat steps as through dd.

ee. Remove test equipment.

ff. To return to initial settings, set Model 1702A controls as follows:

gg. Refer to schematics 15 and 16 if adjustment cannot be made.

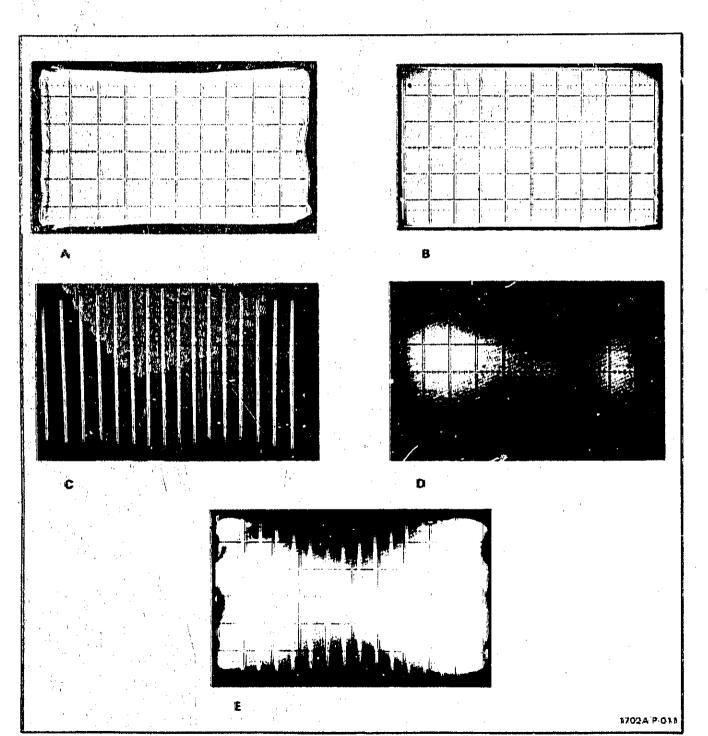


Figure 5-14. Typical CRT Displays

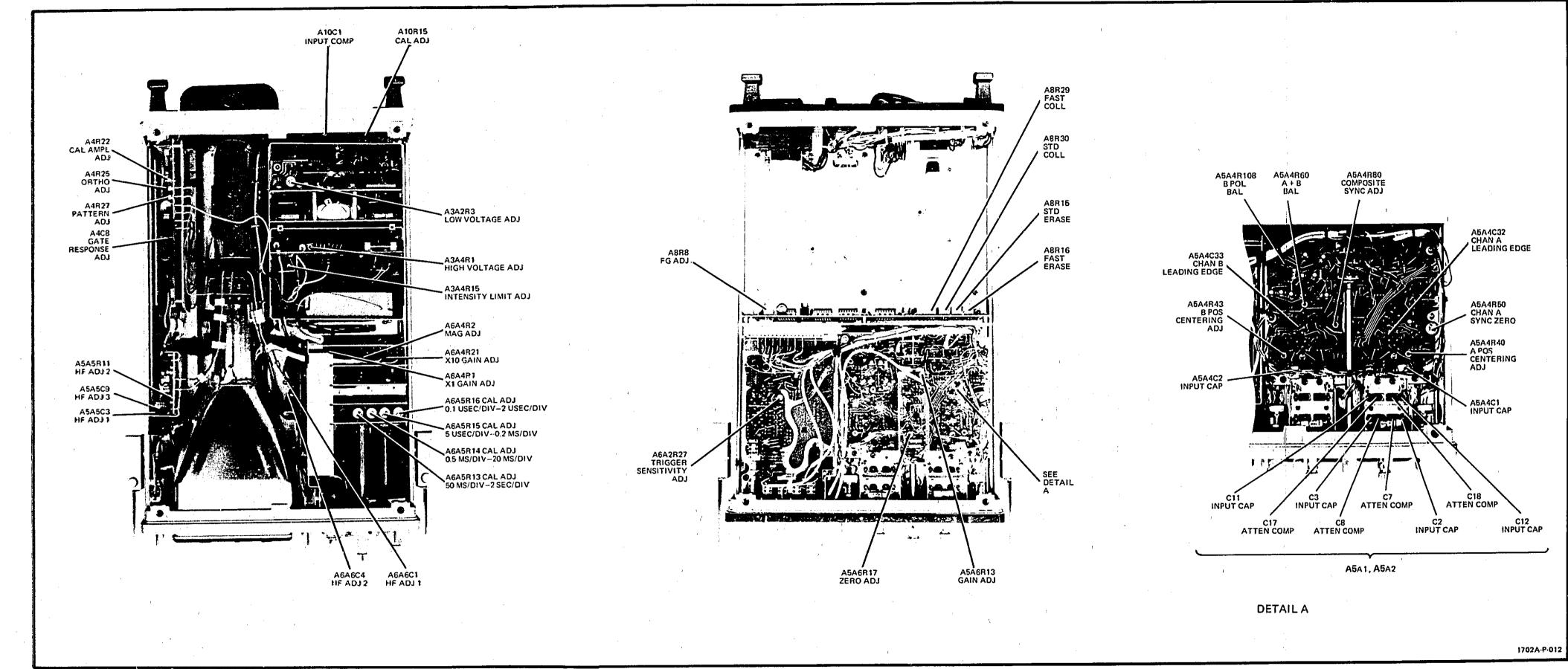


Figure 5-15.
Adjustment Locations
5-23

Replaceable Parts Model 1702A

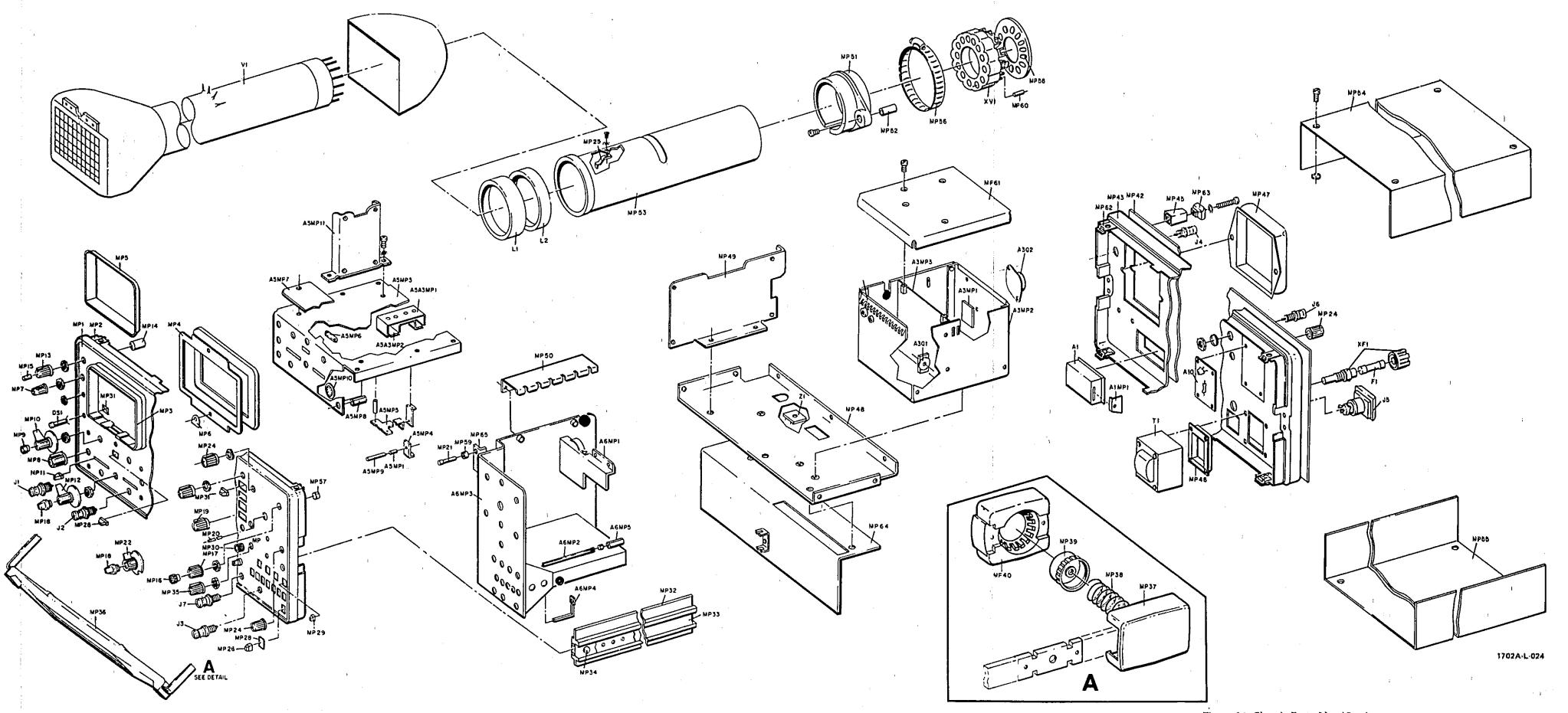


Figure 6-1, Chassis Parts Identification

## BECTION VI REPLACEABLE PARTS

## 6-1. INTRODUCTION.

62. This section contains information for ordering replacement parts. The abbreviations used in the parts list are described in table 64. Table 62 lists the parts in alphanumeric order by reference designator and includes the manufacturer and manufacturer's part number. Table 6-8 contains the list of manufacturers' codes.

## 6-3. ORDERING INFORMATION.

6.1. To obtain replacement parts from Rewlett-Packard, address order or inquiry to the nearest Rewlett-Packard Sales/Service Office and supply the following information:

- n. Instrument model and serial number.
- b. III) part number of Itemtal.
- o. Quantity of part(#) de#ired,
- d. Reference designator of part(s).

6.5. To order a part not listed in the table, provide the following information:

- a. Instrument model and serial number.
- b. Description of the part, including Ametica and location in the instrument.
  - a. Quantity desired.

Table 8-1. Abbreviations for Replaceable Parts List

٨	AMPLIIKIS)	H	HENRYHERD	NPN	NEGATIVE POBITIVE:	HWV	DEVENSE WORKSHIP
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Table 6:9: Replaceable Parts

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Table 6-2. Replaceable Parts (Cont'd)

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Table 6-2. Replaceable Parts (Cont'd)

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57-0446  57-0438  57-0438  57-0406  57-0406  57-0413	L	REFAD MET FLA 750 UMM 18 1746 RIVAN FLM IOU UMM 108 EIN 1726 RIFAD MET FLA 5-211K UMM 18 1746 MIFAD MET FLA 5-211K UMM 18 1746 MIFAD MET FLA 90-9 UMM 18 1746 MIFAD MET FLA 90-9 UMM 18 1746 MIFAD MET FLA 912 UMM 18 1746 MIFAD MET FLA 301 UMM 18 1746 MIFAD MET FLA 50-1 UMM 18 1746 MIFAD MET FLA 50-1 UMM 18 1746 MIFAD MET FLA 50-15K UMM 18 1746 MIFAD UMM 100 UMM 100 1746 MIFAD UMM 100 UMM 100 1746 MIFAD MET FLA 50-9 UMM 18 1786 MIFAD MET FLA 50-9 UMM 18 1786 MIFAD MET FLA 50-9 UMM 18 1786 MIFAD UMM 15 UMM 100 1776 MIFAD UMM 15 UMM 100 1776 MIFAD UMM 15 TO UMM 18 1776 MIFAD UMM 15 TO UMM 18 1776 MIFAD UMM 15 TO UMM 18 1776 MIFAD UMM 17 DUM 100 1746 MIFAD UMM 100 UMM 100 1746 MIFAD UMM 100 UMM 100 1746 MIFAD UMM 100 UMM 100 1746	284 80 284 80 284 80 284 80 284 80 284 80 284 80 284 80 21121 21121 284 80 21121 21121 284 80 21121	0757 0426 21c0 1984 C757 0438  0757 0290 3058 3430 3757 3460 0757 0799 0757 3334  5098 3430 C757 0413 9757 0290 C8 1011 C8 1011 C8 1011 C757 0450 0757 0450
-0-1984 57-0438 57-0438 57-0430 57-0430 57-0799 57-0799 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 57-0411 57-0411 57-0411 57-0411 57-0411 57-0411	L	RIVAR FLM DUL UMM 104 LEN 1/2m  RIFAD MET FLA D-11K UMM 16 1/2m  RIFAD MET FLA 20-19K UMM 16 1/2m  RIFAD MET FLA 20-5 UMM 16 1/2m  RIFAD MET FLA 121 UMM 16 1/2m  RIFAD MET FLA 121 UMM 16 1/2m  RIFAD MET FLA 30-5 UMM 16 1/2m  RIFAD MET FLA 30-5 UMM 16 1/2m  RIFAD MET FLA 30-7 UMM 16 1/2m  RIFAD CUMP 100 UMM 100 1/4m  RIFAD CUMP 100 UMM 100 1/4m  RIFAD CUMP 100 UMM 100 1/4m  RIFAD MET FLA 00-9 UMM 18 1/2m  RIFAD MET FLA 00-9 UMM 18 1/2m  RIFAD MET FLA 00-9 UMM 18 1/2m  RIFAD WET FLA 00-9 UMM 18 1/2m  RIFAD WET FLA 00-0 UMM 18 1/2m  RIFAD UMP 19 UMM 100 1/4m	28483 28483 28483 28483 28483 28483 28483 28483 21121 21121 28483 28483 21421 21421 21443 21443 21443 21443	2100 1986 C757 0438 U757 0290 958 1450 U757 0460 U757 0334 C98 1450 C757 0411 C757 0411 C8 1311 U757 0450 U757 0450 U757 0450 U757 0417
57-0438  57-0438  57-0430  57-0430  57-0799  57-0330  90-3430  57-0433  57-0433  57-0481  57-0460  57-0481  57-0487  57-0487  57-0487  57-0487  57-0487  57-0487	₹ 1	RIFAD MET FLA D-IIK UHM LE IZHH  HEFAD MET FLA D-IIK UHM LE IZHH  HEFAD MET FLA 20-5 UHM LE IZHH  HEFAD MET FLA 30-1 UHM LE IZHH  HEFAD MET FLA 121 UHM LE IZHH  HEFAD MET FLA 121 UHM LE IZHH  HEFAD MET FLA 122 UHM LE IZHH  HEFAD MET FLA 30-1 UHM LE IZHH  HEFAD MET FLA 30-2 UHM LE IZHH  HEFAD CUMP IQU UHM LE IZHH  HEFAD CUMP IQU UHM LE IZHH  HEFAD MET FLA 90-9 UHM LE IZHH  HEFAD MET FLA 0-19 UHM LE IZHH  HEFAD MET FLA 0-19 UHM LE IZHH  HEFAD MET FLA 70-0 UHM LE IZHH  HEFAD UMP JS UHM LE IZHH  HEFAD UMP JS UHM LE IZHH  HEFAD UMP JS UHM LE IZHH  HEFAD UMP IS UMM IZH IZHH	2848G 28480 28480 28480 28480 28480 28480 21121 21121 28480 26480 26480 21121 21121	C757 0438  0757 0290  9658 3430  3757 3400  0757 0799  0757 0334  5098 3430  C757 0411  0757 0297  C6 1011  0757 0450  0757 0467
78-3430 57-0400 57-0400 57-0433 57-0433 57-0433 57-0413 57-0413 57-0413 57-0413 57-0413 57-0413 58-3401 58-	l l	MIFAD MEE FLM 28.5 UMM EE 1766 MIFAD MEE FLM 90.9 UMM EE 1766 MIFAD MEE FLM 30.1 UMM EE 1766 MIFAD MEE FLM 30.1 UMM EE 1766 MIFAD MEE FLM 30.2 UMM EE 1766 MIFAD MEE FLM 30.2 UMM EE 1766 MIFAD MEE FLM 30.2 UMM EE 1766 MIFAD CUMP 100 UMM 10.5 1766 MIFAD CUMP 100 UMM 10.5 1766 MIFAD MEE FLM 90.9 UMM EE 1766 MIFAD MEE FLM 90.9 UMM EE 1766 MIFAD MEE FLM 90.9 UMM EE 1766 MIFAD UMM 15 UMM EE 1776 MIFAD UMM 15 UMM EE 1776 MIFAD WEE FLM 90.9 UMM EE 1776 MIFAD WEE FLM 90.9 UMM EE 1776 MIFAD UMM 15 UMM EE 1776 MIFAD UMM 15 UMM EE 1776 MIFAD UMM 17 UMM 10.5 1776 MIFAD UMM 10 UMM 10.5 1776	284 EU 21121 21121 284 EU 285 EU 285 EU 285 EU 285 EU 285	9098 3430 3737 3450 9137 6799 9757 9334 5098 3430 6757 0413 9757 3290 68 1911 9757 3290 68 1911 9757 4450 9757-9418 69 3761
57-040L 97-0799 57-0330 99-3410 57-0413 57-0413 57-0416 64-1011 57-0416 57-0416 57-0416 57-0416 57-0416 57-0417 14-1011 14-1011 14-1011 14-1011 14-1011	l l	ALFAD MET FLA 9GL9 OHM LE 1200 ALFAD MET FLA 121 UHM LE 1240 ALFAD MET FLA 2215 UHM LE 1240 ALFAD MET FLA 2015 UHM LE 1240 ALFAD MET FLA 2425 UHM LE 1240 ALFAD MET FLA 2425 UHM LE 1240 ALFAD COMP 100 UHM LUE 1240 ALFAD COMP 100 UHM LUE 1240 ALFAD MET FLA 019 UHM LE 1240 ALFAD MET FLA 019 UHM LE 1240 ALFAD MET FLA 019 UHM LE 1270 ALFAD UUMP 15 UHM LE 1270 ALFAD UUMP 15 UHM LE 1270 ALFAD UUMP 16 UHM LE 1270 ALFAD UUMP 17 UHM LE 1270	28480 28480 28480 28480 21121 01121 28480 24490 11121 28480	3757 3460 0757 6799 0757 3334 5098 3430 6757 0413 9757 3290 68 1011 68 1011 0757 0450 0757 0417
90 3430 57-0413 57-0413 57-0290 54-1011 54-1011 57-0410 57-0410 58-1417 58-	1	RIFAD MET FLM 128 UMM 18 172m  RIFAD MET FLM 3GL CHM 18 174m  AIFAD MET FLM 3GL CHM 18 174m  RIFAD MET FLM 0-154 OHM 18 174m  MIFAD MET FLM 0-15 CHM 18 174m  MIFAD MET FLM 0-15 CHM 18 174m  MIFAD MET FLM 0-15 CHM 18 174m  RIFAD MET FLM 0-15 CHM 18 174m  RIFAD MET FLM 750 CHM 18 174m  RIFAD MET FLM 750 CHM 18 174m  RIFAD CUMP 15 CHM 16 174m  RIFAD CUMP 15 CHM 16 174m	45-63 25-80 25-80 28-50 28-50 21-21 21-21 25-80 25-80 21-21	0757 C799 0757 0334 5098 3430 C757 0413 5757 0297 C6 1011 C8 1311 0757 0450 0757-0418 C0 3701
9w 3430 57-0413 57-0290 54-1011 64-1011 57 0410 57 0410 57 0410 57 0410 57 0410 57 0410 57 0411 57 0411 57 0411 57 0411 57 0411 57 0411 57 0411		ATFXD MET FLA 21.5 OHM 16 1/80 HEFXD MET FLA 242 CHM 18 1/80 HEFXD MET FLA 6.15K CHM 18 1/80 REFXD COMP 100 CHM 100 1/80 REFXD COMP 100 CHM 100 1/80 METXD MET FER 90.9 CHM 16 1/80 MOT ASSIGNED HEFXD MET FLA 6.19 CHM 18 1/80 MOT ASSIGNED HEFXD MET FLA 6.19 CHM 18 1/80 METXD COMP 25 CHM 18 1/20 HEFXD COMP 25 CHM 18 1/20 REFXD MET FLA 750 CHM 18 1/20 REFXD MET FLA 750 CHM 18 1/80 HEFAD COMP 10 CHM 100 1/80 HEFAD COMP 10 CHM 10 CH	25+80 284-80 214-80 21121 21121 254-80 204-90 21121 254-90 21121	5098 3430 C757 0413 9757 0290 C8 1011 C8 1011 9757 0450 0757-0418 C0 3701 9757 0817 9757 0817
57-G413 57-U29G 54-1011 54-1011 57-U46G 57-U46G 54-39U1 54-39U1 57-C417 54-10U1 54-10U1 57-U332 52-U441		HIPAU MET FLE 192 CHM 18 1786 RIFAU MET FLM OLISK CHM 18 1786 RIFAU CHMP 100 CHM 100 1786 AIFAU CHMP 100 CHM 100 1786 AIFAU CHMP 100 CHM 100 1786 NOT ASSEGNEU HIFAU MET FLM OLIS CHM 100 1788 NOT ASSEGNEU HIFAU MET FLM OLIS CHM 100 1788 AIFAU CHMP 150 CHM 100 1788 AIFAU CHMP 150 CHM 100 1788 AIFAU CHMP 150 CHM 100 1788 AIFAU CHMP 170 CHM 100 1788 AIFAU CHMP 170 CHM 100 1788 AIFAU CHMP 100 CHM 100 1788 AIFAU CHMP 100 CHM 100 1788	284 80 244 80 C1121 C1121 284 80 254 80 C1121 284 80 C1121 C1121 C144 80 C1121	C757 0413 1 1757 0297
54-1011 57-0400 57-0400 57-0418 54-3901 57-0417 54-1001 54-1001 57-04192 52-041		RIFAU CUMP IQU CHM LOC 1/AM RIFAU CUMP IQU CHM LC 1/AM RIFAU MEF PER 90.9 CHM IZ 1/AM NOF ASSIGNEU RIFAU MEF PER 919 CHM IZ 1/AM NOF ASSIGNEU RIFAU CUMP 39 CHM LZ 1/AM RIFAU CUMP 39 CHM LZ 1/AM RIFAU CUMP 19 CHM IZ 1/AM RIFAU CUMP 10 CHM IZ 1/AM RIFAU CUMP 10 CHM IZ 1/AM RIFAU CUMP 10 CHM IZ 1/AM	28480 C1121 C1121 28480 20490 C1121 28480 C1121	0757 0297 Co toll Ct toll 0757 0450 0757-0418 Ct oxcl 0757 0817 0757 0817
14-1011 57 4460 57 6418 54-3441 57 4417 57-617 14-1661 14-1601 57-4712		ATFAD COMP TOU OHM TO TANK  ATFAD HEF PER YOUY CHAITS TANK  NOT ASSEGNED  ATFAD HEF PER OLY CHAITS TANK  NOT ASSEGNED  ATFAD COMP TO OLY CHAITS TANK  ATFAD HEF FER FOU OHM TO TANK  ATFAD COMP TO OHM TO TANK	01121 28480 28480 1121 28480 28480 01121	CB 1311 0757 0450 0757-0418 CO 3701 0757 0817 0757 0817
57 G418 57 G418 57 G417 57-C417 64-16G1 64-16G1 57-U732 62-1641		NOT ASSEGNED ATFAD HEF FER OLD CHM LE 1756 NOT ASSEGNED ATFAD HEF FER 750 CHM LE 1726 ATFAD HEF FER 750 CHM LE 1726 ATFAD CUMP LE 750 CHM LE 1726 ATFAD CUMP LE 750 CHM LE 1746 ATFAD CUMP LE CHM LCE 1746 ATFAD CUMP LE CHM LCE 1746	20400 1121 20400 20400 01121	6757-0418 CO-3761 6757-6817 6757-0817
4- 390 k 57-C 417 14-160 k 14-160 k 57-0 f 32		NIFAD MEE PER 019 CHM 18 1766 NOT ASSECTED REPAIR CUMP 35 CHM E38 E746 REPAIR NEE PER 750 CHM 18 1726 REPAIR NEE PER 750 CHM 18 1726 REPAIR NEE PER 750 CHM 18 1726 REPAIR CUMP 10 CHM 108 1746 REPAIR CUMP 10 CHM 108 1746	_1121 	CG 37C1 GF57 C817 GF57 G617
57 udl 7 57-c 817 54-166 1 54-160 1 57-u 732 52 t 64 8		REPAU COMP 35 OHM ESE EZAM REPAU MEE FE'F 750 OHM ES EZAM REPAU MEE FE'S 750 OHM ES EZAM REPAU COMP IO OHM ESE EZAM REPAU COMP IO OHM ESE EZAM	28483 28483 61121	6757 CB17 6757 GB17
37-C 817 14-166 t 14-160 t 57-U 732 12-64 t 12-64 t		AIFAD MET FLA 750 OHM 1% 1/2H AIFAD COMP 10 OHM 10% 1/4H HIFAD COMP 10 OHM 10% 1/4H	28480 01121	u757 Uel7
14-1661 14-1601 57-0732 12-664 12-6641		RIFAU COMP IO UNA ICE 1746 RIFAU COMP IC UNA ICE 1746	61121	
14-100 1 57-0 732 12: 6 G4 1 12-0 04 1		HEFAD CEMP IC CHM ICE 174%		E ik Flafr I
57-0732 -2: EG45 12-0043				CB 10c1
2-041			28740	G757-G732
	, i	DILDEFUREARUUMN 5-EEV 54 DIGDEFUREARUUMN 5-EEV 54	64713 -4713	5216935 98 5216935 44
01-86626 i	l	BOARD ASSY: CHANNEL A OUTPUT	28480	01/01 66626
0-0374	3	CIFXID TANT, 10 UF 10% 20VDCW	56289	150D106X902082 DYS
0-0374 0-3443		C:FXD TANT, 10:UF 10% 20VDCW	56289	150D106X902082 DYS
0-3443	1	C:FXD CER 0.1 UF +80-20% 50VDCW C:FXD CER 0.1 UF +80-20% 50VDCW	72982 72982	8131 050 651 104Z 8131 063 651-104Z
5-0085	ı	TSTR FET (MATCHED PAIR)	28480	1855-0085
5-0085		TSTR:FET (MATCHED PAIR)	28480	1855-0085 2N3906
3-0036 4-0215	}	TSTR:SI PNP TSTR:SI NPN	80131	2N3904
4-2211	l	R: FXD: COMP 220 OHM 10% 1/4W	80131 01121	CB 2211
42211	- 1	R: FXD COMP 220 OHM 10% 1/4W	01121	CB 2211 CB 1021
4 1021	1	R: FXD COMP 1000 OHM 10% 1/4W	01121	0757 0438
7 0438 7 0484		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757 0454 0757 0446
7 0448	9	R:FXD MET FLM 33.2K OHM 1% 1/8W R:FXD MET FLM 15.0K OHM 1% 1/8W	28480 28480	CB 2231
4 2231	38	R: FXD COMP 22K OHM 10% 1/4W	01127	0757 0446
7 0446 4 1541		RIFXO MET FLM 15.0K OHM 1% 1/8W	28480	C8 1541 C8 5621
45621	* !	R: FXD: COMP 150K OHM 10% 1/4W R: FXD: COMP 5.5K OHM 10% 1/4W	01121 01121	C8 F62†
45621	ı	R: FXD COMP 5.6K OHM 10% 1/4W	01121	CB 3901 2100-2061
43001	ŀ	B:FXD COMP 39 OHM 10% 1/4W	01121	0757 0410
0-2061 7 0410:	,	R:VAR FEM 200 OHM 10% LIN 1/2W R:FXD MET FEM 301 OHM 1% 1/8W	28480	CB 3001
4 300 \$	· ' [	R: FXD: COMP 3B OHM 10% 1/4W	28480 01121	1820-0216
0-0216 02-65804	1	ICOP, AMP. AVOL-50K MIN.	28480	ı
U2-65802 C: U7: 9	1	HORIZENTAL AMPLIFIER MEDULE LIGHTEENDICATER OF MOS	28450	01702 65804
U-07U9	į	EIGHFIENDECATOR 90, VCC		6140-000-003; : 6140-000-003
01:00609	3	SHIELD: HOLDOFF	21:480	01701 00609
01-23706 01-60602	! !		28460	01701-23706
01 63703	2	SHAFT ASSY: PUSHBUTTON EXTENSION		01701 60602 - 01701 63703
30-23201	ī	COUPLER: SWITCH EXTENSION	28480	01830-23201
L- 1841	1	HEVAN TOUR WHM 264 LEN 1836	28440	2100 1891
10-3014 1-3014	1	REVAR COMP DUAL 2UR LINE 208 EIN	26480	2166 3614
F1001-0		PIVAR COMP 20% DHM 20% 27108	28480	2100-3615
7 0435	2	REFXID MET FLM 0.92K OHM 1% 1/8W	28480	2100 - JCC4 0757 0435
7 0283 'ul-elaua	1	RIFXD MET FUM 2K OHM 1/K 1/8W CABLE ASSY: CLAX	28480 28480	0757 0283 01731 01006
	2	CABLE AŠSYICGAX	28450	61701 01010
VI-alalu	l.	DUAND ASSYCHURIZENTAL MOTHER	28480	01700 66631
00-66531		THERESE NOW	28480	0160-2207
	, 1	I WARRANT TO THE STATE OF THE S	284 8u	2N3417 6757 6453
かいたい りりりりつ ふしんしきき	2 65804 22-65 80 2 	2 65804  27-45 80 2  107-8  107-9  100509  1 F23705  1 60502  1 63703  2 7  1 23201  1 144  1 1-3414  1 1-3414  1 1-64631  1 1-64631  2 1066531  1 1-64631  2 207	2 48804 22-43802 1 HIRELENGEATER AMPLIFIER MUDULE 1-0709 1-0709 1-0709 1-0709 1-0709 1-0709 1-0709 1-0709 1-0709 1-0709 1-0709 1-0700 1	2 68804 22-63802 1 HIRELINELATER AMPLIFIER MUDULE 1 160709 1 EIGHTERNIELATER 9C 90C 72765 1 SHIELD: HOLDOFF 1 28480 1 60600 1 SHIELD: HOLDOFF 1 28480 1 60600 1 SHIELD: HOLDOFF 1 28480 1 SHIELD: ASSY: PORIZ 1 28480

Table 6-2. Replaceable Parts (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
SHIAGE	0684 3331		R: FXD COMP 33K OHM 10% 1/4W	01121	CD 3211
JOALN J	W0E4-1U41		MERAD COMP SER CHM TOX 1/4W	01121	CB 3331 CB 1041
##14nk 4140k	LDEY-1641 L757-4418		FIFRD LEMP LUCK DHM LUC LYAN	01151	CB 1041
Analmo	L757-UZA)		REFAU MET FLM 619 OHM 14 1786 REFAU MET FLM 2-CUK CHM 14 1766	28480 28480	0757-0416 0757-0283
-Joaln7	ŭ757: ú413		PEPAD HET FEM 392 DHM 18 1786	28560	U757 - C413
AGALFB BRIABA	LnE5-2221 0684 1031		REFRIE LUMP 2200 OHN 10% 1746	61121	CB 2221
ABATRIO	0684 2231		R: FXD COMP 10K OHM 10% 1/4W RESISTOR: FXD 22K 10% 26W CC TUBULAR	01121 01121	CB 1031
ACAIS!	3101-1460 3101-1397	l i	SELECTED SHOUTTON DPUT	71550	CB 2231 PB-1
40A15J	2,00	•	NSK+ PART OF AGAISZ	İ	
Athlish			NON, PART OF AGAIS2		
ADALAAL ADALAA			HUT ASSIGNED NUT ASSIGNED		1
ADALKAS ADALKAS	1251-1626	3	CONNECTURING 62 x 121 24 CENTACT	71765	252-12-30-300
PORTAD	1251- 1626		HUT ASSIGNED 12 X 121 24 CENTACT	71/65	252-12-30-300
40AlX=6 7AXIA04	1/51 10/0		NUT ASSIGNED		ļ
8042	017ct-665c7	1	CUMMECTURIPE 12 x 121 24 CONTACT BUARD ASSYFTATOLER	71.785 504.3 <del>9</del>	252-12-30-300
#6A2CL	L170-11043		CIFAD MY GANZZUF BUR AGGYECH	24446	64FDA224
AOM2C2 BOAZC3	0146/6263 6166-3451	ž.	CIFAD RICA SU PF 5%	28480	0140-0203
402264	1.164-2264		CIFAD CER 15-UE UF +8U 2CE ICCYDCH CIFAD HICA IUOPF 5%	72136	C0238101F1032525-C0H R0H15F10133C
Johico Inlico	1120-2197 1100-2264	),	CIFAD MICA ID PF 5% CIFED MICA IDDPF 5%	72136	AUM15C1UOJ3C
Atrici Atrici	(100 345)		CIFAD CER U.LS UP +8L 201 100VUL	72136 56269	FDH15F101J3C Cu23A101L5032525-CDH
AGAZLO	61mC=0197 61c6+3453		CIFAD ELECT 2.2 UF 108 20VCCM CIFAO CER 0.05 UF .80 20 C 10CVDCM	50229	1500225X9020A2 DYS
#0#26]6 #0#26]1	U161,-3453		CIFAU CER +=+5 UF +80 20E 10GVOCH	56289 56289	CU23A101L5032525-CDH CU23A101L5032525-CDH
ADAKET2	L100-3453 L10C 2514		CIFAD CER words of the 20% leaved	50289	CU23A101L5032525-CDH
ADAZCHI ADAZCHZ	1901-6440	[	DIGUET SILICUM JOHA JOHA	36249 07263	1233C2U CDH 1642 FUG1688
JOA2LK 3	1901-0648		Diudeisilicum suma sumy Diudeisilicum suma sumy	07263	FOGICES
Anafera Anafera	tout-rusu tout-rusu	1	DIOGERSTEILING TOMA JOHN	07263	FDG1088
JOAJCHO	1501-0050		VAUE: ANDE: ANDE SIDULA CESTULA VAUE ANGE NODITALES SOUTO	07263 07263	FDG1088 FDG1088
AGAZENT.	1901-0040 1901-0640		DIGDERSILICON JUMA JUNY .	07263	FDG108B
A0A2G1	1455-c 045		DIUDERSTEECH JOHA JOHA ) TSTREGET EMATCHED PAER?	1.7263 26480	FDG1C88 185> OU85
40247 408547	1.0 0.00	. ]	PAR MATCHED PAIR LISTED UNCER ABAZOL		
164254	185+ 0296 1854+0290		TSTREST NAM / TSTREST NAM	284 BG	1#54-6296
CUSAGE GUSAGE	1654-0296		ISTRISE UPN	28480 28480	1854 U256 1854-0298
\$0A2U7	1852-0015	-	TSTRESS NPN	28486	1854-0296
ADAZUA	1853-1015	ļ	TSTRIST PNP TSTRIST PNP	60131	2N3040
\$6A2010 \$6A2010	1054-0296	:	TSTHILL NPN	80131 254E0	2N364J 1854-0298
ADAZULL	1451-4916	_ , ·	TSTRESE PRP	28486 80131	1854 0296 203946
30A2012	1859 0436		TSTREST PNP	80131	2N3900
101701# 101701#	1853-4 G36 1853-G036		TSTREST PRP	16108	2N3400
An&2u15	1854-0215	i	TSTREST PAP TSTREST NPM	8C131 80131	2h390b 2h3904
AGAZULO	1853-0049	ا د	TATKESE PHP	19490	1859 CO49
4075018	1853 CC49 1853~0039	, Ι	TSTREST PNP	28480	1853 0049
INSAOL	U084-1641	1	TSTREST PAP : REFRO COMP ICON CHM TOS 174h	80131 01121	2N3038A CB 1G41
ADAZNZ ADAZNS	1010-757U 4040-757U	1 1	REFAU MET FLA 100K UNM 18 172H REFAU MET FLA 909K UNM 18 178H	264 60	0757-0367
Bonake	Jens 1 3401		REFAU COMP 39 OHN TOE 1/4H	284 60	U757-0488
464245	0757-0442		KIFAD MET FEM LUNCK UMM 12 1786	01121 28480	CB 3901 0757-0442
ADAZRO ADAZRI	C084-1931		MIFAU COMP 39 CHM TUE 1/4h MIFAU COMP TUK CHM TUE 1/4h	01121	CB 3901
ADAZNB .	4084-3503	1	KIPAU CUMP 19 UMM TOE 1748	01121	CB 1031
304249 3042410	L68# 3321		KIFAD COMP 3300 CHR LOT 1/4H	01121	CB 3321
JOA2N11	6757-9401 6084-2221	i : [	REFRO MET FEM 100 CHM 12 1/6W REFRO COMP 2200 CHM 102 1/4W	28480	0757-0401
86A2K12 80A2K13	U157-0401 U757-0273	1	REFAU MET FEM 100 CHM 12 1788	28480	CB 2221 0757- 0401
AGAZNIA	UE98-1446	_ ,	REPAG MET FLM J-DIR UHM 18 1/88	26460	0757- 0273
JOA2K15	₩4-1401 I	1	RIFAD MET FEM 383 OHM EE 174W RIFAD CCMP 39 OHM 1CT 174W	28460	0098 3446
8022n10 8082n17	0757-0442 0684-3901	- 1	KEFAU MET PLM 10.CK OHN 12 1784	C1121 28480	CB 3961 0757- U442
JOAZKES	U084-1U31	. [	REFAU COMP 39 OHM 1GC 1/4H REFAU COMP ICK CHM 1GE 1/4H	01121 01121	CB 3901
AUA ZH E9	1064 3901	1	REFAD COMP 39 OHM 10% 1/4m	01121	Ca 1031
ACP THE TOTAL TOTA	6757-6401	- 1	RIFAU HET FEM 100 CHM 12 1/84	28480	CB 3961 U757 0401

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference			is p-5' Habiaceanie Laute (Counci)	Mir	Ass. b. Ab.
Designation	HP Part Number	Qty	Description	Code	Mfr Part Number
1542401 1544401 1544464	4757-4401 Long-1901 4757-4468	b	HIPAD HET PEM BUD DHM BE BYRH HIPAD LLMP IY CHM BUS BYRH HIPAD HET PEM BUDK WHM BE BYRH	# # 9 10 6 1 1 1 1 2 4 4 H C	utet enos en stel utet enes
esecate dentact asecate telest asecate	0757-U424 2100-221 100-221 100-221 100-221		REFAU MET FEM YUNK CHM ET 17Am REFAU CCMP 2000 UNM EL EZM REFAU CCMP 2000 UNM EL EZM REFAU CCMP 2000 UNM EL EZM REFAU MET FEM LABOR UNM ET 17Am	24480 24480 24880 24480	4767-0488 4767-4676 476-477-478-478-4787-6478
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See introduction to this section for ordering information

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#### **SECTION VII**

#### MANUAL CHANGES AND OPTIONS

## 7-1. INTRODUCTION.

7-2. This section contains information required to backdate or update this manual for a specific instrument. Descriptions of special options and standard options are also in this section.

#### 7-3. MANUAL CHANGES.

7-4. This manual applies directly to instruments having the same serial prefix shown on the manual title page. If the serial prefix of the instrument is not the same as the one on the title page or covered by an enclosed MANUAL CHANGES sheet, order a copy of Supplement B to the instrument manual (HP Part No. 01702-90904). Supplement B carries information for backdating this manual to cover older instruments. If a MANUAL CHANGES sheet is supplied, make all indicated ERRATA corrections.

#### 7-5. SPECIAL OPTIONS.

7-6. Most customer special application requirements and/or specifications can be met by factory modification of a standard instrument. A standard instrument modified in this way will carry a special option number, such as Model 0000A/Option C01.

7-7. An operating and service manual and a manual insert are provided with each special option instrument. The operating and service manual contains information about the standard instrument. The manual insert for the special option describes the factory modifications required to produce the special option instrument. Amend the operating and service manual by changing it to include all manual insert information. When these changes are made, the operating and service manual will apply to the special option instrument.

7-8. If you have ordered a special option instrument and the manual insert is missing, notify the nearest Hewlett-Packard Sales/Service Office. Be sure to give a full description of the instrument, including the complete serial number and special option number.

#### 7-9. STANDARD OPTIONS.

7-10. Standard options are modifications installed on HP instruments at the factory and are available on request. Table 7-1 lists the Model 1702A standard options.

Table 7-1. Model 1702A Standard Options

Option	Description	3 HP Part No.
001	Instrument set at factory for 230V operation: Fuse, .25 ASB for 230-volt operation.	Fuse: 2110-0018
012	Standard Model 1702A with Model 10103B Battery Pack.	Model 10103B Battery Pack

#### **SECTION VIII**

#### SCHEMATICS AND TROUBLESHOOTING

#### 8-1. INTRODUCTION.

8-2. This section contains schematics, repair and replacement information, component-identification illustrations, waveforms, and test conditions. Table 8-3 defines symbols and conventions used on the schematics. A disassembly procedure for removing the CRT and instrument modules for repair and replacement is also contained in this section.

#### 8-3. SCHEMATICS.

- 8-4. Schematics are printed on foldout pages for easy reference to the text and figures in other sections. The schematics are drawn to show the electronic function of the circuits. Any one schematic may include all or part of several different physical assemblies. Non MH-standard symbols and conventions used in the schematics are defined in table 8-3.
- 8-5. The schematics are numbered in sequence with a bold number in a box at the lower right-hand corner of each page. These numbers are used to cross reference signal connections between the schematics. At each circuit breaking point, a number in a circle is shown, followed by another number in bold type. The circled number indicates the signal or circuit and the bold number indicates the associated schematic that contains the source or destination of the signal. To find the source or destination of the signal, turn to the indicated schematic and find the circled number in question.
- 8-6. A table on each schematic lists all components shown on the schematic by reference designation. Component reference designators that have been deleted from the schematic are listed below the table.
- 8-7. All components within the bordered areas of the schematic are physically located on etched circuit boards. Components not physically located on an etched circuit board are shown in the unbordered areas of the schematic.

#### 8-8. REFERENCE DESIGNATIONS.

8-9. The unit system of reference designations used in this manual is in accordance with the provisions of USA Standard Y32.16-1968, Reference Designations for Electrical and Electronics Parts and Equipments, dated March 1, 1968. Minor variations from the standard, due to design and manufacturing practices, may be noted.

- 8-10. Each electrical component is assigned a class letter and a number. This letter-number combination is the basic reference designation. Components which are part of an assembly have, in addition to the basic designation, a prefix designation indicating the assembly of which the component is a part. For instance, resistor R23 on assembly A1 is called A1R23.
- 8-11. Assemblies are numbered consecutively. If an assembly reference designation is assigned and later deleted, that number is not reused.

#### 8-12. COMPONENT LOCATIONS.

- 8-13. Locations of components on assemblies and subassemblies are illustrated on photographs adjacent to the schematics. Since the schematics are drawn to show function, portions of a particular assembly may appear on several different schematics. The component-location photograph is printed next to the schematic that shows most of the circuitry on the assembly. In some cases, a particular component-location photograph may appear adjacent to more than one schematic.
- 8-14. Components located on the chassis are identified in figures 8-4 and 8-5. The locations of all adjustments are shown in Section V.

#### 8-15. PREVENTIVE MAINTENANCE.

8-16. Preventive maintenance consists of periodic performance checks, calibration, mechanical inspection, lubrication, and other services designed to prevent breakdown and failure. Performance checks and calibration are covered in Section V of this manual. The other preventive maintenance services are covered in the following paragraphs.

#### 8-17. MECHANICAL INSPECTION.

- 8-18. Periodically inspect the instrument for damaged components, excess grease, dirt, and corrosion. Look for loose and misaligned assemblies. Ensure that all screws and fasteners are tight and serviceable.
- 8-19. Refer to the paragraphs in this section on repair and replacement for instructions on replacing damaged components.
- 8-20 Painted surfaces can be cleaned with a commercial, spray-type, window cleaner or with a mild

soap and water solution. Excess grease can be removed with a degreaser such as M-180 FREON TF DEGREASER produced by Miller-Stevenson Company.

8-21. Corroded spots are best removed with soap and water. Stubborn residues can be removed with a fine abrasive. When using abrasives, be careful that fine particles do not fall into the instrument. Such areas should be protected from further corrosion by an application of a silicone resin such as GE DRI-FILM 88.

#### 8-22. SWITCH MAINTENANCE.

- 8-23. The pushbutton switches used in this instrument have been designed for long, trouble-free service. In the event that one of these switches becomes defective, replacement rather than repair is recommended.
- 8-24. The rotary switches in this instrument can easily be serviced after removal of the assembly on which the switch is mounted. In the case of the TIME/DIV switch, the TIME/DIV switch shaft must be removed. Refer to the paragraphs on repair and replacement in this section for instructions on disassembly of the modules in the instrument.
- 8-25. Conventional rotary switches are serviced by cleaning the contacts with a degreaser such as M-180 FREON TF DEGREASER produced by Miller-Stevenson Chemical Company. The contact surfaces are then lubricated with a lubricant comparable to LUBRIPLATE FML produced by the Fiske Brothers Refining Company. LUBRIPLATE FML is available from the Hewlett-Packard Company. Order HP Part No. 6040-0305.
- 8-26. The switches on the sweep time assembly and holdoff assembly can be serviced as follows:
- a. Remove TIME/DIV knob and shaft (paragraph 8-39).
- b. Remove printed circuit board keeper from top of assemblies.
- c. Remove assembly or assemblies to be serviced. See figure 8-5 for assembly locations.
  - d. Note orientation of open part of rotor section.

Note V

The following steps use the sweep time assembly (figure 8-24) as an example.

- e. Remove retainer ring MP1.
- f. Separate two rotor sections, SIMP1 and SIMP2, from etched circuit board.

- g. Check contact area of etched circuit board. If contact area shows excessive wear, replace etched circuit board.
- h. Check contacts on two rotor sections. If contacts show excessive wenr, replace rotor,
- i. Clean and lubricate contacts on etched circuit board, and rotors as described in paragraph 8-25,
- j. Place rotor sections on etched circuit board and reinstall retainer ring MP1.
- k. Position open part of rotor section as noted in step d.
- l. Reinstall TIME/DIV shaft and knob assembly.

## 8-27. REPAIR AND REPLACEMENT.

8-28. The following paragraphs provide procedures for removal and replacement of assemblies, sub-assemblies, and components. Special servicing instructions for the etched circuit boards are provided in paragraph 8-54. Section VI provides a detailed parts list for use in ordering replacement parts. Refer to table 8-2 for the location of a particular assembly,

## 8-29. CRT REMOVAL AND REPLACEMENT.

#### WARNING

To prevent personal injury, wear a face mask or goggles when handling the CRT. Wear protective gloves and handle the CRT carefully.

- 8-30. To remove and replace the CRT, proceed as follows:
  - a. Remove instrument top and bottom covers.
  - b. Remove rear panel CRT socket cover.
  - c. Remove two screws from rear of CRT shield,
  - d. Remove CRT socket.
  - e. Remove CRT shock mounting screws.
  - f. Remove CRT clamp.
  - g. Remove leads from CRT neck.
- h. Remove two screws holding vertical output amplifier shield and tilt to one side.
- i. Remove two screws holding A9 high voltage connector assembly.

- J. Remove Hexible lends from Att high voltage connector assembly.
  - k. Unplug snap on CRT.
  - 1. Rotate shock mount 45 degrees and remove,
- m. Place one hand on front of CRT and use other hand to slide CRT toward rear of instrument until CRT can be raised upward and out of instrument,
  - n. Remove CRT from CRT shield,
  - o. To reinstall, reverse removal procedure.

## 8-31. VERTICAL AMPLIFIER MODULE REMOVAL AND REPLACEMENT.

- 832. To remove the vertical amplifier module, proceed as follows:
- a. Using allen wrench, loosen allen screws in POSITION, VOLTS/DIV, and DISPLAY control knobs.
  - b. Remove control knobs.
  - e. Pull plastic covers from coupling switches.
- d. Remove top and bottom covers from instrument.
- e. Disconnect main harness wires from vertical preamplifier assembly,
- f. Disconnect two wires from delay line to vertical output amplifier,
- g. Remove two screws holding vertical output amplifier to vertical amplifier module.
  - h. Remove vertical output amplifier assembly,
  - i. Hold vertical preamplifier assembly,
- j. Remove nuts on VOLTS/DIV and POSITION controls.
  - k. Gently lift vertical module assembly out,
- l. To reinstall vertical amplifier module, reverse removal procedure.

#### 8-33. DELAY LINE REMOVAL AND REPLACEMENT.

- 8-34. To remove the delay line from the vertical amplifier module, proceed as follows:
- a. Remove vertical amplifier module as described in paragraph 8-31.

- b. Unsolder two wires (red, blue) from end of delay line to vertical preamplifier assembly, Mark locations of wires to facilitate correct reassembly.
- e. Remove two center screws from bottom side of vertical module (C, figure 8-1).
  - d. Rotate delay line slightly and remove,

#### Note

The two wires to the vertical output amplifier assembly go through a rubber grommet. These two wires must be enrefully brought through the grommet during removal of the delay line.

e. To reinstall delay line, reverso removal procedure.

#### 8-35, ATTENUATOR REMOVAL AND REPLACEMENT.

- 836. To remove the attenuator assemblies from the vertical amplifier module, proceed as follows:
- a. Remove vertical amplifier module as described in paragraph 8-31.
  - b. Remove locking nuts (A, figure 8-1).
- Remove six screws on bottom side of vertical amplifier module (B and C, figure 8-1),
- d. Remove delay line as described in paragraph 8-33.
- e. Unsolder C1 from BNC input connectors (figure 8-2).
- f. Remove nuts holding BNC connectors to shield.
  - g. Remove BNC connectors.
  - h. Slide vertical preamplifier back from shield,
- i. Raise vertical preamplifier up and unsolder components connected between attenuators and vertical preamplifier board.
- j. Remove two screws for each attenuator from top side of preamplifier board.
  - k. Lift attenuators from board.
- To reinstall attenuators, reverse removal procedure,

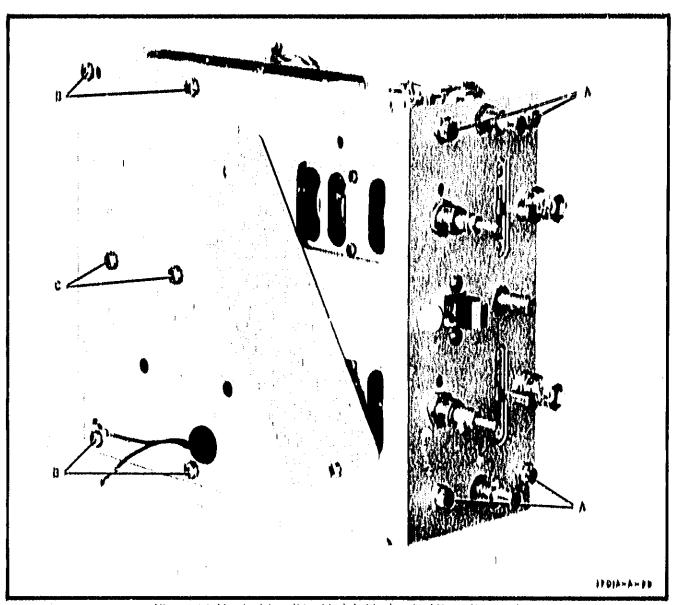


Figure 8-1. Vertical Amplifier Module Mechanical Parts Romoval

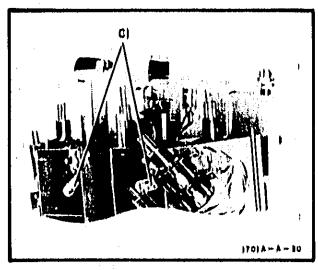


Figure 8-2. Attenuator Removal

# 8-07. REMOVAL AND REPLACEMENT OF ABBEMBLIEB IN HORIZONTAL AMPLIFIER MODULE.

8-38. The following paragraphs provide information required to remove and replace the various assemblies in the horizontal amplifier module.

8-30. TIME/DIV Siritch Removal and Replacement. To remove the TIME/DIV switch, proceed as follows:

- B. Sol TIME/DIV to R SEC.
- b. Lausen locking collar setscrew on inside front panel of instrument.
  - e. Pull TIME/DIV shall out.
- d. To reinstall TIME/DIV shaft, reverse removal procedure.

- 8-10. Physia Assemblies Removal and Replacement. Atterrepoyatof the TIME-TIME shatt the three physia assemblies in the horizontal amplifier module can be removed as follows:
- a. Homove etched circuit bourd keeper from top at assembles.
- h. Gently rock assemblies from side to side while pulling apward to remove from seckets.
- e. To reindall assembles, reverse removal proredure.
- 8-11. Tripper Assembly and Herizontal Mother Haard Removal and Replacement. To remove the tripper assembly and horizontal mather board, proceed as follows:
- a. Romavo TIME/DIV shall as described in paraaranh 860.
- b. Remove three assembles as described in paragraph 8:40.
- e. Disconnect whee stop and bottom) to horizon: tal preamplifier board.
- d. Homove two screws from horizontal preamply for board.
  - , e. Disconnect wires to trigger assembly,
- f. Reparate horizontal amplifier from trigger assembly and horizontal mother board.
  - в. Remove lonfzontal preamplifier bourd.
- his Hold tripper nevently and remove four scrows that hold nesembly.
  - 4. Untefully remove trianger assembly.
- J. Horkontal mother board can be removed by disconnecting wires connected to II.
  - k. To reliatell, reverse removal procedure.

## BAR. POWER BUPPLY MODULE REMOVAL AND REP

- 8-18. To remove power supply module from Instrument, proceed as follows:
  - a. Turn Instrument off and remove power coal.
  - b. Remove top and bottom covers.
  - e. Unplus post-accelerator lead.

#### Mate

the not attempt to remove lead from CTCP aloos.

- d. Turn Instrument on its side,
- e. Remove buttery If Instrument is Eighton 19:
- 6. Upploy Add) connecting power supply to main calles
- g: Mathy #1 Postdrive acrowdriver, remove two Nothend acrows directly in front of power transforms refer er.
- h. To refustall power supply module, reverse remarks procedure.

# AHA. POWER BUPPLY MODULE DIBABBEMBLY AND REABBEMBLY.

- tistic. Positions combine power supply module, proceed as follows:
  - n. Hemove mover hos cover.
- b. Using board puller faralshed with service life, hook on inside of standoffs between two low voltage boards and pull straight out:
  - e. The connect QV from low voltage mother boards
- d. Maconnect QL benda from high voltage eachles for:
  - e. Hemove high voltage exclibitor.
  - 4. Turn histrument over,
- g. Remove four screws holding power supply module to buttery desk.
  - h: Türn İnstrument over:
  - i. Hemove high volume oscillator shield:
- ). Hemove two screws holding low voltage mothor board.
  - k. Hemove low voltage mather bonds
  - 4 To relietally reverse removal procedures

#### male: Bemigonductor removal and replace Menti

is 17. Pigure wil is included to help identity the leads on the common shapes and sizes at semiconductor devices. When removing a semiconductor, use long-noved places as a heat sigh between the device applications.

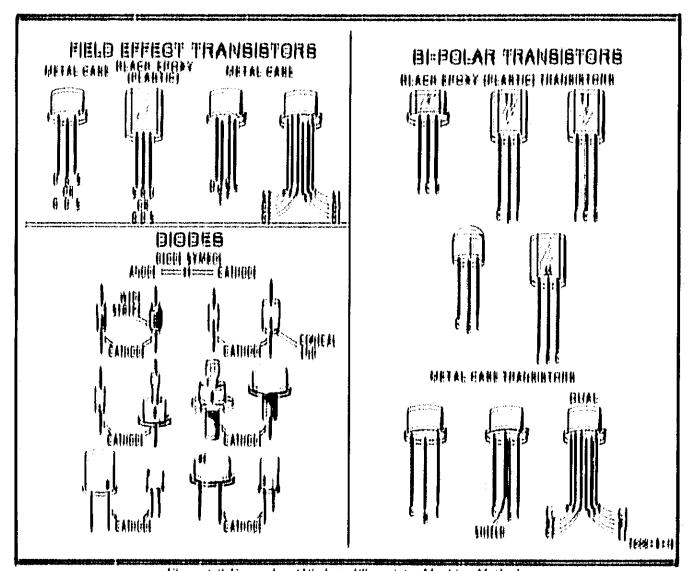


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## BIABI ATTENUATOR BERVIGING:

Bill. A metal plate provides access to the attenuintons. The plate is forated under the front of the fift. Borrier for the attenuation is accomplished by remarking the the attenuation is selected, replace the motal plate. After the attenuation have been serviced, replace the motal plate and plate and title.

## 8:50, GINOUIT BOARDS,

8:61. The following paragraphs provide information regarding servicing procedures for eleked eigeth bounds, use of heat sinks, and special soldering considerations.

## BIBBI HOARD CONNECTIONS

p 68: Baumopha romertop are dentified on elective tomen by the color color of the colorestrap street tomestar by the color color all the colorestrap street formertor plan op plays and between the literatified by other parameters of a letter. The latters (t. 1. 6), and (t) have been amitted. Table bit shows the types of boost commentaries and boost comments.

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- b: When politer in thirty permiter with devolutering tend when an alchest blooder performing an entire time.
- e: Repeat steps a and to his each feat until all leads are free:
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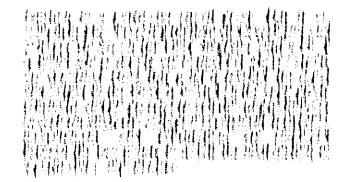
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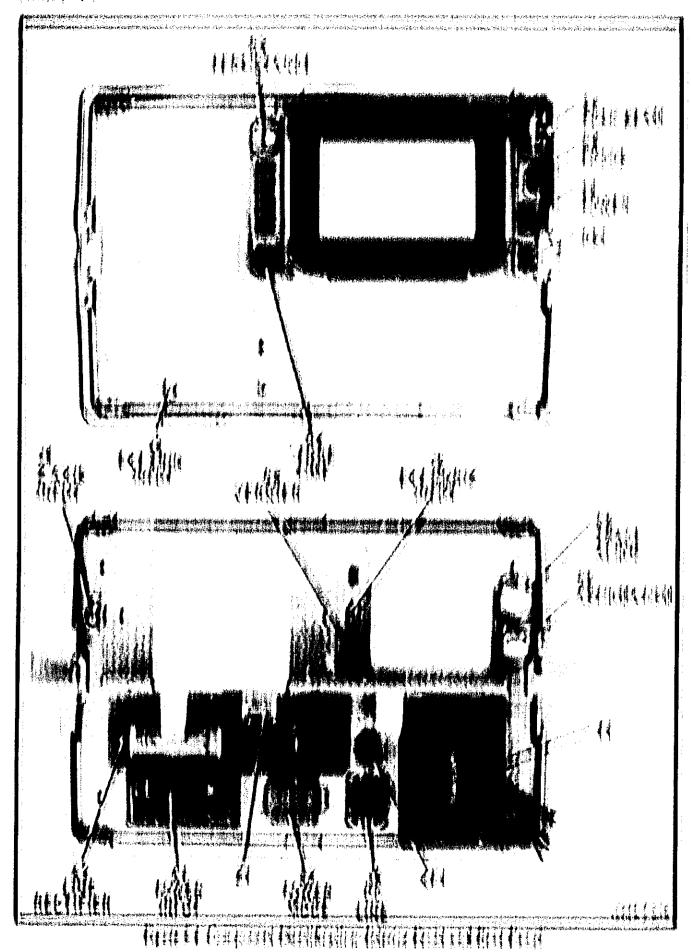
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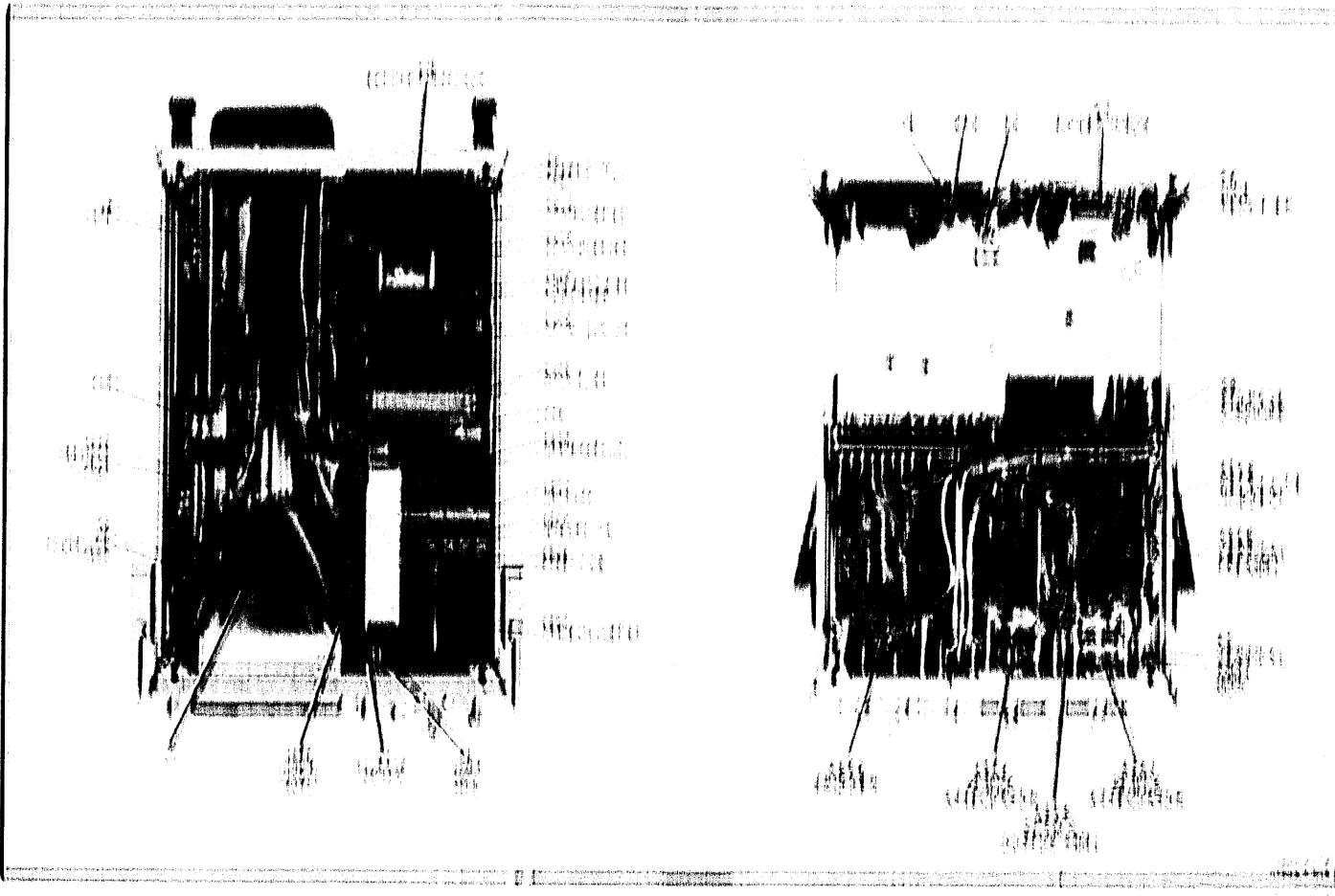
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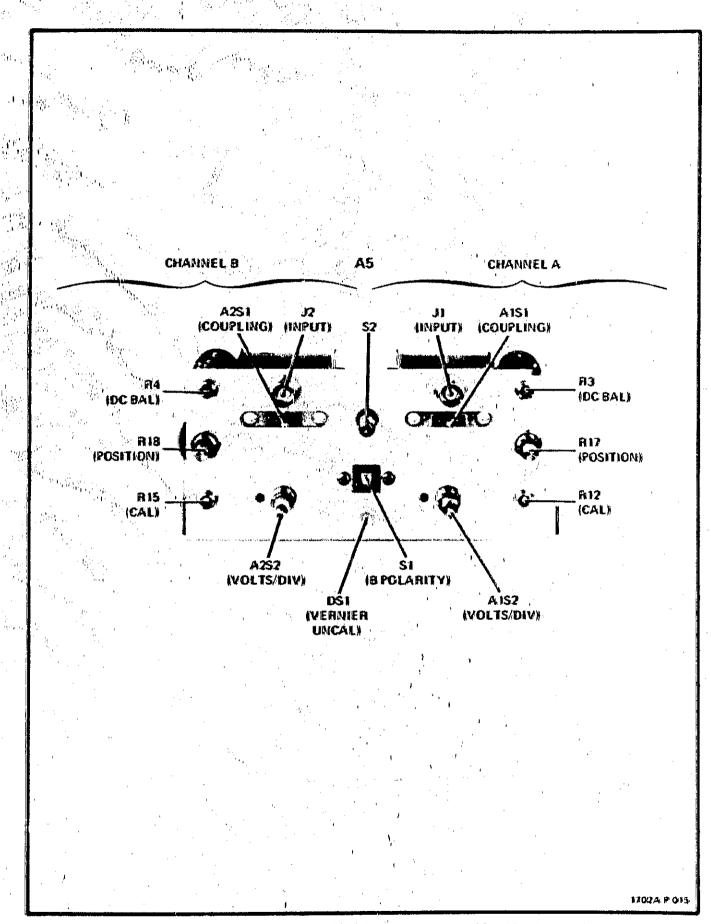


Figure 3-6. Vertical Amphifier Module, A5, Component Identification

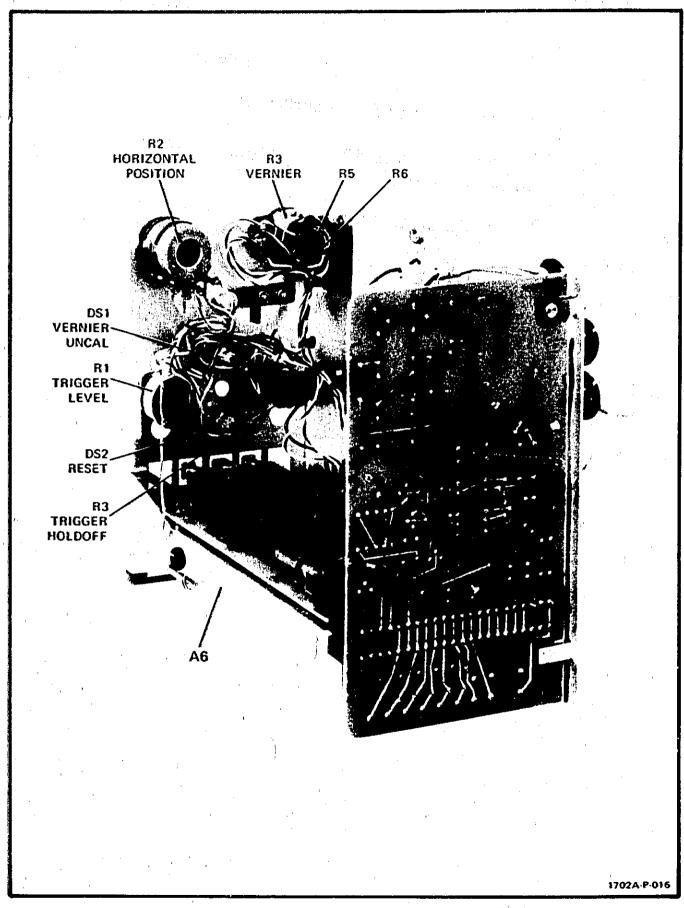


Figure \$7. Horizontal Amplifier Module, A6, Component Identification

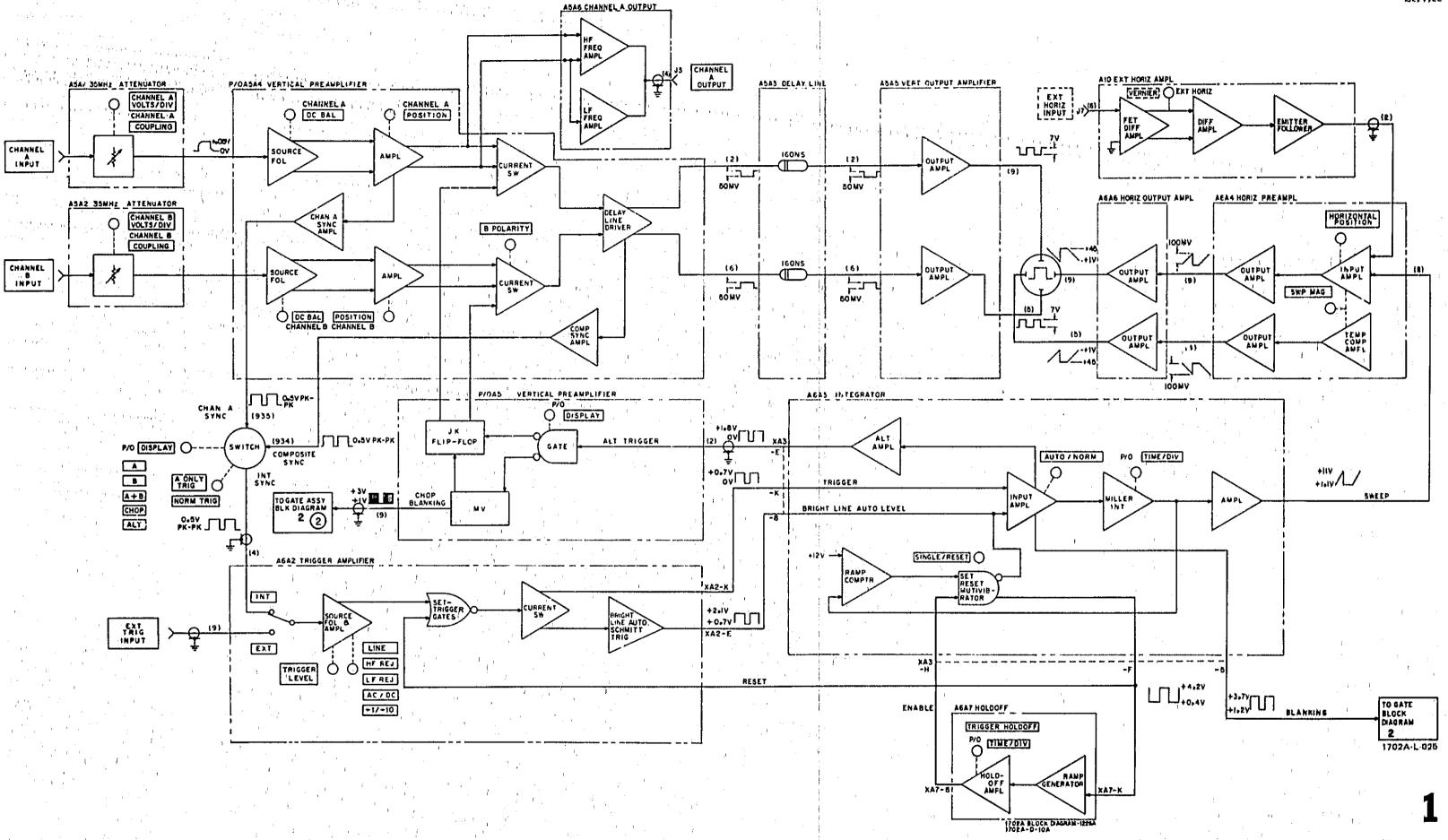
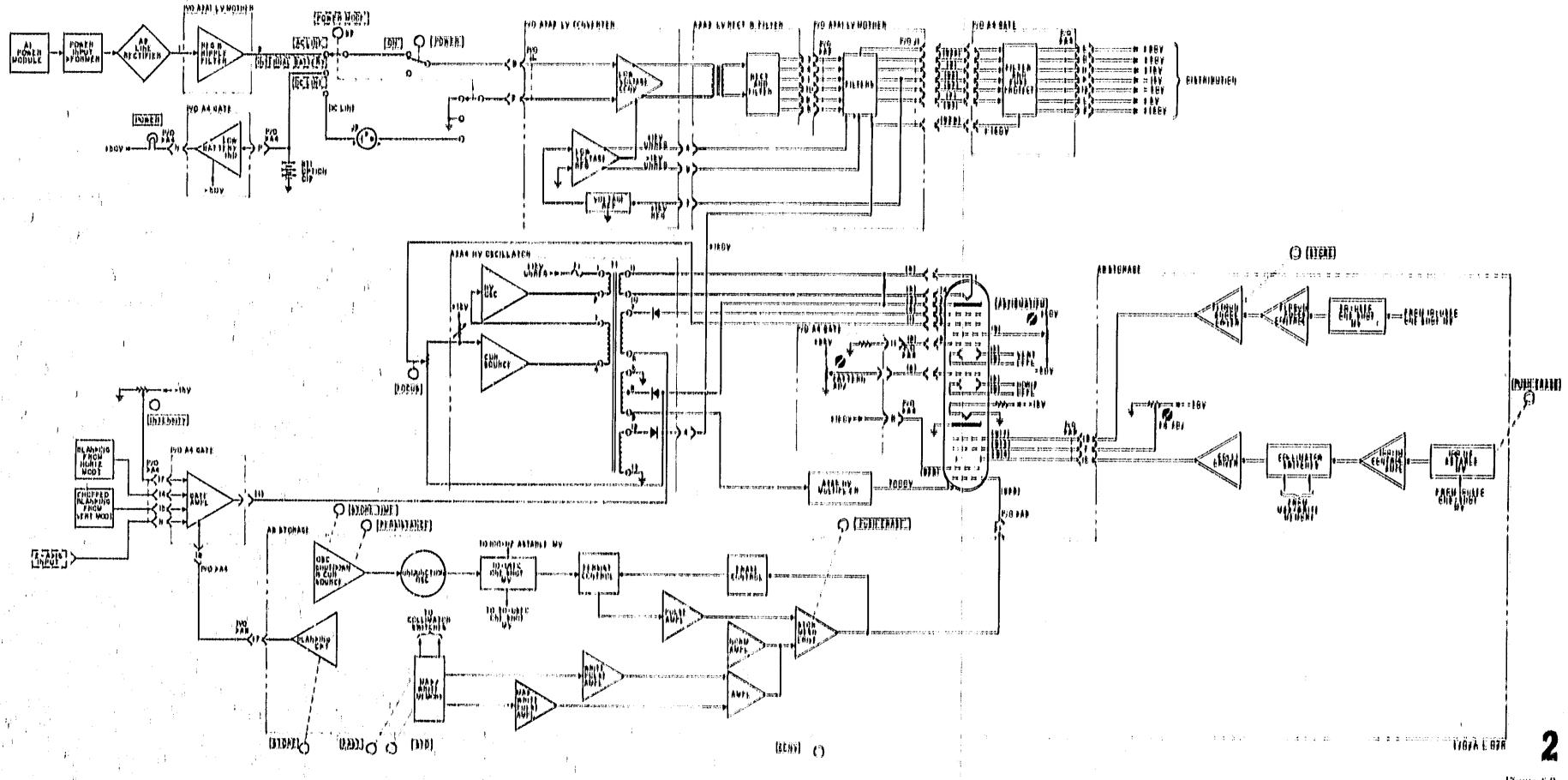
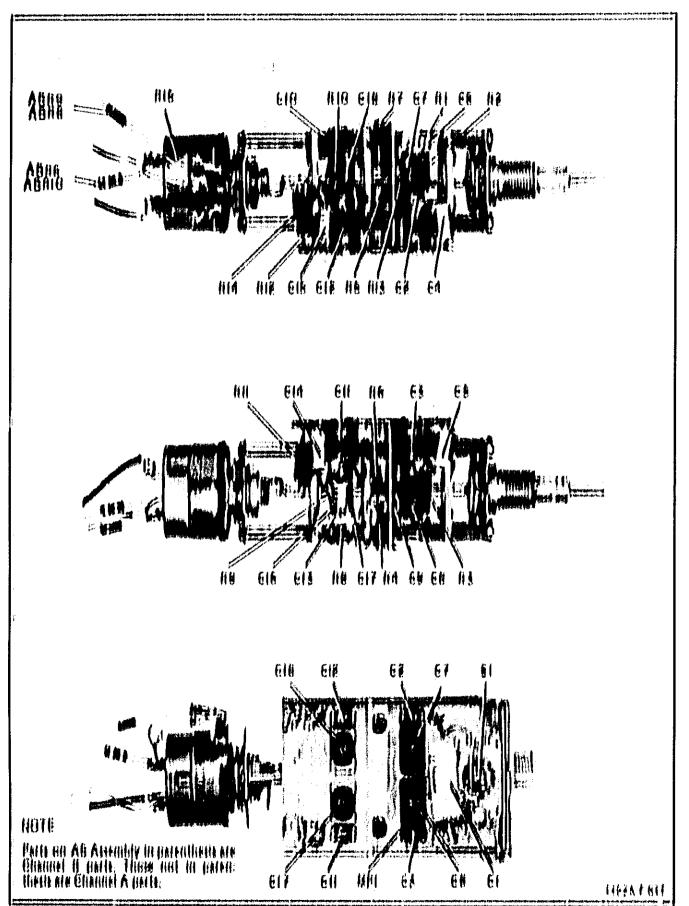


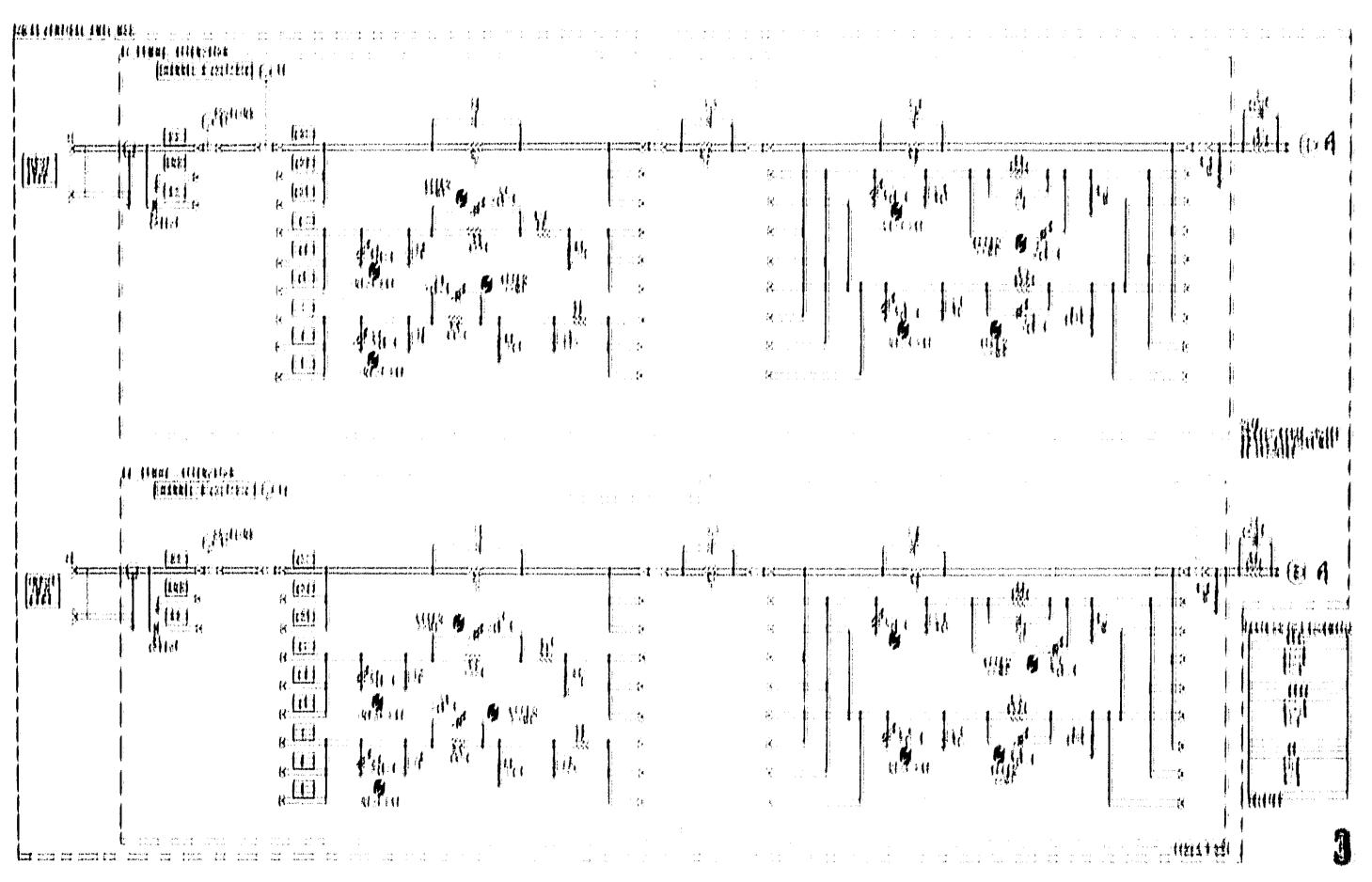
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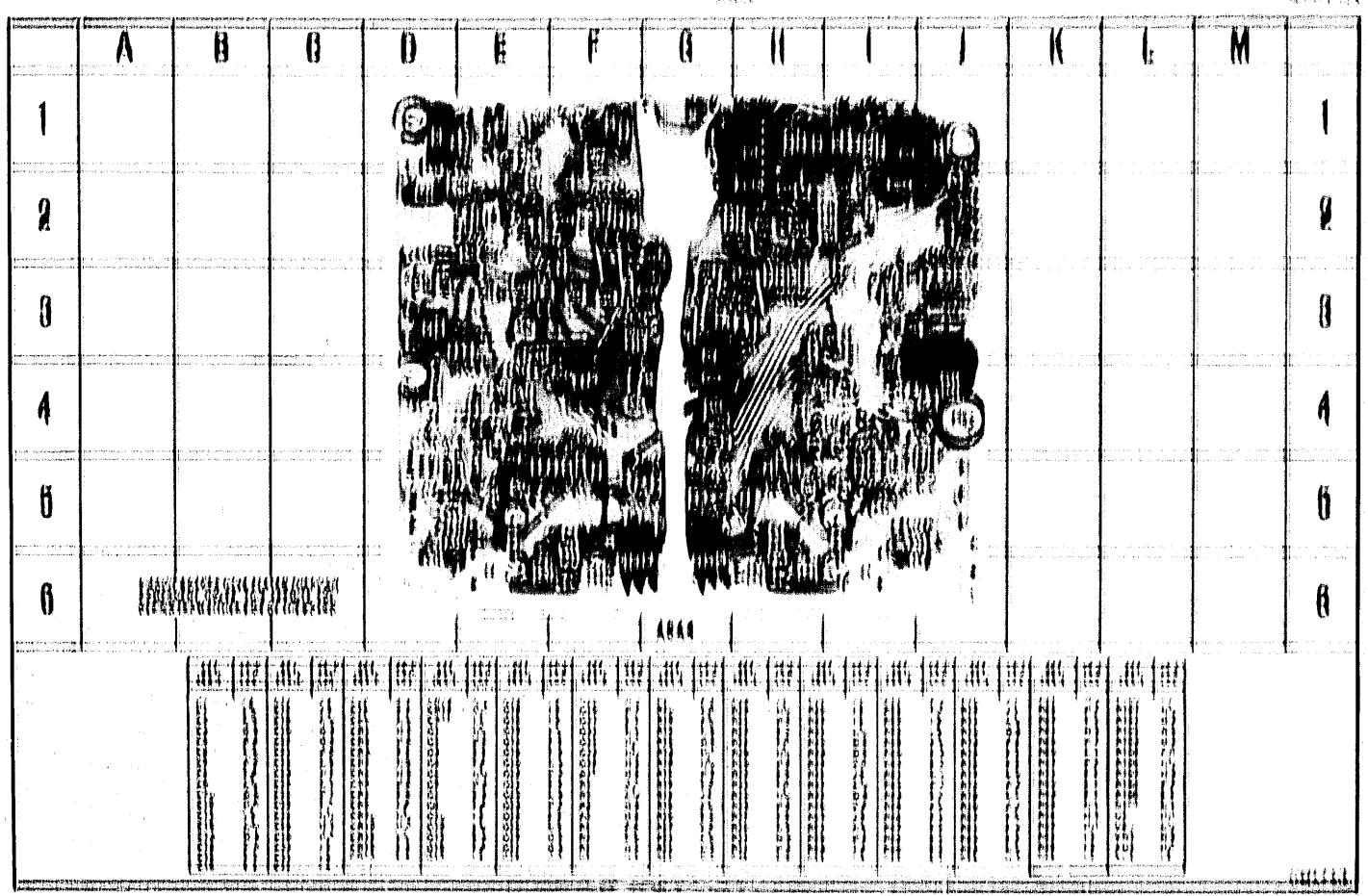


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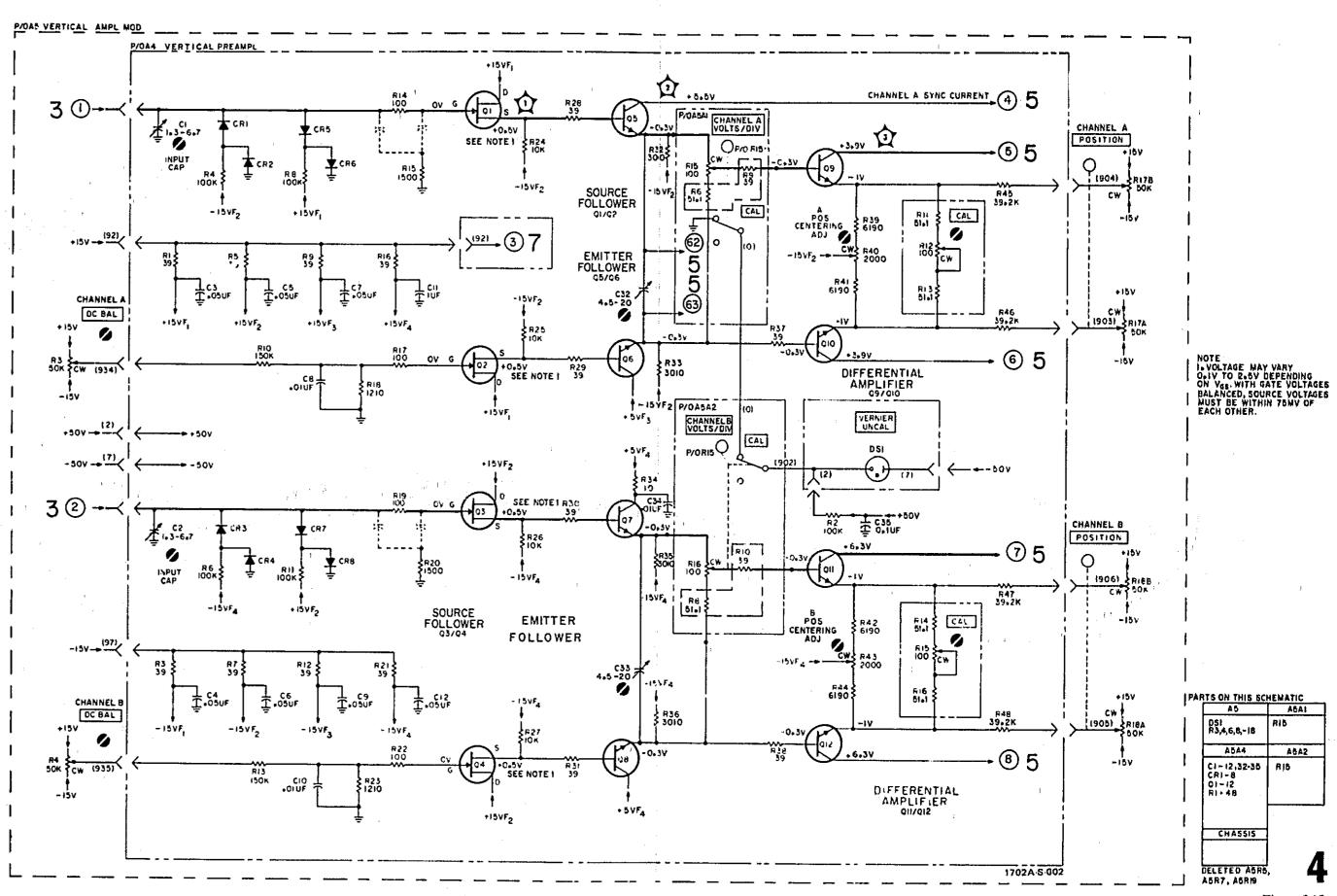


Physics 8:10: 68-81116 Attenuation, AGA1 and AGA2 Component Identification





# DC VOLTAGE MEASUREMENT CONDITIONS A. Set: B. All voltages are referenced to chassis DISPLAY..... A ground. All indications are nominal and channel A POSITION..... midrange may vary slightly. channel A vernier..... CAL channel A coupling ...... GND **WAVEFORM MEASUREMENT CONDITIONS** A. Set: B. Connect CAL 1 VOLT signal to channel A INPUT. channel A vernier..... CAL C. All waveforms are referenced to chassis channel A coupling ...... AC ground. The monitor oscilloscope's vertical channel B coupling ...... GND sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph. 5 MV/DIV 0.2 MS/DIV 5 MV/DIV 0.2 MS/DIV 5 MV/DIV 0.2 MS/DIV 1702A P 019



Vertical Preamplifier A5A4, Schematic (1 of 4)

# DO VOLTAGE MEASUREMENT CONDITIONS

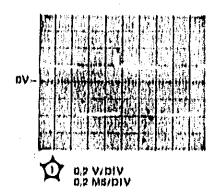
۸.	Butt
	DBPLAY A
	- channel A POSITION midrange
	- channel A vernier
	channel & VOLTBADIY
	channel A coupling (INI)

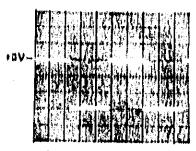
B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.

# **WAVEFORM MEABURIMENT CONDITIONS**

۸.	Bett
	DISPLAY
	- channel A POSITION midrange
	- channel A vernier
	- channel A-VOLTS/DJV
	channel A coupling Act

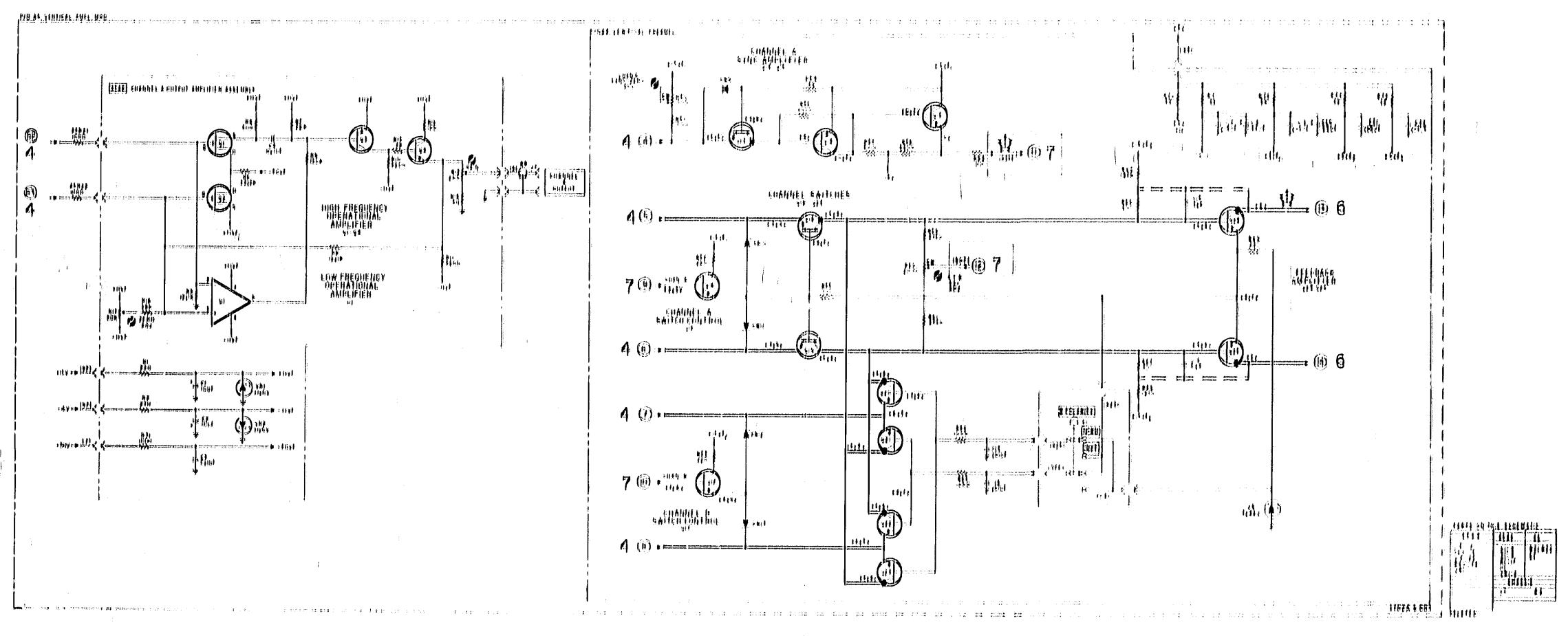
- B. Connect CAL I VOLT to channel A INPUT.
- C. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity tusing a 14 probe) and sweep speed settings are shown below on each waveform photograph.





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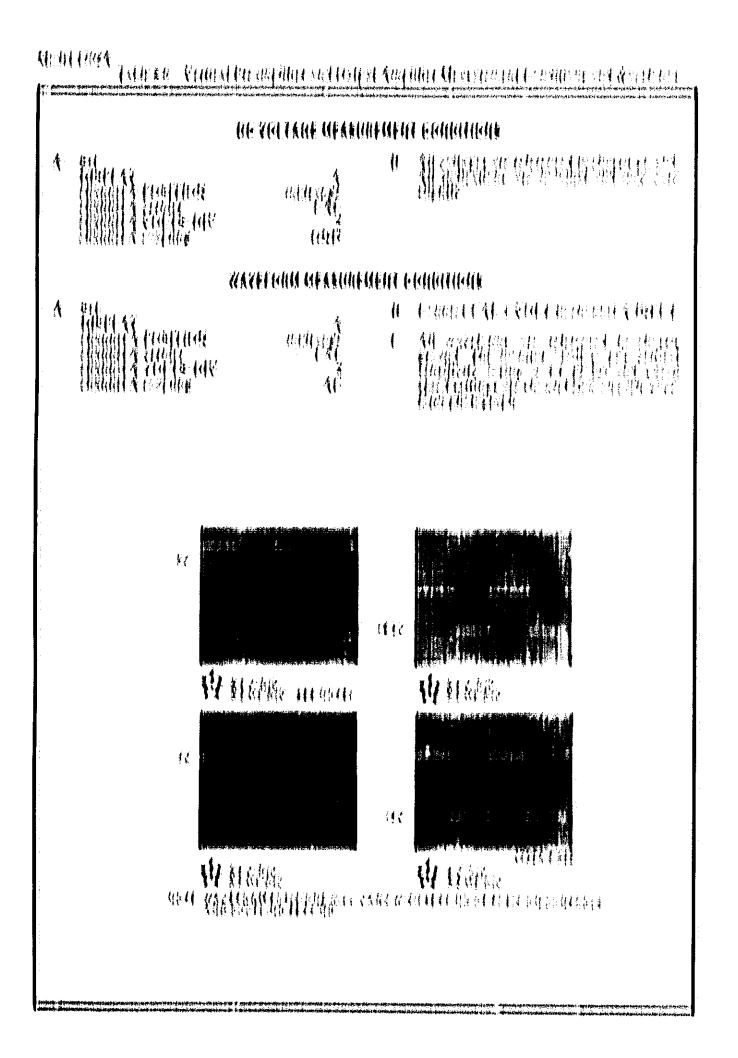
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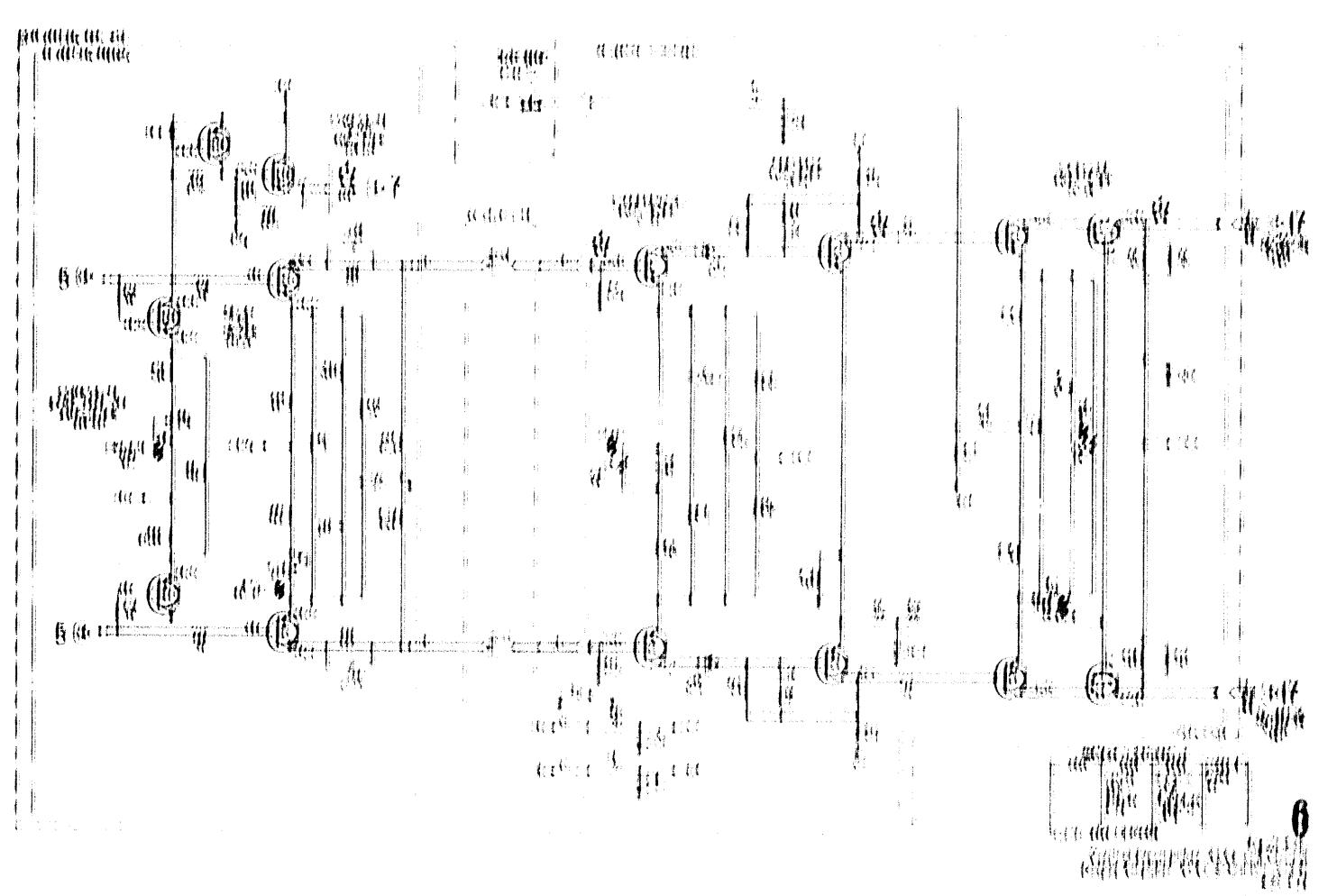
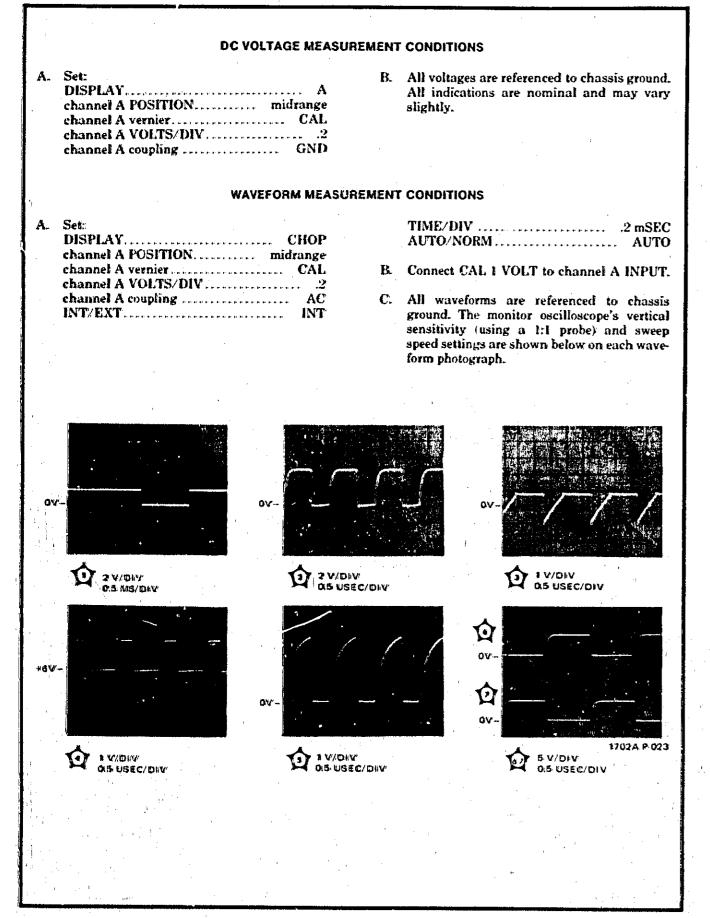


Table 8-7. Vertical Preamplifier Measurement Conditions and Waveforms.



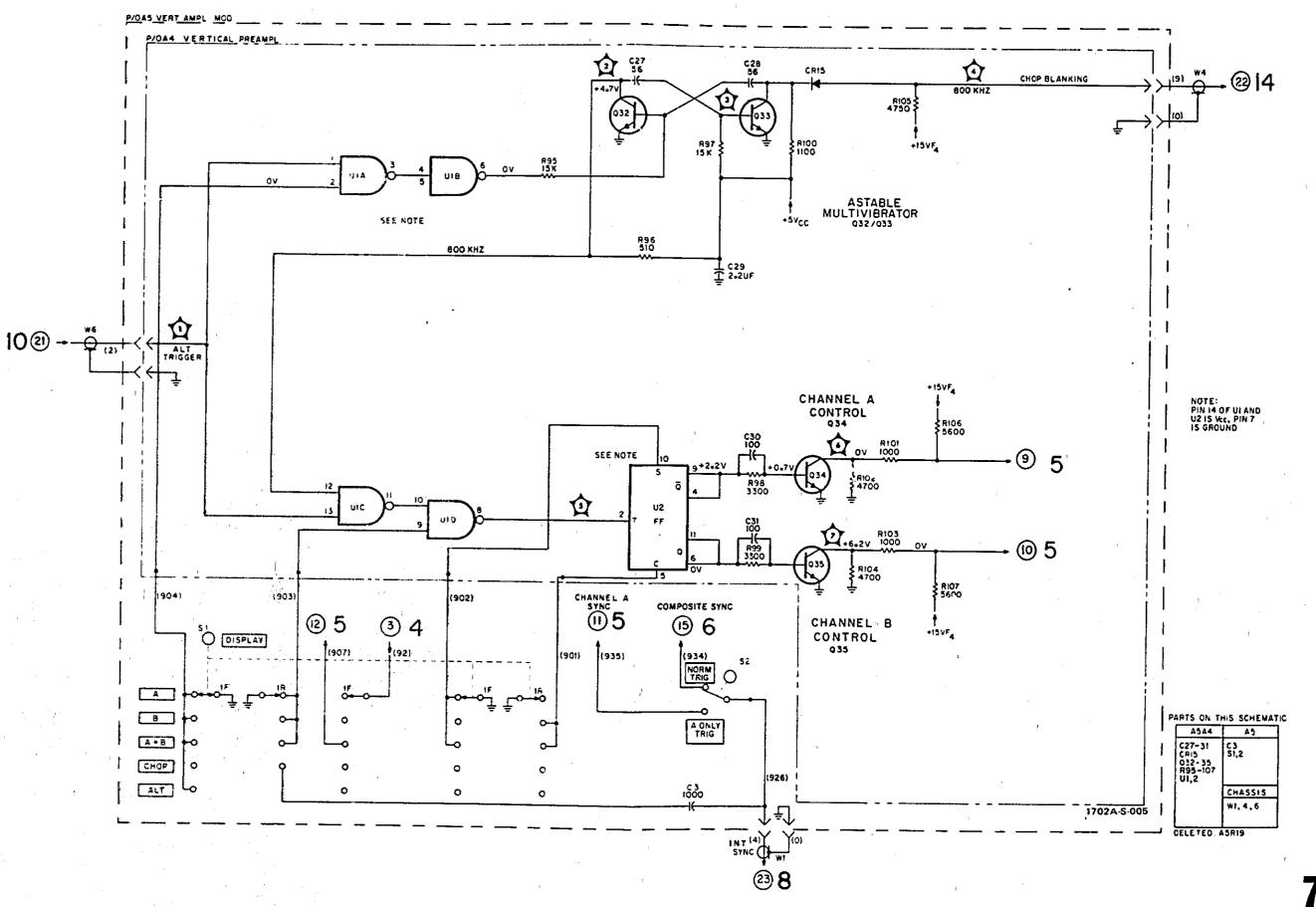


Figure 8-17.
Vertical Preamplifier, A5A4, Schematic (4 of 4)

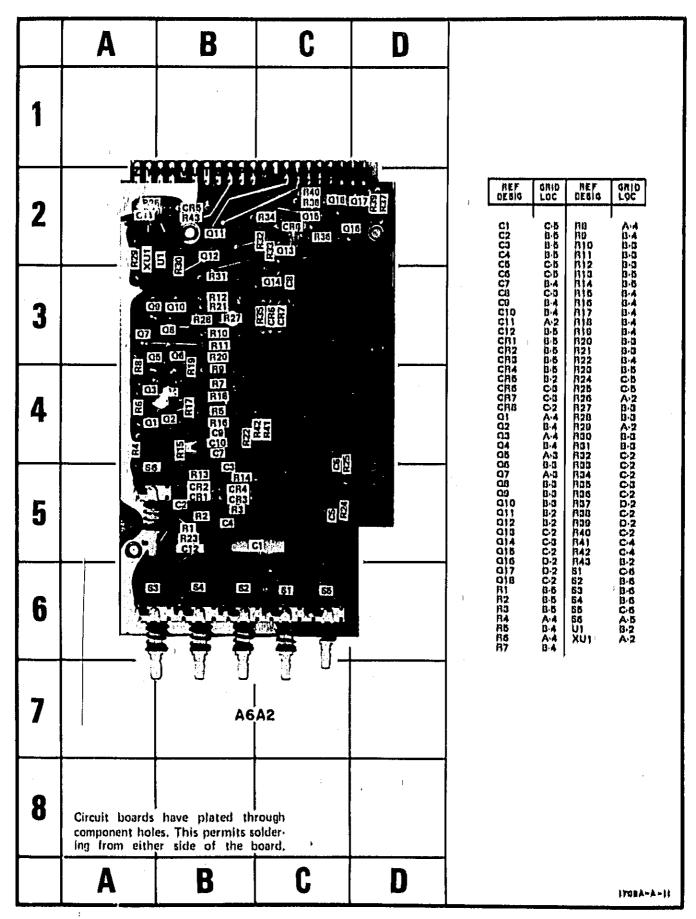
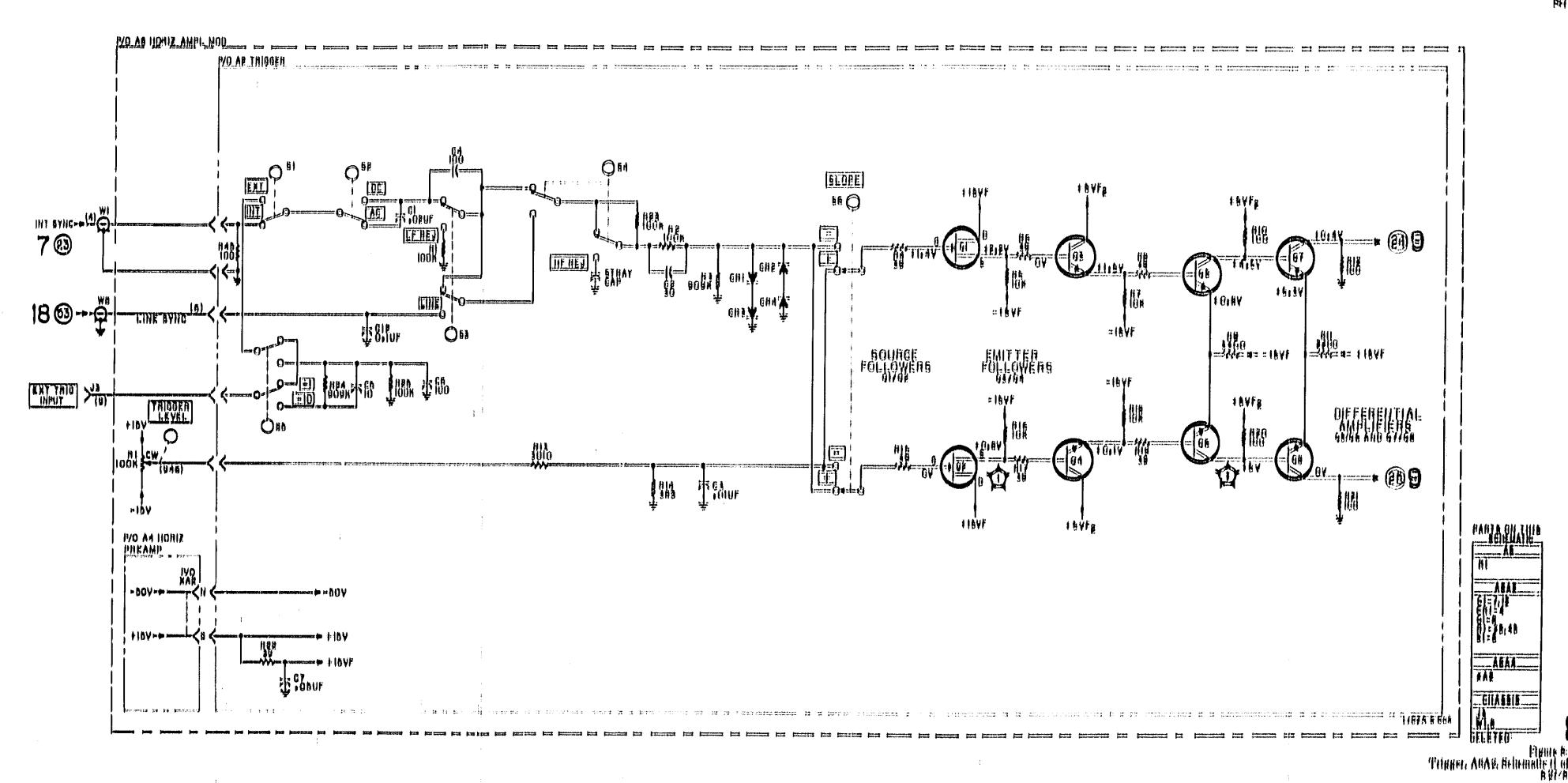
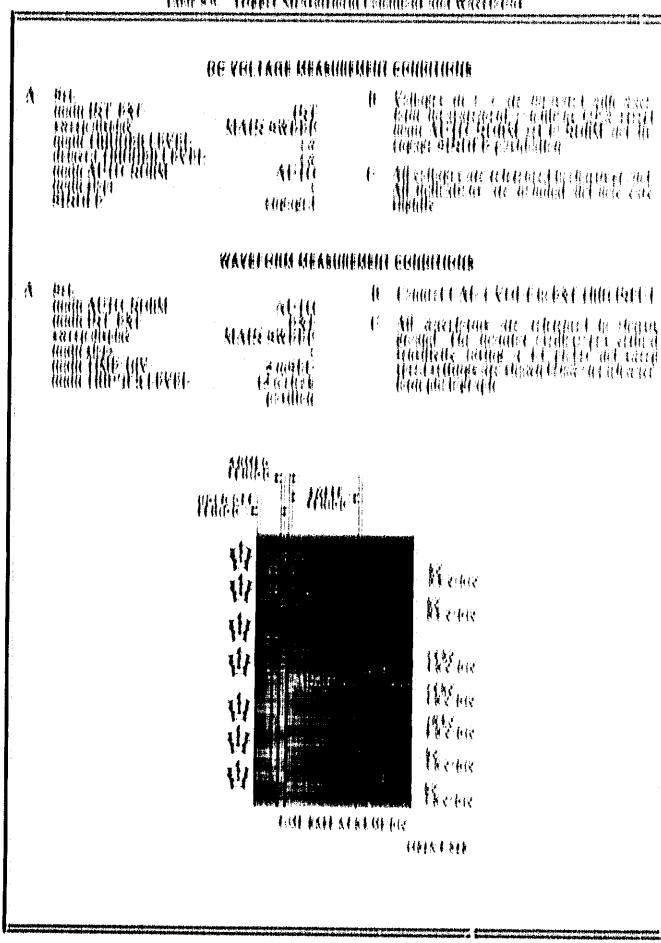


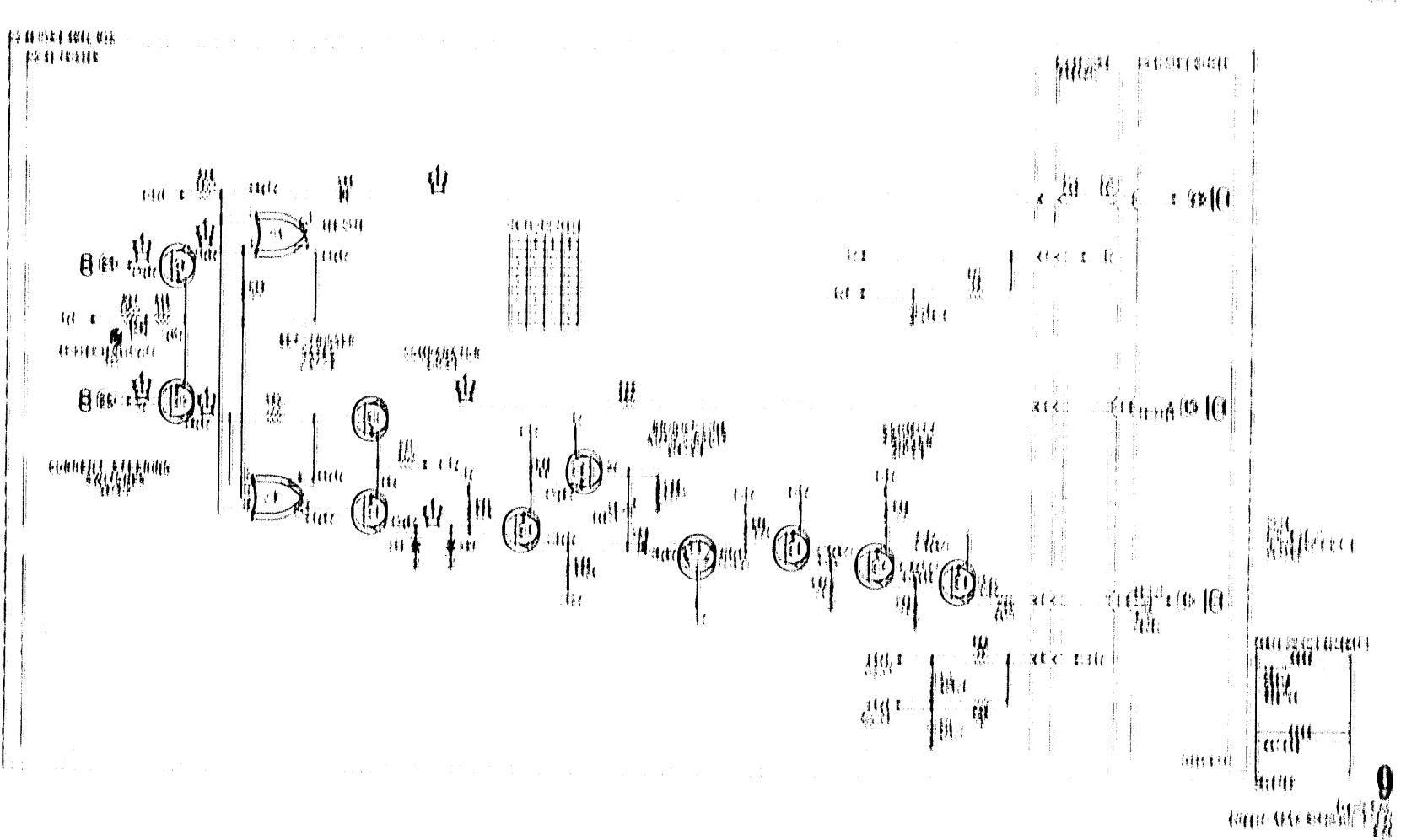
Figure 8-18. Trigger, A6A2, Component Identification

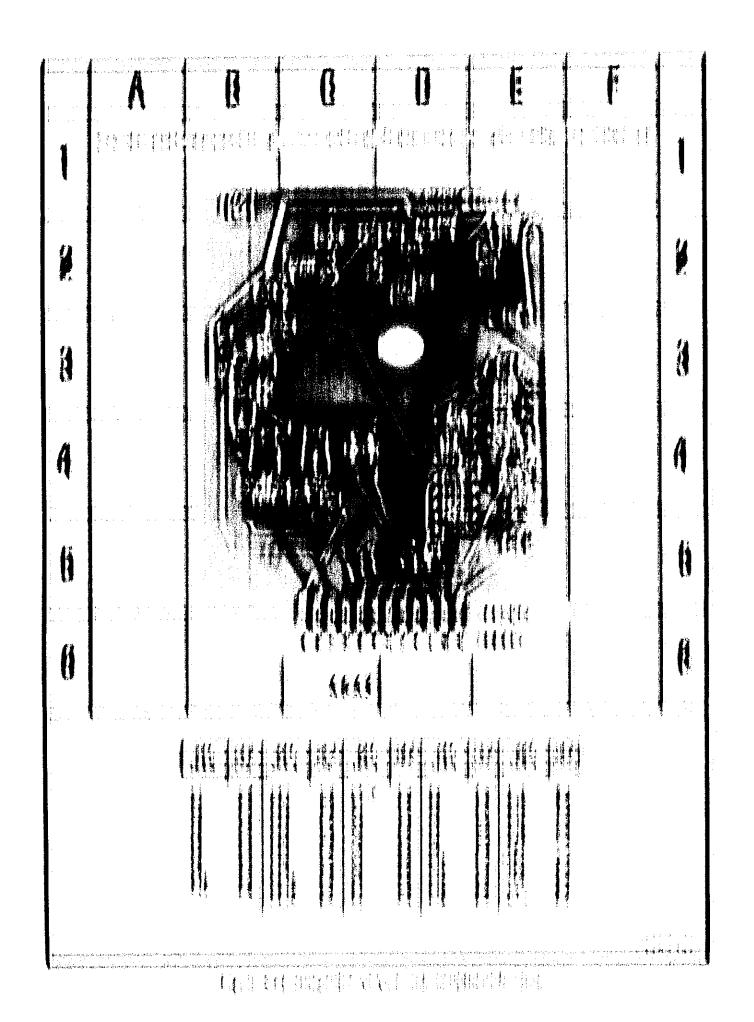
Table 8-8. Channel A Output Amplifier Measurement Conditions and Waveforms

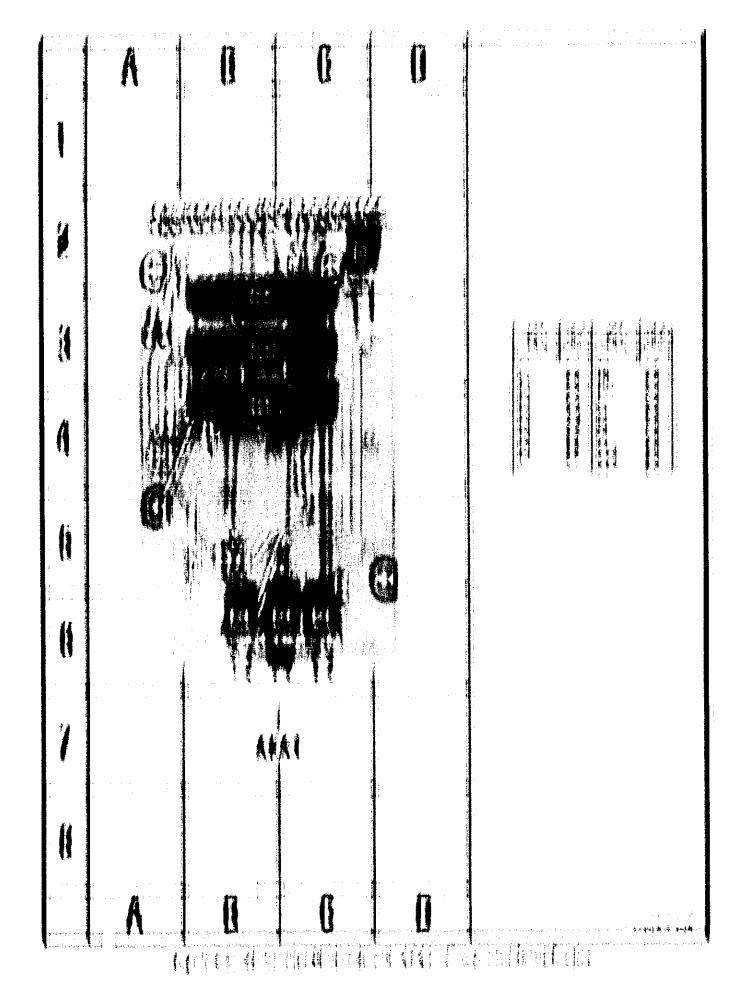
# DO VOLTAGE MEABUREMENT CONDITIONS B. Connect CAL 1 VOLT signal to EXT THIC INPUT. AUTO/NORM ..... AUTO BWP MACILLAND ST. C. All waveforms are referenced to chassis INTEXT..... EXT ground. The monitor oscilloscope's vertical sensitivity tusing a VI probe) and sweep speed settings are shown below in each wave-form photograph. TIMEADIV ..... R mbec TRICKER LEVEL..... Bro'eloek WAVEFORM MEABUREMENT CONDITIONS B. All voltages are referenced to chassis ground. All indications are nominal and may vary AUTO/NORM...... AUTO SINGLE .... engaged SWP MAG..... XI INTEXT..... INT TRIGGER LEVEL.... ew Blope...... • 17098 1.006 עומיט פים אין 10.1 V/DIV 0.9 MB/DIV











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DC VOLTAGE	MEASUREMENT	CONDITIONS

AUTO/NORM	AUTO
INT/EXT	INT
TRIGGER LEVEL	., cw
SINGLE e	ngaged

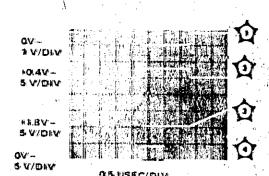
- B. Voltages in () are measured with AUTO/NORM set to NORM and SINGLE disengaged.
- C. All voltages are referenced to chassis ground.
  All indications are nominal and may vary slightly.

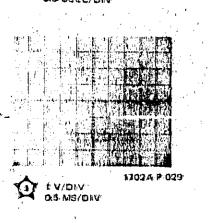
#### **WAVEFORM MEASUREMENT CONDITIONS**

#### A. Set:

AUTO/NORM	NORM
INT/EXT	
slope	2 mSEC

- B. Connect CAL & VOLT to EXT TRIG INPUT.
- C. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.
- D. All waveforms are time related.





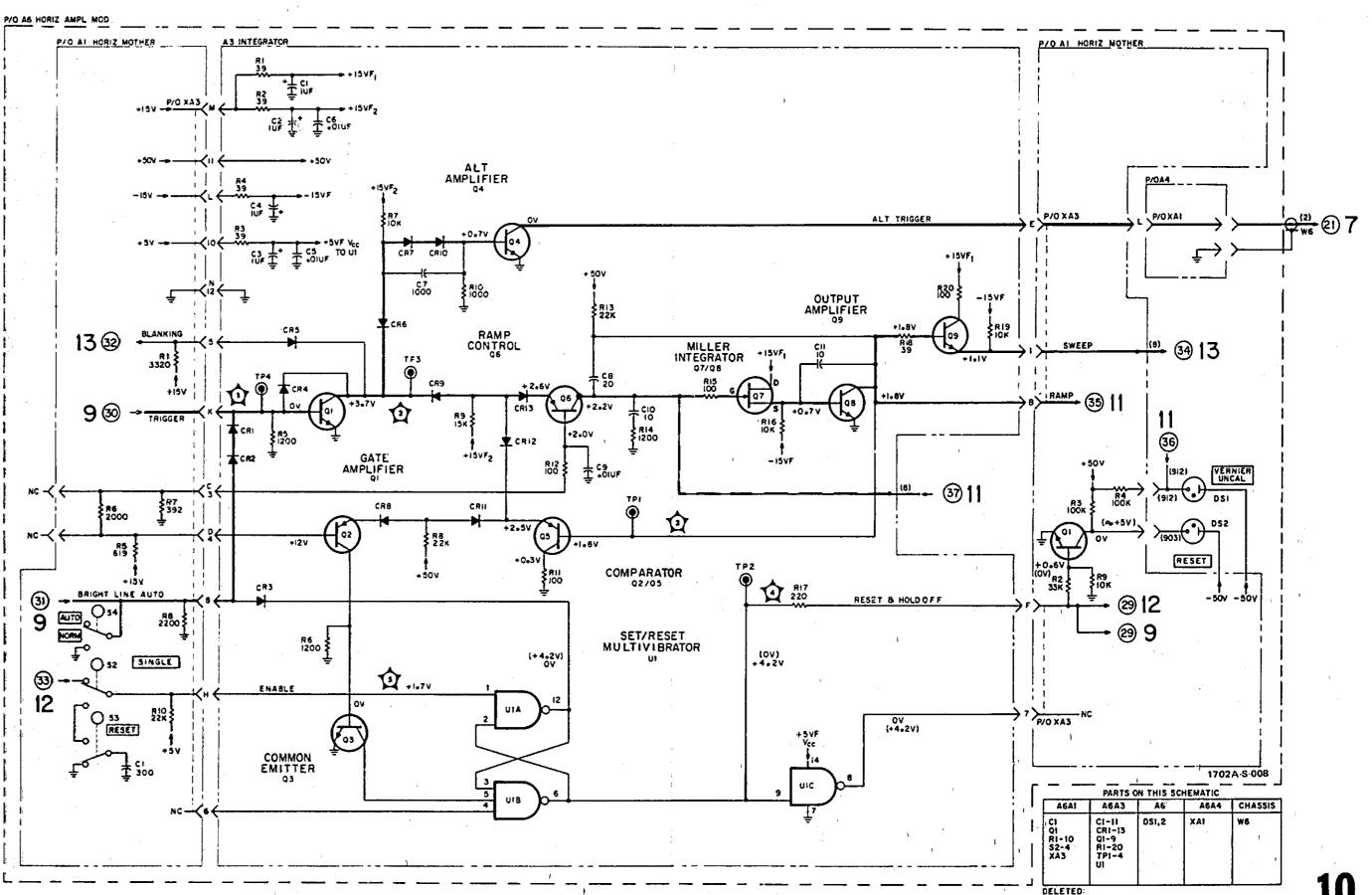


Figure 8-23.
Integrator, A6A3, Schematic

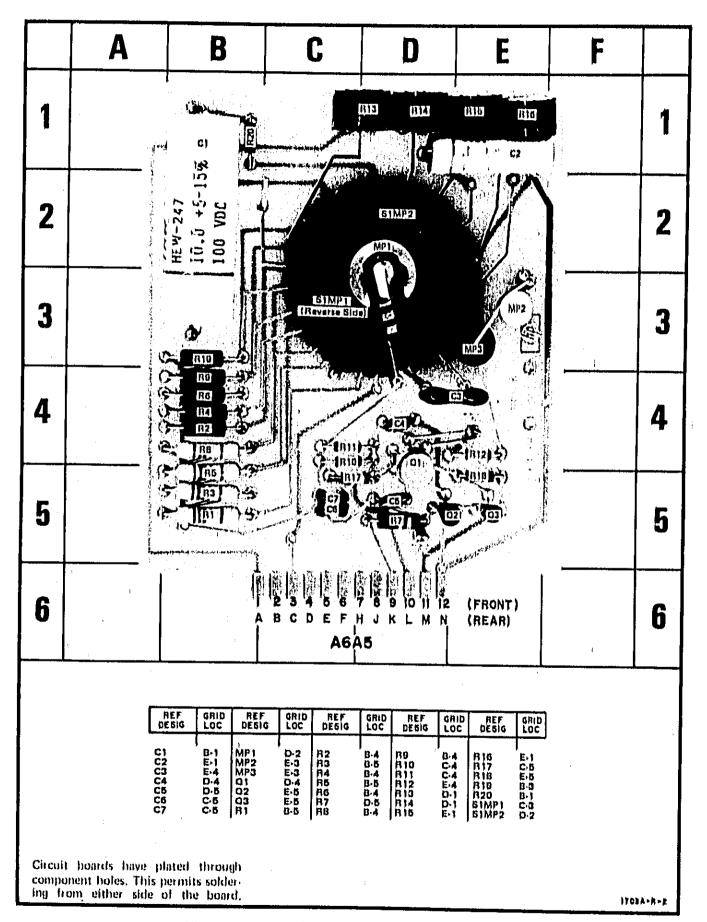
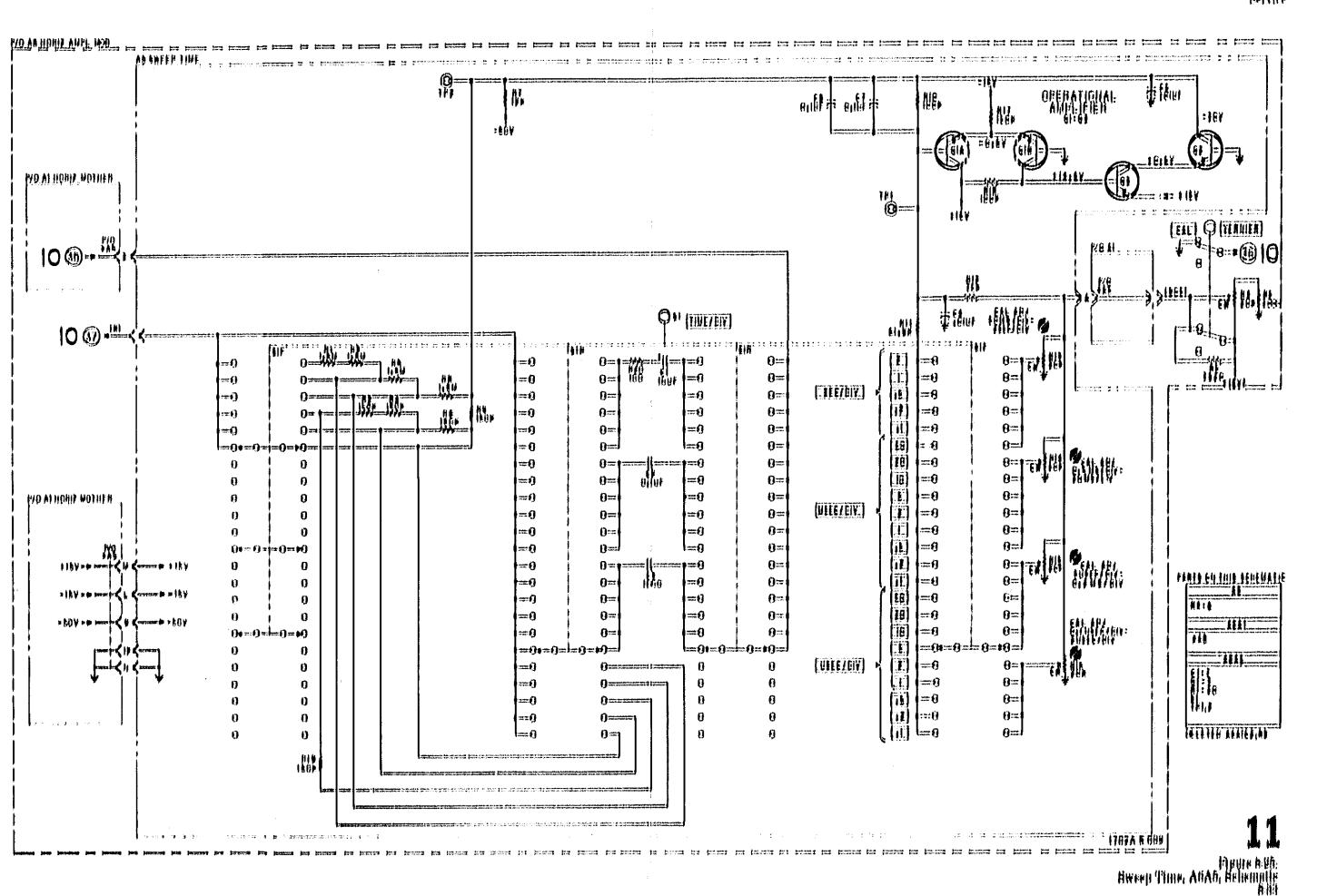


Figure 8-24, Sweep Time, A6A5, Component Identification

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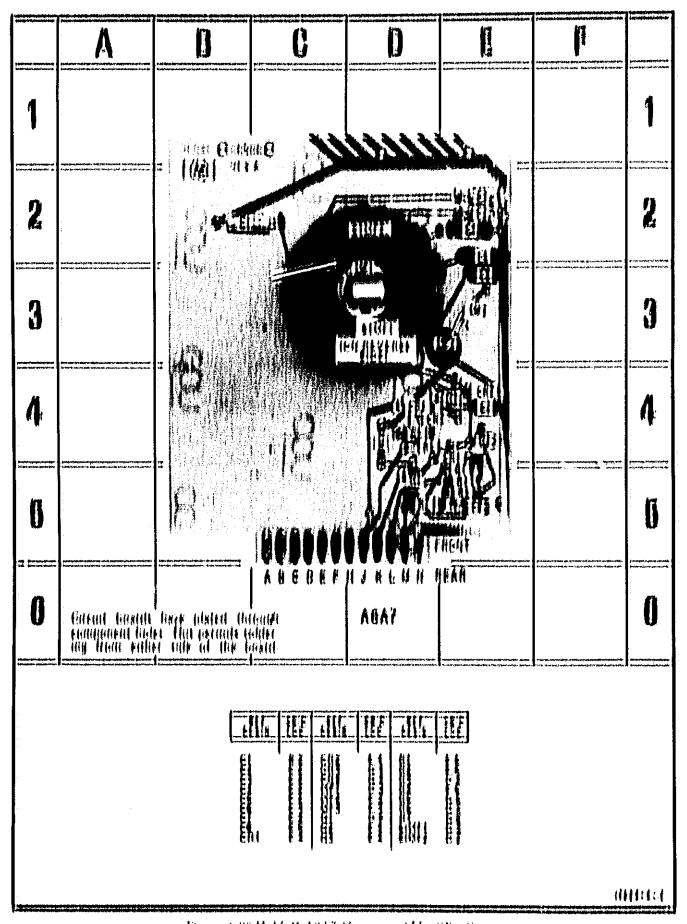
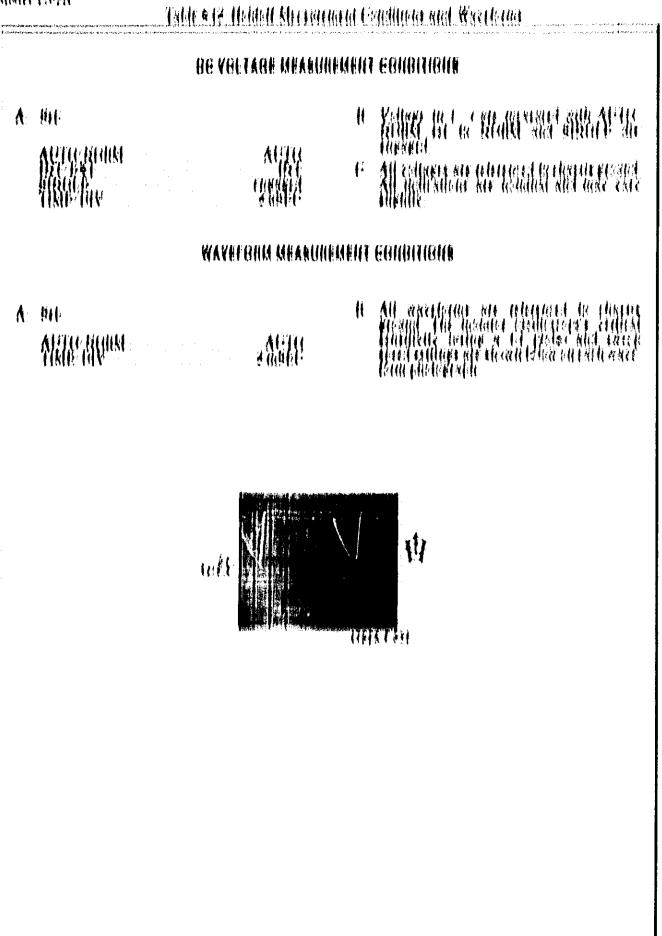
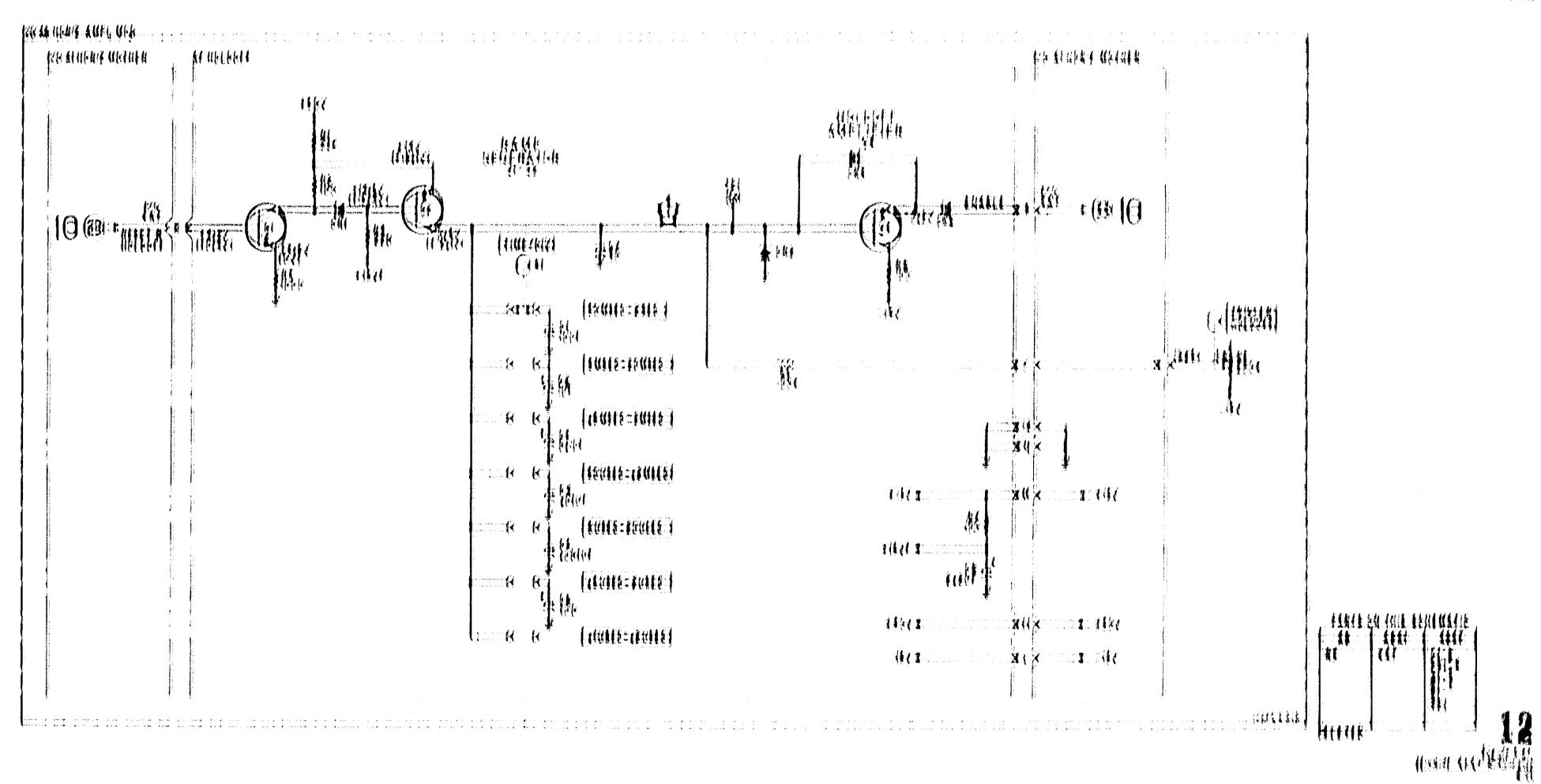


Figure 8 86 Holdoff ABATA Component Identification





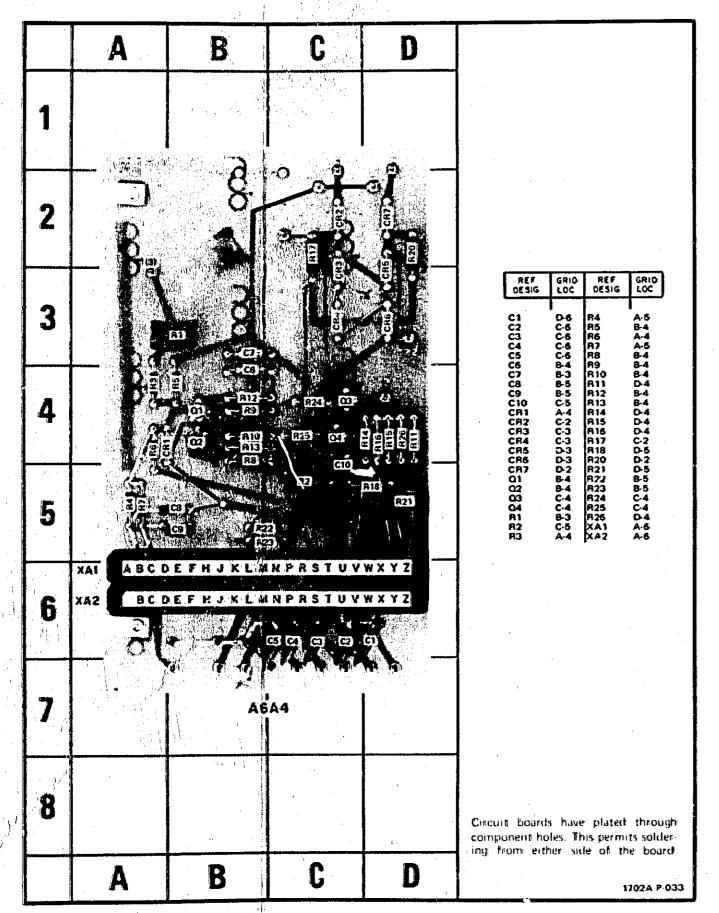


Figure 8-28. Horizontal Preamplifier, A6A4, Component Identification

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Figure 8-29. Horizontal Output Amplifier, A6A6, Component Identification

Service

Model 1702A

Table 8-13. Horiz Preamp and Output Ampl Measurement Conditions and Waveforms

# DC VOLTAGE MEASUREMENT CONDITIONS

A. Set:

AUTO/NORM AUTO
INT/EXT INT
SINGLE engaged
TIME/DIV 2 mSEC
HORIZONTAL POSITION centered

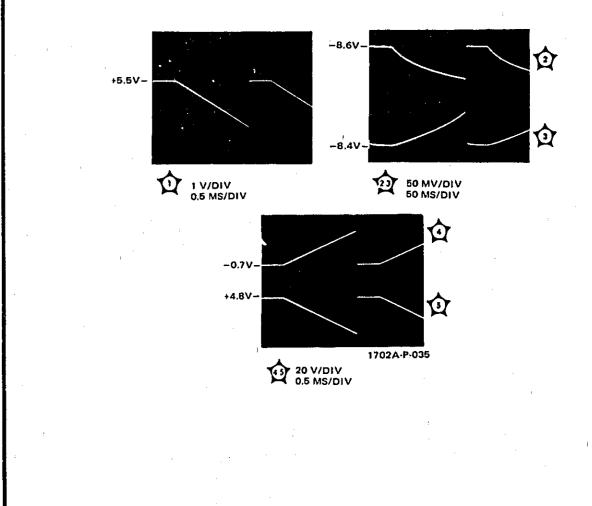
B. All voltages are referenced to chassis ground.
All indications are nominal and may vary slightly.

# WAVEFORM MEASUREMENT CONDITIONS

A. Set:

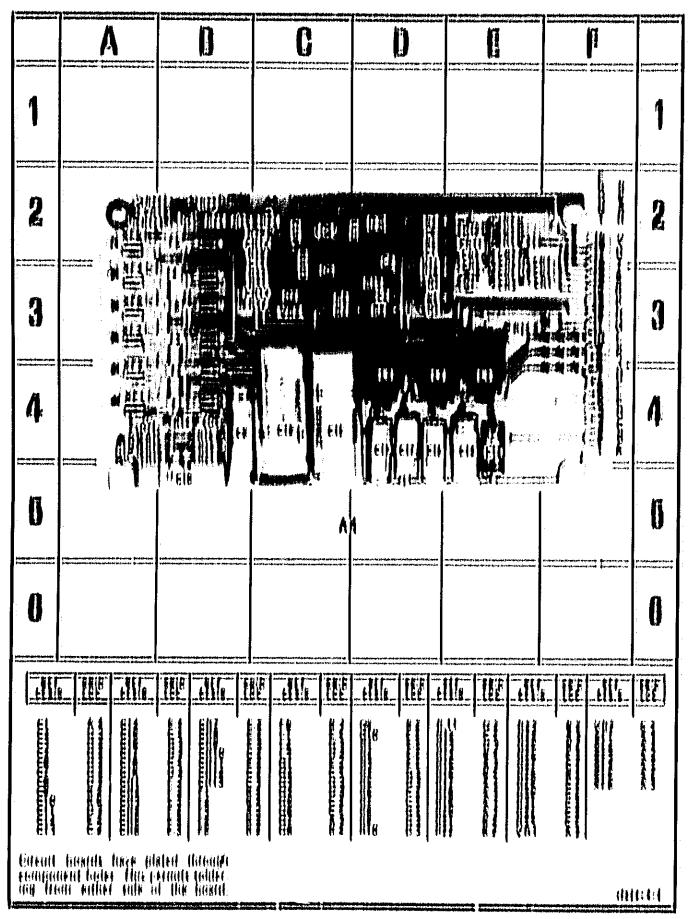
AUTO/NORM AUTO
INT/EXT INT
slope +
TIME/DIV .2 mSEC

B. All waveforms are referenced to chassis ground. The monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below on each waveform photograph.

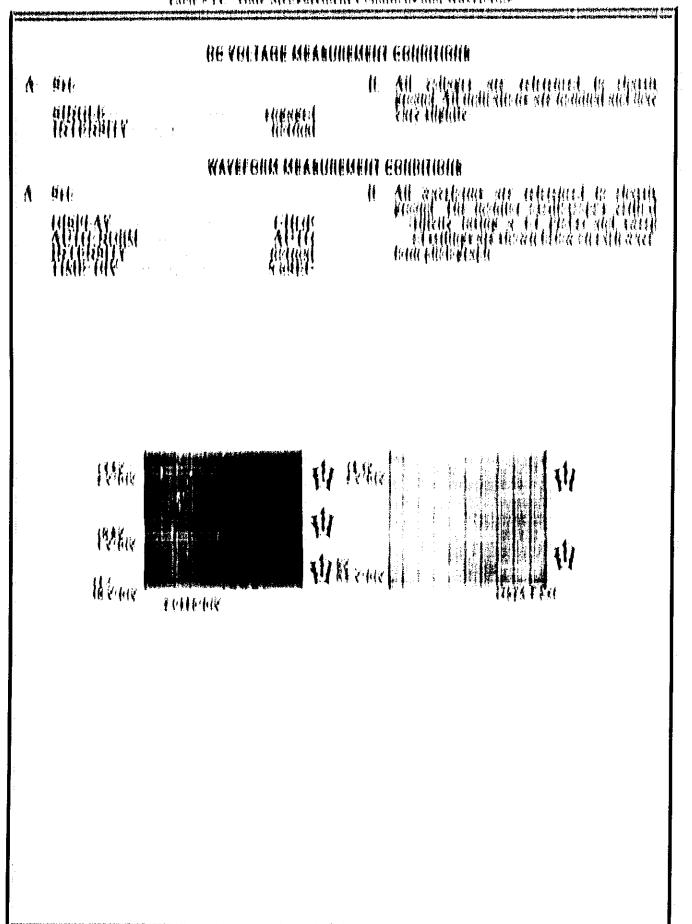


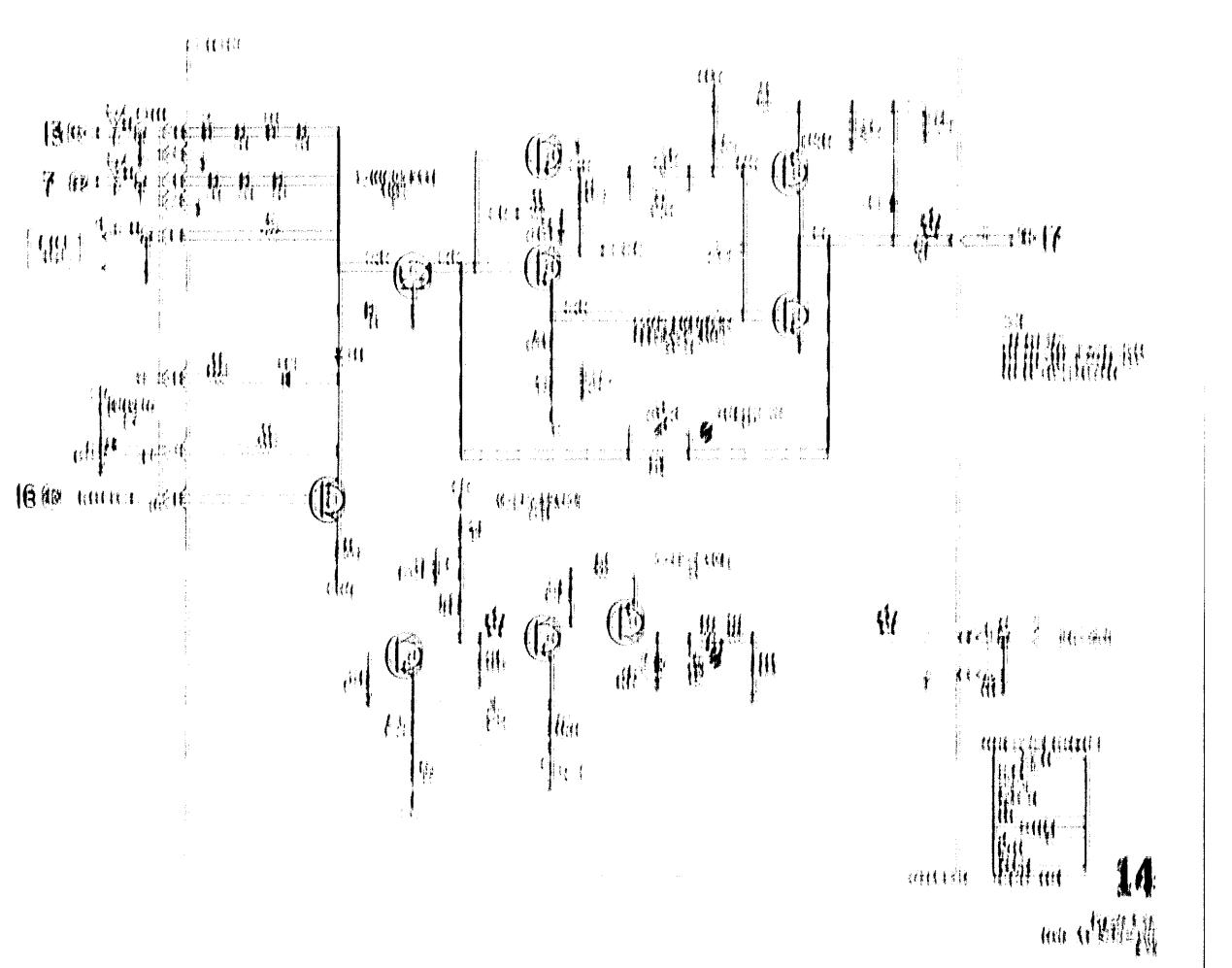
Model 1702A

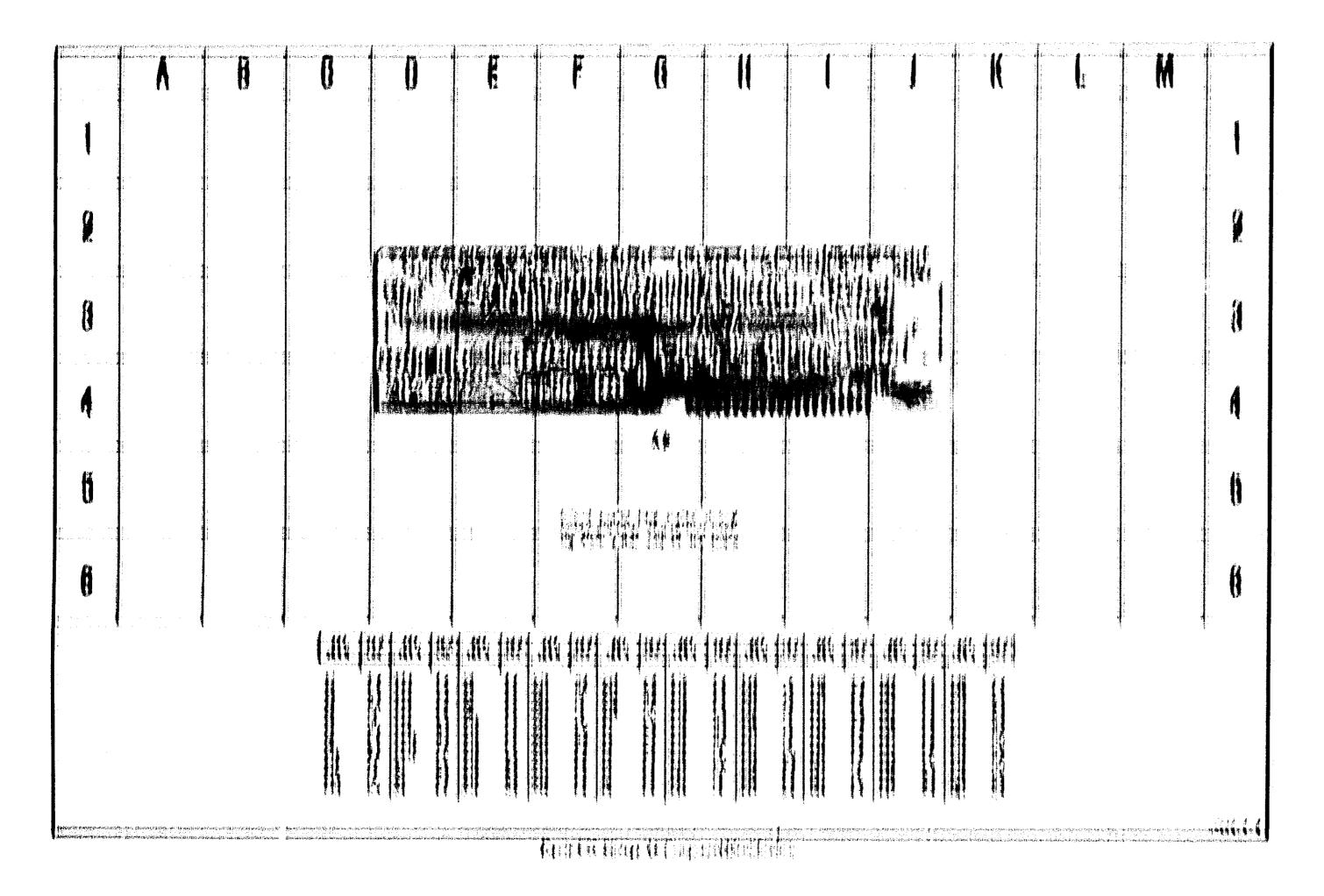
1707A 6 611 13 Page 6 80, Thorizontal Presuplifier, A6A1, and Horizontal Couput Amplifier, A6A6, Beliefield 6-17



Physics 841. Class, A & Component Identification







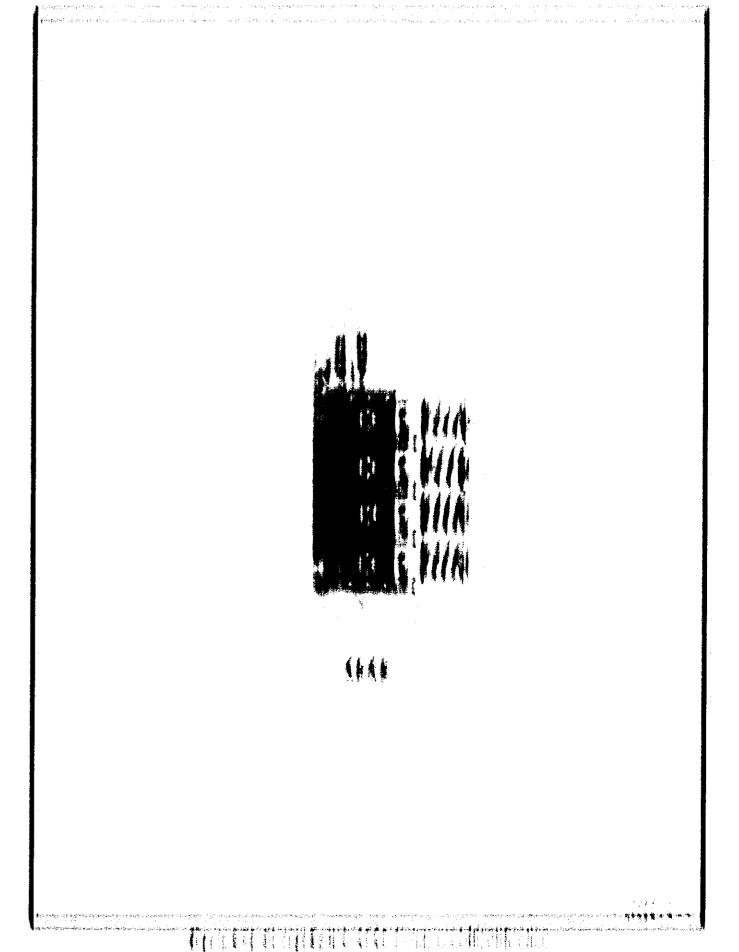


Table 8-15 and 8-16. Storage Circuit Measurement Conditions and Waveforms

WAVEFORM TEST POINT	STD	FAST	CONV	STORE	ERASE
Ċ	#5 <b>0V</b> level	+50V dc level	+50V dc level "		No change from previous mode selected.
				Frequency de- pends on setting of store time pot 87	
	Level depends on setting of Std Erase pot R15	Levell depends on setting of Fast Erase pot R16	–50V dc level	+2.4V dc level	Level depends on setting of Std or Fast Erase pots.
垃					J
	Frequency depen Persistence: pot 8				Occurs in std or Fast mode only, otherwise no change from pre- vious mode selected
<b>1</b>	#21V dc levell approx.	# <b>74V</b> diz levell approx	#21V dc or #74V dc level approx. Depends on whether Std or Fast was used fast.	#21V dc or #74V dc level approx. Depends on whether Std or Fast was used last.	Occurs in Std or Fast Mode only, otherwise no change from previous mode selected.
					Level depends on whether Std or Fast was used last.
垃	-1.4V de leveli	- <b>3.4V</b> dc levell	-1.4V dc level	+0.8V dc ievel	+0.8V dc level in STD or FAST only. Otherwise no change from pre- vious mode selected.

Table 8-15 and 8-16. Storage Circuit Measurement Conditions and Waveforms (Cont'd)

WAVEFORM TEST POINT	STD	FAST	CONV	STORE	ERASE
Ŷ	Frequency depends on PER- SISTENCE setting.	Same as STD mode.	+4.3V dc level	Frequency depends on STORE TIME setting.	No change from mode selected.
<b>Q</b>	+0.8V dc level	+0.8V dc level	+0.8∨ dc level	+0.8V dc level	Occurs in Std or Fast mode only. Otherwise no change from previous mode selected.

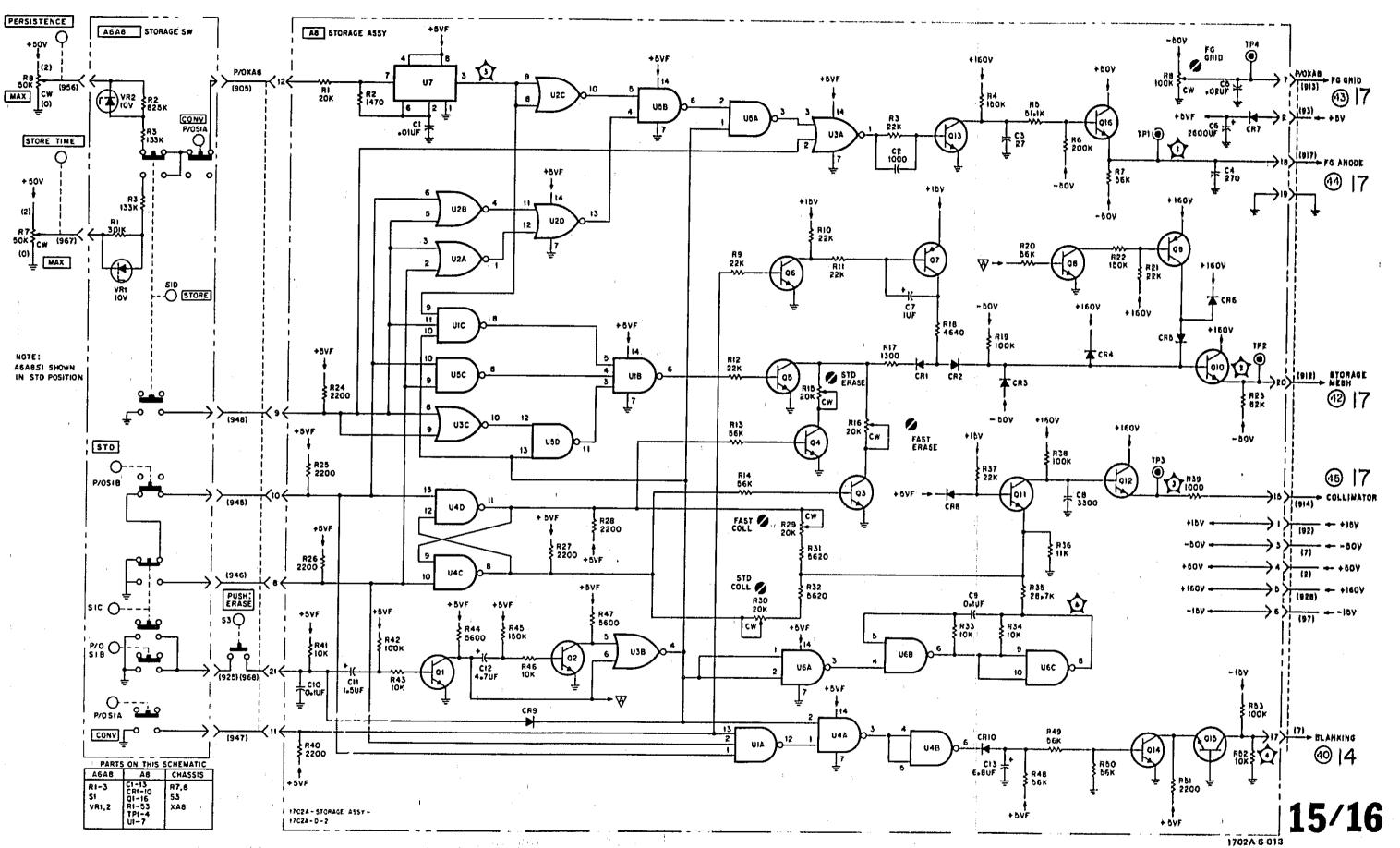


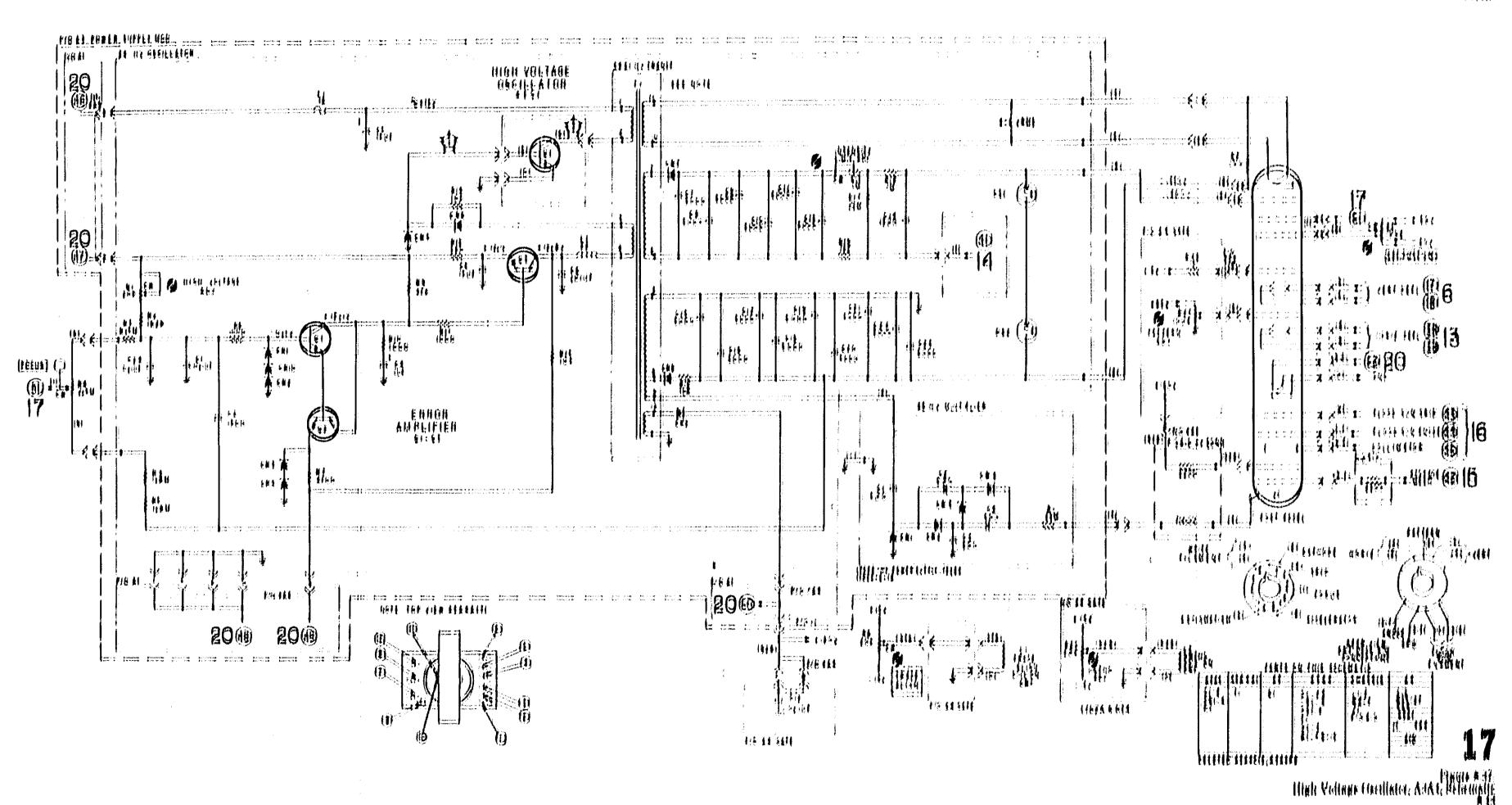
Figure 8-35 Storage Circuit A8 Schematic

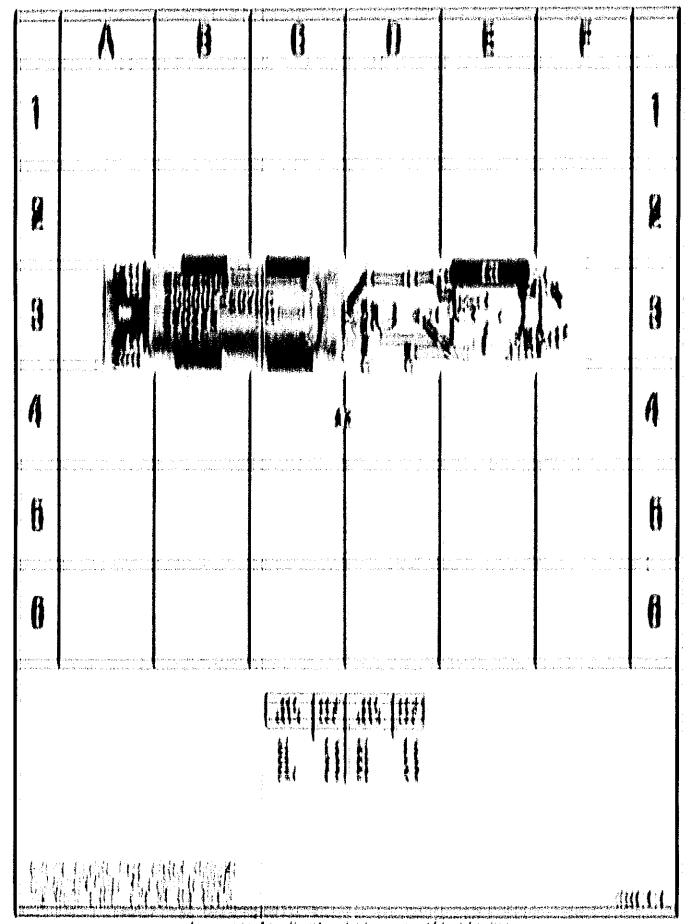
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Figure 8-86, High Voltage Oscillator ABA4, Component Identification

Pable 8-17. High Voltage Oscillator Measurement Conditions and Waveforms

	DO VOLTAGE MEABUREMENT GONDITIONS
٨١	DARBER
۸,	Help His All waveforms are referenced to chassle ground. The monitor oscilloscope's vertical sepsitivity tostage a let probe and sweep special settlings are shown below on each wave form photograph.
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ny (* )	DC VOLTAGE MEASU	GE MEASUREMENT CONDITIONS						
A. Set:  POWER MODE  POWER	AC LINE ON	B. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.						
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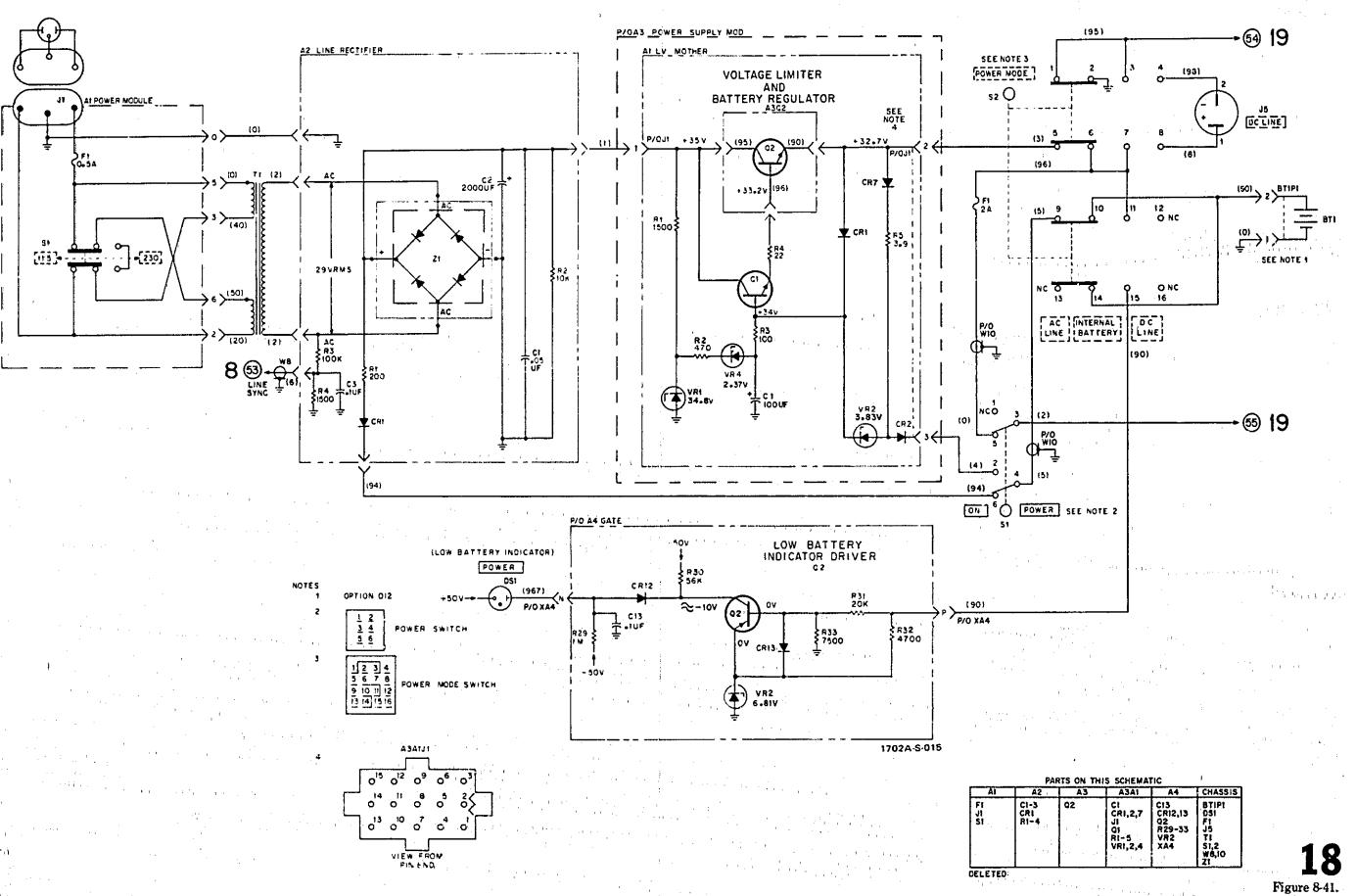


Figure 8-41.
Power Input and Line Rectifier Schematic

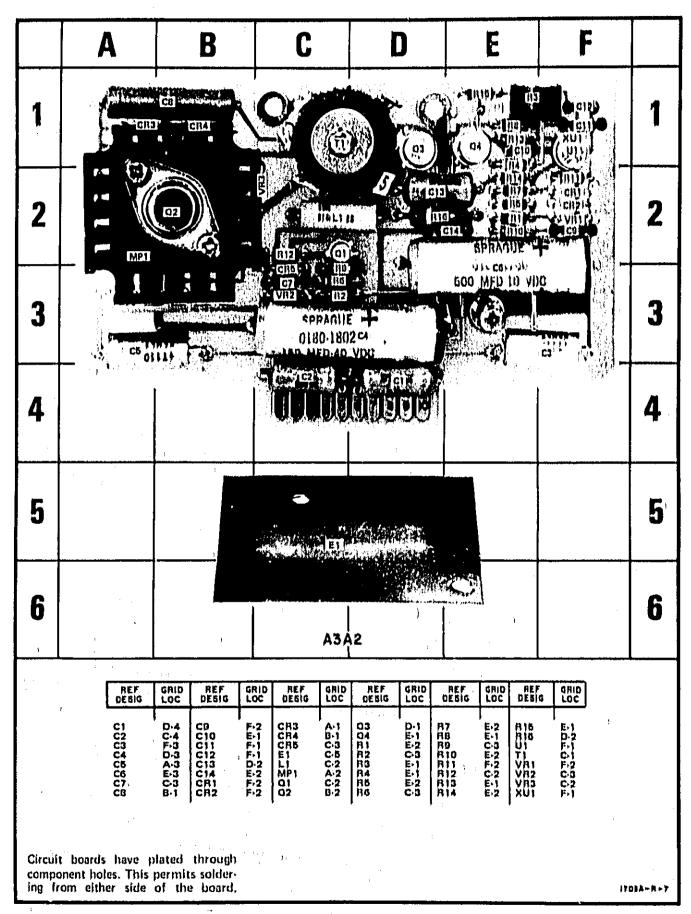
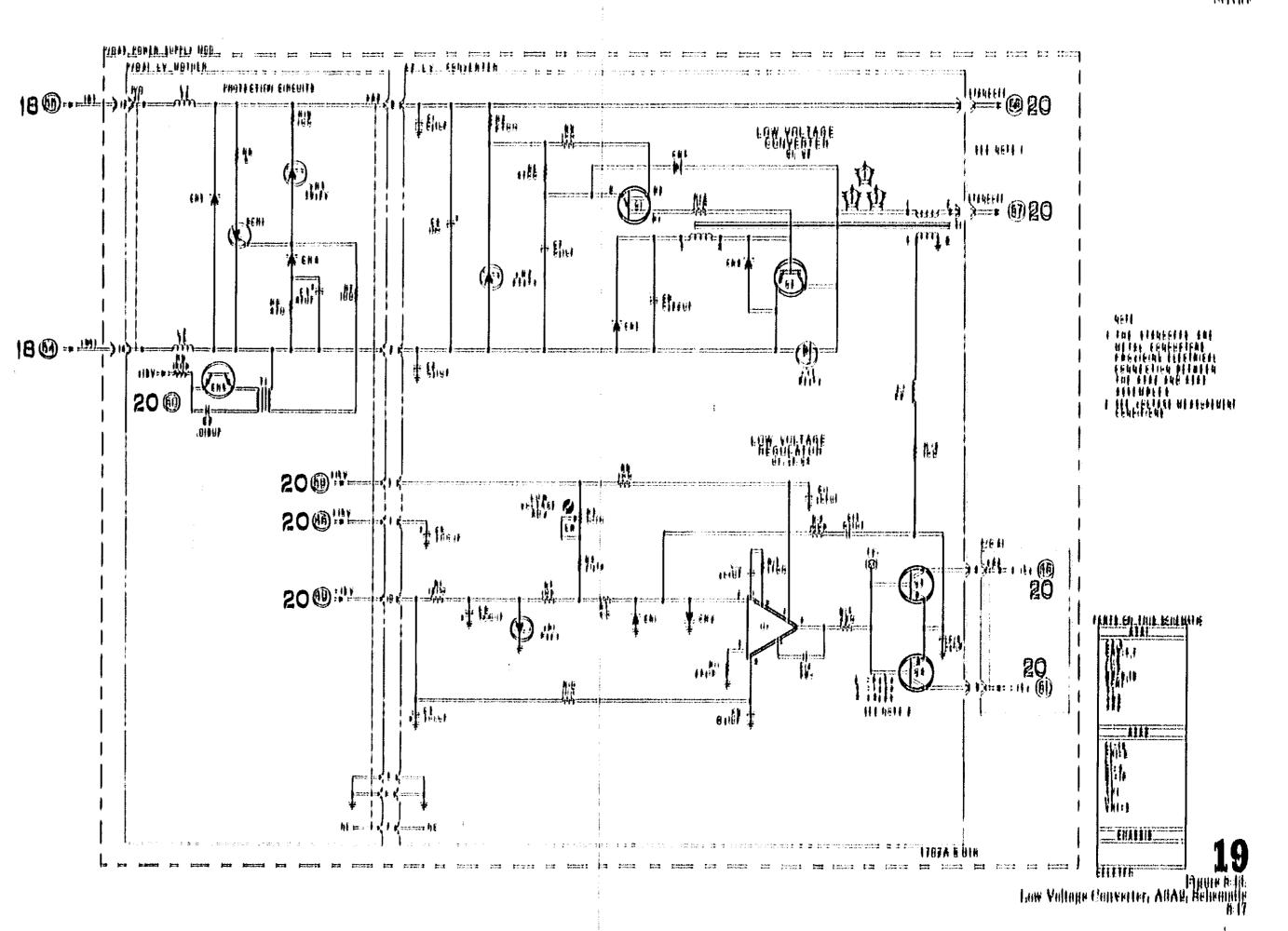


Figure 8-42. Low Voltage Converter, ABA2, Component Identification

Table 8-10. Low Voltage Converter Measurement Conditions and Waveforms

	DO VOLTADE MEABURI	A HA	r ganditions
۸,	Hult	)),	
В,	POWER ON POWER MODE DU LINE Connects		DCLINE 11.5 Vdv Monsurv (I)
	Mensure (1)	E,	All voltages are referenced to chassis ground. All indications are nominal and may vary slightly.
C),	Connecti DC LINE		
	•	an aire	nakiniriakio
۸,	MAVEFORM MEASUREN		Compete Compete
	POWER ON POWER MODE DO LINE	,,,	DC LINE HA Vile
В	Connect: DU LINE 36 Vde		Моннито 🏚
	<b>A</b>	<b>F</b> .	All waveforms are referenced to chassis
Ø,	Monauro 🛈 Connect:	•••	ground. The monitor oscilloscope's vertical sensitivity (using a 1:) probe) and sweep speed settings are shown below on each wave-
,	DC LINE 94 Vde		apoed aettinga nyé ahown bélow on each wavé- form photograph.
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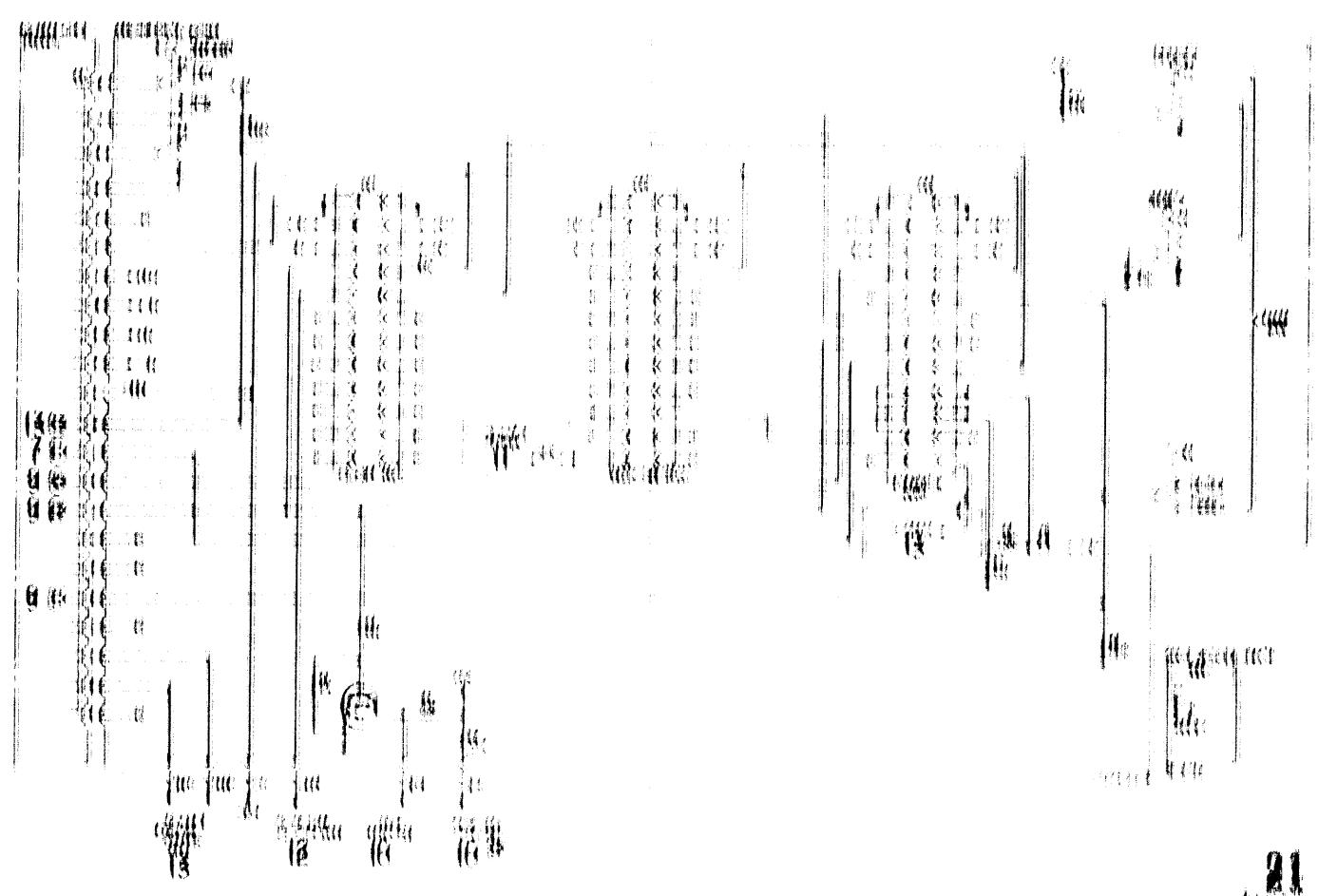


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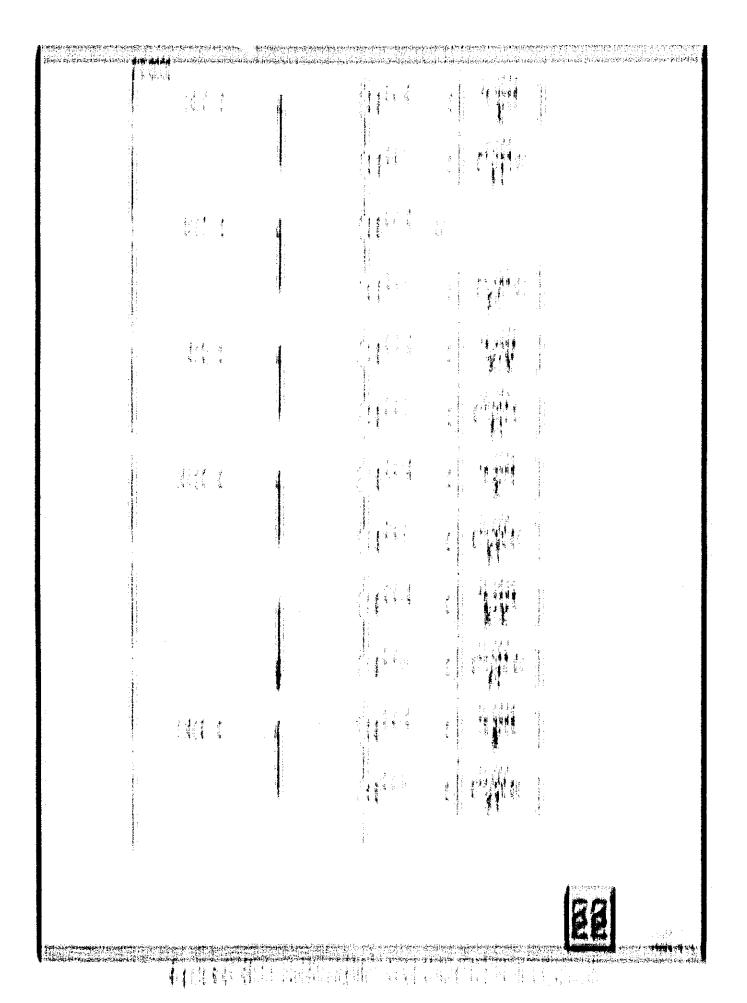
Phone & H. Das Restiller and Piller AdAs, Component Identification

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**MODEL 1702A** 

#### **OSCILLOSCOPE**

Manual Serials Prefixed: 1406A Manual Printed: FEB 1974

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

•	Serial Prefix - Number	Make Changes	Serial Prefix or Number	Make Changes
	1422A	1		,
	1508A	1, 2		
	1520A	1 Thru 3		
	-			

#### **ERRATA**

Page 1-0, figure 1-1,

Replace with figure 1-1 attached to this manual changes sheet.

Page 1-6, table 1-2,

Under ACCESSORIES FURNISHED:

Change 10006B to read 10006D, and delete the dc power plug. The dc power plug is not furnished with the standard Model 1702A instrument but may be ordered separately (HP Part No. 1251-2614).

Page 5-21, paragraph 5-204,

Delete: A5A5C3 from steps d, h, and i.

Page 6-0, figure 6-1,

Replace the corresponding parts of figure 6-1 with the parts illustrated in figure 1 of this manual changes sheet.

Table 6-2.

A5A6 (page 6-2): Add Mfr Code 28480.
Δ Add: DS1, HP Part No. 1450-0709, LIGHTIND NEON WHT TP LENS, Mfr Code 72765,
Mfr Part No. 6140-000-603.

MP23: Delete Mfr Code and Mfr Part No. MP32: Change to HP Part No. 01703-23701, FAIL:SIDE, Mfr Code 28480, Mfr Part No. 01703-23701.

MP34: Change to HP Part No. 01701-64101, COVER ASSY: RAIL FRONT, Mfr Code 28480, Mfr Part No. 01701-64101.

MP35; Change to HP Part No. 0050-1757, GEAR: SUPPORT, Mfr Code 28480, Mfr Part No. 0050-1757.

Table 6-2 (Cont'd).

MP36: Change to HP Part No. 01701-25002, HANDLE:ARM LEFT, Mfr Code 28480, Mfr Part No. 01701-25002.

Add: MP36H1, HP Part No. 01701-23707, SHAFT: PAWL, Mfr Code 28480, Mfr Part No. 01701-23707.

MP37: Change to HP Part No. 01701-25001, HANDLE:ARM RIGHT, Mfr Code 28480, Mfr Part No. 01701-25001.

MP38: Change to HP Part No. 01701-64901, HANDLE ASSY, Mfr Code 28480, Mfr Part No. 01701-64901.

MP40: Change to HP Part No. 7120-3042, NAME-PLATE: HANDLE, Mfr Code 28480, Mfr Part No. 7120-3042.

Add: MP41, HP Part No. 01701-07201, INSERT: HANDLE FRONT, Mfr Code 28480, Mfr Part No. 01701-07201.

MP42: Change to HP Part No. 01701-07202, INSERT: HANDLE REAR, Mfr Code 28480, Mfr Part No. 01701-07202.

MP43: Change to HP Part No. 01701-27401, BUTTON, Mfr Code 28480, Mfr Part No. 01701-27401.

MP45: Change to HP Part No. 0510-0091, RING:RETAINING STL EXTERNAL, Mfr Code 79136, Mfr Part No. 5103-25-SMD.

MP46: Change to HP Part No. 3050-0253, WASHER: SPRING, Mfr Code 28480, Mfr Part No. 3050-0253.

MP47 Change to HP Part No. 0510-0956, RING: RETAINING 0.188 IN. SHAFT, Mfr Code 79136, Mfr Part No. 5133-18-MD.

19 May 1975

 $\Delta$  = Latest additions to this change sheet.

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

Supplement A for 01702-90904

#### ERRATA (Cont'd)

Table 6-2 (Cont'd),

MP48: Change to HP Part No. 0050-1758, PAWL, Mfr Code 28480, Mfr Part No. 0050-1758.

MP49: Change to HP Part No. 2190-0924, WASHER: WAVE SPRING, Mfr Code 28480, Mfr Part No. 2190-0924.

MP50: Change to HP Part No. 0050-1756, GEAR: HANDLE, Mfr Code 28480, Mfr Part No. 0050-1756.

MP51: Change to HP Part No. 1460-0295, SPRING: COMPRESSION, Mfr Code 00000, Mfr Part No. OBD.

MP57: Change HP Part No. and Mfr Part No. to 1500-0364.

R4: Change to HP Part No. 2100-0583, R: VAR COMP 2.5 MEGOHM 10% LIN 1/2W, Mfr Code 21697, Mfr Part No. 382VX.

S1: Change HP Part No. to 3101-0940.

S2: Change Description to read, SWITCH: PART OF REAR PANEL (SEE MP42 PWR MODE).

W1: Change HP Part No. and Mfr Part No. to 01703-61615.

W7 (01701-61620): Delete.

W8 (01702-61602): Change reference designator to W13.

W12: Change HP Part No. and Mfr Part No. to 01703-61611.

A1MP1: Change HP Part No. to 5000-5085. A3Q1: Change to HP Part No. 1854-0609,

TRANSISTOR: NPN SI PD = 83.5W FT = 4MHZ, Mfr Code 04713, Mfr Part No. SJE974.

Add: A3W1, HP Part No. 5060-0585, CABLE: Q1 CONNECTOR, Mfr Code 28480, Mfr Part No. 5060-0585.

Δ A3A1R7: Change to HP Part No. 0757-0908, R:FXD MET FLM 220 OHM 2.6 1/8W, Mfr Code 28480, Mfr Part No. 0757-0908.

Δ A3A1R19: Change to HP Part No. 0683-2705, R:FXD COMP 27 OHM 5% 1/4W, Mfr Code 01121, Mfr Part No. CB2705.

Add: A3A2MP1, HP Part No. 1205-0227, HEAT DISSIPATOR: SEMICONDUCTOR, Mfr Code 28480, Mfr Part No. 1205-0227.

Add: A3A4A1, HP Part No. 01703-61104, TRANS-FORMER ASSY: HIGH VOLTAGE, Mfr Code 28480, Mfr Part No. 01703-61104.

A3A4C7 through A3A4C12: Change to HP Part No. 0160-3801, C:FXD CER 5000 PF 20% 3K VDCW, Mfr Code 56289, Mfr Part No. 44C148A1,

A3A4C15 through A3A4C23: Change to HP Part No. 0160-3801, C:FXD CER 5000 PF 20% 3K VDCW, Mfr Code 56289, Mfr Part No. 44C148A1.

A3A4CR9: Change to HP Part No. 1901-0669, DIODE:SILICON 200-1A, Mfr Code 28480, Mfr Part No. 1901-0669. Table 6-2 (Cont'd),

A3A4R15: Change to HP Part No. 2100-3359, R:VAR CERMET 2 MEGOHM 20% TYPE V 1/2W, Mfr Code 73138, Mfr Part No. 72XR2M.

Delete: A3A4T1.

A3A5: Change to HP Part No. 01703-61103, ASSY:HIGH VOLTAGE MULTIPLIER, Mfr Code 28480, Mfr Part No. 01703-61103.

A4Q1: Change to HP Part No. 1854-0215, TQ1, TSTR:SI NPN, Mfr Code 80131, Mfr Part No. 2N3904.

A5A1C7: Change to HP Part No. 0121-0407, C:VAR TRIMMER 0.7-3.0 PF, Mfr Code 72982, Mfr Part No. 536-016.

A5A1C8: Change to HP Part No. 0121-0407, C:VAR TRIMMER 0,7-3.0 PF, Mfr Code 72982, Mfr Part No. 536-016.

A5A1C17: Change to HP Part No. 0121-0407, C:VAR TRIMMER 0,7-3.0 PF, Mfr Code 72982, Mfr Part No. 536-016.

A5A1C18: Change to HP Part No. 0121-0407, C:VAR TRIMMER 0.7-3.0 PF, Mfr Code 72982, Mfr Part No. 536-016.

Add: A5A4L1, HP Part No. 01701-66541, COIL: FXD 10 UH, Mfr Code 28480, Mfr Part No. 01701-66541.

A5A4R95: Change to HP Part No. 0684-1231, R:FXD COMP 12K OHM 10% 1/4W, Mir Code 01121, Mir Part No. CB 1231.

A5A4R97: Change to HP Part No. 0684-1831, R:FXD COMP 18K OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB 1831.

Delete: A5A5C3.

Δ A5A5Q1: Change HP Part No. and Mfr Part No. to 1853-0203.

Δ A5A5Q2: Change HP Part No. and Mfr Part No. to 1853-0203.

Δ A5A5Q3: Change HP Part No. and Mfr Part No. to 1853-0015.

Δ A5A5Q4: Change HP Part No. and Mfr Part No. to 1853-0015. A5A6: Change HP Part No. and Mfr Part No. to

01707-66503 (affects pages 6-2 and 6-12). A5A6C4: Change Mfr Part No. to 8131-050-651-104Z.

A5A6Q1: Change Mfr Part No. to 1855-0085.

A5A6Q2: Change Mfr Part No. to 1855-0085.

A5A6Q3: Change Mfr Part No. to 2N3906.

A5A6Q4: Change Mfr Part No. to 2N3904.

A5A6R1: Change Mfr Part No. to CB2211.

A5A6R2: Change to HP Part No. 0684-2711, R:FXD COMP 270 OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. C82711.

A5A6R3: Change Mir Part No. to CB1021.

A5A6R4: Change Mfr Part No. to 0757-0438.

A5A6R5: Change Mfr Part No. to 0757-0454.

A5A6R6: Change to HP Part No. 0757-0444,

R:FXD MET FLM 12.1K OHM 1% 1/8W, Mfr Code 28480, Mfr Part No. 0757-0444.

#### ERRATA (Cont'd)

Table 6-2 (Cont'd),

A5A6R7: Change Mfr Part No. to CB2231,

A5A6R8: Change to HP Part No. 0757-0444,

R:FXD MET FLM 12,1K OHM 1% 1/8W, Mir Code 28480, Mir Part No. 0757-0444.

A6A6R9: Change Mir Part No. to CB1541.

A5A6R10: Change Mfr Part No. to CB5621,

A5A6R11: Change Mfr Part No, to CB5621,

A5A6R12: Change to HP Part No. 0684-1011, R:FXD COMP 100 OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB1011.

A5A6R13: Change Mfr Part No, to 2100-2026.

A5A6R14: Change to HP Part No. 0757-0416,

R:FXD MET FLM 611 OHM 1% 1/8W, Mfr Code 28480, Mfr Part No. 0757-0416.

A5A6R15: Change Mfr Part No. to CB3901.

Add: A5A6R16, HP Part No. 0684-6831, R:FXD COMP 68K OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB6831.

Add: A5A6R17, HP Part No. 2100-2031, RtVAR 50K OHM 10% LIN 1/2W, Mir Code 28480, Mir Part No. 2100-2031.

A5A6U1: Change Mfr Part No. to 1820-0216. Add: A5A6VR1, HP Part No. 1902-3171, DIODE: BREAKDOWN 11.0V 5%, Mfr Code 28480, Mfr

Part No. 1902-3171.

Add: A5A6VR2, HP Part No. 1902-3171, DIODE: BREAKDOWN 11.0V 5%, Mfr Code 28480, Mfr Part No. 1902-3171.

A6 (Page 6-12): Change HP Part No. to 01702-65804. A6A1S2: Change to HP Part No. 3101-1397, SWITCH:PUSHBUTTON 2-POLE 3-STATION, MIr Code 28480, Mfr Part No. 3101-1397.

A6A2R34: Change to HP Part No. 06B4-3341, R:FXD COMP 330K OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB3341.

Δ Add: A6A3CR14, HP Part No. 1901-0040, D10DE: SILICON 30MA 30WV, Mfr Code 07263, Mfr Part No. FDG 1088.

A6A6 (page 6-2 only): Change HP Part No. and Mfr Part No. to 01703-66510.

A6A6C2: Change to HP Part No. 0160-3670, C:FXD CER 0.1 UF 20% 200VDCW, Mir Code 72982, Mfr Part No. 8131-M200-651-104M.

A6A6C7: Change to HP Part No. 0160-3665, C:FXD CER 0.01 UF +80-20% 500VDCW, Mfr Code 56289, Mfr Part No. C023A501J103ZS25-CDH.

A6A6C8; Change to HP Part No. 0160-3665, C:FXD CER 0.01 UF +80-20% 500VDCW, Mfr Code 56289, Mfr Part No. C023A501J103ZS25-CDH.

A6A6C9: Change to HP Part No. 0160-3670, C:FXD CER 0.1 UF 20% 200VDCW, Mfr Code 72982, Mfr Part No. 8131-M200-661-104M.

A6A6C10: Change to HP Part No. 0160-0370, C:FXD CER 0.1 UF 20% 200VDCW, Mfr Code 72982, Mfr Part No. 8131-M200-661-104M.

Schematic 3,

ABA1G7: Change value to 0,7-3,0,

A6A1CB: Change value to 0,7-3,0,

A5A1G17: Change value to 0,7-3,0,

A6A1G18: Change value to 0,7-3,0,

A5A2C7: Change value to 0,7-3.0,

A5A2C8: Change value to 0,7-3,0,

A5A2C17: Change value to 0.7-3.0.

A5A2C18: Change value to 0.7-3.0.

Page 8-18, figure 8-12,

Replace with figure 8-17 supplied with this manual changes sheet.

Page 8-20,

Add: Figure B-13A supplied with this manual changes sheet.

Schematic 5,

A5R21: Change reference designator to A5R20 and value to 909.

A5R22: Change reference designator to A5R21 and value to 909.

WB: Change reference designator to W13,

Schematic 6.

Delete: A5A5C3.

Schematic 7.

Add: AbA4L1 (10 UH) between junction of A5A4CR15/A5A4R105 and cable W4.

A5A4R95: Change value to 12K.

A5A4R97: Change value to 18K.

Δ Schematic 10,

A6A3O6: Change collector voltage to read -1,2V, Add: A6A3CR14 in signal path between A6A3CR2 and junction of A6A3CR3/pin B, Connect cathode to A6A3CR2,

Schematic 13.

AGAGRIG: Show applied power of +BOVF.

AGAGR 14: Show applied power of +BOVF.

W8: Delete reference designator,

A6A6C2: Change value to 0.1 UF,

A6A6C9: Change value to 0,1 UF,

A6A6C10: Change value to 0,1 UF,

Page 8-40, figure 8-33,

Replace with figure 8-33 included with this manual changes sheet,

Schematic 15/16,

Wire color (956) to P/O AGAB: Change to wire color (967).

Wire color (967) to P/O AGAB: Change to wire color (956).

Delete: AGABR3 connected from AGABS1A to junction of AGABR1/AGABVR1. Replace with straight wire connection.

Schematic 17,

A3A4R15: Change value to 2M.

Schematic 18,

Delete: Wire color (0) from ground pin of A1J1. Add: Wire color (45) from ground pin of A1J1 to chassis ground.

# ERRATA (Cont'd)

#### A Schematic 10,

ABA1: Replace this portion of the schematic with figure 2 supplied with this manual changes sheet.

Page B-40, figure 0-44, MP2: Relocate post to 1-1, Delate: MP3.

# CHANGE 1

#### Table 6-2

A3A5: Change HP Part No. and Mfr Part No. to 01703-61106.

Schematic 17,
ADABITE Change value to 0.6M,
Addi: ABABITE (22M) between ABABITE and
junction of ABABCR4/ABABCA,
Add: ABABCB (800 PF) between junction of
ABABR1/ABABR2 and ground.

# A CHANGE 2

#### Table 6-2,

MPA3: Change HP Part No. and Mfr Part No. to 6001-1060.

W12: Change HP Part No. and Mir Part No. to 01703-61013.

#### Schumatic 18,

52: Disconnect wire from pin 14 to junction pin 10 and BT1P1. Connect wire color (2) from pin 14 to 51, pin 3.

#### A CHANGE 3

#### Page 1-6, table 1-2,

Under ACCESSORIES FURNISHED, Changer
Model 10101B to read Accessory Pouch (HP
Part No. 5040-0202),

Page 6-0, figure 6-1,

Delete: MP1B designator associated with MP22.
Knob is part of MP22.

Table 6-2,

MP22: Change HP Part No. and Mfr Part No. to 01700-67405.

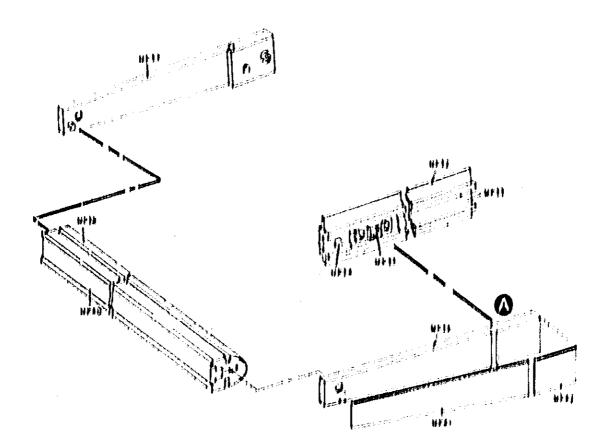
Table 6-2 (Contbl).

MP34: Change HP Part No, and Mtr Part No, to 01707-04102,

MP64: Change HP Part No. and Mtr Part No. to 01703-04106.

Addi MP60, HP Part No. 5040-0516, COVEH: PANEL FRONT, Mir Code 28480, Mir Part No. 5040-0516.

Add: MP70, HP Part No. 1640-0202, POUGH: ACCESSORY, Mir Code 28400, Mir Part No. 1640-0202.



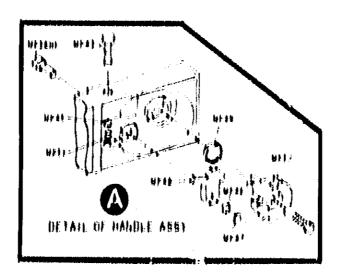


Figure 1. Exploded View Changes

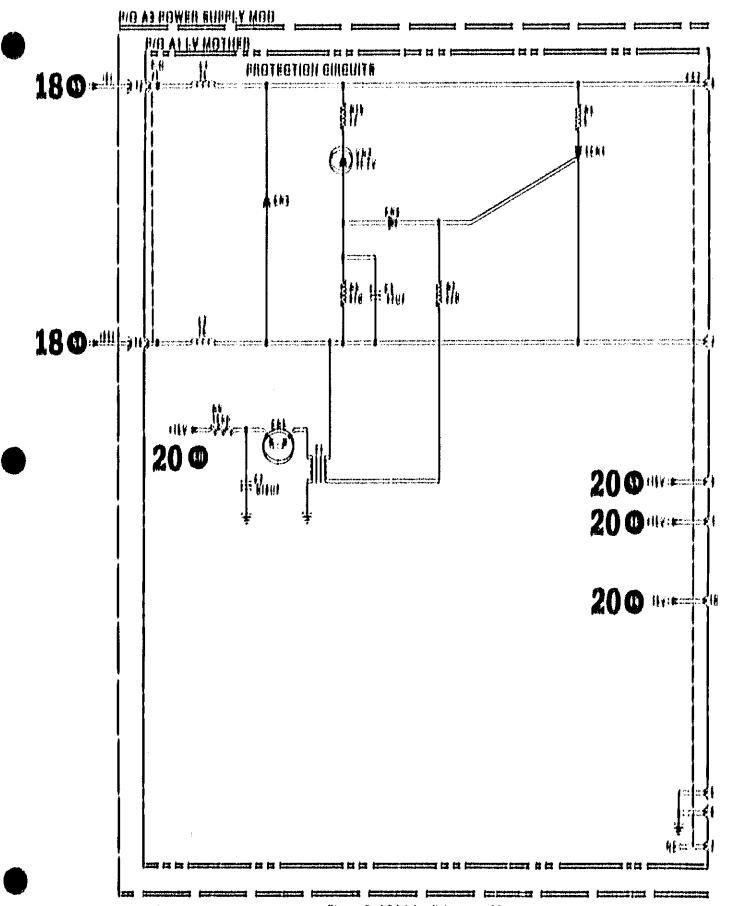


Figure 9: A8A1 for Behamatic 10

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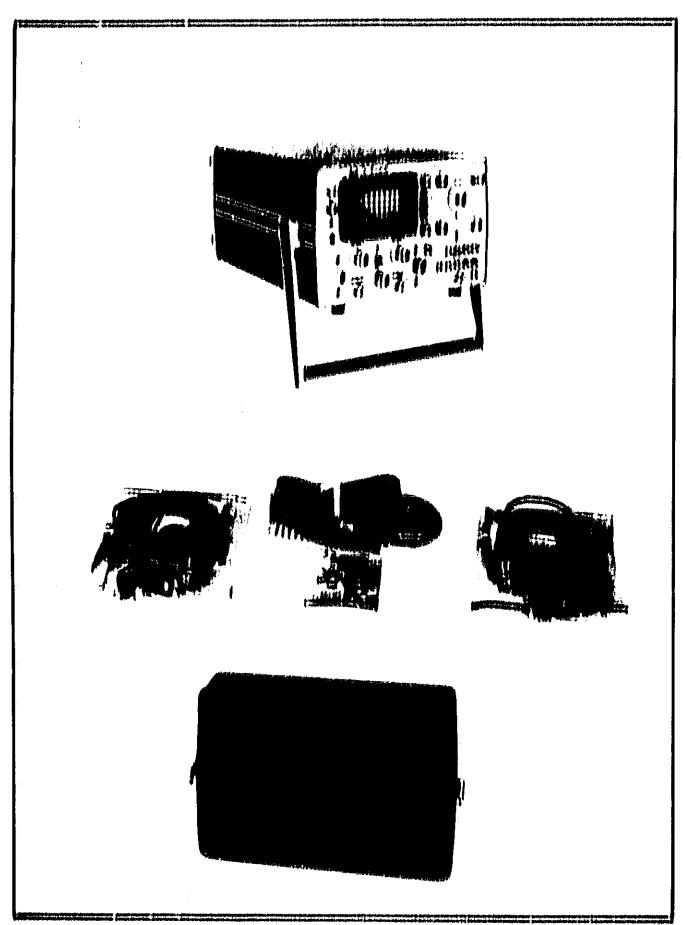
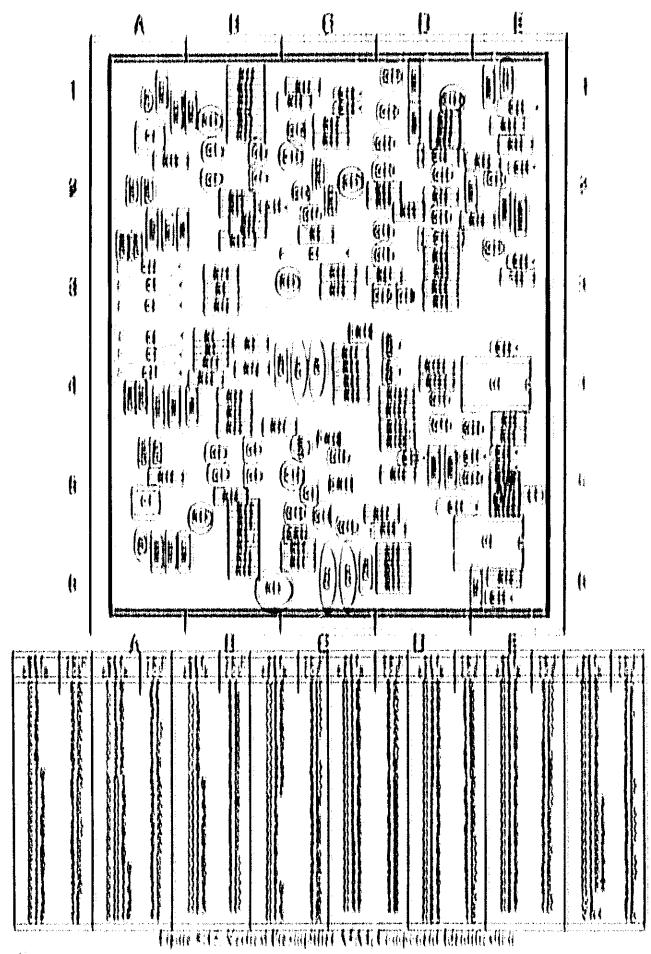
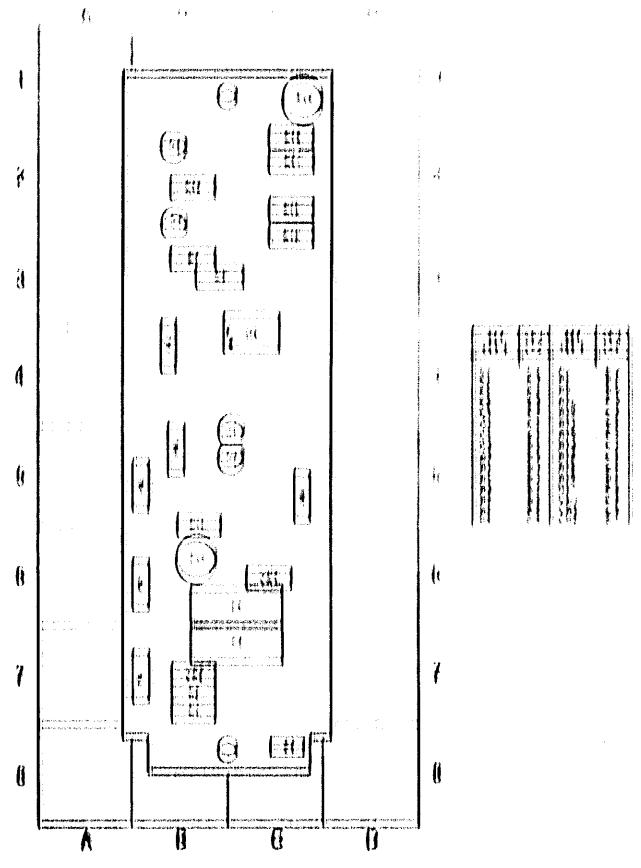


figure 1.1. Model tiloga and Accessories





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