Errata

Title & Document Type: **1809A Four Channel Vertical Amplifier Operating and Service Manual**

Manual Part Number: **01809-90903**

Revision Date: **January 1977**

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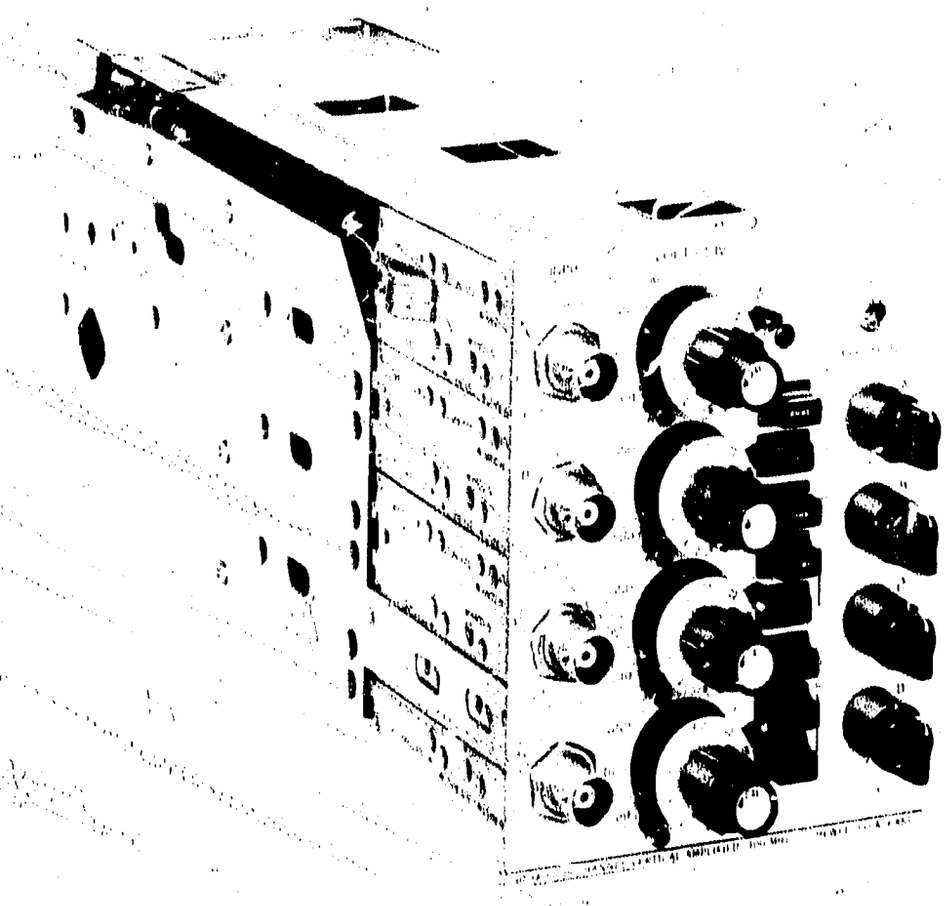
OPERATING AND SERVICE MANUAL

1809A
FOUR CHANNEL VERTICAL AMPLIFIER



HEWLETT hp PACKARD

HP 1809A

CERTIFICATION

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

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANT-ABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

Service contracts or customer assistance agreements are available for Hewlett-Packard products.

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

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OPERATING AND SERVICE MANUAL

MODEL 1809A
FOUR CHANNEL
VERTICAL AMPLIFIER

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **1424A.**

For additional information about serial numbers, see INSTRUMENT AND MANUAL IDENTIFICATION in Section I.

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

Manual Part Number 01809-90903
Microfiche Part Number 01809-90803

PRINTED: JANUARY 1977

SAFETY SUMMARY

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

GROUND THE INSTRUMENT.

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

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

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

KEEP AWAY FROM LIVE CIRCUITS.

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

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

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

DANGEROUS PROCEDURE WARNINGS.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

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

SS-1-1/76

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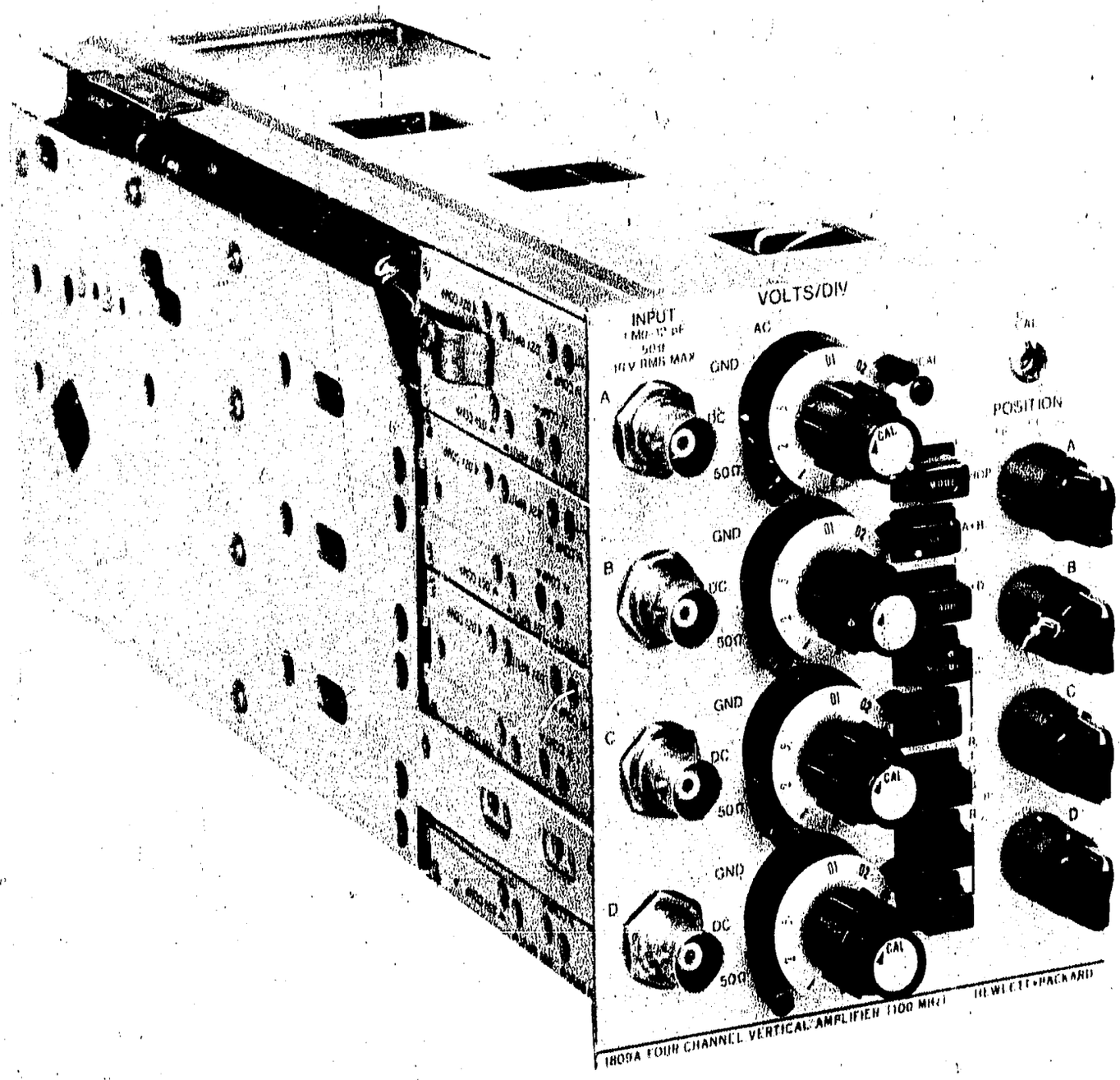


1809A-P-001

Figure 1-1. Model 1809A Four-channel Vertical Amplifier

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This manual provides operating and servicing information for the Hewlett-Packard Model 1809A Four-channel Vertical Amplifier (figure 1-1). The manual is divided into eight sections, each covering a specific topic or aspect of the instrument. All schematics are located at the rear of the manual and can be unfolded and used for reference while reading any part of the manual.

1-3. This section contains a description of the Model 1809A. The instrument specifications are listed in table 1-1. Table 1-2 lists and describes the abbreviations used throughout this manual except in Section VI. The parts listed in Section VI are a computer readout and use computer-supplied abbreviations (table 6-1).

1-4. INSTRUMENT DESCRIPTION.

1-5. The Hewlett-Packard Model 1809A. Four-channel Vertical Amplifier is a versatile, wideband, plug-in unit for the HP 180-series oscilloscope system. As a vertical amplifier plug-in, the Model 1809A mates with all 180 time base plug-ins (refer to Section II for instrument compatibility). The following paragraphs provide a brief description of the Model 1809A.

1-6. INPUT IMPEDANCE. The four-channel input impedance characteristics of Model 1809A permit a wide variety of useful applications. The high impedance input, 1 megohm (±1%) shunted by approximately 12 pF capacitance, provides excellent general purpose measurement capabilities to 100 MHz. High impedance input is available for either ac or dc input coupling. A selectable 50-ohm input impedance provides a 50-ohm input termination (±2%) with a VSWR of less than 1.3:1 at 100 MHz on all ranges. A high quality 50-ohm termination is maintained by compensation for the normal input capacitance that is not possible with external terminations. This internal termination also allows the high 10-volt maximum input capability.

1-7. BANDWIDTH.

1-8. High Impedance Input. Bandwidth limits for the high impedance input are measured 3 dB down when compared to a 6-division reference signal from a terminated 50-ohm source. Bandwidth for the Model 1809A, set for a dc-coupled, high-impedance input, is dc to 100 MHz. Bandwidth for an ac-coupled, high impedance input is from approximately 10 Hz to 100 MHz.

1-9. 50-Ohm Input. Bandwidth for the 50-ohm input impedance is from dc to 100 MHz. Bandwidth is measured with a 6-division reference signal from a terminated 50-ohm source (internal 50-ohm impedance provides an ideal termination for a 50-ohm source).

1-10. RISE TIME. Rise time for the Model 1809A (measured between 10% and 90% amplitude levels) is less than 3.5 nanoseconds when measured on a 6-division input step from a terminated 50-ohm source.

1-11. DEFLECTION SENSITIVITY. Deflection factors range from 10 mV/div to 5V/div in 9 calibrated positions. Attenuator accuracy is ±2%. A vernier for each channel provides continuous adjustment between all deflection factor ranges and extends maximum deflection factor to at least 12.5V/div.

1-12. MODES OF OPERATION. In addition to single-channel display, several combinations of displays are available. Other display combinations are CHOP, ALT, and algebraic addition of channels A+B and C+D.

1-13. Chop. During CHOP display each channel is displayed during the same sweep. In this mode the CRT beam is switched between four channels at a 500 kHz rate (approximately). To eliminate undesirable channel switching transients from a display, the CRT beam is blanked during switching. When using the algebraic functions ±A±B and ±C±D, the switching rate between the two displayed channels is appproximately 1 MHz.

1-14. Alt. During ALT display, each channel is displayed on alternate sweeps of the CRT beam. ALT display is particularly useful for making four-channel comparison measurements with relatively fast sweep speeds.

1-15. A+B and C+D Modes. The A+B and C+D modes of operation present an algebraic display of channels A+B and C+D. By using the front-panel control switches (OFF-ON-INVT), either channel A or B (C or D) can be inverted to obtain differential ±A±B (±C±D) display. The common-mode rejection ratio (CMRR) for differential amplifier operation is at least 20 dB from dc to 80 MHz on 10 mV/div to 5 V/div ranges.

1-16. TRIGGERING. The sync amplifier in the Model 1809A provides the internal trigger signal to the time base plug-in. The CRT display can be synchronized by any channel or the composite signal of the display.

1-17. Triggering occurs on signals from dc to 50 MHz that cause 0.5 division or more of vertical deflection, increasing to 1 division or more of vertical deflection at 100 MHz in all display modes with Model 1824A, 1825A, or 1820C time bases.

1-18. MAXIMUM SIGNAL INPUT. The maximum safe input signal is ±300 volts (dc + peak ac) at 1 kHz or less on all ranges except the 10 mV/div range. On the 10 mV/div range, the maximum safe input signal is ±150 volts (dc + peak ac) at 1 kHz or less.

1-19. WARRANTY.

1-20. The warranty statement applicable to this instrument is printed inside the front cover of this manual.

CAUTION

The warranty may be void for instruments having a mutilated serial number tag.

1-21. ACCESSORIES AVAILABLE.

1-22. Hewlett-Packard maintains a complete line of accessories for use with the Model 1809A. Some of the more popular accessories include the HP Model 10014A voltage divider probe (10:1), the HP Model 10407A plug-in extender, and extender board assembly (HP Part No. 01834-63901). For additional information concerning accessories available for the Model 1809A, contact your nearest HP Sales/Service Office. A convenient world-wide listing of HP Sales/Service Offices is located at the rear of this manual.

1-23. INSTRUMENT AND MANUAL IDENTIFICATION.

1-24. This manual applies directly to Model 1809A instruments with a serial prefix number as listed on the manual title page. The serial prefix number is the first group of digits in the instrumet serial number (figure 1-2). The instrument serial number is printed on a tag located on the rear panel of the plug-in.

1-25. Check the serial prefix number of the instrument. If the serial prefix number is different from that listed on the title page of this manual, refer to Section VII, or the MANUAL CHANGES sheet (if any) for instructions to adapt this manual for proper instrument coverage. Errors in the manual are listed under errata on the MANUAL CHANGES sheet.

1-26. INQUIRIES.

1-27. Refer any questions regarding the manual, the MANUAL CHANGES sheet, or the instrument to the nearest HP Sales/Service Office. Always identify the instrument by model number in all correspondence.

Table 1-1. Specifications

VERTICAL AMPLIFIER

MODES OF OPERATION

Channel A, B, C, or D or any combination displayed alternately on successive sweeps (ALT); channels A, B, C, or D or combination displayed by switching between 4 channels at approximately 500 kHz rate (CHOP) with blanking during switching; channels ±A, ±B, or ±C±D or channels ±A±B, ±C, ±D or any combination displayed in ALT or CHOP; chop rate is approximately 750 kHz for three traces; channels ±A±B displayed in ALT or CHOP with ±C±D; chop rate is approximately 1 MHz.

EACH CHANNEL (4)

Bandwidth: 3 dB down from 6-division reference signal measured with or without probe HP Model 10014A front terminated 50-ohm source.

DC coupled: dc to 100 MHz.

AC coupled: approximately 10 Hz to 100 MHz; lower limit approximately 1 Hz with HP Model 10014A probe when ac coupled.

Rise Time: ≤3.5 nanoseconds (measured with or without HP Model 10014A probe; 10% to 90% of 6-division input step from a terminated 50-ohm source).

Deflection Factor: 0.01 V/div to 5 V/div (9 calibrated positions) in 1, 2, 5 sequence.

Attenuator Accuracy: ±2%.

Vernier: continuous adjustment between deflection factor ranges; extends maximum deflection factor to at least 12.5 V/div. UNCAL indicator lights when vernier is not in CAL detent position.

Signal delay: signals are delayed to view leading edge of pulse without advanced external trigger.

Input coupling: selectable AC, DC, GND or 50-ohm. GND position disconnects signal and grounds amplifier input.

Table 1-1. Specifications (Cont'd)

Input RC:
AC-DC: 1 megohm ±1% shunted by approximately 12 pF.
50-ohm: 50 ohms ±2% VSWR, 1.3:1 100 MHz on all ranges.

Maximum input:
AC-DC: ±300V (dc + peak ac) at 1 kHz or less; ±150V (dc + peak ac) on 0.01 V/div range at 1 kHz or less.
50-ohm: 10V rms (dc-coupled input).
Polarity: any channel may be inverted for ±A, ±B, ±C, or ±D operation.

Algebraic Addition (A+B and C+D):
Amplifier: bandwidth and deflection factors unchanged; any channel may be inverted for ±A±B or ±C±D operation.

Differential Input (A—B or C—D) common mode: CMRR is at least 20 dB from dc to 80 MHz on 0.01 V/div to 5V/div ranges.

Triggering:
Source: selectable from channel A, B, C, D, or composite (on displayed signal) in all display modes.

Frequency:

Time Base plug-in	Trigger Frequency (except chop)	Required Vertical Deflection
1820C		
1824A-1825A	dc to 50 MHz	0.5 div
1840A, 1841A	dc to 100 MHz	1 div
1820B, 1822B	dc to 50 MHz	0.5 div
	dc to 100 MHz	2 div
1820A, 1821A	dc to 50 MHz	1 div

GENERAL

WEIGHT: Net 7 lb (3.2 kg); shipping, 10 lb (4.5 kg).

ENVIRONMENT
(Plug-in operates within specifications over following ranges.)
Temperature: 0°C to 55°C.
Humidity: 95% relative humidity to 40°C.
Altitude: to 15,000 ft (4.5 km).
Vibration: vibrated in three planes for 15 minutes each with 0.010 inch excursion, 10 to 55 Hz.

Table 1-2. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A	ASSEMBLY
AT	ATTENUATOR RESISTIVE TERMINATION
B	MOTOR, FAN
BT	BATTERY
C	CAPACITOR
CP	COUPLING
CR	DIODE
DL	DELAY LINE
DS	DEVICE SIGNALING (LAMP)
E	MISC. ELECTRICAL PART
F	FUSE
FL	FILTER
H	HARDWARE
J	JACK
K	RELAY
L	INDUCTOR
LS	SPEAKER
M	METER
MP	MECHANICAL PART
P	PLUG
PS	POWER SUPPLY
Q	TRANSISTOR
R	RESISTOR
RT	THERMISTOR
S	SWITCH
T	TRANSFORMER
TB	TERMINAL BOARD
TP	TEST POINT
U	INTEGRATED CIRCUIT (UNREPAIRABLE)
V	VACUUM TUBE, NEON BULB, PHOTOCELL, ETC.
VR	VOLTAGE REGULATOR (DIODE)
W	CABLE
X	SOCKET
Y	CRYSTAL
Z	NETWORK

ABBREVIATIONS

A	AMPERE(S)
A	AMPERE TURN(S)
ampl	AMPLIFIER(S)
assy	ASSEMBLY
ampltd	AMPLITUDE
bd	BOARD(S)
bp	BANDPASS
c	CENTI (10^{-2})
C	CARBON
ccw	COUNTERCLOCKWISE
coax.	COAXIAL
coef	COEFFICIENT
com	COMMON
CRT	CATHODE RAY TUBE
cw	CLOCKWISE
d	DECI (10^{-1})
dB	DECIBEL
ext	EXTERNAL
F	FARAD(S)
FET	FIELD EFFECT TRANSISTOR(S)
G	GIGA (10^{9})
gnd	GROUND(ED)
H	HENRY(IES)
hr	HOUR(S)
HP	HEWLETT-PACKARD
Hz	HERTZ
if.	INTERMEDIATE FREQ.
intl	INTERNAL
k	KILO (10^{3})
lb	POUND(S)
lpf	LOW PASS FILTER(S)
m	MILLI (10^{-3})
M	MEGA (10^{6})
ms	MILLISECOND
n	NANO (10^{-9})
nc	NORMALLY CLOSED
no.	NORMALLY OPEN
npn	NEGATIVE-POSITIVE-NEGATIVE
ns	NANOSECOND
p	PICO (10^{-12})
pc	PRINTED (ETCHED) CIRCUIT(S)
pk	PEAK
pnp	POSITIVE NEGATIVE POSITIVE
p/o	PART OF
p-p	PEAK-TO-PEAK
prgm.	PROGRAM
prv	PEAK INVERSE VOLTAGE(S)
ps	PICOSECOND
pwv	PEAK WORKING VOLTAGE
rf	RADIO FREQUENCY
rfi	RADIO FREQUENCY INTERFERENCE
rms	ROOT MEAN SQUARE
rwv	REVERSE WORKING VOLTAGE
SCR	SILICON CONTROLLED RECTIFIER
sec	SECOND(S)
std	STANDARD
trmr	TRIMMER
u	MICRO (10^{-6})
usec	MICROSECOND
V	VOLTS
var	VARIABLE
w/	WITH
w/o	WITHOUT
wiv	WORKING INVERSE VOLTAGE

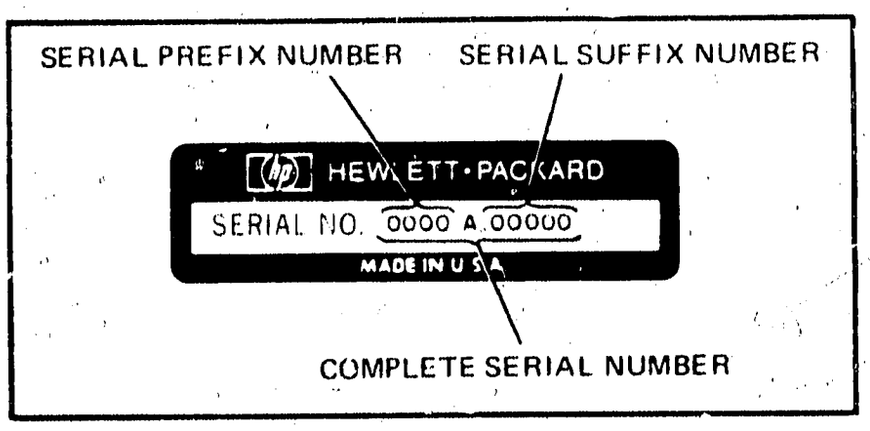


Figure 1-2. Instrument Serial Number

INSTALLATION

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains instructions for performing an initial inspection and installation of the Model 1809A. Installation procedure and precautions are presented in step-by-step order. The procedure 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 the 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 on the inside front cover of this manual. If the instrument does not operate as specified, refer to the claims paragraph in this section.

2-6. INSTALLATION.

2-7. Model 1809A is designed to mate with a 180-series horizontal plug-in and fit into the plug-in compartment of the 180-series oscilloscope mainframe. Figure 2-1 shows the interconnection and coupling mechanism of each plug-in. Power for the Model 1809A is supplied by the oscilloscope mainframe through the horizontal plug-in. To install the Model 1809A, proceed as follows:

a. Pull horizontal plug-in locking bar toward rear of plug-in.

b. Match vertical and horizontal connectors and engage by pressing together (ensure locking bar guide lugs are properly positioned).

c. When plug-ins are joined, press locking bar forward to lock them together.

d. Lift up on latch release and rotate latch downward.

e. Insert plug-ins into 180-series mainframe.

f. When plug-ins are inserted completely into compartment, rotate latch upward and push forward to lock. Assemblies are now locked into mainframe and ready for use.

2-8. INSTRUMENT COMPATIBILITY.

2-9. Model 1809A is primarily designed for use with Model 1824A and Model 1825A time base plug-ins and 180-series oscilloscope mainframe.

2-10. CLAIMS.

2-11. The warranty statement applicable to this instrument is printed on the inside front cover of this manual. If physical damage is found or if operation is not as specified when the instrument is received, notify the carrier and the nearest HP 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.

2-12. REPACKING FOR SHIPMENT.

2-13. If the instrument is to be shipped to an HP Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-14. 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 for shipping an instrument normally include the following:

a. A double walled carton with test strength of 275 pounds.

b. Heavy paper or sheets of cardboard to protect all instrument surfaces; use nonabrasive material such as polyurethane or a sealed-air packaging material such as AIRCAP around all projecting parts.

c. At least 4 inches of tightly packed, industry-approved, shock-absorbing material such as extra-firm polurethane foam.

d. Heavy-duty shipping tape for securing outside of carton.

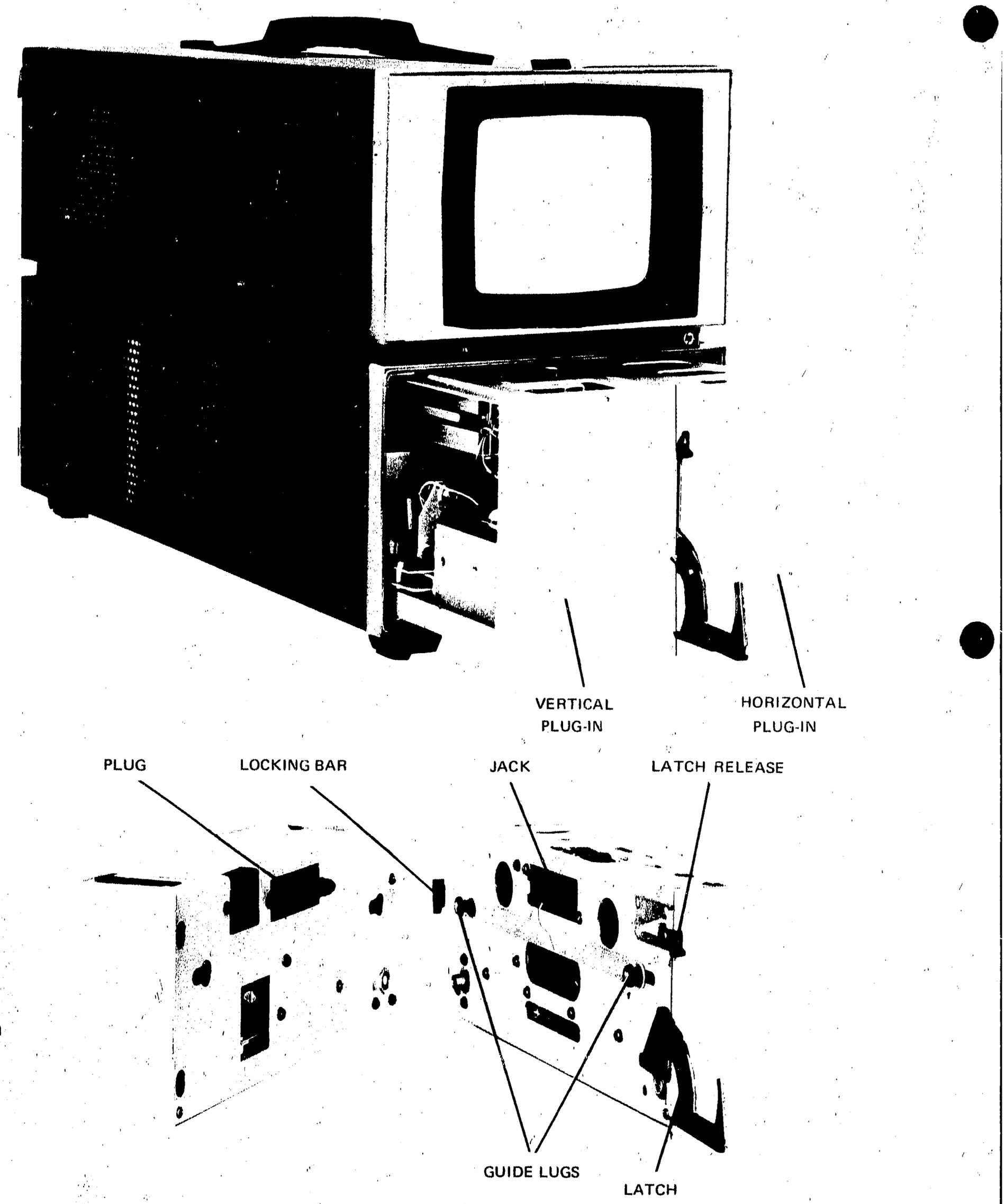


Figure 2-1. Plug-in Mating

OPERATION

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section provides general operating instructions and application information for Model 1809A. Front-panel controls and connectors are identified and briefly described in figure 3-3. General operating instructions are provided in figures 3-5 through 3-9. Initial turn-on procedures are detailed in figure 3-4.

3-3. CONTROLS AND CONNECTORS.

3-4. Figure 3-3 shows the front panel of the instrument and provides functional descriptions of the operating controls and connectors. Since all four channels are identical, only the controls for channel A and those common to all channels are described in the figure. A more detailed description of some of the controls is given in the following paragraphs.

3-5. INPUT COUPLING. This lever switch selects either capacitive (AC) or direct (DC) coupling of the input to the vertical preamplifier. In AC or DC coupling, the input signal is terminated in 1 megohm.

3-6. Another position of the lever switch provides for DC coupling and termination of the input signal into 50 ohms. A GND position is also provided. The GND position of the coupling switch can be used to set a zero reference before measuring dc voltages without disconnecting the incoming signal. The switch should be positioned to DC when viewing long duration pulses, dc levels of waveforms, or measuring dc voltages. AC coupling should be selected when viewing ac waveforms having large dc reference levels. To prevent input distortion use the 50Ω position for equipment requiring 50-ohm termination.

3-7. VOLTS/DIV. There are nine calibrated sensitivity ranges from .01 volts/division to 5 volts/division for each of the four channels. All nine ranges are calibrated to the VOLTS/DIV switches when the vernier controls are fully clockwise in detent position.

3-8. If any vernier control is turned from its full clockwise position, the UNCAL indicator lights to signify the volts/division ranges for that channel are no longer calibrated to the VOLTS/DIV switch. In the fully counterclockwise position, the vernier control decreases the sensitivity of each volts/division range for its associated channel up to at least two and a half times. For example, when the VOLTS/DIV switch is set to the 5-volt position and the vernier is turned fully counterclockwise, the range is extended to at least 12.5 volts/division.

3-9. DISPLAY MODE. There are two modes of channel switching controlled by the MODE push-button switch: ALT or CHOP. In the ALT mode of operation, channel switching alternates between channels (see figure 3-1) to display a different channel during each CRT sweep. ALT mode of operation is recommended for use with fast, time-base sweep speeds. Slow sweep speeds will cause the display to flicker.

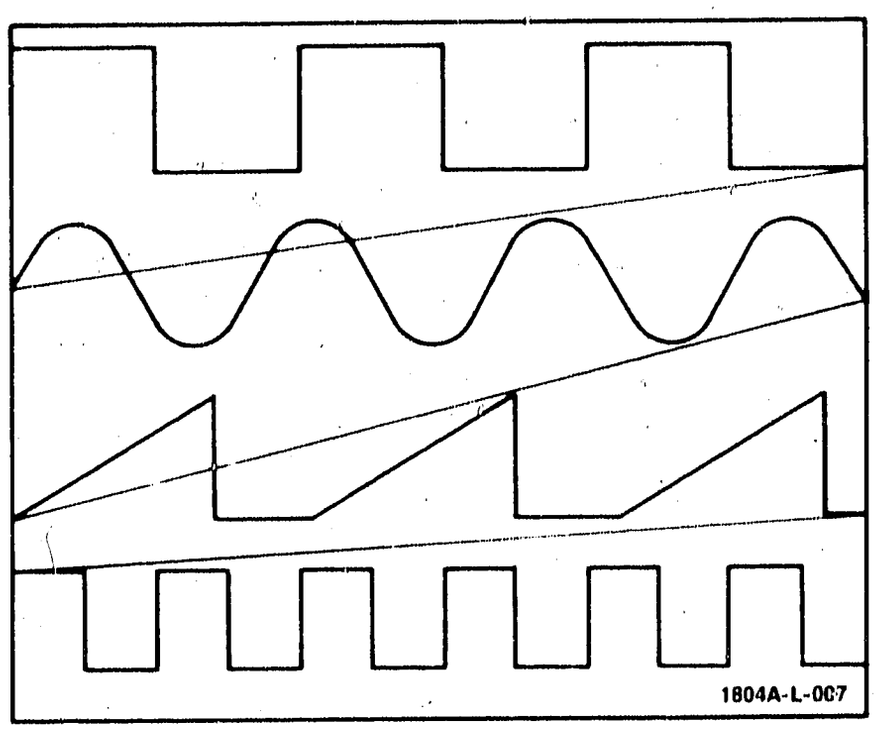


Figure 3-1. ALT Display

3-10. During CHOP mode of operation, channel switching is chopped between the four channels at an approximate 500-kHz rate. CHOP mode of operation is recommended for use with slow, time-base sweep speeds. Fast sweep speeds will result in a dotted trace as shown in figure 3-2. The chop frequency may be increased to 3 MHz, giving a 1.5 MHz, two-channel display rate and a 750 kHz, four-channel display rate. This will result, however, in less trace brightness and less CRT blanking (chop transients will be more apparent). To make the modification, change A15C6 from 270 pF to 200 pF (HP Part No. 0140-0198).

3-11. TRIGGER SELECTION. System synchronization from a vertical input signal is possible when internal triggering is selected by the time-base trigger source control. When time related signals are being viewed, best results can be obtained by using a single-channel sync (trigger A, B, C, or D).

3-12. When signals are not time related, it is necessary to use a composite sync with each channel's

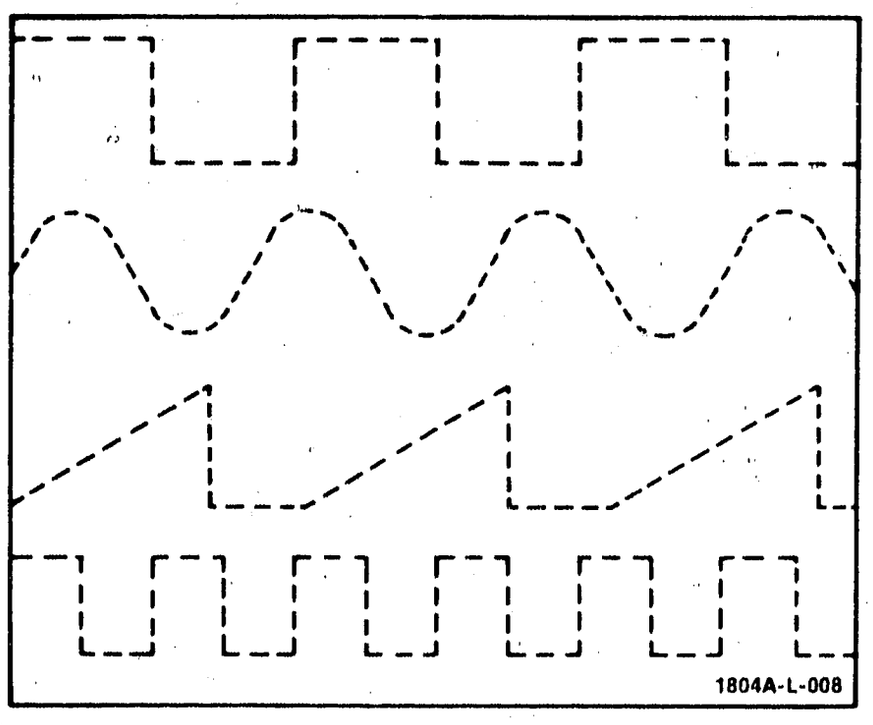


Figure 3-2. CHOP Display

input signal triggering its own sweep. If COMP triggering is selected and the time base mode switch is in NORM, the Model 1809A will trigger a sweep for each channel that satisfies triggering conditions. If any channel does not meet triggering conditions, the Model 1809A will stop triggering at that channel.

3-13. A+B OR C+D OPERATION. The A+B or C+D mode of operation displays the algebraic sum of the signals applied to the INPUT connectors of channels A and B or channels C and D. To operate in this mode press ADD pushbutton switch to its A+B (C+D) position. Any combination of operation (±A±B or ±C±D) is obtained by setting the OFF-ON-INVT switch for channels A and B or channels C and D to the ON or INVT psoition.

3-14. OPERATING PROCEDURES.

3-15. Figure 3-4 through 3-9 are operating plates containing step-by-step operating procedures indexed to photographs. The figures describe the operations to be accomplished in achieving the different modes of operation.

3-16. OPERATOR'S PERFORMANCE CHECK.

3-17. Operation of the Model 1809A may be checked without the use of additional test equipment by using the CALIBRATOR output of the oscilloscope main frame as a signal source. Each channel control should be checked for proper operation. To check specifications listed in table 1-1, refer to Section V for the performance checks.

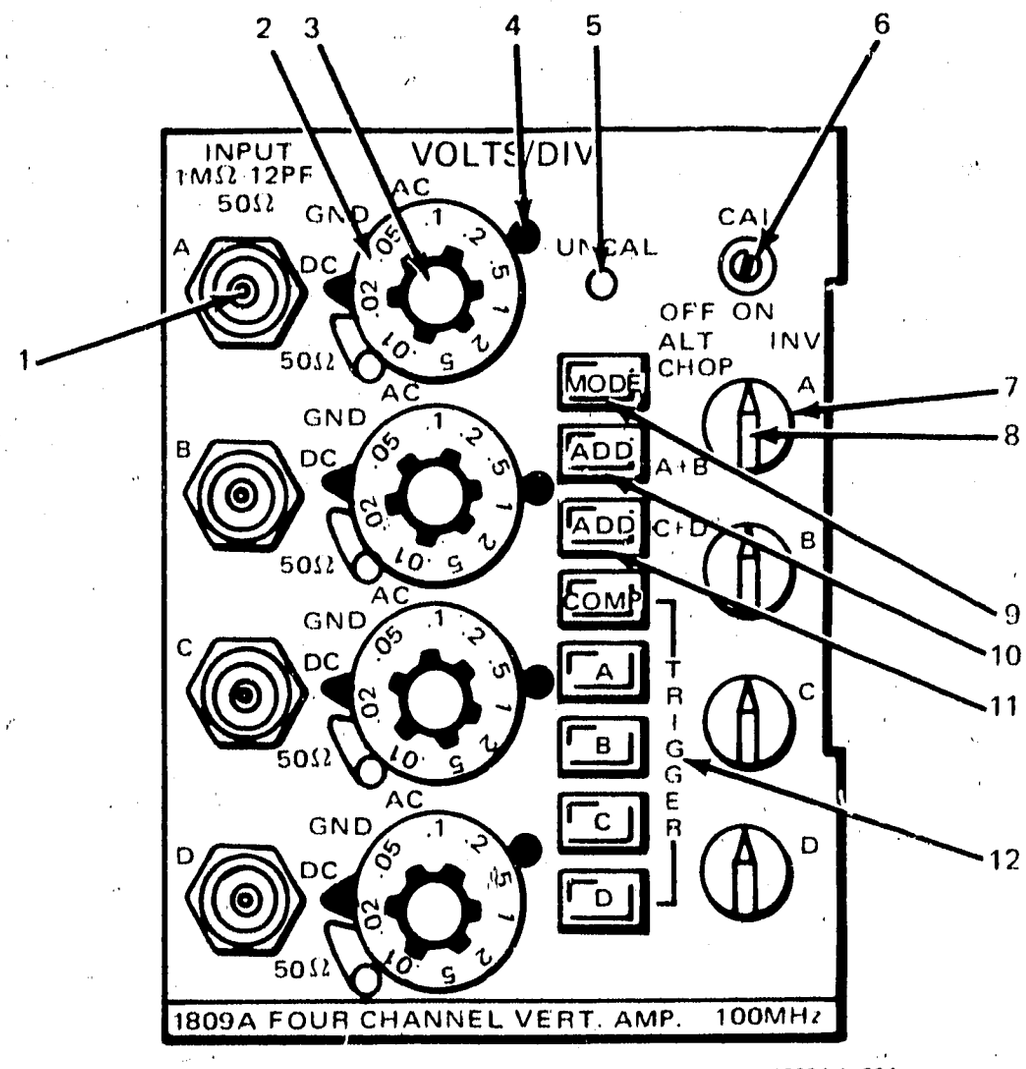
NOTE

High frequency calibration of the Model 1809A is performed at the factory using the internal 50Ω coupling termination that is compensated to neutralize the attenuator input capacitance. When using the Model 1809A in a 50-ohm system, the internal 50Ω termination should be used. The use of an external 50-ohm feedthrough type termination will not give the optimum response unless the vertical amplifier is recalibrated.

3-18. APPLICATIONS.

3-19. Dual-input impedance characteristics combined with four-channel, 100-MHz bandwidth provide accurate measurement and troubleshooting applications in both digital and analog circuits. The Model 1809A is ideal for logic measurements and comparisons for TTL, ECL, and MOS circuits.

3-20. Time-related measurements can be displayed by selecting a trigger source from either channel A, B, C, or D. This permits triggering on any channel while viewing the time relationship with the orher channels. In composite triggering, each channel is individually triggered by the signal applied to it.



1809A-L-001

1. INPUT. BNC connector for channel A input signal.

2. VOLTS/DIV. Selects vertical deflection factor.

3. Vernier. Provides continuous adjustment of volts/div between calibrated positions of VOLTS/DIV switch.

4. Coupling. Lever switch that selects capacitive (AC), direct (DC), or 50-ohm coupling of input signal. GND position disconnects input signal and grounds input to vertical preamplifier.

NOTE

Items 1 through 4 identify channel A controls and connector. Similar controls and connectors for the other channels function identifically.

5. UNCAL lamp. Lights when any channel vernier is out of CAL detent position.

6. CAL. Adjustment to calibrate output amplifier.

7. Position A. Varies vertical position of channel A display. (Position controls for other channels function identically.)

8. OFF-ON-INVT. Channel A selector switch. OFF position prevents channel from processing input signals. ON position processes signals applied to INPUT connector. INVT position reverses polarity of input signal. (OFF-ON-INVT controls for other channels function identically.)

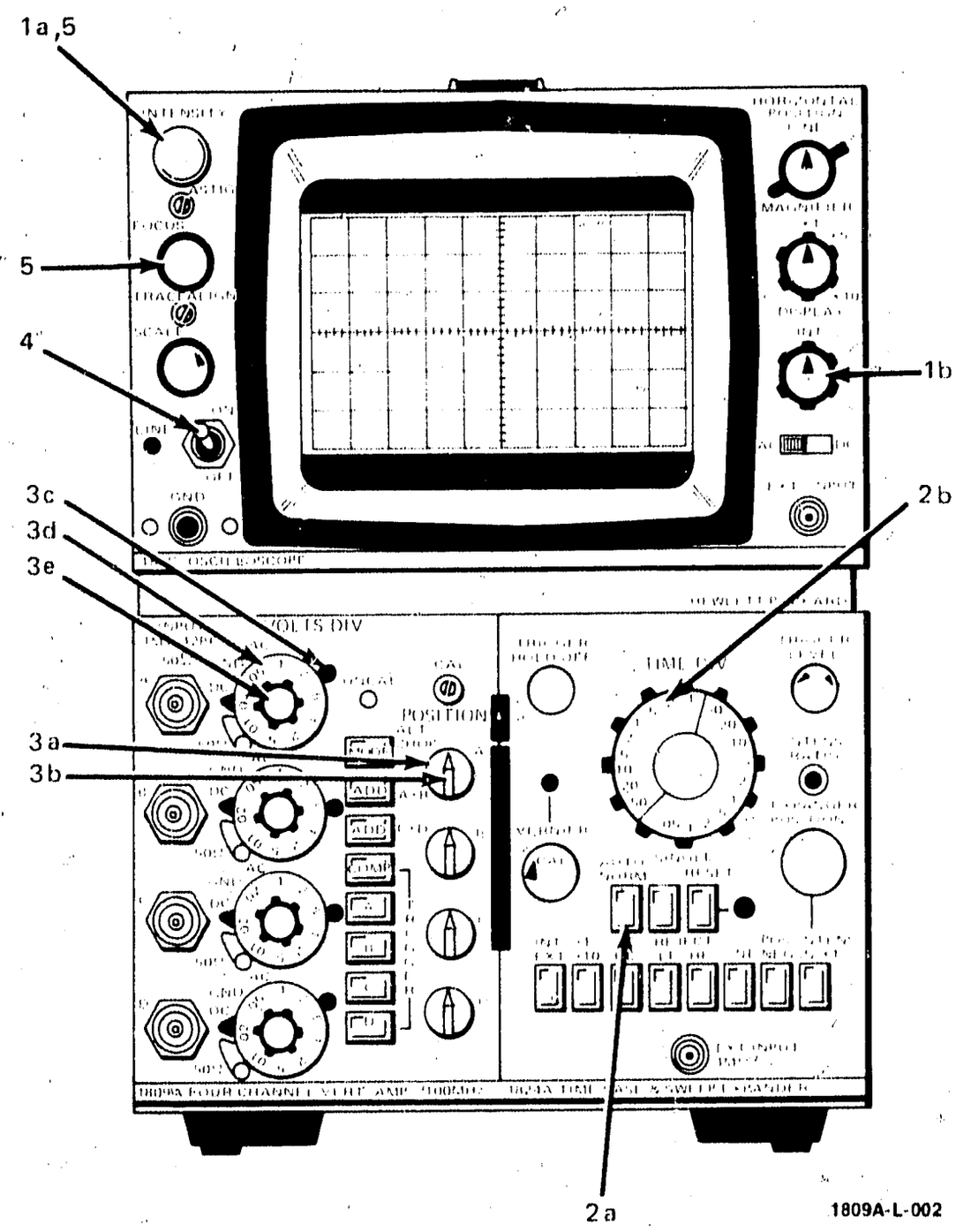
9. MODE. Pushbutton switch that selects CHOP or ALT mode of display.

10. ADD. Pushbutton switch that selects algebraic addition of channels A and B.

11. ADD. Pushbutton switch that selects algebraic addition of channels C and D.

12. Trigger source. Pushbutton switches that select triggering signal from channel A, channel B, channel C, channel D, or on displayed signal (COMP).

Figure 3-3. Controls and Connectors



1. Set mainframe controls as follows:

   a. intensity ..... fully ccw
   b. display ..... internal

2. Set time base controls as follows:

   a. sweep mode ..... automatic
   b. time/division ..... .2 msec

3. Set Model 1809A controls (all channels when applicable) as follows:

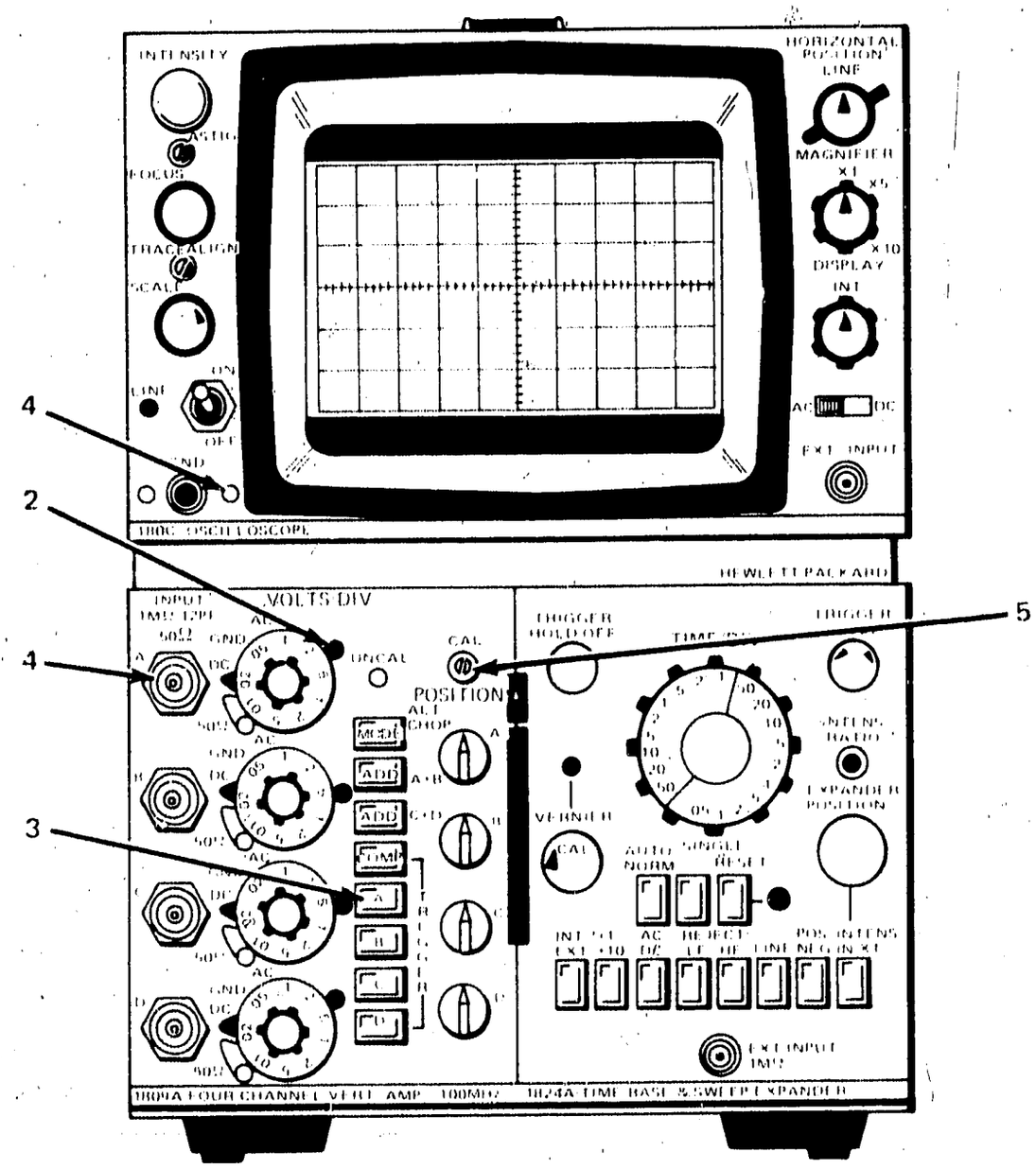
   a. POSITION ..... midrange
   b. OFF-ON-INVT ..... ON
   c. Coupling ..... GND
   d. VOLTS/DIV 2
   e. Vernier ..... CAL detent

4. Apply power to oscilloscope.

5. Adjust intensity and focus for sharp and just visible trace.

6. Adjust time base for stable sweep.

Figure 3-4. Initial Turn-on Procedure



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1. Perform the initial turn-on procedure in figure 3-4.

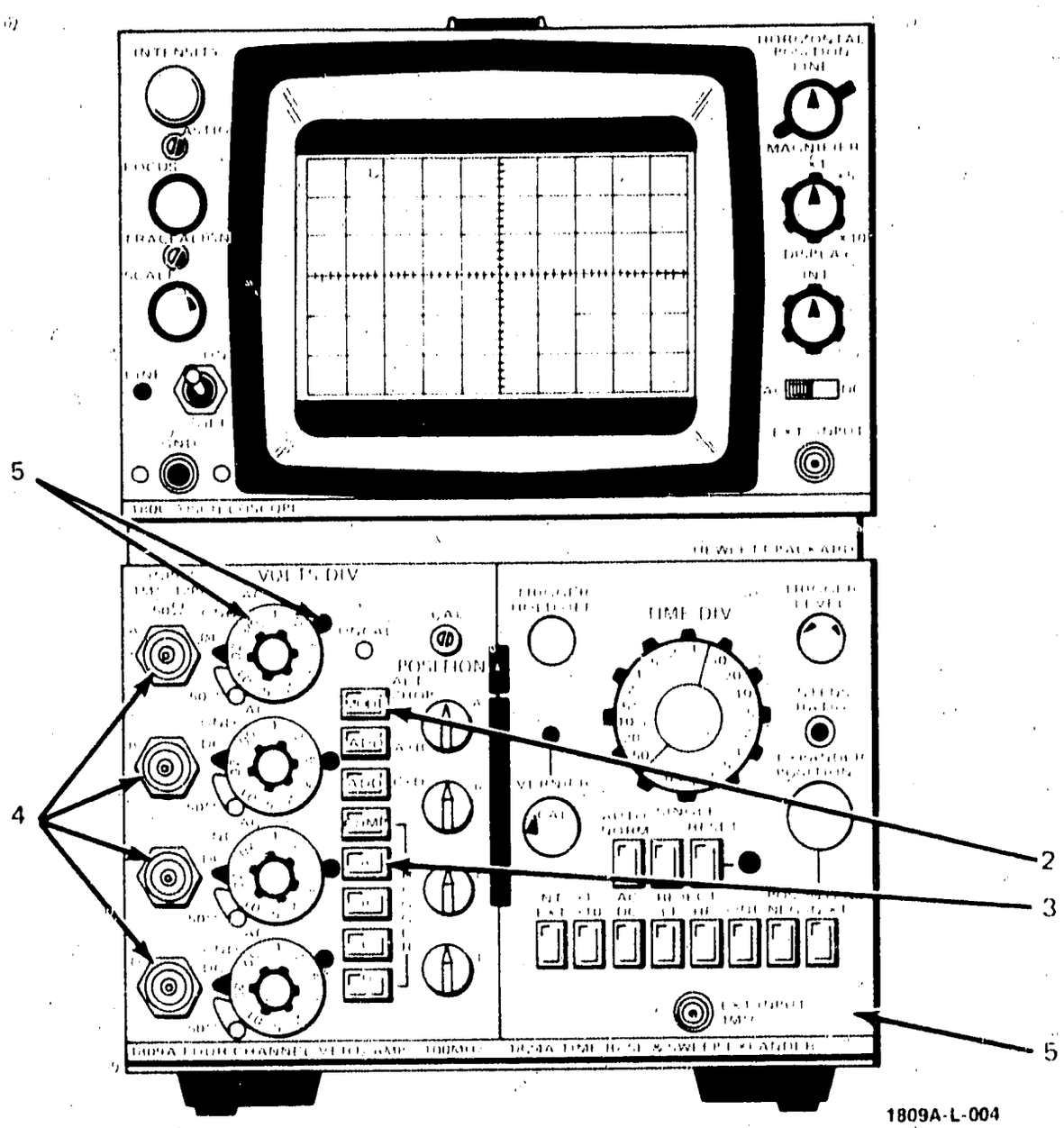
2. Set channel A coupling switch to DC.

3. Set trigger source to A.

4. Connect compensated 10:1 divider probe between the 10-volt oscilloscope calibrator jack and the channel A INPUT connector.

5. Since the 10-volt calibrator signal is attenuated to 1 volt, observe 5 divisions of vertical deflection. If necessary, adjust CAL for 5 divisions.

Figure 3-5. Amplifier Calibration



1. Perform initial turn-on procedure (figure 3-4).

2. Set MODE switch to CHOP position.

3. Set trigger source to channel A.

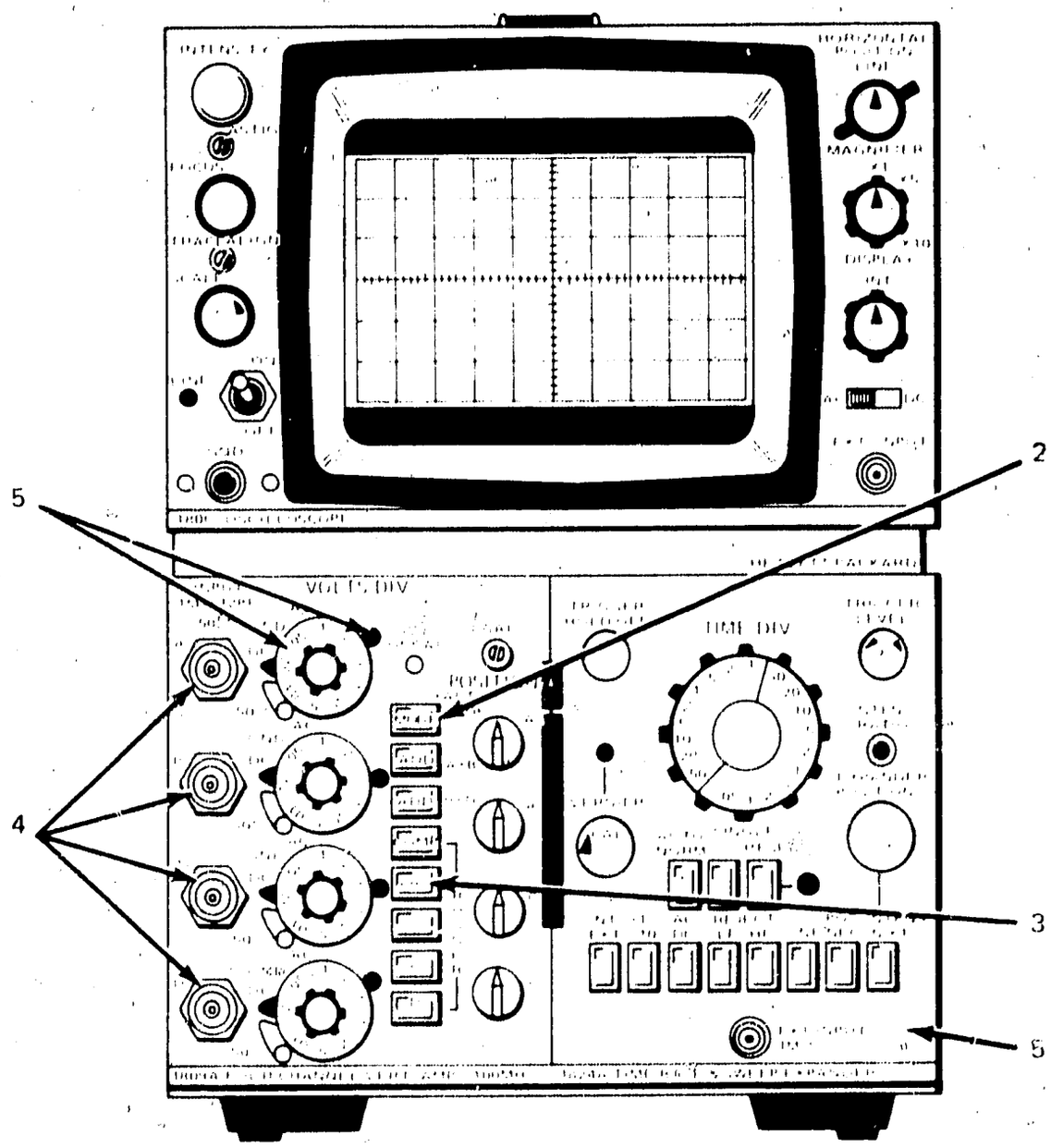
NOTE

During CHOP operation, four signals can be viewed simultaneously on a time sharing basis. CHOP mode of operation is recommended for use with slow sweep speeds (0.2 msec/division or slower).

4. Apply signals to channel A, B, C, and D INPUT connectors.

5. Set coupling, VOLTS/DIV, and time base plug-in controls as required.

Figure 3-6. CHOP Mode Operation



1. Perform initial turn-on procedure (figure 3-4).

2. Set MODE switch to ALT position.

3. Set trigger source to channel A.

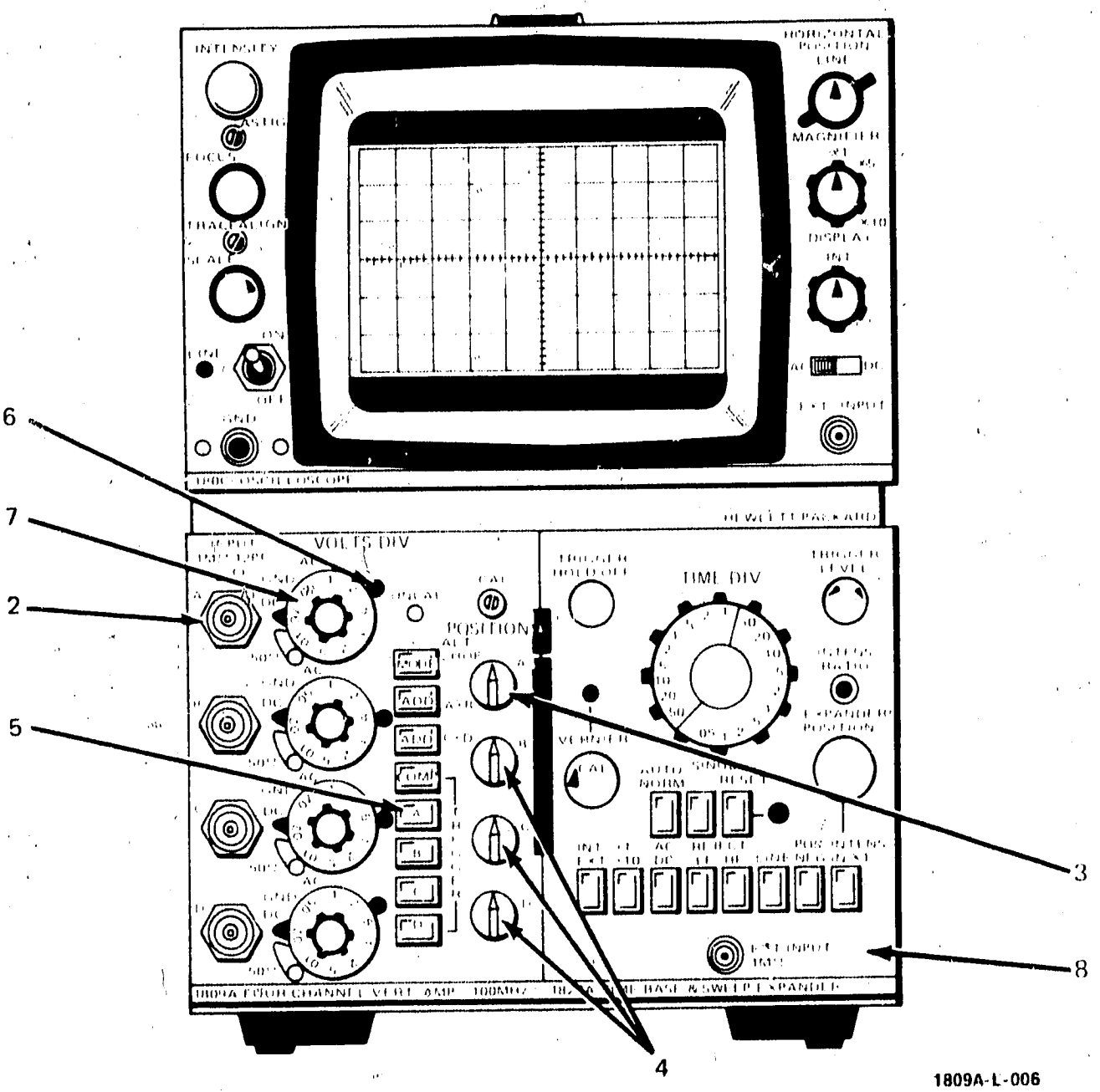
NOTE

During ALT operation, four signals can be viewed simultaneously. Sweep alternates to display individual channels on each sweep. ALT operation is recommended for use with fast sweep speeds. Slow sweep speeds will result in objectionable flicker.

4. Apply signals to channel A, B, C, and D INPUT connectors.

5. Set coupling, VOLTS/DIV, and time base controls as required.

Figure 3-7. ALT Mode Operation



1. Perform initial turn-on procedure (figure 3-4).

2. Connect signal to channel A INPUT connector.

3. Set channel A OFF-ON-INVT switch to ON.

4. Set channels B, C, and D OFF-ON-INVT switches to OFF.

5. Set trigger source to channel A.

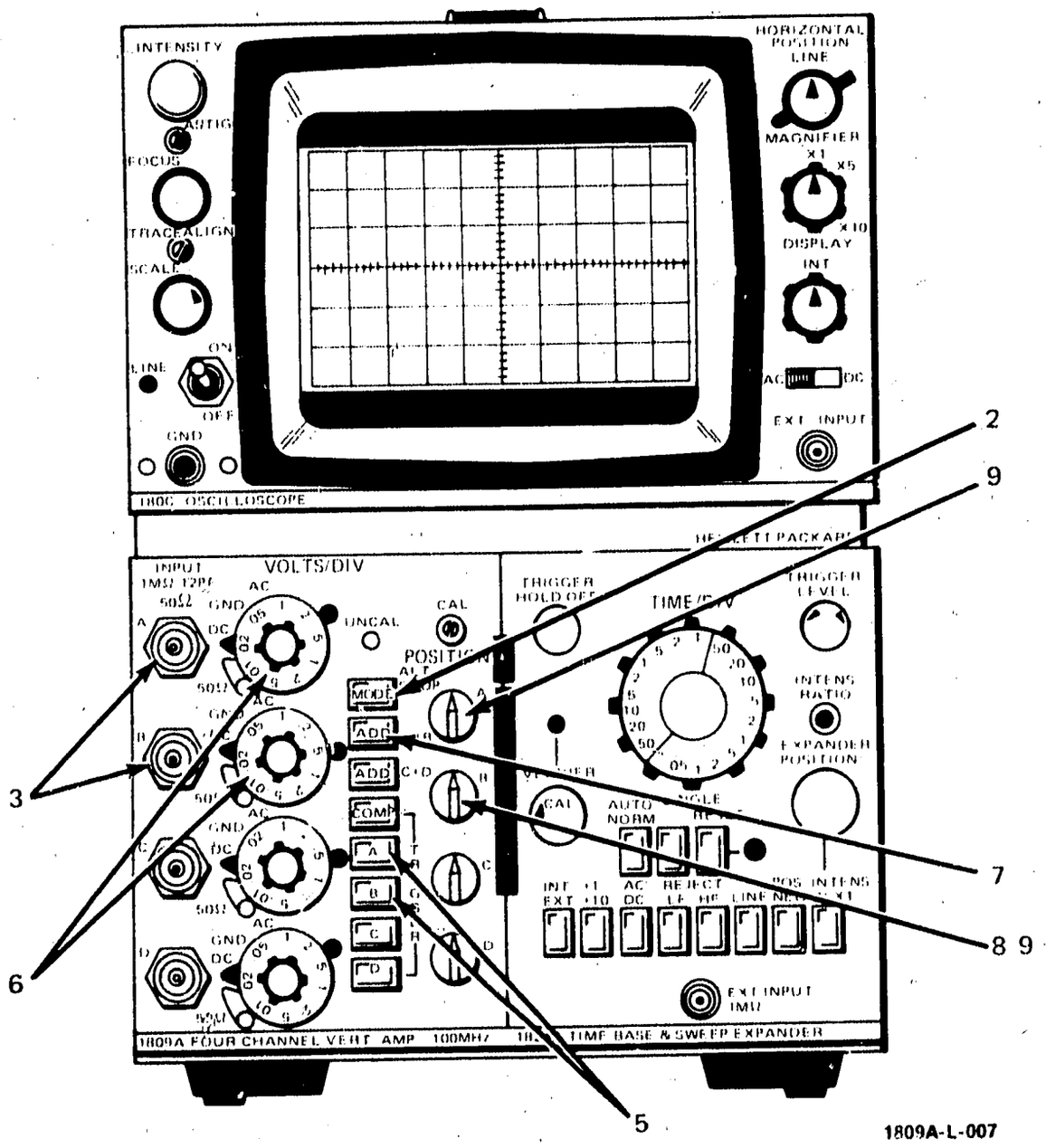
6. Set channel A coupling as required.

7. Set channel A VOLTS/DIV switch as required.

8. Set time base plug-in controls as required.

9. For channel B, C, or D operation, apply steps 2 through 7 to selected channel.

Figure 3-8. Single Channel Operation



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±A±B OPERATION

1. Perform initial turn-on procedure (figure 3-4).
2. Set MODE switch to ALT position.
3. Connect signals to channels A and B INPUT connectors.
4. Set trigger source to channel A or channel B as desired.
5. Set channels A and B coupling as required.
6. Set channels A and B VOLTS/DIV switches as required.
7. Set ADD switch to A+B position.
8. For A—B operation, set channel B OFF-ON-INVT switch to INVT position.
9. For —A+B operation, set channel A OFF-ON-INVT switch to INVT position and channel B OFF-ON-INVT switch to ON position.

±C±D OPERATION

A. Accomplish steps 1 through 9 for ±A±B Operation except substitute channel C for channel A and channel D for channel B.

Figure 3-9. ±A±B and ±C±D Operations

THEORY

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains the theory of operation for the Model 1809A. Functional descriptions keyed to an overall, simplified block diagram (schematic 1) are provided first. The functional descriptions are followed by a detailed theory of operation. The detailed circuit descriptions are keyed to the schematics located in Section VIII.

4-3. BLOCK DIAGRAM DISCUSSION.

4-4. Since the operation of channels A, B, C, and D are identical, the following text is applicable to any vertical channel.

4-5. ATTENUATOR. The channel attenuator receives the input signal applied to the front-panel INPUT connector. The attenuator has three main functions: it selects the desired type of input coupling (50Ω, DC, GND, AC), it sets the vertical deflection factor (.01 V/div to 5 V/div) as selected by the front-panel VOLTS/DIV switch, and its output stage forms an impedance converter. The output of the impedance converter is applied to the vertical preamplifier assembly associated with the attenuator.

4-6. VERTICAL PREAMPLIFIER. The vertical preamplifier assembly consists of one integrated circuit and associated control and biasing networks. The integrated circuit amplifies the applied signal and furnishes the sync control signal for the sync amplifier.

4-7. Front-panel controls associated with the vertical preamplifier are the channel position control, the VOLTS/DIV vernier, the trigger source switch, and the OFF-ON-INVT switch.

4-8. BUFFER AMPLIFIER ASSEMBLY. The outputs of channel A and channel B preamplifiers are connected together and fed through a 300-ohm impedance cable to a buffer stage on the sync amplifier assembly. The channel C and D preamplifier outputs are connected in the same manner to another buffer stage on the sync amplifier assembly. The differential outputs of the two buffer stages are connected together and applied to a differential, delay-line driver stage. The delay line driver stage applies the signal through the delay line to the output amplifier assembly.

4-9. The composite sync signal is picked off at the output of the delay line driver stage. The differential signal is applied to a differential-to-single-ended converter stage. The single-ended signal is amplified and applied through an emitter-follower stage to the time base plug-in unit of the oscilloscope.

4-10. DELAY LINE. The delay line assembly provides approximately 160-nanoseconds delay to the vertical signal. This allows the horizontal circuits of the time base plug-in unit sufficient time to react to the sync signal so that the display on the oscilloscope CRT is in the proper time relationship.

4-11. MAIN AMPLIFIER. The main amplifier, A10A1, consists primarily of an integrated circuit, A10A1U1. The remainder of the circuit provides high frequency adjustment and output balance adjustment. Output balance is adjusted by variable resistor A10A1R3. In addition, the main amplifier provides the necessary current gain for output amplifiers Q1/Q2 and Q3/Q4.

4-12. OUTPUT AMPLIFIER. Integrated circuit A10A1U1 provides two outputs. One side drives output amplifier Q1/Q2 and the other drives output amplifier Q3/Q4. Each output amplifier has a feedback signal to its input for compensation, which is adjustable with A10A2C1. The vertical deflection signal from the output amplifiers, Q1/Q2 and Q3/Q4, is applied to the CRT deflection plates.

4-13. CHANNEL CONTROL. The channel control assembly consists of logic circuits that select the type of display to be presented on the oscilloscope CRT: channel A, channel B, channel C, channel D; channels ±A±B, channels ±C±D; and CHOP or ALT mode of operation. In addition, the chop blanking signal, which blanks the oscilloscope CRT screen during channel switching (CHOP), is developed on this assembly.

4-14. CIRCUIT DETAILS.

4-15. The following paragraphs provide a detailed explanation of the individual circuits in the Model 1809A. Circuits that are identical for all four channels are only explained for channel A.

4-16. ATTENUATOR ASSEMBLIES A1, A2, A3, AND A4.

4-17. GENERAL INFORMATION. (See Schematics 2 and 3.) Attenuator assembly A1 is a two-section cam-actuated attenuator consisting of 13 in-line cams. The first three cams, mounted on the outer shaft, from coupling switch A1S1. The remaining 10 cams,

mounted on an inner shaft, form VOLTS/DIV switch A1S2. The cams actuate push rods to close spring-switch contacts.

4-18. Most components on the attenuators are deposited on a ceramic substrate by thick-film process. Those components that are deposited on the substrate have no reference designators assigned. Their values, as shown on the schematics, are nominal values and should be used for reference only. If a malfunction occurs in an attenuator assembly, it is recommended that the substrate be replaced with a like unit.

4-19. INPUT. The cams controlled by coupling switch A1S1 actuate spring switches A1A1S1 through A1A1S3. A table located on the schematics explains the switch closure sequence for each front-panel coupling switch position.

4-20. The remaining 10 cams, controlled by VOLTS/DIV switch A1S2, actuate spring contact switches A1A1S4 through A1A1S13. A table located on the schematics explains the switch closure sequence for each front-panel VOLTS/DIV switch setting.

4-21. ATTENUATOR CIRCUITS. The VOLTS/DIV switch controls a two-section cascaded attenuator. Each section is made up of three separate attenuation networks. The first section contains the X1, X10, and X100 networks. The second section contains the X1, X2, and X5 networks. Each switch position cascades a network in the first section with a network in the second section. By cascading different network combinations the attenuator provides .01 V/div vertical deflection.

4-22. There is no adjustment for the straight-through range (.01 V/div). Each of the other attenuator networks has an input capacitance adjustment as well as a compensation adjustment. The input capacitance for each network is matched to the input capacitance of the straight-through range to achieve a uniform input capacitance over the entire range of inputs. The second adjustment for each range provides high frequency compensation.

4-23. The output of the attenuator is applied to the gate of field-effect transistor (FET) Q1A. The FET maintains a high impedance that reduces input loading. The input resistance is established by a 1-megohm resistor deposited on the substrate.

4-24. Source followers Q1A and Q1B form a high-to-low impedance converter stage. The stage (Q1A/Q1B) is balanced in the gate circuit of Q1B. The attenuator balance adjustment is potentiometer A5R2 on the channel A preamplifier assembly.

4-25. PREAMPLIFIERS AND OUTPUT CIRCUITRY.

4-26. Each of the four channels has its own preamplifier assembly consisting of an integrated circuit and associated controls. The integrated circuit, U1, amplifies the differential signal from the attenuator and applies it to a buffer stage on assembly A9.

4-27. Any channel can be selected as the sync source. For example, when channel A triggering is desired, trigger switch A11S1E is pressed (see schematic 4). With trigger switch A11S1E engaged, enabling bias is applied to the sync pickoff circuit in U1. The sync signal that is developed at pin 22 is applied to part of the sync amplifier on assembly A9. The trigger switches (A11S1E through A11S1H) are mechanically constructed so that only one switch can be engaged at one time. When COMP trigger switch A11S1D is pressed, all trigger switches are released.

4-28. The gain of each preamplifier is separately adjustable by CAL potentiometer R11. With the front-panel VOLTS/DIV vernier in CAL detent, R11 on each preamplifier assembly is adjusted so that each assembly has the same output level for a given input.

4-29. Integrated circuit U1 is also controlled by the individual channel OFF-ON-INVT switch. In the ON position, U1 amplifies the input signal and applies it to assembly A9. In the INVT position, reverse bias is applied to a straight-through amplifying stage in U1. With the amplifying stage cut off, an inverting stage is biased on. This results in the input signal being inverted before it is applied to assembly A9.

4-30. Each channel has a POSITION control located on the front panel. Vertical positioning of the viewed display is accomplished by varying the applied dc offset voltage to integrated circuit U1. This results in shifting the vertical dc level of the output signal and therefore causes the CRT display to move up or down. The dc offset voltage developed by the POSITION control (A12R1, A12R3, or A12R4) is applied to its associated channel IC (pin 3).

4-31. The output circuit of each channel preamplifier is controlled by an OR gate on control assembly A15. Assembly A15 furnishes the enabling bias to the output stage of the preamplifier. Except in A+B or C+D mode of operation, only one channel output stage is enabled at any given time. Refer to paragraph 4-45 for operation of channel control assembly A15.

4-32. High-frequency response is also adjusted on the individual preamplifier assemblies. Potentiometer R4 and variable capacitor C2 are adjusted for optimum high-frequency response.

4-33. BUFFER AMPLIFIER. (See Schematics 8 and 9). The differential outputs of channel A and channel B preamplifiers are connected together. These outputs are applied through a 300-ohm impedance cable to a buffer stage on amplifier assembly A9 (schematic

8). The outputs of channel C and channel D are connected identically to another buffer stage.

4-34. The differential outputs of the two buffer stages are applied to a delay line driver stage consisting of A9Q5/A9Q6. Transistors A9Q5 and A9Q6 develop the current level necessary to drive the delay line.

4-35. When the add function (A+B) is selected by the front-panel ADD (A+B) switch A11S1B, a voltage source (+15V) is applied to the junction of resistors A9R12/A9R13. This voltage source supplies the additional current required for simultaneous dual channel operation. The add function for channels C and D is identical to that of channels A and B except that ADD (C+D) switch A11S1C supplies the voltage to the junction of A9R1/A9R2.

4-36. The FIND BEAM switch on the front panel of the oscilloscope supplies-12.6 volts to the emitter circuits of delay line driver transistors A9Q5/A9Q6. When the FIND BEAM switch is pressed, the voltage for the emitter circuits is supplied through dropping resistor A9R34. The reduced current ensures that the vertical deflection factor is such that the trace is returned to the viewing area of the CRT.

4-37. High-frequency response is also adjusted in delay line driver stage. Potentiometer A9R30 and variable capacitor A9C8 are adjusted for optimum high-frequency response. A9R55 is adjusted for optimum low-frequency response.

4-38. The differential output of the delay line driver is also applied to the sync amplifier that develops the composite sync signal (schematic 9). The differential signal is applied to the base circuits of A9Q7 and A9Q8 where differential to single-ended conversion takes place. SYNC BAL adjustment A9R42 compensates for any imbalance that may exist throughout the signal path.

4-39. SYNC AMPLIFIER (See schematic 9). The single ended sync signal is applied through a common base amplifier to the main sync board A16. The sync amplifier consists of a series-shunt differential pair followed by a common emitter, series feedback differential stage. The signal is then taken from one side of the differential stage and connected to a complimentary emitter follower A16Q7/A16Q8. The complimentary emitter follower provides a low impedance signal to synchronize the time base.

4-40. In COMP mode triggering, the sync signal is developed from the signal furnished by the delay line driver. When single channel triggering is selected, the channel trigger switch (A11S1E, A11S1F, A11S1G, or A11S1H) enables the sync pickoff circuit in its associated preamplifier assembly by applying enabling bias (+7.15V) to pin 20 on A10A1U1. The output of the sync pickoff circuit (pin 22 of A10A1U1) is applied to amplifier assembly A9. The sync signal is connected through a diode (A9CR3, A9CR4, A9CR5, or A9CR6) to the emitter circuit of A9Q10 (schematic 9). In addition, when any trigger switch (A11S1E, A11S1F, A11S1G, or A11S1H) is engaged +15 volts is also applied to the base circuit of A9Q9. This voltage inhibits the sync signal generated in the delay line driver circuit.

4-41. The sync signal, generated by the preamplifier assembly, is buffered by A9Q10 and applied to the main sync amplifier.

4-42. DELAY LINE. The signals from delay line drivers A9Q5 and A9Q6 (see schematic 8) are applied to delay line assembly A14. The delay line has an impedance of approximately 150 ohms and provides a time delay of approximately 160 nanoseconds. This delay is sufficient to allow the internal sync signal to trigger the time base plug-in unit to start the horizontal sweep prior to the beginning of the vertical portion of the display. Without the insertion of this time delay in the signal path, the sweep would start after the signal reached the vertical deflection plates of the CRT and the leading edge of fast rise time signals would not be displayed.

4-43. MAIN AMPLIFIER. (See Schematic 10). The main amplifier A10A1 contains an integrated circuit that provides the current gain for the entire system. The gain of A10A1U1 is adjusted by front panel CAL control R5. This adjustment is used to calibrate the Model 1809A to different oscilloscope mainframes. Signal response is also adjusted in amplifier A10A1U1. Variable capacitors A10A1C3 and A10A1C7, and variable resistors A10A1R12 and A10A1R13 are adjusted for optimum high-frequency response.

4-44. OUTPUT AMPLIFIER. (See Schematic 10.) Signals from the main amplifier drive two shunt output amplifiers that provide the voltage gain necessary to drive the CRT. One side drives shunt output amplifier Q1/Q2 and the other side drives shunt output amplifier Q3/Q4. Each amplifier feeds a portion of its output signal back to its input through a compensation network. Amplifier Q3/Q4 has a high frequency corner adjustment HF9. The vertical deflection signal from the output amplifier is applied to the CRT deflection plates in the oscilloscope mainframe.

4-45. CHANNEL CONTROL. (See Schematic 11.)

4-46. Chop Operation. When CHOP mode of operation is selected by MODE switch A11S1A, a ground is applied to pin 2 on OR/NOR gate A15U6A. With a ground applied to pin 2, A15U6A operates as an astable multivibrator. The repetition rate of A15U6A, controlled by feedback capacitor A15C6, is approximately 1.6 MHz. The NOR gate output of A15U6A is applied to an input on NOR gate A15U6B. The output of A15U6B furnishes the clock signal for J-K flip-flop A15U1A/A15U1B. The Q and $\overline{Q}$

outputs of the J-K flip-flops are applied through gating circuits to furnish the enabling voltage for the output stage of the preamplifier assemblies.

4-47. Output configuration of the dual flip-flop, A15U1, is such that at any given count only one section of OR gate A15U5 produces an enabling voltage for its associated preamplifier assembly. However, this sequence is modified for A+B and C+D operation. When ADD switch A11S1B is engaged for A+B operation (see schematic 8), a logic +V potential is applied to an input on AND gate A15U4D (pin 13). When the J-K flip-flop state is such that channel A preamplifier is enabled by A15U5A, the output of A15U4D is high. The output of A15U4D is applied to OR gate A15U5B that enables the channel B preamplifier. With both channel A and channel B enabled, their output signals are summed at the 300-ohm impedance cable and applied to the buffer stage on assembly A9.

4-48. The logic +V potential from ADD switch A11S1B is also applied to AND gate A15U4B (pin 4). With a high applied to both inputs, the output of A15U4B (pin 5) is high. Since the output of A15U4B and channel B OFF-ON-INVT switch A12S2 are connected in a wired-OR configuration, AND gate A15U3A functions as if A12S2 was in the OFF position. The output of A15U3A functions as follows: with A12S2 in its OFF position and flip-flop A15U1 in channel A enabling configuration, A15U3A applies a high to the set input on flip-flop A15U1B. Upon receipt of a clock pulse from A15U6B, flip-flop A15U1 switches from the channel A enabling configuration to the channel C enabling configuration, thus, bypassing channel B. All channel OFF-ON-INVT switches function the same. The AND gates associated with the switches are A15U3A, A15U3B, A15U3C, and A15U3D.

4-49. When ADD switch A11S1C is engaged for C+D operation, the same sequence of operation for channel C and channel D occurs as explained for channel A and channel B in paragraph 4-48. The ADD gates associated with ADD C+D operation are A15U4A and A15U4C.

4-50. Alt Operation. When ALT mode of operation is selected by MODE switch A11S1A, logic +V potential is applied to an input or OR/NOR gate A15U6A. The outputs of A15U6A are held low for the NOR section and high for the OR section.

4-51. In ALT mode of operation, clock generator A15U6B is controlled by the alternate trigger signal that is furnished by the time base plug-in unit. The alternate trigger signal is directly related to the unblanking gate signal that is used to turn on the CRT intensity. The positive going alternate trigger signal is applied to the base circuit of transistor A15Q3 that is normally cut off. With a positive voltage applied to its base, A15Q3 turns on. This action applies a low to clock generator A15U6B (pin 13). This causes the output of A15U6B to go high. When the alternate trigger signal ends, A15Q3 turns off and a high is now applied to A15U6B (pin 13). The negative transition at the output of A15U6B clocks J-K flip-flop A15U1A and A15U1B. Operation of the flip-flops and their associated gating circuits was described in paragraphs 4-46 through 4-49.

4-52. Chop Blanking. The chop oscillator also drives the chop blanking circuit. The output of the oscillator is connected through an RC network to a current switch. This generates a fixed delay to compensate for the delay line in the main amplifier. The signal is then connected through an emitter follower to A15U7 that functions as a one-shot. This one-shot generates a pulse of the desired blanking width. The signal then goes to A15Q6, which functions as a level translator.

PERFORMANCE CHECK

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains step-by-step procedures for checking the instrument specifications as given in table 1-1 of this manual. The performance checks are arranged in numerical order. For best results this order should be followed. Included in this section are test setups, procedures, and test equipment required. Most test points and adjustment locations are shown in figure 5-8 located at the end of this section. The procedures for making all internal adjustments are covered in paragraphs 5-17 through 5-25.

5-3. EQUIPMENT REQUIRED.

5-4. A complete list of recommended test equipment and accessories is given 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 CHECKS.

5-6. The performance checks given in this section are suitable for incoming inspection, preventative maintenance, and troubleshooting. The checks are designed to verify the published instrument specifications. Perform the checks in the order given, and record the measurement information on the performance check record at the end of the performance checks.

5-7. PERFORMANCE CHECK RECORD. Each measurement point in the performance checks is repeated in the performance check record. The pages may be removed for filing. The first time the performance check is made, enter the results on the performance check and file it for future reference.

5-8. INITIAL CONTROL SETTINGS.

a. Install Model 1809A with time base plug-in into oscilloscope mainframe.

b. Apply external power to oscilloscope mainframe and allow 15 minutes warm-up for stabilization.

c. Set Model 1809A front-panel controls (all channels) as follows:

VOLTS/DIV	0.1
Vernier	CAL detent
Coupling	AC
OFF-ON-INVT	ON
POSITION	midrange
Trigger	COMP

d. Set oscilloscope mainframe controls as follows:

Display	internal
Magnifier	X1
Intensity	normal

e. Set time base plug-in controls as follows:

TIME/DIV	1 ms
AUTO/NORM	AUTO
Trigger	internal

f. Set oscilloscope and time base plug-in controls to obtain stable traces on CRT screen.

5-9. INITIAL CHECKS.

a. Set front-panel controls as indicated in paragraph 5-8. Four traces should appear on CRT screen.

b. Set trigger source to A. Four traces should appear on CRT screen.

c. Accomplish step b for triggers B, C, and D.

d. Rotate channel A position control over its entire range. Channel A trace should move full vertical graticule range.

e. Accomplish step d for channels B, C, and D position controls.

f. Set ADD pushbutton switch to A+B. Either channel position control should move trace vertically.

g. Set ADD pushbutton switch to C+D. Either channel position control should move trace vertically.

h. If instrument fails to meet check, refer to Section VIII of this manual for troubleshooting information.

5-10. DEFLECTION FACTOR.

a. Connect equipment as shown in figure 5-1.

Table 5-1. Recommended Test Equipment

Instrument		Required Characteristics	Required For
Type	Model		
Oscilloscope	HP 180-series	Oscilloscope Mainframe	P, A T
Time Base	HP 1820C or 1825A		
Voltmeter Calibrator	HP H01-738 BR	50 mV to 30 V p-p, accuracy 0.2%	P, A, T
Audio Oscillator	HP 204C	Frequency: 2 kHz	A, T
Multifunction Digital Voltmeter	HP 3465A	Voltage Range: 1000V Accuracy: ±0.1% Resistance Range: 1 megohm Accuracy: ±0.1%	P, T
VHF Oscillator	HP 3200B	Frequency: 10-100 MHz	P, T
RF Voltmeter	HP 3406A	dB Range: >17.5 dB	P, T
Dual Directional Coupler	HP 778D	Frequency: 100 MHz Attenuation: 20 dB nominal	P, T
LCR Meter	HP 4332A	Range: 15 pF	A, T
Square Wave Generator	HP 211B	Frequency: 10 kHz Rise time: <5 ns	A, T
Constant Amplitude Signal Generator	Tektronix Type 191	50 kHz to 100 MHz rep rate, 120 mV to 5V amplitude, constant amplitude	P, T
Pulse Generator	Tektronix Type 106	Rise time <1 ns, amplitude >.5V, overshoot and ringing <2%, pulsewidth >1 us, perturbation <1%	P, A, T
10:1 Probe	HP 10014A	10:1 Division Ratio, 10 megohm shunted by 10 pF	P, T
10 dB Attenuator	GR 874 G10	10 dB Attenuation	P, T
44-in. BNC Cable	HP 10501A	BNC 44-in.	P, A, T
9-in. BNC Cable (2)	HP 10502A	BNC 9-in.	P, A, T
Adapter	HP Part No. 1251-2277	Twin Banana Plug to BNC Female Adapter	P, A, T
BNC TEE (2)	HP Part No. 1250-0781	BNC Connection	P, T
50Ω TEE (2)	HP 11063A	Sampling Probe Tee	P, T

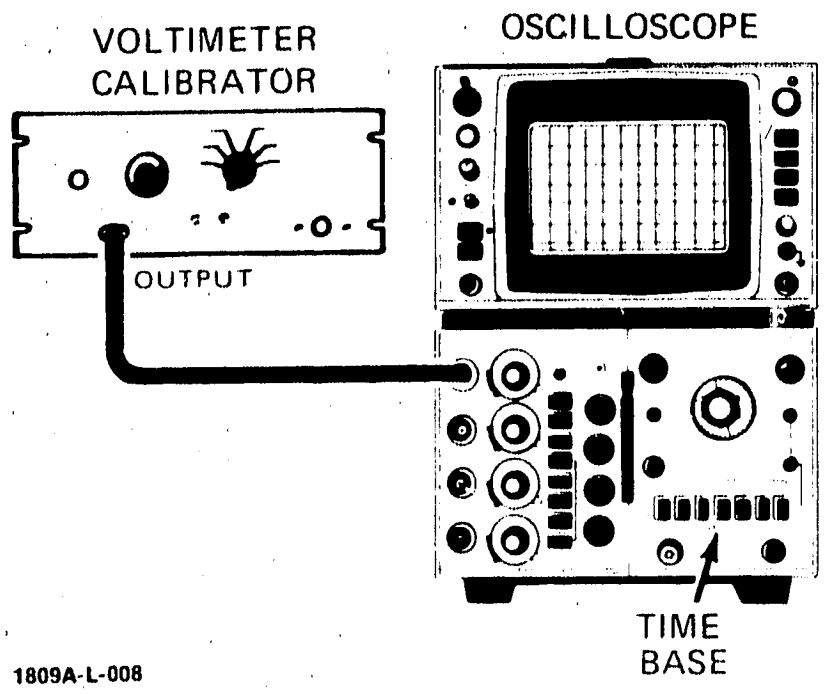


Figure 5-1. Deflection Factor Test Setup

b. Set Model 1809A front-panel controls as indicated in paragraph 5-8.

c. Set voltmeter calibrator controls for 50-mV p-p output signal.

d. Adjust CAL potentiometer for 5-division display.

e. Observe vertical deflection factors specified in table 5-2.

Table 5-2. Deflection Factor Accuracy

Voltmeter Calibrator Settings (Volts p-p)	VOLTS/DIV Settings	Vertical display (div)
0.05	.01	5 ±.10 div
0.1	.02	5 ±.10 div
0.3	.05	6 ±.12 div
0.5	.1	5 ±.10 div
1	.2	5 ±.10 div
3	.5	6 ±.12 div
5	1	5 ±.10 div
10	2	5 ±.10 div
30	5	6 ±.12 div

f. Set channel A VOLTS/DIV switch to 5.

g. Set voltmeter calibrator output for 30V p-p.

h. Rotate channel A vernier control fully counterclockwise. Vernier UNCAL indicator should light and vertical display reduction should be <2.4 divisions.

i. Rotate channel A vernier control fully clockwise to detent position.

j. Repeat steps a through i for channels B, C, and D.

k. Disconnect test equipment.

l. If instrument fails to meet check, refer to Section VIII for troubleshooting information.

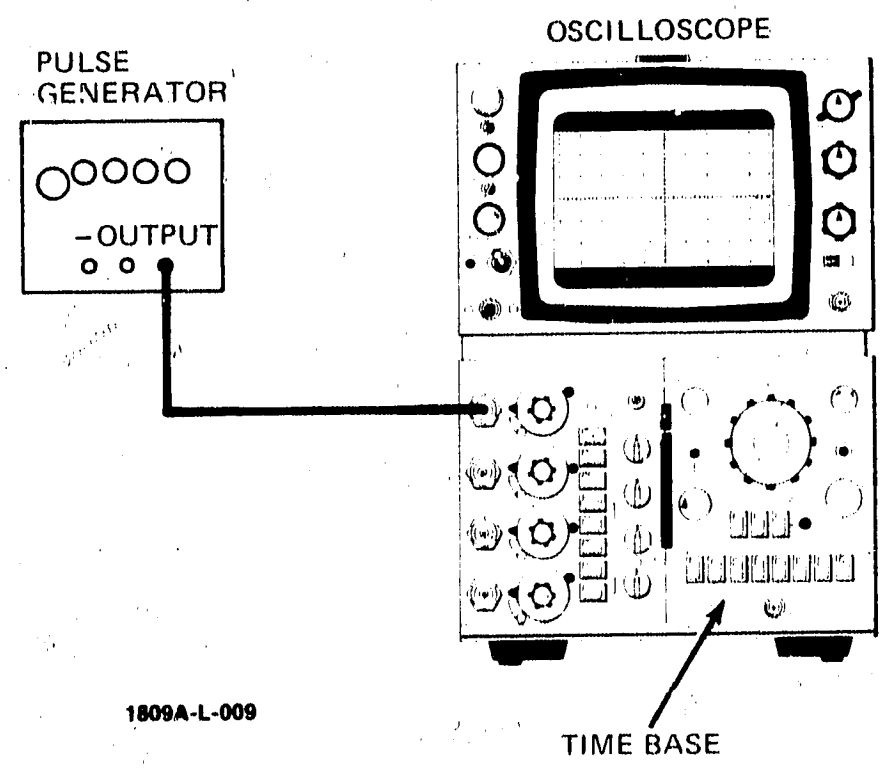


Figure 5-2. Rise Time Test Setup

5-11. RISE TIME.

a. Connect equipment as shown in figure 5-2.

b. Set Model 1809A front-panel controls as shown in paragraph 5-8, except for following:

Trigger ..... A
Coupling A 50Ω

c. Adjust pulse generator for 50-kHz 60-mV output. Rise time shall be ≤3.5 ns.

d. Repeat steps a through c for channels B, C, and D.

e. Disconnect test equipment.

5-12. BANDWIDTH.

a. Connect equipment as shown in figure 5-3, with constant amplitude signal generator and 10-dB attenuator to channel A INPUT.

b. Set Model 1809A front-panel controls as shown in paragraph 5-8, except for following:

Trigger ..... A
Coupling..... 50Ω
VOLTS/DIV..... .01

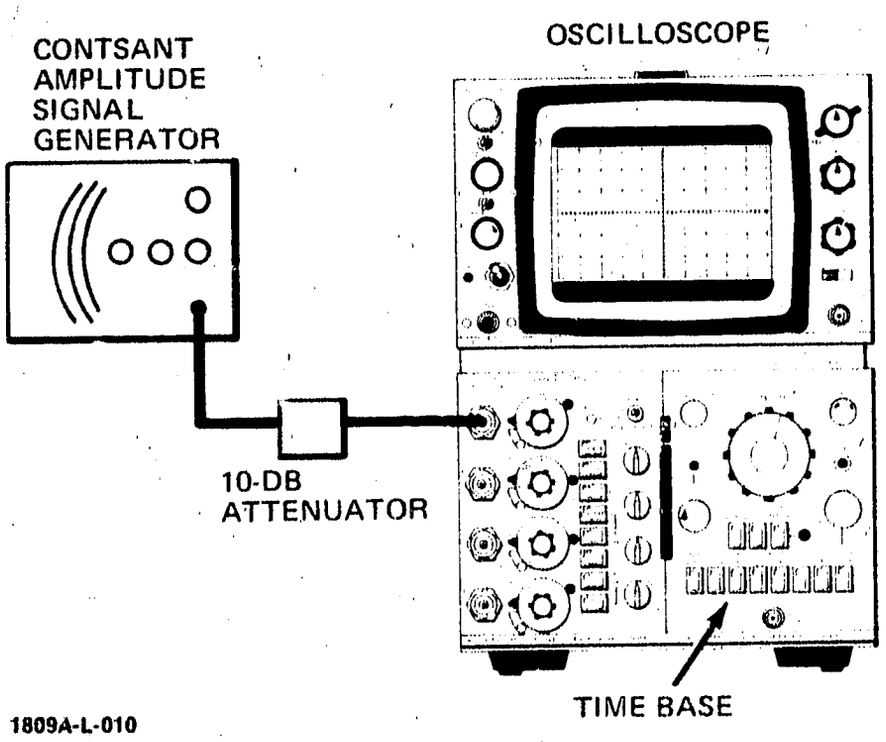


Figure 5-3. Bandwidth Test Setup

c. Set constant amplitude signal generator for 1-MHz output.

d. Adjust constant amplitude signal generator for 6-division display.

e. Increase constant amplitude signal generator frequency to 100 MHz. Deflection shall be >4.2 divisions (3 dB down).

f. Repeat steps a through e for channels B thru D.

g. Disconnect test equipment.

h. If instrument fails to meet check, refer to Section VIII for troubleshooting information.

5-13. INPUT RESISTANCE.

a. Connect instruments as shown in figure 5-4.

b. Set Model 1809A channel A coupling to DC.

c. Set multifunction digital voltmeter controls to measure 1 megohm. Indication on multifunction digital voltmeter should be 1 megohm ±1%.

d. Check all channel A VOLTS/DIV ranges for step c indication.

e. Set channel A coupling to 50Ω.

f. Set multifunction digital voltmeter controls to measure 50 ohms. Indication on multifunction digital voltmeter should be 50 ohms ±2%.

g. Check all channel A VOLTS/DIV ranges for step f indication.

h. Accomplish steps a through g for channels B, C, and D.

i. Disconnect test equipment.

j. If instrument fails to meet check, refer to attenuator section in Section VIII for troubleshooting information.

5-14. COMMON MODE REJECTION.

a. Connect equipment as shown in figure 5-5.

b. Set Model 1809A front-panel controls as follows:

OFF-ON-INVT (channels A and B)	ON
OFF-ON-INVT (channels C and D)	OFF
Coupling (all channels)	AC
VOLTS/DIV (all channels)	.01
ADD	A+B

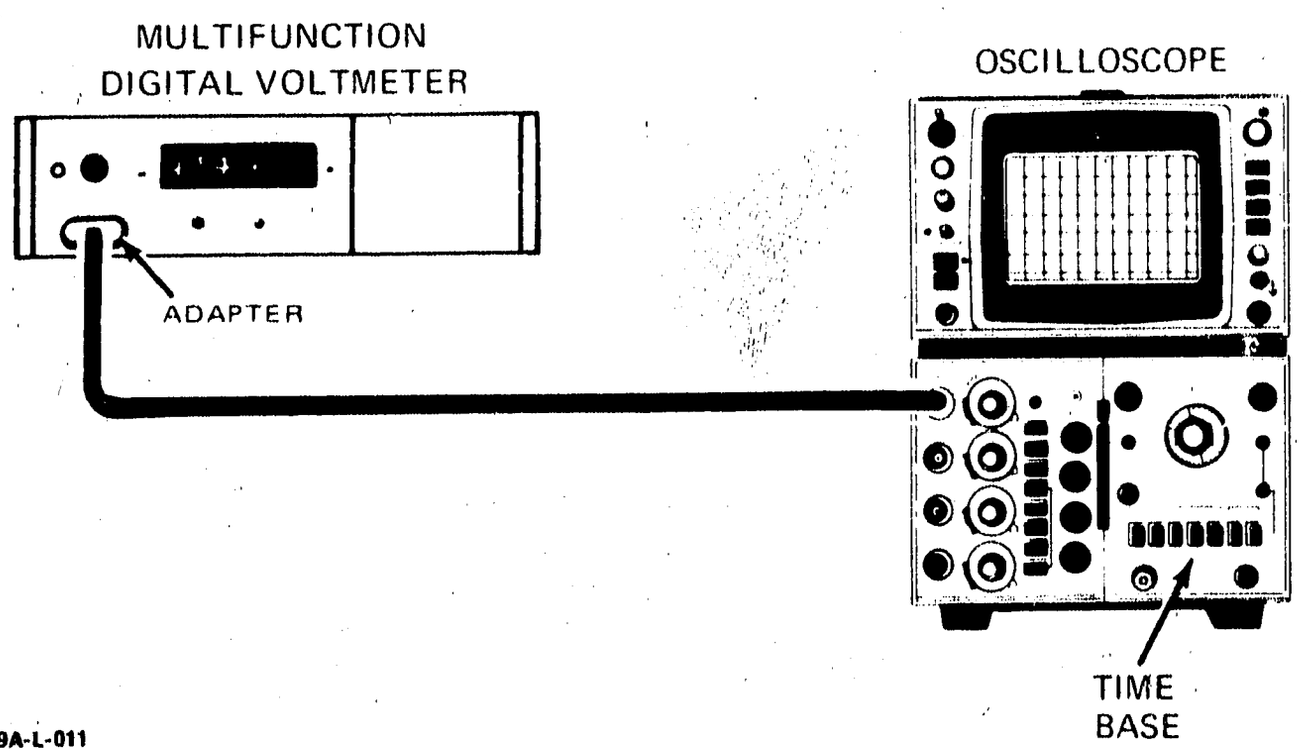


Figure 5-4. Input Resistance Test Setup

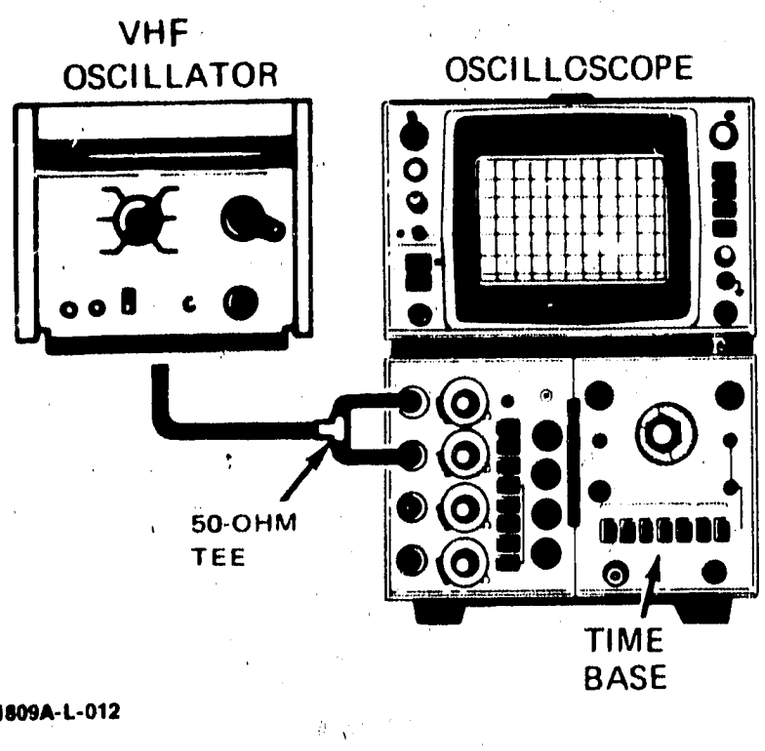


Figure 5-5. CMR Test Setup

c. Set vhf oscillator controls for 80-MHz 6-division output display.

d. Set channel B OFF-ON-INVT switch to INVT position. Deflection shall be equal to or less than 0.6 division.

NOTE

Cable lengths from Tee connections to channel INPUT connectors should be as short as possible and of the same electrical length. In addition, if the specified deflection cannot be met, the verniers may be used to bring the deflection down.

e. Accomplish steps a through d for channels C and D.

f. Disconnect test equipment.

g. If instrument fails to meet check, refer to Section VIII for troubleshooting information.

5-15. VSWR CHECK.

a. Connect equipment as shown in figure 5-6.

b. Set Model 1809A channel A coupling to 50Ω.

c. With rf voltmeter probe connected to point B (see figure 5-6), adjust vhf oscillator for 100-MHz output and 0 dB reading on rf voltmeter.

d. Connect rf voltmeter to point A.

e. Check all VOLTS/DIV ranges. Reflection coefficient on all ranges shall be >17.5 dB (1.3:1) as indicated on rf voltmeter.

f. Accomplish steps a through e for channels B, C, and D.

g. Disconnect test equipment.

h. If instrument fails to meet check, refer to Section VIII for troubleshooting information.

5-16. TRIGGERING

a. Connect equipment as shown in figure 5-7.

b. Connect constant amplitude signal generator to channel A INPUT.

c. Set Model 1809A front-panel controls as shown in paragraph 5-8, except for following:

Figure 5-6. VSWR Test Setup

Trigger ..... A
VOLTS/DIV A 5
Coupling..... DC

d. Observe displays as specified in table 5-3.

Table 5-3. Triggering

Time Base Plug-in	Constant Amplitude Signal Generator	Vertical Deflection Required to Trigger
1820C, 1824A 1825A, 1840A	50 MHz	>0.5 division
1841A	100 MHz	>1 division
1820B, 1822A	50 MHz	>0.5 division
	100 MHz	>2 divisions
1820A, 1821A	50 MHz	>1 division

e. Disconnect test equipment.

f. If instrument fails to meet check, refer to Section VIII for troubleshooting information.

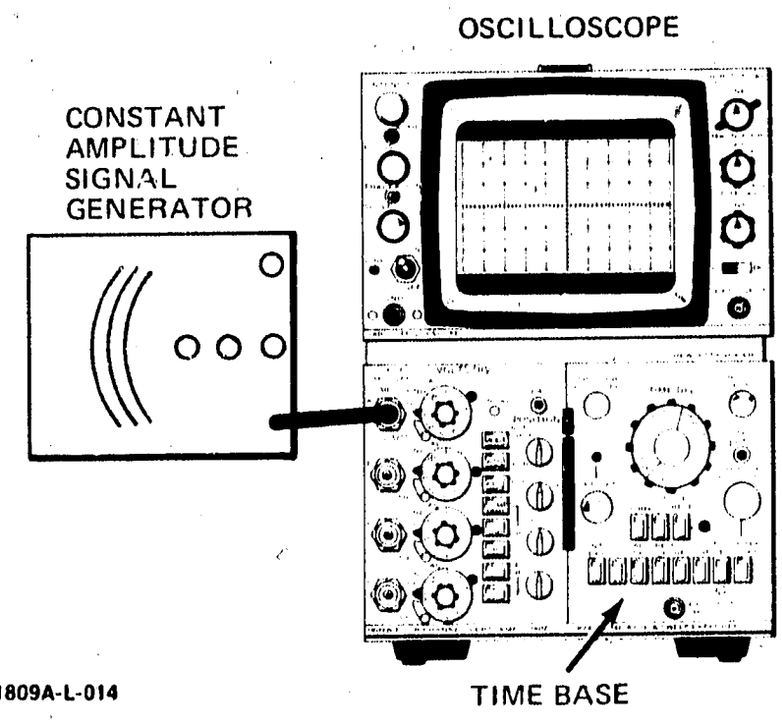


Figure 5-7. Triggering Test Setup

PERFORMANCE CHECK RECORD

MODEL 1809A

Instrument Serial Number _____ **Date** _____

Check	Specification	Measured	
DEFLECTION FACTOR (channels A and B)		Ch A	Ch B
.01 VOLTS/DIV	5 ±.10 div	____	____
.02 VOLTS/DIV	5 ±.10 div	____	____
.05 VOLTS/DIV	6 ±.12 div	____	____
.1 VOLTS/DIV	5 ±.10 div	____	____
.2 VOLTS/DIV	5 ±.10 div	____	____
.5 VOLTS/DIV	6 ±.12 div	____	____
1 VOLTS/DIV	5 ±.10 div	____	____
2 VOLTS/DIV	5 ±.10 div	____	____
5 VOLTS/DIV	6 ±.12 div	____	____
vernier	≤2.4 div	____	____
DEFLECTION FACTOR (channels C and D)		Ch C	Ch D
.01 VOLTS/DIV	5 ±.10 div	____	____
.02 VOLTS/DIV	5 ±.10 div	____	____
.05 VOLTS/DIV	6 ±.10 div	____	____
.1 VOLTS/DIV	5 ±.10 div	____	____
.2 VOLTS/DIV	5 ±.10 div	____	____
.5 VOLTS/DIV	6 ±.12 div	____	____
1 VOLTS/DIV	5 ±.10 div	____	____
2 VOLTS/DIV	5 ±.10 div	____	____
5 VOLTS/DIV	6 ±.12 div	____	____
vernier	≤2.4 div	____	____
RISE TIME			
Channel A rise time (ON)	≤3.5 ns	____	____
Channel A rise time (INVT)	≤3.5 ns	____	____
Channel B rise time (ON)	≤3.5 ns	____	____
Channel B rise time (INVT)	≤3.5 ns	____	____
Channel C rise time (ON)	≤3.5 ns	____	____
Channel C rise time (INVT)	≤3.5 ns	____	____
Channel D rise time (ON)	≤3.5 ns	____	____
Channel D rise time (INVT)	≤3.5 ns	____	____
BANDWIDTH			
Channel A bandwidth	≥4.2 div	____	____
Channel B bandwidth	≥4.2 div	____	____
Channel C bandwidth	≥4.2 div	____	____
Channel D bandwidth	≤4.2 div	____	____

PERFORMANCE CHECK RECORD

MODEL 1809A

Instrument Serial Number _____ Date _____

Check	Specification	Measured
INPUT RESISTANCE		
DC Resistance (Channels A and B)		Ch A Ch B
.01 VOLTS/DIV	1 megohm ±1%	____ ____
.02 VOLTS/DIV	1 megohm ±1%	____ ____
.05 VOLTS/DIV	1 megohm ±1%	____ ____
.1 VOLTS/DIV	1 megohm ±1%	____ ____
.2 VOLTS/DIV	1 megohm ±1%	____ ____
.5 VOLTS/DIV	1 megohm ±1%	____ ____
1 VOLTS/DIV	1 megohm ±1%	____ ____
2 VOLTS/DIV	1 megohm ±1%	____ ____
5 VOLTS/DIV	1 megohm ±1%	____ ____
50Ω Resistance (Channels A and B)		Ch A Ch B
.01 VOLTS/DIV	50 ohms ±2%	____ ____
.02 VOLTS/DIV	50 ohms ±2%	____ ____
.05 VOLTS/DIV	50 ohms ±2%	____ ____
.1 VOLTS/DIV	50 ohms ±2%	____ ____
.2 VOLTS/DIV	50 ohms ±2%	____ ____
.5 VOLTS/DIV	50 ohms ±2%	____ ____
1 VOLTS/DIV	50 ohms ±2%	____ ____
2 VOLTS/DIV	50 ohms ±2%	____ ____
5 VOLTS/DIV	50 ohms ±2%	____ ____
DC Resistance (Channels C and D)		Ch C Ch D
.01 VOLTS/DIV	1 megohm ±1%	____ ____
.02 VOLTS/DIV	1 megohm ±1%	____ ____
.05 VOLTS/DIV	1 megohm ±1%	____ ____
.1 VOLTS/DIV	1 megohm ±1%	____ ____
.2 VOLTS/DIV	1 megohm ±1%	____ ____
.5 VOLTS/DIV	1 megohm ±1%	____ ____
1 VOLTS/DIV	1 megohm ±1%	____ ____
2 VOLTS/DIV	1 megohm ±1%	____ ____
5 VOLTS/DIV	1 megohm ±1%	____ ____
50Ω Resistance (Channels C and D)		Ch C Ch D
.01 VOLTS/DIV	50 ohms ±2%	____ ____
.02 VOLTS/DIV	50 ohms ±2%	____ ____
.05 VOLTS/DIV	50 ohms ±2%	____ ____
.1 VOLTS/DIV	50 ohms ±2%	____ ____
.2 VOLTS/DIV	50 ohms ±2%	____ ____
.5 VOLTS/DIV	50 ohms ±2%	____ ____
1 VOLTS/DIV	50 ohms ±2%	____ ____
2 VOLTS/DIV	50 ohms ±2%	____ ____
5 VOLTS/DIV	50 ohms ±2%	____ ____

PERFORMANCE CHECK RECORD

MODEL 1809A

Instrument Serial Number _____ Date _____

Check	Specification	Measured
COMMON MODE REJECTION		
Channels A and B (80 MHz)		
.01 VOLTS/DIV	≤0.6 div	_____
.02 VOLTS/DIV	≤0.6 div	_____
.05 VOLTS/DIV	≤0.6 div	_____
.1 VOLTS/DIV	≤0.6 div	_____
.2 VOLTS/DIV	≤0.6 div	_____
.5 VOLTS/DIV	≤0.6 div	_____
1 VOLTS/DIV	≤0.6 div	_____
2 VOLTS/DIV	≤0.6 div	_____
5 VOLTS/DIV	≤0.6 div	_____
Channels C and D (80 MHz)		
.01 VOLTS/DIV	≤0.6 div	_____
.02 VOLTS/DIV	≤0.6 div	_____
.05 VOLTS/DIV	≤0.6 div	_____
.1 VOLTS/DIV	≤0.6 div	_____
.2 VOLTS/DIV	≤0.6 div	_____
.5 VOLTS/DIV	≤0.6 div	_____
1 VOLTS/DIV	≤0.6 div	_____
2 VOLTS/DIV	≤0.6 div	_____
5 VOLTS/DIV	≤0.6 div	_____
VSWR		
Channels A and B (100 MHz)		Ch A Ch B
.01 VOLTS/DIV	≥17.5 dB	_____ _____
.02 VOLTS/DIV	≥17.5 dB	_____ _____
.05 VOLTS/DIV	≥17.5 dB	_____ _____
.1 VOLTS/DIV	≥17.5 dB	_____ _____
.2 VOLTS/DIV	≥17.5 dB	_____ _____
.5 VOLTS/DIV	≥17.5 dB	_____ _____
1 VOLTS/DIV	≥17.5 dB	_____ _____
2 VOLTS/DIV	≥17.5 dB	_____ _____
5 VOLTS/DIV	≥17.5 dB	_____ _____
Channels C and D (100 MHz)		Ch C Ch D
.01 VOLTS/DIV	≥17.5 dB	_____ _____
.02 VOLTS/DIV	≥17.5 dB	_____ _____
.05 VOLTS/DIV	≥17.5 dB	_____ _____
.1 VOLTS/DIV	≥17.5 dB	_____ _____
.2 VOLTS/DIV	≥17.5 dB	_____ _____
.5 VOLTS/DIV	≥17.5 dB	_____ _____
1 VOLTS/DIV	≥17.5 dB	_____ _____
2 VOLTS/DIV	≥17.5 dB	_____ _____
5 VOLTS/DIV	≥17.5 dB	_____ _____

PERFORMANCE CHECK RECORD
MODEL 1809A

Instrument Serial Number _____ **Date** _____

Check	Specification	Measured
TRIGGERING		
Time Base Plug-in		
1820C	>0.5 division	
1824A	>0.5 division	
1825A	>0.5 division	
1840A	>0.5 division	
1841A	>1.0 division	
1820B	>0.5 division	
1822A	>0.5 division	
1820B	>2.0 divisions	
1822A	>2.0 divisions	
1820A	>1.0 division	
1821A	>1.0 division	

5-17. ADJUSTMENT PROCEDURES.

5-18. The following paragraphs outline the procedure for accomplishing the adjustments required for the Model 1809A. Use the equipment recommended in table 5-1 or similar equipment having at least equivalent capability. Use a nonmetallic adjustment tool when making adjustments.

5-19. The adjustment procedures should be performed in the sequence listed, since some adjustments are dependent on control settings and results of previous steps. The adjustments may be accomplished individually, if desired, by referring to the preliminary control settings and the steps before the desired procedure.

5-20. DC BAL ADJUSTMENT.

a. Remove oscilloscope's left, lower side panel.

b. Set front-panel controls as indicated in paragraph 5-8 except as follows:

Coupling	GND
OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF

c. Switching channel A OFF-ON-INVT switch between ON and INVT position, adjust A5R2 for no shift in channel A trace.

d. Accomplish steps b and c for chann B, C, and D using adjustments A6R2, A7R2, and A8R2.

5-21. OUTPUT BAL ADJUSTMENT.

a. Accomplish paragraph 5-20.

b. Set front-panel controls as indicated in paragraph 5-8 except as follows:

OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF
Coupling (channel A)	GND

c. Press FIND BEAM switch on front-panel.

d. While holding FIND BEAM switch depressed, rotate channel A position control over its entire range.

e. Check that trace moves symetrically (vertically) about center screen.

f. Adjust output balance potentiometer A10A1R3 on assembly A10A1 to accomplish step e.

NOTE

The output balance adjustment can be accomplished using any channel (A, B, C, or D). In this procedure channel A was used.

5-22. GAIN ADJUSTMENTS.

a. Set front-panel controls as indicated in paragraph 5-8 except as follows:

Model 1809A

OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF
Coupling (all channels)	AC

Time Base

TIME/DIV	1 mSEC
Trigger slope	positive

b. Connect voltmeter calibrator to channel A input.

c. Set voltmeter calibrator for 50-mV p-p output.

d. Adjust Model 1809A front-panel CAL potentiometer R5 for approximately 5 divisions of display.

e. Adjust channel A CAL potentiometer A5R11 for maximum amplitude display; then reduce amplitude 10%.

f. Set front-panel CAL potentiometer R5 for exactly 5 divisions of display.

g. Connect voltmeter calibrator signal to channel B INPUT connector.

h. Adjust channel B CAL potentiometer A6R11 for exactly 5-division display.

i. Repeat steps g and h for channels C and D, using adjustments A7R11 and A8R11.

j. Disconnect voltmeter calibrator from Model 1809A.

NOTE

Gain in the 50Ω position may differ from gain in the AC and DC positions. This difference will be proportional to the amount of resistance in the input lead (1 ohm will cause a 2% variation). If a greater degree of accuracy in the 50Ω position is required, perform the following steps:

k. Set 1809A input coupling (both channels) to 50Ω.

l. Connect accurate 30-mVdc signal to channel A INPUT connector.

NOTE

Ensure minimum resistance in the input lead.

m. Adjust front-panel VOLTS/DIV CAL potentiometer for exactly 6-division trace displacement.

n. Disconnect test equipment.

o. Set 1809A front-panel controls to initial settings.

5-23. ATTENUATOR ADJUSTMENTS.

a. Set front-panel controls as indicated in paragraph 5-8 except as follows:

OFF-ON-INVT (channel B)	ON
OFF-ON-INVT (channels A, C, and D)	OFF
Coupling (all channels)	DC
VOLTS/DIV (all channels)	.02

b. Connect output of square wave generator to channel B INPUT connector.

c. Set square wave generator controls for 10-kHz output signal.

d. On channel B attenuator assembly A2A1, adjust .02V COMP capacitor A2A1C8 for flat square wave response.

e. Set channel B VOLTS/DIV switch to .05 position.

f. Adjust .05V COMP capacitor A2A1C6 for flat square wave response.

g. Set channel B VOLTS/DIV switch to .1 position.

h. Adjust .1V COMP capacitor A2A1C4 for flat square wave response.

i. Set channel B VOLTS/DIV switch to 1 position.

j. Adjust 1V COMP capacitor A2A1C2 for flat square wave response.

k. Set channel B VOLTS/DIV switch to .2 position.

l. Adjust .02 input capacitor A2A1C7 for best square wave response.

m. Set channel B VOLTS/DIV switch to .5 position.

n. Adjust .02V INPUT capacitor A2A1C5 for best square wave response.

o. Disconnect square wave generator from Model 1809A.

p. Set channel B VOLTS/DIV Switch to .01.

q. Connect LCR meter with short BNC cable to channel B input. Note indication on LCR meter of approximately 12 pF.

r. Set channel B VOLTS/DIV switch to .1 position.

s. Adjust .1V INPUT capacitor A2A1C3 for 0.5 pF less than capacitance indication noted in step q.

t. Set channel B VOLTS/DIV switch to 1 position.

u. Adjust 1V INPUT capacitor A2A1C1 for same capacitance indication noted in step q.

v. Accomplish steps a through u for channel A, C, and D using adjustments on assemblies A1A1, A3A1, and A4A1.

NOTE

With the Model 1809A and the time base plug-in unit installed in the oscilloscope, part of channel A attenuator adjustments are covered by the oscilloscope frame. To make these adjustments on channel A, the plug-in units must be partically removed from the mainframe, an adjustment made, the plug-in units reinserted into the mainframe, and a check made on the latest adjustment. This procedure must be repeated until the channel A attenuator is properly adjusted.

w. Disconnect test equipment.

5-24. SYNC BALANCE ADJUSTMENT.

a. Set front-panel controls as indicated in paragraph 5-8 except as follows:

OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF
VOLTS/DIV (channel A)	1V
Coupling (all channels)	GND
Trigger	A
Trigger coupling (time base)	AC

b. Using audio oscillator, apply 2 kHz sine wave to channel A INPUT connector.

c. Adjust audio oscillator output for 4-division display.

d. Set time base trigger to DC.

e. Adjust sync bal A5R17 to trigger at center graticule.

f. Repeat steps b through e and adjust A6R17 (channel B), A7R17 (channel C), and A8R17(channel D) in step e.

g. Connect audio oscillator to any channel INPUT connector. Turn unused channel ON/OFF/INV switches to OFF position.

h. Set audio oscillator output for 2-kHz sine wave.

i. Repeat steps b through e, except set trigger to COMP. Use A5R42 to adjust triggering at center of graticule.

j. Disconnect test equipment.

5-25. PULSE RESPONSE ADJUSTMENTS.

a. Set front-panel controls as indicated in paragrapn 5-8 except as follows:

VOLTS/DIV (channel A)	.01
OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF
Coupling (all channels)	50Ω

b. Connect fast rise time pulse generator to channel A input connector.

c. Set time base controls for .1 us output.

d. Adjust time base plug-in unit controls for stable display.

e. Adjust pulse generator for 6 div pulse.

f. On channel A preamplifier assembly A5, alternately adjust A5C2 and A5R4 for optimum pulse response.

NOTE

Optimum pulse response is defined as minimum overshoot, minimum hook, and optimum leading edge on pulse.

g. On intermediate assembly A9, alternately adjust A9C8, A9R30, and A9R55 for optimum pulse response.

h. On main amplifier assembly A10A1 and on output assembly A10A2, Adjust A10A1C3, A10A1C7, A10A1R12, A10A1R13, and A10A2C1 for optimum pulse response.

i. Repeat steps f through h until optimum pulse response is reached.

j. Accomplish steps a through f for channels B, C, and D using A6C2/A6R4, A7C2/A7R4, and A8C2/A8R4 for pulse response adjustments.

NOTE

Do not reset adjustments on assemblies A9, A10A1, and A10A2 after initial adjustments with channel A.

k. Disconnect test equipment.

This completes the adjustment procedures for the Model 1809A.

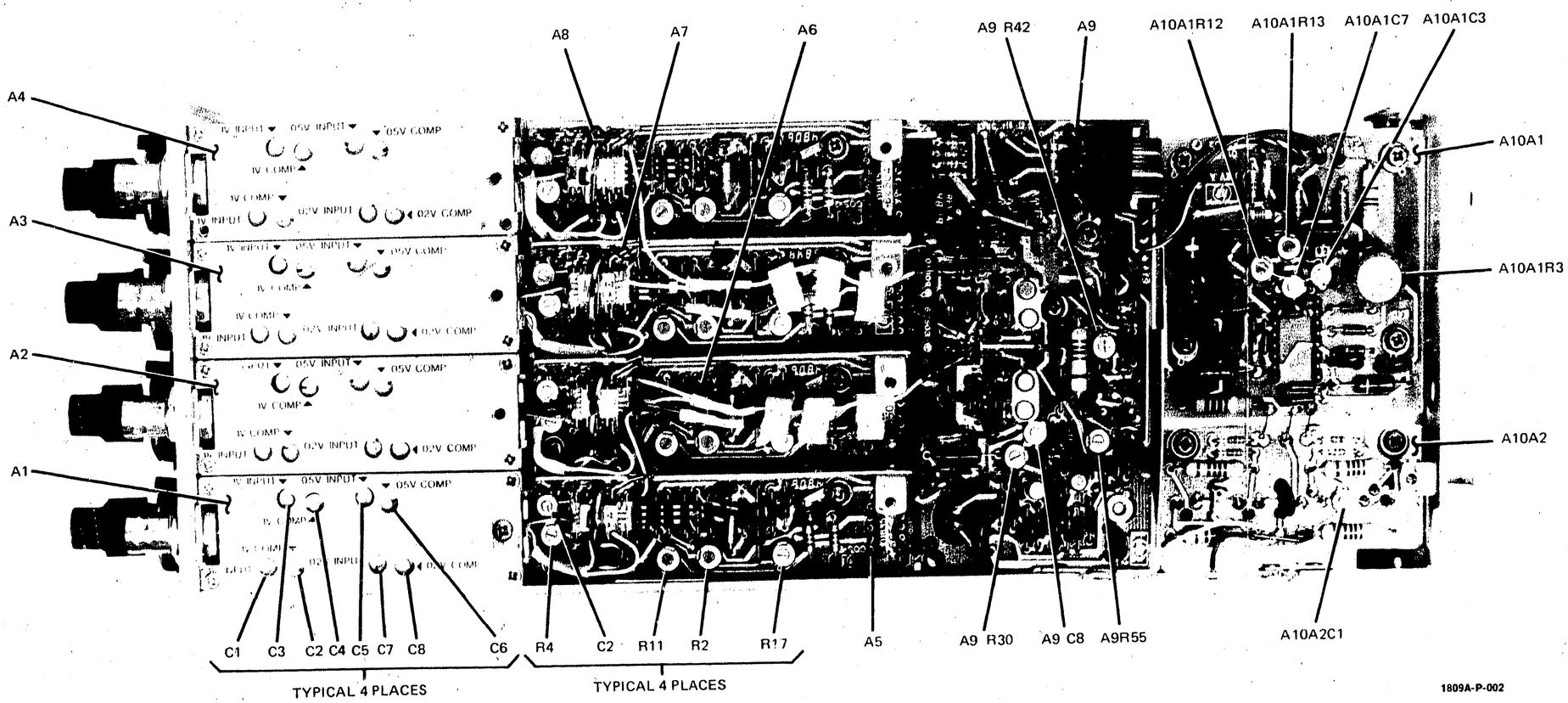
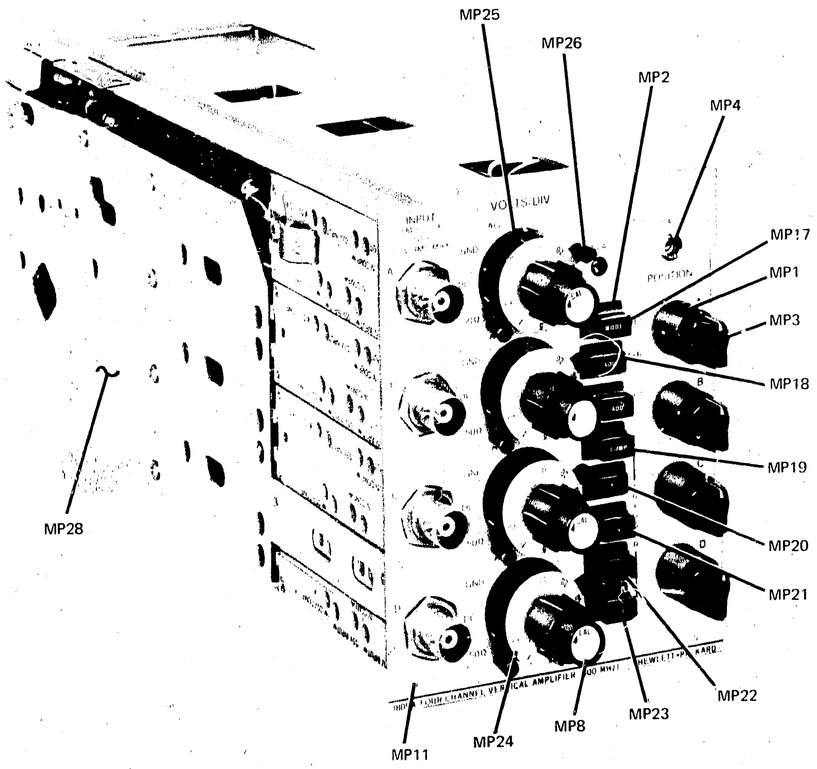
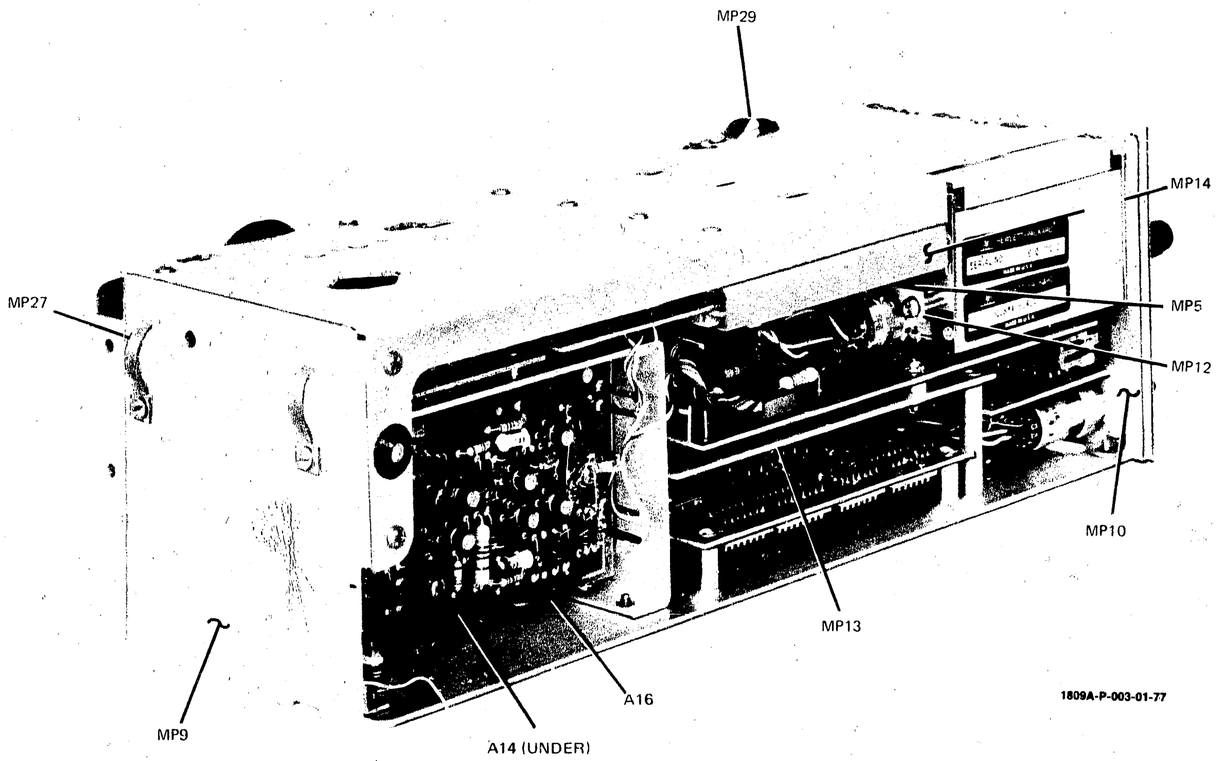


Figure 5-8.
Adjustment Locations

PARTS LIST





1809A-P-003-01-77

Figure 6-1. Illustrated Parts Breakdown

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. The abbreviations used in the parts list are described in table 6-1. Table 6-2 lists the parts in alphanumeric order by reference designation and includes the manufacturer and manufacturer's part number. Table 6-3 contains the list of manufacturers' codes.

6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts from Hewlett-Packard, address order or inquiry to the nearest Hewlett-Packard Sales/Service Office and supply the following information:

a. Instrument model and serial number.

b. HP part number of item(s).

c. Quantity of part(s) desired.

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 function and location in the instrument.

c. Quantity desired.

Table 6-1. Abbreviations for Replaceable Parts List

A	AMPERE(S)	H	HENRY(IES)	NPN	NEGATIVE POSITIVE NEGATIVE	RWV	REVERSE WORKING VOLTAGE
ASSY	ASSEMBLY	HG	MERCURY				
		HP	HEWLETT-PACKARD	NSR	NOT SEPARATELY REPLACEABLE	S-B	SLOW-BLOW
BD	BOARD(S)	HZ	HERTZ			SCR	SILICON CONTROLLED RECTIFIER
BH	BINDER HEAD						
BP	BANDPASS	IF	INTERMEDIATE FREQ.			SE	SELENIUM
		IMPG	IMPREGNATED	OBD	ORDER BY DESCRIPTION	SEC	SECOND(S)
C	CENTI (10^{-2})	INCD	INCANDESCENT			SECT	SECTION(S)
CAR	CARBON	INCL	INCLUDE(S)	OH	OVAL HEAD	SI	SILICON
CCW	COUNTERCLOCKWISE	INS	INSULATION(ED)	OX	OXIDE	SIL	SILVER
CER	CERAMIC	INT	INTERNAL			SL	SLIDE
CMO	CABINET MOUNT ONLY			P	PEAK	SP	SINGLE POLE
COAX	COAXIAL	K	KILO (10^{3})	PC	PRINTED (ETCHED) CIRCUIT(S)	SPL	SPECIAL
COEF	COEFFICIENT	KG	KILOGRAM			ST	SINGLE THROW
COMP	COMPOSITION			PF	PICOFARADS	STD	STANDARD
CONN	CONNECTOR(S)	LB	POUND(S)	PHL	PHILLIPS		
CRT	CATHODE-RAY TUBE	LH	LEFT HAND	PIV	PEAK INVERSE VOLTAGE(S)	TA	TANTALUM
CW	CLOCKWISE	LIN	LINEAR TAPER			TD	TIME DELAY
		LOG	LOGARITHMIC TAPER	PNP	POSITIVE-NEGATIVE POSITIVE	TFL	TEFLON
D	DECI (10^{-1})	LPF	LOW-PASS FILTER(S)			TGL	TOGGLE
DEPC	DEPOSITED CARBON	LVR	LEVER	P/O	PART OF	THYR	THYRISTOR
DP	DOUBLE POLE			PORC	PORCELAIN	TI	TITANIUM
DT	DOUBLE THROW	M	MILLI (10^{-3})	POS	POSITION(S)	TNLDIO	TUNNEL DIODE(S)
		MEG	MEGA (10^{6})	POT	POTENTIOMETER(S)	TOL	TOLERANCE
ELECT	ELECTROLYTIC	MET FILM	METAL FILM	P-P	PEAK-TO-PEAK	TRIM	TRIMMER
ENCAP	ENCAPSULATED	MET OX	METAL OXIDE	PRGM	PROGRAM		
EXT	EXTERNAL	MFR	MANUFACTURER	PS	POLYSTYRENE		
		MINAT	MINIATURE	PWV	PEAK WORKING VOLTAGE	U	MICRO (10^{-6})
F	FARAD(S)	MOM	MOMENTARY				
FET	FIELD-EFFECT TRANSISTOR(S)	MTG	MOUNTING			V	VOLTS
		MY	MYLAR	RECT	RECTIFIER(S)	VAR	VARIABLE
FH	FLAT HEAD			RF	RADIO FREQUENCY	VDCW	DC WORKING VOLT(S)
FIL H	FILLISTER HEAD	N	NANO (10^{-9})	RFI	RADIO FREQUENCY INTERFERENCE		
FXD	FIXED	N/C	NORMALLY CLOSED			W	WATT(S)
		NE	NEON	RH	ROUND HEAD OR RIGHT HAND	W/	WITH
G	GIGA (10^{9})	N/O	NORMALLY OPEN			WIV	WORKING INVERSE VOLTAGE
GE	GERMANIUM	NOP	NEGATIVE POSITIVE ZERO (ZERO TEMPERATURE COEFFICIENT)	RMO	RACK MOUNT ONLY	W/O	WITHOUT
GL	GLASS			RMS	ROOT MEAN SQUARE	WW	WIREWOUND
GRD	GROUNDED						

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
A1	01834-63401		ATTENUATOR ASSY:CHANNEL A	28480	01834-63401
A2	01834-63401		ATTENUATOR ASSY:CHANNEL B	28480	01834-63401
A3	01834-63401		ATTENUATOR ASSY:CHANNEL C	28480	01834-63401
A4	01834-63401		ATTENUATOR ASSY:CHANNEL D	28480	01834-63401
A5	01835-66504		PREAMPL ASSY:CHANNEL A	28480	01835-66504
A6	01835-66504		PREAMPL ASSY:CHANNEL B	28480	01835-66504
A7	01835-66504		PREAMPL ASSY:CHANNEL C	28480	01835-66504
A8	01835-66504		PREAMPL ASSY:CHANNEL D	28480	01835-66504
A9	01809-66503		BOARD ASSY:INTERMEDIATE	28480	01809-66503
A10	NOT AVAILABLE AS ASSEMBLY		OUTPUT AMPLIFIER ASSY		
A10A1	01809-66502	1	BD ASSY:MAIN AMP	28480	01809-66502
A10A2	01809-66501		BOARD ASSY:OUTPUT	28480	01809-66501
A11	01809-66507		BOARD ASSY:MOTHER	28480	01809-66507
A12	01834-66510		BOARD ASSY:POSITION-INVERTER	28480	01834-66510
A13	01809-66506		BOARD ASSY:CHASSIS INTERCONNECT	28480	01809-66506
A14	01809-61601		ASSY:DELAY LINE	28480	01809-61601
A15	01809-66504		BOARD ASSY:CHANNEL CONTROL	28480	01809-66504
A16	01809-66505	1	BOARD ASSY:SYNC	28480	01809-66505
DS1	2140-0018	1	LAMP:GLOW 1.0 MILLIAMPS 0.1W	08806	A9A-CNE 2E1
J1	1250-0897	1	CONN:COAX 75 OHM MALE	24931	33JR137-1
L1 thru L16	9170-0016	24	CORE-SHIELDING BEAD	02114	56-590-65A1/3B
MP1	0370-0682	4	KNOB:RND BLK 0.540" DIA (POSITION)	28480	0370-0682
MP2	0370-0451	8	BEZEL:PUSHBUTTON KNOB BLK NYLON	28480	0370-0451
MP3	0370-2498	4	KNOB:BAR (OFF-ON-INVT)	28480	0370-2498
MP4	1490-0968	1	BUSHING:POTENTIOMETER 1/4-32 EXT THRD	00000	OBD
MP5	5040-0218	4	COUPLER:SWITCH SHAFT	28480	5040-0218
MP6	5060-0451	1	LENS ASSY	28480	5060-0451
MP7	5060-0458	1	HEADER:LAMP	28480	5060-0458
MP8	01804-67401	1	KNOB ASSY:VERNIER (CAL)	28480	01804-67401
MP9	01834-00204	1	PANEL:REAR	28480	01834-00204
MP10	01834-00201	1	PANEL:SUB	28480	01834-00201
MP11	01809-00201	1	PANEL:FRONT	28480	01809-00201
MP12	01834-01201	1	BRACKET:POTENTIOMETER MOUNTING	28480	01834-01201
MP13	01834-01203	1	BRACKET:MAIN	28480	01834-01203
MP14	01835-01201	1	BRACKET:PREAMPLIFIER	28480	01835-01201
MP15	01808-23201	1	SHAFT:VERNIER	28480	01808-23201
MP16	01809-60101	1	ASSY:CHASSIS	28480	01809-60101
MP17	01834-67401	1	PUSHBUTTON ASSY:MODE	28480	01834-67401
MP18	01834-67402	2	PUSHBUTTON ASSY:ADD	28480	01834-67402
MP19	01834-67403	1	PUSHBUTTON ASSY:COMP	28480	01834-67403
MP20	01834-67404	1	PUSHBUTTON ASSY:A	28480	01834-67404
MP21	01834-67405	1	PUSHBUTTON ASSY:B	28480	01834-67405
MP22	01834-67406	1	PUSHBUTTON ASSY:C	28480	01834-67406
MP23	01834-67407	1	PUSHBUTTON ASSY:D	28480	01834-67407
MP24	01834-67409	4	KNOB ASSY:VOLTS/DIV	28480	01834-67409
MP25	01834-67410	4	SPACER:DIAL ASSY	28480	01834-67410
MP26	5040-7475	4	LEVER:COUPLING	28480	5040-7475
MP27	00180-09104	2	CLIP:GND	28480	00180-09104
MP28	01809-04701	1	SUPPORT:PLUGIN	28480	01809-04701
MP29	01834-09103	1	SPRING:GROUNDING	28480	01834-09103
Q1	1854-0567	4	TSTR	28480	1854-0567
Q2	1854-0567		TSTR	28480	1854-0567
Q3	1854-0567		TSTR	28480	1854-0567
Q4	1854-0567		TSTR	28480	1854-0567
R1	2100-0547	4	R:VAR COMP 5K OHM 20% 10 CCW 1/8W	28480	2100-0547
R2	2100-0547		R:VAR COMP 5K OHM 20% 10 CCW 1/8W	28480	2100-0547
R3	2100-0547		R:VAR COMP 5K OHM 20% 10 CCW 1/8W	28480	2100-0547
R4	2100-0547		R:VAR COMP 5K OHM 20% 10 CCW 1/8W	28480	2100-0547
R5	2100-2062	1	R:VAR COMP 1K OHM 10% LIN 1/2W	28480	2100-2062
R6	0811-1861	2	R:FXD FLM 750 OHM 5% 5W	56289	0811-1861
R7	0811-1861		R:FXD FLM 750 OHM 5% 5W	56289	0811-1861
W1	NOT ASSIGNED				
W2	01834-61603	2	CABLE ASSY:IMPEDANCE	28480	01834-61603
W3	01834-61603		CABLE ASSY:IMPEDANCE	28480	01834-61603
XQ1	5000-0543	4	HOLDER:TSTR	28480	5000-0543
XQ2	5000-0543		HOLDER:TSTR	28480	5000-0543
XQ3	5000-0543		HOLDER:TSTR	28480	5000-0543
XQ4	5000-0543		HOLDER:TSTR	28480	5000-0543

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	01834-63401	4	ATTENUATOR ASSY:CHANNEL A	28480	01834-63401
A1A1	5081-3008	4	ASSY:SUBSTRATE	28480	5081-3008
A1A1Q1	1855-0408	4	TSTR:DUAL	28480	1855-0408
A2	01834-63401		ATTENUATOR ASSY:CHANNEL B (SAME AS A1, USE PREFIX A2)	28480	01834-63401
A3	01834-63401		ATTENUATOR ASSY:CHANNEL C (SAME AS A1, USE PREFIX A3)	28480	01834-63401
A4	01834-63401		ATTENUATOR ASSY:CHANNEL D (SAME AS A1, USE PREFIX A4)	28480	01834-63401
A5	01835-66504	4	PREAMPL ASSY:CHANNEL A	28480	01835-66504
A5C1	0160-3567	3	C:FXD CER 10.0 PF 5% 100VDCW	72982	8101-100-COG-100J
A5C2	0121-0467	3	C:VAR CER 3.0-9.0 PF 100VDCW	72982	511-000-3-9A
*A5C3	0160-3565	7	C:FXD CER 6.8 PF 100VDCW	72982	8101-100-COG-689J
A5C4	0180-0291	7	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A5C5	0160-3565		C:FXD CER 6.8 PF 100VDCW	72982	8101-100-COG-689J
A5C6	0160-3470	12	C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A5C7	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A5C8	0160-3567		C:FXD CER 10.0 PF 5% 100VDCW	72982	8101-100-COG-100J
A5C9	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A5C10	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A5C11	0160-3802		C:FXD CER 150 PF + — 10% 50VDCW	28480	0160-3802
A5C12	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A5C13	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A5C14	0160-3802		C:FXD CER 150 PF +80 —10% 50VDCW	28480	0160-3802
A5CR1	1910-0030	1	DIODE:SWITCHING 15V MAX 50MA	28480	1910-0030
A5L1	9100-2268	2	COIL:FXD 22.0 UH 10%	82142	09-1316-4K
A5L2	9100-2268	2	COIL:FXD 22.0 UH 10%	82142	09-1316-4K
A5L3	9170-0016		CORE-SHIELDING BEAD	02114	56-590-65A1/3B
A5L4	9170-0016		CORE-SHIELDING BEAD	02114	56-590-65A1/3B
A5R1	0698-7274	1	R:FXD FLM 38.3K OHM 2% 1/8W	28480	0698-7274
A5R2	2100-2655	1	R:VAR CERMET 100K OHM 10% LIN 1/2W	28480	2100-2655
A5R3	0698-7242	1	R:FXD FLM 1.78K OHM 2% 1/8W	28480	0698-7242
A5R4	2100-1984	1	R:VAR FLM 100 OHM 10% LIN 1/2W	28480	2100-1984
A5R5	0757-0069	1	R:VAR MET FLM 121 OHM 1% 1/4W	28480	0757-0069
A5R6	0698-7252	3	R:FXD FLM 4.64K OHM 2% 1/8W	28480	0698-7252
A5R7	0698-7252		R:FXD FLM 4.64K OHM 2% 1/8W	28480	0698-7252
A5R8	0698-7243	1	R:FXD FLM 1.96K OHM 2% 1/8W	28480	0698-7243
A5R9	0757-1094	1	R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
A5R10	0757-0421	2	R:FXD MET FLM 825 OHM 1% 1/8W	28480	0757-0421
A5R11	2100-1986	2	R:VAR CERMET 1000 OHM 10% LIN 1/2W	28480	2100-1986
A5R12	0757-0444	1	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
A5R13	0757-0438	2	R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A5R14	0757-0431	2	R:FXD MET FLM 2.43K OHM 1% 1/8W	28480	0757-0431
A5R15	0757-0447	1	R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
A5R16	0757-0279	1	R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
A5R17	2100-2216	1	R:VAR FLM 5K OHM 10% LIN 1/2W	28480	2100-2216
A5R18	0757-0418	2	R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
A5R19	0698-7212	3	R:FXD FLM 100 OHM 2% 1/8W	28480	0698-7212
A5U1		1	IC:P/O A5 (NSR)		
A5VR1	1902-3125	4	DIODE-BREAKDOWN 6.98V 2%	04713	SZ 10939-138
A5XU1	1200-0441	6	SOCKET:IC 14 PIN MINATURE	28480	1200-0441
A6	01835-66504		PREAMPL ASSY:CHANNEL B SAME AS A5, USE PREFIX A6	28480	01835-66504
A7	01835-66504		PREAMPL ASSY:CHANNEL C SAME AS A5, USE PREFIX A7	28480	01835-66504
A8	01835-66504		PREAMPL ASSY:CHANNEL D SAME AS A5, USE PREFIX A8	28480	01835-66504
A9	01809-66503	1	BOARD ASSY:INTERMEDIATE	28480	01809-66503
A9C1	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A9C2	0160-3647	2	C:FXD CER 22 PF 5% 100VDCW	72982	8111-A112-COG-220J
A9C3	0160-3565		C:FXD CER 6.8 PF 100VDCW	72982	8101-100-COG-689J
A9C4	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A9C5	0160-3647		C:FXD CER 22 PF 5% 100VDCW	72982	8111-A112-COG-220J
A9C6	0160-3565		C:FXD CER 6.8 PF 100VDCW	72982	8101-100-COG-689J
A9C7	0160-2204	1	C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A9C8	0121-0467		C:VAR CER 3.0-9.0 PF 100VDCW	72982	511-000-3-9A
A9C9	0160-3799		C:FXD CER 18 PF ±10% 100VDCW	28480	0160-3799
A9C10	0140-0191		C:FXD MICA 56 PF ±5% 300VDCW	28480	0140-0191
A9C11	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A9C12	0160-3451	27	C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9C13	0160-3567		C:FXD CER 10.0 PF 5% 100VDCW	72982	8101-100-COG-100J
A9C14	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A9C15	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A9C16	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A9C17	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A9C18	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A9C19	0160-3446		C:FXD CER 220 PF ±10% 1000VDCW	28480	0160-3446
A9C20	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A9C21	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A9C22	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	72982	8121-050-651-103Z
A9C23	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A9CR1	0122-0287	2	DIODE-VVC SI	04713	SMV389-287
A9CR2	0122-0287		DIODE-VVCSI	04713	SMV389-287
A9CR3	1901-0047	4	DIODE JUNCTION:SILICON 20PIV	28480	1901-0047
A9CR4	1901-0047		DIODE JUNCTION:SILICON 20PIV	28480	1901-0047
A9CR5	1901-0047		DIODE JUNCTION:SILICON 20PIV	28480	1901-0047
A9CR6	1901-0047		DIODE JUNCTION:SILICON 20 PIV	28480	1901-0047
A9CR7	1901-0040	7	DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A9CR8	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A9J1	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A9L1	9100-2257		COIL/CHOKE .82 UH 10%	24226	10/820
A9L2	9100-2257		COIL/CHOKE .82 UH 10%	24226	10/820
A9Q1	5080-9675	1	TSTR:MATCHED QUAD	28480	5080-9675
A9Q2			PART OF A9Q1		
A9Q3			PART OF A9Q1		
A9Q4			PART OF A9Q		
A9Q5	1854-0546	2	TSTR:SI NPN	28480	1854-0546
A9Q6	1854-0546		TSTR:SI NPN	28480	1854-0546
A9Q7	1853-0352	4	TSTR:SI PNP	28480	1853-0352
A9Q8	1853-0352		TSTR:SI PNP	28480	1853-0352
A9Q9	1853-0352		TSTR:SI PNP	28480	1853-0352
A9Q10	1853-0352		TSTR:SI PNP	28480	1853-0352
A9R1	0698-7239		R:FXD MET OX 1.33K OHM 2% 1/20W	28480	0698-7239
A9R2	0698-7239		R:FXD MET OX 1.33K OHM 2% 1/20W	28480	0698-7239
A9R3	0757-0284	6	R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A9R4	0757-0284		R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A9R5	0757-0718	2	R:FXD MET FLM 200 OHM 1% 1/4W	28480	0757-0718
A9R6	0698-7197	2	R:FXD FLM 23.7 OHM 2.0% 1/20W	28480	0698-7197
A9R7	0698-7197		R:FXD FLM 23.7 OHM 2.0% 1/20W	28480	0698-7197
A9R8	0698-7239	5	R:FXD FLM 1.33K OHM 2% 1/8W	28480	0698-7239
A9R9	0698-7239		R:FXD FLM 1.33K OHM 2% 1/8W	28480	0698-7239
A9R10	0698-7235	2	R:FXD FLM 909 OHM 2% 1/8W	28480	0698-7235
A9R11	0698-7209	2	R:FXD FLM 75 OHM 2% 1/8W	28480	0698-7209
A9R12	0698-7239		R:FXD MET OX 1.33K OHM 2% 1/20W	28480	0698-7239
A9R13	0698-7239		R:FXD MET OX 1.33K OHM 2% 1/20W	28480	0698-7239
A9R14	0757-0284		R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A9R15	0757-0284		R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A9R16	0757-0718		R:FXD MET FLM 200 OHM 1% 1/4W	28480	0757-0718
A9R17	0698-7197	2	R:FXD FLM 23.7 OHM 2% 1/20W	28480	0698-7197
A9R18	0698-7197		R:FXD FLM 23.7 OHM 2% 1/20W	28480	0698-7197
A9R19	0698-7239		R:FXD FLM 1.33K OHM 2% 1/20W	28480	0698-7239
A9R20	0698-7239		R:FXD FLM 1.33K OHM 2% 1/20W	28480	0698-7239
A9R21	0698-7235		R:FXD FLM 909 OHM 2% 1/8W	28480	0698-7235
A9R22	0698-7209		R:FXD FLM 75 OHM 2% 1/8W	28480	0698-7209
A9R23	0757-0276	1	R:FXD FLM 61.9 OHM 1% 1/8W	24546	C4-1/8-TO-6192-F
A9R24	0757-0284		R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A9R25	0757-0284		R:FXD MET FLM 150 OHM 1% 1/8W	28480	0757-0284
A9R26	0698-7229	1	R:FXD FLM 511 OHM 2% 1/8W	28480	0698-7229
A9R27	0698-7239		R:FXD FLM 1.33K OHM 2% 1/20W	28480	0698-7239
A9R28	0698-7196	2	R:FXD FLM 21.5 OHM 2% 1/8W	28480	0698-7196
A9R29	0698-7196		R:FXD FLM 21.5 OHM 2% 1/8W	28480	0698-7196
A9R30	2100-1788	1	R:VAR FLM 500 OHM 10% LIN 1/2W	28480	2100-1788
A9R31	0698-7254	1	R:FXD MET OX 5.62K OHM 2% 1/8W	24546	C3-1/8-TO-5621-G
A9R32	0698-7206	2	R:FXD MET OX 56.2 OHM 2% 1/8W	24546	C3-1/8TOO-56R2-G
A9R33	0698-7206		R:FXD MET OX 56.2 OHM 2% 1/8W	24546	C3-1/8-TOO-56R2-G
A9R34	0698-7268	1	R:FXD FLM 21.5K OHM 2% 1/8W	28480	0698-7268
A9R35	0757-0197	1	R:FXD MET FLM 1.5K 1% 1/2W	30983	MF7C1/2-TO-1501-F
A9R36	0698-3439		R:FXD MET FLM 178 OHM 1% 1/8W	16299	C4-1/8-TO-178R-F
A9R37	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	24546	C4-1/8-TO-101-F
A9R38	0698-3439		R:FXD MET FLM 178 OHM 1% 1/8W	16299	C4-1/8-TO-178R-F
A9R39	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	24546	C4-1/8-TO-101-F

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9R40	0757-0407	2	R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407
A9R41	0757-0407		R:FXD MET FLM 200 OHM 1% 1/8W	28480	0757-0407
A9R42	2100-1986		R:VAR CERMET 1000 OHM 10% LIN 1/2W	28480	2100-1986
A9R43	0757-0431		R:FXD MET FLM 2430 OHM 1% 1/8W	28480	0757-0431
A9R44	0698-7219	2	R:FXD MET OX 196 OHM 2% 1/8W	24546	C3-1/8-TO-196R-G
A9R45	0698-7219		R:FXD MET OX 196 OHM 2% 1/8W	24546	C3-1/8-TO-196R-G
A9R46	0698-7228	1	R:FXD FLM 464 OHM 2% 1/8W	28480	0698-7228
A9R47	0757-0430	1	R:FXD FLM 2.21K OHM 1% 1/8W	28480	0757-0430
A9R48	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
A9R49	0757-0405	1	R:FXD MET FLM 162 OHM 1% 1/8W	28480	0757-0405
A9R50*	0757-0424		R:FXD MET FLM 1.1K OHM 1% 1/8W	24546	C4-1/8-T0-1101-F
A9R50*	0757-0280	5	R:FXD MET FLM 1K OHM 1% 1/8W	24546	C4-1/8-T0-1001-F
A9R51	0698-7236		R:FXD FLM 1K OHM 2% 1/8W	28480	0698-7236
A9R52	0698-7212		R:FXD FLM 100 OHM 2% 1/8W	28480	0698-7212
A9R53	0698-7250	1	R:FXD FLM 3.83K OHM 2% 1/8W	28480	0698-7250
A9R54	0698-7224	1	R:FXD MET OX 316 OHM 2% 1/20W	28480	0698-7224
A9R55	2100-2216	1	R:VAR CERMET 5K OHM 10%	28480	2100-2216
A9R56			NOT USED		
A9R57	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	24546	C4-1/8-TO-101-F
A9RT1	0837-0035	1	THERMISTOR:DISC TYPE	89473	10617
A9VR1	1902-0636	2	DIODE:ZENER	28480	1902-0636
A9VR2	1902-0636		DIODE: ZENER	28480	1902-0636
A9VR3	1902-3171	1	DIODE BREAKDOWN:11.0V 5%	28480	1902-3171
A9VR4	1902-3182	1	DIODE BREAKDOWN:SILICON 12.1V 5%	28480	1902-3182
A9VR5	1902-0072	1	DIODE:BREAKDOWN 2% 7.87V 400mW	28480	1902-0072
A9VR6			NOT USED		
A9VR7	1902-0049	1	DIODE:BREAKDOWN 6.19V 5%	04713	SZ10939-122
A9W1	01809-61602	1	CABLE ASSY:COAX	28480	01809-61602
A10	NOT AVAILABLE AS ASSEMBLY		OUTPUT AMPLIFIER ASSY		
A10A1	01809-66502	1	MAIN AMPLIFIER BD ASSY	28480	01809-66502
A19A1C1	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	28480	0160-3470
A10A1C2	0140-0151		C:FXD MICA 820 PF ±2% 300VDCW	72136	DM15F821G0300WV1CR
A10A1C3	0121-0467		C:VAR CER 3-9 PF	28480	0121-0467
A10A1C4	0160-3567		C:FXD CER 10 PF ±5% 100VDCW	28480	0160-3567
A10A1C5	0160-2261		C:FXD CER 15 PF ±5% 500VDCW	28480	0160-2261
A10A1C6	0160-3565		C:FXD CER 6.8 PF ±5% 100VDCW FACTORY SELECT	28480	0160-3565
A10A1C7	0121-0467		C:VAR CER 3-9 PF	28480	0121-0467
A10A1C8	1060-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1C9	5180-0230		C:FXD TA 1.0 UF ±20% 50VDCW	56289	150D105X0050A2
A10A1C10	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1C11	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1C12	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1C13	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1C14	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1C15	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1C16	0180-0230		C:FXD TA 1.0 UF ±20% 50VDCW	56289	150D105X0050A2
A10A1C17	1060-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1C18	1060-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A1CR1	1901-0040		DIODE: SI 50MA 30WV	07263	FDG1088
A10A1CR2	1901-0040		DIODE:SI 50MA 30WV	07263	FDG1088
A10A1L1	9100-2251		COIL:FXD RF .22UH 10%	28480	9100-2251
A10A1L2	9100-2251		COIL:FXD RF .22UH 10%	28480	9100-2251
A10A1R1	0757-0406		R:FXD MET FLM 182 OHM 1% 1/8W	24546	C4-1/8-TO-182R-F
A10A1R2	0698-7209		R:FXD METOX 75 OHM 2% 1/20W	28480	C3-1/8-TOO-75R0-G
A10A1R3	2100-1772		R:VAR WW 500 OHM 5%	28480	2100-1772
A10A1R4	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	16299	C4-1/8-TO-4221-F
A10A1R5	0698-3154		R:FXD MET FLM 4.22K OHM 1% 1/8W	16299	C4-1/8-TO-4221-F
A10A1R6	0757-0724		R:FXD MET FLM 392 OHM 1% 1/4W	24546	C5-1/4-TO-392R-F
A10A1R7	0757-0397		R:FXD MET FLM 68.1 OHM 1% 1/8W	24546	C4-1/8-TO-68R1-F
A10A1R8	0757-0406		R:FXD MET FLM 182 OHM 1% 1/8W	24546	C4-1/8-TO-182R-F
A10A1R9	0698-7228		R:FXD MET OX 464 OHM 2% 1/20W	24546	C3-1/8-TO-464R-G
A10A1R10	0757-0444		R:FXD MET FLM 12.1 OHM 1% 1/8W	24546	C4-1/8-TO-12I2-F
A10A1R11	0757-0442		R:FXD MET FLM 10K OHM 1% 1/8W	24546	C4-1/8-TO-1002-F
A10A1R12	2100-2061		R:VAR C 200 OHM 10%	28480	2100-2061
A10A1R13	2100-1738		R:VAR C 10K OHM 10%	28480	2100-1738
A10A1R14	0757-0817		R:FXD MET FLM 750 OHM 1% 1/2W	30983	MF7C1/2-TO-751-F
A10A1R15	0698-7209		R:FXD MET OX 75 OHM 2% 1/20W	24546	C3-1/8-TOO-75R0-G
A10A1R16	0757-0737		R:FXD MET FLM 1.62K OHM 1% 1/4W	24546	C5-1/4-TO-1621-F
A10A1R17	0757-0716		R:FXD MET FLM 162 OHM 1% 1/4W	24546	C5-1/4-TO-162R-F
A10A1R18	0757-0397		R:FXD MET FLM 68.1 OHM 1% 1/8W	24546	C4-1/8-TO-68R1-F
A10A1R19	0761-0025		R:FXD MET OX 120 OHM 5% 1W	24546	FP32-1/TOO-121-J
A10A1R20	0761-0014		R:FXD MET OX 180 OHM 5% 1W	24546	FP32-1/TOO-181-J
A10A1U1	5081-3015		IC (NOT P/O A10A1-ORDER SEPARATELY)	28480	5081-3015
A10A1VR1	1902-3149		DIODE:BREAKDOWN 9.09V .4W MAX PD	04713	SZ10939-170

See introduction to this section for ordering information

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10A2	01809-66501	1	OUTPUT BD ASSY	28480	01809-66501
A10A2C1	0121-0466		C:VAR CER 1-3 PF	28480	0121-0466
A10A2C2	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A10A2C3	0160-2240		C:FXD CER 2 PF 500VDCW	28480	0160-2240
A10A2CR1	1901-0040		DIODE:SI 50MA 30WV	07263	FDG1088
A10A2CR2	1901-0040		DIODE:SI 50MA 30WV	07263	FDG1088
A10A2CR3	1901-0040		DIODE:SI 50MA 30WV	07263	FDG1088
A10A2CR4	1901-0040		DIODE:SI 50MA 30WV	07263	FDG1088
A10A2R1	0757-0159		R:FXD MET FLM 1K OHM 1% 1/2W	30983	MF7C1/2-TO-1R0-F
A10A2R2	0757-0159		R:FXD MET FLM 1K OHM 1% 1/2W	30983	MF7C1/2-TO-1R0-F
A10A2R3	0757-0169		R:FXD MET FLM 1K OHM 1% 1/2W	30983	MF7C1/2-TO-1R0-F
A10A2R4	0757-0159		R:FXD MET FLM 1K OHM 1% 1/2W	30983	MF7C1/2-TO-1R0-F
A11	01809-66507	1	BOARD ASSY:MOTHER	28480	01809-66507
A11C1	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A11C2	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A11C3	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A11C4	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A11C5	0180-0230	2	C:FXD ELECT 1.0 UF 20% 50VDCW	56289	150D105X0050A2-DYS
A11C6	0180-0230		C:FXD ELECT 1.0 UF 20% 50VDCW	56289	150D105X0050A2-DYS
A11J1	1200-0438	4	SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A11J2	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A11L1	9100-2257		COIL/CHOKE .82 UH 10%	24226	10/820
A11R1	0757-0453	1	R:FXD MET FLM 30.1K OHM 1% 1/8W	28480	0757-0453
A11R2	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
A11R3	0757-0821	4	R:FXD MET FLM 1.21K OHM 1% 1/2W	30983	MF7C1/2-TO-1211-F
A11R4	0757-0821		R:FXD MET FLM 1.21K OHM 1% 1/2W	30983	MF7C1/2-TO-1211-F
A11R5	0757-0821		R:FXD MET FLM 1.21K OHM 1% 1/2W	30983	MF7C1/2-TO-1211-F
A11R6	0757-0821		R:FXD MET FLM 1.21K OHM 1% 1/2W	30983	MF7C1/2-TO-1211-F
A11R7	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A11R8	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
A11R9			DELETED		
A11S1	3101-0580	1	SWITCH:PUSHBUTTON	28480	3101-0580
A11VR1	1902-0074	1	DIODE:BREAKDOWN 7.15V 5%	04713	SZ10939-140
A11W1	8120-0573	4	CABLE:SPECTRO STRIP	28480	8120-0573
A11W2	8120-0573		CABLE:SPECTRO STRIP	28480	8120-0573
A11W3	8120-0573		CABLE:SPECTRO STRIP	28480	8120-0573
A11W4	8120-0573		CABLE:SPECTRO STRIP	28480	8120-0573
A11W5	8120-0572	1	CABLE:SPECTRO STRIP	28480	8120-0572
A12	01834-66510	1	BOARD ASSY:POSITION-INVERTER	28480	01834-66510
A12R1	2100-3437	4	R:VAR COMP 10K OHM 20% LIN 1/4W W/SW	28480	2100-3437
A12R2	2100-3437		R:VAR COMP 10K OHM 20% LIN 1/4W W/SW	28480	2100-3437
A12R3	2100-3437		R:VAR COMP 10K OHM 20% LIN 1/4W W/SW	28480	2100-3437
A12R4	2100-3437		R:VAR COMP 10K OHM 20% LIN 1/4W W/SW	28480	2100-3437
A12R5	0757-0436	1	R:FXD MET FLM 4.32K OHM 1% 1/8W	28480	0757-0436
A12S1			NSR:PART OF A12R1		
A12S2			NSR:PART OF A12R2		
A12S3			NSR:PART OF A12R3		
A12S4			NSR:PART OF A12R4		
A12W1	8120-0574	1	CABLE:SPECTRO STRIP	28480	8120-0574
A13	01809-66506	1	BOARD ASSY:CHASSIS INTERCONNECT	28480	01809-66506
A13C1	0160-3665		C:FXD CER 0.01 UF +80 —20% 500VDCW	56289	C071A501K103ZS25-CD
A13C2	0180-0094		C:FXD ELECT 100 UF +75 —10% 25VDCW	56289	30D107G025DD2-DSM
A13C3	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CD
A13C4	0180-0094		C:FXD ELECT 100 UF +75 —10% 25VDCW	56289	30D107G025DD2-DSM
A13C5	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CD
A13C6	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CD
A13C7	0160-3665		C:FXD CER 0.01 UF +80 —20% 500VDCW	56289	C071A501K103ZS25-CD
A13P1	01801-27601	1	P:MALE 24 PIN	28480	01801-27601
A13W1	8120-0575	1	CBL ASSY:RBN 16	28480	8120-0575
A13XA15	1251-0553	1	CONNECTOR:PC EDGE (2 X 5) 10 CONTACT	74868	225-21021-105
A14	01809-61601	1	ASSY:DELAY LINE	28480	01809-61601
A15	01809-66504	1	BOARD ASSY:CHANNEL CONTROL	28480	01809-66504
A15C1	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	28480	0160-3470
A15C2	0180-0230		C:FXD TA 1.0 UF ±20% 50VAC	56289	150D105X0050A2
A15C3	0180-0230		C:FXD TA 1.0 UF ±20% 50VDCW	56289	150D105X0050A2
A15C4	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A15C5	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	28480	0160-3470
A15C6	0140-0206		C:FXD MICA 270 PF ±5% 500VDCW	72136	DM15F271J0500WV1CR
A15C7	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15C8	0160-2204		C:FXD MICA 100 PF ±5% 300VDCW	28480	0160-2204
A15C9	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	28480	0160-3470
A15C10	0160-3470		C:FXD CER 0.01 UF +80 —20% 50VDCW	28480	0160-3470
A15C11	0140-0192		C:FXD MICA 68 PF ±5% 300VDCW	72136	DM15F271J0500WV1CR
A15C12	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A15C13	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A15C14	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A15C15	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A15C16	0180-0230		C:FXD TA 1.0 UF ±20% 50VDCW	56289	150D105X0050A2
A15C17	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	56289	C023B101F103ZS25-CDH
A15CR1	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A15CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A15CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
A15L1	9100-2251		COIL:FXD RF .22UH 10%	28480	9100-2251
A15L2	9100-2251		COIL:FXD RF .22UH 10%	28480	9100-2251
A15Q1	1854-0215		TSTR:SI NPN	80131	2N3904
A15Q2	1854-0215		TSTR:SI NPN	80131	2N3904
A15Q3	1854-0215		TSTR:SI NPN	80131	2N3904
A15Q4	1854-0215		TSTR:SI NPN	80131	2N3904
A15Q5	1854-0215		TSTR:SI NPN	80131	2N3904
A15Q6	1853-0015		TSTR:SI PNP	80131	2N3640
A15R1	0757-0437	1	R:FXD MET FLM 4750 OHM 1% 1/8W	28480	0757-0437
A15R2	0757-0427	2	R:FXD MET FLM 1.5K OHM 1% 1/8W	28480	0757-0427
A15R3	0757-0289		R:FXD MET FLM 13.3K OHM 1% 1/8W	30983	MF4C1/8-TO-1332-F
A15R4	0698-0082	1	R:FXD MET FLM 464 OHM 1% 1/8W	16299	C4-1/8-TO-4640-F
A15R5	0757-0283		R:FXD MET FLM 2K OHM 1% 1/8W	24546	C4-1/8-TO-2001-F
A15R6	0757-0422		R:FXD MET FLM 909 OHM 1% 1/8W	24546	C4-1/8-TO-909R-F
A15R7	0757-0413	1	R:FXD MET FLM 392 OHM 1% 1/8W	28480	0757-0413
A15R8	0757-0410		R:FXD MET FLM 301 OHM 1% 1/8W	28480	0757-0410
A15R9	0757-0410		R:FXD MET FLM 301 OHM 1% 1/8W	28480	0757-0410
A15R10	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	24546	C4-1/8-TO-1213-F
A15R11	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	24546	C4-1/8-TO-619R-F
A15R12	0757-0431		R:FXD MET FLM 2.43K OHM 1% 1/8W	24546	C4-1/8-TO-2431-F
A15R13	0757-0283	2	R:FXD MET FLM 2K OHM 1% 1/8W	24546	C4-1/8-TO-2001-F
A15R14	0698-3440	1	R:FXD MET FLM 196 OHM 1% 1/8W	16299	C4-1/8-TO-196R-F
A15R15	0757-0419		R:FXD MET FLM 681 OHM 1% 1/8W	24546	C4-1/8-TO-681R-F
A15R16	0757-0274	1	R:FXD MET FLM 1.21K OHM 1% 1/8W	24546	C4-1/8-TO-1213-F
A15R17	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	16299	C4-1/8-TO-4640-F
A15R18	0757-0283		R:FXD MET FLM 2K OHM 1% 1/8W	24546	C4-1/8-TO-2001-F
A15R19	0757-0427	1	R:FXD MET FLM 1.5K OHM 1% 1/8W	24546	C4-1/8-TO-1501-F
A15R20	0698-7236		R:FXD MET OX 1K OHM 2% 1/20W	28480	0698-7236
A15R21	0698-7236		R:FXD MET OX 1K OHM 2% 1/20W	28480	0698-7236
A15R22	0698-7236		R:FXD MET OX 1K OHM 2% 1/20W	28480	0698-7236
A15R23	0698-7236		R:FXD MET OX 1K OHM 2% 1/20W	28480	0698-7236
A15R24	0757-0283		R:FXD MET FLM 2K OHM 1% 1/8W	24546	C4-1/8-TO-2001-F
A15R25			NOT USED		
A15R26	0811-0610		R:FXL WW 56 OHM 5%	91637	CW5-2
A15R27			NOT USED		
A15R28	0698-3150	1	R:FXD MET FLM 2.37K OHM 1% 1/8W	16299	C4-1/8-TO-2371-F
A15U1	1820-0581	1	IC:DIGITAL ECL DUAL AC-COUPLED J-K F-F	28480	1820-0581
A15U2	1820-0145	1	IC:DIGITAL QUAD 2-INPT NOR GATE	28480	1820-0145
A15U3	1820-0897	2	IC:ECL QUAD 2-INPUT AND GATE	04713	MC1047B
A15U4	1820-0897		IC:ECL QUAD 2 INPUT AND GATE	04713	MC1047B
A15U5	1820-0275		IC:ECL TO TTL QUAD 2-INPUT OR TRANS.	04713	MC1039P
A15U6	1820-0142	2	IC:4-INPUT, 2-OR(NOR	04713	MC1004P
A15U7	1820-0142		IC:4-INPUT, 2-OR/NOR	04713	MC1004P
A15VR1	1902-0052	1	DIODE:BREAKDOWN 6.81V 400 MW	04713	SZ10939-135
A15VR2	1902-3094	1	DIODE:BREAKDOWN 5.11V 400 MW	04713	SZ10939-99
A15XU1	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A15XU2	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A15XU3	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A15XU4	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A15XU5	1200-0438		SOCKET:IC 16 CONTACT DUAL TYPE, BROWN	00779	583529-1
A15XU6	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A15XU7	1200-0441		SOCKET:IC 14 PIN MINIATURE	28480	1200-0441
A16	01809-66505	1	BOARD ASSY:SYNC	28480	01809-66505
A16C1	0160-3450		C:FXD CER .005 UF ±10% 250VDCW	28480	0160-3450
A16C2	0160-3450		C:FXD CER .005 UF ±10% 250VDCW	28480	0160-3450
A16C3	0160-3569		C:FXD CER 27 PF ±5% 100VDCW	28480	0160-3569
A16C4	0160-2234		C:FXD CER.51 PF 500VDCW	28480	0160-2234
A16C5	0160-2234		C:FXD CER .51 PF 500VDCW	28480	0160-2234

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16C6	0160-3567		C:FXD CER 10 PF ±5% 100VDCW	28480	0160-3567
A16C7	0160-3443		C:FXD CER 0.1 UF +80 —20% 50VDCW	28480	0160-3443
A16C8	0180-0230		C:FXD TA 1.0 UF ±20% 50VDCW	56289	150D105X0050A2
A16C9	0160-3443		C:FXD CER 0.1 UF +80 —20% 50VDCW	28480	0160-3443
A16C10	0180-0230		C:FXD TA 1.0 UF ±20% 50VDCW	56289	150D105X0050A2
A1C11	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A16C12	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A16C13	0160-3451		C:FXD CER 0.01 UF +80 —20% 100VDCW	28480	0160-3451
A16C14	0160-3592		C:FXD CER 2.4 PF 200VDCW	28480	0160-3592
A16C15	0160-0298		C:FXD 1500 PF ±10% 200VDCW	56289	292P15292
A16CR1	1901-0040		DIODE:SI 50 MA 30WV	07263	FDG1088
A16CR2	1901-0040		DIODE:SI 50 MA 30WV	07263	FDG1088
A16CR3	1901-0040		DIODE:SI 50 MA 30WV	07263	FDG1088
A16CR4	1901-0040		DIODE:SI 50 MA 30WV	07263	FDG1088
A16L1	9100-2251		COIL:FXD RF .22 UH 10%	28480	9100-2251
A16L2	9100-2251		COIL:FXD RF .22 UH 10%	28480	9100-2251
A16Q1	1854-0345		TSTR:SI NPN	04713	2N5179
A16Q2	1854-0345		TSTR:SI NPN	04713	2N5179
A16Q3	1854-0345		TSTR:SI NPN	04713	2N5179
A16Q4	1854-0345		TSTR:SI NPN	04713	2N5179
A16Q5	1854-0345		TSTR:SI NPN	04713	2N5179
A16Q6	1854-0345		TSTR:SI NPN	04713	2N5179
A16Q7	1854-0296		TSTR:SI NPN	28480	1854-0296
A16Q8	1853-0354		TSTR:SI PNP	28480	1853-0354
A16Q9	1854-0071		TSTR:SI NPN	28480	1854-0071
A16R1	0757-0316		R:FXD MET FLM 42.2 OHM 1% 1/8W	24546	C4-1/8-TO-42R2-F
A16R2	0757-0422		R:FXD MET FLM 909 OHM 1% 1/8W	24546	C4-1/8-TO-909R-F
A16R3	0757-0422		R:FXD MET FLM 909 OHM 1% 1/8W	24546	C4-1/8-TO-909R-F
A16R4	0757-0399		R:FXD MET FLM 82.5 OHM 1% 1/8W	24546	C4-1/8-TO-82R5-F
A16R5	0698-3444		R:FXD MET FLM 316 OHM 1% 1/8W	16299	C4-1/8-TO-316R-F
A16R6	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	24546	C4-1/8-TO-5111-F
A16R7	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	24546	C4-1/8-TO-1003-F
A16R8	0757-0316		R:FXD MET FLM 42.2 OHM 1% 1/8W	24546	C4-1/8-TO-42R2-F
A16R9	0757-0316		R:FXD MET FLM 42.2 OHM 1% 1/8W	24546	C4-1/8-TO-42R2-F
A16R10	0757-0274		R:FXD MET FLM 1.21K OHM 1% 1/8W	24546	C4-1/8-TO-1213-F
A16R11	0757-1094		R:FXD MET FLM 1.47K OHM 1% 1/8W	24546	C4-1/8-TO-1471-F
A16R12	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	16299	C4-1/8-TO-383R-F
A16R13	0698-3446		R:FXD MET FLM 383 OHM 1% 1/8W	16299	C4-1/8-TO-383R-F
A16R14	0757-0422		R:FXD MET FLM 909 OHM 1% 1/8W	24546	C4-1/8-TO-909R-F
A16R15	0757-0422		R:FXD MET FLM 909 OHM 1% 1/8W	24546	C4-1/8-TO-909R-F
A16R16	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	03888	PME55-1/8-TO-21R5-F
A16R17	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	03888	PME55-1/8-TO-21R5-F
A16R18	0698-3439		R:FXD MET FLM 178 OHM 1% 1/8W	16299	C4-1/8-TO-178R-F
A16R19	0757-0402		R:FXD MET FLM 110 OHM 1% 1/8W	24546	C4-1/8-TO-111-F
A16R20	0757-0402		R:FXD MET FLM 110 OHM 1% 1/8W	24546	C4-1/8-TO-111-F
A16R21	0757-0817		R:FXD MET FLM 750 OHM 1% 1/2W	30983	MF7C1/2-TO-751-F
A16R22	0757-0465		R:FXD MET FLM 100K OHM 1% 1/8W	24546	C4-1/8-TO-1003-F
A16R23	0698-3430		R:FXD MET FLM 21.5 OHM 1% 1/8W	03888	PME55-1/8-TO-21R5-F
A16R24	0757-0415		R:FXD MET FLM 475 OHM 1% 1/8W	24546	C4-1/8-TO-475R-F
A16R25	0757-0415		R:FXD MET FLM 475 OHM 1% 1/8W	24546	C4-1/8-TO-475R-F
A16R26	0757-0316		R:FXD MET FLM 42.2 OHM 1% 1/8W	24546	C4-1/8-TO-42R2-F
A16R27	0757-0316		R:FXD MET FLM 42.2 OHM 1% 1/8W	24546	C4-1/8-TO-42R2-F
A16R28	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	24546	C4-1/8-TO-5111-F
A16R29	0757-0419		R:FXD MET FLM 681 OHM 1% 1/8W	24546	C4-1/8-TO-681R-F
A16VR1	1902-3139		DIODE:BREAKDOWN 8.25V .4W MAX PD	04713	SZ10939-158

See introduction to this section for ordering information

Table 6-3. List of Manufacturers' Codes

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
00779	AMP INC. (AIRCRAFT MARINE PROD.)	HARRISBURG, PA.	17101
02114	FERROXCUBE CORP	SAUGERTIES, N.Y.	12477
03888	PYROFILM CORP	WHIPPANY, N.J	07981
04713	MOTOROLA SEMICONDUCTOR PROD. INC.	PHOENIX, ARIZ.	85008
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
08806	G. E. CO. MINIATURE LAMP DEPT.	CLEVELAND, OHIO	44112
16299	CORNING GL WK ELEC CMPNT DIV.	RALEIGH, N.C.	27604
24226	GOWANDA ELECT CORP.	GOWANDA, N.Y	14070
24546	CORNING GL WK (C STYLE RES)	BRADFORD, PA.	16701
24931	SPECIALTY CONN CO. INC.	IND. IN.	46227
28480	HEWLETT-PACKARD CO. CORPORATE HQ	YOUR NEAREST HP OFFICE	
30983	MEPCO/ELECTRA CORP (VAR RES)	SAN DIEGO, CA.	92121
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PROD. INC.	ERIE, PA.	16512
74868	AMPHENOL CORP. RF DIV.	DANBURY, CONN.	06810
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
82142	AIRCO SPEER ELECT. COMP.	DU BOIS, PA.	15801

BACK DATING MANUAL CHANGES

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. Description of special options and standard options are also in this section.

7-3. MANUAL CHANGES.

7-4. This manual applies directly to the instrument 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, find your serial prefix in table 7-1 and make the changes to the manual that are listed for that serial prefix. When making changes listed in table 7-1, make the change with the highest number first. Example: if backdating changes 1, 2, and 3 are required for your serial prefix, do change 3 first, then change 2, and finally change 1. If the serial prefix of the instrument is not listed either in the title page or in table 7-1, refer to an enclosed MANUAL CHANGES sheet for updating information. Also, if a MANUAL CHANGES sheet is supplied, make all indicated ERRATA corrections.

Table 7-1. Manual Changes

Serial Prefix	Make Changes
No backdating changes are required at this time.	

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 (and MANUAL CHANGES sheet information, if applicable). 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. Contact the nearest Hewlett-Packard Sales/Service Office for information concerning standard options.

SCHEMATIC DIAGRAMS TROUBLE-SHOOTING

Table 8-1. Schematic Notes

Refer to MIL-STD-15-1A and MIL-STD-806 for schematic symbols not listed in this table.

ETCHED CIRCUIT BOARD

FRONT PANEL MARKING

REAR PANEL MARKING

FRONT PANEL CONTROL

SCREWDRIVER ADJUSTMENT

TP1 ELECTRICAL TEST POINT TP (WITH NUMBER)

1 WAVEFORM TEST POINT (WITH NUMBER)

SINGLE PIN CONNECTOR ON BOARD

A PIN OF A PLUG IN BOARD (WITH LETTER OR NUMBER)

COAXIAL CABLE CONNECTED TO SNAP-ON JACK

COAXIAL CABLE CONNECTED DIRECTLY TO BOARD

MAIN SIGNAL PATH

PRIMARY FEEDBACK PATH

SECONDARY FEEDBACK PATH

P/O PART OF

NC NO CONNECTION

CW CLOCKWISE END OF VARIABLE RESISTOR

G D S FIELD EFFECT TRANSISTOR (P-TYPE BASE)

G D S FIELD EFFECT TRANSISTOR (N-TYPE BASE)

BREAKDOWN DIODE (VOLTAGE REGULATOR)

TUNNEL DIODE

STEP RECOVERY DIODE

CIRCUITS OR COMPONENTS DRAWN WITH DASHED LINES (PHANTOM) SHOW FUNCTION ONLY AND ARE NOT INTENDED TO BE COMPLETE. THE CIRCUIT OR COMPONENT IS SHOWN IN DETAIL ON ANOTHER SCHEMATIC.

6 SIGNAL REFERENCE

2 SCHEMATIC REFERENCE

(925) WIRE COLORS ARE GIVEN BY NUMBERS IN PARENTHESIS USING THE RESISTOR COLOR CODE

| (925) IS WHT RED GRN |

0 BLACK	5 GREEN
1 BROWN	6 BLUE
2 RED	7 VIOLET
3 ORANGE	8 GRAY
4 YELLOW	9 WHITE

* OPTIMUM VALUE SELECTED AT FACTORY, TYPICAL VALUE SHOWN; PART MAY HAVE BEEN OMITTED.

UNLESS OTHERWISE INDICATED:
RESISTANCE IN OHMS
CAPACITANCE IN PICOFARADS
INDUCTANCE IN MICROHENRIES

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

This section contains schematics, repair and replacement information, component-identification illustrations, test conditions, and troubleshooting information for the Model 1809A. Schematic 1 is a detailed block diagram that provides a guide to locating possible problems when troubleshooting. Table 8-1 defines symbols and conventions used on the schematics. A disassembly procedure for attenuator repair and replacement is also contained in this section.

NOTE

Current amplifiers are used throughout the instrument. This manual does not contain waveform photographs because current waveforms will not aid in troubleshooting the Model 1809A.

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-MIL-standard symbols and conventions used in the schematics are defined in table 8-1.

8-5. The schmatics are numbered in sequence with a large bold number 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.

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. REFERENCE DESIGNATIONS.

8-8. 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.

8-9. Each electrical component is assigned a class letter and a number. This letter-number combination is the basic reference designation. Components that 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 of assembly A1 is designated as A1R23.

8-10. Assemblies are numbered consecutively. If an assembly reference designation is assigned and later deleted, that number is not reused.

8-11. COMPONENT LOCATIONS.

8-12. Locations of components on assemblies and subassemblies are illustrated in figures 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 identification is printed next to the schematic that shows most of the circuitry on the assembly.

8-13. Chassis parts are identified on figure 6-1 in Section VI. The locations of most adjustments are shown in Section V.

8-14. PREVENTIVE MAINTENANCE.

8-15. 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.

8-16. MECHANICAL INSPECTION. 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.

8-17. Refer to the paragraphs in this section on repair and replacement for instructions on replacing damaged components.

8-18. 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.

8-19. 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 instrument. Such areas should be protected from further corrosion by an application of a silicon resin such as GE DRI-FILM 88.

8-20. SWITCH MAINTENANCE. 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.

8-21. REPAIR AND REPLACEMENT.

8-22. The following paragraphs provide procedures for removal and replacement of attenuator assemblies, and other components. Special servicing instructions for etched circuit boards are provided in paragraph 8-28. Section VI provides a detailed parts list for use in ordering replacement parts.

8-23. ATTENUATOR REPAIR. Attenuator assemblies A1 through A4 use a thick-film substrate type circuit board with cam-actuated spring switch contacts. Because of the advanced design of the attenuators, it is best to send the attenuators to the nearest HP Sales/Service Office for repair. The following paragraphs provide instructions for disassembly, assembly, and care while handling.

CAUTION

Always wear protective cotton gloves (such as HP Part Number 8650-0030) while handling the thick-film substrate. The substrate is extremely susceptible to conduction paths caused by finger prints.

8-24. The only repairs that should be attempted, by other than factory personnel, are replacement of the thick-film substrate and impedance converter transistor Q1. If a mechanical failure occurs, replace the entire attenuator by following the procedures outlined in paragraph 8-27.

NOTE

When replacing Q1 on any attenuator assembly, lead 4 of the replacement transistor must be removed (cut off close to the mechanical base of the transistor).

8-25. ATTENUATOR DISASSEMBLY. To disassemble the attenuator, proceed as follows:

a. Set coupling switch to GND position.

b. Set VOLTS/DIV switch to .01 position.

c. Remove attenuator adjustment cover by removing 4 retaining screws.

d. Unsolder attenuator output wires (color code (4) and (1)) from preamplifier assembly (A5 through A8). Use controlled output type soldering iron with tip temperature of 700°F (371°C).

e. Disconnect attenuator voltage wires (square pin connections) from preamplifier assembly (A5 through A8.)

f. Unsolder input wire from BNC connector (A1J1 through A4J1).

g. Tilt rear of substrate about 45 degrees (so contacts clear pushrods).

h. Remove substrate from spring mounting clips by sliding substrate toward preamplifier assembly.

8-26. SUBSTRATE INSTALLATION. To install attenuator substrate, proceed as follows:

a. Hold substrate with spring contacts down and input toward BNC connector (A1J1 through A4J1).

b. Tilt substrate about 45 degrees while sliding it under spring mounting clips at front of attenuator.

c. Verify substrate is centered in and flush with side cover channels.

d. Solder input wire from BNC connector to substrate. Use controlled output type soldering iron with tip temperature of 700°F (371°C).

e. Solder output wires (color code (4) and (1)) to preamplifier assembly (A5 through A8).

f. Verify grounding springs are seated inside adjustment cover channels (figure 8-1).

g. Install adjustment cover.

NOTE

Slight pressure applied to the adjustment cover may be necessary to align holes.

8-27. ATTENUATOR REMOVAL. The mechanical switch section of the attenuator is ruggedly constructed and will normally require no replacement. In the event of a mechanical malfunction, the entire attenuator should be replaced. To remove the attenuator from the instrument proceed as follows:

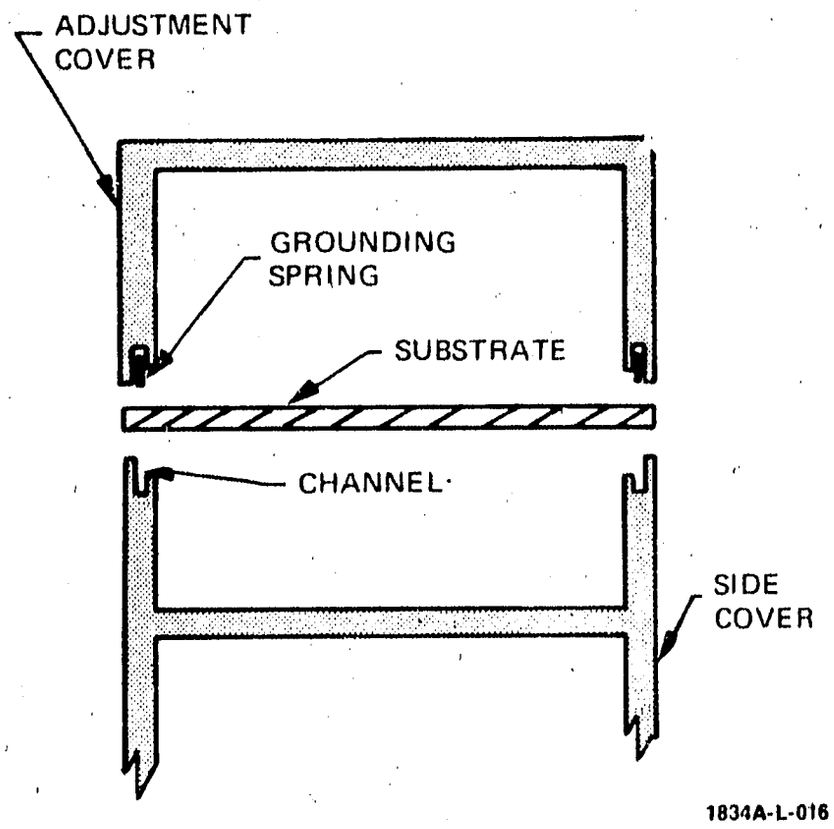


Figure 8-1. Attenuator Assembly

a. Remove plug-in support (side panel).

b. Unsolder wires from preamplifier assemblies to buffer assembly.

c. Disconnect dual twin-lead wire connections from buffer amplifier.

d. Remove chassis attaching screw from preamplifier assembly support.

e. Remove sub-panel attaching screws from chassis.

f. Move front panel and attachments forward approximately 1 inch.

g. Disconnect mother board assembly cables from preamplifier assemblies.

h. Disconnect A12 assembly cable from mother board assembly.

i. Disconnect POSITION potentiometer wires from mother board assembly.

j. Disconnect CAL potentiometer wire from mother board assembly.

k. Disconnect A12 assembly wire from chassis interconnect assembly A13.

l. Unsolder wires from vernier potentiometer of attenuator to be removed.

m. Remove vernier knobs, volts/division knobs, and coupling levers.

n. Unsolder twin-lead wires (impedance cable) from associated preamplifier of attenuator being removed.

o. Remove front-panel attaching hardware of attenuator being removed.

p. Remove rear attaching screw from associated preamplifier of attenuator being removed.

q. Remove attenuator and associated preamplifier from front panel location.

r. Disconnect attenuator wires from associated preamplifier assembly.

s. Remove vernier bracket attaching screws.

t. Remove vernier shaft from attenuator.

u. To reinstall attenuator, reverse removal procedure.

8-28. CIRCUIT BOARDS.

8-29. The following paragraphs provide information regarding servicing procedures for etched circuit boards, use of heat sinks, and special soldering considerations.

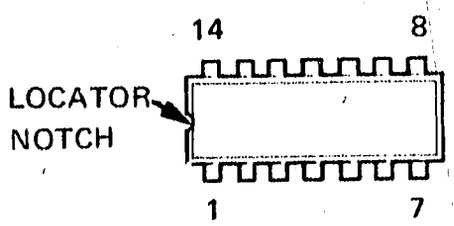
8-30. BOARD CONNECTIONS. Square-pin connectors are identified on circuit boards by the color code of the connecting wire. Connector pins on plugs and jacks are identified by either a numeral or a letter. The letters G, I, O, and Q have been omitted. Table 8-1 shows the types of board connections used in the instrument.

8-31. SERVICING ETCHED CIRCUIT BOARDS. This instrument uses etched circuit boards with plated-through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components, such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information for repair of etched circuit boards.

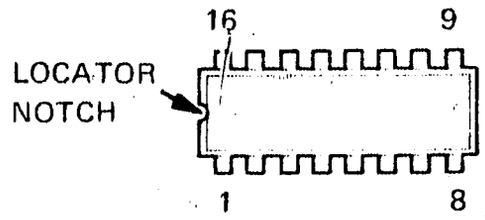
8-32. SEMICONDUCTOR REMOVAL AND REPLACEMENT. Figure 8-2 is included to help identify the leads on the common shapes and sizes of semiconductor devices. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as used for the original part.

INTEGRATED CIRCUITS

14 PIN INTEGRATED CIRCUIT

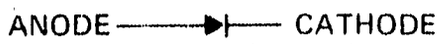


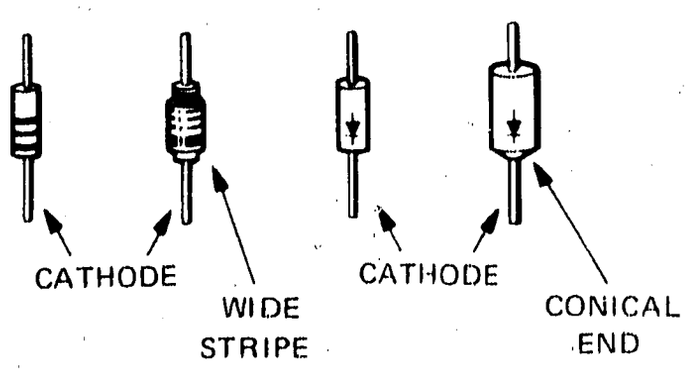
16 PIN INTEGRATED CIRCUIT

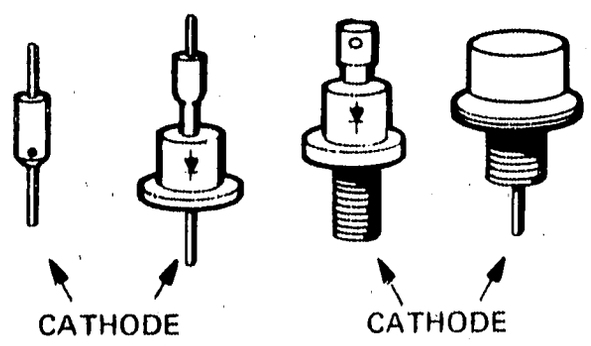


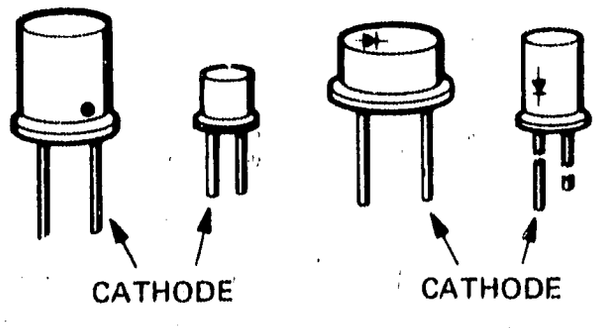
DIODES

DIODE SYMBOL



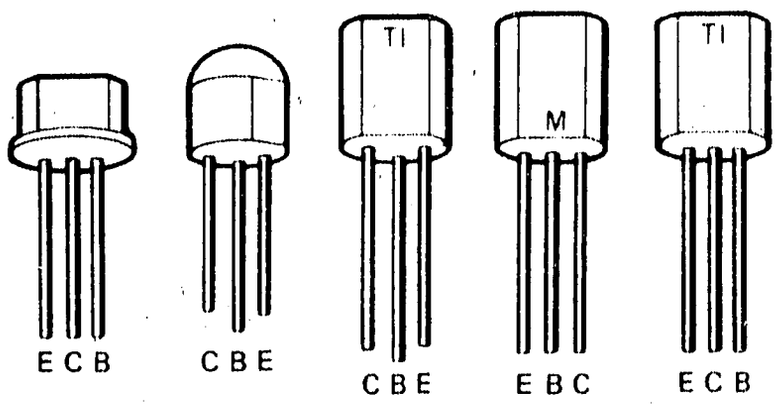




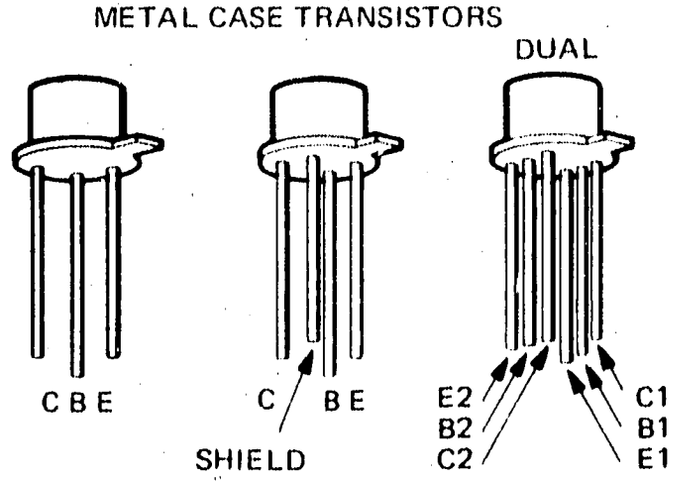


BI-POLAR TRANSISTORS

BLACK EPOXY (PLASTIC) TRANSISTORS



METAL CASE TRANSISTORS



FIELD EFFECT TRANSISTORS

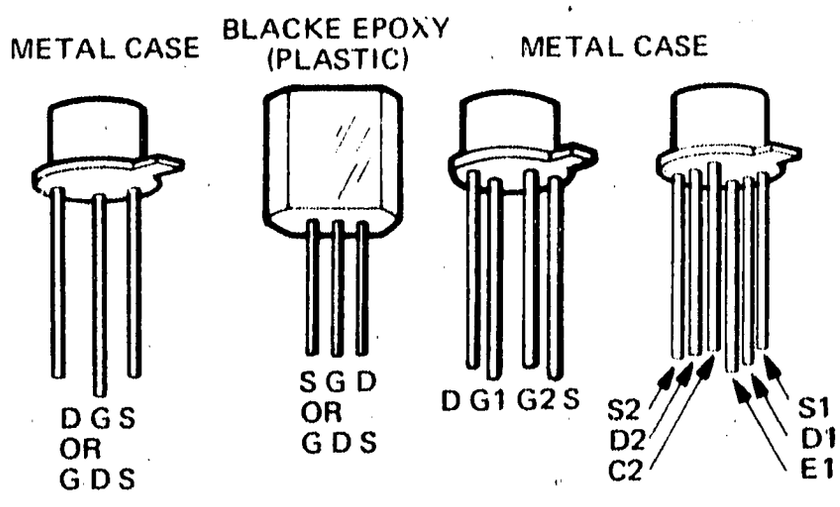


Figure 8-2. Semiconductor Terminal Identification

8-33. INTEGRATED CIRCUIT REPLACEMENT.

CAUTION

Unless an integrated circuit has definitely failed, be careful to prevent damage when removing or replacing it.

8-34. The integrated circuits in this instrument are of two general configurations: plug-in types and those soldered in place. Remove a plug-in integrated circuit with a straight pull away from the board. Soldered integrated circuits can be removed with soldering irons which simultaneously heat all connections. These irons are available from various manufacturers. Soldering irons with built-in desoldering tools also facilitate quick removal.

8-35. Use the following procedure for removing an integrated circuit with a standard soldering iron.

a. Heat lead solder joint. Use small tip such as a Weller No. PT-H7 iron.

b. When solder is fluid, remove with desoldering tool such as deluxe Model Soldapullt manufactured by Edsyn Company of California.

c. Repeat steps a and b for each lead until all leads are free.

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

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

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

CAUTION

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

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

8-36. When replacing an integrated circuit, note the mark or notch used for orientation. The component-identification photographs and the integrated circuit pin-location diagrams in this manual show the correct orientation.

8-37. SOLDERING TOOL, SOLDER, AND AIDS. Table 8-2 contains a list of soldering tools, solder, and soldering aids. These items or equivalents should be used to obtain the very best results when repairing and replacing soldered-in components on etched circuit boards.

8-38. HEAT SINK REMOVAL. There are two types of transistor heat sinks: the friction type and the screw-on type. The friction type can be removed by care-

Table 8-2. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering tool	Soldering Unsoldering	Wattage rating: 37.5 Tip Temp: 750-800°F	Ungar #775 handle with Ungar #1237 Heating Unit
Soldering Tip	Soldering	Shape: chisel	Ungar #PL113
Desoldering aid	To remove molten solder from connection	Suction device	Soldapullt by Edsyn Co., Arleta, California
Resin (flux) Solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Acetone Lacquer Thinner Isopropyl Alcohol (100% dry)
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead). 18-gauge (SWG) preferred	
Protective Coating	Contamination, Corrosion protection	Good electrical insulation, corrosion-prevention properties	Silicon Resin such as GE DRI-FILM 88

fully pulling them off. To remove the screw-on type, proceed as follows:

a. Remove transistor from circuit board.

b. Grasp cooling fins with taped pliers.

c. Remove nut with 1/2-inch wrench.

CAUTION

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

8-39. TROUBLESHOOTING.

8-40. The most important prerequisite for successful troubleshooting is understanding how the instrument is designed to operate and correct use of front-panel controls. Improper control settings or circuit connections can cause apparent malfunctions. Read Section III (operating procedure) for an explanation of controls and connectors and general operating considerations. Read Section IV (Principles of Operation) for explanations of circuit theory.

8-41. If trouble is suspected, visually inspect the instrument. Look for loose or burned components that might suggest a source of trouble. Check to see that all circuit board connections are making good contact and are not shorting to an adjacent circuit. If no obvious trouble is found, check the power supply voltages in the instrument. Prior to any extensive troubleshooting, also check the external power sources.

8-42. DC VOLTAGES. On some of the schematics, dc voltages are indicated for active components (transistors, etc). Conditions for making these voltage measurements are listed adjacent to the schematics. Since the conditions for making the measurements may differ from one circuit to another, always check the specific conditions listed adjacent to the schematic.

8-43. CIRCUIT CHECKING. The block diagram (schematic 1) has been provided to enable rapid isolation of a malfunction to a particular circuit group. Once the circuit group is isolated, the input and output to the block are located on the appropriate schematic and progressive troubleshooting techniques (voltage measurements, resistance measurements, and substitution) are employed between two points to isolate the malfunction to a particular component(s).

8-44. INITIAL TROUBLESHOOTING PROCEDURE. Before troubleshooting the Model 1809A in detail, try to perform the adjustment procedures listed in Section V of this manual. Some apparent malfunctions can be corrected by these adjustments; in addition, the inability to obtain a correct adjustment will often reveal the source of trouble.

8-45. TROUBLE DIAGNOSIS. By use of front-panel controls, obtain as many symptoms of the malfunction as possible. From the symptoms noted, one can usually determine which circuit is malfunctioning.

8-46. The sync pulse required for internal triggering is developed in the vertical preamplifier section. If the instrument does not trigger internally, but triggers properly when an external trigger is applied, the vertical preamplifier section should be checked.

8-47. Most stages in the vertical preamplifier section are current amplifiers which make signal tracing difficult. When troubleshooting the preamplifier, check dc bias voltages for best results.

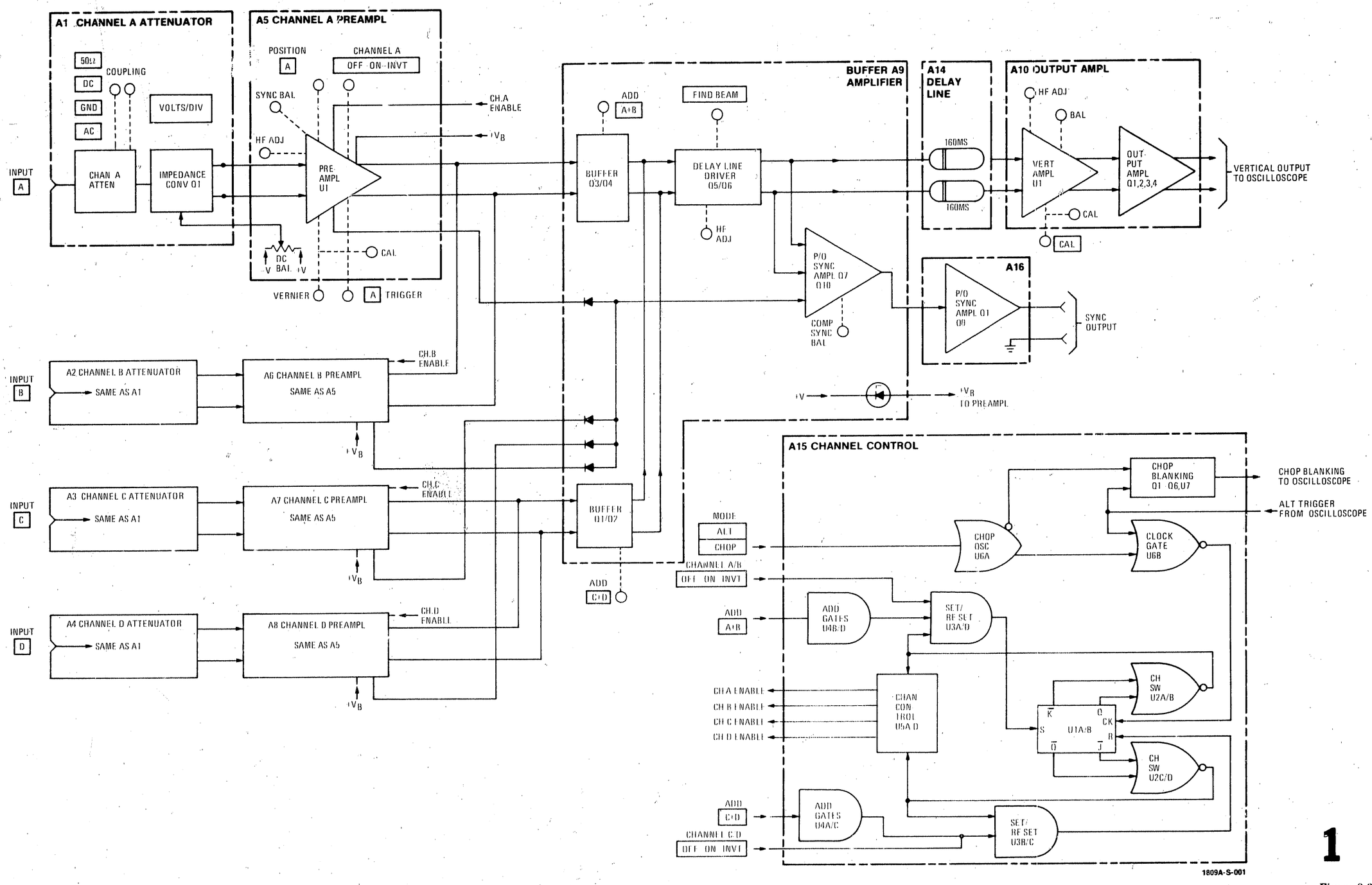


Figure 8-3.
Troubleshooting Block Diagram

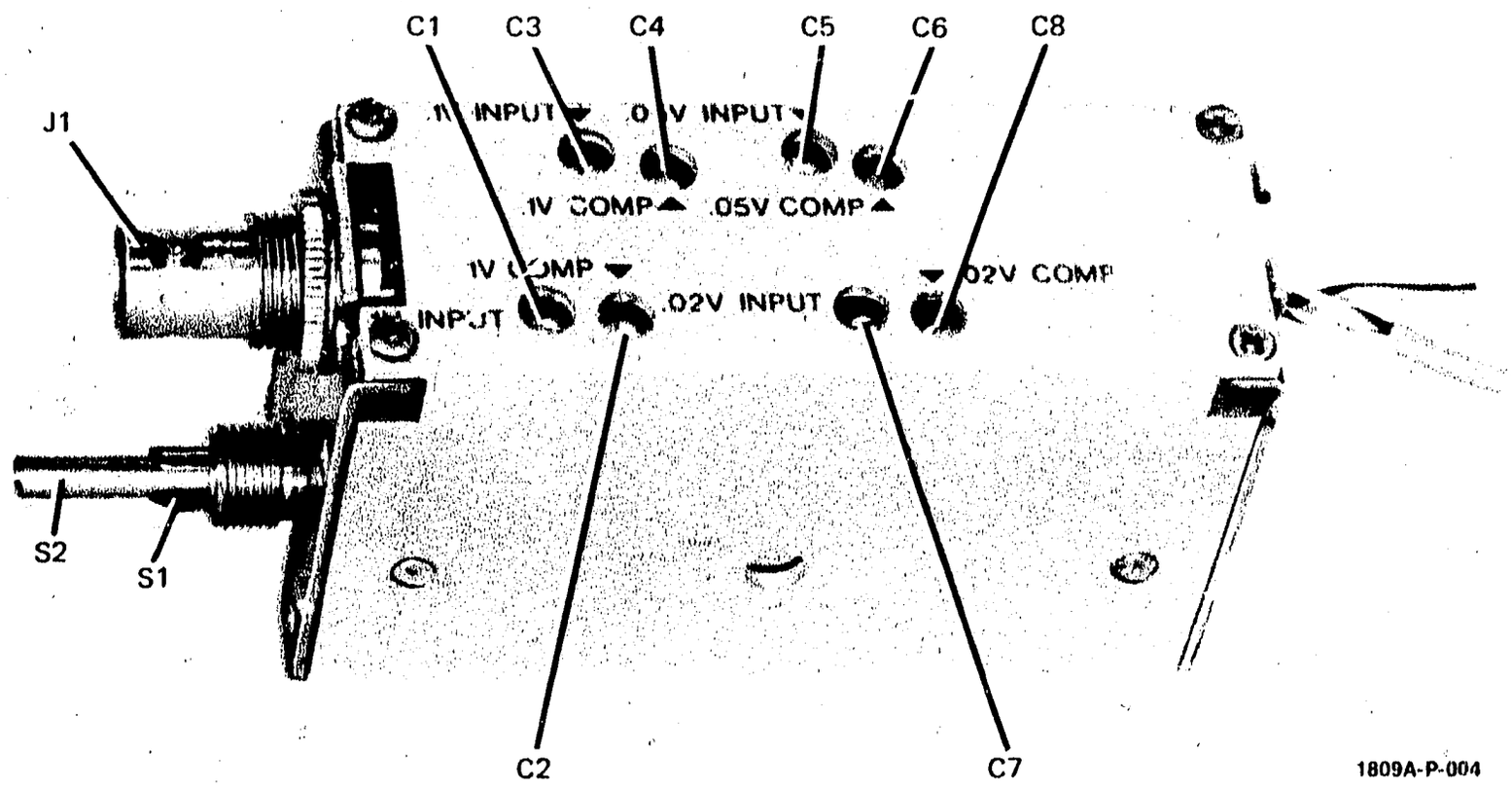


Figure 8-4. Attenuator Component Identification

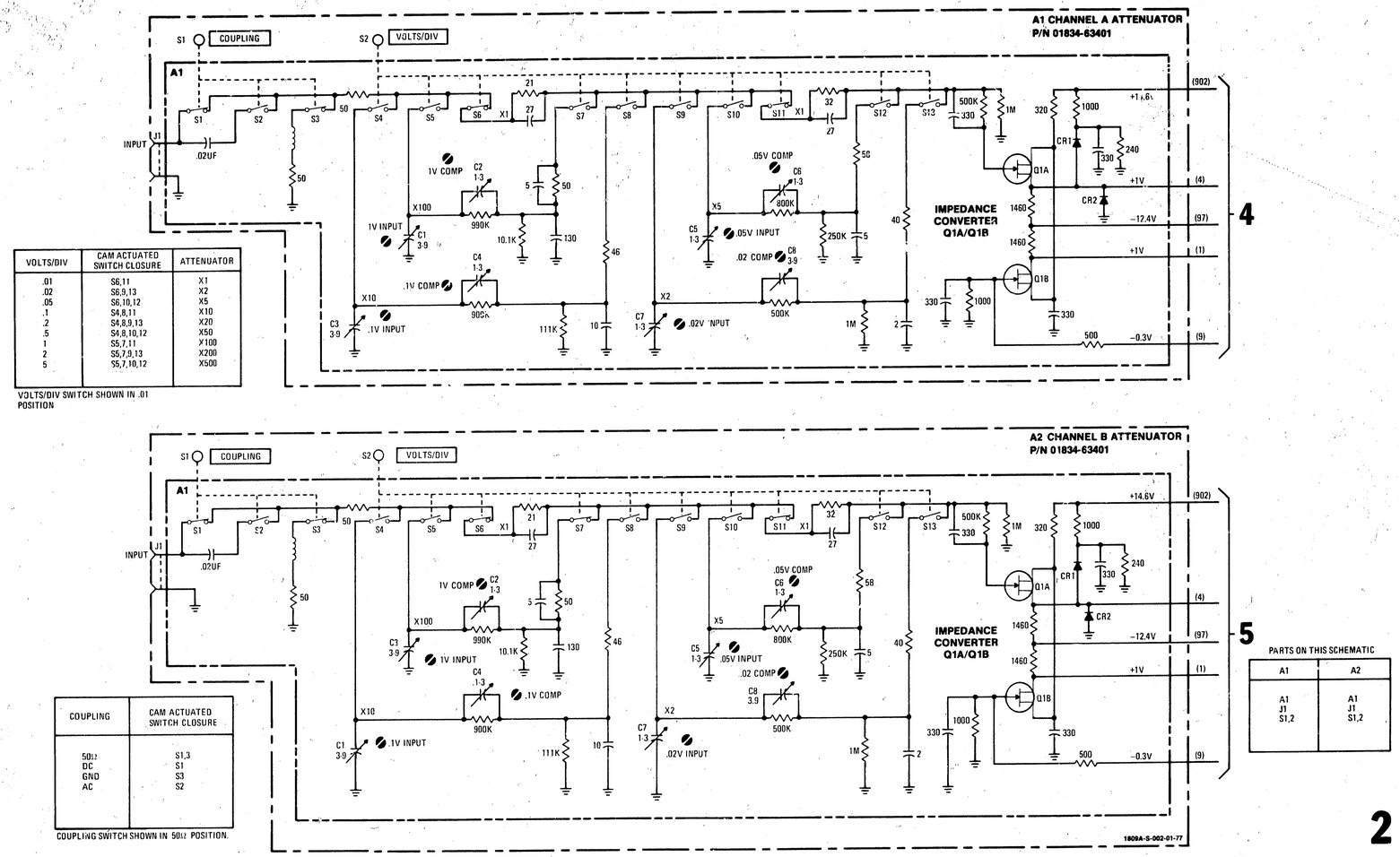
Table 8-3. Schematic 2 Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows (channel A and channel B):

Coupling	GND
OFF-ON-INVT	ON
POSITION	midrange
VOLTS/DIV	5
Vernier	CAL detent

2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.



VOLTS/DIV	CAM ACTUATED SWITCH CLOSURE	ATTENUATOR
.01	S6,11	X1
.02	S6,9,13	X2
.05	S6,10,12	X5
.1	S4,8,11	X10
.2	S4,8,9,13	X20
.5	S4,8,10,12	X50
1	S5,7,11	X100
2	S5,7,9,13	X200
5	S5,7,10,12	X500

COUPLING	CAM ACTUATED SWITCH CLOSURE
50Ω	S1,3
DC	S1
GND	S3
AC	S2

Figure 8-5.
Channel A -Channel B Attenuator, Schematic 2

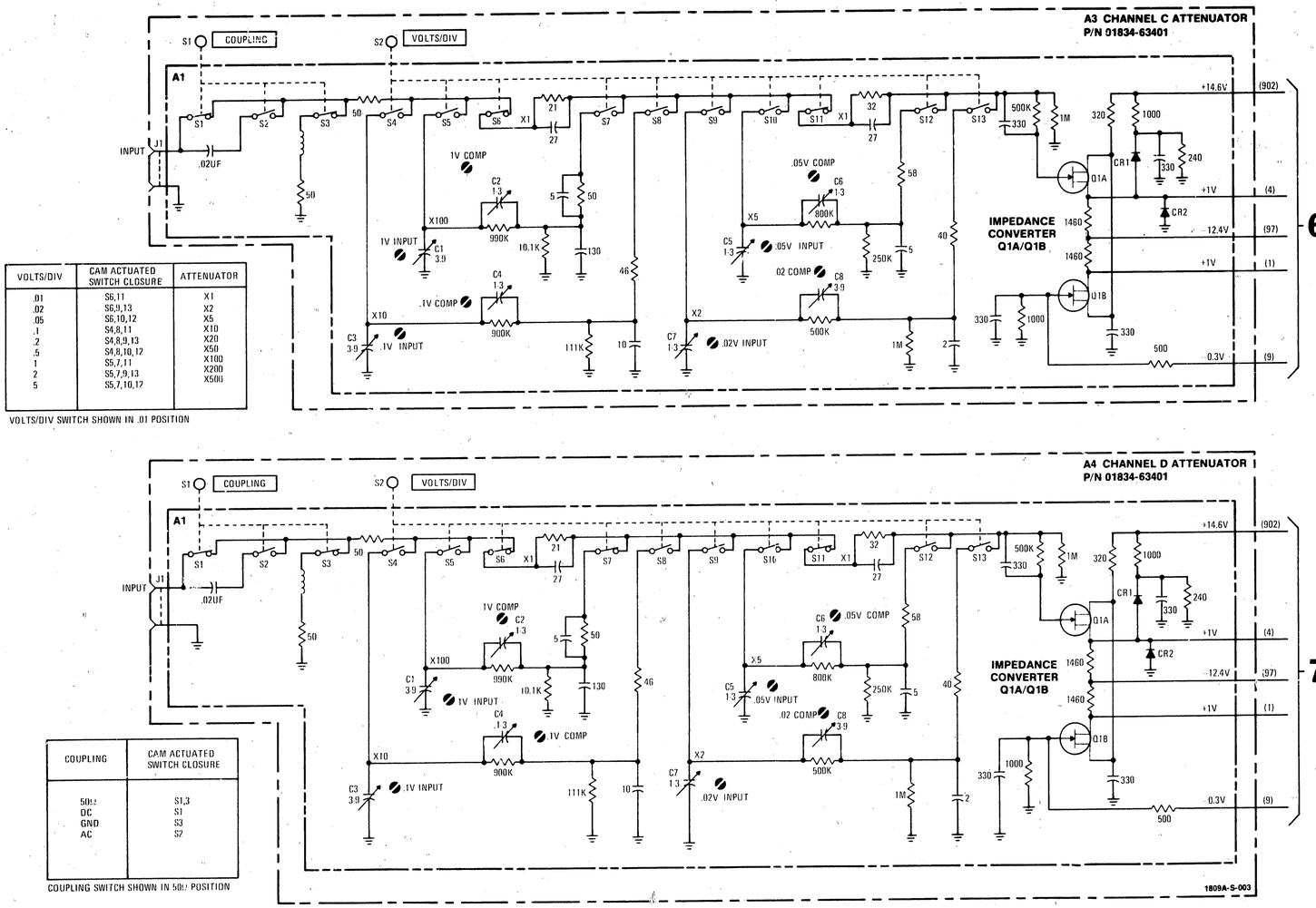
Table 8-4. Schematic 3 Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows (channel C and channel D):

Coupling	GND
OFF-ON-INVT	ON
POSITION	midrange
VOLTS/DIV	5
Vernier	CAL detent

2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.



VOLTS/DIV	CAM ACTUATED SWITCH CLOSURE	ATTENUATOR
.01	S6,11	X1
.02	S6,9,13	X2
.05	S6,10,12	X5
.1	S4,8,11	X10
.2	S4,8,9,13	X20
.5	S4,8,10,12	X50
1	S5,7,11	X100
2	S5,7,9,13	X200
5	S5,7,10,12	X500

VOLTS/DIV SWITCH SHOWN IN .01 POSITION

COUPLING	CAM ACTUATED SWITCH CLOSURE
50Ω	S1,3
DC	S1
GND	S3
AC	S2

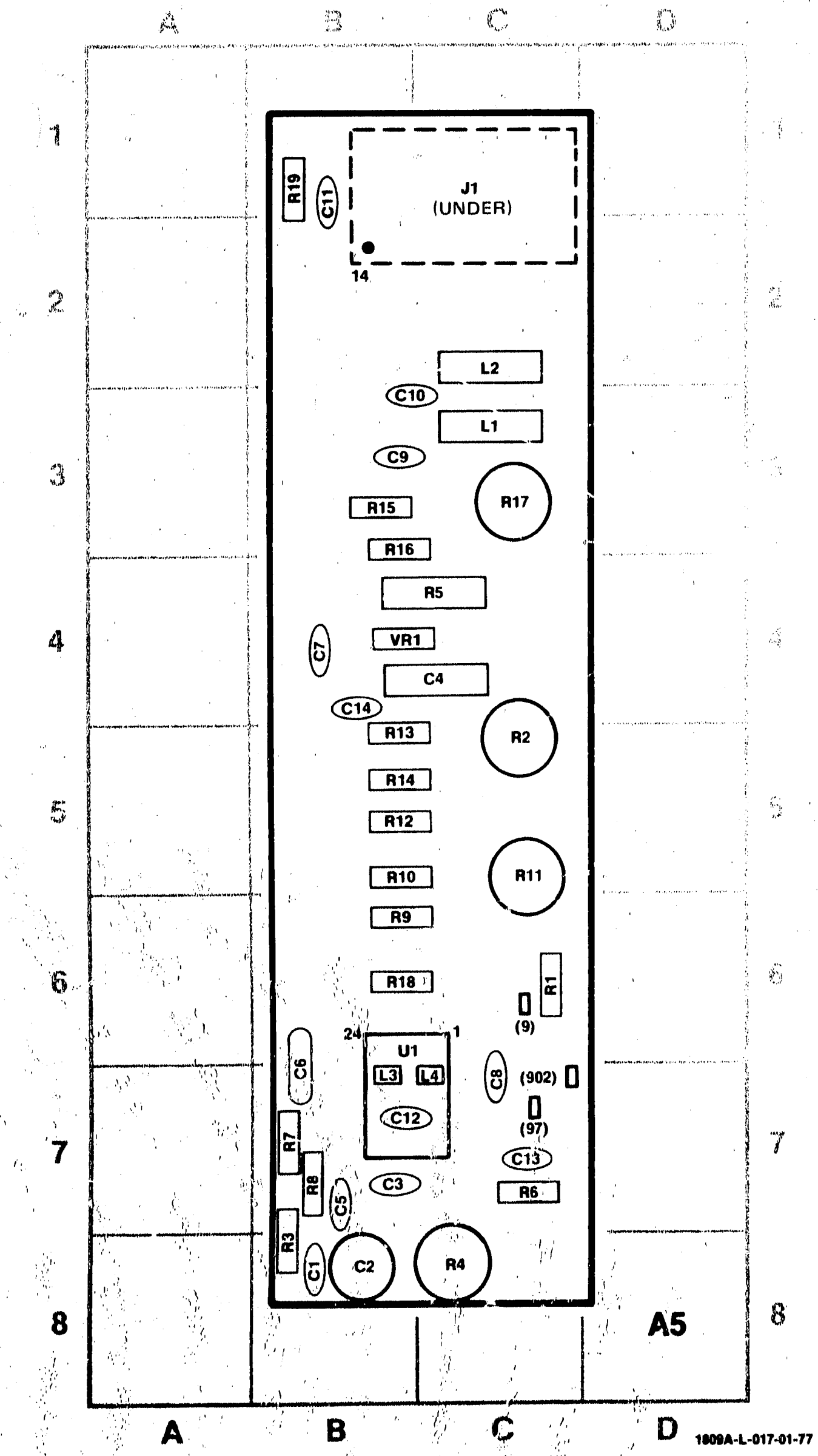
COUPLING SWITCH SHOWN IN 50Ω POSITION

PARTS ON THIS SCHEMATIC

A3	A4
A1 J1 S1,2	A1 J1 S1,2

3

Figure 8-6.
Channel C - Channel D Attenuator, Schematic 3



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-8	R2	C-5
C2	B-8	R3	B-8
C3	B-7	R4	C-8
C4	C-4	R5	B-4
C5	B-7	R6	C-7
C6	B-7	R7	B-7
C7	B-4	R8	B-7
C8	C-7	R9	B-6
C9	B-3	R10	B-5
C10	B-3	R11	C-5
C11	B-1	R12	B-5
C12	B-7	R13	B-5
C13	C-7	R14	B-5
C14	B-4	R15	B-3
J1	C-1	R16	B-4
L1	C-3	R17	C-3
L2	C-2	R18	B-6
L3	B-7	R19	B-1
L4	C-7	U1	B-7
R1	C-6	VR1	B-4

Figure 8-7. Component Identification, Assembly A5

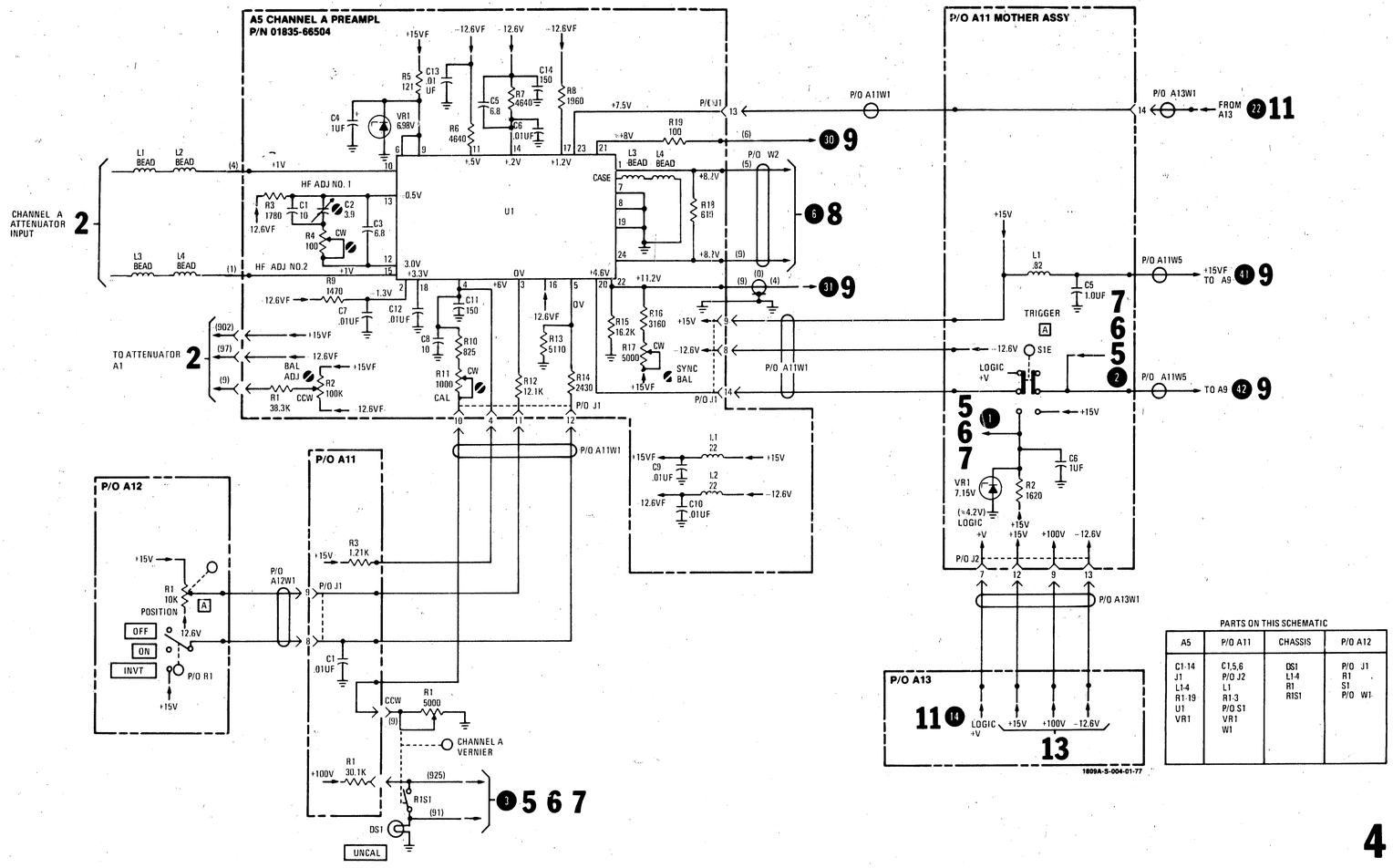
Table 8-5. Schematic 4 Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows:

Coupling (all channels)	GND
OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF
POSITION (channel A)	midrange
VOLTS/DIV (channel A)	5
Vernier (channel A)	CAL detent

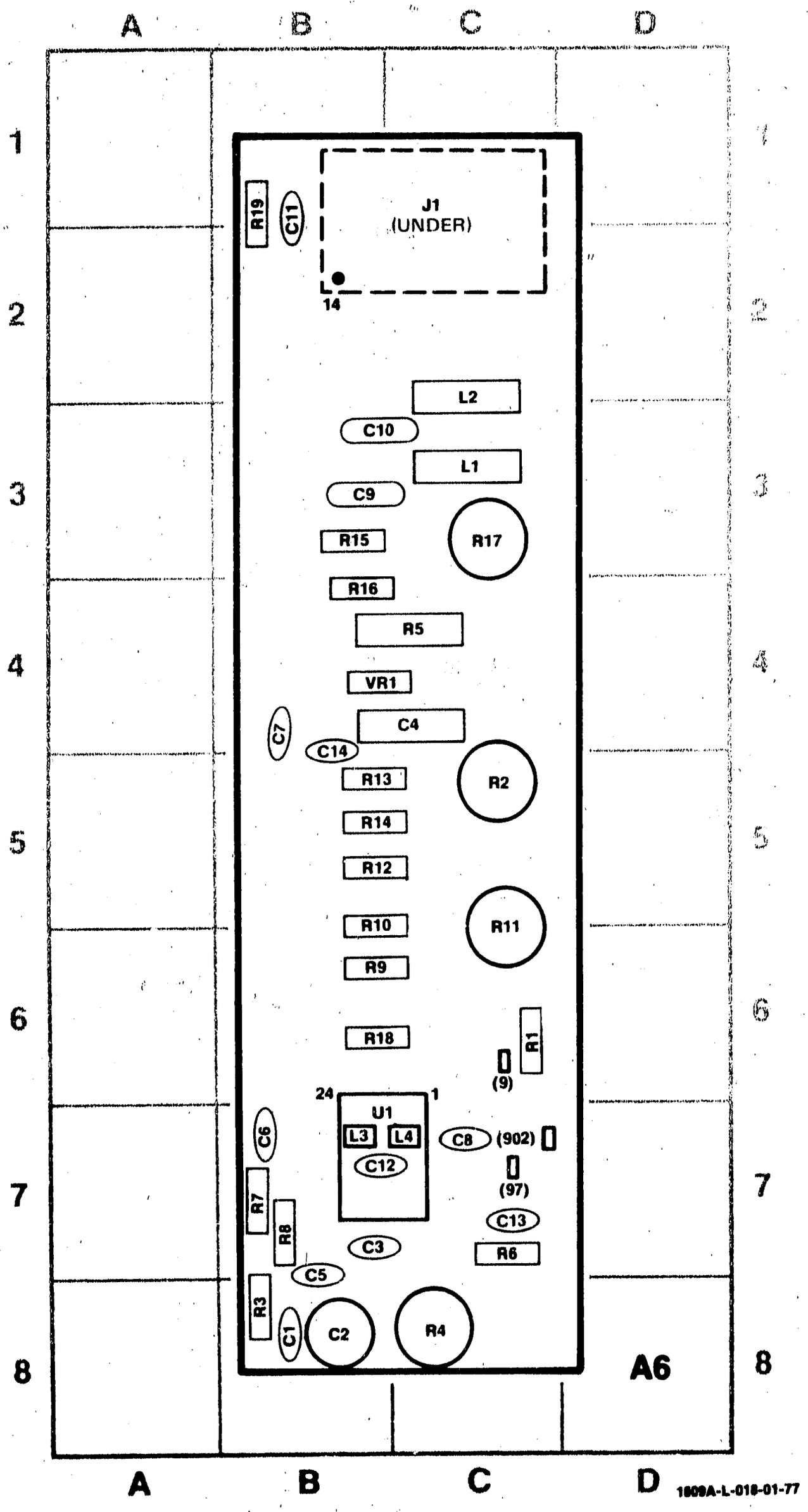
2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.



PARTS ON THIS SCHEMATIC

A5	P/O A11	CHASSIS	P/O A12
C1-14	C1,5,6	DS1	P/O J1
J1	P/O J2	L1-4	R1
L1-4	L1	R1	S1
R1-19	R1-3	R1S1	P/O W1
U1	P/O S1		
VR1	VR1		
	W1		

Figure 8-8.
Channel A Preamplifier, Schematic 4



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-8	R2	C-5
C2	B-8	R3	B-8
C3	B-7	R4	C-8
C4	C-4	R5	B-4
C5	B-7	R6	C-7
C6	B-7	R7	B-7
C7	B-4	R8	B-7
C8	C-7	R9	B-6
C9	B-3	R10	B-5
C10	B-3	R11	C-5
C11	B-1	R12	B-5
C12	B-7	R13	B-5
C13	C-7	R14	B-5
C14	B-4	R15	B-3
J1	C-1	R16	B-4
L1	C-3	R17	C-3
L2	C-2	R18	B-6
L3	B-7	R19	B-1
L4	C-7	U1	B-7
R1	C-6	VR1	B-4

Figure 8-9. Component Identification, Assembly A6

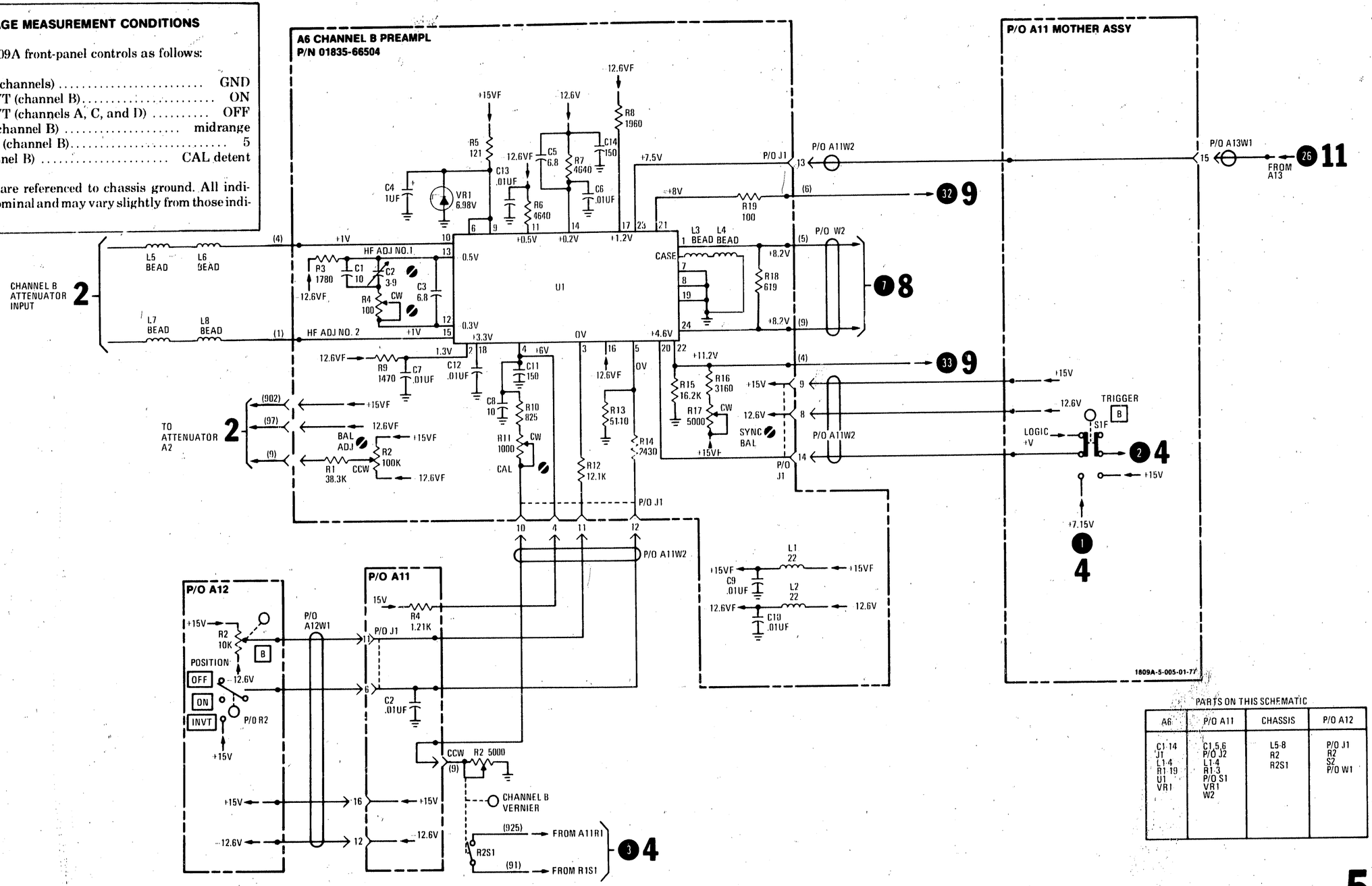
Table 8-6. Schematic 5 Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows:

Coupling (all channels)	GND
OFF-ON-INVT (channel B)	ON
OFF-ON-INVT (channels A, C, and D)	OFF
POSITION (channel B)	midrange
VOLTS/DIV (channel B)	5
Vernier (channel B)	CAL detent

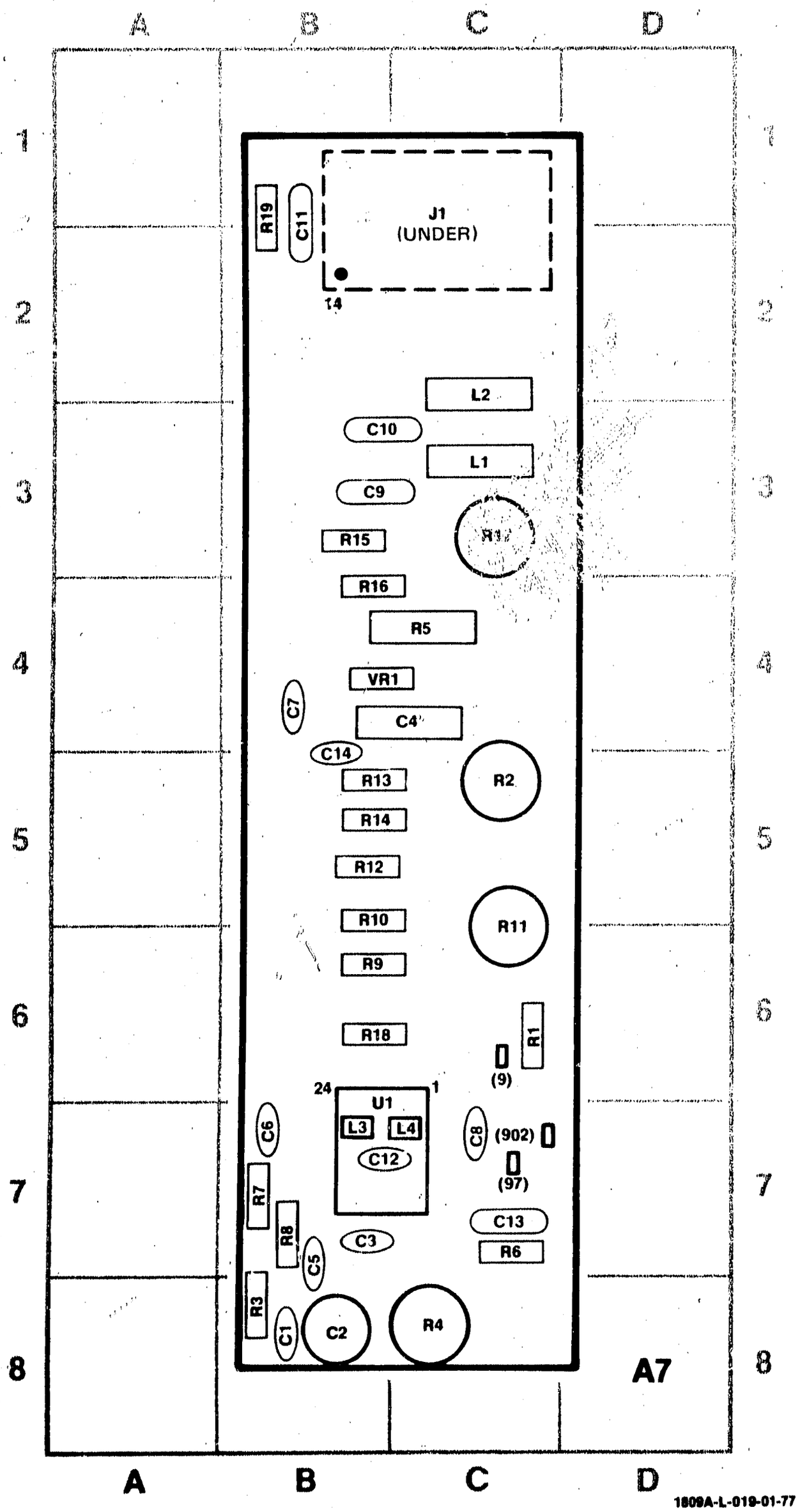
2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.



PARTS ON THIS SCHEMATIC

A6	P/O A11	CHASSIS	P/O A12
C1-14 J1 L1-4 R1-19 U1 VR1	C1,5,6 P/O J2 L1-4 R1-3 P/O S1 VR1 W2	L5-8 R2 R2S1	P/O J1 R2 S2 P/O W1

Figure 8-10. Channel B Preamplifier, Schematic 5



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-8	R2	C-5
C2	B-8	R3	B-8
C3	B-7	R4	C-8
C4	C-4	R5	B-4
C5	B-7	R6	C-7
C6	B-7	R7	B-7
C7	B-4	R8	B-7
C8	C-7	R9	B-6
C9	B-3	R10	B-5
C10	B-3	R11	C-5
C11	B-1	R12	B-5
C12	B-7	R13	B-5
C13	C-7	R14	B-5
C14	B-4	R15	B-3
J1	C-1	R16	B-3
L1	C-3	R17	C-3
L2	C-2	R18	B-6
L3	B-7	R19	B-1
L4	C-7	U1	B-7
R1	C-6	VR1	B-4

Figure 8-11. Component Identification, Assembly A7

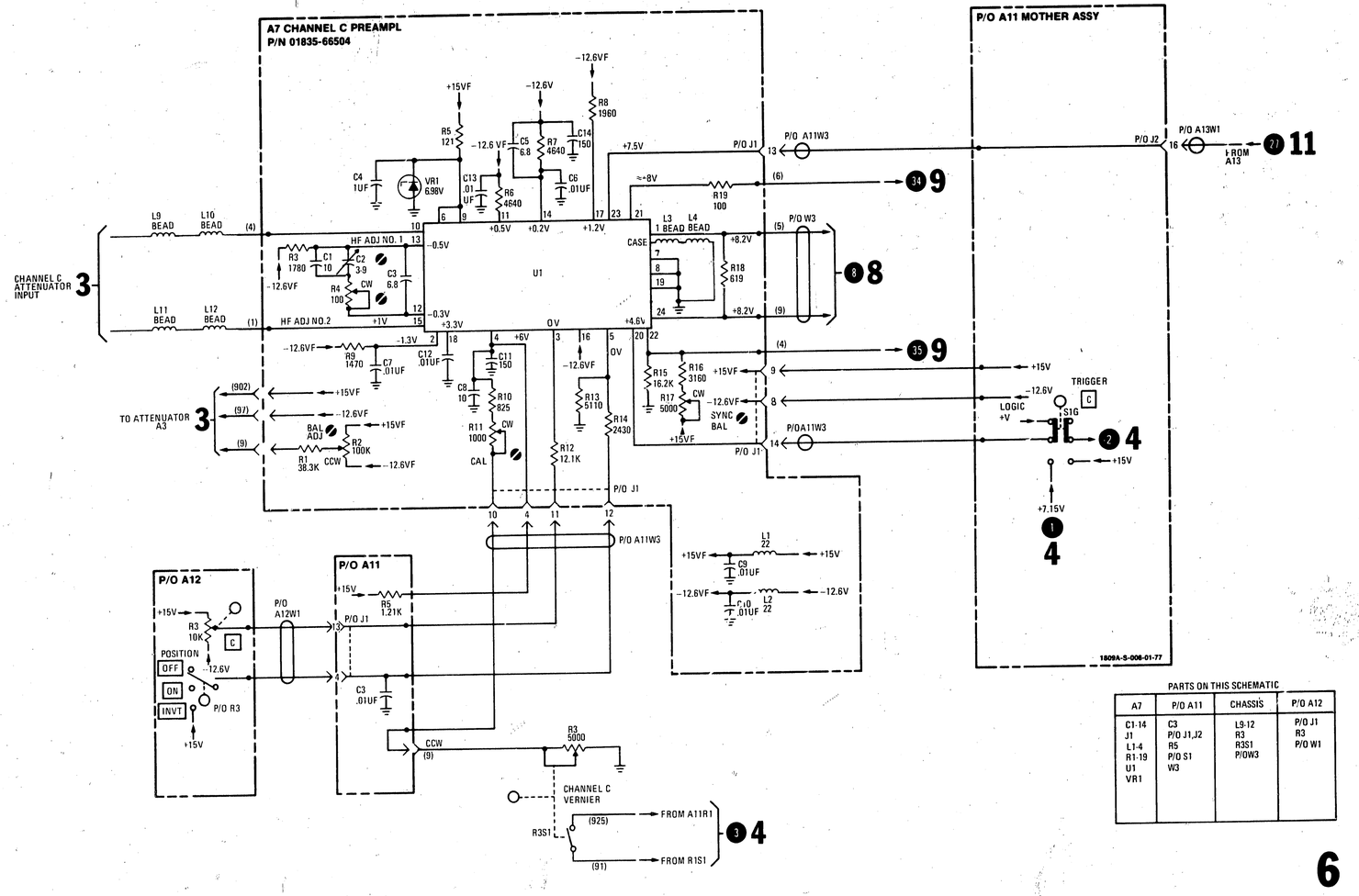
Table 8-7. Schematic 6 Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows:

Coupling (all channels)	GND
OFF-ON-INVT (channel C)	ON
OFF-ON-INVT (channels A, B, and D)	OFF
POSITION (channel C)	midrange
VOLTS/DIV (channel C)	5
Vernier (channel C)	CAL detent

2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.

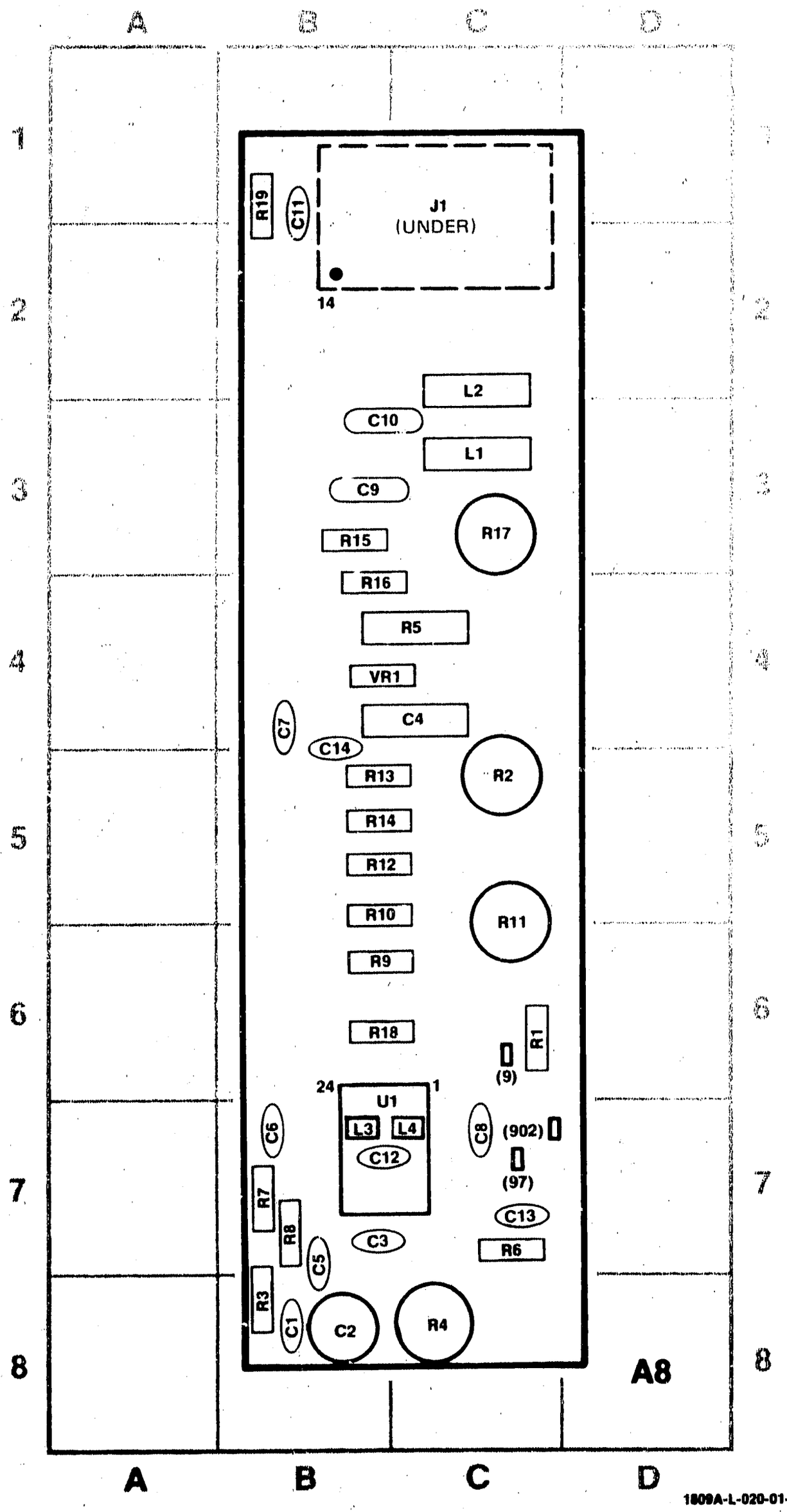


PARTS ON THIS SCHEMATIC

A7	P/O A11	CHASSIS	P/O A12
C1-14	C3	L9-12	P/O J1
J1	P/O J1,J2	R3	R3
L1-4	R5	R3S1	P/O W1
R1-19	P/O S1	P/OW3	
U1	W3		
VR1			

6

Figure 8-12.
Channel C Preamplifier, Schematic 6



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-8	R2	C-5
C2	B-8	R3	B-8
C3	B-7	R4	C-8
C4	C-4	R5	B-4
C5	B-7	R6	C-7
C6	B-7	R7	B-7
C7	B-4	R8	B-7
C8	C-7	R9	B-6
C9	B-3	R10	B-5
C10	B-3	R11	C-5
C11	B-1	R12	B-5
C12	B-7	R13	B-5
C13	C-7	R14	B-5
C14	B-4	R15	B-3
J1	C-1	R16	B-4
L1	C-3	R17	C-3
L2	C-2	R18	B-6
L3	B-7	R19	B-1
L4	C-7	U1	B-7
R1	C-6	VR1	B-4

Figure 8-13. Component Identification, Assembly A8

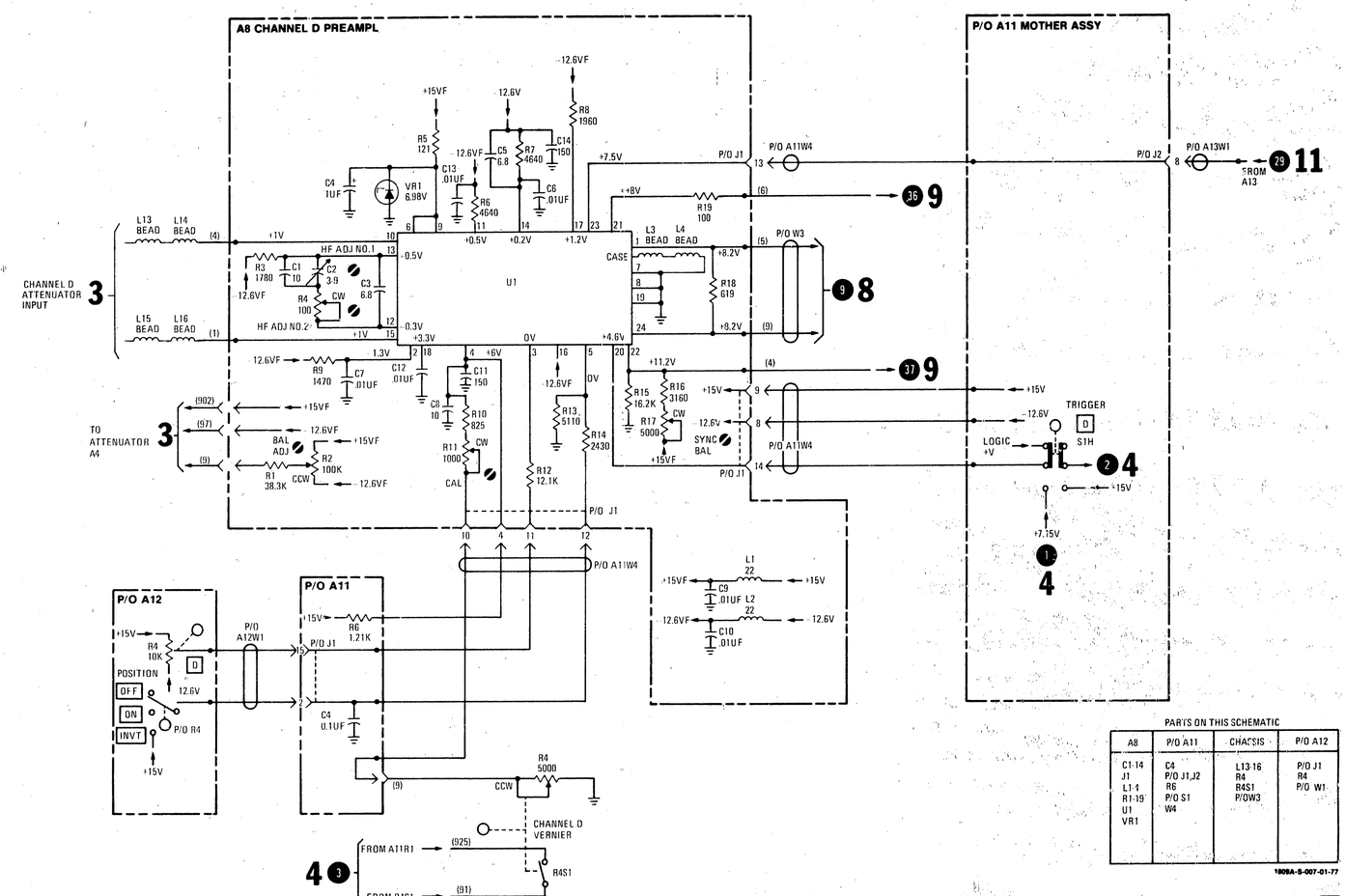
Table 8-8. Schematic 7 Mesurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows:

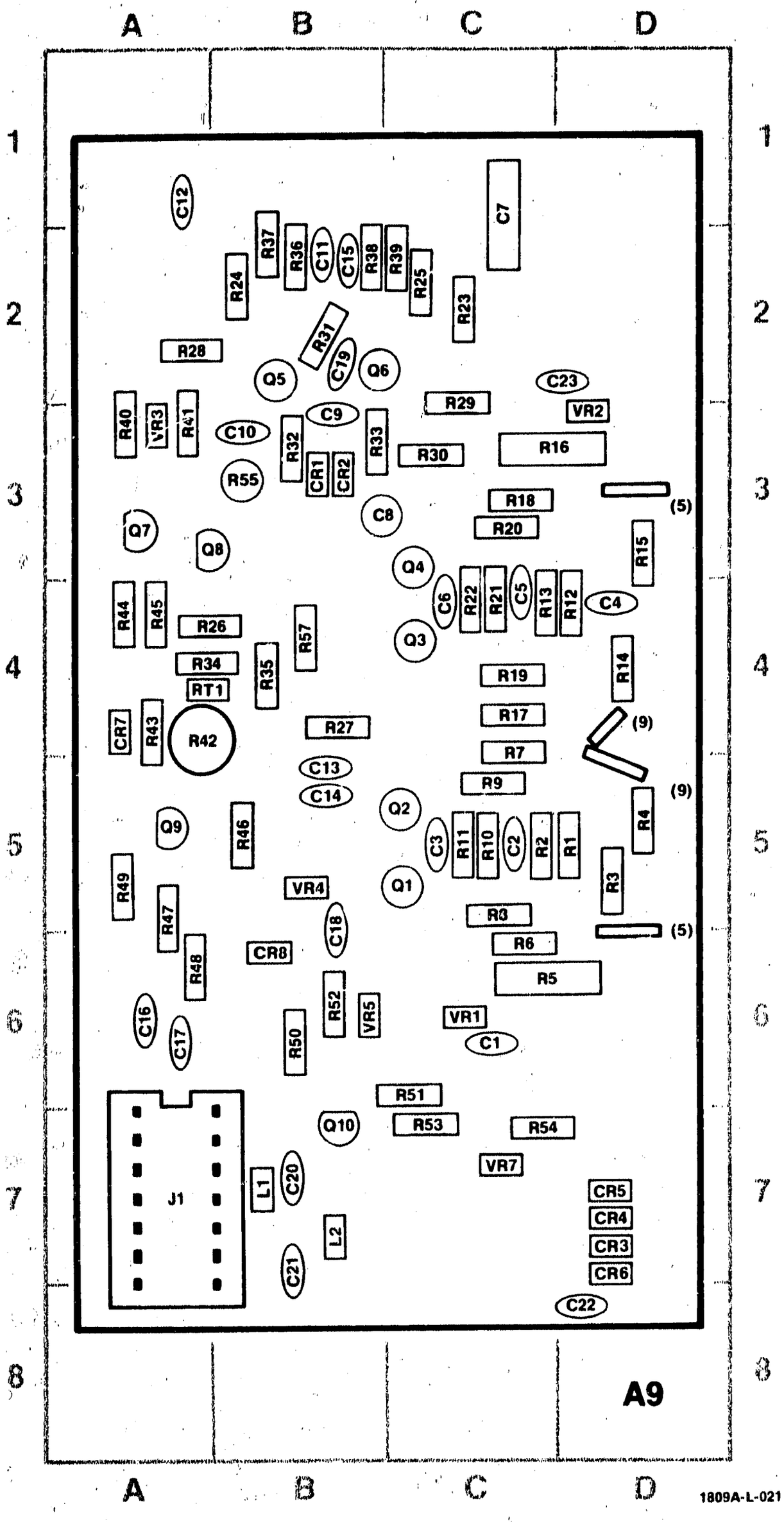
Coupling (all channels)	GND
OFF-ON-INVT (channel D)	ON
OFF-ON-INVT (channels A, B, and C)	OFF
POSITION (channel D)	midrange
VOLTS/DIV (channel D)	5
Vernier (channel D)	CAL detent

2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.



7

Figure 8-14.
Channel D Preamplifier, Schematic 7



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-6	Q3	C-4	R29	C-3
C2	C-5	Q4	C-3	R30	C-3
C3	C-5	Q5	B-2	R31	B-2
C4	D-4	Q6	B-2	R32	B-3
C5	C-4	Q7	A-3	R33	B-3
C6	C-4	Q8	A-3	R34	A-4
C7	C-1	Q9	A-5	R35	B-4
C8	B-3	Q10	B-7	R36	B-2
C9	B-3	R1	D-5	R37	B-2
C10	B-3	R2	C-5	R38	B-2
C11	B-2	R3	D-5	R39	C-2
C12	A-1	R4	D-5	R40	A-3
C13	B-5	R5	C-6	R41	A-3
C14	B-5	R6	C-6	R42	A-4
C15	B-2	R7	C-5	R43	A-4
C16	A-6	R8	C-5	R44	A-4
C17	A-6	R9	C-5	R45	A-4
C18	B-6	R10	C-5	R46	B-5
C19	B-2	R11	C-5	R47	A-5
C20	B-7	R12	D-4	R48	A-6
C21	B-7	R13	C-4	R49	A-5
C22	D-8	R14	D-4	R50	B-6
C23	D-2	R15	D-3	R51	C-6
CR1	B-3	R16	C-3	R52	B-6
CR2	B-3	R17	C-4	R53	C-7
CR3	D-7	R18	C-3	R54	C-7
CR4	D-7	R19	C-4	R55	B-3
CR5	D-7	R20	C-3	R57	B-4
CR6	D-8	R21	C-4	RT1	A-4
CR7	A-4	R22	C-4	VR1	C-6
CR8	B-6	R23	C-2	VR2	D-3
J1	A-7	R24	B-2	VR3	A-3
L1	B-7	R25	C-2	VR4	B-5
L2	B-7	R26	A-4	VR5	B-6
Q1	C-5	R27	B-4	VR7	C-7
Q2	C-5	R28	A-2		

DELETED: A9: C24, R56, VR6

Figure 8-15. Component Identification, Assembly A9

Table 8-9. Schematic 8 Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows:

Coupling (all channels)	GND
OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF
POSITION (channel A)	midrange
VOLTS/DIV (channel A)	5
Vernier (channel A)	CAL detent

2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.

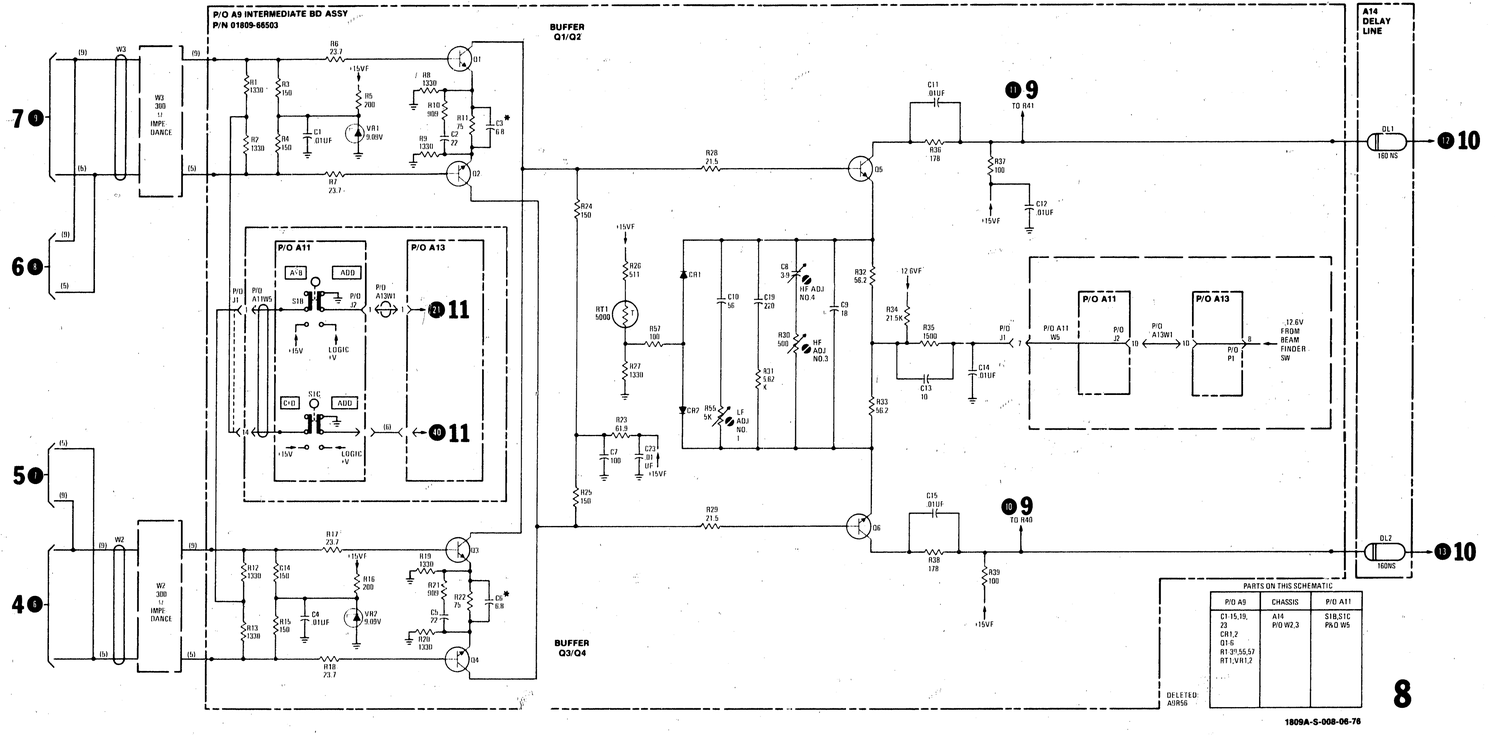
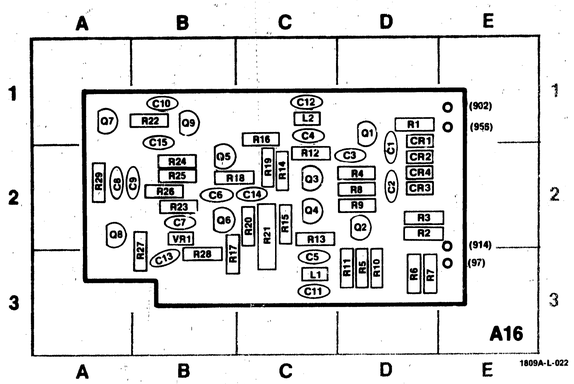
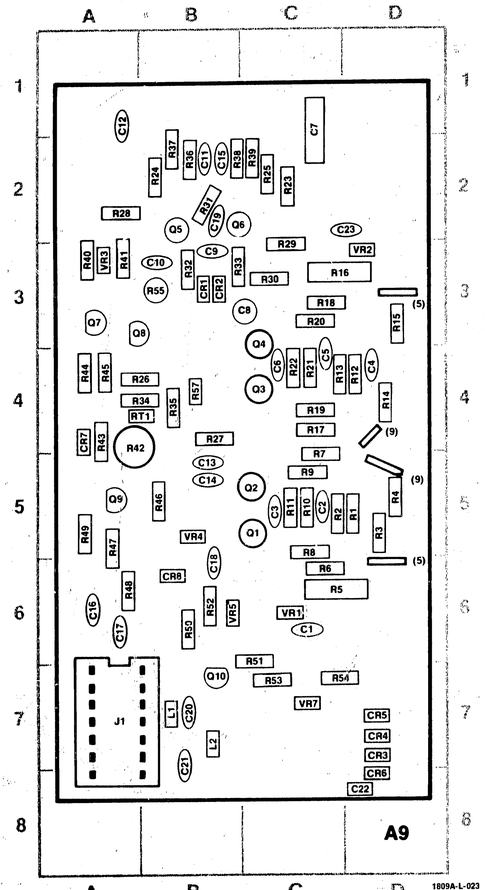


Figure 8-16.
Buffer Amplifier. Schematic 8



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-2	L2	C-1	R11	D-3
C2	D-2	Q1	D-1	R12	C-2
C3	D-2	Q2	D-2	R13	C-2
C4	C-1	Q3	C-2	R14	C-2
C5	C-3	Q4	C-2	R15	C-2
C6	B-2	Q5	B-2	R16	C-1
C7	B-2	Q6	B-2	R17	B-3
C8	A-2	Q7	A-1	R18	B-2
C9	A-2	Q8	A-2	R19	C-2
C10	B-1	Q9	B-1	R20	C-2
C11	C-3	R1	D-1	R21	C-2
C12	C-1	R2	D-2	R22	B-1
C13	B-3	R3	D-2	R23	B-2
C14	C-2	R4	D-2	R24	B-2
C15	B-1	R5	D-3	R25	B-2
CR1	D-2	R6	D-3	R26	B-2
CR2	D-2	R7	D-3	R27	B-3
CR3	D-2	R8	D-2	R28	B-3
CR4	D-2	R9	D-2	R29	A-2
L1	C-3	R10	D-3	VR1	B-2

Figure 8-17. Component Identification, Assembly A16



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-6	CR5	D-7	R11	C-5	R38	B-2
C2	C-5	CR6	D-8	R12	D-4	R39	C-2
C3	C-5	CR7	A-4	R13	D-4	R40	A-3
C4	D-4	CR8	B-6	R14	D-4	R41	A-3
C5	C-4	J1	A-7	R15	D-3	R42	A-4
C6	C-4	L1	B-7	R16	C-3	R43	A-4
C7	C-1	L2	B-7	R17	C-4	R44	A-4
C8	B-3	Q1	C-5	R18	C-3	R45	A-4
C9	B-3	Q2	C-5	R19	C-4	R46	B-5
C10	B-3	Q3	C-4	R20	C-3	R47	A-5
C11	B-2	Q4	C-3	R21	C-4	R48	A-6
C12	A-1	Q5	B-2	R22	C-4	R49	A-5
C13	B-5	Q6	B-2	R23	C-2	R50	B-6
C14	B-5	Q7	A-3	R24	B-2	R51	C-6
C15	B-2	Q8	A-3	R25	C-2	R52	B-6
C16	A-6	Q9	A-5	R26	A-4	R53	C-7
C17	A-6	Q10	B-7	R27	B-4	R54	C-7
C18	B-6	R1	D-5	R28	A-2	R55	B-3
C19	B-2	R2	C-5	R29	C-3	R57	B-4
C20	B-7	R3	D-5	R30	C-3	RT1	A-4
C21	B-7	R4	D-5	R31	B-2	VR1	C-6
C22	D-8	R5	C-6	R32	B-3	VR2	D-3
C23	D-2	R6	C-6	R33	B-3	VR3	A-3
CR1	B-3	R7	C-5	R34	A-4	VR4	B-5
CR2	B-3	R8	C-5	R35	B-4	VR5	B-6
CR3	D-7	R9	C-5	R36	B-2	VR7	C-7
CR4	D-7	R10	C-5	R37	B-2		

DELETED: A9: C24, R56, VR6

Figure 8-18. Component Identification, Assembly A9

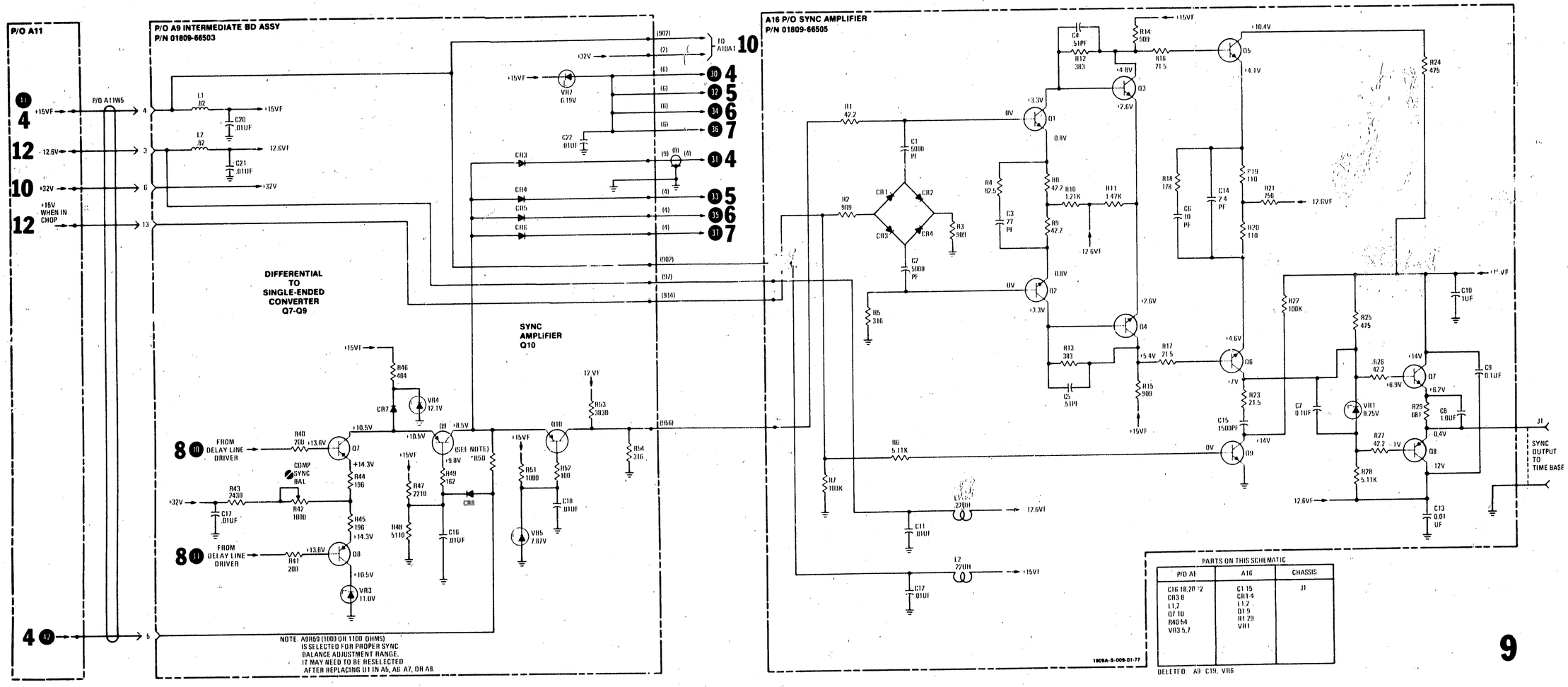
Table 8-10. Schematic 9 Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows:

Coupling (all channels)	GND
OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF
POSITION (channel A)	midrange
VOLTS/DIV (channel A)	5
Vernier (channel A)	CAL detent
Trigger Source	COMP

2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.



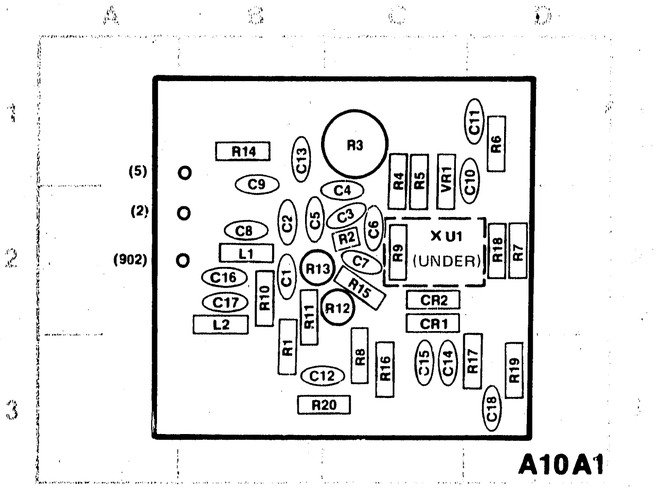
PARTS ON THIS SCHEMATIC

P/O A1	A16	CHASSIS
C16 18,20 22 CR3 8 L1,2 Q7 10 R40 54 VR3 5,7	C1 15 CR1 4 L1,2 Q1 9 R1 29 VR1	J1

DELETED: A9 C19, VR6

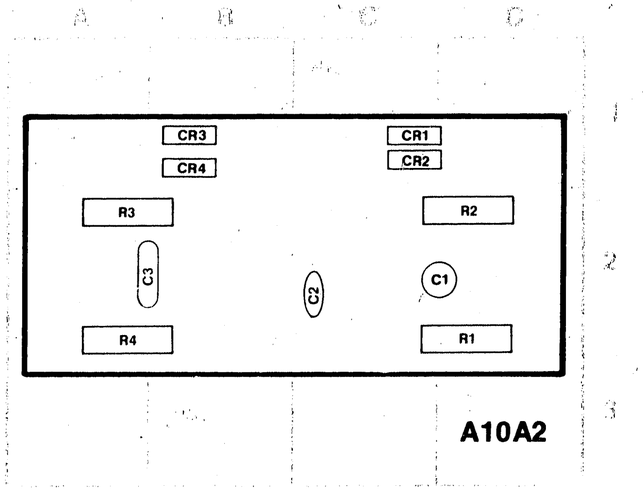
9

Figure 8-19.
Sync Amplifier, Schematic 9



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-2	R1	B-3
C2	B-2	R2	C-2
C3	C-2	R3	C-1
C4	C-2	R4	C-1
C5	B-2	R5	C-1
C6	C-2	R6	D-1
C7	C-2	R7	D-2
C8	B-2	R8	C-3
C9	B-2	R9	C-2
C10	D-1	R10	B-2
C11	D-1	R11	B-2
C12	C-2	R12	C-2
C13	B-1	R13	B-2
C14	C-3	R14	B-1
C15	C-3	R15	C-2
C16	B-2	R16	C-3
C17	B-2	R17	C-3
C18	D-3	R18	D-2
L1	B-2	R19	D-3
L2	B-2	R20	C-3
		VR1	C-1

Figure 8-20. Component Identification, Assembly A10A1



REF DESIG	GRID LOC
C1	D-2
C2	C-2
C3	A-2
CR1	C-1
CR2	C-1
CR3	B-1
CR4	B-1
R1	D-2
R2	D-2
R3	A-2
R4	A-3

Figure 8-21. Component Identification, Assembly A10A2

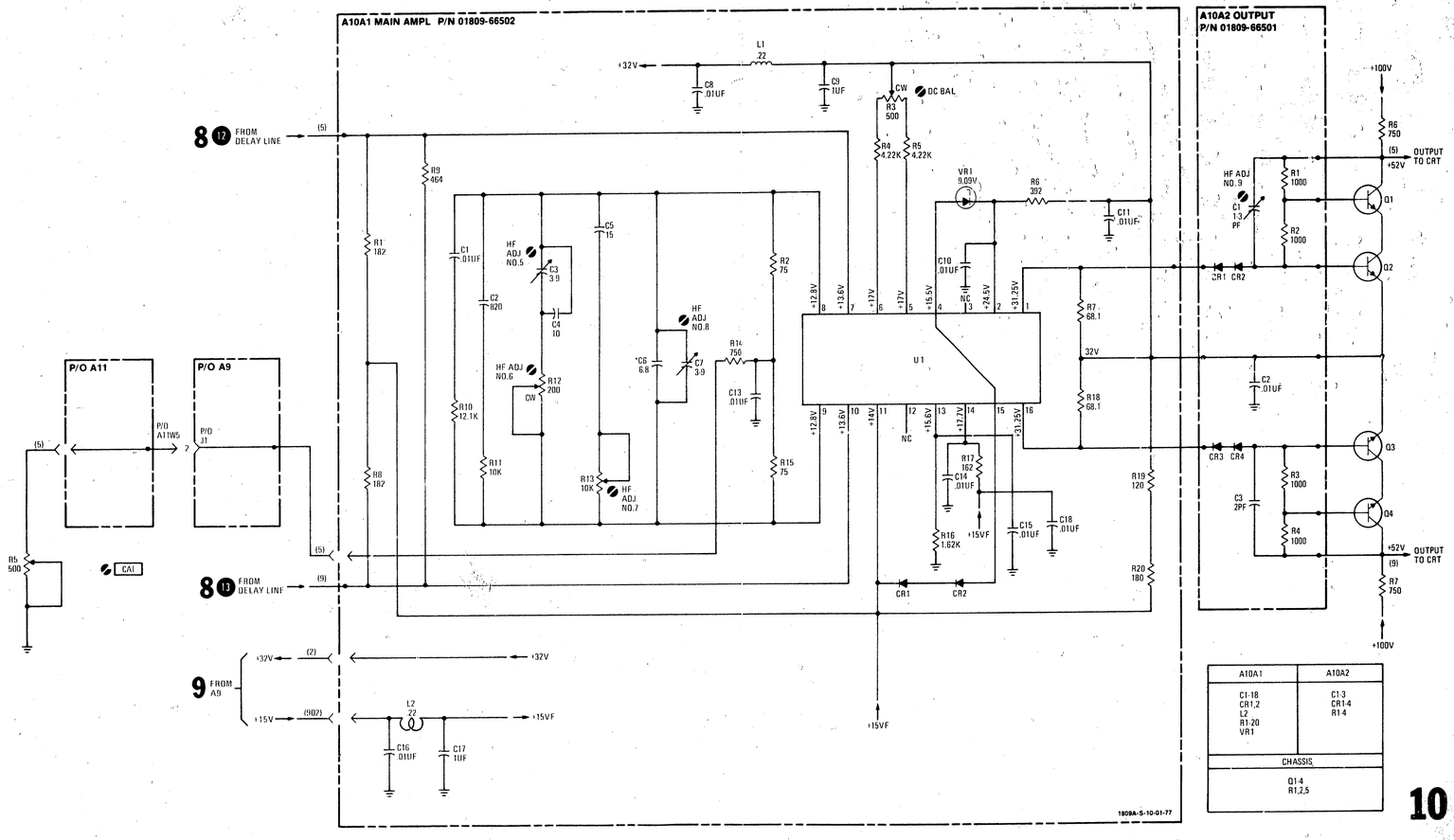
Table 8-11. Schematic 10 Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set Model 1809A front-panel controls as follows:

Coupling (all channels)	GND
OFF-ON-INVT (channel A)	ON
OFF-ON-INVT (channels B, C, and D)	OFF
POSITION (channel A)	midrange
VOLTS/DIV (channel A)	5
Vernier (channel A)	CAL detent

2. All voltages are referenced to chassis ground. All indications are nominal and may vary slightly from those indicated.



A10A1	A10A2
C1-18 CR1,2 L2 R1-20 VR1	C1-3 CR1-4 R1-4
CHASSIS	
Q1-4 R1,2,5	

10

Figure 8-22.
Output Amplifier, Schematic 10

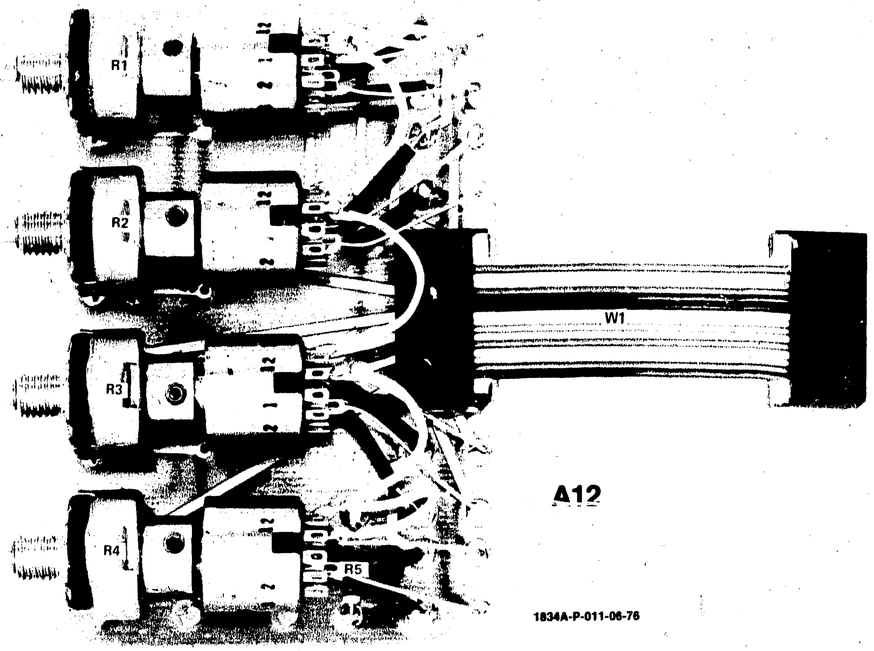
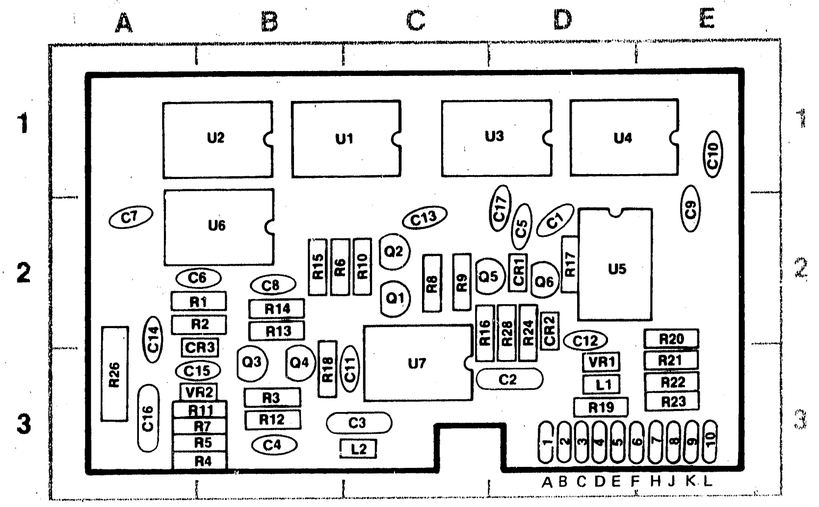


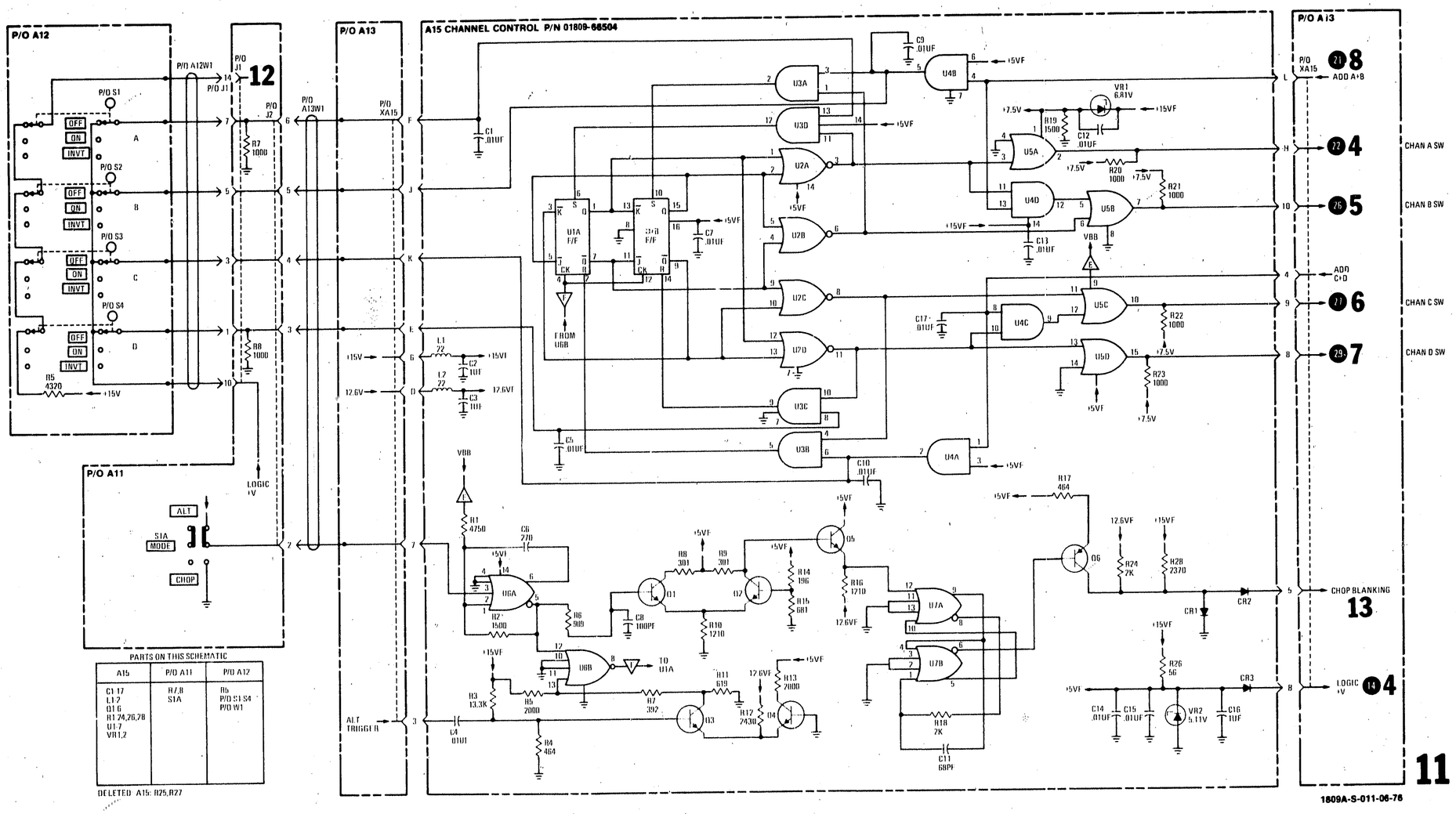
Figure 8-23. Component Identification, Assembly A12



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-2	Q2	C-2	R16	C-2
C2	D-3	Q3	B-3	R17	D-2
C3	C-3	Q4	B-3	R18	B-3
C4	B-3	Q5	C-2	R19	D-3
C5	D-2	Q6	D-2	R20	E-2
C6	B-2	R1	B-2	R21	E-3
C7	A-2	R2	B-2	R22	E-3
C8	B-2	R3	B-3	R23	E-3
C9	E-2	R4	B-3	R24	D-2
C10	E-1	R5	B-3	R26	A-3
C11	C-3	R6	B-2	R28	D-2
C12	D-2	R7	B-3	U1	C-1
C13	C-2	R8	C-2	U2	B-1
C14	A-2	R9	C-2	U3	C-1
C15	B-3	R10	C-2	U4	D-1
C16	A-3	R11	B-3	U5	D-2
C17	D-2	R12	B-3	U6	B-2
L1	D-3	R13	B-2	U7	C-3
L2	C-3	R14	B-2	VR1	D-3
Q1	C-2	R15	B-2	VR2	B-3

A15

Figure 8-24. Component Identification, Assembly A15

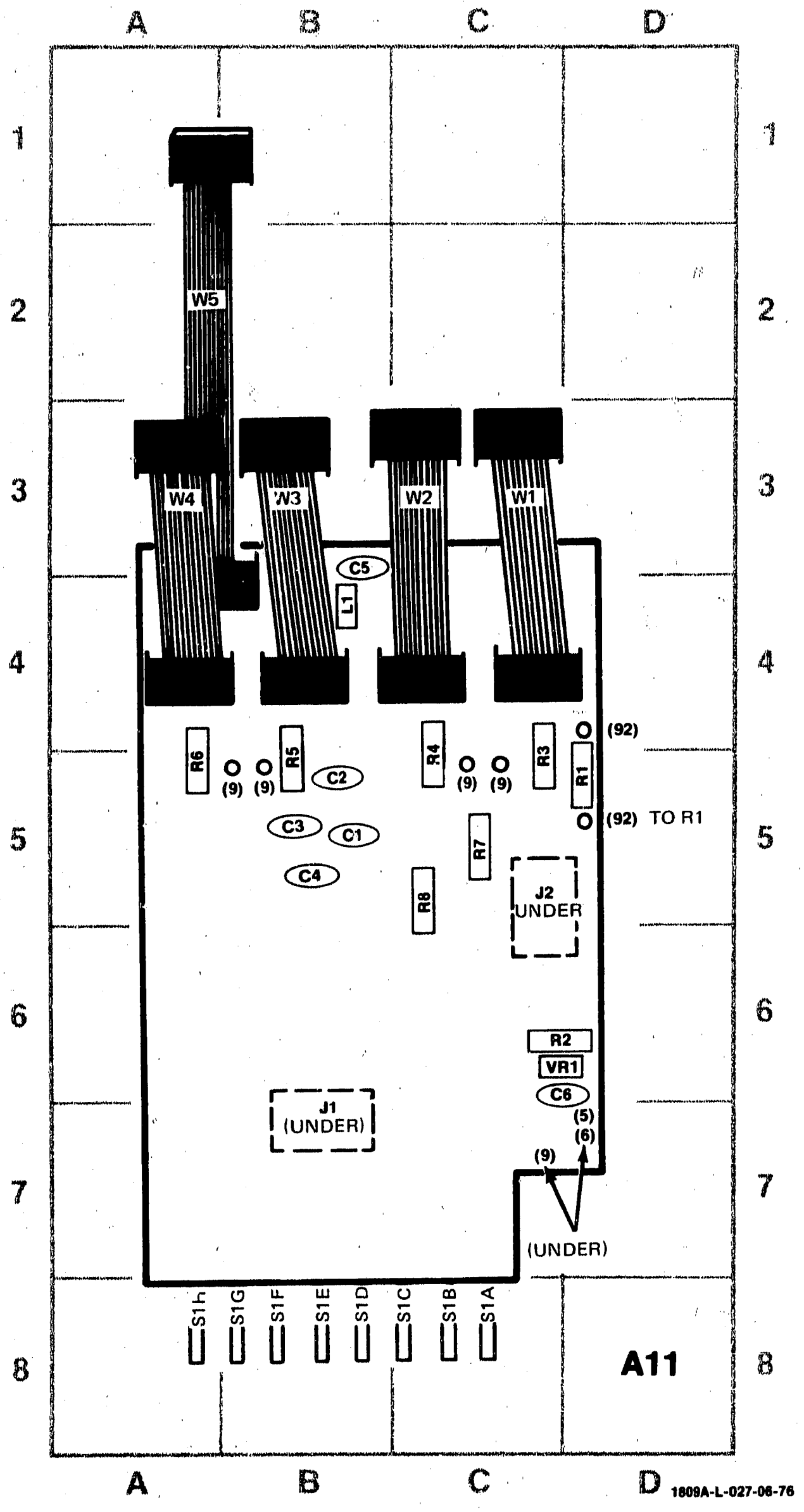


PARTS ON THIS SCHEMATIC

A15	P/O A11	P/O A12
C1-17 L1-2 Q1-6 R1-24,26,28 U1-7 VR1,2	R7,8 S1A	R5 P/O S1-S4 P/O W1

DELETED: A15: R25,R27

Figure 8-25.
Channel Control, Schematic 11



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-5	R8	C-5
C2	B-5	S1A	C-8
C3	B-5	S1B	C-8
C4	B-5	S1C	C-8
C5	B-3	S1D	B-8
C6	C-6	S1E	B-8
J1	B-7	S1F	B-8
J2	C-5	S1G	B-8
L1	B-4	S1H	A-8
R1	D-5	VR1	C-6
R2	C-6	W1	C-3
R3	C-5	W2	C-3
R4	C-5	W3	B-3
R5	B-5	W4	A-3
R6	A-5	W5	A-2
R7	C-5		

Figure 8-26. Component Identification, Assembly A11.

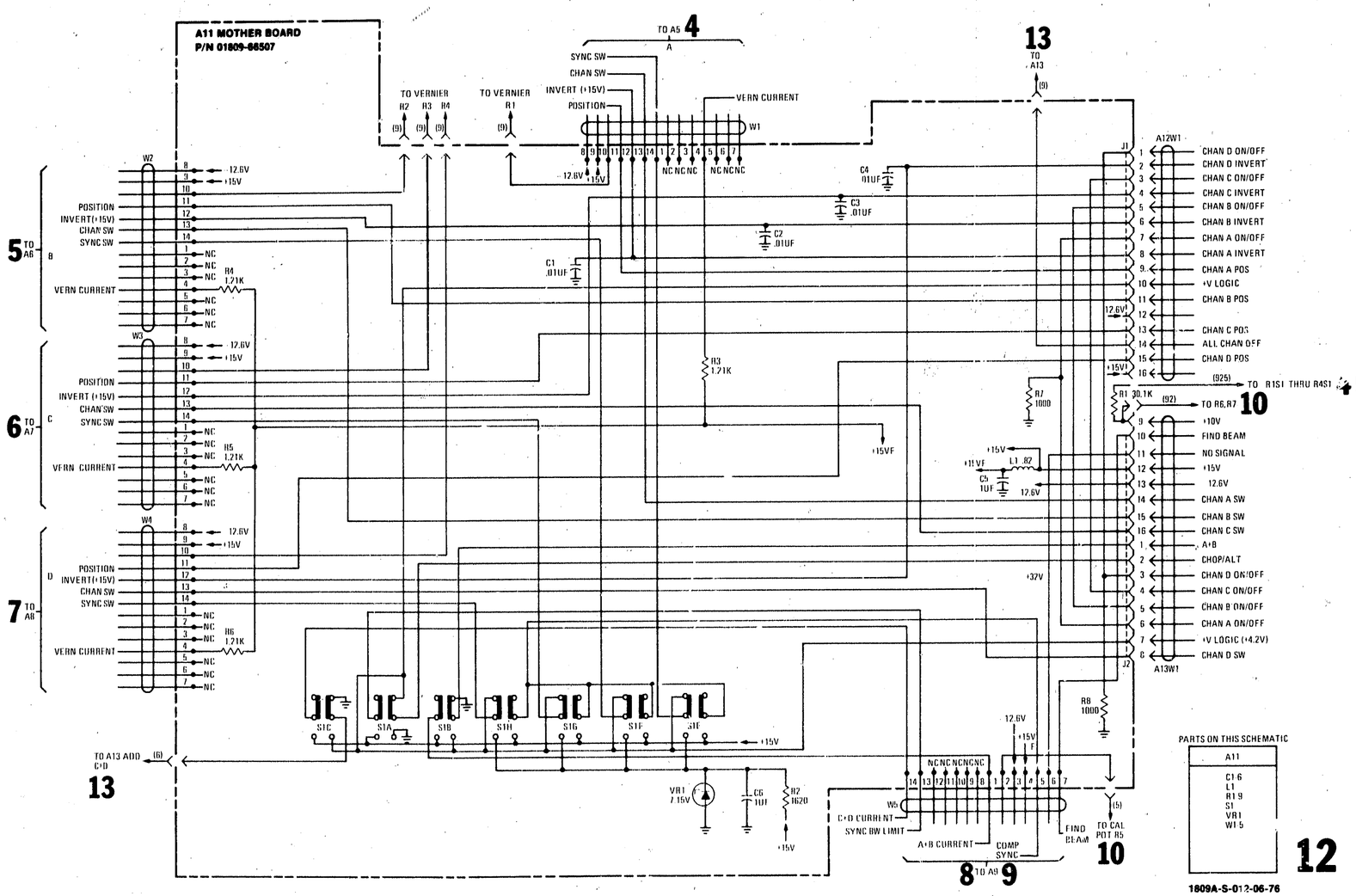
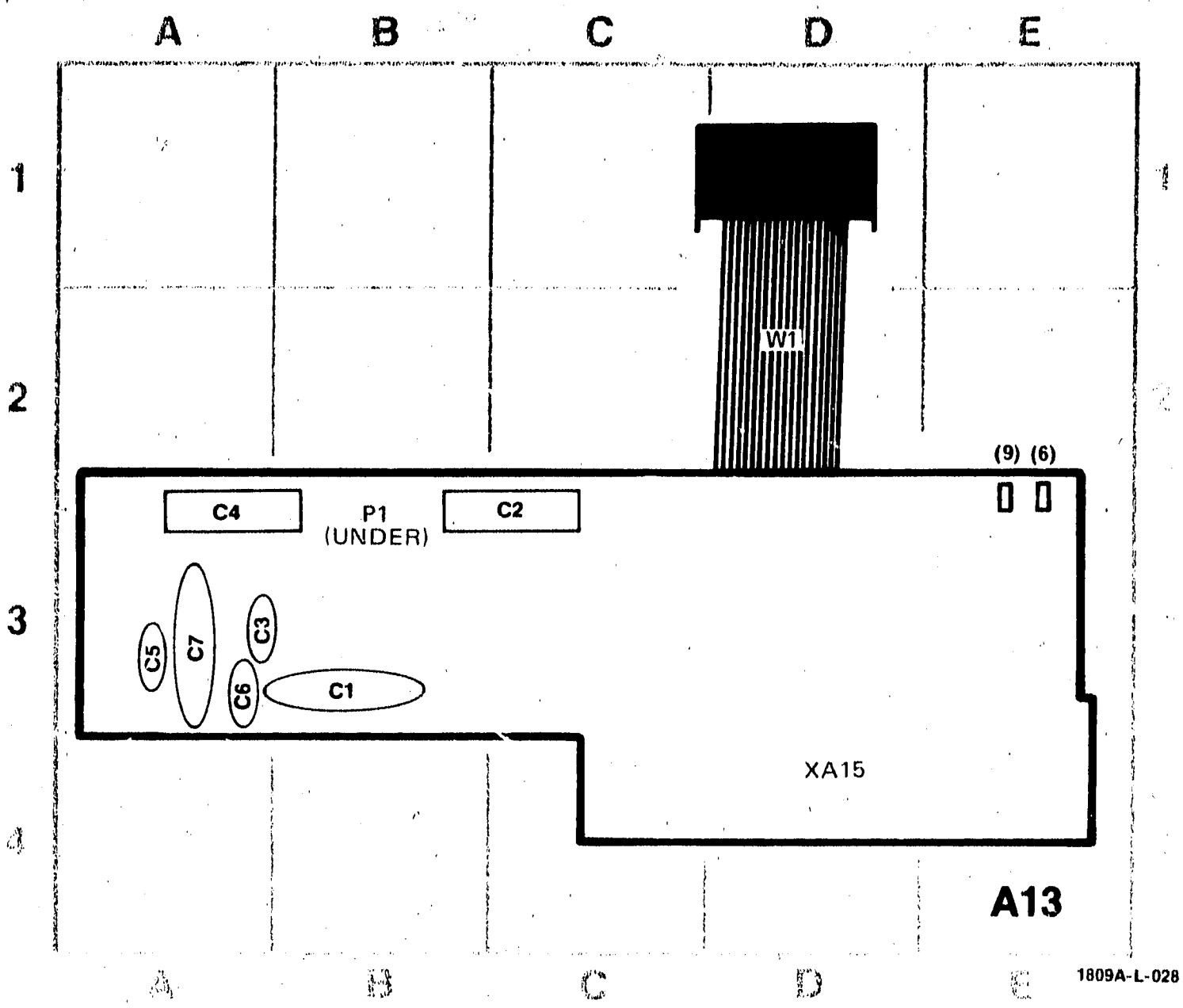


Figure 8-27.
Mother Board Assembly, Schematic 12



REF DESIG	GRID LOC
C1	B-3
C2	C-3
C3	A-3
C4	A-3
C5	A-3
C6	A-3
C7	A-3
W1	D-2
XA15	D-4

Figure 8-28. Component Identification, Assembly A13

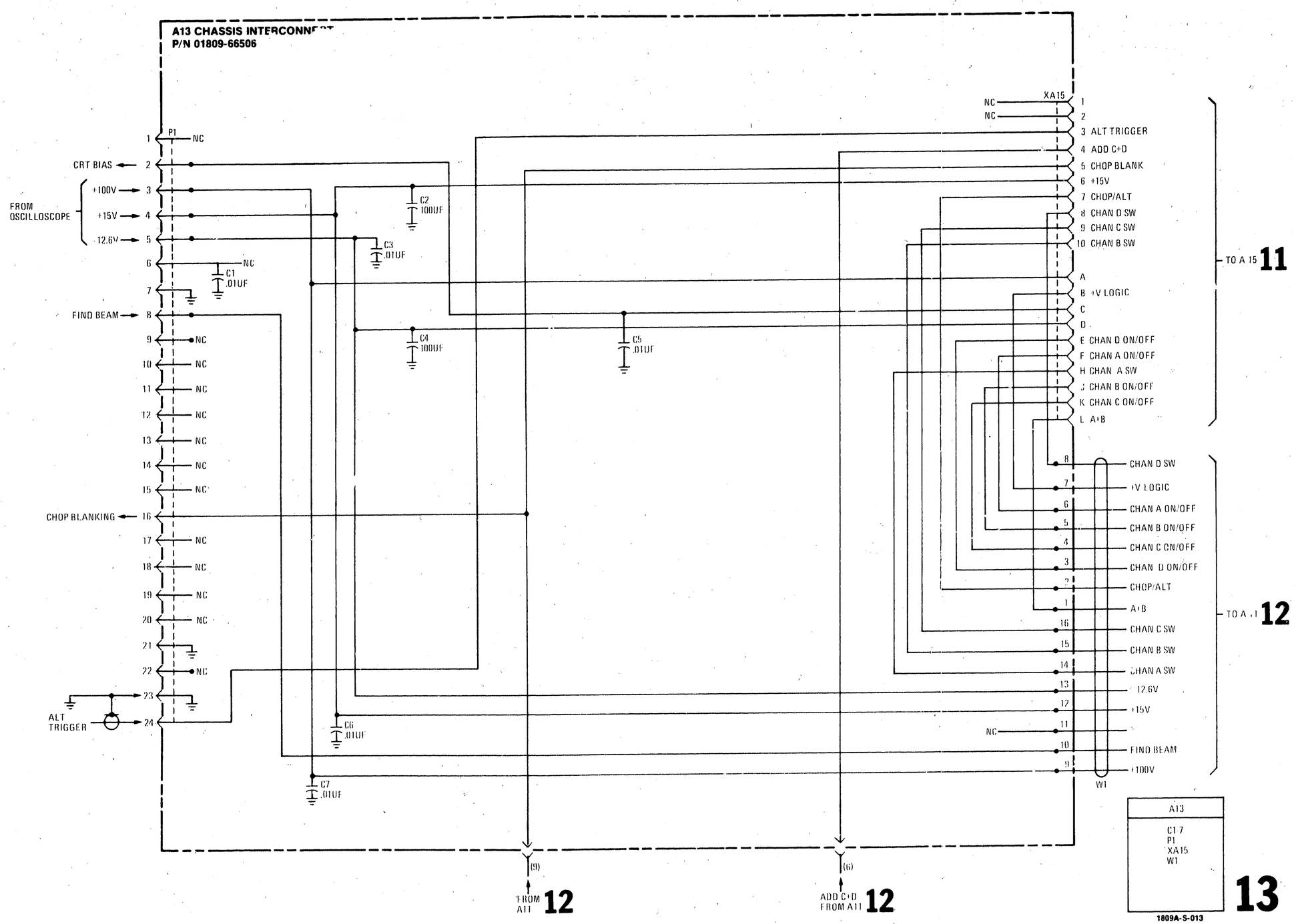


Figure 8-29.
Chassis Interconnect Board, Schematic 13

MANUAL CHANGES

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number:	1809A
Date Printed:	January 1977
Part Number:	01809-90903

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

To use this supplement:

Make all ERRATA corrections.

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

Serial Prefix or Number	Make Manual Changes
2043A	1
2323A	1, 2

Serial Prefix or Number	Make Manual Changes

▲ NEW ITEM

▲ PREFERRED PARTS

Table 1 of this change, Replaceable Parts.

Change: A15C11, HP and Mfr Part No. 0140-0176, Qty 1, CD9, C: FXD MICA 100PF ±2% 300V, Mfr Code 28480.

Change: A15C12, HP and Mfr Part No. 0140-0175, Qty 1, CD8, C: FXD MICA 39PF ±2% 300V, Mfr Code 28480.

Change: A15R5, HP Part No. 0757-0401, Qty 1, CD0, R: FXD MF 100 1% 1/8W, Mfr Code 24546, Mfr Part No. C4/-1/8-TO-100R-F.

Change: A15R6, HP Part No. 0757-0435, Qty 1, CD0, R: FXD MF 3.92K 1% 1/8W, Mfr Code 24546, Mfr Part No. C4/-1/8-TO-3921-F.

Figure 2 of this change, Channel Control, Schematic 11.

Change: C11 to 100.

Change: C12 to 39.

Change: R5 to 100.

Change: R6 to 3920.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

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CHANGE 1

Section VI, Replaceable Parts (pages 6-6 and 6-7),
Replace A15 and associated components with items listed in Table 1 of this document.

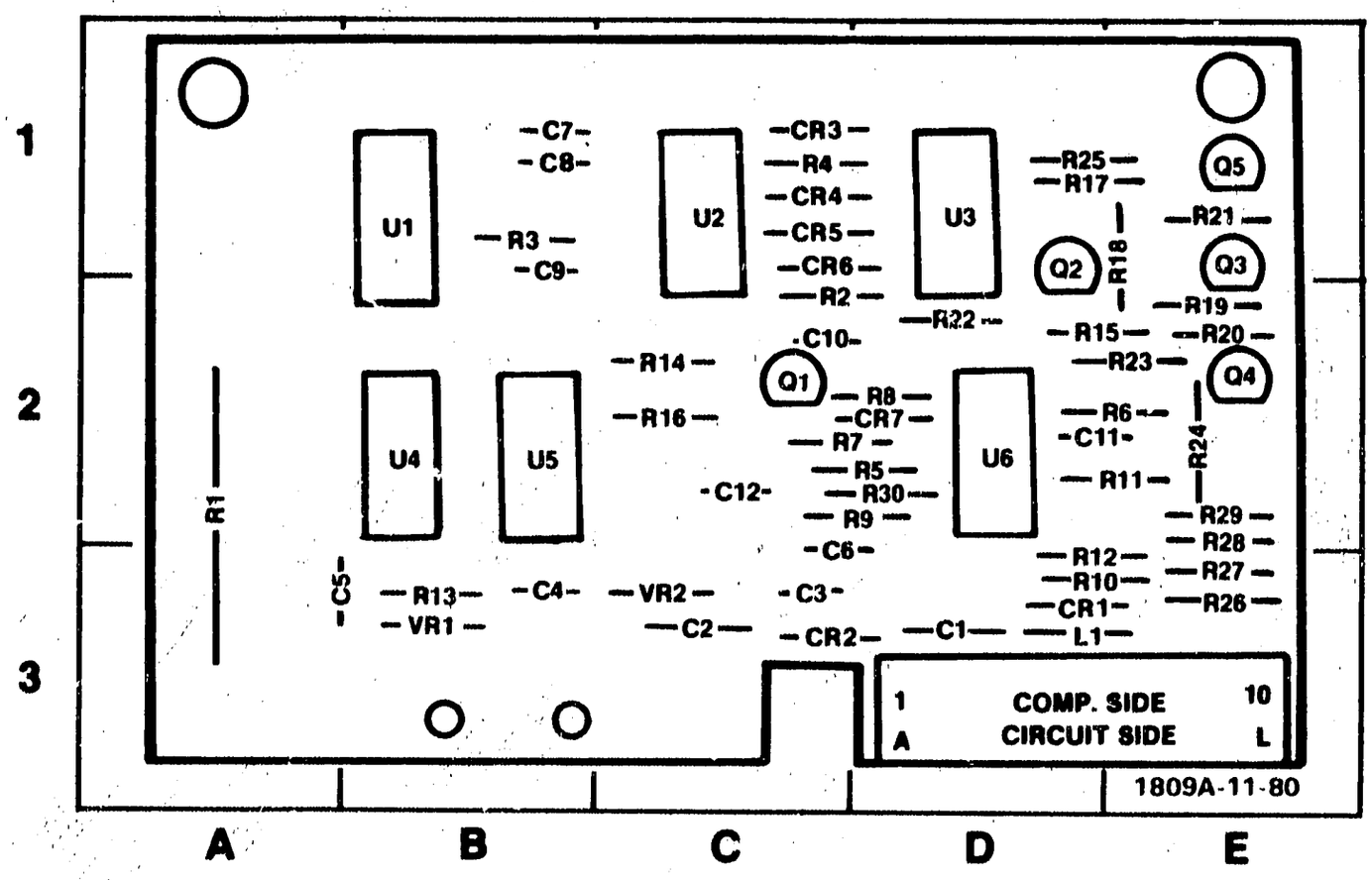
Section VIII, Service,
Page 8-26: Replace Figure 8-24 (Component Identification, Assembly A15) with Figure 1 of this document.
Page 8-27: Replace Figure 8-25 (Channel Control, Schematic 11) with Figure 2 of this document.

▲ CHANGE 2

Page 6-2, Table 6-2. Replaceable Parts.
Change: A14, HP and Mfr Part Number to 01809-61604.

Table 1 Replaceable Parts

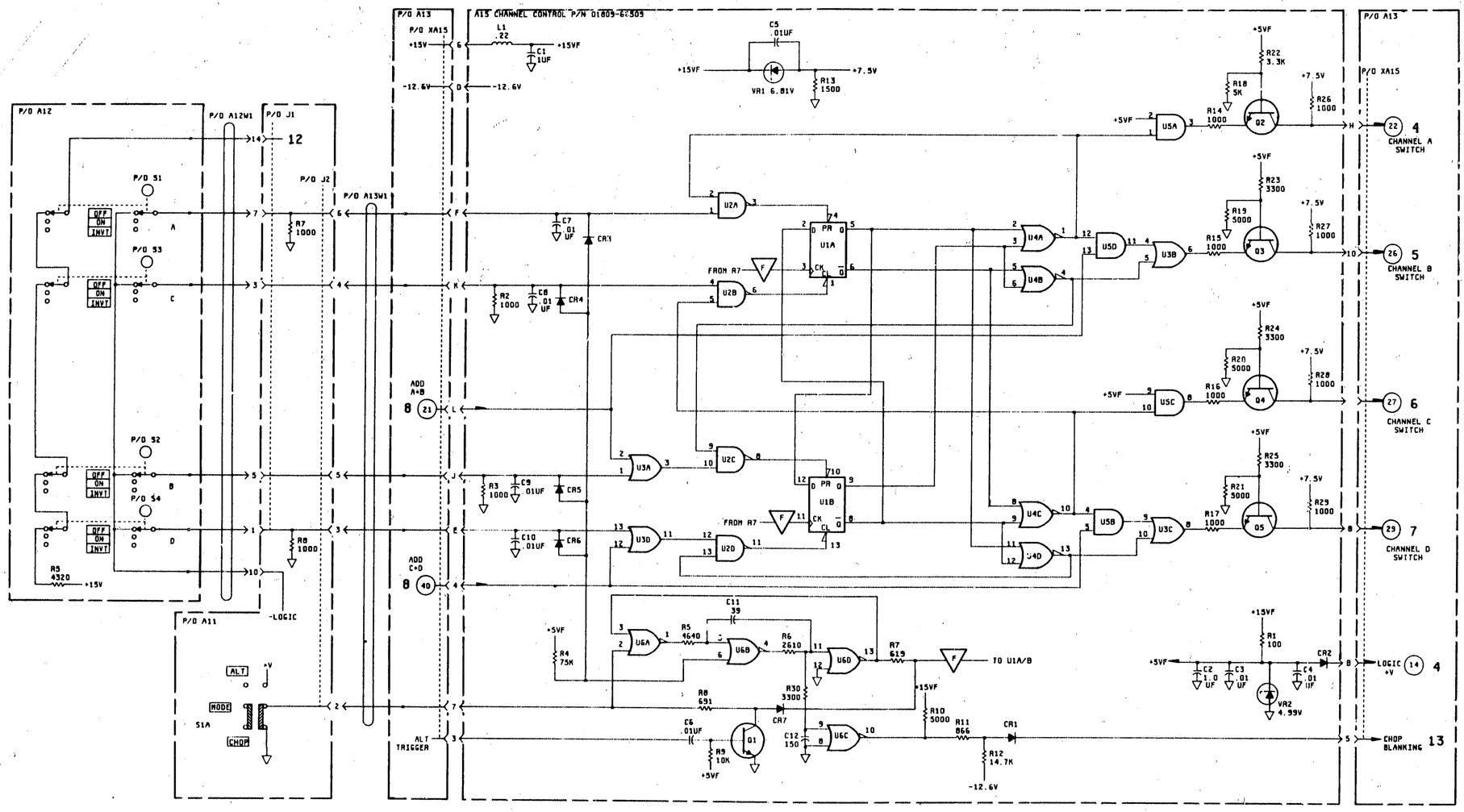
Reference Designation	HP Part Number	Qty	C D	Description	Mfr Code	Mfr Part Number
A15	01809-66509	1	7	BOARD ASSY: CHANNEL CONTROL	28480	01809-66509
A15C1	0180-0230	2	0	C: FXD TA 1.0UF ±20% 50V	56289	150D105X0050A2
A15C2	0180-0230		0	C: FXD TA 1.0UF ±20% 50V	56289	150D105X0050A2
A15C3	0160-3451	8	1	C: FXD CER 0.01UF +80 ×20% 100V	28480	0160-3451
A15C4	0160-3451		1	C: FXD CER 0.01UF +80 ×20% 100V	28480	0160-3451
A15C5	0160-3451		1	C: FXD CER 0.01UF +80 ×20% 100V	28480	0160-3451
A15C6	0160-3451		1	C: FXD CER 0.01UF +80 ×20% 100V	28480	0160-3451
A15C7	0160-3451		1	C: FXD CER 0.01UF +80 ×20% 100V	28480	0160-3451
A15C8	0160-3451		1	C: FXD CER 0.01UF +80 ×20% 100V	28480	0160-3451
A15C9	0160-3451		1	C: FXD CER 0.01UF +80 ×20% 100V	28480	0160-3451
A15C10	0160-3451		1	C: FXD CER 0.01UF +80 ×20% 100V	28480	0160-3451
A15C11	0140-0175	1		C: FXD MICA 39PF 2% 300V	28480	0140-0175
A15C12	0140-0196	1	3	C: FXD MICA 150PF 5% 300V	28480	0140-0196
A15CR1	1901-0040	7	1	DIODE: SILICON 30V 50MA	28480	1901-0040
A15CR2	1901-0040		1	DIODE: SILICON 30V 50MA	28480	1901-0040
A15CR3	1901-0040		1	DIODE: SILICON 30V 50MA	28480	1901-0040
A15CR4	1901-0040		1	DIODE: SILICON 30V 50MA	28480	1901-0040
A15CR5	1901-0040		1	DIODE: SILICON 30V 50MA	28480	1901-0040
A15CR6	1901-0040		1	DIODE: SILICON 30V 50MA	28480	1901-0040
A15CR7	1901-0040		1	DIODE: SILICON 30V 50MA	28480	1901-0040
A15L1	9100-2251	1	0	COIL: FXD RF 0.22UH 10%	28480	9100-2251
A15Q1	1854-0215	5	1	TSTR: SI NPN	80131	2N3904
A15Q2	1854-0215		1	TSTR: SI NPN	80131	2N3904
A15Q3	1854-0215		1	TSTR: SI NPN	80131	2N3904
A15Q4	1854-0215		1	TSTR: SI NPN	80131	2N3904
A15Q5	1854-0215		1	TSTR: SI NPN	80131	2N3904
A15R1	0812-0018	1	3	R:RXD WW 100 OHM 5W 3%	28480	0812-0081
A15R2	0757-0280	10	3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R3	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R4	0757-0969	1	5	R:FXD MF 75K OHM 2% 1/8W	28480	0757-0969
A15R5	0698-3155	1	1	R:FXD MF 4.64 K OHM 1% 1/8W	24546	C4-1/8-TO-4641-F
A15R6	0698-0085	1	0	R:FXD MF 2.61 K OHM 1% 1/8W	24546	C4-1/8-TO-2611-F
A15R7	0757-0418	2	9	R:FXD MF 619 OHM 1% 1/8W	24546	C4-1/8-TO-619R-F
A15R8	0757-0418		9	R:FXD MF 619 OHM 1% 1/8W	24546	C4-1/8-TO-619R-F
A15R9	0757-0948	1	0	R:FXD MF 10K OHM 2% 1/8W	28480	0757-0948
A15R10	0698-4002	5	9	R:FXD MF 5K OHM 1% 1/8W	24546	C4-1/8-TO-5001-F
A15R11	0698-3495	1	2	R:FXD MF 866 OHM 1% 1/8W	24546	C4 1/8-TO-866R-F
A15R12	0698-3156	1	2	R:FXD MF 14.7K OHM 1% 1/8W	24546	C4-1/8-TO-1472-F
A15R13	0757-0427	1	0	R:FXD MF 1.5K OHM 1% 1/8W	24546	C4-1/8-TO-1501-F
A15R14	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R15	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R16	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R17	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R18	0698-4002		9	R:FXD MF 5K OHM 1% 1/8W	24546	C4-1/8-TO-5001-F
A15R19	0698-4002		9	R:FXD MF 5K OHM 1% 1/8W	24546	C4-1/8-TO-5001-F
A15R20	0698-4002		9	R:FXD MF 5K OHM 1% 1/8W	24546	C4-1/8-TO-5001-F
A15R21	0698-4002		9	R:FXD MF 5K OHM 1% 1/8W	24546	C4-1/8-TO-5001-F
A15R22	0757-0936	4	6	R:FXD MF 3.3K OHM 2% 1/8W	24546	C4-1/8-TO-3301-G
A15R23	0757-0936		6	R:FXD MF 3.3K OHM 2% 1/8W	24546	C4-1/8-TO-3301-G
A15R24	0757-0936		6	R:FXD MF 3.3K OHM 2% 1/8W	24546	C4-1/8-TO-3301-G
A15R25	0757-0936		6	R:FXD MF 3.3K OHM 2% 1/8W	24546	C4-1/8-TO-3301-G
A15R26	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R27	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R28	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R29	0757-0280		3	R:FXD MF 1K OHM 1% 1/8W	24546	C4-1/8-TO-1001-F
A15R30	0757-0433	1	8	R:FXD MF 3.32K OHM 1% 1/8W	24546	C4-1/8-TO-3321-F
A15U1	1820-1112	1	8	IC FF TTL LS D-TYPE	18324	74LS74AN
A15U2	1820-1197	1	9	IC GATE TTL NAND QUAD 2-INPUT	18324	74LS00N
A15U3	1820-1208	1	3	IC GATE TTL OR QUAD 2-INPUT	01295	SN74LS32N
A15U4	1820-1144	2	6	IC GATE TTL NOR QUAD 2-INPUT	18324	74LS02N
A15U5	1820-1201	1	6	IC GATE TTL AND QUAD 2-INPUT	18324	74LS08N
A15U6	1820-1144		6	IC GATE TTL NOR QUAD 2-INPUT	18324	74LS02N
A15VR1	1902-0052	1	7	DIODE: ZNR 6.81V 2% DO-35 PD= 4W	28480	1902-0052
A15VR2	1902-3092	1	1	DIODE: ZNR 4.99V 2% DO-35 PD= 4W	28480	1902-3092
A15XU1	1200-0638	6	7	SOCKET:IC 14 PIN DIP	28480	1200-0638
A15XU2	1200-0638		7	SOCKET:IC 14 PIN DIP	28480	1200-0638
A15XU3	1200-0638		7	SOCKET:IC 14 PIN DIP	28480	1200-0638
A15XU4	1200-0638		7	SOCKET:IC 14 PIN DIP	28480	1200-0638
A15XU5	1200-0638		7	SOCKET:IC 14 PIN DIP	28480	1200-0638
A15XU6	1200-0638		7	SOCKET:IC 14 PIN DIP	28480	1200-0638



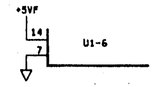
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-3	Q1	C-2	R16	C-2	U6	D-2
C2	C-3	Q2	D-1	R17	D-1		
C3	C-3	Q3	E-1	R18	E-1	VR1	B-3
C4	B-3	Q4	E-2	R19	E-2	VR2	C-3
C5	A-3	Q5	E-1	R20	E-2		
C6	C-3			R21	E-1		
C7	B-1						
C8	B-1	R1	A-2	R22	D-2		
C9	B-1	R2	C-2	R23	E-2		
C10	C-2	R3	B-1	R24	E-2		
C11	D-2	R4	C-1	R25	D-1		
C12	C-2	R5	D-2	R26	E-3		
		R6	E-2	R27	E-3		
CR1	D-3	R7	C-2	R28	E-3		
CR2	C-3	R8	D-2	R29	E-2		
CR3	C-1	R9	C-2	R30	D-2		
CR4	C-1	R10	D-3				
CR5	C-1	R11	E-2	U1	B-1		
CR6	C-1	R12	D-3	U2	C-1		
CR7	D-2	R13	B-3	U3	D-1		
		R14	C-2	U4	B-2		
L1	D-3	R15	D-2	U5	B-2		

A15

Figure 1. Component Identification Assembly A15



IC DEVICE POWER CONNECTIONS



NOTES:

1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED:
   LOGIC LEVELS ARE TTL:
   +2.0V TO +5.0V=LOGIC"1"=H
   0V TO +0.8V=LOGIC"0"=L

PARTS ON THIS SCHEMATIC

A15	P/O A11	P/O A12
C1-12 L1 Q1-5 R1-30 U1-6 VR1-2 CR1-7	R7,8 S1A J1	R5 P/O S1-S4 P/O W1
		P/O A13
		XA15 W1

1809A/100

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Figure 2.
Channel Control, Schematic 11