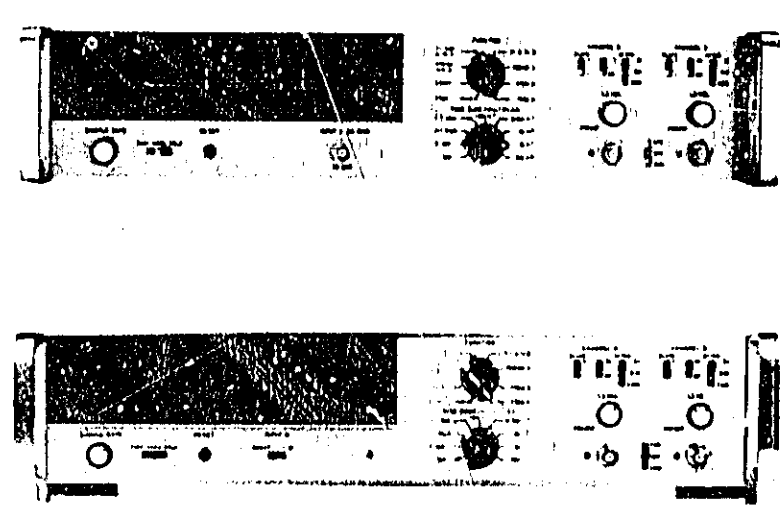
OPERATING AND SERVICE MANUAL

TIMER COUNTER

5326A/5327A



HEWLETT hp PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

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

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

5326A/5327A

TIMER/COUNTER

OPERATING AND SERVICE MANUAL

SERIAL PREFIX:
5326A — 1312A
5327A — 1312A

This manual applies to HP Models 5326A and 5327A having serial prefix 1312A.

SERIAL PREFIXES NOT LISTED

For serial prefixes above 1312A, a "Manual Supplement" sheet is included with this manual. For serial prefixes below 1312A, refer to Section VII of this manual.

5301 STEVENS CREEK BLVD., SANTA CLARA, CALIF. 95050

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HEWLETT PACKARD

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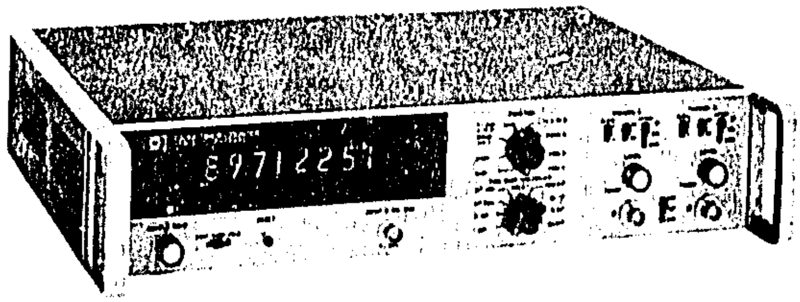
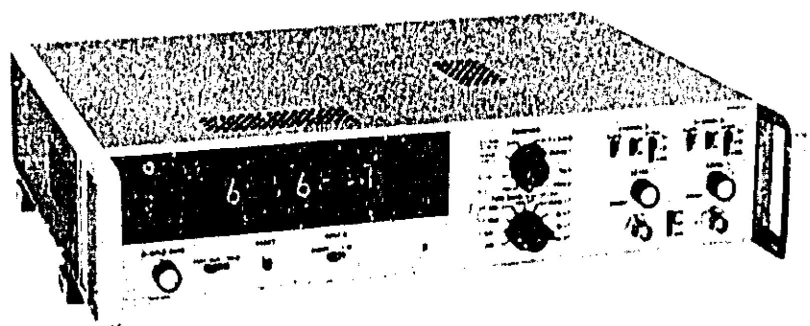
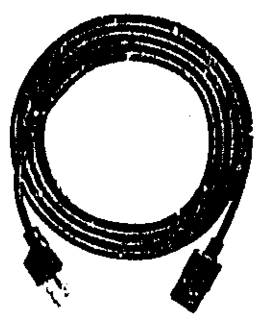


MODEL 5326A



MODEL 5327A



POWER CORD

SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION

1-2. The Hewlett-Packard Models 5326A/5327A are frequency counters that have a variety of functions. The basic difference between the two models is the addition of the prescaler assembly in the 5327A. This assembly increases the upper frequency limit from 50 MHz to 550 MHz. The 5326A uses a high-sensitivity, 50-ohm input amplifier in place of the prescaler.

1-3. The instruments measure frequency, period, period average, time interval, time interval average, and ratio. Features include a 7-digit display (8-digits optional), 1M ohm and 50-ohm inputs, display storage, and blanking for insignificant digits in the display. Decimal point and unit readouts are displayed automatically with each operating selection. Two independent input channels are provided for time interval measurements. Each input channel has an attenuator, trigger slope selector, level control, ac-dc coupling, and an oscilloscope marker output. Table 1-1 lists the electrical and mechanical specifications.

1-4. IDENTIFICATION

1-5. Hewlett-Packard uses a two-section serial number mounted on the rear panel. Earlier instruments use an 8-digit serial number (000-00000). The first three digits are a serial prefix number; the last five digits refer to the specific instrument. Later instruments use a 9-digit serial number (0000A00000). The first four digits are the serial prefix and the last five digits refer to the specific instrument. If the serial prefix of your instrument differs from that listed on the title page of this manual, there are differences between this manual and your instrument. Lower serial prefixes are documented in Section VII, and higher serial prefixes are covered with manual change sheets included with the manual. If the change sheet is missing, contact the nearest Hewlett-Packard Sales and Service Office listed on the inside rear cover of this manual.

1-6. APPLICATIONS

1-7. The 5326A/5327A Counters are particularly adaptable to timing measurements such as pulse width, pulse repetition frequency, and propagation delay. The time interval average mode measures time interval on repetitive signals with resolution better than one nanosecond. When used with microwave test systems, group delay, phase, and level measurements can be performed.

1-8. OPTIONS

1-9. The instrument can be ordered with the following options: Option 001, 8-digit display; Option 002, remote programming; Option 003, digital recorder outputs; Option 004, remote programming for all signal input conditions; Option 010, Temperature Compensated Oscillator; Option 011, HP 10544A Oven Oscillator.

Table 1-1. Equipment Supplied

Description	HP Part No.
Detachable Power Cord, 7½ ft. (231 cm) long	8120-1378
Rack Mounting Kit	05326-60029

Table 1-2. Accessories Available

Description	HP Part No.
Digital Recorders	5050B, 5055A
Interconnect Cable, Digital Recorder, 6 ft. (183 cm)	562A-16C
50-ohm BNC to BNC Coaxial Cable, 4 ft. (122 cm)	10503-6001
Circuit Board Extender, 15-pin (two required)	5060-0049
Input Amplifier Circuit Board Extender	10532-60001
Circuit Board Extender, 18-pin	5060-2041
Extender Board Kit; includes two 5060-0049, and one each 5060-2041, and 10532-60001	10532A

Table 1-3. Specifications

INPUT CHANNELS A AND B

Range:
dc coupled: 0-50 MHz
ac coupled: 20 Hz 50 MHz

Sensitivity:
0.1 V rms sine wave
0.3 V p-p pulse
8 ns minimum pulse width
Sensitivity can be decreased by 10 or 100 times, using the ATTENUATOR switch.

Impedance: 1 MΩ shunted by less than 25 pF

Dynamic Input Voltage Range:
0.1 to 3 V rms ac times attenuator setting.
±5 Vdc times attenuator setting.

Trigger Level:
PRESET to center triggering about 0 V or variable over the range of -3 V to +3 V times attenuator setting. Trigger threshold band <1.0 mV, referred to input at maximum frequency.

Overload Protection:
250 V rms on all attenuator settings, except 25 V rms on X1 above 50 kHz.

Slope:
Independent selection of positive or negative slope.

Channel Inputs: Common or separate lines.

Marker Outputs:
Rear panel BNC's DTL pulse, low for approximately 2 μs after trigger point for A and B channels.

INPUT CHANNEL C

5327A

Range:
direct: 0-50 MHz, dc coupled
prescaled: 0-550 MHz, dc coupled

Sensitivity:
direct: 15 mV rms
prescaled: 25 mV rms

Impedance: 50Ω nominal

Maximum Input: 3.5 volts rms; 5 volts peak

Trigger Level: 0 volts

5326A

Range: 0 to 50 MHz, dc coupled

Sensitivity:
5 mV rms

Impedance: 50Ω nominal
Maximum Input: 5 volts rms; 7.5 volts peak
Trigger Level: 0 volts

CAUTION

Do not exceed voltage specification or damage will occur.

START (Totalizing and Scaling)

Range: 0 - 10 MHz

Factor: 1 - 10^8 selectable in decade steps

Output: Rear panel TIME BASE BNC

Display:
Channel A input divided by scaling factor

FREQUENCY

Range:
0 - 50 MHz (5326A)
0 - 550 MHz (5327A)

Input:
Channel A; channel C for direct and for prescaled (switchable). Channel A provides triggered frequency measurement

Gate Times: 0.1 μs to 10 s in decade steps

Accuracy:
±1 count displayed* ± time base accuracy

Display:
kHz, MHz, or GHz with positioned decimal point

TIME INTERVAL

Range: 0.1 μs to 10^8 seconds

Input:
Channels A and B; can be common or separate

Frequency Counted:
10 MHz to 0.1 Hz selectable in decade steps

Accuracy:
±1 count ± time base accuracy ± trigger error.**

Display:
μs, ms, seconds or 10's of seconds with positioned decimal point

TIME INTERVAL AVERAGE

Range: 0.15 ns to 10 seconds

Intervals Averaged:
1 to 10^8 selectable in decade steps

*When prescaled by 10, ±1 count displayed is ±10 counts of the input signal.

Table 1-3. Specifications (Continued)

Input:
Start - Channel A; Stop - Channel B can be separate or common

Frequency Counted: 10 MHz

Accuracy: ± time base accuracy ± 2 ns

$$\pm \frac{(\text{trigger error}^{**} + 100\ \text{ns})}{\sqrt{\text{intervals averaged}}}$$

Dead Time:
Minimum time between STOP (Channel B trigger) and START (Channel A trigger): 150 ns

Display: ns, μs, with positioned decimal point

PERIOD

Range: 0 - 10 MHz

Input: Channel A

Frequency Counted:
10 MHz to 0.1 Hz selectable in decade steps

Accuracy:
±1 count ± time base accuracy ± trigger error.***

Display:
μs, ms, seconds or 10's of seconds with positioned decimal point

PERIOD AVERAGE

Range: 0 - 10 MHz

Periods Averaged: 1 to 10^{8} selectable in decade steps.

Input: Channel A

Frequency Counted: 10 MHz

Accuracy:
± time base accuracy ± 1 count displayed ± trigger error ***

Display: ns, μs, with positioned decimal point

RATIO

Display: (Any Input Function)
F_{ext} times MULTIPLIER (M).
M = 1 to 10^{8} (10 to 10^{9} when prescaling) selectable in decade steps

Range:
Input Function: See appropriate Function Section F_{ext} (External Oscillator Input) 100 Hz - 10 MHz

Mode:
Any Input Function

Accuracy:
Accuracy of selected input function ± trigger error of F_{ext}.

TIME BASE

Crystal Frequency: 10 MHz

Stability:

Aging Rate: <3 parts in 10^{7}/mo.
Temperature: <±2.5 parts in 10^{6}, 0° to 50°C.
Line Voltage: <±1 part in 10^{7} for 10% line variation.
Short-term Fluctuation: Typically <5 parts in 10^{9} rms (typical), one-second average (at constant temperature).

Oscillator Output:
10 MHz, TTL type output levels, 50Ω series impedance at rear panel BNC.

External Input: 100 Hz - 10 MHz; 1 V rms into 1kΩ

Time Base Output:
Negative pulses, +3 V to 0 V (open circuit), typically 100 ns wide. In START, output frequency is INPUT A divided by TIME BASE/MULTIPLIER switch setting. Available at rear panel BNC.

Gate Output:

TTL level pulses; low while gate open, high while gate closed. Available at rear panel BNC.

GENERAL

Display: 7 digits (8 optional)

Blanking:
Suppresses display of unwanted zeros left of the most significant digit

Display Storage:

Holds reading between samples. Rear panel switch overrides storage

**For any waveshape, trigger error is less than

$$\frac{0.0025}{\text{Signal Slope (V/}\mu\text{s)}}\ \mu\text{s}.$$

***Trigger error is less than ±0.3% of one period ÷ periods averaged for signals with 40 dB or better signal-to-noise ratio and 100 mV rms amplitude.

Table 1-3. Specifications (Continued)

Sample Rate:
FAST position: Continuously variable from less than 100 μs to approximately 20 ms.
NORM position: Continuously variable from less than 25 ms to approximately 5 seconds.
HOLD position: Display can be held indefinitely.

Overflow:
Neon indicates when display range is exceeded.

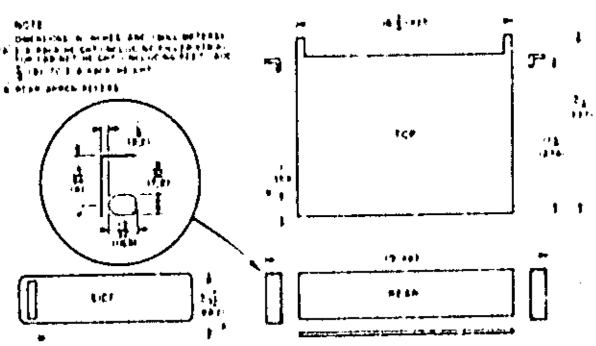
Operating Temperature: 0° to 50°C.

Power Requirements:
115 or 230 volts ±10%, 50 to 60 Hz, 70 watts maximum.

Weight:
Net, 16 lb. (7,4 kg).
Shipping, 18 lb, 16 oz. (8,7 kg).

Accessories Furnished:
Power Cord, 7-½ ft. Rack Mount Kit.

DIMENSIONS



ACCESSORIES AVAILABLE

HP 10503A, 50Ω BNC Cable, 4 ft (122 cm).
HP 10532A, Extender Board Kit containing 2 ea. 15-pin extender 5060-0049, 1 ea. 18-pin extender 5060-2041, and 1 ea. Amplifier Extender, 10532-60001.
HP 10542A, Remote Programming Interface enables interfacing between the 5326/27 Series counter with Option 004 and 40-bit Output Register. Includes two (2) 7-bit Digital-to-Analog Converters for level controls and decoding for time base and function selector.
HP Cable 562A-16C, 6 ft. (183 cm) to connect 5326/27 Series with Option 003 to HP 5050B or 5055A Digital Recorder.

OPTIONS

Option 001: 8-digit display.

Option 002: Remote programming.

Controls:
All front panel controls are single line programmable except:
SEP-COM (separate-common) switch; the check function is programmable.
FAST/NORM Mode.
Input Attenuators.
AC/DC Input Signal Coupling.

Control Signal:
Single line control using either contact closure to ground or DTL drive on all lines except trigger levels which are analog programmed (±3 Vac).

Connector:
Rear panel connector: HP 1251-0085; Amphenol 57-40360-375. (36-pin blue ribbon).

Mating connector: HP 1251-0084; Amphenol 57-30360-375 (not supplied).

Option 003: Digital output (for numerals and polarity only).

Code:
4-line 1-2-4-8 BCD, "1" state high. "0" state +0.25 V at -1 mA; "1" state: +5 V open circuit, 2.5 kΩ source impedance nominal.

Print Command:
+5 V to 0 V, dc coupled, occurs at end of gate.

Storeage:
Buffer storage is provided so BCD output is constant while next measurement is being made.

Inhibit Input:
Inhibits gate when instrument's cycle time is less than the time required for external equipment to interrogate BCD outputs. Positive inhibit +5 Vdc.

Connector:
Rear panel connector: HP 1251-0087; Amphenol 57-40500-375 (50-pin blue ribbon). Mating connector: HP 1251-0086; Amphenol 57-30500-375 (not supplied).

Table 1-3. Specifications (Continued)

Option 004: Remote Programming including all signal input conditions.

Controls:
All front panel controls are programmable except FAST/NORM Mode.

Control Signal:
Signal line control using either contact closure to ground or DTL drive on all lines except trigger levels which are analog programmable (±3 Vdc).

Connector:
Rear panel connector: HP 1251-0087; Amphenol 57-40500-375 (50-pin blue ribbon)
Mating Connector: HP 1251-0086; Amphenol 57-30500-375 (not supplied).

Option 010: Temperature Compensated Oscillator
Aging Rate: $<1 \times 10^{-7}$/month
Temperature Stability (0° to 50°C): $<\pm 5 \times 10^{-7}$
Short Term Fluctuation (1 sec avg): $<1 \times 10^{-9}$ rms (typical).
Warmup: Room Temerature Crystal.
Line Voltage (10% change): $<\pm 5 \times 10^{-8}$.

Option 011: HP 10544A Oven Oscillator
Aging Rate: $<5 \times 10^{-10}$/day.
Temperature Stability (0° to 50°C): $<3 \times 10^{-9}$
Short Term Fluctuation (1 sec avg): $<1 \times 10^{-11}$ rms.
Warmup: $<\pm 5 \times 10^{-9}$ in 15 minutes.
Line Voltage (10% change): $<5 \times 10^{-9}$.

SECTION II

INSTALLATION

2-1 INTRODUCTION

2-2. This section contains information for unpacking, inspection, repacking, storage, and installation. The instructions for remote programming are also given in this section.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dents, broken knobs, etc.). If the instrument is damaged or fails to self-check (Self-Check Procedures, Table 3-1), notify the carrier and nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Retain the shipping carton and padding material for the carrier's inspection. The sales and service office will arrange for the repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. STORAGE AND SHIPMENT

2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment always use the best packaging methods available. Your Hewlett-Packard Sales and Service Office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are two recommended packaging methods:

a. RUBBERIZED HAIR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq. in. bursting test) with 2-inch rubberized hair pads placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit.

b. EXCELSIOR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb/sq. in. bursting test) with a layer of excelsior about six inches thick packed firmly against all surfaces of the instrument.

2-7. ENVIRONMENT. Conditions during storage and shipment should normally be limited as follows:

a. Maximum altitude: 25,000 feet.

b. Minimum temperature: -40°F (-40°C)

c. Maximum temperature: +167°F (+75°C).

2-8. RACK INSTALLATION

2-9. The counter is ready for bench operation as shipped from the factory. Additional parts necessary for rack mounting are packaged with the instrument. To convert to rack installation, proceed as follows:

a. Remove tilt stand.

b. Remove feet (press the foot-release button, slide foot toward center of instrument, and lift off).

c. Remove adhesive-backed trim strips at front end of sides.

d. Attach filler strip along bottom edge of front panel using two screws on outer edges of filler strip. Omit the center screw.

e. Attach flanges to front end of sides (larger corner notch toward bottom of instrument). Instrument is now ready to mount in standard rack.

CAUTION

Ambient temperature in rack during operation should not exceed 122°F (50°C). Be sure instrument position in rack permits adequate air circulation and that nearby equipment does not discharge hot air directly on the instrument.

2-10. POWER CONNECTION

2-11. LINE VOLTAGE. The counter may be operated from either 115 or 230 volt (±10%) power lines with frequencies from 50 to 60 Hz. A slide switch on the rear panel permits quick conversion for operation from either voltage. Insert a narrow-blade screwdriver in the switch slot and slide the switch to the right for 230 volt operation ("230" marking exposed) or to the left for 115 volt operation ("115" marking exposed). The counter is supplied with a 115 volt fuse; be sure to change this fuse for 230 volt operation, see Table 2-1.

CAUTION

Before plugging instrument to ac power line be sure slide switch is properly positioned.

Table 2-1. 115/230 Volt Conversion

Line Voltage Conversion	115 Volt	230 Volt
Slide Switch	Left (115)	Right (230)
AC Line Fuse	1.50 Ampere (Slow-Blow) (HP 2110-0304)	0.8 Ampere (Slow-Blow) (HP 2110-0020)

2-12. POWER CABLE. The counter is equipped with a detachable 3-wire power cable. Proceed as follows for installation.

a. Connect plug (3-socket connector) to ac line jack at rear of instrument.

b. Connect plug (2-blade with round grounding pin) to 3-wire (grounded) power outlet. Exposed portions of instrument are grounded through the round pin on the plug for safety; when only 2-blade outlet is available, use connector adapter (HP Part No. 1251-0048), then connect short wire from side of adapter to ground.

2-13. REMOTE PROGRAMMING, OPTION 002

2-14. The following paragraphs describe remote programming requirements for the counter with Option 002. See Paragraph 2-33 for Option 004 programming.

2-15. Front Panel Controls

2-16. The following front-panel controls are programmable:

a. FUNCTION
b. TIME BASE/MULTIPLIER
c. CHECK function
d. SLOPE
e. SAMPLE RATE and HOLD
f. LEVEL controls
g. INPUT C switch (5327A only)
h. RESET

2-17. The following front-panel controls are NOT programmable:

a. AC/DC
b. SEP-COM
c. FAST/NORM
d. ATTEN

2-18. The trigger level controls may be remotely programmed or the front-panel LEVEL controls may be used. It is possible to program the LEVEL controls without programming the remainder of the front-panel controls. When remote programming is used, the LEVEL controls must be set to PRESET. Display time may be remotely programmed and/or the front-panel controls may be used.

2-19. Remote Programming Requirements

2-20. All lines may be controlled by TTL or DTL signals or contact closure to ground when the unit is being remotely programmed: except the trigger levels which are programmed by an analog level (if programmed) and the display time line (Hold), J10 pin 35, which should NOT be pulled up to +5 V by less than 200Ω while programming.

2-21. When the unit is NOT being programmed (Ext line high), all the lines should be left open or pulled up to +5 V by not less than 5kΩ, except the trigger levels, which should be open circuited.

2-22. Remote Programming Procedure

2-23. In order to remotely program the counter, the following must be done:

a. Set FUNCTION switch to any function but START or STOP.

b. Ground the EXT line at rear-panel REMOTE PROGRAM connector J10(37). This disables the front panel switches. Ground is available at J10(36).

c. Select the desired function.

d. Select the desired time base.

e. Select the slope (+ or -) for CHANNEL A and B. This is accomplished by grounding the Slope line for (-) and leaving it open for (+). Slope A line is J10(28). Slope B line is J10(29).

f. Select the trigger level for input signal.

g. Adjust the display time.

h. Manual reset is available by grounding (<.7 V) pin 34. Check is available by grounding pin 14.

2-24. Function Selection Programming

2-25. To program the desired function, ground (<.7 V) the proper line at J10 as follows:

STOP	Pin 32
START	Pins 1 and 32
PERIOD AVERAGE	Pin 2
T.I. AVG.	Pin 3
T.I. A to B	Pin 4
PERIOD	Pin 5
FREQ. A	Pin 6
FREQ. C DIRECT	Pin 7
FREQ. C ÷ 10	Pins 7 and 18

2-26. Time Base Selection Programming

2-27. To program the Time Base, ground (<.7 V) the proper line at J10 as follows:

.1 μs/1	Pin 19
1 μs/10	Pin 20
10 μs/10^2	Pin 21
.1 ms/10^3	Pin 22
1 ms/10^4	Pin 23
10 ms/10^5	Pin 24
.1 s/10^6	Pin 25
1 s/10^7	Pin 26
10 s/10^8	Pin 27

2-28. Trigger Level Programming

2-29. To program the trigger level, the LEVEL controls must be set to PRESET. Select the trigger level by placing a dc voltage between -3.0 and +3.0 volts on the level input line (Level A = J10 pin 30, Level B = J10 pin 31). This voltage, times the attenuator setting, is the trigger level. Preset is programmed by leaving the pin open on contact closure to ground. Grounding is preferable if noise exists on the remote programming line.

2-30. The front-panel LEVEL controls may be used manually if programming of the trigger levels is undesirable. Also, note the AC/DC and ATTEN switches on the front-panel must be set manually, as they are NOT programmable.

2-31. Sample Rate Adjustment

2-32. Adjusting the display time can be accomplished in several ways:

a. Manually adjust the display time by using the front-panel SAMPLE RATE controls.

b. Set the SAMPLE RATE control cw and the FAST/NORM/HOLD switch to NORM and connect a 1 megohm pot in series with a 1.5k ohm resistor from +5 V to pin 35. This will give a display time range of about 10 ms to 5 sec. If a shorter time is desired, set the FAST/NORM/HOLD switch to FAST, which gives a range of about 50 μs to 10 ms.

c. Set the SAMPLE RATE control cw in FAST and hold the Hold line (pin 35) to ground for the desired display time. The display will continue for about 100 μs after the ground is released.

2-33. REMOTE PROGRAMMING, OPTION 004

2-34. The following paragraphs describe remote programming requirements for the counter with Option 004.

2-35. Front Panel Controls

2-36. All front-panel controls are programmable, except the FAST/NORM/HOLD switch. The trigger level controls may be remotely programmed, or the front-panel LEVEL controls may be used. It is possible to program the front-panel LEVEL controls without programming the remainder of the front-panel controls. When remote programming the trigger levels, the LEVEL controls must be set to PRESET. The display time may be remotely programmed and/or the front-panel controls may be used.

2-37. Remote Programming Requirements

2-38. All lines may be controlled by TTL or DTL signals or contact closure to ground when the unit is being remotely programmed: except the trigger levels which are programmed by an analog level (if programmed) and the display time line (Hold), J10 pin 16, which should NOT be pulled up to +5 V by less than 200Ω while programming.

2-39. When the unit is NOT being programmed (EXT line high), all the lines should be left open or pulled up to +5 V by not less than 5kΩ, except the trigger levels, which should be open circuited.

2-40. Remote Programming Procedure

2-41. In order to remotely program the counter, the following must be done:

a. Set FUNCTION switch to any position but START or STOP.

b. Ground the EXT line at rear-panel REMOTE PROGRAM connector J10(34). This disables the front panel switches. Ground is available at J10(1, 2, 15).

c. Select the desired function.

d. Select the desired time base.

e. Select the signal conditioning.

f. Select the trigger level for input signal.

g. Adjust the display time.

h. Manual reset is available by ground (<.7 V) pin 17. Check is available by grounding pin 37.

2-42. Function Selection Programming

2-43. To program the desired function, ground (<.7 V) the proper line at J10 as follows:

STOP	Pin 19
START	Pins 46, 19
PERIOD AVERAGE	Pin 47
T.I. AVG.	Pin 45
T.I. A to B	Pin 44
PERIOD	Pin 43
FREQ. A	Pin 42
FREQ. C DIRECT	Pin 41
FREQ C ÷ 10 (5327A only)	Pin 33

2-44. Time Base Selection Programming

2-45. To program the time base, ground (<.7 V) the proper line at J10 as follows:

.1 μs/1	Pin 28
1 μs/10	Pin 29
10 μs/10^2	Pin 27
.1 ms/10^3	Pin 26
1 ms/10^4	Pin 25
10 ms/10^5	Pin 24
.1 s/10^6	Pin 30
1 s/10^7	Pin 31
10 s/10^8	Pin 32

2-46. Signal Conditioning Programming

2-47. Program the input conditions by grounding the proper line as follows:

CONDITION	LINE J10	INPUT
AC/DC A	11	AC=H DC=L
SLOPE A	23	+ = H - = L
ATTENUATOR A	13, 14	13 - H, 14 - H = X1 13 - L, 14 - H = X10 13 - H, 14 - L = X100
AC/DC B	7	AC = H DC = L
SLOPE B	22	+ = H - = L
ATTENUATOR B	9, 10	9 - H, 10 - H = X1 9 - L, 10 - H = X10 9 - H, 10 - L = X100
SEP/COM	6	COM = L, SEP = H
CHECK	37	CHK = L

2-48. Trigger Level Programming

2-49. To program the trigger level, the LEVEL controls must be set to PRESET. Select the trigger level by placing a dc voltage between -3.0 and +3.0 volts on the level input line (Level A = J10 pin 21, Level B = J10 pin 20). This voltage, times the attenuator setting, is the trigger level. Preset is programmed by leaving the pin open or contact closure to ground. Grounding is preferable if noise exists on the remote programming line.

2-50. The front-panel LEVEL controls may be used manually if programming of the trigg vels is undesirable.

2-51. Sample Rate Adjustment

2-52. Adjusting the display time can be accomplished in several ways:

a. Manually adjust the display time by using the front-panel SAMPLE RATE controls.

b. Set the SAMPLE RATE control cw and the FAST/NORM/HOLD switch to NORM and connect a 1 megohm pot in series with a 1.5k ohm resistor from +5 V to pin 16. This will give a display time range of about 10 ms to 5 sec. If a shorter time is desired, set the FAST/NORM/HOLD switch to FAST, which gives a range of about 50 μs to 10 ms.

e. Set the SAMPLE RATE control cw in FAST and hold the Hold line (pin 16) to ground for the desired display time. The display will continue for about 100 μs after the ground is released.

2-53. SAMPLE RATE DISABLE-COMPUTER INHIBIT

2-54. The sample rate disable line is used only with the start command to initiate a totalizing measurement. The sample rate disable command disables auto reset and enables continuous plus and minus transfer commands.

2-55. The computer inhibit command (when Low) inhibits the main gate from opening. This command may be sent from a computer to prevent the counter from making any further measurements. It may also be used as an external sample rate signal, since the command would determine the time between measurements. Auto reset and print command signals are not disabled by computer inhibit.

NOTE

DO NOT ground or other wise program any of the remote programming lines if the unit is not being operated remotely (EXT line HIGH = not programmed remotely). The line should be left open or, at worst, be pulled up to +5 V by a source impedance of not less than 5 kΩ.

2-56. BLANKING DEFEAT

2-57. This counter is designed to blank insignificant zeros (zeros to left of data). When blanking occurs, the digital recorder output for the blanked columns is BCD 15 (HHHH). To use this instrument with a digit-analog converter, it is necessary to defeat the blanking feature by repositioning the two jumpers on the A9 Display board. Move the jumpers to position 2, as shown in A9 Component Locator (Section VIII). This connects pin 10 of A9U7 and A9U8 to +5 V. Also, lift the pin 1 lead of A8U2 and connect pin 1 to ground (available at U2 pin 7).

SECTION III

OPERATION

3-1. INTRODUCTION

3-2. Section III contains the operating information required to obtain the most effective performance from the instrument. This includes a general description of the operating modes, the function of all controls and indicators, a self-check procedure, and setup procedures for making basic measurements.

3-3. OPERATING MODES

3-4. The following paragraphs describe the operating modes of totalize, frequency, period, time interval, and ratio.

3-5. Totalize Mode

3-6. START and STOP positions on the FUNCTION selector allow manual opening and closing of the counter's main gate. When the switch is in the START position, the counter does not measure frequency, but instead, counts the number of times the signal passes through the trigger point. The input signal, connected to the front-panel CHANNEL A jack, is divided by the MULTIPLIER switch setting prior to counting. For example, when the MULTIPLIER switch is set to the 1 position, every pulse is counted. When the switch is set to 10^3, the counter registers every thousandth pulse. When the FUNCTION switch is set to STOP, the counter stops totalizing and holds the displayed count until the RESET switch is pressed or the MULTIPLIER switch setting is changed. If the FUNCTION switch is again set to START before a reset is generated, the count continues to totalize from the previously displayed value. With the FUNCTION switch set to START, the scaled input signal is available at the rear-panel TIME BASE OUTPUT jack. The unit indicators and decimal points are blanked during the totalize mode. The C light is on (in START), indicating counting is taking place.

3-7. Frequency Modes

3-8. Three frequency modes are available in the 5327A: Frequency A, Frequency C prescaled, and Frequency C direct. (The prescale operation is not included in the 5326A.) In the Frequency A mode, the input signal connects to the high impedance CHANNEL A input jack and can be conditioned with the LEVEL, SLOPE, and ATTEN controls. In the Frequency C modes, the input signal is connected to the INPUT C jack (50 ohm). The signal is not conditioned by any front-panel controls but may be counted either directly (50 MHz) or by prescaling (550 MHz), depending on the setting of the INPUT C switch. The C channel of the 5326A model counts the signal directly.

3-9. Period Modes

3-10. The period and period average modes allow single period measurements or multiple period averages to be made with input frequencies into CHANNEL A of up to 10 MHz. These modes are useful for making low frequency measurements where maximum resolution is desired.

3-11. For single period measurements, the MULTIPLIER switch scales the time base frequency and selects the placement of the decimal point and determines the resolution of the measurement.

3-12. The period average mode is used for increased resolution and reduced inaccuracies. For example, if 10^2 period averaging is selected, the counter will display the average of 100 periods with the proper decimal point. In this example, trigger error is 100 times less than in a single period measurement.

3-13. Time Interval Modes

3-14. Two modes of time interval measurements can be selected: time interval and time interval average. The time interval modes measure the time between points on a single waveform or between separate input signals; thus, pulse width and phase differences can be measured. Separate slope and level controls allow variable triggering levels on either the + or - slope. Marker A and B outputs are available at the rear panel to intensity-modulate an HP 180A oscilloscope. The markers indicate the trigger point of the counter's input circuits and provide a visual means of adjusting the trigger points to measure the time interval between any two points and are useful to about 100 kHz.

3-15. In time interval measurements, Channel A opens the main gate and Channel B closes the main gate. While the main gate is open, the internal oscillator, divided by the setting of the MULTIPLIER switch, is totalized by the counter and readout on the display. The less the division factor, the more pulses of the internal oscillator there are to count and, therefore, the better the resolution and accuracy.

3-16. With time interval average, the main gate is open for the number of time intervals selected by the MULTIPLIER switch. The internal oscillator pulses (not divided) are totalized only during the individual time intervals. Once Channel B triggers, there must be a time lapse of 150 ns before Channel A can trigger. Averaging of time intervals results in increased resolutions and reduced inaccuracies. For a further explanation of theory, refer to Paragraph 4-27.

3-17. Ratio

3-18. The counter may be used to measure the ratio of two signals in either the frequency or period mode. By setting the rear-panel OSC INT-EXT switch to EXT, the counter will accept an external signal (F_{ext}) for use as the internal oscillator. This frequency should be 100 Hz to 10 MHz at 1 V rms minimum to 5 V peak maximum. A second signal (F_A), applied to either INPUT A or C jack, is used as the comparator signal. The MULTIPLIER switch controls the resolution of the display. For a ratio of frequencies, the Ratio = $\frac{F_A}{F_{ext}} = \frac{\text{DISPLAYED NUMBER}}{\text{MULTIPLIER SETTING}}$. For a ratio of periods (P), the Ratio =

$$\frac{P_A}{P_{ext}} = \frac{F_{ext}}{F_A} = \frac{\text{DISPLAYED NUMBER}}{\text{MULTIPLIER SETTING}}$$

3-19. Disregard the units and decimal point; also, ignore any zeros to the left of the most significant digit. It makes no difference which signal is higher in frequency, as long as the two frequencies are within the specifications of their respective channels.

3-20. MARKER OUTPUTS

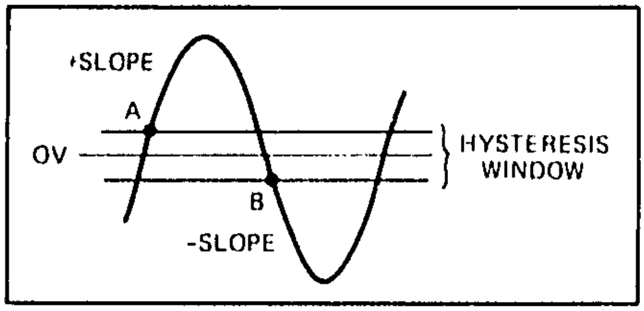
3-21. Two marker output jacks are mounted on the counter's rear panel. These outputs provide a negative-going 2 μs pulse (approx.) at DTL levels each time the input signal passes through the trigger point of Channel A or B. The pulses may be used to trigger other circuits or may be applied to the Z axis of an HP 180 Oscilloscope. When using the pulses to intensity modulate an oscilloscope, note that the actual trigger point is the leading edge of the pulse. The marker's pulse width determines the upper frequency limit of the input signal. The pulses overlap on the oscilloscope trace when the period of the signal is less than the pulse width.

3-22. HYSTERESIS

3-23. Each input channel has a small amount of hysteresis (about 100 mV). If the SLOPE switch is set to "+," the trigger pulse occurs at the top of the hysteresis "window." If the SLOPE switch is set to "-," the pulse occurs on the bottom line of the window. In other words, the signal must pass through the entire hysteresis window before a trigger pulse is generated.

3-24. When measuring frequency or period, the counter positions the hysteresis band around zero (see Figure 3-1). This assumes a waveform with no dc component and the counter's LEVEL control is in the PRESET position. The input amplifier then yields maximum input sensitivity for both positions of the SLOPE switch. The offset introduces no measurement error, since the trigger point is repetitive from cycle to cycle. The trigger point is point A for + slope and point B for - slope.

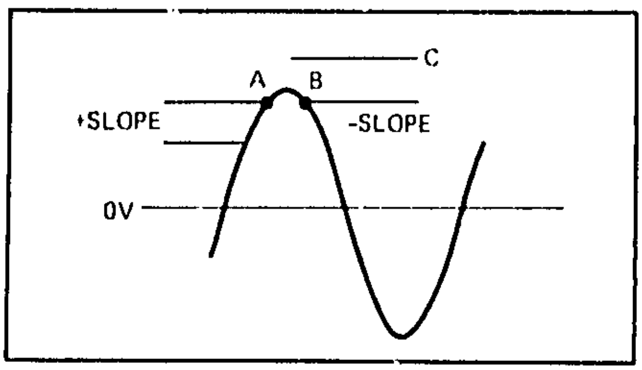
Figure 3-1. Hysteresis Offset



3-25. Time Interval Compensation

3-26. In the time interval modes only, both input amplifiers have an automatic compensation network that keeps the trigger level at the same potential when switching from positive to negative slope (see Figure 3-2). In this example, the window shifts upward to accomplish this. There is the possibility, therefore, that if Point A is near the top of the signal, switching to negative slope will place a portion of the window outside the signal (C). In such case, there would be no triggering. When switching from time interval to frequency, or vice versa, the trigger point shifts by half the hysteresis band.

Figure 3-2. Hysteresis Compensation



3-27. ACCURACY

3-28. FREQUENCY MEASUREMENTS. The basic counter accuracy is determined by two factors. One factor is the aging rate of the 10 MHz crystal standard in the time base (less than 3 parts in 10^7 per month). A second factor is the inherent error of ± 1 count of the display's least significant digit, which is present in all electronic counters. This error is due to phasing between the timing pulse that operates the electronic gate and the pulses that pass through the gate to the counting assembly. The chart in Figure 3-3 shows the error possible for frequency and period measurements.

3-29. The formula for determining the actual frequency is given as follows:

$$\text{error} = \pm\left(\frac{1}{f_1 \times \text{gate length (sec)}}\right) \pm E$$

The expression

$$\frac{1}{f_1 \times \text{gate length (sec)}}$$

equals the ± 1 count ambiguity, where f_1 equals measured frequency (Hz) and gate length equals the selected gate time in seconds. E equals the time base accuracy (monthly drift rate of the individual time base times the number of months since calibration, frequency change due to ambient temperature change, absolute off-set at standardization, and line voltage effects).

3-30. An example of frequency error calculation is as follows:

$$f_1 = 3\ \text{MHz}\ (3 \times 10^6\ \text{Hz})$$

$$\text{gate length} = .1\ \text{sec}\ (1 \times 10^{-1})$$

$$E = 3 \text{ parts in } 10^7 \text{ per month times 2 months}$$
$$= 6 \text{ parts in } 10^7$$

$$\text{error} = \frac{1}{(3 \times 10^6)\,(1 \times 10^{-1})} \pm \frac{6}{10^7}$$

$$= 3.3 \times 10^{-6} \pm 6 \times 10^{-7} = 3.9 \times 10^{-6}$$

or 3.9 parts in 10^6

3-31. PERIOD MEASUREMENTS. There are three factors contributing to the accuracy of period average measurements:

a. The aging rate of the 10 MHz crystal standard.

b. The ± 1 count ambiguity.

c. The trigger error for one period.
Assuming a signal-to-noise ratio of 40 dB, the trigger error is less than 0.3% at rate sensitivity. A general formula for finding the percentage error to be expected under various conditions is as follows:

$$A = 100\left(\pm \frac{f_2}{nf_1} \pm \frac{e}{n} \pm E\right)$$

A Accuracy in percent

f_1 = Time base frequency counted

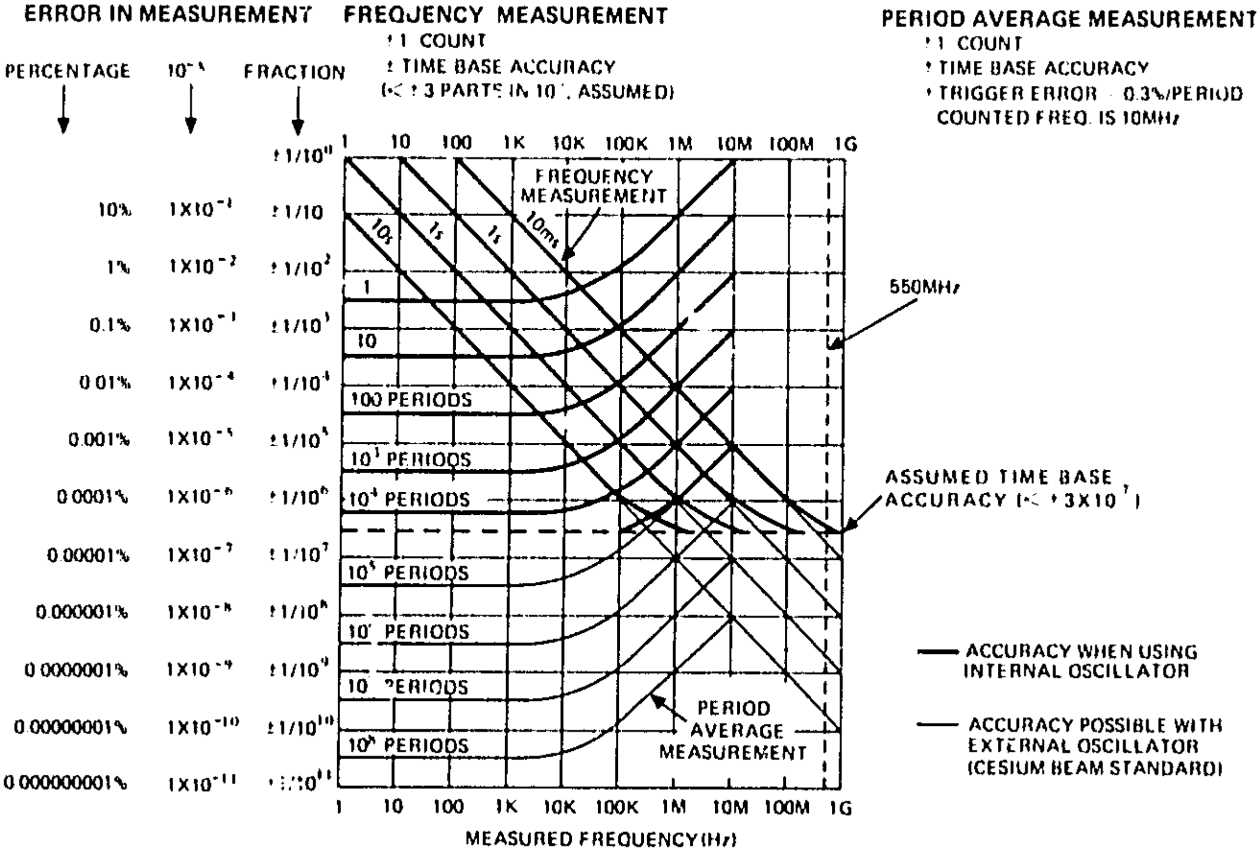
f_2 = Frequency of input signal (Hz)

n = Number of periods averaged

e = 3×10^{-3} (trigger error for one period, 40 dB S/N at rated sensitivity.)

E = time base accuracy (monthy drift rate of individual time base times the number of months since calibration, absolute value of off-set at standardization, frequency change due to ambient temperature change, and line voltage effects). A plot of the above formula is shown in Figure 3-3.

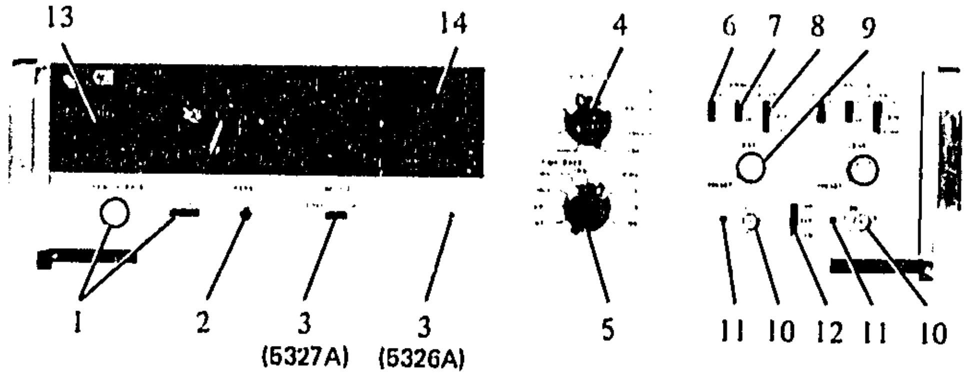
Figure 3-3. Measurement Accuracy



NOTE

FOR 550MHZ INPUT (÷10) USE LINE TO RIGHT OF ACTUAL GATE LENGTH TO DETERMINE ACCURACY OF MEASUREMENT, SINCE ± 1 COUNT ERROR REPRESENTS ±10 COUNTS OF INPUT SIGNAL WHEN PRESCALING BY 10.

Figure 3-4. Front Panel Controls and Indicators



1. SAMPLE RATE control. Applies primary power. Workds in conjunction with FAST/NORM/HOLD switch to control interval between measurements.

   a. FAST - Varies display time from <100 μs to >20 ms. STORAGE switch (rear panel) must be ON to use this mode.

   b. NORM - Varies display time from <20 ms to >5 seconds.

   c. HOLD - Holds display indefinitely.

2. RESET Switch. Resets display and internal count to zero and starts new measurement.

3. INPUT C (5327A ONLY). Switch to select DIRECT (0-50 MHz) or ÷10 (0-550 MHz) operation for INPUT C connector on rear panel. See Figure 3-5.

   INPUT C (5326A ONLY). 50-ohm input connector for 0 to 50 MHz frequency measurements. Has dc coupling and sensitivity of 5 mV rms sine wave. Trigger level is zero volts. Maximum input is ±5 volts rms referenced to ground (DO NOT EXCEED).

4. FUNCTION selector. Selects mode of operation. Blue lettering matches corresponding blue lettering on TIME BASE/MULTIPLIER switch.

   a. STOP, START - Used for totalize mode to manually open and close counter's main gate and to turn scaled output on and off. Frequency input range is 0 to 10 MHz.

   b. PERIOD AVG A - Sets counter to measure period of signal applied to CHANNEL A input. Use MULTIPLIER switch to select number of periods to be averaged. Input frequency range is 0 to 10 MHz.

   c. T. I. AVG A to B - Sets counter to measure average time interval, A to B. Channel A starts interval and Channel B stops the interval. Use MULTIPLIER selector to set number of time intervals to be averaged. Time interval input range is 150 ps to 10 sec; there must be a 150 ns deadtime between intervals.

   d. T. I. A to B - Sets counter to measure time interval A to B. Channel A starts measurement and Channel B stops the measurement. T. I. input range is 0.1 μs to 10^8 sec. The internal time base frequency is divided by the setting of the MULTIPLIER switch and totalized for subsequent display. The more cycles of the oscillator frequency that are counted during A to B time, the better the resolution. There must be 150 ns deadtime between Channel B and Channel Ab trigger points.

   e. PERIOD A - Sets counter to measure a single period of the signal applied to CHANNEL A input. Use MULTIPLIER switch to set counted internal oscillator frequency and therefore the desire resolution. Frequency input range is 0 to 10 MHz.

   f. FREQ A - Set counter to measure frequency applied to CHANNEL A input. Use TIME BASE switch to set gate time and resolution. Frequency input range is 0 to 50 MHz.

   g. FREQ C - Similar to FREQ A, except sets counter to measure frequency applied to INPUT C jack. 50-ohm input impedance. See INPUT C.

Figure 3-4. Front Panel Controls and Indicators (Continued)

5. TIME BASE/MULTIPLIER switch. The function of the switch changes with each mode of operation:

 a. TOTALIZE - Determines scaling factor for input signal prior to counting.

 b. PERIOD AVG A - Selects number of periods to be averaged.

 c. T. I. AVG A to B - Selects number of time intervals to be averaged.

 d. T. I. A to B - Selects scaling factor for internal oscillator signal.

 e. PERIOD A - Selects scaling factor for internal oscillator signal.

 f. FREQ A and FREQ C - Sets gate time.

6. SLOPE switch. Permits triggering on positive or negative slope of input signal.

7. AC-DC switch. Selects direct or capacitor coupling for input signal. Minimum input frequency on AC setting is 20 Hz.

8. ATTEN switch. Selects attenuation for input signal. Used in conjunction with LEVEL control to set input triggering point. Maximum input: 250 V rms on all ranges except 25 V rms on X1 range above 50 kHz. Recommended input is 0.1 V rms to 2 V rms times ATTEN setting.

9. LEVEL control. Used in conjunction with ATTEN switch to determine voltage at which triggering occurs. With X1 attenuator setting, level is variable ±3 V; on X10, ±30 V; and X100, ±300 V.

10. Input jacks. Input jacks to Channels A AND B. Input impedance is 1 MΩ shunted by less than 25 pF. By using a 10 to 1 divider probe, input impedance can be increased to 10 MΩ.

11. Trigger lamps adjacent to input jacks indicate when amplifier triggering occurs.

12. CHK-SEP-COM switch. (Check-separate-common).

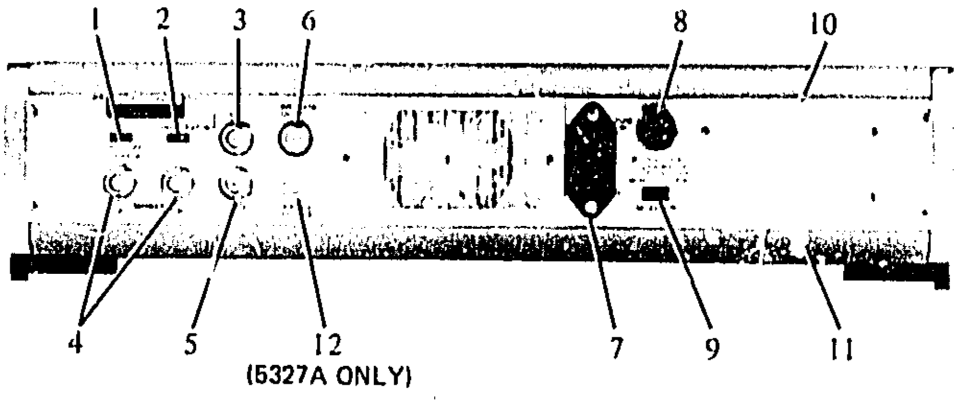
 a. CHK - Connects internal 10 MHz time base to Channels A and B circuitry to check that unit is functioning. No indication in T. I. or T. I. Avg; ignore displayed digits in period average.

 b. COM-SEP - Connects A and B inputs in parallel when set to COM position. When applying two separate inputs, set switch to SEP. When set to COM, input impedance is 500 kΩ shunted with less than 50 pF.

13. C (count) light. Lights when counter's main gate is open. For short-duration gate times, the annunciator circuits include a 50 ms one-shot MV to allow a visible flash of the C light.

14. * (asterisk). Indicates that proper units are not displayed with combination of function/time base selection. To interpret display, add a zero to the right of least significant digit displayed on the counter.

Figure 3-5. Rear Panel Controls and Connectors



1. STORAGE switch. When set to ON, provides display storage while new measurement is being made. In OFF position, allows continuous display of counting process.

2. OSC INT-EXT swit... position, selects normal count... eration using internal time base. In EXT position, permits use of external time base.

3. OSC jack. With INT-EXT switch set to INT, provides 10 MHz, >3 V p-p output (no load), 50Ω series impedance. With INT-EXT switch set to EXT, allows use of external time base from 100 Hz to 10 MHz at >1 volt rms (5 V peak maximum).

4. MARKER A and B jacks. Provides marker outputs to intensity modulate HP 180 Oscilloscope. Markers begin coincident with channel trigger points.

5. GATE jack. Provides >2.4 volts output (open circuit) for external use. Has 50Ω series impedance. Output is low when counter's main gate is open and high when gate is closed.

6. TIME BASE OUTPUT jack. Provides negative going > +3 to 0 V pulses (open circuit), >50 nanoseconds wide. The line has a 50Ω series impedance. In START, frequency output is CHANNEL A signal divided by MULTIPLIER setting.

7. AC LINE IEC type with offset pin connected to chassis.

8. AC LINE FUSE. 1.50 A at 115 V, 800 mA at 230 V.

9. 115/230 volt switch. Insert narrow screwdriver and slide switch to show desired voltage.

10. DIGITAL RECORDER connector (Option 003 only). 50-pin connector for digital recorder interconnection.

11. REMOTE PROGRAM connector. Option 002: 36-pin connector to allow remote control of counter modes and functions.

    Option 004: 50-pin connector to allow remote control of all counter functions except FAST/NORM.

12. INPUT C (5327A only). 50-ohm input for 0 to 50 MHz or 0 to 550 MHz frequency measurements. When INPUT C switch is in ÷ 10 position, frequency range is 0 to 550 MHz, coupling is dc, and sensitivity is 25 mV rms sine wave. With INPUT C switch in DIRECT position, frequency range is 0 to 50 MHz, sensitivity is 15 mV rms sine wave, coupling is dc. For either setting of the INPUT C switch, maximum input is 3.5 volts rms referenced to ground (DO NOT EXCEED), and trigger level is zero volts.

Table 3-1. Self-Check

1. Set SAMPLE RATE control slightly clockwise out of OFF.

2. Set FAST/NORM/HOLD switch to NORM.

3. Set FUNCTION switch to STOP.

4. Set MULTIPLIER selector to 1.

5. Set CHK-SEP-COM switch to CHK.

6. Press RESET and check that counter's right hand column displays a 0 and all other digits are blanked.

7. Set FUNCTION switch to START and check that counter totalizes and C light is on. Check that OF light goes on as display overflows. Set TIME BASE/MULTIPLIER to each position and check that counter totalizes in each position.

8. Set FUNCTION switch to STOP. Check that C light goes out and display is held.

9. Set FUNCTION to PERIOD AVG A. Set MULTIPLIER as shown in table below and check for proper display.

Period Average Self-Check

MULTIPLIER	DISPLAY	ANNUNCIATOR
1	.1	μs
10	.10	μs
10^2	.100	μs
10^3	100.0	ns
10^4	100.00	ns
10^5	100.000	ns
10^6	100.0000	ns
10^7 Standard	00.00000	ns OF
10^7 Option 001	100.00000	ns
10^8 Standard	0.000000	ns OF
10^8 Option 001	00.000000	ns OF

NOTE

Digits noted are for reference, actual display may differ by several counts.

10. Set FUNCTION to T.I. AVG A to B. Set MULTIPLIER as shown in table below and check for proper display.

Time Interval Average Self Check

MULTIPLIER	DISPLAY	ANNUNCIATOR
1	.0	μs
10	.00	μs
10^2	.000	μs
10^3	.0	ns
10^4	.00	ns
10^5	.000	ns
10^6	.0000	ns
10^7	.00000	ns
10^8	.000000	ns

11. Set FUNCTION to T. I. A to B. Rotate MULTIPLIER switch as shown in the following table (Step 12) and check for proper display.

12. Set FUNCTION to PERIOD A. Set MULTIPLIER switch as shown in the following table and check for proper display.

Time Interval and Period Self-Check

MULTIPLIER	DISPLAY	ANNUNCIATOR
1*	.1 ± 1 count	μs
10	0	μs
10^2	.00	ms
10^3	.0	ms
10^4	0	ms
10^5	.00	s
10^6	.0	s
10^7	0	s
10^8	0	*

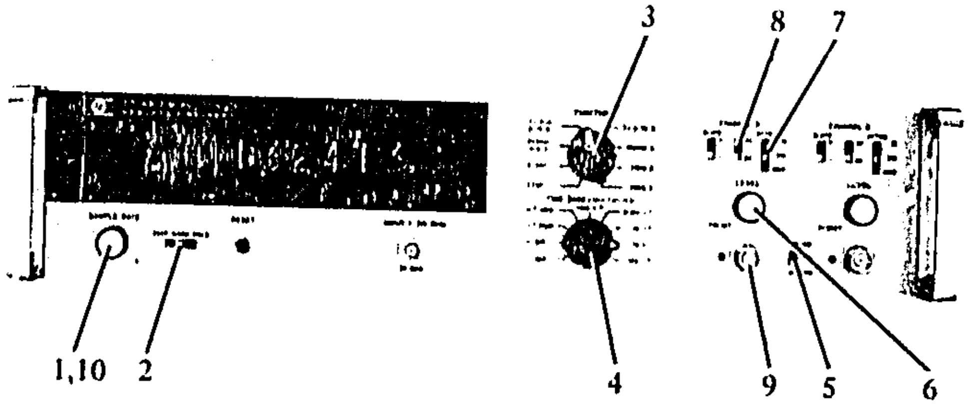
*NOTE: For Time Interval Self-Check, display is .0 μs for MULTIPLIER setting of 1.

13. Set FUNCTION to FREQ A. Set TIME BASE switch as shown in table below and check for proper display.

Frequency A Self Check

TIME BASE	DISPLAY		ANNUNCIATOR
.1 μs	.01	±1 count	GHz
1 μs	10	±1 count	MHz
10 μs	10.0	±1 count	MHz
.1 ms	10.00	±1 count	MHz
1 ms	10.000	±1 count	MHz
10 ms	10000.0	±1 count	kHz
.1 s	10000.00	±1 count	kHz
1 s	0000.000	±1 count	kHz OF
	10000.000	±1 count	kHz (Option 001)
10 s	000.0000	±1 count	kHz OF
	0000.0000	±1 count	kHz OF (Opt. 001)

Figure 3-6. Frequency A Measurements

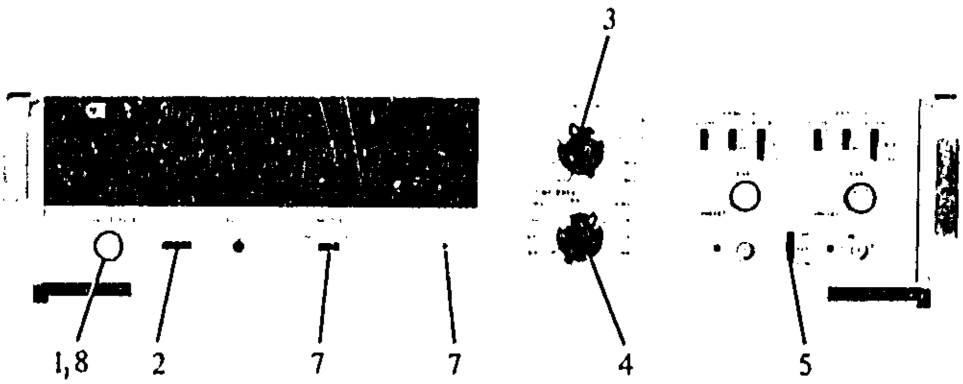


1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to FREQ A.
4. Set TIME BASE switch for desired gate time.
5. Set CHK-SEP-COM switch to SEP.
6. Set CHANNEL A LEVEL control to desired trigger level or to PRESET to trigger at zero volts.
7. Set ATTEN switch to match input signal amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 50 MHz) to CHANNEL A input jack.
10. Adjust SAMPLE RATE control for convenient measurement interval.

NOTE

When the input signal is removed from CHANNEL A or the signal level is insufficient to trigger Channel A, the count light (C) will not cycle. This is normal for this counter and does not indicate a malfunction.

Figure 3-7. Frequency C Measurements



1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to FREQ C.
4. Set TIME BASE switch for desired resolution.
5. Set CHK-SEP-COM switch to SEP.
6. Set INPUT C switch to DIRECT.
7. For 5326A: Connect input signal (0 to 50 MHz, ±7.5 V peak maximum, 5 mV rms minimum) to input C connector. Input impedance is 50 Ω nominal.

   For 5327A: Connect input signal (Direct: 0 to 50 MHz, ±5V peak maximum, 15 mV minimum. Prescaled: 0 to 550 MHz, ±5V peak maximum 25 mV minimum) to input C connector on the rear panel.
8. Adjust SAMPLE RATE control for convenient measurement interval.

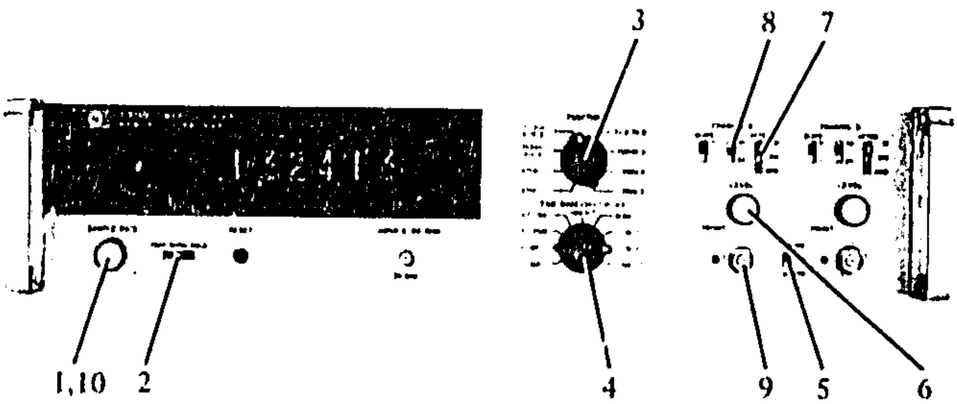
NOTE

For frequencies from 0 to 550 MHz with minimum levels of 15 mV rms, connect signal to INPUT C jack and place INPUT C switch in ÷ 10 position.

CAUTION

Damage will occur if INPUT C voltage specifications are exceeded.

Figure 3-8. Period Measurements



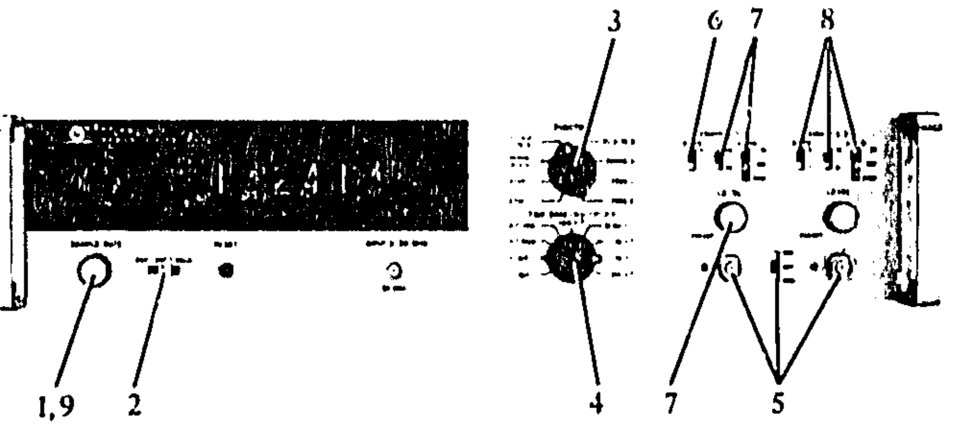
Period

1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to PERIOD A.
4. Set MULTIPLIER switch for desired resolution.
5. Set CHK-SEP-COM switch to SEP.
6. Set CHANNEL A LEVEL control to desired trigger level or to PRESET to trigger at zero volts.
7. Set ATTEN switch to match input signal's amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 10 MHz) to CHANNEL A input jack.
10. Adjust SAMPLE RATE control for a convenient interval between measurements.

Period Average

1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to PERIOD AVG A.
4. Set MULTIPLIER switch to number of periods to be averaged.
5. Set CHK-SEP-COM switch to SEP.
6. Set CHANNEL A LEVEL control to desired trigger level or to PRESET to trigger at zero volts.
7. Set ATTEN switch to match input signal amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 10 MHz) to CHANNEL A input jack.
10. Adjust SAMPLE RATE control for convenient measurement interval.

Figure 3-9. Time Interval Measurements



Single Time Interval

1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to T.I. A to B.
4. Set MUTLIPLIER switch for desired resolution.
5. If start-stop signals are from a common source, connect signal to CHANNEL A input and set CHK-SEP-COM switch to COM. If start-stop signals are from separate sources, connect start signal to CHANNEL A input and stop signal to CHANNEL B input and CHK-SEP-COM switch to SEP.
6. Set CHANNEL A SLOPE switch to + for triggering on positive slope of signal or to - for triggering on negative slope of signal.
7. Set CHANNEL A LEVEL and ATTEN switches to start measurement at desired voltage level. Select AC or DC coupling. For frequencies below 100 kHz, use MARKER A OUTPUT jack on rear panel to display starting point on an oscilloscope.
8. Set CHANNEL B, AC-DC, LEVEL, SLOPE, and ATTEN controls to stop measurement at desired level. For frequencies below 100 kHz, use MARKER B OUTPUT to display stopping point on oscilloscope.
9. Adjust SAMPLE RATE control for convenient measurement interval.

NOTE

There must be at least 150 ns between the STOP pulse (Channel B trigger) and the next START pulse (Channel A trigger).

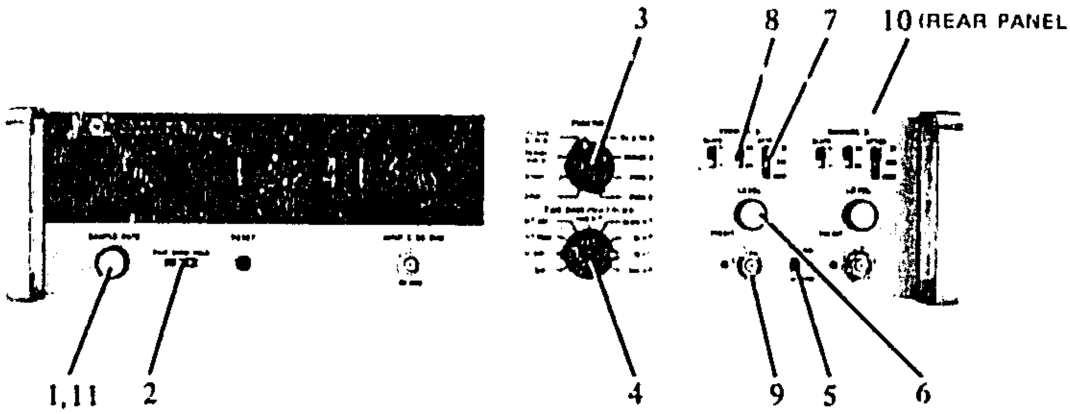
Time Interval Average

1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch T.I. AVG A.
4. Set MULTIPLIER switch to number of time intervals to be averaged.
5. If start-stop signals are from a common source, connect signal to CHANNEL A input and set CHK-SEP-COM switch to COM. If start-stop signals are from separate sources, connect start signal to CHANNEL A input and stop signal to CHANNEL B input and CHK-SEP-COM switch to SEP.
6. Set CHANNEL A SLOPE switch to + for triggering on positive slope of signal or to - for triggering on negative slope of signal.
7. Set CHANNEL A, LEVEL, and ATTEN to start the measurement at desired voltage level. Select AC or DC coupling. For frequencies below 100 kHz, use MARKER A OUTPUT jack on rear panel to display starting point on oscilloscope.
8. Set CHANNEL B, AC-DC, LEVEL, SLOPE, and ATTEN to stop the measurement at desired level. For frequencies below 100 kHz, use MARKER B OUTPUT to display stopping point on oscilloscope.
9. Adjust SAMPLE RATE control for convenient measurement interval.

NOTE

STOP to START delay must be >150 ns and input rate should not be 10 MHz x $\frac{M}{N}$ (M and N integers).

Figure 3-10. Ratio Measurements



1. Set SAMPLE RATE control slightly clockwise out of OFF.

2. Set FAST/NORM/HOLD switch to NORM.

3. Set FUNCTION switch to FREQ A or FREQ C, direct or prescaled.

4. Set MUTLIPLIER switch to desired dividing factor for F_{ext}.

5. Set CHK-SEP-COM switch to SEP.

6. Set CHANNEL A LEVEL control to desired trigger level or to PRESET to trigger at zero volts.

7. Set ATTEN switch to match input amplitude.

8. Set AC-DC switch to AC or DC.

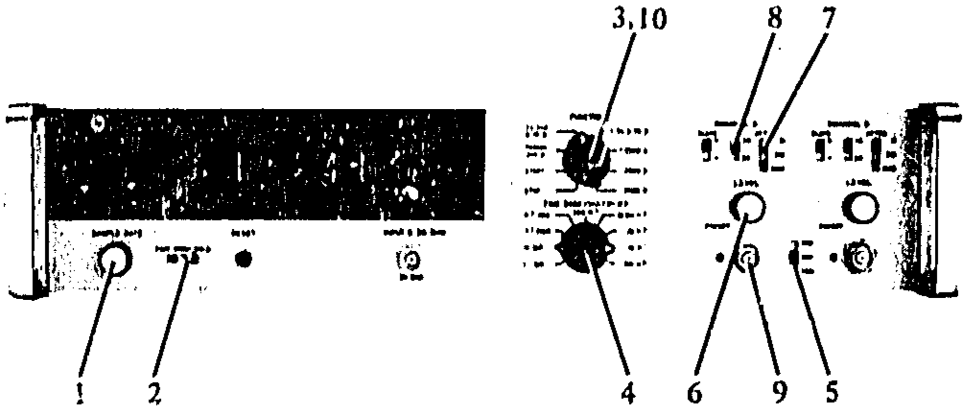
9. Connect F_A (0 to 50 MHz) to CHANNEL A input jack or F_C to INPUT C.

10. Set OSC INT-EXT switch to EXT (rear-panel). Connect F_{ext} to OSC jack. Fext can be 100 Hz to 10 MHz 1 V rms (min) to 5 V peak maximum.

11. Adjust SAMPLE RATE control for convenient measurement interval.

12. Ratio $= \frac{F_A \text{ or } F_C}{F_{ext}} = \frac{\text{DISPLAY}}{\text{MULTIPLIER}}$. Disregard units and decimal point.

Figure 3-11. Totalize Measurements



1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to STOP.
4. Set MULTIPLIER switch to input signal scaling factor.
5. Set CHK-SEP-COM switch to SEP.
6. Set LEVEL control to desired trigger level or to PRESET for triggering at zero volts.
7. Set ATTEN switch to match input signal's amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 10 MHz) to CHANNEL A input jack.
10. Set FUNCTION switch to START.

NOTE

A scaled output of the input signal is available at the rear-panel TIME BASE OUTPUT BNC. The division is determined by the MULTIPLIER switch setting.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section discusses the general operating principles of the instrument. Assembly description is covered in more detail in Section VIII, opposite each schematic diagram. Logic fundamentals are explained in Paragraphs 4-3 through 4-16.

4-3. LOGIC SYMBOLS

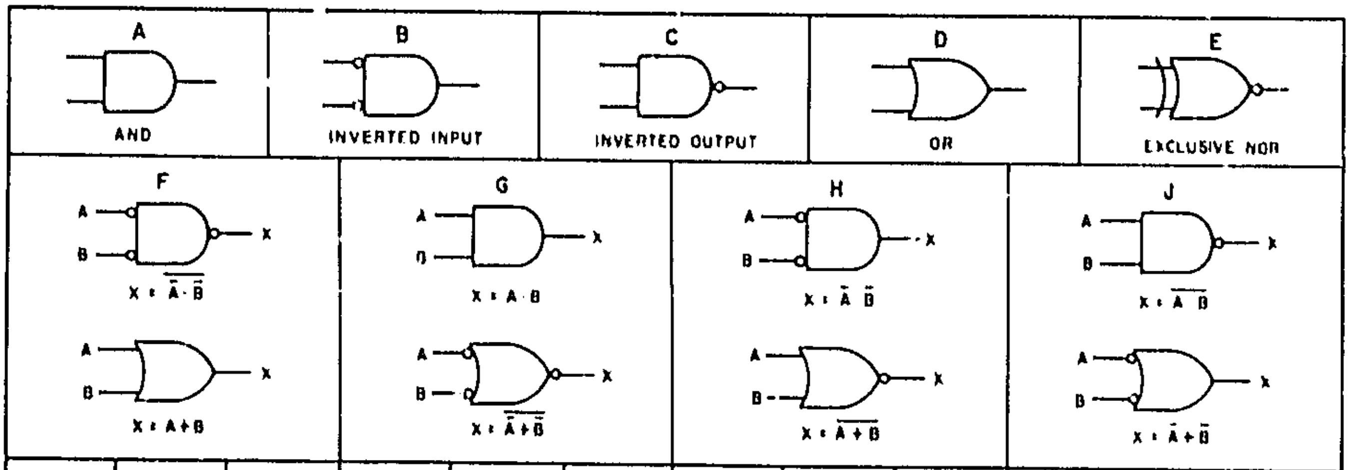
4-4. Two states exist in the binary system, 1 and 0. In positive logic, the 1 state is more positive than the 0 state. High (H) and low (L) are used to represent the 1 and 0 levels. *HIGH ALWAYS REPRESENTS THE MORE POSITIVE LEVEL, WHETHER IT BE POSITIVE OR NEGATIVE LOGIC.*

4-5. A circle at the input line of a logic symbol indicates that a low activates the function. Figure 4-1B shows that a low at both inputs produces a high output. A circle at the output line of a logic symbol indicates a low when activated, as shown in Figure 4-1C.

4-6. Gating and Logic

4-7. Figure 4-1A represents a basic AND gate. The output is high if all inputs are high. An AND gate may have two or more inputs. Figure 4-1D represents a basic OR gate. The OR gate output is high if one or more of its inputs is high. An OR gate may have two or more inputs. An OR gate with a circle on the output is called a NOR gate. An AND gate with a circle on the output is called a NAND gate. An EXCLUSIVE NOR (Figure 4-1E) has two inputs; and the output will be low if one, but not both, of the inputs is high. The output will be high if the inputs are both low or both high.

Figure 4-1. Gate Symbols and Logic Comparisons



A	B	X	A	B	X	A	B	X	A	B	X
H	H	H	H	H	H	H	H	L	H	H	L
H	L	H	H	L	L	H	L	L	H	L	H
L	H	H	L	H	L	L	H	L	L	H	H
L	L	L	L	L	L	L	L	H	L	L	H

4-8. INTEGRATED CIRCUIT OPERATION

4-9. JK Master-Slave Flip-Flop

4-10. The JK master-slave flip-flop is basically a bistable multivibrator. With simultaneous high inputs to J and K, before the clock pulse, Q and $\overline{Q}$ will change states after the clock pulse. Refer to Figure 4-2 and Table 4-1. This circuit triggers on the trailing edge (negative transition) of the clock pulse. The set (S) and reset (R) inputs operate as follows: when a low is applied to set input, $\overline{Q}$ goes low and Q goes high; when a low is applied to reset input, Q goes low and $\overline{Q}$ goes high. Set or reset can override all other inputs at any time.

Figure 4-2. JK Flip-Flop

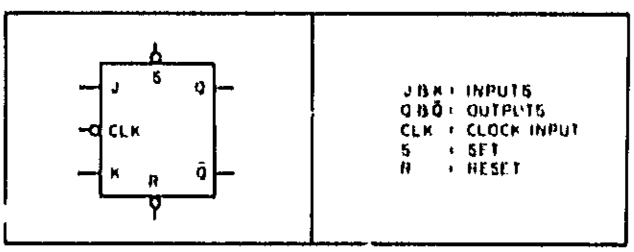


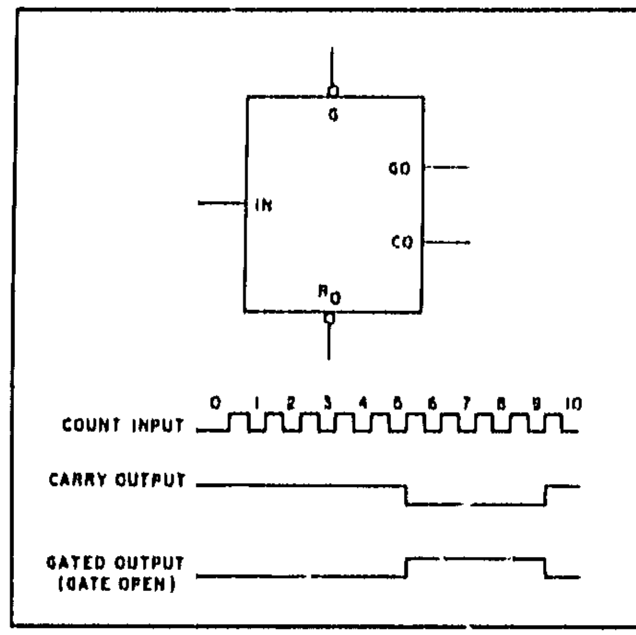
Table 4-1. Truth Table

t_n		$t_n + 1$		t_n = Before clock pulse
J	K	Q	$\overline{Q}$	$t_n + 1$ = After clock pulse
L	L	Q_n	$\overline{Q}_n$	If J = L and K = L, then Q and $\overline{Q}$ will not change from what they were before the clock pulse.
H	L	H	L	If J = H and K = L, then Q will be H and $\overline{Q}$ will be L after the clock pulse.
L	H	L	H	If J = L and K = H, then Q will be L and $\overline{Q}$ will be H after a clock pulse.
H	H	$\overline{Q}_n$	Q_n	If J = H and K = H before the clock pulse, then after the clock pulse Q and $\overline{Q}$ will change states.

4-11. Time-Base Decade

4-12. In the reset state, Carry Output (CO) (see Figure 4-3) is high and, if the Gate input (G) is low, Gated Output (GO) is low. Ten pulses on the Gate input produce a negative transition at the Gated Output. If the G input is high, GO is open-circuited regardless of the count. The Carry Output gives a positive transition after 10 pulses.

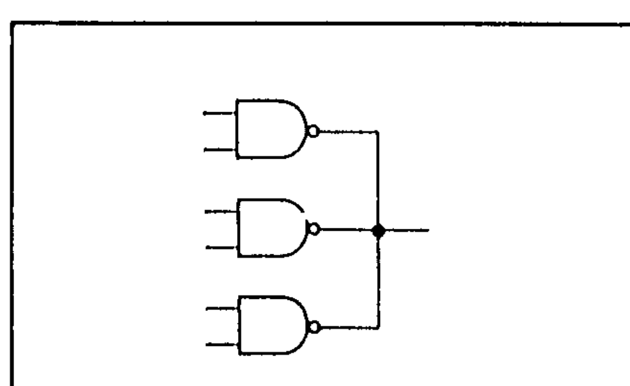
Figure 4-3. Time-Base Decade 1820-0412



4-13. Open-Collector Gate

4-14. The output of an open-collector gate can be paralleled with gates of the same type to perform a wire-OR function, as shown in Figure 4-4. When the outputs are tied to the same line, any one of the gates can pull the line low without damaging itself.

Figure 4-4. Open-Collector Gate 1820-0327



4-15. Logic Levels

4-16. This counter uses three types of logic: TTL (transistor-transistor logic), ECL (emitter-coupled logic), and DTL (diode-transistor logic). See Table 4-2 for specific logic levels.

Table 4-2. Logic Levels

Type	H (Min)	L (Max)	Trigger	Supply
ECL	-.7 V	-1.4 V	-1.2 V	-5.0 V
TTL	2.4 V	0.4 V	1.5 V	5.0 V
DTL	2.6 V	0.4 V	1.5 V	5.0 V

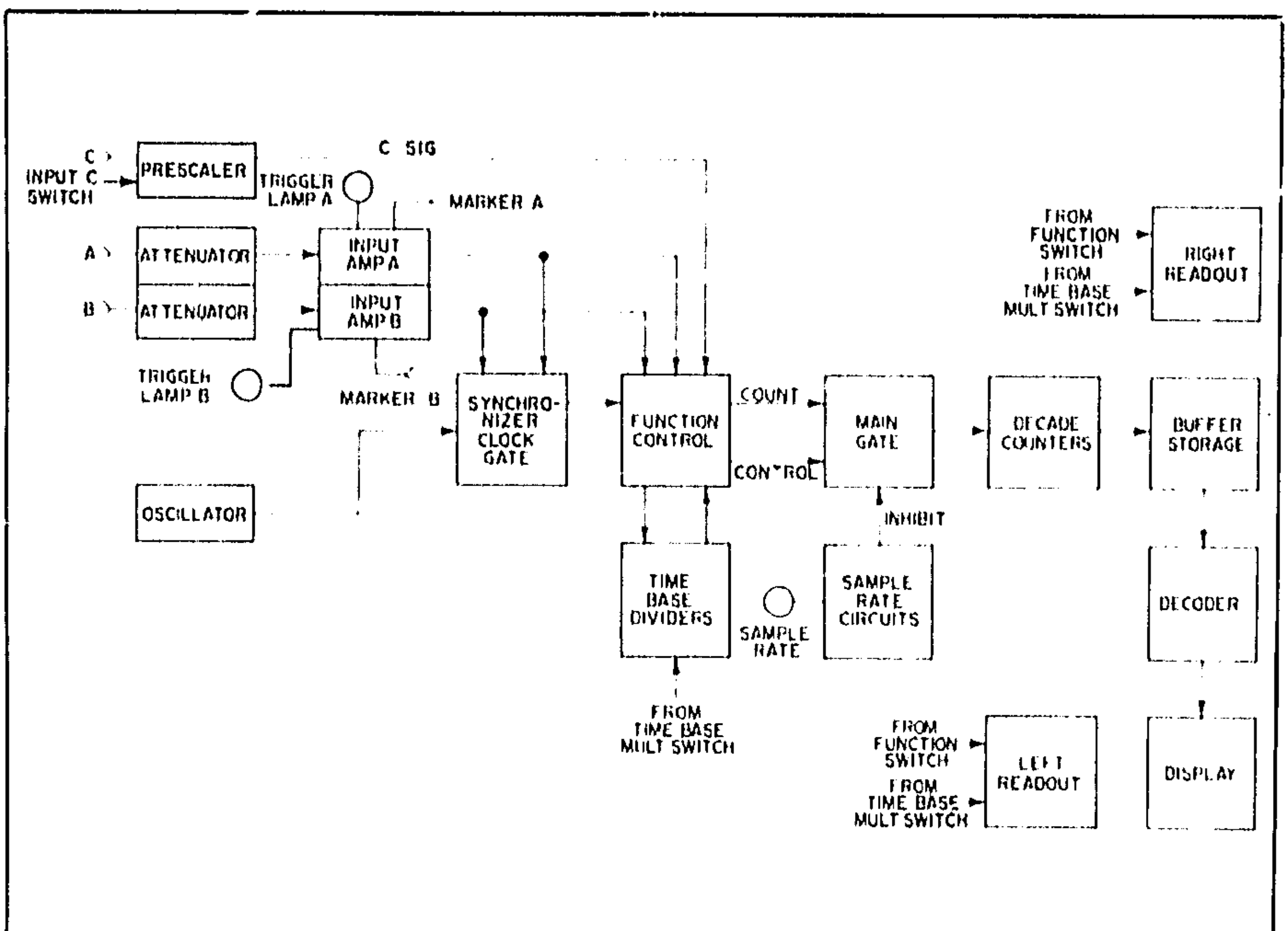
4-17. OVERALL COUNTER OPERATION

4-18. The signal connected to CHANNEL A is conditioned by the front-panel switches of the Attenuator Assembly (Figure 4-5). These switches set the operating conditions for trigger level, coupling, and the required slope. The Input Amplifier converts the signal into narrow pulses for more efficient usage throughout the counter. In the 5327A, INPUT C provides an alternate path through the Prescaler Assembly, which divides the signal by 10 or passes it directly to the Function Control Assembly. The path taken is determined by the setting of the front-panel INPUT C switch.

4-19. The Function Control accepts both the input signal and the 10 MHz internal oscillator pulses and routes them in accordance with the mode of operation being used. One of these signals is sent to the A5 Time Base Assembly, which divides the signal as determined by the front panel TIME BASE/MULTIPLIER switch. The first and last pulse of the divided signal control the length of time the main gate is open. During this time, the other signal is sent directly to the main gate for totalizing in the decade counters and is subsequently displayed. The synchronizer prevents the main gate from opening until an input signal is present.

4-20. The sample rate circuits control the interval between measurements. When the main gate closes, these circuits provide a delay, as controlled by the

Figure 4-5. Functional Block Diagram



front panel SAMPLE RATE controls. When the sample rate period has elapsed, a reset pulse is generated to reset the counter and start a new measurement.

4-21. The signal to be counted, either the internal oscillator or input signal, passes through the main gate to the decade counters. The buffer storage registers store the BCD count before it is translated into a decimal equivalent and displayed on the front panel. Also displayed on the front panel are the units of measurement and the decimal point. The left and right readout assemblies contain the unit indicators and the logic necessary to position the decimal point.

4-22. Frequency Modes

4-23. Frequency is defined as the number of periodic events per unit of time. The counter, therefore, measures an unknown signal (COUNT) for a known length of time (Figures 4-6 and 4-7). The 10 MHz internal oscillator provides the known time and controls the opening of the main gate. The Time Base Assembly divides the oscillator frequency by powers of 10 to open the main gate from 10^{-7} seconds to 10 seconds. The longer the gate is open, the more pulses of the unknown frequency are counted and, therefore, the better the resolution and accuracy.

4-24. Period Modes

4-25. In the Period Mode, the main gate is open for the period of the input signal (Figure 4-8). The Time Base dividers scale the 10 MHz oscillator signal by powers of 10 from 1 to 10^8, as determined by the MULTIPLIER switch. This oscillator signal (COUNT) is counted during the gate time (period) by the decade counters and is subsequently displayed.

4-26. In the Period Average Mode, the MULTIPLIER switch selects the number of periods to be averaged (Figure 4-9). The Time Base dividers count the number of periods selected with the switch and holds the main gate open until this count is complete. The Decade Counter totalizes the oscillator pulses while the main gate is open.

4-27. Time Interval Modes

4-28. In the Time Interval Mode (Figure 4-10), Channel A signal controls the start of the measurement, while Channel B signal stops the measurement. The two signals control the state of the arming flip-flop, which, in turn, enables the Clock Gate to pass oscillator pulses to the Time Base Divider. The oscillator signal is scaled, congruent with the setting of the MULTIPLIER switch, before it is passed through the main gate to the counting assemblies.

4-29. For the Time Interval Average measurements (Figure 4-11), the setting of the MULTIPLIER switch determines the number of intervals that are averaged. The oscillator signal is counted directly for the duration of each, individual time interval that is being averaged. Once the Time Base Divider totalizes the number of selected intervals, the main gate closes and the measurement is displayed. See Page 8-24 for timing diagrams and a technical description.

Figure 4-6. Frequency A Mode Flow Diagram

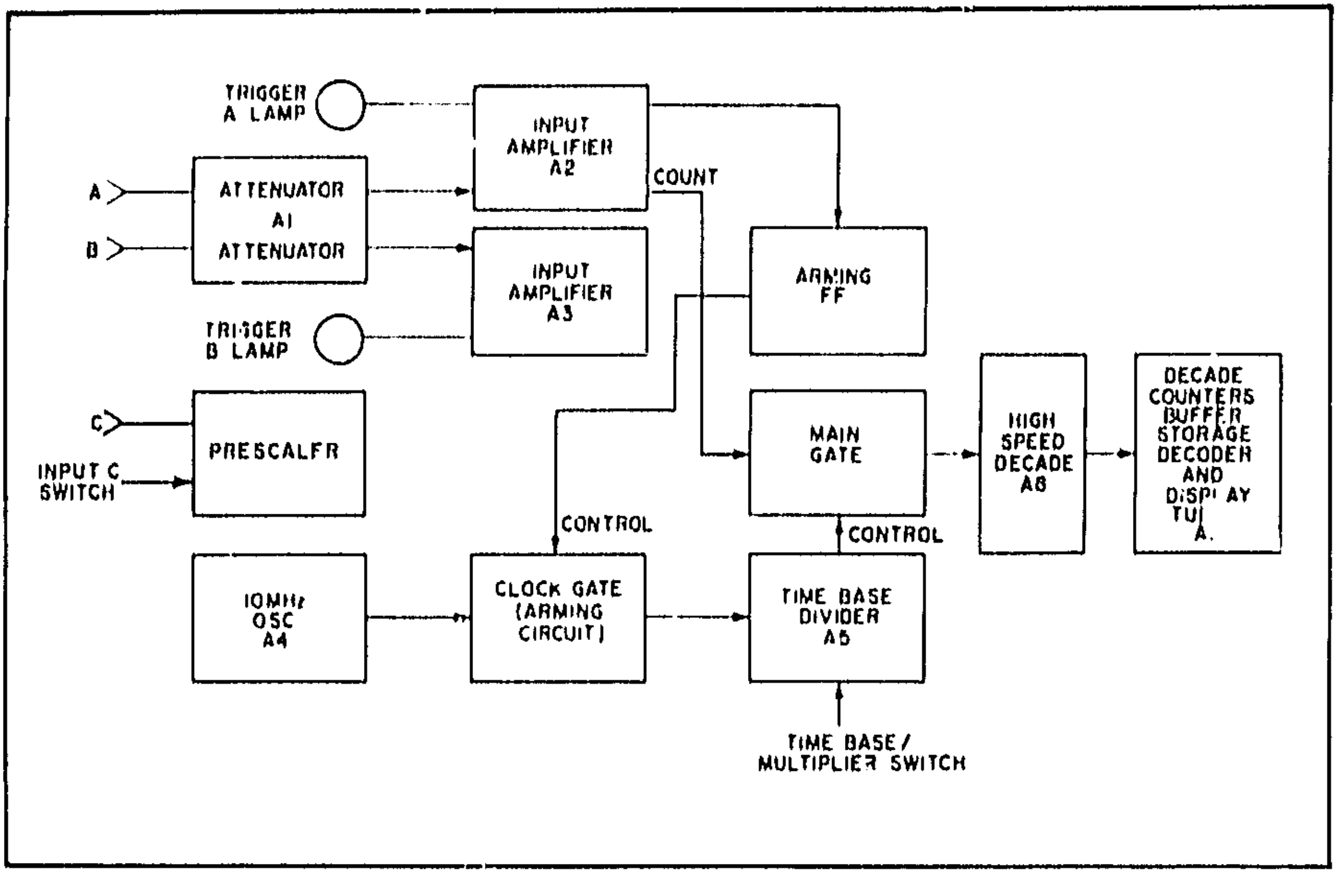


Figure 4-7. Frequency C Mode Flow Diagram

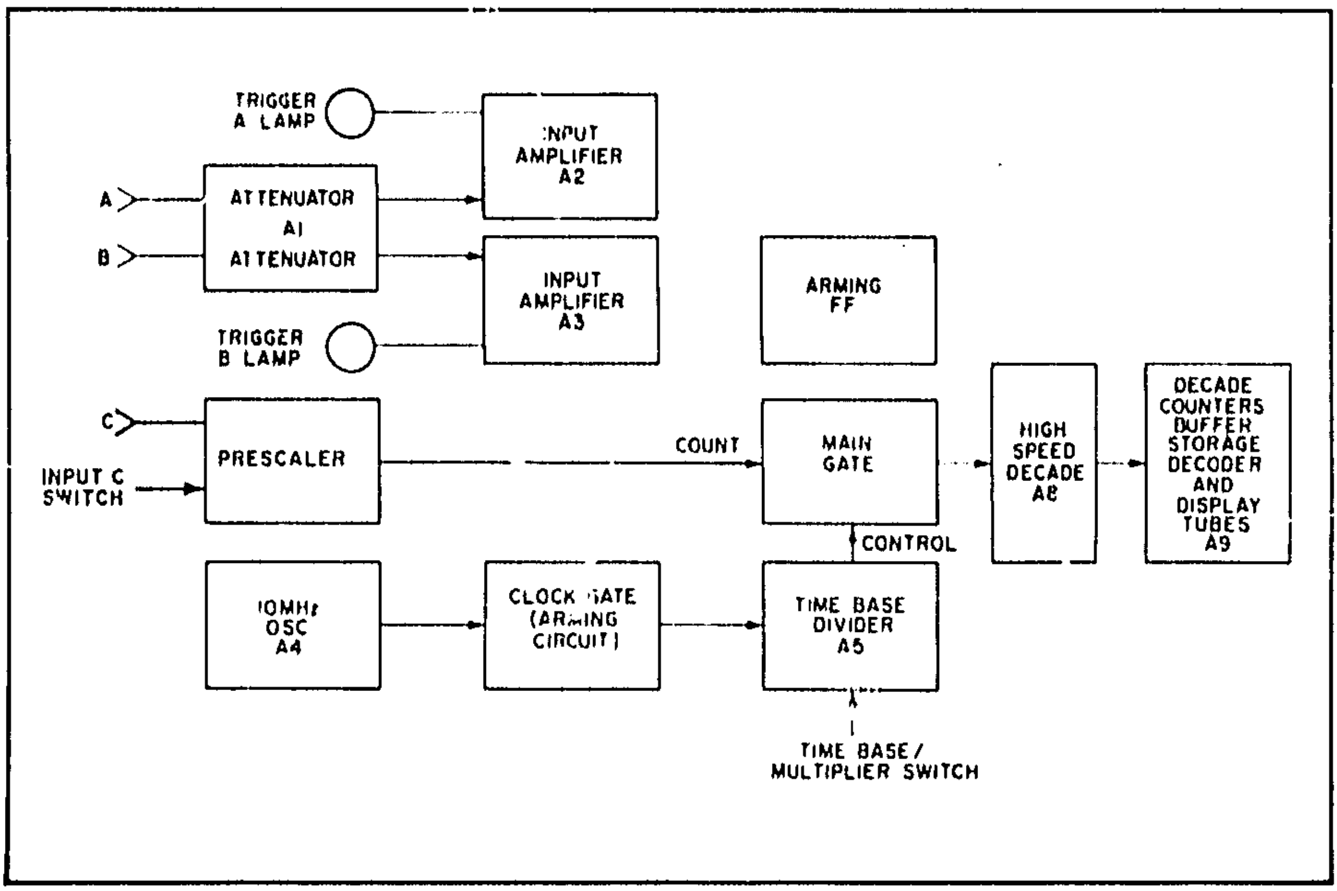


Figure 4-8. Period Mode Flow Diagram

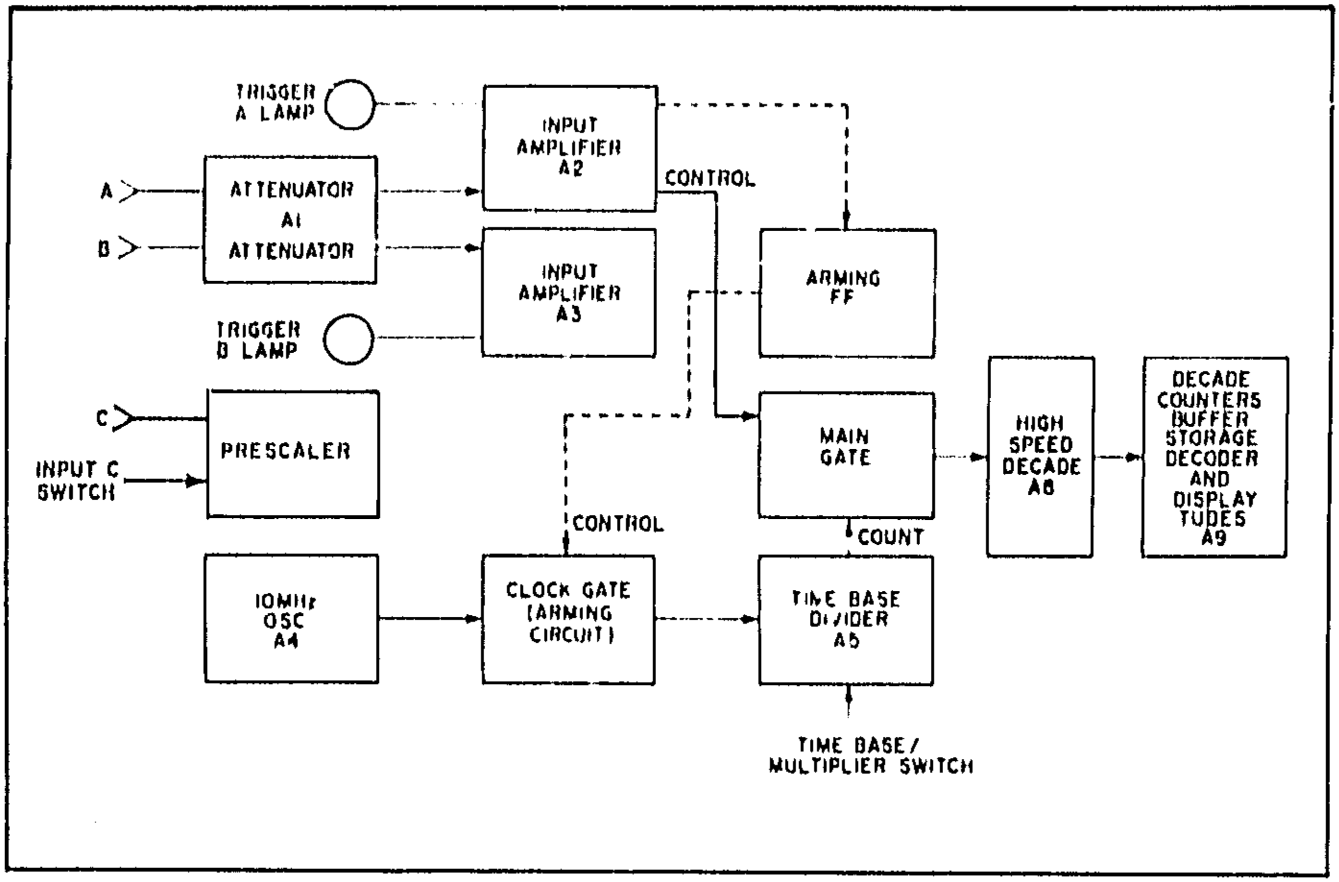


Figure 4-9. Period Average Mode Flow Diagram

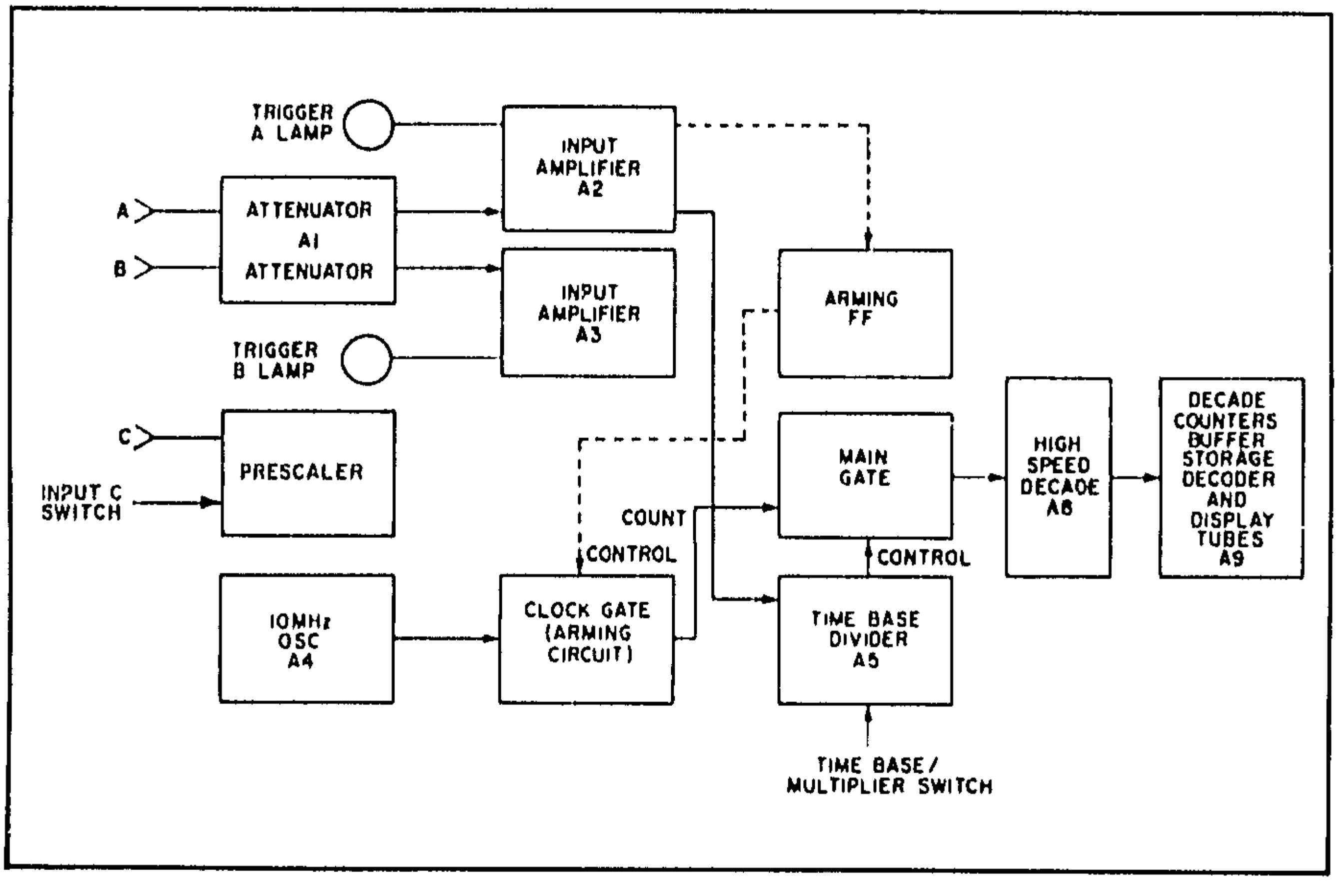


Figure 4-10. Time Interval Mode Flow Diagram

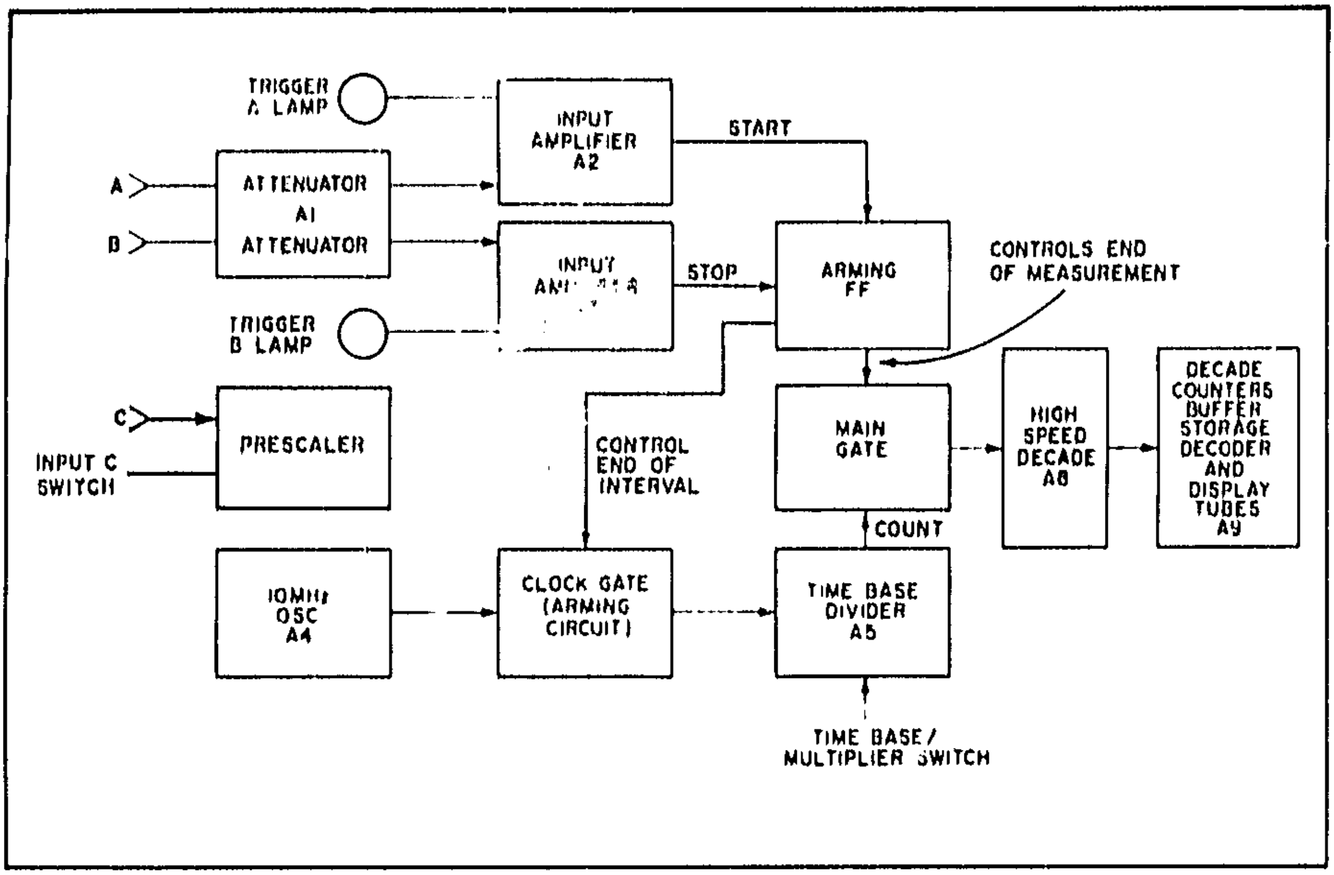


Figure 4-11. Time Interval Average Mode Flow Diagram

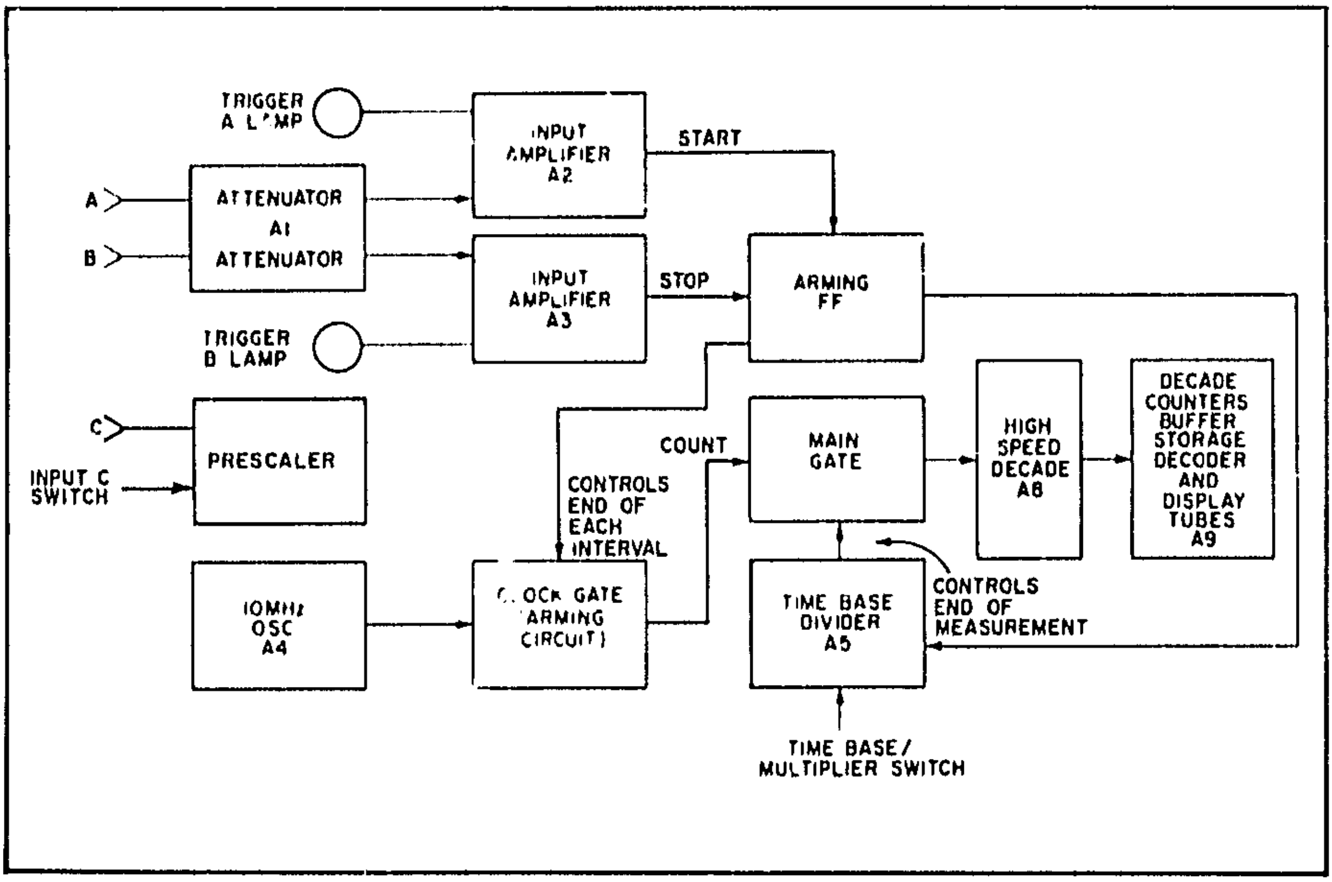
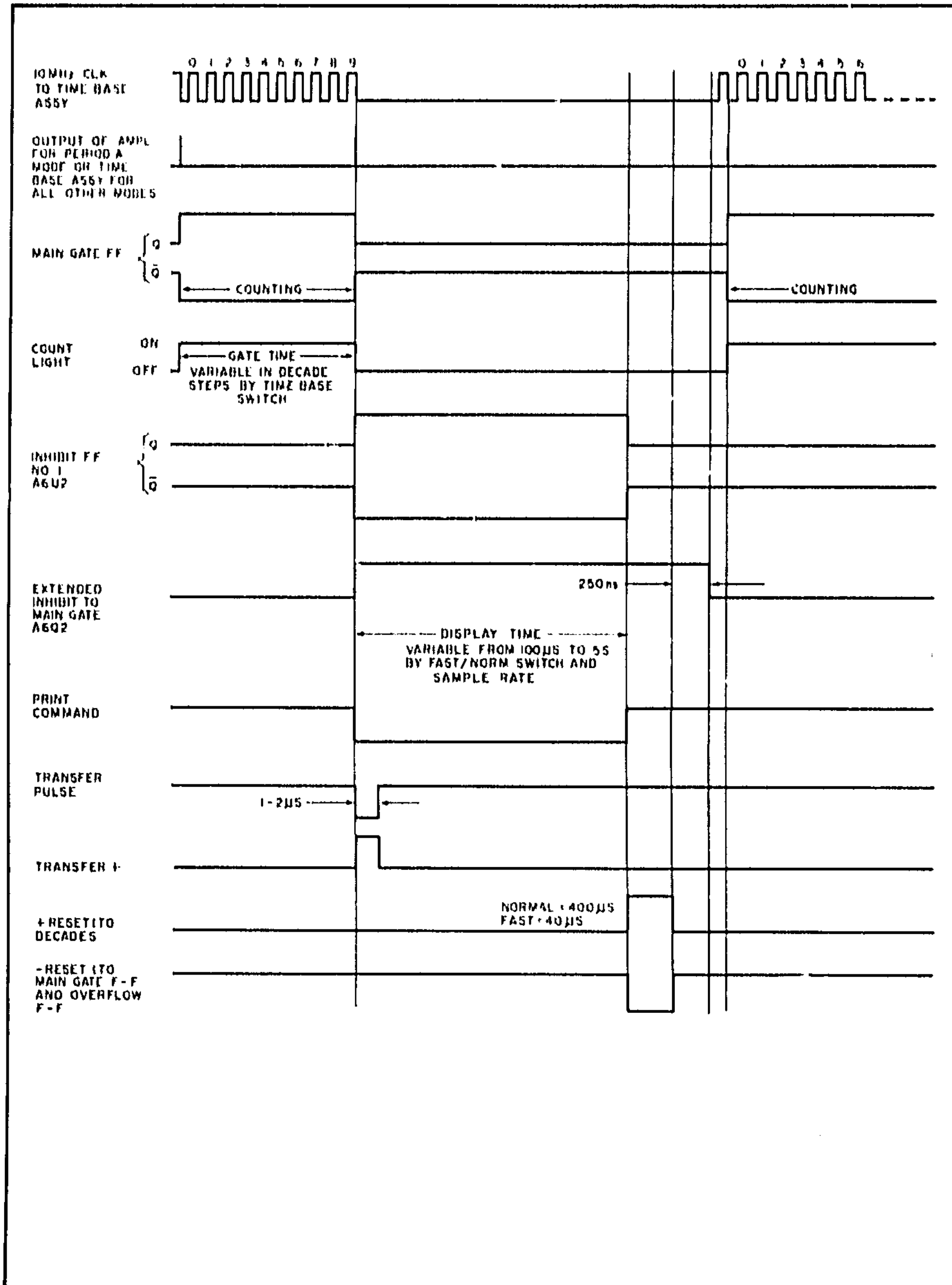


Figure 4-12. Timing Diagram



SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section gives maintenance and service information. Included is a table of assemblies, recommended test equipment, in-cabinet performance checks, which may be used to verify proper counter operations, and adjustments.

5-3. ASSEMBLY DESIGNATIONS

5-4. Table 5-1 lists the designations, name, and Hewlett-Packard part number of assemblies used in this instrument.

5-5. TEST EQUIPMENT

5-6. Test equipment recommended for maintaining and checking performance is listed in Table 5-2. Test equipment having equivalent characteristics may be substituted for the equipment listed.

Table 5-1. Assembly Identification

Assembly	Description	HP Part No.
A1	Attenuator	05326-60047
A1	Attenuator (Option 004)	05327-60034
A2	Input Amplifier	05326-60004
A3	Input Amplifier	05326-60004
A4	Oscillator	05326-60002
A5	Time Base Control	05326-60005
A6	Sample Rate	05326-60013
A7	Function Control	05327-60031
A8	Display Support	05326-60009
A9	Display	05326-60008
A9	Display (Option 001)	05326-60025
A10	Right Readout	05327-60002
A11	Left Readout	05327-60003
A12	Voltmeter Input Amplifier	Not Used
A13	Voltmeter V-F Converter	Not Used
A14	DVM Logic	Not Used
A15	Regulator	05327-60020
A16	Interconnect	05327-60026
A17	Input C Amp (5326A)	05326-60031
A18	Prescaler (5327A)	05327-60033

5-7. ASSEMBLY CONNECTION IDENTIFICATION

5-8. Throughout the manual, connections to printed circuit assemblies are referred to in abbreviated form. For example, connection to A3, pin 10 is A3(10).

5-9. IN-CABINET PERFORMANCE CHECK

5-10. GENERAL. The performance check (Table 5-3) and test card can be used to verify proper operation of all circuits of the counter and may also be used:

a. As part of an incoming inspection check of instrument specifications.

b. Periodically, for instruments used in systems where maximum reliability is important.

c. As part of a procedure to locate defective circuits.

d. After any repairs or adjustments and before returning instrument to regular service.

e. As a permanent record of instrument maintenance performed, because the test record pages are perforated and may be removed.

5-11. VARIABLE LINE VOLTAGE. During the test (Table 5-3), the counter should be connected to a variable voltage source, so the line voltage may be varied ±10% from nominal (115 or 230 Vac).

5-12. INSTRUMENT COVER REMOVAL

5-13. To remove top or bottom cover, remove the four screws that secure cover to instrument. Slide cover toward rear of instrument and lift off. To replace cover, reverse procedure.

WARNING

115/230 VAC AND +175 VDC SUPPLY WIRES ARE EXPOSED WHEN EITHER TOP OR BOTTOM COVER IS REMOVED. USE EXTREME CAUTION DURING TROUBLESHOOTING, ADJUSTMENT, OR REPAIR. AVOID DAMAGE TO INSTRUMENT BY REMOVING POWER BEFORE REMOVING OR REPLACING COVERS, ASSEMBLIES, OR COMPONENTS.

5-14. REPAIR

5-15. Printed Circuit Component Replacement

5-16. Component lead holes in the circuit boards have plated-through walls to ensure good electrical contact between conductors on opposite sides of the board. To prevent damage to the plating and the replacement component, apply heat sparingly, and work carefully.

5-17. Replacing Integrated Circuits

5-18. Following are two recommended methods of replacing integrated circuits:

a. SOLDER GOBBLER. This is the best method. Solder is removed from board by a soldering iron with a hollow tip connected to a vacuum source.

b. CLIP-OUT. This method should be used as a last resort only. Clip the leads as close to the base as possible. With a soldering iron and long nose pliers, carefully remove the wires from each hole. Then clean the holes.

5-19. ADJUSTMENTS

5-20. The adjustments in Table 5-4 are in the order they should be performed but should not be done unless:

a. A trouble has been repaired which would affect these values.

b. The instrument does not meet all specifications while performing the check in Table 5-3 (In-Cabinet Performance Checks).

Table 5-2. Recommended Test Equipment

Instrument Type	Required Characteristics	Recommended Type
Frequency Standard	1 MHz Output	HP 107AR
Oscilloscope Vertical Plug-In Time Base Plug-In	50 MHz Bandwidth 50 mV/cm Sensitivity 50 MHz Bandwidth	HP 180A HP 1801A HP 1820A
Test Oscillator (two required)	10 Hz to 10 MHz at 5 volts peak-to-peak	HP 651B
Audio Oscillator	2 Hz to 100 kHz at 100 mV rms	HP 202C
HF Signal Generator	50 kHz to 50 MHz at 3 V rms	HP 606B
VHF Signal Generator	10 MHz to 480 MHz	HP 608F
Frequency Doubler	240 - 550 MHz	HP 10515A
Pulse Generator	10 MHz repetition rate, 8 ns pulse width, 0.3 volts peak-to-peak output	HP 216A
Electronic Counter	0.1 Hz to 10 MHz Frequency Measurements	HP 5245L
Variable Line Transformer	103 to 127 V rms and 206 to 254 V rms	Electronic Power Stat 3PF116 (115V); 3PF216 (230V)
Digital Recorder	Print Rate: 10 lines/sec. Data Input: +8421 BCD parallel entry, accepts 1 = +5 V, 0 = +0.25 V. Accepts negative going +5 to 0 V print command	HP 5055A
DC Voltmeter	0 to 200 Vdc, 1 % accuracy	HP 412A
AC VTVM	0 to 250 Vac	HP 400F
RF Voltmeter	1 mV to 3 V	HP 3406A

Table 5-3. In-Cabinet Performance Check

1 TIME BASE STABILITY AND OUTPUT

a. Set counter controls as follows:

SAMPLE RATE	Mid-position
FAST/NORM/HOLD	NORM
FUNCTION	FREQ A
TIME BASE/MULTIPLIER	10s
SLOPE A	+
AC/DC	DC
ATTEN	X1
CHK-SEP-COM	SEP
LEVEL	PRESET
STORAGE	ON
OSC	[illegible]

NOTE

Allow one-hour warm up before proceeding to step b.

b. Connect 1 MHz frequency standard to CHANNEL A input.

c. A counter display of 000.0000 (1000.0000 Option 001) indicates that counter time base frequency is exactly 10 MHz. The offset between counter time base and 1 MHz frequency standard can be determined by subtracting 10 MHz from the indicated oscillator frequency.

COUNTER DISPLAY	A4 OSCILLATOR FREQUENCY
999 9950 kHz	10 000 050 Hz
999.9960	10 000 040
999.9970	10 000 030
999.9980	10 000 020
999.9990	10 000 010
1 000.0000	10 000 000
1 000.0010	9 999 990
1 000.0020	9 999 980
1 000.0030	9 999 970
1 000.0040	9 999 960
1 000.0050	9 999 950

d. Record frequency offset on test card. For long-term stability, operate the counter continuously for at least one month. Measure frequency offset at one-month intervals.

e. To calibrate the counter time base to the frequency standard, perform time-base adjustment in Table 5-4.

NOTE

Temperature must be held constant or compensation for temperature difference must be made whenever a frequency difference is recorded. Unless a record of the temperature and date of last calibration is available, the frequency offset should not be considered drift or aging rate of the 10 MHz crystal.

f. To check time base stability vs. line voltage variations, connect variable transformer to counter power cord. Vary line voltage ±10% and record frequency difference on test card; it should be ≤ 1 part in 10^7.

g. To check time base stability vs. temperature, vary counter operating temperature between 0° and 50°C. Record frequency difference on test card; it should be ≤±2.5 parts in 10^6.

Table 5-3. In-Cabinet Performance Check (Continued)

h. Connect oscilloscope vertical input to OSC jack on counter rear panel. Use 10:1 probe at OSC jack.

i. Oscilloscope should display 10 MHz nominal at > 2.4 volts peak-to-peak amplitude. Record on test card.

2. DISPLAY, DECIMAL POINTS, AND DIVIDERS

Proper operation is verified in the Self-Check procedures in Table 3-1. Record on test card.

3. FREQUENCY RESPONSE AND SENSITIVITY

CHANNEL A

a. Set counter controls as in 1a., except TIME BASE to 1s and AC/DC switch to AC.

b. Connect a BNC T connector to CHANNEL A input jack. Connect sine wave test oscillator output to T connector. Connect oscilloscope vertical input to T connector to monitor input signal amplitude; use a 50-ohm feedthrough at oscilloscope BNC.

c. Adjust test oscillator from 20 Hz to 50 MHz, maintaining 100 mVrms input amplitude. Counter should properly display all frequencies in this range. Record on test card.

d. Set audio oscillator frequency to 2 Hz. Counter should not count. Switch AC/DC switch to DC. Counter should count input signal.

e. Connect a BNC T connector to Z axis input of oscilloscope. Connect counter MARKER A and B outputs to T connector.

f. Adjust test oscillator output for 1000 Hz at 8 volts peak-to-peak indication.

g. Set CHANNEL A LEVEL to PRESET and check that osc lloscope marker is at 0 volts.

h. Set CHANNEL A SLOPE to +. Vary CHANNEL A LEVEL control and check that marker is variable over at least -3.0 to +3.0 volts on the positive slope of waveform.

i. Set CHANNEL A SLOPE to -. Vary CHANNEL A LEVEL control and check that marker dot is variable over at least -3.0 to +3.0 volts on the negative slope of waveform. Record on test card.

j. Set CHK-SEP-COM switch on COM and repeat marker test for CHANNEL B. Record on test card.

INPUT C (For 5327A perform all steps; for 5326A perform steps a and f thru h).

a. Disconnect oscilloscope and input to CHANNEL A. Remove 50Ω feedthrough and connect cable to INPUT C jack.

b. Set FUNCTION selector to FREQ C, TIME BASE to 1s, and input selector to ÷10 (5327A).

c. Use the set of frequency generators (Table 5-2) necessary to cover the input frequency from 0 to 550 MHz, while maintaining 25 mV rms input level. Adjust TIME BASE switch as necessary for best display.

d. Check for stable count within stability of oscillator. Record on test card.

e. For 5327A, set input selector switch to DIRECT.

f. Set FUNCTION selector to FREQ C and TIME BASE to 1s.

g. Use the set of frequency generators necessary to cover the input frequency from 0 to 50 MHz, while maintaining 15 mV rms input level for the 5327A or 5 mV rms for the 5326A. Adjust TIME BASE switch as necessary for best display.

Table 5-3. In-Cabinet Performance Check (Continued)

g. Check for stable count within stability of oscillator. Record on test card. Disconnect setup.

4. PULSE OPERATION

a. Set counter controls as follows:

FUNCTION	FREQ A
TIME BASE	1 s
SLOPE A	+
AC/DC (A)	DC
ATTEN (A)	X1
LEVEL (A)	PRESET
CHK-SEP-COM	SEP
STORAGE	ON
OSC	INT

b. Connect BNC T connector to oscilloscope vertical input. Connect pulse generator to T. Connect CHANNEL A input to T connector, using 50Ω feedthrough at the counter input.

c. Adjust pulse generator output for 10 MHz repetition rate, 15 ns pulse width at 0.3 volts peak-to-peak indication on oscilloscope.

d. Check that counter displays the repetition rate, count light flashes, and trigger A lamp is on. Record on test card.

e. Remove input connection from CHANNEL A input jack. Remove 50Ω feedthrough and connect cable to INPUT C jack. Set FUNCTION selector to FREQ C. Set INPUT C switch to DIRECT.

f. Set pulse generator output to 10 MHz repetition rate, 15 nsec wide pulses, at 300 mV peak-to-peak.

g. Check that counter displays repetition rate and count lamp flashes. Record on test card.

h. Repeat above check for 10 kHz.

5. PERIOD AND PERIOD AVERAGE

a. Set counter controls as in step 1a. with FUNCTION to PERIOD A and MULTIPLIER to 10^3 or as needed. Set audio oscillator to 2 Hz at 100 mVrms.

b. Connect oscillator to CHANNEL A input, using BNC T. Connect oscilloscope to T, using 50Ω feedthrough at oscilloscope BNC.

c. Vary audio and test oscillator frequency from 2 Hz to 10 MHz, maintaining 100 mVrms input amplitude. Vary MULTIPLIER as needed to maintain meaningful display with change of frequency. Counter should properly display the period of the frequencies in this range within accuracy spec of the instrument. Record on test card.

d. Set FUNCTION switch to PERIOD AVG A and repeat step c. Record on test card.

6. TIME INTERVAL AND TIME INTERVAL AVERAGE

a. Set counter controls as follows:

SAMPLE RATE	Mid-position
FAST/NORM/HOLD	NORM
FUNCTION	T.I. A to B
MULTIPLIER	1
SLOPE A	+
SLOPE B	-

(Continued)

Table 5-3. In-Cabinet Performance Check (Continued)

a. Counter control settings (cont'd):

AC/DC (A and B)	AC
ATTEN (A and B)	X1
LEVEL (A and B)	PRESET
CHK-SEP-COM	COM

b. Connect test oscillator to CHANNEL A input. Set oscillator for 1 MHz output at 300 mVrms. Observe display for .5 μs ±1 count ± trigger error. Record on test card.

c. Set FUNCTION to T.I. AVG and MULTIPLIER to 10^4. Set signal source to < 2 MHz.* Counter should display one half the period of the input signal.

$$\pm 2 \text{ ns} \pm \frac{\text{trigger error} \pm 100 \text{ ns}^{**}}{\sqrt{\text{number of intervals averaged}}}$$

7. TOTALIZE

a. Set counter controls as follows:

FUNCTION	START
MULTIPLIER	1
CHK-SEP-COM	CHK

b. Check that display totalizes, count light (C) is on and trigger A and B lamps light. Record on test card.

c. Using 10:1 divider probe, connect oscilloscope vertical input to TIME BASE OUTPUT jack on counter rear panel.

d. Check that oscilloscope indicates 10 MHz negative going pulses at least 3 volts peak-to-peak, typically > 30 nsec at 50% points. Set MULTIPLIER switch to 10 and observe 1 MHz output pulses, typically 100 nsec.

e. Disconnect oscilloscope from TIME BASE OUTPUT jack and connect TIME BASE OUTPUT to 5245L Electronic Counter input. Set 5245L for frequency measurements.

f. Set MULTIPLIER as follows, and check for proper counter display. Record on test card.

MULTIPLIER	5245 DISPLAY
1	10 MHz
10	1 MHz
10^2	100 kHz
10^3	10 kHz
10^4	1 kHz
10^5	100 Hz
10^6	10 Hz
10^7	1 Hz
10^8	.1 Hz

*2 MHz must NOT be exact or display will be ambiguous.
**±1 count.

Table 5-3. In-Cabinet Performance Check (Continued)

8. RATIO

   a. Set counter controls as follows:

FUNCTION	FREQ A
MULTIPLIER	10^1
SLOPE A	+
AC/DC	AC
ATTEN	X1
CHK-SEP-COM	SEP
LEVEL A	PRESET
OSC (rear panel)	EXT

   b. Connect test oscillator to OSC jack, using BNC T. Connect oscilloscope to T connector, using 50Ω feedthrough at oscilloscope BNC. Set oscillator output for 10 MHz at 1 Vrms.

   c. Connect BNC T connector to counter's CHANNEL A jack. Connect second test oscillator to T connector. Connect second channel of dual channel oscilloscope vertical input to T connector, using 50Ω feedthrough at oscilloscope BNC. Set variable oscillator for 100 kHz at 100 mV rms display on oscilloscope.

   d. Check that counter displays 100. Disregard units and decimal point. Record on test card.

   e. Repeat test using 100 Hz into OSC jack and 100 kHz into CHANNEL A. Set MULTIPLIER to 10^1. Display should be ratio of two input frequencies X 10^1 (approximately 10^4). Disregard decimal point and units. Record on test card.

9. GATE OUTPUT AND SAMPLE RATE

   a. Disconnect setup.

   b. Set counter controls as follows:

FUNCTION	FREQ
TIME-BASE	1 ms
CHK-SEP-COM	CHK
FAST/NORM/HOLD	FAST
SAMPLE RATE	max ccw

   c. Using 10:1 divider probe, connect oscilloscope vertical input to GATE output and observe positive pulses ≥ 2.4V with a pulse width of < 100 μs. Record on test card.

   d. Slowly rotate SAMPLE RATE clockwise and observe that the pulse width increases.

   e. Set the TIME BASE switch to 10 ms and rotate the SAMPLE RATE fully clockwise. Observe that the pulse width is > 20 ms. Record on test card.

   f. Set FAST/NORM/HOLD to NORM and turn SAMPLE RATE fully counterclockwise, just out of OFF. Observe the positive pulse width is < 20 ms. Record on test card.

   g. Slowly rotate the SAMPLE RATE clockwise, observing an increase in the pulse width.

   h. Set TIME BASE to 1s and rotate SAMPLE RATE fully clockwise. Verify that the time between flashes of the count (C) lamp is greater than 5 seconds. Record on test card.

   i. Set FUNCTION to START and check that gate output is TTL Low (< 0.4V).

   j. Set FUNCTION to STOP and verify that gate output is TTL High (> 2.4V).

Table 5-3. In-Cabinet Performance Check (Continued)

10. DIGITAL RECORDER (Option 003)

a. Set counter controls as follows:

FUNCTION	FREQ A
TIME BASE	1 s
COM-SEP-CHK	CHK
FAST/NORM/HOLD	NORM
SAMPLE RATE	Mid-position

b. Connect oscilloscope to J9(4). Observe oscilloscope display a print command (drop from >2.4 V to <0.4 V) immediately after the C lamp goes out.

c. Connect jumper from J9(25) to J9(22).

d. Check that counter's main gate is inhibited. C light does not flash, and no print command pulses are generated.

e. Verify proper output by connecting a 5055A printer to J9. Printed output should agree with counter display. Logic probe or voltmeter may be used to verify that output logic levels agree with instrument display. Record on test card.

Table 5-4. Adjustments

1. POWER SUPPLY A15

a. Connect counter line cord to variable power transformer. Monitor output voltage with AC VTVM. Adjust transformer for 117 volt indication on VTVM.

b. Turn counter SAMPLE RATE control clockwise out of OFF.

c. Connect VTVM to A15 Pin 7 and adjust A15R10 for +16.5 V.

d. Connect VTVM to A15 Pin 6 and adjust A15R13 for -16.5 V.

2. SENSITIVITY AND OFFSET A2, A3

a. Connect a BNC T connector to CHANNEL A input jack.

b. Connect test oscillator output to T connector.

c. Connect oscilloscope vertical input to T connector, using 50Ω feedthrough at oscilloscope input BNC.

d. Connect counter MARKER A output to oscilloscope Z-axis input.

e. Adjust test oscillator for 1 kHz output at 100 mV rms.

f. Set counter controls as follows:

FUNCTION	FREQ A
CHK-SEP-COM	SEP
ATTEN	X1
AC-DC	DC
LEVEL	PRESET

g. Set SLOPE A switch to - and + positions and observe marker position on oscilloscope waveform.

h. On Input Amplifier board A2, adjust A2R2 SENS pot until + and - marker positions have a symmetrical offset about the zero volt axis for + and - slope switch positions.

i. Adjust test oscillator for 1 kHz output at 200 mV rms.

j. Set counter FUNCTION switch to T.I. A to B.

k. On Input Amplifier, adjust A2R24 TRIG LEVEL pot until markers are at 0 volts for both + and - SLOPE switch positions.

l. Repeat procedure for CHANNEL B input (Amplifier Board A3).

3. OPTION 004 ATTENUATOR A1

Set:

TIME BASE	0.1 sec.
AC/DC	DC
SEP/COM	SEP
ATTEN A/B	X10

a. Using an HP 412A or equivalent, measure voltage at CHANNEL A jack.

b. Adjust R56 for < ±1 mV reading.

c. Measure voltage at CHANNEL B jack.

d. Adjust R9 for < ±1 mV reading.

e. Set A and B attenuators to X100 position.

f. Measure voltage at CHANNEL B jack.

g. Adjust R32 for < ±1 mV reading.

h. Measure voltage at CHANNEL A jack.

i. Adjust R33 for < ±1 mV reading.

4. OSCILLATOR A4

a. Connect 1 MHz frequency standard to CHANNEL A jack.

b. Set counter controls as follows:

CHK-SEP-COM	SEP
FUNCTION	FREQ A
TIME BASE	10s
SAMPLE RATE	slightly clockwise out of OFF

c. Remove top cover.

d. Using insulated tuning tool, adjust A4C3 until display indicates all zeros with cover on. (Wait 10 seconds between adjustments for counter to make measurement.)

NOTE

For standard instruments without Option 001, the counter display will overflow; however, all digits are valid.

5. PRESCALER ADJUSTMENTS A18 (5327A):

a. Set counter controls as follows:

FUNCTION	FREQ C
TIME BASE	0.1s
INPUT C	+10

b. With no input signal applied, adjust R3 offset pot for 0 V on U2 pin 4.

Table 5-4. Adjustments (Continued)

c. Adjust R10 bias pot for 0.65 ±.05 V on U2 pin 3.

d. Adjust R27 bias pot for 0.9 ±.05 V on U3 pin 3.

e. Check that the previously adjusted voltage on U2 pin 3 is correct. If voltage has shifted, adjust R10 for proper reading and recheck U3 pin 3.

f. Set HP VHF Signal Generator and doubler for 550 MHz at 1 V rms. Measure the output with an HP 3406A RF Voltmeter using a 50Ω termination at the probe. Connect signal source to INPUT C of counter.

g. Reduce output level until counter's display becomes unstable. Adjust R3 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase signal level until display just becomes stable.

h. Disconnect input and connect to voltmeter; reading should be 25 mV or less. Check other frequencies within the band.

i. Set INPUT C switch to DIRECT.

j. Change input signal to 50 MHz at 15 mV. Counter should display 50 MHz.

6. INPUT C AMPLIFIER A17 (5326A)

a. Set counter controls as follows:

FUNCTION .... FREQ C
TIME BASE 0.1s

b. Set HP 606B HF Signal Generator (or equivalent) for 50 MHz at 500 mV rms. Measure the output signal of 606B with an HP 411A RF Millivoltmeter, using a 50Ω termination. Connect signal source to INPUT C of counter.

c. Reduce output level until counter's display becomes unstable. Adjust R11 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase the signal level until display just becomes stable.

d. Disconnect input and connect to voltmeter, reading should be less than 5 mV. Check other frequencies within the band.

Table 5-5. D.P. and Annunciator Troubleshooting

Function Switch	Multiplier Switch	n	μ	m	s	•	Decimal					
							10^5	10^4	10^3	10^2	10^1	10^0
Period AVG A	1		x		x							x
	10		x		x						x	
	10^2		x		x					x		
	10^3	x			x							x
	10^4	x			x						x	
	10^5	x			x					x		
	10^6	x			x				x			
	10^7	x			x			x				
	10^8	x			x		x					
T.I. AVG A to B	1		x		x							x
	10		x		x						x	
	10^2		x		x					x		
	10^3	x			x							x
	10^4	x			x						x	
	10^5	x			x					x		
	10^6	x			x				x			
	10^7	x			x			x				
	10^8	x			x		x					
T.I. A to B	1		x		x							x
	10		x		x							
	10^2			x	x						x	
	10^3			x	x							x
	10^4			x	x							
	10^5				x						x	
	10^6				x							x
	10^7				x							
	10^8					x						
Period A	1		x		x							x
	10		x		x							
	10^2			x	x						x	
	10^3			x	x							x
	10^4			x	x							
	10^5				x						x	
	10^6				x							x
	10^7				x							
	10^8					x						

Table 5-5. D.P. and Annunciator Troubleshooting (Cont'd)

Function Switch	Multiplier Switch	G	k	M	Hz	Decimal					
						10^5	10^4	10^3	10^2	10^1	10^0
Freq. A	1	x			x					x	
	10			x	x						
	10^2			x	x						x
	10^3			x	x					x	
	10^4			x	x				x		
	10^5		x		x						x
	10^6		x		x					x	
	10^7		x		x				x		
	10^8		x		x			x			
Freq. C DIRECT	1	x			x					x	
	10			x	x						
	10^2			x	x						x
	10^3			x	x					x	
	10^4			x	x				x		
	10^5		x		x						x
	10^6		x		x					x	
	10^7		x		x				x		
	10^8		x		x			x			
Freq. C PRESCALE	1	x			x						x
	10	x			x					x	
	10^2			x	x						
	10^3			x	x						x
	10^4			x	x					x	
	10^5		x		x						
	10^6		x		x						x
	10^7		x		x					x	
	10^8		x		x				x		

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5326A/5327A Timer/Counter — Test Performed by ______________________

Serial No. ______________ — Date ______________________

DESCRIPTION	CHECK
1. TIME BASE STABILITY AND OUTPUT	
Aging Rate: < 3 parts in 10^7 per month	______
Line Voltage: < 1 part in 10^7 for 10% line variation	______
Temperature: <±2.5 parts in 10^6, 0-50°C	______
Output: 10 MHz, > 2.4 volts peak-to-peak	______
2. DISPLAY, DECIMAL POINTS, AND DIVIDERS	
As per self-check procedures, Table 3-1	______
3. FREQUENCY RESPONSE AND SENSITIVITY	
Frequency A Range: 0 to 50 MHz	______
Frequency C Range: 0 to 550 MHz (prescaled 5327A)	______
0 to 50 MHz (direct)	______
Sensitivity, Frequency A: 100 mV rms	______
Frequency C (5326A): 5 mV rms	______
Frequency C (5327A Direct): 15 mV rms	______
Frequency C (5327A Prescaled): 25 mV rms	______
Channel A Preset: 0 volts	______
Channel A Level: +3.0 to -3.0 volts	______
Channel B Preset: 0 volts	______
Channel B Level: +3.0 to -3.0 volts	______
4. PULSE OPERATION	
CHANNEL A: Sensitivity: 0.3 volts peak-to-peak	______
Pulse Width: 15 ns	______
INPUT C: Sensitivity: 0.3 volts peak-to-peak	______
Pulse Width: 15 ns	______
5. PERIOD AND PERIOD OPERATION	
Frequency Range: 0 to 10 MHz at 100 mV	______
6. TIME INTERVAL AND TIME INTERVAL AVERAGE	
Time Interval: 0.5 μs at 300 mV	______
Time Interval Average: 1/2 period of input signal	______
7. TOTALIZE	
Range: 0 to 10 MHz	______
Output: Rear panel TIME BASE BNC	______
Factor: 1 to 10^8 in decade steps	______

PERFORMANCE CHECK TEST CARD

8. RATIO

   Range Channel A: 0 to 50 MHz ________
   Range External Input: 100 Hz to 10 MHz ________

9. GATE OUTPUT AND SAMPLE RATE: Output: Step c ________
   Step e ________
   Step f ________
   Step h ________

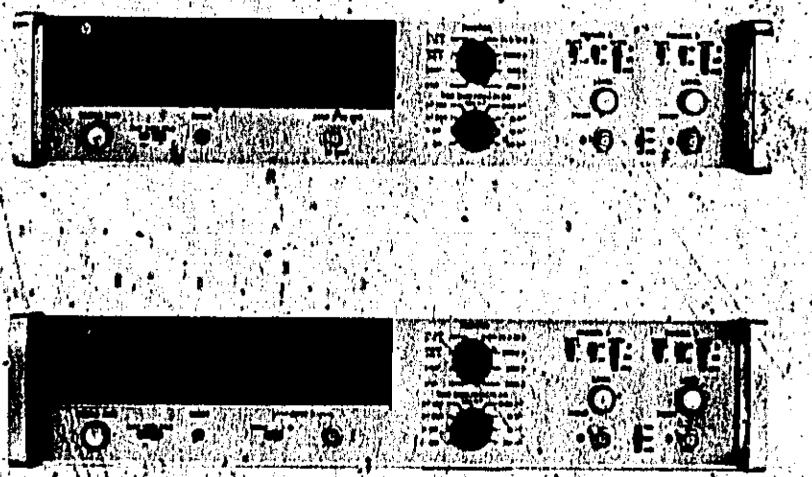
10. DIGITAL RECORDER

    Print Command: +5V to 0V ________
    Output: Corresponds to input data ________

OPERATING AND SERVICE MANUAL

TIMER COUNTER

5326A/5327A



HEWLETT hp PACKARD

CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

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

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

5326A/5327A
TIMER/COUNTER

OPERATING AND SERVICE MANUAL

SERIAL PREFIX:
5326A — 1136A
5327A — 1120A

This manual applies to HP Model 5326A having serial prefix 1136A and HP Model 5327A having serial prefix 1120A.

SERIAL PREFIXES NOT LISTED

For serial prefixes above 1136A (5326A) and 1120A (5327A), a "Manual Supplement" sheet is included with this manual. For serial prefixes below 1136A and 1120A, refer to Section VII of this manual.

5301 STEVENS CREEK BLVD., SANTA CLARA, CALIF. 95050

Printed: MAR 1972

THIS MANUAL PRINTED ON 100% RECYCLED PAPER

HEWLETT hp PACKARD

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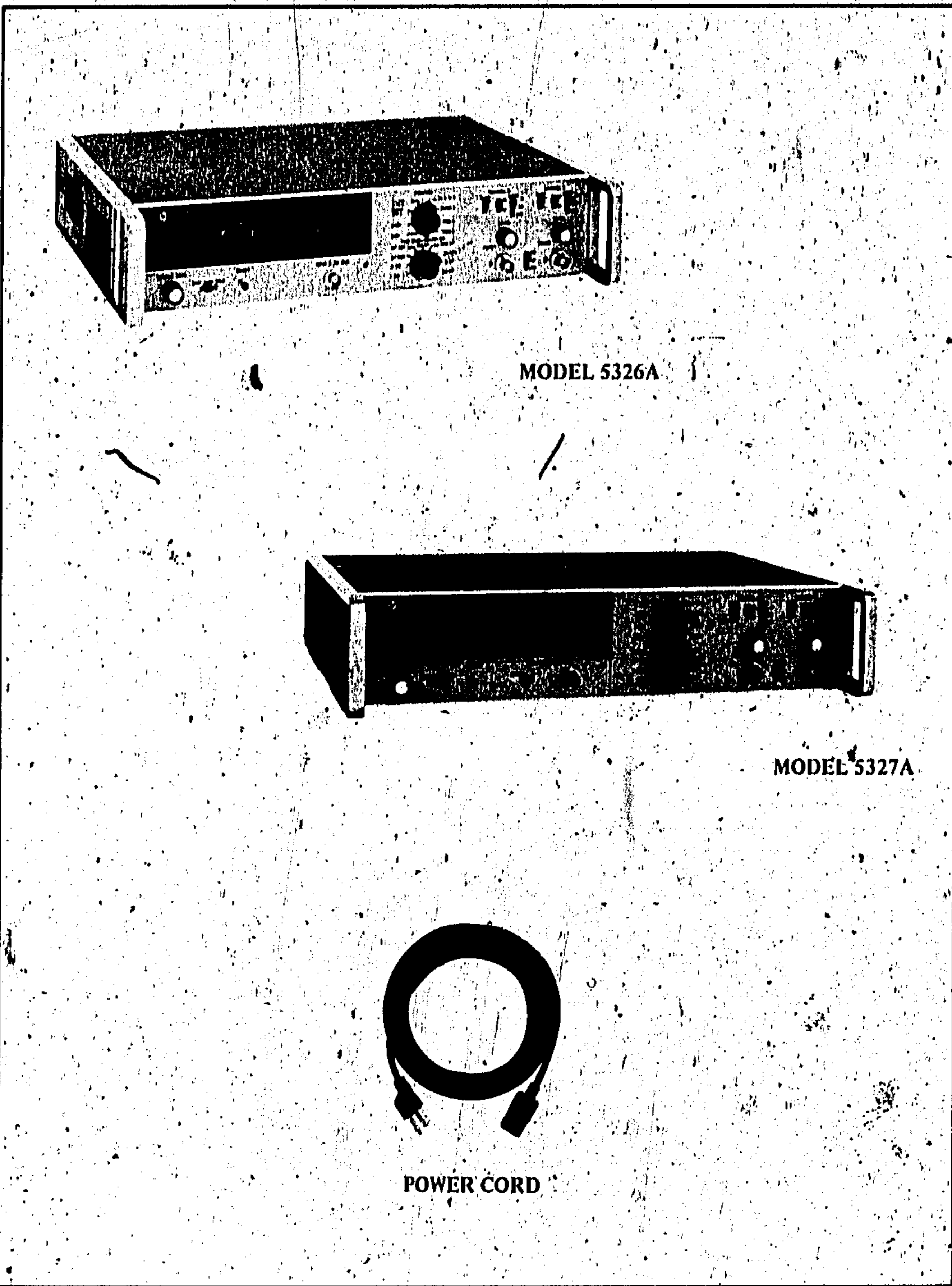
Figure 1-1. HP Model 5326A/5327A Timer/Counter



SECTION I

GENERAL INFORMATION

1-1. DESCRIPTION

1-2. The Hewlett-Packard Models 5326A/5327A are frequency counters that have a variety of functions. The basic difference between the two models is the addition of the prescaler assembly in the 5327A. This assembly increases the upper frequency limit from 50 MHz to 550 MHz. The 5326A uses a high-sensitivity, 50-ohm input amplifier in place of the prescaler.

1-3. The instruments measure frequency, period, period average, time interval, time interval average, and ratio. Features include a 7-digit display (8-digits optional), 1M ohm and 50-ohm inputs, display storage, and blanking for insignificant digits in the display. Decimal point and unit readouts are displayed automatically with each operating selection. Two independent input channels are provided for time interval measurements. Each input channel has an attenuator, trigger slope selector, level control, ac-dc coupling, and an oscilloscope marker output. Table 1-1 lists the electrical and mechanical specifications.

1-4. IDENTIFICATION

1-5. Hewlett-Packard uses a two-section serial number mounted on the rear panel. Earlier instruments use an 8-digit serial number (000-00000). The first three digits are a serial prefix number; the last five digits refer to the specific instrument. Later instruments use a 9-digit serial number (0000A00000). The first four digits are the serial prefix and the last five digits refer to the specific instrument. If the serial prefix of your instrument differs from that listed on the title page of this manual, there are differences between this manual and your instrument. Lower serial prefixes are documented in Section VII, and higher serial prefixes are covered with manual change sheets included with the manual. If the change sheet is missing, contact the nearest Hewlett-Packard Sales and Service Office listed on the inside rear cover of this manual.

1-6. APPLICATIONS

1-7. The 5326A/5327A Counters are particularly adaptable to timing measurements such as pulse width, pulse repetition frequency, and propagation delay. The time interval average mode measures time interval on repetitive signals with resolution better than one nanosecond. When used with microwave test systems, group delay, phase, and level measurements can be performed.

1-8. OPTIONS

1-9. The instrument can be ordered with the following options: Option 001, 8-digit display; Option 002, remote programming; Option 003, digital recorder outputs; and Option 004, remote programming for all signal input conditions.

Table 1-1. Equipment Supplied

Description	HP Part No.
Detachable Power Cord, 7½ ft. (231 cm) long	8120-1348
Rack Mounting Kit	05326-60029

Table 1-2. Accessories Available

Description	HP Part No.
Digital Recorders	5050B, 5055A
Interconnect Cable, Digital Recorder, 6 ft. (183 cm)	562A-16C
50-ohm BNC to BNC Coaxial Cable, 4 ft. (122 cm)	10503-6001
Circuit Board Extender, 15-pin (two required)	5060-0049
Input Amplifier Circuit Board Extender	10532-60001
Circuit Board Extender, 18-pin	5060-2041
Extender Board Kit; includes two 5060-0049, and one each 5060-2041, and 10532-60001	10532A

Table 1-3. Specifications

INPUT CHANNELS A AND B

Range:
dc coupled: 0-50 MHz
ac coupled: 20 Hz - 50 MHz

Sensitivity:
0.1 V rms sine wave
0.3 V p-p pulse
8 ns minimum pulse width
Sensitivity can be decreased by 10 or 100 times, using the ATTENUATOR switch.

Impedance: 1 MΩ shunted by less than 25 pF

Dynamic Input Voltage Range:
0.1 to 3 V rms ac times attenuator setting
±5 Vdc times attenuator setting.

Trigger Level:
PRESET to center triggering about 0 V or variable over the range of -3 V to +3 V times attenuator setting. Trigger threshold band <1.0 mV, referred to input at maximum frequency.

Overload Protection:
250 V rms on all attenuator settings, except 25 V rms on X1 above 50 kHz.

Slope:
Independent selection of positive or negative slope.

Channel Inputs: Common or separate lines.

Marker Outputs:
Rear panel BNC's DTL pulse, low for approximately 2 μs after trigger point for A and B channels.

INPUT CHANNEL C

5327A

Range:
direct: 1 kHz - 50 MHz, ac coupled
prescaled: 0-550 MHz, dc coupled

Sensitivity:
direct: 5 mV rms
prescaled: 100 mV rms

Impedance: 50Ω nominal

Maximum Input: 5 volts rms; 7.5 volts peak

Trigger Level: 0 volts

5326A

Range: 0 to 50 MHz, dc coupled

Sensitivity:
5 mV rms

Impedance: 50Ω nominal
Maximum Input: 5 volts rms; 7.5 volts peak
Trigger Level: 0 volts

CAUTION

Do not exceed voltage specification or damage will occur.

START (Totalizing and Scaling)

Range: 0 - 10 MHz

Factor: 1 - 10^8 selectable in decade steps

Output: Rear panel TIME BASE BNC

Display:
Channel A input divided by scaling factor

FREQUENCY

Range:
0 - 50 MHz (5326A)
0 - 550 MHz (5327A)

Input:
Channel A; channel C for direct and for prescaled (switchable). Channel A provides triggered frequency measurement

Gate Times: 0.1 μs to 10 s in decade steps

Accuracy:
Direct: ±1 count ± time base accuracy.
Prescaled: ±10 counts* ± time base accuracy

Display:
kHz, MHz, or GHz with positioned decimal point

TIME INTERVAL

Range: 0.1 μs to 10^4 seconds

Input:
Channels A and B; can be common or separate

Frequency Counted:
10 MHz to 0.1 Hz in decade steps

Accuracy:
±1 count ± time base accuracy ± trigger error.**

Display:
μs, ms, seconds or 10's of seconds with positioned decimal point

TIME INTERVAL AVERAGE

Range: 0.15 ns to 10 s

Intervals Averaged:
1 - 10^8 selectable in decade steps

*±10 counts of input frequency (±1 count displayed).

Table 1-3. Specifications (Continued)

Input:
Channels A and B; can be common or separate

Frequency Counted: 10 MHz

Minimum Time Stop to Start: 100 ns

Accuracy: ± time base accuracy ± 2 ns

$$\pm \frac{\text{(trigger error** + 100 ns)}}{\sqrt{\text{intervals averaged}}}$$

Display: ns, μs with positioned decimal point

PERIOD

Range: 0 - 10 MHz

Input: Channel A

Frequency Counted:
10 MHz to 0.1 Hz in decade steps

Accuracy:
±1 count ± time base accuracy ± trigger error***

Display:
μs, ms, seconds or 10's of seconds with positioned decimal point

PERIOD AVERAGE

Range: 0 - 10 MHz

Periods Averaged: 1 - 10^8 selectable in decade steps.

Input: Channel A

Frequency Counted: 10 MHz

Accuracy:
± time base accuracy ± 1 count ± trigger error***

Display: ns, μs, with positioned decimal point

RATIO

Display:
F_A/F_{ext} or F_C/F_{ext} times MULTIPLIER (M).
M = 1 to 10^8, selectable in decade steps

Range:
F_A (Channel A or Channel C) 0 - 50 MHz
F_{ext} (External Oscillator Input) 100 Hz to 10 MHz

Mode:
Operating mode will be either FREQUENCY A or FREQUENCY C

Accuracy:
± 1 count of F_A ± trigger error of F_{ext}

TIME BASE

Crystal Frequency: 10 MHz

Stability:

Aging Rate: <3 parts in 10^7/mo.
Temperature: <±2.5 parts in 10^6, 0° to 50°C.
Line Voltage: <±1 part in 10^7 for 10% line variation.
Short-term Fluctuation: Typically <5 parts in 10^9, one-second average (at constant temperature)

Oscillator Output:
10 MHz, TTL type output levels, 50Ω series impedance at rear panel BNC

External Input: 100 Hz - 10 MHz, 1 V rms into 1kΩ

Time Base Output:
Negative pulses, +4 V to 0 V (open circuit), typically 100 ns wide. In START, output is 10 MHz divided by TIME BASE/MULTIPLIER switch setting. Available at rear panel BNC.

Gate Output:
TTL level pulses; low while gate open, high while gate closed. Available at rear panel BNC.

GENERAL

Display: 7 digits (8 optional)

Blanking:
Suppresses display of unwanted zeros left of the most significant digit

Display Storage:
Holds reading between samples. Rear panel switch overrides storage

**For any waveshape, trigger error is less than

$$\pm \frac{0.0025}{\text{Signal Slope (V/μs)}} \text{μs.}$$

***Trigger error is less than ±0.3% of one period ÷ periods averaged for signals with 40 dB or better signal-to-noise ratio and 100 mV rms amplitude.

Table 1-3. Specifications (Continued)

Sample Rate:
FAST position: Continuously variable from less than 100 µs to approximately 20 ms. NORM position: Continuously variable from less than 20 ms to approximately 5 seconds. HOLD position: Display can be held indefinitely.

Overflow:
Neon indicates when display range is exceeded.

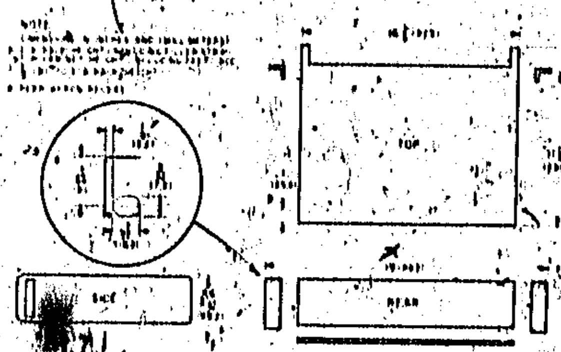
Operating Temperature: 0° to 50°C

Power Requirements:
115 or 230 volts ±10%, 50 to 60 Hz, 70 watts maximum

Weight:
Net, 16 lb.(7,4 kg). Shipping, 18 lb. 16 oz(8,7 kg)

Accessories Furnished:
Power Cord, 7½ ft. Rack Mount Kit.

DIMENSIONS



ACCESSORIES AVAILABLE

HP 10503A, 50Ω BNC Cable, 4 ft (122 cm)
HP 10532A, Extender Board Kit containing 2 ea. 15-pin extender 5060-0049, 1 ea. 18-pin extender 5060-2041, and 1 ea. Amplifier Extender, 10532-60001
HP10542A, Remote Programming Interface enables interfacing between the 5326/5327 Series counter with Option 004 and 40-bit Output Register. Includes two (2) 7-bit Digital-to-Analog Converters for level controls and decoding for time base and function selector.
HP Cable 562A-16C, 6 ft. (183 cm) to connect 5326/5327 Series with Option 003 to HP 5050B or 5055A Digital Recorder

Option 001: 8-digit display

Option 002: Remote programming

Controls:
All front panel controls are single line programmable except:
SEP-COM (separate-common) switch; the check function is programmable
FAST/NORM Mode
Input Attenuators,
AC/DC Input Signal Coupling

Control Signal:
Single line control using either contact closure to ground or DTL drive on all lines except trigger levels which are analog programmed (±3 Vdc)

Connector:
Rear panel connector: HP 1251-0085; Amphenol 57-40360-375, (36-pin blue ribbon).
Mating connector: HP 1251-0084; Amphenol 57-30360-375

Option 003: Digital output (for numerals and polarity only)

Code:
4-line 1-2-4-8 BCD, "1" state high, "0" state ≤0.25 V at -1 mA; "1" state: +5 V open circuit, 2.5 kΩ source impedance nominal

Print Command:
+5 V to 0 V, dc coupled; occurs at end of gate.

Storage:
Buffer storage is provided so BCD output is constant while next measurement is being made

Inhibit Input:
Inhibits gate when instrument's cycle time is less than the time required for external equipment to interrogate BCD outputs. Positive inhibit +5 Vdc

Connector:
Rear panel connector: HP 1251-0087; Amphenol 57-40500-375 (50-pin blue ribbon).
Mating connector: HP 1251-0086; Amphenol 57-30500-375.

Option 004: Remote Programming including all signal input conditions.

Controls:
All front panel controls are programmable except FAST/NORM Mode.

Control Signal:
Single line control using either contact closure to ground or DTL drive on all lines except trigger levels which are analog programmable (±3 Vdc).

Connector:
Rear panel connector: HP 1251-0087; Amphenol 57-40500-375 (50-pin blue ribbon)
Mating Connector: HP 1251-0086; Amphenol 57-30500-375.

SECTION II

INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information for unpacking, inspection, repacking, storage, and installation. The instructions for remote programming are also given in this section.

2-3. UNPACKING AND INSPECTION

2-4. If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dents, broken knobs, etc.). If the instrument is damaged or fails to self-check (Self-Check Procedures, Table 3-1), notify the carrier and nearest Hewlett-Packard Sales and Service Office immediately (offices are listed at the back of this manual). Retain the shipping carton and padding material for the carrier's inspection. The sales and service office will arrange for the repair or replacement of your instrument without waiting for the claim against the carrier to be settled.

2-5. STORAGE AND SHIPMENT

2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment always use the best packaging methods available. Your Hewlett-Packard Sales and Service Office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are two recommended packaging methods:

a. RUBBERIZED HAIR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq. in. bursting test) with 2-inch rubberized hair pads placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit.

b. EXCELSIOR. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb/sq. in. bursting test) with a layer of excelsior about six inches thick packed firmly against all surfaces of the instrument.

2-7. ENVIRONMENT. Conditions during storage and shipment should normally be limited as follows:

a. Maximum altitude: 25,000 feet.

b. Minimum temperature: -40°F (-40°C).

c. Maximum temperature: +167°F (+75°C).

2-8. RACK INSTALLATION

2-9. The counter is ready for bench operation as shipped from the factory. Additional parts necessary for rack mounting are packaged with the instrument. To convert to rack installation, proceed as follows:

a. Remove tilt stand.

b. Remove feet (press the foot-release button, slide foot toward center of instrument, and lift off).

c. Remove adhesive-backed trim strips at front end of sides.

d. Attach filler strip along bottom edge of front panel using two screws on outer edges of filler strip. Omit the center screw.

e. Attach flanges to front end of sides (larger corner notch toward bottom of instrument). Instrument is now ready to mount in standard rack.

CAUTION

Ambient temperature in rack during operation should not exceed 122°F (50°C). Be sure instrument position in rack permits adequate air circulation and that nearby equipment does not discharge hot air directly on the instrument.

2-10. POWER CONNECTION

2-11. LINE VOLTAGE. The counter may be operated from either 115 or 230 volt (±10%) power lines with frequencies from 50 to 60 Hz. A slide switch on the rear panel permits quick conversion for operation from either voltage. Insert a narrow-blade screwdriver in the switch slot and slide the switch to the right for 230 volt operation ("230" marking exposed) or to the left for 115 volt operation ("115" marking exposed). The counter is supplied with a 115 volt fuse; be sure to change this fuse for 230 volt operation, see Table 2-1.

CAUTION

Before plugging instrument to ac power line be sure slide switch is properly positioned.

Table 2-1. 115/230 Volt Conversion

Line Voltage Conversion	115 Volt	230 Volt
Slide Switch	Left (115)	Right (230)
AC Line Fuse	1.50 Ampere (Slow-Blow) (HP 2110-0304)	0.8 Ampere (Slow-Blow) (HP 2110-0020)

2-12. POWER CABLE. The counter is equipped with a detachable 3-wire power cable. Proceed as follows for installation.

a. Connect plug (3-socket connector) to ac line jack at rear of instrument.

b. Connect plug (2-blade with round grounding pin) to 3-wire (grounded) power outlet. Exposed portions of instrument are grounded through the round pin on the plug for safety; when only 2-blade outlet is available, use connector adapter (HP Part No. 1251-0048), then connect short wire from side of adapter to ground.

2-13. REMOTE PROGRAMMING, OPTION 002

2-14. The following paragraphs describe remote programming requirements for the counter with Option 002. See Paragraph 2-33 for Option 004 programming.

2-15. Front Panel Controls

2-16. The following front-panel controls are programmable:

a. FUNCTION

b. TIME BASE/MULTIPLIER

c. CHECK function

d. SLOPE

e. SAMPLE RATE and HOLD

f. LEVEL controls

g. INPUT C switch (5327A only)

h. RESET

2-17. The following front-panel controls are NOT programmable:

a. AC/DC

b. SEP-COM

c. FAST/NORM

d. ATTEN

2-18. The trigger level controls may be remotely programmed or the front-panel LEVEL controls may be used. It is possible to program the LEVEL controls without programming the remainder of the front-panel controls. When remote programming is used, the LEVEL controls must be set to PRESET. Display time may be remotely programmed and/or the front-panel controls may be used.

2-19. Remote Programming Requirements

2-20. All lines may be controlled by TTL or DTL signals or contact closure to ground when the unit is being remotely programmed; except the trigger levels which are programmed by an analog level (if programmed) and the display time line (Hold), J10 pin 35, which should NOT be pulled up to +5 V by less than 200Ω while programming.

2-21. When the unit is NOT being programmed (Ext line high), all the lines should be left open or pulled up to +5 V by not less than 5kΩ, except the trigger levels, which should be open circuited.

2-22. Remote Programming Procedure

2-23. In order to remotely program the counter, the following must be done:

a. Set FUNCTION switch to any function but START or STOP.

b. Ground the EXT line at rear-panel REMOTE PROGRAM connector J10(17). This disables the front panel switches. Ground is available at J10(36).

c. Select the desired function.

d. Select the desired time base.

e. Select the slope (+ or -) for CHANNEL A and B. This is accomplished by grounding the Slope line for (-) and leaving it open for (+). Slope A line is J10(28). Slope B line is J10(29).

f. Select the trigger level for input signal.

g. Adjust the display time.

h. Manual reset is available by grounding (<.7 V) pin 34. Check is available by grounding pin 14.

2-24. Function Selection Programming

2-25. To program the desired function, ground (<.7 V) the proper line at J10 as follows:

STOP	Pin 32
START	Pins 1 and 32
PERIOD AVERAGE	Pin 2
T.I. AVG.	Pin 3
T.I. A to B	Pin 4
PERIOD	Pin 5
FREQ. A	Pin 6
FREQ. C DIRECT	Pin 7
FREQ. C ÷10	Pins 7 and 18

2-26. Time Base Selection Programming

2-27. To program the Time Base, ground (<.7 V) the proper line at J10 as follows:

.1 µs/1	Pin 19
1 µs/10	Pin 20
10 µs/10^2	Pin 21
.1 ms/10^3	Pin 22
1 ms/10^4	Pin 23
10 ms/10^5	Pin 24
.1 s/10^6	Pin 25
1 s/10^7	Pin 26
10 s/10^8	Pin 27

2-28. Trigger Level Programming

2-29. To program the trigger level, the LEVEL controls must be set to PRESET. Select the trigger level by placing a dc voltage between -3.0 and +3.0 volts on the level input line (Level A = J10 pin 30, Level B = J10 pin 31). This voltage, times the attenuator setting, is the trigger level. Preset is programmed by leaving the pin open on contact closure to ground. Grounding is preferable if noise exists on the remote programming line.

2-30. The front-panel LEVEL controls may be used manually if programming of the trigger levels is undesirable. Also, note the AC/DC and ATTEN switches on the front-panel must be set manually, as they are NOT programmable.

2-31. Sample Rate Adjustment

2-32. Adjusting the display time can be accomplished in several ways:

a. Manually adjust the display time by using the front-panel SAMPLE RATE controls.

b. Set the SAMPLE RATE control cw and the FAST/NORM/HOLD switch to NORM and connect a 1 megohm pot in series with a 1.5k ohm resistor from +5 V to pin 35. This will give a display time range of about 10 ms to 5 sec. If a shorter time is desired, set the FAST/NORM/HOLD switch to FAST, which gives a range of about 50 µs to 10 ms.

c. Set the SAMPLE RATE control cw in FAST and hold the Hold line (pin 35) to ground for the desired display time. The display will continue for about 100 µs after the ground is released.

2-33. REMOTE PROGRAMMING, OPTION 004

2-34. The following paragraphs describe remote programming requirements for the counter with Option 004.

2-35. Front Panel Controls

2-36. All front-panel controls are programmable, except the FAST/NORM/HOLD switch. The trigger level controls may be remotely programmed, or the front-panel LEVEL controls may be used. It is possible to program the front-panel LEVEL controls without programming the remainder of the front-panel controls. When remote programming the trigger levels, the LEVEL controls must be set to PRESET. The display time may be remotely programmed and/or the front-panel controls may be used.

2-37. Remote Programming Requirements

2-38. All lines may be controlled by TTL or DTL signals or contact closure to ground when the unit is being remotely programmed; except the trigger levels which are programmed by an analog level (if programmed) and the display time line (Hold), J10 pin 16, which should NOT be pulled up to +5 V by less than 200Ω while programming.

2-39. When the unit is NOT being programmed (EXT line high), all the lines should be left open or pulled up to +5 V by not less than 5kΩ, except the trigger levels, which should be open circuited.

2-40. Remote Programming Procedure

2-41. In order to remotely program the counter, the following must be done:

a. Set FUNCTION switch to any position but START or STOP.

b. Ground the EXT line at rear-panel REMOTE PROGRAM connector J10(34). This disables the front panel switches. Ground is available at J10(36).

c. Select the desired function.

d. Select the desired time base.

e. Select the signal conditioning.

f. Select the trigger level for input signal.

g. Adjust the display time.

h. Manual reset is available by ground (<.7 V) pin 17. Check is available by grounding pin 37.

2-42. Function Selection Programming

2-43. To program the desired function, ground (<.7 V) the proper line at J10 as follows:

STOP	Pin 19
START	Pins 46, 19
PERIOD AVERAGE	Pin 47
T.I. AVG.	Pin 45
T.I. A to B	Pin 44
PERIOD	Pin 43
FREQ. A	Pin 42
FREQ. C DIRECT	Pin 41
FREQ C ÷ 10 (5327A only)	Pin 33

2-44. Time Base Selection Programming

2-45. To program the time base, ground (<.7 V) the proper line at J10 as follows:

.1 μs/1	Pin 28
1 μs/10	Pin 29
10 μs/10^2	Pin 27
.1 ms/10^3	Pin 26
1 ms/10^4	Pin 25
10 ms/10^5	Pin 24
.1 s/10^6	Pin 30
1 s/10^7	Pin 31
10 s/10^8	Pin 32

2-46. Signal Conditioning Programming

2-47. Program the input conditions by grounding the proper line as follows:

CONDITION	LINE J10	INPUT
AC/DC A	11	AC=H DC=L
SLOPE A	23	+ = H − = L
ATTENUATOR A	13, 14	13 - H, 14 - H = X1 13 - L, 14 - H = X10 13 - H, 14 - L = X100
AC/DC B	7	AC = H DC = L
SLOPE B	22	+ = H − = L
ATTENUATOR B	9, 10	9 - H, 10 - H = X1 9 - L, 10 - H = X10 9 - H, 10 - L = X100
SEP/COM	6	COM = L, SEP = H
CHECK	37	CHK = L

2-48. Trigger Level Programming

2-49. To program the trigger level, the LEVEL controls must be set to PRESET. Select the trigger level by placing a dc voltage between -3.0 and +3.0 volts on the level input line (Level A = J10 pin 21, Level B = J10 pin 20). This voltage, times the attenuator setting, is the trigger level. Preset is programmed by leaving the pin open or contact closure to ground. Grounding is preferable if noise exists on the remote programming line.

2-50. The front-panel LEVEL controls may be used manually if programming of the trigger levels is undesirable.

2-51. Sample Rate Adjustment

2-52. Adjusting the display time can be accomplished in several ways:

a. Manually adjust the display time by using the front-panel SAMPLE RATE controls.

b. Set the SAMPLE RATE control cw and the FAST/NORM/HOLD switch to NORM and connect a 1 megohm pot in series with a 1.5k ohm resistor from +5 V to pin 16. This will give a display time range of about 10 ms to 5 sec. If a shorter time is desired, set the FAST/NORM/HOLD switch to FAST, which gives a range of about 50 μs to 10 ms.

c. Set the SAMPLE RATE control cw in FAST and hold the Hold line (pin 16) to ground for the desired display time. The display will continue for about 100 μs after the ground is released.

2-53. BLANKING DEFEAT

2-54. This counter is designed to blank insignificant zeros (zeros to left of data). When blanking occurs, the digital recorder output for the blanked columns is BCD 15 (HHHH). To use this instrument with a digital-analog converter, it is necessary to defeat the blanking feature by repositioning the two jumpers on the A9 Display board. Move the jumpers to position 2, as shown in A9 Component Locator (Section VIII). This connects pin 10 of A9U7 and A9U8 to +5 V. Also, lift the pin 1 lead of A8U2 and connect pin 1 to ground (available at U2 pin 7).

SECTION III

OPERATION

3-1. INTRODUCTION

3-2. Section III contains the operating information required to obtain the most effective performance from the instrument. This includes a general description of the operating modes, the function of all controls and indicators, a self-check procedure, and setup procedures for making basic measurements.

3-3. OPERATING MODES

3-4. The following paragraphs describe the operating modes of totalize, frequency, period, time interval, and ratio.

3-5. Totalize Mode

3-6. START and STOP positions on the FUNCTION selector allow manual opening and closing of the counter's main gate. When the switch is in the START position, the counter does not measure frequency, but instead, counts the number of times the signal passes through the trigger point. The input signal, connected to the front-panel CHANNEL A jack, is divided by the MULTIPLIER switch setting prior to counting. For example, when the MULTIPLIER switch is set to the 1 position, every pulse is counted. When the switch is set to 10^3, the counter registers every thousandth pulse. When the FUNCTION switch is set to STOP, the counter stops totalizing and holds the displayed count until the RESET switch is pressed or the MULTIPLIER switch setting is changed. If the FUNCTION switch is again set to START before a reset is generated, the count continues to totalize from the previously displayed value. With the FUNCTION switch set to START, the scaled input signal is available at the rear-panel TIME BASE OUTPUT jack. The unit indicators and decimal points are blanked during the totalize mode. The C light is on (in START), indicating counting is taking place.

3-7. Frequency Modes

3-8. Three frequency modes are available in the 5327A: Frequency A, Frequency C prescaled, and Frequency C direct. (The prescale operation is not included in the 5326A.) In the Frequency A mode, the input signal connects to the high impedance CHANNEL A input jack and can be conditioned with the LEVEL, SLOPE, and ATTEN controls. In the Frequency C modes, the input signal is connected to the INPUT C jack (50 ohm). The signal is not conditioned by any front-panel controls but may be counted either directly (50 MHz) or by prescaling (550 MHz), depending on the setting of the INPUT C switch. The C channel of the 5326A model counts the signal directly.

3-9. Period Modes

3-10. The period and period average modes allow single period measurements or multiple period averages to be made with input frequencies into CHANNEL A of up to 10 MHz. These modes are useful for making low frequency measurements where maximum resolution is desired.

3-11. For single period measurements, the MULTIPLIER switch scales the time base frequency and selects the placement of the decimal point and determines the resolution of the measurement.

3-12. The period average mode is used for increased resolution and reduced inaccuracies. For example, if 10^2 period averaging is selected, the counter will display the average of 100 periods with the proper decimal point. In this example, trigger error is 100 times less than in a single period measurement.

3-13. Time Interval Modes

3-14. Two modes of time interval measurements can be selected: time interval and time interval average. The time interval modes measure the time between points on a single waveform or between separate input signals; thus, pulse width and phase differences can be measured. Separate slope and level controls allow variable triggering levels on either the + or - slope. Marker A and B outputs are available at the rear panel to intensity-modulate an HP 180A oscilloscope. The markers indicate the trigger point of the counter's input circuits and provide a visual means of adjusting the trigger points to measure the time interval between any two points and are useful to about 100 kHz.

3-15. In time interval measurements, Channel A opens the main gate and Channel B closes the main gate. While the main gate is open, the internal oscillator, divided by the setting of the MULTIPLIER switch, is totalized by the counter and readout on the display. The less the division factor, the more pulses of the internal oscillator there are to count and, therefore, the better the resolution and accuracy.

3-16. With time interval average, the main gate is open for the number of time intervals selected by the MULTIPLIER switch. The internal oscillator pulses (not divided) are totalized only during the individual time intervals. Once Channel B triggers, there must be a time lapse of 150 ns before Channel A can trigger. Averaging of time intervals results in increased resolutions and reduced inaccuracies. For a further explanation of theory, refer to Paragraph 4-27.

3-17. Ratio

3-18. The counter may be used to measure the ratio of two signals in either the frequency or period mode. By setting the rear-panel OSC INT-EXT switch to EXT, the counter will accept an external signal (F_{ext}) for use as the internal oscillator. This frequency should be 100 Hz to 10 MHz at 1 V rms minimum to 5 V peak maximum. A second signal (F_A), applied to either INPUT A or C jack, is used as the comparator signal. The MULTIPLIER switch controls the resolution of the display. For a ratio of frequencies, the Ratio = $\frac{F_A}{F_{ext}} = \frac{\text{DISPLAYED NUMBER}}{\text{MULTIPLIER SETTING}}$. For a ratio of periods (P), the Ratio =

$$\frac{P_A}{P_{ext}} = \frac{F_{ext}}{F_A} = \frac{\text{DISPLAYED NUMBER}}{\text{MULTIPLIER SETTING}}$$

3-19. Disregard the units and decimal point; also, ignore any zeros to the left of the most significant digit. It makes no difference which signal is higher in frequency, as long as the two frequencies are within the specifications of their respective channels.

3-20. MARKER OUTPUTS

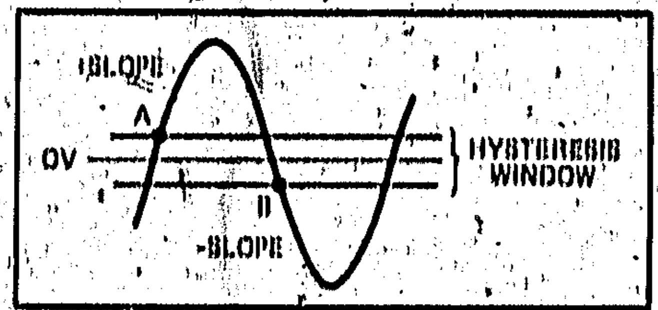
3-21. Two marker output jacks are mounted on the counter's rear panel. These outputs provide a negative-going 2 µs pulse (approx.) at DTL levels each time the input signal passes through the trigger point of Channel A or B. The pulses may be used to trigger other circuits or may be applied to the Z axis of an HP 180 Oscilloscope. When using the pulses to intensity modulate an oscilloscope, note that the actual trigger point is the leading edge of the pulse. The marker's pulse width determines the upper frequency limit of the input signal. The pulses overlap on the oscilloscope trace when the period of the signal is less than the pulse width.

3-22. HYSTERESIS

3-23. Each input channel has a small amount of hysteresis (about 100 mV). If the SLOPE switch is set to "+," the trigger pulse occurs at the top of the hysteresis "window." If the SLOPE switch is set to "-," the pulse occurs on the bottom line of the window. In other words, the signal must pass through the entire hysteresis window before a trigger pulse is generated.

3-24. When measuring frequency or period, the counter positions the hysteresis band around zero (see Figure 3-1). This assumes a waveform with no dc component and the counter's LEVEL control is in the PRESET position. The input amplifier then yields maximum input sensitivity for both positions of the SLOPE switch. The offset introduces no measurement error, since the trigger point is repetitive from cycle to cycle. The trigger point is point A for + slope and point B for - slope.

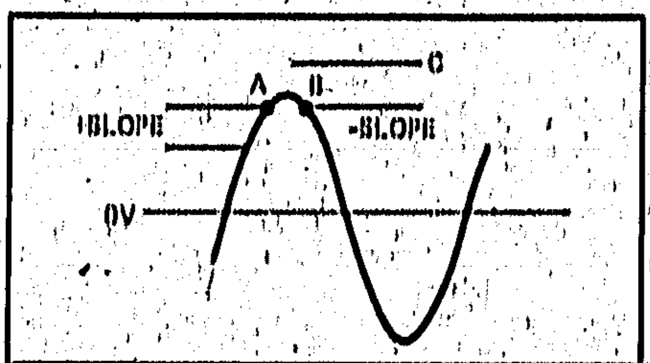
Figure 3-1. Hysteresis Offset



3-25. Time Interval Compensation

3-26. In the time interval modes only, both input amplifiers have an automatic compensation network that keeps the trigger level at the same potential when switching from positive to negative slope (see Figure 3-2). In this example, the window shifts upward to accomplish this. There is the possibility, therefore, that if Point A is near the top of the signal, switching to negative slope will place a portion of the window outside the signal (C). In such case, there would be no triggering. When switching from time interval to frequency, or vice versa, the trigger point shifts by half the hysteresis band.

Figure 3-2. Hysteresis Compensation



3-27. ACCURACY

3-28. FREQUENCY MEASUREMENTS. The basic counter accuracy is determined by two factors. One factor is the aging rate of the 10 MHz crystal standard in the time base (less than 3 parts in 10^7 per month). A second factor is the inherent error of ±1 count of the display's least significant digit, which is present in all electronic counters. This error is due to phasing between the timing pulse that operates the electronic gate and the pulses that pass through the gate to the counting assembly. The chart in Figure 3-3 shows the error possible for frequency and period measurements.

3-29. The formula for determining the actual frequency is given as follows:

$$\text{error} = \pm \left(\frac{1}{f_1 \times \text{gate length (sec)}} \right) \pm K$$

The expression

$$\frac{1}{f_1 \times \text{gate length (sec)}}$$

equals the ± 1 count ambiguity, where f_1 equals measured frequency (Hz) and gate length equals the selected gate time in seconds. K equals the time base accuracy (monthly drift rate of the individual time base times the number of months since calibration, frequency change due to ambient temperature change, absolute offset at standardization, and line voltage effects).

3-30. An example of frequency error calculation is as follows:

$$f_1 = 5 \text{ MHz } (5 \times 10^6 \text{ Hz})$$

$$\text{gate length} = .1 \text{ sec } (1 \times 10^{-1})$$

$$K = 3 \text{ parts in } 10^7 \text{ per month times 2 months}$$
$$= 6 \text{ parts in } 10^7$$

$$\text{error} = \frac{1}{(5 \times 10^6)(1 \times 10^{-1})} + \frac{6}{10^7}$$

$$= 0.2 \times 10^{-5} + 6 \times 10^{-7} = 2.6 \times 10^{-6}$$
$$\text{or } 2.6 \text{ parts in } 10^6$$

3-31. PERIOD MEASUREMENTS. There are three factors contributing to the accuracy of period average measurements:

a. The aging rate of the 10 MHz crystal standard.

b. The ± 1 count ambiguity.

c. The trigger error for one period.
Assuming a signal-to-noise ratio of 40 dB, the trigger error is less than 0.3% at rated sensitivity. A general formula for finding the percentage error to be expected under various conditions is as follows:

$$A = 100 \left(\pm \frac{f_B}{n f_1} \pm \frac{e}{n} \pm K \right)$$

A = Accuracy in percent

f_1 = Time base frequency counted

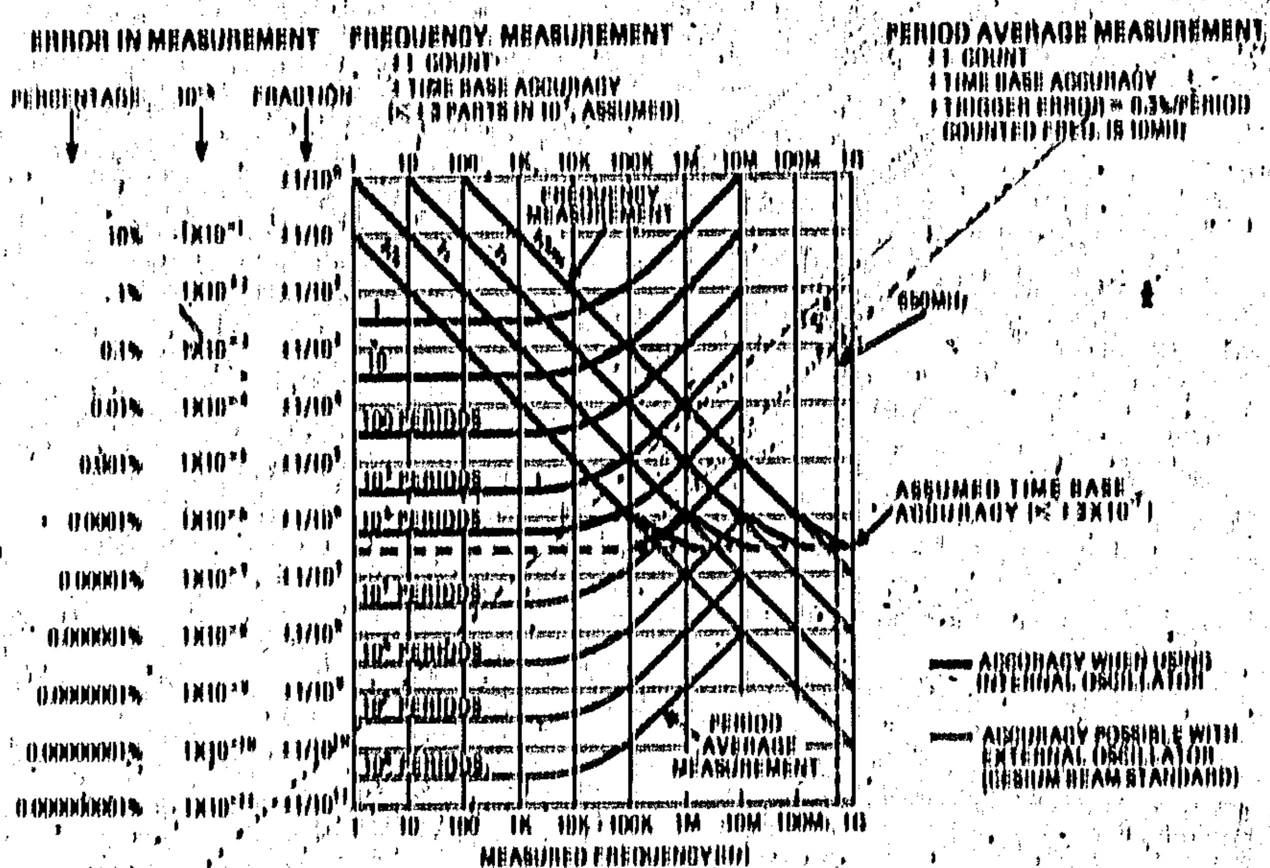
f_B = Frequency of input signal (Hz)

n = Number of periods averaged

e = 3 x 10^{-3} (trigger error for one period, 40 dB S/N at rated sensitivity.)

K = time base accuracy (monthly drift rate of individual time base times the number of months since calibration, absolute value of offset at standardization, frequency change due to ambient temperature change, and line voltage effects). A plot of the above formula is shown in Figure 3-3.

Figure 3-3. Measurement Accuracy



NOTE

FOR 550MHz INPUT (÷10) USE LINE TO RIGHT OF ACTUAL GATE LENGTH TO DETERMINE ACCURACY OF MEASUREMENT, SINCE ±1 COUNT ERROR REPRESENTS ±10 COUNTS OF INPUT SIGNAL WHEN PRESCALING BY 10.

Figure 3-4. Front Panel Controls and Indicators

1. SAMPLE RATE control. Applies primary power. Works in conjunction with FAST/NORM/HOLD switch to control interval between measurements.

   a. FAST - Varies display time from <100 µs to >20 ms. STORAGE switch (rear panel) must be ON to use this mode.

   b. NORM - Varies display time from 20 ms to >5 seconds.

   c. HOLD - Holds display indefinitely.

2. RESET Switch. Resets display and internal count to zero and starts new measurement.

3. INPUT C (5997A). 50-ohm input for 0 to 500 MHz frequency measurements. Has dc coupling (with INPUT C switch in ÷ 10 position) and sensitivity of 100 mV rms sine wave (300 mV peak-to-peak pulse). Maximum input is ±5 volts referenced to ground (DO NOT EXCEED). Trigger level is zero volts. The input is ac coupled with the INPUT C switch in DIRECT position. The frequency range is 1 kHz to 50 MHz with a sensitivity of 5 mV.

   INPUT C (5996A). 50-ohm input for 0 to 50 MHz frequency measurements. Has dc coupling and sensitivity of 5 mV rms sine wave. Trigger level is zero volts. Maximum input is ±5 volts referenced to ground (DO NOT EXCEED).

4. FUNCTION selector. Selects mode of operation. Blue lettering matches corresponding blue lettering on TIME BASE/MULTIPLIER switch.

   a. STOP, START - Used for totalize mode to manually open and close counter's main gate and to turn sealed output on and off. Frequency input range is 0 to 10 MHz.

   b. PERIOD AVG A - Sets counter to measure period of signal applied to CHANNEL A input. Use MULTIPLIER switch to select number of periods to be averaged. Input frequency range is 0 to 10 MHz.

   c. T.I. AVG A to B - Sets counter to measure average time interval, A to B. Channel A starts interval and Channel B stops the interval. Use MULTIPLIER selector to set number of time intervals to be averaged. Time interval input range is 150 ns to 10 sec; there must be a 150 ns deadtime between intervals.

   d. T.I. A to B - Sets counter to measure time interval A to B. Channel A starts measurement and Channel B stops the measurement. T.I. input range is 0.1 µs to 10^{8} sec. The internal time base frequency is divided by the setting of the MULTIPLIER switch and totalized for subsequent display. The more cycles of the oscillator frequency that are counted during A to B time, the better the resolution. There must be 150 ns deadtime between Channel B and Channel A trigger points.

   e. PERIOD A - Sets counter to measure a single period of the signal applied to CHANNEL A input. Use MULTIPLIER switch to set counted internal oscillator frequency and therefore the desired resolution. Frequency input range is 0 to 10 MHz.

   f. FREQ A - Sets counter to measure frequency applied to CHANNEL A input. Use TIME BASE switch to set gate time and resolution. Frequency input range is 0 to 50 MHz.

Figure 3-4. Front Panel Controls and Indicators (Continued)

g. FREQ C - Similar to FREQ A, except sets counter to measure frequency applied to INPUT C jack. 50-ohm input impedance. 5 V rms/7.5 V peak maximum input. Frequency range is 0 to 500 MHz prescaled or 1 kHz to 50 kHz direct. For the 5326B, the frequency range is 0 to 50 MHz. See INPUT C.

5. TIME BASE/MULTIPLIER switch. The function of the switch changes with each mode of operation.

a. TOTALIZE - Determines scaling factor for input signal prior to counting.

b. PERIOD AVG A - Selects number of periods to be averaged.

c. T.I. AVG A to B - Selects number of time intervals to be averaged.

d. T.I. A to B - Selects scaling factor for internal oscillator signal.

e. PERIOD A - Selects scaling factor for internal oscillator signal.

f. FREQ A and FREQ C - Sets gate time.

6. SLOPE switch. Permits triggering on positive or negative slope of input signal.

7. AC-DC switch. Selects direct or capacitor coupling for input signal. Minimum input frequency on AC setting is 20 Hz.

8. ATTEN switch. Selects attenuation for input signal. Used in conjunction with LEVEL control to set input triggering point. Maximum input: 250 V rms on all ranges except 25 V rms on X1 range above 50 kHz. Recommended input is 0.1 V rms to 2 V rms times ATTEN setting.

9. LEVEL control. Used in conjunction with ATTEN switch to determine voltage at which triggering occurs. With X1 attenuator setting, level is variable ±3 V; on X10, ±30 V, and X100, ±300 V.

10. Input jacks. Input jacks of Channels A and B. Input impedance is 1 MΩ shunted by less than 25 pF. By using a 10 to 1 divider probe, input impedance can be increased to 10 MΩ.

11. Trigger lamps adjacent to input jacks indicate when amplifier triggering occurs.

12. CHK-SEP-COM switch. (Check-separate-common)

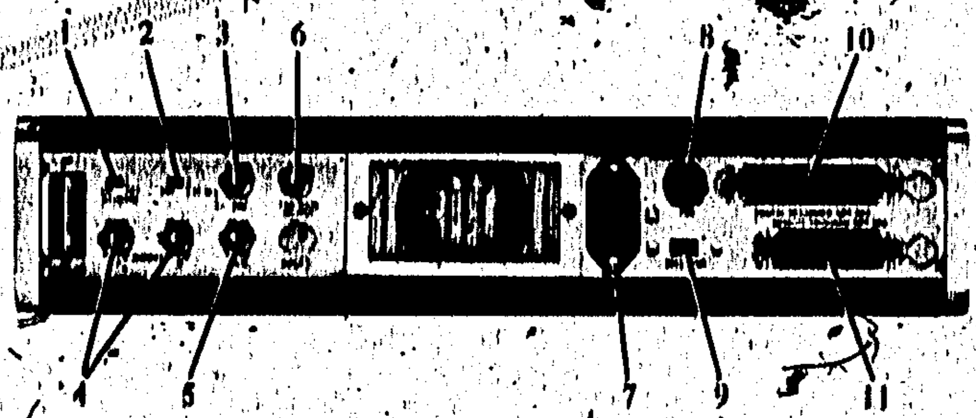
a. CHK - Connects internal 10 MHz time base to Channels A and B circuitry to check that unit is functioning. No indication in T.I. or T.I. Avg; ignore displayed digits in period average.

b. COM-SEP - Connects A and B inputs in parallel when set to COM position. When applying two separate inputs, set switch to SEP. When set to COM, input impedance is 500 kΩ shunted with less than 50 pF.

13. G (gate) light. Lights when counter's main gate is open. For short-duration gate times, the annunciator circuits include a 50 ms one-shot MV to allow a visible flash of the G light.

14. * (asterisk). Indicates that proper units are not displayed with combination of function/time base selection. To interpret display, add a zero to the right of least significant digit displayed on the counter.

Figure 3-5. Rear Panel Controls and Connectors



1. STORAGE switch. When set to ON, provides display storage while new measurement is being made. In OFF position, allows continuous display of counting process.

2. OSC INT-EXT switch. In INT position, selects normal counter operation using internal time base. In EXT position, permits use of external time base.

3. OSC jack. With INT-EXT switch set to INT, provides 10 MHz, >3 V p-p output (no load), 50Ω series impedance. With INT-EXT switch set to EXT, allows use of external time base from 100 Hz to 10 MHz at >1 volt rms (5 V peak maximum).

4. MARKER A and B jacks. Provides marker outputs to intensity modulate HP 180 Oscilloscope. Markers begin coincident with channel trigger points.

5. GATE jack. Provides >2.4 volts output (open circuit) for external use. Has 50Ω series impedance. Output is low when counter's main gate is open and high when gate is closed.

6. TIME BASE OUTPUT jack. Provides negative going > +3 to 0 V pulses (open circuit), >50 nanoseconds wide. The line has a 50Ω series impedance. In START, frequency output is CHANNEL A signal divided by MULTIPLIER setting.

7. AC LINE. IEC type with offset pin connected to chassis.

8. AC LINE FUSE. 1.50 A at 115 V, 800 mA at 230 V.

9. 115/230 volt switch. Insert narrow screwdriver and slide switch to show desired voltage.

10. DIGITAL RECORDER connector (Option 003 only). 50-pin connector for digital recorder interconnection.

11. REMOTE PROGRAM connector. Option 002: 36-pin connector to allow remote control of counter modes and functions.

Option 004: 50-pin connector to allow remote control of all counter functions except FAST/NORM.

Table 3-1. Self-Check

1. Set SAMPLE RATE control slightly clockwise out of OFF.

2. Set FAST/NORM/HOLD switch to NORM.

3. Set FUNCTION switch to STOP.

4. Set MULTIPLIER selector to 1.

5. Set CHK-SEP-COM switch to CHK.

6. Press RESET and check that counter's right hand column displays a 0 and all other digits are blanked.

7. Set FUNCTION switch to START and check that counter totalizes and C light is on. Check that OF light goes on as display overflows. Set TIME BASE/MULTIPLIER to each position and check that counter totalizes in each position.

8. Set FUNCTION switch to STOP. Check that C light goes out and display is held.

9. Set FUNCTION to PERIOD AVG A. Set MULTIPLIER as shown in table below, and check for proper display.

Period Average Self-Check

MULTIPLIER	DISPLAY	ANNUNCIATOR
1	.1	μs
10	.10	μs
10^2	.100	μs
10^3	100.0	ns
10^4	100.00	ns
10^5	100.000	ns
10^6	100.0000	ns
10^7 Standard	00.00000	ns OF
10^7 Option 001	100.00000	ns
10^8 Standard	0.000000	ns OF
10^8 Option 001	00.000000	ns OF

NOTE

Digits noted are for reference, actual display may differ by several counts.

10. Set FUNCTION to T.I. AVG A to B. Set MULTIPLIER as shown in table below and check for proper display.

Time Interval Average Self Check

MULTIPLIER	DISPLAY	ANNUNCIATOR
1	.0	μs
10	.00	μs
10^2	.000	μs
10^3	.0	ns
10^4	.00	ns
10^5	.000	ns
10^6	.0000	ns
10^7	.00000	ns
10^8	.000000	ns

11. Set FUNCTION to T. I. A to B. *Rotate MULTIPLIER switch as shown in the following table (Step 12) and check for proper display.

12. Set FUNCTION to PERIOD A. Set MULTIPLIER switch as shown in the following table and check for proper display.

Time Interval and Period Self-Check

MULTIPLIER	DISPLAY	ANNUNCIATOR
1*	.1 ± 1 count	μs
10	.0	μs
10^2	.00	ms
10^3	.0	ms
10^4	0	ms
10^5	.00	s
10^6	.0	s
10^7	0	s
10^8	0	s

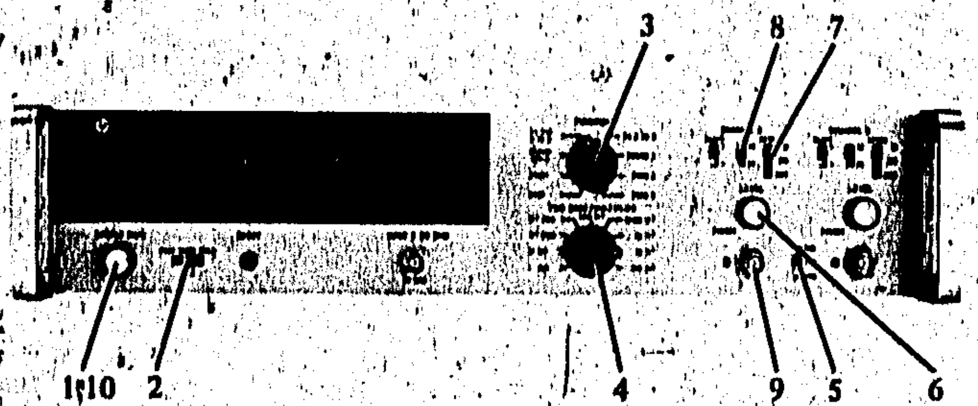
*NOTE: For Time Interval Self-Check, display is .0 μs for MULTIPLIER setting of 1.

13. Set FUNCTION to FREQ A. Set TIME BASE switch as shown in table below and check for proper display.

Frequency A Self Check

TIME BASE	DISPLAY		ANNUNCIATOR
.1 μs	.01	±1 count	GHz
1 μs	10	±1 count	MHz
10 μs	10.0	±1 count	MHz
.1 ms	10.00	±1 count	MHz
1 ms	10.000	±1 count	MHz
10 ms	10000.0	±1 count	kHz
.1 s	10000.00	±1 count	kHz
1 s	0000.000	±1 count	kHz OF
	10000.000	±1 count	kHz (Option 001)
10 s	000.0000	±1 count	kHz OF
	0000.0000	±1 count	kHz OF (Opt. 001)

Figure 3-6. Frequency A Measurements



1. Set SAMPLE RATE control slightly clockwise out of OFF.

2. Set FAST/NORM/HOLD switch to NORM.

3. Set FUNCTION switch to FREQ A.

4. Set TIME BASE switch for desired gate time.

5. Set CHK-SEP-COM switch to SEP.

6. Set CHANNEL A LEVEL control to desired trigger level or to PRESET to trigger at zero volts.

7. Set ATTEN switch to match input signal amplitude.

8. Set AC-DC switch to AC or DC.

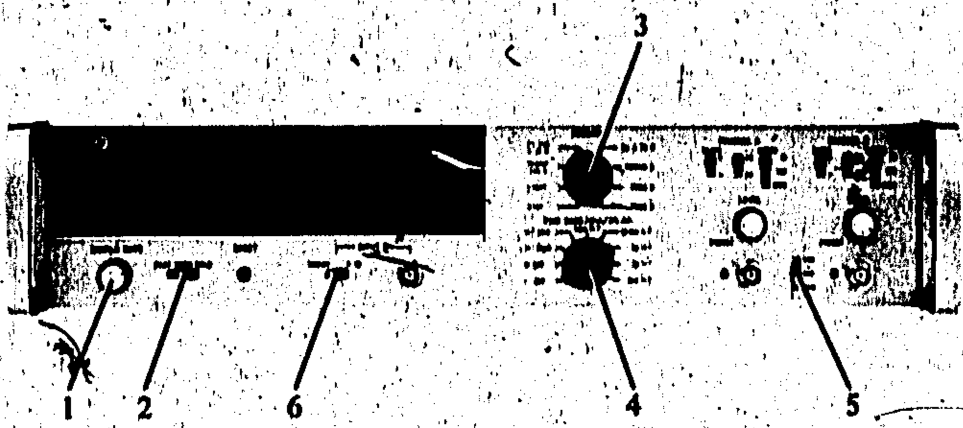
9. Connect input signal (0 to 50 MHz) to CHANNEL A input jack.

10. Adjust SAMPLE RATE control for convenient measurement interval.

NOTE

When the input signal is removed from CHANNEL A or the signal level is insufficient to trigger Channel A, the count light (C) will not cycle. This is normal for this counter and does not indicate a malfunction.

Figure 3-7. Frequency C Measurements



1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to FREQ C.
4. Set TIME BASE switch for desired resolution.
5. Set CHK-SEP-COM switch to SEP.
6. Set INPUT C switch to DIRECT.
7. Connect input signal (1 kHz to 50 MHz, ±5 V peak maximum, 5 mV rms minimum) to INPUT C connector (rear panel). Input impedance is 50Ω nominal. For the 5326A, input frequency is 0 to 50 MHz.
8. Adjust SAMPLE RATE control for convenient measurement interval.

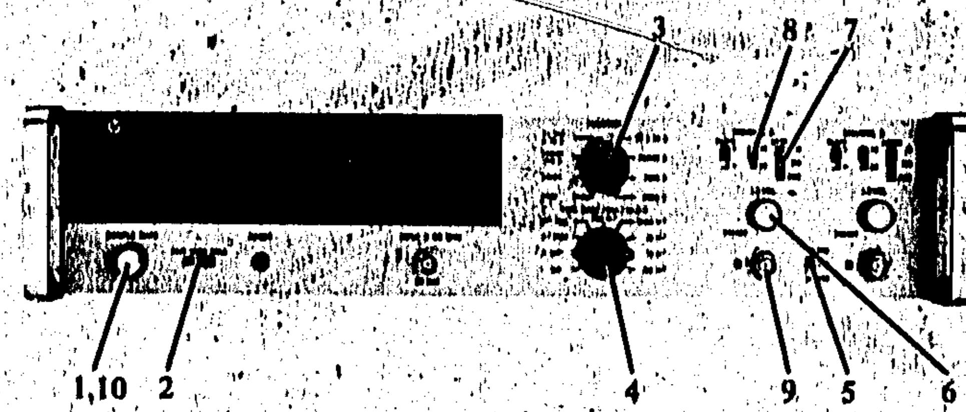
NOTE

For frequencies from 0 to 550 MHz with minimum levels of 100 mV rms, connect signal to INPUT C jack and place INPUT C switch in ÷10 position.

CAUTION

Damage will occur if INPUT C voltage specifications are exceeded.

Figure 3-8. Period Measurements



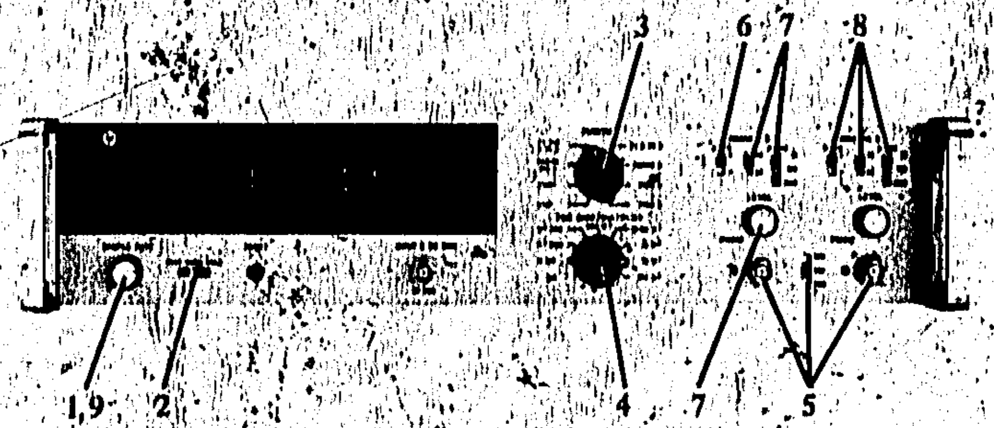
Period

1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to PERIOD A.
4. Set MULTIPLIER switch for desired resolution.
5. Set CHK-SEP-COM switch to SEP.
6. Set CHANNEL A LEVEL control to desired trigger level or to PRESET to trigger at zero volts.
7. Set ATTEN switch to match input signal's amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 10 MHz) to CHANNEL A input jack.
10. Adjust SAMPLE RATE control for a convenient interval between measurements.

Period Average

1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to PERIOD AVG A.
4. Set MULTIPLIER switch to number of periods to be averaged.
5. Set CHK-SEP-COM switch to SEP.
6. Set CHANNEL A LEVEL control to desired trigger level or to PRESET to trigger at zero volts.
7. Set ATTEN switch to match input signal amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 10 MHz) to CHANNEL A input jack.
10. Adjust SAMPLE RATE control for convenient measurement interval.

Figure 3-9. Time Interval Measurements



Single Time Interval

1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to T.I. A to B.
4. Set MUTLIPLIER switch for desired resolution.
5. If start-stop signals are from a common source, connect signal to CHANNEL A input and set CHK-SEP-COM switch to COM. If start-stop signals are from separate sources, connect start signal to CHANNEL A input and stop signal to CHANNEL B input and CHK-SEP-COM switch to SEP.
6. Set CHANNEL A SLOPE switch to + for triggering on positive slope of signal or to - for triggering on negative slope of signal.
7. Set CHANNEL A LEVEL and ATTEN switches to start measurement at desired voltage level. Select AC or DC coupling. For frequencies below 100 kHz, use MARKER A OUTPUT jack on rear panel to display starting point on an oscilloscope.
8. Set CHANNEL B, AC-DC, LEVEL, SLOPE, and ATTEN controls to stop measurement at desired level. For frequencies below 100 kHz, use MARKER B OUTPUT to display stopping point on oscilloscope.
9. Adjust SAMPLE RATE control for convenient measurement interval.

NOTE

There must be at least 150 ns between the STOP pulse (Channel B trigger) and the next START pulse (Channel A trigger).

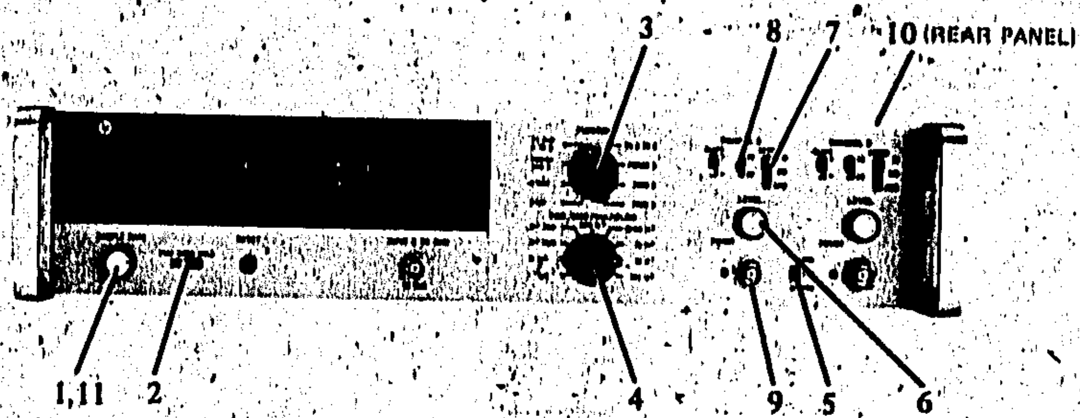
Time Interval Average

1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch T.I. AVG A.
4. Set MULTIPLIER switch to number of time intervals to be averaged.
5. If start-stop signals are from a common source, connect signal to CHANNEL A input and set CHK-SEP-COM switch to COM. If start-stop signals are from separate sources, connect start signal to CHANNEL A input and stop signal to CHANNEL B input and CHK-SEP-COM switch to SEP.
6. Set CHANNEL A SLOPE switch to + for triggering on positive slope of signal or to - for triggering on negative slope of signal.
7. Set CHANNEL A, LEVEL, and ATTEN to start the measurement at desired voltage level. Select AC or DC coupling. For frequencies below 100 kHz, use MARKER A OUTPUT jack on rear panel to display starting point on oscilloscope.
8. Set CHANNEL B, AC-DC, LEVEL, SLOPE, and ATTEN to stop the measurement at desired level. For frequencies below 100 kHz, use MARKER B OUTPUT to display stopping point on oscilloscope.
9. Adjust SAMPLE RATE control for convenient measurement interval.

NOTE

STOP to START delay must be >150 ns and input rate should not be 10 MHz x $\frac{M}{N}$ (M and N integers).

Figure 3-10. Ratio Measurements



1. Set SAMPLE RATE control slightly clockwise out of OFF.

2. Set FAST/NORM/HOLD switch to NORM.

3. Set FUNCTION switch to FREQ A or FREQ C, direct or prescaled.

4. Set MUTLIPLIER switch to desired dividing factor for F_{ext}.

5. Set CHK-SEP-COM switch to SEP.

6. Set CHANNEL A LEVEL control to desired trigger level or to PRESET to trigger at zero volts.

7. Set ATTEN switch to match input amplitude.

8. Set AC-DC switch to AC or DC.

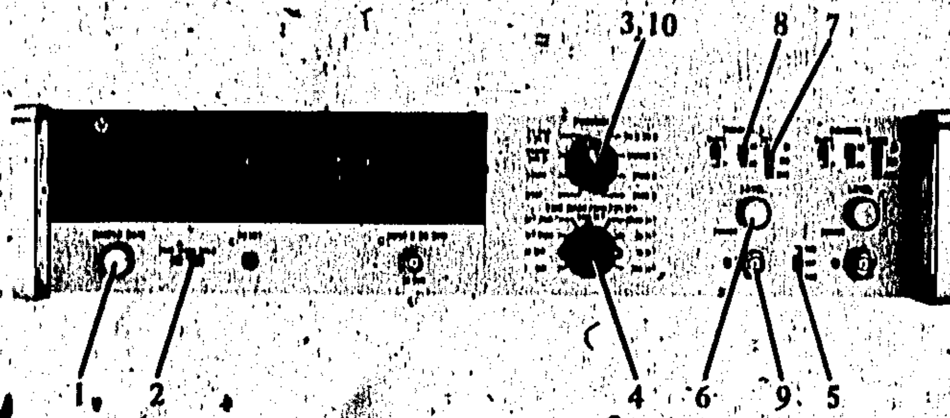
9. Connect F_A (0 to 50 MHz) to CHANNEL A input jack or F_C to INPUT C.

10. Set OSC INT-EXT switch to EXT (rear-panel). Connect F_{ext} to OSC jack. Fext can be 100 Hz to 10 MHz 1 V rms (min) to 5 V peak maximum.

11. Adjust SAMPLE RATE control for convenient measurement interval.

12. Ratio $= \frac{F_A \text{ or } F_C}{F_{ext}} = \frac{\text{DISPLAY}}{\text{MULTIPLIER}}$. Disregard units and decimal point.

Figure 3-11. Totalize Measurements



1. Set SAMPLE RATE control slightly clockwise out of OFF.
2. Set FAST/NORM/HOLD switch to NORM.
3. Set FUNCTION switch to STOP.
4. Set MULTIPLIER switch to input signal scaling factor.
5. Set CHK-SEP-COM switch to SEP.
6. Set LEVEL control to desired trigger level or to PRESET for triggering at zero volts.
7. Set ATTEN switch to match input signal's amplitude.
8. Set AC-DC switch to AC or DC.
9. Connect input signal (0 to 10 MHz) to CHANNEL A input jack.
10. Set FUNCTION switch to START.

NOTE

A scaled output of the input signal is available at the rear-panel TIME BASE OUTPUT BNC. The division is determined by the MULTIPLIER switch setting.

SECTION IV

THEORY OF OPERATION

4-1. INTRODUCTION

4-2. This section discusses the general operating principles of the instrument. Assembly description is covered in more detail in Section VIII, opposite each schematic diagram. Logic fundamentals are explained in Paragraphs 4-3 through 4-16.

4-3. LOGIC SYMBOLS

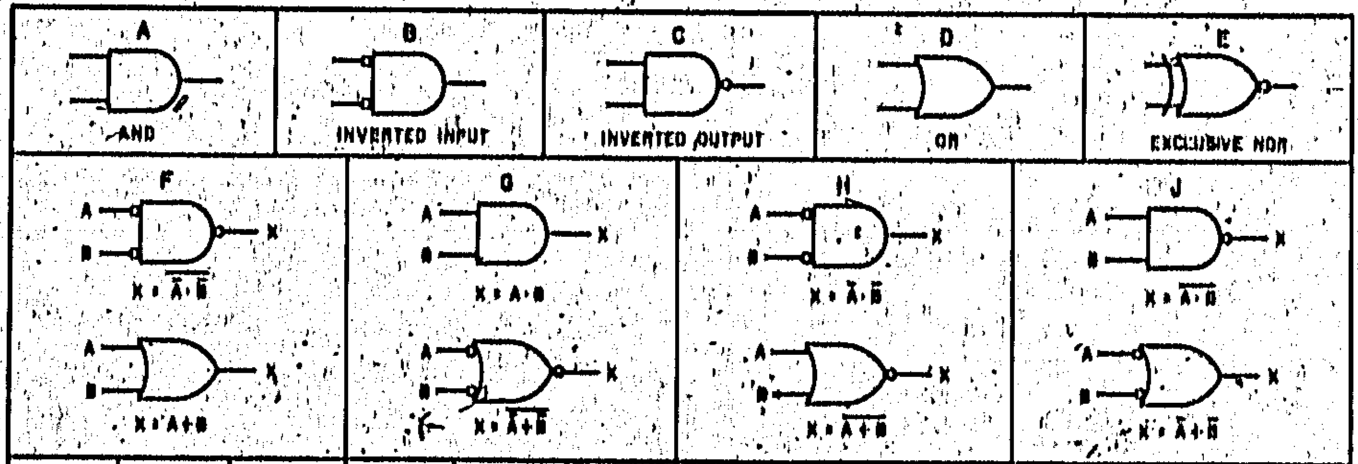
4-4. Two states exist in the binary system, 1 and 0. In positive logic, the 1 state is more positive than the 0 state. High (H) and low (L) are used to represent the 1 and 0 levels. *HIGH ALWAYS REPRESENTS THE MORE POSITIVE LEVEL, WHETHER IT BE POSITIVE OR NEGATIVE LOGIC.*

4-5. A circle at the input line of a logic symbol indicates that a low activates the function. Figure 4-1B shows that a low at both inputs produces a high output. A circle at the output line of a logic symbol indicates a low when activated, as shown in Figure 4-1C.

4-6. Gating and Logic

4-7. Figure 4-1A represents a basic AND gate. The output is high if all inputs are high. An AND gate may have two or more inputs. Figure 4-1D represents a basic OR gate. The OR gate output is high if one or more of its inputs is high. An OR gate may have two or more inputs. An OR gate with a circle on the output is called a NOR gate. An AND gate with a circle on the output is called a NAND gate. An EXCLUSIVE NOR (Figure 4-1E) has two inputs; and the output will be low if one, but not both, of the inputs is high. The output will be high if the inputs are both low or both high.

Figure 4-1. Gate Symbols and Logic Comparisons



A	B	X	A	B	X	A	B	X	A	B	X
H	H	H	H	H	H	H	H	L	H	H	L
H	L	H	H	L	L	H	L	L	H	L	H
L	H	H	L	H	L	L	H	L	L	H	H
L	L	L	L	L	L	L	L	H	L	L	H

4-8. INTEGRATED CIRCUIT OPERATION

4-9. JK Master-Slave Flip-Flop

4-10. The JK master-slave flip-flop is basically a bistable multivibrator. With simultaneous high inputs to J and K, before the clock pulse, Q and $\overline{Q}$ will change state after the clock pulse. Refer to Figure 4-2 and Table 4-1. This circuit triggers on the trailing edge (negative transition) of the clock pulse. The set (S) and reset (R) inputs operate as follows: when a low is applied to set input, $\overline{Q}$ goes low and Q goes high; when a low is applied to reset input, Q goes low and $\overline{Q}$ goes high. Set or reset can override all other inputs at any time.

Figure 4-2. JK Flip-Flop

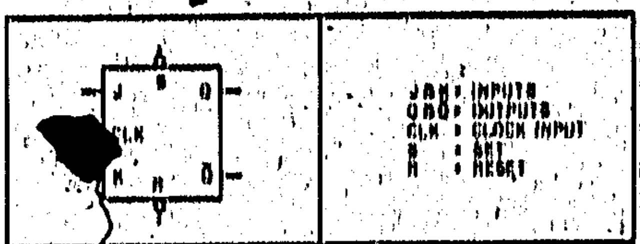


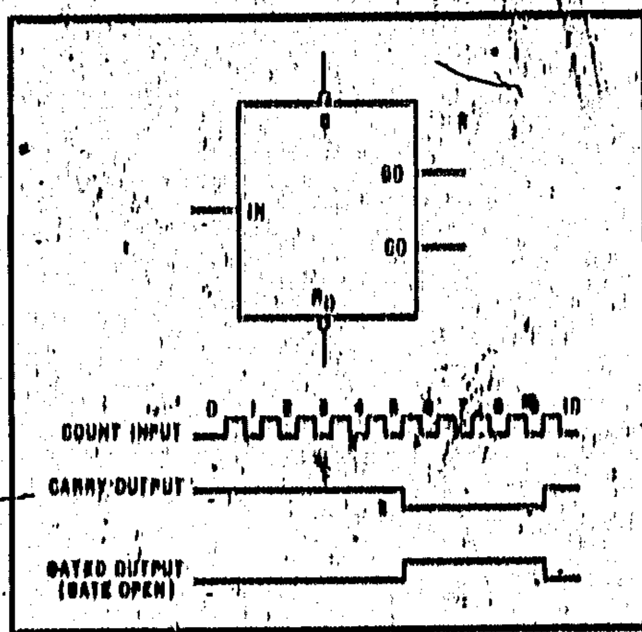
Table 4-1. Truth Table

t_n		$t_n + 1$		t_n = Before clock pulse
J	K	Q	$\overline{Q}$	$t_n + 1$ = After clock pulse
L	L	Q_n	$\overline{Q}_n$	If J = L and K = L, then Q and $\overline{Q}$ will not change from what they were before the clock pulse.
H	L	H	L	If J = H and K = L, then Q will be H and $\overline{Q}$ will be L after the clock pulse.
L	H	L	H	If J = L and K = H, then Q will be L and $\overline{Q}$ will be H after a clock pulse.
H	H	$\overline{Q}_n$	Q_n	If J = H and K = H before the clock pulse, then after the clock pulse Q and $\overline{Q}$ will change states.

4-11. Time-Base Decade

4-12. In the reset state, Carry Output (CO) (see Figure 4-3) is high and, if the Gate input (G) is low, Gated Output (GO) is low. Ten pulses on the Gate input produce a negative transition at the Gated Output. If the G input is high, GO is open-circuited regardless of the count. The Carry Output gives a positive transition after 10 pulses.

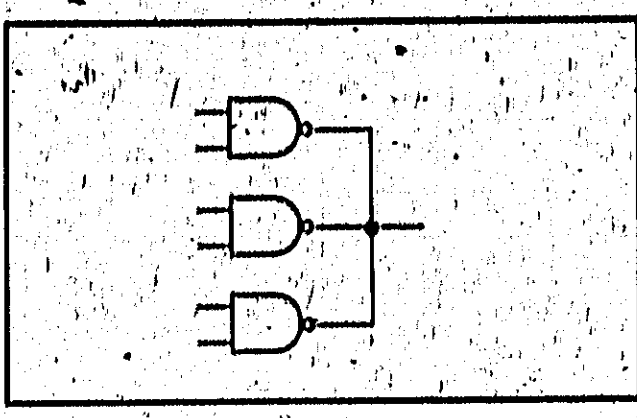
Figure 4-3. Time-Base Decade 1820-0418



4-13. Open-Collector Gate

4-14. The output of an open-collector gate can be paralleled with gates of the same type to perform a wire-OR function, as shown in Figure 4-4. When the outputs are tied to the same line, any one of the gates can pull the line low without damaging itself.

Figure 4-4. Open-Collector Gate 1820-0327



4-15. Logic Levels

4-16. This counter uses three types of logic: TTL (transistor-transistor logic), ECL (emitter-coupled logic), and DTL (diode-transistor logic). See Table 4-2 for specific logic levels.

Table 4-2. Logic Levels

Type	H (Min)	L (Max)	Trigger	Supply
ECL	-.7 V	-1.4 V	-1.8 V	-5.0 V
TTL	2.4 V	0.4 V	1.5 V	5.0 V
DTL	2.6 V	0.4 V	1.5 V	5.0 V

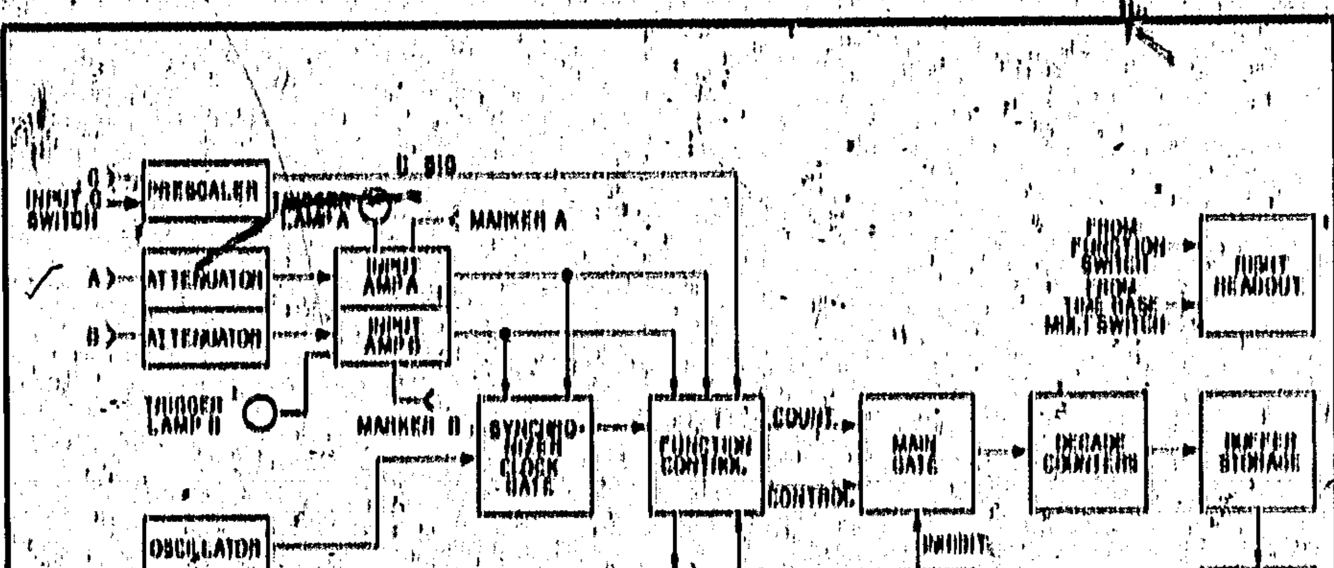
4-17. OVERALL COUNTER OPERATION

4-18. The signal connected to CHANNEL A is conditioned by the front-panel switches of the Attenuator Assembly (Figure 4-5). These switches set the operating conditions for trigger level, coupling, and the required slope. The Input Amplifier converts the signal into narrow pulses for more efficient usage throughout the counter. In the 5327A, INPUT C provides an alternate path through the Prescaler Assembly, which divides the signal by 10 or passes it directly to the Function Control Assembly. The path taken is determined by the setting of the front-panel INPUT C switch.

4-19. The Function Control accepts both the input signal and the 10 MHz internal oscillator pulses and routes them in accordance with the mode of operation being used. One of these signals is sent to the A5 Time Base Assembly, which divides the signal as determined by the front panel TIME BASE/MULTIPLIER switch. The first and last pulse of the divided signal control the length of time the main gate is open. During this time, the other signal is sent directly to the main gate for totalizing in the decade counters and is subsequently displayed. The synchronizer prevents the main gate from opening until an input signal is present.

4-20. The sample rate circuits control the interval between measurements. When the main gate closes, these circuits provide a delay, as controlled by the

Figure 4-5. Functional Block Diagram



front panel SAMPLE RATE controls. When the sample rate period has elapsed, a reset pulse is generated to reset the counter and start a new measurement.

4-21. The signal to be counted, either the internal oscillator or input signal, passes through the main gate to the decade counters. The buffer storage registers store the BCD count before it is translated into a decimal equivalent and displayed on the front panel. Also displayed on the front panel are the units of measurement and the decimal point. The left and right readout assemblies contain the unit indicators and the logic necessary to position the decimal point.

4-22. Frequency Modes

4-23. Frequency is defined as the number of periodic events per unit of time. The counter, therefore, measures an unknown signal (COUNT) for a known length of time (Figures 4-6 and 4-7). The 10 MHz internal oscillator provides the known time and controls the opening of the main gate. The Time Base Assembly divides the oscillator frequency by powers of 10 to open the main gate from 10^{-7} seconds to 10 seconds. The longer the gate is open, the more pulses of the unknown frequency are counted and, therefore, the better the resolution and accuracy.

4-24. Period Modes

4-25. In the Period Mode, the main gate is open for the period of the input signal (Figure 4-8). The Time Base dividers scale the 10 MHz oscillator signal by powers of 10 from 1 to 10^8, as determined by the MULTIPLIER switch. This oscillator signal (COUNT) is counted during the gate time (period) by the decade counters and is subsequently displayed.

4-26. In the Period Average Mode, the MULTIPLIER switch selects the number of periods to be averaged (Figure 4-9). The Time Base dividers count the number of periods selected with the switch and holds the main gate open until this count is complete. The Decade Counter totalizes the oscillator pulses while the main gate is open.

4-27. Time Interval Modes

4-28. In the Time Interval Mode (Figure 4-10), Channel A signal controls the start of the measurement, while Channel B signal stops the measurement. The two signals control the state of the arming flip-flop, which, in turn, enables the Clock Gate to pass oscillator pulses to the Time Base Divider. The oscillator signal is scaled, congruent with the setting of the MULTIPLIER switch, before it is passed through the main gate to the counting assemblies.

4-29. For the Time Interval Average measurements (Figure 4-11), the setting of the MULTIPLIER switch determines the number of intervals that are averaged. The oscillator signal is counted directly for the duration of each, individual time interval that is being averaged. Once the Time Base Divider totalizes the number of selected intervals, the main gate closes and the measurement is displayed. See Page 8-20 for timing diagrams and a technical description.

Figure 4-6. Frequency A Mode Flow Diagram

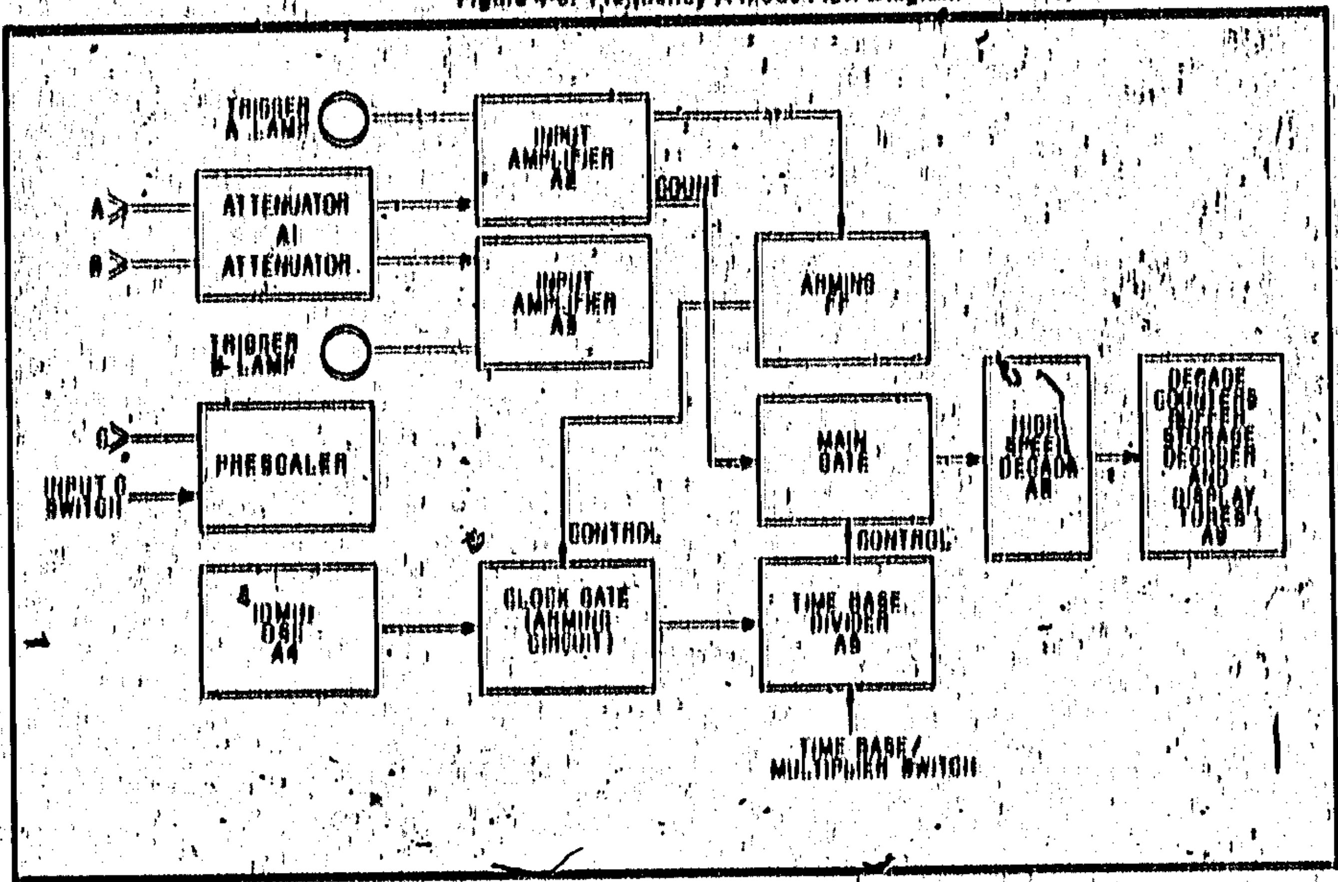


Figure 4-7. Frequency C Mode Flow Diagram

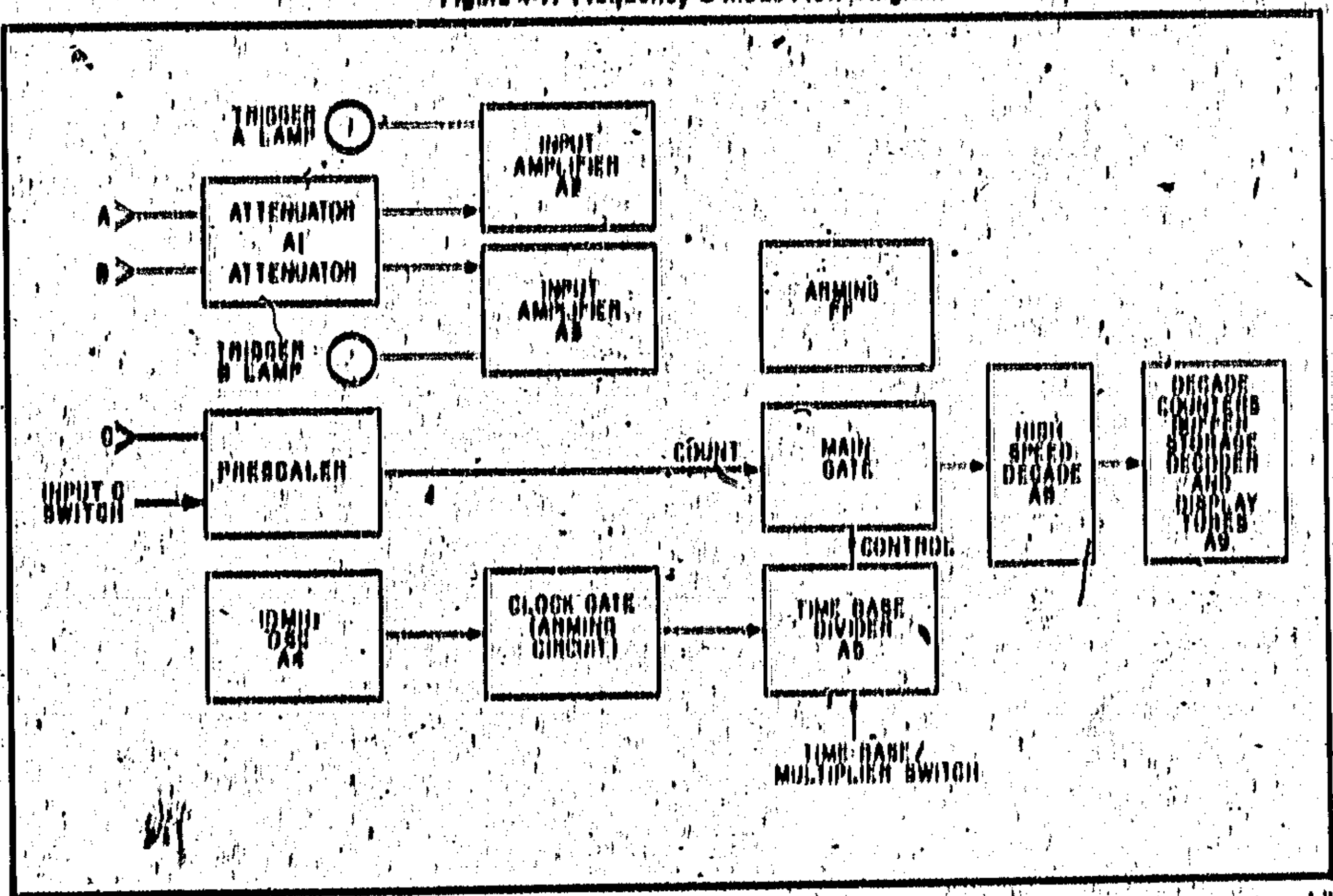


Figure 4-8. Period Mode Flow Diagram

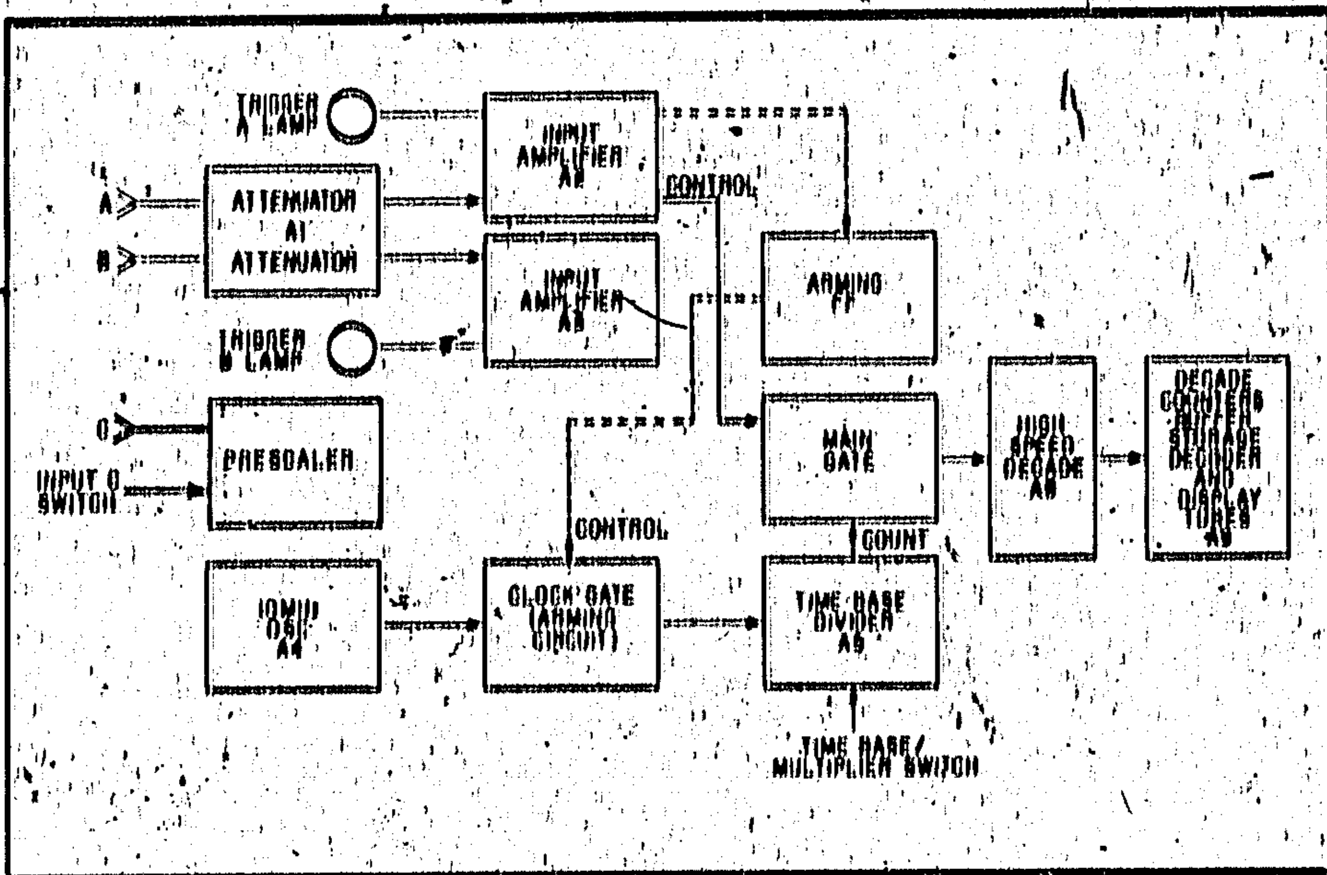


Figure 4-9. Period Average Mode Flow Diagram

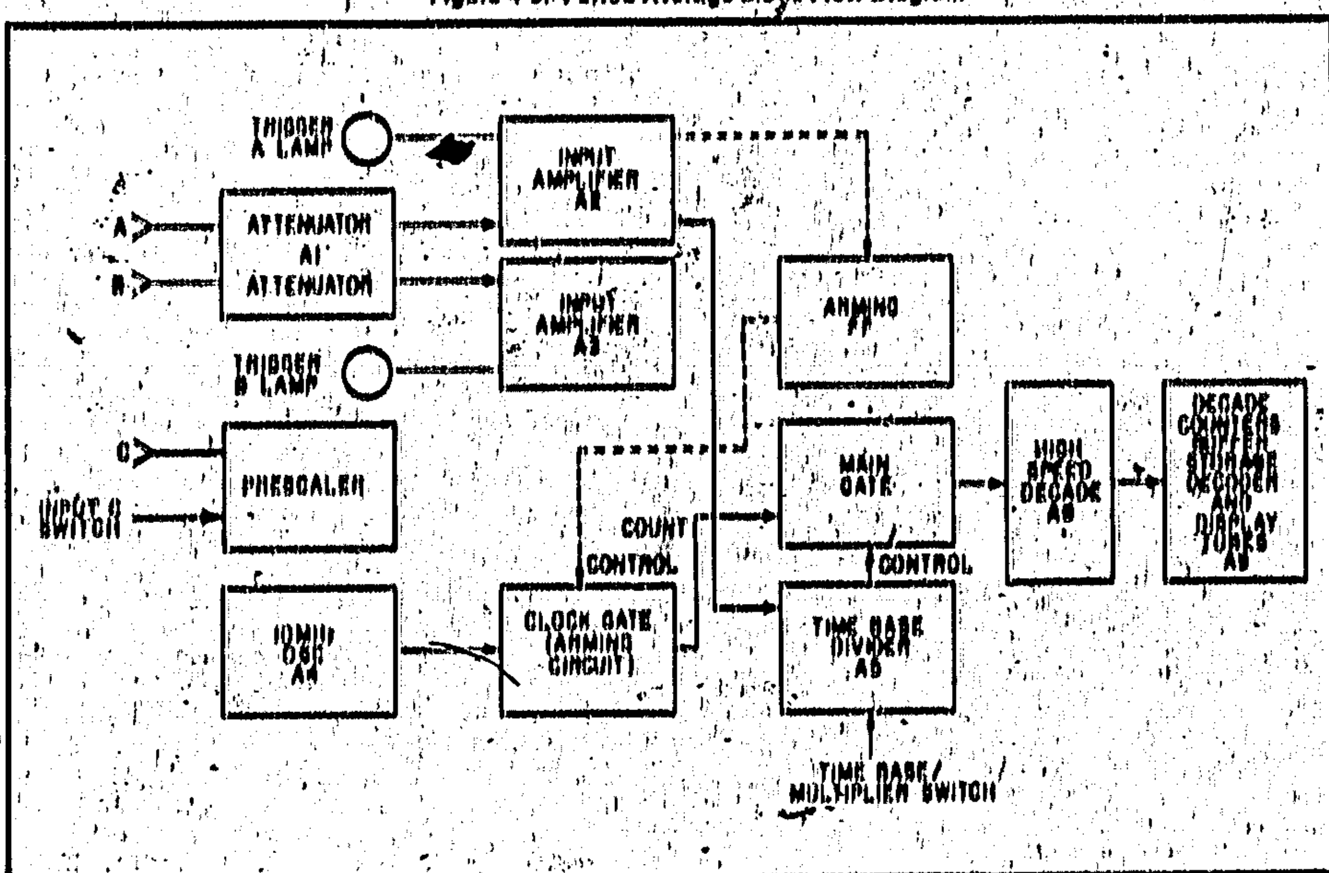


Figure 4-10. Time Interval Mode Flow Diagram

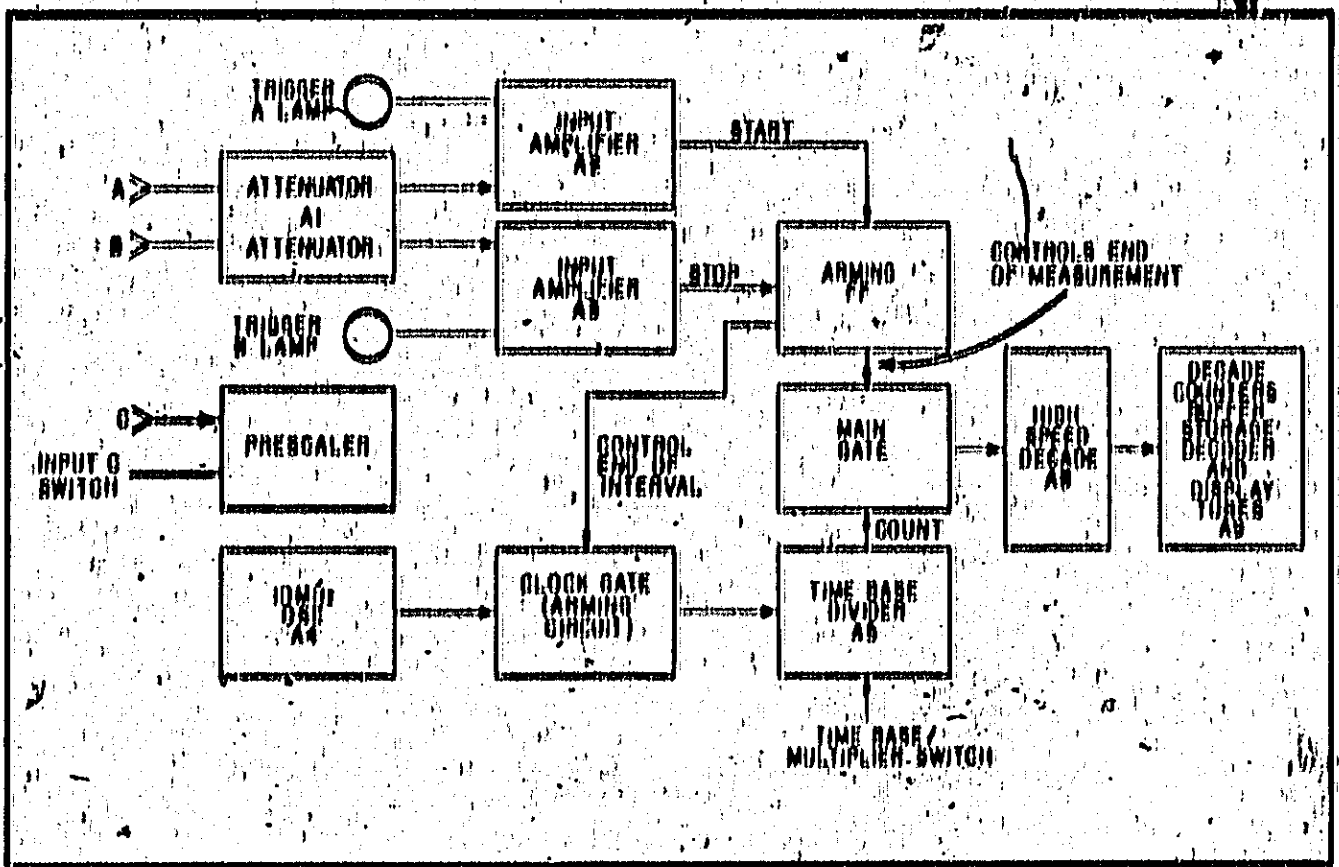


Figure 4-11. Time Interval Average Mode Flow Diagram

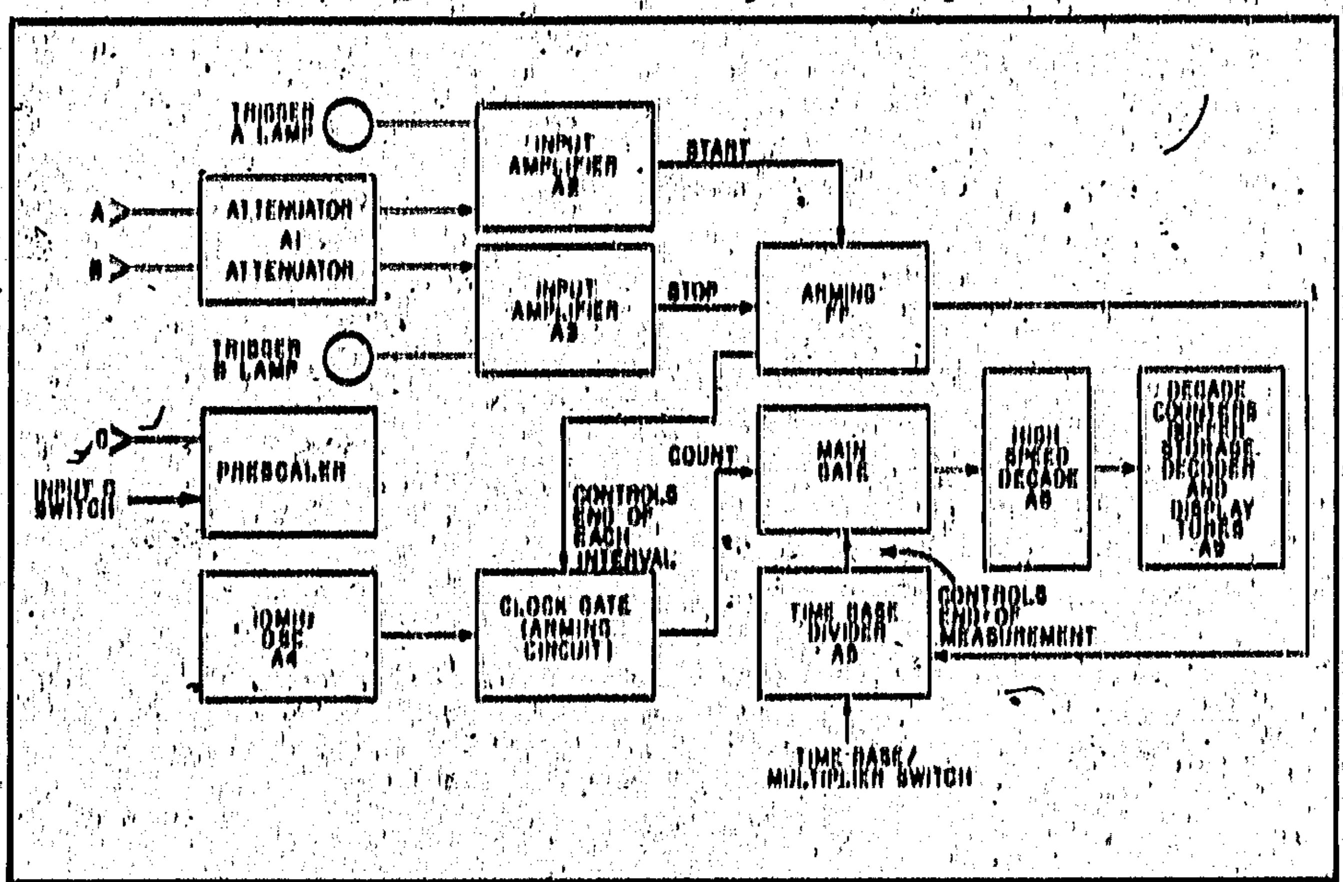
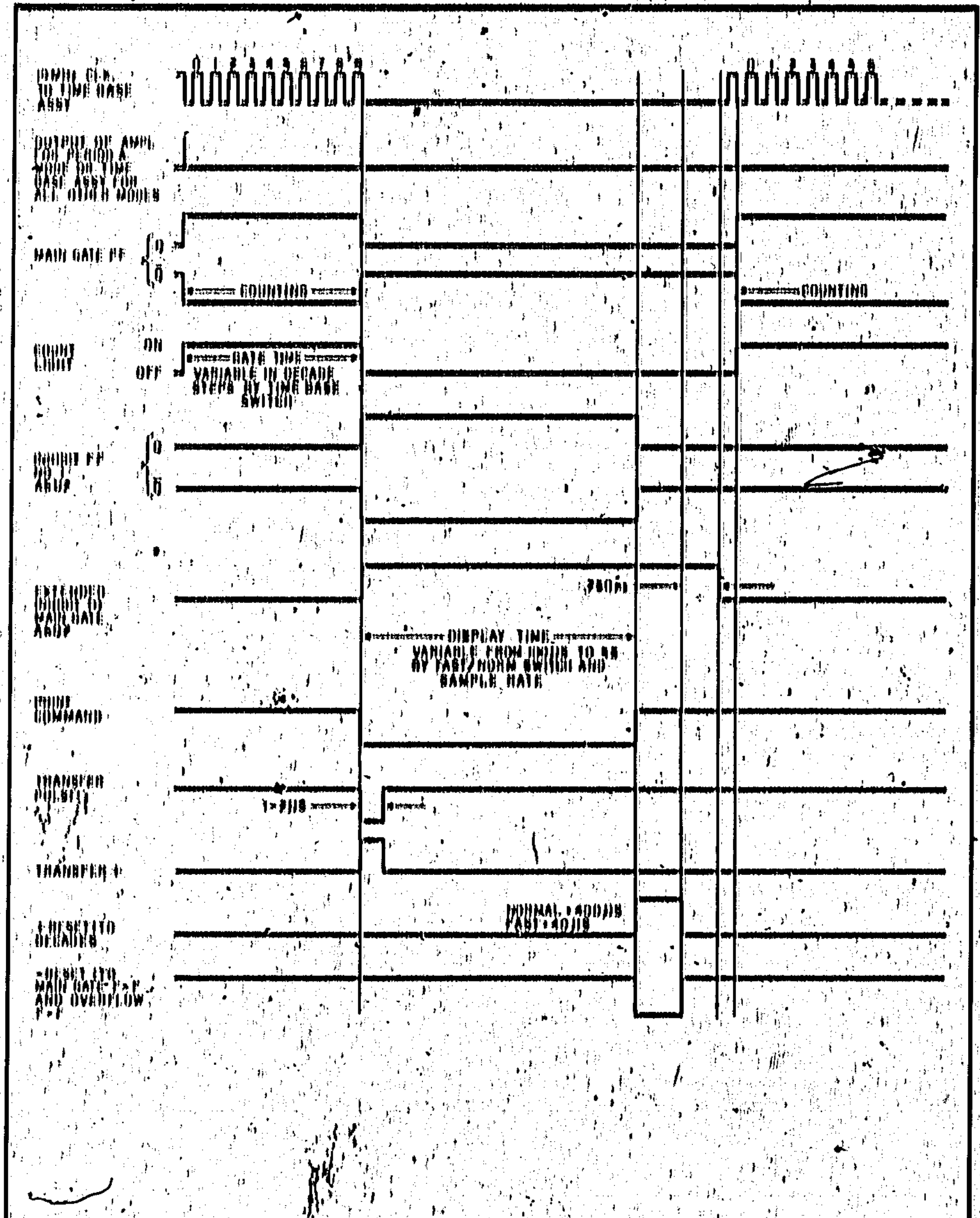


Figure 4-12. Timing Diagram



SECTION V

MAINTENANCE

5-1. INTRODUCTION

5-2. This section gives maintenance and service information. Included is a table of assemblies, recommended test equipment, in-cabinet performance checks, which may be used to verify proper counter operations, and adjustments.

5-3. ASSEMBLY DESIGNATIONS

5-4. Table 5-1 lists the designations, name, and Hewlett-Packard part number of assemblies used in this instrument.

5-5. TEST EQUIPMENT

5-6. Test equipment recommended for maintaining and checking performance is listed in Table 5-2. Test equipment having equivalent characteristics may be substituted for the equipment listed.

Table 5-1. Assembly Identification

Assembly	Description	HP Part No.
A1	Attenuator	05326-60003
A1	Attenuator (Option 004)	05327-60018
A2	Input Amplifier	05326-60004
A3	Input Amplifier	05326-60004
A4	Oscillator	05326-60002
A5	Time Base Control	05326-60005
A6	Sample Rate	05326-60013
A7	Function Control	05327-60004
A8	Display Support	05326-60009
A9	Display	05326-60008
A9	Display (Option 001)	05326-60025
A10	Right Readout	05327-60002
A11	Left Readout	05327-60003
A12	Voltmeter Input Amplifier	Not Used
A13	Voltmeter V-F Converter	Not Used
A14	DVM Logic	Not Used
A15	Regulator	05327-60020
A16	Interconnect	05327-60026
A16	Interconnect (5327A)	05327-60005
A17	Input C Amp (5326A)	05326-60031
A18	Prescaler (5327A)	05327-60009 or 05327-60029

5-7. ASSEMBLY CONNECTION IDENTIFICATION

5-8. Throughout the manual, connections to printed circuit assemblies are referred to in abbreviated form. For example, connection to A3, pin 10 is A3(10).

5-9. IN-CABINET PERFORMANCE CHECK

5-10. GENERAL. The performance check (Table 5-3) and test card can be used to verify proper operation of all circuits of the counter and may also be used:

a. As part of an incoming inspection check of instrument specifications.

b. Periodically, for instruments used in systems where maximum reliability is important.

c. As part of a procedure to locate defective circuits.

d. After any repairs or adjustments and before returning instrument to regular service.

e. As a permanent record of instrument maintenance performed, because the test record pages are perforated and may be removed.

5-11. VARIABLE LINE VOLTAGE. During the test (Table 5-3), the counter should be connected to a variable voltage source, so the line voltage may be varied ±10% from nominal (115 or 230 Vac).

5-12. INSTRUMENT COVER REMOVAL

5-13. To remove top or bottom cover, remove the four screws that secure cover to instrument. Slide cover toward rear of instrument and lift off. To replace cover, reverse procedure.

WARNING

115/230 VAC AND +175 VDC SUPPLY WIRES ARE EXPOSED WHEN EITHER TOP OR BOTTOM COVER IS REMOVED. USE EXTREME CAUTION DURING TROUBLESHOOTING, ADJUSTMENT, OR REPAIR. AVOID DAMAGE TO INSTRUMENT BY REMOVING POWER BEFORE REMOVING OR REPLACING COVERS, ASSEMBLIES, OR COMPONENTS.

5-14. REPAIR

5-15. Printed Circuit Component Replacement

5-16. Component lead holes in the circuit boards have plated-through walls to ensure good electrical contact between conductors on opposite sides of the board. To prevent damage to the plating and the replacement component, apply heat sparingly, and work carefully.

5-17. Replacing Integrated Circuits

5-18. Following are two recommended methods of replacing integrated circuits:

a. SOLDER GOBBLER. This is the best method. Solder is removed from board by a soldering iron with a hollow tip connected to a vacuum source.

b. CLIP-OUT. This method should be used as a last resort only. Clip the leads as close to the base as possible. With a soldering iron and long nose pliers, carefully remove the wires from each hole. Then clean the holes.

5-19. ADJUSTMENTS

5-20. The adjustments in Table 5-4 are in the order they should be performed but should not be done unless:

a. A trouble has been repaired which would affect these values.

b. The instrument does not meet all specifications while performing the check in Table 5-3 (In-Cabinet Performance Checks).

Table 5-2. Recommended Test Equipment

Instrument Type	Required Characteristics	Recommended Type
Frequency Standard	1 MHz Output	HP 107AR
Oscilloscope Vertical Plug-In Time Base Plug-In	50 MHz Bandwidth 50 mV/cm Sensitivity 50 MHz Bandwidth	HP 180A HP 1801A HP 1820A
Test Oscillator (two required)	10 Hz to 10 MHz at 5 volts peak-to-peak	HP 651B
Audio Oscillator	2 Hz to 100 kHz at 100 mV rms	HP 202C
HF Signal Generator	50 kHz to 50 MHz at 3 V rms	HP 606B
VHF Signal Generator	10 MHz to 480 MHz	HP 608F
Frequency Doubler	240 - 550 MHz	HP 10515A
Pulse Generator	10 MHz repetition rate, 8 ns pulse width, 0.3 volts peak-to-peak output	HP 216A
Electronic Counter	0.1 Hz to 10 MHz Frequency Measurements	HP 5245L
Variable Line Transformer	103 to 127 V rms and 206 to 254 V rms	Electronic Power Stat 3PF116 (115V); 3PF216 (230V)
Digital Recorder	Print Rate: 10 lines/sec. Data Input: †8421 BCD parallel entry, accepts 1 = +5 V, 0 = +0.25 V. Accepts negative going +5 to 0 V print command	HP 5055A
DC Voltmeter	0 to 200 Vdc, 1% accuracy	HP 412A
AC VTVM	0 to 250 Vac	HP 400F
RF Voltmeter	1 mV to 3 V	HP 3406A

Table 5-3. In-Cabinet Performance Check

1. TIME BASE STABILITY AND OUTPUT

a. Set counter controls as follows:

SAMPLE RATE	Mid-position
FAST/NORM/HOLD	NORM
FUNCTION	FREQ A
TIME BASE/MULTIPLIER	10s
SLOPE A	+
AC/DC	DC
ATTEN	X1
CHK-SEP-COM	SEP
LEVEL	PRESET
STORAGE	ON
OSC	INT

NOTE

Allow one-hour warm-up before proceeding to step b.

b. Connect 1 MHz frequency standard to CHANNEL A input.

c. A counter display of 000.0000 (1000.0000 Option 001) indicates that counter time base frequency is exactly 10 MHz. The offset between counter time base and 1 MHz frequency standard can be determined by subtracting 10 MHz from the indicated oscillator frequency.

COUNTER DISPLAY	A4 OSCILLATOR FREQUENCY
999.9950 kHz	10 000 050 Hz
999.9960	10 000 040
999.9970	10 000 030
999.9980	10 000 020
999.9990	10 000 010
1 000.0000	10 000 000
1 000.0010	9 999 990
1 000.0020	9 999 980
1 000.0030	9 999 970
1 000.0040	9 999 960
1 000.0050	9 999 950

d. Record frequency offset on test card. For long-term stability, operate the counter continuously for at least one month. Measure frequency offset at one-month intervals.

e. To calibrate the counter time base to the frequency standard, perform time-base adjustment in Table 5-4.

NOTE

Temperature must be held constant or compensation for temperature difference must be made whenever a frequency difference is recorded. Unless a record of the temperature and date of last calibration is available, the frequency offset should not be considered drift or aging rate of the 10 MHz crystal.

f. To check time base stability vs. line voltage variations, connect variable transformer to counter power cord. Vary line voltage ±10% and record frequency difference on test card; it should be ≤ 1 part in 10^7.

g. To check time base stability vs. temperature, vary counter operating temperature between 0° and 50°C. Record frequency difference on test card; it should be ≤±2.5 parts in 10^6.

Table 5-3. In-Cabinet Performance Check (Continued)

h. Connect oscilloscope vertical input to OSC jack on counter rear panel. Use 10:1 probe at OSC jack.

i. Oscilloscope should display 10 MHz nominal at > 2.4 volts peak-to-peak amplitude. Record on test card.

2. DISPLAY, DECIMAL POINTS, AND DIVIDERS

Proper operation is verified in the Self-Check procedures in Table 5-1. Record on test card.

3. FREQUENCY RESPONSE AND SENSITIVITY

CHANNEL A

a. Set counter controls as in 1a., except TIME BASE to 1s and AC/DC switch to AC.

b. Connect a BNC T connector to CHANNEL A input jack. Connect sine wave test oscillator output to T connector. Connect oscilloscope vertical input to T connector to monitor input signal amplitude; use a 50-ohm feedthrough at oscilloscope BNC.

c. Adjust test oscillator from 20 Hz to 50 MHz, maintaining 100 mVrms input amplitude. Counter should properly display all frequencies in this range. Record on test card.

d. Set audio oscillator frequency to 2 Hz. Counter should not count. Switch AC/DC switch to DC. Counter should count input signal.

e. Connect a BNC T connector to Z axis input of oscilloscope. Connect counter MARKER A and B outputs to T connector.

f. Adjust test oscillator output for 1000 Hz at 6 volts peak-to-peak indication.

g. Set CHANNEL A LEVEL to PRESET and check that oscilloscope marker is at 0 volts.

h. Set CHANNEL A SLOPE to +. Vary CHANNEL A LEVEL control and check that marker is variable over at least -3.0 to +3.0 volts on the positive slope of waveform.

i. Set CHANNEL A SLOPE to -. Vary CHANNEL A LEVEL control and check that marker dot is variable over at least -3.0 to +3.0 volts on the negative slope of waveform. Record on test card.

j. Set CHK-SEP-COM switch on COM and repeat marker test for CHANNEL B. Record on test card.

INPUT C

a. Disconnect oscilloscope and input to CHANNEL A. Remove 50Ω feedthrough and connect cable to INPUT C jack.

b. Set FUNCTION selector to FREQ C, TIME BASE to 1s, and input selector to ÷10 (5327A).

c. Use the set of frequency generators (Table 5-2) necessary to cover the input frequency from 2 Hz to 550 MHz, while maintaining 100 mVrms input level. Adjust TIME BASE switch as necessary for best display.

d. Check for stable count within stability of oscillator. Record on test card.

e. Set input selector switch to DIRECT.

f. Use the set of frequency generators necessary to cover the input frequency from 1 kHz to 50 MHz, while maintaining 5 mV rms input level. Adjust TIME BASE switch as necessary for best display. On 5326A vary frequency from 0 to 50 MHz.

Table 5-3. In-Cabinet Performance Check (Continued)

g. Check for stable count within stability of oscillator. Record on test card. Disconnect setup.

4. PULSE OPERATION

a. Set counter controls as follows:

FUNCTION	FREQ A
TIME BASE	1 s
SLOPE A	+
AC/DC (A)	DC
ATTEN (A)	X1
LEVEL (A)	PRESET
CHK-SEP-COM	SEP
STORAGE	ON
OSC	INT

b. Connect BNC T connector to oscilloscope vertical input. Connect pulse generator to T. Connect CHANNEL A input to T connector, using 50Ω feedthrough at the counter input.

c. Adjust pulse generator output for 10 MHz repetition rate, 15 ns pulse width at 0.5 volts peak-to-peak indication on oscilloscope.

d. Check that counter displays the repetition rate, count light flashes, and trigger A lamp is on. Record on test card.

e. Remove input connection from CHANNEL A input jack. Remove 50Ω feedthrough and connect cable to INPUT C jack. Set FUNCTION selector to FREQ C. Set INPUT C switch to DIRECT.

f. Set pulse generator output to 10 MHz repetition rate, 15 nsec wide pulses, at 500 mV peak-to-peak.

g. Check that counter displays repetition rate and count lamp flashes. Record on test card.

h. Repeat above check for 10 kHz.

5. PERIOD AND PERIOD AVERAGE

a. Set counter controls as in step 1a, with FUNCTION to PERIOD A and MULTIPLIER to 10^3 or as needed. Set audio oscillator to 2 Hz at 100 mVrms.

b. Connect oscillator to CHANNEL A input, using BNC T. Connect oscilloscope to T, using 50Ω feedthrough at oscilloscope BNC.

c. Vary audio and test oscillator frequency from 2 Hz to 10 MHz, maintaining 100 mVrms input amplitude. Vary MULTIPLIER as needed to maintain meaningful display with change of frequency. Counter should properly display the period of the frequencies in this range within accuracy spec of the instrument. Record on test card.

d. Set FUNCTION switch to PERIOD AVG A and repeat step c. Record on test card.

6. TIME INTERVAL AND TIME INTERVAL AVERAGE

a. Set counter controls as follows:

SAMPLE RATE	Mid-position
FAST/NORM/HOLD	NORM
FUNCTION	T.I. A to B
MULTIPLIER	1
SLOPE A	+
SLOPE B	-

(Continued)

Table 5-3. In-Cabinet Performance Check (Continued)

a. Counter control settings (cont'd):

AC/DC (A and B)	AC
ATTEN (A and B)	X1
LEVEL (A and B)	PRESET
CHK-SEP-COM	COM

b. Connect test oscillator to CHANNEL A input. Set oscillator for 1 MHz output at 300 mVrms. Observe display for .5 μs ±1 count ± trigger error. Record on test card.

c. Set FUNCTION to T.I. AVG and MULTIPLIER to 10^4. Set signal source to ≈ 2 MHz.* Counter should display one half the period of the input signal.

$$\pm 2 \text{ ns} \pm \frac{\text{trigger error} \pm 100 \text{ ns}^{**}}{\sqrt{\text{number of intervals averaged}}}$$

7. TOTALIZE

a. Set counter controls as follows:

FUNCTION	START
MULTIPLIER	1
CHK-SEP-COM	CHK

b. Check that display totalizes, count light (C) is on and trigger A and B lamps light. Record on test card.

c. Using 10:1 divider probe, connect oscilloscope vertical input to TIME BASE OUTPUT jack on counter rear panel.

d. Check that oscilloscope indicates 10 MHz negative going pulses at least 3 volts peak-to-peak, typically > 30 nsec at 50% points. Set MULTIPLIER switch to 10 and observe 1 MHz output pulses, typically 100 nsec.

e. Disconnect oscilloscope from TIME BASE OUTPUT jack and connect TIME BASE OUTPUT to 5245L Electronic Counter input. Set 5245L for frequency measurements.

f. Set MULTIPLIER as follows, and check for proper counter display. Record on test card.

MULTIPLIER	5245 DISPLAY
1	10 MHz
10	1 MHz
10^2	100 kHz
10^3	10 kHz
10^4	1 kHz
10^5	100 Hz
10^6	10 Hz
10^7	1 Hz
10^8	.1 Hz

*2 MHz must NOT be exact or display will be ambiguous.
**±1 count.

Table 5-3. In-Cabinet Performance Check (Continued)

8. RATIO

a. Set counter controls as follows:

FUNCTION	FREQ A
MULTIPLIER	10^0
SLOPE A	+
AC/DC	AC
ATTEN	X1
CHK-SEP-COM	SEP
LEVEL A	PRESET
OSC (rear panel)	EXT

b. Connect test oscillator to OSC jack, using BNC T. Connect oscilloscope to T connector, using 50Ω feedthrough at oscilloscope BNC. Set oscillator output for 10 MHz at 1 Vrms.

c. Connect BNC T connector to counter's CHANNEL A jack. Connect second test oscillator to T connector. Connect second channel of dual channel oscilloscope vertical input to T connector, using 50Ω feedthrough at oscilloscope BNC. Set variable oscillator for 100 kHz at 100 mV rms display on oscilloscope.

d. Check that counter displays 100. Disregard units and decimal point. Record on test card.

e. Repeat test using 100 Hz into OSC jack and 100 kHz into CHANNEL A. Set MULTIPLIER to 10^3. Display should be ratio of two input frequencies X 10^3 (approximately 10^6). Disregard decimal point and units. Record on test card.

9. GATE OUTPUT AND SAMPLE RATE

a. Disconnect setup.

b. Set counter controls as follows:

FUNCTION	FREQ
TIME-BASE	1 ms
CHK-SEP-COM	CHK
FAST/NORM/HOLD	FAST
SAMPLE RATE	max ccw

c. Using 10:1 divider probe, connect oscilloscope vertical input to GATE output and observe positive pulses ≥ 2.4V with a pulse width of < 100 µs. Record on test card.

d. Slowly rotate SAMPLE RATE clockwise and observe that the pulse width increases.

e. Set the TIME BASE switch to 10 ms and rotate the SAMPLE RATE fully clockwise. Observe that the pulse width is > 20 ms. Record on test card.

f. Set FAST/NORM/HOLD to NORM and turn SAMPLE RATE fully counterclockwise, just out of OFF. Observe the positive pulse width is < 20 ms. Record on test card.

g. Slowly rotate the SAMPLE RATE clockwise, observing an increase in the pulse width.

h. Set TIME BASE to 1s and rotate SAMPLE RATE fully clockwise. Verify that the time between flashes of the count (C) lamp is greater than 5 seconds. Record on test card.

i. Set FUNCTION to START and check that gate output is TTL Low (< 0.4V).

j. Set FUNCTION to STOP and verify that gate output is TTL High (> 2.4V).

Table 5-3. In-Cabinet Performance Check (Continued)

10. DIGITAL RECORDER (Option 003)

a. Set counter controls as follows:

FUNCTION	FREQ A
TIME BASE	1 s
COM-SEP-CHK	CHK
FAST/NORM/HOLD	NORM
SAMPLE RATE	Mid-position

b. Connect oscilloscope to J9(48). Observe oscilloscope display a print command (drop from >2.4 V to <0.4 V) immediately after the G lamp goes out.

c. Connect jumper from J9(25) to J9(29).

d. Check that counter's main gate is inhibited, G light does not flash, and no print command pulses are generated.

e. Verify proper output by connecting a 5055A printer to J9. Printed output should agree with counter display. Logic probe or voltmeter may be used to verify that output logic levels agree with instrument display. Record on test card.

Table 5-4. Adjustments

1. POWER SUPPLY A15

a. Connect counter line cord to variable power transformer. Monitor output voltage with AC VTVM. Adjust transformer for 117 volt indication on VTVM.

b. Turn counter SAMPLE RATE control clockwise out of OFF.

c. Connect VTVM to A15 Pin 7 and adjust A15R10 for +16.5 V.

d. Connect VTVM to A15 Pin 6 and adjust A15R18 for -16.5 V.

2. SENSITIVITY AND OFFSET A2, A3

a. Connect a BNC T connector to CHANNEL A input jack.

b. Connect test oscillator output to T connector.

c. Connect oscilloscope vertical input to T connector, using 50Ω feedthrough at oscilloscope input BNC.

d. Connect counter MARKER A output to oscilloscope Z-axis input.

e. Adjust test oscillator for 1 kHz output at 100 mV rms.

f. Set counter controls as follows:

FUNCTION .... FREQ A
CHK-SEP-COM .... SEP
ATTEN X1
AC-DC .... DC
LEVEL .... PRESET

g. Set SLOPE A switch to - and + positions and observe marker position on oscilloscope waveform.

h. On Input Amplifier board A2, adjust A2R2 SENS pot until + and - marker positions have a symmetrical offset about the zero volt axis for + and - slope switch positions.

i. Adjust test oscillator for 1 kHz output at 200 mV rms.

j. Set counter FUNCTION switch to T.I. A to B.

k. On Input Amplifier, adjust A2R24 TRIG LEVEL pot until markers are at 0 volts for both + and - SLOPE switch positions.

l. Repeat procedure for CHANNEL B input (Amplifier Board A3).

3. OPTION 001 ATTENUATOR A1

Set:

TIME BASE .... 0.1 sec.
AC/DC .... DC
SEP/COM .... SEP
ATTEN A/B X10

a. Using an HP 412A or equivalent, measure voltage at CHANNEL A jack.

b. Adjust R36 for ≤ ±1 mV reading.

c. Measure voltage at CHANNEL B jack.

d. Adjust R9 for ≤ ±1 mV reading.

e. Set A and B attenuators to X100 position.

f. Measure voltage at CHANNEL B jack.

g. Adjust R32 for ≤ ±1 mV reading.

h. Measure voltage at CHANNEL A jack.

i. Adjust R33 for ≤ ±1 mV reading.

4. OSCILLATOR A4

a. Connect 1 MHz frequency standard to CHANNEL A jack.

b. Set counter controls as follows:

CHK-SEP-COM .... SEP
FUNCTION .... FREQ A
TIME BASE 10s
SAMPLE RATE .... slightly clockwise out of OFF

c. Remove top cover.

d. Using insulated tuning tool, adjust A4C3 until display indicates all zeros with cover on. (Wait 10 seconds between adjustments for counter to make measurement.)

NOTE

For standard instruments without Option 001, the counter display will overflow; however, all digits are valid.

5. PRESCALER A18 (5327A - (05327-60009))

SENSITIVITY ADJUST FOR PRESCALE MODE

a. Set counter controls as follows:

FUNCTION .... FREQ C
TIME BASE 0.1s
INPUT C switch .... ÷10

Table 5-4. Adjustments (Continued)

b. Set HP VHF Signal Generator and doubler for 550 MHz at 500 mV rms. Measure the output with an HP 8405A RF Voltmeter using a 50Ω termination at the probe. Connect signal source to INPUT C of counter.

c. Reduce output level until counter's display becomes unstable. Adjust R1 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase signal level until display just becomes stable.

d. Disconnect input and connect to voltmeter, should read less than 100 mV.

SENSITIVITY ADJUST FOR DIRECT MODE

a. Set INPUT C switch to DIRECT.

b. Connect setup as in step 5b, except use an HP 608F VHF Signal Generator with the output set to 50 MHz at 50 mV.

c. Reduce output level until counter's display becomes unstable. Adjust R2 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase signal level until display just becomes stable.

d. Disconnect input and connect to voltmeter, should read less than 5 mV.

6. PRESCALER A18 (5327A - 05327-60029)

The 05327-60029 board has an additional potentiometer, R28, than has the 05327-60009 board. Perform the Step 5 adjustment and, in addition, adjust R28 as follows:

a. Rotate R28 fully clockwise.

b. If unable to obtain a stable count at 550 MHz, turn R28 slightly counterclockwise.

c. Check for a stable counter reading.

7. INPUT C AMPLIFIER A17 (5326A)

a. Set counter controls as follows:

FUNCTION .... FREQ C
TIME BASE 0.1s

b. Set HP 606B HF Signal Generator (or equivalent) for 50 MHz at 500 mV rms. Measure the output signal of 606B with an HP 411A RF Millivoltmeter, using a 50Ω termination. Connect signal source to INPUT C of counter.

c. Reduce output level until counter's display becomes unstable. Adjust R11 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase the signal level until display just becomes stable.

d. Disconnect input and connect to voltmeter, reading should be less than 5 mV. Check other frequencies within the band.

Table 5-5. D.P. and Annunciator Troubleshooting

Function Switch	Multiplier Switch	n	μ	m	s	*	Decimal 10^5	10^4	10^3	10^2	10^1	10^0
Period AVG A	1		x		x							x
	10		x		x						x	
	10^2		x		x					x		
	10^3	x			x							x
	10^4	x			x						x	
	10^5	x			x					x		
	10^6	x			x				x			
	10^7	x			x			x				
	10^8	x			x		x					
T.I. AVG A to B	1		x		x							x
	10		x		x						x	
	10^2		x		x					x		
	10^3	x			x							x
	10^4	x			x						x	
	10^5	x			x					x		
	10^6	x			x				x			
	10^7	x			x			x				
	10^8	x			x		x					
T.I. A to B	1		x		x							x
	10		x		x							
	10^2			x	x						x	
	10^3			x	x							x
	10^4			x	x							
	10^5				x						x	
	10^6				x							x
	10^7				x							
	10^8					x						
Period A	1		x		x							x
	10		x		x							
	10^2			x	x						x	
	10^3			x	x							x
	10^4			x	x							
	10^5				x						x	
	10^6				x							x
	10^7				x							
	10^8					x						

Table 5-5. D.P. and Annunciator Troubleshooting (Cont'd)

Function Switch	Multiplier Switch	G	k	M	Hz	Decimal					
						10^5	10^4	10^3	10^2	10^1	10^0
Freq. A	1	x			x					x	
	10			x	x						
	10^2			x	x						x
	10^3			x	x					x	
	10^4			x	x				x		
	10^5		x		x						x
	10^6		x		x					x	
	10^7		x		x				x		
	10^8		x		x			x			
Freq. C DIRECT	1	x			x					x	
	10			x	x						
	10^2			x	x						x
	10^3			x	x					x	
	10^4			x	x				x		
	10^5		x		x						x
	10^6		x		x					x	
	10^7		x		x				x		
	10^8		x		x			x			
Freq. C PRESCALE	1	x			x						x
	10	x			x					x	
	10^2			x	x						
	10^3			x	x						x
	10^4			x	x					x	
	10^5		x		x						
	10^6		x		x						x
	10^7		x		x					x	
	10^8		x		x				x		

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 5326A/5327A Timer/Counter — Test Performed by ____________

Serial No. ____________ Date ____________

DESCRIPTION	CHECK
1. TIME BASE STABILITY AND OUTPUT	
Aging Rate: < 3 parts in 10^7 per month	____
Line Voltage: < 1 part in 10^7 for 10% line variation	____
Temperature: <2.5 parts in 10^6, 0-50°C	____
Output: 10 MHz, > 2.4 volts peak-to-peak	____
2. DISPLAY, DECIMAL POINTS, AND DIVIDERS	
As per self-check procedures, Table 3-1	____
3. FREQUENCY RESPONSE AND SENSITIVITY	
Frequency A Range: 0 to 50 MHz	____
Frequency C Range: 0 to 550 MHz (prescaled 5327A)	____
1 kHz to 50 MHz (direct 5327A)	____
0 to 50 MHz (5326A)	____
Sensitivity, Frequency A and Frequency C (prescaled): 100 mV (5327A)	____
Frequency C (direct): 5 mV	____
Channel A Preset: 0 volts	____
Channel A Level: +3.0 to -3.0 volts	____
Channel B Preset: 0 volts	____
Channel B Level: +3.0 to -3.0 volts	____
4. PULSE OPERATION	
CHANNEL A: Sensitivity: 0.3 volts peak-to-peak	____
Pulse Width: 15 ns	____
INPUT C: Sensitivity: 0.3 volts peak-to-peak	____
Pulse Width: 15 ns	____
5. PERIOD AND PERIOD OPERATION	
Frequency Range: 0 to 10 MHz at 100 mV	____
6. TIME INTERVAL AND TIME INTERVAL AVERAGE	
Time Interval: 0.0 µs at 300 mV	____
Time Interval Average: 1/2 period of input signal	____
7. TOTALIZE	
Range: 0 to 10 MHz	____
Output: Rear panel TIME BASE BNC	____
Factor: 1 to 10^8 in decade steps	____

PERFORMANCE CHECK TEST CARD

8. **RATIO**

Range Channel A: 0 to 50 MHz ______
Range External Input: 100 Hz to 10 MHz ______

9. **GATE OUTPUT AND SAMPLE RATE:** Output: Step c ______
Step e ______
Step f ______
Step h ______

10. **DIGITAL RECORDER**

Print Command: +5V to 0V ______
Output: Corresponds to input data ______

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and HP Part Number of each part, together with any applicable notes. The table includes the following information.

a. Description of part (see abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-2.

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION

6-5. To obtain replacement parts, address order of inquiry to your local Hewlett-Packard Sales and Service Office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part numbers.

6-6. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A	assembly	F	fuse	MP	mechanical part	U	integrated circuit
B	motor	FL	filter	P	plug	V	vacuum, tube, neon bulb, photocell, etc.
BT	battery	IC	integrated circuit	Q	transistor	VR	voltage regulator
C	capacitor	J	jack	R	resistor	W	cable
CP	coupler	K	relay	RT	thermistor	X	socket
CR	diode	L	inductor	S	switch	Y	crystal
DL	delay line	LS	loud speaker	T	transformer	Z	tuned cavity, network
DS	device signaling (lamp)	M	meter	TB	terminal board		
E	misc electronic part	MK	microphone	TP	test point		

ABBREVIATIONS

A	amperes
AFC	automatic frequency control
AMPL	amplifier
BFO	beat frequency oscillator
BE CU	beryllium copper
BH	binder head
BP	bandpass
BRS	brass
BWO	backward wave oscillator
CCW	counter-clockwise
CER	ceramic
CMO	cabinet mount only
COEF	coefficient
COM	common
COMP	composition
COMPL	complete
CONN	connector
CP	cadmium plate
CRT	cathode-ray tube
CW	clockwise
DEPC	deposited carbon
DR	drive
ELECT	electrolytic
ENCAP	encapsulated
EXT	external
F	farads
FH	flat head
FIL H	fillister head
FXD	fixed
G	giga (10^9)
GE	germanium
GL	glass
GRD	ground(ed)

H	henries
HDW	hardware
HEX	hexagonal
HG	mercury
HR	hour(s)
HZ	hertz
IF	intermediate freq
IMPG	impregnated
INCD	incandescent
INCL	include(s)
INS	insulation(ed)
INT	internal
K	kilo - 1000
LH	left hand
LIN	linear taper
LK WASH	lock washer
LOG	logarithmic taper
LPF	low pass filter
M	milli - 10^{-3}
MEG	meg - 10^6
MET FLM	metal film
MET OX	metallic oxide
MFR	manufacturer
MHZ	mega hertz
MINAT	miniature
MOM	momentary
MOS	metal oxide substrate
MTG	mounting
MY	"mylar"
N	nano (10^{-9})
N/C	normally closed
NE	neon
NI PL	nickel plate

N/O	normally open
NOM	nominal
NPO	negative positive zero (zero temperature coefficient)
NPN	negative-positive-negative
NRFR	not recommended for field replacement
NSR	not separately replaceable
OBD	order by description
OH	oval head
OX	oxide
P	peak
PC	printed circuit
PF	picofarads - 10^{-12} farads
PH BRZ	phosphor bronze
PHL	Phillips
PIV	peak inverse voltage
PNP	positive-negative-positive
P/O	part of
POLY	polystyrene
PORC	porcelain
POS	position(s)
POT	potentiometer
PP	peak-to-peak
PT	point
PWV	peak working voltage
RECT	rectifier
RF	radio frequency
RH	round head or right hand

RMO	rack mount only
RMS	root-mean square
RWV	reverse working voltage
S-B	slow-blow
SCR	screw
SE	selenium
SECT	section(s)
SEMICON	semiconductor
SI	silicon
SIL	silver
SL	slide
SPG	spring
SPL	special
SST	stainless steel
SR	split ring
STL	steel
TA	tantalum
TD	time delay
TGL	toggle
THD	thread
TI	titanium
TOL	tolerance
TRIM	trimmer
TWT	traveling wave tube
U	micro 10^{-6}
VAR	variable
VDCW	dc working volts
W/	with
W	watts
WIV	working inverse voltage
WW	wirewound
W/O	without

01194-14

Figure 6-1. Panel Designations

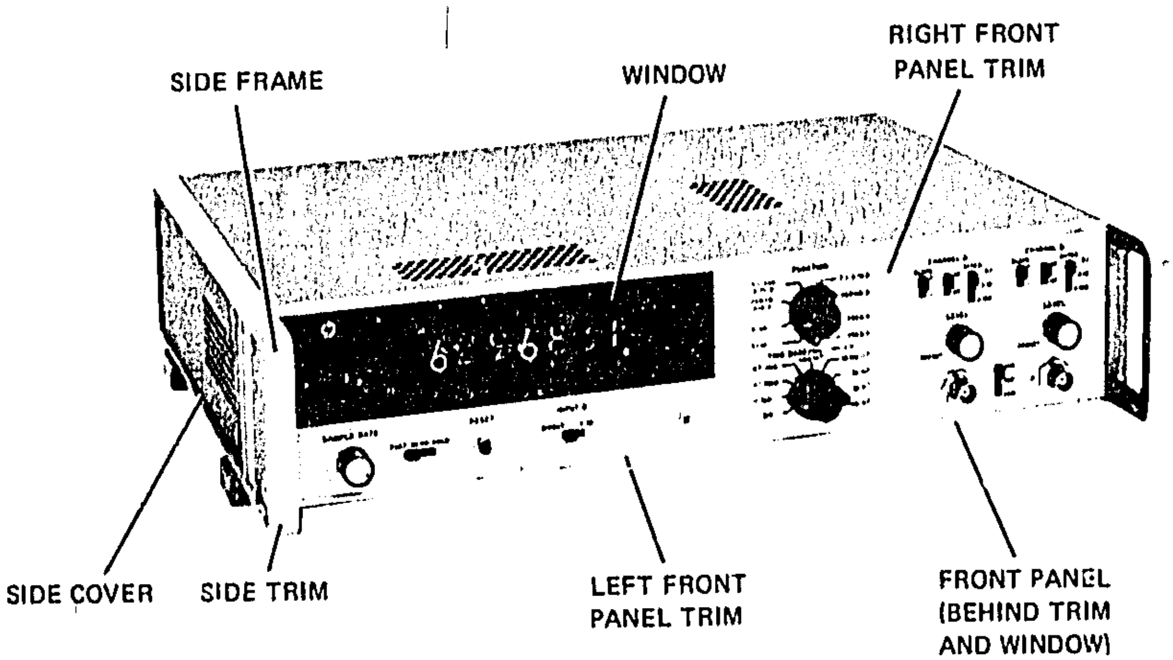


Table 6-1. Replacement Parts, Standard Instrument

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05326-60047	1	ATTENUATOR ASSY (SERIES 1224A) (LOADED ON 05326 20047 BLANK BOARD)	28480	05326-60047
A1C1	0160-2244	2	CAPACITOR, FXD, 3PF+-.25PF # 500WVDC	28480	0160-2244
A1C2	0160-0939	2	CAPACITOR, FXD, 430PF+-5% 300WVDC	28480	0160-0939
A1C3	0160-0378	2	CAPACITOR, FXD, .7PF+-5% 500WVDC	28480	0160-0378
A1C4	0160 0161	15	CAPACITOR, FXD, .01UF 10% 200WVDC	56289	192P10302 PTS
A1C5	0160-2140	2	CAPACITOR, FXD, 470PF+80-20% 1000WVDC	28480	0160-2140
A1C6	0160-2930		CAPACITOR, FXD, .01UF+80-20% 100WVDC	01418	TA
A1C7	0160-2197	2	CAPACITOR, FXD, 10PF+-5% 300WVDC	28480	0160-2197
A1C8	0160-2146	2	CAPACITOR, FXD, .02UF+80-20% 100WVDC	28480	0160 2146
A1C9	0160-2930		CAPACITOR, FXD, .01UF+80-20% 100WVDC	01418	TA
A1C10	0160-2244		CAPACITOR, FXD, 3PF+-.25PF # 500WVDC	28480	0160-2244
A1C11	0160-0939		CAPACITOR, FXD, 430PF+-5% 300WVDC	28480	0160-0939
A1C12	0160-0378		CAPACITOR, FXD, .7PF+-5% 500WVDC	28480	0160-0378
A1C13	0160 0161		CAPACITOR, FXD, .01UF+10% 200WVDC	56289	192P10302 PTS
A1C14	0160 2140		CAPACITOR, FXD, 470PF+80-20% 1000WVDC	28480	0160-2140
A1C15	0160-2930		CAPACITOR, FXD, .01UF+80-20% 100WVDC	01418	TA
A1C16	0160-2197		CAPACITOR, FXD, 10PF+-5% 300WVDC	28480	0160-2197
A1C17	0160-2146		CAPACITOR, FXD, .02UF+80-20% 100WVDC	28480	0160-2146
A1CR1	1910-0016	17	DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR2	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR3	1901-0376	4	DIODE, GEN PRP, SI, 35V MAX VRM 50MA	28480	1901-0376
A1CR4	1901-0376		DIODE, GEN PRP, SI, 35V MAX VRM 50MA	28480	1901-0376
A1CR5			NOT ASSIGNED		
A1CR6	1902-0041	4	DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-0041
A1CR7	1902-0041		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-0041
A1CR8			NOT ASSIGNED		
A1CR9	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR10	1901-0376		DIODE, GEN PRP, SI, 35V MAX VRM 50MA	28480	1901-0376
A1CR11	1901-0376		DIODE, GEN PRP, SI, 35V MAX VRM 50MA	28480	1901-0376
A1CR12			NOT ASSIGNED		
A1CR13	1902-0041		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-0041
A1CR14	1902-0041		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-0041
A1DS1	2140-0047	2	LAMP, GLOW, BULB T-2, 105V	74276	A1C
A1DS2	2140-0047		LAMP, GLOW, BULB T-2, 105V	74276	A1C
A1J1	1251-0472	2	CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-300
A1J2	1251-0472		CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-300
A1J3	1250-[illegible]	2	CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1163
A1J4	125[illegible]63		CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1163
A1Q1	1855-0336	2	TSTR:SI FET DUAL N-CHANNEL	17856	DN377
A1Q2	1855-0336		TSTR:SI FET DUAL N-CHANNEL	17856	DN377
A1R1	0683-2235	4	RESISTOR, FXD, 22K5% .25W CC TUBULAR	01121	CB2235
A1R2	0683-9145	2	RESISTOR, FXD, 910K5% .25W CC TUBULAR	01121	CB9145
A1R3	0683-1015	22	RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A1R4	0757-0947	2	RESISTOR, FXD, 9.1K2% .125W F TUBULAR	24546	C4-1/8-T0-9101-G
A1R5	0757-0973	4	RESISTOR, FXD, 110K2% .125W F TUBULAR	24546	C4-1/8-T0-1102-G
A1R6	0683-1055	4	RESISTOR, FXD, 1M5% .25W CC TUBULAR	01121	CB1055
A1R7	0757-0973		RESISTOR, FXD, 110K2% .125W F TUBULAR	24546	C4-1/8-T0-1102-G
A1R8	0683-2215	8	RESISTOR, FXD, 220 OHM5% .25W CC	01121	CB2215
A1R9	0683-4715	7	RESISTOR, FXD, 470 OHM5% .25W CC	01121	CB4715
A1R10	0683-1055		RESISTOR, FXD, 1M5% .25W CC TUBULAR	01121	CB1055
A1R11	0683-3325	16	RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A1R12	0683-4715		RESISTOR, FXD, 470 OHM5% .25W CC	01121	CB4715
A1R13	0683-4715		RESISTOR, FXD, 470 OHM5% .25W CC	01121	CB4715
A1R14	0683-2225	15	RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A1R15	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A1R16	0683-2235		RESISTOR, FXD, 22K5% .25W CC TUBULAR	01121	CB2235
A1R17	0683-9145		RESISTOR, FXD, 910K5% .25W CC TUBULAR	01121	CB9145
A1R18	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A1R19	0757-0947		RESISTOR, FXD, 9.1K2% .125W F TUBULAR	24546	C4-1/8-T0-9101-G
A1R20	0757-0973		RESISTOR, FXD, 110K2% .125W F TUBULAR	24546	C4-1/8-T0-1102-G
A1R21	0683-1055		RESISTOR, FXD, 1M5% .25W CC TUBULAR	01121	CB1055
A1R22	0757-0973		RESISTOR, FXD, 110K2% .125W F TUBULAR	24546	C4-1/8-T0-1102-G
A1R23	0683-2215		RESISTOR, FXD, 220 OHM5% .25W CC	01121	CB2215
A1R24	2100-3228	2	RESISTOR, VAR, 10K 20% PC SPST SW	28480	2100-3228
A1R25	0683-1055		RESISTOR, FXD, 1M5% .25W CC TUBULAR	01121	CB1055
A1R26	2100-3228		RESISTOR, VAR, 10K 20% PC SPST SW	28480	2100-3228
A1R27	0683-4715		RESISTOR, FXD, 470 OHM5% .25W CC	01121	CB4715
A1R28	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A1R29	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A1R30	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A1R31	0683-1005	6	RESISTOR, FXD, 10 OHM5% .25W CC TUBULAR	01121	CB1005

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R32	0683-1005		RESISTOR, FXD, 10 OHMS 5% .25W CC TUBULAR	01121	CB1005
A1R33	0683-1005		RESISTOR, FXD, 10 OHMS 5% .25W CC TUBULAR	01121	CB1005
A1R34	0683-1005		RESISTOR, FXD, 10 OHMS 5% .25W CC TUBULAR	01121	CB1005
A1S1	3101-1313	1	SWITCH, SL, DP3T NS, .5A 125VAC/DC	28480	3101-1313
A1S2	3101-1279	2	SWITCH, SL, DP3T NS, .5A 125VAC/DC	28480	3101-1279
A1S3	3101-1279		SWITCH, SL, DP3T NS, .5A 125VAC/DC	28480	3101-1279
A1S4	3101-1311	5	SWITCH, SL, DPDT NS, .5A 125VAC/DC	28480	3101-1311
A1S5	3101-1278	2	SWITCH, SL, DPDT NS, .5A 125VAC/DC	28480	3101-1278
A1S6	3101-1278		SWITCH, SL, DPDT NS, .5A 125VAC/DC	28480	3101-1278
A1S7	3101-1311		SWITCH, SL, DPDT NS, .5A 125VAC/DC	28480	3101-1311
A1S8			N.S.R. PART OF R24		
A1S9			N.S.R. PART OF R26		
A2	05326-60004	2	INPUT AMPLIFIER ASSY (SERIES 072) (LOADED ON 05326-20004 BLANK BOARD)	28480	05326-60004
A2C1	0160-2930		CAPACITOR, FXD, .01UF +80-20% 100WVDC	01418	TA
A2C2	0160-2930	1	CAPACITOR, FXD, .01 +80 20% 100WVDC	01418	TA
A2C3	0160-2930		CAPACITOR, FXD, .01UF +80-20% 100WVDC	01418	TA
A2C4	0180-0197	8	CAPACITOR-FXD, 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C5	0180-0197		CAPACITOR-FXD, 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A2C6	0160-0153	4	CAPACITOR, FXD, .001UF+-10% 200WVDC	56289	192P10292
A2C7	0170-0055	4	CAPACITOR, FXD, .1UF+-20% 200WVDC	56289	192P10492
A2C8	0170-0055		CAPACITOR, FXD, .1UF+-20% 200WVDC	56289	192P10492
A2C9	0160-2930		CAPACITOR, FXD, .01UF +80-20% 100WVDC	01418	TA
A2C10	0160-2930		CAPACITOR, FXD, .01UF +80-20% 100WVDC	01418	TA
A2CR1	1902-0049	2	DIODE, VREG, 6.19V VZ, .4W MAX	28480	1902-0049
A2CR2	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A2CR3	1901-0040	20	DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A2CR4	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A2CR5	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A2L1	9140-0144		COIL, FXD, RF 4.7UH	28480	9140-0144
A2L2	9100-2265	4	COIL, FXD, MOLDED RF CHOKE, 47 UH 10%	24226	10/470
A2L3	9140-0144		COIL, FXD, MOLDED RF CHOKE, 4.7UH 10%	24226	10/471
A2L4	9140-0144		COIL, FXD, MOLDED RF CHOKE, 4.7UH 10%	24226	10/471
A2L5	9100-2255		COIL, FXD, MOLDED RF CHOKE, .47UH 10%	24226	10/470
A2L6	9140-0144		COIL, FXD, MOLDED RF CHOKE, 4.7UH 10%	24226	10/471
A2L7	9140-0144		COIL, FXD, MOLDED RF CHOKE, 4.7UH 10%	24226	10/471
A2L8	9140-0142	4	COIL, FXD, MOLDED RF CHOKE, 2.2UH 10%	24226	10/221
A2L9	9140-0144		COIL, FXD, MOLDED RF CHOKE, 4.7UH 10%	24226	10/471
A2L10	9140-0144		COIL, FXD, MOLDED RF CHOKE, 4.7UH 10%	24226	10/471
A2Q1	1854-0092	21	TRANSISTOR, NPN SI	28480	1854-0092
A2Q2	1853-0015	20	TRANSISTOR, PNP SI	28480	1853-0015
A2Q3	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A2Q4	1854-0345	6	TRANSISTOR, 2N5179 NPN SI	04713	2N5179
A2Q5	1854-0345		TRANSISTOR, 2N5179 NPN SI	04713	2N5179
A2Q6	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A2Q7	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A2Q8	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A2Q9	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A2Q10	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A2Q11	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A2Q12	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A2Q13	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A2Q14	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A2Q15	1854-0071	22	TRANSISTOR, NPN SI	28480	1854-0071
A2Q16	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A2Q17	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A2Q18	1854-0345	8	TRANSISTOR, NPN SI	07263	S33307
A2Q19	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A2Q20	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A2R1	0683-6835	1	RESISTOR, FXD, 68K 5% .25W CC TUBULAR	01121	CB6835
A2R2	2100-2520	2	RESISTOR, VAR, TRMR, 50 OHM 20% C	19701	ET50X500
A2R3	0683-2215		RESISTOR, FXD, 220 OHMS 5% .25W CC	01121	CB2215
A2R4	0683-2405	2	RESISTOR, FXD, 24 OHMS 5% .25W CC TUBULAR	01121	CB2405
A2R5	0683-3625	5	RESISTOR, FXD, 3.6K 5% .25W CC TUBULAR	01121	CB3625
A2R6	0683-1015		RESISTOR, FXD, 100 OHMS 5% .25W CC	01121	CB1015
A2R7	0683-3025	7	RESISTOR, FXD, 3K 5% .25W CC TUBULAR	01121	CB3025
A2R8	0683-1025	13	RESISTOR, FXD, 1K 5% .25W CC TUBULAR	01121	CB1025
A2R9	0698-3113	5	RESISTOR, FXD, 100 OHMS 5% .125W CC	01121	BB1015
A2R10	0698-3381	4	RESISTOR, FXD, 150 OHMS 5% .125W CC	01121	BB1515
A2R11	0698-5175	4	RESISTOR, FXD, 360 OHMS 5% .125W CC	01121	BB3615
A2R12	0698-3375	2	RESISTOR, FXD, 68 OHMS 5% .125W CC	01121	BB6805

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2R13	0698-3375	2	RESISTOR, FXD, 33 OHM5% .125W CC	01121	BB3305
A2R14	0683-1525	11	RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A2R15	0698-5180	4	RESISTOR, FXD, 2K5% .125W CC TUBULAR	01121	BB2025
A2R16	0698-5175		RESISTOR, FXD, 360 OHM5% .125W CC	01121	BB3615
A2R17	0698-3381		RESISTOR, FXD, 150 OHM5% .125W CC	01121	BB1515
A2R18	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A2R19	0698-3113		RESISTOR, FXD, 100 OHM5% .125W CC	01121	BB1015
A2R20	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A2R21	0683-3025		RESISTOR, FXD, 3K5% .25W CC TUBULAR	01121	CB3025
A2R22	0683-3625		RESISTOR, FXD, 3.6K5% .25W CC TUBULAR	01121	CB3625
A2R23	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A2R24	2100-2521	2	RESISTOR, VAR, TRMR, 2KOHM 10% C	19701	ET50X202
A2R25	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A2R26	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A2R27	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A2R28	0683-6815	6	RESISTOR, FXD, 680 OHM5% .25W CC	01121	CB6815
A2R29	0683-6815		RESISTOR, FXD, 680 OHM5% .25W CC	01121	CB6815
A2R30	0683-4725	4	RESISTOR, FXD, 4.7K5% .25W CC TUBULAR	01121	CB4725
A2R31	0683-1035	21	RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A2R32	0683-3315	6	RESISTOR, FXD, 330 OHM5% .25W CC	01121	CB3315
A2R33	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A2R34	0683-3315		RESISTOR, FXD, 330 OHM5% .25W CC	01121	CB3315
A2R35	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A2R36	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A2R37	0683-2235		RESISTOR, FXD, 22K5% .25W CC TUBULAR	01121	CB2235
A2R38	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A2R39	0683-2215		RESISTOR, FXD, 220 OHM5% .25W CC	01121	CB2215
A2R40	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A2R41	0683-1525		RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A2R42	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A2R43	0683-3035	2	RESISTOR, FXD, 30K5% .25W CC TUBULAR	01121	CB3035
A2R44	0683-3015	7	RESISTOR, FXD, 300 OHM5% .25W CC	01121	CB3015
A2R45	0683-3315		RESISTOR, FXD, 330 OHM5% .25W CC	01121	CB3315
A2R46	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A2R47	0683-1065	2	RESISTOR, FXD, 10M5% .25W CC TUBULAR	01121	CB1065
A2R48	0683-2055	2	RESISTOR, FXD, 2M5% .25W CC TUBULAR	01121	CB2055
A2R49	0683-2715	5	RESISTOR, FXD, 270 OHM5% .25W CC	01121	CB2715
A2R50	0683-2715		RESISTOR, FXD, 270 OHM5% .25W CC	01121	CB2715
A2U1	1820-0238	2	INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	[illegible]181CP
A2U2	1820-0142	1	INTEGRATED CIRCUIT, DGTL, ECL DUAL 4	04713	MC1004P
A3			SAME AS A2, USE PREFIX A3.		
A4	05326-60002	1	OSCILLATOR ASSY (SERIES 103[illegible]) (LOADED ON 05326-20002 BLANK BOARD)	28480	05326-60002
A4C1	0160-0151	1	CAPACITOR,FXD, .01UF+-10% 200WVDC	56289	292P10392
A4C2	0180-0197		CAPACITOR-FXD, 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A4C3	0121-0059	1	CAPACITOR, VAR, TRMR, CER, 2/8PF	73899	DV11PR8A
A4C4	0160-2264	1	CAPACITOR,FXD, 20PF+-5% 500WVDC	28480	0160-2264
A4C5	0160 2030		CAPACITOR,FXD, .01UF+80-20% 100WVDC	01418	TA
A4L1	9100-2276	1	COIL, FXD, MOLDED RF CHOKE, 100UH 10%	24226	10/103
A4Q1	1850-0158	1	TRANSISTOR, 2N2635 PNP GE	04713	2N2635
A4R1	0698-40[illegible]	1	RESISTOR, FXD, 46.4 OHM1% .125W F	16299	C4-1/8-T0-46R4-F
A4R2	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A4R3	0683-3015		RESISTOR, FXD, 300 OHM5% .25W CC	01121	CB3015
A4R4	0683-3015		RESISTOR, FXD, 300 OHM5% .25W CC	01121	CB3015
A4U1	1820-0142		INTEGRATED CIRCUIT, DGTL, ECL DUAL 4	04713	MC1004P
A4Y1	0410-0405	1	CRYSTAL,QUARTZ 10 MHZ	28480	0410-0405
A5	05326-60005	1	TIME BASE CONTROL ASSY (SERIES 1172) (LOADED ON 05326-2000[illegible] BLANK BOARD)	28480	05326-60005
A5C1	0180-0197		CAPACITOR-FXD, 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A5C2	0160-0127		CAPACITOR,FXD, 1UF+-20% 25WVDC	28480	0160-0127
A5C3	0180-0291	2	CAPACITOR-FXD, 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A5C4	0160-2150	1	CAPACITOR,FXD, 33PF+-5% 300WVDC	28480	0160-2150
A5C5	0160-2204	2	CAPACITOR,FXD, 100PF+-5% 300WVDC	28480	0160-2204
A5CR1	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5Q1	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A5Q2	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A5Q3	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A5Q4	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A5Q5	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A5Q6	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A5R1	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A5R2	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A5R3	0683-5105	4	RESISTOR, FXD, 51 OHM5% .25W CC TUBULAR	01121	CB5105
A5R4	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A5R5	0683-4715		RESISTOR, FXD, 470 OHM5% .25W CC	01121	CB4715
A5R6	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A5R7	0683-1225	2	RESISTOR, FXD, 1.2K5% .25W CC TUBULAR FACTORY SELECTED PART	01121	CB1225
A5R8	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A5R9	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A5R10	0683-2215		RESISTOR, FXD, 220 OHM5% .25W CC	01121	CB2215
A5R11	0683-6835		RESISTOR, FXD, 68K5% .25W CC TUBULAR	01121	CB6835
A5R12	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A5R13	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A5R14	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A5R15	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A5R16	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A5R17	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A5R18	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A5R19	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A5R20	0683-5105		RESISTOR, FXD, 51 OHM5% .25W CC TUBULAR	01121	CB5105
A5R21	0683-5105		RESISTOR, FXD, 51 OHM5% .25W CC TUBULAR	01121	CB5105
A5U1	1820-0413	8	INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0413
A5U2	1820-0413		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0413
A5U3	1820-0413		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0413
A5U4	1820-0413		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0413
A5U5	1820-0054	4	INTEGRATED CIRCUIT, DGTL, TTL QUAD 2	01295	SN7400N
A5U6	1820-0413		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0413
A5U7	1820-0413		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0413
A5U8	1820-0413		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0413
A5U9	1820-0413		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0413
A5U10	1820-0174	1	INTEGRATED CIRCUIT, DGTL, TTL HEX	01295	SN7404N
A6	05326-60013	1	SAMPLE RATE ASSY (SERIES 1224A) (PLACED ON 05326-20013 BLANK BOARD).	28480	05326-60013
A6C1	0160-2201	1	CAPACITOR,FXD, 51PF+-5% 300WVDC	28480	0160-2201
A6C2	0160-0134	1	CAPACITOR,FXD, 220PF+-5% 300WVDC	14655	RDM15F221J3C
A6C3	0180-0228	1	CAPACITOR-FXD, 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A6C4	0160-0166	1	CAPACITOR,FXD, .068UF+-10% 200WVDC	56289	292P68392
A6C5	0140-0195	1	CAPACITOR,FXD, 82PF+-5% 300WVDC	72136	DM15E820J0300WV1CR
A6C6	0160-0153		CAPACITOR,FXD, .001UF+-10% 200WVDC	56289	292P10292
A6C7	0160-2199	2	CAPACITOR,FXD, 30PF+-5% 300WVDC	28480	0160-2199
A6C7			FACTORY SELECTED PART		
A6C8	0160-0153		CAPACITOR,FXD, .001UF+-10% 200WVDC	56289	292P10292
A6C9	0180-0291		CAPACITOR-FXD, 1UF+-10% 35VDC TA-SOLID	56289	150D105X9035A2
A6C10	0160-0161	1	CAPACITOR,FXD, .01UF+-10% 200WVDC	56289	192P10392-PTS
A6C11	0180-0114	2	CAPACITOR-FXD, 50UF+75-10% 25VDC AL	56289	30D506G025BA2
A6C12	0180-0114		CAPACITOR-FXD, 50UF+75-10% 25VDC AL	56289	30D506G025BA2
A6CR1	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR2	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR3	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A6CR4	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A6CR5	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR6			NOT ASSIGNED		
A6CR7	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR8	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR9	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A6CR10	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6CR11	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A6Q1	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6Q2	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6Q3	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6Q4	1854-0009	6	TRANSISTOR, 2N709 NPN SI	28480	1854-0009
A6Q5	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6Q6	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6Q7	1854-0215	1	TRANSISTOR, NPN SI	04713	SPS 3611
A6Q8	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6Q9	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6Q10	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6Q11	1854-0009		TRANSISTOR, 2N709 NPN SI	28480	1854-0009
A6Q12	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6Q13	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A6R1	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A6R2	0683-1525		RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A6R3	0683-5125	8	RESISTOR, FXD, 5.1K5% .25W CC TUBULAR	01121	CB5125
A6R4	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R5	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R6	0683-5125		RESISTOR, FXD, 5.1K5% .25W CC TUBULAR	01121	CB5125
A6R7	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R8	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A6R9	0683-3015		RESISTOR, FXD, 300 OHM5% .25W CC	01121	CB3015
A6R10	0683-2025	9	RESISTOR, FXD, 2K5% .25W CC TUBULAR	01121	CB2025
A6R11	0683-2735	5	RESISTOR, FXD, 27K5% .25W CC TUBULAR	01121	CB2735
A6R12	0683-5125		RESISTOR, FXD, 5.1K5% .25W CC TUBULAR	01121	CB5125
A6R13	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A6R14	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R15	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A6R16	0683-5125		RESISTOR, FXD, 5.1K5% .25W CC TUBULAR	01121	CB5125
A6R17	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A6R18	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A6R19	0683-5115	9	RESISTOR, FXD, 510 OHM5% .25W CC	01121	CB5115
A6R20	0683-2735		RESISTOR, FXD, 27K5% .25W CC TUBULAR	01121	CB2735
A6R21	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R22	0683-3915	1	RESISTOR, FXD, 390 OHM5% .25W CC	01121	CB3915
A6R23	0683-2025		RESISTOR, FXD, 2K5% .25W CC TUBULAR	01121	CB2025
A6R24	0683-6215	1	RESISTOR, FXD, 620 OHM5% .25W CC	01121	CB6215
A6R25	0683-1525		RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A6R26	0683-2025		RESISTOR, FXD, 2K5% .25W CC TUBULAR	01121	CB2025
A6R27	0683-3025		RESISTOR, FXD, 3K5% .25W CC TUBULAR	01121	CB3025
A6R28	0683-9115	1	RESISTOR, FXD, 910 OHM5% .25W CC	01121	CB9115
A6R29	0683-1525		RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A6R30	0683 2415		RESISTOR, FXD, 240 OHM5% .25W CC	01121	CB2415
A6R31	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R32	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R33	0683-2735		RESISTOR, FXD, 27K5% .25W CC TUBULAR	01121	CB2735
A6R34	0683-2735		RESISTOR, FXD, 27K5% .25W CC TUBULAR	01121	CB2735
A6R35	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R36	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R37	0683-2045	1	RESISTOR, FXD, 200K5% .25W CC TUBULAR	01121	CB2045
A6R38	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R39	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A6R40	0683 4735		RESISTOR, FXD, 47K5% .25W CC TUBULAR	01121	CB4735
A6R41	0683-1525		RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A6R42	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A6R43	0683-4735	1	RESISTOR, FXD, 47K5% .25W CC TUBULAR	01121	CB4735
A6R44	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A6U1	1820-0054		INTEGRATED CIRCUIT, DGTL, TTL QUAD 2	01295	SN7400N
A6U2	1820-0272	1	INTEGRATED CIRCUIT, DGTL, ECL TYPE D	04713	MC1022P
A6U3	1820-0068	1	INTEGRATED CIRCUIT, DGTL, TTL TRIPLE 3	01295	SN7410N
A6U4	1820-0054		INTEGRATED CIRCUIT, DGTL, TTL QUAD 2	01295	SN7400N
A6U5	1820-0328	1	INTEGRATED CIRCUIT, DGTL, TTL QUAD 2	01295	SN7402N
A6U6	1820-0147	4	INTEGRATED CIRCUIT, DGTL, ECL TRIPLE 3	04713	MC1007P
A7	05327-60031	1	BOARD ASSY FUNCTION CONTROL (SERIES 1224A) (LOADED ON 05327-20031 BLANK BOARD.	28480	05327-60031
A7C1	0160-2306	1	CAPACITOR,FXD, 27PF+-5% 300WVDC	28480	0160-2306
A7C2	0150-0042	1	CAPACITOR,FXD, 4.7PF+-5% 500WVDC	28480	0150-0042
A7CR1	1901-0536	1	DIODE, PWR RECT, SI, 100V MAX VRM 100A	03508	1N3265R
A7R1	0683-1125	4	RESISTOR, FXD, 1.1K5% .25W CC TUBULAR	01121	CB1125
A7R2	0683-1825	6	RESISTOR, FXD, 1.8K5% .25W CC TUBULAR	01121	CB1825
A7R3	0683-1825		RESISTOR, FXD, 1.8K5% .25W CC TUBULAR	01121	CB1825
A7R4	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A7R5	0683-3925	4	RESISTOR, FXD, 3.9K5% .25W CC TUBULAR	01121	CB3925
A7R6	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A7R7	0683-1125		RESISTOR, FXD, 1.1K5% .25W CC TUBULAR	01121	CB1125
A7R8	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7R9	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A7R10	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A7R11	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A7R12	0683-3325		RESISTOR, FXD, 3.3K5% .25W CC TUBULAR	01121	CB3325
A7R13	0683-1525		RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A7R14	0683-1525		RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A7R15	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A7R16	0683-5115		RESISTOR, FXD, 510 OHM5% .25W CC	01121	CB5115
A7R17	0683-3015		RESISTOR, FXD, 300 OHM5% .25W CC	01121	CB3015
A7R18	0683-3015		RESISTOR, FXD, 300 OHM5% .25W CC	01121	CB3015
A7R19	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A7R20	0683-1125		RESISTOR, FXD, 1.1K5% .25W CC TUBULAR	01121	CB1125
A7R21	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A7R22	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A7R23	0683-4715		RESISTOR, FXD, 470 OHM5% .25W CC	01121	CB4715
A7R24	0683-1515	3	RESISTOR, FXD, 150 OHM5% .25W CC	01121	CB1515
A7R25	0683-2415	1	RESISTOR, FXD, 240 OHM5% .25W CC	01121	CB2415
A7R26	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A7R27	0683-5115		RESISTOR, FXD, 510 OHM5% .25W CC	01121	CB5115
A7R28	0683-5115		RESISTOR, FXD, 510 OHM5% .25W CC	01121	CB5115
A7R29	0683-7515	3	RESISTOR, FXD, 750 OHM5% .25W CC	01121	CB7515
A7R30	0683-5115		RESISTOR, FXD, 510 OHM5% .25W CC	01121	CB5115
A7U1	1820-0102	5	INTEGRATED CIRCUIT, DGTL, ECL J-K FLIP	04713	MC1013P
A7U2	1820-0489	5	IC:ECL	28480	1820-0489
A7U3	1200-0474	2	SOCKET, ELEC, IC 14-CONT DIP SLDR TERM	06776	ICN-143-S3
A7U3	1820-0147		INTEGRATED CIRCUIT, DGTL, ECL TRIPLE 3	04713	MC1007P
A7U4	1820-0102		INTEGRATED CIRCUIT, DGTL, ECL J-K FLIP	04713	MC1013P
A7U5	1820-0440	1	INTEGRATED CIRCUIT, DGTL, ECL DUAL R-S	04713	MC1014P
A7U5	1200-0474		SOCKET, ELEC, IC 14-CONT DIP SLDR TERM	06776	ICN-143-S3
A7U6	1820-0147		INTEGRATED CIRCUIT, DGTL, ECL TRIPLE 3	04713	MC1007P
A7U7	1820-0489		IC:ECL	28480	1820-0489
A7U8	1820-0212	1	INTEGRATED CIRCUIT, DGTL, ECL QUAD LINE	04713	MC1020P
A7U9	1820-0489		IC:ECL	28480	1820-0489
A7U10	1820-0145	1	INTEGRATED CIRCUIT, DGTL, ECL QUAD 2	04713	MC1010P
A7U11	1820-0200	1	INTEGRATED CIRCUIT, DGTL, ECL QUAD	04713	MC1030P
A7U12	1820-0489		IC:ECL	28480	1820-0489
A7U13	1820-0252	1	INTEGRATED CIRCUIT, DGTL, ECL DUAL J-	04713	MC1026P
A7U14	1820-0605	1	INTEGRATED CIRCUIT, DGTL, ECL QUAD LINE	04713	MC10115P
A7U15	1820-0808	1	INTEGRATED CIRCUIT, DGTL, ECL DUAL 3	04713	MC10111P
A8	05326-60009	1	DISPLAY SUPPORT ASSY (SERIES 944) (LOADED ON 05326-20009 BLANK BOARD).	28480	05326-60009
A8C1	0160-2030		CAPACITOR,FXD, .01UF+80-20% 100WVDC	91418	TA
A8C2	0160-2199		CAPACITOR,FXD, 30PF+-5% 300WVDC	28480	0160-2199
A8CR1	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A8CR2	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A8CR3	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A8CR4	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A8P1	1251-2035	1	CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-300
A8Q1	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A8Q2	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A8Q3	1854-0365		TRANSISTOR, NPN SI	07263	S33307
A8Q4	1854-0365		TRANSISTOR, NPN SI	07263	S33307
A8Q5	1854-0365		TRANSISTOR, NPN SI	07263	S33307
A8Q6	1854-0365		TRANSISTOR, NPN SI	07263	S33307
A8Q7	1854-0365		TRANSISTOR, NPN SI	07263	S33307
A8Q8	1854-0365		TRANSISTOR, NPN SI	07263	S33307
A8Q9	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A8Q10	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A8Q11	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A8R1	0683-1125		RESISTOR, FXD, 1.1K5% .25W CC TUBULAR	01121	CB1125
A8R2	0683-1045	7	RESISTOR, FXD, 100K5% .25W CC TUBULAR	01121	CB1045
A8R3	0683-1045		RESISTOR, FXD, 100K5% .25W CC TUBULAR	01121	CB1045
A8R4	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A8R5	0683-1255	6	RESISTOR, FXD, 1.2M5% .25W CC TUBULAR	01121	CB1255
A8R6	0683-1255		RESISTOR, FXD, 1.2M5% .25W CC TUBULAR	01121	CB1255
A8R7	0683-1255		RESISTOR, FXD, 1.2M5% .25W CC TUBULAR	01121	CB1255
A8R8	0683-1255		RESISTOR, FXD, 1.2M5% .25W CC TUBULAR	01121	CB1255
A8R9	0683-1255		RESISTOR, FXD, 1.2M5% .25W CC TUBULAR	01121	CB1255
A8R10	0683-1255		RESISTOR, FXD, 1.2M5% .25W CC TUBULAR	01121	CB1255
A8R11	0683-2425	1	RESISTOR, FXD, 2.4K5% .25W CC TUBULAR	01121	CB2425

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8R12	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A8R13	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A8R14	0683-2715		RESISTOR, FXD, 270 OHM5% .25W CC	01121	CB2715
A8R15	0683-4725		RESISTOR, FXD, 4.7K5% .25W CC TUBULAR	01121	CB4725
A8R16	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A8R17	0683-4725		RESISTOR, FXD, 4.7K5% .25W CC TUBULAR	01121	CB4725
A8R18	0683-5115		RESISTOR, FXD, 510 OHM5% .25W CC	01121	CB5115
A8R19	0683-1045		RESISTOR, FXD, 100K5% .25W CC TUBULAR	01121	CB1045
A8R20	0683-1045		RESISTOR, FXD, 100K5% .25W CC TUBULAR	01121	CB1045
A8R21	0683-2725	2	RESISTOR, FXD, 2.7K5% .25W CC TUBULAR	01121	CB2725
A8R22	0683-5115		RESISTOR, FXD, 510 OHM5% .25W CC	01121	CB5115
A8R23	0683-1045		RESISTOR, FXD, 100K5% .25W CC TUBULAR	01121	CB1045
A8R24	0683-2725		RESISTOR, FXD, 2.7K5% .25W CC TUBULAR	01121	CB2725
A8R25	0683-1535	4	RESISTOR, FXD, 15K5% .25W CC TUBULAR	01121	CB1535
A8R26	0683-2225		RESISTOR, FXD, 2.2K5% .25W CC TUBULAR	01121	CB2225
A8U1	1820-0094	1	INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC846P
A8U2	1820-0307	1	INTEGRATED CIRCUIT, DGTL, DTL HEX	07263	U6A993659X
A8U3	1820-0143	1	INTEGRATED CIRCUIT, DGTL, ECL J-K FLIP	04713	MC1027P
A8U4	1820-0102		INTEGRATED CIRCUIT, DGTL, ECL J-K FLIP	04713	MC1013P
A8U5	1820-0102		INTEGRATED CIRCUIT, DGTL, ECL J-K FLIP	04713	MC1013P
A8U6	1820-0102		INTEGRATED CIRCUIT, DGTL, ECL J-K FLIP	04713	MC1013P
A9	05326-60008/25	1	DISPLAY ASSY (SERIES 1224A) (LOADED ON 05326-20008 BLANK BOARD)	28480	05326-60008/25
A9DS1	1970-0042	6	TUBE, ELCTRN, B5750-5, IND,	28480	1970-0042
A9DS1	1200-0405	6	SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS2	1970-0042		TUBE, ELCTRN, B5750-5, IND,	28480	1970-0042
A9DS2	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS3	1970-0042		TUBE, ELCTRN, B5750-5, IND,	28480	1970-0042
A9DS3	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS4	1970-0042		TUBE, ELCTRN, B5750-5, IND,	28480	1970-0042
A9DS4	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS5	1970-0042		TUBE, ELCTRN, B5750-5, IND,	28480	1970-0042
A9DS5	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS6	1970-0042		TUBE, ELCTRN, B5750-5, IND,	28480	1970-0042
A9DS6	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS7	1970-0042		TUBE, ELCTRN, B5750-5, IND,	28480	1970-0042
A9DS7	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS8	1970-0042		TUBE, ELCTRN, B5750-5, IND,	28480	1970-0042
A9DS8	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9R1	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A9R2	0698-8431	9	R:FXD COMP 7500 OHM 5% 1/4W	28480	0698-8431
A9R3	0683-1026		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB1026
A9R4	0698-8431		R:FXD COMP 7500 OHM 5% 1/4W	28480	0698-8431
A9R5	0698-8431		R:FXD COMP 7500 OHM 5% 1/4W	28480	0698-8431
A9R6	0698-8431		R:FXD COMP 7500 OHM 5% 1/4W	28480	0698-8431
A9R7	0698-8431		R:FXD COMP 7500 OHM 5% 1/4W	28480	0698-8431
A9R8	0698-8431		R:FXD COMP 7500 OHM 5% 1/4W	28480	0698-8431
A9R9	0698-8431		R:FXD COMP 7500 OHM 5% 1/4W	28480	0698-8431
A9R10	0683-1005		RESISTOR, FXD, 10 OHM5% .25W CC TUBULAR	01121	CB1005
A9R11	0698-8431		R:FXD COMP 7500 OHM 5% 1/4W	28480	0698-8431
A9R12	0683-1005		RESISTOR, FXD, 10 OHM5% .25W CC TUBULAR	01121	CB1005
A9U1	1820-0275	1	INTEGRATED CIRCUIT, DGTL, ECL-TO-TTL	04713	MC1035P
A9U2	1820-0232	6	IC:TTL INPT, BLANKING DECADE COUNTER	28480	1820-0232
A9U3	1820-0232		IC:TTL INPT, BLANKING DECADE COUNTER	28480	1820-0232
A9U4	1820-0232		IC:TTL INPT, BLANKING DECADE COUNTER	28480	1820-0232
A9U5	1820-0232		IC:TTL INPT, BLANKING DECADE COUNTER	28480	1820-0232
A9U6	1820-0232		IC:TTL INPT, BLANKING DECADE COUNTER	28480	1820-0232
A9U7	1820-0232		IC:TTL INPT, BLANKING DECADE COUNTER	28480	1820-0232
A9U8	1820-0119	1	INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0119
A9U9	1820-0116	8	INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U10	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U11	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U12	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U13	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U14	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U15	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U16	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U17	1820-0729	1	INTEGRATED CIRCUIT, DGTL, TTL* BCD-TO	28480	1820-0729
A9U18	1820-0092	2	INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U19	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9U20	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U21	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U22	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U23	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U24	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A10	05327-60002	1	RIGHT READOUT ASSY (SERIES 1120A, REV. B) (LOADED ON 05327-20002 BLANK BOARD).	28480	05327-60002
	05326 00009	2	BRACKET READOUT	28480	05326 00009
	05330 40002	6	BLOCK ANNUNCIATOR	28480	05330 40002
	05326 80008	1	INDICATOR MASK (U,N,S)	28480	05326 80008
	05326 80009	1	INDICATOR MASK (V,M,HZ)	28480	05326 80009
	05326 80010	1	INDICATOR MASK (°,K,G)	28480	05326 80010
A10CR1	1901 0040		DIODE SILICON 30MA 30WV	07263	FDG1088
A10CR2	1901 0040		DIODE SILICON 30MA 30WV	07263 28480	FDG1088
A10DS1	2140-0313	14	LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A10DS2	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A10DS3	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A10DS4	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A10DS5	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A10DS6	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A10DS7	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A10DS8	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A10Q1	1854-0009		TRANSISTOR, 2N709 NPN SI	28480	1854-0009
A10Q2	1854-0009		TRANSISTOR, 2N709 NPN SI	28480	1854-0009
A10Q3	1854-0009		TRANSISTOR, 2N709 NPN SI	28480	1854-0009
A10Q4	1854-0474	13	TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10Q5	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10Q6	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10Q7	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10Q8	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10Q9	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10Q10	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10Q11	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10Q12	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A10R1	0683-5125		RESISTOR, FXD, 5.1K5% .25W CC TUBULAR	01121	CB5125
A10R2	0683-5125		RESISTOR, FXD, 5.1K5% .25W CC TUBULAR	01121	CB5125
A10R3	0683-5125		RESISTOR, FXD, 5.1K5% .25W CC TUBULAR	01121	CB5125
A10R4	0683-3025		RESISTOR, FXD, 3K5% .25W CC TUBULAR	01121	CB3025
A10R5	0683-2025		RESISTOR, FXD, 2K5% .25W CC TUBULAR	01121	CB2025
A10R6	0683-2025		RESISTOR, FXD, 2K5% .25W CC TUBULAR	01121	CB2025
A10R7	0683-3025		RESISTOR, FXD, 3K5% .25W CC TUBULAR	01121	CB3025
A10R8	0683-5135	6	RESISTOR, FXD, 51K5% .25W CC TUBULAR	01121	CB5135
A10R9	0683-5135		RESISTOR, FXD, 51K5% .25W CC TUBULAR	01121	CB5135
A10U1	1820-0274	5	INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A10U2	1820-0274		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A10U3	1820-0274		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A10U4	1820-0274		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A10U5	1820-0310	1	INTEGRATED CIRCUIT, DGTL, DTL TRIPLE 3	01295	SN15862N
A10U6	1820-0273	3	INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A10U7	1820-0273		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A11	05327-60003	1	LEFT READOUT ASSY (SERIES 1040A, REV. A) (LOADED ON 05327-20003 BLANK BOARD).	28480	05327-60003
	05326-00009		BRACKET:READOUT	28480	05326-00009
	05330-40002		BLOCK:ANNUNCIATOR	28480	05330-40002
	05326-80011	1	INDICATOR:MASK (EXT, C, OF)	28480	05326-80011
A11C1	0160-2200	1	CAPACITOR,FXD, 43PF+-5% 300WVDC	28480	0160-2200
A11DS1	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A11DS2	2140-0313		LAMP, GLOW, BULB T-2, 58V	08806	C2A-B
A11DS3	2140-0313		LAMP, GLOW, BULB T 2, 68V	08806	C2A-B
A11Q1	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A11Q2	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A11Q3	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474
A11Q4	1854-0474		TRANSISTOR,NPN SI (SELECT IDENT 2N5551)	28480	1854-0474

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11R1	0683-2035	1	RESISTOR, FXD, 20K5% .25W CC TUBULAR	01121	CB2035
A11R2	0683-1035		RESISTOR, FXD, 10K5% .25W CC TUBULAR	01121	CB1035
A11R3	0683-5125		RESISTOR, FXD, 5.1K5% .25W CC TUBULAR	01121	CB5125
A11R4	0683-5135		RESISTOR, FXD, 51K5% .25W CC TUBULAR	01121	CB5135
A11R5	0683-2025		RESISTOR, FXD, 2K5% .25W CC TUBULAR	01121	CB2025
A11R6	0683-5135		RESISTOR, FXD, 51K5% .25W CC TUBULAR	01121	CB5135
A11R7	0683-5126		RESISTOR, FXD, 5100 5% .25W CC TUBULAR	01121	CB5126
A11R8	0683-5135		RESISTOR, FXD, 51K5% .25W CC TUBULAR	01121	CB5135
A11R9	0683-5126		RESISTOR, FXD, 5100 5% .25W CC TUBULAR	01121	CB5126
A11R10	0683-1525		RESISTOR, FXD, 1.5K5% .25W CC TUBULAR	01121	CB1525
A11R11	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A11U1	1820-0054		INTEGRATED CIRCUIT, DGTL, TTL QUAD 2	01295	SN7400N
A11U2	1820-0274		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A11U3	1820-0274		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A11U4	1820-0274		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A11U5	1820-0175	1	INTEGRATED CIRCUIT, DGTL, TTL HEX	01295	SN7405N
A11U6	1820-0274		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A11U7	1820-0273		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A11U8	1820-0274		INTEGRATED CIRCUIT, DGTL, DTL QUAD 2	04713	MC1808P
A12			NOT ASSIGNED		
A13			NOT ASSIGNED		
A14			NOT ASSIGNED		
A15	05326-60020	1	BOARD ASSY POWER SUPPLY (SERIES 1312A) (LOADED ON 05326-20020 BLANK BOARD).	28480	05326-60020
	0510-0207	1	PRESS-IN STANDOFF, 4-40, .188 LG, .062	28480	0510-0207
	2200-0145	1	SCREW,MACHINE, 4-40 UNC-2A .438 IN PAN	71250	
	5040-0409	1	SPACER:SHIELD	28480	5040-0409
A15C1	0160-0163	1	CAPACITOR,FXD, .033UF+-10% 200WVDC	56289	292P33392
A15C2	0180-0114		CAPACITOR-FXD, 40UF+75-10% 25VDC AL	56289	30D405G025BA2
A15C3	0180-0114		CAPACITOR-FXD, 40UF+75-10% 25VDC AL	56289	30D405G025BA2
A15C4	0180-0114		CAPACITOR-FXD, 40UF+75-10% 25VDC AL	56289	30D405G025BA2
A15C5	0180-0114		CAPACITOR-FXD, 40UF+75-10% 25VDC AL	56289	30D405G025BA2
A15C6	0160-3878	26	CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A15C7	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A15C8	0160-3277	2	CAPACITOR,FXD, .01UF+-20% 50WVDC	28480	0160-3277
A15C9	0160-3277		CAPACITOR,FXD, .01UF+-20% 50WVDC	28480	0160-3277
A15CR1	1902-3002	2	DIODE, VREG, 2.37V VZ, .4W MAX	28480	1902-3002
A15CR2	1902-0551	2	DIODE, VREG, 6.19V VZ, 1W MAX	28480	1902-0551
A15CR3	1902-0551		DIODE, VREG, 6.19V VZ, 1W MAX	28480	1902-0551
A15CR4	1902-3002		DIODE, VREG, 2.37V VZ, .4W MAX	28480	1902-3002
A15CR5	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A15CR6	1902-3094	4	DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-3094
A15CR7	1902-3094		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-3094
A15CR8	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A15CR9	1902-3094		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-3094
A15CR10	1902-3094		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-3094
A15CR11	1902-3394	1	DIODE, VREG, 75V VZ, .4W MAX	28480	1902-3394
A15CR12	1902-3429	1	DIODE, VREG, 100V VZ, .4W MAX	28480	1902-3429
A15CR13	1901-0033	2	DIODE, GEN PRP, SI, 100V MAX VRM 200MA	28480	1901-0033
A15CR14	1901-0033		DIODE, GEN PRP, SI, 100V MAX VRM 200MA	28480	1901-0033
A15CR15	1901-0044	4	DIODE, SWITCHING, SI, 50V MAX VRM 50MA	28480	1901-0044
A15CR16	1901-0044		DIODE, SWITCHING, SI, 50V MAX VRM 50MA	28480	1901-0044
A15CR17	1901-0044		DIODE, SWITCHING, SI, 50V MAX VRM 50MA	28480	1901-0044
A15CR18	1901-0044		DIODE, SWITCHING, SI, 50V MAX VRM 50MA	28480	1901-0044
A15F1	2110-0460	1	FUSE:1/32 AMP	28480	2110-0460
A15F1	1400-0110	1	FUSEHOLDER, BIPIN SKT, THD CAP, 5A 125V	71400	BODY WITH O-RING HAF
A15Q1	1854-0300	1	TRANSISTOR, NPN SI	28480	1854-0300
A15Q2	1853-0073	1	TRANSISTOR, PNP SI	28480	1853-0073
A15Q3	1854-0039	1	TRANSISTOR, 2N3053 NPN SI	04713	2N3053
A15Q4	1853-0012	1	TRANSISTOR, 2N2904A PNP SI	01295	2N2904A
A15Q5	1854-0232	1	TRANSISTOR, NPN SI	28480	1854-0232
A15Q6	1853-0020	2	TRANSISTOR, PNP SI	28480	1853-0020
A15Q7	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A15Q8	1854-0474		TRANSISTOR, NPN SI	28480	1854-0474
A15Q9	1854-0071		TRANSISTOR, NPN SI	28480	1854-0071
A15Q10	1853-0020		TRANSISTOR, PNP SI	28480	1853-0020
A15R1	0683-2735		RESISTOR, FXD, 27K5% .25W CC TUBULAR	01121	CB2735
A15R2	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15R3	0683-1015		RESISTOR, FXD, 100 OHM 5% .25W CC	01121	CB1015
A15R4	0683-3925		RESISTOR, FXD, 3.9K 5% .25W CC TUBULAR	01121	CB3925
A15R5	0683-3925		RESISTOR, FXD, 3.9K 5% .25W CC TUBULAR	01121	CB3925
A15R6	0686-1305	1	RESISTOR, FXD, 13 OHM 5% .5W CC TUBULAR	01121	EB1305
A15R7	0683-6816		RESISTOR, FXD, 680 OHM 5% .25W CC TUBULAR	01121	CB6816
A15R8	0683-6816		RESISTOR, FXD, 680 OHM 5% .25W CC TUBULAR	01121	CB6816
A15R9	0683-1325	2	RESISTOR, FXD, 1.3K 5% .25W CC TUBULAR	01121	CB1325
A15R10	2100-2093	2	RESISTOR, VAR, TRMR, 200 OHM 30% CC	28480	2100-2093
A15R11	0683-6815		RESISTOR, FXD, 680 OHM 5% .25W CC	01121	CB6815
A15R12	0683-6815		RESISTOR, FXD, 680 OHM 5% .25W CC	01121	CB6815
A15R13	2100-2093		RESISTOR, VAR, TRMR, 200 OHM 30% CC	28480	2100-2093
A15R14	0683-1325		RESISTOR, FXD, 1.3K 5% .25W CC TUBULAR	01121	CB1325
A15R15	0683-0275	4	RESISTOR, FXD, 2.7 OHM 5% .25W CC	01121	CB27G5
A15R16	0683-0275		RESISTOR, FXD, 2.7 OHM 5% .25W CC	01121	CB27G5
A15R17	0683-0275		RESISTOR, FXD, 2.7 OHM 5% .25W CC	01121	CB27G5
A15R18	0683-0275		RESISTOR, FXD, 2.7 OHM 5% .25W CC	01121	CB27G5
A16	05327-60026	1	BOARD ASSY:CONNECTOR (SERIES 1132A) (LOADED ON 05327-20027 BLANK BOARD)	28480	05327-60026
A16C1	0180-2362	1	CAPACITOR-FXD, 6000UF+75-10% 15VDC AL	28480	0180-2362
A16C2	0180-2296	1	CAPACITOR-FXD, 4000UF+75-10% 15VDC AL	56289	39D167 DSBISEI
A16C3	0180-1962	1	CAPACITOR-FXD, 15UF+50-10% 250VDC AL	56289	39D156F250FJ4
A16C4	0180-2382	2	CAPACITOR-FXD, 1500UF+75-10% 30VDC AL	56289	39D293
A16C5	0180-2382		CAPACITOR-FXD, 1600UF+75-10% 30VDC AL	56289	39D293
A16C6	0160-2204		CAPACITOR-FXD, 100PF+-5% 300WVDC	28480	0160-2204
A16CR1	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A16CR2	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A16CR3	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A16CR4	1901-0028	2	DIODE, PWR RECT, SI, 400V MAX VRM 750MA	28480	1901-0028
A16CR5	1901-0028		DIODE, PWR RECT, SI, 400V MAX VRM 750MA	28480	1901-0028
A16CR6	1901-0029	4	DIODE, PWR RECT, SI, 600V MAX VRM 750MA	28480	1901-0029
A16CR7	1901-0029		DIODE, PWR RECT, SI, 600V MAX VRM 750MA	28480	1901-0029
A16CR8	1901-0029		DIODE, PWR RECT, SI, 600V MAX VRM 750MA	28480	1901-0029
A16CR9	1901-0029		DIODE, PWR RECT, SI, 600V MAX VRM 750MA	28480	1901-0029
A16CR10	1901-0415	4	DIODE, PWR RECT, SI, 50V MAX VRM 1.5A	28480	1901-0415
A16CR11	1901-0415		DIODE, PWR RECT, SI, 50V MAX VRM 1.5A	28480	1901-0415
A16CR12	1901-0415		DIODE, PWR RECT, SI, 50V MAX VRM 1.5A	28480	1901-0415
A16CR13	1901-0415		DIODE, PWR RECT, SI, 50V MAX VRM 1.5A	28480	1901-0415
A16CR14	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A16CR15	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A16CR16	1901-0460	2	DIODE, STABISTOR, SI, 15V MAX VRM 150MA	28480	1901-0460
A16CR17	1901-0460		DIODE, STABISTOR, SI, 15V MAX VRM 150MA	28480	1901-0460
A16CR18	1910-0034	1	DIODE, SWITCHING, GE, 30V MAX VRM 80MA	28480	1910-0034
A16Q1	1854-0005		TRANSISTOR, 2N709 NPN SI	28480	1854-0005
A16R1	0812-0021	1	RESISTOR, FXD, .47 OHM 5% 3W PW TUBULAR	91637	CW2B1-3-T2-47/100-J
A16R2	0812-0021	1	RESISTOR, FXD, 47 OHM 5% 3W PW TUBULAR	91637	CW2B1-3-T2-47/100-J
A16R3	0686-2045	1	RESISTOR, FXD, 200K 5% .5W CC TUBULAR	01121	EB2045
A16R4	0683-0825	1	RESISTOR, FXD, 8.2 OHM 5% .25W CC	01121	CB82G5
A16R5	0683-1025		RESISTOR, FXD, 1K 5% .25W CC TUBULAR	01121	CB1025
A16R6	0683-5115		RESISTOR, FXD, 510 OHM 5% .25W CC	01121	CB5115
A16R7	0698-3153	2	RESISTOR, FXD, 3.83K 1% .125W F TUBULAR	16299	C4-1/8-T0-3831-F
A16R8	0757-0439	1	RESISTOR, FXD, 6.81K 1% .125W F TUBULAR	24546	C4-1/8-T0-6811-F
A16U1	1820-0196	1	INTEGRATED CIRCUIT, LIN, VOLTAGE	07263	U5F7723393
A16XA2	1251-1886	6	CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A16XA3	1251-1886		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A16XA4	1251-1886		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A16XA5	1251-1886		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A16XA6	1251-2134	4	CONNECTOR, PC EDGE, 18-CONT, DIP SOLDER	71785	252-18-30-340
A16XA7	1251-2134		CONNECTOR, PC EDGE, 18-CONT, DIP SOLDER	71785	252-18-30-340
A16XA8	1251-1886		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A16XA9	1251-1886		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A16XA10	1251-2134		CONNECTOR, PC EDGE, 18-CONT, DIP SOLDER	71785	252-18-30-340
A16XA11	1251-2134		CONNECTOR, PC EDGE, 18-CONT, DIP SOLDER	71785	252-18-30-340
A16XA12 THRU	1251-1886		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A16XA15	1251-1886		CONNECTOR, PC EDGE, 15-CONT, DIP SOLDER	71785	252-15-30-340
A16XA18	1251-1886		CONNECTOR, PC EDGE, 15 CONT, DIP SOLDER	71785	252-15-30-340
A17	05326-60031	1	BOARD ASSY:INPUT C AMPLIFIER (SERIES 1136A, REV C) (LOADED ON 05326-20031 BLANK BOARD).	28480	05326-60031

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A17C1	0160-0157		CAPACITOR-FXD, 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A17C2	0160-0157		CAPACITOR-FXD, 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A17C3	0160-2049	4	CAPACITOR-FXD, .005UF+80-20% 500WVDC	28480	0160-2049
A17C4	0160-2049		CAPACITOR-FXD, .005UF+80-20% 500WVDC	28480	0160-2049
A17C5	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A17C6	0180-0106	2	CAPACITOR-FXD, 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
A17C7	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A17C8	0180-0106		CAPACITOR-FXD, 60UF+-20% 6VDC TA-SOLID	56289	150D606X0006B2
A17C9	0150-0055	2	CAPACITOR-FXD, 10PF+-5% 500WVDC	28480	0150-0055
A17C10	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A17C11	0150-0045	1	CAPACITOR-FXD, 8.2PF+-5% 500WVDC	28480	0150-0045
A17C12	0150-0055		CAPACITOR-FXD, 10PF+-5% 500WVDC	28480	0150-0055
A17C13	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A17CR1	1901-0047	2	DIODE, SWITCHING, SI, 20V MAX VRM 75MA	28480	1901-0047
A17CR2	1901-0047		DIODE, SWITCHING, SI, 20V MAX VRM 75MA	28480	1901-0047
A17CR3	1912-0005	1	DIODE-TUNNEL, GERMANIUM	03508	1N3712
A17J1	1250-0836	2	CONNECTOR-COAX, SMC, 50 OHM MALE	98291	50-051-0000
A17L1	9100-2259	1	COIL, FXD, MOLDED RF CHOKE, 1.5UH 10%	24226	10/151
A17L2	9140-0142		COIL, FXD, MOLDED RF CHOKE, 2.2UH 10%	24226	10/221
A17L3	9140-0142		COIL, FXD, MOLDED RF CHOKE, 2.2UH 10%	24226	10/221
A17L4	9100-2256	1	COIL, FXD, MOLDED RF CHOKE, .56UH 10%	24226	10/560
A17MP1	05326-00031	1	SHIELD:NOISE	28480	05326-00031
A17Q1	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A17Q2	1853-0015		TRANSISTOR, PNP SI	28480	1853-0015
A17Q3	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A17Q4	1854-0345		TRANSISTOR, 2N5179 NPN SI	04713	2N5179
A17R1	0760-0012	1	RESISTOR, FXD, 51 OHM 2% 1W MO TUBULAR	28480	0760-0012
A17R2	0758-0093	1	RESISTOR, FXD, 56 OHM 5% .25W F TUBULAR	24546	C5-1/4-T0-56R0-J
A17R3	0683-1045		RESISTOR, FXD, 100K 5% .25W CC TUBULAR	01121	CB1045
A17R4	0683-7515		RESISTOR, FXD, 750 OHM 5% .25W CC	01121	CB7515
A17R5	0683-1515		RESISTOR, FXD, 150 OHM 5% .25W CC	01121	CB1515
A17R6	0683-1825		RESISTOR, FXD, 1.8K 5% .25W CC TUBULAR	01121	CB1825
A17R7	0683-1825		RESISTOR, FXD, 1.8K 5% .25W CC TUBULAR	01121	CB1825
A17R8	0683-1825		RESISTOR, FXD, 1.8K 5% .25W CC TUBULAR	01121	CB1825
A17R9	0683-1825		RESISTOR, FXD, 1.8K 5% .25W CC TUBULAR	01121	CB1825
A17R10	0683-2215		RESISTOR, FXD, 220 OHM 5% .25W CC	01121	CB2215
A17R11	2100-2633	2	RESISTOR, VAR, TRMR, 1KOHM 10% C	19701	ET50X102
A17R12	0683-2015	2	RESISTOR, FXD, 200 OHM 5% .25W CC	01121	CB2015
A17R13	0683-2015		RESISTOR, FXD, 200 OHM 5% .25W CC	01121	CB2015
A17R14	0683-1515		RESISTOR, FXD, 150 OHM 5% .25W CC	01121	CB1515
A17R15	0683-5105		RESISTOR, FXD, 51 OHM 5% .25W CC TUBULAR	01121	CB5105
A17R16	0683-7515		RESISTOR, FXD, 750 OHM 5% .25W CC	01121	CB7515
A17R17	0683-1045		RESISTOR, FXD, 100K 5% .25W CC TUBULAR	01121	CB1045
A17R18	0683-1225		RESISTOR, FXD, 1.2K 5% .25W CC TUBULAR	01121	CB1225
A17R19	0683-3625		RESISTOR, FXD, 3.6K 5% .25W CC TUBULAR	01121	CB3625
A17R20			NOT ASSIGNED		
A17R21	0698-3153		RESISTOR, FXD, 3.83K 1% .125W F TUBULAR	16299	C4-1/8-T0-3831-F
A17R22	0757-0284	1	RESISTOR, FXD, 150 OHM 1% .125W F	24546	C4-1/8-T0-151-F
A17R23	0757-0280	1	RESISTOR, FXD, 1K 1% .125W F TUBULAR	24546	C4-1/8-T0-1001-F
A17R24	0683-4715		RESISTOR, FXD, 470 OHM 5% .25W CC	01121	CB4715
A17R25	0683-5615	1	RESISTOR, FXD, 560 OHM 5% .25W CC	01121	CB5615
A17R26	0757-0416	1	RESISTOR, FXD, 511 OHM 1% .125W F	24546	C4-1/8-T0-511R-F
A17U1	1858-0004	1	INTEGRATED CIRCUIT, LIN, TRANSISTOR	86684	CA3049
A17U2	1820-0147		INTEGRATED CIRCUIT, DGTL, ECL TRIPLE 3	04713	MC1007P
A18	05327-60031	1	BOARD ASSY:HIGH SENSITIVITY PRESCALER (SERIES 1248A) (LOADED ON 05327-20033 BLANK BOARD).	28480	05327-60031
A18C1	0180-0228		CAPACITOR-FXD, 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A18C2	0160-2049		CAPACITOR-FXD, .005UF+80-20% 500WVDC	28480	0160-2049
A18C3	0160-3879	3	CAPACITOR-FXD, .01UF+-20% 100WVDC	28480	0160-3879
A18C4	0160-2049		CAPACITOR-FXD, .005UF+80-20% 500WVDC	28480	0160-2049
A18C5	0180-0228		CAPACITOR-FXD, 22UF+-10% 15VDC TA-SOLID	56289	150D226X9015B2
A18C6	0160-3879		CAPACITOR-FXD, .01UF+-20% 100WVDC	28480	0160-3879
A18C7	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C8	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C9	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C10	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C11	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C12	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C13	0160-3878		CAPACITOR-FXD, .001UF+-20% 100WVDC	28480	0160-3878

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18C14	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C15	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C16	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C17	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C18	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C19	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C20	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C21	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C22	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C23	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C24	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C25	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C26	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C27	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18C28	0160-3879		CAPACITOR,FXD, .01UF+-20% 100WVDC	28480	0160-3879
A18C29	0160-3878		CAPACITOR,FXD, .001UF+-20% 100WVDC	28480	0160-3878
A18CR1	1901-0050	2	DIODE, SWITCHING, SI, 80V MAX VRM 200MA	28480	1901-0050
A18CR2	1901-0050		DIODE, SWITCHING, SI, 80V MAX VRM 200MA	28480	1901-0050
A18CR3	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A18CR4	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A18CR5	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A18CR6	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A18F1	2110-0436	2	FUSE, .1A 125V	28480	2110-0436
A18F2	2110-0436		FUSE, .1A 125V	28480	2110-0436
A18J1	1250-0836		CONNECTOR-COAX, SMC, 50 OHM MALE	98291	50-053-0000
A18L1	9100-1788	2	COIL:CHOKE	02114	VK200-10/4B
A18L2	9100-1788		COIL:CHOKE	02114	VK200-10/4B
A18Q1	1854-0345		TRANSISTOR, 2N5179 NPN SI	04713	2N5179
A18Q2	1854-0092		TRANSISTOR, NPN SI	28480	1854-0092
A18R1	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A18R2	0698-5996	2	RESISTOR, FXD, 560 OHM5% .125W CC	01121	BB5615
A18R3	2100-2633		RESISTOR, VAR, TRMR, 1KOHM 10% C	19701	ET50X102
A18R4	0683-3925		RESISTOR, FXD, 3.9K5% .25W CC TUBULAR	01121	[illegible]3925
A18R5	0698-3378	5	RESISTOR, FXD, 51 OHM5% .125W CC	01121	BB[illegible]05
A18R6	0698-3378		RESISTOR, FXD, 51 OHM5% .125W CC	01121	[illegible]
A18R7	0698-3111	5	RESISTOR, FXD, 30 OHM5% .125W CC	01121	BB3005
A18R8	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A18R9	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A18R10	2100-2413	2	RESISTOR, VAR, TRMR, 200 OHM 10% C	19701	ET50X201
A18R11	0698-6283	2	RESISTOR, FXD, 10 OHM5% .125W CC	01121	BB1005
A18R12	0683-1505	2	RESISTOR, FXD, 15 OHM5% .25W CC TUBULAR	01121	CB1505
A18R13	0698-3374	4	RESISTOR, FXD, 20 OHM5% .125W CC	01121	BB2005
A18R14			NOT ASSIGNED		
A18R15	0698-5180		RESISTOR, FXD, 2K5% .125W CC TUBULAR	01121	BB2025
A18R16	0698-3378		RESISTOR, FXD, 51 OHM5% .125W CC	01121	BB5105
A18R17	0698-3374		RESISTOR, FXD, 20 OHM5% .125W CC	01121	BB2005
A18R18	0683-4315	5	RESISTOR, FXD, 430 OHM5% .25W CC	01121	CB4315
A18R19	0698-5180		RESISTOR, FXD, 2K5% .125W CC TUBULAR	01121	BB2025
A18R20	0698-3111		RESISTOR, FXD, 30 OHM5% .125W CC	01121	BB3005
A18R21	0698-5996		RESISTOR, FXD, 560 OHM5% .125W CC	01121	BB5615
A18R22	0698-4131	4	RESISTOR, FXD, 56 OHM5% .125W CC	01121	BB5605
A18R23	0698-4131		RESISTOR, FXD, 56 OHM5% .125W CC	01121	BB5605
A18R24	0698-3111		RESISTOR, FXD, 30 OHM5% .125W CC	01121	BB3005
A18R25	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A18R26	0683-1015		RESISTOR, FXD, 100 OHM5% .25W CC	01121	CB1015
A18R27	2100-2413		RESISTOR, VAR, TRMR, 200 OHM 10% C	19701	ET50X201
A18R28	0698-6283		RESISTOR, FXD, 10 OHM5% .125W CC	01121	BB1005
A18R29	0698-5103	2	RESISTOR, FXD, 430 OHM5% .125W CC	01121	BB4315
A18R30	0698-5103		RESISTOR, FXD, 430 OHM5% .125W CC	01121	BB4315
A18R31	0683-1505		RESISTOR, FXD, 15 OHM5% .25W CC TUBULAR	01121	CB1505
A18R32			NOT ASSIGNED		
A18R33	0698-3374		RESISTOR, FXD, 20 OHM5% .125W CC	01121	BB2005
A18R34	0698-5175	1	RESISTOR, FXD, 1.8K5% .125W CC TUBULAR	01121	BB1825
A18R35	0698-3378		RESISTOR, FXD, 51 OHM5% .125W CC	01121	BB5105
A18R36	0698-3111		RESISTOR, FXD, 30 OHM5% .125W CC	01121	BB3005
A18R37	0698-3378		RESISTOR, FXD, 51 OHM5% .125W CC	01121	BB5105
A18R38	0698-3374		RESISTOR, FXD, 20 OHM5% .125W CC	01121	BB2005
A18R39	0683-4315		RESISTOR, FXD, 430 OHM5% .25W CC	01121	CB4315
A18R40	0698-4131		RESISTOR, FXD, 56 OHM5% .125W CC	01121	BB5605
A18R41	0698-5563	1	RESISTOR, FXD, 180 OHM5% .125W CC	01121	BB1815
A18R42	0698-4131		RESISTOR, FXD, 56 OHM5% .125W CC	01121	BB5605
A18R43	0698-3111		RESISTOR, FXD, 30 OHM5% .125W CC	01121	BB3005
A18R44	0698-3113		RESISTOR, FXD, 100 OHM5% .125W CC	01121	BB1015
A18R45			NOT ASSIGNED		
A18R46	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18R47	0683-3905	1	RESISTOR, FXD, 39 OHM5% .25W CC TUBULAR	01121	CB3905
A18R48	0683-8215	1	RESISTOR, FXD, 820 OHM5% .25W CC	01121	CB8215
A18R49	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A18R50	0683-4315		RESISTOR, FXD, 430 OHM5% .25W CC	01121	CB4315
A18R51	0683-4315		RESISTOR, FXD, 430 OHM5% .25W CC	01121	CB4315
A18R52	0683-4315		RESISTOR, FXD, 430 OHM5% .25W CC	01121	CB4315
A18U1	5088-7002	1	IC:LIMITER	28480	5088-7002
A18U2	1826-0084	1	INTEGRATED CIRCUIT, LIN, WIDE BAND	28480	1826-0084
A18U3	1826-0085	1	INTEGRATED CIRCUIT, LIN, WIDE BAND	28480	1826-0085
A18U4	1820-0736	1	IC:DIGITAL	28480	1820-0736
OR	OR				
A18U4	1820-0558	1	IC:DUAL-BINARY	28480	1820-0558
A18U5	1820-0714	1	IC:DIGITAL QUINARY DIVIDER	28480	1820-0714
A18U6	1820-0489		IC:ECL	28480	1820-0489
A18U7	1821-0001	2	INTEGRATED CIRCUIT, LIN, TRANSISTOR	02735	CA3046
A18U8	1821-0001		INTEGRATED CIRCUIT, LIN, TRANSISTOR	02735	CA3046
A18U9	1820-0802	1	INTEGRATED CIRCUIT, DGTL, ECL QUAD 2	04713	MC10102P

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			INTERNAL & OTHER PARTS		
	0370-0104	9	KNOB:BLK BAR W/ARROW 1/4" SHAFT	28480	0370-0104
			(TIME BASE/FUNCTION)		
	01821-67401	2	KNOB:TRIGGER LEVEL	28480	01821-67401
			(LEVEL)		
	00180-67403	6	KNOB ASSY	28480	00180-67403
			(SAMPLE RATE)		
	5040-0170	3	GUIDE:PLUG-IN PC BOARD	28480	5040-0170
	5060-0109		CONNECTOR:15 CONTACTS	28480	5060-0109
	05326-00010	1	SHIELD:NIXIE	28480	05326-00010
	05326-00018	1	CHASSIS	28480	05326-00018
	05326-20046	1	BOARD:REAR PANEL CONNECTOR	28480	05326-20046
	05326-60032	1	CABLE ASSY:POWER	28480	05326-60032
	05327-60037	1	CABLE ASSY:PRESCALER	28480	05327-60037
	8120-1378	1	CABLE, UNSHLD 3-COND 18AWG	70903	KH-7081
			PAINTED CABINET PARTS		
	05325-00009	1	COVER:BOTTOM(OPT X95)	28480	05325-00009
	05326-00006	1	RIGHT FRONT PANEL TRIM	28480	05326-00006
	05326-00003	1	LEFT FRONT PANEL TRIM, OPT A85/X95	28480	05326-00003
			(COLOR OPTION A85/X95)		
	05326-00021	2	SIDE COVER	28480	05326-00021
	05326-00022	1	TOP COVER(OPT X95)	28480	05326-00022
	05326-60029	2	KIT:RACK MOUNT(OPT A85/X95)	28480	05326-60029
			CONSISTING OF:		
	2370-0012	3	SCREW,MACHINE, 6-32 UNC-2A .25 IN 100	90123	
	2510-0047	4	SCREW,MACHINE, 8-32 UNC-2A .4.8 IN PAN	78901	
	5020-0706	1	BRACKET:LEFT	28480	5020-0706
	5020-0707	1	BRACKET:RIGHT	28480	5020-0707
	05326-40002	1	STRIP:FILLER GRAY	28480	05326-40002
			OTHER CABINET PARTS		
	0460-0114	12	TAPE:POLYURETHANE 1-1/4 IN WIDE	05471	TESAMOLL-2
			(FOR TOP COVER)		
	1490-0030	1	WIREFORM	28480	1490-0030
	5000-0050	2	TRIM:SIDES	28480	5000-0050
	5060-0729	2	FRAME ASSY:3 X 11(SIDE)	28480	5060-0729
	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
	05326-00001	1	PANEL:FRONT	28480	05326-00001
	05326-00032	1	PANEL:REAR	28480	05327-00032
	05326-00008	1	INSULATOR	28480	05326-00008
	05326-00011	1	PLATE:CONNECTOR,LONG	28480	05326-00011
	05326-20012	1	WINDOW (5326A)	28480	05326-20012
	05327-20010	1	WINDOW (5327A)	28480	05327-20010
	7120-1254	1	PLATE, INFO, HP LOGO; ABS BASE	28480	7120-1254
	05326-00033	1	ADAPTER:(CONNECTOR(OPT 002)	28480	05326-00033
	05326-00020	1	PANEL:FRONT TRIM,OPT A85/X95(5326A ONLY	28480	05326-00020
	05326-00023	1	PANEL:FRONT TRIM, STD	28480	05326-00023
	05326-00024	1	PANEL:FRONT EXTRU, STD COLOR(5326A ONLY	28480	05326-00024
	05327-00002	1	PANEL:FRONT EXTRU,OPT A85/X95(5327A)	28480	05327-00002
	05326-60029		KIT:RACK MOUNT(OPT A85/X95)	28480	05326-60029
	05326-60046	1	KIT:RACK MOUNT, STD COLOR	28480	05326-60046
	05327-00009	1	PANEL:FRONT EXTRU, STD COLOR(5327A)	28480	05327-00009

See introduction to this section for ordering information

Table 6-1. Replacement Parts, Standard Instrument (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			[illegible] PARTS		
B1	3140-0030	1	MOTOR, ELEC, INDUCTION 115VAC 3000 RPM	28480	3140-0030
B1	3150-0035	1	FILTER, EXPANDED ALUMINUM	28480	3150-0035
B1	3160-0035	1	FAN-BLADE, AXL, 2.25 OD .1250	04866	3160-0035
B1	5212A-128	1	BRACKET:FAN	28480	5212A-128
C1	0160-3043	1	CAPACITOR,FXD, .005UF/.005UF+-20%	28480	0160-3043
F1	2110 0020		FUSE, 0.8A 250V SLO BLO	75915	313 800S
F1	2110 0304	1	FUSE, 1.6A 250V SLO-BLO	71400	MDX 1-1/2A
J1			NOT ASSIGNED		
J2	1250-1253	5	CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1253
J3	1250-1253		CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1253
J4	1250-1253		CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1253
J5	1250-1253		CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1253
J6	1250-1253		CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1253
J7			PART OF 05327-60033 PRESCALER ASSY		
J8	1251-2357	1	CONNECTOR, AC PWR, HP-9 MALE FLANGE	82389	EAC301
J9			NOT ASSIGNED		
J10			NOT ASSIGNED		
J11	1250-0212	1	CONNECTOR-COAX, BNC, 50 OHM FEMALE	95712	30409-1
P1	5060-0109	2	CONNECTOR:15 CONTACTS	28480	5060-0109
Q1	1853-0233	1	TRANSISTOR, PNP SI	28480	1853-0233
Q1	05327-20024	2	HEAT SINK FOR Q1 AND Q2	28480	05327-20024
Q1	1200-0081	2	INSULATOR, BSHG,FLG, .115 ID	26365	974-307
Q1	0340-0765	2	INSULATOR, XSTR, .002 THK	28480	0340-0765
Q2	1854-0420	1	TRANSISTOR, NPN SI	28480	1854-0420
Q2	05327-20024		HEAT SINK FOR Q1 AND Q2	28480	05327-20024
Q2	1200-0081		INSULATOR, BSHG,FLG, .115 ID	26365	974-307
Q2	0340-0765		INSULATOR, XSTR, .002 THK	28480	0340-0765
Q2	7124-2195	1	LABEL FOR HEAT SINK	28480	7124-2195
R1	2100-2961	1	RESISTOR, VAR, 1M 20% SPST SW	28480	2100-2961
S1			PART OF R1		
S2	3101-1327	1	SWITCH, SL, DP3T NS, .5A 125VAC/DC (FAST-NORM-HOLD)	28480	3101-1327
S3	3101-1216	1	SWITCH, PB 1 STA LITTEL SPST (RESET)	28480	3101-1216
S4	3101-1311		SWITCH, SL, DPDT NS, .5A 125VAC/DC (INPUT C)	28480	3101-1311
S5	05326-60016	1	SWITCH ASSY:TIME BASE(WIRED)	28480	05326-60016
S6	05326-60019	1	SWITCH ASSY:FUNCTION	28480	05326-60019
S7	3101-1311		SWITCH, SL, DPDT NS, .5A 125VAC/DC (OSC-INT/EXT)	28480	3101-1311
S8	3101-1311		SWITCH, SL, DPDT NS, .5A 125VAC/DC (STORAGE)	28480	3101-1311
S9	3101-1234	1	SWITCH, SL, DPDT NS, 6A 250VAC (SELECTOR 115/230V)	28480	3101-1234
T1	9100-3020	1	TRANSFORMER:POWER (5326A/5327A)	28480	9100-3020

See introduction to this section for ordering information

Table 6-2. Replacement Parts, Options

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			(OPTION 001 - 8 DIGIT DISPLAY) DELETE A9 05326-60008 AND REPLACE WITH A9 05326-60025.		
A9	05326-60025	38	DISPLAY ASSY (SERIES 1032A)	28480	05326-60025
			(LOADED ON 05326-20008 BLANK BOARD)		
A9DS1	1970-0042	8	TUBE, ELECTRN, B5750-S, IND,	28480	1970-0042
A9DS1	1200-0405	8	SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS2	1970-0042		TUBE, ELECTRN, B5750-S, IND,	28480	1970-0042
A9DS2	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS3	1970-0042		TUBE, ELECTRN, B5750-S, IND,	28480	1970-0042
A9DS3	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS4	1970-0042		TUBE, ELECTRN, B5750-S, IND,	28480	1970-0042
A9DS4	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS5	1970-0042		TUBE, ELECTRN, B5750-S, IND,	28480	1970-0042
A9DS5	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS6	1970-0042		TUBE, ELECTRN, B5750-S, IND,	28480	1970-0042
A9DS6	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS7	1970-0042		TUBE, ELECTRN, B5750-S, IND,	28480	1970-0042
A9DS7	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9DS8	1970-0042		TUBE, ELECTRN, B5750-S, IND,	28480	1970-0042
A9DS8	1200-0405		SOCKET, ELEC, TUBE 14-CONT NIXIE PKG	83781	RTS-44
A9R1	0683-1025	2	RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A9R2	0683-7525	8	RESISTOR, FXD, 7.5K5% .25W CC TUBULAR	01121	CB7525
A9R3	0683-1025		RESISTOR, FXD, 1K5% .25W CC TUBULAR	01121	CB1025
A9R4	0683-7525		RESISTOR, FXD, 7.5K5% .25W CC TUBULAR	01121	CB7525
A9R5	0683-7525		RESISTOR, FXD, 7.5K5% .25W CC TUBULAR	01121	CB7525
A9R6	0683-7525		RESISTOR, FXD, 7.5K5% .25W CC TUBULAR	01121	CB7525
A9R7	0683-7525		RESISTOR, FXD, 7.5K5% .25W CC TUBULAR	01121	CB7525
A9R8	0683-7525		RESISTOR, FXD, 7.5K5% .25W CC TUBULAR	01121	CB7525
A9R9	0683-7525		RESISTOR, FXD, 7.5K5% .25W CC TUBULAR	01121	CB7525
A9R10	0683-1005	1	RESISTOR, FXD, 10 OHM5% .25W CC TUBULAR	01121	CB1005
A9R11	0683-7525		RESISTOR, FXD, 7.5K5% .25W CC TUBULAR	01121	CB7525
A9U1	1820-0275	1	INTEGRATED CIRCUIT, DGTL, ECL-TO-TTL	04713	MC1039P
A9U2	1820-0119	7	INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0119
A9U3	1820-0119		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0119
A9U4	1820-0119		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0119
A9U5	1820-0119		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0119
A9U6	1820-0119		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0119
A9U7	1820-0119		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0119
A9U8	1820-0119		INTEGRATED CIRCUIT, DGTL, TTL DECADE	28480	1820-0119
A9U9	1820-0116	8	INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U10	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U11	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U12	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U13	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U14	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U15	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U16	1820-0116		INTEGRATED CIRCUIT, DGTL, TTL* 4-BIT	28480	1820-0116
A9U17	1820-0092	8	INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U18	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U19	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U20	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U21	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	1820-0092
A9U22	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	0092
A9U23	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	0092
A9U24	1820-0092		INTEGRATED CIRCUIT, DGTL, TTL*	28480	0092
			OPTION 002 (REMOTE PROGRAMMING) DELETE 5060-0109 - 15 CONTACT CONNECTOR AND ADD 05327-60013 CABLE ASSY.		
	05327-60013	1	CABLE ASSY,PROGRAMMING	28480	05327-60013
			CONSISTING OF:		
J10	1251-0065	1	CONNECTOR, 36 CONT, FEM, MICRO RIBBON	71785	57-40360-376
W2P1	5060-0113	1	CONNECTOR 45 CONTACT	28480	5060-0113
W2P2	1200-0063	1	LUG CRIMP	28480	1200-0063
			OPTION 003 - DIGITAL OUTPUT. ADD 05326-60012 CABLE ASSY		
J9	1251-0087	1	CONNECTOR, 60 CONT, FEM, MICRO RIBBON	71785	57-40600-375
W1P1	1251-2262	2	CONNECTOR, PC EDGE, 10 CONT, SOLDER EYE	71785	251-10-30-400
W1P2	1251-2262		CONNECTOR, PC EDGE, 10 CONT, SOLDER EYE	71785	251-10-30-400

See introduction to this section for ordering information

Table 6-2. Replacement Parts, Options (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			OPTION 004 EXTENDED REMOTE PROGRAMMING DELETE A1 05326-60047 AND REPLACE WITH A1 05327-60034. DELETE 05326-00004 REAR PANEL & REPLACE WITH 05327-00005 REAR PANEL. ADD W2 CABLE 05327-60019.		
A1	05327-60034	1	BOARD ASSY:REMOTE ATTENUATOR (SERIES 1224A) (LOADED ON 05327-20034 BLANK BOARD).	28480	05327-60034
A1C1	0150-0031	2	CAPACITOR,FXD, 2PF+-5% 500WVDC	28480	0150-0031
A1C2	0150-0031		CAPACITOR,FXD, 2PF+-5% 500WVDC	28480	0150-0031
A1C3	0140-0[illegible]	2	CAPACITOR,FXD, 220PF+-1% 300WVDC	72136	DM15F221F0300WV1C
A1C4	0140-0[illegible]1		CAPACITOR,FXD, 220PF+-1% 300WVDC	72136	DM15F221F0300WV1C
A1C5	0160-0207	2	CAPACITOR,FXD, .01UF+-5% 200WVDC	56289	292P10352
A1C6	0160-0207		CAPACITOR,FXD, .01UF+-5% 200WVDC	56289	292P10352
A1C7	0140-0149	3	CAPACITOR,FXD, 470PF+-5% 300WVDC	72136	DM15F471J0300WV1CR
A1C8	0140-0149		CAPACITOR,FXD, 470PF+-5% 300WVDC	72136	DM15F471J0300WV1CR
A1C9	0160-2055	2	CAPACITOR,FXD, .01UF+80-20% 100WVDC	28480	0160-2055
A1C10	0160-3028	2	CAPACITOR,FXD, 10PF+-10% 100WVDC	28480	0160-3028
A1C11	0160-2055		CAPACITOR,FXD, .01UF+80-20% 100WVDC	28480	0160-2055
A1C12	0160-3028		CAPACITOR,FXD, 10PF+-10% 100WVDC	28480	0160-3028
A1C13	0140-0199	2	CAPACITOR,FXD, 240PF+-5% 300WVDC	72136	DM15F241J0300WV1CR
A1C14	0140-0199		CAPACITOR,FXD, 240PF+-5% 300WVDC	72136	DM15F241J0300WV1CR
A1CR1	1910-0016	8	DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR2	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR3	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR4	1902-0025	1	DIODE, VREG, 10V VZ, .4W MAX	28480	1902-0025
A1CR5	1902-0057	1	DIODE, VREG, 6.49V VZ, .4W MAX	28480	1902-0057
A1CR6	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR7	1906-0024	4	DIODE, MULT, GENERAL PURPOSE SWITCHING,	04713	MMD6150
A1CR8	1906-0024		DIODE, MULT, GENERAL PURPOSE SWITCHING,	04713	MMD6150
A1CR9	1906-0025	4	DIODE, MULT, GENERAL PURPOSE SWITCHING,	04713	MMD6100
A1CR10	1906-0025		DIODE, MULT, GENERAL PURPOSE SWITCHING,	04713	MMD6100
A1CR11	1901-0040	10	DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR12	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR13	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR14	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR15	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR16	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR17	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR18	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR19	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR20	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR21	1906-0025		DIODE, MULT, GENERAL PURPOSE SWITCHING,	04713	MMD6100
A1CR22	1906-0025		DIODE, MULT, GENERAL PURPOSE SWITCHING,	04713	MMD6100
A1CR23	1906-0024		DIODE, MULT, GENERAL PURPOSE SWITCHING,	04713	MMD6150
A1CR24	1906-0024		DIODE, MULT, GENERAL PURPOSE SWITCHING,	04713	MMD6150
A1CR25	1901-0376	4	DIODE, GEN PRP, SI, 35V MAX VRM 50MA	28480	1901-0376
A1CR26	1901-0376		DIODE, GEN PRP, SI, 35V MAX VRM 50MA	28480	1901-0376
A1CR27	1901-0376		DIODE, GEN PRP, SI, 35V MAX VRM 50MA	28480	1901-0376
A1CR28	1901-0376		DIODE, GEN PRP, SI, 35V MAX VRM 50MA	28480	1901-0376
A1CR29	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1CR30	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR31	1910-0016		DIODE, SWITCHING, GE, 60V MAX VRM 60MA	28480	1910-0016
A1CR32	1902-0041	4	DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-0041
A1CR33	1902-0041		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-0041
A1CR34	1902-0041		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-0041
A1CR35	1902-0041		DIODE, VREG, 5.11V VZ, .4W MAX	28480	1902-0041
A1CR36	1901-0040		DIODE, SWITCHING, SI, 30V MAX VRM 50MA	28480	1901-0040
A1DS1	2140-0047	2	LAMP, GLOW, BULB T-2, 105V	74276	A1C
A1DS2	2140-0047		LAMP, GLOW, BULB T-2, 105V	74276	A1C
A1J1	1251-0472	2	CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-300
A1J2	1251-0472		CONNECTOR, PC EDGE, 6-CONT, DIP SOLDER	71785	252-06-30-300
A1J3	1250-1163	2	CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1163
A1J4	1250-1163		CONNECTOR-COAX, BNC, 50 OHM FEMALE	28480	1250-1163
A1K1	0490-0399	5	RELAY, REED, 1A .1A 250V CONT, 12V COIL	28480	0490-0399
A1K2	0490-0399		RELAY, REED, 1A .1A 250V CONT, 12V COIL	28480	0490-0399
A1K3	0490-0399		RELAY, REED, 1A .1A 250V CONT, 12V COIL	28480	0490-0399
A1K4	0490-0399		RELAY, REED, 1A .1A 250V CONT, 12V COIL	28480	0490-0399
A1K5	0490-0399		RELAY, REED, 1A .1A 250V CONT, 12V COIL	28480	0490-0399

See introduction to this section for ordering information

Table 6-2. Replacement Parts, Options (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1Q1	1854-0039	1	TRANSISTOR, 2N3053 NPN SI	04713	2N3053
A1Q2	1853-0001	1	TRANSISTOR, PNP SI	28480	1853-0001
A1Q3	1854-0215	5	TRANSISTOR, NPN SI	04713	SPS 3611
A1Q4	1854-0215		TRANSISTOR, NPN SI	04713	SPS 3611
A1Q5	1853-0036	4	TRANSISTOR, PNP SI	28480	1853-0036
A1Q6	1853-0036		TRANSISTOR, PNP SI	28480	1853-0036
A1Q7	1854-0215		TRANSISTOR, NPN SI	04713	SPS 3611
A1Q8	1854-0215		TRANSISTOR, NPN SI	04713	SPS 3611
A1Q9	1853-0036		TRANSISTOR, PNP SI	28480	1853-0036
A1Q10	1853-0036		TRANSISTOR, PNP SI	28480	1853-0036
A1Q11	1854-0215		TRANSISTOR, NPN SI	04713	SPS 3611
A1Q12	1854-0215		TRANSISTOR, NPN SI	04713	SPS 3611
A1Q13	1855-0334	2	TSTR:SI FET DUAL N-CHANNEL	17856	DN377
A1Q14	1855-0334		TSTR:SI FET DUAL N-CHANNEL	17856	DN377
A1R1	0698-6123	2	RESISTOR, FXD, 20K5% .125W CC TUBULAR	01121	BB2035
A1R2	0698-6123		RESISTOR, FXD, 20K5% .125W CC TUBULAR	01121	BB2035
A1R3	0698-5565	6	RESISTOR, FXD, 2.2K5% .125W CC TUBULAR	01121	BB2225
A1R4	0698-5565		RESISTOR, FXD, 2.2K5% .125W CC TUBULAR	01121	BB2225
A1R5	0686-1515	1	RESISTOR, FXD, 150 OHM5% .5W CC TUBULAR	01121	EB1515
A1R6	0686-1015	1	RESISTOR, FXD, 100 OHM5% .5W CC TUBULAR	01121	EB1015
A1R7	0698-3381	6	RESISTOR, FXD, 150 OHM5% .125W CC	01121	BB1515
A1R8	0698-3381		RESISTOR, FXD, 150 OHM5% .125W CC	01121	BB1515
A1R9	2100-2633	2	RESISTOR, VAR, TRMR, 1KOHM 10% C	19701	ET50X102
A1R10	0698-5103	2	RESISTOR, FXD, 430 OHM5% .125W CC	01121	BB4315
A1R11	0698-5103		RESISTOR, FXD, 430 OHM5% .125W CC	01121	BB4315
A1R12	0698-7965	2	RESISTOR, FXD, 330K5% .125W CC TUBULAR	28480	0698-7965
A1R13	0698-7966	2	RESISTOR, FXD, 680K5% .125W CC TUBULAR	01121	BB6845
A1R14	0698-7966		RESISTOR, FXD, 680K5% .125W CC TUBULAR	01121	BB6845
A1R15	0698-7965		RESISTOR, FXD, 330K5% .125W CC TUBULAR	28480	0698-7965
A1R16	0757-0467	2	RESISTOR, FXD, 121K1% .125W F TUBULAR	24546	C4-1/8-T0-1213-F
A1R17	0757-0467		RESISTOR, FXD, 121K1% .125W F TUBULAR	24546	C4-1/8-T0-1213-F
A1R18	0698-3381		RESISTOR, FXD, 150 OHM5% .125W CC	01121	BB1515
A1R19	0683-3015	2	RESISTOR, FXD, 300 OHM5% .25W CC	01121	CB3015
A1R20	0698-3381		RESISTOR, FXD, 150 OHM5% .125W CC	01121	BB1515
A1R21	0683-3015		RESISTOR, FXD, 300 OHM5% .25W CC	01121	CB3015
A1R22	0698-5568	2	RESISTOR, FXD, 36K5% .125W CC TUBULAR	01121	BB3635
A1R23	0698-6244	4	RESISTOR, FXD, 3.3K5% .125W CC TUBULAR	01121	BB3325
A1R24	0698-5568		RESISTOR, FXD, 36K5% .125W CC TUBULAR	01121	BB3635
A1R25	0698-6244		RESISTOR, FXD, 3.3K5% .125W CC TUBULAR	01121	BB3325
A1R26	0683-1515	2	RESISTOR, FXD, 150 OHM5% .25W CC	01121	CB1515
A1R27	0683-1515		RESISTOR, FXD, 150 OHM5% .25W CC	01121	CB1515
A1R28	0698-6301	2	RESISTOR, FXD, 1.1K5% .125W CC TUBULAR	01121	BB1125
A1R29	0698-6301		RESISTOR, FXD, 1.1K5% .125W CC TUBULAR	01121	BB1125
A1R30	0698-7097	4	RESISTOR, FXD, 1M5% .125W CC TUBULAR	01121	BB1055
A1R31	0698-7097		RESISTOR, FXD, 1M5% .125W CC TUBULAR	01121	BB1055
A1R32	2100-2574	2	RESISTOR, VAR, TRMR, 500 OHM 10% C	19701	ET50X501
A1R33	2100-2574		RESISTOR, VAR, TRMR, 500 OHM 10% C	19701	ET50X501
A1R34	0698-7964	2	RESISTOR, FXD, 100K5% .125W CC TUBULAR	28480	0698-7964
A1R35	0698-7964		RESISTOR, FXD, 100K5% .125W CC TUBULAR	28480	0698-7964
A1R36	0698-3381		RESISTOR, FXD, 150 OHM5% .125W CC	01121	BB1515
A1R37	0698-3381		RESISTOR, FXD, 150 OHM5% .125W CC	01121	BB1515
A1R38	0698-5174	4	RESISTOR, FXD, 200 OHM5% .125W CC	01121	BB2015
A1R39	0698-5174		RESISTOR, FXD, 200 OHM5% .125W CC	01121	BB2015
A1R40	0698-6984	2	RESISTOR, FXD, 470 OHM5% .125W CC	01121	BB4715
A1R41	0698-6984		RESISTOR, FXD, 470 OHM5% .125W CC	01121	BB4715
A1R42	0698-7097		RESISTOR, FXD, 1M5% .125W CC TUBULAR	01121	BB1055
A1R43	0698-7097		RESISTOR, FXD, 1M5% .125W CC TUBULAR	01121	BB1055
A1R44	0698-6244		RESISTOR, FXD, 3.3K5% .125W CC TUBULAR	01121	BB3325
A1R45	0698-6244		RESISTOR, FXD, 3.3K5% .125W CC TUBULAR	01121	BB3325
A1R46	0698-5561	2	RESISTOR, FXD, 6.8 OHM5% .125W CC	01121	BB68G5
A1R47	0698-5561		RESISTOR, FXD, 6.8 OHM5% .125W CC	01121	BB68G5
A1R48	0698-5174		RESISTOR, FXD, 200 OHM5% .125W CC	01121	BB2015
A1R49	2100-2905	2	R:VAR CERMET 10K OHM 10% LIN	28480	2100-2905
A1R50	0698-5174		RESISTOR, FXD, 200 OHM5% .125W CC	01121	BB2015
A1R51	2100-2905		R:VAR CERMET 10K OHM 10% LIN	28480	2100-2905
A1R52	0698-5565		RESISTOR, FXD, 2.2K5% .125W CC TUBULAR	01121	BB2225
A1R53	0698-5565		RESISTOR, FXD, 2.2K5% .125W CC TUBULAR	01121	BB2225
A1R54	0698-5565		RESISTOR, FXD, 2.2K5% .125W CC TUBULAR	01121	BB2225
A1R55	0698-5565		RESISTOR, FXD, 2.2K5% .125W CC TUBULAR	01121	BB2225
A1R56	2100-2633		RESISTOR, VAR, TRMR, 1KOHM 10% C	19701	ET50X102
A1S1	3101-1313	3	SWITCH, SL, DP3T NS, .5A 125VAC/DC	28480	3101-1313
A1S2	3101-1313		SWITCH, SL, DP3T NS, .5A 125VAC/DC	28480	3101-1313
A1S3	3101-1313		SWITCH, SL, DP3T NS, .5A 125VAC/DC	28480	3101-1313
A1S4	3101-1311	4	SWITCH, SL, DPDT NS, .5A 125VAC/DC	28480	3101-1311
A1S5	3101-1311		SWITCH, SL, DPDT NS, .5A 125VAC/DC	28480	3101-1311

See introduction to this section for ordering information

Table 6-2. Replacement Parts, Options (Cont'd)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A152			PART OF A49,		
A157			PART OF A51,		
A156	3101-1311		SWITCH, SL, DPDT NS, .5A 125VAC/DC	28480	3101-1311
A15?	3101-1311		SWITCH, SL, DPDT NS, .5A 125VAC/DC	28480	3101-1311
A101	1820-0274	1	INTEGRATED CIRCUIT, DGTL, HTL QUAD 2	04713	MC780P
A102	1820-0287	2	INTEGRATED CIRCUIT, DGTL, HTL QUAD 2	04713	MC672P
A103	1820-0625	1	INTEGRATED CIRCUIT, DGTL, HTL TRIPLE	04713	MC666P
A104	1820-0287		INTEGRATED CIRCUIT, DGTL, HTL QUAD 2	04713	MC672P
W2	05327-60010	1	CABLE ASSY	28480	05327-60010
W2P1	6060-0113	1	CONNECTOR PRESSURE 45 CONTACT	28480	6060-0113
W2P2	1200-0063	1	LUG CRIMP	28480	1200-0063
J10	1251-0087		CONNECTOR FEMALE 60 PIN MINIATURE	28480	1251-0087

See introduction to this section for ordering information

Table 6-3. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
02114	FERROXCUBE CORP.	SAUGERTIES, N.Y.	12477
02735	RCA SOLID STATE & RECEIVING TUBE DIV.	SOMERVILLE, N.J.	08876
03508	G.E. CO. SEMICONDUCTOR PROD. DEPT.	SYRACUSE, N.Y.	13201
04713	MOTOROLA SEMICONDUCTOR PROD. INC.	PHOENIX, ARIZ.	85008
04868	HEINZ MUELLER ENGINEERING CO INC	FOREST PARK IL	60130
06776	ROBINSON NUGENT INC	NEW ALBANY IN	47150
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
08806	G.E. CO. MINIATURE LAMP DEPT.	CLEVELAND, OHIO	44112
16299	CORNING GLASS WORKS ELECTRONIC COMPONENTS DIVISION	RALEIGH NC	27604
17856	SILICONIX INC.	SUNNYVALE, CALIF.	94086
19701	ELECTRA/MIDLAND CORP.	MINERAL WELLS, TEX.	76067
24226	GOWANDA ELECTRONICS CORP	GOWANDA NY	14070
24546			
26365	GRIES REPRODUCER CORP.	NEW ROCHELLE, N.Y.	10802
28480	HEWLETT-PACKARD CO. CORPORATE HQ	YOUR NEAREST HP OFFICE	
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
78901			
70903	BELDEN CORP.	CHICAGO, ILL.	60644
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.	
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
73899	JFD ELECTRONICS CORP.	BROOKLYN, N.Y.	11219
74276	SIGNALITE INC	NEPTUNE, N.J.	07752
77250	PHEOLL MFG. CO. DIV. ALLIED PROD. CORP.	CHICAGO, ILL.	60650
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
83781	NATIONAL ELECTRONICS INC	GENEVA IL	60134
85471	BOYD A.B. CO.	SAN FRANCISCO,CALIF.	94103
86684	RCA ELECTRONIC COMPONENTS	HARRISON, N.J.	07029
90123	HARPER H M CO THE	MORTON GROVE IL	60053
91637	DALE ELECTRONICS INC.	COLUMBUS, NEB.	68601
95712	BENDIX CORP. THE MICROWAVE DEVICE DIV.	FRANKLIN, IND.	46131
98291	SEALECTRO CORP.	MAMARONECK, N.Y.	10544

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION

7-2. This section contains information necessary to adapt this manual to older instruments. Also included is the operating and installation information for available options. Refer to Section II for remote programming requirements.

7-3. OPTIONS

7-4. Options 001 through 004 are available for 5326A and 5327A models. The following paragraphs describe each option's purpose and operation.

7-5. Option 001, 8-Digit Display

7-6. Option 001 is the addition of an eighth digit to the display assembly. This addition becomes the most significant digit and extends the counter's resolution at higher frequencies. The digit is always blanked if the reading is "0". Option 001 consists of A9 Display Assembly 05326-60025 in place of 05326-60008.

7-7. Option 002, Remote Programming

7-8. Option 002 allows the counter to be computer controlled from a 36-pin connector on the counter's rear panel. Programming instructions are given in Section II. A schematic diagram is included in Section VIII.

7-9. Option 003, Digital Recorder Output

7-10. The data displayed on the counter's front panel can be permanently recorded by connecting a printer to the counter via Option 003. The necessary signals are coupled from A9 Display Assembly to an HP 5055A or 5050B Digital Recorder through J9 on the counter's rear panel (also, see Table 1-3 for specifications and Section VIII for pin references).

7-11. Option 004, Extended Remote Programming

7-12. This option is similar to Option 002 except it includes the remote programming of the AC/DC, SEP-COM-CHK, FAST/NORM, and ATTEN switches. Remote programming of the attenuator board is achieved by connecting the DTL input lines in parallel with the front panel switches (connected at cable points 1 through 8). When the counter is being externally controlled, the A COM line goes high. This high turns off diodes A1CR6, 18, 2, 3, 15, 30, 31, and 1, and disables the front panel switches.

7-13. Option 010 Temperature Compensated Oscillator

7-14. Option 010 consists of a Temperature Compensated Crystal Oscillator (TCXO) (05327-60036) in place of Oscillator Assembly A4 (05326-60002). This option is available for 5326A instruments with Serial Prefix 1032A and above or for all 5327B instruments. The TCXO is not field repairable.

7-15. Option 011 Oven Oscillator

7-16. Option 011 consists of an HP Oven Oscillator (10544-60011) in place of Oscillator Assembly A4 (05326-60002). This option is available for 5326A instruments with Serial Prefix 1240A and above or for 5327A instruments with Serial Prefix 1236A and above. The oven oscillator is not field repairable; for replacement or repair, order rebuilt assembly 10544-60511.

7-17. FIELD INSTALLATION OF OPTIONS

7-18. Installation of Option 001, 8th Digit

7-19. Parts required to install this option are:

1820-0119 Decade Counter U8
1820-0116 Buffer Storage U16
1820-0092 Decoder Driver U24
1970-0042 Display Tube DS8

a. Remove right and left readout boards, A10 and A11.

b. Remove two screws holding display tube shield and remove shield.

c. Remove display board A6 and display support board A8 from the counter by pulling up on the display support board A8. Separate A8 from A9.

d. Install parts on A9 as shown in the component location photo on Figure 8-13 of this manual.

e. Remove R10 to prevent overflow information from U7. R12 carries the overflow when Option 001 is installed. Replace boards in instrument.

f. Perform Self-Check in Table 3-1. Especially note that the OF (overflow) lamp lights when the left-most digit changes from 9 to 0.

7-20. Installation of Option 002, Remote Programming

7-21. To install remote programming capability in units not so equipped, order remote cable assembly HP Part No. 05327-60013, two 4-40 x ¼-inch machine screws, and one 6-32 x ⅝-inch machine screw with hex nut.

a. Remove the plate covering the lower opening in the rear panel for Option 002.

b. The rear-panel interconnect board containing the wiring from the rear-panel BNC's and switches must be removed. To accomplish this, remove the nuts holding the rear-panel BNC's.

c. Remove two screws holding P1A (the 1⅞-inch, black, pressure connector) to the interconnect A16.

d. Remove side covers and six screws holding rear panel. Loosen one side frame. Pull rear panel away from the instrument.

e. Remove the rear-panel interconnect board from the instrument and separate it from P1A by removing two screws.

f. Feed the pressure connector through hole in rear-panel and mount rear-panel connector J10, with screws removed earlier. Position J10 with pin 1 near the side frame.

g. Assemble the rear-panel interconnect board and the new 5-inch long pressure connector P1 with three 6-32 x ⅝-inch screws and hex nuts. Be certain that proper contact is made between interconnect board and P1.

h. Attach P1 to the motherboard using four 4-40 x ¼-inch screws. Do not tighten screws. Route cable as shown in the top internal photo of instrument, Figure 8-4.

CAUTION

SCREWS LONGER THAN ¼-INCH WILL DAMAGE P1.

i. Gently reinstall rear panel. Install BNC lock nuts so that the board is still movable.

j. Observe the alignment of the connector in the motherboard. Tighten the four screws holding P1 to the motherboard, making sure to maintain proper contact.

k. Check contact alignment of P1 with motherboard and with the rear-panel interconnect board. If necessary, loosen the screws in P1 and shift slightly to obtain proper terminal contact.

l. Tighten BNC lock nuts and reassemble instrument.

m. Run a complete performance check on the unit to verify that remote programming is working properly.

7-22. Installation of Option 003, Digital Recorder Output

7-23. Order digital recorder cable assembly HP Part No. 05326-60012.

a. Remove the plate covering the upper opening in the rear panel.

b. Remove right and left readout boards A10 and A11. Remove two screws holding the display tube shield and remove shield. Remove display support board A8 and the display board A9 by pulling up on A8.

c. Feed the two pressure connectors of the recorder cable through the rear panel and mount J9 on the rear panel, using the screws previously removed. Position J9 so pin 1 is near the side frame.

d. Slide the connectors on the A9 board, shown in the photo on Figure 8-4. The connector with the long wires attaches to J1 and is positioned so that pin 1 is toward the front of the instrument. The other connector attaches to J2, and pin 1 is toward the rear of the instrument.

e. Position the P1 cable so it passes between A8 and A11, completely clearing A8. Reinstall A8 and A9.

f. Route the cable around T1 and in front of A8 assembly.

g. Reassemble unit and run a proof-of-performance check of the digital output to verify that the option is installed properly.

7-24. Installation of Option 004, Extended Remote Programming

7-25. Field installation of Option 004 is not available.

7-26. Installation of Option 010 and 011, Oscillator Assemblies

7-27. Remove the standard oscillator A4 and insert the option into XA4 connector. The Option 011 assembly must be mounted to the interconnect board with 6 x 32, ½" screws. Place the fiber washers on the underside of the board.

7-28. MANUAL CHANGES

7-29. This manual applies directly to Model 5326A and 5327A with serial prefix 1312A. Refer to paragraph 1-4 for a description of serial prefixes.

7-30. Newer Instruments

7-31. As changes are made, newer instruments may have serial prefixes that are not listed in this manual. The manuals for these instruments are supplied with a manual change sheet, containing the required information. Contact the nearest Hewlett-Packard Sales and Service Offices if the change sheet is missing.

7-32. Older Instruments

7-33. To adapt this manual to instruments with serial prefixes prior to 1312A, make the backdating changes that apply to your instrument, as listed in the table below.

IMPORTANT

For Model 5326A instruments with serial prefix 1044A or below, a separate manual is required. Older Model 5326A/B 50 MHz Timer/Counter/DVM Operating and Service Manual.

Table 7-1. Manual Backdating Changes

5326A BACKDATING		5327A BACKDATING	
If your 5326A has serial prefix	Make the following changes to your manual	If your 5327A has serial prefix	Make the following changes to your manual
1240A	14	1248A	14
1224A	14, 11	1236A	14, 13
1144A	14, 11, 10	1224A	14, 13, 12, 11
1136A	14, 11, 10, 7, 8	1220A	14, 13, 12, 11, 10
1132A	14, 11, 10, 7, 8, 3	1120A	14, 13, 12, 11, 10, 9-4
1116A	14, 11, 10, 7, 8, 3, 2	1040A	14-4, 11

CHANGE 1

Table 6-1:

Change part numbers to:

COVER: SIDE 3X11 ... 5000-0729 2 ea.
COVER: TOP .... 05325-00008 1 ea.
INSULATOR (Q1 & Q2) ... 0340-0162 2 ea.

NOTE

If replacement of above parts are required, replace with new parts listed in Table 6-1.

Table 6-1 and Figure 8-14 (A10 schematic):
Delete A10CR1 and CR2. Change board series number to 1040A.

CHANGE 2

Figure 8-17, A17 schematic:

Replace Figure 8-17 schematic with Figure 7-1.
Replace Figure 8-17 component locator with Figure 7-2.

Table 6-1:

Delete A17C13 CF .001μF 75V 0160-0975.
Delete A17R25, R26 R:FXD 560 OHM .25W 0683-5615.
Change A17R22 to 120 OHM .25W 0683-1215.
Change A17R23 to 1200 OHM .25W 0683-1225.
Add A17R20 270 OHM .25W 0683-2715.
Change A17 board series to read 1116A Rev A.

CHANGE 3

Table 6-1:

Under chassis parts, change part number of T1 to 9100-2888. (The 9100-3020 has additional current capabilities for special high-stability oscillators.) For replacement, order 9100-3020.

Table 6-1 and Figure 8-16:

Change part number of A16 Interconnect Board to 05327-60005, series 1040A. (The 05327-60026 board accepts special high stability time base assemblies.)

CHANGE 4

Table 6-1:

Change A6R19 to 0683-2025 R:FXD 2000 OHM 5% 1/4W 01121 CB2025.
Change A6 board series to 1036A.

CHANGE 4 (Cont'd)

Table 7-2:
Change A7C2 to 0160-0333 C:FXD MICA 15PF 3000VDCW,00853, RDM 15C150D: C.
Figure 8-10, A6 schematic: Change A6R19 to 2000 OHM.
Figure 7-3, A7 schematic: Change A7C2 to 15PF.

CHANGE 5

Table 6-1:
Change A15CR15-18 to 1901-0040
Change A15R17, R18 to 0683-0395 R:FXD COMP 3.9 OHM 5% 1/4W.
Change board series to 1104A.

Figure 8-16, A15 schematic:
Change A15R17, R18 to 3.9 OHM

Table 6-1:
Under chassis parts, add T1 9100-2888 TRANSFORMER: POWER (5327A). For T1 (9100-3020) change descritpion to indicate use for 5326A only.

CHANGE 6

Table 6-1:
Change A17CR3 to 1912-0007.
Change A17Q4 to 1854-0092.
Change A17R21 to 0683-3625 R:FXD COMP 3600 OHM 5% 1/4W 01121 CB 3625.
Change A17R22 to 0683-1515 R:FXD COMP 150 OHM 5% 1/4W 01121 CB 1515.
Change A17R23 to 0683-1025 R:FXD COMP 1000 OHM 5% 1/4W 01121 CB 1025.
Change A17R26 to 0683-5615 R:FXD COMP 560 OHM 5% 1/4W 01121 CB 5615.
Change board series number to 1128A.

Figure 8-17:
Change A17R21 to 3600 OHM.
Change A17R26 to 560 OHM.
In table of active elements, change part number of A17CR3 to 1912-0007. Change A7Q4 to 1854-0092.
At top of A17 schematic, change series number to 1128A.

CHANGE 7

This change is concerned with the older cabinet colors. 5326A instruments with serial prefixes below 1144A and 5327A instruments with serial prefixes below 1220A had standard colors of light gray panels and blue textered cabinets. For replacement, order parts identified as option X95.

CHANGE 8

Table 6-1:
Delete A15C8 and description.

Figure 8-16, A15 schematic diagram:
Delete A15C8.
Change board series number 1104A.

CHANGE 9

Table 7-3 and Figures 7-6 and 7-7:
Delete the following: A19 05327-60032 Protection Board and all A19 parts. Also delete A19 component locator.

Table 1-2, Table 1-3:
Under specifications for INPUT CHANNEL C, change maximum input to 5 volts rms, 7.5 volts peak.

CHANGE 10

Table 6-1:
Change part number of A1 to 05326-60003 series 944 (loaded on 05326-20003 blank board).
Change part numbers of A1R24 and A1R26 to 2100-2905.
Under other cabinet parts, change 05326-00032 to 05326-00004.
Delete: 05326-00011, 05326-00033, and 05326-20046.
Add 05326-00012 plate: Connector, short J10 cover.
Add 05326-20028 Board: Blank (Rear Panel Interconnect).
Add 05327-00005 Panel: Rear (Option 004).

Figure 8-6, A1 schematic:
Change assembly part number at top of schematic to 05326-60003 series 944A.

CHANGE 11

Paragraph 7-18:
Add following parts to parts required to install Option 001: 0683-7525 7.5KΩ 1/4W resistor R11, 1200-0405 Display Tube Socket

Paragraph 7-18, step e.
Delete step e and replace with the following:
R10 carries the overflow information from the decades and can be placed one of two locations. Move R10 to the location shown in Figure 7-9. In this location, R10 connects to pin 8 of U8.

Figure 8-13:
Replace schematic and componet locator for A9 with Figures 7-8 and 7-9.

Table 6-1:
Delete A6R44 and description.

Figure 8-10, A6 schematic diagram:
Delete A6R44. Draw a straight-through connection from A6C10 to pin 2.

CHANGE 11 (Cont'd)

Table 6-1:

Change A9 part number to "05326-60008".
Delete the following parts and descriptions: A9R11, A9R12, A9U8, A9U16, A9U24, A9DS8, A9XDS8, and A9XU8.
Delete the following parts and descriptions: A16C6, A16CR18, A16Q1, A16R4, A16R5, A16R6, A16R7, A16R8, and A16U1.

Figure 8-22, A16 schematic diagram:

Delete schematic diagram for this portion of A16.

Table 6-1:

Replace parts list for A7 (05327-60031) with Table 7-2 (parts list for 05327-60004).

Figure 8-11, A7 schematic diagram:

Replace schematic diagram with Figure 7-3 (schematic for 05327-60004).
Replace component locator with Figure 7-4.

CHANGE 12

Page 3-5, Figures 3-4 and 3-5:

Indicate that instruments with serial prefixes below 1236A have the INPUT C connector on the front panel.

Table 6-1:

Change A9R2, R4 through R9, and R11 to "0683-7525 R:FXD COMP 7500 OHM 5% 1/4W 01121 CB 7525".
Change A9U17 to "1820-0092".
Under internal and other parts, change 05327-60037 to "05327-60011". Also delete "05327-00009 Panel: Front Extru standard color (5327A only)".

CHANGE 13

Table 6-1:

Delete parts list for A18 and replace with Table 7-3.

Figure 8-18, A18 schematic and component Locator:

Delete component locator and replace with Figure 7-5.
Replace schematic diagram with Figures 7-6 and 7-7.

CHANGE 14

Table 6-1:

Change A9R2, R4-9, and R11 to "0757-0440 R:FXD MET FLM 7500 OHM 5% 1/4W 01121 CB 7525".
Change A15R1 to "0683-2035 R:FXD COMP 20K OHM 5% 1/4W 01121 CB 2035".
Change A15R6 to "0683-1505 to R:FXD COMP 15 OHM 5% 1/2W 01121 EB 1505".
Delete A15F1, A15XF1 and descriptions.
Change board series to 1136A.

Figure 8-16, A15 schematic:

Change A15R1 to 20K.
Change A15R6 to 15 OHM.
Delete A15F1 and draw a straight through connection to pins 1 and A.
Change board series number to 1136A.

Table 7-2. A7 (05327-60004 Series 1132A) Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7	05327-60004	1	BOARD ASSY:FUNCTION CONTROL (SERIES 1132A) (LOADED ON 05327-20004 BLANK BOARD)	28480	05327-60004
A7C1			NOT ASSIGNED		
A7C2	0140-0201	1	C:FXD MICA 12 PF	28480	0140-0201
A7C3	0160-2327	5	C:FXD CER 1000 PF 20% 100VDCW	96733	810488X102M
A7C4	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	810488X102M
A7C5	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	810488X102M
A7C6	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	810488X102M
A7C7	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	810488X102M
A7Q1	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q2	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q3	1854-0009		TSTR:SI NPN	80131	2N709
A7Q4	1854-0009		TSTR:SI NPN	80131	2N709
A7Q5	1854-0009		TSTR:SI NPN	80131	2N709
A7R1	0683-1125	7	R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R2	0683-1825	10	R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A7R3	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A7R4	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R5	0683-3925	4	R:FXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A7R6	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A7R7	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R8	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A7R9	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A7R10	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A7R11	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R12	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A7R13	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R14	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R15	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A7R16	0683-5115	4	R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A7R17	0683-3015		R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A7R18	0683-3015		R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A7R19	0683-2015	5	R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A7R20	0683-2725	3	R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A7R21	0683-7515	3	R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A7R22	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A7R23	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R24	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A7R25	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R26	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R27	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A7R28	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A7R29	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7U1	1820-0102	4	INTEGRATED CIRCUIT:J-K FLIP FLOP	04713	MC1013P
A7U2	1820-0489	5	IC:ECL	28480	1820-0489
A7U3	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A7U4	1820-0440	1	IC:ECL DUAL RS F/F	04713	MC1016P
A7U5	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A7U6	1820-0489		IC:ECL	28480	1820-0489
A7U7	1820-0212	2	IC:ECL QUAD LINE RECEIVER	04713	MC1020P
A7U8	1820-0489		IC:ECL	28480	1820-0489
A7U9	1820-0145	2	IC:DIGITAL QUAD 2-INPT NOR GATE	28480	1820-0145
A7U10	1820-0489		IC:ECL	28480	1820-0489
A7U11	1820-0252	1	IC:ECL DUAL 3-4 INPT OR/NOR GATE	04713	MC1026P
A7U12	1820-0200	1	IC:ECL QUAD EXCL. OR GATE	04713	MC 1030P

See introduction to this section for ordering information

Table 7-3. A18 (05327-60029 Series 1116A) Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18	05327-60029	1	BOARD ASSY PRESCALER (SERIES 1116A) (LOADED ON 05327-20029 BLANK BOARD)	28480	05327-60029
A18C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C2	0160-0575		C:FXD CER 0.001 UF 20% 75VDCW	12574	55M-.001-98
A18C3	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C4	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	55M-.001-98
A18C5	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C6	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	55M-.001-98
A18C7	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	55M-.001-98
A18C8	0140-0225	1	C:FXD MICA 300 PF 1%	28480	0140-0225
A18C9	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	55M-.001-98
A18C10	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	55M-.001-98
A18C11	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C12	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C13	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18C14	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18CR1	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A18CR2	1912-0007		DIODE:TUNNEL EIA TYPE 1N3714	03508	1N3714 SPEC
A18CR3	1902-3048	1	DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A18J1	1250-0816		CONNECTOR:RF SUB-MINIATURE	98291	50-053-0000
A18L1	9140-0168		COIL,FXD RF 1 UH 10%	[illegible]	1025-20
A18L2	9100-2251	1	COIL:FXD RF 0.22 UH 10%	28480	9100-2251
A18Q1	1853-0015		TSTR:SI PNP	80131	2N3640
A18Q2	1854-0345		TSTR:SI NPN	80131	2N5179
A18Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A18R1	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R2	2100-2521		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A18R3	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R4	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R5	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A18R6	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R7	0698-3378	1	R:FXD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R8	0683-1815	1	R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815
A18R9	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R10	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A18R11	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	[illegible]
A18R12	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	[illegible]
A18R13	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	25
A18R14	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	2015
A18R15	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R17	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A18R18	0683-4315	1	R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R19	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A18R20	0683-8205	1	R:FXD COMP 82 OHM 5% 1/4W	01121	CB 8205
A18R21	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A18R22	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A18R23	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R24	0683-2405		R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A18R25	0698-3374	1	R:FXD CARBON 20 OHM 5% 1/8W	28480	0698-3374
A18R26	0683-3615		R:FXD COMP 360 OHM 5% 1/4W	01121	CB 3615
A18R27	0683-2715		R:FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A18R28	2100-2670	1	R:VAR CERMET 20 OHM 30% LIN 1/2W	28480	2100-2670
A18U1	5088-7002	1	IC:LIMITER	28480	5088-7002
A18U2	5088-7001	1	IC:AMP AND TRIG	28480	5088-7001
A18U3	1820-0716	1	IC:DIGITAL	28480	1820-0716
A18U4	1820-0784	1	IC:BINARY-QUINARY	28480	1820-0784
A18U5	1820-0499		IC:ECL	28480	1820-0499
A18U6	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A18U7	1858-0004		TSTR ARRAY:SI NPN DUAL DIFF, AMPL.	28480	1858-0004
A18U8	1820-0790	1	IC:DIGITAL	28480	1820-0790
A18XU2	1251-1556	11	CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A18XU4	1251-1556		CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A18XU4	1205-0243	1	HEAT DISSIPATOR	28480	1205-0243
A18XU4	1205-0244	1	RETAINER	28480	1205-0244
A18XU4	0520-0129	2	SCREW:PAN HD POZI DR 2-56 X 0.312" LG	00000	OBD
A18XU4	0610-0001	2	NUT:HEX 2-56 X 0.188"	00000	OBD
	3050-0062	1	WASHER:FLAT, BAKELITE	00000	OBD
	3050-0079	2	WASHER:NYLON 0.1875" OD	00000	OBD

See introduction to this section for ordering information

Table 7-4. A18 (05327-60009 Series 1040A) Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18	05327-60009	1	PRESCALER ASSY (SERIES 1040A)	28480	05327-60009
			(LOADED ON 05327-20009 BLANK BOARD)		
	3050-0062	2	WASHER:FLAT, BAKELITE	00000	OBD
A18C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C2	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-9R
A18C3	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C4	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-9R
A18C5	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C7	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-9R
A18C8	0140-0225	.	C:FXD MICA 100 PF 1%	28480	0140-0225
A18C9	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-9R
A18C10	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	5SM-.001-9R
A18C11	0180 0197		C:FXD ELEC. 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C12	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C13	0160-2049	4	C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18C14	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18CR1	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A18CR2	1912-0007		DIODE:TUNNEL EIA TYPE 1N3716	03508	1N3716 SPEC
A18CR3	1902-3048	2	DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A18J1	1250-0836		CONNECTOR:RF SUB-MINIATURE	98291	50-051-0000
A18L2	9100-2251	2	COIL:FXD RF 0.22 UH 10%	28480	9100-2251
A18Q1	1853-0015		TSTR:SI PNP	80131	2N3640
A18Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A18Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A18R1	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R2	2100-2521		R:VAR F&M 2000 OHM 10% LIN 1/2W	28480	2100-2521
A18R3	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R4	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R5	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A18R6	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R7	0698-3378		R:FXD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R8	0683-1815		R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815
A18R9	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R10	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A18R11	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R12	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R13	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R14	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R15	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R17	0683-1515	2	R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A18R18	0683-4315		R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R19	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R20	0683-8205	2	R:FXD COMP 82 OHM 5% 1/4W	01121	CB 8205
A18R21	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A18R22	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A18R23	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R24	0683-2405		R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A18U1	5088-7002		IC:LIMITER	28480	5088-7002
A18U2	5088-7001		IC:AMP AND TRIG	28480	5088-7001
A18U3	1820-0736		IC:DIGITAL	28480	1820-0736
A18U4	1820-0714	1	IC:DIGITAL QUINARY DIVIDER	28480	1820-0714
A18U5	1820-0489		IC:ECL	28480	1820-0489
A18U6	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A18U7	1858-0006		TSTR ARRAY:SI NPN DUAL DIFF. AMPL.	28480	1858-0006
A18XU2	1251-1556	45	CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A19	05327-60032		PROTECTION BOARD	28480	05327-60032
A19	05327-20032		BLANK BOARD	28480	05327-20032
A19C1	0180-0228		C FXD TANT 22UF 10% 15V	28480	0180-0228
A19C2	0180-0228		C FXD TANT 22UF 10% 15V	28480	0180-0228
A19CR1	1901-0050		DIODE SILICON	28480	1901-0050
A19CR2	1901-0050		DIODE SILICON	28480	1901-0050
A19F	2110-0436		FUSE 0.1 AMP	28480	2110-0436
A19J1	1250-1408		CONNECTOR SUBMIN	28480	1250-1408
A19J2	1250-0835		CONNECTOR SUBMIN	28480	1250-0835
A19XF1A	1251-3205		SOCKET MINIATURE	28480	1251-3205
A19XF1B	1251-3205		SOCKET MINIATURE	28480	1251-3205

See introduction to this section for ordering information

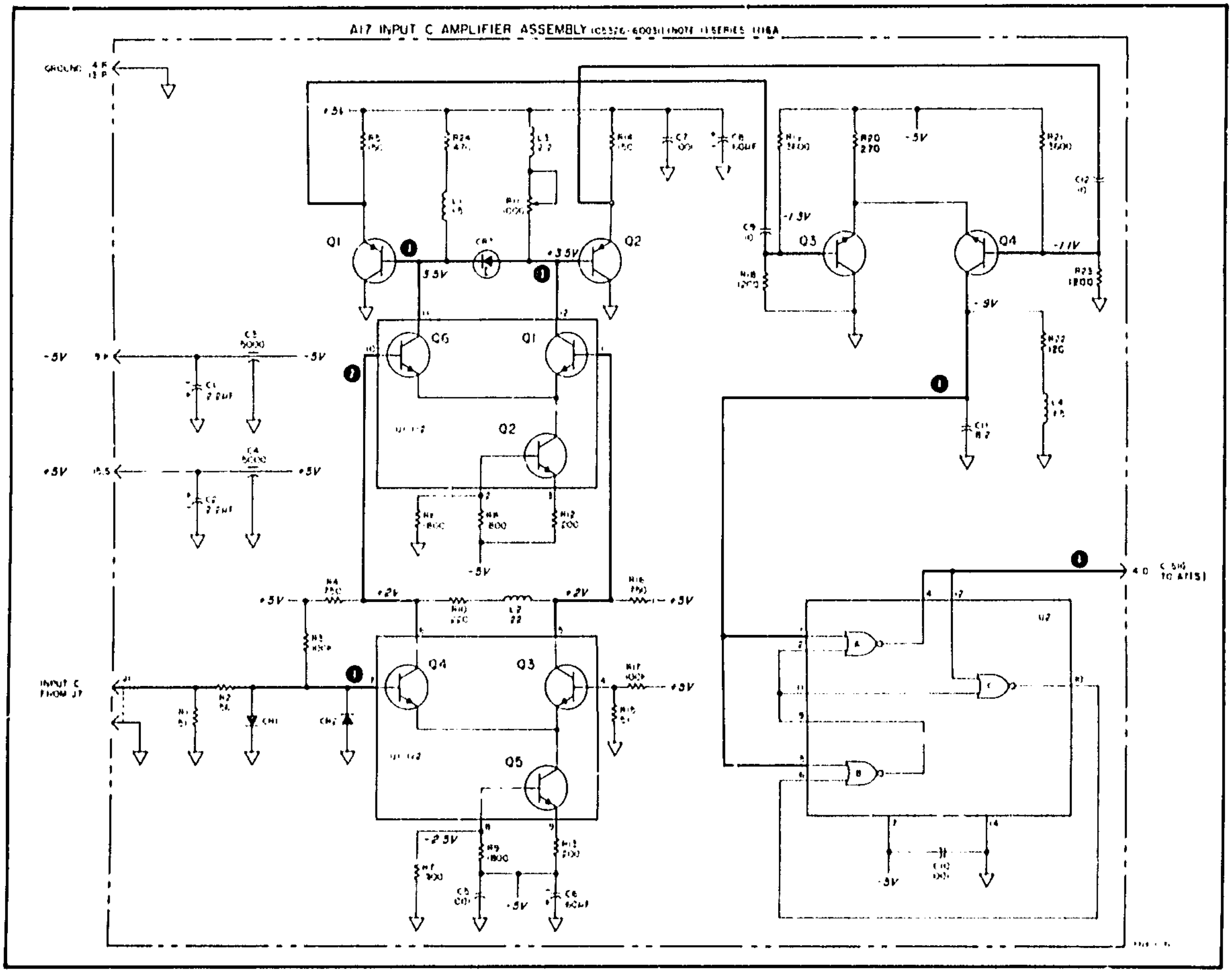


Figure 7-1. A17 Input C Amplifier Assembly Series 1116A (5326A Only)

Figure 7-2. A17 Series 1116A Component Locator

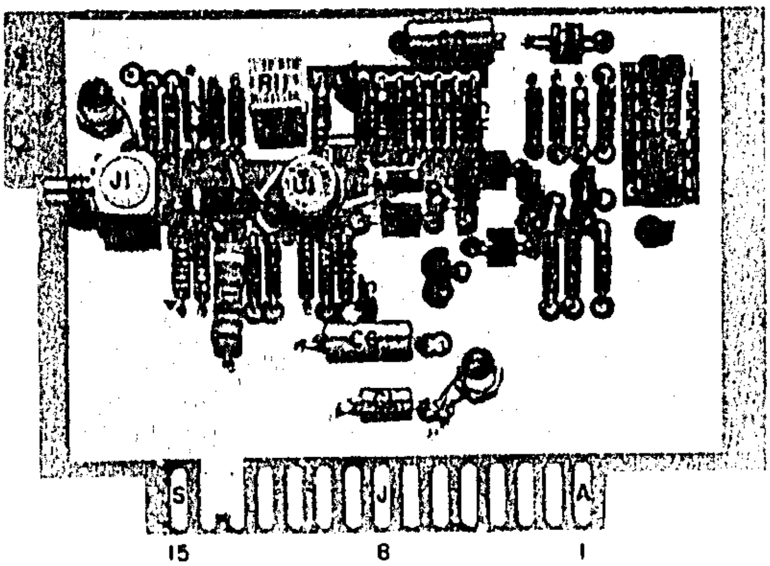


Figure 7-3. A7 Function Control Assembly, Series 1040A

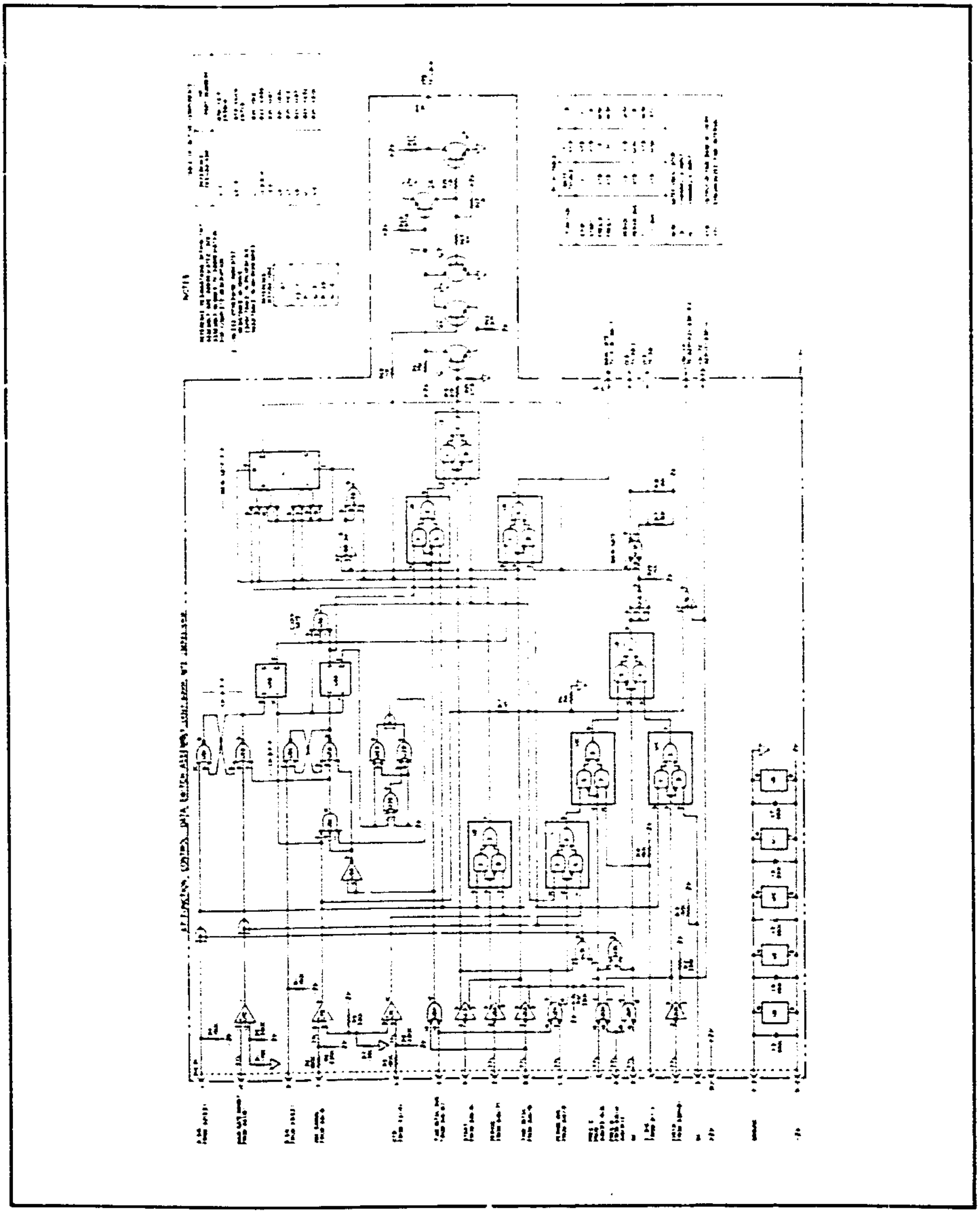


Figure 7-4. A7 Component Locator, Serie. 1040A

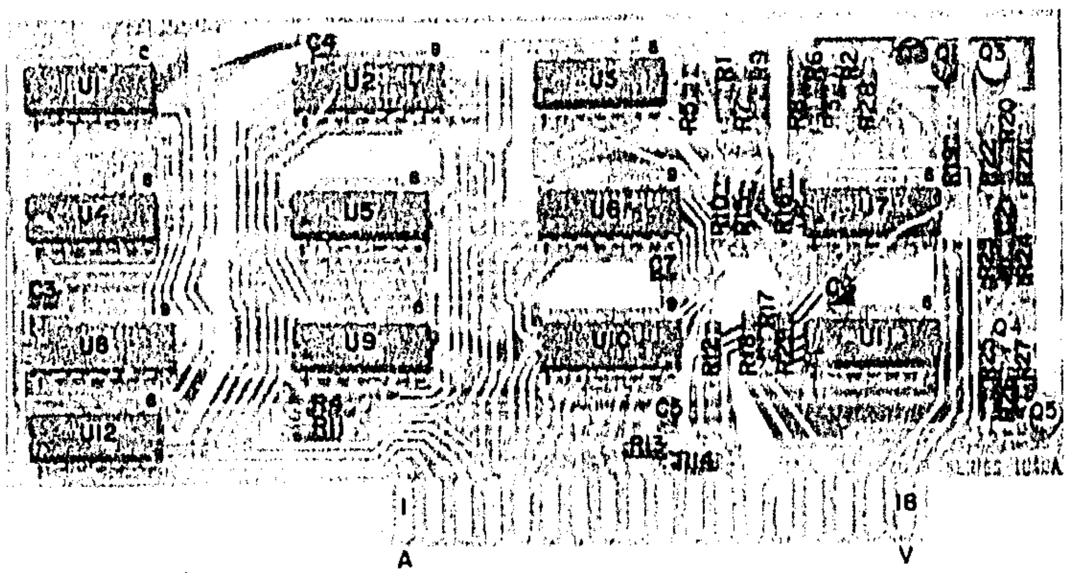
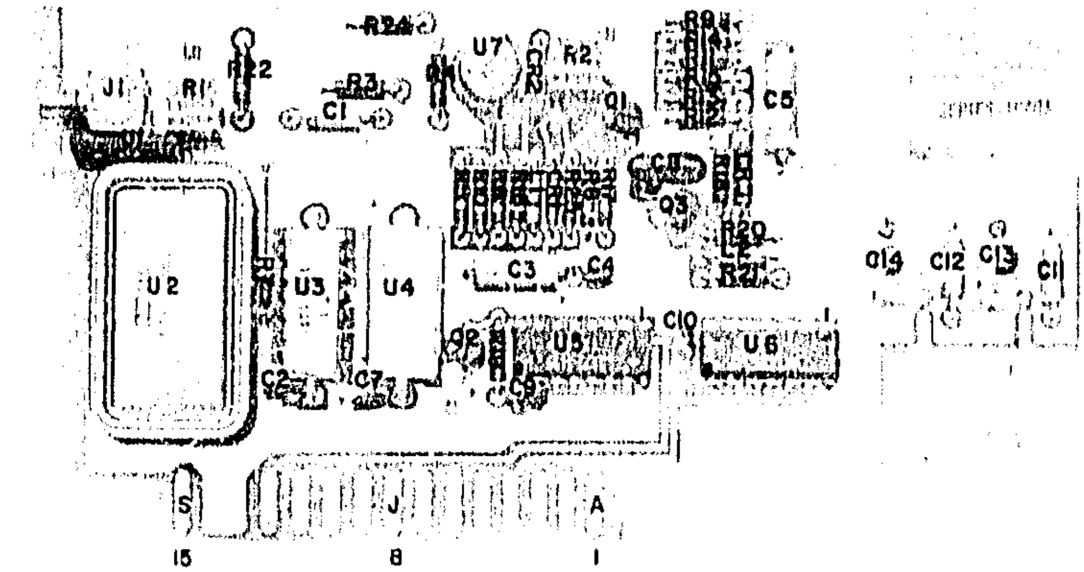


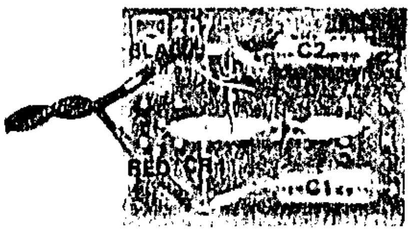
Figure 7-5. A18 and A19 Component Locators

The 5327A model may be supplied with either A18 Prescaler Assembly. Both assemblies perform the same function. Note that separate schematics, component locators, and parts lists are supplied for each assembly.

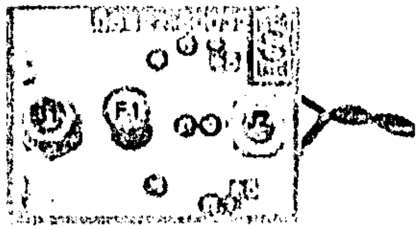
A18

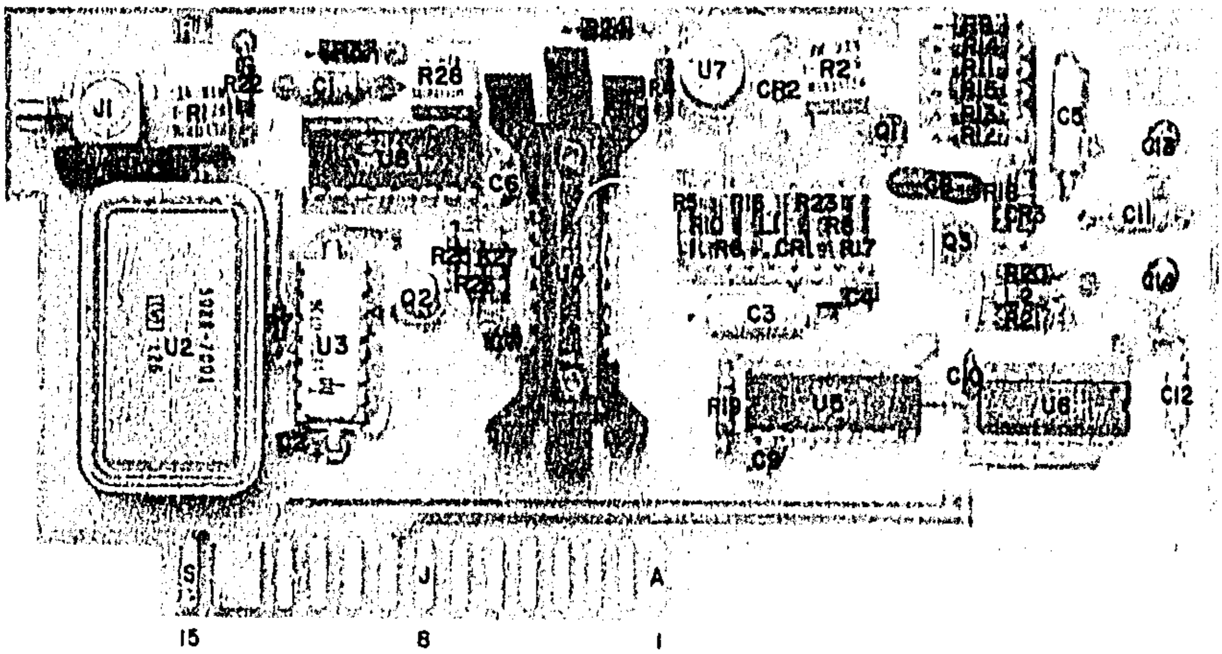


A18 (05327-60009)



A19
PROTECTION
BOARD





A18 (05327-60029)

Figure 7-6. A18 Prescaler Board Assembly (05327-60009) (5327A Only)

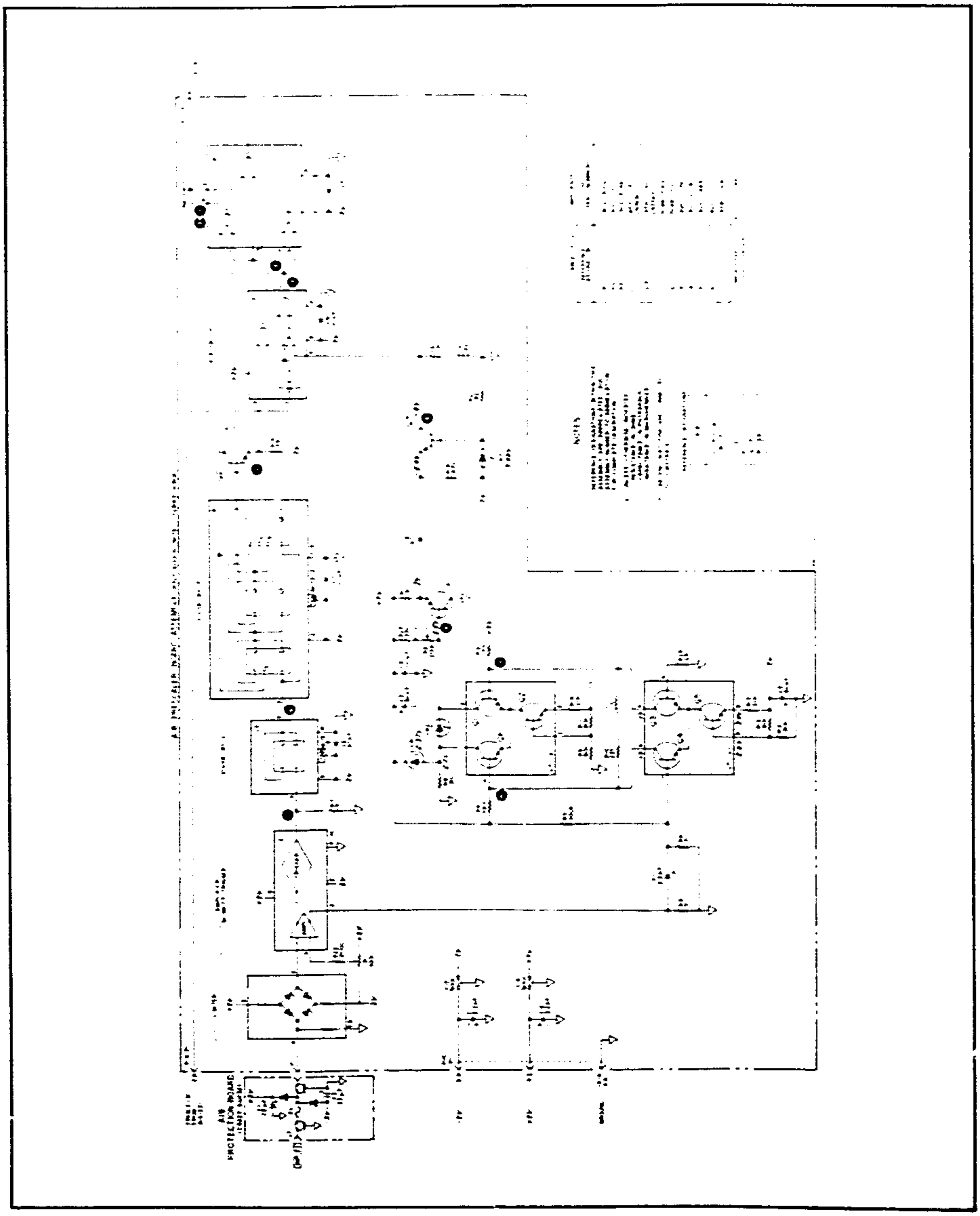


Figure 7-7. A18 Prescaler Board Assembly (05327-60029) (5327A Only)

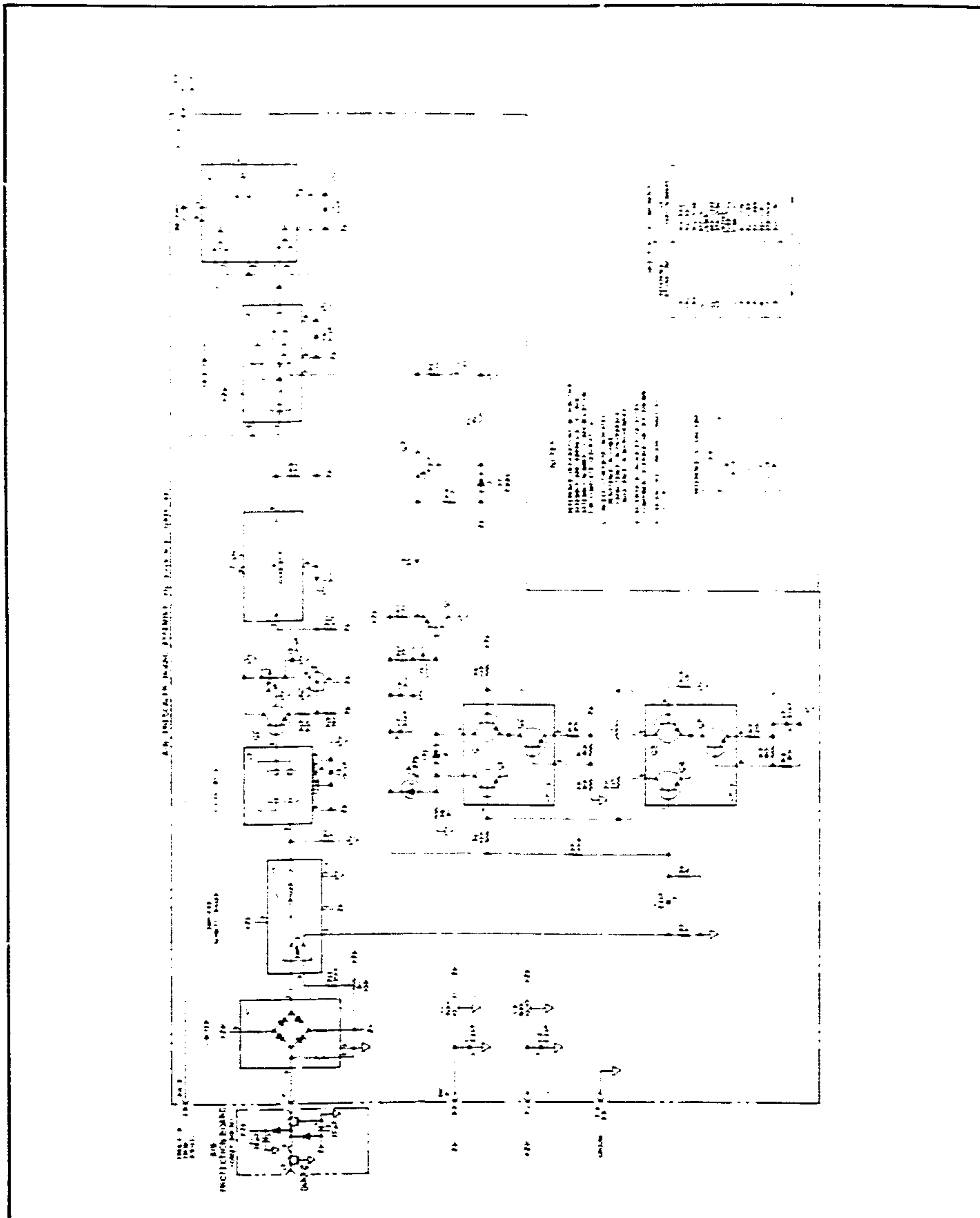


Figure 7-8. A9 Display Assembly (Option 001)

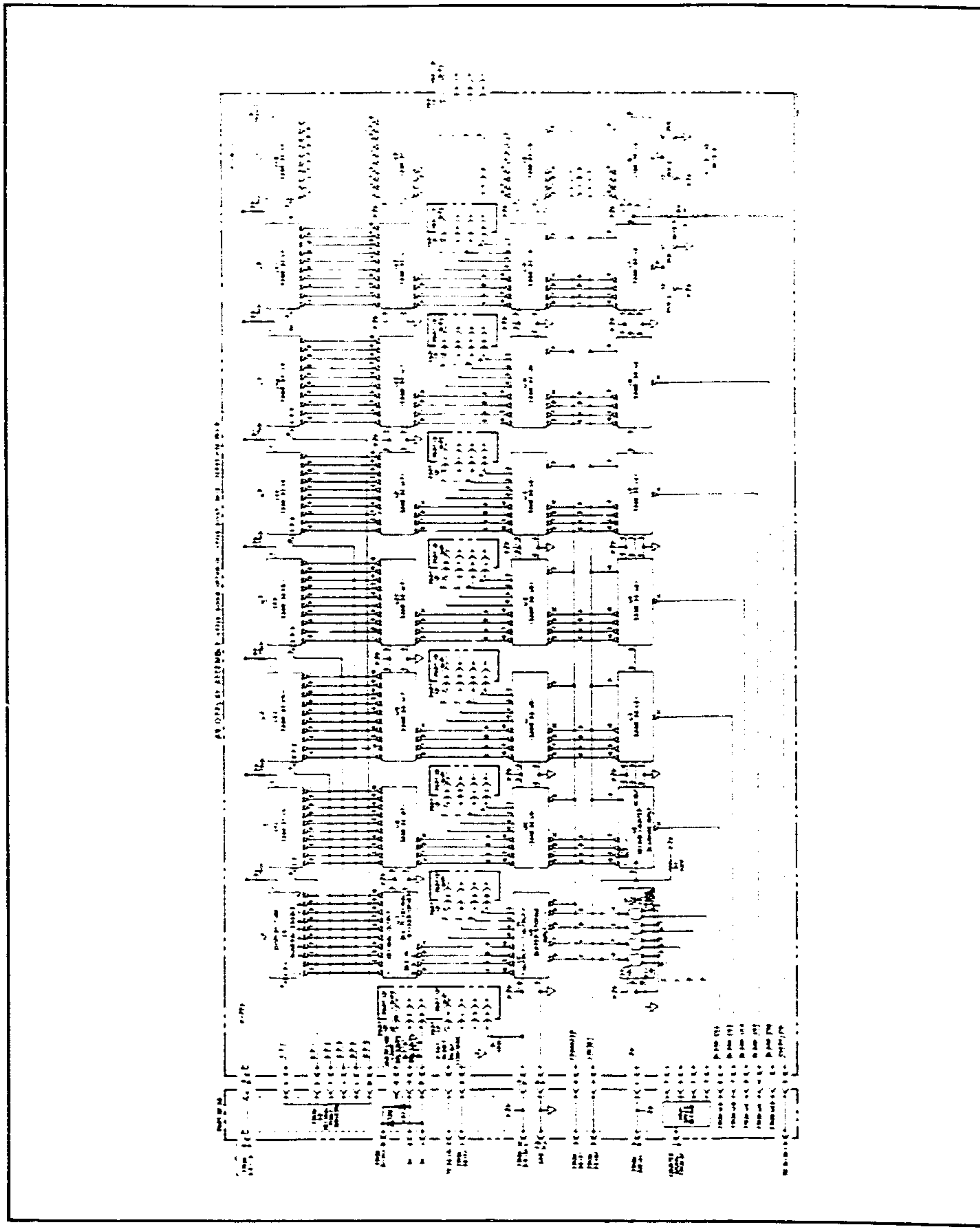
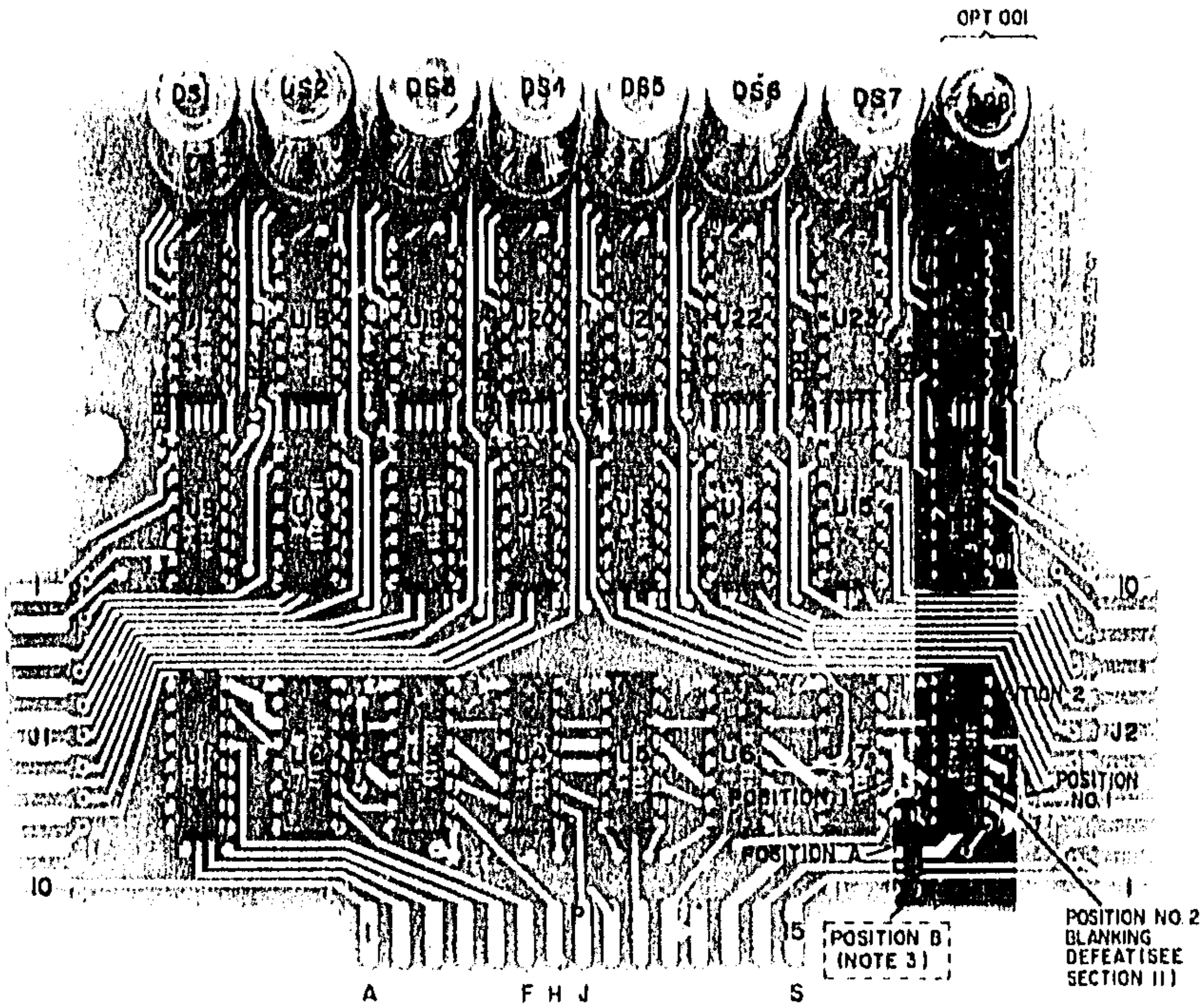


Figure 7-9. A9 Display Assembly (Option 001), Component Locator



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED RESISTANCE IN OHMS.
3. R10 IS WIRED TO B FOR OPTION 001

REFERENCE DESIGNATIONS

NO PREFIX	A8	A9
	CR2,3	
		DS1-8
	J1	J1, 2
	P1	P1
		R1-11
		U1-24
W1P1,P2		

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
A8	
CR2,3	1910-0016
A9	
U1	1820-0275 MC1039P
U2-8	1820-0119
U9-16	1820-0116
U17-24	1820-0092

SECTION VIII

SCHEMATIC DIAGRAMS

This section contains the following:

a. Schematic diagram notes.

b. Schematics.

c. Component locators.

d. IC outline drawings.

e. Waveforms.

f. Simplified block diagrams.

g. Theory of operation.

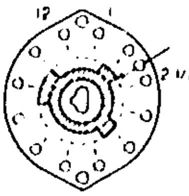
h. Troubleshooting.

Figure 8-1. Schematic Diagram Notes

SYMBOLS

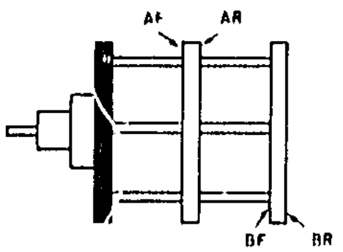
FRONT PANEL	MAIN SIGNAL PATH
REAR PANEL	FEEDBACK PATH
INTERIOR AND PC BOARD	TEST POINT
WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE	"AND" GATE
POWER LINE GROUND	"OR" GATE
CIRCUIT COMMON GROUND	INVERTER
FLOATING GROUND	NAND GATE
CHASSIS GROUND	NOR GATE
KNOB CONTROL	EXCLUSIVE NOR
SCREWDRIVER ADJUST	

SWITCH DESIGNATIONS



A3S1BR(2-1/2)

A3S1	SWITCH S1 WITHIN ASSEMBLY A3
B	2ND WAFER FROM FRONT (A 1ST, ETC)
R	REAR OF WAFER (F FRONT)
(2-1/2)	TERMINAL LOCATION 2 1/2 (VIEWED FROM FRONT)



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

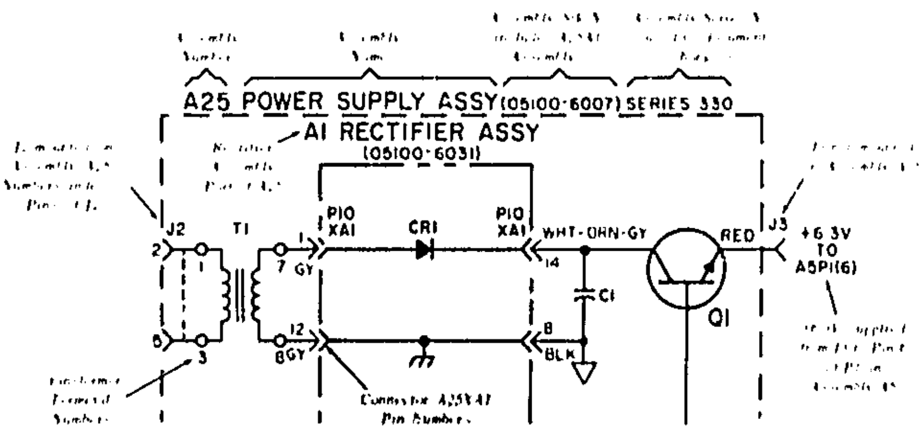
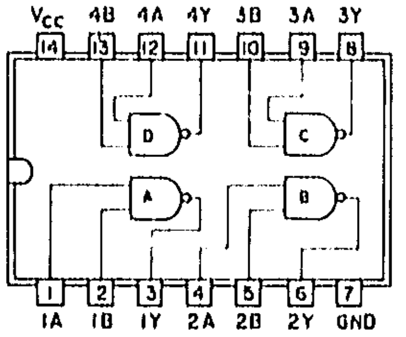


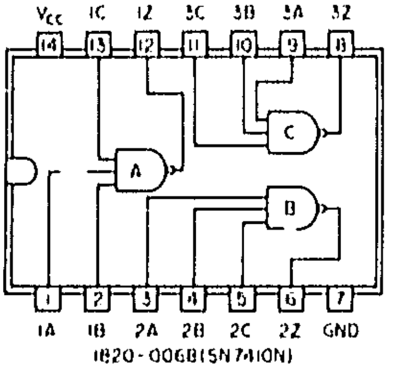
Figure 8-2. Integrated Circuit Diagrams

1820-0054



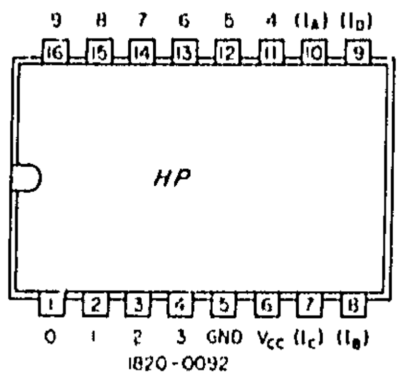
1820-0054(SN7400N)
QUADRUPLE 2-INPUT POSITIVE NAND GATE
NOTE: POSITIVE LOGIC $Y = \overline{AB}$

1820-0068



1820-0068(SN7410N)
TRIPLE 3-INPUT POSITIVE NAND GATE
POSITIVE LOGIC $Y = \overline{ABC}$

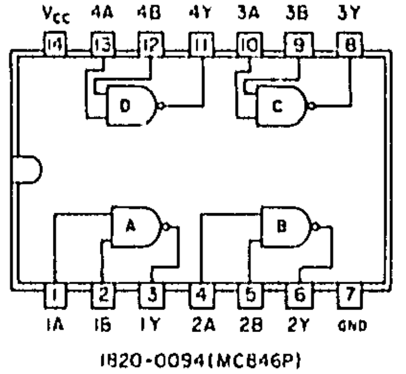
1820-0092



1820-0092
DRIVER
NEGATIVE LOGIC

I_A(1)	I_B(2)	I_C(4)	I_D(8)	"ON" OUTPUT
H	H	H	H	0
L	H	H	H	1
H	L	H	H	2
L	L	H	H	3
H	H	L	H	4
L	H	L	H	5
H	L	L	H	6
L	L	L	H	7
H	H	H	L	8
L	H	H	L	9
BCD 10 - 15				NONE

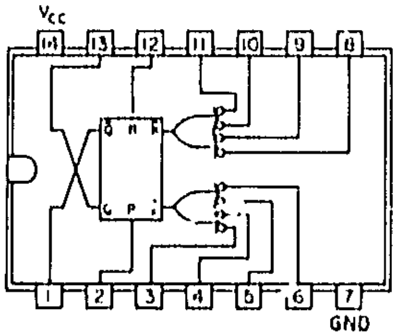
1820-0094



1820-0094(MC846P)
QUADRUPLE 2 INPUT POSITIVE NAND GATE
NOTE: POSITIVE LOGIC $Y = \overline{AB}$

Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0102



1820-0102(MC1013P)
85MHz J-K FLIP-FLOP

R-S TRUTH TABLE

R	S	Q^{n+1}
12	2	13
0	0	Q^n
0	1	1
1	0	0
1		ND

ALL $\bar{J}$ $\bar{K}$ INPUTS ARE STATIC

$\bar{J}_D \cdot \bar{K}_D$ TRUTH TABLE

$\bar{J}_D$	$\bar{K}_D$	Q^{n+1}
[illegible]	[illegible]	13
0	0	Q^n
0	[illegible]	0
1	0	1
1	1	$\bar{Q}^n$

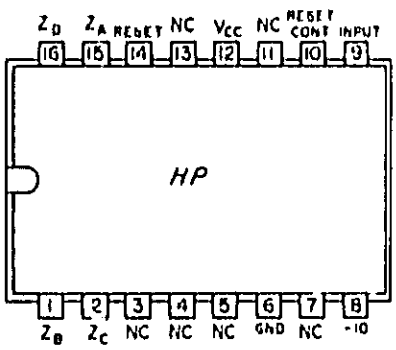
ALL OTHER $\bar{J}$ $\bar{K}$ INPUTS AND THE R-S INPUTS ARE AT A "O" LEVEL

CLOCKED $\bar{J}$ $\bar{K}$ TRUTH TABLE

$\bar{J}$	$\bar{K}$	C_D	Q^n
[illegible]	[illegible]	[illegible]	13
[illegible]	[illegible]	[illegible]	Q^n
0	0	1	$\bar{Q}^n$
0	1	1	1
1	0	1	0
1	1	1	Q^n

ALL OTHER $\bar{J}$ $\bar{K}$ INPUTS AND THE R-S INPUTS ARE AT A "O" LEVEL

1820-0117



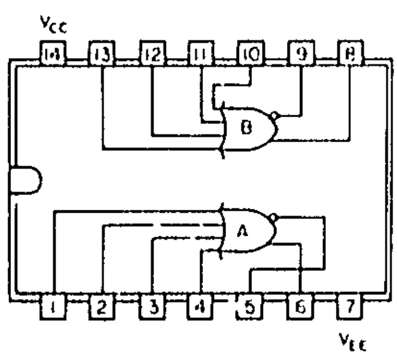
1820-0117,0119,0232
BLANKING DECADE COUNTER
NEGATIVE LOGIC 1 = LOW
0 = HIGH

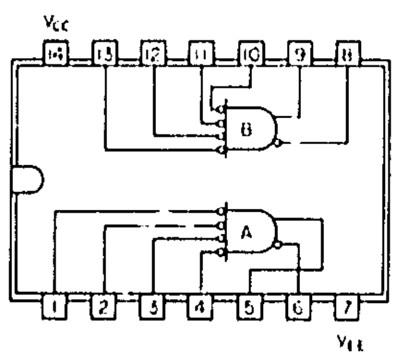
TRUTH TABLE

INPUT PULSE	OUTPUT A	OUTPUT B	OUTPUT C	OUTPUT D
0	H	H	H	H
1	L	H	H	H
2	H	L	H	H
3	L	L	H	H
4	H	H	L	H
5	L	H	L	H
6	H	L	L	H
7	L	L	L	H
8	H	H	H	L
9	L	H	H	L
RESET CONTROL HIGH & RESET PULSE	H	H	H	H
RESET CONTROL LOW & RESET PULSE	L	L	L	L

POSITIVE PULSE APPLIED TO RESET WILL
A. RESET A,B C & D TO LOW IF RESET CONTROL IS LOW.
B. RESET A,B,C & D TO HIGH IF RESET CONTROL IS HIGH.
C. THE ·O OUTPUT WILL ALWAYS BE RESET TO HIGH STATE

1820-0142





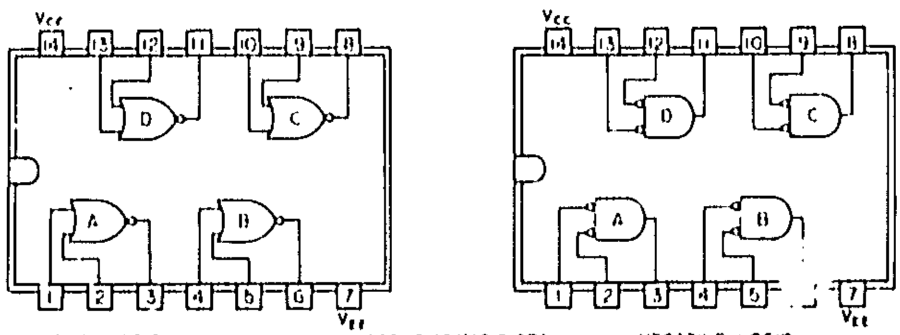
POSITIVE LOGIC
$5 = \overline{1+2+3+4}$
$6 = 1+2+3+4$

1820-0142(MC1004P)
ECL DUAL 4-INPUT 2-OR,2-NOR

NEGATIVE LOGIC
$5 = \overline{1 \cdot 2 \cdot 3 \cdot 4}$
$6 = 1 \cdot 2 \cdot 3 \cdot 4$

Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0145

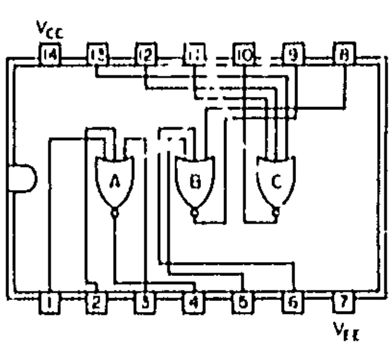


POSITIVE LOGIC
3 = $\overline{1+2}$

1820-0145(MC1010P)
ECL QUAD 2-INP NOR

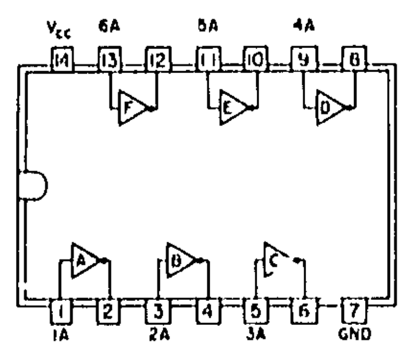
NEGATIVE LOGIC
3 = $\overline{1 \cdot 2}$

1820-0147

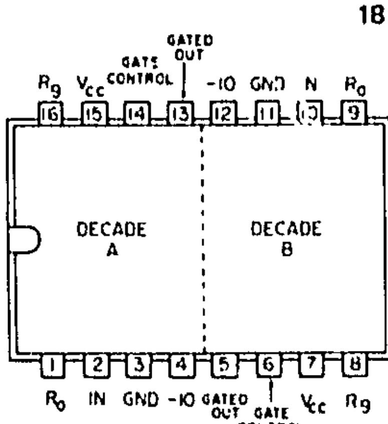


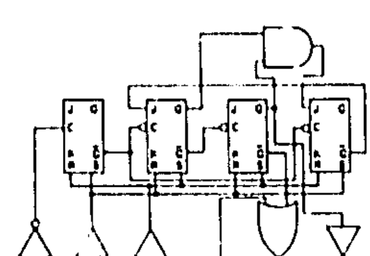
1820-0147 (MC1007P)
TRIPLE 3-INPUT GATES

1820-0174



1820-0198 and 1820-0199

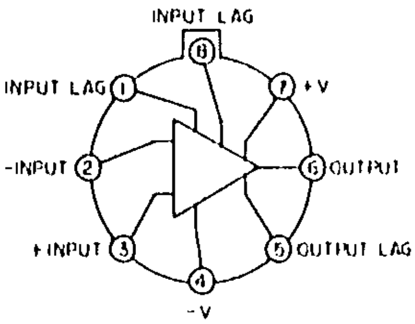




DECADE	CLOCK (COUNT) INPUT	RESET 0 INPUT	RESET 9 INPUT	GATE CONT	GATED OUTPUT	÷10 CARRY	V_{CC}	GND	HP PART NUMBER
A	2	1	16	14	13	4	15	3	1820-0198
B	10	9	8	6	5	12	7	11	1820-0199
PINS									
	2	1	8	6	5	4	7	3	1820-0412 1820-0413
	2	1	16	14	13	4	15	3	1820-0226 1820-0227

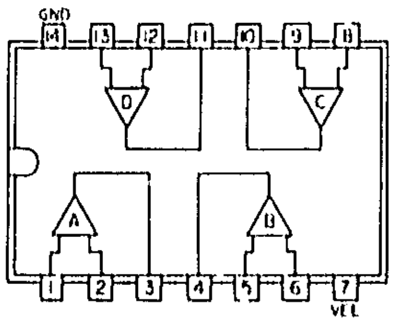
Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0201



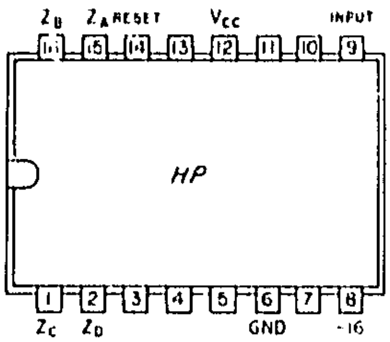
1820-0201 (MC 1439G)
OPERATIONAL AMPLIFIER

1820-0212



1820-0212
QUADRUPLE LINE RECEIVER

1820-0209



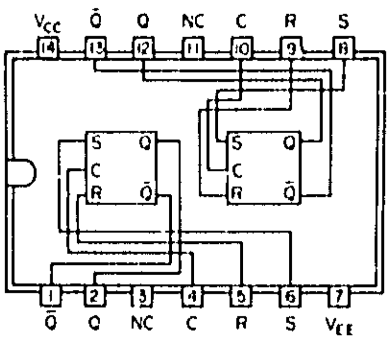
1820-0209
DIVIDE BY 16 COUNTER
NEGATIVE LOGIC 1 = LOW
0 = HIGH

TRUTH TABLE

IN	A	B	C	D
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H
10	L	H	L	H
11	H	H	L	H
12	L	L	H	H
13	H	L	H	H
14	L	H	H	H
15	H	H	H	H

THE ÷16 OUTPUT WILL GO HIGH ON COUNT 8 AND LOW ON COUNT 16 OR RESET

1820-0213



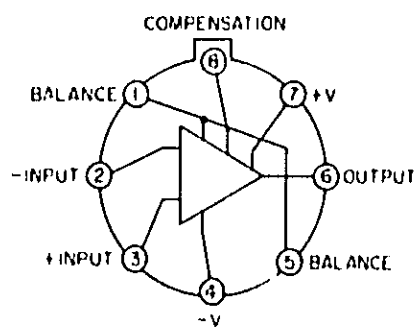
1820-0213 (MC 1014P)
DUAL RS FF

TRUTH TABLE

R	S	C	Q^{n+1}
0	1	1	1
1	0	1	0
0	0	1	Q^n
1	1	1	ND
*	*	0	Q^n

*EITHER STATE
N D = NOT DEFINED

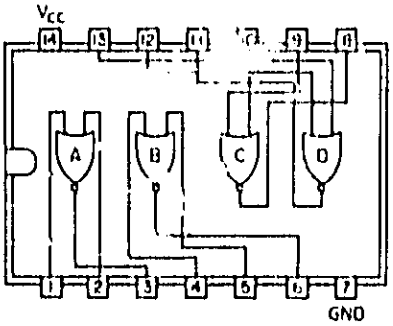
1820-0223



1820-0223 (LM 301A)
OPERATIONAL AMPLIFIER

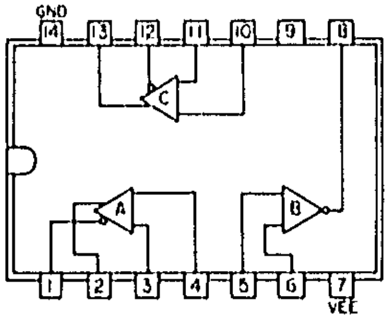
Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0238



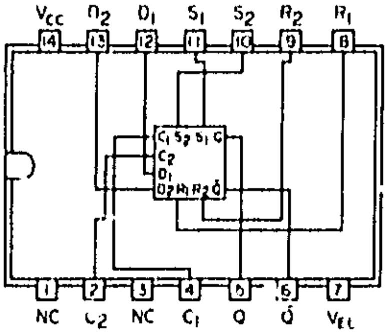
1820-0238 (MC 1810P)
QUAD 2-INPUT NOR GATES

1820-0253



1820-0253
TRIPLE DIFFERENTIAL AMPLIFIER

1820-0272



1820-0272 (MC 1022P)
TYPE "D" FLIP-FLOP

CLOCKED TRUTH TABLE

	D	C	Q^{n+1}	$\bar{Q}^{n+1}$
PIN No.	12 or 13	2 or 4	5	6
	0	0	Q^n	$\bar{Q}^n$
	1	0	Q^n	$\bar{Q}^n$
	0	1*	0	1
	1	1*	1	0

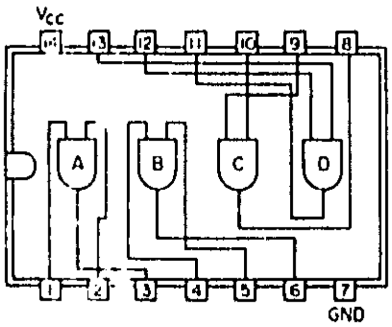
*A "1" OR CLOCK INPUT IS DEFINED FOR THIS FLIP-FLOP AS A CHANGE IN LEVEL FROM A LOW INPUT TO A HIGH INPUT.

R-S TRUTH TABLE

	R	S	Q^{n+1}	$\bar{Q}^{n+1}$
PIN No.	8 or 9	10 or 11	5	6
	0	0	Q^n	$\bar{Q}^n$
	0	1	1	0
	1	0	0	1
	1	1	ND	ND

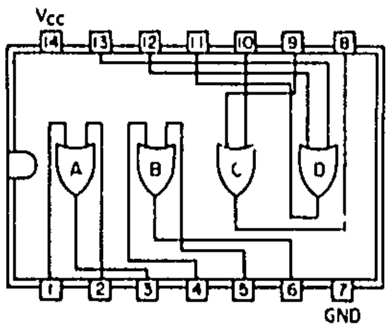
ND = NOT DEFINED

1820-0273



1820-0273 (MC 1806P)
QUAD 2-INPUT AND GATES

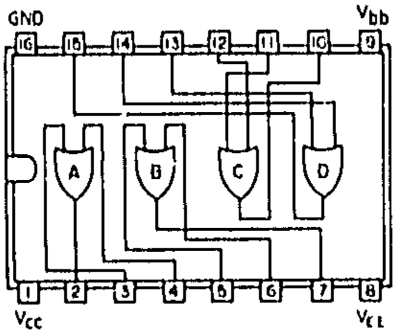
1820-0274



1820-0274 (MC 1808P)
QUAD 2-INPUT OR GATES

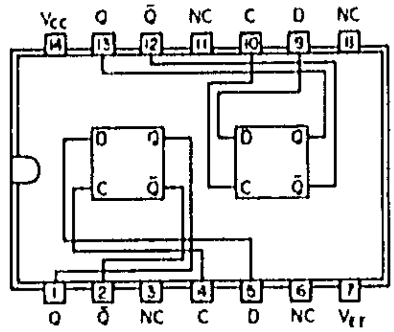
Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0275



1820-0275 (MC 1039P)
QUAD TRANSLATOR 2-INPUT OR GATES

1820-0276

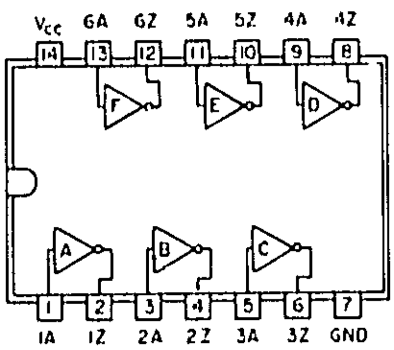


TRUTH TABLE

D	C	Q^{n+1}
0	1	Q^n
1	1	Q^n
0	0	0
1	0	1

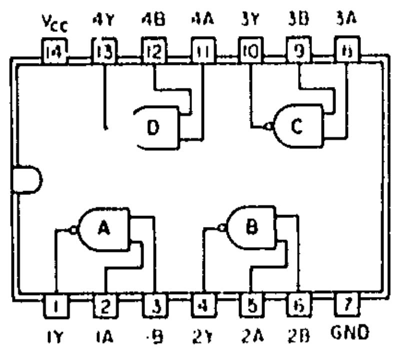
1820-0276 (MC 1033P)
DUAL RS FF

1820-0307



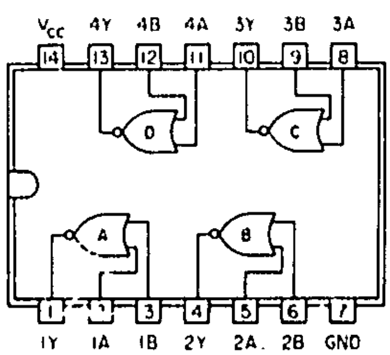
1820-0175, 0307 (MC10270)
HEX INVERTER

1820-0327



1820-0327 (SN7401N)
QUAD 2-INPUT NAND WITH OPEN COLLECTOR
POSITIVE LOGIC $Y = \overline{AB}$

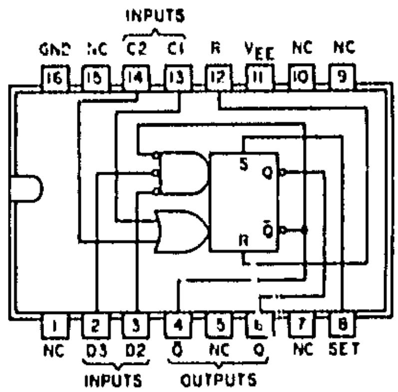
1820-0328



1820-0328 (SN7402N)
QUAD 2-INPUT NOR GATE
POSITIVE LOGIC $Y = \overline{A+B}$

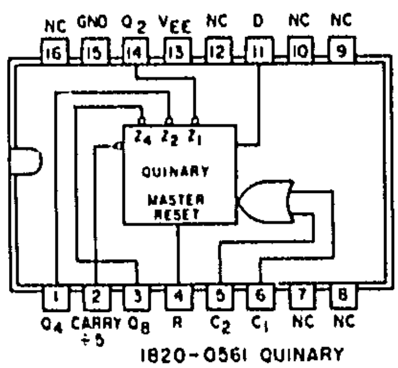
Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0558



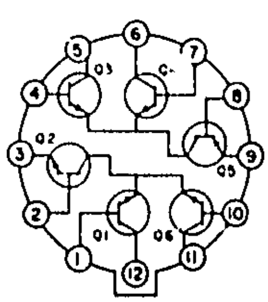
1820-0558
ECL HIGH SPEED D-BINARY

1820-0561



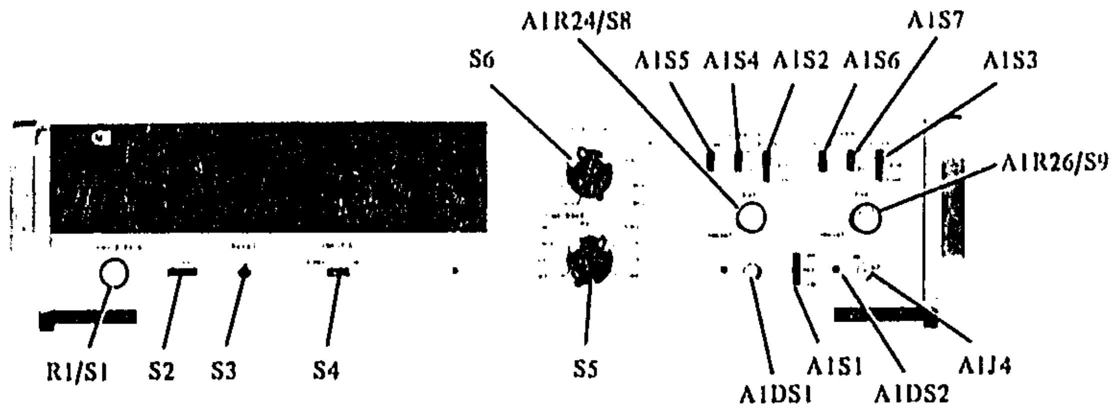
1820-0561 QUINARY

1858-0004



1858-0004
TRANSISTOR ARRAY
(BOTTOM VIEW)

Figure 8-3. 532" A Front and Rear Panels



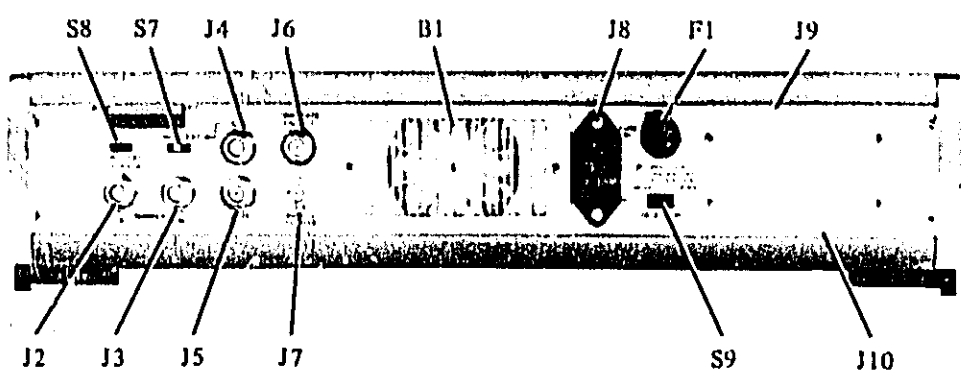


Figure 8-4. Model 5326A Top Internal View

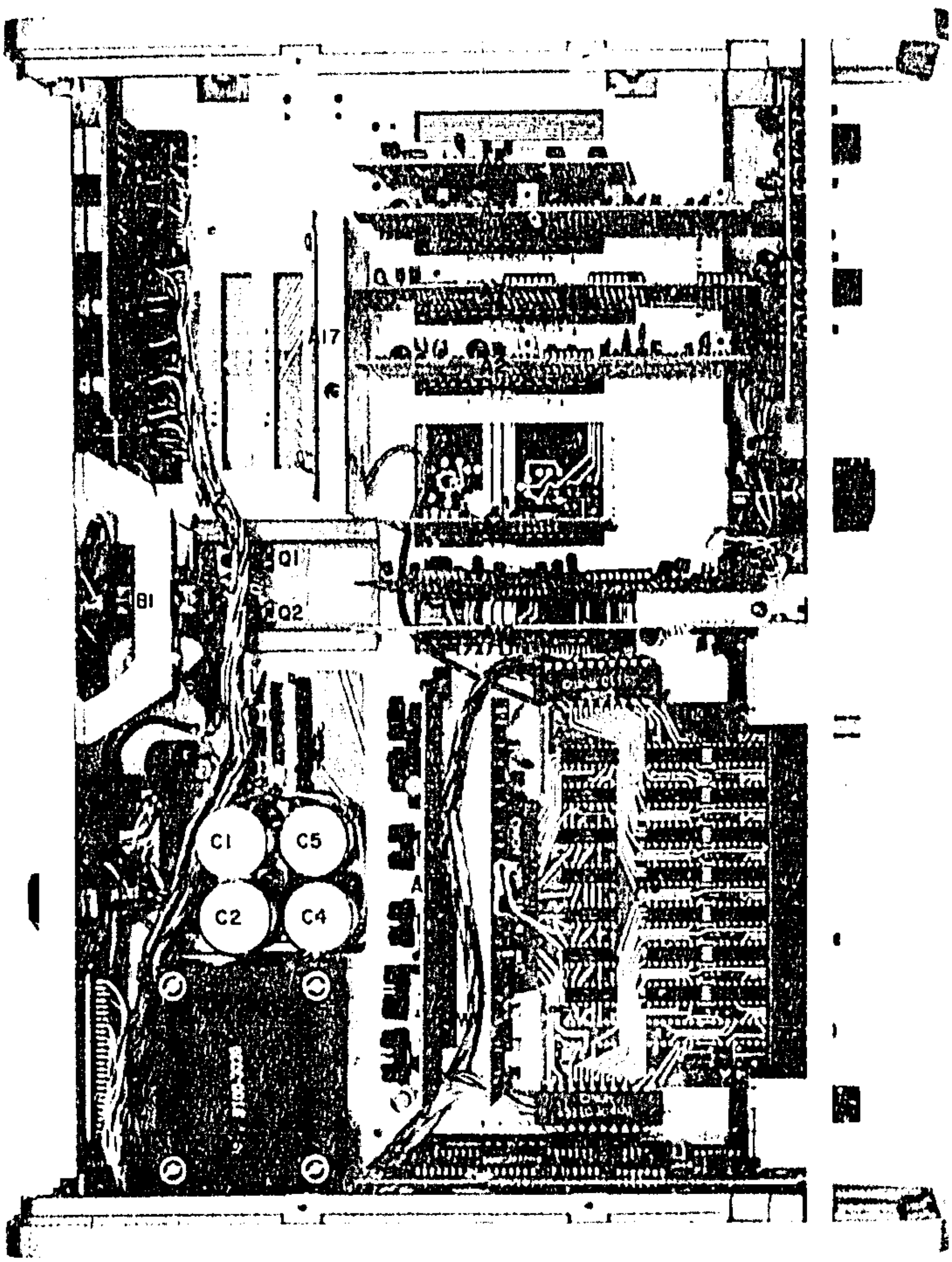
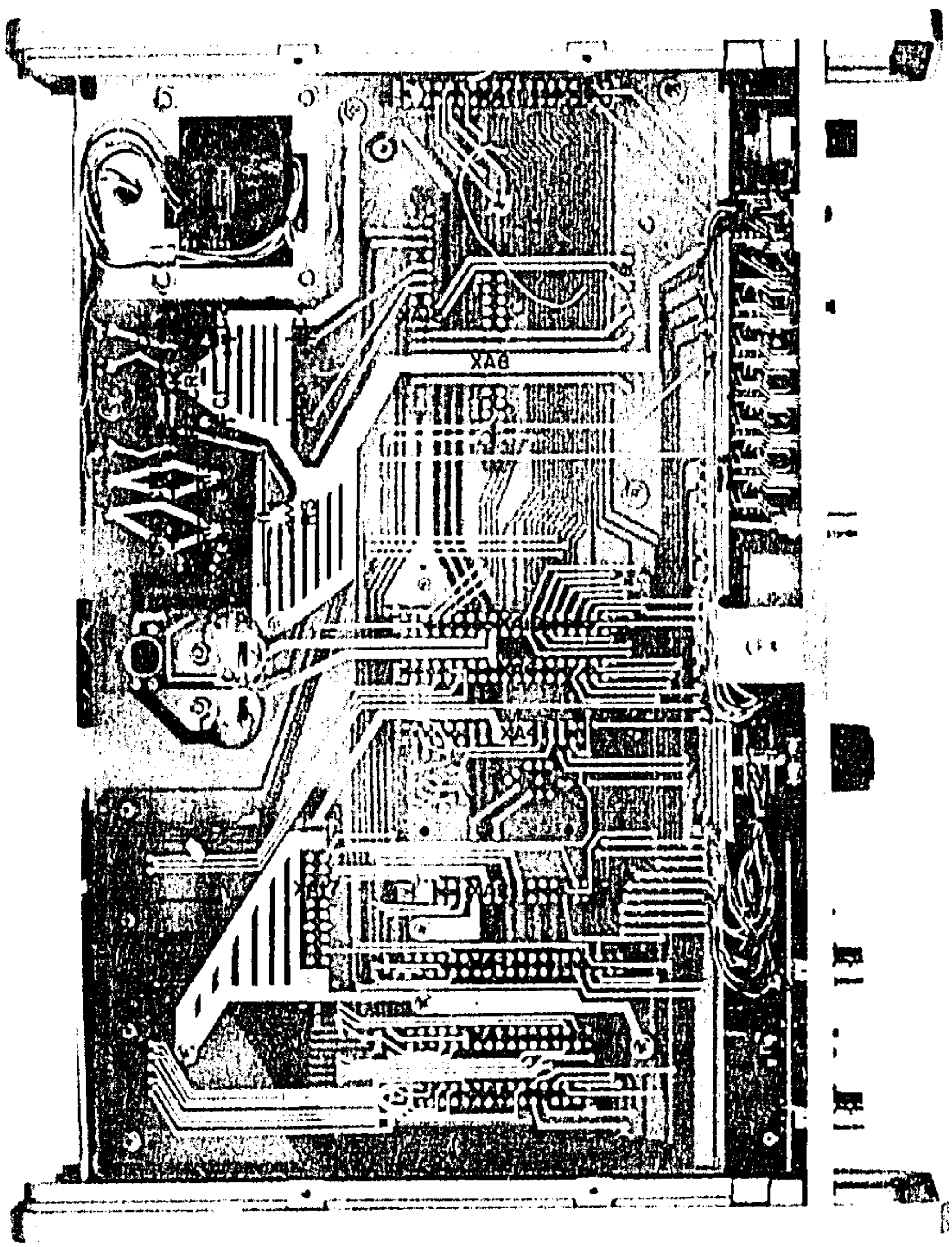


Figure 8-5. Model 5326A Bottom Internal View



A1 ATTENUATOR OPERATION

Attenuator Assembly A1 consists of two input attenuator channels. Since the channels are identical, only Channel A will be described. Channel A input signals are routed through J3 to the attenuator network. When ATTEN switch S2 is set to X1, the full input signal is fed to the gate of Q1A. With the ATTEN switch in X10, R2, R5, C1, and C3 serve as a 10:1 voltage divider. In the X100 position, the 100:1 divider consists of R2, R4, C1, and C2. R3 provides damping.

When AC DC switch S4 is set to AC, C4 is in series with the signal path. CR3 and CR4 limit the input amplitude to Q1A to approximately ±5.8 volts. R7 and R8 provide current limiting. C5 compensates Q1A input capacitance.

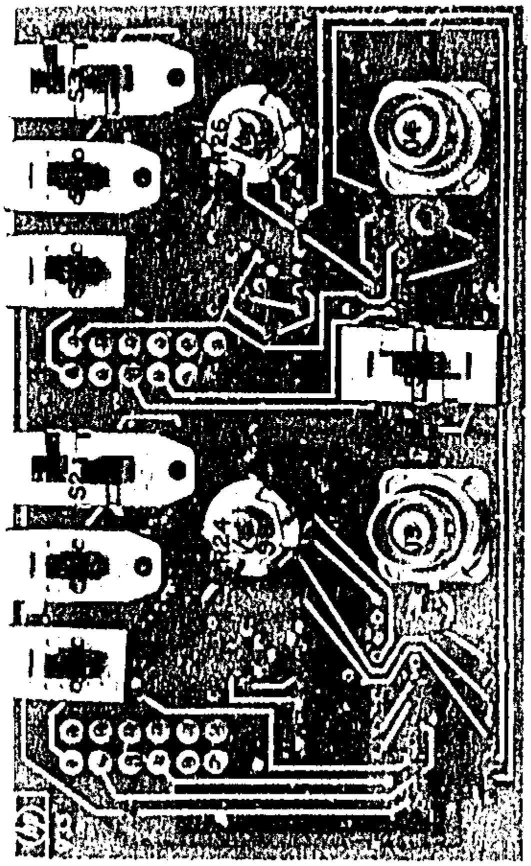
Q1A and Q1B form a differential amplifier connected as source followers. The outputs are fed to A2 via pins 5 and 6 of J1. LEVEL potentiometer R24 determines the trigger level on Q1B gate. The trigger level can be preset to zero volts or varied from -3 to +3 volts, or with the LEVEL control set to PRESET, an external trigger level can be applied at J10 to A1J1(D) for remote programming. Diodes CR6 and CR7 develop 5 volts for the input protection and level pots. R12 adds symmetry to the voltage range of R24. R11 lowers the impedance of Q1B gate circuit to limit stray charges and false triggering. R10 and C8 form a filter to prevent noise from triggering the differential amplifier.

When SLOPE switch S5 is set to -, a ground is supplied via CR2 to J1 pin A. This sets amplifier trigger A2 to trigger on the negative slope of the input signal. When remote programming is used, J1(C) is held high to disable the SLOPE switches and the CHK switch.

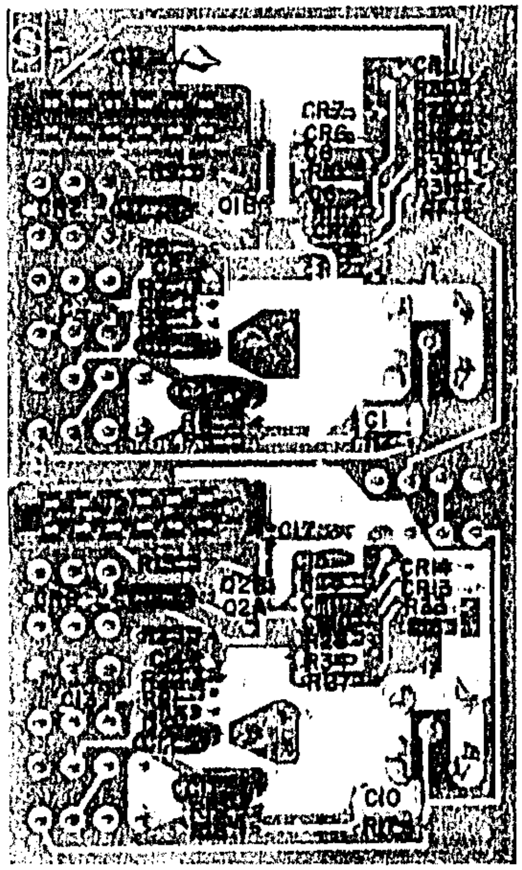
COM-SEP-CHK switch S1 connects inputs A and B in parallel when set to COM and grounds J2(C) via CR1 for the check mode.

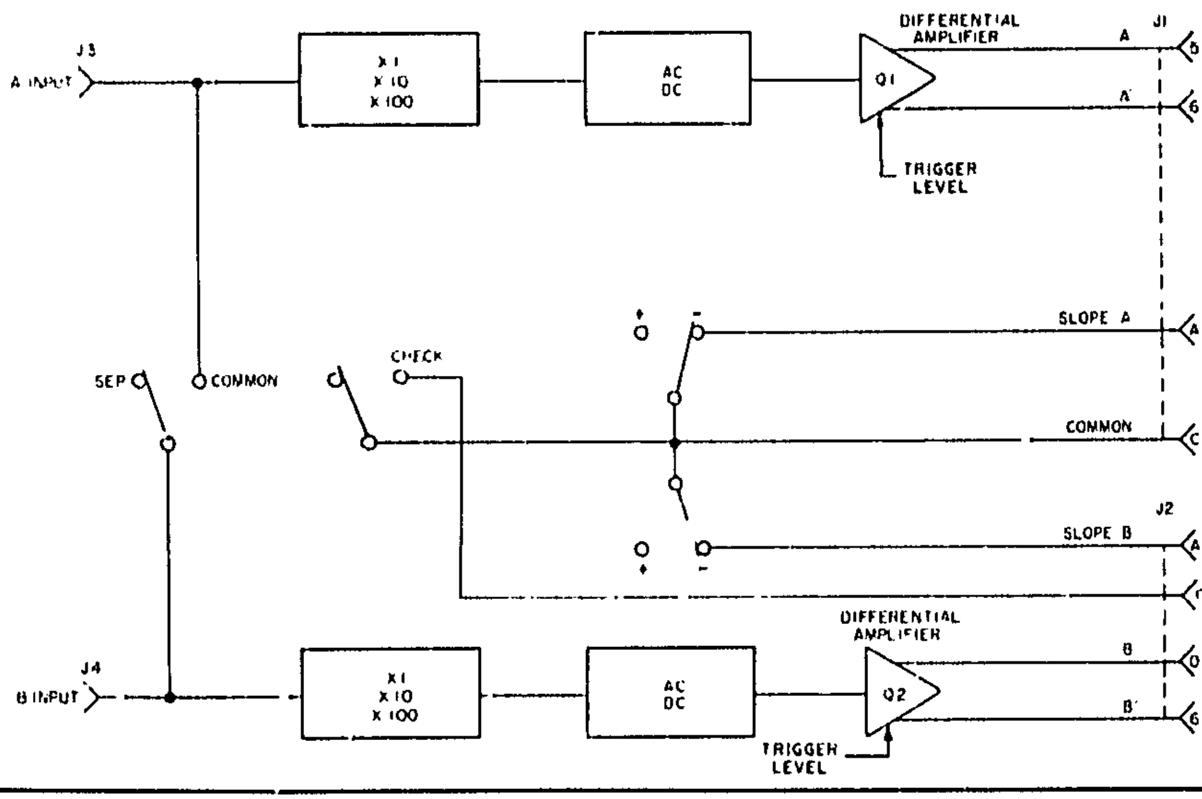
A1 contains trigger lights DS1 and DS2 and current limiters R1 and R2. CR1, CR2, and CR9 eliminate interaction of the remote programming signals.

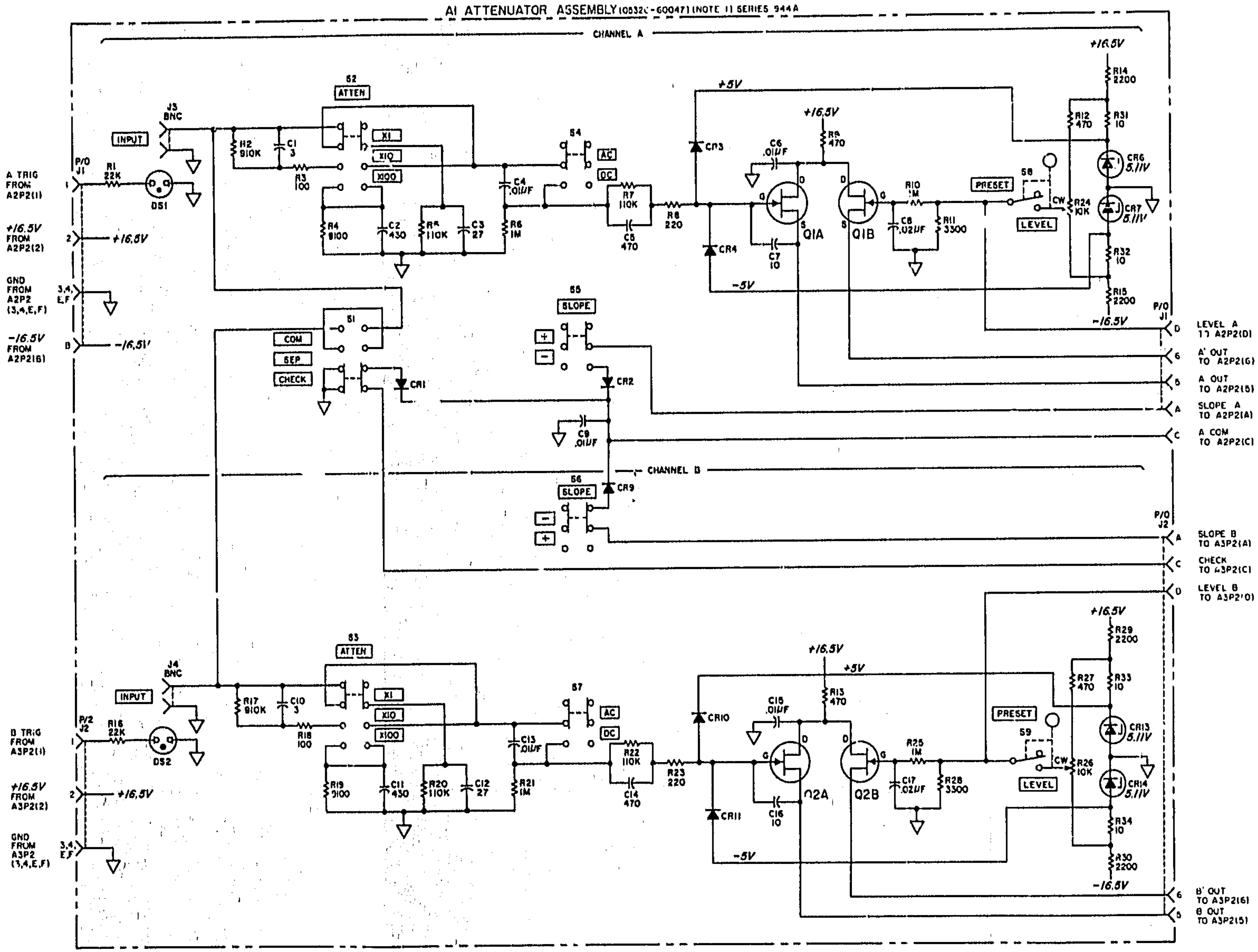
TOP



BOTTOM




J3
A INPUT
X 1
X 10
X 100
AC
DC
DIFFERENTIAL
AMPLIFIER
Q1
J1
A
A'
TRIGGER
LEVEL
+
-
SLOPE A
SEP
COMMON
CHECK
COMMON
J2
SLOPE B
+
-
DIFFERENTIAL
AMPLIFIER
J4
B INPUT
X 1
X 10
X 100
AC
DC
Q2
B
B'
TRIGGER
LEVEL



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

A1
C1-17 CR1-4,6,7, 9-11,13,14 DS1,2 J1-4 Q1,2 R1-34 S1-9

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,2,9	1910-0016
CR3,4,10,11	1901-0376
CR6,7,13,14	1902-0041
Q1,2	1855-0334

05326-D-1A

COMPLETE PARTS LIST FOR THE THIS ASSEMBLY IS LOCATED ON PAGE 6-3

Figure 8-6. A1 Attenuator Assembly

A2, A3 AMPLIFIER/TRIGGER OPERATION

Two input amplifier assemblies are provided: A2 for Channel A and A3 for Channel B. Since the assemblies are identical, only one will be described. The input signal and the trigger level are received from A1 via P2(5) and P2(6) respectively. Potentiometer R2 is adjusted to cancel out offset voltages due to imbalances in the circuit.

The differential amplifier (Q1 and Q8) serves to clip a small window out of the input signal waveform. The outputs of Q1 and Q8 drive another differential amplifier Q2 and Q6. Q2 and Q6 inject a current drive input to differential Schmitt trigger Q3, Q4, Q5, and Q7.

Q3 and Q7 are common base amplifiers, which present a low input impedance and high output impedance to Q4 and Q5. This arrangement allows for greater high-speed operation of Q4 and Q5. C2 and R15 reduce the hysteresis of the Schmitt trigger to give greater reliability at the high frequencies. Two out-of-phase signals from this circuit are routed to Q9 and Q10. The output levels shift from approximately +0.8 to +0.5 volts.

The SLOPE switch on A1 drives U1D(11) low for a +slope selection and U1A(3) low for a -slope selection. This allows either the in-phase signal or the out-of-phase signal to be switched to Q13 via Q10 and Q12 for +slope or via Q9 and Q11 for -slope.

The differentiator circuit consists of Q13 and feedback network L8 and R32. The circuit develops 10 ns pulses at the collector of Q13. CR3 and CR4 bias Q13 so that the collector circuit is compatible with ECL output driver U2B.

U2A(6) drives trigger-lamp driver Q16, Q17, Q18, Q19, and Q20. The circuit consists of RS FF Q16-Q17 and one-shot Q19-Q20. When U2A(6) is low, Q16 turns off and Q17 turns on. With Q17 on, Q18 cuts off to drive P1(1) high, which will light the trigger lamp DS1 on A1. As C8 charges, Q20 base goes positive. When Q20 base is approximately ground potential, the one-shot fires to turn off Q19 and Q17.

The marker circuit, Q15 and Q14, is a pulse stretcher that provides a low marker output at P1(12, N). When the input amplifier circuits trigger, U2B(8) provides a positive spike to Q14 base to drive Q14 collector below ground and allow CR5 to conduct. This makes the charge on C6 more positive. When U2B(8) returns to logical zero (approximately -1.6 V), Q14 is back biased and turns off, allowing Q15 to turn on to drive the marker output line low. After C6 has discharged through R36, Q14 turns on again, Q15 turns off, and the marker output returns to the high state.

During the check mode, A1P1(C) is held high to disable U2B and enable U2A. With U2B disabled, the marker pulses are inhibited. With U2A enabled, the 10 MHz check signal at P1(4,D) connects to the amplifier output line P1(5,E).

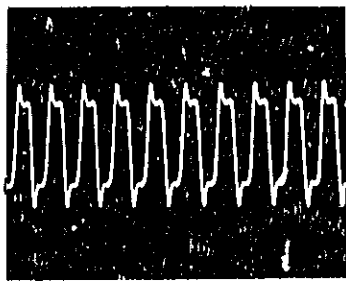
A2 TROUBLESHOOTING

When tracing the signal through the amplifier assembly, a good starting point is the collector of Q4, test point 4. With a sine wave input and the LEVEL control set to zero, this waveform should always resemble a square wave, due to the action of the Schmitt Trigger. A second check would be test point 6. If no signal is available there, check the slope gates of U1 and transistors Q9-Q12. Make use of the waveforms that are provided on this page. Once the problem is confined to a general area, use dc voltage checks to pinpoint the trouble.

Figure 8-6
A1 ATTENUATOR ASSEMBLY

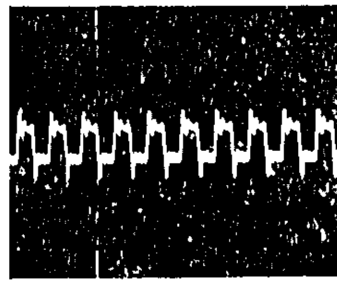
(See Page 8-15)

Part of Figure 8-7. A2, A3 Input Amplifier Assembly



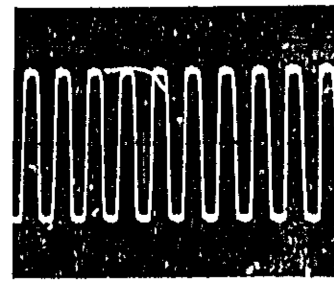
— +9.4 V

1 .05 V/cm
.1 μs/cm
ac oupled



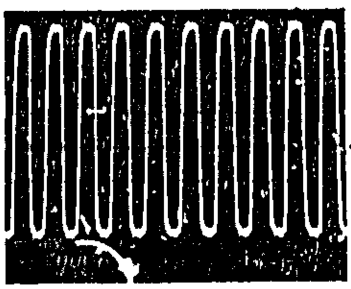
— +7.5 V

2 .01 V/cm
.1 μs/cm
ac coupled



— -3.6 V

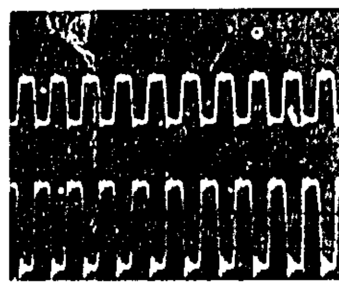
3 .05 V/cm
.1 μs/cm
ac coupled



— 0 V

4 .02 V/cm
.1 μs/cm

a

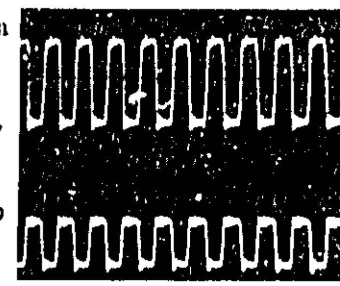


b

— 0 V
— 0 V

5 +SLOPE
a. Q10 emitter
b. Q9 emitter
.05 V/cm, .1 μs/cm

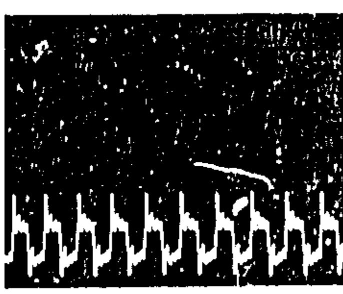
a



b

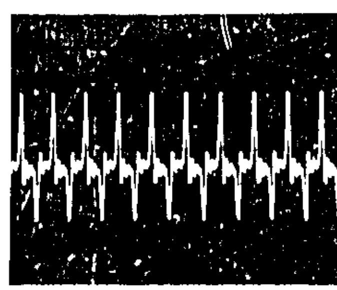
— 0 V
— 0 V

5 -SLOPE
a. Q10 emitter
b. Q9 emitter
.05 V/cm, .1 μs/cm



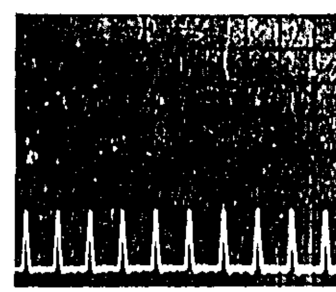
— 0 V

6 .02V/cm
.1 μs/cm



— 0 V

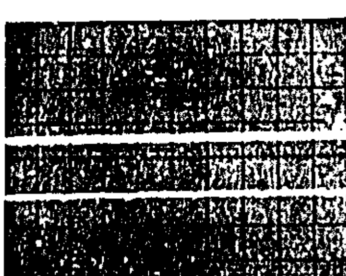
7 .05 V/cm
.1 μs/cm



— 0 V

8 .05 V/cm
.1 μs/cm

a



b

— 0 V
— 0 V

9 a. base -.05 V/cm
b. collector -5 V/cm
10 ms/cm
CHOP B

DC VOLTAGES:

Set counter controls as stated.
Disconnect input signal.

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C7. A2 is mounted on extender board.

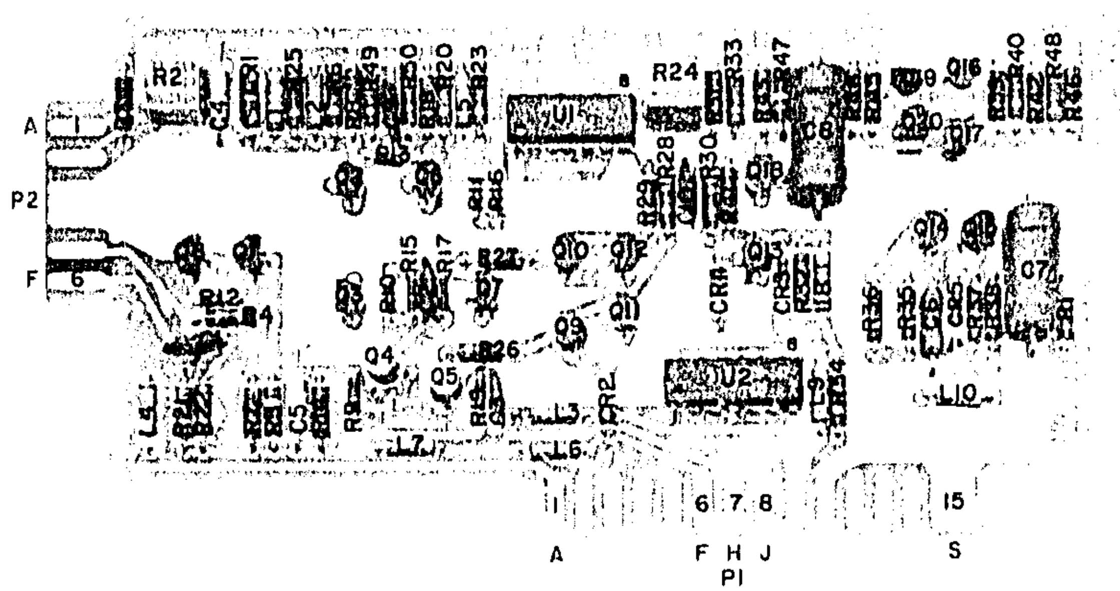
COUNTER CONTROLS:

CHANNEL A jack	connect 10 MHz sine wave at 1 V rms
FUNCTION	FREQ A
TIME BASE	1 ms
ATTEN	X1
LEVEL	PRESET
CHK SEP COM	SEP
SAMPLE RATE	FAST ccw
SLOPE	+

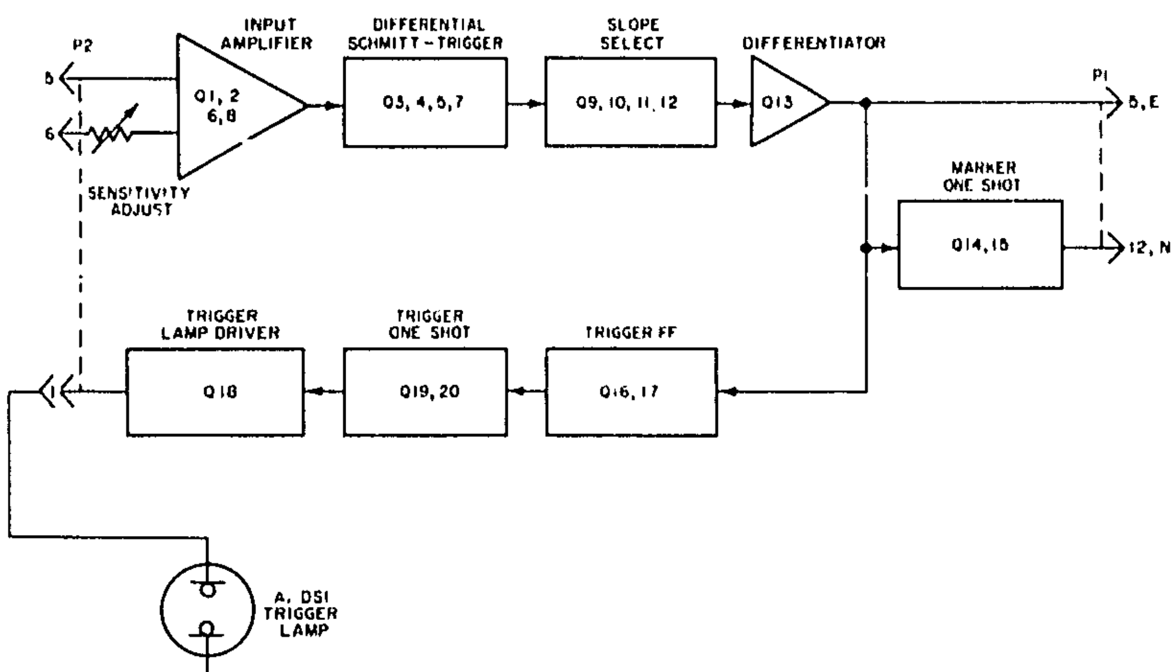
OSCILLOSCOPE CONTROLS:
(except as noted)

SWEEP MODE	AUTO
TRIGGER	INT
SLOPE	+
DISPLAY	for dual waveforms, use ALT B

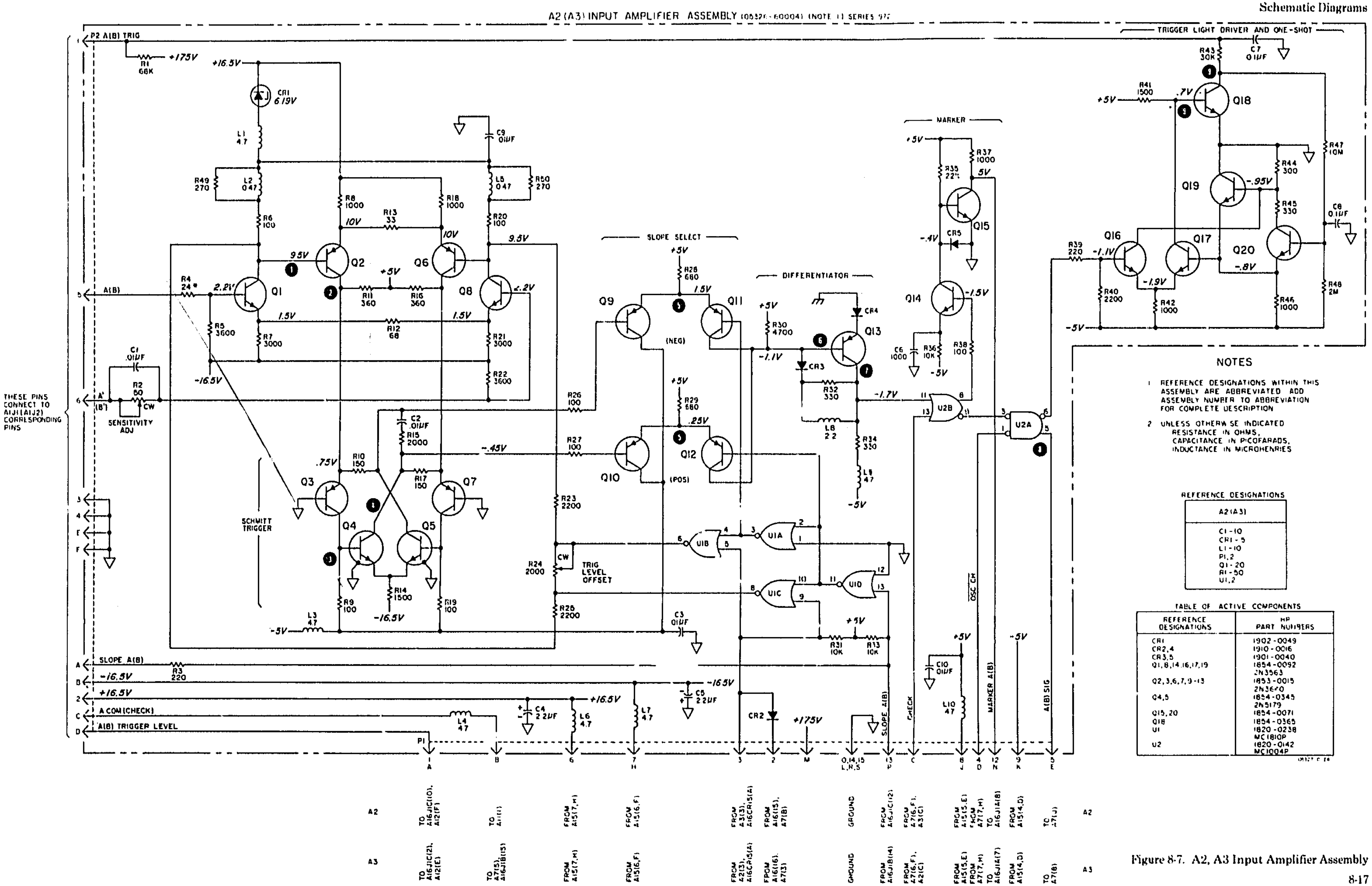
MORE DATA UNDER FOLD



A
P2
F
6
R2
R24
U1
U2
Q4
Q5
L7
L10
15
A
F H J
S
P1



P2
5
6
INPUT AMPLIFIER
Q1, 2 6, 8
SENSITIVITY ADJUST
DIFFERENTIAL SCHMITT-TRIGGER
Q3, 4, 5, 7
SLOPE SELECT
Q9, 10, 11, 12
DIFFERENTIATOR
Q13
P1
5, E
MARKER ONE SHOT
Q14, 15
12, N
TRIGGER LAMP DRIVER
Q18
TRIGGER ONE SHOT
Q19, 20
TRIGGER FF
Q16, 17
1
A, DS1 TRIGGER LAMP



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION
2. UNLESS OTHERWISE INDICATED RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS, INDUCTANCE IN MICROHENRIES

REFERENCE DESIGNATIONS

A2(A3)
C1-10 CR1-5 L1-10 P1,2 Q1-20 R1-50 U1,2

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1	1902-0049
CR2,4	1910-0016
CR3,5	1901-0040
Q1,8,14,16,17,19	1854-0092 2N3563
Q2,3,6,7,9-13	1853-0015 2N3640
Q4,5	1854-0345 2N5179
Q15,20	1854-0071
Q18	1854-0365
U1	1820-0238 MC1810P
U2	1820-0142 MC1004P

Figure 8-7. A2, A3 Input Amplifier Assembly

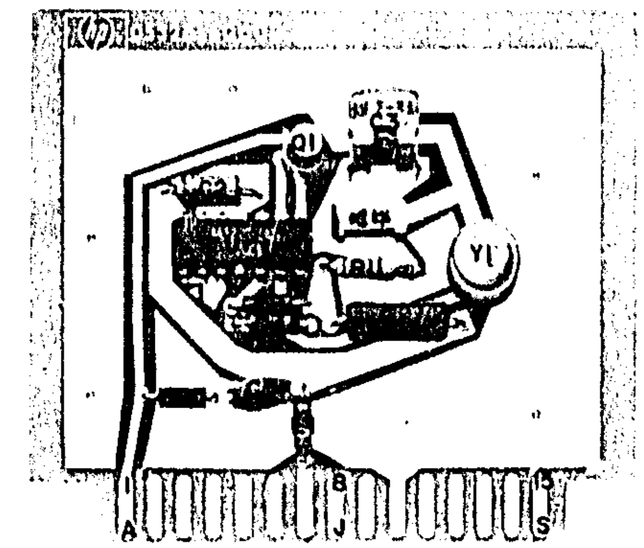
A4 OSCILLATOR OPERATION

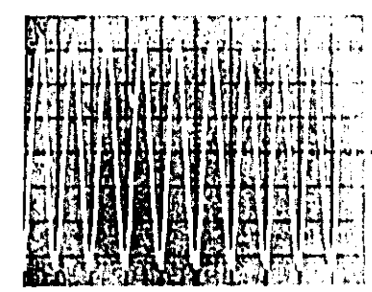
The 10 MHz oscillator assembly consists of oscillator U1A, buffer U1B, and level shifter Q1. U1A operates like an amplifier with positive feedback. The positive feedback path is from the noninverted output of U1A(6) through 10 MHz crystal Y1, trimmer capacitor C3, and C4 to U1A(4). Negative feedback is used to establish the input bias for U1A. The negative feedback path consists of R1 and R2. The inverted output of U1A(5) connects to buffer U1B(10). The buffer provides isolation between the oscillator and the output. The outputs of U1B(8) and (9) switch from approximately 3.5 to 4.25 volts. When one output is 3.5 volts, the other output is 4.25 volts. Level shifter Q1 converts the output of U1B to an approximate square wave of 0 to +4 volts.

Figure 8-7
A2, A3 INPUT AMPLIFIER ASSEMBLY

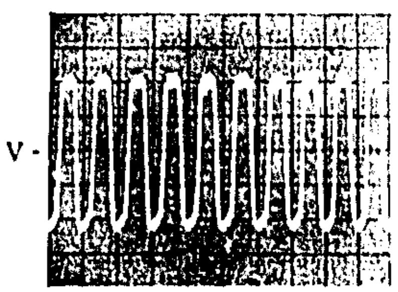
(See Page 8-17)

Part of Figure 8-8. A4 Oscillator Assembly

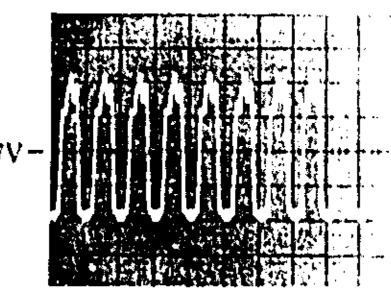




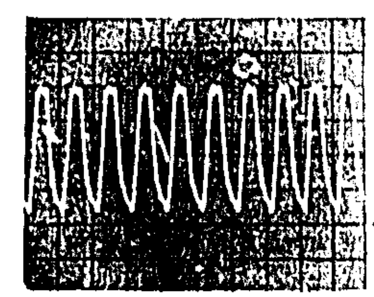
1 .01 V/cm
.1 μs/cm
ac coupled



2 .02 V/cm
.1 μs/cm
ac coupled



3 .02 V/cm
.1 μs/cm
ac coupled

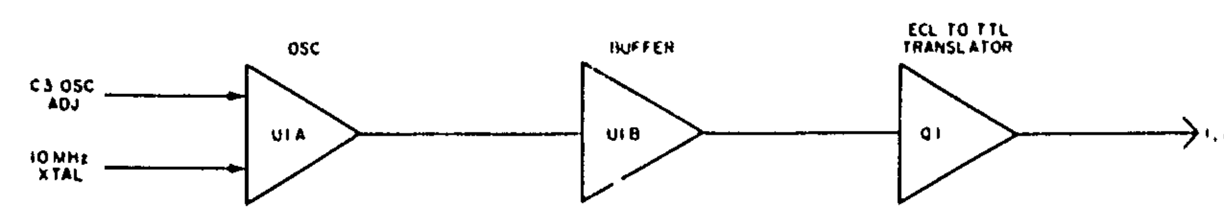


4 .1 V/cm
.1 μs/cm

All waveforms taken through 10:1 divider probe. Divider probe's 8½" ground lead is connected to ground side of C5.

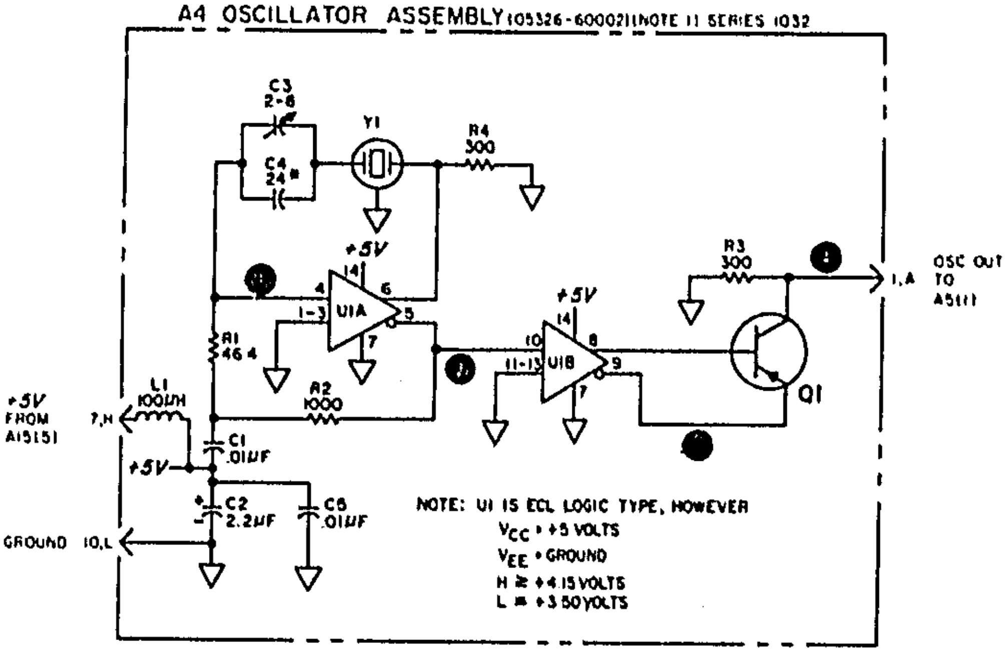
COUNTER CONTROLS:

INT-EXT (rear panel) .... INT



MORE DATA UNDER THIS FOLD

Figure 8-8. A4 Oscillator Assembly



SEE FIGURE 8-22 FOR INTERCONNECTING WIRING AND OPTION 010 AND 011

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS,
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A4
C1-5 L1 Q1 R1-4 U1 Y1

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
Q1	1850-0158 2N2635
U1	1820-0142
Y1	0410-0405

Part of Figure 8-9. Time Base Control Assembly

A5 TIME BASE OPERATION

This assembly contains 8 decade dividers, which are controlled by TIME BASE switch S5. The input signal is 10 MHz for the frequency mode. For the totalize and period average modes, the decade dividers receive CHANNEL A signals.

When a particular decade receives a gate-enable signal the corresponding gated output line is enabled. For example, if S5 is set to .1 second U1(6) is grounded. This gates the divided signal out on U1(5). The gated outputs are connected together on a common line to C5. C5 differentiates the high to low transitions into approximately 100 ns pulses at U5C(8). When S5 is set to .1 μs, the input signal bypasses the decade dividers and passes through U10D and U5D. The output of U5C feeds through U10C to A7 and also through U10E to the rear-panel TIME BASE OUTPUT jack J6.

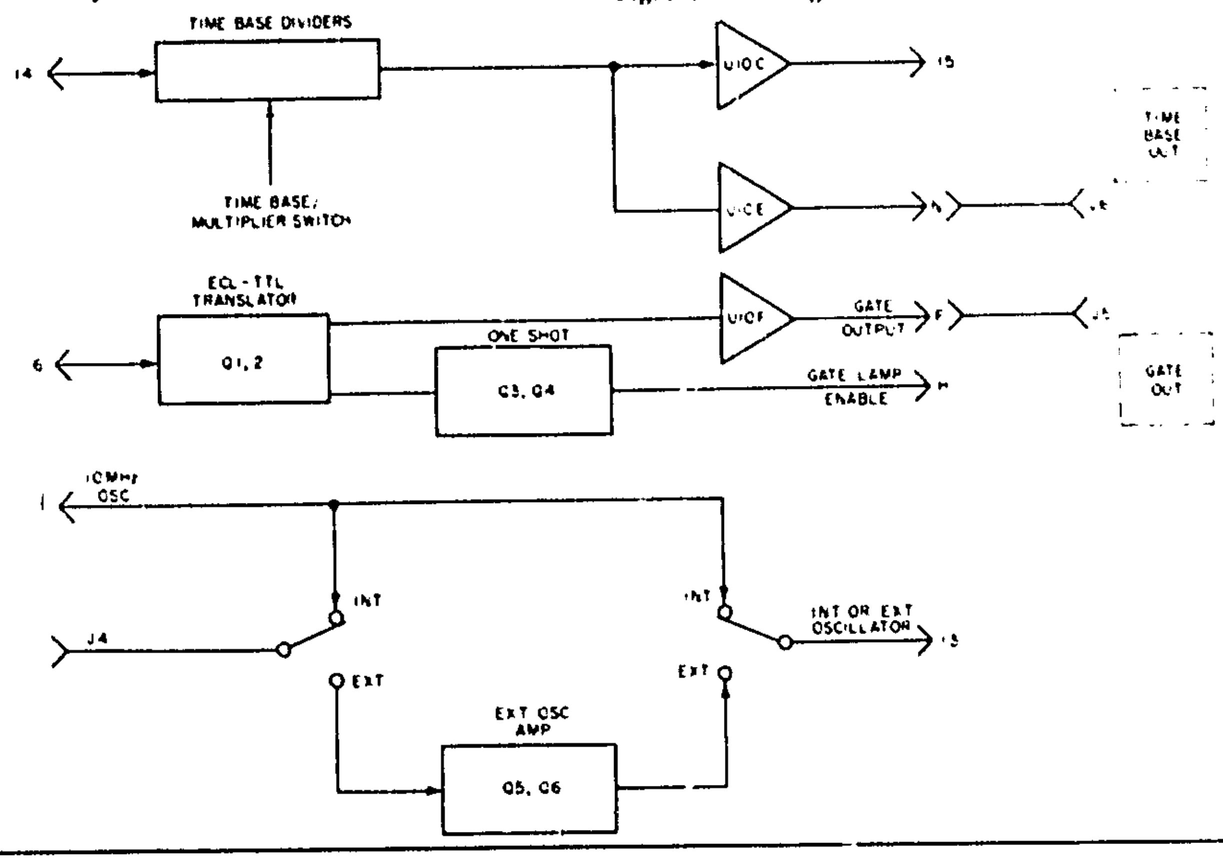
Q1 and Q2 form an ECL to TTL translator. When the main gate opens (low is main-gate enable), Q2 turns on the start one-shot Q3/Q4. During short gate-length times, this holds the gate lamp enable line low for approximately 50 ms to extend the time the gate lamp is on. When Q1 collector goes high, a low is developed at U10F(12) and routed to the GATE OUT jack J5.

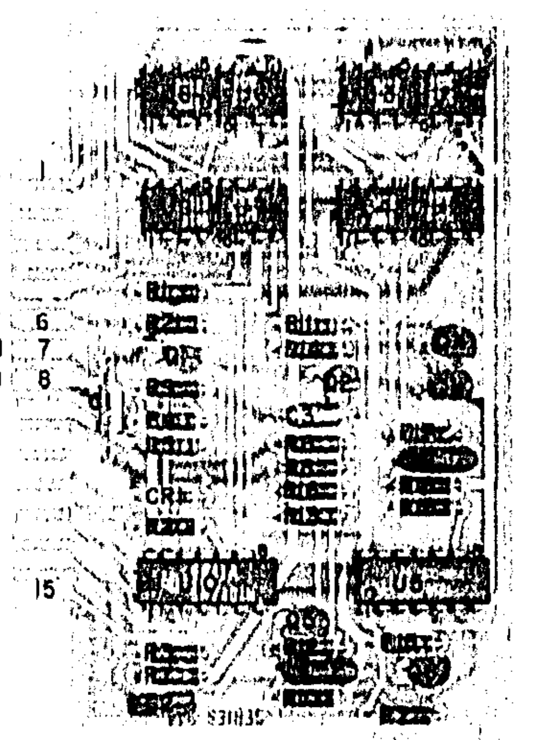
U5A and U5B select either the internal or external oscillator signal. When S7 is set to EXT, the internal oscillator signal is inhibited and the external oscillator signal passes through Schmitt trigger Q5 and Q6 to U5B and XA5(13).

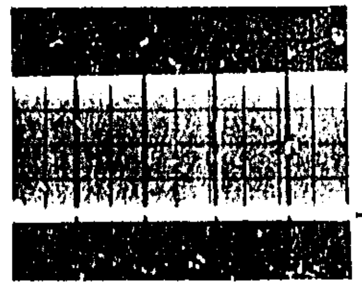
A5 TROUBLESHOOTING

When troubleshooting the Time Base Dividers, place the FUNCTION switch to START and SEP/COM/CHK to CHK. Step the TIME BASE switch through each position and note the counter's display. When the counter stops totalizing, check for a low on pin 6 of the selected decade. If the counter does not totalize for any position of the TIME BASE switch, the problem is in the circuitry of U10B, U10C, or U5C. Before the gated output is sent to the A7 Function Control, it is differentiated by C5 and R18. This produces extremely sharp pulses, which are best observed when the gate time is 0.1 μs (TIME BASE switch).

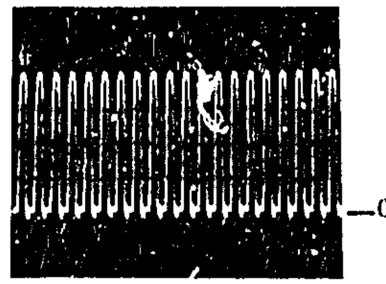
To check the operation of the Gate Lamp one-shot, check for waveform 5 and 6 with SAMPLE RATE switch to NORM. The Collector of Q3 should be Low for about 50 ms, regardless of the gate time.



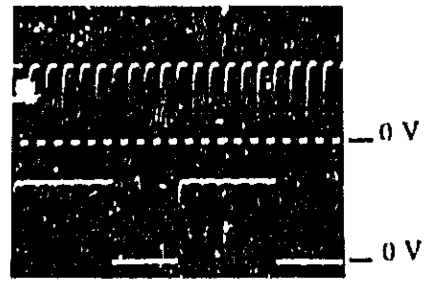




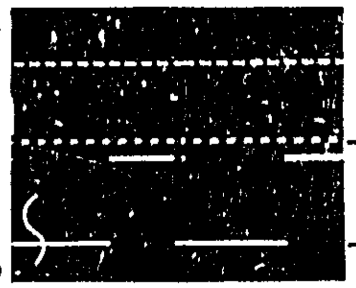
① .1 V/cm
.5 ms/cm



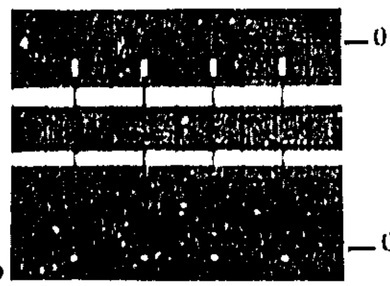
② .1 V/cm
.2 µs/cm



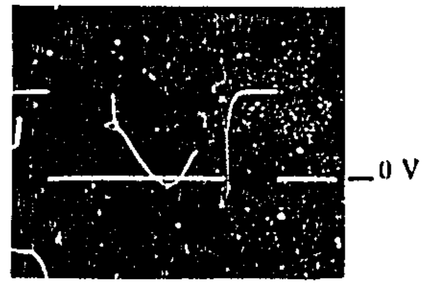
③ a. U7(2) .2 V/cm
b. U7(4) 2 µs/cm



④ a. U2(2) .2 V/cm
b. U2(5) .2 ms/cm



⑤ a. Q1 base - .1 V/cm
b. Q1 collector - .2 V/cm
.5 ms/cm



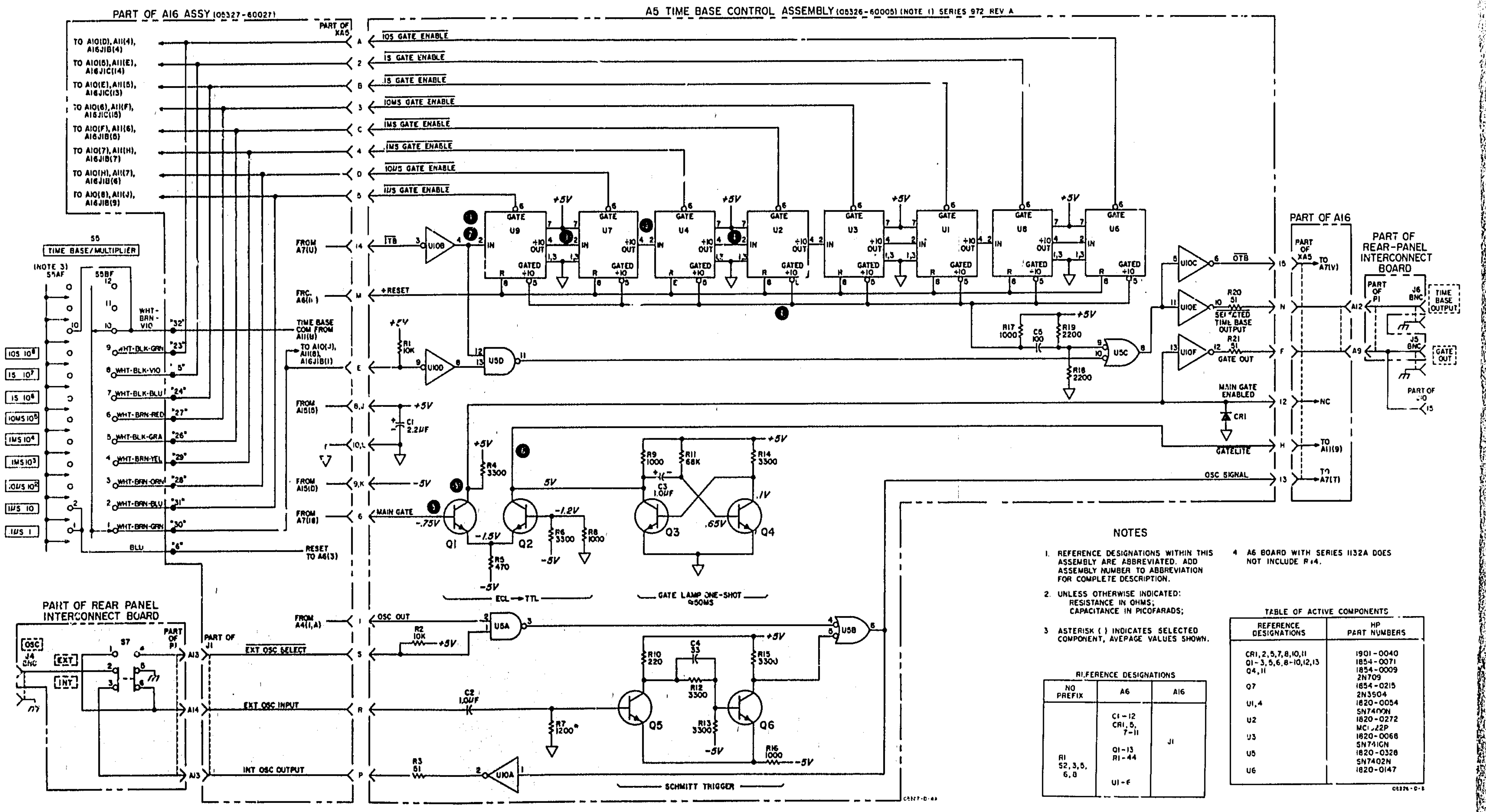
⑥ .2 V/cm
10 ms/cm
SAMPLE RATE - NORM
SWEEP MODE - NORM

COUNTER CONTROLS:
(except as noted)
Use settings of A2 Assembly

DC VOLTAGES:
Set counter controls as stated.
Disconnect input signal. Push RESET.

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C1. A5 is mounted on extender board.

OSCILLOSCOPE CONTROLS:
(except as noted)
Use settings of A2 Assembly



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
3. ASTERISK ( ) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
4. A6 BOARD WITH SERIES 1132A DOES NOT INCLUDE R44.

REFERENCE DESIGNATIONS

NO PREFIX	A6	A16
R1 S2, 3, 5, 6, 8	C1 - 12 CR1, 5, 7 - 11 Q1 - 13 R1 - 44 U1 - 6	J1

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1, 2, 5, 7, 8, 10, 11	1901-0040
Q1 - 3, 5, 6, 8 - 10, 12, 13	1854-0071
Q4, 11	1854-0009 2N709
Q7	1854-0215 2N3504
U1, 4	1820-0054 SN7400N
U2	1820-0272 MC1022P
U3	1820-0068 SN7410N
U5	1820-0328 SN7402N
U6	1820-0147

Figure 8-9. A5 Time Base Control Assembly

A6 SAMPLE RATE OPERATION

The sample-rate circuits determine interrogation rates for the input signal and provide several functions for the various operating modes. These functions include generating reset, transfer, print command, and main-gate inhibit signals. In addition, the circuits receive computer inhibit, printer inhibit, and manual reset signals. The circuits also serve to control storage and display-hold functions.

As an example of operation, assume the following operating conditions: STORAGE to ON, SAMPLE RATE to FAST, no printer inhibit, no computer inhibit, no manual reset, and main gate open. At the end of the gate time, Pin 17 goes high, which sets inhibit flip-flop U2. This sends a signal to U6C to gene ate a high inhibit at U6B(9). In addition, a low is generated at Q4 collector to trigger the sample rate one-shot if no printer inhibit is present at U5B(6). The display time starts at this point, and the high at U5C(10) generates a low at U1D(11). The resulting high on U1C(8) turns on Q6, giving a low at the collector, which is the print command. Also at this time, the low on U1B(6) activates U4C through differentiator C5 to generate the positive and negative transfer signals at pins T and K, respectively.

When the sample rate one-shot is set, U1B(6) goes low to turn off Q7, allowing the +5 V supply and R41 - R1 to charge C4 for the display time. C3 is also connected for the NORM position. R1 varies the display time by varying the time required to bring Q8 base to a sufficient plus value to trigger Schmitt Trigger Q8 through Q10. This gives a high at U1A(1). The reset will be delayed until there is no print inhibit. U1A(3) will go low, generating a high at U3B(6), which is fed out at A6(16). The negative reset at U3C(8) is fed out at pin 9 in addition to being used to reset the sample rate one-shot.

The positive reset is used on A6 after passing through level shifter CR7 and CR8. The positive reset turns on Q1 and applies an ECL high to clear U2 and also turns on Q2, which maintains inhibit approximately 200 ns after the end of the reset pulse. At this time, the inhibit goes low and the main-gate circuits are free to function.

Q11 circuitry is a reset one-shot that ensures a sufficiently long reset pulse. The reset pulse width is approximately 40 µs or 400 µs, as determined by the FAST/NORM switch. For NORM sample rates, S2 switches C10 in parallel with C8. The sample rate disable line (pins 10, L) is low during START mode and maintains continuous transfer through CR3 and prohibits main-gate inhibit through U4B in addition to holding down Q8 base through CR2. This prevents the reset from being generated.

When STORAGE is OFF, U5A is activated to maintain transfer through CR4. The manual reset (pin 3) holds the reset one-shot in the ON state as long as the RESET button is depressed (reset low). It also maintains the transfer during the same time to clear the display. In addition, it turns on the main-gate inhibit, even if the main gate is open. The manual reset signal is low if the RESET button is depressed or if the TIME BASE or FUNCTION switch is between positions. (No reset is generated between start and stop positions.)

A6 TROUBLESHOOTING

Troubleshooting the Sample Rate board is best accomplished when the board is in a static state. The procedure given below examines each section separately when the circuit is in a working, but static, condition. Perform the tests in order listed. The schematic shows the circuit levels after RESET is pushed. These levels should be used as a reference.

NOTE

Do not use an input signal when performing the tests below.

MAIN GATE INHIBIT, PRINT COMMAND DRIVER, and SAMPLE RATE ONE-SHOT. Before troubleshooting, perform the procedure below.

FUNCTION switch	FREQ A
TIME BASE switch	1 s
SAMPLE RATE switch	HOLD
SLOPE switch	+
CHK-SEP-COM	SEP
STORAGE switch	ON
LEVEL control	full cw
Push RESET	
LEVEL	full ccw

(Note that trigger lamp fires)

The purpose of this procedure is to set these circuits to the point immediately after the main gate closes. Varying the LEVEL control triggers a pulse to open the main gate for 1 second, and pin 17 goes Low during the gate time. U2 sets when the gate closes (positive transition) and remains set with the SAMPLE RATE switch set to HOLD. Once U2 sets, check for a Low on U5C(8). This generates a High on U1C(8) and a Low on U1D(6). Check that U4C(8) pulses High and Q6 collector sets Low. The main gate inhibit line at U6B(9) should now be High. The collector of Q7 is not now affected.

SAMPLE RATE INHIBIT. The sample rate inhibit gates are controlled by the FUNCTION and STORAGE switches and by a print inhibit signal. With the controls set as above, check for the levels shown on the schematic.

SCHMITT TRIGGER. The Schmitt Trigger and Q7 should be checked by using an input signal. Set the counter controls as listed under the waveforms. In waveform five, the repetition rate of the pulses changes with gate time, but pulse width remains the same. Pulse width changes with the SAMPLE RATE controls, but not spacing.

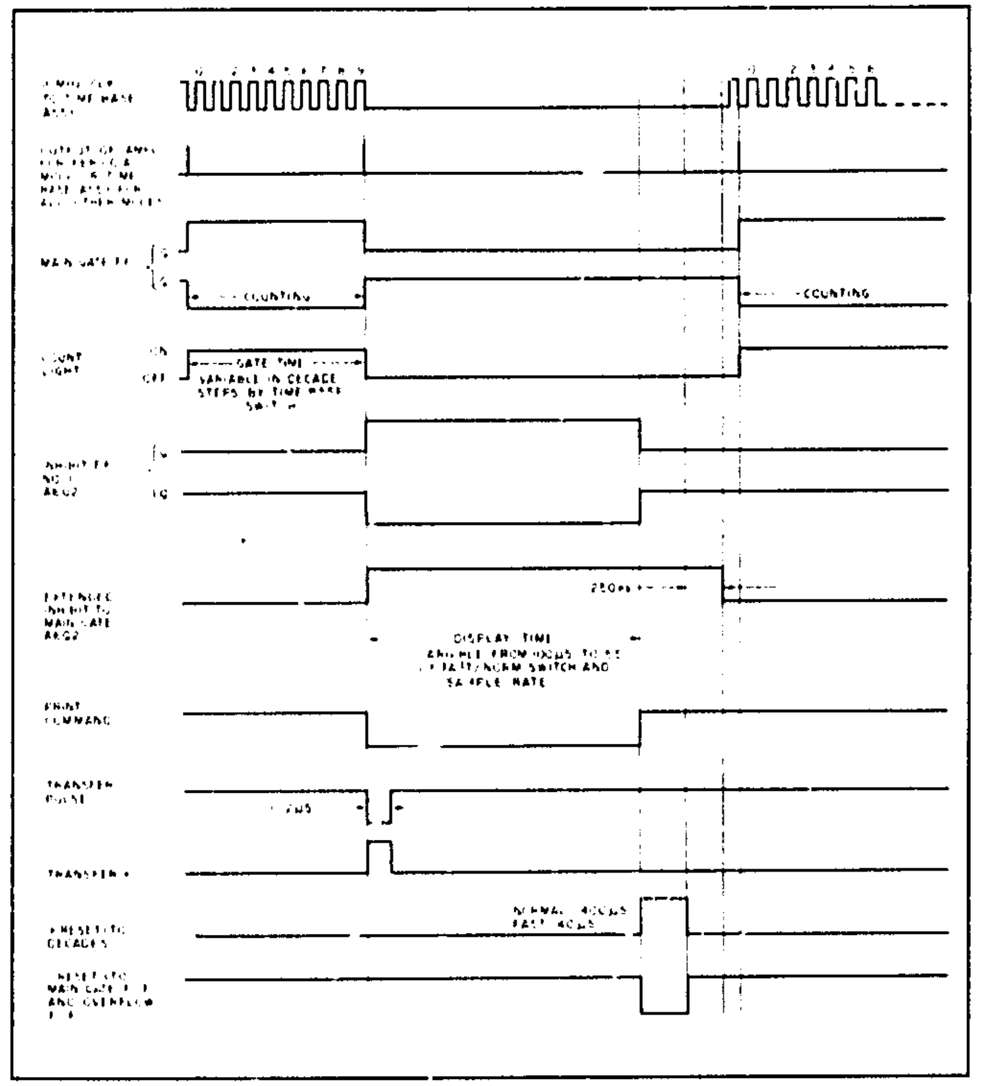
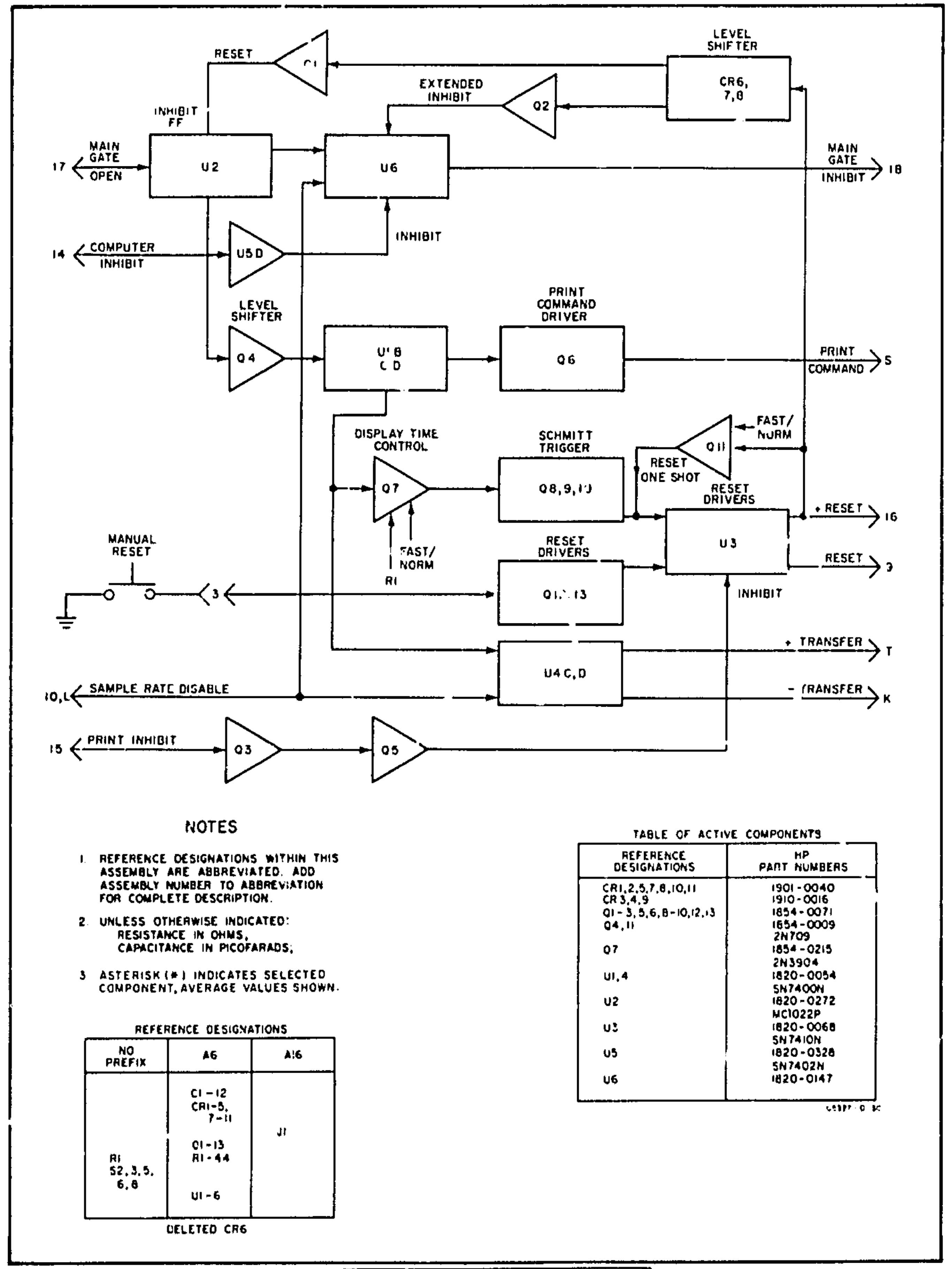


Figure 8-9
A5 TIME BASE CONTROL ASSEMBLY

(See Page 8-21)

Part of Figure 8-10. A6 Sample Rate Assembly



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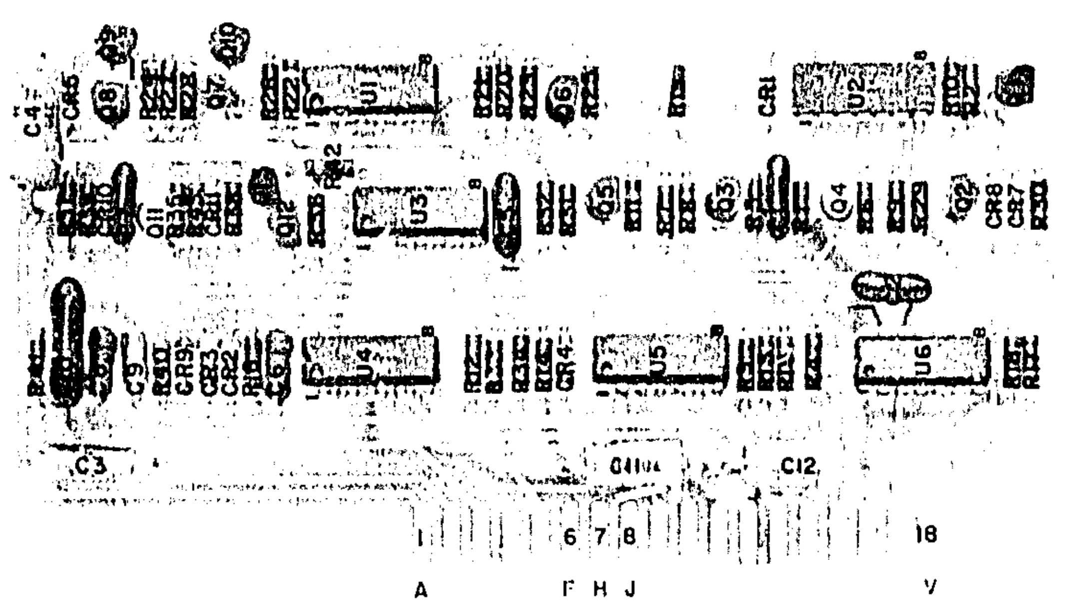
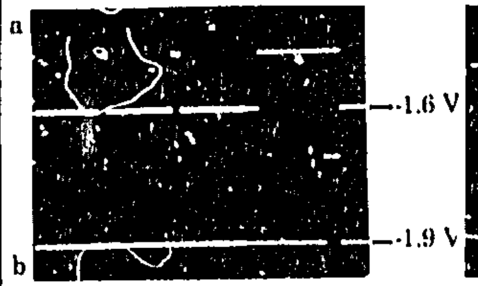
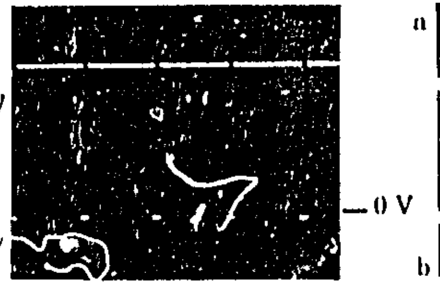


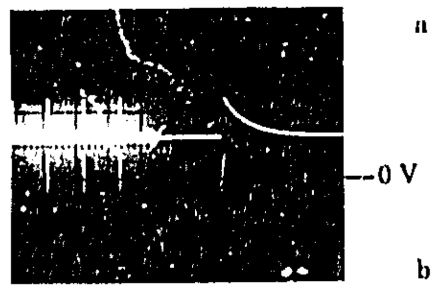


1 a. U2(2)
b. U2(5)
.05 V/cm
SWEEP to MIXED
MAIN — .5 ms/cm
DELAYED — 50µs/cm

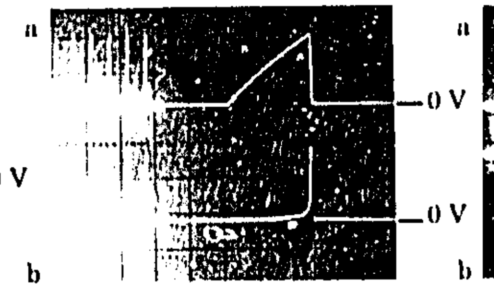


2 .1 V/cm
.5 ms/cm

3 a. U1(6)
b. U1(9)
.2 V/cm
5 ms/cm



4 .2 V/cm
SWEEP to MIXED
MAIN — 1 ms/cm
DELAYED — 10 µs/cm



5 a. Q7 — .1 V/cm
b. Q10 — .05 V/cm
SWEEP to MIXED
MAIN — 2 ms/cm
DELAYED — 20 µs/cm

6 a. U3(6)
b. Q11 collector
.2 V/cm
SWEEP to MIXED
MAIN — 1 ms/cm
DELAYED — 10 µs/cm

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C11. A6 is mounted on extender board.

OSCILLOSCOPE CONTROLS:
Use settings of A2 Assembly

DC VOLTAGES:
Set counter controls as stated.
Disconnect input signal.
Push RESET.

HE,LE — ECL levels
H,L — TTL levels

COUNTER CONTROLS:
Use settings of A2 Assembly

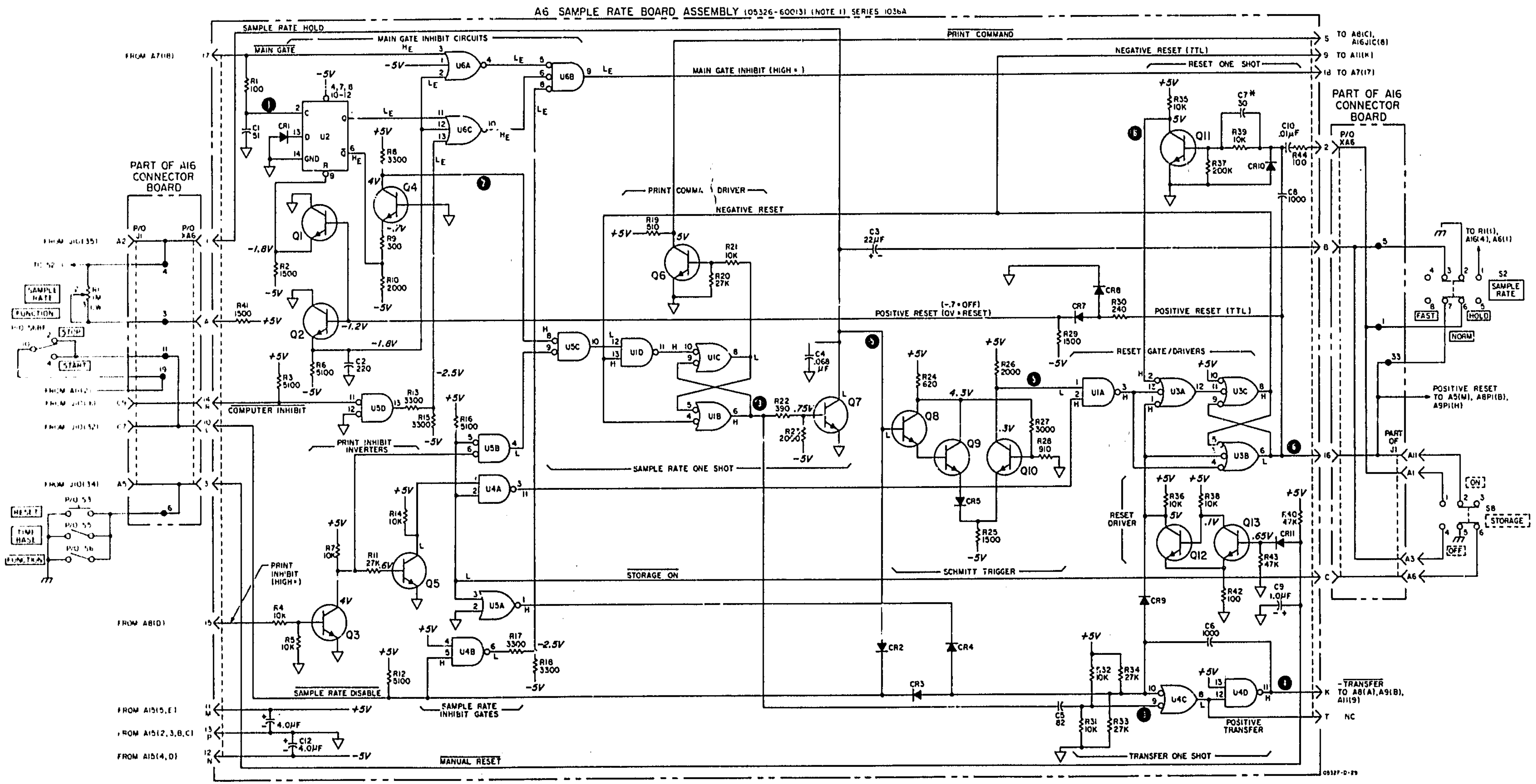


Figure 8-10. A6 Sample Rate Assembly

A7 FUNCTION CONTROL OPERATION

This assembly contains the gating, flip-flops, one-shots, and translators necessary to interconnect the oscillator, time base, and input channel signals to the time base and decade counting assemblies. Table I lists the functional interconnections for each function of the counter.

An example of the operation in the FREQ A mode will explain the typical circuit operation. This wi' be expanded to the other functions. Assuming the start of a new mea. ement, main gate inhibit (pin 17) has just gone low (at the end of the . 'play time). Upon the arrival of the first subsequent channel A input annel A flip-flop sets, making U5B(9) High. Upon the n. . ting ed of the oscillator signal (pin T, TTL levels; U8B(4) E. . le..els), U5B sets and arms the oscillator gate U3A. The gated oscillator signal is then connected to the time base input one-shot U4, h generates 50 ns, negative-going pulses to time base input (pin U).

The time base will return a puise upon receipt of the 1st and Nth pulse delivered from pin U (N = multiplier setting on front panel). The 1st pulse arriving at pin V is translated from TTL to ECL by U8 and then goes on to toggle (set) main gate flip-flop U1. This opens the main gate (U13B), and the decade counting assembly counts the signal (in this case, input A — see Table I). Upon the arrival of the 2nd time base output pulse, U1 toggles closed, shutting main gate U13B and signaling A6 to start the display cycle (pin 18). A6 returns a High MINH (pin 17) and the main gate flip-flop U1, synchronizer U5, and ITB one-shot U4 are locked closed at the end of the display. MINH goes low and the cycle repeats.

Continued

In the period mode, the main gate F-F U1 is toggled by the input A signal so that it is set for exactly one period of A. The counted signal is the oscillator di ided by the MULTIPLIER switch setting.

In period average, the input A signal goes to the time base, which generates a pulse on the 1st and Nth pulse. These pulses toggle the main gate, and the oscillator is counted during N periods of A.

In START, the main gate is held open and the input signal, which is scaled by the time base, is counted. The FREQ C operati n is the same as FREQ A, except that the input synchronizer U5B is held on by U10. IC's U2, 3, 7, 8, 9, 10, and 12 are combination TTL/ECL translators and data switches. The function inputs (FREQ A, FREQ C, etc.) are TTL low true and are pulled up by internal 10k-ohm pullups on the translators. U8(3) is the check signal to Amplifier A2 and A3 In normal it is low; while in check, it is high with negative 10 ns pulees at 10 MHz.

In time interval, the operation is similar to period, but U1 is set continuously. MGATE OUT (pin 18) is now controlled by the output of U5B. The following explanation describes how the synchronizer U5A and B works in a time interval mode.

Assuming a display cycle has just been completed, the flip-flops formed by U11 and U6 and U5 sections have been reset. Two conditions can occur.

First — If a channel A signal occurs before a B signal, the A signal will set the channel A flip-flop before the B sets the B flip-flop (see Timing Diagram). When the first leading edge of the oscillator occurs after the A F-F is set, U5B is set, opening the clock gate and instructing A6 that the measurement has started (pin 18). The oscillator signal goes to the time base and is divided, returns, and is sent out through the main gate to A8 for subsequent display. When the B signal occurs, the leading edge of the next clock pulse sets U5A, closing the clock gate.

The U5A $\overline{Q}$ low signal goes back to U6(11) and waits about 50 ns for the falling edge of the oscillator. At this point, U6(10) goes high, resetting the A and B flip-flops, putting lows at the D input of U5A and B. When the clock pulse again rises positive, U6(10) goes low (about the 10 ns after the clock edge) and U5A and B are closed to the "cleared" state.

Second — If a B signal occurs before an A, U5A would be set first, and no counting would occur. Also, it would take about 150 ns for U5A to complete the resetting described above; so if an A signal occurred during this time, it would be ignored. If the B-to-A delay is >150 ns, the A signal would start the interval as described above.

With time interval averaging, the input synchronizers work the same way, but the oscillator (not divided) is counted for the duration of each individual time interval that is being averaged. The first input A signal sets flip-flop U5B, which enables U3A to gate an oscillator pulse to the time base dividers. The dividers are now set to zero, from their previous reset-to-nine state. During this time, a channel B signal was received to complete the first time interval; but this first interval is not counted, since the main gate was closed. The time base output pulse enables the main gate to pass clock pulses for the duration of the time interval. After N intervals, the time base returns a pulse to close the main gate.

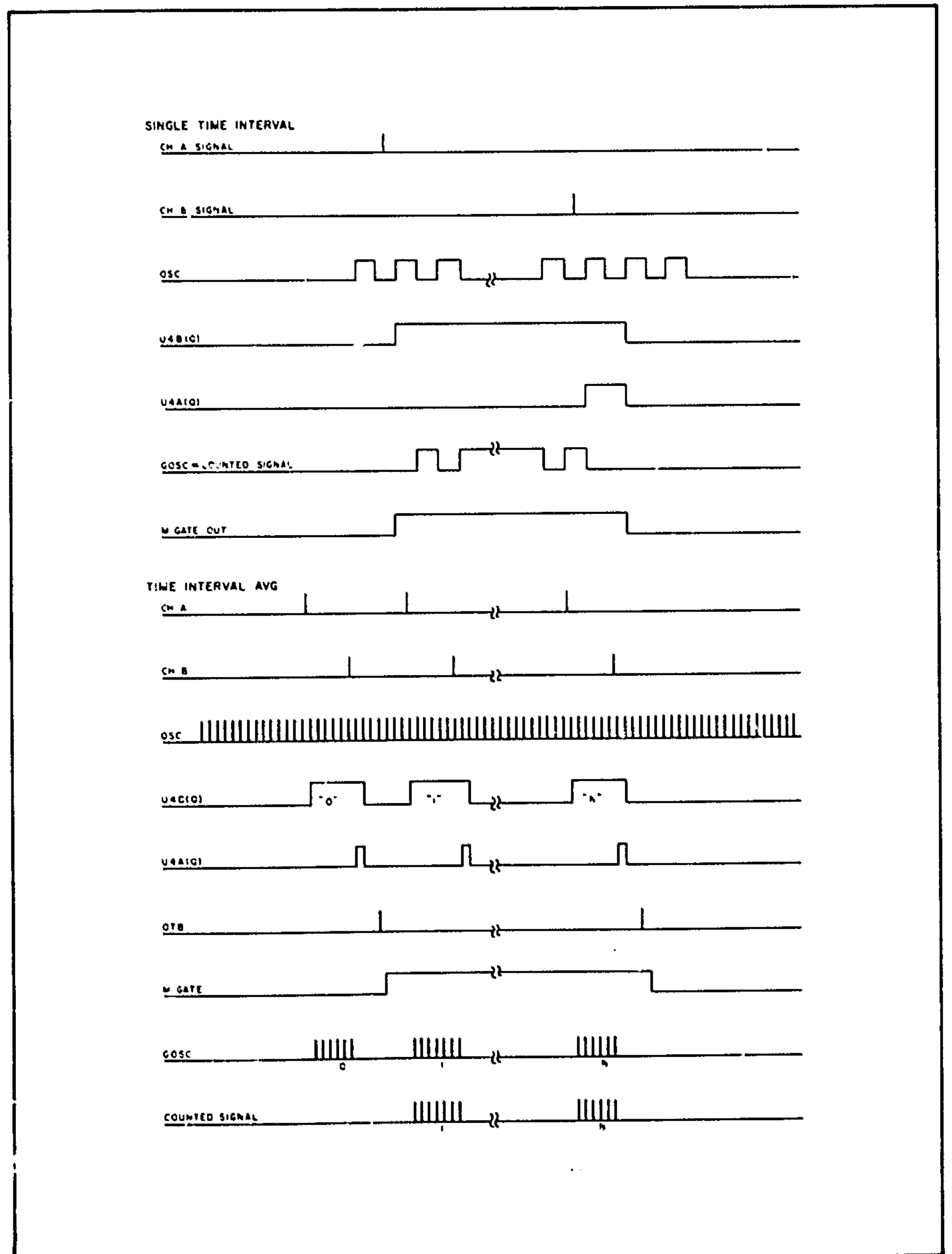
Table I. Functional Interconnections

FUNCTION	MGFF TOGGLE	TO DCA	ITB
STOP	0	OTB	0
START	1	OTB	IA
FREQ A	OTB	IA	GOSC
FREQ C	OTB	IC	GOSC
DVM•RA•RB	OTB	IV	GOSC
PERIOD	IA	OTB	GOSC
PERIOD AVG.	OTB	GOSC	IA
T. I.	1	OTB	GOSC
T. I. AVG.	OTB	GOSC	STI

DCA - Decade Counting Assembly
GOSC - Gated Oscillator
IA - Input A Signal
IC - Input C Signal
ITB - Input to Time Base
IV - DVM V-F Converter Output
OTB - Output of Time Base
STI - Synchronized Time Interval

Figure 8-10
A6 SAMPLE RATE ASSEMBLY
(See Page 8-23)

Timing Diagram for Time Interval Measurements



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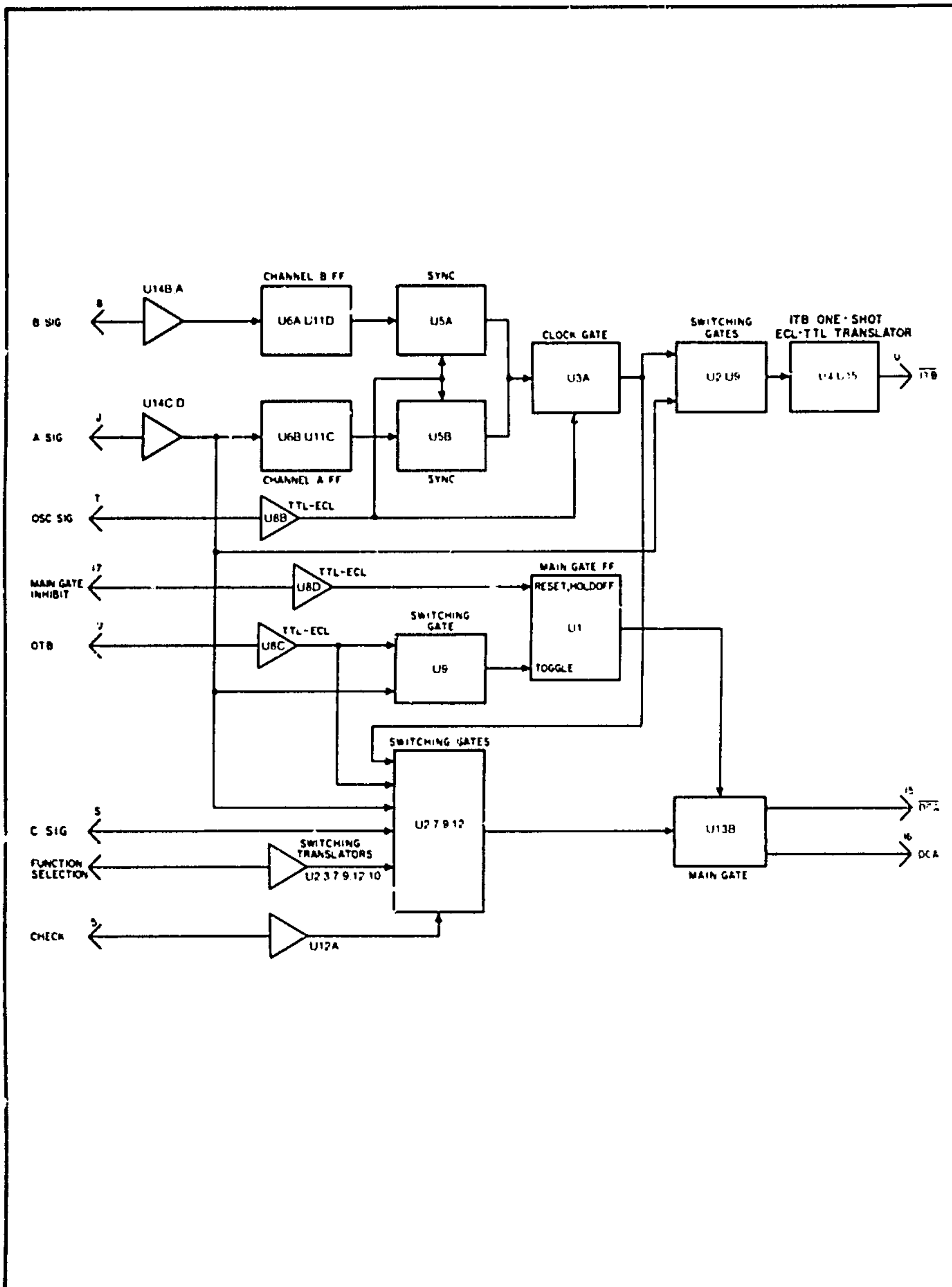
Part of Figure 8-11. A7 Function Control Assembly



SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphanumerical order of their reference designators and indicates the description and HP Part Number of each part, together with any applicable notes. The table includes the following information.

a. Description of part (see abbreviations below).

b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-2.

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Sales and Service Office (see lists at rear of this manual for addresses). Identify parts by their Hewlett-Packard part numbers.

6-6. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	MP	= mechanical part	U	= integrated circuit
B	= motor	FL	= filter	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
BT	= battery	IC	= integrated circuit	Q	= transistor		
C	= capacitor	J	= jack	R	= resistor	VR	= voltage regulator
CP	= coupler	K	= relay	RT	= thermistor	W	= cable
CR	= diode	L	= inductor	S	= switch	X	= socket
DL	= delay line	LS	= loud speaker	T	= transformer	Y	= crystal
DS	= device signaling (lamp)	M	= meter	TB	= terminal board	Z	= tuned cavity, network
E	= misc electronic part	MK	= microphone	TP	= test point		

ABBREVIATIONS

A	= amperes	H	= henries	N/O	= normally open	RMO	= rack mount only
AFC	= automatic frequency control	HDW	= hardware	NOM	= nominal	RMS	= root-mean square
AMPL	= amplifier	HEX	= hexagonal	NPO	= negative positive zero (zero temperature coefficient)	RWV	= reverse working voltage
BFO	= beat frequency oscillator	HG	= mercury	NPN	= negative-positive-negative	S-B	= slow-blow
BE CU	= beryllium copper	HR	= hour(s)	NRFR	= not recommended for field replacement	SCR	= screw
BH	= binder head	HZ	= hertz	NSR	= not separately replaceable	SE	= selenium
BP	= bandpass	IF	= intermediate freq	OBD	= order by description	SECT	= section(s)
BRS	= brass	IMPG	= impregnated	OH	= oval head	SEMICON	= semiconductor
BWO	= backward wave oscillator	INCD	= incandescent	OX	= oxide	SI	= silicon
CCW	= counter-clockwise	INCL	= include(s)	P	= peak	SIL	= silver
CER	= ceramic	INS	= insulation(ed)	PC	= printed circuit	SL	= slide
CMO	= cabinet mount only	INT	= internal	PF	= picofarads = 10^{-12} farads	SPG	= spring
COEF	= coefficient	K	= kilo = 1000	PH BRZ	= phosphor bronze	SPL	= special
COM	= common	LH	= left hand	PHL	= Phillips	SST	= stainless steel
COMP	= composition	LIN	= linear taper	PIV	= peak inverse voltage	SR	= split ring
COMPL	= complete	LK WASH	= lock washer	PNP	= positive-negative-positive	STL	= steel
CONN	= connector	LOG	= logarithmic taper	P/O	= part of	TA	= tantalum
CP	= cadmium plate	LPF	= low pass filter	POLY	= polystyrene	TD	= time delay
CRT	= cathode-ray tube	M	= milli = 10^{-3}	PORC	= porcelain	TGL	= toggle
CW	= clockwise	MEG	= meg = 10^6	POS	= position(s)	THD	= thread
DEP	= deposited carbon	MET FLM	= metal film	POT	= potentiometer	TI	= titanium
DR	= drive	MET OX	= metallic oxide	PP	= peak-to-peak	TOL	= tolerance
ELECT	= electrolytic	MFR	= manufacturer	PT	= point	TRIM	= trimmer
ENCAP	= encapsulated	MHZ	= mega hertz	PWV	= peak working voltage	TWT	= traveling wave tube
EXT	= external	MINAT	= miniature	RECT	= rectifier	U	= micro = 10^{-6}
F	= farads	MOM	= momentary	RF	= radio frequency	VAR	= variable
FH	= flat head	MOS	= metal oxide substrate	RH	= round head or right hand	VDCW	= dc working volts
FIL H	= fillister head	MTG	= mounting			W/	= with
FXD	= fixed	MY	= "mylar"			W	= watts
G	= giga (10^9)	N	= nano (10^{-9})			WIV	= working inverse voltage
GE	= germanium	N/C	= normally closed			WW	= wirewound
GL	= glass	NE	= neon			W/O	= without
GRD	= ground(ed)	NI PL	= nickel plate				

01194-14

Figure 6-1. Panel Designations

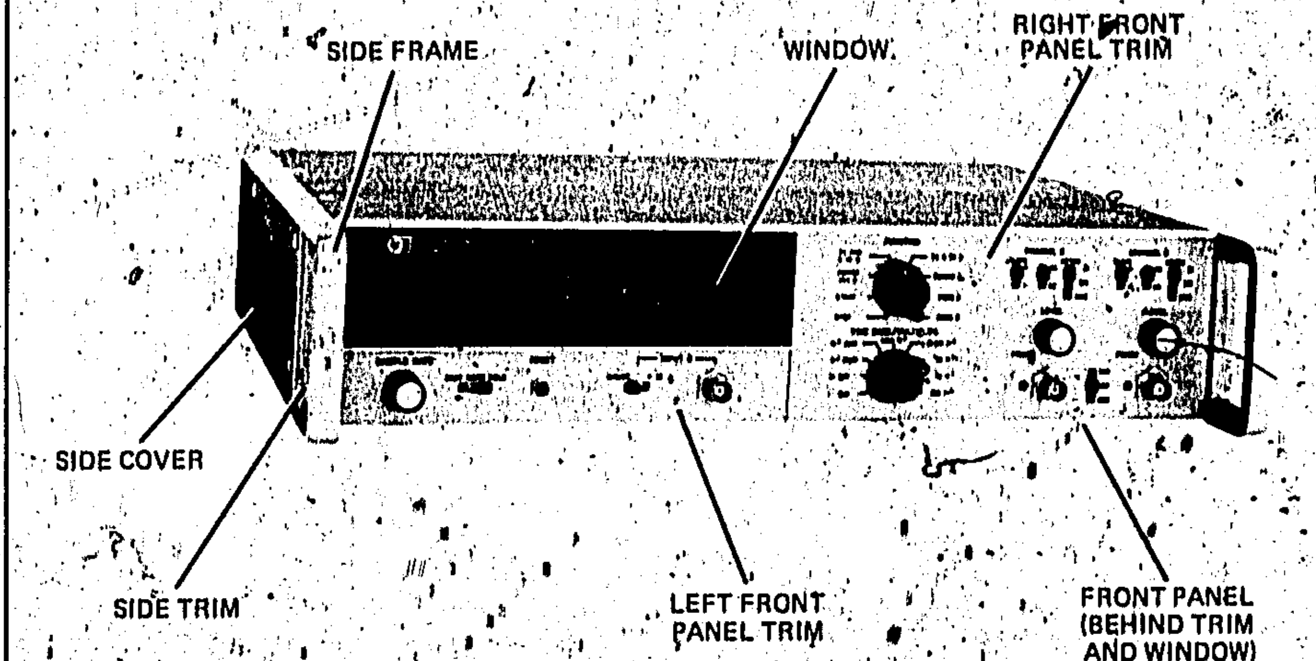


Table 6-1. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	05326-60003	1	ATTENUATOR ASSY (SERIES 944) (LOADED ON 05326-20003 BLANK BOARD)	28480	05326-60003
A1C1	0160-2244	2	C:FXD CER 3.0+/-0.25 PF 500VDCW	28480	0160-2244
A1C2	0160-0939	2	C: FXD MICA 430 PF 5% 300 VDCW	28480	0160-0939
A1C3	0160-0378	2	C:FXD MICA 27PF 5% 500 VDCW	72136	RDM15E270J5S
A1C4	0160-0161	4	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A1C5	0160-2140	2	C:FXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A1C6	0160-2930	19	C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1C7	0160-2197	2	C:FXD MICA 10 PF 5% 300 VDCW	72136	RDM15C100J3C
A1C8	0160-2146	2	C:FXD CER 0.02 UF +80-20% 100VDCW	91418	TA
A1C9	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1C10	0160-2244		C:FXD CER 3.0+/-0.25 PF 500VDCW	28480	0160-2244
A1C11	0160-0939		C: FXD MICA 430 PF 5% 300 VDCW	28480	0160-0939
A1C12	0160-0378		C:FXD MICA 27PF 5% 500 VDCW	72136	RDM15E270J5S
A1C13	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A1C14	0160-2140		C:FXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B
A1C15	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A1C16	0160-2197		C:FXD MICA 10 PF 5% 300 VDCW	72136	RDM15C100J3C
A1C17	0160-2146		C:FXD CER 0.02 UF +80-20% 100VDCW	91418	TA
A1CR1	1910-0016	24	DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR2	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR3	1901-0376	6	DIODE:SILICON 35V	28480	1901-0376
A1CR4	1901-0376		DIODE:SILICON 35V	28480	1901-0376
A1CR6	1902-0041	4	DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A1CR7	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A1CR9	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR10	1901-0376		DIODE:SILICON 35V	28480	1901-0376
A1CR11	1901-0376		DIODE:SILICON 35V	28480	1901-0376
A1CR13	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A1CR14	1902-0041		DIODE:BREAKDOWN 5.11V 5%	04713	SZ10939-98
A1DS1	2140-0047	2	LAMP:NEON GLOW 0.8 MILLIAMPS	08806	A1C
A1DS2	2140-0047		LAMP:NEON GLOW 0.8 MILLIAMPS	08806	A1C
A1J1	1251-0472	2	CONNECTOR:PC 12 CONTACTS	71785	252-06-30-300
A1J2	1251-0472		CONNECTOR:PC 12 CONTACTS	71785	252-06-30-300
A1J3	1250-1163	2	CONNECTOR:RF BNC INPUT	28480	1250-1163
A1J4	1250-1163		CONNECTOR:RF BNC INPUT	28480	1250-1163
A1Q1	1855-0334	2	TSTR:SI FET DUAL N-CHANNEL	17856	DN377
A1Q2	1855-0334		TSTR:SI FET DUAL N-CHANNEL	17856	DN377
A1R1	0683-2235	4	R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
A1R2	0683-9145	4	R:FXD COMP 910K OHM 5% 1/4W	01121	CB 9145
A1R3	0683-1015	20	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A1R4	0683-9125	2	R:FXD COMP 9100 OHM 5% 1/4W	01121	CB 9125
A1R5	0698-3576	4	R:FXD COMP 110K OHM 5% 1/4W	28480	0698-3576
A1R6	0683-1055	4	R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R7	0698-3576		R:FXD COMP 110K OHM 5% 1/4W	28480	0698-3576
A1R8	0683-2215	9	R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A1R9	0683-4715	9	R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R10	0683-1055	4	R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R11	0683-3325	19	R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1R12	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R13	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R14	0683-2225	24	R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A1R15	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A1R16	0683-2235		R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
A1R17	0683-9145		R:FXD COMP 910K OHM 5% 1/4W	01121	CB 9145
A1R18	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A1R19	0683-9125		R:FXD COMP 9100 OHM 5% 1/4W	01121	CB 9125
A1R20	0698-3576		R:FXD COMP 110K OHM 5% 1/4W	28480	0698-3576
A1R21	0683-1055		R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R22	0698-3576		R:FXD COMP 110K OHM 5% 1/4W	28480	0698-3576
A1R23	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A1R24	2100-2905	2	R:VAR CERMET 10K OHM 10% LIN	28480	2100-2905
A1R25	0683-1055		R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
A1R26	2100-2905		R:VAR CERMET 10K OHM 10% LIN	28480	2100-2905
A1R27	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A1R28	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A1R29	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A1R30	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A1R31	0683-1005	5	R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A1R32	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1R33	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A1R34	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A1S1	3101-1313	1	SWITCH:SLIDE DP3T 0.5A 125V AC/DC	79727	G128S-0004
A1S2	3101-1279	2	SWITCH:SLIDE DP 3 POSITIONS	79727	G-128-S-0016
A1S3	3101-1279		SWITCH:SLIDE DP 3 POSITIONS	79727	G-128-S-0016
A1S4	3101-1311	4	SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G126-0020
A1S5	3101-1278	2	SWITCH:SLIDE DPDT	79727	G-126-0007
A1S6	3101-1278		SWITCH:SLIDE DPDT	79727	G-126-0007
A1S7	3101-1311		SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G126-0020
A1S8			PART OF R24		
A1S9			PART OF R26		
A2	05326-60004	2a	INPUT AMPLIFIER ASSY (SERIES 972) (LOADED ON 05326-20004 BLANK BOARD)	28480	05326-60004
A2C1	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2C2	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2C3	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2C4	0180-0197	15	C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A2C5	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A2C6	0160-0153	4	C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A2C7	0170-0055	6	C:FXD MY 0.1UF 20% 200VDCW	56289	192P10402
A2C8	0170-0055		C:FXD MY 0.1UF 20% 200VDCW	56289	192P10402
A2C9	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2C10	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A2CR1	1902-0049	3	DIODE:BREAKDOWN 6.19V 5%	04713	SZ10939-122
A2CR2	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A2CR3	1901-0040	28	DIODE:SILICON 30MA 30WV	07263	FDG1088
A2CR4	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A2CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A2L1	9140-0144	14	COIL:FXD RF 4.7 UH	28480	9140-0144
A2L2	9100-2255	4	COIL/CHOKE 0.47 UH 10%	28480	9100-2255
A2L3	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L4	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L5	9100-2255		COIL/CHOKE 0.47 UH 10%	28480	9100-2255
A2L6	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L7	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L8	9140-0142	4	COIL:FXD RF 2.20 UH 10%	82142	09-4436-4K
A2L9	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2L10	9140-0144		COIL:FXD RF 4.7 UH	28480	9140-0144
A2Q1	1854-0092	26	TSTR:SI NPN	80131	2N3563
A2Q2	1853-0015	24	TSTR:SI PNP	80131	2N3640
A2Q3	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q4	1854-0345	5	TSTR:SI NPN	80131	2N5179
A2Q5	1854-0345		TSTR:SI NPN	80131	2N5179
A2Q6	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q7	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q8	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q9	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q10	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q11	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q12	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q13	1853-0015		TSTR:SI PNP	80131	2N3640
A2Q14	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q15	1854-0071	23	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2Q16	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q17	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q18	1854-0345	8	TSTR:SI NPN	80131	2N4410
A2Q19	1854-0092		TSTR:SI NPN	80131	2N3563
A2Q20	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A2R1	0683-6835	3	R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835
A2R2	2100-2520	2	R:VAR CERMET 50 OHM 20% TYPE V 1/2W	28480	2100-2520
A2R3	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A2R4	0683-2405	3	R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A2R5	0683-3625	4	R:FXD COMP 3600 OHM 5% 1/4W	01121	CB 3625
A2R6	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R7	0683-3025	7	R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A2R8	0683-1025	29	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R9	0698-3113	4	R:FXD CARBON 100 OHM 5% 1/8W	28480	0698-3113
A2R10	0698-3381	4	R:FXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A2R11	0698-5175	4	R:FXD COMP 360 OHM 5% 1/8W	28480	0698-5175
A2R12	0698-3379	2	R:FXD COMP 68 OHM 5% 1/8W	28480	0698-3379
A2R13	0698-3375	2	R:FXD COMP 33 OHM 5% 1/8W	28480	0698-3375

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2R14	0683-1525	15	R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A2R15	0698-5180	2	R:FXD COMP 2K OHM 5% 1/8W	28480	0698-5180
A2R16	0698-5175		R:FXD COMP 360 OHM 5% 1/8W	28480	0698-5175
A2R17	0698-3381		R:FXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A2R18	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R19	0698-3113		R:FXD CARBON 100 OHM 5% 1/8W	28480	0698-3113
A2R20	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R21	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A2R22	0683-3625		R:FXD COMP 3600 OHM 5% 1/4W	01121	CB 3625
A2R23	0683-2225	1	R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A2R24	2100-2521	3	R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A2R25	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A2R26	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R27	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R28	0683-6815	9	R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A2R29	0683-6815		R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A2R30	0683-4725	6	R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A2R31	0683-1035	22	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R32	0683-3315	7	R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A2R33	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R34	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A2R35	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A2R36	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A2R37	0683-2235		R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
A2R38	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R39	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A2R40	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A2R41	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A2R42	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R43	0683-3035	2	R:FXD COMP 30K OHM 5% 1/4W	01121	CB 3035
A2R44	0683-3015	7	R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A2R45	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A2R46	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A2R47	0683-1065	2	R:FXD COMP 10M OHM 5% 1/4W	01121	CB 1065
A2R48	0683-2055	2	R:FXD COMP 2 MEGOHM 5% 1/4W	01121	CB 2055
A2R49	0683-2715	6	R:FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A2R50	0683-2715		R:FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A2U1	1820-0238	2	INTEGRATED CIRCUIT:DTL 2 INPUT NOR GATE	04713	MC 1810P
A2U2	1820-0142	3	INTEGRATED CIRCUIT:4INPUT,2-OR/NOR	04713	MC1004P
A3			SAME AS A2, USE PREFIX A3		
A4	05326-60002	1	OSCILLATOR ASSY (SERIES 1032)	28480	05326-60002
			(LOADED ON 05326-20002 BLANK BOARD)		
A4C1	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A4C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A4C3	0121-0059	1	C:VAR CER 2-8 PF 300VDCW	28480	0121-0059
A4C4	0160-2264	1	C:FXD CER 20 PF 5% 500VDCW	72982	301-000-COG0-200J
A4C5	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A4L1	9100-2276	1	COIL/CHOKE 100 UH 10%	28480	9100-2276
A4Q1	1850-0158	1	TSTR:GE PNP	80131	2N2635
A4R1	0698-4037	1	R:FXD MET FLM 46.4 OHM 1% 1/8W	28480	0698-4037
A4R2	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A4R3	0683-3015		R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A4R4	0683-3015		R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A4U1	1820-0142		INTEGRATED CIRCUIT:4INPUT,2-OR/NOR	04713	MC1004P
A4Y1	0410-0405	1	CRYSTAL:QUARTZ 10 MHZ	28480	0410-0405
A5	05326-60005	1	TIME BASE CONTROL ASSY	28480	05326-60005
			(SERIES 972)		
			(LOADED ON 05326-20005 BLANK BOARD)		
A5C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A5C2	0160-0127	1	C:FXD CER 1.0 UF 20% 25VDCW	56289	5C13CS-CML
A5C3	0180-0291	12	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A5C4	0160-2150	5	C:FXD MICA 33 PF 5%	28480	0160-2150
A5C5	0160-2204	1	C:FXD MICA 100PF 5%	72136	RDM15F101J3C
A5CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A5Q1	1854-0092		TSTR:SI NPN	80131	2N3563
A5Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A5Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q4	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A5R1	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A5R2	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A5R3	0683-5105	6	R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A5R4	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A5R5	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A5R6	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A5R7	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R8	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R9	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R10	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A5R11	0683-6835		R:FXD COMP 68K OHM 5% 1/4W	01121	CB 6835
A5R12	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A5R13	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A5R14	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A5R15	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A5R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R17	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A5R18	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A5R19	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A5R20	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A5R21	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A5U1	1820-0412	7	INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0412
A5U2	1820-0412		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0412
A5U3	1820-0412		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0412
A5U4	1820-0412		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0412
A5U5	1820-0054	4	IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A5U6	1820-0412		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0412
A5U7	1820-0412		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0412
A5U8	1820-0412		INTEGRATED CIRCUIT:DECADE DIVIDER	28480	1820-0412
A5U9	1820-0413	2	IC:TTL DECADE DIVIDER 12.5 MHZ MIN.	28480	1820-0413
A5U10	1820-0174	1	IC:TTL HEX INVERTER*	01295	SN7404N
A6	05326-60013	1	SAMPLE RATE ASSY.	28480	05326-60013
			(SERIES 1036A)		
			(LOADED ON 05326-20013 BLANK BOARD)		
A6C1	0160-2201	1	C:FXD MICA 51 PF 5%	72136	RDM15E510J3C
A6C2	0160-0134	1	C:FXD MICA 220PF 5% 300VDCW	14655	RDM15F221J3C
A6C3	0180-0228	1	C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
A6C4	0160-0166	1	C:FXD MY 0.068 UF 10% 200VDCW	56289	192P68392-PTS
A6C5	0140-0193	1	C:FXD MICA 82 PF 5%	28480	0140-0193
A6C6	0160-0153		C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A6C7	0160-2199	2	C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A6C8	0160-0153		C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
A6C9	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
A6C10	0160-0161		C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
A6C11	0180-0114	6	C:FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A6C12	0180-0114		C:FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A6CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR3	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A6CR4	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A6CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR7	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR9	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A6CR10	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6CR11	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A6Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q2	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q4	1854-0009	9	TSTR:SI NPN	80131	2N709
A6Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q7	1854-0215	3	TSTR:SI NPN	80131	2N3904
A6Q8	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q9	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q10	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071

*See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A6Q11	1854-0009		TSTR:SI NPN	80131	2N709
A6Q12	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6Q13	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A6R1	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A6R2	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A6R3	0683-5125	11	R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6R4	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R5	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R6	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6R7	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R8	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R9	0683-3015		R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A6R10	0683-2025	8	R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A6R11	0683-2735	4	R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A6R12	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6R13	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R14	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R15	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R16	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A6R17	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R18	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A6R19	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A6R20	0683-2735		R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A6R21	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R22	0683-3915	3	R:FXD COMP 390 OHM 5% 1/4W	01121	CB 3915
A6R23	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A6R24	0683-6215	1	R:FXD COMP 620 OHM 5% 1/4W	01121	CB 6215
A6R25	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A6R26	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A6R27	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A6R28	0683-9115	1	R:FXD COMP 910 OHM 5% 1/4W	01121	CB 9115
A6R29	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A6R30	0683-2415	1	R:FXD COMP 240 OHM 5% 1/4W	01121	CB 2415
A6R31	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R32	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R33	0683-2735		R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A6R34	0683-2735		R:FXD COMP 27K OHM 5% 1/4W	01121	CB 2735
A6R35	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R36	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R37	0683-2045	1	R:FXD COMP 200K OHM 5% 1/4W	01121	CB 2045
A6R38	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R39	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A6R40	0683-4735	2	R:FXD COMP 47K OHM 5% 1/4W	01121	CB 4735
A6R41	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A6R42	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A6R43	0683-4735		R:FXD COMP 47K OHM 5% 1/4W	01121	CB 4735
A6U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A6U2	1820-0272	1	IC:ECL TYPE D F/F	04713	MC1022P
A6U3	1820-0068	1	IC:TTL TRIPLE 3-INPUT POS NAND GATE	12040	SN7410N
A6U4	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A6U5	1820-0328	1	IC:TTL QUAD 2-INPT NOR GATE	04713	SN7402N
A6U6	1820-0147	5	IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A7	05327-60004	1	BOARD ASSY:FUNCTION CONTROL (SERIES 1040A, REV. C) (LOADED ON 05327-20004 BLANK BOARD)	28480	05327-60004
A7C1			NOT ASSIGNED		
A7C2	0160-0333	1	C:FXD MICA 15+/-0.5 PF 300 VDCW	00853	RDM15C150D3C
A7C3	0160-2327	5	C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A7C4	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A7C5	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A7C6	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A7C7	0160-2327		C:FXD CER 1000 PF 20% 100VDCW	96733	B104BX102M
A7Q1	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q2	1854-0215		TSTR:SI NPN	80131	2N3904
A7Q3	1854-0009		TSTR:SI NPN	80131	2N709
A7Q4	1854-0009		TSTR:SI NPN	80131	2N709
A7Q5	1854-0009		TSTR:SI NPN	80131	2N709
A7R1	0683-1125	7	R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125

* See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A7R2	0683-1825	10	R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A7R3	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A7R4	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R5	0683-3925	4	R:FXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A7R6	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A7R7	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R8	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A7R9	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A7R10	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A7R11	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R12	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
A7R13	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R14	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A7R15	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A7R16	0683-5115	4	R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A7R17	0683-3015		R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A7R18	0683-3015		R:FXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A7R19	0683-2015	5	R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A7R20	0683-2725	3	R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A7R21	0683-7515	3	R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A7R22	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A7R23	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R24	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A7R25	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R26	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7R27	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A7R28	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A7R29	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A7U1	1820-0102	4	INTEGRATED CIRCUIT:J-K FLIP FLOP	04713	MC1013P
A7U2	1820-0489	5	IC:ECL	28480	1820-0489
A7U3	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A7U4	1820-0440	1	IC:ECL DUAL RS F/F	04713	MC1016P
A7U5	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A7U6	1820-0489		IC:ECL	28480	1820-0489
A7U7	1820-0212	2	IC:ECL QUAD LINE RECEIVER	04713	MC1020P
A7U8	1820-0489		IC:ECL	28480	1820-0489
A7U9	1820-0145	2	IC:DIGITAL QUAD 2-INPT NOR GATE	28480	1820-0145
A7U10	1820-0489		IC:ECL	28480	1820-0489
A7U11	1820-0252	1	IC:ECL DUAL 3-4 INPT OR/NOR GATE	04713	MC1026P
A7U12	1820-0200	1	IC:ECL QUAD EXCL. OR GATE	04713	MC 1030P
A8	05326-60009	1	DISPLAY SUPPORT ASSY (SERIES 944) (LOADED ON 05326-20009 BLANK BOARD)	28480	05326-60009
A8C1	0160-2930		C:FXD CER 0.01 UF +80-20% 100VDCW	91418	TA
A8C2	0160-2199		C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
A8CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8CR2	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D236L
A8CR3	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D236L
A8CR4	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A8J1	1251-2035	1	CONNECTOR:PC EDGE (2 X 15) 30 CONTACT	71785	252-15-30-300
A8Q1	1854-0092		TSTR:SI NPN	80131	2N3563
A8Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A8Q3	1854-0365		TSTR:SI NPN	80131	2N4410
A8Q4	1854-0365		TSTR:SI NPN	80131	2N4410
A8Q5	1854-0365		TSTR:SI NPN	80131	2N4410
A8Q6	1854-0365		TSTR:SI NPN	80131	2N4410
A8Q7	1854-0365		TSTR:SI NPN	80131	2N4410
A8Q8	1854-0365		TSTR:SI NPN	80131	2N4410
A8Q9	1854-0092		TSTR:SI NPN	80131	2N3563
A8Q10	1854-0092		TSTR:SI NPN	80131	2N3563
A8Q11	1854-0092		TSTR:SI NPN	80131	2N3563
A8R1	0683-1125		R:FXD COMP 1100 OHM 5% 1/4W	01121	CB 1125
A8R2	0683-1045	8	R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R3	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R4	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R5	0683-1255	6	R:FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R6	0683-1255		R:FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R7	0683-1255		R:FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R8	0683-1255		R:FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R9	0683-1255		R:FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R10	0683-1255		R:FXD COMP 1.2 MEGOHM 5% 1/4W	01121	CB 1255
A8R11	0683-2425	1	R:FXD COMP 2400 OHM 5% 1/4W	01121	CB 2425
A8R12	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015

See Introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A8R13	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R14	0683-2715		R:FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A8R15	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A8R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A8R17	0683-4725		R:FXD COMP 4700 OHM 5% 1/4W	01121	CB 4725
A8R18	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A8R19	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R20	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R21	0683-2725		R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A8R22	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A8R23	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A8R24	0683-2725		R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
A8R25	0683-1535		R:FXD COMP 15K OHM 5% 1/4W	01121	CB 1535
A8R26	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
A8U1	1820-0094		IC:DTL QUAD 2-INPUT GATE	04713	SC6903PK
A8U2	1820-0307	1	IC:DIGITAL DTL HEX INVERTER		
A8U3	1820-0143	1	INTEGRATED CIRCUIT:AC COUPLED JK F/F	04713	MC1027P
A8U4	1820-0102		INTEGRATED CIRCUIT:J-K FLIP FLOP	04713	MC1013P
A8U5	1820-0102		INTEGRATED CIRCUIT:J-K FLIP FLOP	04713	MC1013P
A8U6	1820-0102		INTEGRATED CIRCUIT:J-K FLIP FLOP	04713	MC1013P
A9	05326-60008	1	DISPLAY ASSY (SERIES 1032A)	28480	05326-60008
			(LOADED ON 05326-20008 BLANK BOARD)		
A9DS1	1970-0042	7	TUBE:NUMERICAL INDICATOR	83594	8-5750-5
A9DS1	1200-0405	7	SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS2	1970-0042		TUBE:NUMERICAL INDICATOR	83594	8-5750-5
A9DS2	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS3	1970-0042		TUBE:NUMERICAL INDICATOR	83594	8-5750-5
A9DS3	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS4	1970-0042		TUBE:NUMERICAL INDICATOR	83594	8-5750-5
A9DS4	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS5	1970-0042		TUBE:NUMERICAL INDICATOR	83594	8-5750-5
A9DS5	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS6	1970-0042		TUBE:NUMERICAL INDICATOR	83594	8-5750-5
A9DS6	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS7	1970-0042		TUBE:NUMERICAL INDICATOR	83594	8-5750-5
A9DS7	1200-0405		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9R1	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R2	0683-7525	7	R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R3	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R4	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R5	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R6	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R7	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R8	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R9	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R10	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A9U1	1820-0275	1	IC:ECL TO TTL QUAD 2-INPT OR TRANS.	04713	MC1039P
A9U2	1820-0119	6	IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U3	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U4	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U5	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U6	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U7	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U9	1820-0116	7	IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U10	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U11	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U12	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U13	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U14	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U15	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U17	1820-0092	7	INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U18	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U19	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U20	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U21	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U22	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U23	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A10	05327-60002	1	RIGHT READOUT ASSY (SERIES 1120A, REV. B) (LOADED ON 05327-20002 BLANK BOARD)	28480	05327-60002
	05326-00009	2	BRACKET:READOUT	28480	05326-00009
	05326-80008	1	INDICATOR:MASK (U,M,S,)	28480	05326-80008
	05326-80009	1	INDICATOR:MASK (K,M,HZ)	28480	05326-80009
	05326-80010	1	INDICATOR:MASK (9,K,G)	28480	05326-80010
	05330-40002	2	BLOCK:ANNUNCIATOR	28480	05330-40002
A10CR1	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A10CR2	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A10DS1	2140-0313	11	LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS2	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS3	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS4	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS5	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS6	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS7	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10DS8	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A10Q1	1854-0009		TSTR:SI NPN	80131	2N709
A10Q2	1854-0009		TSTR:SI NPN	80131	2N709
A10Q3	1854-0009		TSTR:SI NPN	80131	2N709
A10Q4	1854-0474	13	TSTR:SI NPN	28480	1854-0474
A10Q5	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q6	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q7	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q8	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q9	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q10	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q11	1854-0474		TSTR:SI NPN	28480	1854-0474
A10Q12	1854-0474		TSTR:SI NPN	28480	1854-0474
A10R1	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A10R2	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A10R3	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A10R4	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A10R5	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A10R6	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A10R7	0683-3025		R:FXD COMP 3000 OHM 5% 1/4W	01121	CB 3025
A10R8	0683-5135	5	R:FXD COMP 51K OHM 5% 1/4W	01121	CB 5135
A10R9	0683-5135		R:FXD COMP 51K OHM 5% 1/4W	01121	CB 5135
A10U1	1820-0274	12	IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A10U2	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A10U3	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A10U4	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A10U5	1820-0310	1	IC:DTL TRIPLE 3-INPUT NAND GATE	04713	SC6910PK
A10U6	1820-0273	4	IC:DTL QUAD 2-INPT AND GATE	28480	1820-0273
A10U7	1820-0273		IC:DTL QUAD 2-INPT AND GATE	28480	1820-0273
A11	05327-60003	1	LEFT READOUT ASSY (SERIES 1040A, REV. A) (LOADED ON 05327-20003 BLANK BOARD)	28480	05327-60003
	05326-00009		BRACKET:READOUT	28480	05326-00009
	05326-80011	1	INDICATOR:MASK (EXT, C, OF)	28480	05326-80011
	05330-40002		BLOCK:ANNUNCIATOR	28480	05330-40002
A11C1	0160-2200	1	C:FXD MICA 43 PF 5% 300 VDCW	72136	RDM15E430J3C
A11DS1	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A11DS2	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A11DS3	2140-0313		LAMP:NEON GLOW FROSTED 1.9 MILLIAMPS	08806	C2A-B
A11Q1	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A11Q2	1854-0474		TSTR:SI NPN	28480	1854-0474
A11Q3	1854-0474		TSTR:SI NPN	28480	1854-0474
A11Q4	1854-0474		TSTR:SI NPN	28480	1854-0474

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A11R1	0683-2035	2	R:FXD COMP 20K OHM 5% 1/4W	01121	CB 2035
A11R2	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
A11R3	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A11R4	0683-5135		R:FXD COMP 51K OHM 5% 1/4W	01121	CB 5135
A11R5	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A11R6	0683-5135		R:FXD COMP 51K OHM 5% 1/4W	01121	CB 5135
A11R7	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A11R8	0683-5135		R:FXD COMP 51K OHM 5% 1/4W	01121	CB 5135
A11R9	0683-5125		R:FXD COMP 5100 OHM 5% 1/4W	01121	CB 5125
A11R10	0683-1525		R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
A11R11	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A11U1	1820-0054		IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
A11U2	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U3	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U4	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U5	1820-0175	1	IC:TTL HEX INVERTER	01295	SN5260
A11U6	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A11U7	1820-0273		IC:DTL QUAD 2-INPT AND GATE	28480	1820-0273
A11U8	1820-0274		IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A15	05327-60020	1	BOARD ASSY:POWER SUPPLY (SERIES 1040A) (LOADED [illegible]-20020 BLANK BOARD)	28480	05327-60020
	0510-0207		NUT:CAPTIVE 4-40 X 0.188 LG	28480	0510-0207
	2200-0145	3	SCREW:PAN HD POZI DR 4-40 X 0.438	00000	OBD
	5040-0409	1	SPACER:SHIELD	28480	5040-0409
A15C1	0160-0163	1	C:FXD MY 0.033 UF 10% 200VDCW	56289	192P33392-PTS
A15C2	0180-0114		C:FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C3	0180-0114		C:FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C4	0180-0114		C:FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C5	0180-0114		C:FXD ELECT 4.0 UF +100-10% 25VDCW	28480	0180-0114
A15C6	0160-0975	2	C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A15C7	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A15CR1	1902-3002	3	DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A15CR2	1902-0551	2	DIODE BREAKDOWN:6.19V 5%	28480	1902-0551
A15CR3	1902-0551		DIODE BREAKDOWN:6.19V 5%	28480	1902-0551
A15CR4	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A15CR5	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR6	1902-3094	4	DIODE BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR7	1902-3094		DIODE BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR8	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR9	1902-3094		DIODE BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR10	1902-3094		DIODE BREAKDOWN:5.11V 2%	28480	1902-3094
A15CR11	1902-3394	1	DIODE BREAKDOWN:75 V 2%	28480	1902-3394
A15CR12	1902-3429	1	DIODE BREAKDOWN:100 V 2%	28480	1902-3429
A15CR13	1901-0033	2	DIODE:SILICON 100MA 180WV	07263	FD3369
A15CR14	1901-0033		DIODE:SILICON 100MA 180WV	07263	FD3369
A15CR15	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR17	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15CR18	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A15Q1	1854-0300	1	TSTR:SI NPN	28480	1854-0300
A15Q1	1205-0018	2	HEAT SINK:SEMICONDUCTOR	05820	203-CB
A15Q2	1853-0073	1	TSTR:SI PNP	28480	1853-0073
A15Q2	1205-0018		HEAT SINK:SEMICONDUCTOR	05820	203-CB
A15Q3	1854-0039	1	TSTR:SI NPN	80131	2N3053

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Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A15Q3	1205-0033	2	HEAT SINK:SEMICONDUCTOR	05820	207-CB
A15Q4	1853-0012	1	TSTR:SI PNP	80131	2N2904A
A15Q4	1205-0033		HEAT SINK:SEMICONDUCTOR	05820	207-CB
A15Q5	1854-0232	1	TSTR:SI NPN(SELECTED FROM 2N3440)	28480	1854-0232
A15Q5	1205-0061	1	HEAT SINK:SEMICONDUCTOR	05820	209-CB
A15Q6	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A15Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A15Q8	1854-0474		TSTR:SI NPN	28480	1854-0474
A15Q9	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
A15Q10	1853-0020		TSTR:SI PNP(SELECTED FROM 2N3702)	28480	1853-0020
A15R1	0683-2035		R:FXD COMP 20K OHM 5% 1/4W	01121	CB 2035
A15R2	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A15R3	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A15R4	0683-3925		R:FXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A15R5	0683-3925		R:FXD COMP 3900 OHM 5% 1/4W	01121	CB 3925
A15R6	0686-1505	1	R:FXD COMP 15 OHM 5% 1/2W	01121	EB 1505
A15R7	0683-6815		R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R8	0683-6815		R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R9	0683-1325	2	R:FXD COMP 1300 OHM 5% 1/4W	01121	CB 1325
A15R10	2100-2093	2	R:VAR COMP 200 OHM 30% LIN 1/8W	28480	2100-2093
A15R11	0683-6815		R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R12	0683-6815		R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
A15R13	2100-2093		R:VAR COMP 200 OHM 30% LIN 1/8W	28480	2100-2093
A15R14	0683-1325		R:FXD COMP 1300 OHM 5% 1/4W	01121	CB 1325
A15R15	0683-0275	2	R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 27G5
A15R16	0683-0275		R:FXD COMP 2.7 OHM 5% 1/4W	01121	CB 27G5
A15R17	0683-0395	2	R:FXD COMP 3.9 OHM 5% 1/4W	01121	CB 39G5
A15R18	0683-0395		R:FXD COMP 3.9 OHM 5% 1/4W	01121	CB 39G5
A16	05327-60005	1	BOARD ASSY:CONNECTOR (SERIES 1040A) (LOADED ON 05327-60006 BLANK BOARD) USES SAME PARTS AS A16 05327-60026	28480	05327-60005
A16	05327-60026	1	BOARD ASSY:CONNECTOR (SERIES 1132A) (LOADED ON 05327-20027 BLANK BOARD)	28480	05327-60026
A16C1	0180-2352	1	C:FXD ELECT 6000 UF +75-10% 15VDCW	28480	0180-2352
A16C2	0180-2296	1	C:FXD ELECT 4000 UF +75-10% 15VDCW	56289	39D167-DSB(SE)
A16C3	0180-1962	1	C:FXD AL ELECT 15 UF +50-10% 250VDCW	56289	39D156F250EJ4-DSB
A16C4	0180-2382	2	C:FXD AL ELECT 1500 UF +75-10% 30VDCW	56289	39D293
A16C5	0180-2382		C:FXD AL ELECT 1500 UF +75-10% 30VDCW	56289	39D293
A16CR1	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A16CR2	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A16CR3	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A16CR4	1901-0045	2	DIODE:SILICON 0.75A 100PIV	04713	SR1358-7
A16CR5	1901-0045		DIODE:SILICON 0.75A 100PIV	04713	SR1358-7
A16CR6	1901-0029	4	DIODE:SILICON 600 PIV	28480	1901-0029
A16CR7	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A16CR8	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A16CR9	1901-0029		DIODE:SILICON 600 PIV	28480	1901-0029
A16CR10	1901-0415	4	DIODE:SILICON 50 PIV 3A	28480	1901-0415
A16CR11	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A16CR12	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A16CR13	1901-0415		DIODE:SILICON 50 PIV 3A	28480	1901-0415
A16CR14	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A16CR15	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A16CR16	1901-0460	2	DIODE:SILICON 3-JUNCTION STABISTOR	03508	STB523
A16CR17	1901-0460		DIODE:SILICON 3-JUNCTION STABISTOR	03508	STB523
A16R1	0812-0021	2	R:FXD WW 0.47 OHM 5% 3W	28480	0812-0021
A16R2	0812-0021		R:FXD WW 0.47 OHM 5% 3W	28480	0812-0021
A16R3	0686-2045	1	R:FXD COMP 200K OHM 5% .5W	01121	EB 2045
A16XA1			NOT ASSIGNED		
A16XA2	1251-1886	11	CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA3	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340

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Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A16XA4	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA5	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA6	1251-2134		CONNECTOR:PC (2X18)36 CONTACTS	71785	252-18-30-340
A16XA7	1251-2134		CONNECTOR:PC (2X18)36 CONTACTS	71785	252-18-30-340
A16XA8	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA9	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA10	1251-2134		CONNECTOR:PC (2X18)36 CONTACTS	71785	252-18-30-340
A16XA11	1251-2134		CONNECTOR:PC (2X18)36 CONTACTS	71785	252-18-30-340
A16XA12	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA13	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA14	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA15	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A16XA16			NOT ASSIGNED		
A16XA17			NOT ASSIGNED		
A16XA18	1251-1886		CONN:PC 30-CONTACT (2X15)	71785	252-15-30-340
A17	05326-60031		BOARD ASSY,INPUT C AMPLIFIER (SERIES 1128A) 5326A ONLY (LOADED ON 05326-20031 BLANK BOARD)	28480	05326-60031
A17C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A17C2	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A17C3	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A17C4	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A17C5	0160-0975	4	C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A17C6	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A17C7	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A17C8	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A17C9	0150-0055	2	C:FXD TI DIOXIDE 10 PF 5% 500VDCW	78488	TYPE GA
A17C10	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A17C11	0150-0045	1	C:FXD TI 8.2 PF 5% 500VDCW	78488	TYPE GA
A17C12	0150-0055		C:FXD TI DIOXIDE 10 PF 5% 500VDCW	78488	TYPE GA
A17C13	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A17CR1	1901-0047	2	DIODE JUNCTION:SILICON 20PIV	28480	1901-0047
A17CR2	1901-0047		DIODE JUNCTION:SILICON 20PIV	28480	1901-0047
A17CR3	1912-0007	2	DIODE:TUNNEL [illegible] TYPE 1N3714	03508	1N3714 SPEC.
A17J1	1250-0836	2	CONNECTOR:RF SUB-MINIATURE	98291	50-051-0000
A17L1	9100-2259	1	COIL/CHOKE 1.50 UH 10%	99800	1025-14
A17L2	9140-0142		COIL:FXD RF 2.20 UH 10%	82142	09-4436-4K
A17L3	9140-0142		COIL:FXD RF 2.20 UH 10%	82142	09-4436-4K
A17L4	9100-2256	1	COIL/CHOKE 0.56 UH 10%	13019	09-4426-3K
A17Q1	1853-0015		TSTR:SI PNP	80131	2N3640
A17Q2	1853-0015		TSTR:SI PNP	80131	2N3640
A17Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A17Q4	1854-0092		TSTR:SI NPN	80131	2N3563
A17R1	0760-0012	1	R:FXD MET OX 51 OHM 2% 1W	28480	0760-0012
A17R2	0758-0093	1	R:FXD MET OX 56 OHM 5% 1/4W	28480	0758-0093
A17R3	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A17R4	0683-7515		R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A17R5	0683-1515	4	R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A17R6	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A17R7	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A17R8	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A17R9	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A17R10	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A17R11	2100-2633	2	R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A17R12	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A17R13	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A17R14	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A17R15	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A17R16	0683-7515		R:FXD COMP 750 OHM 5% 1/4W	01121	CB 7515
A17R17	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A17R18	0683-1225	1	R:FXD COMP 1200 OHM 5% 1/4W	01121	CB 1225
A17R19	0683-3625		R:FXD COMP 3600 OHM 5% 1/4W	01121	CB 3625
A17R21	0683-3625		R:FXD COMP 3600 OHM 5% 1/4W	01121	CB 3625
A17R22	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A17R23	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A17R24	0683-4715		R:FXD COMP 470 OHM 5% 1/4W	01121	CB 4715
A17R25	0683-5615		R:FXD COMP 560 OHM 5% 1/4W	01121	CB 5615
A17R26	0683-5615		R:FXD COMP 560 OHM 5% 1/4W	01121	CB 5615
A17U1	1858-0004	2	TSTR ARRAY:SI NPN DUAL DIFF. AMPL.	28480	1858-0004
A17U2	1820-0147		IC:ECL TRIPLE(3-INPT NOR GATE	04713	MC100[illegible]P

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18	05327-60009	1	PRESCALER ASSY (SERIES 1404A)	28480	05327-60009
			(LOADED ON 05327-20009 BLANK BOARD)		
	3050-0042	2	WASHER:FLAT, BAKELITE	00000	OBD
A18C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C2	0160-0973		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C3	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C4	0160-0973		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C5	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C7	0160-0973		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C8	0140-0225		C:FXD MICA 300 PF 5%	28480	0140-0225
A18C9	0160-0973		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C10	0160-0973		C:FXD CER 0.001 UF 20% 75VDCW	12574	SSM-.001-98
A18C11	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C12	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C13	0160-2049	4	C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18C14	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18CR1	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A18CR2	1912-0007		DIODE:TUNNEL EIA TYPE 1N3714	03508	1N3714 SPEC
A18CR3	1902-3048	2	DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A18J1	1250-0836		CONNECTOR:RF SUB-MINIATURE	98291	50-053-0000
A18L1	9100-2251		COIL:FXD RF 0.22 UH 10%	28480	9100-2251
A18Q1	1853-0015		TSTR:SI PNP	80131	2N3640
A18Q2	1854-0092		TSTR:SI NPN	80131	2N3563
A18Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A18R1	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R2	2100-2521		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A18R3	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R4	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R5	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A18R6	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R7	0698-3378		R:FXD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R8	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A18R9	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R10	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A18R11	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R12	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R13	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R14	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R15	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R17	0683-1515	2	R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A18R18	0683-4315		R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R19	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R20	0683-8205	2	R:FXD COMP 82 OHM 5% 1/4W	01121	CB 8205
A18R21	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A18R22	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A18R23	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R24	0683-2405		R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A18U1	5088-7002		IC:LIMITER	28480	5088-7002
A18U2	5088-7001		IC:AMP AND TRIG	28480	5088-7001
A18U3	1820-0736		IC:DIGITAL	28480	1820-0736
A18U4	1820-0714		IC:DIGITAL QUINARY DIVIDER	28480	1820-0714
A18U5	1820-0489		IC:ECL	28480	1820-0489
A18U6	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A18U7	1858-0004		TSTR ARRAY:SI NPN DUAL DIFF. AMPL	28480	1858-0004
A18XU2	1251-1556	.45	CONNECTOR:SINGLE CONTACT	00779	2-330808-8

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A18	05327-60029	1	BOARD ASSY:PRESCALER (SERIES 1116A) (LOADED ON 05327-80029 BLANK BOARD)	28480	05327-60029
A18C1	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C2	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12974	SSM-.001-98
A18C3	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C4	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12974	SSM-.001-98
A18C5	0180-0106		C:FXD ELECT 60 UF 20% 6VDCW	28480	0180-0106
A18C6	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12974	SSM-.001-98
A18C7	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12974	SSM-.001-98
A18C8	0140-0225	1	C:FXD MICA 300 PF 1%	28480	0140-0225
A18C9	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12974	SSM-.001-98
A18C10	0160-0975		C:FXD CER 0.001 UF 20% 75VDCW	12974	SSM-.001-98
A18C11	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C12	0180-0197		C:FXD ELECT 2.2 UF 10% 20VDCW	56289	150D225X9020A2-DYS
A18C13	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18C14	0160-2049		C:FXD CER FEED-THRU 5000 PF +80-20%	28480	0160-2049
A18CR1	1902-3002		DIODE BREAKDOWN:2.37V 5%	28480	1902-3002
A18CR2	1912-0007		DIODE:TUNNEL EIA TYPE 1N3716	03508	1N3716 SPEC
A18CR3	1902-3048	1	DIODE BREAKDOWN:SILICON 3.48V 5%	28480	1902-3048
A18J1	1250-0836		CONNECTOR:RF SUB-MINIATURE	98291	50-051-0000
A18L1	9140-0158		COIL-FXD RF 1 UH 10%	99800	1025-30
A18L2	9100-2251		COIL:FXD RF 0.22 UH 10%	28480	9100-2251
A18Q1	1853-0015		TSTR:SI PNP	80131	2N3640
A18Q2	1854-0345		TSTR:SI NPN	80131	2N5179
A18Q3	1854-0092		TSTR:SI NPN	80131	2N3563
A18R1	2100-2633		R:VAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A18R2	2100-2521		R:VAR FLM 2000 OHM 10% LIN 1/2W	28480	2100-2521
A18R3	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R4	0683-5105		R:FXD COMP 51 OHM 5% 1/4W	01121	CB 5105
A18R5	0683-1045		R:FXD COMP 100K OHMS 5% 1/4W	01121	CB 1045
A18R6	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R7	0698-3378	1	R:FXD CARBON 51 OHM 5% 1/8W	28480	0698-3378
A18R8	0683-1815	1	R:FXD COMP 180 OHM 5% 1/4W	01121	CB 1815
A18R9	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R10	0683-2215		R:FXD COMP 220 OHM 5% 1/4W	01121	CB 2215
A18R11	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R12	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R13	0683-1825		R:FXD COMP 1800 OHM 5% 1/4W	01121	CB 1825
A18R14	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R15	0683-2015		R:FXD COMP 200 OHM 5% 1/4W	01121	CB 2015
A18R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A18R17	0683-1515		R:FXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A18R18	0683-4315	1	R:FXD COMP 430 OHM 5% 1/4W	01121	CB 4315
A18R19	0683-5115		R:FXD COMP 510 OHM 5% 1/4W	01121	CB 5115
A18R20	0683-8205	1	R:FXD COMP 82 OHM 5% 1/4W	01121	CB 8205
A18R21	0683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
A18R22	0683-2025		R:FXD COMP 2000 OHM 5% 1/4W	01121	CB 2025
A18R23	0683-3315		R:FXD COMP 330 OHM 5% 1/4W	01121	CB 3315
A18R24	0683-2405		R:FXD COMP 24 OHM 5% 1/4W	01121	CB 2405
A18R25	0698-3374	1	R:FXD CARBON 20 OHM 5% 1/8W	28480	0698-3374
A18R26	0683-3615		R:FXD COMP 360 OHM 5% 1/4W	01121	CB 3615
A18R27	0683-2715		R:FXD COMP 270 OHM 5% 1/4W	01121	CB 2715
A18R28	2100-2670	1	R:VAR CERMET 20 OHM 20% LIN 1/2W	28480	2100-2670
A18U1	5088-7002	1	IC:LIMITER	28480	5088-7002
A18U2	5088-7001	1	IC:AMP AND TRIG	28480	5088-7001
A18U3	1820-0736	1	IC:DIGITAL	28480	1820-0736
A18U4	1820-0784	1	IC:BINARY-QUINARY	28480	1820-0784
A18U5	1820-0489		IC:ECL	28480	1820-0489
A18U6	1820-0147		IC:ECL TRIPLE 3-INPT NOR GATE	04713	MC1007P
A18U7	1858-0004		TSTR ARRAY:SI NPN DUAL DIFF. AMPL.	28480	1858-0004
A18U8	1820-0790	1	IC:DIGITAL	28480	1820-0790
A18XU2	1251-1556	31	CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A18XU4	1251-1556		CONNECTOR:SINGLE CONTACT	00779	2-330808-8
A18XU4	1205-0243	1	HEAT DISSIPATOR	28480	1205-0243
A18XU4	1205-0244	2	RETAINER	28480	1205-0244
A18XU4	0520-0129	2	SCREW:PAN HD/POZI DR 2-56 X 0.312" LG	00000	OBD
A18XU4	0610-0001	2	NUT:HEX 2-56 X 0.188"	00000	OBD
	3050-0042	1	WASHER:FLAT, BAKELITE	00000	OBD
	3050-0079	2	WASHER:NYLON 0.1875" OD	00000	OBD

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			CHASSIS PARTS		
E1	3150-0019	1	FILTER:AIR	28480	3150-0019
B1	3140-0030	1	MOTOR:SHADED POLE	28480	3140-0030
B1	3160-0035	1	FAN:IMPELLER AXIAL 2-1/4 DIAM	04870	2 1/4 FMF 125 5
B1	5212A-128	1	BRACKET:FAN	28480	5212A-128
C1	0160-3043	1	C:FXD CER 2 X 0.005 UF 20% 250VAC	56289	29C147A-CDH
F1	2110-0020	1	FUSE:0.6A 250V SLOW-BLOW	75915	313.600
F1	2110-0304	1	FUSE:CARTRIDGE 1.5 AMP 250V SLOW-BLOW	71400	MDX-1-1/2A
J1			NOT ASSIGNED	98474	DF 21NC
				98474	DF 21 RANDOM
J2	1250-1253	6	CONNECTOR:RF BNC MOUNT JACK	24931	28JR196-1
J3	1250-1253		CONNECTOR:RF BNC MOUNT JACK	24931	28JR196-1
J4	1250-1253		CONNECTOR:RF BNC MOUNT JACK	24931	28JR196-1
J5	1250-1253		CONNECTOR:RF BNC MOUNT JACK	24931	28JR196-1
J6	1250-1253		CONNECTOR:RF BNC MOUNT JACK	24931	28JR196-1
J7			PART OF 05327-60011 PRESCALER ASSY		
J8	1251-2357	1	SOCKET:3-PIN MALE POWER RECEPTACLE	82389	EAC-301
J11	1250-0212	1	CONNECTOR:JACK CHASSIS BNC	95712	30409-1
P1	5060-0109	1	CONNECTOR:15 CONTACTS	28480	5060-0109
Q1	1853-0233	1	TSTR:SI PNP	01295	TIP 32
Q2	1854-0470	1	TSTR:SI NPN	28480	1854-0470
Q2	05327-20024	1	HEAT SINK FOR Q1 AND Q2	28480	05327-20024
	7120-2105	1	LABEL FOR HEAT SINK	28480	7120-2105
R1	2100-2961	1	R:VAR COMP 1 MEGOHM 10% 10 CLOG 1/4W	28480	2100-2961
S1			PART OF R1		
S2	3101-1327	1	SWITCH:SLIDE DPST 0.5A 125V AC/DC (FAST-NORM-HOLD)	79727	G1205-0006
S3	3101-1216	1	SWITCH:PUSHBUTTON SPST (RESET)	82389	35-1036
S4	3101-1311		SWITCH:SLIDE DPDT 0.5A, 125V AC/DC (INPUT C)	79727	G126-0020
S5	05326-60018	1	SWITCH ASSY:TIME BASE(WIRED)	28480	05326-60018
S6	05326-60019	1	SWITCH ASSY:FUNCTION(WIRED)	28480	05326-60019
S7	3101-1311		SWITCH:SLIDE DPDT 0.5A 125V AC/DC (OSC-INT/EXT)	79727	G126-0020
S8	3101-1311		SWITCH:SLIDE DPDT 0.5A 125V AC/DC (STORAGE)	[illegible]	G126-0020
S9	3101-1234	1	SWITCH:SLIDE DPDT (SELECTOR 115/230V)	[illegible]	11A-1242
T1	9100-2888	1	TRANSFORMER:POWER (5327A)	[illegible]	9100-2888
T1	9100-3020		TRANSFORMER:POWER (5326A)	[illegible]	9100-3020
			OTHER CABINET PARTS		
	0460-0114	12	TAPE:POLYURETHANE 1-1/4 IN WIDE (FOR TOP COVER)	[illegible]	TESANOLL-2
	1490-0030	1	STAND:TILT	[illegible]	1490-0030
	5000-0050	2	TRIM:SIDES	[illegible]	5000-0050
	5060-0729	2	FRAME ASSY:3 X 11(SIDE)	[illegible]	5060-0729
	5060-0767	5	FOOT ASSY:FM	28480	5060-0767
	05326-00001	1	PANEL:FRONT	28480	05326-00001
	05326-00004	1	PANEL:REAR	28480	05326-00004
	05327-00005		PANEL:REAR (OPT 011)	28480	05327-00005
	05326-00008	1	INSULATOR (FOR BOTTOM COVER)	28480	05326-00008
	05326-00011	1	PLATE:CONNECTOR, LONG (J8 COVER)	28480	05326-00011
	05326-00012	1	PLATE:CONNECTOR, SHORT (J10 COVER)	28480	05326-00012
	05326-20012	1	WINDOW (5326A)	28480	05326-20012
	05327-20010	1	WINDOW (5327A)	28480	05327-20010
	7120-1254	1	TRADEMARK (HP LOGO).	28480	7120-1254
			PAINTED CABINET PARTS		
	05325-00009	1	COVER:BOTTOM	28480	05325-00009
	05326-00006	1	RIGHT FRONT PANEL TRIM	28480	05326-00006
	05326-00003	1	LEFT FRONT PANEL TRIM	28480	05326-00003
	05326-00021	2	SIDE COVER	28480	05326-00021
	05326-00022	1	TOP COVER	28480	05326-00022
	05326-60029	1	KIT:RACK MOUNT (CONSISTING OF:	28480	05326-60029

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	2370-0012	3	SCREW-SET FLAT HD POZI DR 6-32 X 3/8	28480	2370-0012
	2510-0047	4	SCREW-PAN HD POZI DR 6-32 X 0.438 LG	00000	OBD
	5020-0706	1	BRACKET-LEFT	28480	5020-0706
	5020-0707	1	BRACKET-RIGHT	28480	5020-0707
	05326-40007	1	STRIP-FILLER GRAY	28480	05326-40007
			INTERNAL AND OTHER PARTS		
	0370-0104	2	KNOB-BLK BAR (TIME BASE)	28480	0370-0104
	0370-0104		KNOB-BLK BAR (FUNCTION)	28480	0370-0104
	01621-67401	1	KNOB (LEVEL)	28480	01621-67401
	01621-67403	1	KNOB (SAMPLE RATE)	28480	01621-67403
	5040-0170	1	GUIDE PLUG-IN PC BOARD SUPPORT	28480	5040-0170
	5060-0109	1	CONNECTOR 15 CONTACTS	28480	5060-0109
	05326-00010	1	SHIELD SIDE	28480	05326-00010
	05326-00018	1	CHASSIS	28480	05326-00018
	05326-20018	1	BOARD BLANK (REAR PANEL INTERCONNECT)	28480	05326-20018
	05326-60032	1	CABLE ASSY POWER	28480	05326-60032
	05327-60011	1	CABLE ASSY PRESCALER (5327A)	28480	05327-60011
	8120-1348	1	CORD LINE	70903	KHR-7911

NOTE

SEE PAGE 6-2 FOR CABINET PARTS IDENTIFICATION.

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9			OPTION 001 (8 DIGIT DISPLAY) DELETE A9 05326-60008 AND REPLACE WITH A9 05326-60025.		
	05326-60025	1	DISPLAY ASSY (SERIES 1032A)	28480	05326-60025
			LOADED ON 05326-20008 BLANK BOARD.		
A9DS1	1970-0042	8	TUBE:NUMERICAL INDICATOR	83594	B-5750-S
A9XDS1	1200-0409	8	SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS2	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-S
A9XDS2	1200-0409		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS3	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-S
A9XDS3	1200-0409		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS4	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-S
A9XDS4	1200-0409		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS5	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-S
A9XDS5	1200-0409		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS6	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-S
A9XDS6	1200-0409		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS7	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-S
A9XDS7	1200-0409		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9DS8	1970-0042		TUBE:NUMERICAL INDICATOR	83594	B-5750-S
A9XDS8	1200-0409		SOCKET:TUBE FOR 5700 SERIES	83594	SK 207
A9R1	0683-1025	2	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R2	0683-7525	8	R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R3	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
A9R4	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R5	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R6	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R7	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R8	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R9	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9R10	0683-1005	1	R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
A9R11	0683-7525		R:FXD COMP 7500 OHM 5% 1/4W	01121	CB 7525
A9U1	1820-0378	1	IC:ECL TO TTL QUAD 2-INPT OR TRANS	04713	MC1039P
A9U2	1820-0119	7	IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U3	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U4	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U5	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U6	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U7	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U8	1820-0119		IC:TTL BLANKING DECADE COUNTER	28480	1820-0119
A9U9	1820-0116	8	IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U10	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U11	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U12	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U13	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U14	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U15	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U16	1820-0116		IC:4-BIT BUFF STORE GATED OUTS	28480	1820-0116
A9U17	1820-0092	8	INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U18	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U19	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U20	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U21	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U22	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U23	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
A9U24	1820-0092		INTEGRATED CIRCUIT:DECODER-DIVIDER	28480	1820-0092
			OPTION 002 (REMOTE PROGRAMMING) DELETE 5060-0100 15 CONTACT CONNECTOR AND ADD 05327-60013 CABLE ASSY		
	05327-60013	1	CABLE ASSY PROGRAMMING CONSISTING OF:	28480	05327-60013
J10	1251-0086	1	CONNECTOR FEMALE 36 PIN MINAT	28480	1251-0086
W9P1	5060-0119	1	CONNECTOR:15 CONTACT	28480	5060-0119
W9P2	1400-0084	1	[illegible]	28480	1400-0084
			OPTION 003 (DIGITAL OUTPUT ADD 05326-60011 CABLE ASSY		
J8	1251-0087	1	CONNECTOR FEMALE 50 PIN MINAT	28480	1251-0087
W1P1	1251-2357	2	CONNECTOR:PC (2 x 10) 20 CONTACTS	76530	251-10-30-400
W1P2	1251-2357		CONNECTOR:PC (2 x 10) 20 CONTACTS	76530	251-10-30-400

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued).

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			OPTION 004 -EXTENDED REMOTE PROGRAMMING Delete A1 05326-60003 and replace with A1 05327-60018. Delete 05326-00004 rear panel and replace with 05327-00008 rear panel. Add W2 cable 05327-60019.		
A1	05327-60018	1	SERIES 1040A BOARD ASSY:REMOTE ATTENUATOR LOADED ON 05327-20009 BLANK BOARD	28480	05327-60018
A1C1	0140-0031	2	C:FXD TI 2 PF 5% 500VDCW	28480	TYPE OA
A1C2	0140-0031		C:FXD TI 2 PF 5% 500VDCW	28480	TYPE OA
A1C3	0140-0221	2	C:FXD MICA 220 PF 1%	28480	0140-0221
A1C4	0140-0221		C:FXD MICA 220 PF 1%	28480	0140-0221
A1C5	0160-0207	2	C:FXD MYLAR 0.01UF 5% 200VDCW	28480	0160-0207
A1C6	0160-0207		C:FXD MYLAR 0.01UF 5% 200VDCW	28480	0160-0207
A1C7	0140-0149	3	C:FXD MICA 470 PF 5%	72136	DM15F471J35
A1C8	0140-0149		C:FXD MICA 470 PF 5%	72136	DM15F471J35
A1C9	0160-2055	2	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A1C10	0160-3028	2	C:FXD CER 10PF 10% 75VDCW	32574	MIN-C-10-K
A1C11	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
A1C12	0160-3028		C:FXD CER 10PF 10% 75VDCW	32574	MIN-C-10-K
A1C13	0140-0199	2	C:FXD MICA 240 PF 5%	28480	0140-0199
A1C14	0140-0199		C:FXD MICA 240 PF 5%	28480	0140-0199
A1CR1	1910-0016	8	DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR2	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR3	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR4	1902-0079	1	DIODE:BREAKDOWN:10.0V 5% 400 MW	28480	1902-0079
A1CR5	1902-0057	1	DIODE BREAKDOWN:6.49V	28480	1902-0057
A1CR6	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR7	1906-0026	4	DIODE ASSY:SI	28480	1906-0026
A1CR8	1906-0026		DIODE ASSY:SI	28480	1906-0026
A1CR9	1906-0025	4	DIODE ASSY:SI	28480	1906-0025
A1CR10	1906-0025		DIODE ASSY:SI	28480	1906-0025
A1CR11	1901-0040	10	DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR12	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR13	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR14	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR15	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR16	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR17	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR18	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR19	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR20	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR21	1906-0025		DIODE ASSY:SI	28480	1906-0025
A1CR22	1906-0025		DIODE ASSY:SI	28480	1906-0025
A1CR23	1906-0026		DIODE ASSY:SI	28480	1906-0026
A1CR24	1906-0026		DIODE ASSY:SI	28480	1906-0026
A1CR25	1901-0376	4	DIODE:SILICON 35V	28480	1901-0376
A1CR26	1901-0376		DIODE:SILICON 35V	28480	1901-0376
A1CR27	1901-0376		DIODE:SILICON 35V	28480	1901-0376
A1CR28	1901-0376		DIODE:SILICON 35V	28480	1901-0376
A1CR29	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1CR30	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR31	1910-0016		DIODE:GERMANIUM 100MA/0.85V 60PIV	93332	D2361
A1CR32	1902-0061	4	DIODE:BREAKDOWN 6.11V 5%	04713	SZ10939-98
A1CR33	1902-0061		DIODE:BREAKDOWN 6.11V 5%	04713	SZ10939-98
A1CR34	1902-0061		DIODE:BREAKDOWN 6.11V 5%	04713	SZ10939-98
A1CR35	1902-0061		DIODE:BREAKDOWN 6.11V 5%	04713	SZ10939-98
A1CR36	1901-0040		DIODE:SILICON 30MA 30WV	07263	FDG1088
A1DS1	2140-0047	2	LAMP:NEON GLOW 0.8 MILLIAMPS	08806	A1C
A1DS2	2140-0047		LAMP:NEON GLOW 0.8 MILLIAMPS	08806	A1C
A1J1	1251-0472	2	CONNECTOR:PC 12 CONTACTS	71785	252-06-30-300
A1J2	1251-0472		CONNECTOR:PC 12 CONTACTS	71785	252-06-30-300
A1J3	1250-1163	2	CONNECTOR:RF BNC INPUT	28480	1250-1163
A1J4	1250-1163		CONNECTOR:RF BNC INPUT	28480	1250-1163
A1K1	0490-0399	5	RELAY:REED ASSY, 1200 OHM 12VDC	28480	0490-0399
A1K2	0490-0399		RELAY:REED ASSY, 1200 OHM 12VDC	28480	0490-0399
A1K3	0490-0399		RELAY:REED ASSY, 1200 OHM 12VDC	28480	0490-0399
A1K4	0490-0399		RELAY:REED ASSY, 1200 OHM 12VDC	28480	0490-0399
A1K5	0490-0399		RELAY:REED ASSY, 1200 OHM 12VDC	28480	0490-0399
A1Q1	1854-0039	1	TSTR:SI NPN	80131	2N3053
A1Q2	1853-0001	1	TSTR:SI PNP(SELECTED FROM 2N1132)	28480	1853-0001
A1Q3	1854-0215	2	TSTR:SI NPN	80131	2N3904
A1Q4	1854-0215		TSTR:SI NPN	80131	2N3904
A1Q5	1853-0036	2	TSTR:SI PNP	80131	2N3906
A1Q6	1853-0036		TSTR:SI PNP	80131	2N3906

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1Q7	1854-0215		TSTR:SI NPN	80131	2N3904
A1Q8	1854-0215		TSTR:SI NPN	80131	2N3904
A1Q9	1853-0036		TSTR:SI PNP	80131	2N3906
A1Q10	1853-0036		TSTR:SI PNP	80131	2N3906
A1Q11	1854-0215		TSTR:SI NPN	80131	2N3904
A1Q12	1854-0215		TSTR:SI NPN	80131	2N3904
A1Q13	1855-0334	2	TSTR:SI FET DUAL N-CHANNEL	17856	DN377
A1Q14	1855-0334		TSTR:SI FET DUAL N-CHANNEL	17856	DN377
A1R1	0698-6123	2	RIFXD COMP 20K OHM 5% 1/8W	28480	0698-6123
A1R2	0698-6123		RIFXD COMP 20K OHM 5% 1/8W	28480	0698-6123
A1R3	0698-5565	6	RIFXD CARBON 2.2K OHM 5% 1/8W	28480	0698-5565
A1R4	0698-5565		RIFXD CARBON 2.2K OHM 5% 1/8W	28480	0698-5565
A1R5	0686-1515	1	RIFXD COMP 150 OHM 5% 1/2W	01121	EB 1515
A1R6	0698-5563	1	RIFXD CARBON 180 OHM 5% 1/8W	28480	0698-5563
A1R7	0698-3381	6	RIFXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A1R8	0698-3381		RIFXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A1R9	2100-2633	2	RIVAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A1R10	0698-5103	2	RIFXD COMP 430 OHM 5% 1/8W	28480	0698-5103
A1R11	0698-5103		RIFXD COMP 430 OHM 5% 1/8W	28480	0698-5103
A1R12	0698-7965	2	RIFXD COMP 330K OHM 5% 1/8W	01121	BB 3345
A1R13	0698-7966	2	RIFXD COMP 680K OHM 5% 1/8W	01121	BB 6845
A1R14	0698-7966		RIFXD COMP 680K OHM 5% 1/8W	01121	BB 6845
A1R15	0698-7965		RIFXD COMP 330K OHM 5% 1/8W	01121	BB 3345
A1R16	0757-0467	2	RIFXD MET FLM 121K OHM 1% 1/8W	28480	0757-0467
A1R17	0757-0467		RIFXD MET FLM 121K OHM 1% 1/8W	28480	0757-0467
A1R18	0698-3381		RIFXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A1R19	0683-3015	2	RIFXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A1R20	0698-3381		RIFXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A1R21	0683-3015		RIFXD COMP 300 OHM 5% 1/4W	01121	CB 3015
A1R22	0698-5568	2	RIFXD CARBON 36K OHM 5% 1/8W	28480	0698-5568
A1R23	0698-6244	4	RIFXD COMP 3.3K OHM 5% 1/8W	01121	BB 3325
A1R24	0698-5568		RIFXD CARBON 36K OHM 5% 1/8W	28480	0698-5568
A1R25	0698-6244		RIFXD COMP 3.3K OHM 5% 1/8W	01121	BB 3325
A1R26	0683-1515	2	RIFXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A1R27	0683-1515		RIFXD COMP 150 OHM 5% 1/4W	01121	CB 1515
A1R28	0698-6381	2	RIFXD COMP 11K OHM 5% 1/8W	28480	0698-6381
A1R29	0698-6381		RIFXD COMP 11K OHM 5% 1/8W	28480	0698-6381
A1R30	0698-7097	4	RIFXD COMP 1 MEGOHM 5% 1/8W	01121	BB 1055
A1R31	0698-7097		RIFXD COMP 1 MEGOHM 5% 1/8W	01121	BB 1055
A1R32	2100-2874	2	RIVAR CERMET 500 OHM 10% LIN 1/2W	28480	2100-2874
A1R33	2100-2874		RIVAR CERMET 500 OHM 10% LIN 1/2W	28480	2100-2874
A1R34	0698-7964	12	RIFXD COMP 100K OHM 5% 1/8W	01121	BB 1045
A1R35	0698-7964		RIFXD COMP 100K OHM 5% 1/8W	01121	BB 1045
A1R36	0698-3381		RIFXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A1R37	0698-3381		RIFXD COMP 150 OHM 5% 1/8W	28480	0698-3381
A1R38	0698-5174	4	RIFXD COMP 200 OHM 5% 1/8W	28480	0698-5174
A1R39	0698-5174		RIFXD COMP 200 OHM 5% 1/8W	28480	0698-5174
A1R40	0698-6984	2	RIFXD COMP 470 OHM 5% 1/8W	28480	0698-6984
A1R41	0698-6984		RIFXD COMP 470 OHM 5% 1/8W	28480	0698-6984
A1R42	0698-7097		RIFXD COMP 1 MEGOHM 5% 1/8W	01121	BB 1055
A1R43	0698-7097		RIFXD COMP 1 MEGOHM 5% 1/8W	01121	BB 1055
A1R44	0698-6244		RIFXD COMP 3.3K OHM 5% 1/8W	01121	BB 3325
A1R45	0698-6244		RIFXD COMP 3.3K OHM 5% 1/8W	01121	BB 3325
A1R46	0698-5561	2	RIFXD COMP 6.8 OHM 5% 1/8W	28480	0698-5561
A1R47	0698-5561		RIFXD COMP 6.8 OHM 5% 1/8W	28480	0698-5561
A1R48	0698-5174		RIFXD COMP 200 OHM 5% 1/8W	28480	0698-5174
A1R49	2100-2905	2	RIVAR CERMET 10K OHM 10% LIN	28480	2100-2905
A1R50	0698-5174		RIFXD COMP 200 OHM 5% 1/8W	28480	0698-5174
A1R51	2100-2905		RIVAR CERMET 10K OHM 10% LIN	28480	2100-2905
A1R52	0698-5565		RIFXD CARBON 2.2K OHM 5% 1/8W	28480	0698-5565
A1R53	0698-5565		RIFXD CARBON 2.2K OHM 5% 1/8W	28480	0698-5565
A1R54	0698-5565		RIFXD CARBON 2.2K OHM 5% 1/8W	28480	0698-5565
A1R55	0698-5565		RIFXD CARBON 2.2K OHM 5% 1/8W	28480	0698-5565
A1R56	2100-2633		RIVAR CERMET 1K OHM 10% LIN 1/2W	28480	2100-2633
A1S1	3101-1313	3	SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G125-0004
A1S2	3101-1313		SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G125-0004
A1S3	3101-1313		SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G125-0004
A1S4	3101-1311	4	SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G126-0020
A1S5	3101-1311		SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G126-0020
A1S6			PART OF R49		
A1S7			PART OF R51		
A1S8	3101-1311		SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G126-0020
A1S9	3101-1311		SWITCH:SLIDE DPDT 0.5A 125V AC/DC	79727	G126-0020
A1U1	1820-0274	1	IC:DTL QUAD 2-INPT OR GATE	28480	1820-0274
A1U2	1820-0287	2	IC:DIGITAL QUAD 2-INPT NAND GATE	28480	1820-0287

See introduction to this section for ordering information

Table 6-1. Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1U3	1820-0675		IC:HTL TRIPLE LEVEL TRANSLATOR(TTL-HTL)	04713	MC666P
A1U4	1820-0207		IC:DIGITAL QUAD 2-INPT NAND GATE	28480	1820-0207
W2	06327-60019	1	CABLE ASSY	28480	06327-60019
W2P2	1200-0063	1	LUG:CRIMP	28480	1200-0063
W2P1	6010-0113	1	CONNECTOR:PRESSURE 45 CONTACT	28480	6010-0113
J10	1251-0087	1	CONNECTOR:FEMALE 50 PIN MINAT	28480	1251-0087

See introduction to this section for ordering information

Table 6-2. Manufacturers Code List

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
C0000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
00779	AMP INC.(AIRCRAFT MARINE PROD.)	HARRISBURG, PA.	17101
00853	SANGAMO ELECTRIC CO.PICKENS DIV.	PICKENS, S.C.	29671
01121	ALLEN BRADLEY CO.	MILWAUKEE, WIS.	53204
01295	TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV.	DALLAS, TEX.	75231
03508	G.E. CO. SEMICONDUCTOR PROD. DEPT.	SYRACUSE, N.Y.	13201
04713	MOTOROLA SEMICONDUCTOR PROD.INC.	PHOENIX, ARIZ.	85008
04870	P M MOTOR CO.	WESTCHESTER, ILL.	60156
05820	WAKEFIELD ENGINEERING INC.	WAKEFIELD, MASS.	01880
07263	FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.	MOUNTAIN VIEW, CALIF.	94040
08806	G.E. CO. MINIATURE LAMP DEPT.	CLEVELAND, OHIO	44112
12040	NATIONAL SEMICONDUCTOR CORP.	DANBURY, CONN.	06810
12574	GULTON IND. INC. DATA SYSTEM DIV.	ALBUQUERQUE, N.M.	87108
13019	AIRCO SUPPLY CO. INC.	WITCHITA, KANS.	67210
14655	CORNELL DUBLIER ELECT. DIV.FEDERAL PACIFIC ELECT. CO	NEWARK, N.J.	07105
17856	SILICONIX INC.	SUNNYVALE, CALIF.	94086
19701	ELECTRA/MIDLAND CORP.	MINERAL WELLS, TEX.	76067
24931	SPECIALTY CONNECTOR CO. INC.	INDIANAPOLIS, IND.	46227
28480	HEWLETT-PACKARD COMPANY	PALO ALTO, CALIF.	94304
56289	SPRAGUE ELECTRIC CO.	N. ADAMS, MASS.	01247
59474	SUPERIOR ELECTRIC CO. THE	BRISTOL, CONN.	06010
71400	BUSSMANN MFG. DIV. MC GRAW-EDISON CO.	ST. LOUIS, MO.	63017
71785	CINCH MFG. CO. DIV TRW INC.	ELK GROVE VILLAGE, ILL.	
72136	ELECTRO MOTIVE MFG. CO. INC.	WILLIMANTIC, CONN.	06226
72982	ERIE TECHNOLOGICAL PRCD. INC.	ERIE, PA.	16512
75915	LITTELFUSE INC.	DES PLAINES, ILL.	60016
76488	STACKPOLE CARBON CO.	ST. MARYS, PA.	15857
79727	CONTINENTAL-WIRT ELECTRONICS CORP.	PHILADELPHIA, PA.	19144
80131	ELECTRONIC INDUSTRIES ASSOCIATION	WASHINGTON D.C.	20006
82142	AIRCO SPEER ELECT. COMP.	DU BOIS, PA.	15801
82389	SWITCHCRAFT INC.	CHICAGO, ILL.	60630
83594	BURROUGHS CORP. ELECT. COMP. DIV.	PLAINSFIELD, N.J.	07061
85471	BOYD A.B. CO.	SAN FRANCISCO,CALIF.	94103
91418	RADIO MATERIALS CO.	CHICAGO, ILL.	60646
95332	SYLVANIA ELECTRIC PROD. INC. SEMICONDUCTOR DIV.	WOBURN, MASS.	01801
95712	BENDIX CORP. THE MICROWAVE DEVICE DIV.	FRANKLIN, IND.	46131
98733	SAN FERNANDO ELECT. MFG. CO.	SAN FERNANDO, CALIF.	91341
98291	SEALECTRO CORP.	MAMARONECK, N.Y.	10544
99800	DELEVAN ELECTRONICS CORP.	E. AURORA, N.Y.	14052

SECTION VII

MANUAL CHANGES AND OPTIONS

7-1. INTRODUCTION

7-2. This section contains information necessary to adapt this manual to older instruments. Also included is the operating and installation information for available options. Refer to Section II for remote programming requirements.

7-3. MANUAL CHANGES

7-4. This manual applies directly to Models 5326A with serial prefix 1136A and 5327A with serial prefix 1120A (refer to Paragraph 1-4).

7-5. New Instruments

7-6. As changes are made, newer instruments may have serial prefixes that are not listed in this manual. The manuals for these instruments are supplied with a manual change sheet, containing the required information. Contact the nearest Hewlett-Packard Sales and Service Office if this sheet is missing.

7-7. Older Instruments

7-8. To adapt this manual to instruments having a serial prefix prior to 1136A for the 5326A or 1120A for the 5327A, perform the backdating that applies to your instrument serial prefix, as listed in the table below.

IMPORTANT

For Model 5326A with serial prefix 1044A or below, a separate manual is required. Order "Model 5326A/B 50 MHz Timer/Counter/DVM Operating and Service Manual."

Serial Prefix		Perform Change
5326A	5327A	
1132A		1
1116A		1,2
	1040A	3

CHANGE 1

a. In Table 6-1, change part number of T1 Power Transformer to 9100-2888. (The 9100-3020 has additional current capabilities for special high-stability oscillators.) For replacement, order 9100-3020.

b. In Tables 5-1 and 6-1 and Figure 8-16, change part number of A16 Interconnect Board to 05327-60005, series 1040A (the 05327-60026 board accepts special high-stability time base assemblies.)

CHANGE 2

a. Replace A17 Input C Amplifier Assembly schematic with Figure 7-1.

b. Replace A17 Input C Amplifier Assembly component locator with Figure 7-2.

c. In Table 6-1:

Delete: A17C13 CF .001 μF 75V 0160-0975 1 ea.
A17R25, A17R26 RF 560Ω .25W 0683-5615 2 ea.
Change A17R22 to read: 120Ω .25W 0683-1215 1 ea.
Change A17R23 to read: 1200Ω .25W 0683-1225 1 ea.
Add: A17R20 270Ω .25W 0683-2715 1 ea.
Change board series number to read 1116A, Rev. A.

CHANGE 3

a. In Table 6-1, change part numbers to read:

COVER-SIDE 3x11 .... 5000-0729 2 ea.
COVER-TOP .... 05325-00008 1 ea.
INSULATOR (Q1 & Q2) .... 0340-0162 2 ea.

NOTE

If replacement of any of the above parts is required, replace with new parts listed in Table 6-1.

b. In Table 6-1 and on A10 schematic (Section VIII), Delete: A10CR1 and A10CR2. Change board series number to 1040A.

7-9. OPTIONS

7-10. Options 001 through 004 are available for 5326A and 5327A models. The following paragraphs describe each option's purpose and operation.

7-11. Option 001, 8 Digit Display

7-12. Option 001 is the addition of an eighth digit to the display assembly. This addition becomes the most significant digit and extends the counter's resolution at higher frequencies. The digit is always blanked if the reading is "0". Option 001 consists of A9 Display Assembly 05326-60025 in place of 05326-60008.

7-13. Option 002, Remote Programming

7-14. Option 002 allows the counter to be computer controlled from a 36-pin connector on the counter's rear panel. Programming instructions are given in Section II. A schematic diagram is included in Section VIII.

7-15. Option 003, Digital Recorder Output

7-16. The data displayed on the counter's front panel can be permanently recorded by connecting a printer to the counter via Option 003. The necessary signals are coupled from A9 Display Assembly to an HP 5055A or 5050B Digital Recorder through J9 on the counter's rear panel (also, see Table 1-3 for specifications and Section VIII for pin references).

7-17. Option 004, Extended Remote Programming

7-18. This option is similar to Option 002 except it includes the remote programming of the AC/DC, SEP-COM-CHK, FAST/NORM, and ATTEN switches. Remote programming of the attenuator board is achieved by connecting the DTL input lines in parallel with the front panel switches (connected at cable points 1 through 8). When the counter is being externally controlled, the A COM line goes high. This high turns off diodes A1CR6, 18, 2, 3, 15, 30, 31, and 1, and disables the front panel switches.

7-19. FIELD INSTALLATION OF OPTIONS

7-20. Installation of Option 001, 8th Digit

7-21. Parts required to install this option are:

1820-0110 Decade Counter U8
1820-0116 Buffer Storage U16
1820-0092 Decoder Driver U24
0683-7525 7.5 kΩ, ¼ watt resistor R11
1200-0405 Display Tube Socket
1970-0042 Display Tube DS8

a. Remove right and left readout boards, A10 and A11.

b. Remove two screws holding display tube shield and remove shield.

c. Remove display board A9 and display support board A8 from the counter by pulling up on the display support board A8. Separate A8 from A9.

d. Install parts on A9 as shown in the component location photo on Figure 8-18 of this manual, and solder in place.

e. R10 carries the overflow information from the decades and can be placed in one of two locations. Move R10 to the location shown in the photo. In this location, R10 connects to pin 8 of U8.

f. Perform Self-Check in Table 3-1. Especially note that the OF (overflow) lamp lights when the leftmost digit changes from 9 to 0.

7-22. Installation of Option 002, Remote Programming

7-23. To install remote programming capability in units not so equipped, order remote cable assembly HP Part No. 05327-60010, two 4-40 x ¼-inch machine screws, and one 6-32 x ⅜-inch machine screw with hex nut.

a. Remove the plate covering the lower opening in the rear panel for Option 002.

b. The rear-panel interconnect board containing the wiring from the rear-panel BNC's and switches must be removed. To accomplish this, remove the nuts holding the rear-panel BNC's.

c. Remove two screws holding P1A (the 1½-inch, black, pressure connector) to the interconnect A16.

d. Remove side covers and six screws holding rear panel. Loosen one side frame. Pull rear panel away from the instrument.

e. Remove the rear-panel interconnect board from the instrument and separate it from P1A by removing two screws.

f. Feed the pressure connector through hole in rear-panel and mount rear-panel connector J10, with screws removed earlier. Position J10 with pin 1 near the side frame.

g. Assemble the rear-panel interconnect board and the new 5-inch long pressure connector P1 with three 6-32 x ⅜-inch screws and hex nuts. Be certain that proper contact is made between interconnect board and P1.

h. Attach P1 to the motherboard using four 4-40 x ¼-inch screws. Do not tighten screws. Route cable as shown in the top internal photo of instrument, Figure 8-4.

CAUTION

SCREWS LONGER THAN ¼-INCH WILL DAMAGE P1.

i. Gently reinstall rear panel. Install BNC lock nuts so that the board is still movable.

j. Observe the alignment of the connector in the motherboard. Tighten the four screws holding P1 to the motherboard, making sure to maintain proper contact.

k. Check contact alignment of P1 with motherboard and with the rear-panel interconnect board. If necessary, loosen the screws in P1 and shift slightly to obtain proper terminal contact.

l. Tighten BNC lock nuts and reassemble instrument.

m. Run a complete performance check on the unit to verify that remote programming is working properly.

7-24. Installation of Option 003, Digital Recorder Output

7-25. Order digital recorder cable assembly HP Part No. 05326-60012.

a. Remove the plate covering the upper opening in the rear panel.

b. Remove right and left readout boards A10 and A11. Remove two screws holding the display tube shield and remove shield. Remove display support board A8 and the display board A9 by pulling up on A8.

c. Feed the two pressure connectors of the recorder cable through the rear panel and mount J9 on the rear panel, using the screws previously removed. Position J9 so pin 1 is near the side frame.

d. Slide the connectors on the A9 board, shown in the photo on Figure 8-4. The connector with the long wires attaches to J1 and is positioned so that pin 1 is toward the front of the instrument. The other connector attaches to J8, and pin 1 is toward the rear of the instrument.

e. Position the P1 cable so it passes between A8 and A11, completely clearing A8. Reinstall A8 and A9.

f. Route the cable around T1 and in front of A8 assembly.

g. Reassemble unit and run a proof-of-performance check of the digital output to verify that the option is installed properly.

7-26. Installation of Option 004, Extended Remote Programming

7-27. Field installation of Option 004 is not available.

Figure 7-1. A17 Input C Amplifier Assembly (5326A Only)

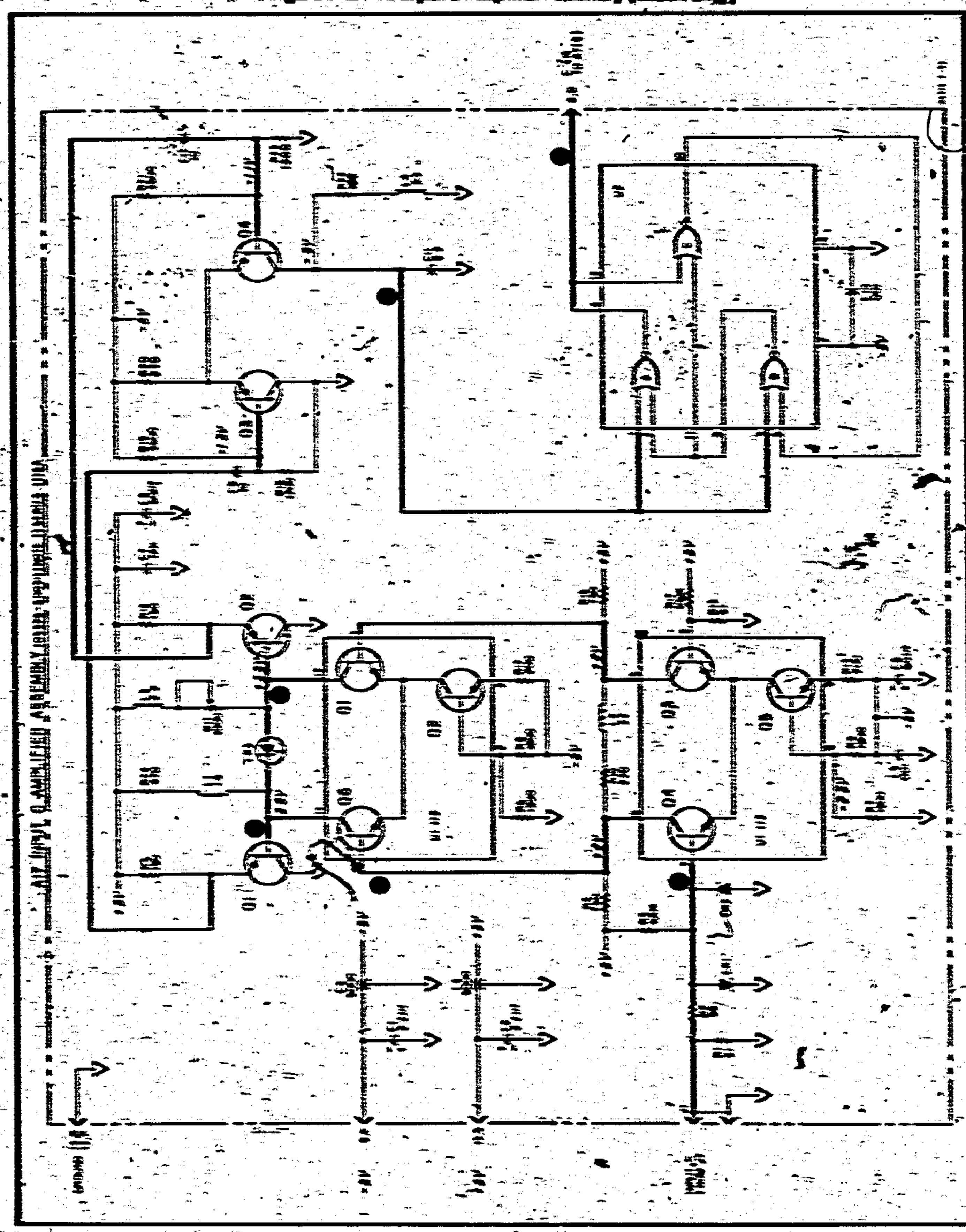


Figure 7-2. A17 Component Locator

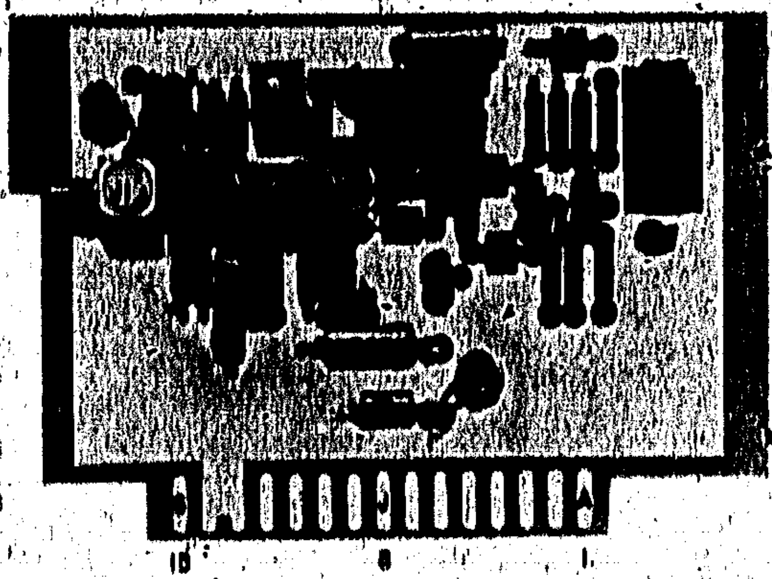
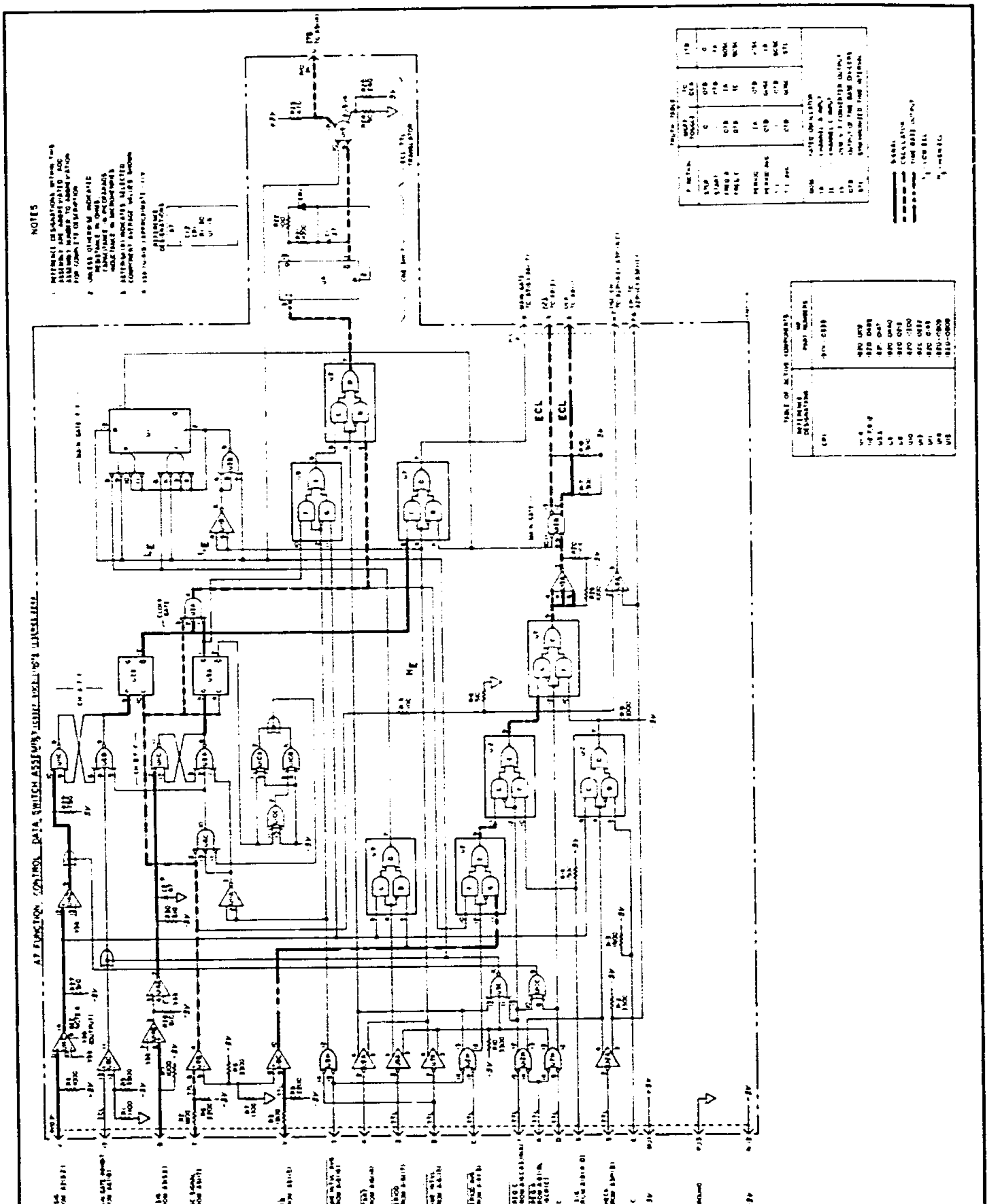
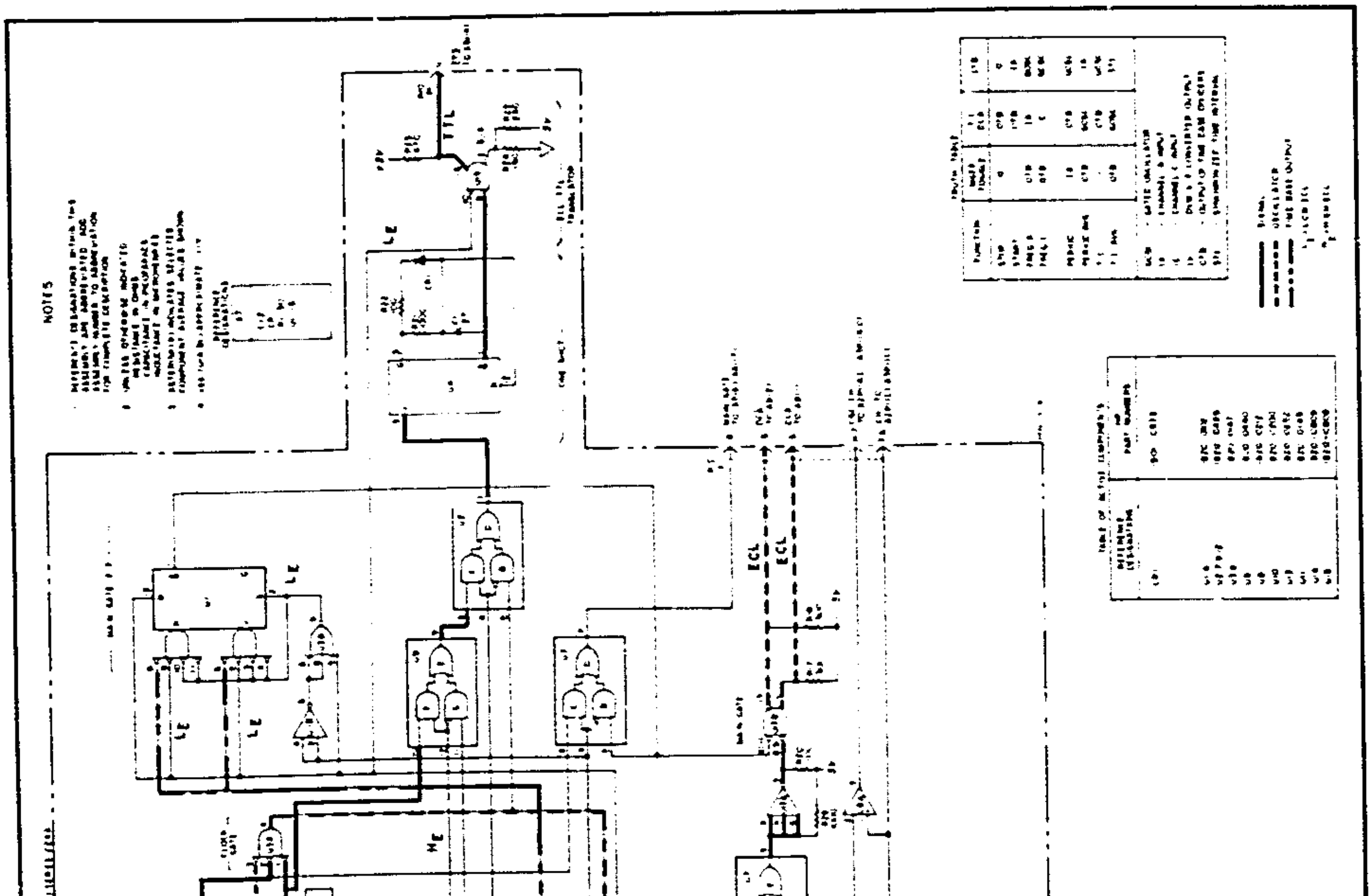


Figure 8-22
5326A/5327A INTERCONNECTION DIAGRAM
(Stock No. 05326-90026)

TIME INTERVAL FLOW DIAGRAM
Part of Figure 8-11. A7 Function Control Assembly

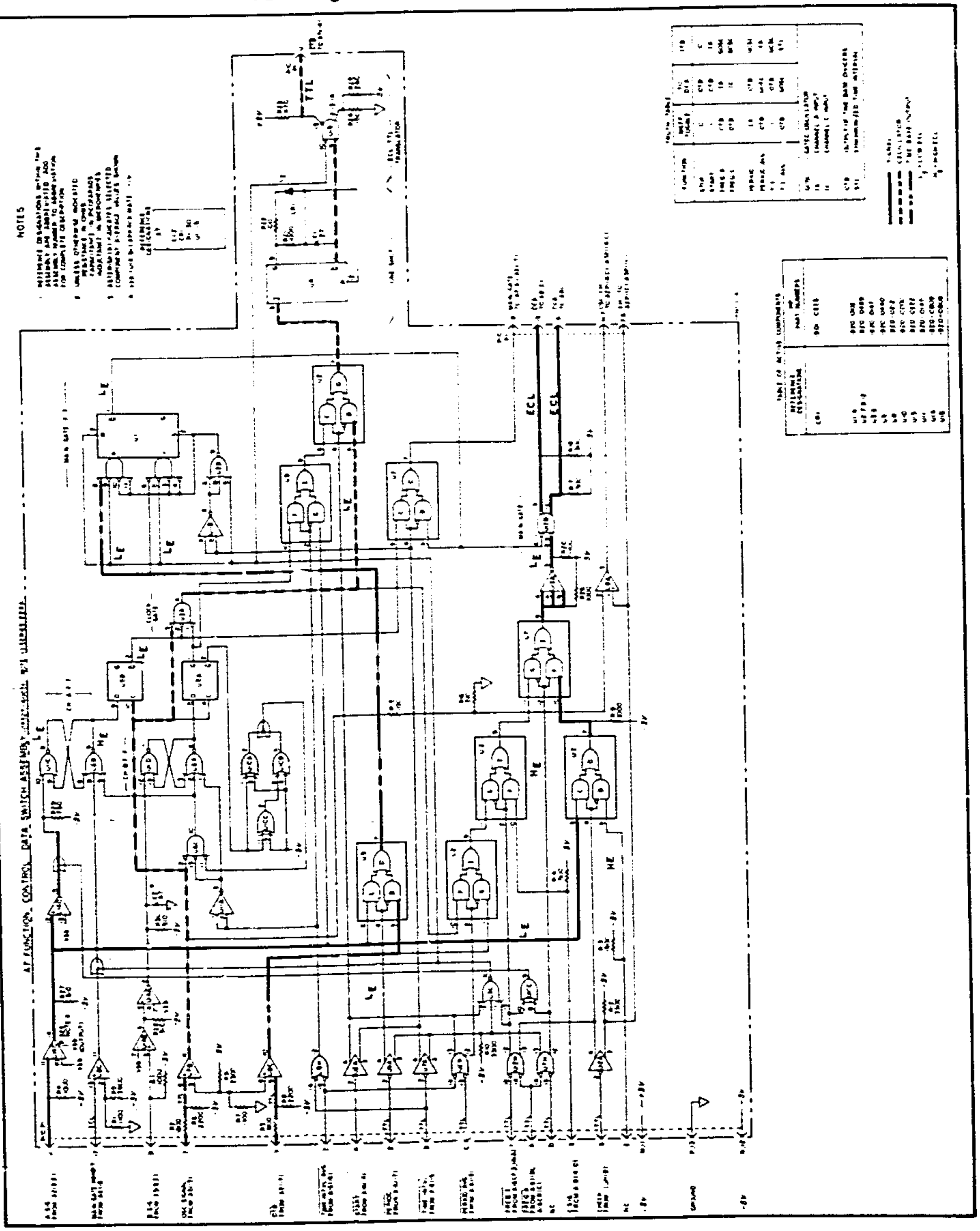


TIME INTERVAL AVERAGE FLOW DIAGRAM
Part of Figure 8-11. A7 Function Control Assembly



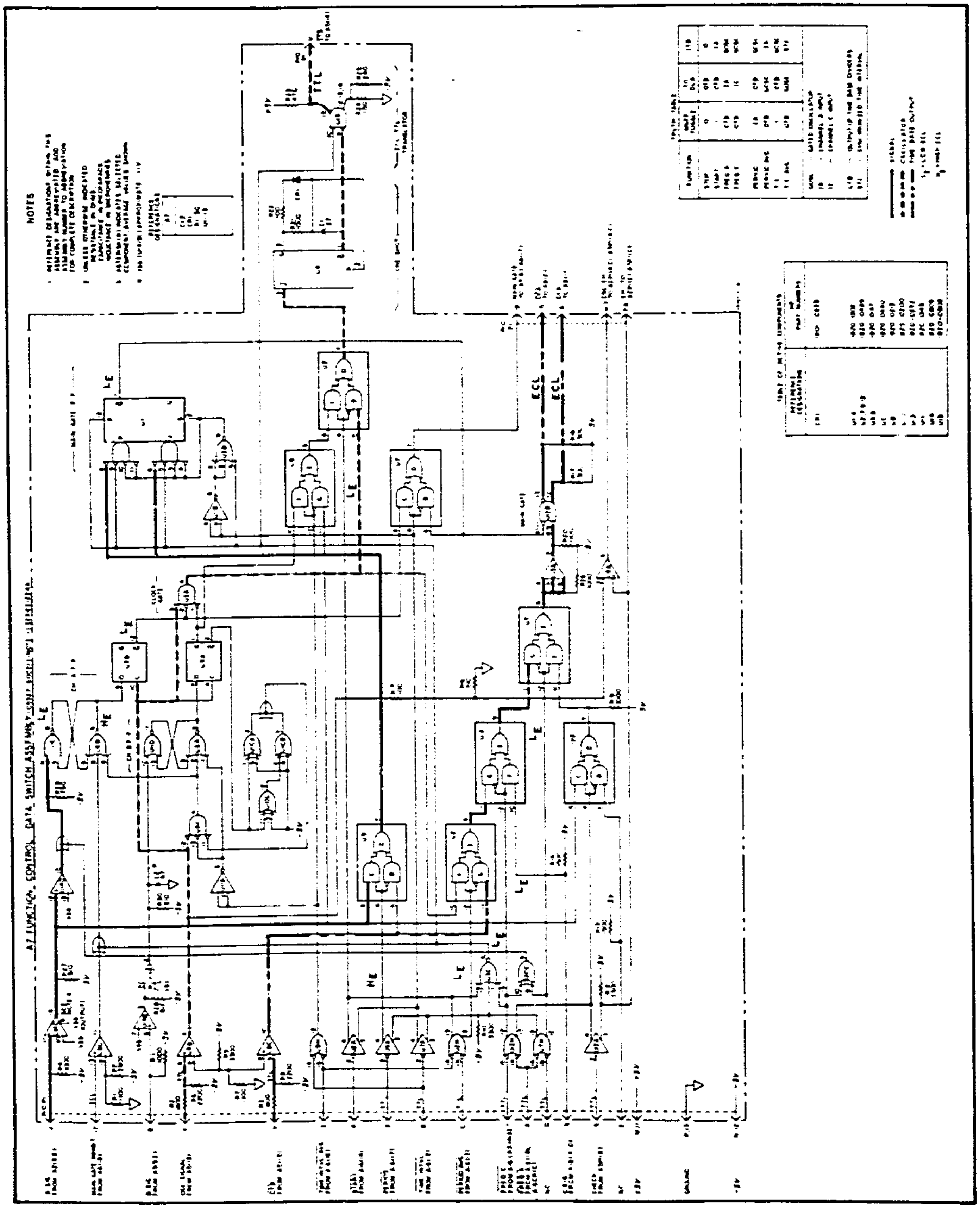
PERIOD AVERAGE FLOW DIAGRAM

Part of Figure 8-11. A7 Function Control A sembly



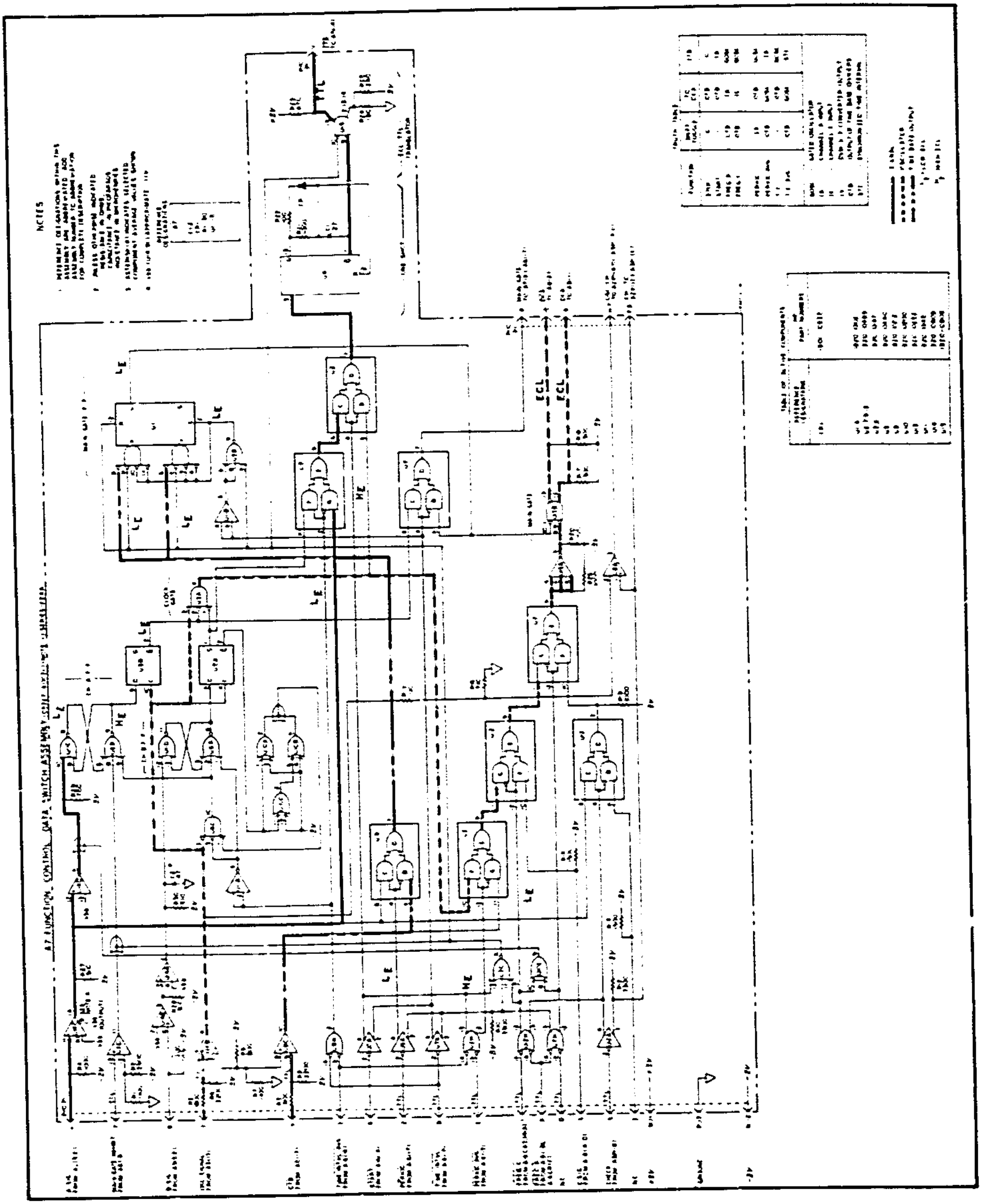
PERIOD FLOW DIAGRAM

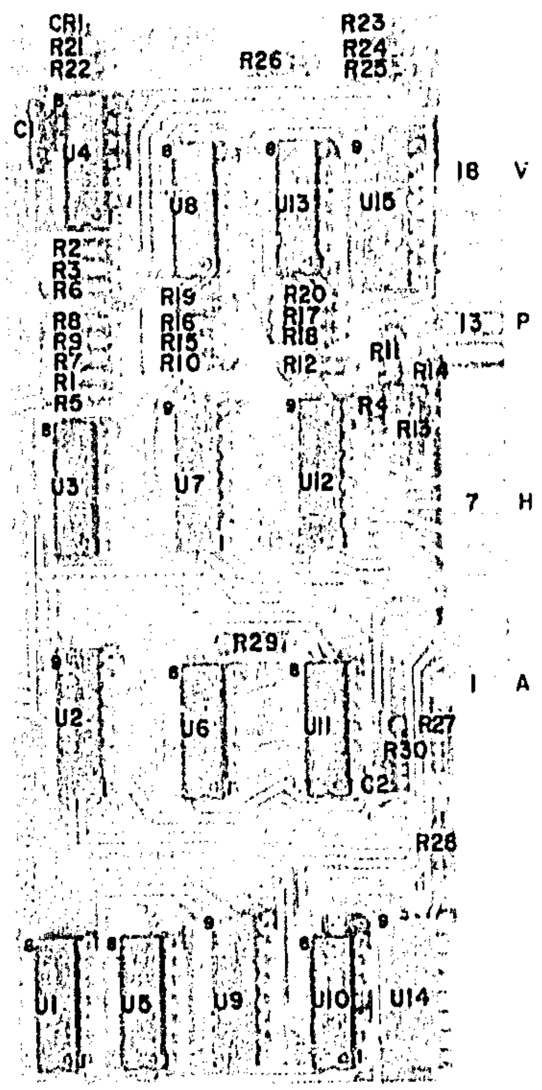
Part of Figure 8-11. A7 Function Control Assembly

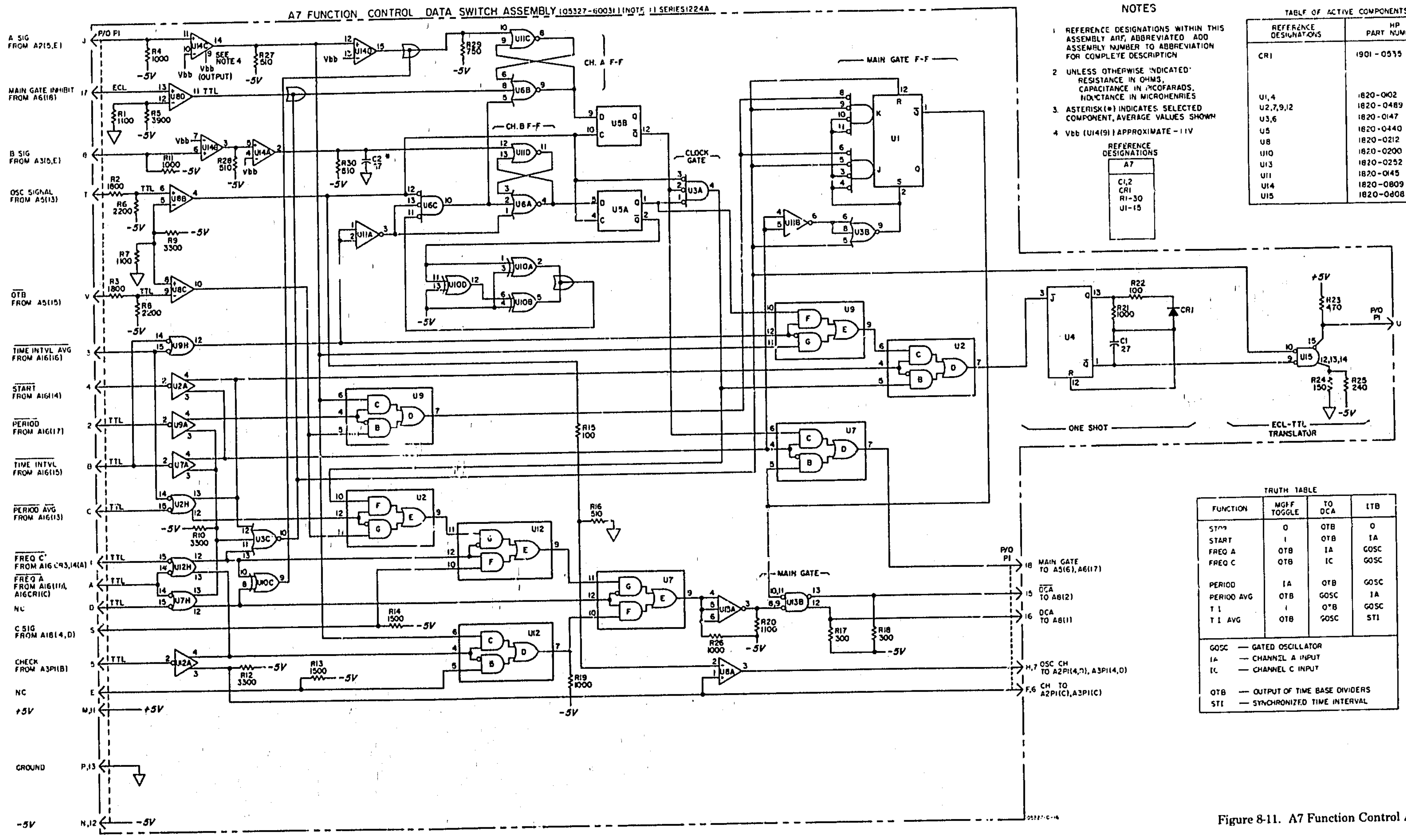


FREQ A FLOW DIAGRAM

Part of Figure 8-11. A7 Function Control Assembly







NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS, INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. Vbb (U14(9)) APPROXIMATE -1.1V

REFERENCE DESIGNATIONS

A7
C1,2 CR1 R1-30 U1-15

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1	1901-0535
U1,4	1820-0102
U2,7,9,12	1820-0489
U3,6	1820-0147
U5	1820-0440
U8	1820-0212
U10	1820-0200
U13	1820-0252
U11	1820-0145
U14	1820-0809
U15	1820-0808

TRUTH TABLE

FUNCTION	MGFF TOGGLE	TO DCA	LTB
STOP	0	OTB	0
START	1	OTB	IA
FREQ A	OTB	IA	GOSC
FREQ C	OTB	IC	GOSC
PERIOD	IA	OTB	GOSC
PERIOD AVG	OTB	GOSC	IA
T I	1	OTB	GOSC
T I AVG	OTB	GOSC	STI

GOSC — GATED OSCILLATOR
IA — CHANNEL A INPUT
IC — CHANNEL C INPUT
OTB — OUTPUT OF TIME BASE DIVIDERS
STI — SYNCHRONIZED TIME INTERVAL

Figure 8-11. A7 Function Control Assembly

A8 DISPLAY SUPPORT OPERATION

The display support assembly A8 serves to interconnect the display assembly A9 with the interconnect assembly A16. In addition, A8 contains a high-speed decade counter, decimal point drivers, and blanking (logic) circuits.

The high-speed decade consists of four JK flip-flops U3 through U6. The line receiver, Q2 and Q9, serves to reduce noise levels on the signal from A7 prior to driving U3(6, 9). U3 divides by two and the combination of U4 through U6 divides by five. The decade supplies BCD outputs to A9 via J1(5, 4, 2, 3) for the 10^0 display tube. The D output is also used as the carry output to the next decade counter on A9. Q1 translates the positive TTL reset signal to ECL levels to reset the high-speed decade to zero.

Decimal point drivers Q3 through Q8 work in conjunction with logic circuits on A11 to light the proper decimal points. R15 and R17 provide operating bias for Q3 through Q8. R19, R20, and R23 are current limiters. R2 and R3 provide 87.5 volts pre-bias for the OFF decimal points. R5 through R10 connect the off decimals to the pre-bias voltage to eliminate background glow.

As an example of operation, when a ground is received at P1(S) from A11, Q5 conducts. With Q5 on, decimal point enable line 3 (DP3) is pulled to ground to light the decimal point on A9DS4(10). Also with P1(S) low, U1D(11) is high to unblank A9 U4. When U1D(11) goes high, U1B(6) and U1A(3) are also high to unblank A9U3 and U2. This unblanks A9DS4, DS3, and DS2. DS5 and DS6 remain blanked. DS1 is never blanked, and DS7 and DS8 (Option 001) will always be blanked.

CR2 and CR3 are included for use with the digital recorder Option 003. When overflow occurs, P1(M) and J1(15) go low. CR2 and CR3 cause J1(14 and R) to also go low. When J1(15, 14, R) are low, the recorder will print a zero on the annunciator line. R21 and R24 are pull-up resistors.

A8 TROUBLESHOOTING

High Speed Decade

If a problem in the High-Speed Decade is not readily apparent when checking for the correct waveforms, a step-through method may be preferable. Set the counter as follows:

1. MULTIPLIER switch to 10
2. CHK-SEP-COM switch to CHK.
3. FUNCTION switch to START
4. Press RESET.

The High-Speed Decade has four output lines that are binary weighted DCBA. Release the RESET button and note the counter's display. A typical problem is as follows: The display counts 1...2...3...0...1...2...3...0. When the display reads "0," set the FUNCTION switch to STOP and check the C line for a Low (refer to the table below). Check the input lines of the IC, since their levels depend on the state of other IC's in the circuit (note U4 pin 3 and U6 pin 13). The levels given below are ECL.

	A	B	C	D
DISPLAY	U3(13)	U4(1)	U5(1)	U6(1)
1	L	H	H	H
2	H	L	H	H
3	L	L	H	H
4	H	H	L	H
5	[illegible]	H	L	H
6	H	L	L	H
7	L	L	L	H
8	H	H	H	L
9	L	H	H	L
10	H	H	H	H
11	REPEATS			

Decimal Point and Blanking

Before testing the decimal point and blanking circuitry, set the CHK-SEP-COM switch to SEP and disconnect the input signal.

DECIMAL POINT. To check the decimal point circuitry, set FUNCTION switch to PERIOD AVG and position the TIME BASE switch to pull the required D.P. line Low.

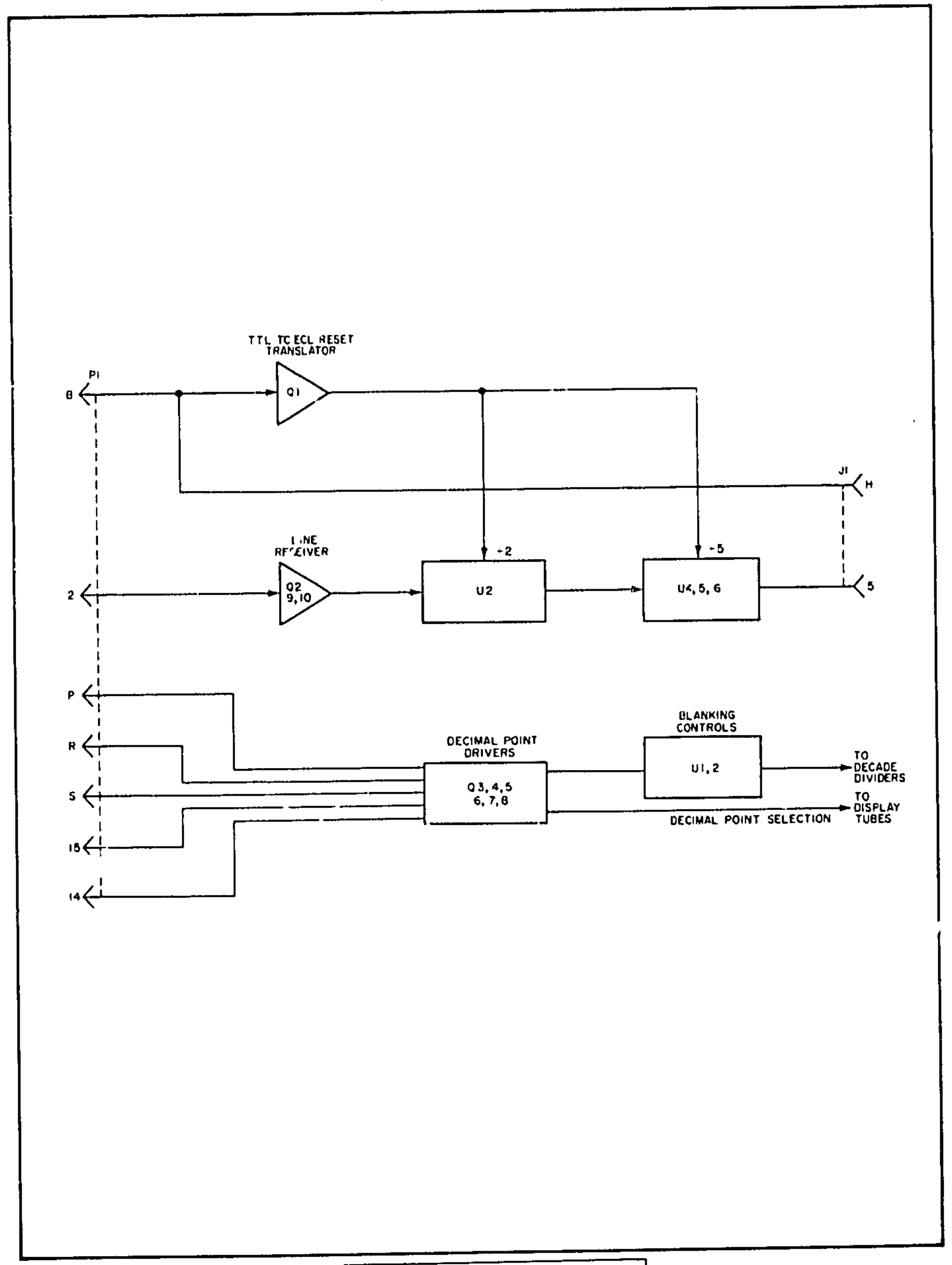
LINE	MULTIPLIER POSITION	DRIVER
D.P.0	1	Q8
D.P.1	10	Q7
D.P.2	10^2	Q6
D.P.3	10^3	Q5
D.P.4	10^4	Q4
D.P.5	10^5	Q3

BLANKING. To check the blanking circuitry, set the FUNCTION switch to PERIOD AVG and MULTIPLIER switch to 1. All digits, except the first one, should now be blanked. If another digit is lit, check that line at A8J1 for a High level, which indicates a problem on that line.

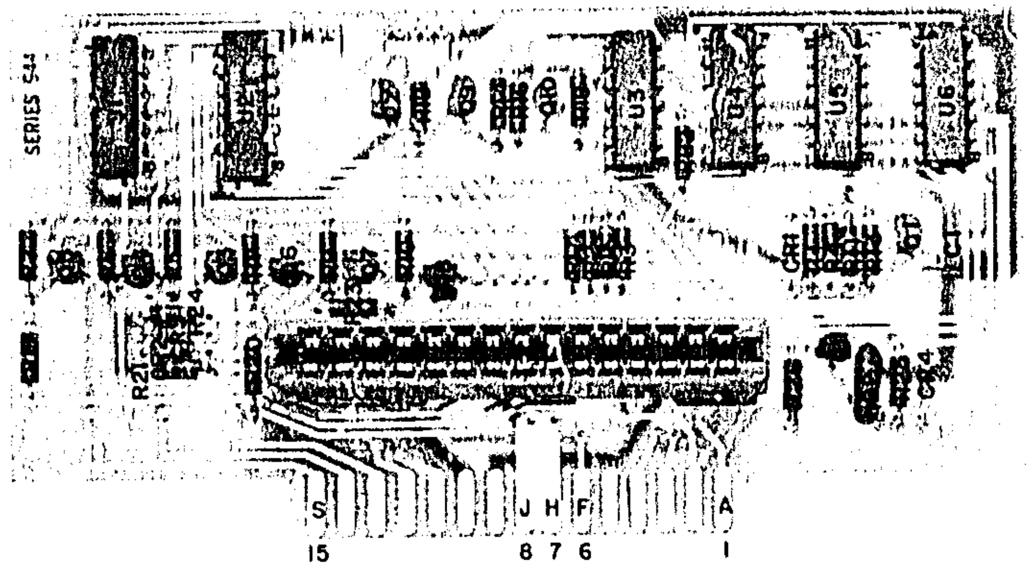
Figure 8-11
A7 FUNCTION CONTROL ASSEMBLY

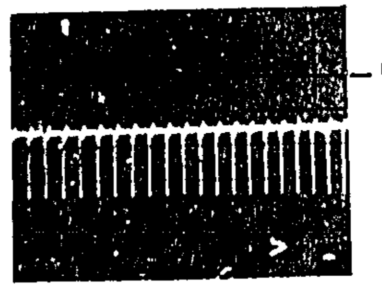
(See Page 8-31)

Part of Figure 8-12. A8 Display Support Assembly

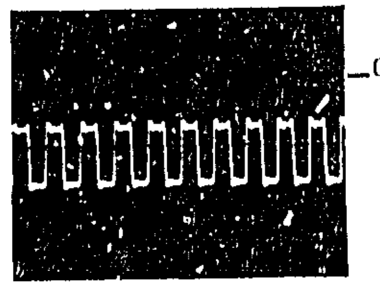


MORE DATA UNDER THIS FOLD

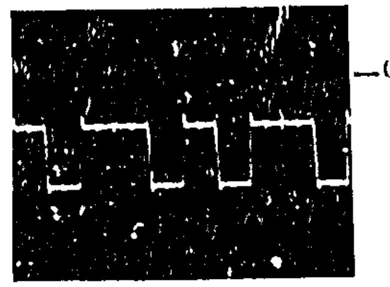




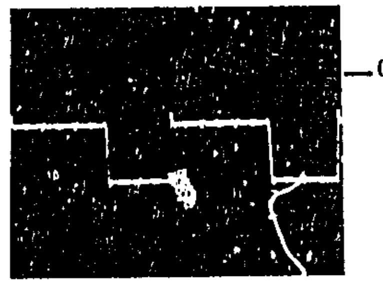
1



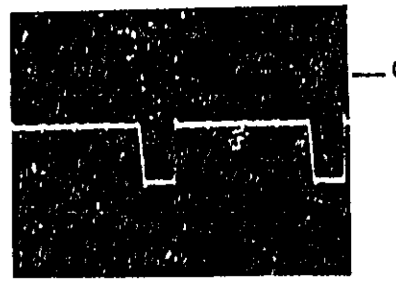
2



3



4



5

All waveforms taken with 10:1 divider probe; ground lead is connected to junction of R15, R3.

COUNTER CONTROLS:
Use settings of A2 Assembly

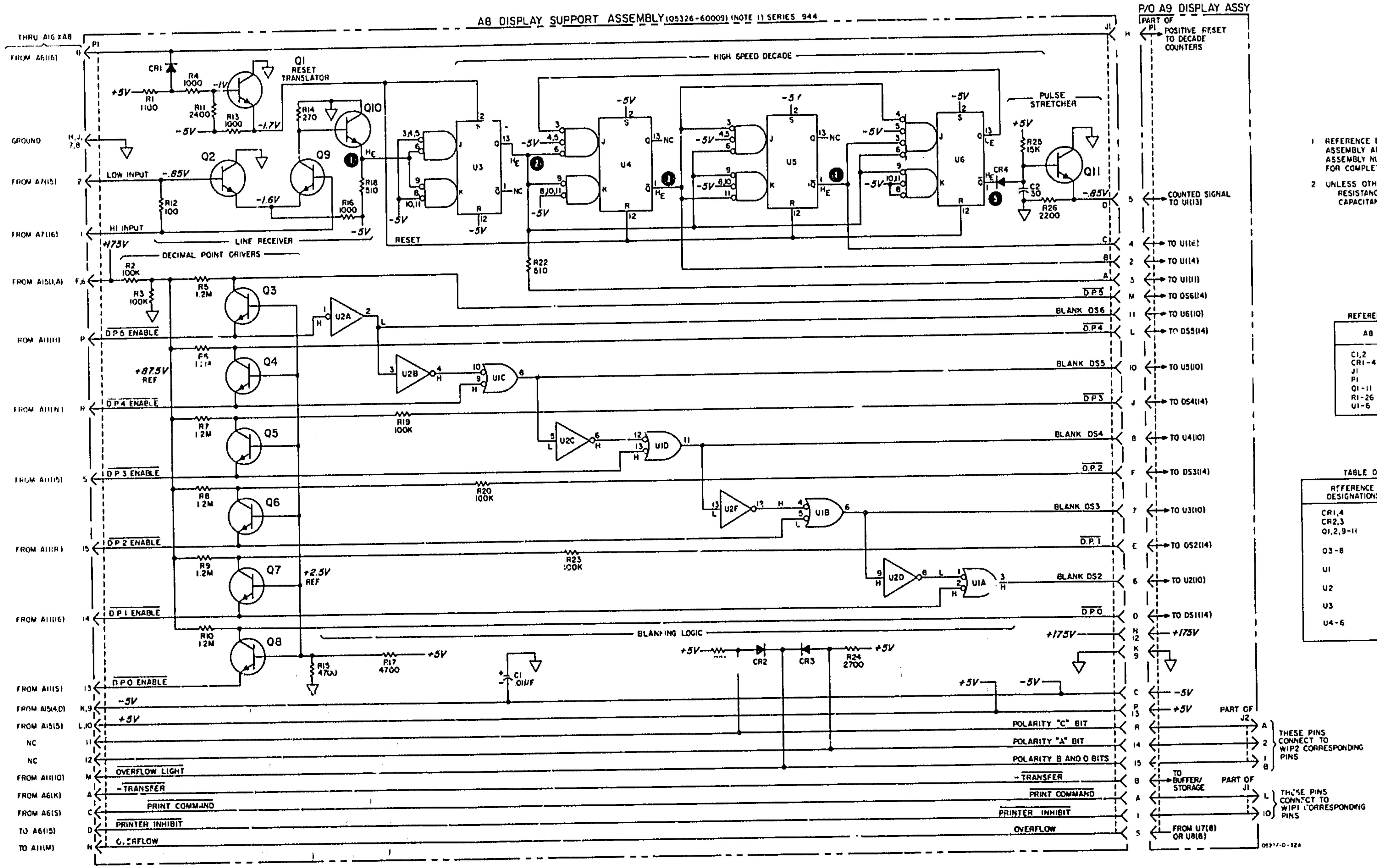
DC VOLTAGES:

Set counter controls as stated. Disconnect input signal. Push RESET.

HE,LE — ECL Levels
H,L — TTL Levels

OSCILLOSCOPE CONTROLS:

VOLTS/CM	.05 V/cm
TIME/CM	.2 μs/cm
SWEEP MODE	AUTO
TRIGGER	INT
SLOPE	+



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS.

REFERENCE DESIGNATIONS

A8	A9
C1,2 CR1-4 J1 P1 Q1-11 R1-26 U1-6	J1,2 P1

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,4	1901-0040
CR2,3	1910-0016
Q1,2,9-11	1854-0092 2N3563
Q3-8	1854-0365 2N4410
U1	1820-0094 MC846P
U2	1820-0307 MC836F
U3	1820-0143 MC1027
U4-6	1820-0102 MC1013P

Figure 8-12. A8 Display Support Assembly

A9 DISPLAY ASSEMBLY OPERATION

Display assembly A9 contains decade counters U2 through U7, buffer storage units U9 through U15. BCD to decimal converters U17 through U23, and display tubes DS1 through DS7.

U1 translates the ECL data from A8 into TTL levels for use by circuits on A9. Each translator of U1 is noninverting. The D output at U1(15) is the counted signal divided by 10 and is used as the input to 10[1] decade U2.

Decade counters U2 through U7 count the number of input pulses while the main gate is open. Each decade provides a -8421 BCD output to the corresponding buffer storage unit. When pin 14 (reset) goes High, the decades reset to zero if pin 10 is High; the decades reset to 15 (blank) if pin 10 is Low. The ECL decade on A8 never blanks. U7 and U8 (Option 001) always blank. The last decade supplies an overflow output at pin 8 when the count exceeds the capacity.

Buffer storage units U9 through U15 receive the BCD outputs of the decades. When the counter operates in the storage-on mode, data is transferred when a low transfer pulse arrives at pin 5 of the buffers. When the transfer line is high, the buffers will store the data to allow a continuous display while a new measurement is being made. During storage-off or totalize mode, BCD data is continuously fed from the buffers to the decoders. The buffers also supply -8421 BCD outputs to A9 J1 and J2 for further distribution to J9 when Option 003 is included.

Decoder drivers U17 through U23 receive the -8421 BCD data and provide a decoded decimal output to light the corresponding numeral on the display tube. The terminal for an illuminated numeral will be approximately +2 volts whereas an extinguished numeral is typically +100 volts. The decimal point terminal (14) of the display tube is +5 volts when lit and about 87.5 volts when extinguished.

A9 TROUBLESHOOTING

The A9 Display Assembly may be set up for troubleshooting with either of two methods. A highly accurate oscillator may be used for a front-panel input signal. Any difference in count from the input signal is then immediately obvious on the display. Check for the proper signal division of the decade counter in previous column. As an alternate method, place the CHK/SEP/COM switch in CHK and the FUNCTION switch in START. Allow the count to totalize until the problem occurs; then, set the FUNCTION switch to STOP. Use the TIME BASE switch to adjust the rate of counting. When the problem appears, check the circuitry of that column.

Start by checking the Buffer-Storage outputs (U9-U15) for the BCD code of the number that should be displayed, rather than what is displayed (see Table 1). Check that the Buffer-Storage code pulls the proper decimal line low on the BCD-to-Decimal Decoder.

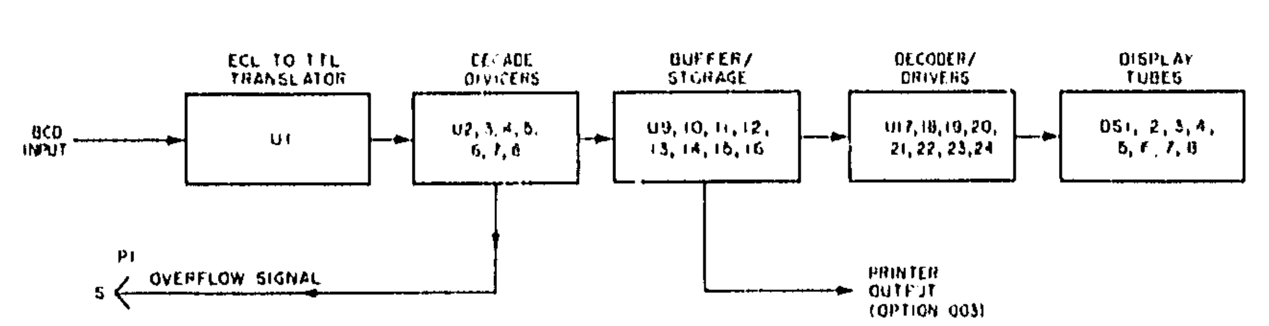
Table 1

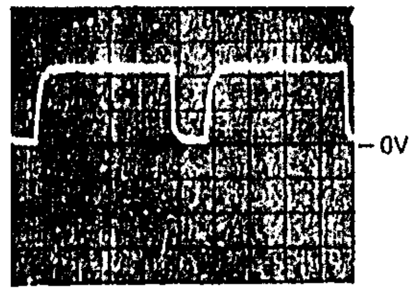
DISPLAYED DIGIT	BUFFER STORAGE BCD (TTL)			
	8	4	2	1
0	H	H	H	H
1	H	H	H	L
2	H	H	L	H
3	H	H	L	L
4	H	L	H	H
5	H	L	H	L
6	H	L	L	H
7	H	L	L	L
8	L	H	H	H
9	L	H	H	L
Blank	L	L	L	L

Figure 8-12
A8 DISPLAY SUPPORT ASSEMBLY

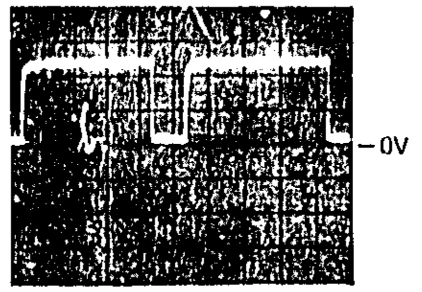
(See Page 8-32)

Part of Figure 8-13. A9 Display Assembly (Option 001)

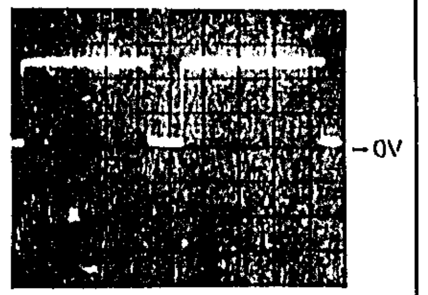




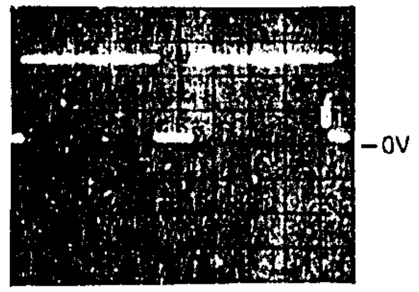
U1(15)
.2 V/cm
.2 μs/cm



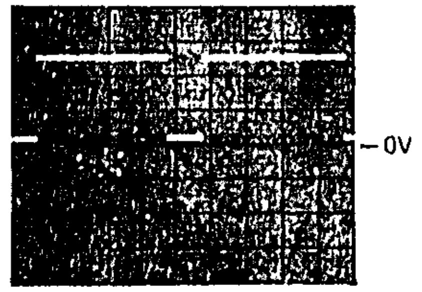
U2(8)
.2 V/cm
2 μs/cm



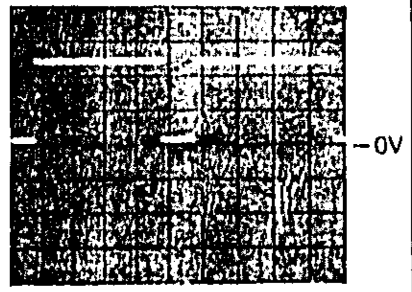
U3(8)
.2 V/cm
20 μs/cm



U4(8)
.2 V/cm
.2 ms/cm



U5(8)
.2 V/cm
2 ms/cm



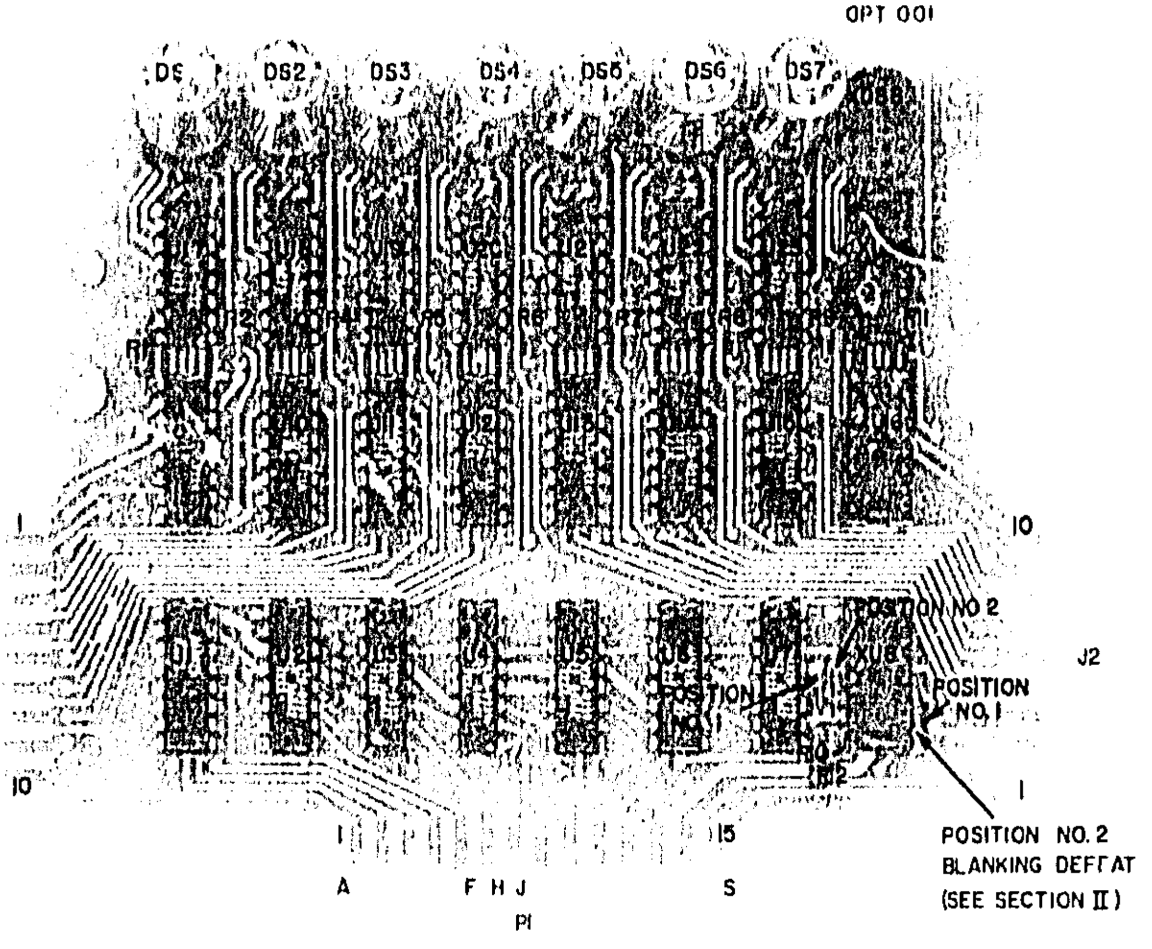
U6(8)
.2 V/cm
20 ms/cm

All waveforms dc coupled through 10:1 probe. Center line of graticule is zero volts. Triggering is internal ac.

COUNTER CONTROLS:

FUNCTION .... START
MULTIPLIER 1
CHK/NORM .... CHK

MORE DATA UNDER THIS FOLD



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS;
3. R10 IS REMOVED FROM BOARD IN OPTION 001.
4. DS8, U8, 16, 24 ARE ADDED FOR OPTION 001.

REFERENCE DESIGNATIONS

NO PREFIX	A8	A9
	CR1, 2	DS1-7
	J1	J1, 2
		P1
		R1-12
		U1-7, 9-15, 17-23
W1P1, P2		

NOT USED:
A9-
U8, U16

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
A8	
CR1	1901-0040
CR2	[illegible]-0016
A9	
U1	1820-0275
	MC1039P
U2-7	1820-0119
U9-15	1820-0116
U18-23	1820-0092
U17	1820-0729

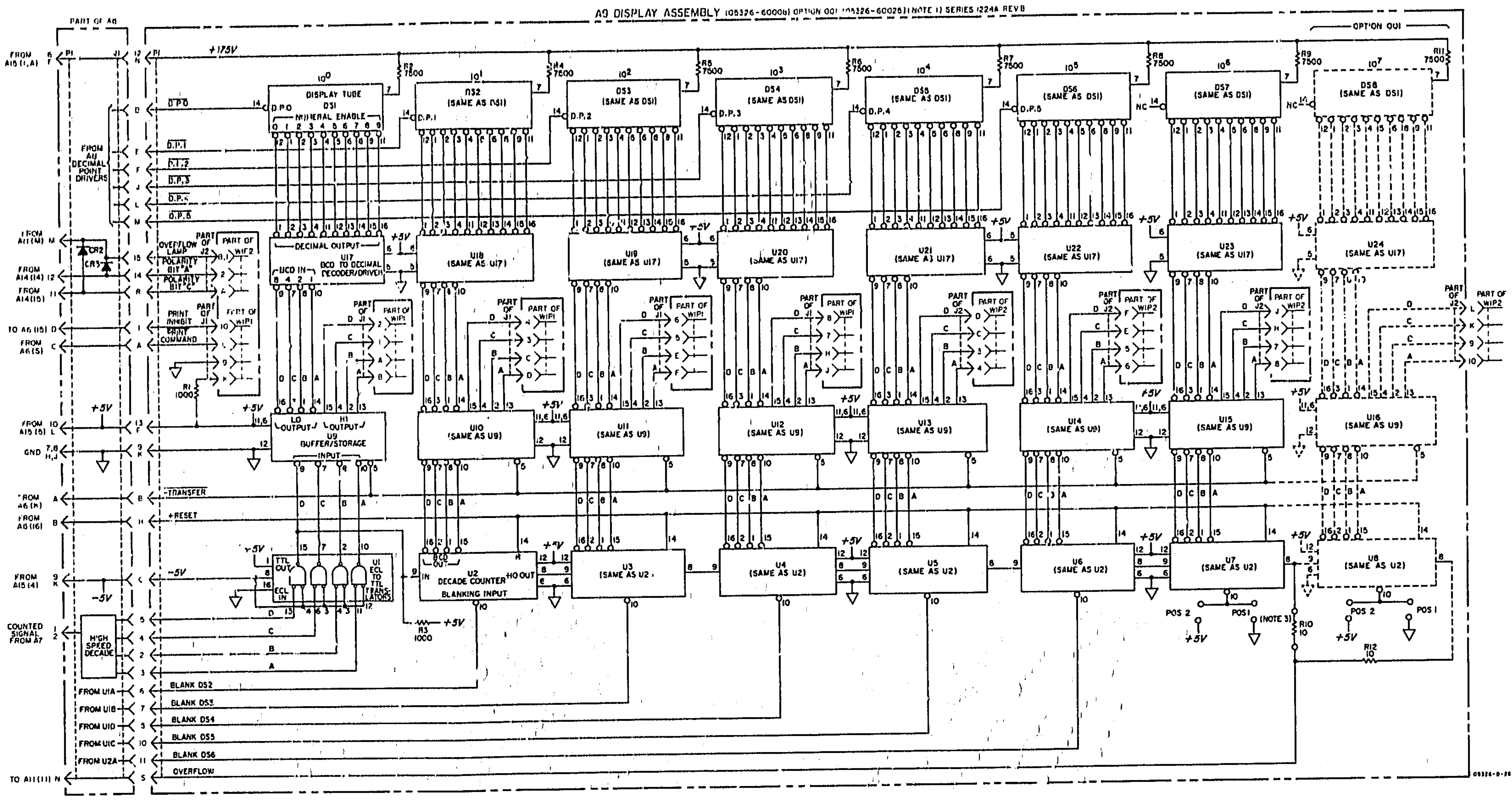


Figure 8-13. A9 Display Assembly for Standard Instrument and Option 001

A10 RIGHT READOUT OPERATION

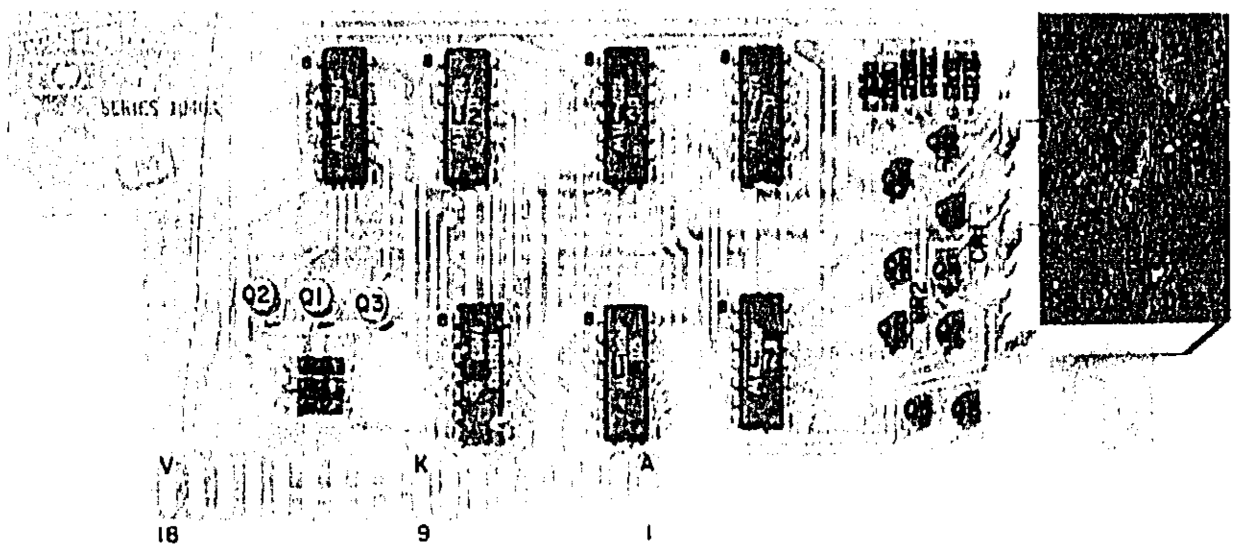
The right readout contains DTL logic to provide the proper measurement units for a given setting of the front-panel controls. A10 logic is negative true, and a low (≤0.8 volts) to the emitter of any driver transistor will light the given neon. When a DTL high is applied on the emitters, the transistor is reverse biased to turn off the neon lamps. The voltage dividers provide a reference of 2 V (nominal) to the bases of the drivers, when no annunciators are on.

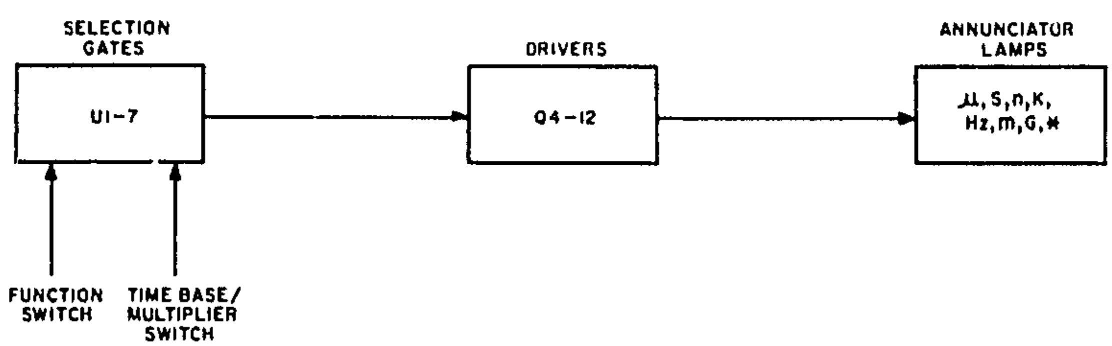
Selecting a function mode and time base pulls a pair of these lines low, activating a gate. This low on the gate output will forward bias the driver transistor to turn on the annunciator lamp. For example, selection of frequency and 1 ms makes the output of U4D(11) low, turning on Q9 to light DS5. Q10 also turns on, lighting DS6.

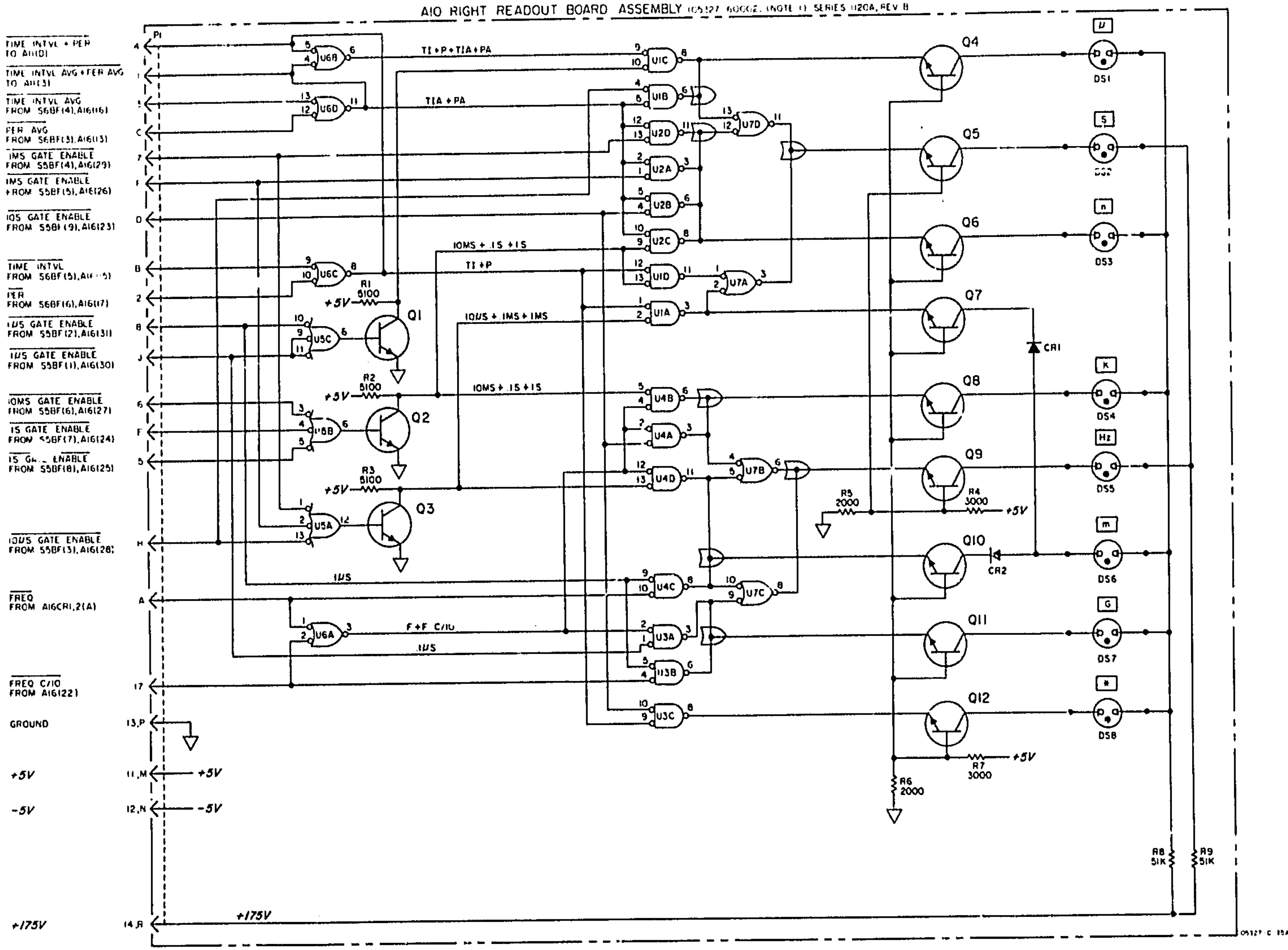
The asterisk (*) annunciator (DS8) is activated when the counter is in the time interval or period mode and the time base is 10s. An asterisk indicates the proper units are not displayed.

A10 TROUBLESHOOTING

Select the specific function mode and time base combination that is faulty. Check the gate that is common to the two lines. For instance, when using frequency and a 1 ms gate time, check U4D; when using .1 μs, U3A becomes the common gate. Refer to Table 5-5 for the proper annunciator lighting conditions


Q2
Q1
Q3
V
K
A
18
9
1


SELECTION GATES
U1-7
DRIVERS
Q4-12
ANNUNCIATOR LAMPS
μ, S, n, K,
Hz, m, G, *
FUNCTION SWITCH
TIME BASE/ MULTIPLIER SWITCH



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION
2. UNLESS OTHERWISE INDICATED RESISTANCE IN OHMS.

REFERENCE DESIGNATIONS

A10
CR1,2 DS1-8 P1 Q1-12 R1-9 U1-7

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,2	1901-0040
Q1-3	1854-0009 2N709
Q4-12	1854-0474 2N5551
U1-4	1820-0274 MC1808
U5	1820-0310 MC662
U6,7	1820-0273

Figure 8-14. A10 Right Readout Assembly

A11 LEFT READOUT OPERATION

The left readout contains DTL logic to select the proper decimal point corresponding to the TIME BASE SETTING. It also contains the switch common drivers for the time base, function, and amplifier common lines (for remote programming), a storage circuit and lamp for the overflow signal, the gate light, and the EXT light.

The overflow signal from the ÷ 10 output of A9U7 (U8, Option 001) enters through pin M and is differentiated by C2 and R1. Q1 turns on momentarily to set flip-flop U1A&D. During the transfer pulse, the information at U1A&D is transferred to the overflow storage flip-flop U1B&C. The overflow condition drives U1C(8) low to turn Q2 on and light overflow lamp DS1. The next reset pulse clears flip-flop U1A&D; however, U1B&C are not reset until the transfer pulse arrives. With storage off, transfer is on continuously.

A low at pin L turns on Q3 to light the count lamp, DS2. Similarly, a low at pin A lights the EXT lamp and opens the common lines for the TIME BASE, FUNCTION, and SLOPE switches. This disables these controls to allow remote programming of the unit.

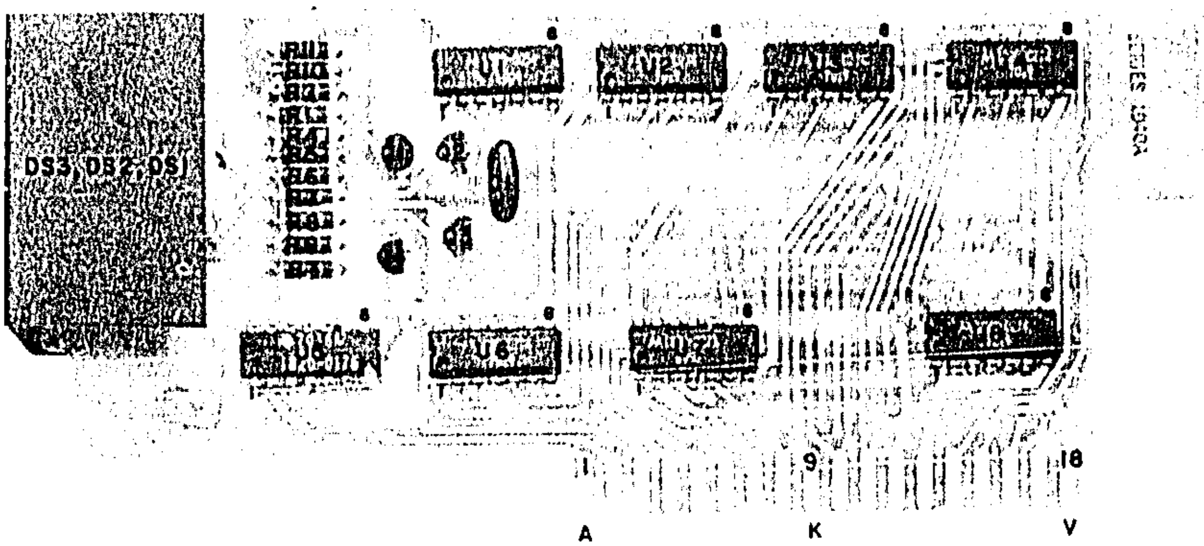
Decimal selection and resultant blanking are accomplished by the negative logic AND gates. For any pair of low inputs, a specific decimal point line is held low, lighting the decimal point. There are a number of combinations for each decimal; therefore, the output of each AND gate is paralleled to give a wired OR configuration (any output low = all low).

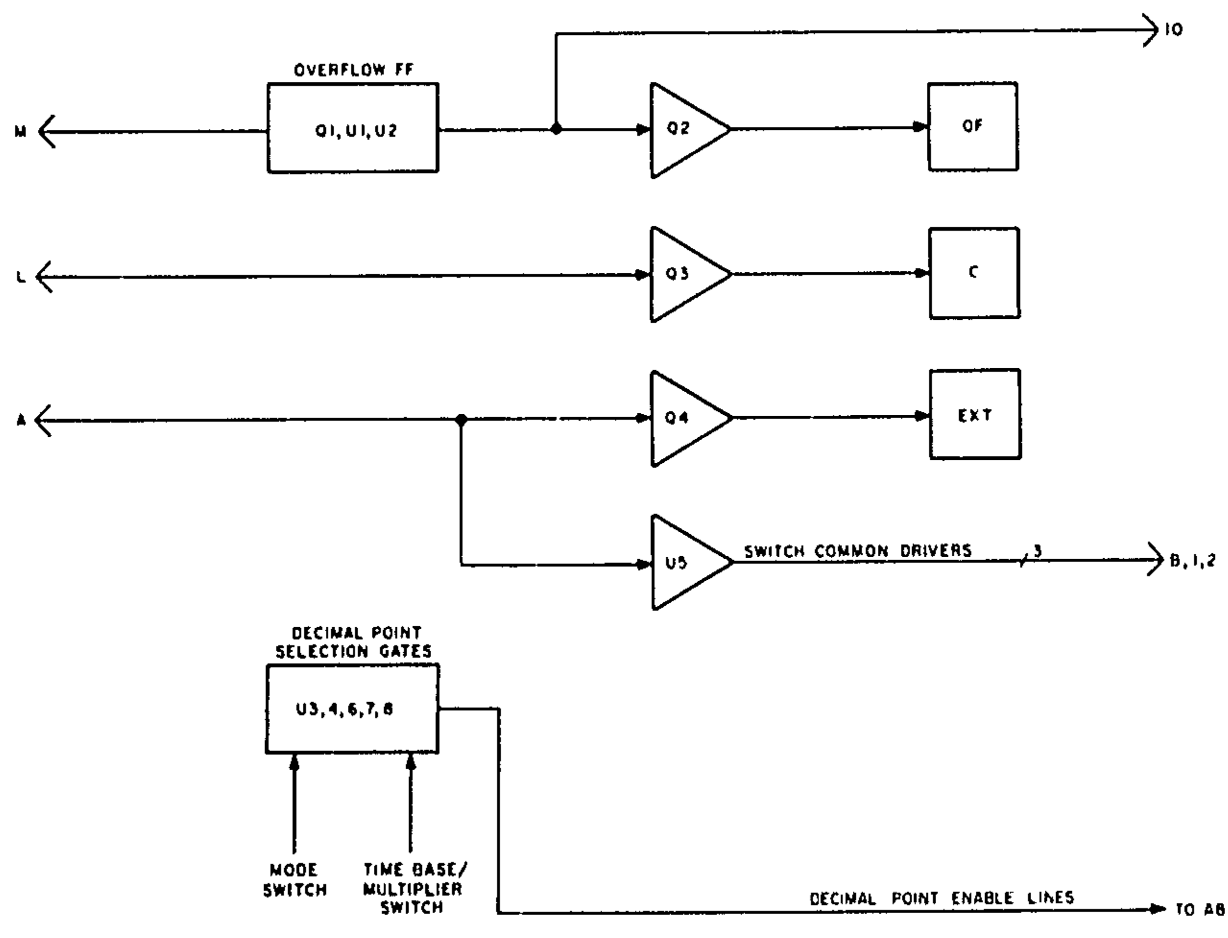
A11 TROUBLESHOOTING

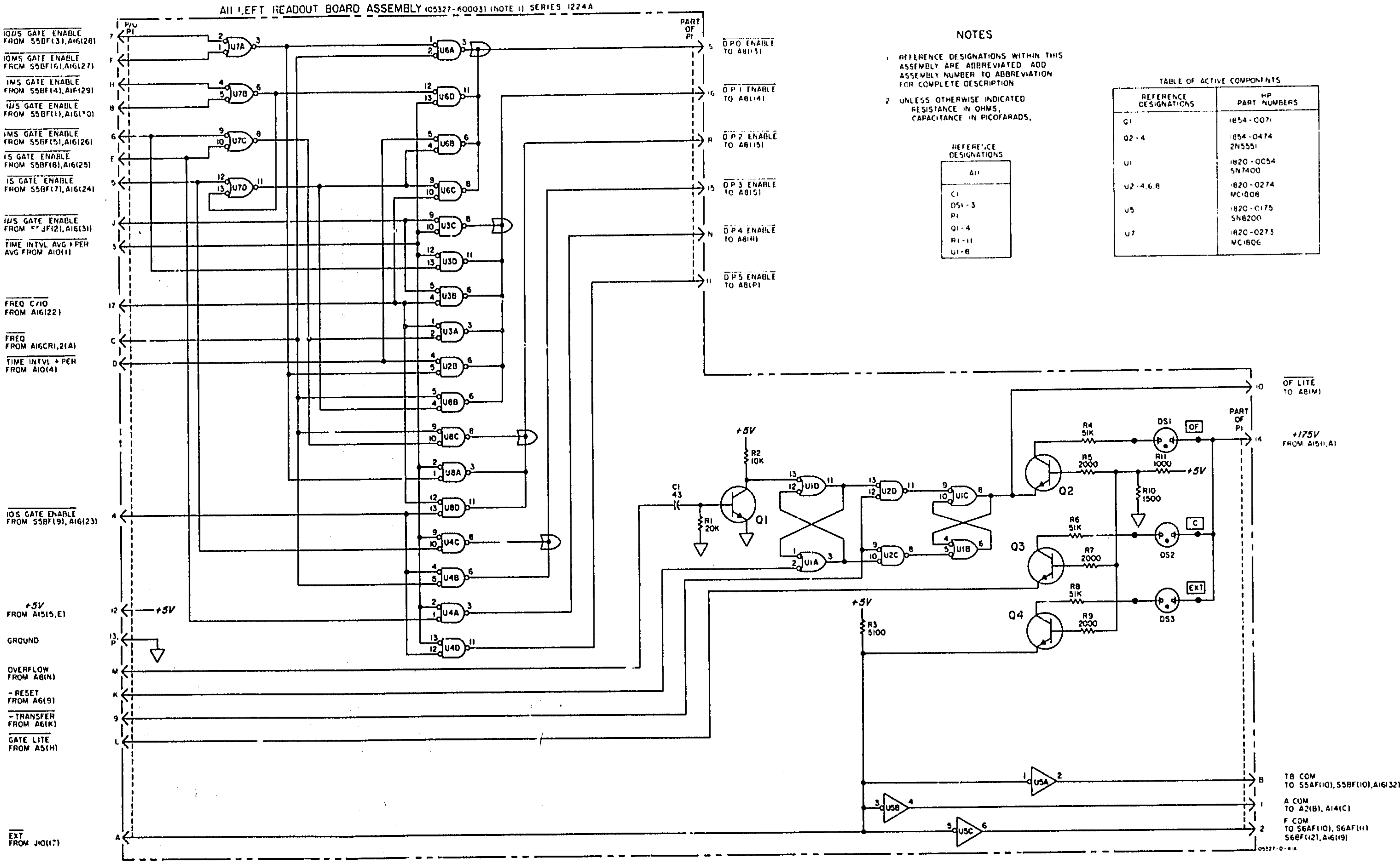
Select the specific function mode and time base combination that is faulty. Check the gate that is common to the two lines. Refer to Table 5-5 for the proper annunciator lighting conditions.

To check the overflow circuits, set the FUNCTION switch to START and select a fast gate time. When the most significant digit on the counter's display changes from 9 to 0, both flip-flops in the overflow circuit should set. As an initial test, check U2 for a High on pin 13. The second flip-flop (U1B and U1C) should have a Low on pin 8 and a High on pin 6.

In any mode other than START, the -TRANSFER line pulses Low, rather than being held Low. If the OF light does not turn off at the end of the display time, check that the -RESET pulse clears flip-flop U1A&D.


DS3, DS2, DS1
9
18
A
K
V


OVERFLOW FF
Q1, U1, U2
M
10
Q2
OF
L
Q3
C
A
Q4
EXT
U5
SWITCH COMMON DRIVERS
3
B, 1, 2
DECIMAL POINT
SELECTION GATES
U3, 4, 6, 7, 8
MODE
SWITCH
TIME BASE/
MULTIPLIER
SWITCH
DECIMAL POINT ENABLE LINES
TO A8



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION
2. UNLESS OTHERWISE INDICATED RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS.

REFERENCE DESIGNATIONS

A11
C1
DS1 - 3
P1
Q1 - 4
R1 - 11
U1 - 8

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
Q1	1854-0071
Q2 - 4	1854-0474 2N5551
U1	1820-0054 SN7400
U2 - 4,6,8	1820-0274 MC1808
U5	1820-0175 SN8200
U7	1820-0273 MC1806

Figure 8-15. A11 Left Readout Assembly

A15-A16 POWER SUPPLY OPERATION

The power supply provides +175, +16.5 V and +5 V. Transformer T1 has a 115/220 primary and secondaries with open circuit voltages of 181 V at the red leads, 21 V at the orange, and 18.6 V between the green leads, with the winding center tapped to ground.

A15 CR6-9 comprise a full-wave bridge whose output is fed to filter C3 and bleeder R3. Q5 is a series pass regulator. A constant reference voltage is developed across CR11 and CR12 through resistor R1. When the output voltage at XA15(1, A) decreases, Q5 increases conduction to increase the output voltage. Q8 is a current limiter that senses the voltage drop across R6. Output current above approximately 60 mA turns on Q8 and shunts base current from Q5, tending to turn Q5 off and limit the current. C1 adds oscillation stability to the regulator.

For the +16.5 V supplies, the orange leads of T1 connect to half wave rectifier CR4 and filter C4. Q1 is a series pass regulator and Q9 performs the same function as CR11&CR12 in the 175 V supply except that R10 provides a means to adjust the output. Assume that a Q1 base current is flowing through R2 and Q6. The resulting Q1 collector current establishes a voltage at the output, which is divided across R9, R10, and R1 . If the voltage at the wiper of R10 is greater than that across CR9, Q9 will be turned on, shunting base current from Q1. This will tend to turn off Q1 and lower the regulated voltage. Thus, varying R10 establishes the largest output voltage that can exist before Q9 turns on to cut back Q1. Resistors R17, R18, and diodes CR15-18 provide current limit action at 180 mA similar to the +175 V supply.

Q6 is a prere . that gives the circuit better line regulation and lower r than the Zener diodes of the 175 V supply. With CR1 as a reference, Q6 is a constant current circuit that maintains a Q1 base current independent of variations of the input (line voltage changes and ripple). R4 is needed to establish the current through CR1. The -16.5 V supply is complementary. The 5 V supplies are also complementary and only the + will be discussed.

The output from the T1 green leads is fed through full wave rectifier CR10 and CR11 into filter C1. It then passes through overload current limiter R1 and into the series pass regulator Q1, to the 5 V output at Q1C. Q3 is a driver for Q1 and has approximately 5.75 V on its base, developed across CR6 and CR5 by the current from the 16.5 V supply through R7. If the voltage at the emitter 5.1 V, Q3 is turned on providing base current to turn on Q1, raising the output voltage. Q3 turns off when its emitter gets above 5.1 V. C2 is the output filter to maintain a low output impedance at high frequencies.

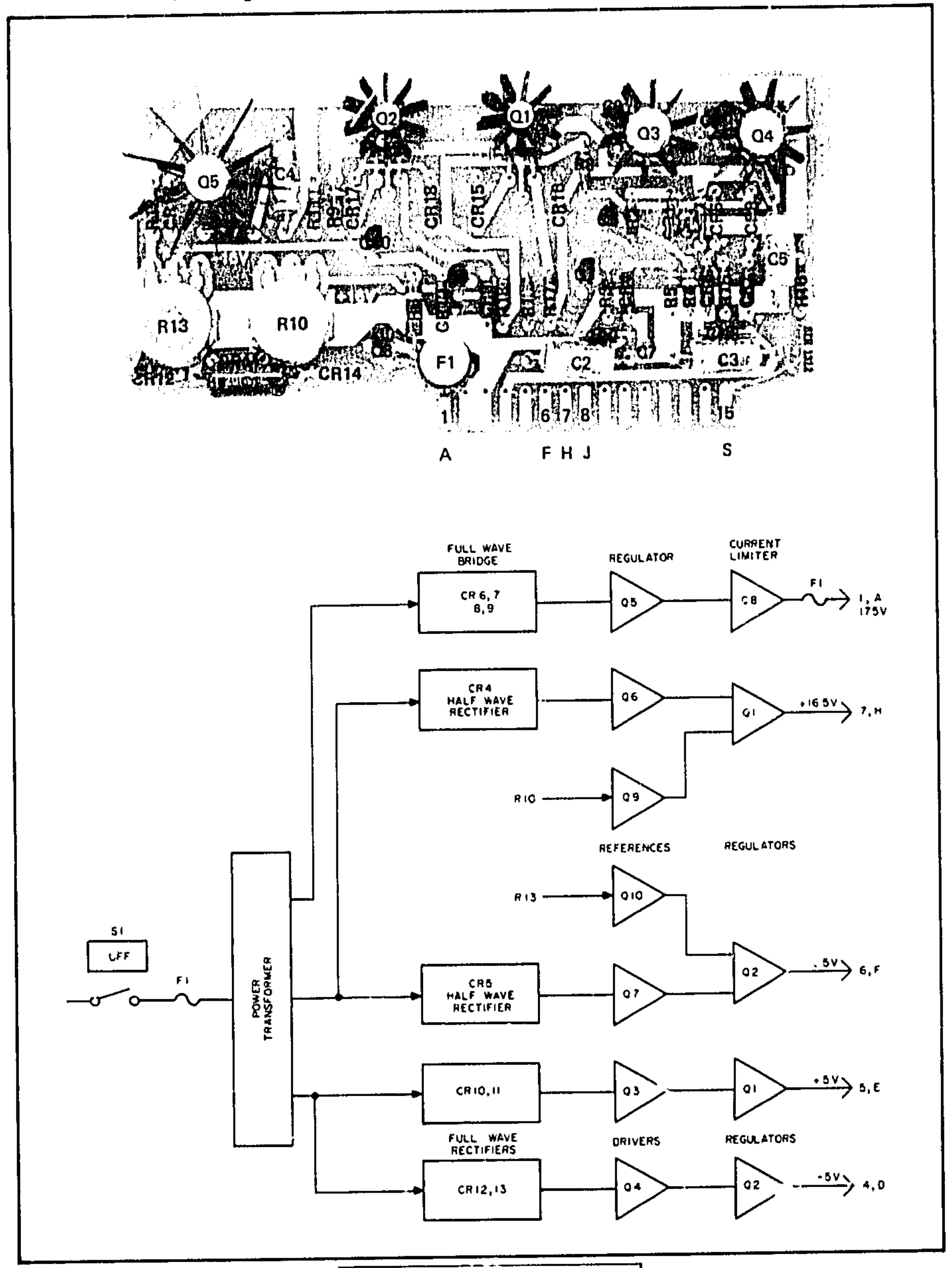
CR2 clamps the output at 6 V to provide protection for the IC's in case the 16.5 V or 175 V line should momentarily short to the 5 V line. CR5 provides thermal compensation for Q3.

Note that the 16.5 V supply is needed for operation of the 5 V supply. If the + or - 16.5 V supply fails, the corresponding 5 V supply will be inoperative.

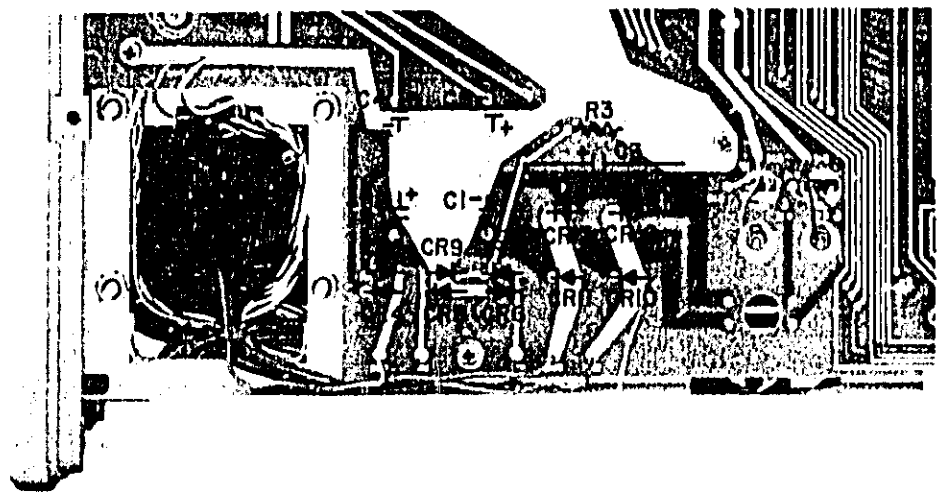
Figure 8-15
A11 LEFT READOUT ASSEMBLY

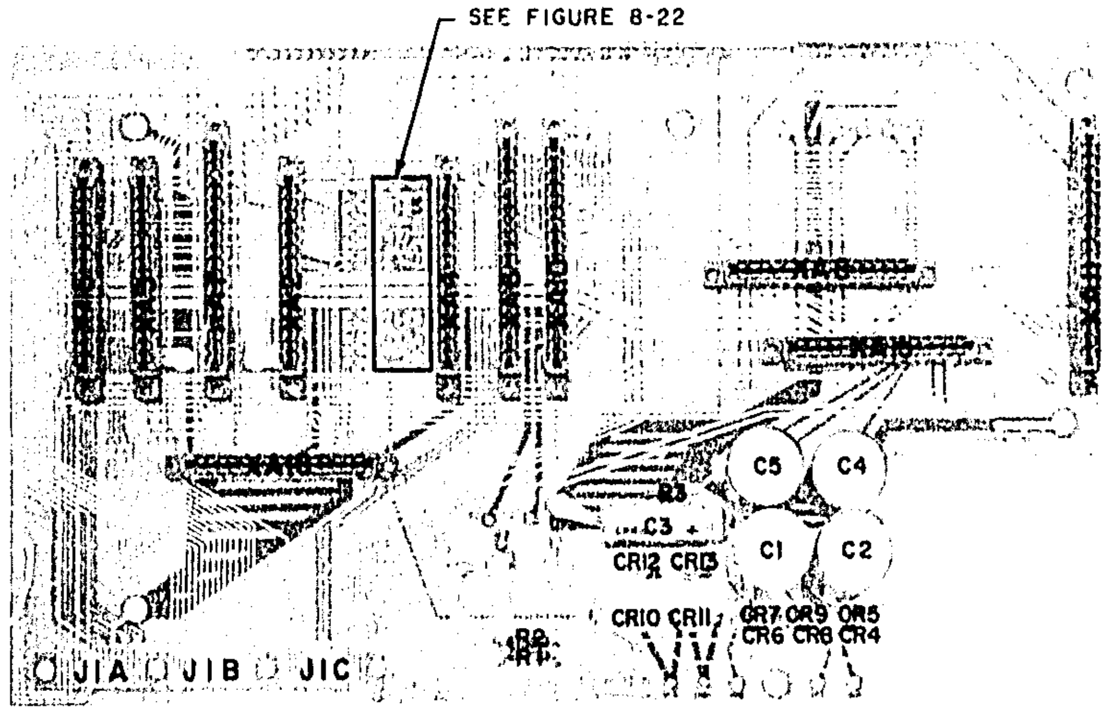
(See Page 8-39)

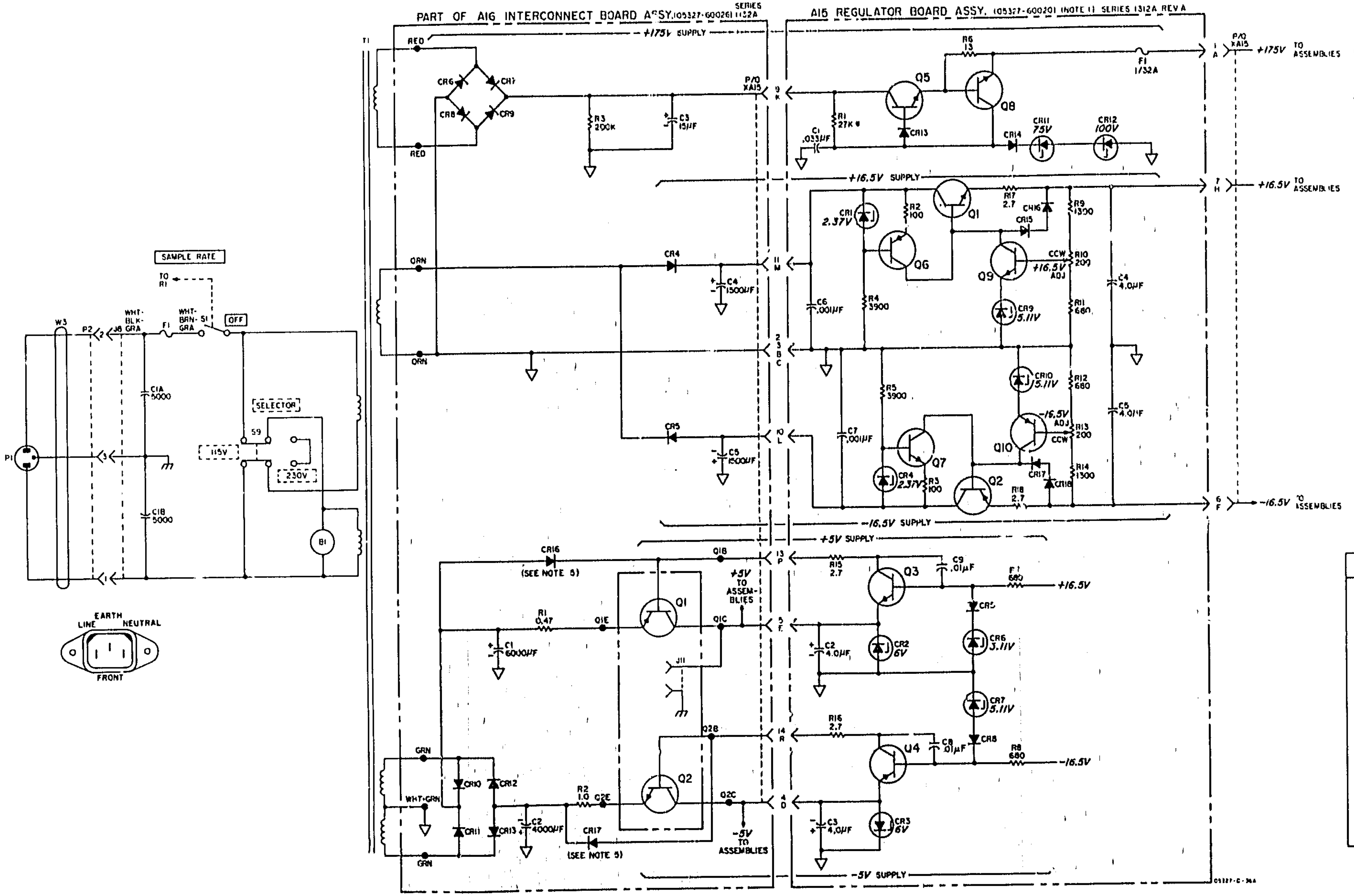
Part of Figure 8-16. A15, A16 Regulator Board, Interconnect Board Assembly



MORE DATA UNDER THIS FOLD







NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS.
3. A15 Q1-5 HAVE HEAT SINK
4. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
5. CR16 AND CR17 ARE 3-JUNCTION SILICON DIODES.

REFERENCE DESIGNATIONS

NO PREFIX	A15	A16
B1		
C1	C1-7	C1-5
	CR1-18	CR4-13, 16,17
F1		
J8, J11		
P2		
Q1, 2	Q1-10	
	R1-18	R1-3
S1, 9		
T1		
W3		

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
NO PREFIX	
Q1	1853-0233
Q2	1854-0420
A15	
CR1,4	1902-3002
CR2,3	1902-0551
CR5,8,15-18	1901-0040
CR6,7,9,10	1902-3094
CR11	1902-3394
CR12	1902-3429
CR13,14	1901-0033
Q1	1854-0300
Q2	1853-0073
Q3	1854-0039
	2N3053
Q4	1853-0012
	2N2904A
Q5	1854-0232
Q6,10	1853-0020
Q7,9	1854-0071
Q8	1854-0474
A16	
CR4,5	1901-0028
CR6-9	1901-0029
CR10-13	1901-0415
CR16,17	1901-0460

Figure 8-16. A15, A16 Regulator Board, Interconnect Board Assembly

A17 INPUT C AMPLIFIER OPERATION

The input amplifier performs two functions: it provides a channel for increased sensitivity and it produces narrow pulses for efficient usage by other counter circuits. The amplifier is not controlled by any front-panel switches.

The input signal is dc coupled into a 50 ohm input impedance (R1) and is fed into the input amplifier, which is protected by R2, CR1, and CR2. Current source U1Q5 feeds the balanced differential amplifier U1Q3, Q4. The twin outputs are loaded by R10 and peaking coil L2. The signal flows to another amplifier circuit, whose outputs control the triggering of the tunnel diode, CR3. The diode is biased for maximum sensitivity with R11. When the diode fires, it produces fast rise and fall times on the input signal.

High-impedance emitter followers (Q1, Q2) ac couple the signal to the single-ended differential amplifier of Q3 and Q4. The short time constants of C9, R18, and C12, R23 differentiate the signal into narrow spikes of about 15 ns. The output circuit of C11, R22, and L4 approaches resonance at high frequencies for improved gain.

The signal is then fed to the one-shot multivibrator U2. The one-shot output goes High (U2, pin 4) when the input goes low. The output goes Low again after about 12 ns, when the level changes have propagated through the gates in a domino effect.

SENSITIVITY ADJUSTMENT

a. Set counter controls as follows:

FUNCTION .... FREQ C

TIME BASE .... 0.1 S

b. Set HP 606B HF Signal Generator (or equivalent) for 50 MHz at 500 mV rms. Measure the output signal of 606B with an HP 411A RF Millivoltmeter, using a 50Ω termination. Connect signal source to INPUT C of counter.

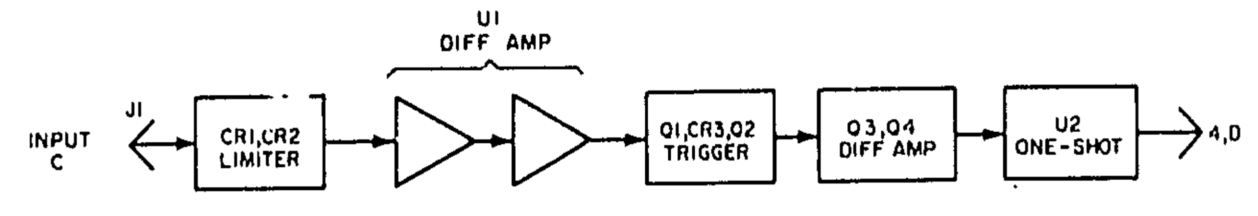
c. Reduce output level until counter's display becomes unstable. Adjust R11 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase the signal level until display just becomes stable.

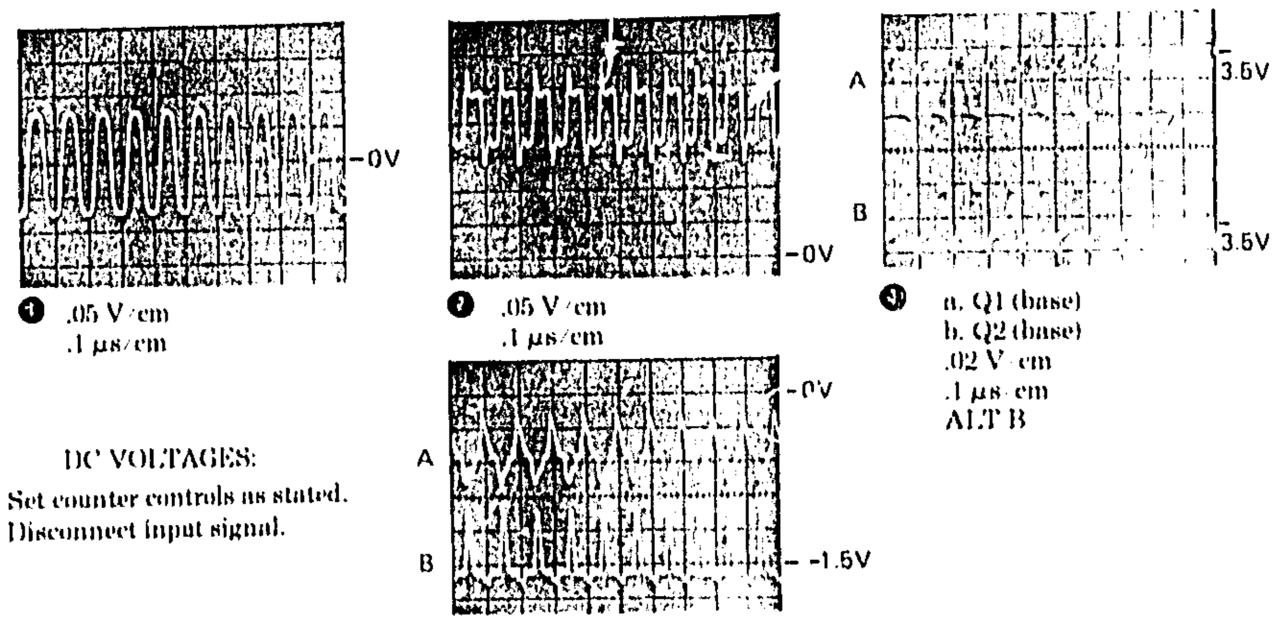
d. Disconnect input and connect to voltmeter, reading should be less than 5 mV. Check other frequencies within the band.

Figure 8-16
A15, A16 REGULATOR BOARD, INTERCONNECT BOARD ASSEMBLY

(See Page 8-41)

Part of Figure 8-17. A17 Component Locator





1 .05 V/cm
.1 μs/cm

2 .05 V/cm
.1 μs/cm

3 a. Q1 (base)
b. Q2 (base)
.02 V/cm
.1 μs/cm
ALT B

4 a. Q4 b. U2(4)
.05 V/cm
.1 μs/cm
ALT B

DC VOLTAGES:

Set counter controls as stated.
Disconnect input signal.

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C6. A17 is mounted on extender board.

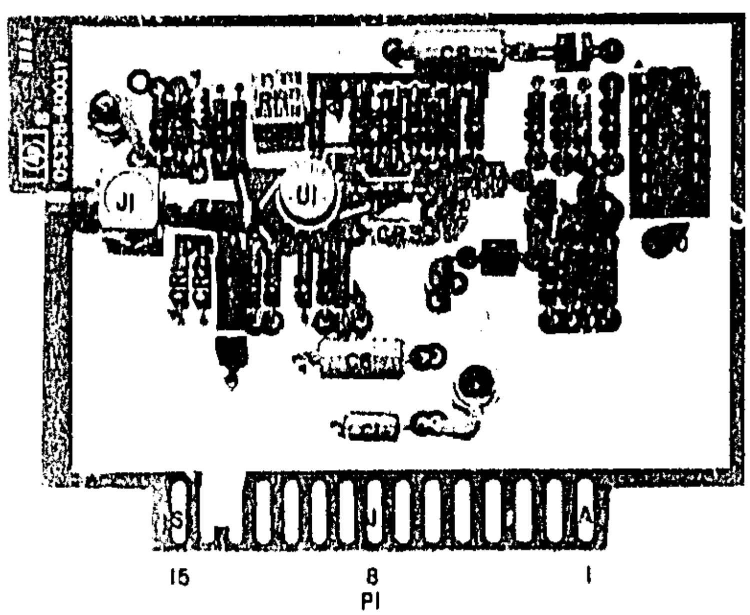
COUNTER CONTROLS:

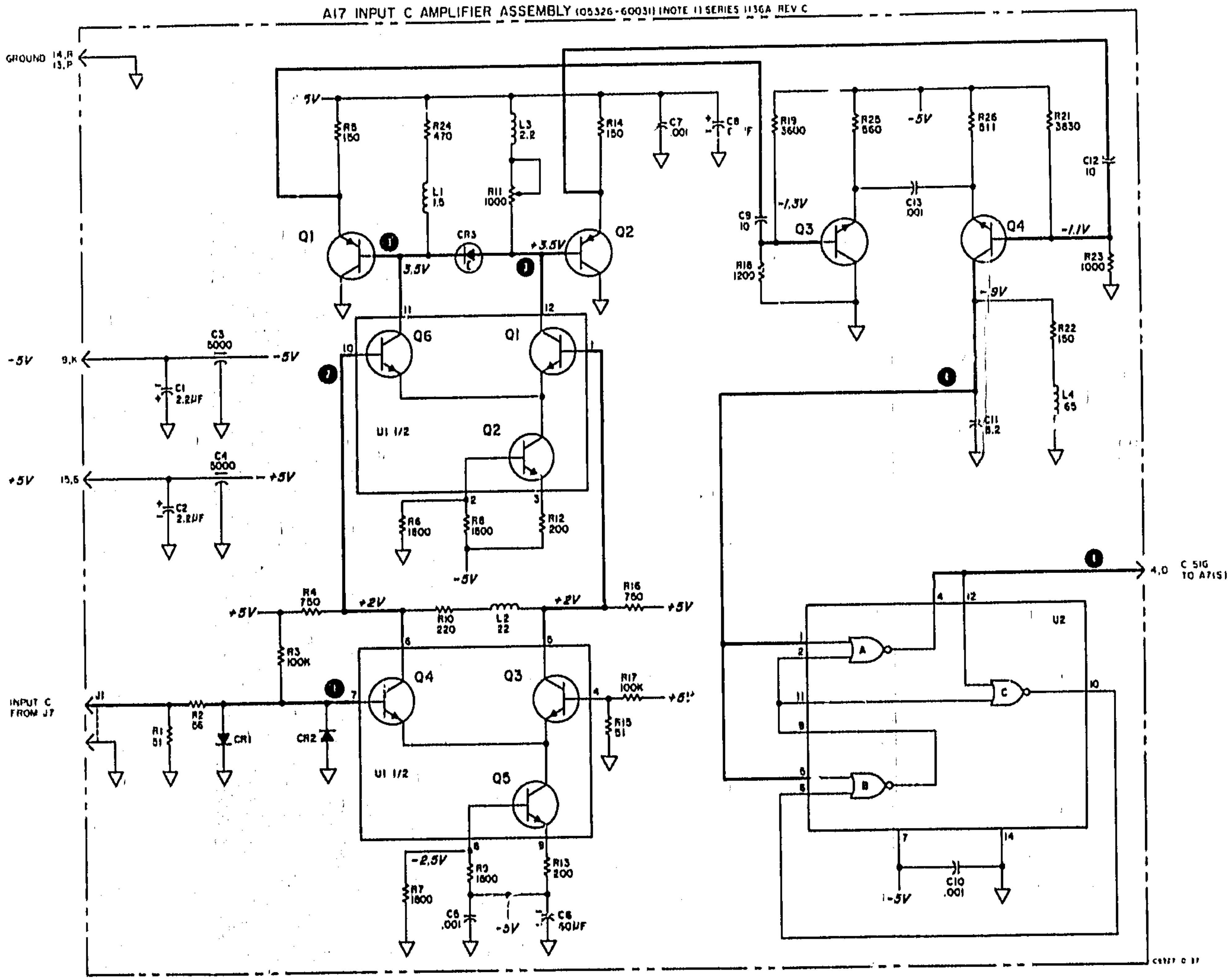
INPUT C jack .... connect 10 MHz sine wave at 1 V rms
FUNCTION .... FREQ C
TIME BASE .... 1 ms
CHK/SEP/COM .... SEP

OSCILLOSCOPE CONTROLS:

SWEEP MODE .... AUTO
TRIGGER .... INT
SLOPE .... +

MORE DATA UNDER THIS FOLD


J1
U1
15
8
1
P1



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCPIPTION
2. UNLESS OTHERWISE INDICATED. RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS, INDUCTANCE IN MICROHENRIES

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,2	1901-0047
CR3	1912-0009
Q1,2	1853-001[illegible]
Q3	1854-0[illegible]92
Q4	1854-[illegible]345
U1	1858-0004
U2	18[illegible]-0346

REFERENCE DESIGNATIONS
A1
C1-13
CR1-3
L1-4
Q1-4
R1-19, 21-26
U1,2

Figure 8-17. A17 Input C Amplifier Assembly (5326A Only)

A18 PRESCALER OPERATION

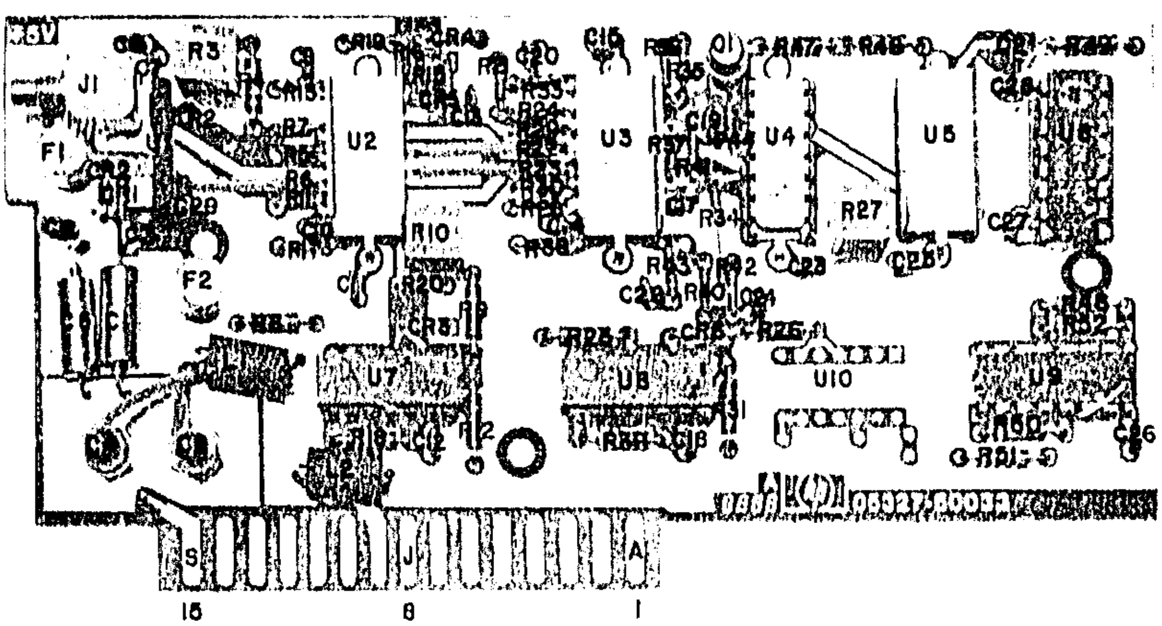
The prescaler board serves a direct amplifier-trigger or as a divide-by-ten amplifier-trigger, with the function controlled by the front-panel input selector switch. With the switch in the PRESCALE position, the circuit performs as follows:

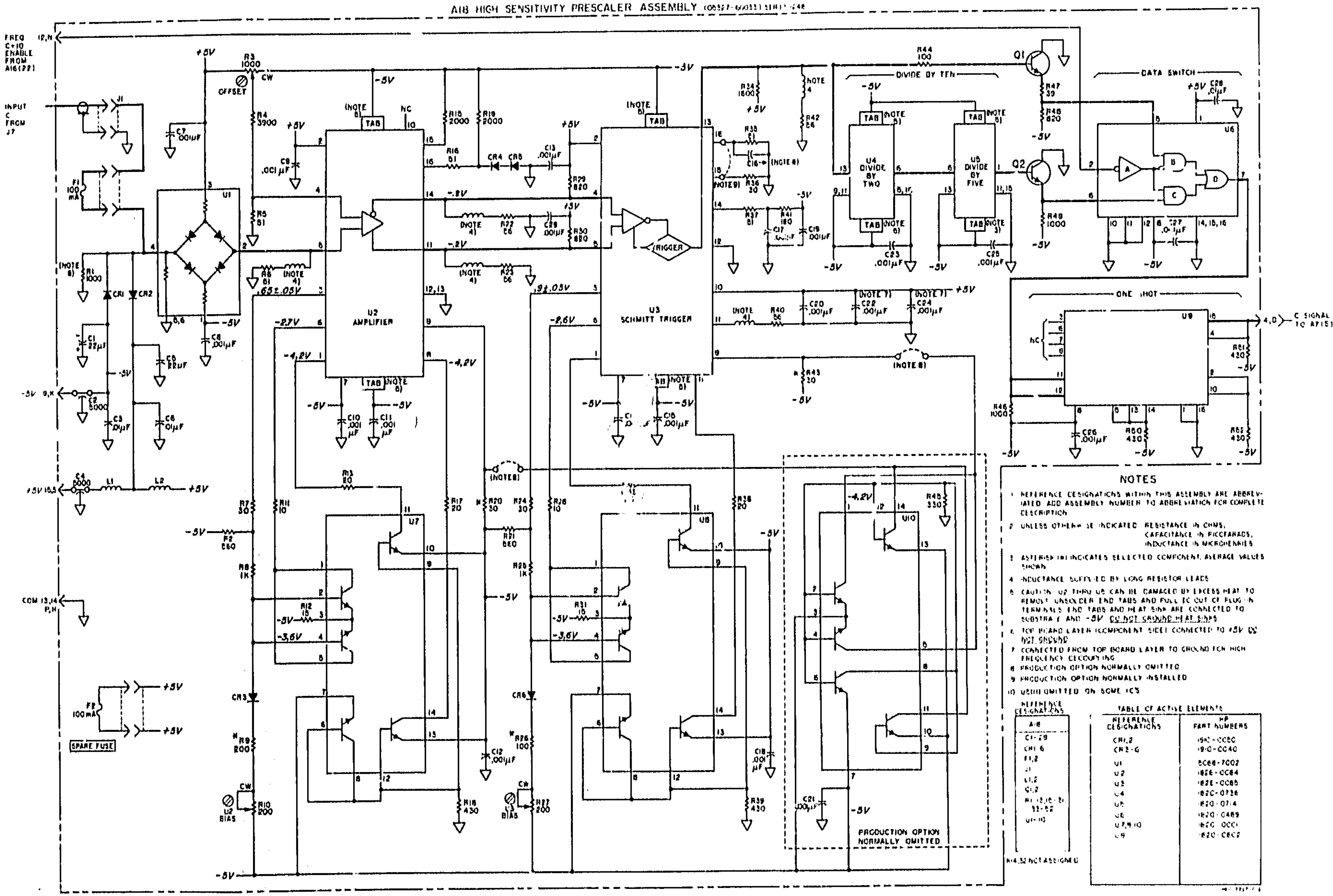
The signal is fed into the 50Ω input of J1. CR1, CR2, and U1 provide protection above 3.5 V rms or 5 V peak. There is about 2 dB loss through U1. The signal is passed to U2 amplifier, which is biased for sensitivity by R3. U3 amplifies the differential input and shapes the signal into a square wave. U4 and U5 combine to divide the signal by ten and Q2 translates the signal from EECL to ECL levels before presenting it to the data switch.

The direct signal, also from U3(13), bypasses the divider network and is sent to the data switch through the level translator Q1. The setting of the INPUT C switch determines whether the data switch will accept the direct or prescaled signal. Pin 2 of U6 is High for direct and Low for prescaled. U9 shapes the positive, square-shpaed pules into narrow spikes before sending the signal to A7 Function board. U7, U8, and U10 (a production option) are constant-current sources for the amplifier circuits.

A18 TROUBLESHOOTING

Before troubleshooting the circuits, check the input protection fuse. If problem is in direct mode only, check Q1 and U6. If problem is in prescale mode only, check U4, U5, U6, and Q2. If aproblem is found in the amplifiers (U2 and U3), remove the input signal and check the dc voltages supplied by the constant-current sources U7 and U8.


J1
F1
R3
U2
U3
U4
U5
R27
F2
R10
U7
U8
U10
U9
S
J
A
15
8
1



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES.
3. ASTERISK (*) INDICATES SELECTED COMPONENT. AVERAGE VALUES SHOWN.
4. INDUCTANCE SUPPLIED BY LONG RESISTOR LEADS.
5. CAUTION: U2 THRU U5 CAN BE DAMAGED BY EXCESS HEAT. TO REMOVE, UNSOLDER END TABS AND PULL IC OUT OF PLUG-IN TERMINALS. END TABS AND HEAT SINK ARE CONNECTED TO SUBSTRATE AND -5V. DO NOT GROUND HEAT SINKS.
6. TOP BOARD LAYER (COMPONENT SIDE) CONNECTED TO +5V. DO NOT GROUND.
7. CONNECTED FROM TOP BOARD LAYER TO GROUND FOR HIGH FREQUENCY DECOUPLING.
8. PRODUCTION OPTION NORMALLY OMITTED.
9. PRODUCTION OPTION NORMALLY INSTALLED.
10. U8(11) OMITTED ON SOME IC'S.

REFERENCE DESIGNATIONS

A18
C1-29
CR1-6
F1,2
J1
L1,2
Q1,2
R1-12,16-31, 33-52
U1-10

R14,32 NOT ASSIGNED

TABLE OF ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,2	1901-0050
CR3-6	1910-0040
U1	5088-7002
U2	1856-0084
U3	1826-0085
U4	1820-0736
U5	1820-0714
U6	1820-0489
U7,9,10	1850-0001
U9	1820-0802

Figure 8-18. A18 Prescaler Board Assembly (5327A Only)

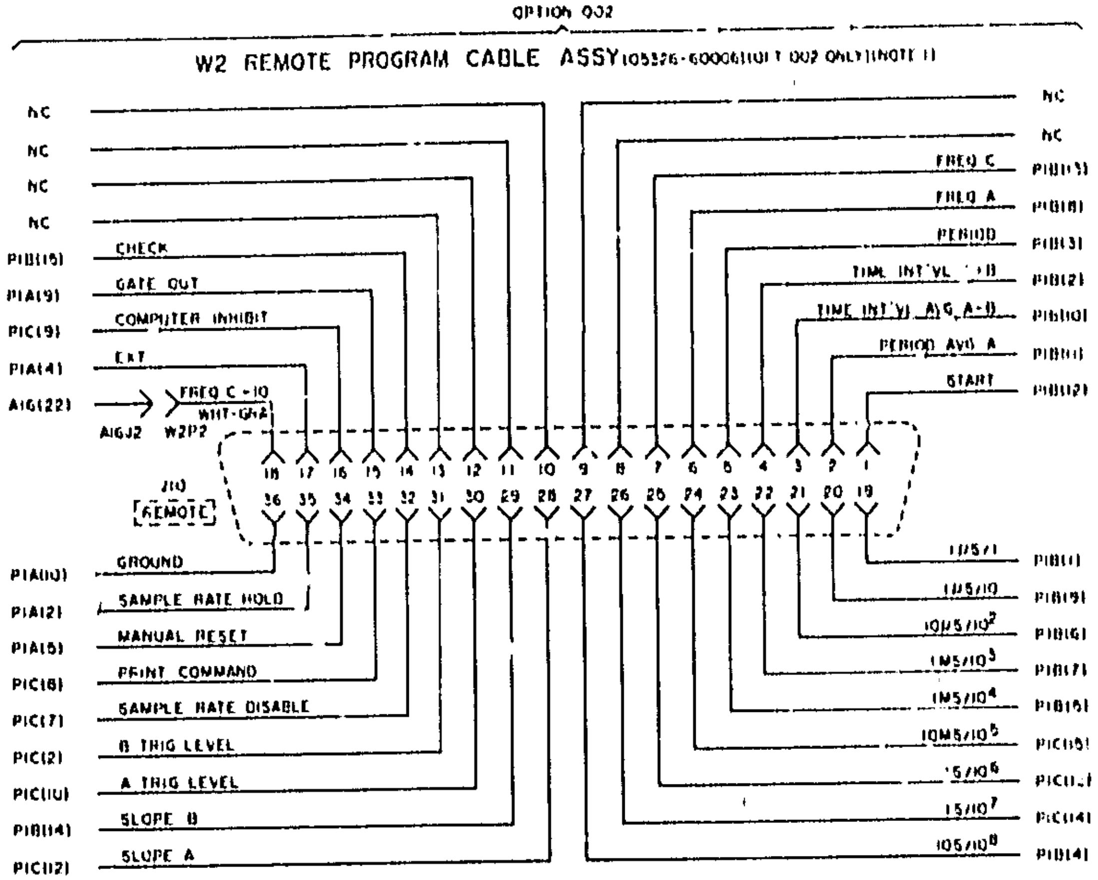
OPTION 002 REMOTE PROGRAMMING

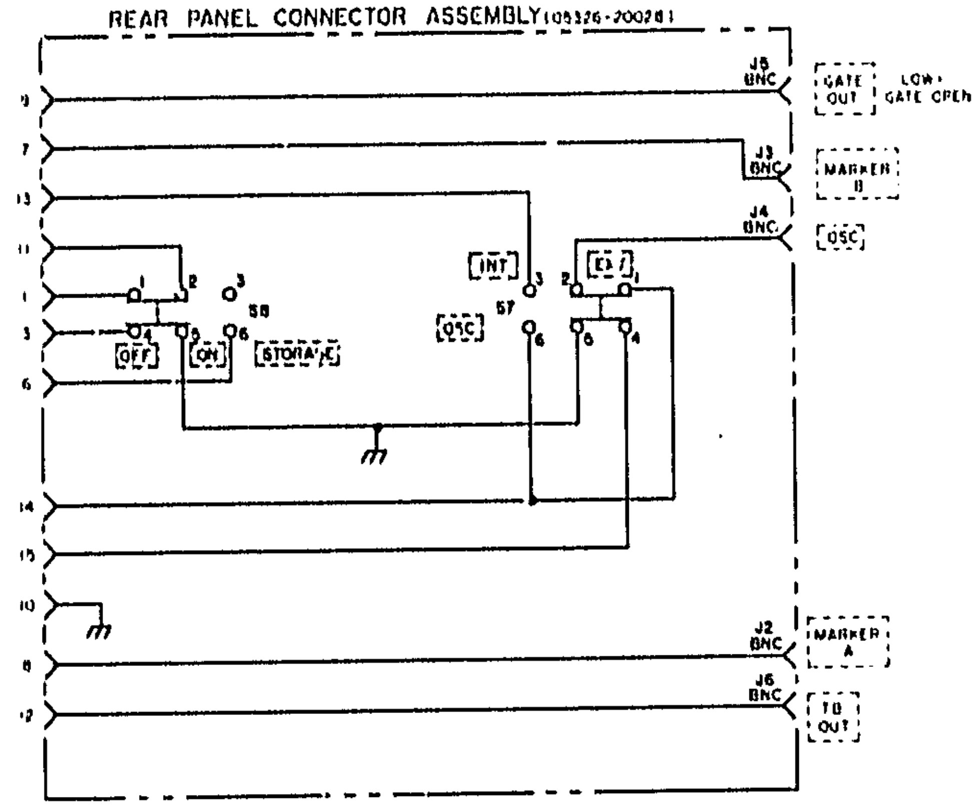
See Section II for programming information.

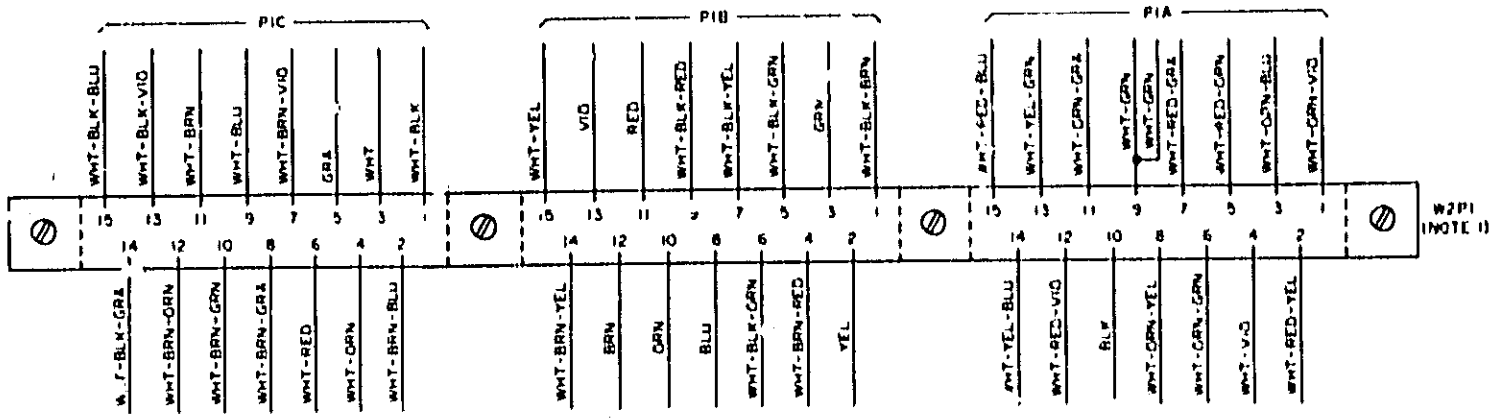
Function	J10 Pin No.	Wire Color	W2P1 Pin No.	Circuit Board Terminals	Level
Start	1	Brn	B12	A16(14)	L = Start Open = Stop
Period Avg A	2	Red	B11	A16(13)	L = Enable
Time Intvl Avg	3	Orn	B10	A16(16)	
Time Intvl	4	Yel	B2	A16(15)	
Period	5	Grn	B3	A16(17)	
Freq A	6	Blu	B8	A16(18)	
Freq C	7	Vio	B13	A16(21)	L = Enable
No connection	8	Gra	C5		
No connection	9	Wht	C3		
No connection	10	Wht-Blk	C1		
No connection	11	Wht-Brn	C11		
No connection	12	Wht-Red	C6		
No connection	13	Wht-Orn	C4		
Check	14	Wht-Yel	B15	XA3(B)	L = Check
Gate Out	15	Wht-Grn	A9	XA5(F)	H = Gate Closed L = Gate Open
Computer Inhibit	16	Wht-Blu	C9	XA6(14)	L = Inhibit
Ext	17	Wht-Vio	A4	XA11(A)	H = Int L = Ext
Freq C ÷ 10	18	Wht-Gra	(W2P2)	A16(22)	L = Enable
.1 μs/1	19	Wht-Blk-Brn	B1	A16(30)	
1 μs/10^1	20	Wht-Blk-Red	B9	A16(31)	
10 μs/10^2	21	Wht-Blk-Orn	B6	A16(28)	
.1 ms/10^3	22	Wht-Blk-Yel	B7	A16(29)	
1 ms/10^4	23	Wht-Blk-Grn	B5	A16(26)	
10 ms/10^5	24	Wht-Blk-Blu	C15	A16(27)	
.1 s/10^6	25	Wht-Blk-Vio	C13	A16(24)	
1 s/10^7	26	Wht-Blk-Gra	C14	A16(25)	
10 s/10^8	27	Wht-Blk-Red	B4	A16(23)	L = Enable
Slope A	28	Wht-Brn-Orn	C12	XA2(13,P)	L = Minus Open = Plus
Slope B	29	Wht-Brn-Yel	B14	XA3(13,P)	L = Minus Open = Plus

Function	J10 Pin No.	Wire Color	W2P1 Pin No.	Circuit Board Terminals	Level
A Trig Level	30	Wht-Brn-Grn	C10	XA2(1,A)	+3 V to -3 V
B Trig Level	31	Wht-Brn-Blu	C2	XA3(1,A)	+3 V to -3 V
Sample Rate Disable	32	Wht-Brn-Vio	C7	A16(11)	L = Disable
Print Command	33	Wht-Brn-Gra	C8	XA6(S)	L = Causes Print
Manual Reset	34	Wht-Red-Orn	A5	A16(6)	L = Reset
Sample Rate Hold	35	Wht-Red-Yel	A2	A16(4)	L = Maintain Display
Ground	36	Blk	A10	Ground	

Logic levels (Input) H ≥ +2.0 V, L ≤ +0.8 V (Output) H ≥ +2.4 V, L ≤ +0.4 V







NOTES

1. IN STANDARD INSTRUMENT, ONLY W2P1A IS WIRED

Figure 8-49. Option 002 Remote Programming Cable Assembly and Rear Panel Connector Assembly

OPTION 003, DIGITAL RECORDER OUTPUT

Option 003 includes cable assembly W1 and rear panel connector J9. The counter (A9 Display Assembly provides +8421 BCD and control line inputs and outputs for use with a printer or other data storage devices.

The annunciator lines (J9-17, 18, 42, and 43) supply overflow, plus, and minus outputs as follows:

FUNCTION	BCD
	8 4 2 1
Overflow	L L L L
All Other Times	H H H H

When the print command line at J9(48) goes low, it indicates that the counter has completed a measurement and the data output may be interrogated. When the inhibit line is held High, the data output is maintained. The line must go high less than 30 μs after the print command goes low. The +5 V reference line (J9-25) has a 1K source impedance and is used for data level references. The 0 volt or ground reference connects to J9(24, 50).

OPTION 004, EXTENDED REMOTE PROGRAMMING

See Section II for remote programming information.

Option 004 Pin Connections

Function	J10 Pin No.	Wire Color	W2P1 Pin No.	Circuit Board Terminals	Level
Ground	1	Blk			
Ground	2	Blk			
-16.5 V Output	3	Orn			
+16.5 V Output	4	Yel			
+5 V Output	5	Grn			
Sep-Com	6	Blu		A1 Cable Point 4	L = Com
Ac-Dc Chan B	7	Vio		A1 Cable Point 7	L = Dc H = Ac
No connection	8	Gra			
X10 Atten B	9	Wht		A1 Cable Point 5	See Section II
X100 Atten B	10	Wht-Blk		A1 Cable Point 6	See Section II
Ac-Dc Chan A	11	Wht-Brn		A1 Cable Point 8	L = Dc H = Ac
No connection	12	Wht-Red			
X10 Atten A	13	Wht-Orn		A1 Cable Point 2	See Section II
X100 Atten A	14	Wht-Yel		A1 Cable Point 3	See Section II

Function	J10 Pin No.	Wire Color	W2P1 Pin No.	Circuit Board Terminals	Level[1]
Ground	15	Blk	A10		
Sample Rate Hold	16	Wht-Blu	A2	A16(4)	L = Maintain Disable
Manual Reset	17	Wht-Vio	A5	A16(6)	L = Reset
Print Command	18	Wht-Gra	C8	XA6(S)	L = Causes Print
Sample Rate Disable	19	Wht-Blk-Brn	C7	A16(11)	L = Disable
Trig Level B	20	Wht-Blk-Red	C2	XA3(1, A)	+3 V to -3 V
Trig Level A	21	Wht-Blk-Orn	C10	XA2(1, A)	+3 V to -3 V
Slope B	22	Wht-Blk-Yel	B14	XA3(13, P)	L = Minus Open = Plus
Slope A	23	Wht-Blk-Grn	C12	XA2(13, P)	L = Minus Open = Plus
10 ms/10^5	24	Wht-Blk-Blu	C15	A16(27)	L = Enable
1 ms/10^4	25	Wht-Blk-Vio	B5	A16(26)	↑
.1 ms/10^3	26	Wht-Blk-Gra	B7	A16(29)	
10 µs/10^2	27	Wht-Brn-Red	B6	A16(28)	
.1 µs/1	28	Wht-Brn-Orn	B1	A16(30)	
1 µs/10	29	Wht-Brn-Yel	B9	A16(31)	
.1 s/10^6	30	Wht-Brn-Grn	C13	A16(24)	
1 s/10^7	31	Wht-Brn-Blu	C14	A16(25)	
10 s/10^8	32	Wht-Brn-Vio	B4	A16(23)	↓
Freq C + 10	33	Wht-Br ra	W2P2	A16(22)	L = Enable
Ext	34	Wht-Red-Orn	A4	XA11(A)	H = Int L = Ext
Computer Inhibit	35	Wht-Red-Yel	C9	XA6(4)	L = Inhibit
Gate Output	36	Wht-Red-Grn	A9	XA5(F)	H = Gate Closed L = Gate Open
Check	37	Wht-Red-Blu	B15	XA3(B)	L = Check
No connection	38	Wht-Red-Vio	C4		
No connection	39	Wht-Red-Gra	C6		
No connection	40	Wht-Orn-Yel	C11		
Freq C	41	Wht-Orn-Grn	B13	A16(21)	L = Enable
Freq A	42	Wht-Orn-Blu	B8	A16(18)	↑
Period	43	Wht-Orn-Vio	B3	A16(17)	
Time Intvl	44	Wht-Orn-Gra	B2	A16(15)	↓
Time Intvl Avg	45	Wht-Yel-Grn	B10	A16(16)	L = Enable
Start	46	Wht-Yel-Blu	B12	A16(14)	L = Start Open = Stop
Period Avg	47	Wht-Yel-Vio	B11	A16(13)	L = Enable
No connection	48	Wht-Yel-Gra	C5		
No connection	49	Wht-Grn-Blu	C3		
No connection	50	Wht-Grn-Vio	C1		

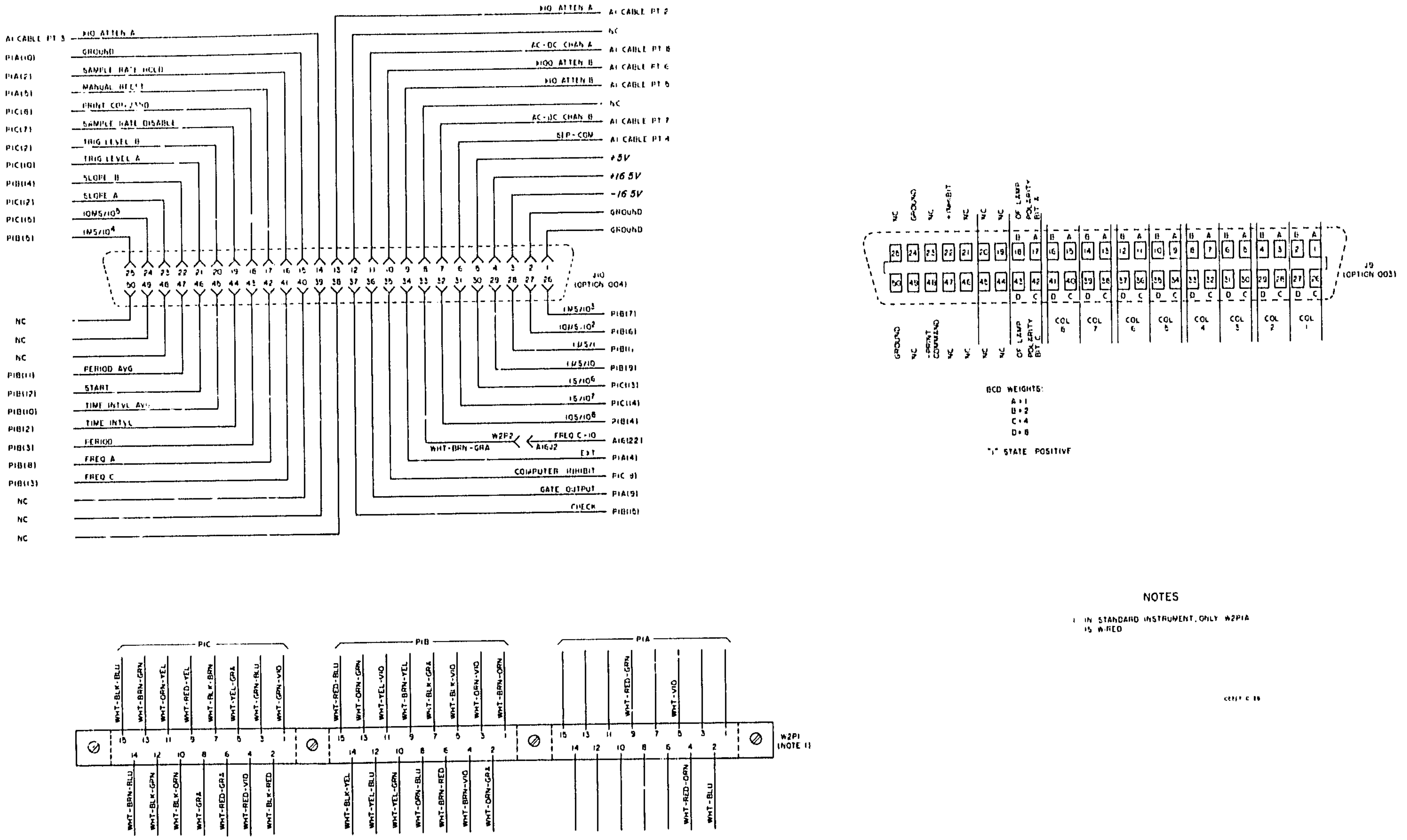


Figure 8-20. Option 004, Remote Programming Cable Assembly and J10 Option 003, Digital Recorder Cable Assembly

A1 OPTION 004 OPERATION

The remote programmable attenuator board attenuates the input signal and routes it to the amplifier boards. The signals from inputs A and B are routed through identical paths.

In the X1 position K2 is closed and the signal is routed directly to K4, which is open with ac coupling and closed with dc. R30 provides the 1 MΩ input impedance. R34, R38, and C7 compensate for high frequency roll-off and also limit the input current to Q1A. Diodes CR25 and CR27 limit the voltage at the input of Q13A to ±5.8 V. Q13A operates as a source follower with a high input impedance and a low output impedance to the amplifier boards. Q1B operates as a source follower, supplying the amplifiers with the dc trigger-level voltage generated either by R49, CR32, and CR33, or from an external analog input (J10). R46, 44, 42, and C13 filter the trigger-level voltage.

In the X1 position, K2 and K4 are closed providing a direct path for the input signal to the gate of Q13A. In the X10 position, K2 is open and diodes CR7 and CR9 are turned on, shorting R16 to ground. R12, R14, and R16 form the dc attenuator. The ac (high frequency) attenuator is formed by C1 and stray capacitance in the circuit.

In the X100 position, K2 is open, CR7 and CR9 are off, and CR21 and CR23 are turned on. C3 and R28 are thus connected to ground. R12, R14, and R28 form the dc portion of the attenuator, while C1, C3, and stray capacitance form the high frequency portion of the attenuator.

The circuitry to drive AC/DC relay K4, and SEP/COM relay K1 is provided by U3 A&C. U3's output is at HTL levels (+12 V, +1.5 V) and thus is sufficient to drive the relays directly. U3's input is at DTL levels and is compatible with remote programming levels. K2 is driven by Q7 and is open when CR7 and CR9 or CR21 and CR23 are on.

Diode pairs CR7 and CR9 are driven by emitter followers Q3 and Q6, which, in turn, are driven by HTL gates U2D AND U2C. U2's power supply, consisting of Q1 and Q2, is +8.9 V and -5.6 V rather than the usual +15 V and 0 V. This special bias moves the HTL input threshold to +1.9 V, rather than the normal +7.5 V. U2D can now be driven by DTL gate U1B. The output swing of U2D is +9 V to -4 V, providing the diode quad CR7 and CR9 with positive turn-on and turn-off signals. R9 is adjusted to minimize the offset voltage of the quad.

Figure 8-20
OPTION 004, REMOTE PROGRAMMING CABLE ASSEMBLY AND J10 OPTION 003, DIGITAL RECORDER CABLE ASSEMBLY

(See Page 8-49)

ADJUSTMENTS

Set:

TIME BASE .... 0.1 sec.
AC/DC .... DC
SEP/COM .... SEP
ATTEN A/B X10

1. Using an HP 412A or equivalent, measure voltage at CHANNEL A jack.
2. Adjust R56 for <±1 mV reading.
3. Measure voltage at CHANNEL B jack.
4. Adjust R9 for <±1 mV reading.
5. Set A and B attenuators to X100 position.
6. Measure voltage at CHANNEL B jack.
7. Adjust R32 for <±1 mV reading.
8. Measure voltage at CHANNEL A jack.
9. Adjust R33 for <±1 mV reading.

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

REFERENCE DESIGNATIONS

A1, OPT.004
C1-14
CR1-36
DS1,2
J1-4
K1-5
Q1-14
R1-56
S1-9
U1-4

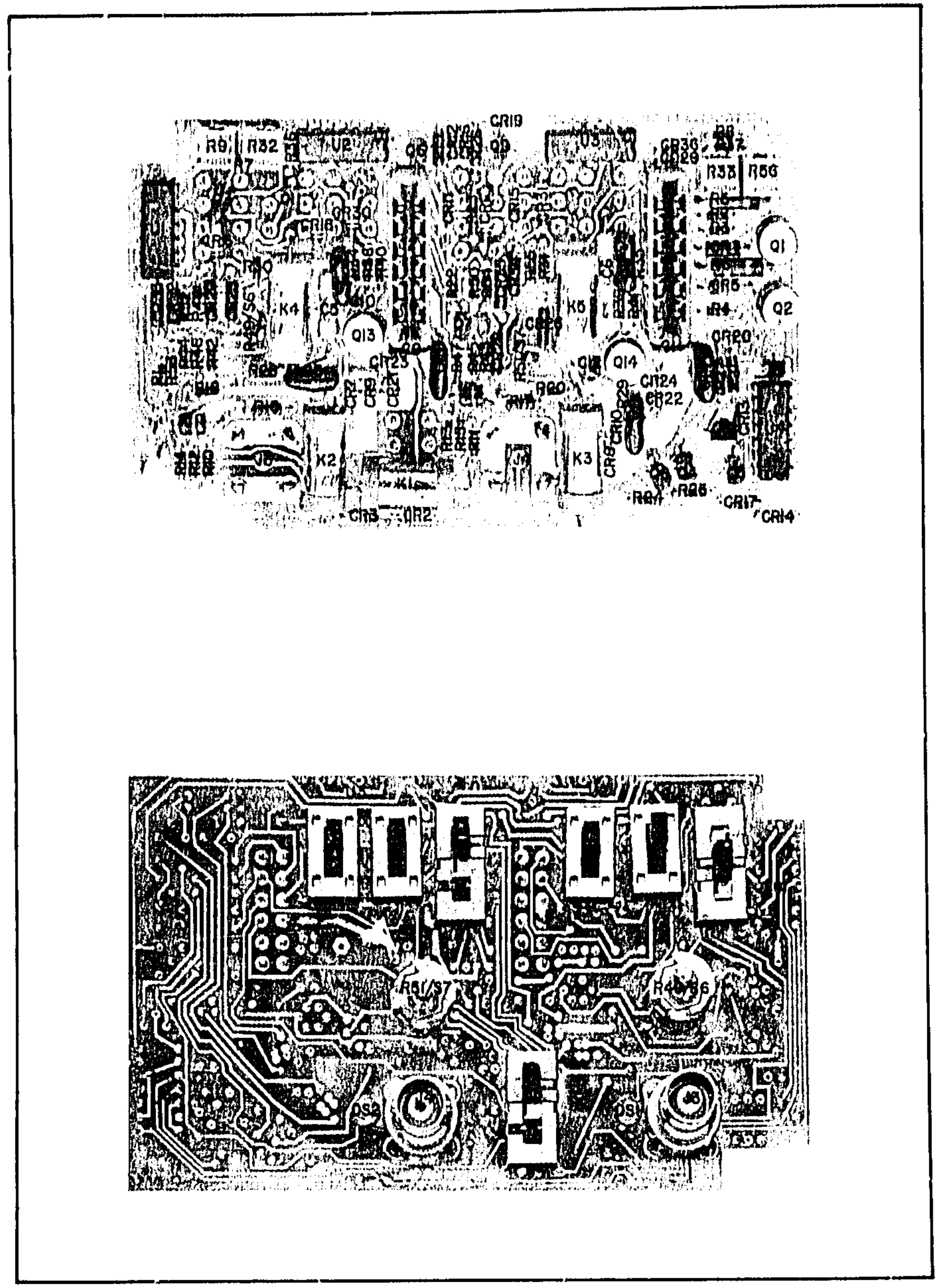
TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1-3,6,15,18,30,31	1910-0016
CR4	1902-0025
CR5	1902-0057
CR7,8,23,24	1906-0024
CR9,10,21,22	1906-0025
CR11-14,16,17, 19,20,29,36	1901-0040
CR25-28	1901-0376
CR32-35	1902-0041
Q1	1854-0039
Q2	1853-0001
Q3,4,7,8,11,12	1854-0215
Q5,6,9,10	1853-0036
Q13,14	1855-0334
U1	1820-0274
U2,4	1820-0287
U3	1820-0625

CABLE POINT	WIRE COLOR	DESTINATION
1	GRN	+5V
2	WHT-ORN	J10(13)
3	WHT-YEL	J10(14)
4	BLU	J10(6)
5	WHT	J10(9)
6	WHT-BLK	J10(10)
7	VIO	J10(7)
8	WHT-BRN	J10(11)

COMPLETE PARTS LIST FOR THIS ASSEMBLY IS LOCATED ON PAGE 8-19

MORE DATA UNDER THIS FOLD



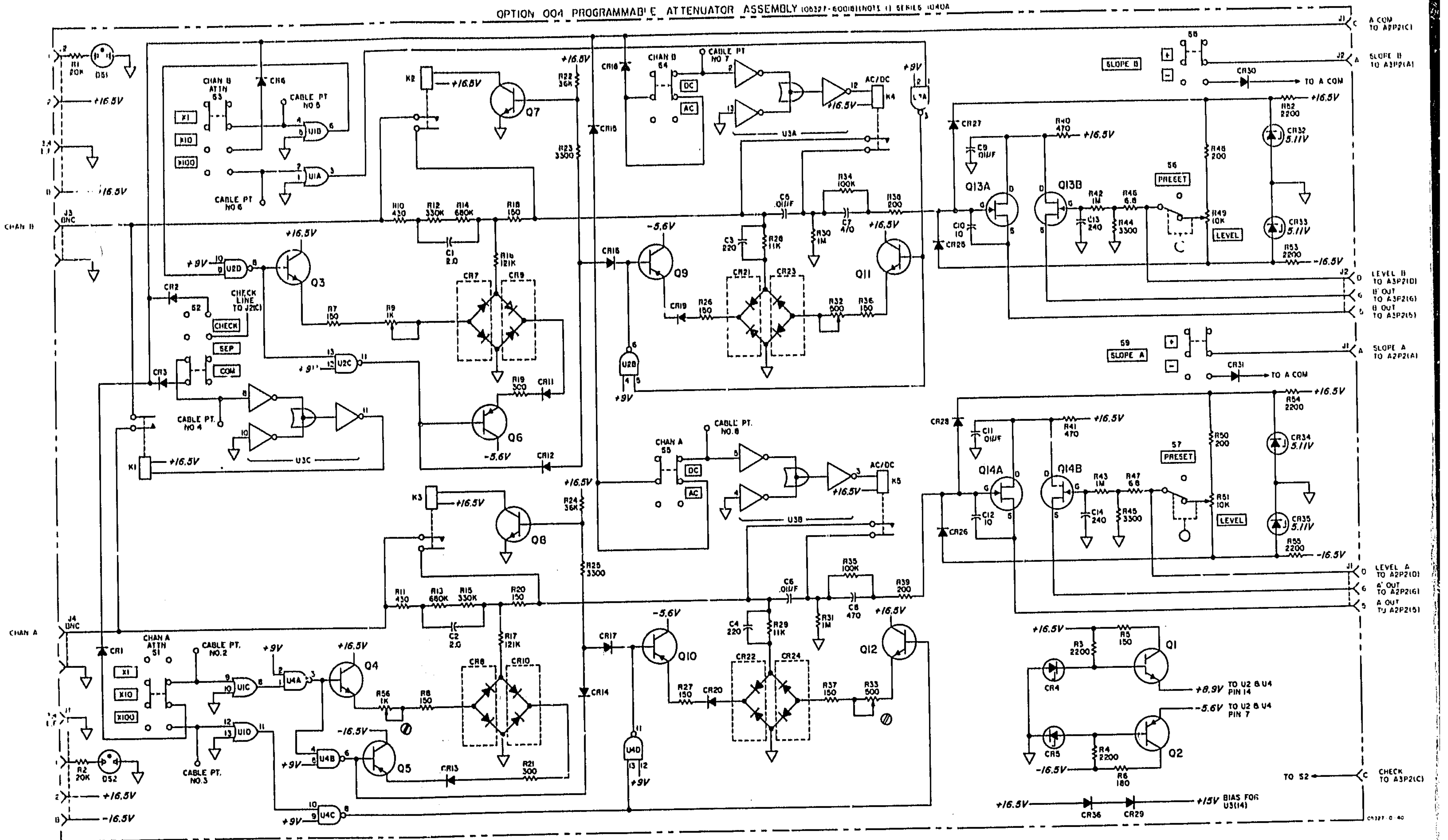
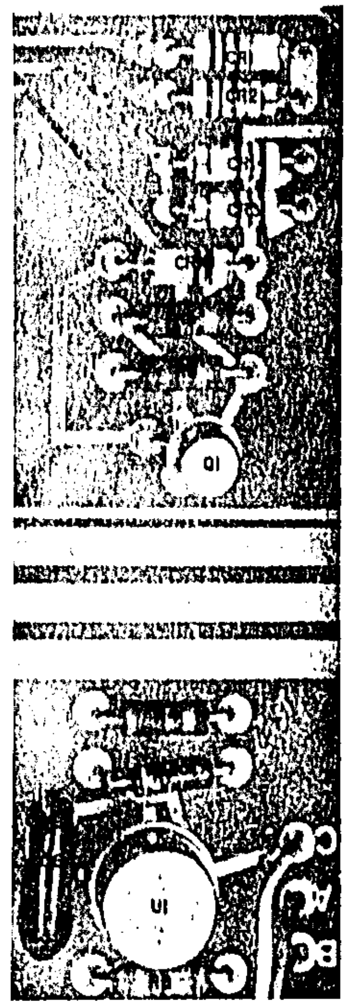


Figure 8-21. A1 Option 004 Programmable Attenuator Assembly



OPTIONS 010 AND 011 A16 INTERCONNECT CIRCUIT BOARD (PARTIAL DIAGRAM) (05327-60026/27/28) SERIES 1224A

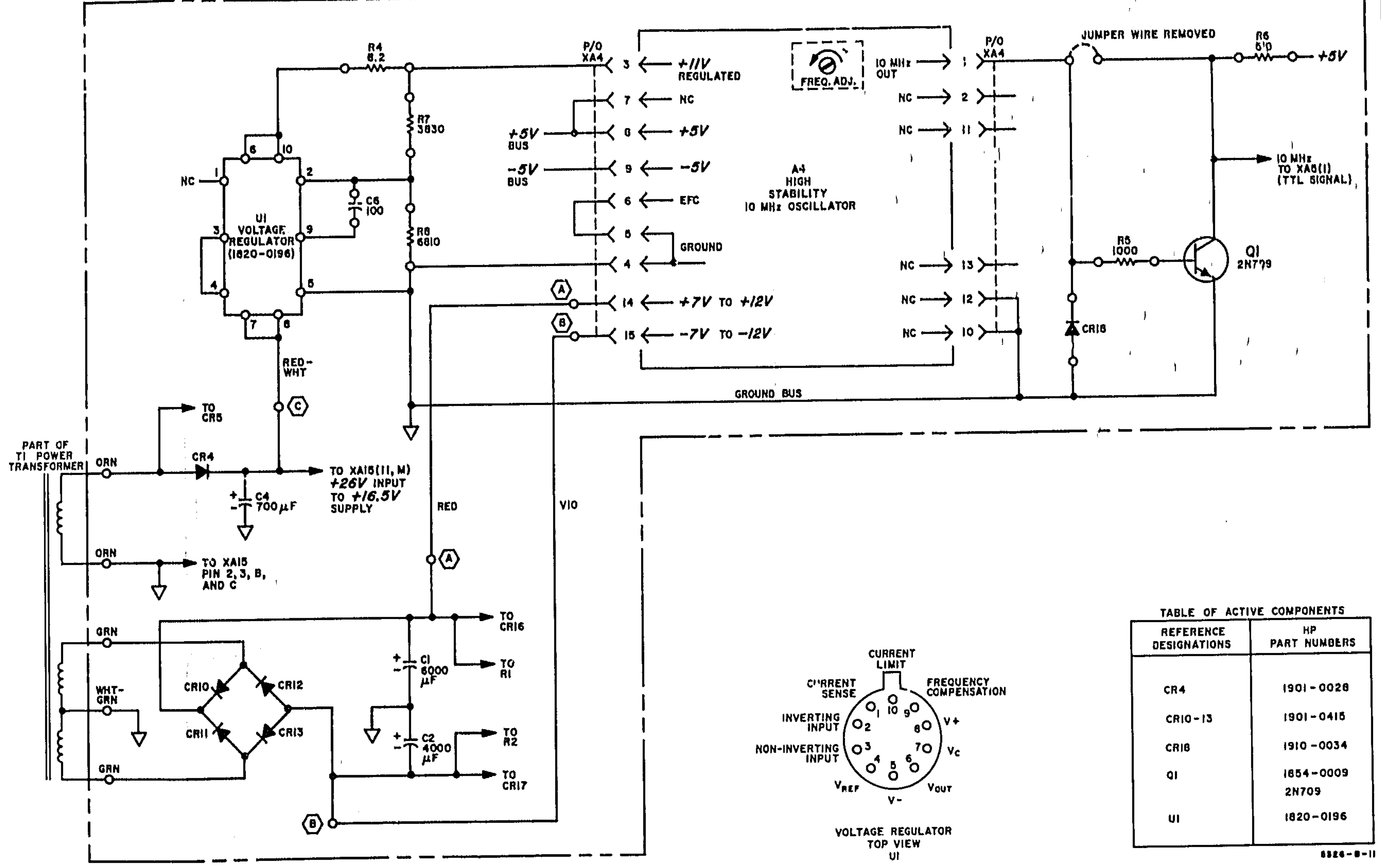


TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR4	1901-0028
CR10-13	1901-0415
CR18	1910-0034
Q1	1854-0009 2N709
U1	1820-0196

Model 5326/27A
Schematic Diagrams

Figure 8-22. Options 010 and 011 and 016 Interconnect Circuit Board

Figure 8-23
5326A/5327A INTERCONNECTION DIAGRAM
(Stock No. 05326-90035)

Figure 8-23
5326A/5327A INTERCONNECTION DIAGRAM
(Stock No. 05326-90035)

SECTION VIII

SCHEMATIC DIAGRAMS

This section contains the following:

a. Schematic diagram notes.

b. Schematics.

c. Component locators.

d. IC outline drawings.

e. Waveforms.

f. Simplified block diagrams.

g. Theory of operation.

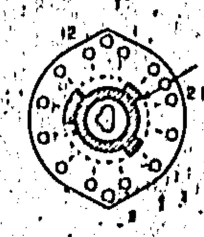
h. Troubleshooting.

Figure 8-1. Schematic Diagram Notes

SYMBOLS

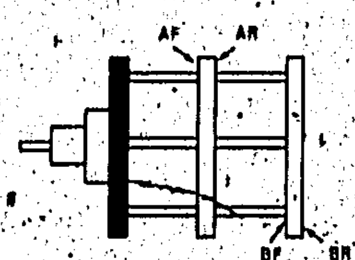
- FRONT PANEL
- REAR PANEL
- INTERIOR AND PC BOARDS
- WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE
- POWER LINE GROUND
- CIRCUIT COMMON GROUND
- FLOATING GROUND
- CHASSIS GROUND
- KNOB CONTROL
- SCREWDRIVER ADJUST
- MAIN SIGNAL PATH
- FEEDBACK PATH
- TEST POINT
- "AND" GATE
- "OR" GATE
- INVERTER
- NAND GATE
- NOR GATE
- EXCLUSIVE NOR

SWITCH DESIGNATIONS



A3S1	SWITCH S1 WITHIN ASSEMBLY A3
B	2ND WAFER FROM FRONT (A=1ST, ETC)
R	REAR OF WAFER (F=FRONT)
(2-1/2)	TERMINAL LOCATION (2 1/2) (VIEWED FROM FRONT)

A3S1BR(2-1/2)



REFERENCE DESIGNATIONS

REFERENCE DESIGNATIONS WITHIN ASSEMBLIES ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION. JACKS ARE THE STATIONARY CONNECTORS AND PLUGS ARE THE MORE MOVEABLE OF TWO CONNECTORS.

ASSEMBLY	ABBREVIATION	COMPLETE DESCRIPTION
A25	C1	A25C1
A25A1	CR1	A25A1CR1
NO PREFIX	J3	J3

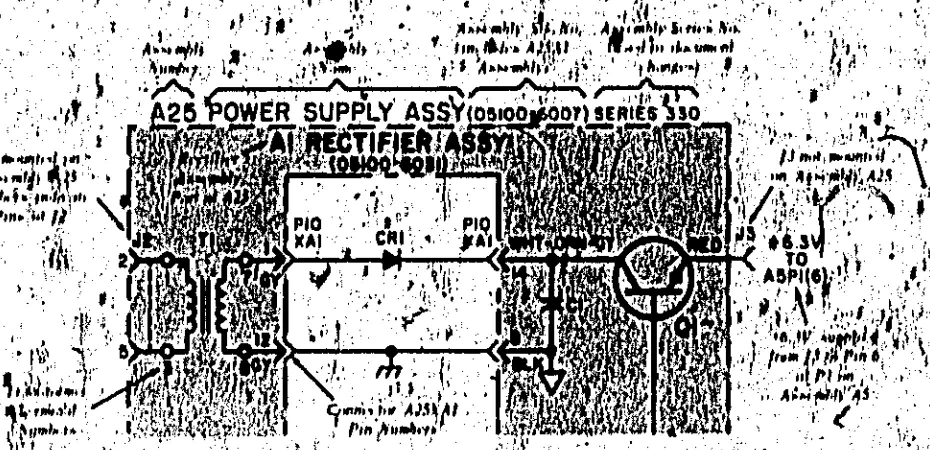
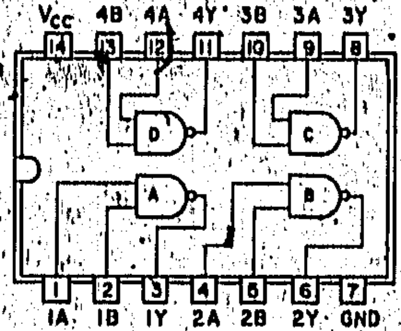


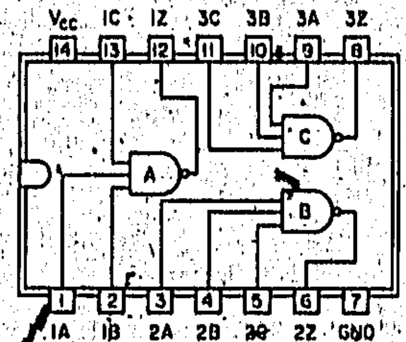
Figure 8-2. Integrated Circuit Diagrams

1820-0054



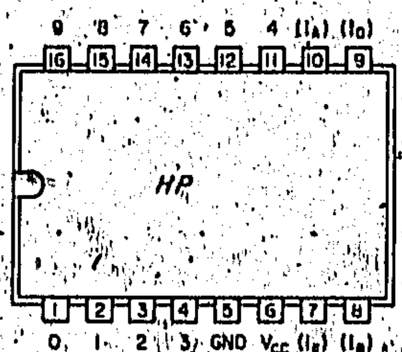
1820-0054(SN7400N)
QUADRUPLE 2-INPUT POSITIVE NAND GATE
NOTE: POSITIVE LOGIC: $Y = \overline{AB}$

1820-0068



1820-0068(SN7410N)
TRIPLE 3-INPUT POSITIVE NAND GATE
POSITIVE LOGIC: $Y = \overline{ABC}$

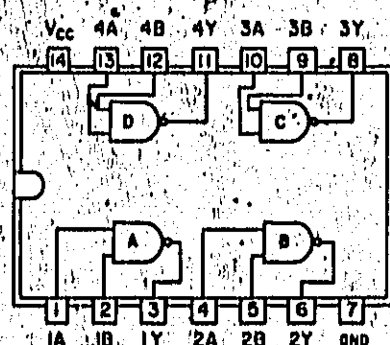
1820-0092



1820-0092
DRIVER
NEGATIVE LOGIC

$I_A(1)$	$I_B(2)$	$I_C(4)$	$I_D(8)$	"ON" OUTPUT
H	H	H	H	0
L	H	H	H	1
H	L	H	H	2
L	L	H	H	3
H	H	L	H	4
L	H	L	H	5
H	L	L	H	6
L	L	L	H	7
H	H	H	L	8
L	H	H	L	9
BCD 10-15				NONE

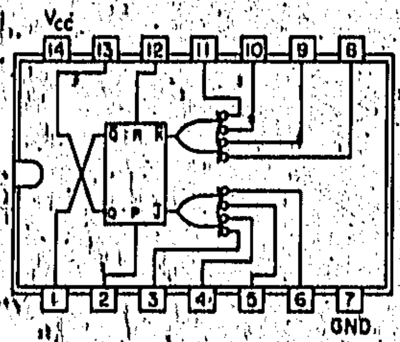
1820-0094



1820-0094(MC846P)
QUADRUPLE 2 INPUT POSITIVE NAND GATE
NOTE: POSITIVE LOGIC $Y = \overline{AB}$

Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0102



1820-0102(MC1013P)
85MHz J-K FLIP-FLOP

R-S TRUTH TABLE

R	S	Q^{n+1}
12	2	13
0	0	Q^n
0	1	1
1	0	0
1	1	ND

ALL $\overline{J}\cdot\overline{K}$ INPUTS ARE STATIC

$\overline{J}_D \cdot \overline{K}_D$ TRUTH TABLE

$\overline{J}_D$	$\overline{K}_D$	Q^{n+1}
•	•	13
0	0	Q^n
0	1	0
1	0	1
1	1	$\overline{Q}^n$

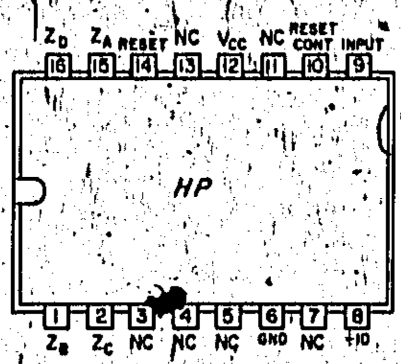
ALL OTHER $\overline{J}\cdot\overline{K}$ INPUTS AND THE R-S INPUTS ARE AT A "0" LEVEL

CLOCKED $\overline{J}\cdot\overline{K}$ TRUTH TABLE

$\overline{J}$	$\overline{K}$	C_D	Q^n
•	•	•	13
φ	φ	0	Q^n
0	0	1	$\overline{Q}^n$
0	1	1	1
1	0	1	0
1	1	1	Q^n

ALL OTHER $\overline{J}\cdot\overline{K}$ INPUTS AND THE R-S INPUTS ARE AT A "0" LEVEL

1820-0117



1820-0117,0119,0232
BLANKING DECADE COUNTER
NEGATIVE LOGIC 1 = LOW
0 = HIGH

TRUTH TABLE

	OUTPUT			
INPUT PULSE	A	B	C	D
0	H	H	H	H
1	L	H	H	H
2	H	L	H	H
3	L	L	H	H
4	H	H	L	H
5	L	H	L	H
6	H	L	L	H
7	L	L	L	H
8	H	H	H	L
9	L	H	H	L
RESET CONTROL HIGH & RESET PULSE	H	H	H	H
RESET CONTROL LOW & RESET PULSE	L	L	L	L

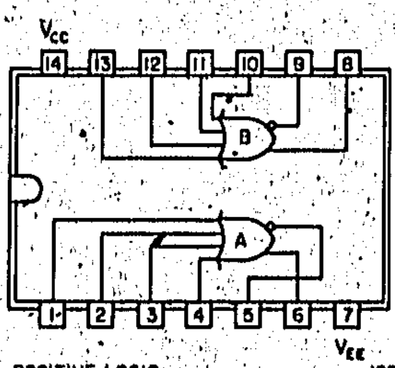
POSITIVE PULSE APPLIED TO RESET WILL:

A. RESET A,B,C & D TO LOW IF RESET CONTROL IS LOW.

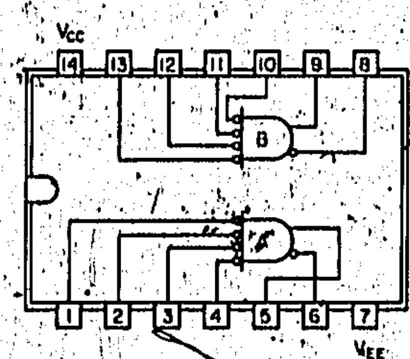
B. RESET A,B,C & D TO HIGH IF RESET CONTROL IS HIGH

C. THE ÷10 OUTPUT WILL ALWAYS BE RESET TO HIGH STATE

1820-0142



POSITIVE LOGIC:
$5 = \overline{1+2+3+4}$
$6 = 1+2+3+4$

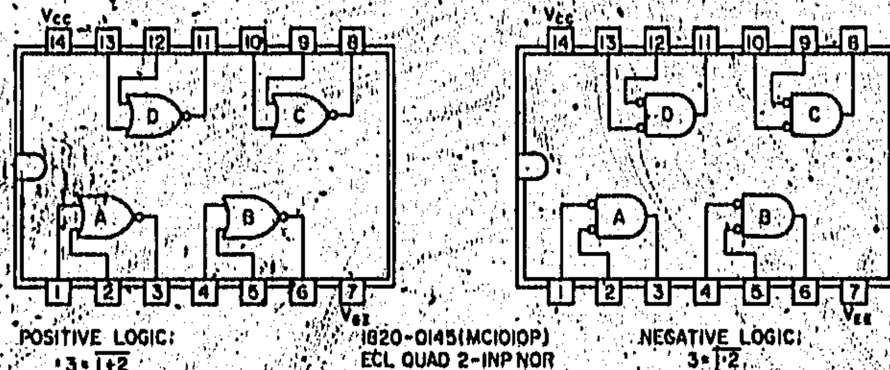


1820-0142(MC1004P)
ECL DUAL 4-INPUT 2-OR,2-NOR

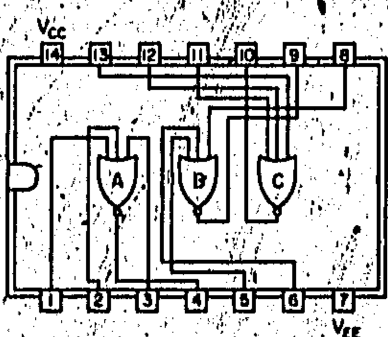
NEGATIVE LOGIC:
$5 = \overline{1\cdot2\cdot3\cdot4}$
$6 = 1\cdot2\cdot3\cdot4$

Figure 8-2. Integrated Circuit Diagrams (Continued)

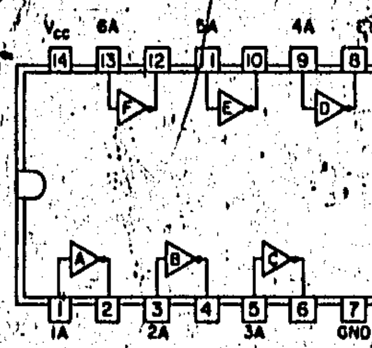
1820-0145



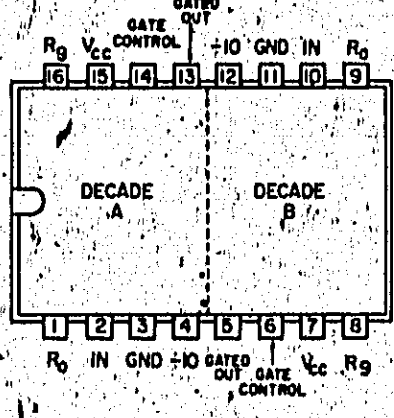
1820-0147

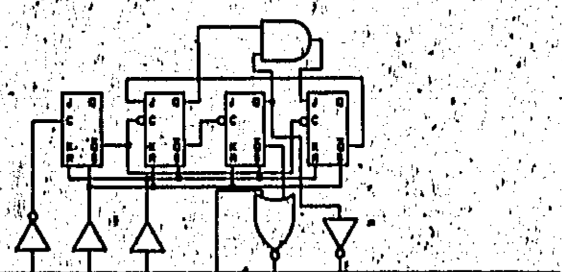


1820-0174



1820-0198 and 1820-0199

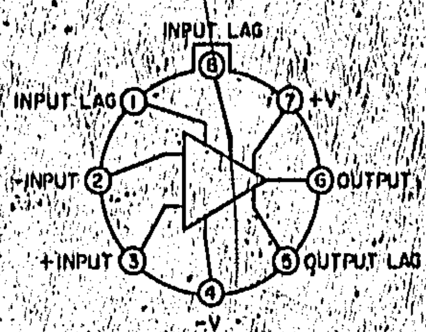




DECADE	CLOCK (COUNT) INPUT	RESET 0 INPUT	RESET 9 INPUT	GATE CONT	GATED OUTPUT	÷10 CARRY	V_{CC}	GND	HP PART NUMBER
A	2	1	16	14	13	4	15	3	1820-0198
B	10	9	8	6	5	12	7	11	1820-0199
PINS									
	2	1	8	6	5	4	7	3	1820-0412 1820-0413
	2	1	16	14	13	4	15	3	1820-0226 1820-0227

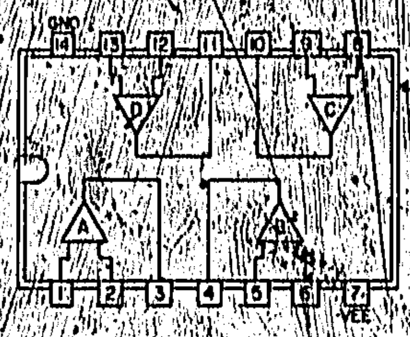
Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0201



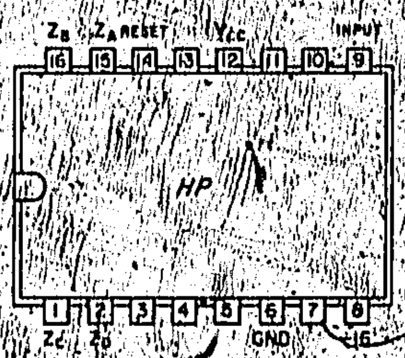
1820-0201 (MC1439G)
OPERATIONAL AMPLIFIER

1820-0212



1820-0212
QUADRUPLE LINE RECEIVER

1820-0209



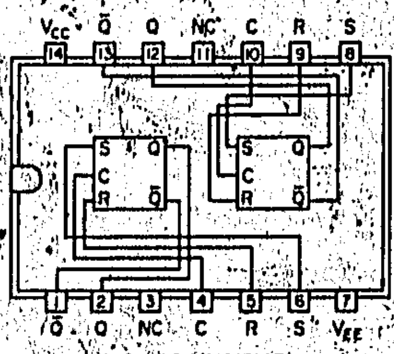
1820-0209
DIVIDE BY 16 COUNTER
NEGATIVE LOGIC 1 = LOW
0 = HIGH

TRUTH TABLE

IN	A	B	C	D
0	L	L	L	L
1	H	L	L	L
2	L	H	L	L
3	H	H	L	L
4	L	L	H	L
5	H	L	H	L
6	L	H	H	L
7	H	H	H	L
8	L	L	L	H
9	H	L	L	H
10	L	H	L	H
11	H	H	L	H
12	L	L	H	H
13	H	L	H	H
14	L	H	H	H
15	H	H	H	H

THE ÷16 OUTPUT WILL GO HIGH ON COUNT 8 AND LOW ON COUNT 16 OR RESET

1820-0213



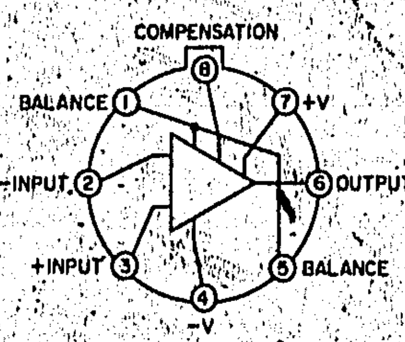
TRUTH TABLE

R	S	C	Q^{n+1}
0	1	1	1
1	0	1	0
0	0	1	Q^n
1	1	1	ND
*	*	0	Q^n

* EITHER STATE
N.D. = NOT DEFINED

1820-0213 (MC10014P)
DUAL RS FF

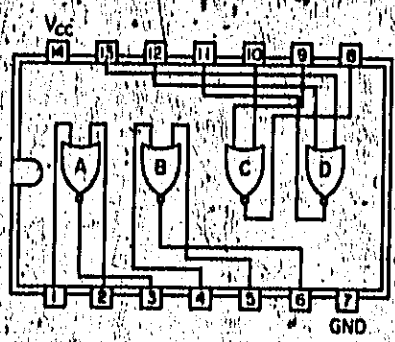
1820-0223



1820-0223 (LM 301A)
OPERATIONAL AMPLIFIER

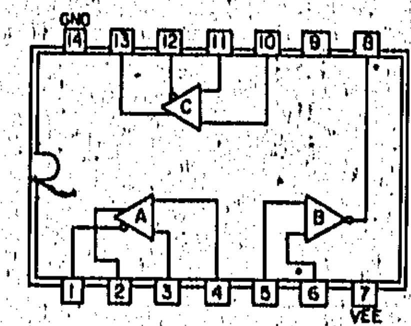
Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0238



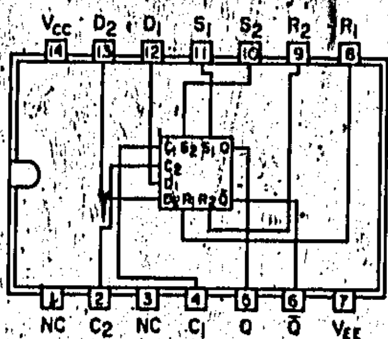
1820-0238 (MC 1810P)
QUAD 2-INPUT NOR GATES

1820-0253



1820-0253
TRIPLE DIFFERENTIAL AMPLIFIER

1820-0272



1820-0272 (MC 1022P)
TYPE "D" FLIP-FLOP

CLOCKED TRUTH TABLE

	D	C	Q^{n+1}	$\bar{Q}^{n+1}$
PIN No.	12 OR 13	2 OR 4	5	6
	0	0	Q^n	$\bar{Q}^n$
	1	0	Q^n	$\bar{Q}^n$
	0	1*	0	1
	1	1*	1	0

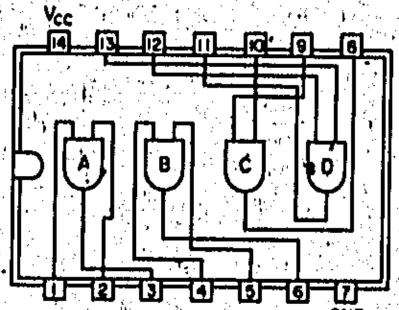
*A "1" OR CLOCK INPUT IS DEFINED FOR THIS FLIP-FLOP AS A CHANGE IN LEVEL FROM A LOW INPUT TO A HIGH INPUT.

R-S TRUTH TABLE

	R	S	Q^{n+1}	$\bar{Q}^{n+1}$
PIN No.	8 OR 9	10 OR 11	5	6
	0	0	Q^n	$\bar{Q}^n$
	0	1	1	0
	1	0	0	1
	1	1	N.D.	N.D.

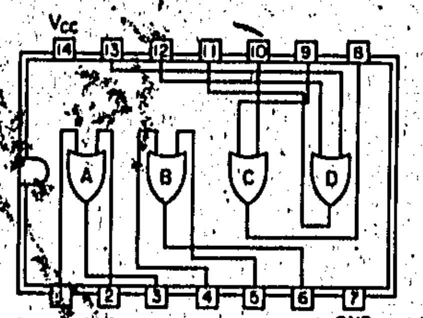
N.D. = NOT DEFINED

1820-0273



1820-0273 (MC 1806P)
QUAD 2-INPUT AND GATES

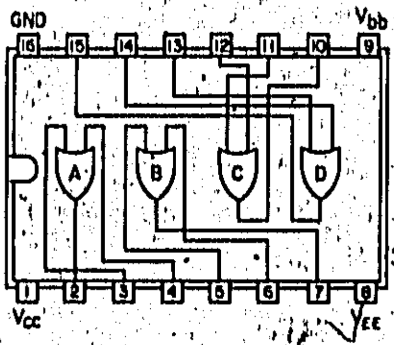
1820-0274



1820-0274 (MC 1808P)
QUAD 2-INPUT OR GATES

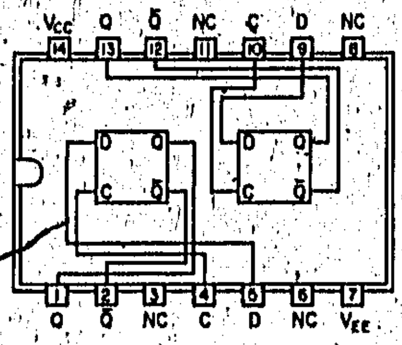
Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0275



1820-0275 (MC 1039P)
QUAD TRANSLATOR 2-INPUT OR GATES

1820-0276

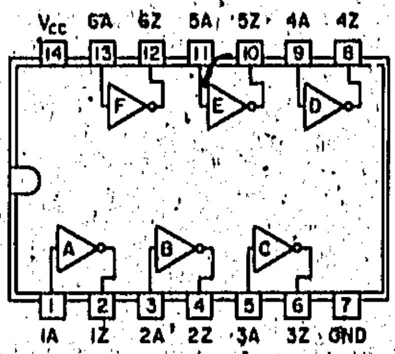


TRUTH TABLE

D	C	Q^{n+1}
Ø	I	Q^n
I	I	$\bar{Q}^n$
Ø	Ø	Ø
I	Ø	I

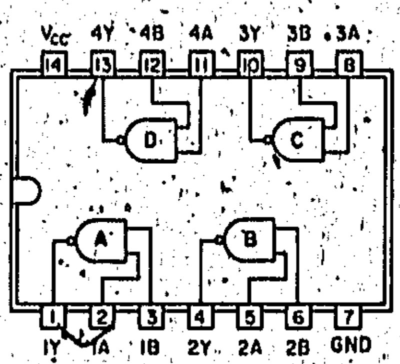
1820-0276 (MC 1033P)
DUAL RS FF

1820-0307



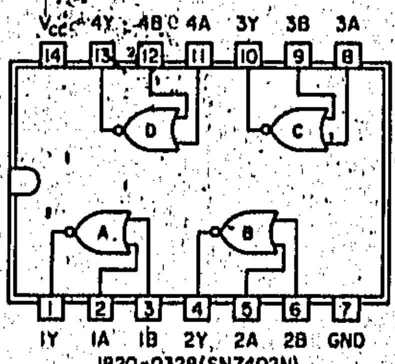
1820-0175, 0307 (MC1027D)
HEX INVERTER

1820-0327



1820-0327 (SN7401N)
QUAD 2-INPUT NAND WITH OPEN COLLECTOR
POSITIVE LOGIC: $Y = \overline{AB}$

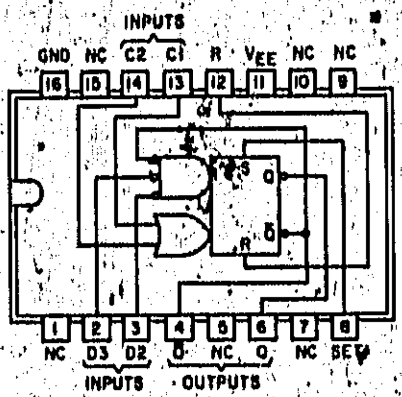
1820-0328



1820-0328 (SN7402N)
QUAD 2-INPUT NOR GATE
POSITIVE LOGIC: $Y = \overline{A+B}$

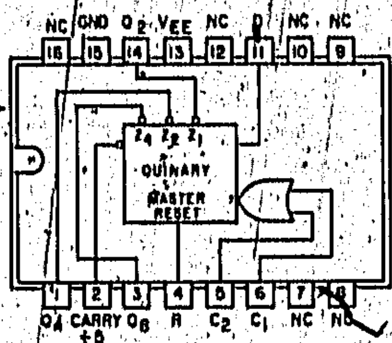
Figure 8-2. Integrated Circuit Diagrams (Continued)

1820-0558



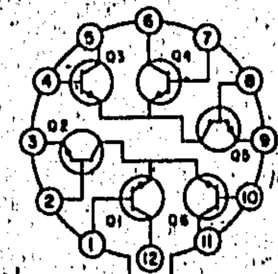
1820-0558
ECL HIGH SPEED D-BINARY

1820-0561



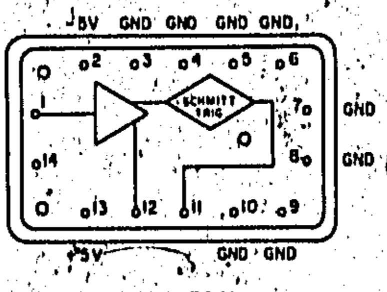
1820-0561 QUINARY

1858-0004



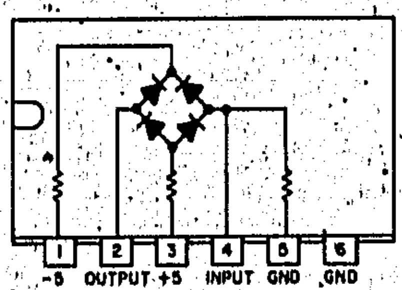
1858-0004
TRANSISTOR ARRAY
(BOTTOM VIEW)

5088-7001



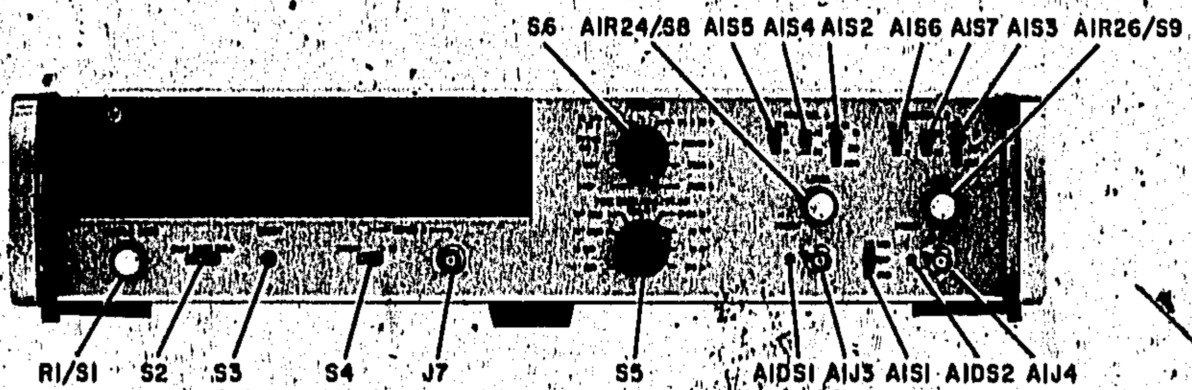
5088-7001
500MHZ SCHMITT & AMP

5088-7002



5088-7002
LIMITER

Figure 8-3. 5327A Front and Rear Panels



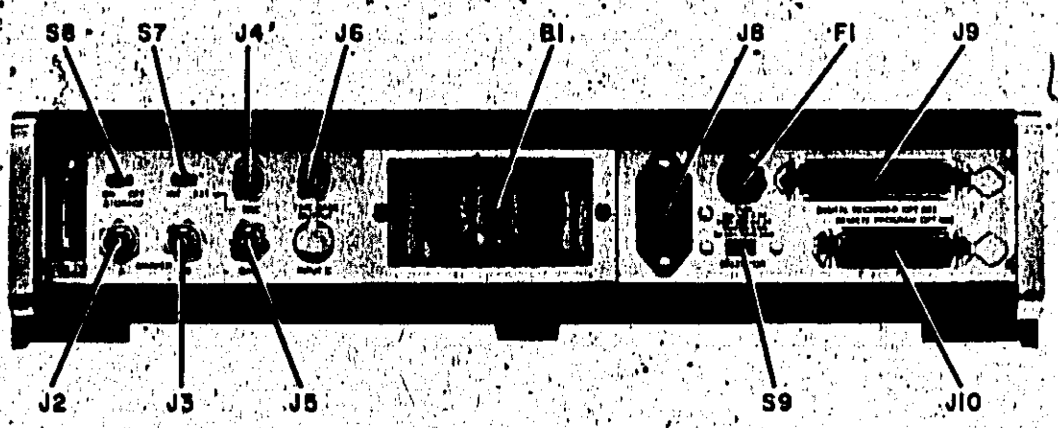


Figure 8-4. Model 5326A Top Internal View

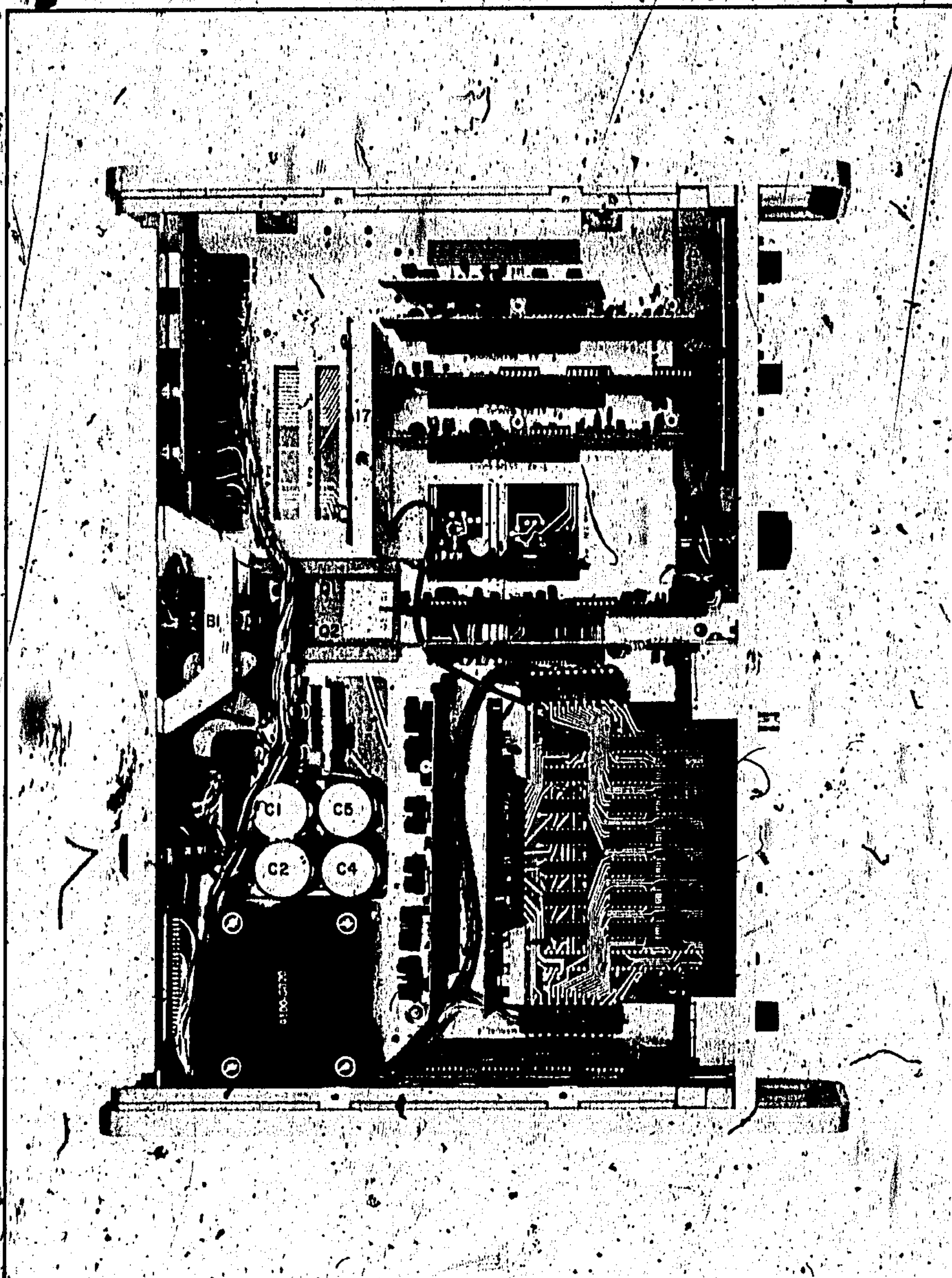
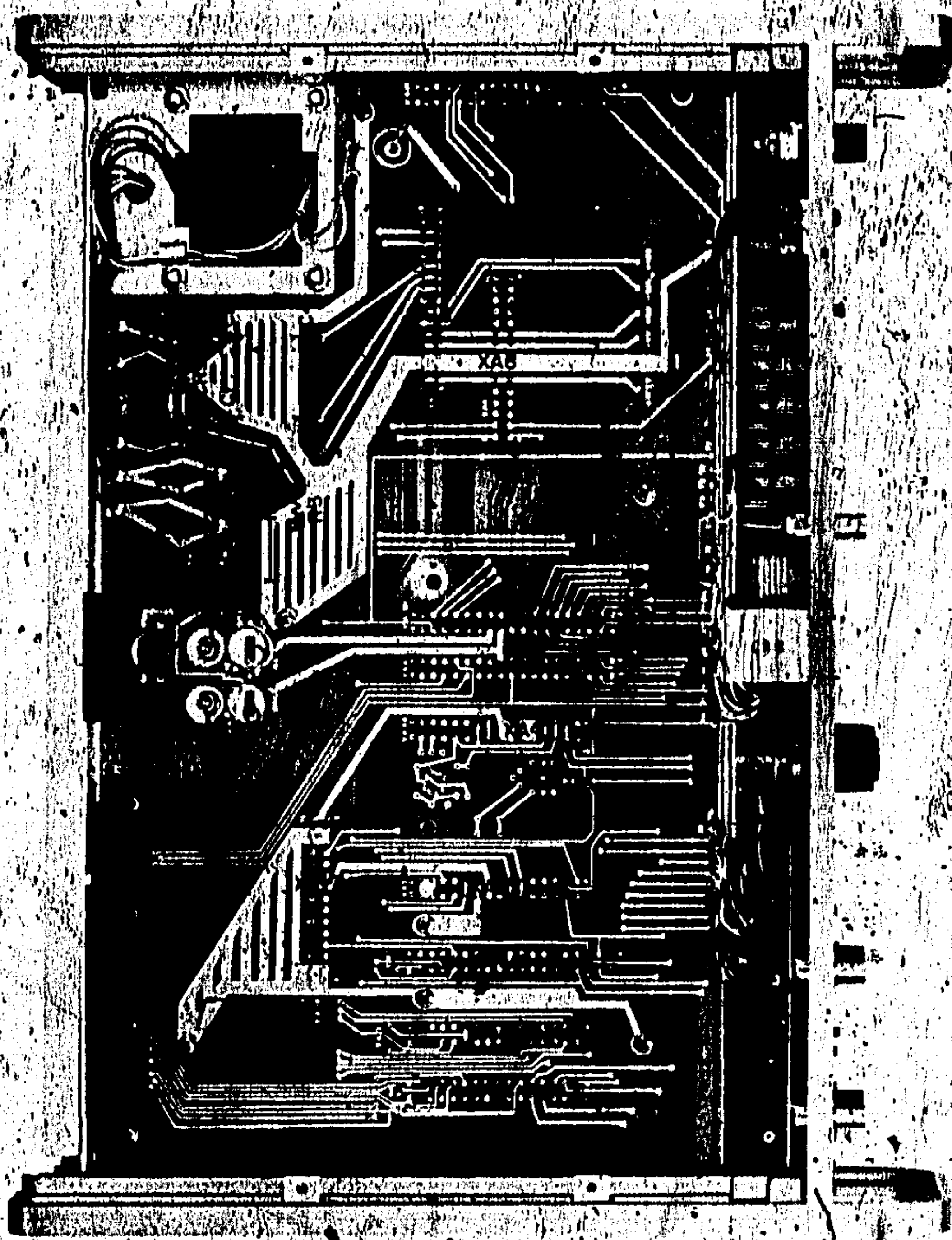


Figure 8-5. Model 5326A Bottom Internal View



A1 ATTENUATOR OPERATION

Attenuator Assembly A1 consists of two input attenuator channels. Since the channels are identical, only Channel A will be described. Channel A input signals are routed through J3 to the attenuator network. When ATTEN switch S2 is set to X1, the full input signal is fed to the gate of Q1A. With the ATTEN switch in X10, R2, R5, C1, and C3 serve as a 10:1 voltage divider. In the X100 position, the 100:1 divider consists of R2, R4, C1, and C2. R3 provides damping.

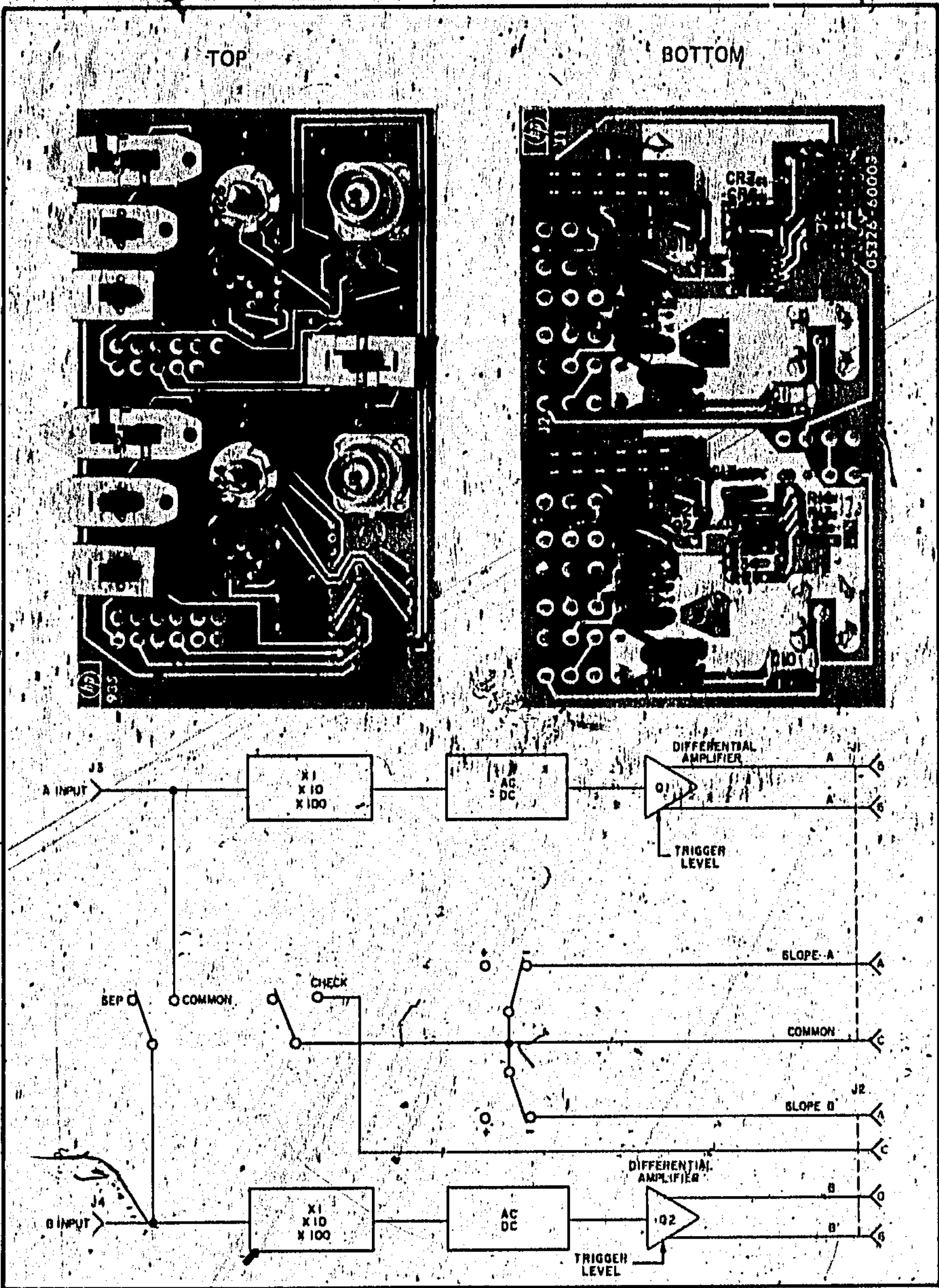
When AC/DC switch S4 is set to AC, C4 is in series with the signal path. CR3 and CR4 limit the input amplitude to Q1A to approximately ±5.8 volts. R7 and R8 provide current limiting. C5 compensates Q1A input capacitance.

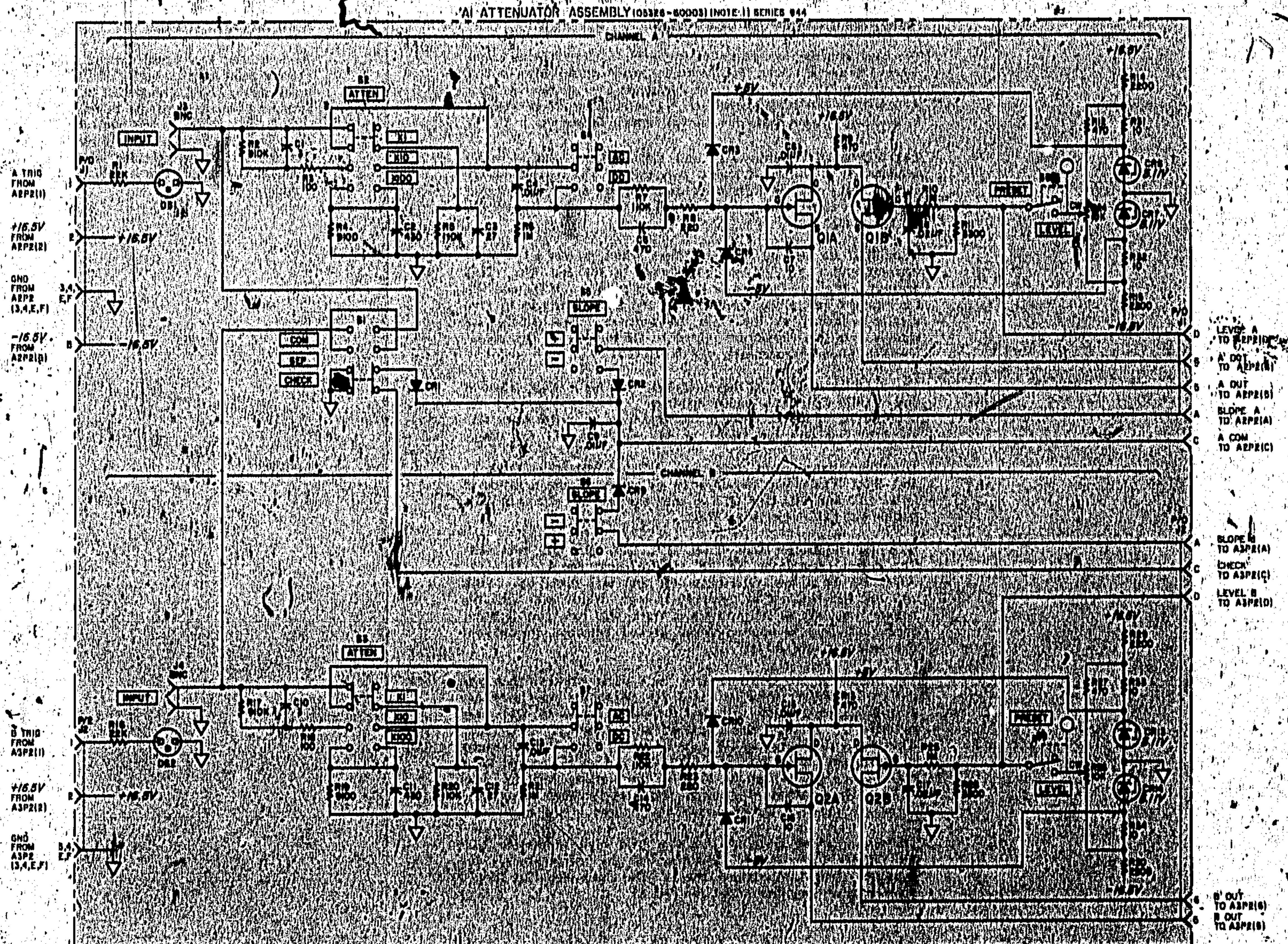
Q1A and Q1B form a differential amplifier connected as source followers. The outputs are fed to A2 via pins 5 and 6 of J1. LEVEL potentiometer R24 determines the trigger level on Q1B gate. The trigger level can be preset to zero volts or varied from -3 to +3 volts; or with the LEVEL control set to PRESET, an external trigger level can be applied at J10 to A1J1(D) for remote programming. Diodes CR6 and CR7 develop 5 volts for the input protection and level pots. R12 adds symmetry to the voltage range of R24. R11 lowers the impedance of Q1B gate circuit to limit stray charges and false triggering. R10 and C8 form a filter to prevent noise from triggering the differential amplifier.

When SLOPE switch S5 is set to -, a ground is supplied via CR2 to J1 pin A. This sets amplifier trigger A2 to trigger on the negative slope of the input signal. When remote programming is used, J1(C) is held high to disable the SLOPE switches and the CHK switch.

COM-SEP-CHK switch S1 connects inputs A and B in parallel when set to COM and grounds J2(C) via CR1 for the check mode.

A1 contains trigger lights DS1 and DS2 and current limiters R1 and R2. CR1, CR2, and CR9 eliminate interaction of the remote programming signals.


TOP
BOTTOM
J3
A INPUT
X1
X10
X100
AC
DC
DIFFERENTIAL
AMPLIFIER
Q1
TRIGGER
LEVEL
J1
A
A'
SLOPE A
SEP
COMMON
CHECK
COMMON
J2
SLOPE B
J4
B INPUT
X1
X10
X100
AC
DC
DIFFERENTIAL
AMPLIFIER
Q2
TRIGGER
LEVEL
B
B'



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

A1
C1-17 CR1-4,6,7, 9-11,13,14, DS1,2 J1-4 Q1,2 R1-34 S1-9

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,2,8	1910-0016
CR3,5,10,11	1901-0376
CR6,7,13,14	1902-0041
Q1,2	1855-0334

05326-8-1

COMPLETE PARTS LIST FOR THE THIS ASSEMBLY IS LOCATED ON PAGE 6-3

Figure 8-6. A1 Attenuator Assembly

A2, A3 AMPLIFIER/TRIGGER OPERATION

Two input amplifier assemblies are provided: A2 for Channel A and A3 for Channel B. Since the assemblies are identical, only one will be described. The input signal and the trigger level are received from A1 via P2(5) and P2(6) respectively. Potentiometer R2 is adjusted to cancel out offset voltages due to imbalances in the circuit.

The differential amplifier (Q1 and Q8) serves to clip a small window out of the input signal waveform. The outputs of Q1 and Q8 drive another differential amplifier Q2 and Q6. Q2 and Q6 inject a current drive input to differential Schmitt trigger Q3, Q4, Q5, and Q7.

Q3 and Q7 are common base amplifiers, which present a low input impedance and high output impedance to Q4 and Q5. This arrangement allows for greater high-speed operation of Q4 and Q5. C2 and R15 reduce the hysteresis of the Schmitt trigger to give greater reliability at the high frequencies. Two out-of-phase signals from this circuit are routed to Q9 and Q10. The output levels shift from approximately +0.8 to +0.5 volts.

The SLOPE switch on A1 drives U1D(11) low for a +slope selection and U1A(3) low for a -slope selection. This allows either the in-phase signal or the out-of-phase signal to be switched to Q13 via Q10 and Q12 for +slope or via Q9 and Q11 for -slope.

The differentiator circuit consists of Q13 and feedback network L8 and R32. The circuit develops 10 ns pulses at the collector of Q13. CR3 and CR4 bias Q13 so that the collector circuit is compatible with ECL output driver U2B.

U2A(6) drives trigger-lamp driver Q16, Q17, Q18, Q19, and Q20. The circuit consists of RS FF Q16-Q17 and one-shot Q19-Q20. When U2A(6) is low, Q16 turns off and Q17 turns on. With Q17 on, Q18 cuts off to drive P1(1) high, which will light the trigger lamp DS1 on A1. As C8 charges, Q20 base goes positive. When Q20 base is approximately ground potential, the one-shot fires to turn off Q19 and Q17.

The marker circuit, Q15 and Q14, is a pulse stretcher that provides a low marker output at P1(12, N). When the input amplifier circuits trigger, U2B(8) provides a positive spike to Q14 base to drive Q14 collector below ground and allow CR5 to conduct. This makes the charge on C6 more positive. When U2B(8) returns to logical zero (approximately -1.6 V), Q14 is back biased and turns off, allowing Q15 to turn on to drive the marker output line low. After C6 has discharged through R36, Q14 turns on again, Q15 turns off, and the marker output line returns to the high state.

During the check mode, A1P1(C) is held high to disable U2B and enable U2A. With U2B disabled, the marker pulses are inhibited. With U2A enabled, the 10 MHz check signal at P1(4,D) connects to the amplifier output line P1(5,E).

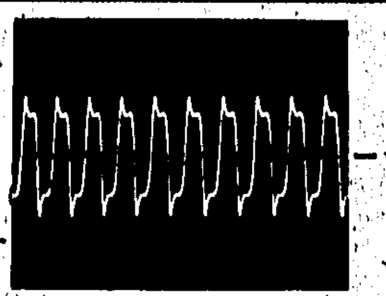
A2 TROUBLESHOOTING

When tracing the signal through the amplifier assembly, a good starting point is the collector of Q4, test point 4. With a sine wave input and the LEVEL control set to zero, this waveform should always resemble a square wave, due to the action of the Schmitt Trigger. A second check would be test point 6. If no signal is available there, check the slope gates of U1 and transistors Q9-Q12. Make use of the waveforms that are provided on this page. Once the problem is confined to a general area, use dc voltage checks to pinpoint the trouble.

Figure 8-6
A1 ATTENUATOR ASSEMBLY

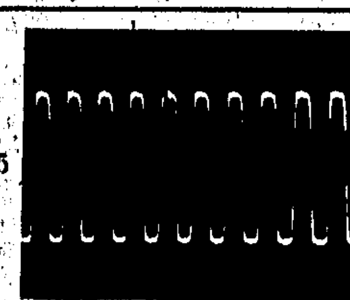
(See Page 8-15)

Part of Figure 8-7. A2, A3 Input Amplifier Assembly

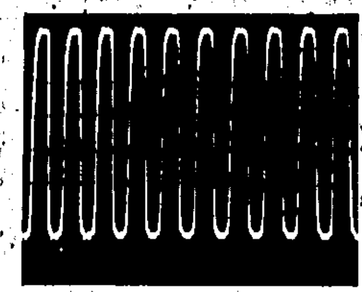


.05 V/cm
.1 µs/cm
ac coupled

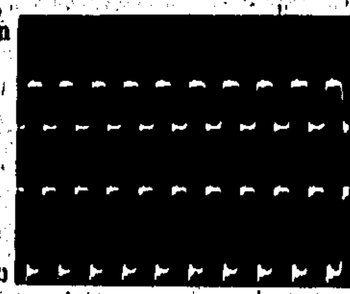
.01 V/cm
.1 µs/cm
ac coupled



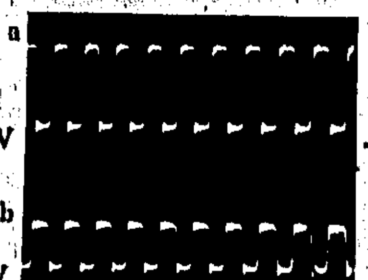
.05 V/cm
.1 µs/cm
ac coupled



.02 V/cm
.1 µs/cm

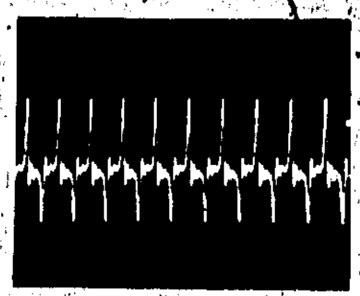


+SLOPE
a. Q10 emitter
b. Q9 emitter
.05 V/cm, .1 µs/cm



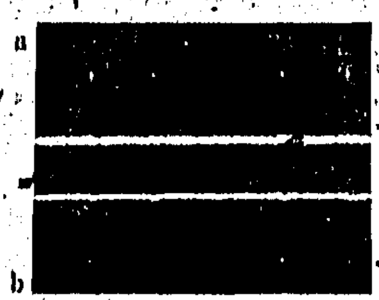
-SLOPE
a. Q10 emitter
b. Q9 emitter
.05 V/cm, .1 µs/cm

.02V/cm
.1 µs/cm



.05 V/cm
.1 µs/cm

.05 V/cm
.1 µs/cm



a. base .05 V/cm
b. collector 5 V/cm
10 ms/cm
CHOP B

DC VOLTAGES:
Set counter controls as stated.
Disconnect input signal.

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C7. A2 is mounted on extender board.

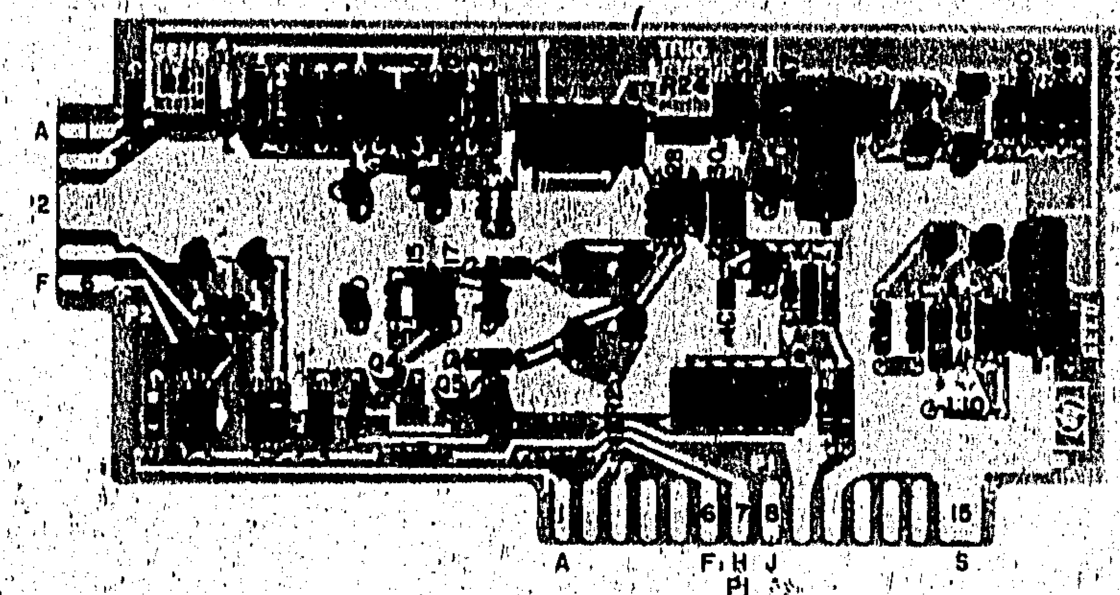
COUNTER CONTROLS:

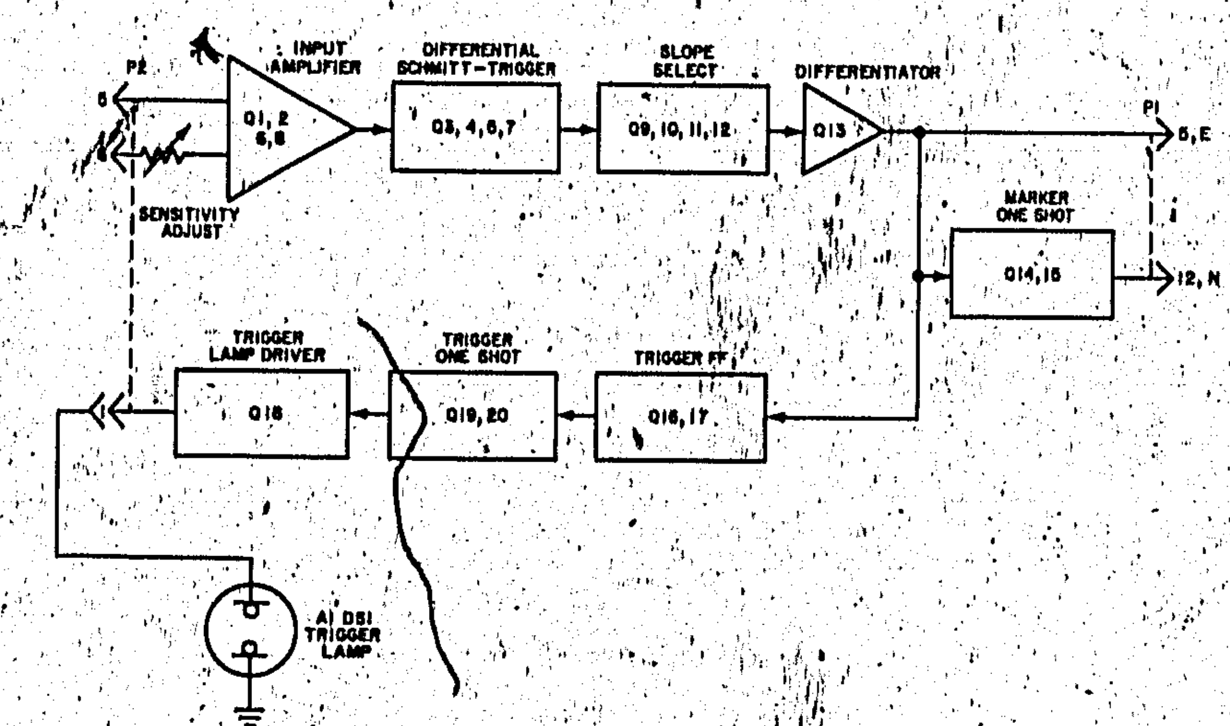
CHANNEL A Jack .... connect 10 MHz sine wave at 1 V rms
FUNCTION .... FREQ A
TIME BASE .... 1 ms
ATTEN X1
LEVEL .... PRESET
CHK/SEP/COM .... SEP
SAMPLE RATE .... FAST ccw
SLOPE .... +

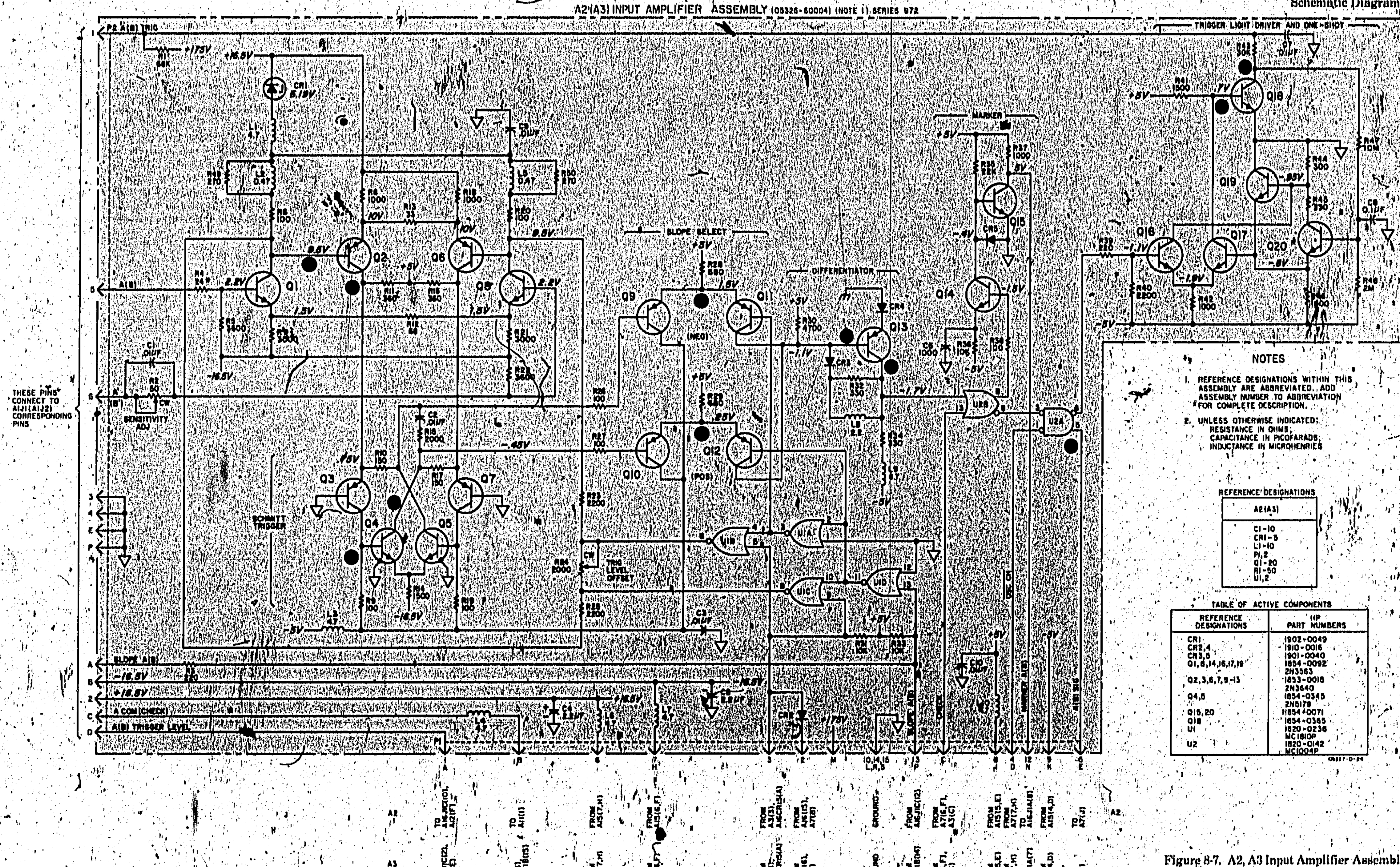
OSCILLOSCOPE CONTROLS:
(except as noted)

SWEEP MODE .... AUTO
TRIGGER .... INT
SLOPE .... +
DISPLAY .... for dual waveforms, use ALT B

MORE DATA UNDER FOLD







NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED;
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

REFERENCE DESIGNATIONS

A2(A3)
C1-10 CR1-5 L1-10 P1,2 Q1-20 R1-50 U1,2

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1	1902-0049
CR2,4	1910-0016
CR3,5	1901-0040
Q1,8,14,16,17,19	1854-0092 2N3563
Q2,3,6,7,9-13	1853-0015 2N3640
Q4,5	1854-0345 2N5179
Q15,20	1854-0071
Q18	1854-0365
U1	1820-0238 MC1610P
U2	1820-0142 MC1004P

05327-D-24

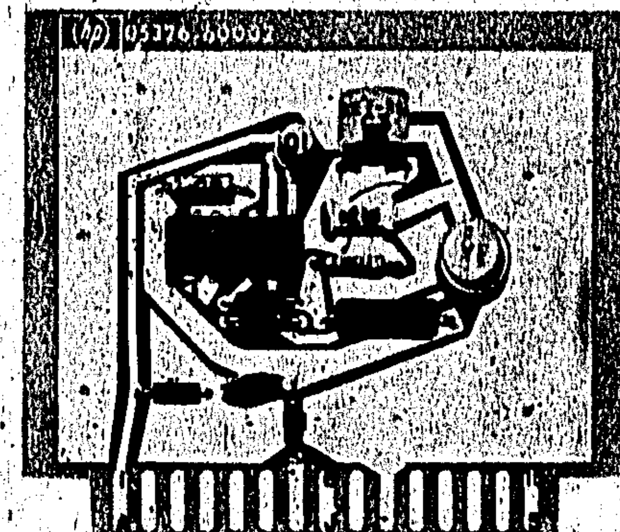
Figure 8-7. A2, A3 Input Amplifier Assembly.

A4 OSCILLATOR OPERATION

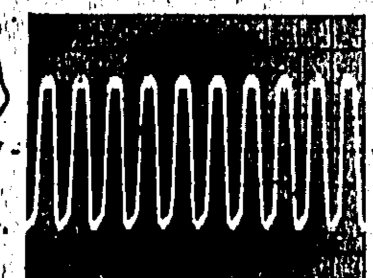
The 10 MHz oscillator assembly consists of oscillator U1A, buffer U1B, and level shifter Q1. U1A operates like an amplifier with positive feedback. The positive feedback path is from the noninverted output of U1A(6) through 10 MHz crystal Y1, trimmer capacitor C3, and C4 to U1A(4). Negative feedback is used to establish the input bias for U1A. The negative feedback path consists of R1 and R2. The inverted output of U1A(5) connects to buffer U1B(10). The buffer provides isolation between the oscillator and the output. The outputs of U1B(8) and (9) switch from approximately 3.5 to 4.25 volts. When one output is 3.5 volts, the other output is 4.25 volts. Level shifter Q1 converts the output of U1B to an approximate square wave of 0 to +4 volts.

Figure 8-7
A2, A3 INPUT AMPLIFIER ASSEMBLY
(See Page 8-17)

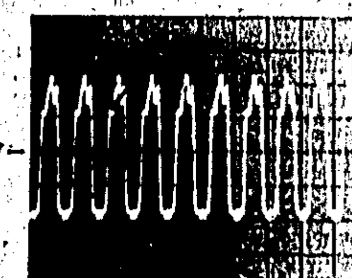
Part of Figure 8-8. A4 Oscillator Assembly



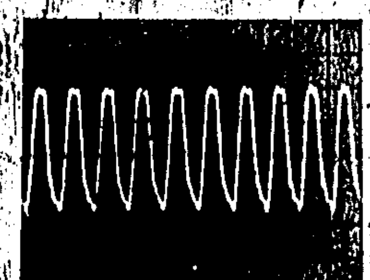
.01 V/cm
.1 µs/cm
ac coupled



.02 V/cm
.1 µs/cm
ac coupled



.02 V/cm
.1 µs/cm
ac coupled

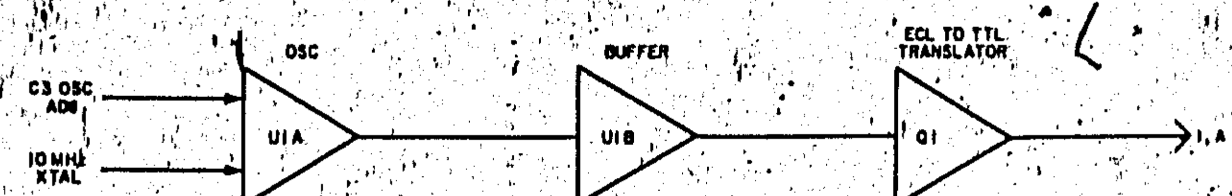


.1 V/cm
.1 µs/cm

All waveforms taken through 10:1 divider probe. Divider probe's 8½" ground lead is connected to ground side of C5.

COUNTER CONTROLS:

INT-EXT (rear panel) .... INT



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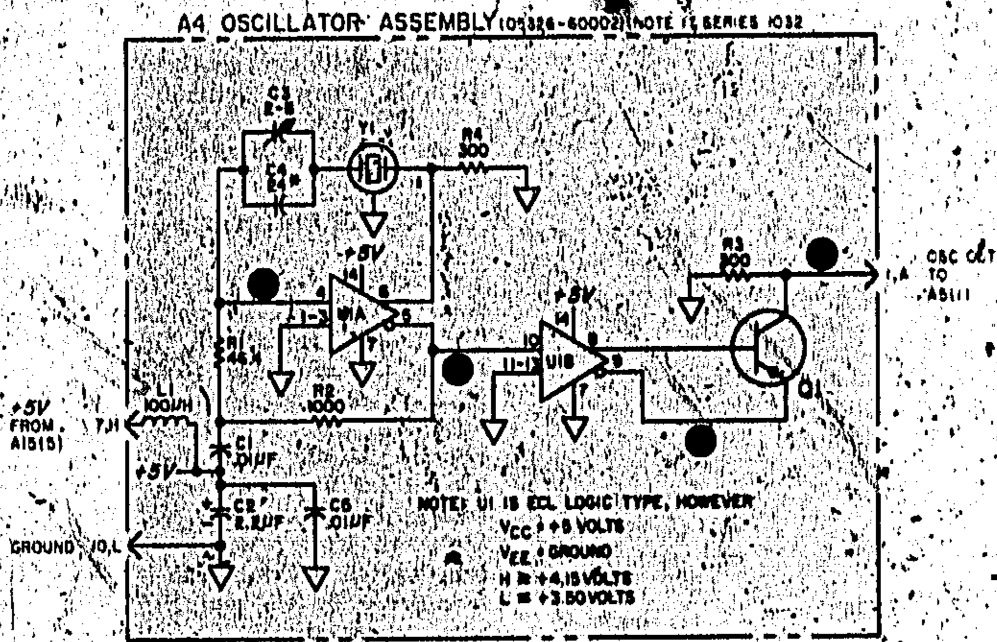


NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

REFERENCE DESIGNATIONS

A4
C1-5
L1
Q1
R1-4
U1
Y1

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
Q1	1850-0158 2N2635
U1	1820-0142
Y1	0410-0405

Figure 8-8. A4 Oscillator Assembly

Part of Figure 8-9. Time Base Control Assembly

A5 TIME BASE OPERATION

This assembly contains 8 decade dividers which are controlled by TIME BASE switch S5. The input signal is 10 MHz for the frequency mode. For the totalize and period-average modes, the decade dividers receive CHANNEL A signals.

When a particular decade receives a gate-enable signal the corresponding gated output line is enabled. For example, if S5 is set to .1 second U1(6) is grounded. This gates the divided signal out on U1(5). The gated outputs are connected together on a common line to C5. C5 differentiates the high to low transitions into approximately 100 ns pulses at U5C(8). When S5 is set to .1 μs, the input signal bypasses the decade dividers and passes through U10D and U5D. The output of U5C feeds through U10C to A7 and also through U10E to the rear-panel TIME BASE OUTPUT jack J6.

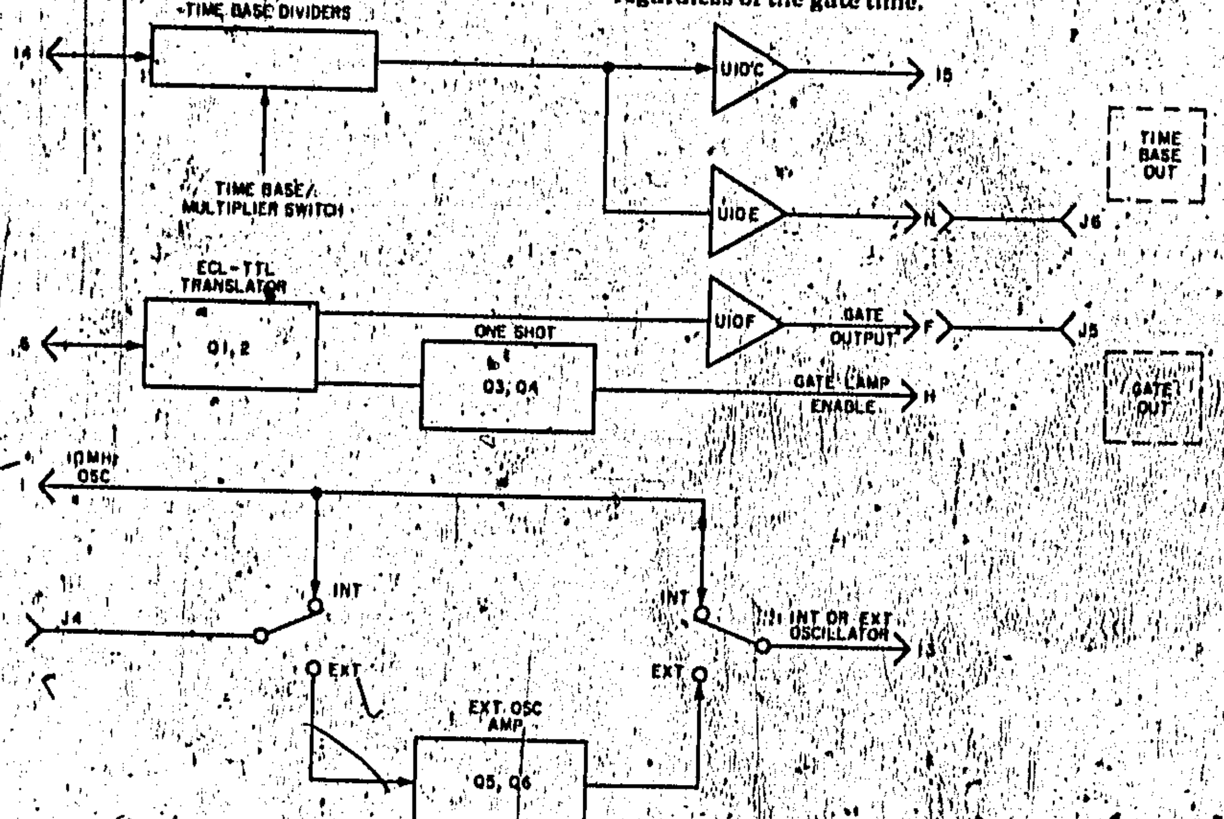
Q1 and Q2 form an ECL to TTL translator. When the main gate opens (low is main gate enable), Q2 turns on the start one-shot Q3/Q4. During short gate-length times, this holds the gate lamp enable line low for approximately 50 ms to extend the time the gate lamp is on. When Q1 collector goes high, a low is developed at U10F(12) and routed to the GATE OUT jack J5.

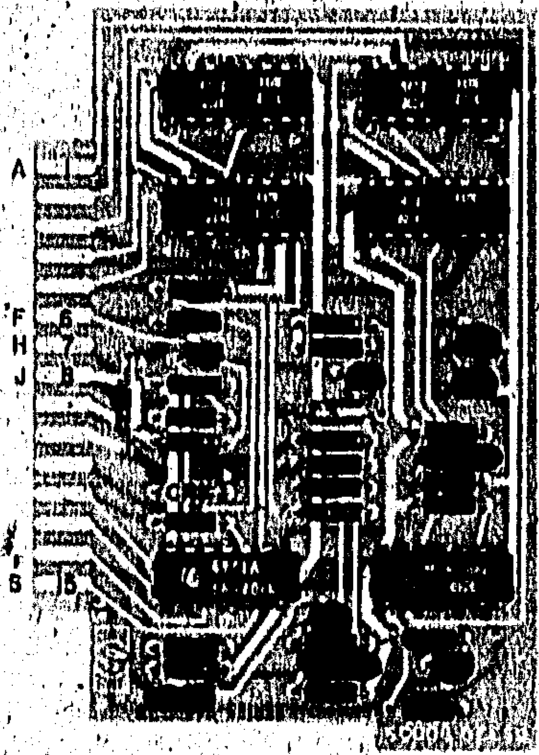
U5A and U5B select either the internal or external oscillator signal. When S7 is set to EXT, the internal oscillator signal is inhibited, and the external oscillator signal passes through Schmitt trigger Q5 and Q6 to U5B and XA5(10).

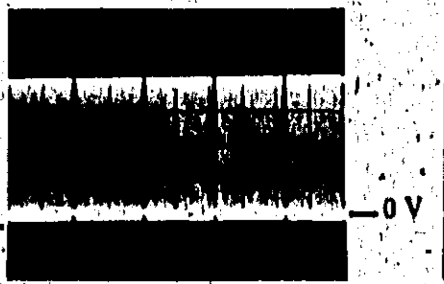
A5 TROUBLESHOOTING

When troubleshooting the Time Base Dividers, place the FUNCTION switch to START and SEP/COM/CHK to CHK. Step the TIME BASE switch through each position and note the counter's display. When the counter stops totalizing, check for a low on pin 6 of the selected decade. If the counter does not totalize for any position of the TIME BASE switch, the problem is in the circuitry of U10B, U10C, or U5C. Before the gated output is sent to the A7 Function Control, it is differentiated by C5 and R18. This produces extremely sharp pulses, which are best observed when the gate time is 0.1 μs (TIME BASE switch).

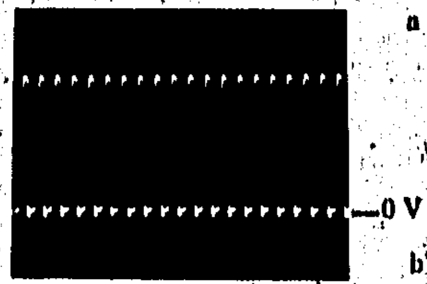
To check the operation of the Gate Lamp one-shot, check for waveform 5 and 6 with SAMPLE RATE switch to NORM. The Collector of Q3 should be Low for about 50 ms, regardless of the gate time.



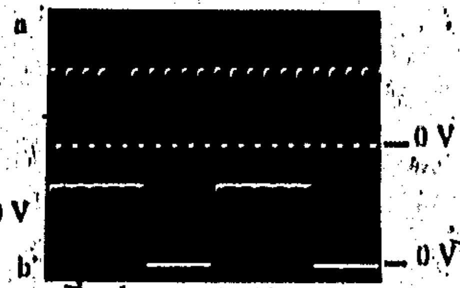




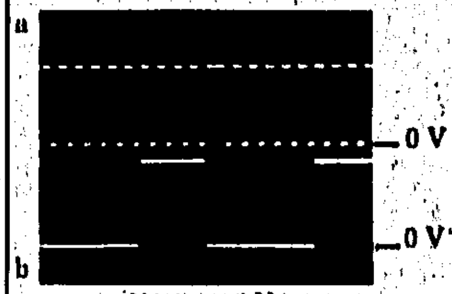
.1 V/cm
.5 ms/cm



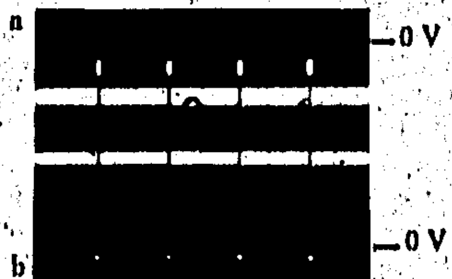
.1 V/cm
.2 µs/cm



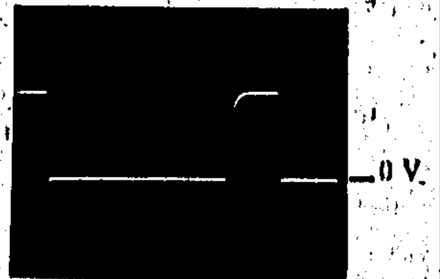
a. U7(2) .2 V/cm
b. U7(4) 2 µs/cm



a. U2(2) .2 V/cm
b. U2(5) .2 ms/cm



a. Q1 base · .1 V/cm
b. Q1 collector · .2 V/cm
.5 ms/cm



.2 V/cm
10 ms/cm
SAMPLE RATE · NORM
SWEEP MODE · NORM

COUNTER CONTROLS:
(except as noted)

Use settings of A2 Assembly

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C1. A5 is mounted on extender board.

DC VOLTAGES:
Set counter controls as stated.
Disconnect input signal. Push RESET.

OSCILLOSCOPE CONTROLS:
(except as noted)

Use settings of A2 Assembly

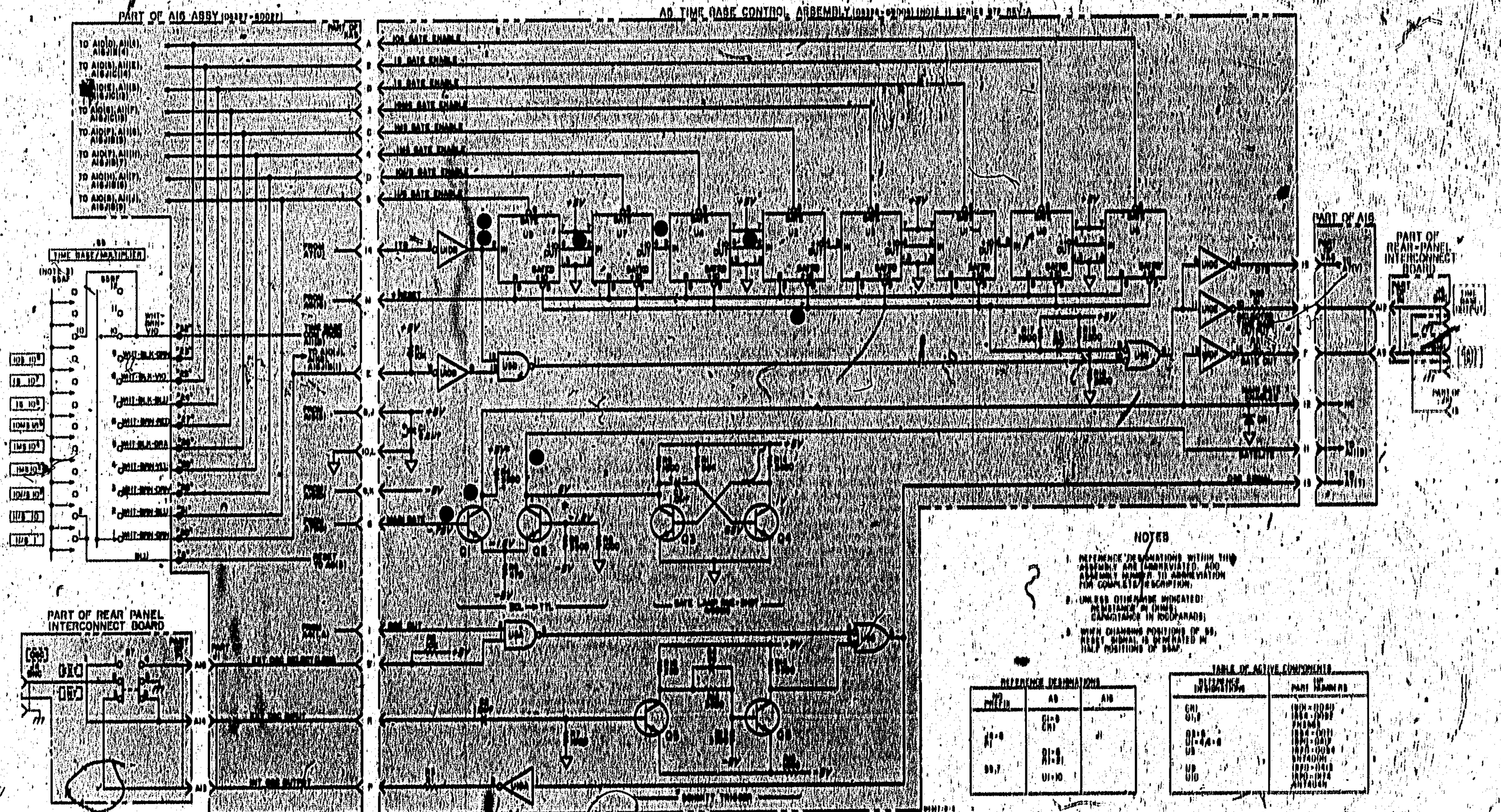


Figure [illegible]. A8 Time Base Control Assembly

A6 SAMPLE RATE OPERATION

The samplerate circuits determine interrogation rates for the input signal and provide several functions for the various operating modes. These functions include generating reset, transfer, print command, and main-gate inhibit signals. In addition, the circuits receive computer inhibit, printer inhibit, and manual reset signals. The circuits also serve to control storage and display-hold functions.

As an example of operation, assume the following operating conditions: STORAGE to ON, SAMPLE RATE to FAST, no printer inhibit, no computer inhibit, no manual reset, and main gate open. At the end of the gate time, Pin 17 goes high, which sets inhibit flip-flop U8. This sends a signal to U8C to generate a high inhibit at U8B(9). In addition, a low is generated at Q4 collector to trigger the sample rate one-shot if no printer inhibit is present at U5B(6). The display time starts at this point, and the high at U5C(10) generates a low at U1D(11). The resulting high on U1C(8) turns on Q6, giving a low at the collector, which is the print command. Also at this time, the low on U1B(6) activates U4C through differentiator C5 to generate the positive and negative transfer signals at pins T and K, respectively.

When the sample rate one-shot is set, U1B(6) goes low to turn off Q7, allowing the +5 V supply and R41 + R1 to charge C4 for the display time. C3 is also connected for the NORM position. R1 varies the display time by varying the time required to bring Q8 base to a sufficient plus value to trigger Schmitt Trigger Q8 through Q10. This gives a high at U1A(1). The reset will be delayed until there is no print inhibit. U1A(3) will go low, generating a high at U8B(6), which is fed out at A8(10). The negative reset at U8C(8) is fed out at pin 9 in addition to being used to reset the sample rate one-shot.

The positive reset is used on A6 after passing through level shifter CR7 and CR8. The positive reset turns on Q1 and applies an ECL high to clear U8 and also turns on Q2, which maintains inhibit approximately 200 ns after the end of the reset pulse. At this time, the inhibit goes low and the main-gate circuits are free to function.

Q11 circuitry is a reset one-shot that ensures a sufficiently long reset pulse. The reset pulse width is approximately 40 μs or 400 μs, as determined by the FAST/NORM switch. For NORM sample rates, S2 switches C10 in parallel with C8. The sample rate disable line (pins 10, L) is low during START mode and maintains continuous transfer through CR3 and prohibits main-gate inhibit through U4B in addition to holding down Q8 base through CR2. This prevents the reset from being generated.

When STORAGE is OFF, U5A is activated to maintain transfer through CR4. The manual reset (pin 8) holds the reset one-shot in the ON state as long as the RESET button is depressed (reset low). It also maintains the transfer during the same time to clear the display. In addition, it turns on the main-gate inhibit, even if the main gate is open. The manual reset signal is low if the RESET button is depressed or if the TIME BASE or FUNCTION switch is between positions. (No reset is generated between start and stop positions.)

A6 TROUBLESHOOTING

Troubleshooting the Sample Rate board is best accomplished when the board is in a static state. The procedure given below examines each section separately when the circuit is in a working, but static, condition. Perform the tests in order listed. The schematic shows the circuit levels after RESET is pushed. These levels should be used as a reference.

NOTE

Do not use an input signal when performing the tests below.

MAIN GATE INHIBIT, PRINT COMMAND DRIVER, and SAMPLE RATE ONESHOT. Before troubleshooting, perform the procedure below.

FUNCTION switch .... FREQ A
TIME BASE switch .... 1 s
SAMPLE RATE switch .... HOLD
SLOPE switch .... +
CHK/SEP/COM .... SEP
STORAGE switch .... ON
LEVEL control .... full cw
Push RESET
LEVEL .... full ccw
(Note that trigger lamp fires)

The purpose of this procedure is to set these circuits to the point immediately after the main gate closes. Varying the LEVEL control triggers a pulse to open the main gate for 1 second, and pin 17 goes Low during the gate time. U2 sets when the gate closes (positive transition) and remains set with the SAMPLE RATE switch set to HOLD. Once U2 sets, check for a Low on U8C(8). This generates a High on U1C(8) and a Low on U1D(8). Check that U4C(8) pulses High and Q6 collector sets Low. The main gate inhibit flop at U8B(8) should now be High. The collector of Q7 is not now affected.

SAMPLE RATE INHIBIT. The sample rate inhibit gates are controlled by the FUNCTION and STORAGE switches and by a print inhibit signal. With the controls set as above, check for the levels shown on the schematic.

SCHMITT TRIGGER. The Schmitt Trigger and Q7 should be checked by using an input signal. Set the counter controls as listed under the waveforms. In waveform five, the repetition rate of the pulses changes with gate time, but pulse width remains the same. Pulse width changes with the SAMPLE RATE controls, but not spacing.

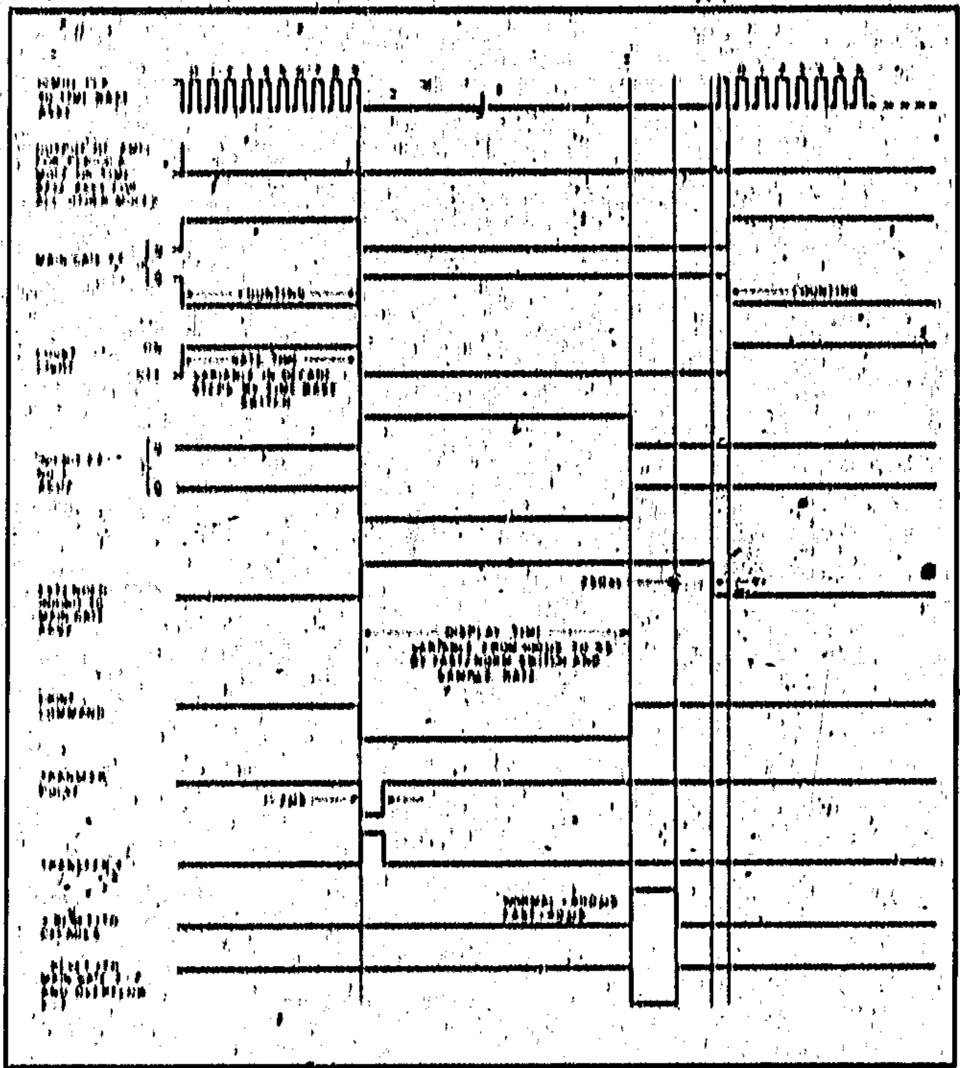
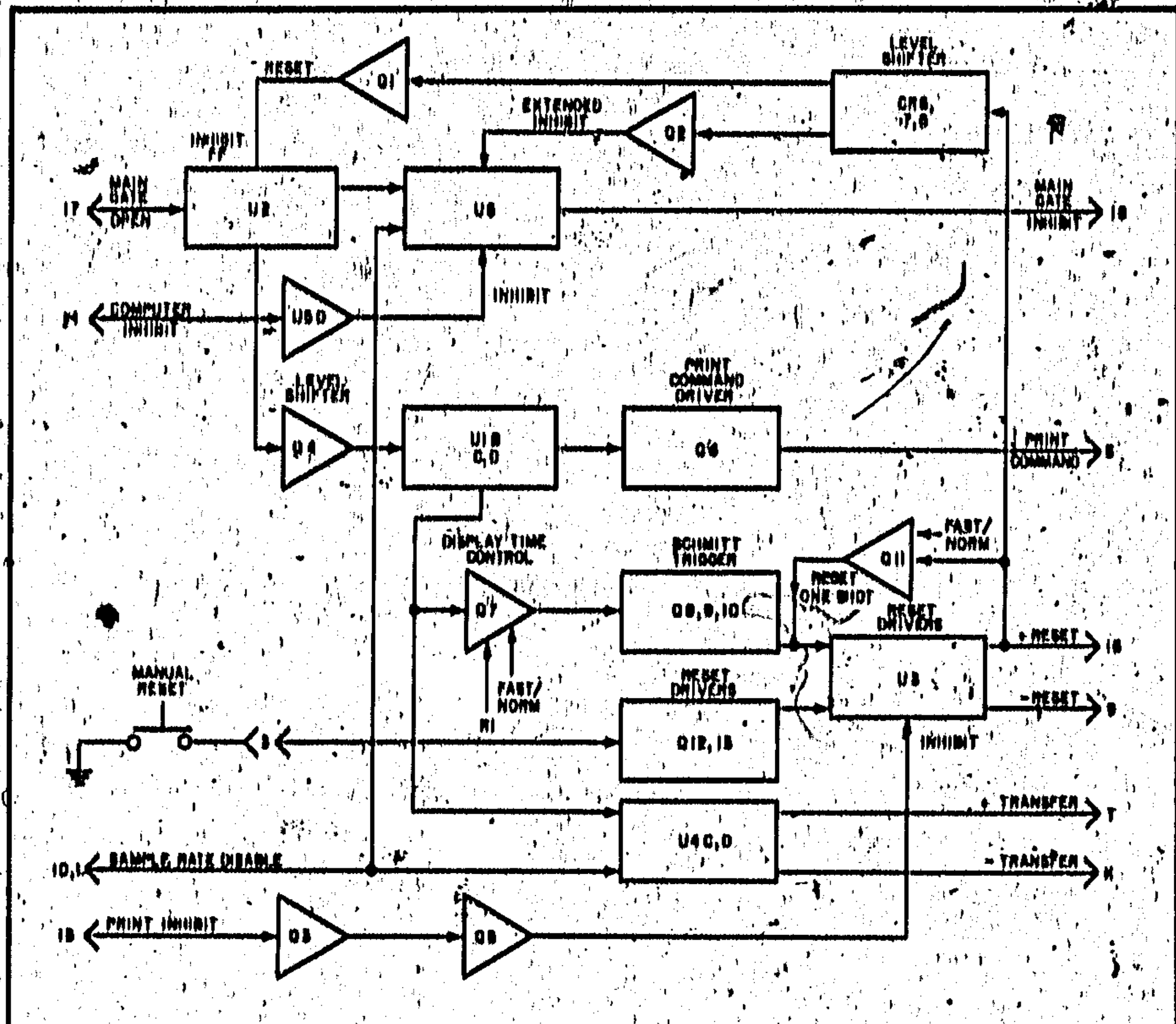


Figure 8-9
A5 TIME BASE CONTROL ASSEMBLY
(See Page 8-21)

Part of Figure 8-10. A8 Sample Rate Assembly



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS.

REFERENCE DESIGNATIONS

NO PREFIX	A8	A18
R1 S2, 3, 5, 6, 8	C1-12 CR1-5, 7-11 Q1-13 R1-43 U1-6	J1

DELETED: CR6

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1, 2, 6, 7, 8, 10, 11	1901-0040
CR3, 4, 9	1910-0016
Q1-3, 5, 6, 8-10, 12, 13	1854-0071
Q4, 11	1854-0009 2N709
Q7	1854-0215 2N3904
U1, 4	1820-0054 SN7400N
U2	1820-0272 MC1022P
U3	1820-0068 SN7410N
U5	1820-0328 SN7402N
U6	1820-0147

05327-B-30

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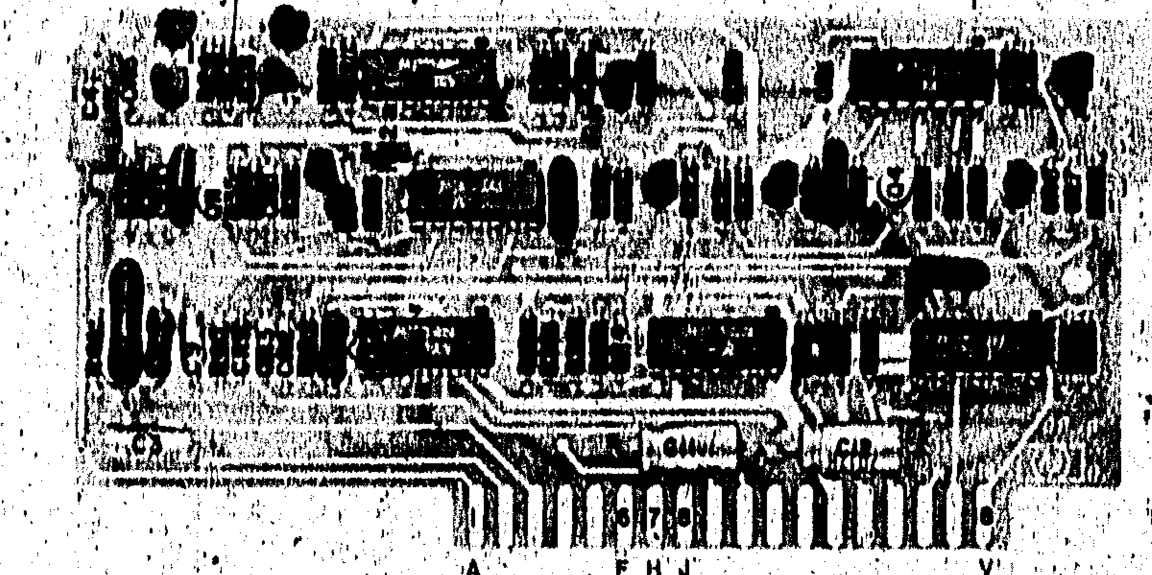
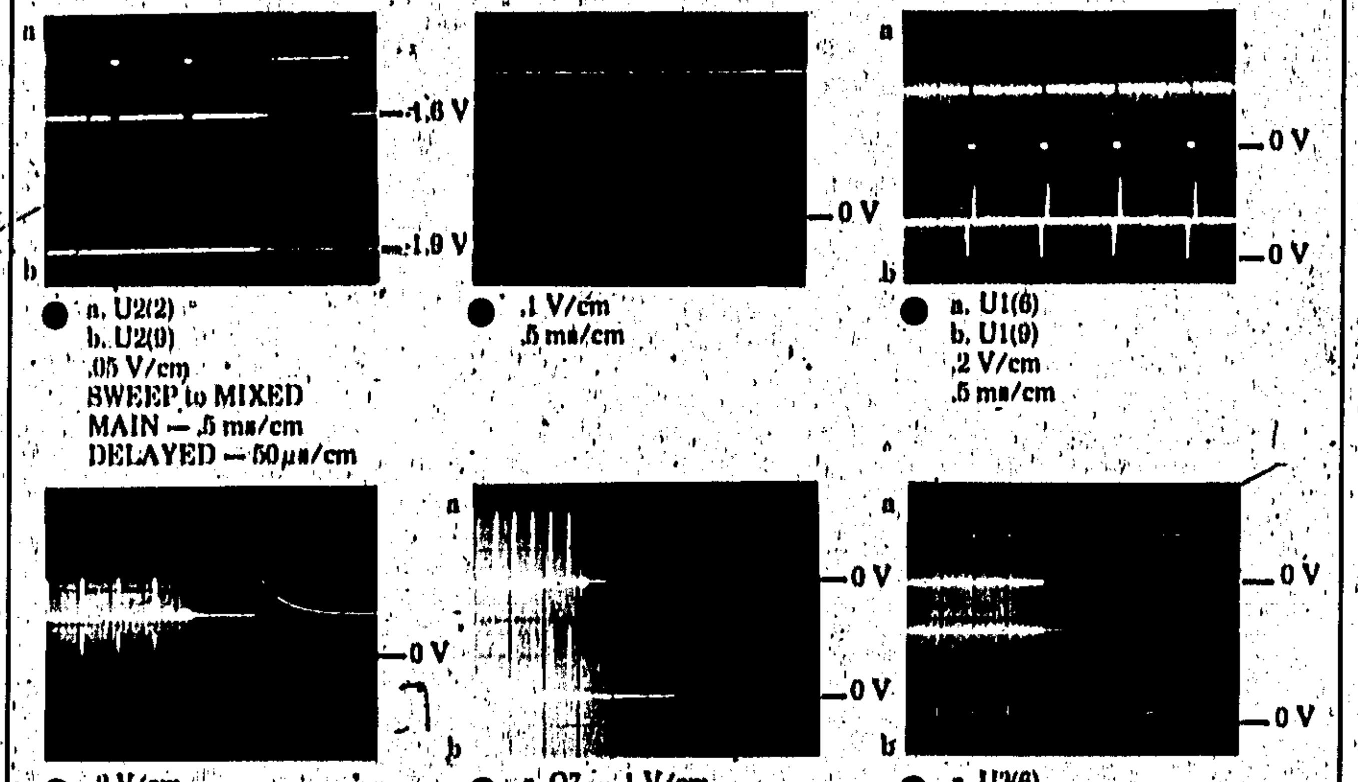




a. U2(2)
b. U2(9)
.05 V/cm
SWEEP to MIXED
MAIN — .5 ms/cm
DELAYED — 50 μs/cm

.1 V/cm
.5 ms/cm

a. U1(6)
b. U1(9)
.2 V/cm
.5 ms/cm

.2 V/cm
SWEEP to MIXED
MAIN — 1 ms/cm
DELAYED — 10 μs/cm

a. Q7 — .1 V/cm
b. Q10 — .05 V/cm
SWEEP to MIXED
MAIN — 2 ms/cm
DELAYED — 20 μs/cm

a. U3(6)
b. Q11 collector
.2 V/cm
SWEEP to MIXED
MAIN — 1 ms/cm
DELAYED — 10 μs/cm

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C11. A6 is mounted on extender board.

OSCILLOSCOPE CONTROLS:
Use settings of A2 Assembly

DC VOLTAGES:
Set counter controls as stated. Disconnect input signal. Push RESET.

HE,LE — ECL levels
H,L — TTL levels

COUNTER CONTROLS:
Use settings of A2 Assembly

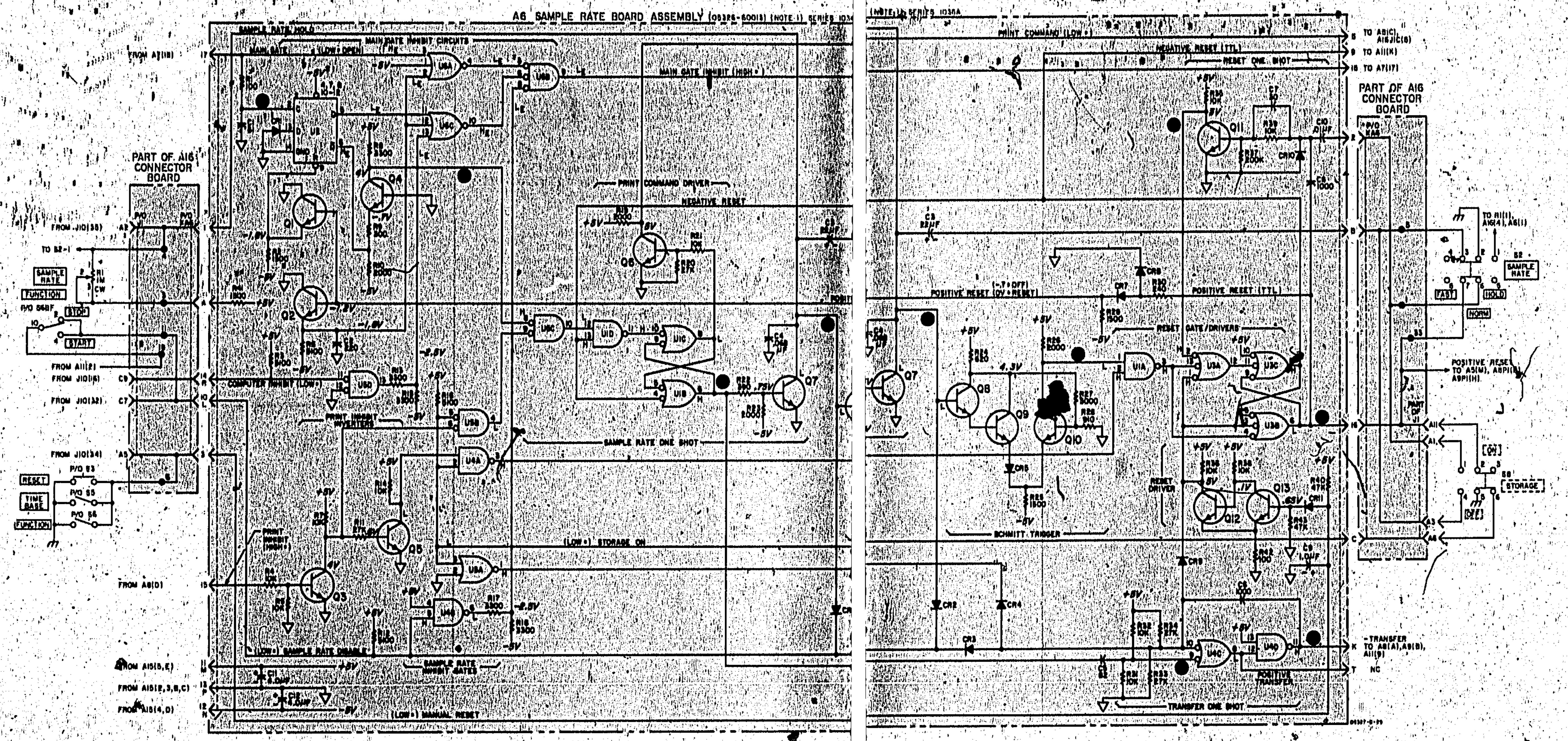


Figure 8-10. A6 Sample Rate Assembly

A7 FUNCTION CONTROL OPERATION

This assembly contains the gating, flip-flops, one-shots, and translators necessary to interconnect the oscillator, time base, and input channel signals to the time base and decade counting assemblies. Table I lists the functional interconnections for each function of the counter.

An example of the operation in the FREQ A mode will explain the typical circuit operation. This will be expanded to the other functions. Assuming the start of a new measurement, main gate inhibit (pin 17) has just gone low (at the end of the display time). Upon the arrival of the first subsequent channel A input, channel A flip-flop sets, making U4B(9) High. Upon the next leading edge of the oscillator signal (pin T, TTL levels; U7(4) ECL levels), U4B sets and arms the oscillator gate U3A. The gated oscillator signal is then connected to the time base input one-shot Q1-Q5, which generates 50 ns, negative-going pulses to the time base input (pin U).

The time base will return a pulse upon receipt of the 1st and Nth pulse delivered from pin U (N = multiplier setting on front panel). The 1st pulse arriving at pin V is translated from TTL to ECL by U7 and then goes on to toggle (set) main gate flip-flop U1. This opens the main gate (U11B), and the decade counting assembly counts the signal (in this case, input A — see Table I). Upon the arrival of the 2nd time base output pulse, U1 toggles closed, shutting main gate U11B and signaling A6 to start the display cycle (pin 18). A6 returns a High MINH (pin 17) and the main gate flip-flop U1, synchronizer U4, and ITB one-shot Q1-5 are locked closed at the end of the display. MINH goes low and the cycle repeats.

In the period mode, the main gate F-F U1 is toggled by the input A signal so that it is set for exactly one period of A. The counted signal is the oscillator divided by the MULTIPLIER switch setting.

In period average, the input A signal goes to the time base, which generates a pulse on the 1st and Nth pulse. These pulses toggle the main gate, and the oscillator is counted during N periods of A.

In START, the main gate is held open and the input signal, which is scaled by the time base, is counted. The Freq C operation is the same as Freq A, except that the input synchronizer U4B is held on by U12. IC's U2, 6, 8, and 10 are combination TTL/ECL translators and data switches. The function inputs (Freq A, Freq C, etc.) are TTL low true and are pulled up by internal 10k-ohm pullups on the translators. U7(3) is the check signal to Amplifier A2 and A3. In normal it is low; while in check, it is high with negative 10 ns pulses at 10 MHz. C2 and R13/R14 generate the 10 ns pulses from the edge of the oscillator signal.

In time interval, the operation is similar to period, but U1 is set continuously. MGATE OUT (pin 18) is now controlled by the output of U4B. The following explanation describes how the synchronizer U4A and B work in a time interval mode.

Assuming a display cycle has just been completed, the flip-flops formed by U5 and U5 and the U4 sections have been reset. Two conditions can occur:

First - If a channel A signal occurs before a B signal, the A signal will set the channel A flip-flop before the B sets the B flip-flop (see Figure I). When the first leading edge of the oscillator occurs after the A F-F is set, U4B is set, opening the clock gate and instructing A6 that the measurement has started (pin 18). The oscillator signal goes to the time base and is divided, returns, and is sent out through the main gate to A6 for subsequent display. When the B signal occurs, the leading edge of the next clock pulse sets U4A, closing the clock gate.

The U4A $\overline{Q}$ low signal goes back to U5(11) and waits about 50 ns for the falling edge of the oscillator. At this point, U5(10) goes high, resetting the A and B flip-flops, putting lows at the D input of U4A and B. When the clock pulse again rises positive, U5(10) goes low (about 10 ns after the clock edge) and U4A and B are clocked to the "cleared" state.

Second - If a B signal occurs before an A, U4A would be set first, and no counting would occur. Also, it would take about 100 ns for U4A to complete the resetting described above; so if an A signal occurred during this time, it would be ignored. If the B-to-A delay is >100 ns, the A signal would start the interval as described above.

With time interval averaging, the input synchronizers work the same way, but the oscillator (not divided) is counted for the duration of each, individual time interval that is being averaged. The first input A signal sets flip-flop U4B, which enables U3A to gate an oscillator pulse to the time base dividers. The dividers are now set to zero, from their previous reset-to-nine state. During this time, a channel B signal was received to complete the first time interval, but this first interval is not counted, since the main gate was closed. The time base output pulse enables the main gate to pass clock pulses for the duration of the time interval. After N intervals, the time base returns a pulse to close the main gate.

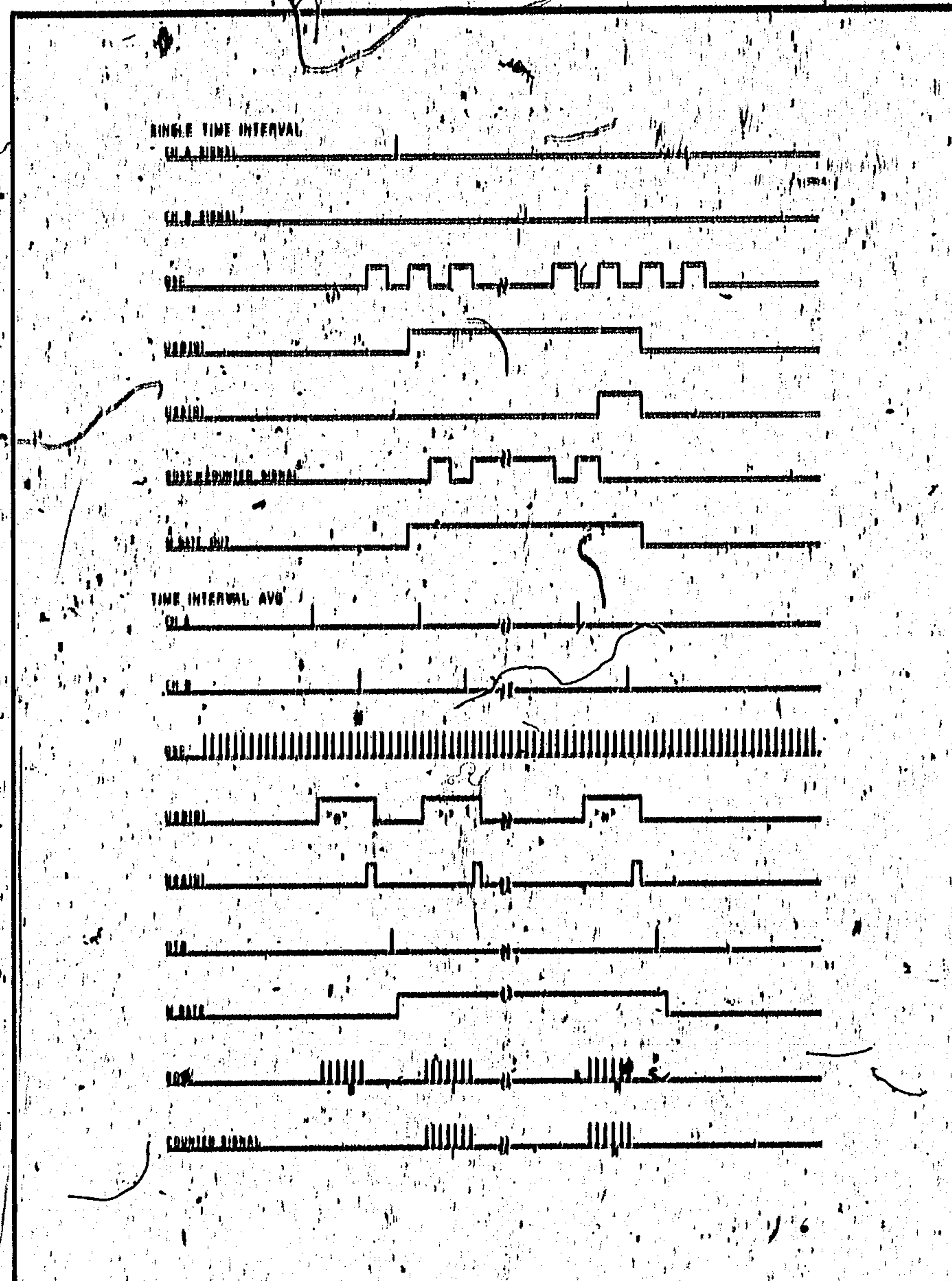
Table I. Functional Interconnections

FUNCTION	MOFF TOGGLE	TO DCA	PTB
STOP	0	OTB	0
START	1	OTB	IA
FREQ A	OTB	IA	GOSC
FREQ C	OTB	IC	GOSC
PERIOD	IA	OTB	GOSC
PERIOD AVG.	OTB	GOSC	IA
T.I.	1	OTB	GOSC
T.I. AVG.	OTB	GOSC	STI

DCA = Divide Counting Assembly
GOSC = Gated Oscillator
IA = Input A Signal
IC = Input C Signal
PTB = Input to Time Base
OTB = Output of Time Base
STI = Synchronized Time Interval

Figure 8-10
A8 SAMPLE RATE ASSEMBLY
(See Page 8-23)

Figure I. Timing Diagram for Time Interval Measurements



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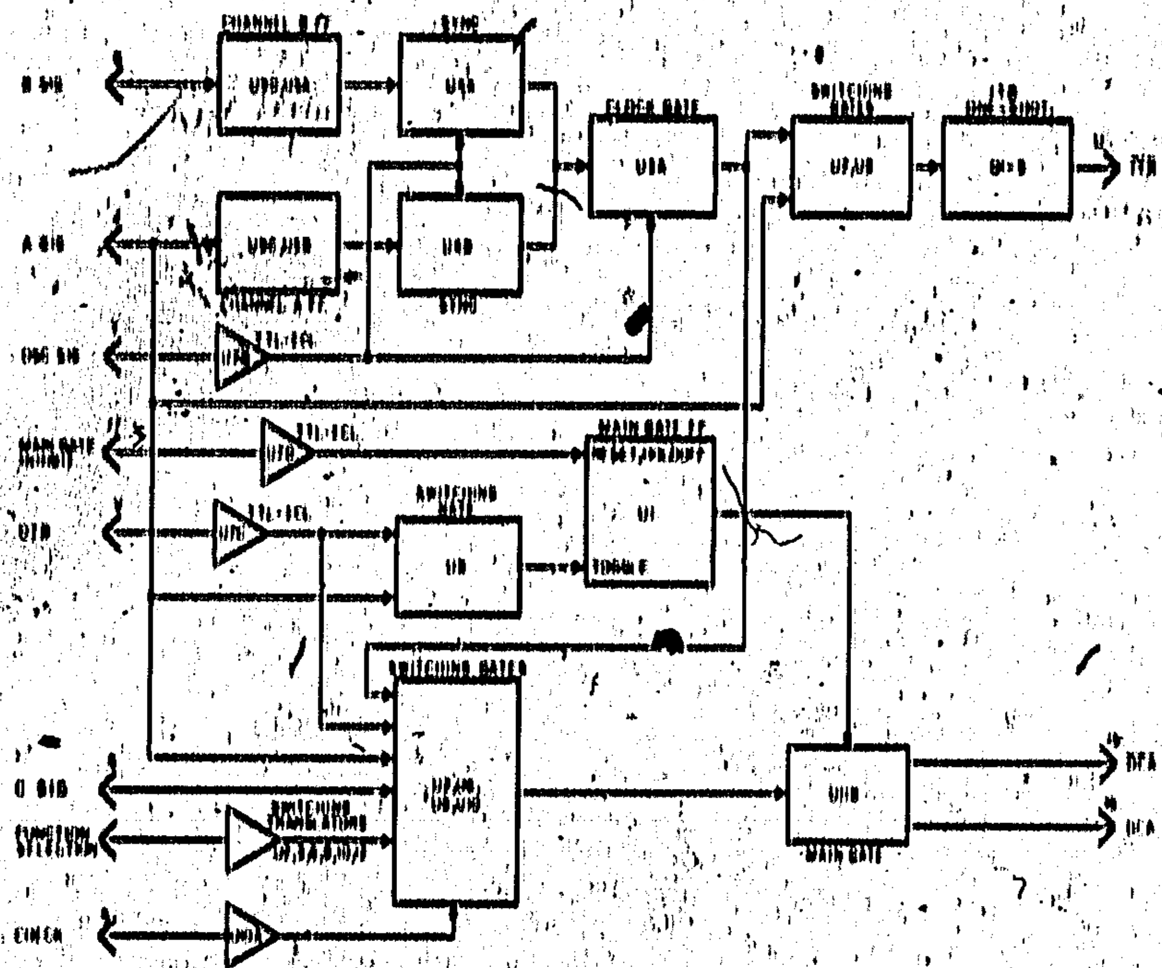
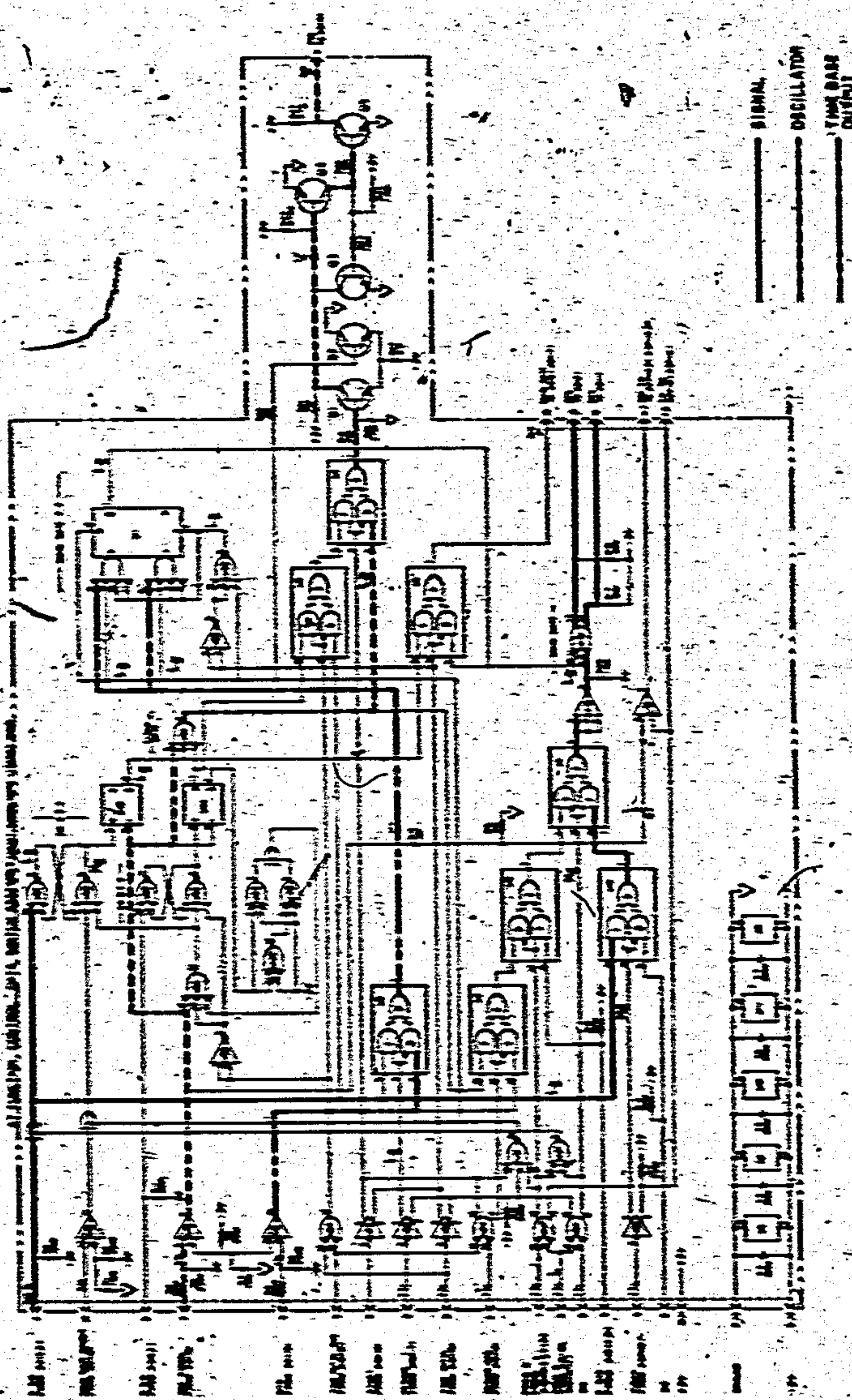
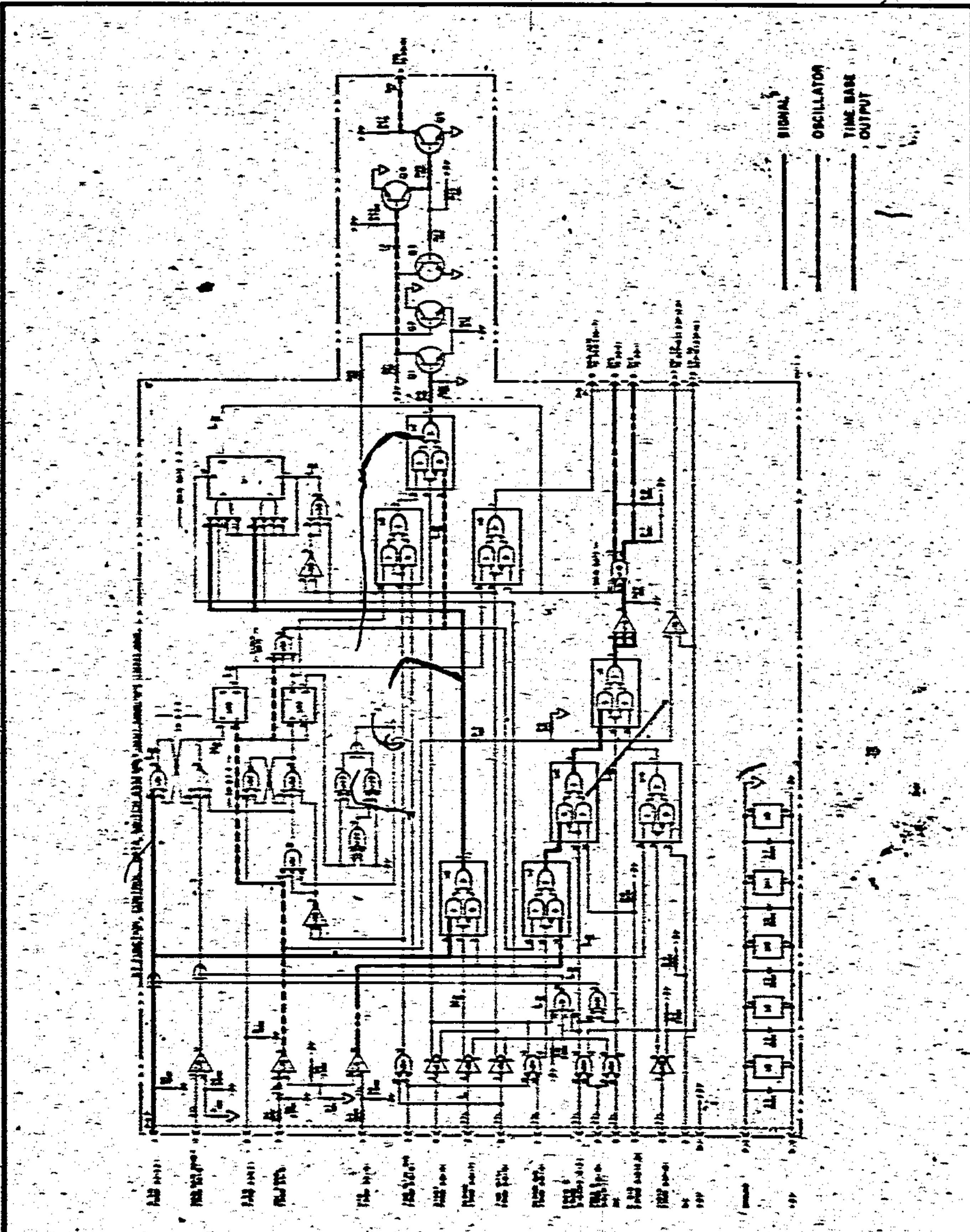
Part of Figure 8-11. A7 Function Control Assembly



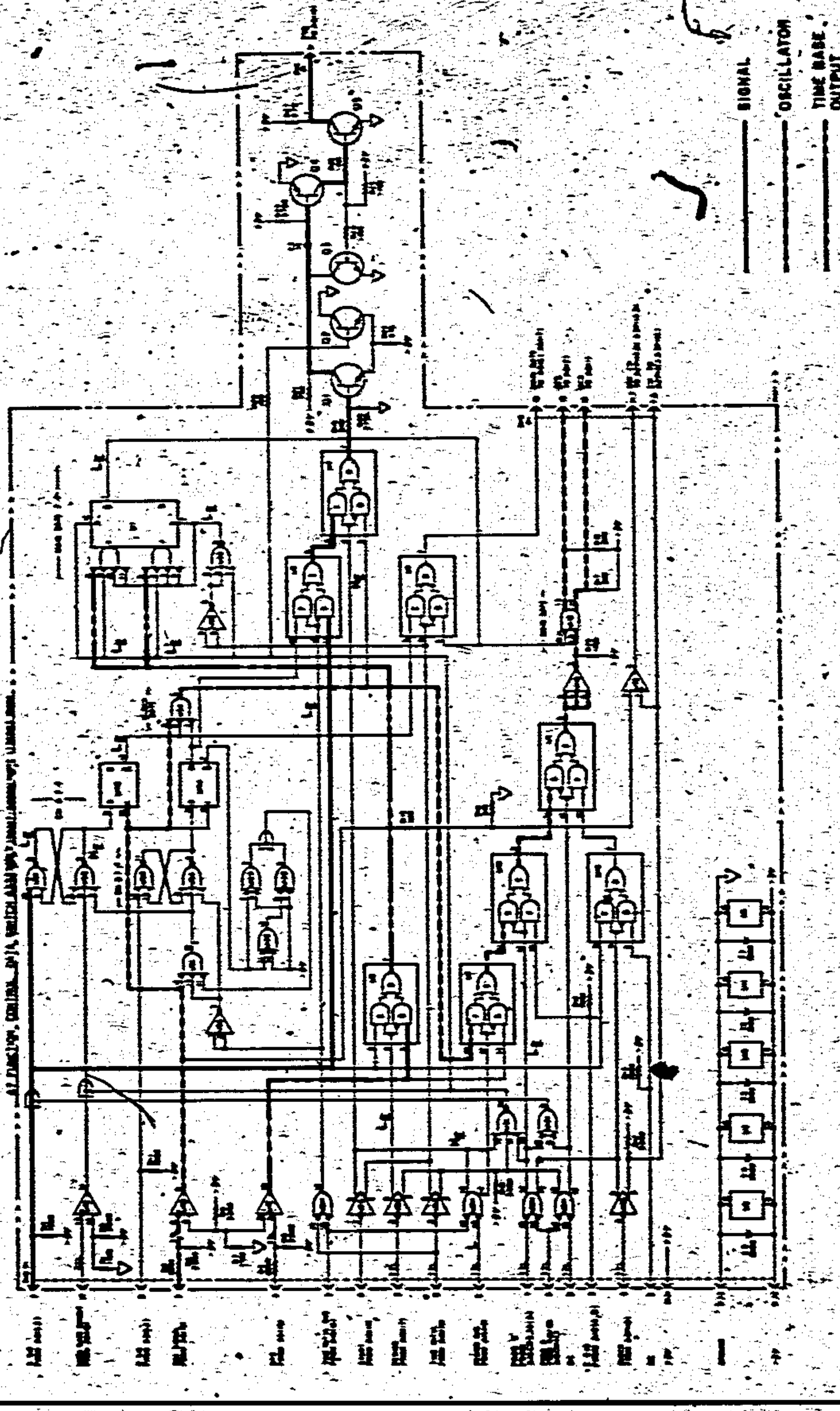
Part of Figure 8-11. Freq A Flow Diagram

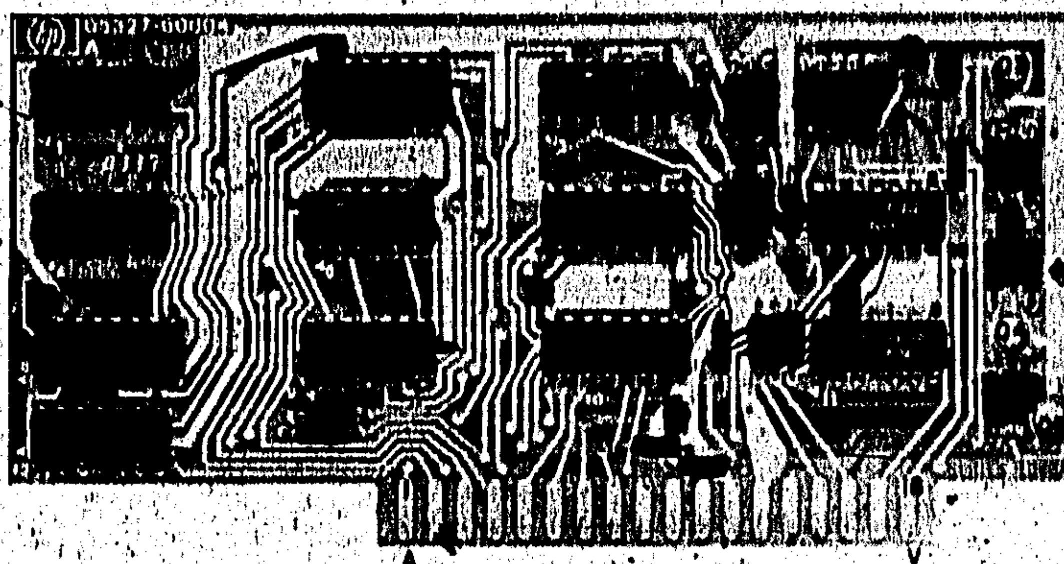


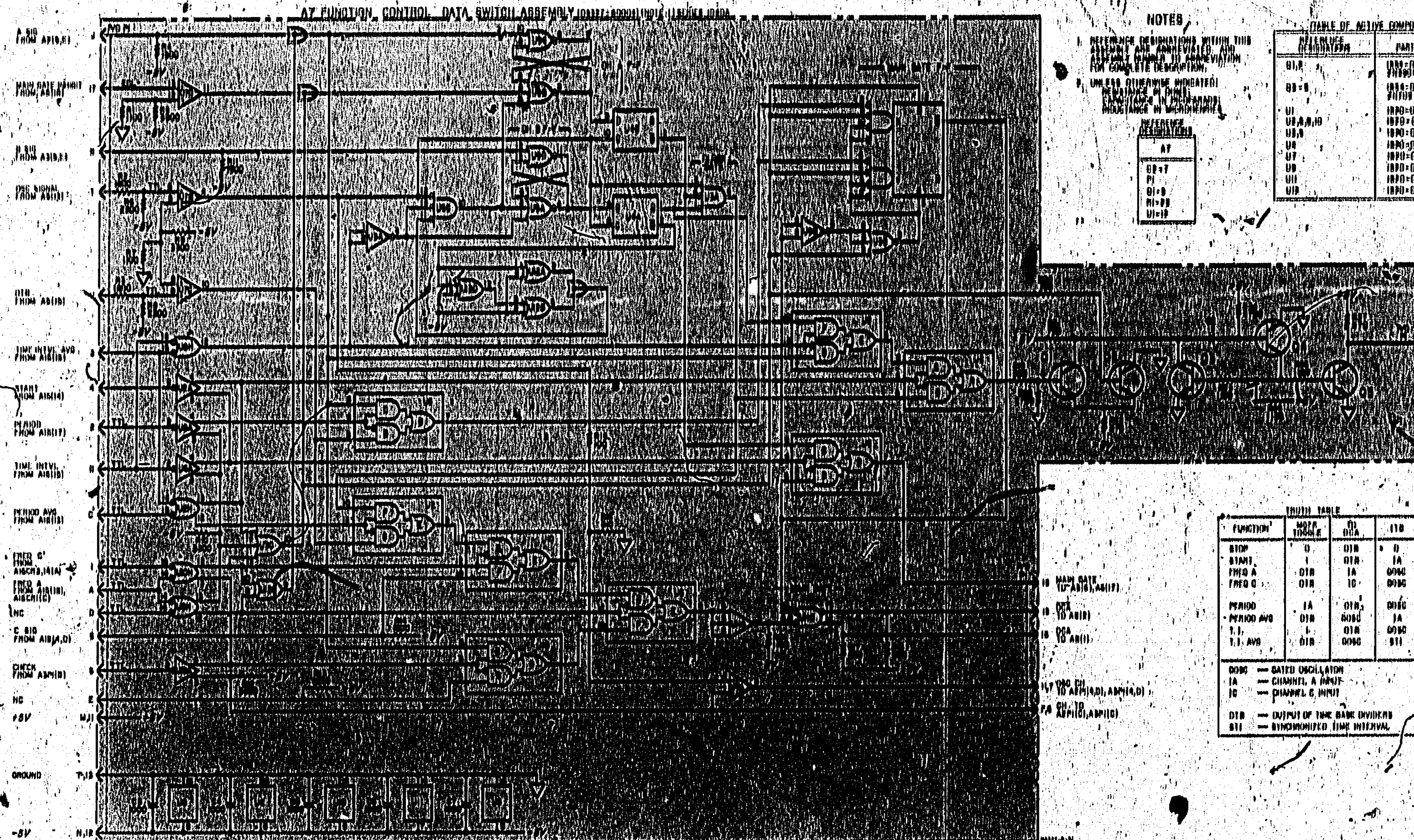
Part of Figure 8-11. Period Flow Diagram



Part of Figure 8-11. Period Average Flow Diagram







NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS; INDUCTANCE IN MICROHENRIES.

REFERENCE DESIGNATIONS
A7
C1-7
P1
Q1-9
R1-29
U1-12

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATORS	HP PART NUMBERS
Q1,8	1853-0010 2N3640
Q2-5	1854-0009 2N709
U1	1820-0054
U2,5,9,10	1820-0068
U3,6	1820-0147
U4	1820-0140
U7	1820-0010
U8	1820-0108
U11	1820-0099
U12	1820-0100

TRUTH TABLE

FUNCTION	MAIN TOGGLE	TO DCA	ITB
STOP	0	DTB	0
START	1	DTB	IA
FREQ A	DTB	IA	GOSC
FREQ C	DTB	IC	GOSC
PERIOD	IA	DTB	GOSC
PERIOD AVG	DTB	GOSC	IA
T.I.	1	DTB	GOSC
T.I. AVG	DTB	GOSC	STI

GOSC — GATED OSCILLATOR
IA — CHANNEL A INPUT
IC — CHANNEL C INPUT
DTB — OUTPUT OF TIME BASE DIVIDERS
STI — SYNCHRONIZED TIME INTERVAL

Figure 8-11. A7 Function Control Assembly

A8 DISPLAY SUPPORT OPERATION

The display support assembly A8 serves to interconnect the display assembly A9 with the interconnect assembly A10. In addition, A8 contains a high-speed decade counter, decimal point drivers, and blanking (logic) circuits.

The high-speed decade consists of four JK flip-flops U3 through U6. The line receiver, Q2 and Q3, serves to reduce noise levels on the signal from A7 prior to driving U3(6, 9). U3 divides by two and the combination of U4 through U6 divides by five. The decade supplies BCD outputs to A9 via J1(5, 4, 2, 3) for the 10⁰ display tube. The D output is also used as the carry output to the next decade counter on A9. Q1 translates the positive TTL reset signal to ECL levels to reset the high-speed decade to zero.

Decimal point drivers Q3 through Q8 work in conjunction with logic circuits on A11 to light the proper decimal points. R15 and R17 provide operating bias for Q3 through Q8. R19, R20, and R23 are current limiters. R2 and R3 provide 87.5 volts pre-bias for the OFF decimal points. R5 through R10 connect the off decimals to the pre-bias voltage to eliminate background glow.

As an example of operation, when a ground is received at P1(8) from A11, Q5 conducts. With Q5 on, decimal point enable line 3 (DP3) is pulled to ground to light the decimal point on A9DS4(10⁴). Also with P1(8) low, U1D(11) is high to unblank A9 U4. When U1D(11) goes high, U1B(6) and U1A(3) are also high to unblank A9U3 and U2. This unblanks A9DS4, DS3, and DS2. DS5 and DS6 remain blanked. DS1 is never blanked, and DS7 and DS8 (Option 001) will always be blanked.

CR2 and CR3 are included for use with the digital recorder Option 003. When overflow occurs, P1(M) and J1(15) go low. CR2 and CR3 cause J1(14 and R) to also go low. When J1(15, 14, R) are low, the recorder will print a zero on the annunciator line. R21 and R24 are pull-up resistors.

A8 TROUBLESHOOTING

High Speed Decade

If a problem in the High-Speed Decade is not readily apparent when checking for the correct waveforms, a step-through method may be preferable. Set the counter as follows:

1. MULTIPLIER switch to 10⁵.
2. CHK/SEP/COM switch to CHK.
3. FUNCTION switch to START.
4. Press RESET.

The High-Speed Decade has four output lines that are binary weighted DCBA. Release the RESET button and note the counter's display. A typical problem is as follows: The display counts 1...2...3...0...1...2...3...0. When the display reads "0," set the FUNCTION switch to STOP and check the C line for a Low (refer to the table below). Check the input lines of the IC, since their levels depend on the state of other IC's in the circuit (note U4 pin 8 and U6 pin 13). The levels given below are ECL.

	A	B	C	D
DISPLAY	U3(10)	U4(1)	U5(1)	U6(1)
1	L	H	H	H
2	H	L	H	H
3	L	L	H	H
4	H	H	L	H
5	L	H	L	H
6	H	L	L	H
7	L	L	L	H
8	H	H	H	L
9	L	H	H	L
10	H	H	H	H
11	REPEATS			

Decimal Point and Blanking

Before testing the decimal point and blanking circuitry, set the CHK/SEP/COM switch to SEP and disconnect the input signal.

DECIMAL POINT. To check the decimal point circuitry, set FUNCTION switch to PERIOD AVG and position the TIME BASE switch to pull the required D.P. line Low.

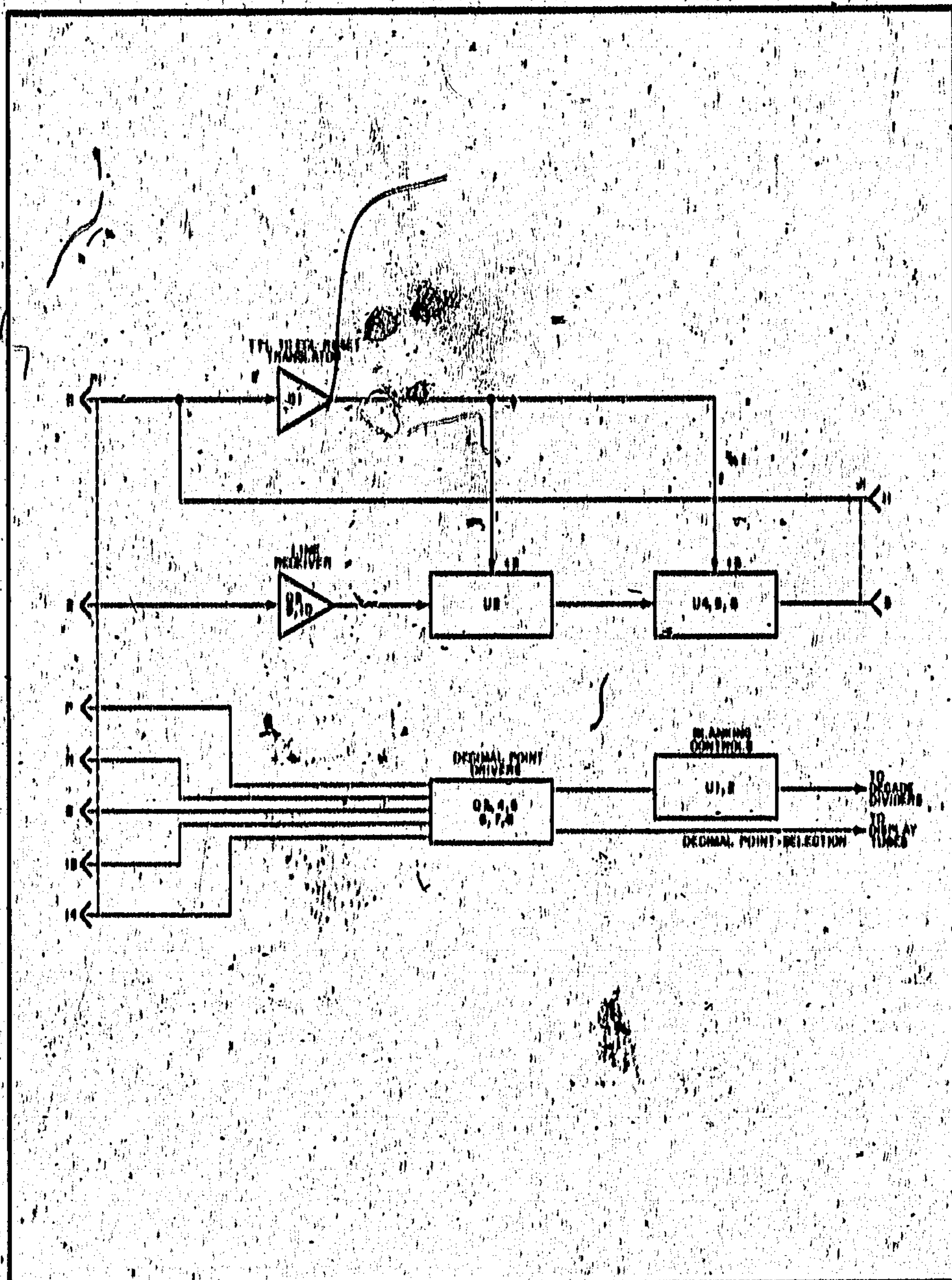
LINE	MULTIPLIER POSITION	DRIVER
D.P.0	1	Q8
D.P.1	10	Q7
D.P.2	10^2	Q6
D.P.3	10^3	Q5
D.P.4	10^4	Q4
D.P.5	10^5	Q3

BLANKING. To check the blanking circuitry, set the FUNCTION switch to PERIOD AVG and MULTIPLIER switch to 1. All digits, except the first one, should now be blanked. If another digit is lit, check that line at A5J1 for a High level, which indicates a problem on that line.

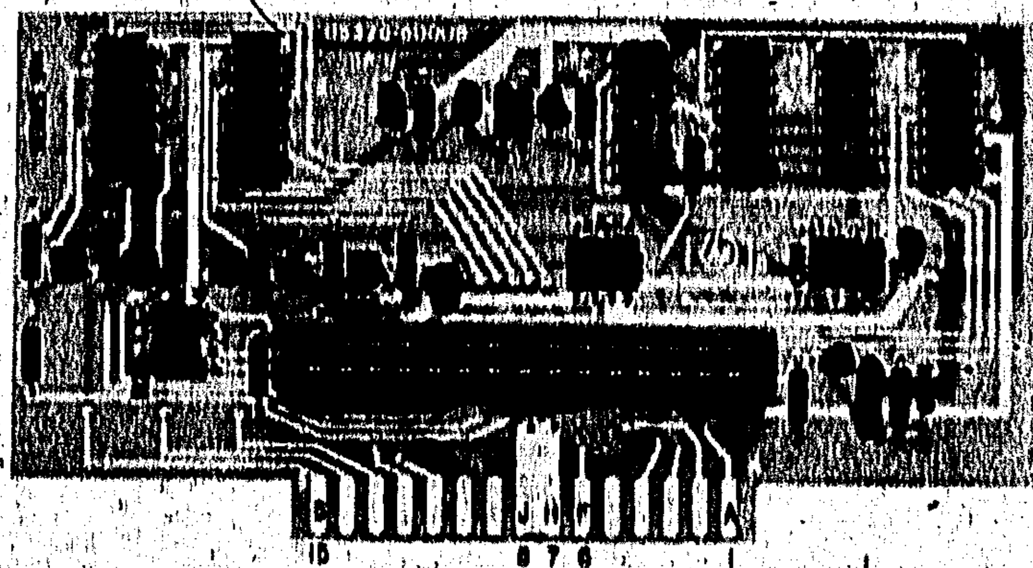
Figure 8-11
A7 FUNCTION CONTROL ASSEMBLY

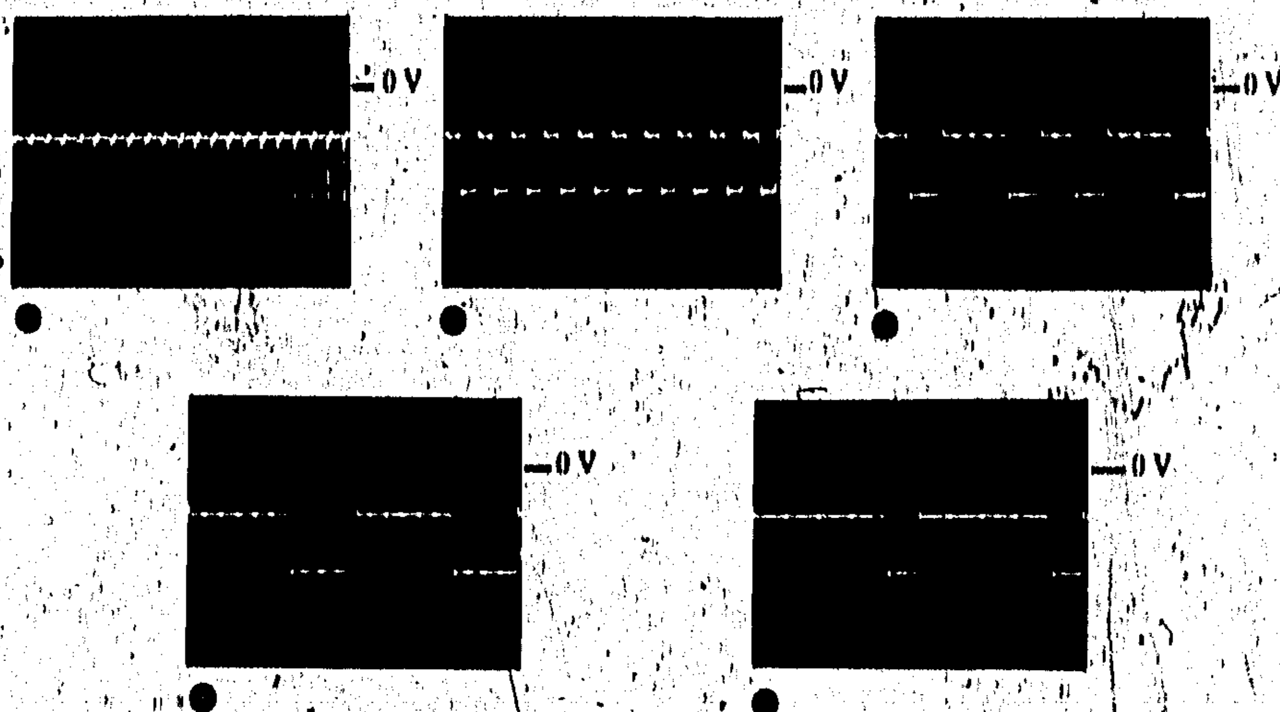
(See Page 8-29)

Part of Figure 8-18. A5 Display Support Assembly.



MORE DATA UNDER THIS FOLD





All waveforms taken with 10:1 divider probe; ground lead is connected to junction of R15, R3.

COUNTER CONTROLS:
Use settings of A2 Assembly

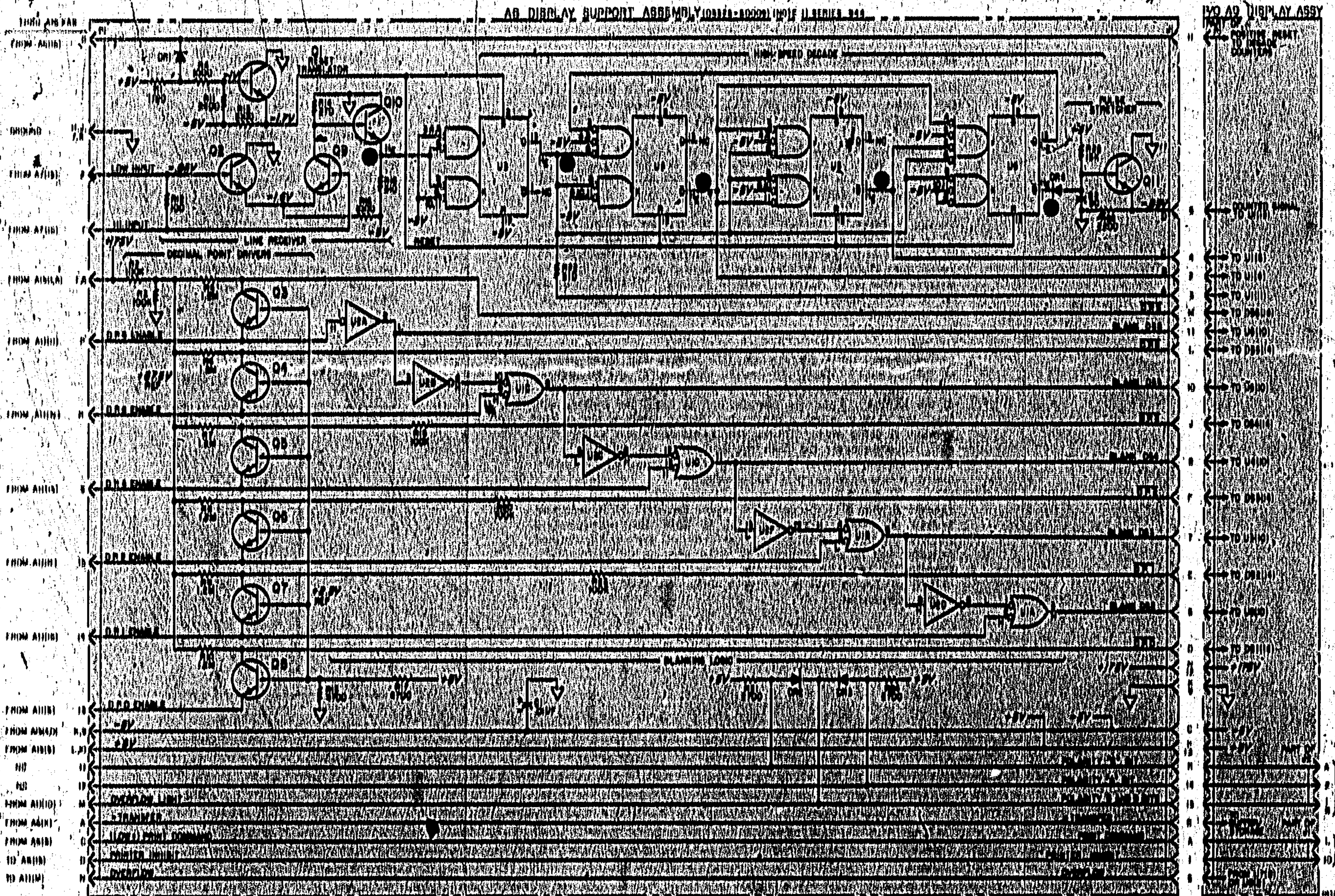
DC VOLTAGES:

Set counter controls as stated.
Disconnect input signal.
Push RESET.

HE,LE — ECL Levels
H,L — TTL Levels

OSCILLOSCOPE CONTROLS:

VOLTS/CM .... .05 V/cm
TIME/CM .... .2 µs/cm
SWEEP MODE .... AUTO
TRIGGER .... INT
SLOPE ....



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS.

REFERENCE DESIGNATIONS

A8	A9
C1,2 CR1-4 J1 Q1-11 R1-29 U1-5	J1,2 P1

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,4	1901-0040
CR2,3	1910-0016
Q1,2,9-11	1854-0071 2N3904
Q3-8	1853-0183 2N4410
U1	1820-0054 MC846P
U2	1820-0207 MC858P
U3	1820-0143 MC1027P
U4-5	1820-0102 MC1011P

Figure 8-12. A8 Display Support Assembly

A9 DISPLAY ASSEMBLY OPERATION

Display assembly A9 contains decade counters U2 through U7, buffer storage units U9 through U15, BCD to decimal converters U17 through U23, and display tubes DS1 though DS7.

U1 translates the ECL data from A8 into TTL levels for use by circuits on A9. Each translator of U1 is noninverting. The D output at U1(15) is the counted signal divided by 10 and is used as the input to 10' decade U2.

Decade counters U2 through U7 count the number of input pulses while the main gate is open. Each decade provides a 8421 BCD output to the corresponding buffer storage unit. When pin 14 (reset) goes High, the decades reset to zero if pin 10 is High; the decades reset to 15 (blank), if pin 10 is Low. The ECL decade on A8 never blanks. U7 and U8 (Option 001) always blank. The last decade supplies an overflow output at pin 8 when the count exceeds the capacity.

Buffer storage units U9 through U15 receive the BCD outputs of the decades. When the counter operates in the storage-on mode, data is transferred when a low transfer pulse arrives at pin 5 of the buffers. When the transfer line is high, the buffers will store the data to allow a continuous display while a new measurement is being made. During storage-off or totalize mode, BCD data is continuously fed from the buffers to the decoders. The buffers also supply 8421 BCD outputs to A9 J1 and J2 for further distribution to J9 when Option 003 is included.

Decoder drivers U17 through U23 receive the 8421 BCD data and provide a decoded decimal output to light the corresponding numeral on the display tube. The terminal for an illuminated numeral will be approximately +2 volts whereas an extinguished numeral is typically +100 volts. The decimal point terminal (14) of the display tube is <5 volts when lit and about 87.5 volts when extinguished.

A9 TROUBLESHOOTING

The A9 Display Assembly may be set up for troubleshooting with either of two methods. A highly accurate oscillator may be used for a front-panel input signal. Any difference in count from the input signal is then immediately obvious on the display. Check for the proper signal division of the decade counter in previous column. As an alternate method, place the CHK/SEP/COM switch in CHK and the FUNCTION switch in START. Allow the count to totalize until the problem occurs; then, set the FUNCTION switch to STOP. Use the TIME BASE switch to adjust the rate of counting. When the problem appears, check the circuitry of that column.

Start by checking the Buffer-Storage outputs (U9-U15) for the BCD code of the number that should be displayed, rather than what is displayed (see Table 1). Check that the Buffer-Storage code pulls the proper decimal line low on the BCD-to-Decimal Decoder.

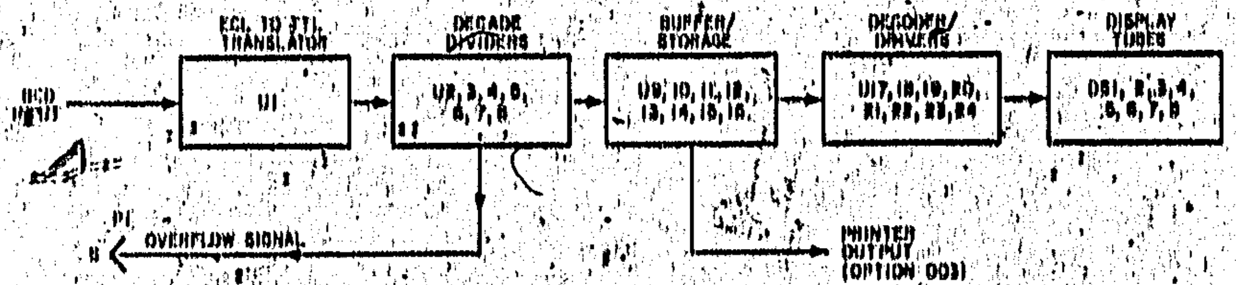
Table 1

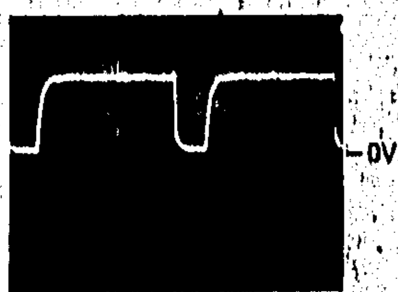
DISPLAYED DIGIT	BUFFER STORAGE BCD (TTL)			
	8	4	2	1
0	H	H	H	H
1	H	H	H	L
2	H	H	L	H
3	H	H	L	L
4	H	L	H	H
5	H	L	H	L
6	H	L	L	H
7	H	L	L	L
8	L	H	H	H
9	L	H	H	L
Blank	L	L	L	L

Figure 8-12
A8 DISPLAY SUPPORT ASSEMBLY

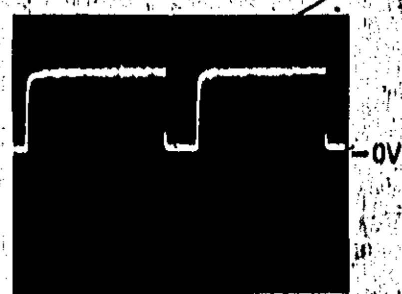
(See Page 8-31)

Part of Figure 8-13, A9 Display Assembly (Option 001)

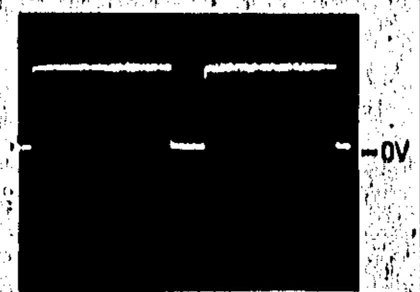




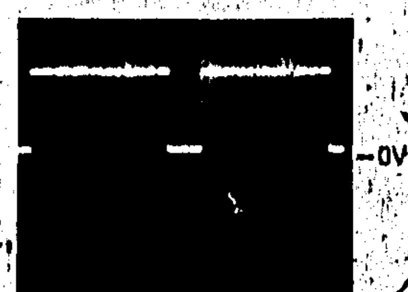
U1(15)
.2 V/cm
.2 µs/cm



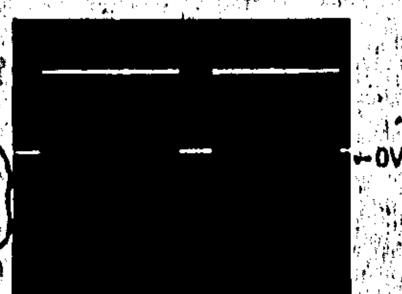
U2(8)
.2 V/cm
2 µs/cm



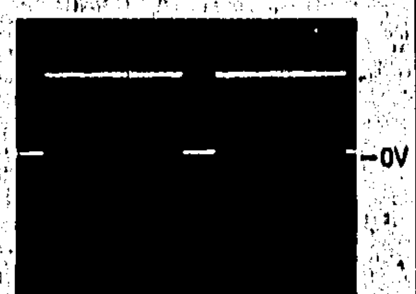
U3(8)
.2 V/cm
20 µs/cm



U4(8)
.2 V/cm
.2 ms/cm



U5(8)
.2 V/cm
2 ms/cm



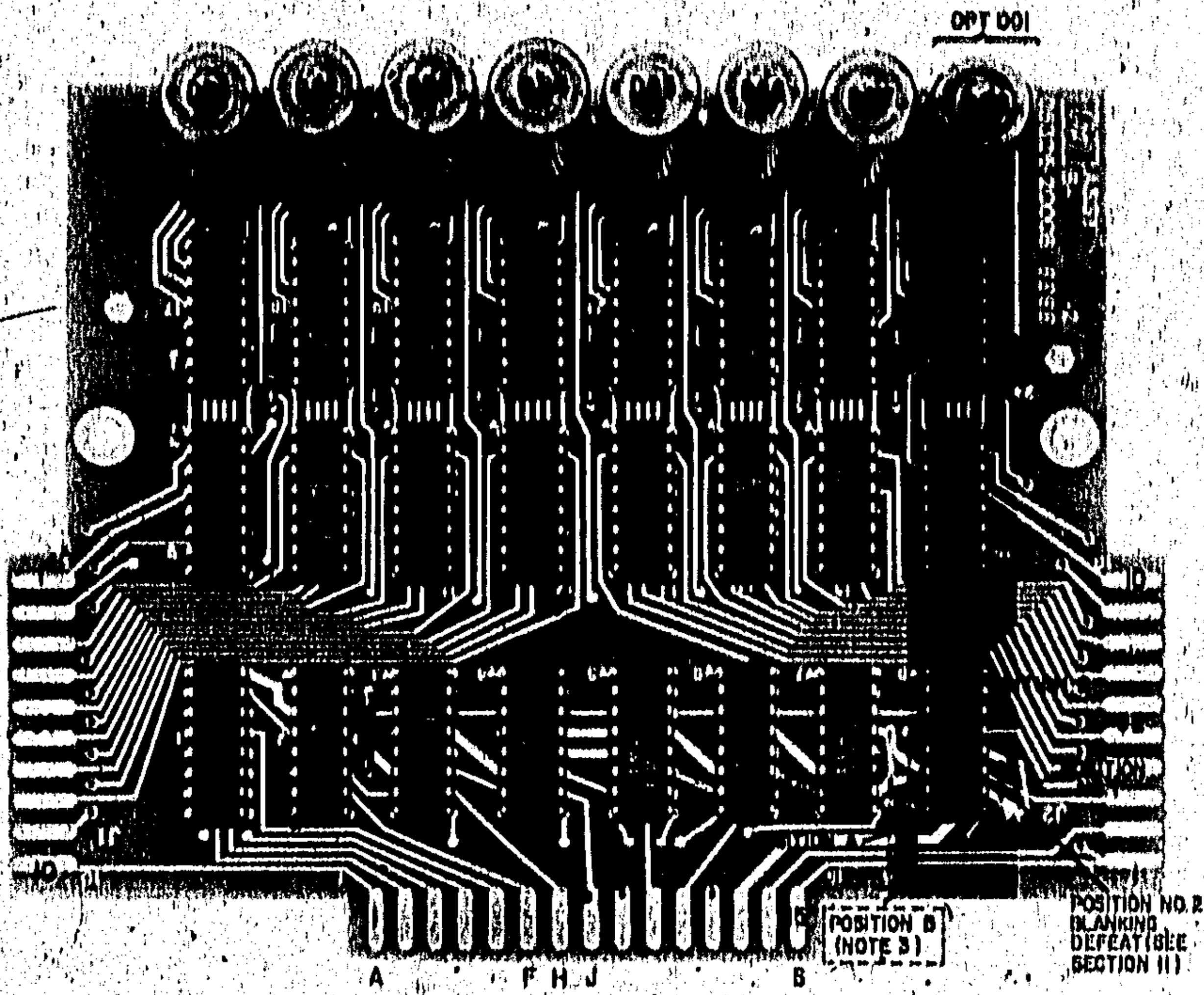
U6(8)
.2 V/cm
20 ms/cm

All waveforms dc coupled through 10:1 probe. Center line of graticule is zero volts. Triggering is internal ac.

COUNTER CONTROLS:

FUNCTION .... START
MULTIPLIER 1
CHK/NORM .... CHK

MORE DATA UNDER THIS FOLD



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS;
3. R10 IS WIRED TO B FOR OPTION 001.

REFERENCE DESIGNATIONS

NO PREFIX	A8	A9
	CR2,3	DS1-8
	J1	J1,2
	P1	P1
		R1-11
		U1-24
W1P1,P2		

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
A8	
CR2,3	1910-0016
A9	
U1	1820-0275 MC1039P
U2-8	1820-0118
U9-16	1820-0116
U17-24	1820-0092

05377-D-24

COMPLETE PARTS LIST FOR 05376-60008 IS LOCATED ON PAGE 6-8. SEE PAGE 6-18 FOR 05376-60075 (OPTION 001) PARTS LIST.

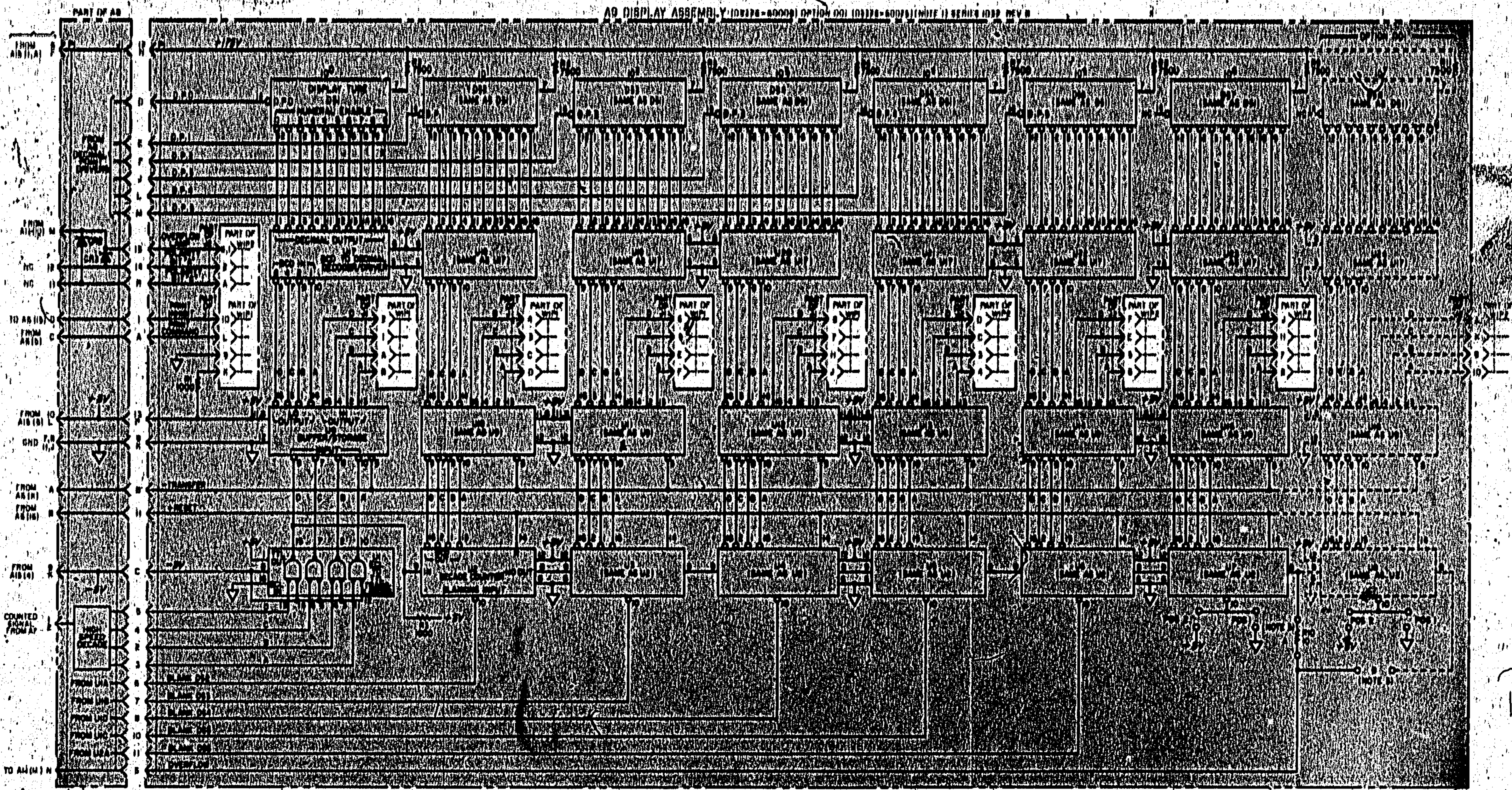


Figure 8-13. A9 Display Assembly (Option 001)

A10 RIGHT READOUT OPERATION

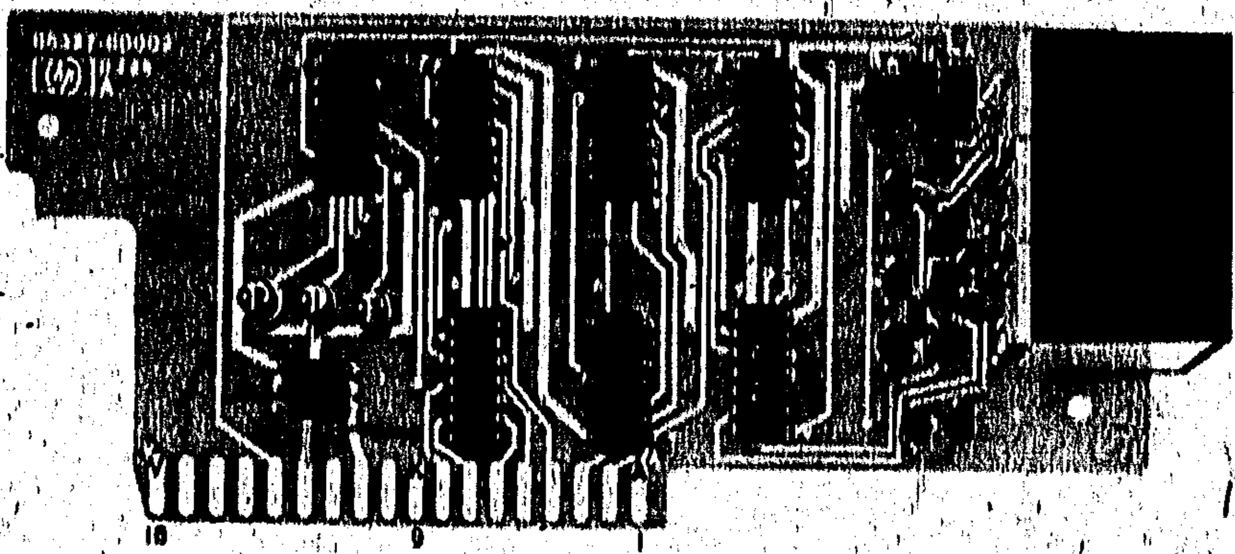
The right readout contains DTL logic to provide the proper measurement units for a given setting of the front-panel controls. A10 logic is negative true, and a low (≤0.8 volts) to the emitter of any driver transistor will light the given neon. When a DTL high is applied on the emitters, the transistor is reverse biased to turn off the neon lamps. The voltage dividers provide a reference of 8 V (nominal) to the bases of the drivers, when no annunciators are on.

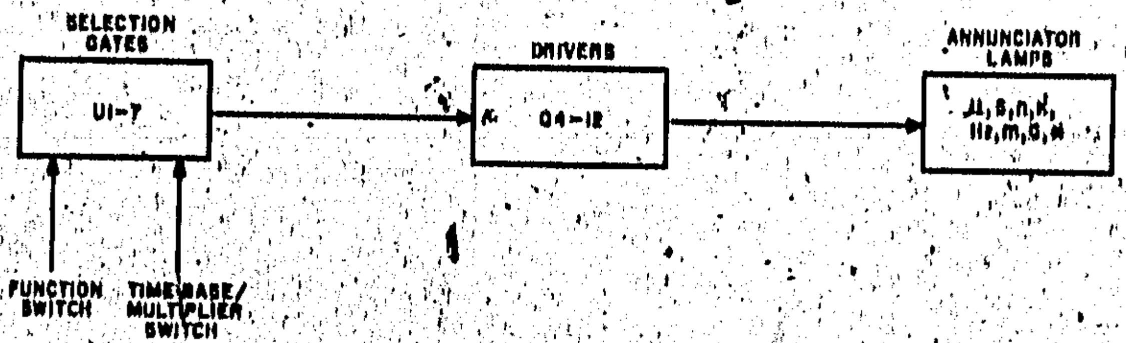
Selecting a function mode and time base pulls a pair of these lines low, activating a gate. This low on the gate output will forward bias the driver transistor to turn on the annunciator lamp. For example, selection of frequency and 1 ms makes the output of U4B(11) low, turning on Q9 to light D85. Q10 also turns on, lighting D86.

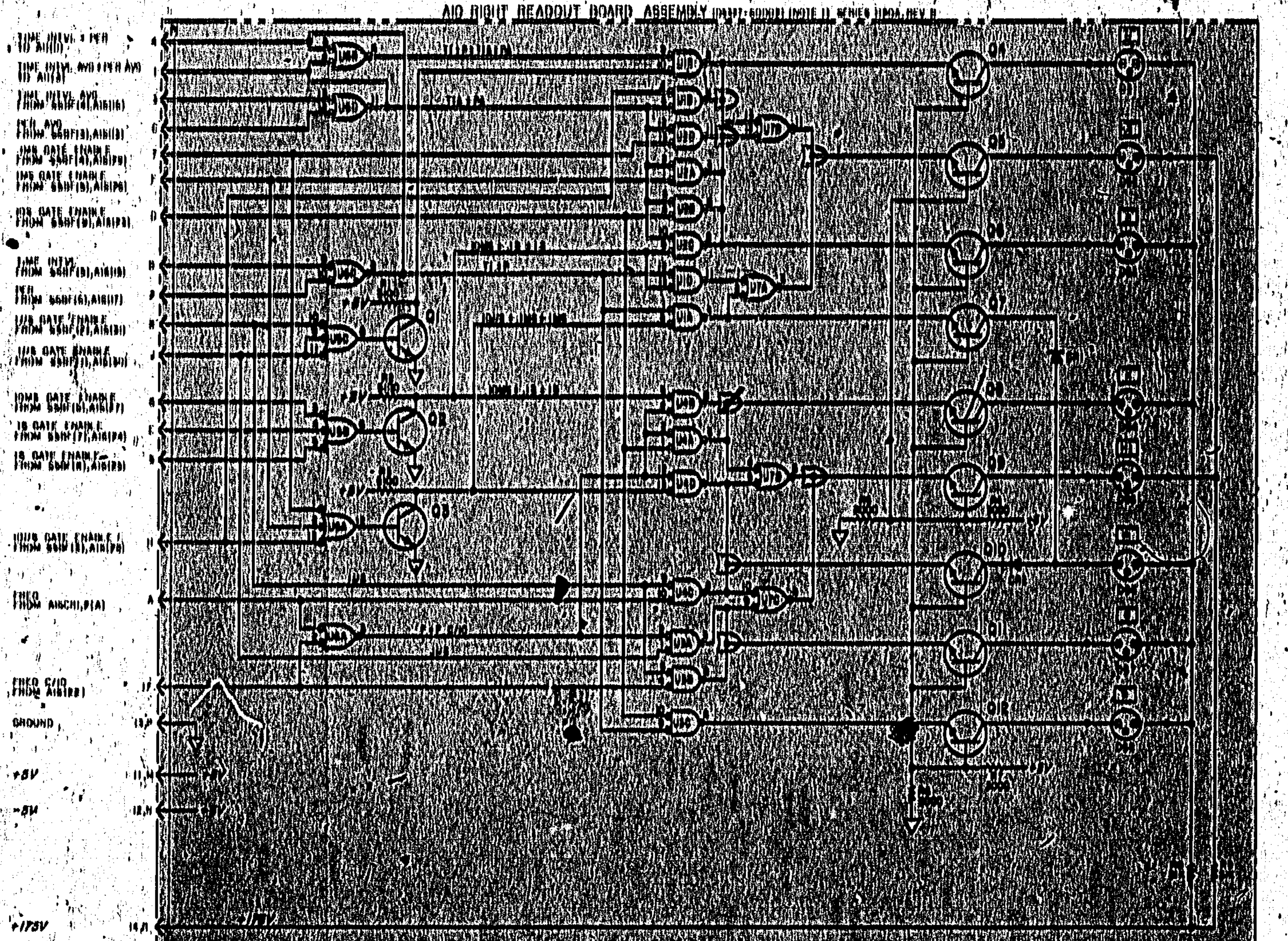
The asterisk (*) annunciator (D88) is activated when the counter is in the time interval or period mode and the time base is 10s. An asterisk indicates the proper units are not displayed.

A10 TROUBLESHOOTING

Select the specific function mode and time base combination that is faulty. Check the gate that is common to the two lines. For instance, when using frequency and a 1 ms gate time, check U4D; when using .1 μs, U3A becomes the common gate. Refer to Table 5-5 for the proper annunciator lighting conditions.




SELECTION GATES
U1-7
DRIVERS
Q4-12
ANNUNCIATOR LAMPS
FUNCTION SWITCH
TIMEBASE/ MULTIPLIER SWITCH



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS.

REFERENCE DESIGNATIONS
A10
CR1,2
DS1-6
R1
Q1-12
R1-9
U1-7

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBER
CR1,2	1901-0040
Q1-3	1854-0[illegible] 2N[illegible]
Q4-12	1854-0074 2N[illegible]
U1-4	1820-[illegible] MC1808
U5	1820-0310 MC862
U6,7	1820-0[illegible]

Figure 8-14. A10 Right Readout Assembly

A11 LEFT READOUT OPERATION

The left readout contains DTL logic to select the proper decimal point corresponding to the TIME BASE SETTING. It also contains the switch common drivers for the time base, function, and amplifier common lines (for remote programming), a storage circuit and lamp for the overflow signal, the gate light, and the EXT light.

The overflow signal from the ÷ 10 output of A9U7 (U8, Option 001) enters through pin M and is differentiated by C2 and R1. Q1 turns on momentarily to set flip-flop U1A&D. During the transfer pulse, the information at U1A&D is transferred to the overflow storage flip-flop U1B&C. The overflow condition drives U1C(8) low to turn Q2 on and light overflow lamp DS1. The next reset pulse clears flip-flop U1A&D; however, U1B&C are not reset until the transfer pulse arrives. With storage off, transfer is on continuously.

A low at pin L turns on Q3 to light the count lamp, DS2. Similarly, a low at pin A lights the EXT lamp and opens the common lines for the TIME BASE, FUNCTION, and SLOPE switches. This disables these controls to allow remote programming of the unit.

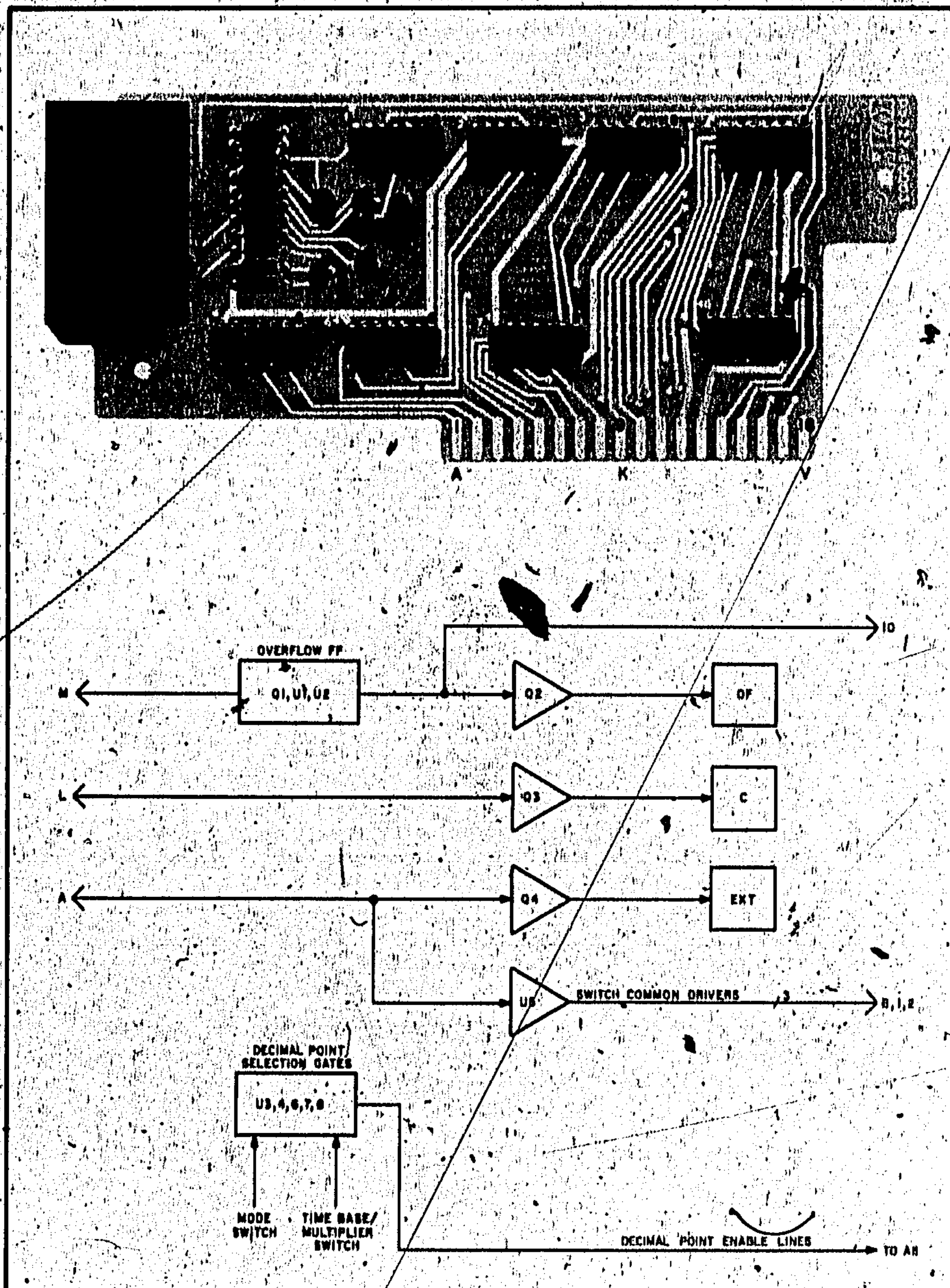
Decimal selection and resultant blanking are accomplished by the negative logic AND gates. For any pair of low inputs, a specific decimal point line is held low, lighting the decimal point. There are a number of combinations for each decimal; therefore, the output of each AND gate is paralleled to give a wired OR configuration (any output low = all low).

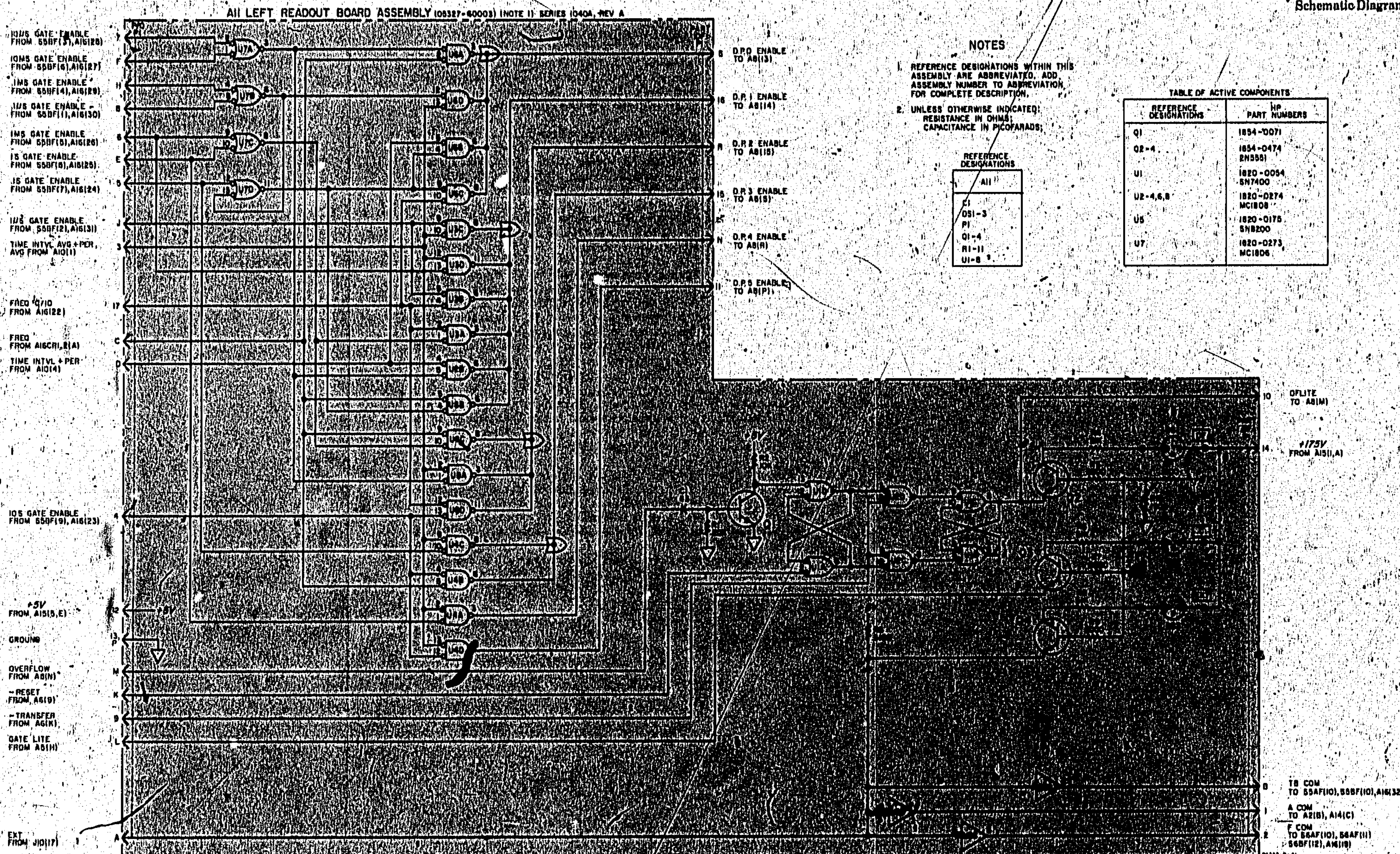
A11 TROUBLESHOOTING

Select the specific function mode and time base combination that is faulty. Check the gate that is common to the two lines. Refer to Table 8-5 for the proper annunciator lighting conditions.

To check the overflow circuits, set the FUNCTION switch to START and select a fast gate time. When the most significant digit on the counter's display changes from 9 to 0, both flip-flops in the overflow circuit should set. As an initial test, check U2 for a High on pin 13. The second flip-flop (U1B and U1C) should have a Low on pin 8 and a High on pin 6.

In any mode other than START, the TRANSFER line pulses Low, rather than being held Low. If the OF light does not turn off at the end of the display time, check that the RESET pulse clears flip-flop U1A&D.


A
K
V
OVERFLOW FF
Q1, U1, U2
M
L
A
Q2
Q3
Q4
U5
10
OF
C
EXT
SWITCH COMMON DRIVERS
3
DECIMAL POINT SELECTION GATES
MODE SWITCH
TIME BASE/ MULTIPLIER SWITCH
DECIMAL POINT ENABLE LINES



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS; CAPACITANCE IN PICOFARADS;

REFERENCE DESIGNATIONS

A11
C1
DS1-3
P1
Q1-4
R1-11
U1-8

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
Q1	1854-0071
Q2-4	1854-0474 2N5551
U1	1820-0054 SN7400
U2-4,6,8	1820-0274 MC1808
U5	1820-0175 SN8200
U7	1820-0273 MC1806

Figure 8-15. A11 Left Readout Assembly

A15-A16 POWER SUPPLY OPERATION

The power supply provides +175, +16.5 V and +5 V. Transformer T1 has a 115/220 primary and secondaries with open circuit voltages of 181 V at the red leads, 21 V at the orange, and 18.6 V between the green leads, with the winding center tapped to ground.

A15 CR6-9 comprise a full-wave bridge whose output is fed to filter C3 and bleeder R3. Q5 is a series pass regulator. A constant reference voltage is developed across CR11 and CR12 through resistor R1. When the output voltage at XA15(1, A) decreases, Q5 increases conduction to increase the output voltage. Q8 is a current limiter that senses the voltage drop across R6. Output current above approximately 60 mA turns on Q8 and shunts base current from Q5, tending to turn Q5 off and limit the current. C1 adds oscillation stability to the regulator.

For the +16.5 V supplies, the orange leads of T1 connect to half wave rectifier CR4 and filter C4. Q1 is a series pass regulator and Q9 performs the same function as CR11&CR12 in the 175 V supply except that R10 provides a means to adjust the output. Assume that a Q1 base current is flowing through R2 and Q6. The resulting Q1 collector current establishes a voltage at the output, which is divided across R9, R10, and R11. If the voltage at the wiper of R10 is greater than that across CR9, Q9 will be turned on, shunting base current from Q1. This will tend to turn off Q1 and lower the regulated voltage. Thus, varying R10 establishes the largest output voltage that can exist before Q9 turns on to cut back Q1. Resistors R17, R18, and diodes CR15-18 provide current limit action at 180 mA similar to the +175 V supply.

Q6 is a preregulator that gives the circuit better line regulation and lower ripple than the Zener diodes of the 175 V supply. With CR1 as a reference, Q6 is a constant current circuit that maintains a Q1 base current independent of variations of the input (line voltage changes and ripple). R4 is needed to establish the current through CR1. The -16.5 V supply is complementary. The 5 V supplies are also complementary and only the + will be discussed.

The output from the T1 green leads is fed through full wave rectifier CR10 and CR11 into filter C1. It then passes through overload current limiter R1 and into the series pass regulator Q1, to the 5 V output at Q1C. Q3 is a driver for Q1 and has approximately 5.75 V on its base, developed across CR6 and CR5 by the current from the 16.5 V supply through R7. If the voltage at the emitter 5.1 V, Q3 is turned on providing base current to turn on Q1, raising the output voltage. Q3 turns off when its emitter gets above 5.1 V. C2 is the output filter to maintain a low output impedance at high frequencies.

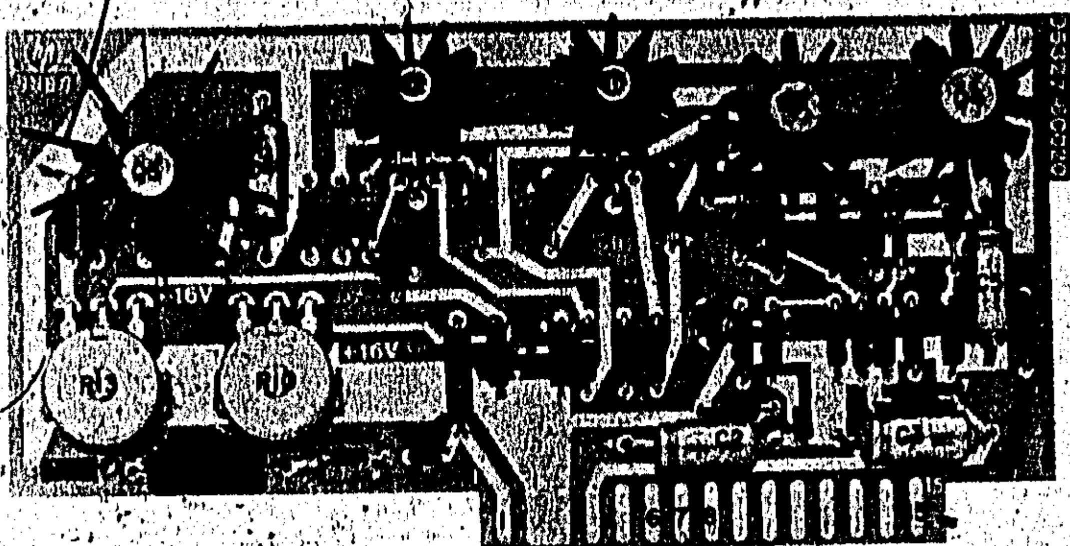
CR2 clamps the output at 6 V to provide protection for the IC's in case the 16.5 V or 175 V line should momentarily short to the 5 V line. CR5 provides thermal compensation for Q3.

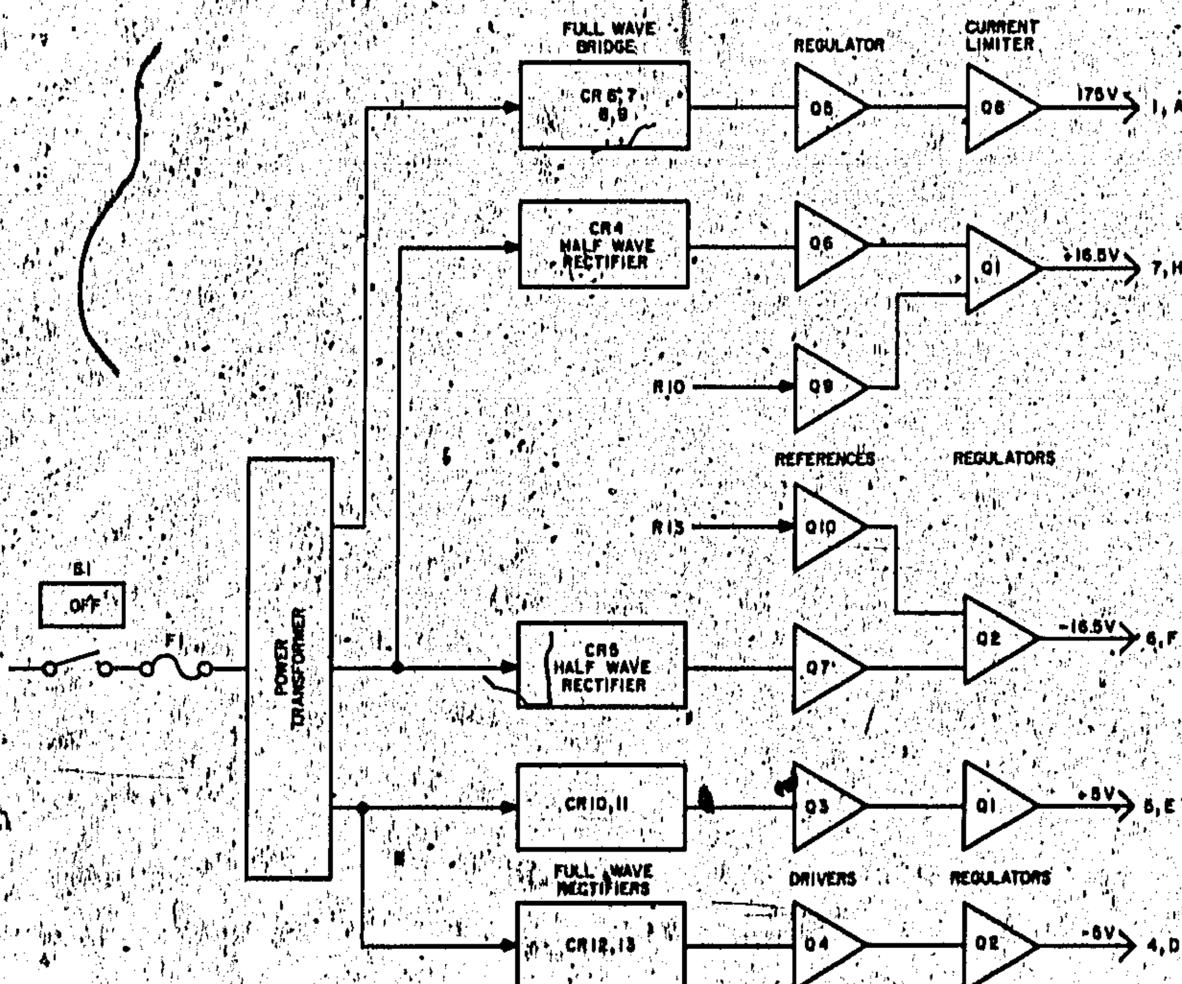
Note that the 16.5 V supply is needed for operation of the 5 V supply. If the + or - 16.5 V supply fails, the corresponding 5 V supply will be inoperative.

Figure 8-15
A11 LEFT READOUT ASSEMBLY

(See Page 8-37)

Part of Figure 8-16. A15, A16 Regulator Board/Interconnect Board Assembly





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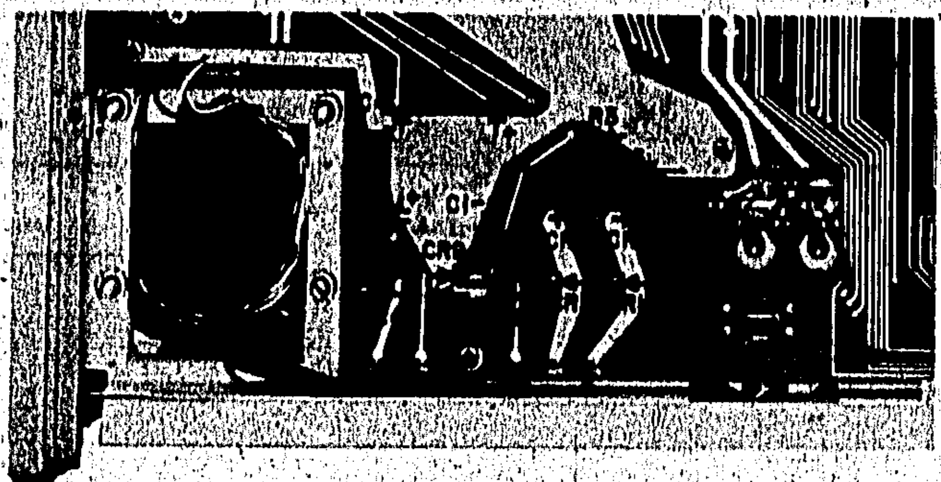
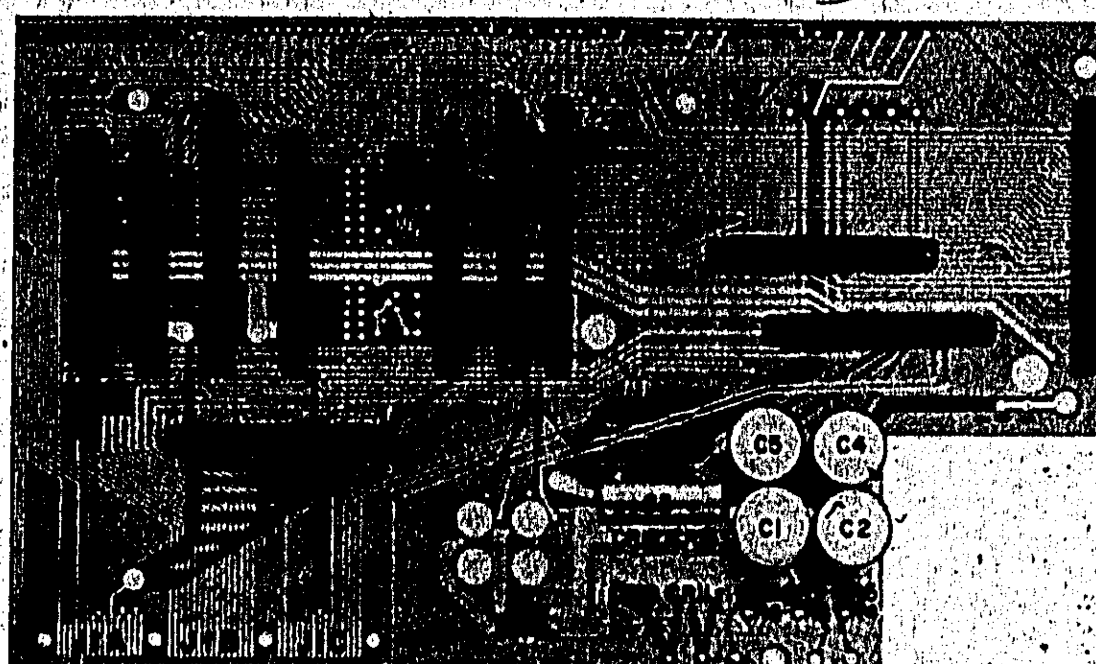
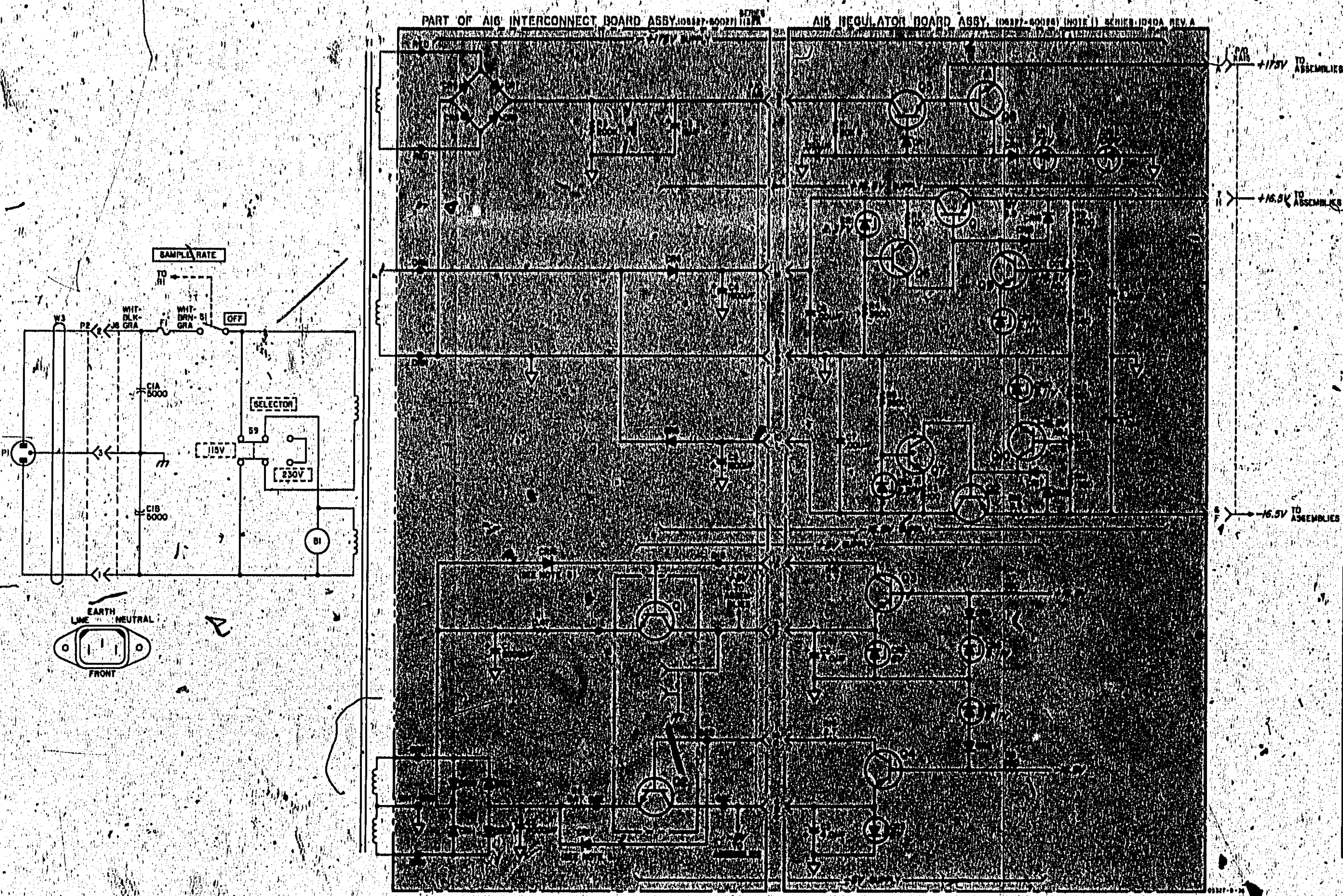

C1


C5
C4
C1
C2



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
3. A15 Q1-5 HAVE HEAT SINK.
4. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
5. CR16 AND CR17 ARE 3-JUNCTION SILICON DIODES.

REFERENCE DESIGNATIONS

NO PREFIX	A15	A16
B1 C1 F1 J8, J11 P2 Q1, 2 S1, 9 T1 W3	C1-7 CR1-18 Q1-10 R1-18	C1-5 CR4-13, 16,17 R1-3

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
NO PREFIX	
Q1	1853-0233
Q2	1854-0420
A15	
CR1, 4	1902-3002
CR2, 3	1902-0551
CR5, 8, 15-18	1901-0040
CR6, 7, 9, 10	1902-3094
CR11	1902-3394
CR12	1902-3429
CR13, 14	1901-0033
Q1	1854-0300
Q2	1853-0073
Q3	1854-0039 2N3053
Q4	1853-0012 2N2904A
Q5	1854-0232
Q6, 10	1853-0020
Q7, 9	1854-0071
Q8	1854-047
A16	
CR4, 5	1901-0045
CR6-9	1901-0029
CR10-13	1901-0415
CR16, 17	1901-0460

Figure 8-16. A15, A16 Regulator Board, Interconnect Board Assembly

A17 INPUT C AMPLIFIER OPERATION

The input amplifier performs two functions: it provides a channel for increased sensitivity and it produces narrow pulses for efficient usage by other counter circuits. The amplifier is not controlled by any front-panel switches.

The input signal is dc coupled into a 50 ohm input impedance (R1) and is fed into the input amplifier, which is protected by R2, CR1, and CR2. Current source U1Q5 feeds the balanced differential amplifier U1Q3, Q4. The twin outputs are loaded by R10 and peaking coil L2. The signal flows to another amplifier circuit, whose outputs control the triggering of the tunnel diode, CR3. The diode is biased for maximum sensitivity with R11. When the diode fires, it produces fast rise and fall times on the input signal.

High-impedance emitter floowers (Q1, Q2) ac couple the signal to the single-ended differential amplifier of Q3 and Q4. The short time constants of C9, R18, and C12, R23 differentiate the signal into narrow spikes of about 15 ns. The output circuit of C11, R22, and L4 approaches resonance at high frequencies for improved gain.

The signal is then fed to the one-shot multivibrator U2. The one-shot output goes High (U2, pin 4) when the input goes low. The output goes Low again after about 12 ns, when the level changes have propagated through the gates in a domino effect.

SENSITIVITY ADJUSTMENT

a. Set counter controls as follows:

FUNCTION .... FREQ C
TIME BASE .... 0.1 S

b. Set HP 606B HF Signal Generator (or equivalent) for 50 MHz at 500 mV rms. Measure the output signal of 606B with an HP 411A RF Millivoltmeter, using a 50Ω termination. Connect signal source to INPUT C of counter.

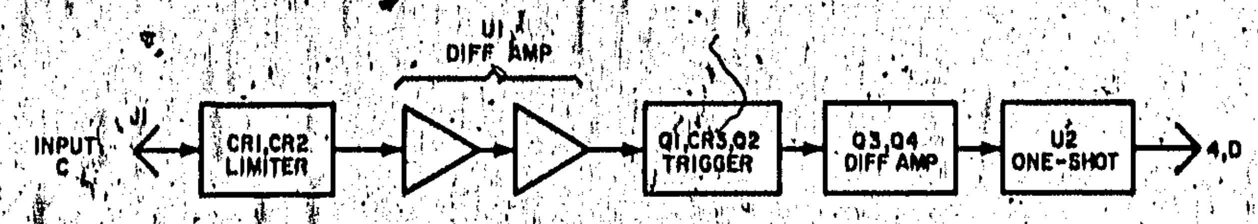
c. Reduce output level until counter's display becomes unstable. Adjust R11 for a stable display. Repeat this procedure until unable to obtain a stable reading. Increase the signal level until display just becomes stable.

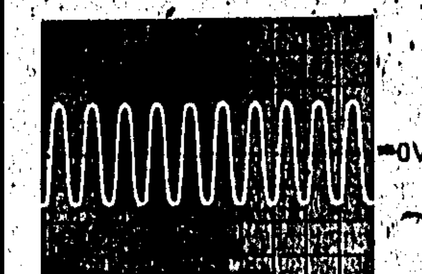
d. Disconnect input and connect to voltmeter, reading should be less than 5 mV. Check other frequencies within the band.

Figure 8-16
A15, A16 REGULATOR BOARD, INTERCONNECT BOARD ASSEMBLY

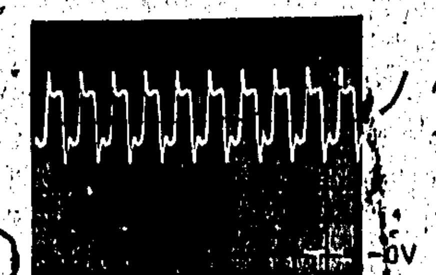
(See Page 8-39)

Part of Figure 8-17. A17 Component Locator

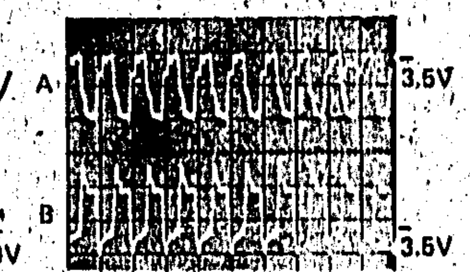




.05 V/cm
.1 µs/cm

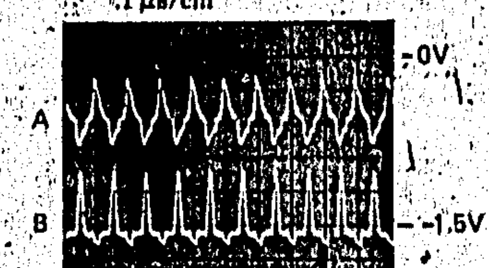


.05 V/cm
.1 µs/cm



a. Q1 (base)
b. Q2 (base)
.02 V/cm
.1 µs/cm
ALT B

DC VOLTAGES:
Set counter controls as stated.
Disconnect input signal.



a. Q4 b. U2(4)
.05 V/cm
.1 µs/cm
ALT B

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C6. A17 is mounted on extender board.

COUNTER CONTROLS:

INPUT C jack .... connect 10 MHz sine wave at 1 V rms
FUNCTION .... FREQ C
TIME BASE .... 1 ms
CHK/SEP/COM .... SEP

OSCILLOSCOPE CONTROLS:

SWEEP MODE .... AUTO
TRIGGER .... INT
SLOPE ....

MORE DATA UNDER THIS FOLD

MANUAL CHANGES

MANUAL DESCRIPTION

INSTRUMENT:	5326A/5327A Timer-Counter Operating and Service Manual
SERIAL PREFIX:	5326A/5327A—1312A
DATE PRINTED:	SEP 1973
HP PART NO:	05326-90035
MICROFICHE NO:	05326-90040

CHANGE DATE: May 6, 1980

(This change supersedes all earlier dated changes)

- Make all changes listed as ERRATA.
- Check the following table for your instrument's serial prefix or serial number and make listed change(s) to manual.

IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL	IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL
1428A	1	1620A04016 & Up (5326A) 1620A00796 & Up (5327A)	1,2,3,4,5,6
1540A (5327A Only)	1,2	1820A	1,2,3,4,5,6,7
1544A (5326A Only)	1,3	1844 (5326A Only)	1,2,3,4,5,6,7,8
1604A (5327A Only)	1,2,3,4	1936A (5326A Only)	1,2,3,4,5,6,7,8,9
1620A	1,2,3,4,5	■ 2012A (5326A Only)	1 through 10

■ **NEW OR REVISED ITEM**

ERRATA

Page 1-1, Table 1-1:
Change Rack Mouting Kit from 05326-60029 to 05326-60046.

Page 5-10, Table 5-4, Steps 5c and d:
Change 0.65 to 0.9 ±.05V at A18U2(3).
Change 0.90 to 0.8 ±.05V at A18U3(3).

Pages 6-7/8 Table 6-1, Replaceable Parts:
Add A7C3 0160-2150 CAPACITOR:FXD 33PF 5% 300V FACTORY SELECTED; 28480; 0160-2150; QT 1.
Add A7XU14 1200-0473 SOCKET:IC 16 PIN; 28480; 1200-0473. With this change A7 05327-60031 is SERIES 1312.

Page 6-8, Table 6-1, Replaceable Parts:
Change A7U10 reference designator only to A7U11.
Change A7U11 reference designator only to A7U10.

Pages 6-14 and 6-15, Table 6-1, Replaceable Parts:
Add "FACTORY SELECT" after description for A18R34 and A18R42.
Change A18U3 from 1826-0085 to "1826-0085 or 1826-0151" in HP and Mfr Part Number columns.

Page 6-22, Table 6-3, Manufacturers Code List:
Add 00779 AMP, INC. P.O. Box 3608, Harrisburg, PA 17105.

Page 8-31, Figure 8-11, A7 Schematic Diagram:
Add A7C3* 33PF; connected from XU14C(11) to XU14C(16) (ground).
Change REFERENCE DESIGNATION table from "C1,2" to "C1-3".

Page 8-40, Part of Figure 8-16:
Replace A15 Component Locator photo with attached Figure 1.

Page 8-45, Figure 8-15, Schematic Diagram:
Add asterisk (*) by A18R34 and A18R42.
In TABLE OF ACTIVE ELEMENTS show 1826-0085 or 1826-0151 for A18U3 and 1820-0736 or 1820-0558 for A18U4.
Change dc voltage at A18U2(3) from .65 ±.05V to .9 ±.05V and voltage at A18U3(3) from .9 ±.05V to .8 ±.05V.

Page 6-9, Table 6-1, Replaceable Parts:
Change A9U2 through U7 from 1820-0232 to 1820-0119 in "HP Part Number" and "Mfr Part Number" columns.

Page 7-2, Paragraph 7-21:
Add the following sentence:
"An HP Part No. 05326-00033 adaper plate will also be required four mounting 36-pin remote programming connector J10".

HEWLETT PACKARD

ERRATA (Cont'd)

Page 6-17, Table 6-1, Replaceable CHASSIS PARTS:
Change Q1 from 1853-0233 to 1853-0356 in "HP" and "Mfr" part number columns.

Change Q2 from 1854-0420 to 1854-0625 in "HP" and "Mfr" part number columns.

NOTE – THE ABOVE TRANSISTORS FOR Q1 AND Q2 ARE RECOMMENDED FOR REPLACEMENT IN ALL INSTRUMENTS. THE HIGHER WATTAGE RATING OF THESE TRANSISTORS WILL IMPROVE INSTRUMENT RELIABILITY.

Page 8-41, Figure 8-16, TABLE OF ACTIVE ELEMENTS:
Change Q1 from 1853-0233 to 1853-0356 and Q2 from 1854-0420 to 1854-0625.

Page 6-15, Table 6-1, A16 (05327-60027) Replaceable Parts:
Change A16XA2 thru XA5, XA8, XA15, and XA18 from 1251-1886 to 1251-2035; Mfr Code to 28480; Mfr Part Number 1251-2035.

Change A16XA6, XA7, XA10, and XA11 from 1251-2134 to 1251-2026; Mfr Code 28480; Mfr Part Number 1251-2026.

Page 6-19, Table 6-2, Replacement Parts, Options:
Change A1C7 and C8 from HP Part Number 0140-0149 to 0160-3533; Mfr Code to 28480; Mfr Part Number to 0160-3533.

Page 1-5, Table 1-3, Specifications:
Change Option 011 Short Term Fluctuation (1 sec avg) to $< 1 \times 10^{-10}$ rms.

Page 8-51, Figure 8-21, A1 (Option 004) Schematic Diagram:
Change circuit board part number from 05327-60018 to 05327-60034 and "SERIES 1040A" to SERIES 1224.

CHANGE 1 (1428A)

Page 6-11/12, Table 6-1:
Change A15F1 from 2110-0460 to 2110-0487 1/20 Amp.
Change A15R6 from 0686-1305 to 0698-5479 8.2 OHM; 01121; EB82G5.
Delete A15F1 Part No. 1400-0110 FUSEHOLDER.
Add A15XF1 1251-3205; 2; SOCKET, MINIATURE SINGLE PIN; 00779; 2-331272-7.

With these changes A15 assembly 05327-60020 is "SERIES 1428". Component locator in attached Figure 1 is applicable for A15 with SERIES 1312 and 1428.

Page 6-14, Table 6-1:
Add A18L3; 05303-80001, 1, COIL, FXD, RF PEAKING, 28480, 05303-80001.
Add "FACTORY SELECTED" to A18R34 and A18R42 "Description".
With these changes A18 assembly 05327-60033 is "SERIES 1428".

Page 8-41, Figure 8-16, A15 Schematic Diagram:
Change A15F1 value from 1/32A to 1/20A.
Change A15R6 value from 12 to 8.2 OHM.
Change "SERIES 1312A REV. A" at top of A15 schematic to "SERIES 1428".

Page 8-45, Figure 8-18, A18 Schematic Diagram:
Add A18L3 in series with A18U3(13) output line. Output circuit trace is cut and one end of A18L3 is connected to the junction of A18U3(13) and A18R34. The other end of A18L3 is connected to the junction of A8R44 and the coil from A18R42.
Change series number at top of A18 schematic diagram to "SERIES 1428".

Page 6-12, Table 6-1:
Change A16R7 from 0698-3153 (3830 ohm) to 0698-3155, 4630 ohms.

Page 8-53, Figure 8-22, Schematic:
Change A16R7 from 3830 to 4630 ohms.
Change SERIES number of A18 circuit board to 1428 on various pages where portions of A16 appear in this manual. This includes the Table of Replaceable Parts.

Page 6-14, Table 6-1:
Change A18R29, A18R30 from 0698-5177 (820 OHM) to 0698-3103 430 OHM.
Add "FACTORY SELECTED VALUE" to description.

Page 8-45, Figure 8-18, A18 Schematic:
Add asterisk (*) adjacent to A18R22, A18R23, A18R29, A18R30, and A16R40.
In Table 6-1 for these resistors add "FACTORY SELECTED VALUE" to description.

Page 1-3, Table 1-3, Specifications:
Delete paragraph [illegible]ning to "Short-Term Fluctuation" under "TIME BASE" heading.

CHANGE 2 (1540A) (5327A ONLY)

Page 5-19, TAble 5-4, Paragraph 5 Prescaler Adjustments:
Change paragraph 5-g to read as follows:
"Reduce output level until counter's display becomes unstable. Alternately adjust A18R3 and A18R53 for a stable display. Repeat procedure until unable to obtain a stable display. Increase signal level until display just becomes stable and make any final adjustments of A18R3 and A18R53".

Page 6-13, Table 6-1, A18 Replaceable Parts (SERIES 1540):
Add A18C30; 0160-3879; CAPACITOR-FXD 0.01 µF 20% 100VDCW CER; 28480; 0160-3879.
Change A18R22 and A18R23 from 0698-4131 (56 ohms) to 0698-3111; RESISTOR-FXD 30 OHM 5% .125W CC; 01121; BB3005.
Change A18R29 and A18R30 from 0698-5103 (430 ohms) to 0698-5177; RESISTOR-FXD 820 OHM 5% .125W CC; 01121; BB8215.
Change A18R34 from 0698-8073 (1600 ohms) to 0698-5178; RESISTOR-FXD 1500 OHM 5% .125W CC; 01121; BB1525.
Add A18R53; 2100-2633; RESISTOR VAR 1000 OHMS 10% COMP SIDE ADJ; 30983; ET50X102.
Add 18R54 and A18R55; 0698-3374; RESISTOR-FXD 20 OHM 5% .125W CC; 01121; BB2005.
Add A18R56; 0698-6283; RESISTOR-FXD 10 OHMS 5%; .125W CC; 01121; BB1005.

Page 8-45, Figure 8-18, A18 Prescaler Assembly Schematic:
Add A18C30 (.01 µF) between common and the "+5V" end of A18R34.
Add A18R53 (1000 ohms) variable resistor between +5.2V and -5.2V. Connect junction of A18C30 and A18R34 to arm of A18R53 in place of "+5V" as shown on schematic diagram.
Change value of A18R34 from 1600 to 1500 ohms.
Change A18R22 and A18R23 from 56 to 30 ohms.
Change A18R29 and A18R30 from 430 to 820 ohms.
Add A18R54 (20 ohms) in series between A18U2 pin 11 and the junction of A18R23, A18R30, and A18U3 pin 5.
Add A18R55 (20 ohms) in series between A18U2 pin 14 and the junction of A18R22, A18R29, and A18U3 pin 4.
Add an asterisk (*) adjacent to A18R54 and A18R55.
Add A18R56 (10 ohms) in series between A18U1 pin 2 and the junction of A18U2 pin 5 and A18R56.
Change "SERIES" number at top of schematic to "1540".

CHANGE 3 (1544A)

Page 1-4, Table 1-3, Specifications for OPTIONS:
Add to Option 001: 8-digit display. "Part of standard Instrument; discontinued as an Option".
Add to Option 003: Digital Output (for numerals and polarity only). "Discontinued as an Option and included as part of the standard instrument".

Page 1-5, Table 1-3, Specifications for OPTIONS:
Delete Option 010 Temperature Compensated Oscillator. This Option is discontinued and is no longer available.

Page 7-1, Options and Manual Changes:
Paragraph 7-14, Delete second sentence.
Paragraph 7-18, Add — "Part of Standard Instrument; Discontinued as an Option".
Paragraph 7-22, Add — "Part of Standard Instrument; Discontinued as an Option".

Page 6-9, Table 6-1, A9 Replaceable Parts:
Replace A9 table for 05326-60008 with table for 05326-60025 A9 on Page 6-18 of Table 6-2.

Page 6-18, Table 6-2:
Add parts for Option 003 as part of standard instrument.

The 5326A/5327A Timer/Counters are furnished less the RACK MOUNTING KIT described in this manual. If ordered at the same time as the instrument, the RACK MOUNTING KIT described in the manual is available as Option 908 at additional cost. If not ordered with an instrument, the RACK MOUNTING KIT is available under HP Part No. 05326-60046. Disregard any manual references stating the instrument is supplied with a rack mounting kit.

Page 6-17, Table 6-1, Chassis Replaceable Parts:
Change XF1 fuseholder from 1400-0084 to the following recommended replacement for all instruments.
Add the following parts on Page 6-17 under CHASSIS PARTS:
XF1; 2100-0465; FUSEHOLDER BAYONET CAP; 75915; 345003-020
XF1; 2110-0470; FUSEHOLDER BODY UL/IEC; 75915; 3450003-010
XF1; 2950-0054; NUT FUSEHOLDER MTG 1/2-28; 28480; 2950-0054

CHANGE 4 (1604A for 5327A)

Page 6-13 and 6-15, Table 6-1, A18 (05327-60033) Replaceable Parts:
Change A18 from SERIES 1540 to 1604.
Add A18R57; 0698-3113; RESISTOR FXD 100 OHM 5% .125W CC; 01121; BB1015.

Page 8-45, Figure 8-18, A18 Schematic Diagram:
Change SERIES 1540 at top of schematic to 1604.
Add 100 ohm resistor R57 in series with +5V input to pin 10 of SCHMITT TRIGGER A18U3.

CHANGE 4 (1604A for 5327A) (Cont'd)

Page 6-17, Table 6-1, Replaceable CHASSIS PARTS:
Change Q1 from 1853-0233 to 1853-0350 in "HP" and "Mfr" part number columns.
Change Q2 from 1854-0420 to 1854-0625 in "HP" and "Mfr" part number columns.
NOTE – THE ABOVE TRANSISTORS FOR Q1 AND Q2 ARE RECOMMENDED FOR REPLACEMENT IN ALL INSTRUMENTS. THE HIGHER WATTAGE RATING OF THESE TRANSISTORS WILL IMPROVE INSTRUMENT RELIABILITY.

Page 8-41, Figure 8-16, TABLE OF ACTIVE ELEMENTS:
Change Q1 from 1853-0233 to 1853-0350 and Q2 from 1854-0420 to 1854-0625.

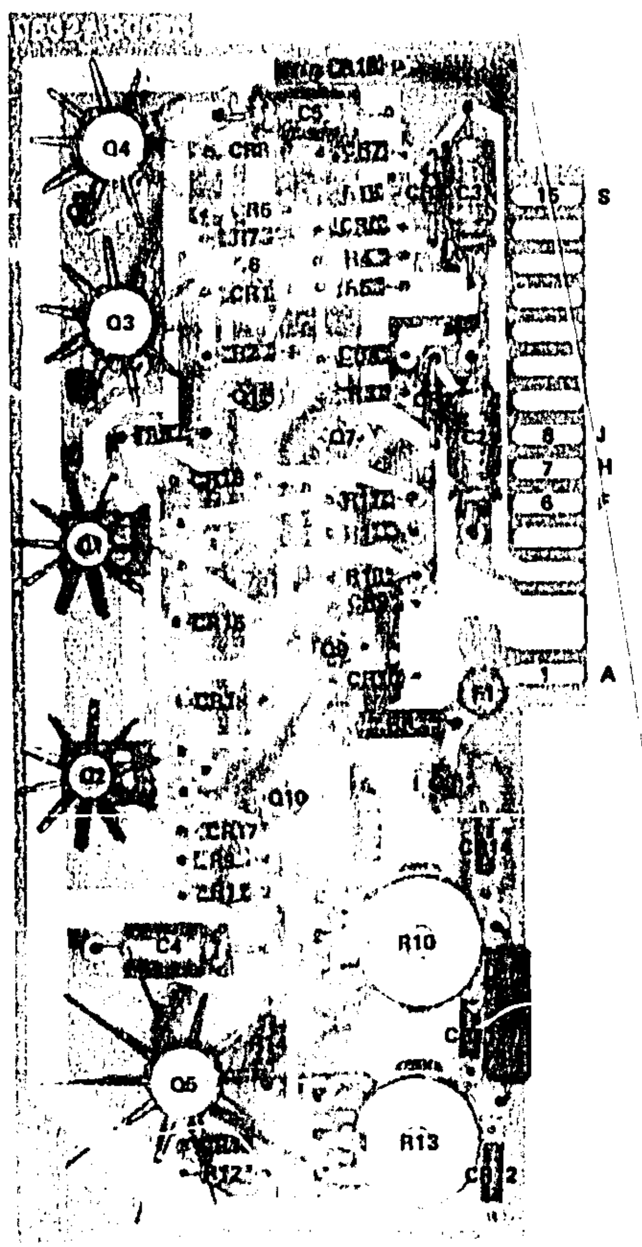


Figure 1. A15 Regulator Board Assembly Component Locator
05327-60020 Series 1312 or 1428

CHANGE 5 (1620A)

Page 6-6, Table 6-1, A6 (05326-60013) Replaceable Parts:
Change A6 series number to 1620.
Change A6C8 from 0160-0153 (.001 UF) to 0160-0299; CAPACITOR, FXD, 1800 PF 10% 200WVDC POLYE; 56289; 292P12292.
Add A6C13: 0180-1735; CAPACITOR-FXD .22 UF 10% 35WVDC TANT; 56289; 150D224X9035A2.

Page 8-23, Figure 8-10, A6 (05326-60013) Schematic Diagram:
Change series number, at top of diagram, from 1036A to 1620.
Change A6C8 from 1000 to 1800 PF.
Add A6C13 capacitor (.22 UF) between circuit board common and junction of A6R12, A7U4B(5), A6CR2, and A6CR3. The positive side of the capacitor goes to the SAMPLE RATE DISABLE line from connector pins 10L and the negative side to circuit board common.
Add A6C13 in REFERENCE DESIGNATION tables.

Page 6-7 and 6-8, Table 6-1, A7 (05327-60031) Replaceable Parts:
Change A7 series number from 1312A to 1620.
Change A7R15 from 0683-1015 (100Ω) to 0683-3915; RESISTOR, FXD, 390 OHM 5%, .25W CC; 01121; CB3915.
Change A7R16 from 0683-5115 (510Ω) to 0683-1525; RESISTOR, FXD, 1500 OHM 5%, .25W CC; 01121; CB5115.

Page 8-31, Figure 8-11, A7 (05327-60031) Schematic Diagram:
Change series number, at top of schematic, from 1312A to 1620.
Change A7R15 from 100 to 390 ohms.
Change A7R16 from 510 to 1500 ohms.

Page 6-12, Table 6-1, A16 (05327-60026) Replaceable Parts:
Change series number from 1132A to 1620.
Change A16R2 from 0811-1732 (1Ω) to 0812-0021 (0.47 OHMS) with same description as A6R1.
Some manuals already have this change.

Page 8-41, Figure 8-16, A16 (05327-60026) Schematic Diagram:
Change A16 series number, at top of diagram, from 1132A to 1620.
Change A16R2 from 1.0 to 0.47 ohm.

Pages 6-12 and 6-13, Table 6-1, A17 (05326-60031) Replaceable Parts:
NOTE: — Some instruments with serial prefix 1136A also have the following change on circuit boards marked "SERIES 1136".
Change A17 from series "1136A, REV C" to series "1620".
Change A17R21 from 0698-3153 (3830Ω) to 0757-0933; RESISTOR, FXD, 2400 OHM 2% ,125W F F TUBULAR; 24546; C4-1/8-TO-2401-G. *FACTORY SELECTED VALUE.

Page 8-43, Figure 8-17, A17 (05326-60031) Schematic Diagram:
Change series number, at top of schematic from "1136" to "1620".
Change A17R21 from 3830 to 2400 ohms.
Add asterisk (*) and "NOTE 3" adjacent to A17R21 in schematic.
Add following note to table of "NOTES":

3. RESISTOR A17R21 SELECTED TO SET DC LEVEL OF A17Q4 COLLECTOR BETWEEN -.80V and -.85V. MINIMUM VALUE FOR A17R21 is 2000 OHMS.

CHANGE 6 (5326A Serial No. 1620A04016 or higher) (5327A Serial No. 1620A00796 or higher)

NOTE — NOT ALL INSTRUMENTS WITH THE ABOVE SERIAL NUMBERS THAT HAVE OPTION 004 EXTENDED REMOTE PROGRAMMING WILL HAVE A SERIES 1620 CIRCUIT BOARD FOR A1.

Page 6-19, Table 6-2, Replaceable Parts for Option 004:
Change A1 (05327-60034) series number from 1224A to 1620.
Add capacitor A1C15, A1C16; 0160-3878; CAPACITOR-FXD 1000 PF 20% 100VDC CER; 28480; 0160-3878.

►Page 8-51, Figure 8-21, A1 (05327-60034) Schematic Diagram:
Change series number, at top of diagram, to 1620.
Add A1C15 and A1C16 capacitors (1000 pF) to A1 diagram. Connect both capacitors between the A COM line from A1J1(C), in upper right corner, and circuit board common.

Page 8-50, A1 REFERENCE DESIGNATIONS TABLE:
Change capacitor listing from C1-14 to C1-16.

CHANGE 7

Instrument serial prefix number does not change and remains 1620A with this change.

Page 6-18, Table 6-1, Chassis Replaceable Parts:
Add the following under CHASSIS PARTS:

XF1; 2110-0564; FUSEHOLDER BODY; 28480; 2110-0564.

XF1; 2110-0565; FUSEHOLDER CAP; 28480; 2110-0565.

XF1; 2110-0569; NUT FUSEHOLDER MTG, PLASTIC HEX; 28480; 2110-0569.

Delete 2110-0465, Fuseholder Cap; 2110-0470, Fuseholder Body; and 2950-0054, Fuseholder Mtg. Deleting these three parts negates part of Change 3.

CHANGE 8 (1844A) (5326A ONLY)

Page 6-5, Table 6-1, A4 OSCILLATOR ASSY REPLACEABLE PARTS:
Change A4 from 05326-60002 to 05326-60052; OSCILLATOR ASSY (SERIES 1844); 28480; 05326-60052.

Change A4 components to those given in attached Table 1.

Page 8-18, Part of Figure 8-8, Component Locator:
Change A4 component locator illustration to the new illustration shown in attached Figure 2.

Page 8-19, Figure 8-8, A4 Schematic Diagram:
Change A4 schematic diagram to the new diagram in attached Figure 3.

Serial Prefix Numbers of 5326A Counters shipped from the factory with the 05326-60052 oscillator change to 1844A. The 05326-60052 Oscillator Assembly is the recommended replacement for A4 in all 5326A/5327A instruments.

TABLE 1. A4 REPLACEABLE PARTS

A4 OSCILLATOR ASSEMBLY 05326-60052 (SERIES 1844)

REF. DESIG.	HP PART NO.	DESCRIPTION
A4C1	0121-0059	CAPACITOR-VAR 2-8 PF 350VDCW
A4C2	0160-2257	CAPACITOR-FXD CER 10PF 5% 500VDCW
A4C3	0160-3878	CAPACITOR-FXD CER 1000PF 20% 100VDCW
A4C4	0121-0061	CAPACITOR-VAR CER 5.5-18 PF 350VDCW
A4C5	0160-3879	CAPACITOR-FXD CER 0.01 UF 20% 100VDCW
A4C6	0180-0197	CAPACITOR-FXD TANT 2.2UF 10% 20VDCW
A4C7	0160-0161	CAPACITOR-FXD POLYE 0.01UF 10% 200VDCW
A4L1	9100-2276	COIL-MLD 100UH 10% Q=50
A4Q1	1853-0015	TRANSISTOR-SI PNP FT=500 MHz 200MW
A4Q2	1853-0015	TRANSISTOR-SI PNP FT=500 MHz 200MW
A4R1	0683-3015	RESISTOR-FXD FC 300Ω 5% .25W
A4R2	0683-1525	RESISTOR-FXD FC 1500Ω 5% .25W
A4R3	0683-2715	RESISTOR-FXD FC 270Ω 5% .25W
A4R4	0683-1525	RESISTOR-FXD FC 1500Ω 5% .25W
A4R5	0683-3905	RESISTOR-FXD FC 39 5% .25W
A4R6	0683-1525	RESISTOR-FXD FC 1500Ω 5% .25W
A4R7	0683-5105	RESISTOR-FXD FC 51Ω 5% .25W
A4U1	1820-1224	IC ECL TRIPLE 2-INPUT LINE RCVR MC 10216P
A4Y1	0140-0405	CRYSTAL 10 MHz

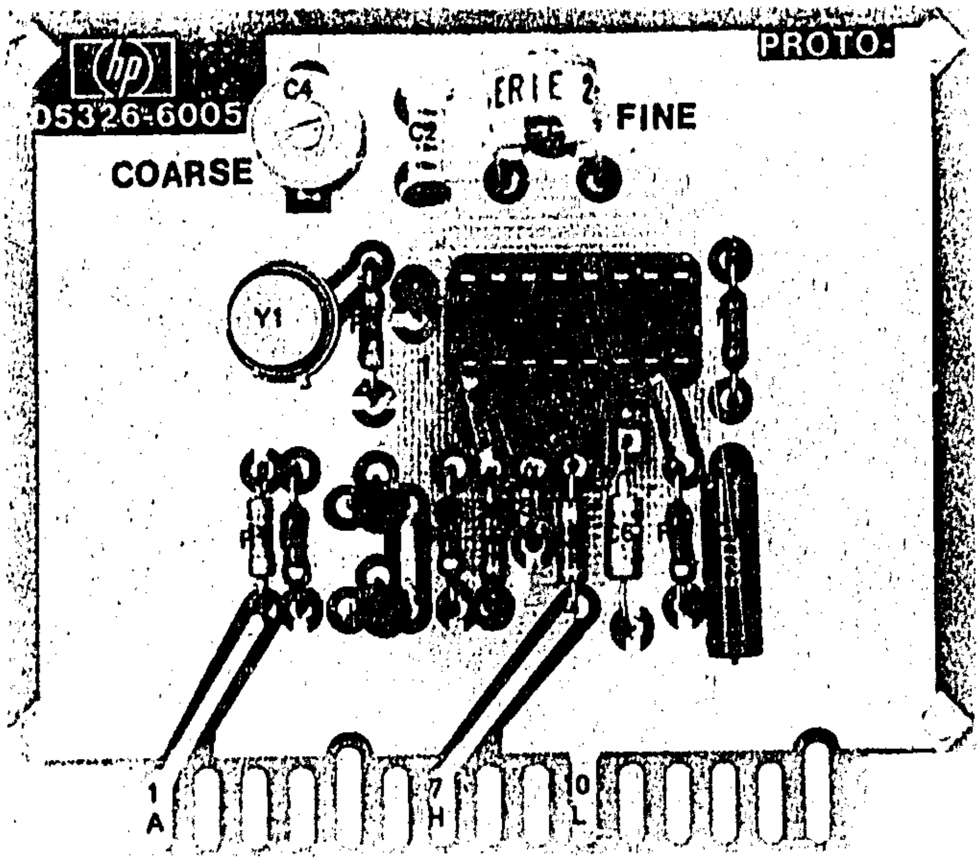
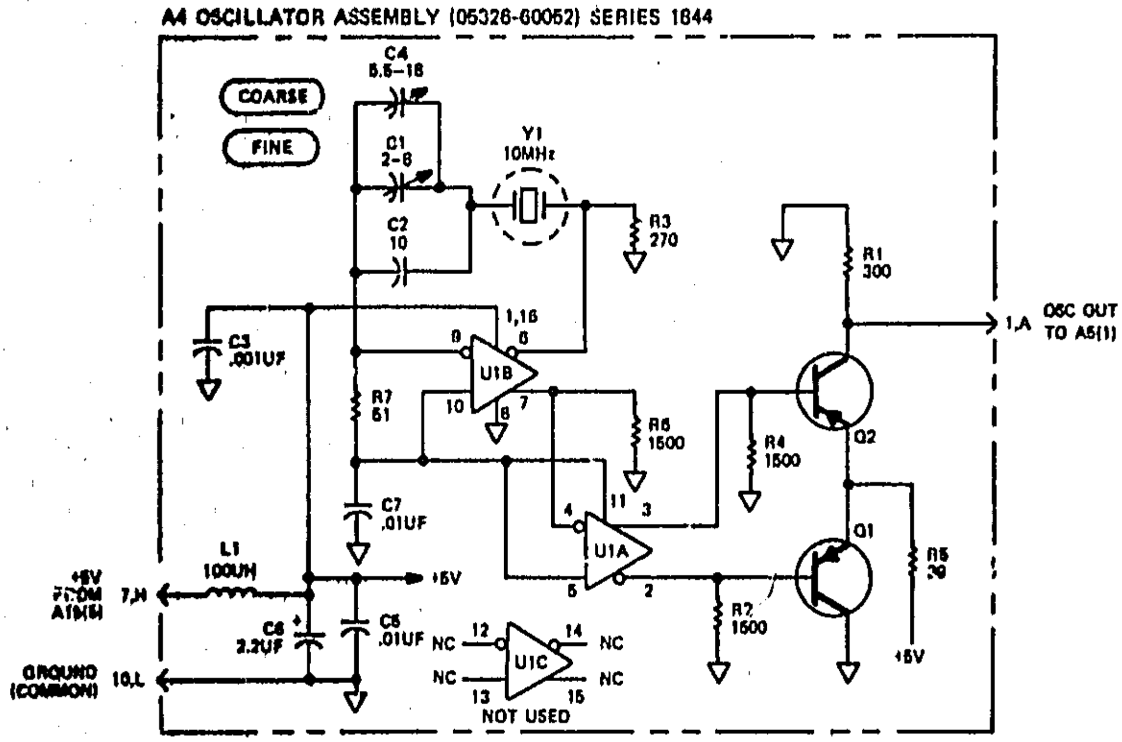


FIGURE 2. 05326-6005 10 MHz OSCILLATOR ASSY (SERIES 1844)



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.

2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

REFERENCE DESIGNATIONS

A4
C1-7
L1
Q1,Q2
R1-7
U1
Y1

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NO.
Q1, Q2	1853-0015 2N3640
U1	1820-0142 MC10216P
Y1	0410-0405

FIGURE 3. A4 (05326-60052) SCHEMATIC DIAGRAM

CHANGE 9 (1936A)
Page 6-3, Table 6-1, Replaceable Parts:
Change A1 (05326-60047) series number from 1224A to 1936.
Change A1S1 from 3101-1598 to 3101-2383; SWITCH-SL DP3T MINTR 0.5A 125VAC PC; 28480; 3101-2383.
Change A1S4 through S7 from 3101-1596 to 3101-2334; SWITCH-SL DPDT MINTR 0.5A 125VAC PC; 28480; 3101-2334.

Page 6-21, Table 6-2, Replaceable Parts (Option 004):
Change A1 (05327-60034) series number from 1620 to 1936.
Change A1S1 through S3 from 3101-1598 to 3101-2383; SWITCH-SL DP3T MINTR 0.5A 125VAC PC; 28480; 3101-2383.
Change A1S4, S5, S8, and S9 from 3101-1596 to 3101-2334; SWITCH-SL DPDT MINTR 0.5A 125VAC PC; 28480; 3101-2334.

Page 8-15, Figure 8-6, A1 (05326-60047) Schematic Diagram:
Change A1 series number from 1224 to 1936.

Page 8-51, Figure 8-21, A1 (05327-60034) Schematic Diagram:
Change A1 series number from 1620 to 1936.

NOTE — The above switches are recommended replacements in all 5326A and 5327A counters.

■ **CHANGE 10**
■ Page 1-3, and Page 3-4:
Under "PERIOD AVERAGE" add:
Measurement errors as large as one period may occur due to coherence between the measured signal and the time base. The error can be reduced by averaging over larger samples.

HP MANUAL CHANGES

MAKE ALL CORRECTIONS IN YOUR MANUAL ACCORDING TO ERRATA.

Check the following table for your instrument serial prefix and make any indicated changes to the manual:

*New or revised item.

MANUAL TITLE: 5326A/27A
MANUAL PRINTED: September 1973
MANUAL PART NO: 05326-90035
CHANGE DATE: 28 September 1976.

SERIAL PREFIX	MAKE CHANGE	SERIAL PREFIX	MAKE CHANGE	SERIAL PREFIX	MAKE CHANGE
1446U	1	1544U-00494	1-5		
1519U	1-2	1641(5327 only)	1-6		
1537U	1-3				
1544U	1-4				

The 5326A/27A is furnished less the RACK MOUNTING KIT described in the manual. If ordered at the same time as the instrument, the RACK MOUNTING KIT described in the manual is available as Option 908 at additional cost. If not ordered with an instrument, the RACK MOUNTING KIT is available under HP Part No. 05326-60046. Disregard any manual references stating the instrument is supplied with a rack mount kit.

ERRATA

Page 1-1, Table 1-1
Change Rack Mtg. Kit from 05326-60029 to 05326-60046

Page 5-5, 4. PULSE OPERATION:
In step a. set LEVEL (A) to "SLIGHTLY +" in place of PRESET

Change step c to read "Adjust pulse generator for positive output for 10 MHz repetition rate, 15ms pulse width for o.3 volts peak-to-peak indication on oscilloscope".

Change step d to read "Adjust counter LEVEL A control until counter triggers and counts. Check that counter displays the repetition rate, count light flashes, and trigger A lamp is ON. Record on test card."

Page 5-10, Table 5-4, Steps 5c and 5d:
Change 0.65 to 0.9 ± .05V at A18U2(3).
Change 0.90 to 0.8 ± .05V at A18U3(3).

Page 6-4
Change A1S5,6 to part no. 3101-1594 Sw. Slide

Page 6-7/8, Table 6-1
Add A7C3 0160-2150 CAPACITOR: FXD 33pF 5% 300V FACTORY SELECTED
Add A7XU14 1200-0473 SOCKET: IC 16 Pin; with this change A7 05327-60031 is REV B SERIES 1312A.

Page 6-8, Table 6-1
Change A7U10 reference designator only to A7U11
Change A7U11 reference designator only to A7U10.

Page 6-9, Table 6-1
Add to A9 Assy part no. 1200-0473 Socket I.C.
Change A9U2-U7 from 1820-0232 to 1820-0119 in "HP Part Number" and "Mfr Part No." columns.

Page 6-12, Table 6-1
Change A16CR4/5 to part no. 1901-0050 Di Si
Change A9R2, 4 9, 11 to part no. 0757-0440 R FXD 7.5K ohm 1% ⅛W

Page 6-13, Table 6-1
ChangeA17, L2 to part no. 9100-2260 Ind Fxd 1.8μH

Page 6-14 and 6-15, Table 6-1
Add "FACTORY SELECT" after description for A18R34 and A18R42.
Change A18U3 from 1826-0085 to 1826-0085 or 1826-0151 in HP and Mfr. Part no. columns.

Page 7-2, Paragraph 7-21
Add the following sentence: "An HP Part No 05326-00033 adapter plate will also be required for mounting 36-pin remote programming connector J10."

Page 8-31, Figure 8-11, A7 schematic:
Add A7C3* 33pF connected from XU14C(11) to XU14C(16) (ground).
Change REFERENCE DESIGNATION table from "C1,2" to "C1-3".

Page 8-40, Part of Figure 8-16
Replace A15 component locator photo with attached Figure 1.

Page 8-45, Figure 8-18, Schematic Diagram
Add Asterisk (*) by A18R34 and A18R42.
In TABLE OF ACTIVE ELEMENTS show 1826-0085 or 1826-0151 for A18U3 and 1820-0736 or 1820-0558 for A18U4.
Change dc voltage at A18U2(3) from .65 ± .05V to .9 ± .05V and voltage at A18U3(3) from .9 ±.05V to .8 ± .05V.

<u>CHANGE 1</u>

Page 6-11/12, Table 6-1
Change A15R6 to part no. 0698-5479 R FXD 8.2Ω 5%
Change A15XF1 to part no. 1251-3205 Cont Skt. (2 reqd)
Change A15F1 to part no. 2110-0487 Fuse 1/20A
(Board blank to Rev D 05326-20020).

Page 6-16, Table 6-1
Change Part No. 05326-00032 Rear Panel to 05326-60049
Item 5050-0160 now total quantity 2.

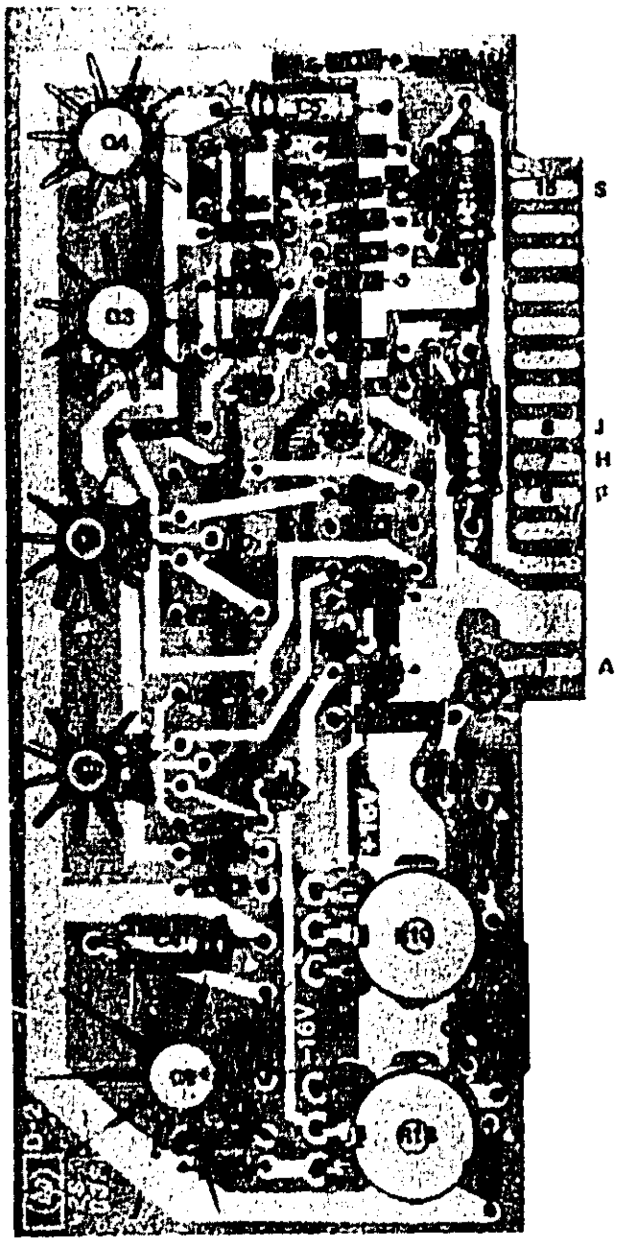


Figure 1. A15 Regulator Board Assembly Component Locator
05327-60020 Series 1312A or 1428A

CHANGE 2

Page 6-13, Table 6-1
Change A18R29, 30 to Part no. 0698-5103 R FXD 430Ω 5% ⅛W
(Add asterisk * to indicate select on test)
Add to A18R22, 23, 40 asterisk (*) to indicate select on test.

CHANGE 3

Page 6-7, Table 6-1
Add A7C3* part no. 0160-2150 C FXD 33pF.

Page 8-31, Fig. 8-11, A7 Function control assy.
Add C3* connected pin 11 U14 to gnd.

CHANGE 4

Page 1-4, Table 1-3 Specifications for OPTIONS
Add to Option 001: 8 digit display. "Part of standard instrument-discontinued as an Option."
Add to Option 003: Digital Output (for numerals and polarity only). "Discontinued as an Option and included as part of the standard instrument."

Page 1-5, Table 1-3, Specifications for OPTIONS
Delete Option 010 Temperature Compensated Oscillator. This Option is discontinued and is no longer available.

Page 7-1, Options and Manual Changes, Paragraph 7-14
Delete second sentence.
Paragraph 7-18
Add "Part of Standard Instrument - Discontinued as an Option".
Paragraph 7-22
Add "Part of Standard Instrument - Discontinued as an Option".

Page 6-9, Table 6-1, A9 Replaceable Parts
Replace A9 table for 05326-60008 with table for 05326-60025 A9 on Page 6-18 of Table 6-2.

Page 6-18, Table 6-2
Add parts for Option 003 as part of standard instrument.

** CHANGE 5 **

Page 6-19 Table 6-2
Add A1C15 part no. 0160-3878 C Fxd .001μF 100VDC

Page 6-17 Table 6-1
Add XF1 part no. 2110-0465 Fuse Pose CAP
Add XF1 part no. 2110-0470 Fuse Post (Replaces 1400-0084 Fuse Holder Extr Post).

CHANGE 6 (5327A only)

Page 5-10, Table 5-4, Paragraph 5 Prescaler Adjustments
Change paragraph 5-g to read as follows: "Reduce output level until counter's display becomes unstable. Alternately adjust A18R3 and A18R53 for a stable display. Repeat procedure until unable to obtain a stable display. Increase signal level until display just becomes stable and make any final adjustments of A18R3 and A18R53."

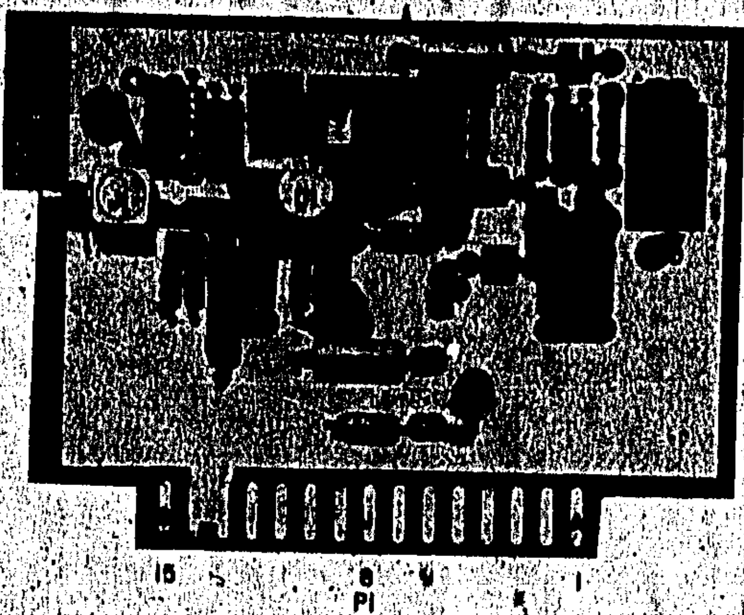
Page 6-13, Table 6-1, A18 Replaceable Parts
Add A18C30; 0160-3879; CAPACITOR-FXD 0.01 µF 20% 100 VDCW OER
Change A18R22 and A18R23 from 0698-4131 (56 ohms) to 0698-3111; R FXD 30 OHM 5% .125W CC
Change A18R29 and A18R30 from 0698-5103(420 ohms) to 0698-5177; R FXD 820 OHM 5% .125W CC

Change A18R34 from 0698-8073 (1600 ohms) to 0698-5178; R FXD 1500 OHMS 5% .125W CC
Add A18R53; 2100-2633; R VAR 1000 OHMS 10% COMP SIDE ADJ;
Add A18R54 and A18R55; 0698-3374; R FXD 20 OHM 5% .125W CC
Add A18R56; 0698-6283; R FXD 10 OHMS 5%; .125W CC

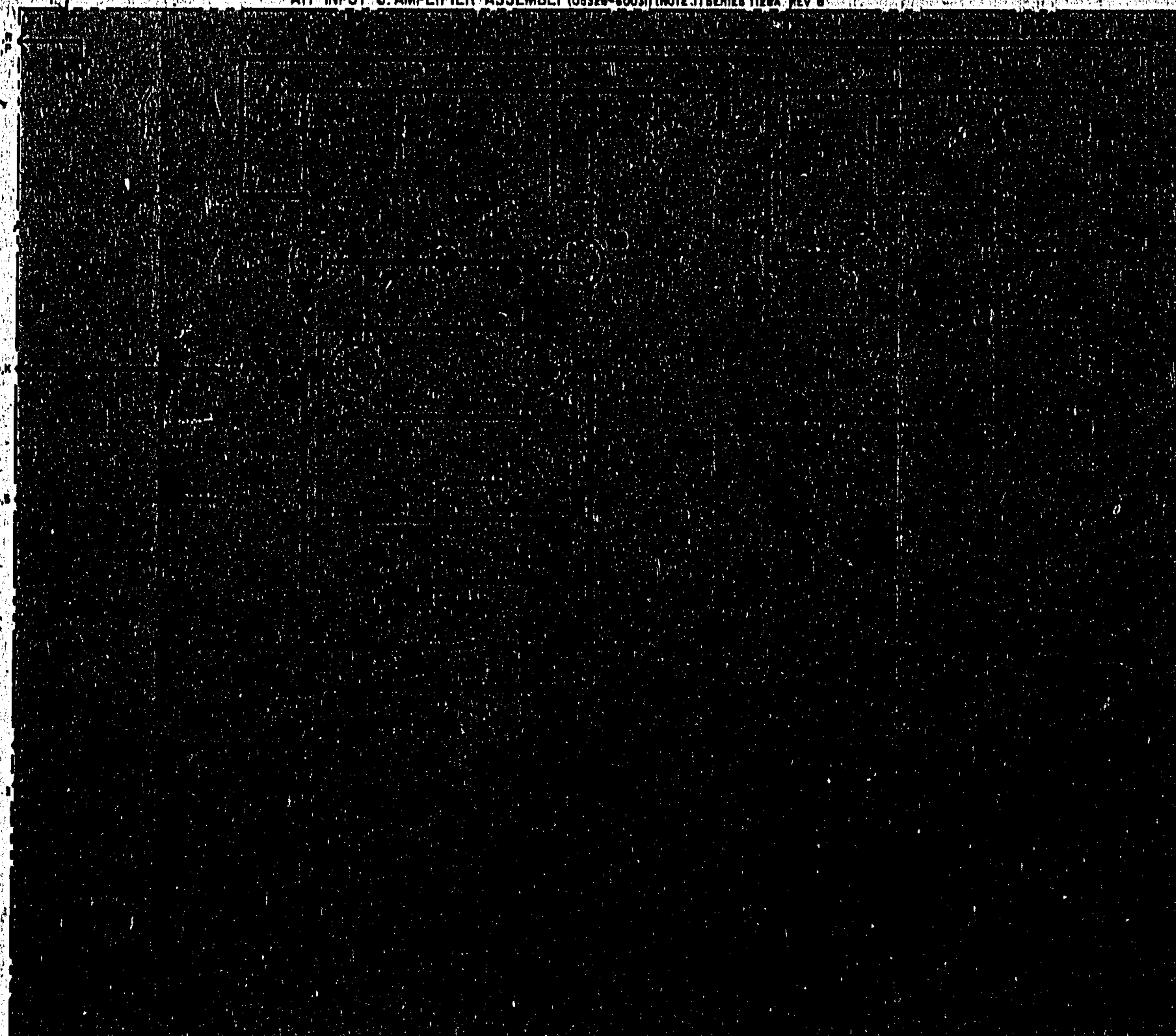
Page 6-13 and 6-15, Table 6-1, A18(05327-60033) Replaceable Parts:
Change A18 from SERIES 1544 to 1645
Add A18R57; 0698-3113; RESISTOR FXD 100 OHM 5% .125W CC

Page 6-14, Table 6-1
Add A18L3; 05303-80001, 1, COIL, FXD, RF PEAKING
Add "FACTORY SELECTED" to A18R34 and A18R42 "Description".

Page 8-45, Figure 8-18, A18 Prescaler Assembly Schematic.
Add A18C30 (.01µF) between common and the "+5V" end of A18R34.
Add A18R53 (1000 ohms) variable resistor between +5.2V and -5.2V. Connect junction of A18C30 and A18R34 to arm of A18R53 in place of "+5V" as shown on schematic diagram.
Change value of A18R34 from 1600 to 1500 ohms.
Change A18R22 and A18R23 from 56 to 30 ohms.
Change A18R29 and A18R30 from 430 to 820 ohms.
Add A18R54 (20 ohms) in series between A18U2 pin 11 and the junction of A18R23, A18R30 and A18U3 pin 5.
Add A18R55 (20 ohms) in series between A18U2 pin 14 and the junction of A18R22, A18R29, and A18U3 pin 4.
Add an asterisk (*) adjacent to A18R54 and A18R55.
Add A18R56 (10 ohms) in series between A18U1 pin 2 and the junction of A18U2 pin 5 and A18R56.
Change SERIES 1544 at top of schematic to 1645.
Add 100 ohm resistor R57 in series with +5V input to pin 10 of SCHMITT TRIGGER A18U3.
Add A18L3 in series with A18U3 (13) output line. Output circuit trace is cut and one end of A18L3 is connected to the junction of A18U3(13) and A18R34. The other end of A18L3 is connected to the junction of A8R44 and the coil from A18R42.
Add asterisk (*) adjacent to A18R22, A18R23, A18R29, A18R30 and A18R40.
In Table 6-1 for these resistors add "FACTORY SELECTED VALUE" to description.


15
8
1
P1

A17 INPUT C AMPLIFIER ASSEMBLY (05326-60031) (NOTE 1) SERIES 1128A REV B



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1,2	1901-0047
CR3	1912-0007
Q1,2	1853-0015
Q3,4	1854-0092
U1	1858-0004
U2	1820-0147

REFERENCE DESIGNATIONS

A1
C1-13
CR1-3
L1-4
Q1-4
R1-19, 21-26
U1,2

Figure 8-17. A17 Input C Amplifier Assembly (5326A Only)

A16 PRESCALER OPERATION

The prescaler board serves as a direct amplifier-trigger or as a divide-by-ten amplifier-trigger, with the function controlled by the front-panel input selector switch. With the switch in the PRESCALE position, the circuit performs as follows:

The signal is fed into the 50Ω input of J1. U1 limits the input level to about ±1 V and provides protection up to 5 V rms. There is about 2 dB loss through U1. The signal is passed to U2 amplifier Schmitt trigger, which is biased for sensitivity by R1. The Schmitt trigger threshold is about 70 mV and triggers independently of frequency. The square wave from U2(11) is divided by two and again by five in U3 and U4, respectively. Q2 translates the signal to ECL levels, before presenting it to the data switch.

At the same time, U2 amplifier is supplying the direct triggering network with the input signal. C1 ac couples the signal and eliminates the effect of U2 amplifier drift. U7 consists of a dual-differential amplifier, which converts the input voltage to an output current which is driven through tunnel diode CR2. The diode performs a Schmitt trigger function and squares the output. R2 is used to vary the bias current through CR2 to control the sensitivity. Q1, Q3, C8, and R18 differentiate the signal and pass the negative pulses at an ECL level to U5 data swich.

The data switch is controlled by the input selector switch (TTL high at U5(2) = Direct; TTL low at U5(2) = Prescale) and connects either the direct or prescaler signal to A7 Function Control by way of the one-shot, U6. The one-shot output goes high (U6(4)) when the input goes low. The output goes low again after about 12 ns when the level changes have propagated through the gates in a domino effect.

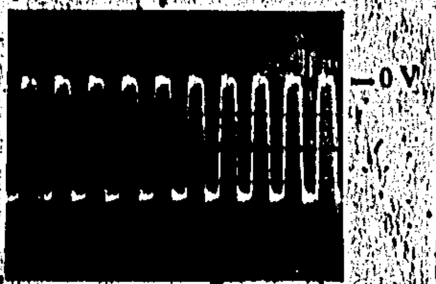
A16 TROUBLESHOOTING

Check for operation by placing the input selector switch in both direct and prescale positions. If the counter does not work with the switch in either position, the trouble is probably in U1, U2, U5, or U6. In the direct mode, start by checking in the tunnel diode (CR2) area; check for proper waveforms of 5 and 6. For the prescale mode, start by checking the output of divided-by-two circuit, U3(6).

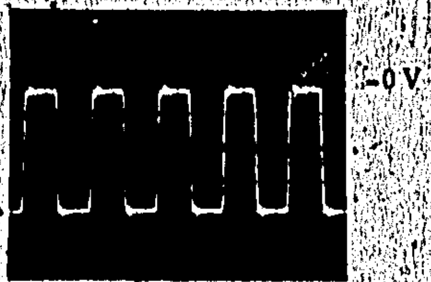
Figure 8-17
A17 INPUT C AMPLIFIER ASSEMBLY (5326A ONLY)

(See Page 8-41)

Part of Figure 8-18. A18 Prescaler Board Assembly

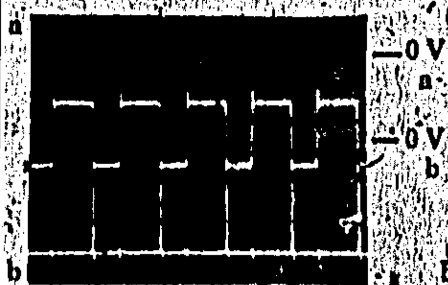


.02 V/cm
.1 μs/cm

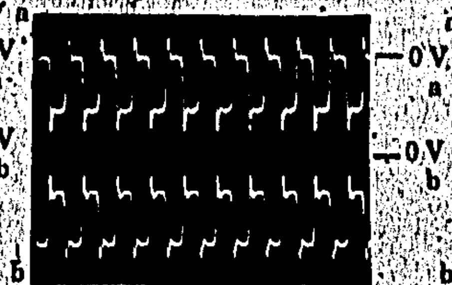


.02 V/cm
.1 μs/cm

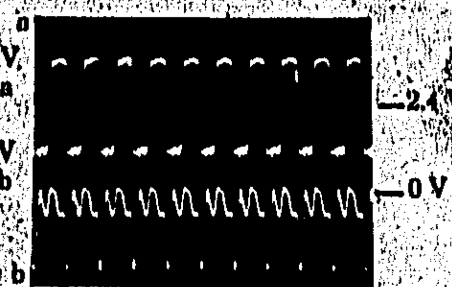
.02 V/cm
.2 μs/cm



a. U5(7)
b. U6(4)
.05 V/cm
.5 μs/cm

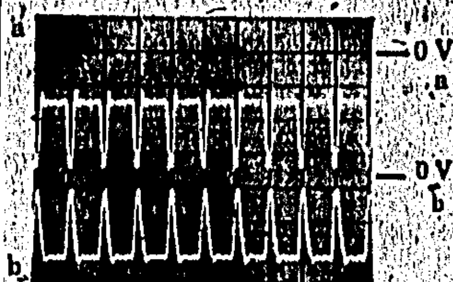


a. U7(10)
b. U7(1)
.05 V/cm
.1 μs/cm



a. Q1 - .02 V/cm
b. Q3 - .1 V/cm
.1 μs/cm

All waveforms taken with 10:1 divider probe; ground lead is connected to ground side of C5. A18 is mounted on extender board.



a. U5(7)
b. U6(4)
.05 V/cm
.1 μs/cm
Direct position

COUNTER CONTROLS
(except as noted)

INPUT C jack .... connect 10 MHz sine wave at 1 V rms
Input Selector .... PRESCALE
FUNCTION .... FREQ C
TIME BASE .... 1 ms
CHK/SEP/COM .... SEP

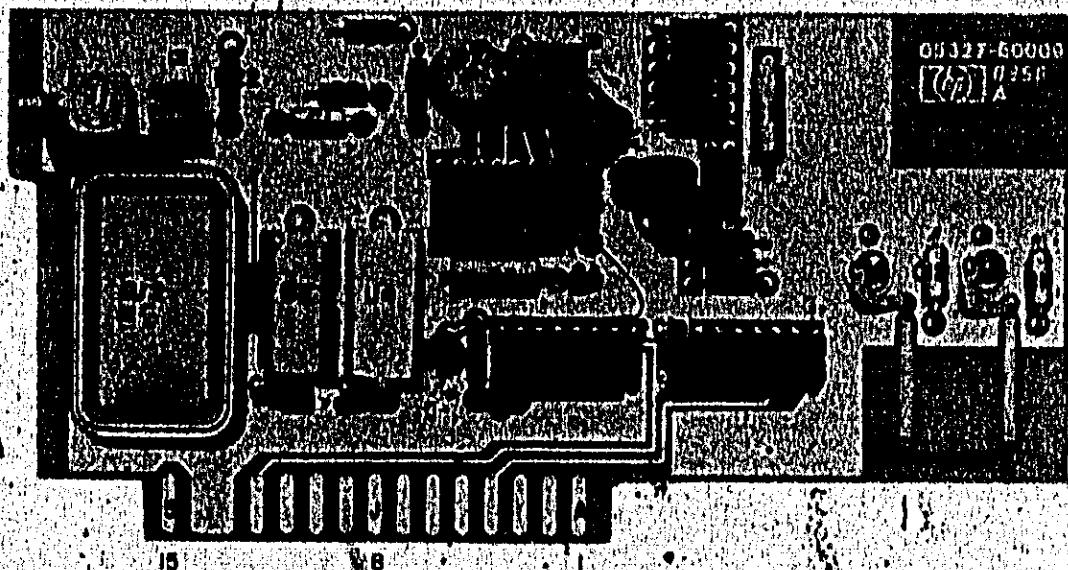
OSCILLOSCOPE CONTROLS

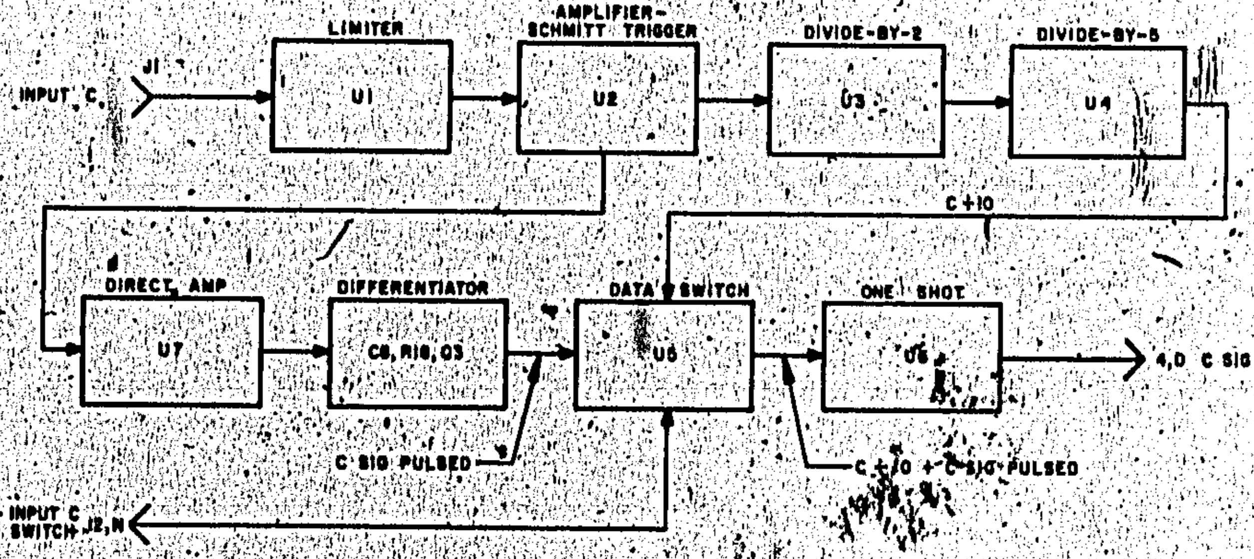
SWEEP MODE .... AUTO
TRIGGER .... INT
SLOPE .... +
DISPLAY .... for dual waveforms, use ALT B

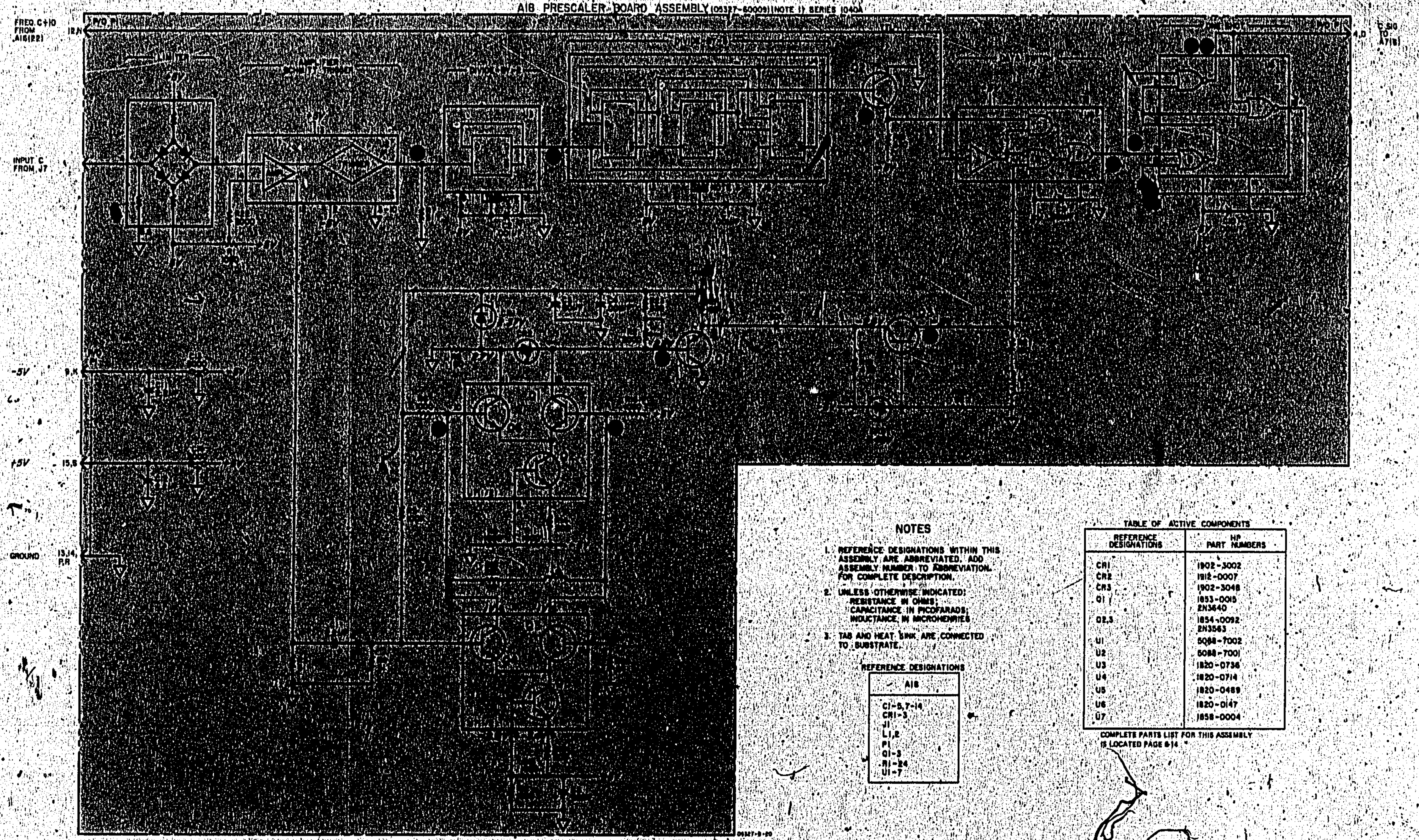
DC VOLTAGES

Set counter controls as stated. Disconnect input signal.

MORE DATA UNDER FOLD


15
8
1


LIMITER
AMPLIFIER-SCHMITT TRIGGER
DIVIDE-BY-2
DIVIDE-BY-5
INPUT C
J1
U1
U2
U3
U4
C ÷10
DIRECT AMP
DIFFERENTIATOR
DATA SWITCH
ONE SHOT
U7
U6
U5
4,D C SIG
C SIG PULSED
C ÷10 + C SIG PULSED
INPUT C SWITCH J2,N



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION. FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. TAB AND HEAT SINK ARE CONNECTED TO SUBSTRATE.

REFERENCE DESIGNATIONS

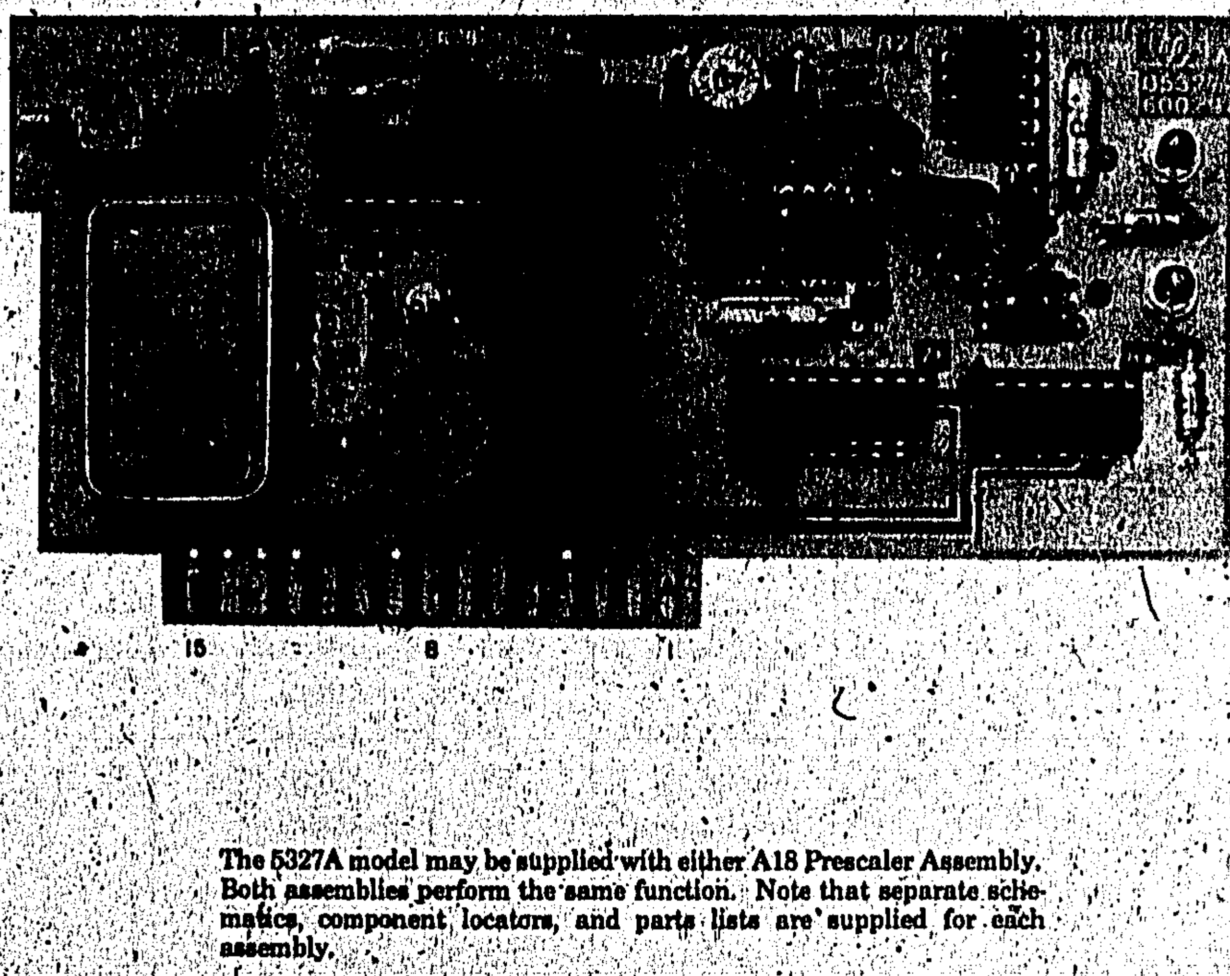
A18
C1-5,7-14
CR1-3
J1
L1,2
P1
Q1-3
R1-24
U1-7

TABLE OF ACTIVE COMPONENTS

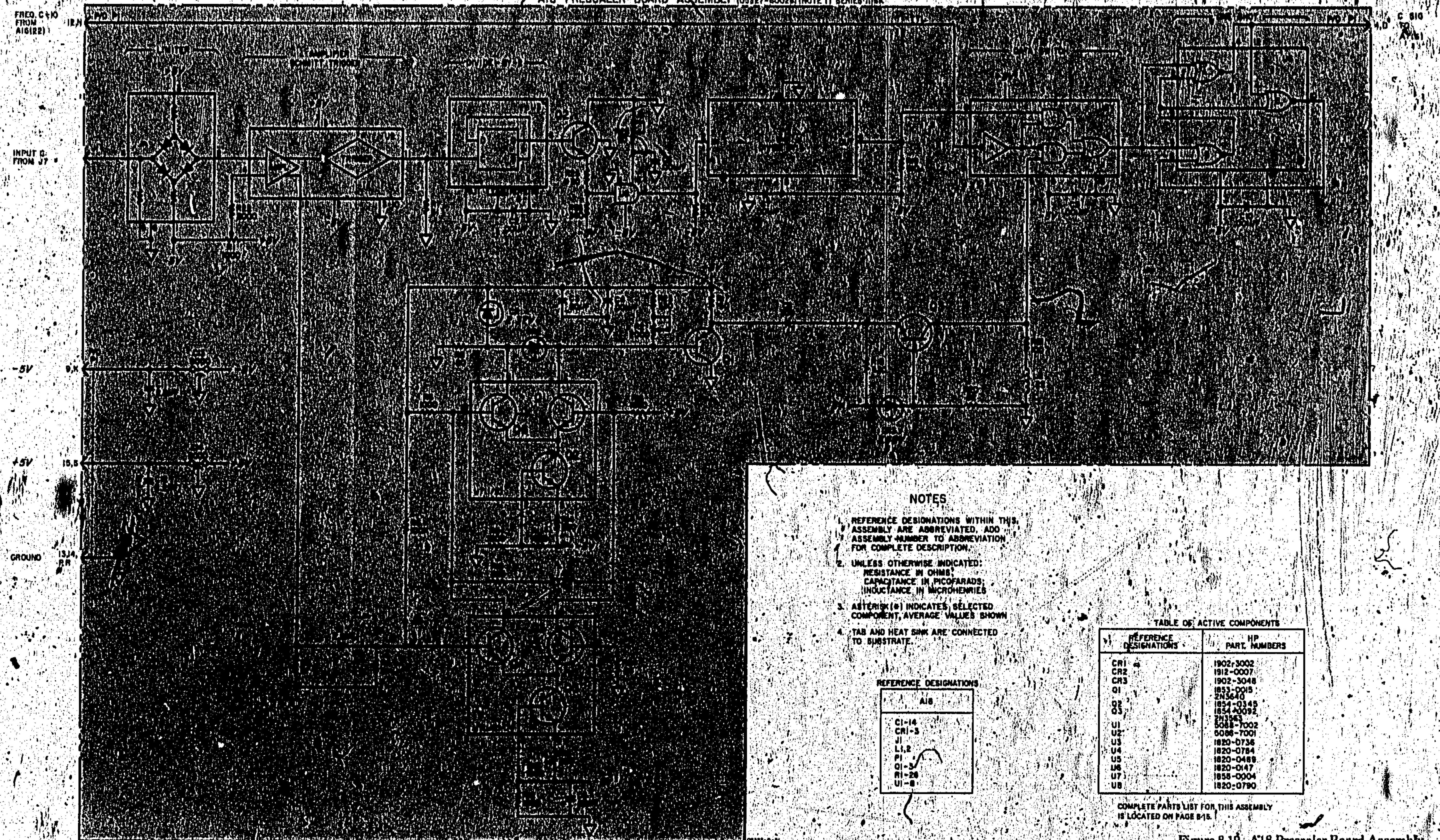
REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1	1902-3002
CR2	1912-0007
CR3	1902-3048
Q1	1853-0015 2N3640
Q2,3	1854-0092 2N3563
U1	5088-7002
U2	5088-7001
U3	1820-0736
U4	1820-0714
U5	1820-0489
U6	1820-0147
U7	1858-0004

COMPLETE PARTS LIST FOR THIS ASSEMBLY IS LOCATED PAGE 8-14

Figure 8-18. A18 Prescaler Board Assembly (5327A Only)



The 5327A model may be supplied with either A18 Prescaler Assembly. Both assemblies perform the same function. Note that separate schematics, component locators, and parts lists are supplied for each assembly.



NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN
4. TAB AND HEAT SINK ARE CONNECTED TO SUBSTRATE.

REFERENCE DESIGNATIONS

A18
C1-14
CR1-3
J1
L1,2
P1
Q1-3
R1-28
U1-8

TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1	1902-3002
CR2	1912-0007
CR3	1902-3048
Q1	1853-0015 2N3640
Q2	1854-0345
Q3	1854-0092 2N3563
U1	5088-7002
U2	5088-7001
U3	1820-0736
U4	1820-0784
U5	1820-0469
U6	1820-0147
U7	1858-0004
U8	1820-0790

COMPLETE PARTS LIST FOR THIS ASSEMBLY IS LOCATED ON PAGE 8-15.

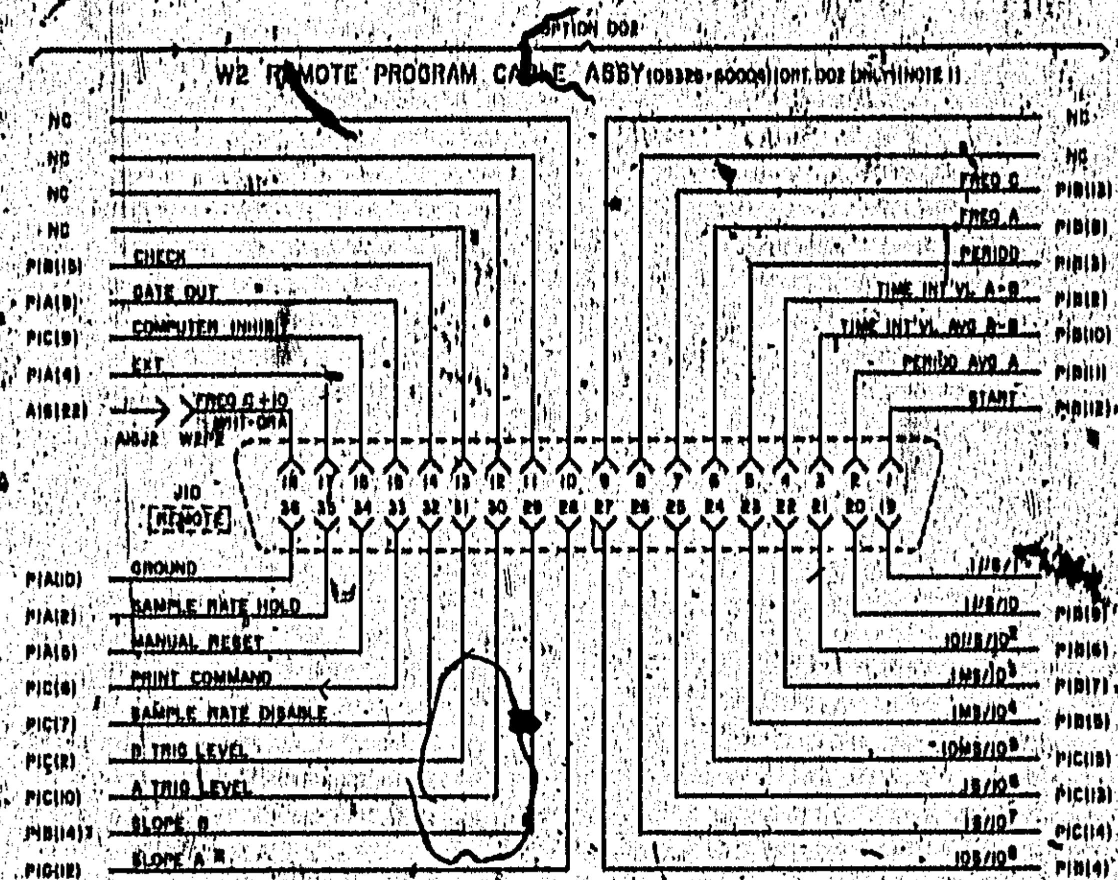
Figure 8-19. A18 Prescaler Board Assembly (5327A Only)

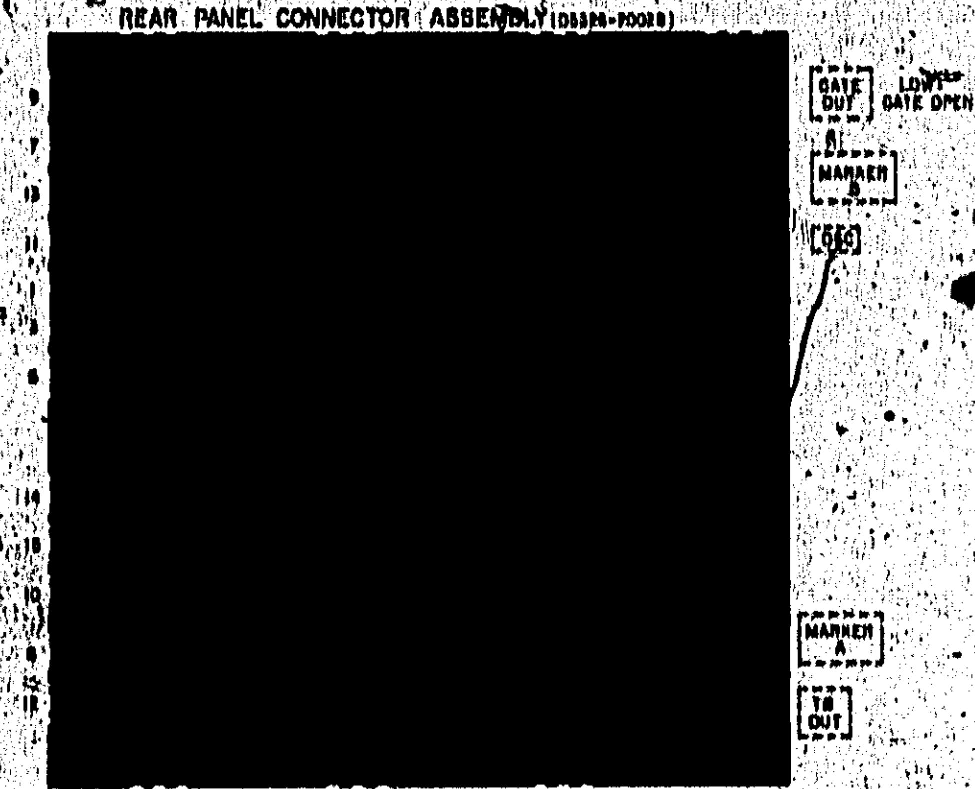
OPTION 002 REMOTE PROGRAMMING

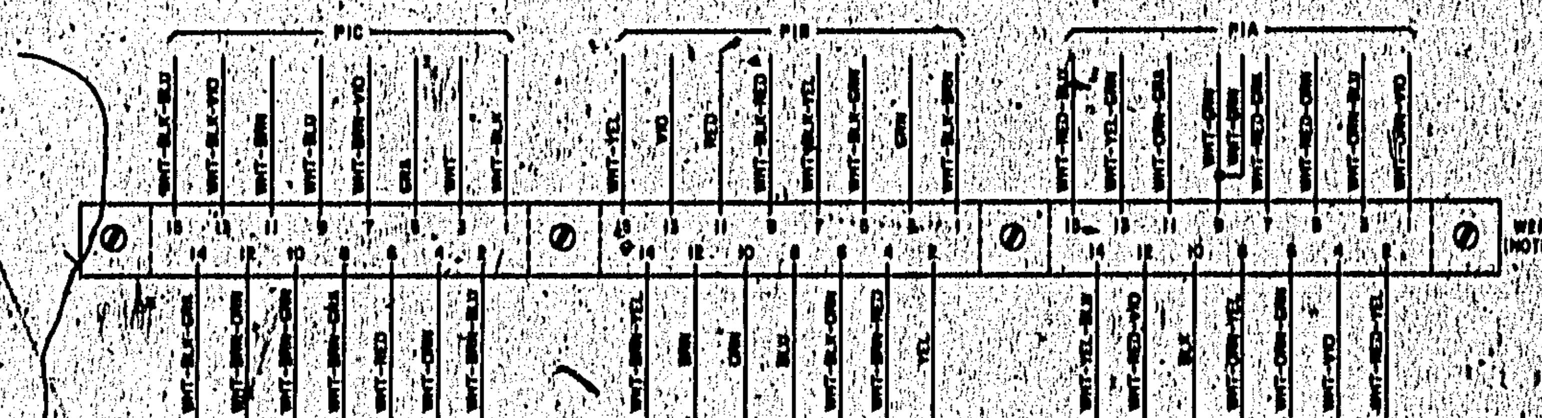
See Section II for programming information.

Function	J10 Pin No.	Wire Color	W2P1 Pin No.	Circuit Board Terminals	Level
Start	1	Brn	B12	A16(14)	L = Start Open = Stop
Period Avg A	2	Red	B11	A16(13)	L = Enable
Time Intvl Avg	3	Orn	B10	A16(16)	↑
Time Intvl	4	Yel	B2	A16(15)	
Period	5	Grn	B3	A16(17)	
Freq A	6	Blu	B8	A16(18)	↓
Freq C	7	Vio	B13	A16(21)	L = Enable
No connection	8	Gry	C5		
No connection	9	Wht	C3		
No connection	10	Wht-Blk	C1		
No connection	11	Wht-Brn	C11		
No connection	12	Wht-Red	C6		
No connection	13	Wht-Orn	C4		
Check	14	Wht-Yel	B15	XA3(B)	L = Check
Gate Out	15	Wht-Grn	A9	XA5(P)	H = Gate Closed L = Gate Open
Computer Inhibit	16	Wht-Blu	C9	XA6(14)	L = Inhibit
Ext	17	Wht-Vio	A4	XA1(A)	H = Int L = Ext
Freq C ÷ 10	18	Wht-Gry	(W2P2)	A16(22)	L = Enable
1 µs/1	19	Wht-Blk-Brn	B1	A16(30)	↑
1 µs/10	20	Wht-Blk-Red	B9	A16(31)	
10 µs/10^2	21	Wht-Blk-Orn	B6	A16(28)	
.1 ms/10^3	22	Wht-Blk-Yel	B7	A16(29)	
1 ms/10^4	23	Wht-Blk-Grn	B5	A16(26)	
10 ms/10^5	24	Wht-Blk-Blu	C15	A16(27)	
.1 s/10^6	25	Wht-Blk-Vio	C13	A16(24)	
1 s/10^7	26	Wht-Blk-Gry	C14	A16(25)	↓
10 s/10^8	27	Wht-Blk-Red	B4	A16(23)	L = Enable
Slope A	28	Wht-Brn-Orn	C12	XA2(13,P)	L = Minus Open = Plus
Slope B	29	Wht-Brn-Yel	B14	XA3(13,P)	L = Minus Open = Plus

Function	J10 Pin No.	Wire Color	W2P1 Pin No.	Circuit Board Terminals	Level
A Trig Level	30	Wht-Brn-Grn	C10	XA2(1,A)	+3 V to -3 V
B Trig Level	31	Wht-Brn-Blu	C2	XA3(1,A)	+3 V to -3 V
Sample Rate Disable	32	Wht-Brn-Vio	C7	A16(11)	L = Disable
Print Command	33	Wht-Brn-Gra	C8	XA6(8)	L = Causes Print
Manual Reset	34	Wht-Red-Orn	A5	A16(6)	L = Reset
Sample Rate Hold	35	Wht-Red-Yel	A2	A16(4)	L = Maintain Display
Ground	36	Blk	A10	Ground	
Logic levels (Input) H > +2.0 V, L < +0.8 V (Output) H > +2.4 V, L < +0.4 V					







NOTES

1. IN STANDARD INSTRUMENT, ONLY W2P1A IS WIRED.

Figure 8-20. Option 002 Remote Programming Cable Assembly and Rear Panel Connector Assembly

OPTION 003, DIGITAL RECORDER OUTPUT

Option 003 includes cable assembly W1 and rear panel connector J9. The counter (A9 Display Assembly) provides 8421 BCD and control line inputs and outputs for use with a printer or other data storage devices.

The annunciator lines (J9-17, 18, 42, and 43) supply overflow, plus, and minus outputs as follows:

FUNCTION	BCD
	8 4 2 1
Overflow	L L L L
All Other Times	H H H H

When the print command line at J9(48) goes low, it indicates that the counter has completed a measurement and the data output may be interrogated. When the inhibit line is held High, the data output is maintained. The line must go high less than 30 μs after the print command goes low. The +5 V reference line (J9-25) has a 1K source impedance and is used for data level references. The 0 volt or ground reference connects to J9(24, 50).

OPTION 004, EXTENDED REMOTE PROGRAMMING

See Section II for remote programming information.

Option 004 Pin Connections

Function	J10 Pin No.	Wire Color	W2P1 Pin No.	Circuit Board Terminals	Level
Ground	1	Blk			
Ground	2	Blk			
-16.5 V Output	3	Orn			
+16.5 V Output	4	Yel			
+5 V Output	5	Grn			
Sep-Com	6	Blu		A1 Cable Point 4	L = Com
Ac-Dc Chan B	7	Vio		A1 Cable Point 7	L = Dc
No connection	8	Gra			H = Ac
X10 Atten B	9	Wht		A1 Cable Point 5	See Section II
X100 Atten B	10	Wht-Blk		A1 Cable Point 6	
Ac-Dc Chan A	11	Wht-Brn		A1 Cable Point 8	L = Dc
No connection	12	Wht-Red			H = Ac
X10 Atten A	13	Wht-Orn		A1 Cable Point 2	See Section II
X100 Atten A	14	Wht-Yel		A1 Cable Point 3	

Function	J10 Pin No.	Wire Color	W2P1 Pin No.	Circuit Board Terminals	Level
Ground	15	Blk	A10		
Sample Rate Hold	16	Wht-Blu	A2	A16(4)	L = Maintain Disable
Manual Reset	17	Wht-Vio	A5	A16(6)	L = Reset
Print Command	18	Wht-Gra	C8	XA6(8)	L = Causes Print
Sample Rate Disable	19	Wht-Blk-Brn	C7	A16(11)	L = Disable
Trig Level B	20	Wht-Blk-Red	C2	XA3(1, A)	+3 V to -3 V
Trig Level A	21	Wht-Blk-Orn	C10	XA2(1, A)	+3 V to -3 V
Slope B	22	Wht-Blk-Yel	B14	XA3(13, P)	L = Minus Open = Plus
Slope A	23	Wht-Blk-Grn	C12	XA2(13, P)	L = Minus Open = Plus
10 ms/10^5	24	Wht-Blk-Blu	C15	A16(27)	L = Enable
1 ms/10^4	25	Wht-Blk-Vio	B5	A16(26)	
.1 ms/10^3	26	Wht-Blk-Grn	B7	A16(29)	
10 µs/10^2	27	Wht-Brn-Red	B6	A16(28)	
.1 µs/1	28	Wht-Brn-Orn	B1	A16(30)	
1 µs/10	29	Wht-Brn-Yel	B9	A16(31)	
.1 s/10^6	30	Wht-Brn-Grn	C13	A16(24)	
1 s/10^7	31	Wht-Brn-Blu	C14	A16(25)	
10 s/10^8	32	Wht-Brn-Vio	B4	A16(23)	
Freq C ÷ 10	33	Wht-Brn-Gra	W2P2	A16(22)	L = Enable
Ext	34	Wht-Red-Orn	A4	XA11(A)	H = Int L = Ext
Computer Inhibit	35	Wht-Red-Yel	C9	XA6(4)	L = Inhibit
Gate Output	36	Wht-Red-Grn	A[illegible]	XA5(F)	H = Gate Closed L = Gate Open
Check	37	Wht-Red-Blu	B15	XA3(B)	L = Check
No connection	38	Wht-Red-Vio	C4		
No connection	39	Wht-Red-Gra	C6		
No connection	40	Wht-Orn-Yel	C11		
Freq C	41	Wht-Orn-Grn	B13	A16(21)	L = Enable
Freq A	42	Wht-Orn-Blu	B8	A16(18)	
Period	43	Wht-Orn-Vio	B3	A16(17)	
Time Intvl	44	Wht-Orn-Gra	B2	A16(15)	
Time Intvl Avg	45	Wht-Yel-Grn	B10	A16(16)	L = Enable
Start	46	Wht-Yel-Blu	B12	A16(14)	L = Start Open = Stop
Period Avg	47	Wht-Yel-Vio	B11	A16(13)	L = Enable
No connection	48	Wht-Yel-Gra	C5		
No connection	49	Wht-Grn-Blu	C3		
No connection	50	Wht-Grn-Vio	C1		

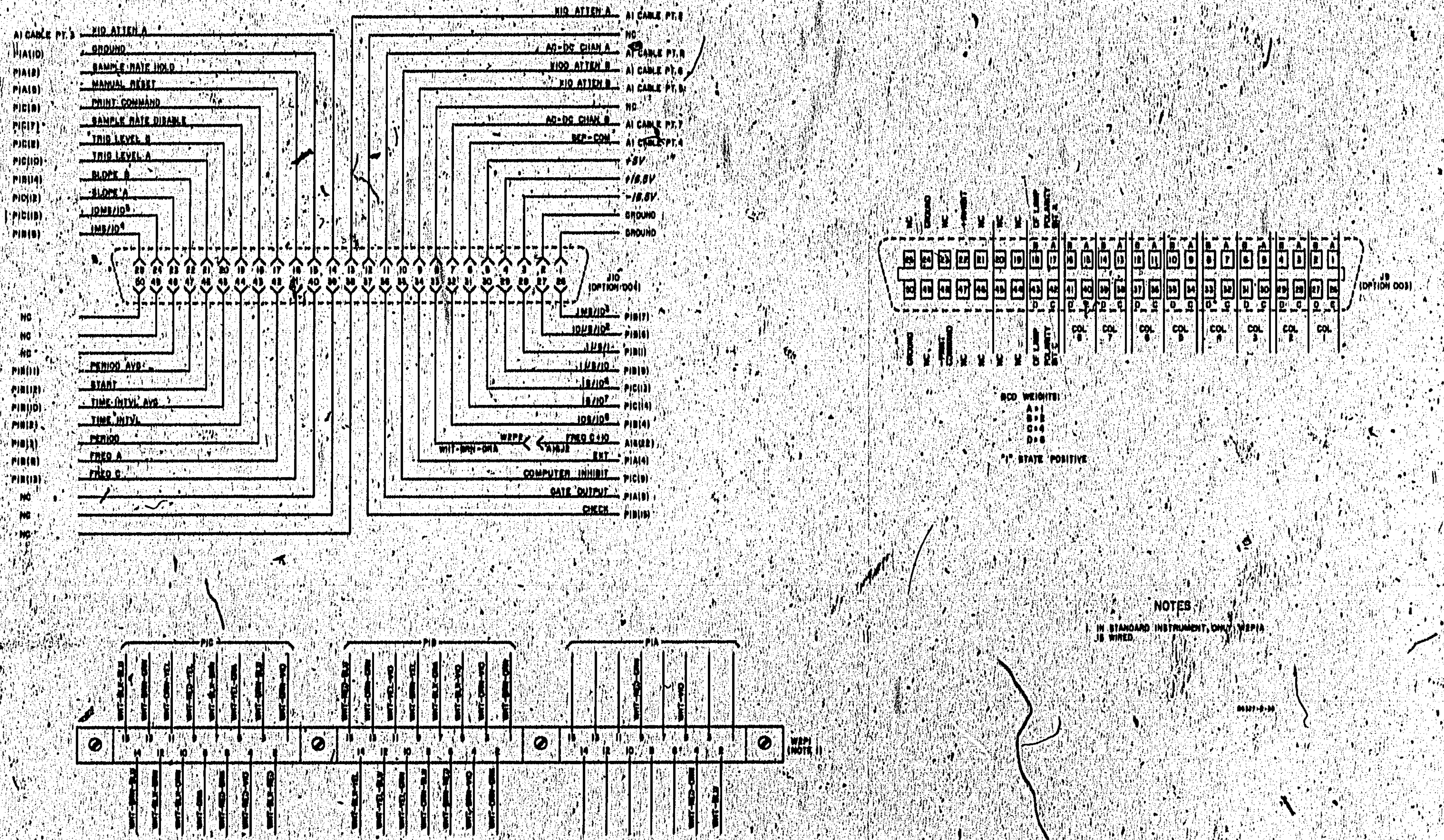


Figure 8-21. Option 004, Remote Programming Cable Assembly and J10 Option 003, Digital Recorder Cable Assembly

A1 OPTION 004 OPERATION

The remote programmable attenuator board attenuates the input signal and routes it to the amplifier boards. The signals from inputs A and B are routed through identical paths.

In the X1 position K2 is closed and the signal is routed directly to K4, which is open with ac coupling and closed with dc. R30 provides the 1 MΩ input impedance. R34, R36 and C7 compensate for high frequency roll-off and also limit the input current to Q1A. Diodes CR25 and CR27 limit the voltage at the input of Q13A to ±5.8 V. Q13A operates as a source follower with a high input impedance and a low output impedance to the amplifier boards. Q13 operates as a source follower, supplying the amplifiers with the dc trigger-level voltage generated either by R49, CR32, and CR33, or from an external analog input (J10). R46, 44, 42, and C13 filter the trigger-level voltage.

In the X1 position, K2 and K4 are closed providing a direct path for the input signal to the gate of Q13A. In the X10 position, K2 is open and diodes CR7 and CR9 are turned on, shorting R16 to ground. R12, R14, and R16 form the dc attenuator. The ac (high frequency) attenuator is formed by C1 and stray capacitance in the circuit.

In the X100 position, K2 is open, CR7 and CR9 are off, and CR21 and CR23 are turned on. C3 and R28 are thus connected to ground. R12, R14, and R28 form the dc portion of the attenuator, while C1, C3, and stray capacitance form the high frequency portion of the attenuator.

The circuitry to drive AC/DC relay K4, and SEP/COM relay K1 is provided by U3 A&C. U3's output is at HTL levels (+12 V, +1.5 V) and thus is sufficient to drive the relays directly. U3's input is at DTL levels, and is compatible with remote programming levels. K2 is driven by Q7 and is open when CR7 and CR9 or CR21 and CR23 are on.

Diode pairs CR7 and CR9 are driven by emitter followers Q3 and Q6, which, in turn, are driven by HTL gates U2D AND U2C. U2's power supply, consisting of Q1 and Q2, is +8.9 V and -5.6 V rather than the usual +15 V and 0 V. This special bias moves the HTL input threshold to +1.9 V, rather than the normal +7.5 V. U2D can now be driven by DTL gate U1D. The output swing of U2D is +9 V to -4 V, providing the diode quad CR7 and CR9 with positive turn-on and turn-off signals. R9 is adjusted to minimize the offset voltage of the quad.

Figure 8-21
OPTION 004, REMOTE PROGRAMMING CABLE ASSEMBLY AND J10 OPTION 003, DIGITAL RECORDER CABLE ASSEMBLY
(See Page 8-49)

ADJUSTMENTS

Set:

TIME BASE .... 0.1 sec
AC/DC .... DC
SEP/COM .... SEP
ATTEN A/B X10

1. Using an HP 412A or equivalent, measure voltage at CHANNEL A jack.
2. Adjust R50 for <±1 mV reading.
3. Measure voltage at CHANNEL B jack.
4. Adjust R9 for <±1 mV reading.
5. Set A and B attenuators to X100 position.
6. Measure voltage at CHANNEL B jack.
7. Adjust R32 for <±1 mV reading.
8. Measure voltage at CHANNEL A jack.
9. Adjust R33 for <±1 mV reading.

REFERENCE DESIGNATIONS

A1, OPT. 004
C1-14
CR1-35
DS1-2
J1-2
K1-5
Q1-14
R1-56
S1-9
U1-4

NOTES

1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS;
   CAPACITANCE IN PICOFARADS;
   INDUCTANCE IN MICROHENRIES

TABLE OF ACTIVE COMPONENTS

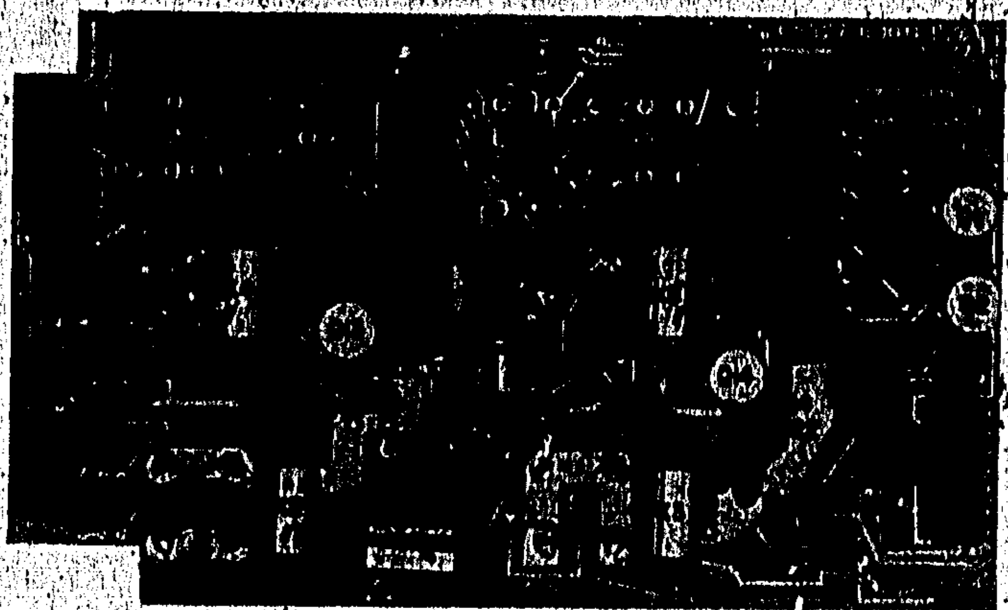
REFERENCE DESIGNATIONS	HP PART NUMBERS
CR1-3,6,15,18,30,31	1910-0016
CR4	1902-0025
CR5	1902-0057
CR7,8,23,24	1906-0024
CR9,10,21,22	1906-0025
CR11-14,16,17, 19,20,29,34	1901-0040
CR25-28	1901-0376
CR32-35	1902-0041
Q1	1854-0039
Q2	1853-0001
Q3,4,7,8,11,12	1854-0215
Q5,6,9,10	1855-0036
Q13,14	1855-0334
U1	1820-0274
U2,4	1820-0207
U3	1820-0482

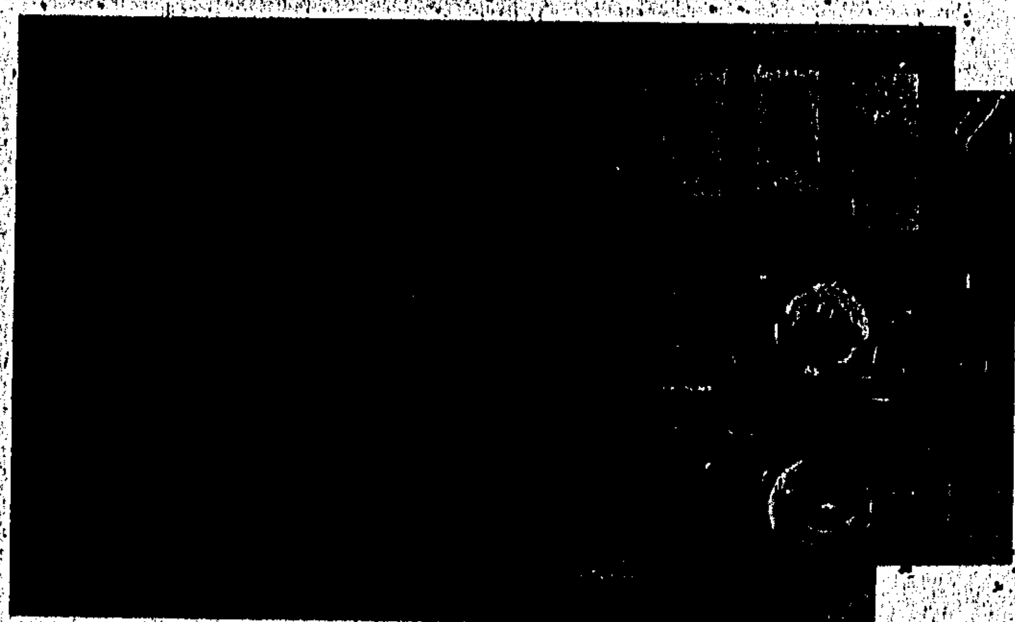
05327-D-10

CABLE POINT	WIRE COLOR	DESTINATION
1	GRN	+5V
2	WHT-ORN	J10(13)
3	WHT-YEL	J10(14)
4	BLU	J10(6)
5	WHT	J10(9)
6	WHT-BLK	J10(10)
7	VIO	J10(7)
8	WHT-BRN	J10(11)

COMPLETE PARTS LIST FOR THIS ASSEMBLY IS LOCATED ON PAGE 6-16.

MORE DATA UNDER THIS FOLD





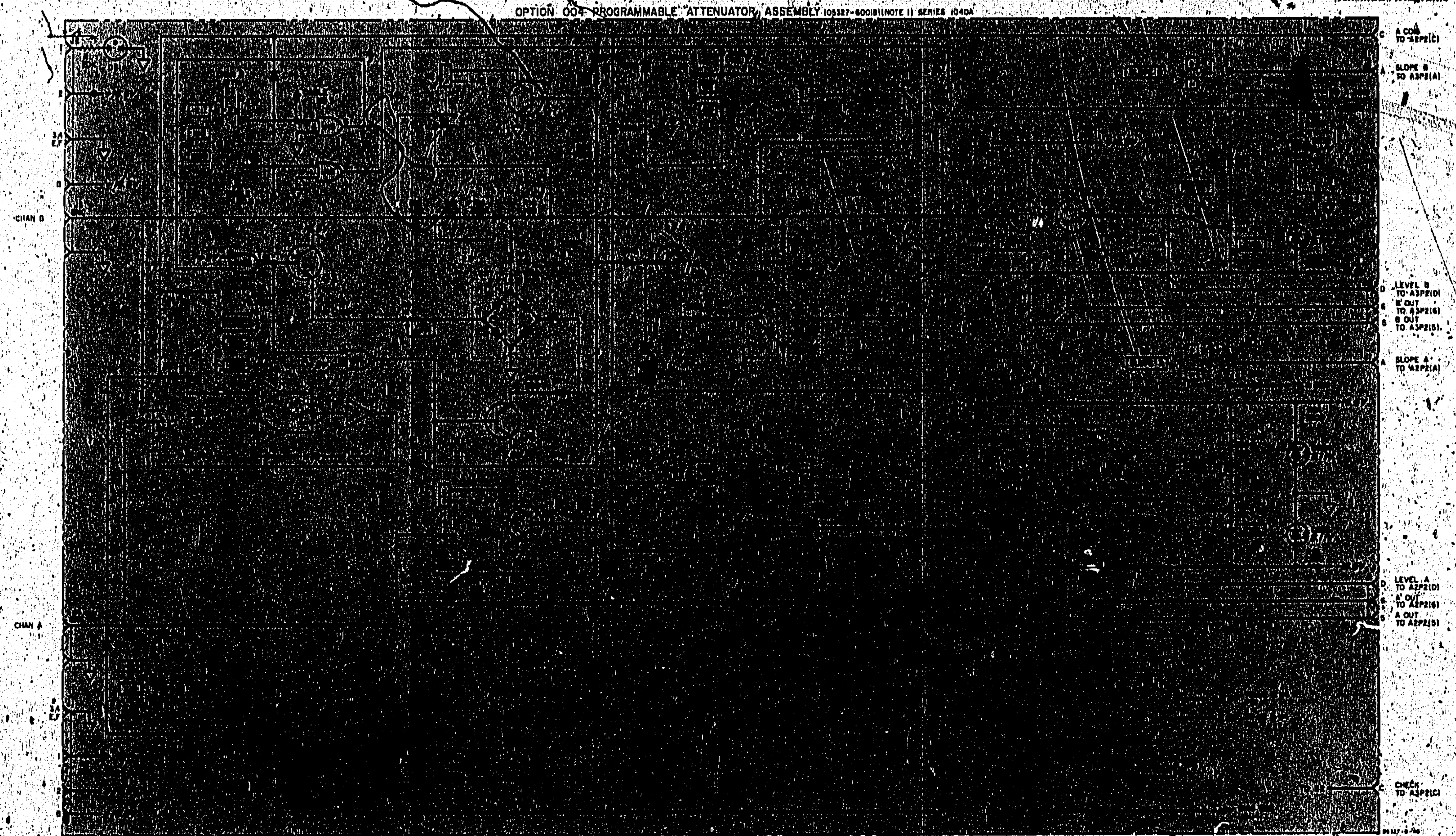


Figure 8-22. A1 Option 004 Programmable Attenuator Assembly

HEWLETT PACKARD

MANUAL CHANGES

MANUAL DESCRIPTION

INSTRUMENT: 5326A/5327A Timer Counter
SERIAL PREFIX: 5326A (1136A)
5327A (1120A)
DATE PRINTED: MAR 1972
HP PART NO: 05326-90026

CHANGE DATE: May 7, 1973

(This change supersedes all earlier dated changes)

- Make all changes listed as ERRATA.
- Check the following table for your instrument's serial prefix or serial number and make listed change(s) to manual.

IF YOUR INSTRUMENT HAS SERIAL PREFIX OR SERIAL NUMBER	MAKE THE FOLLOWING CHANGES TO YOUR MANUAL
1136A (5326A)	1, 2, 3
1144A (5326A)	1, 2, 3, 4, 5
1220A (5327A)	1, 2, 4, 5, 6
1224A (5326A)	1-5, 7
1224A (5327A)	1,2,4,5,6,7
1240A (5326A)	1-5, 7, 8
1236A (5327A)	1, 2, 4-9
1248A (5327A)	1, 2, 4-10
▶1312A (5327A)	1, 2, 4-11
▶1312A (5326A)	1-5, 7, 8, 11

▶ NEW OR REVISED ITEM

ERRATA

Page 8-49/50, Figure 8-21:
Change title of Figure from "J10 OPTION 003" to "J9 OPTION 003".
Change illustration of J9 (OPTION 003) at pin 25 from "NC" to "+5 V (1K ohm source)" – also correct title in List of Figures.

Page 1-3, Table 1-3, TIME BASE, Time Base Output:
Change 2nd sentence to read "In START, output frequency is INPUT A divided by TIME BASE/MULTIPLIER switch setting."

Page 6-3, Table 6-1:
Change A1R24, 26 to 2100-3228

Page 6-11, Table 6-1:
Add A15C9 0160-3277 C:FXD CER .01 UF 50VDCW
Board assemblies with A15C8 and C9 are SERIES 1104A.

Page 8-39, Figure 8-16, A15 Schematic:
Add A15C9 .01 UF as shown in Figure 1:

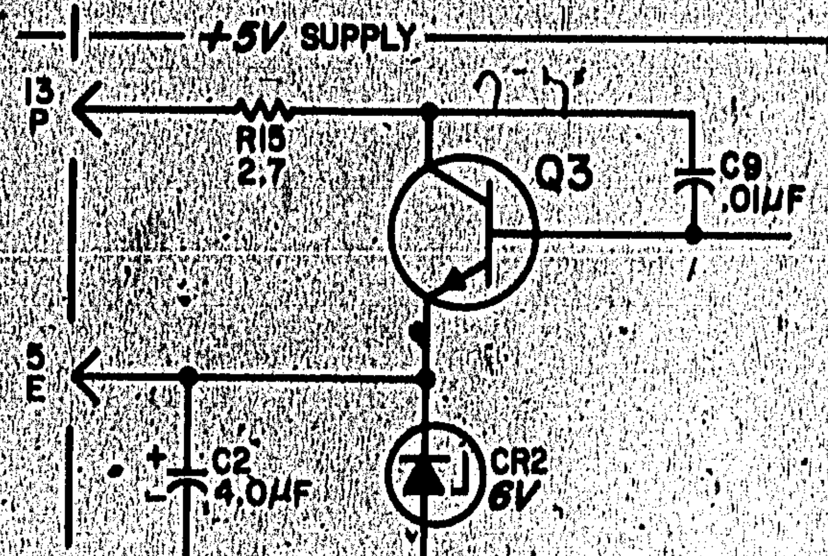


FIGURE 1

ERRATA (Cont'd)

Page 1-2, Table 1-3, Dynamic Input Voltage Range:
Add period (.) after last word of first line, making it read "attenuator setting."

Page 2-4, Paragraph 2-41b:
Change last sentence to read "Ground is available at J10(1, 2)."

Page 6-6, Table 6-1:
Change A5R7 to 0683-1225 1200 OHM FACTORY SELECT VALUE

Page 6-6, Table 6-1:
Add to A6C7 description "FACTORY SELECT VALUE"

Page 6-11, Table 6-1:
Change A16C6, 7 to 0160-3878 1000pF

Page 6-12, Table 6-1:
Change 05327-60026 BLANK BOARD P/N to 05327/20026

Page 6-12, Table 6-1, A16 (05327-60005) and (05327-60026):
Change A16CR4, 5 to 1901-0028 400PIV; MFR PART NUMBER SR1358-9.

Page 6-13, Table 6-1:
Change A17C5, 7, 10, 13 to 0160-3878 1000pF

Page 6-14, Table 6-1:
Change A18C2, 4, 7, 9, 10 to 0160-3878 1000pF

Page 6-15, Table 6-1:
Change A19C2, 4, 6, 7, 9, 10 to 0160-3878 1000pF.
Also make appropriate changes corresponding to four previous items in Figure 8-16, 8-18 & 8-19.

Page 6-19, Table 6-1, OPTION 004:
Change 05327-60018 board (A1) to 05327-60034 SERIES 1224A.

Page 6-19, Table 6-1, OPTION 004-EXTENDED REMOTE PROGRAMMING:
Delete line starting "Delete A1 05326-60003..." and replace with:
"Delete A1 05326-60047 and replace with A1 05327-60034"
Delete following line also.
Change A1 to 05327-60034 SERIES 1224A
Change blank board to 05327-20034

Page 8-21, Figure 8-9:
Change A5R7 to 1200
Add to NOTES: "4. ASTERISK (*) INDICATES COMPONENT, AVERAGE VALUE SHOWN."

Page 8-23, Figure 8-10, A6 schematic:
Add to A6C7 an asterisk (*)
Add NOTE 3 as follows:
"ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN"

Page 8-39, Figure 8-16, A16 schematic:
Change board P/N to (05327-60026)

Page 8-39, Figure 8-16, P/O A16 schematic:
Change (05327-60027) to (05327-60026)
Change A16R2 to "0.47" to "1.0 OHM"

Page 8-39, Figure 8-16, TABLE OF ACTIVE COMPONENTS:
Change A16 CR4, 5 to 1901-0028

Page 8-40, A17 INPUT C AMPLIFIER OPERATION:
Change first line, third paragraph to read:
"High-impedance emitter followers (Q1, Q2)..."

Page 8-49/50, Figure 8-21 titles both pages:
Change "J10 OPTION 003" to "J9 OPTION 003"

Page 6-20, Table 6-1:
Change A1R6 from 0698-5563 to 0686-1515 R: FXD COMP 150 OHM 5% 1/2W

ERRATA (Cont'd)

▶ Page 14, 15 (of this supplement):
    Change A18R29, 30 from 0698-3103 to 0698-3177 820 OHM
    Change A18R34 from 0698-3179 to 0698-8073 1600 OHM
    Change A18R9 from 0683-1015 to 0683-2015 200 OHM; add to description "FACTORY SELECT COMPONENT"
    Add to A18R26 description "FACTORY SELECT COMPONENT".

▶ Page 17 (of this supplement) A18 (05327-60033) schematic:
    Change A18R29, 30 to 820 OHM
    Change A18R34 to 1600 OHM
    Change A18U2(1, 14) voltages from "+.1V" to "-.2V"
    Add to A18R26 an asterisk (*)
    Add to A18R9 an asterisk (*)

▶ Page 6-6, Table 6-1:
    Change U1-4, 6-8 from 1820-0412 to 1820-0413

▶ Page 6-9, Table 6-1:
    Change A9U2-7, HP Part No. to 1820-0119 or 1820-0232.

CHANGE 1

Page 6-7, Table 6-1:
Change A6R19 0683-2035 to 0683-5115 510 OHM
With this change board 05326-60016 is SERIES 1152A

Change A7C3 0160-0385 to 0140-0201 13 PF 5% 500V
With this change board 05327-60004 is SERIES 1152A

Page 8-23, Figure 8-10, A6 schematic:
Change A6R19 to 510 OHM

Page 8-29, Figure 8-11, A7 schematic:
Change A7C3 to 13 PF

CHANGE 2

Page 6-11, Table 6-1:
Change A15CR15-18 1901-0040 to 1901-0044
Change A15R17, R18 0683-0395 to 0683-0275 2.7 OHM
With this change board 05327-60030 is SERIES 1152A

Page 8-39, Figure 8-16, A15 schematic:
Change A15R17, R18 to 2.7 OHM

Page 6-16, Table 6-1:
Delete T1 9100-3333
Change T1 9100-3030 description to (5326A/27A)

CHANGE 3

Page 6-13, Table 6-1:
Change A17CR3 1912-0007 to 1912-0009
Change A17Q4 1854-0092 to 1854-0345
Change A17R21 0683-5625 to 0698-3158 5620 OHM 1% ¼W
Change A17R22 0683-1515 to 0757-0394 150 OHM ¼W
Change A17R23 0683-1025 to 0757-0280 1000 OHM 1% ¼W
Change A17R26 0683-5615 to 0757-0416 511 OHM ¼W
Add 05326-00031 SHIELD:AMPLIFIER
With this change board 05326-60031 is SERIES 1156A REV.C

Page 8-41, Figure 8-17:
Change A17R21 to 5620 OHM
Change A17R26 to 511 OHM
Change A17CR3 to 1912-0009 in TABLE OF ACTIVE COMPONENTS
Change A7Q4 to 1854-0345 in TABLE OF ACTIVE COMPONENTS
At top of schematic change to SERIES 1156A Rev C

CHANGE 4

NOTE: This change provides for the new standard and optional instrument colors. Option A85 designates use of light gray panel with olive gray cabinet. Option X95 designates use of light gray panel and blue textured cabinet. Standard colors are mint gray panel and olive gray cabinet.

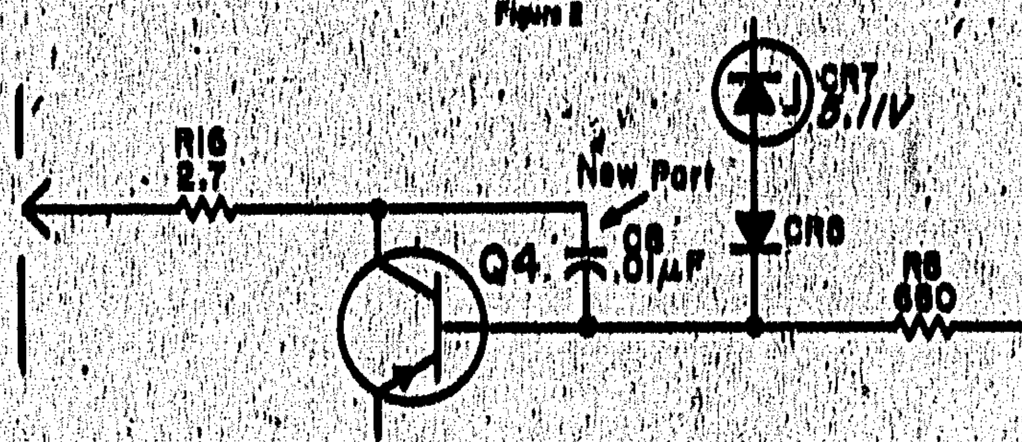
Page 6-16, 17, Table 6-1:
Change 5160-1545 to 5160-1575
05326-00008 Add to description "COLOR OPTION A85/X95"
Add 05326-00030 PANEL: FRONT TRIM COLOR OPTION A85/X95 (5326A ONLY)
Add 05326-00033 PANEL: FRONT TRIM STANDARD COLOR
Add 05326-00034 PANEL: FRONT EXTRU STANDARD COLOR (5326A ONLY)
Add 05327-00008 PANEL: FRONT EXTRU STANDARD COLOR (5327A ONLY)
Add 05327-00009 PANEL: FRONT EXTRU COLOR OPTION A85/X95 (5327A ONLY)
Add 05326-60039 KIT: RACK MOUNT COLOR OPTION A85/X95
Add 05326-60046 KIT: RACK MOUNT STANDARD COLOR
Delete 9100-3333

CHANGE 5

Page 6-11, Table 6-1:
Add A15C8 0160-3277 C:FXD CER .01 UF 50WVDC; 56733; C504BX103M

Page 8-30, Figure 8-16, A15 schematic:
Add A15C8 .01 UF as shown in partial schematic Figure 2
With this change A15 (06327-60020) is SERIES 1150A.

Figure 2

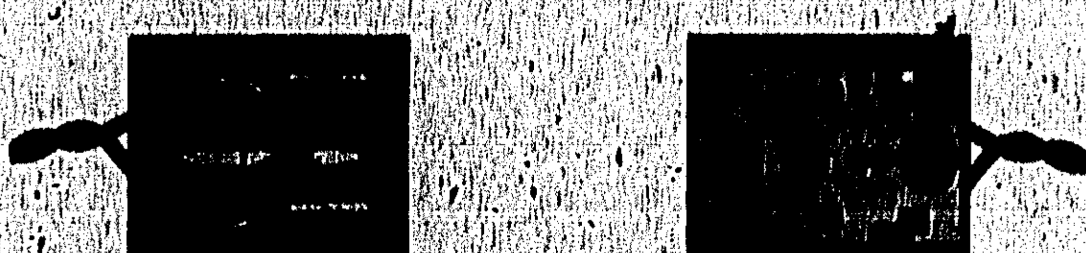


CHANGE 6

Page 6-15, Table 6-1:
Add A19 06327-60032 Protection board
Add A19 06327-80032 Blank board
Add A19C1, 2 0180-0228 C:FXD TANT 22UF 10% 15V
Add A19CR1, 2 1901-0050 DIODE:SILICON
Add A19F1 2110-0436 FUSE: 0.1 AMP
Add A19J1 1250-1408 CONNECTOR:SUBMIN
Add A19J2 1250-0836 CONNECTOR:SUBMIN
Add A19XF1A,B 1251-5306 SOCKET:MINIATURE (2)

Page 8-51a:
Add Figure 8-23, A19 (06327-60032)
Figure 3 Component locator as follows:

Figure 3

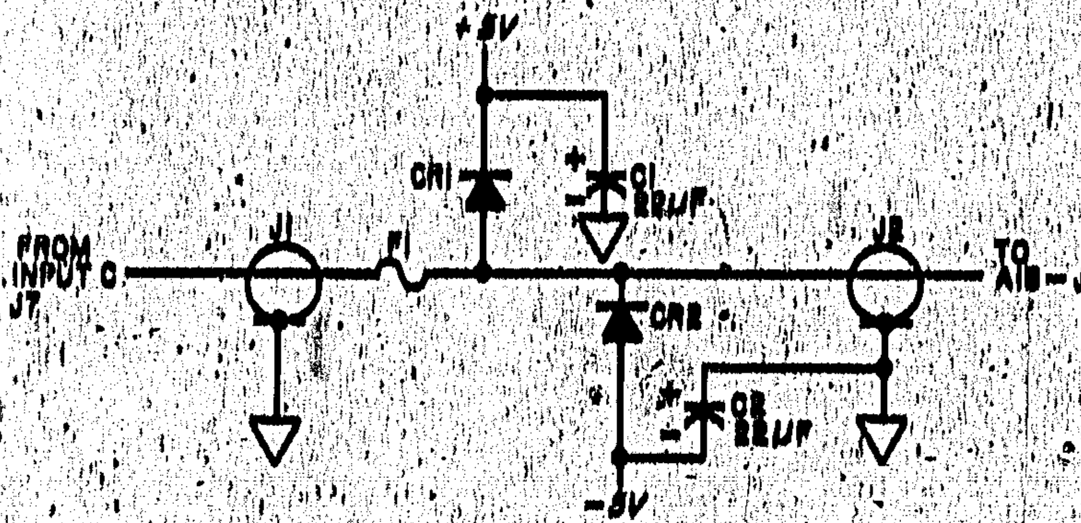


CHANGE 6 (Cont'd)

Page 8-51a:
Add Figure 8-23, A19 (05327-60032)
Figure 4 schematic as follows:

Figure 4

A19 PROTECTION BOARD (05327-60032)



Page 1-2, Table 1-3, INPUT CHANNEL C,
Maximum Input:
Change to read "3.5V rms; 5V peak"

CHANGE 7

Page 6-3, Table 6-1:
Change A1 05326-60003 to 05326-60047; change Series to 1324A;
change blank board to 05326-20047
Change A1 R24, 26 2100-2805 to 2100-3228 in HP part number and Mfr Part No column

Page 6-16, Table 6-1:
Change 05326-00004 to 05326-00032
Delete 05326-00012
05326-20026
05327-00005
Add 05326-00011 PLT: CONN LONG
05326-00033 ADAPTER: CONN (OPT 002)
05326-20046 BOARD: REAR PANEL CONN

Page 8-15, Figure 8-6:
Change assy Part No at top of schematic to (05326-60047) Series 1324A

CHANGE 6

Page 7-2:

Add after Paragraph 7-18, the following:

7-18a. Options 010 and 011, High Stability Oscillators

7-18b. Option 010, Oscillator Assembly A4 (05326-60002) is replaced with TCXO Oscillator Assembly (05327-60036)

7-18c. Option 011, Oscillator Assembly A4 (05326-60002) is replaced with Oscillator Assembly (10544-60011). Options 010 and 011 are available in instruments with Serial Prefix 1240A for 5326A and 1236A for 5327A.

Page 6-7, Table 6-1:

Add A6R44 0683-1015 R: FXD COMP 100 5% 1/4W

With this change A6 (05326-60015) is SERIES 1224A

Page 8-22, Figure 8-10 REFERENCE DESIGNATIONS table:

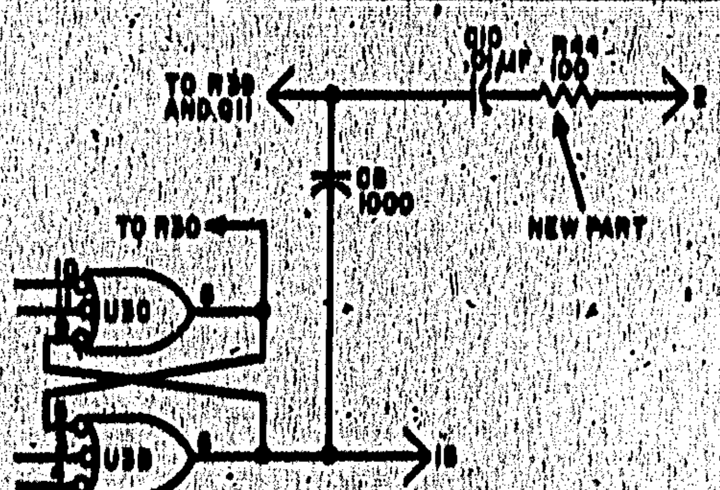
Change A6 column to read "R1-44"

Page 8-23, Figure 8-10 A6 schematic:

Add A6R44 100 OHM as shown in Figure 5 attached.

Figure 5

(A6) 05326-60015 PARTIAL SCHEMATIC



Page 6-9, Table 6-1:

Change A9 to 05326-60008/25 SERIES 1224A

Add A9R11 0683-7525 R: FXD COMP 7500 OHM 5% 1/4W

Add A9R12 0683-1005 R: FXD COMP 10 OHM 5% 1/4W

Add A9U8 1820-0118 IC: TTL BLANKING DECADE COUNTER

Add A9U16 1820-0119 IC: 4-BIT BUFF STORE GATED OUTS

Add A9U24 1820-0092 IC: DECODER-DIVIDER

Add A9DS8 1970-0042 TUBE: NUMERICAL INDICATOR

Add A9DS8 1200-0405 SOCKET: TUBE FOR 5700 SERIES

Add A9XU8, 16, 24 1200-0477 SOCKET: IC

CHANGE 8 (Cont'd)

Page 8-33, Figure 8-13:
Change NOTES, #3 to read "R12 is wired to B for Option 001"

Page 6-11, Table 6-1:
Add A16C6 0160-2204 C: FXD 100 PF
Add A16CR16 1910-0034 DIODE: GER
Add A16Q1 1854-0009 TRANSISTOR: SIL NPN 2N709
Add A16R4 0683-0825 R: FXD 8.2 OHM 1/4W
Add A16R5 0683-1025 R: FXD 1000 OHM 1/4W
Add A16R6 0683-5115 R: FXD 510 OHM 1/4W
Add A16R7 0698-3153 R: FXD 3830 OHM 1% 1/8W
Add A16R8 0757-0439 R: FXD 6810 OHM 1% 1/8W
Add A16U1 1820-0196 IC: VOLTAGE REGULATOR
Above parts are added as shown in attached Figure 6.

Page 6-7/8, Table 6-1:
Change A7 05327-60004 to 05327-60031 SERIES 1224A
The attached parts list is on page 9.

Page 8-29, Figure 8-11, A7 Function Control Assembly:
Replace A7 schematic (05327-60004) with attached schematic.
The A7 schematic (05327-60031 — Figure 7) is shown on page 10.

Replace A7 component locator photo (05327-60004) with Figure 8 photo (05327-60031) page 11.

Page 8-24, A7 FUNCTION CONTROL OPERATION:
Replace text under this heading with following (see page 12).

CHANGE 9

Page 3-5, Figure 3-4, Item 5:
Add to first paragraph: "On instruments with Serial Prefix 1236A and above INPUT C connector is located on rear panel."

Page 6-9, Table 6-1:
Change A9R2, 4-9, 11 from 0683-7525 to 0757-0440 R: FXD MET FLM 7500 OHM 1% 1/8W

Change A9U17 from 1820-0092 to 1820-0729.

Page 6-17, Table 6-1:
Change 05327-60011 to 05327-60037
Add 05327-00009 PANEL: FRONT EXTRU STANDARD COLOR (5327A ONLY)

CHANGE 10

Page 6-14/15, Table 6-1:
Change A15 05327-60009 and 05327-60029 to 05327-60033
Change 05327-20009 and 05327-20029 to 05327-20033

Delete all components prefixed A15 and replace with attached parts list for A15 High Sensitivity Prescaler Assembly (05327-60033) SERIES 1248A, see Page 14 and 15.
Component locator for this new assembly is on Page 16.
Schematic diagram for this new assembly is on Page 17.

CHANGE 11

Page 6-9, Table 6-1:
Change A9R2, 4-9, 11 from 0683-7525 to 0698-8431 7500 OHM

Page 6-11/12, Table 6-1:
Change A15R1 from 0683-2035 to 0683-2735 27K
Change A15R8 from 0698-1505 to 0698-1305 13 OHM
Add A15F1 2110-0480 FUSE: 1/32 AMP
Add 1400-0110 FUSEHOLDER
With this change board 05327-60020-A SERIES 1312A

Page 8-39, Figure 8-16, A15 schematic:
Change A15R1 to 27K
Change A15R8 to 13 OHM
Add A15F1 1/32A fuse between A15(1) and junction of R8 and C8(E).

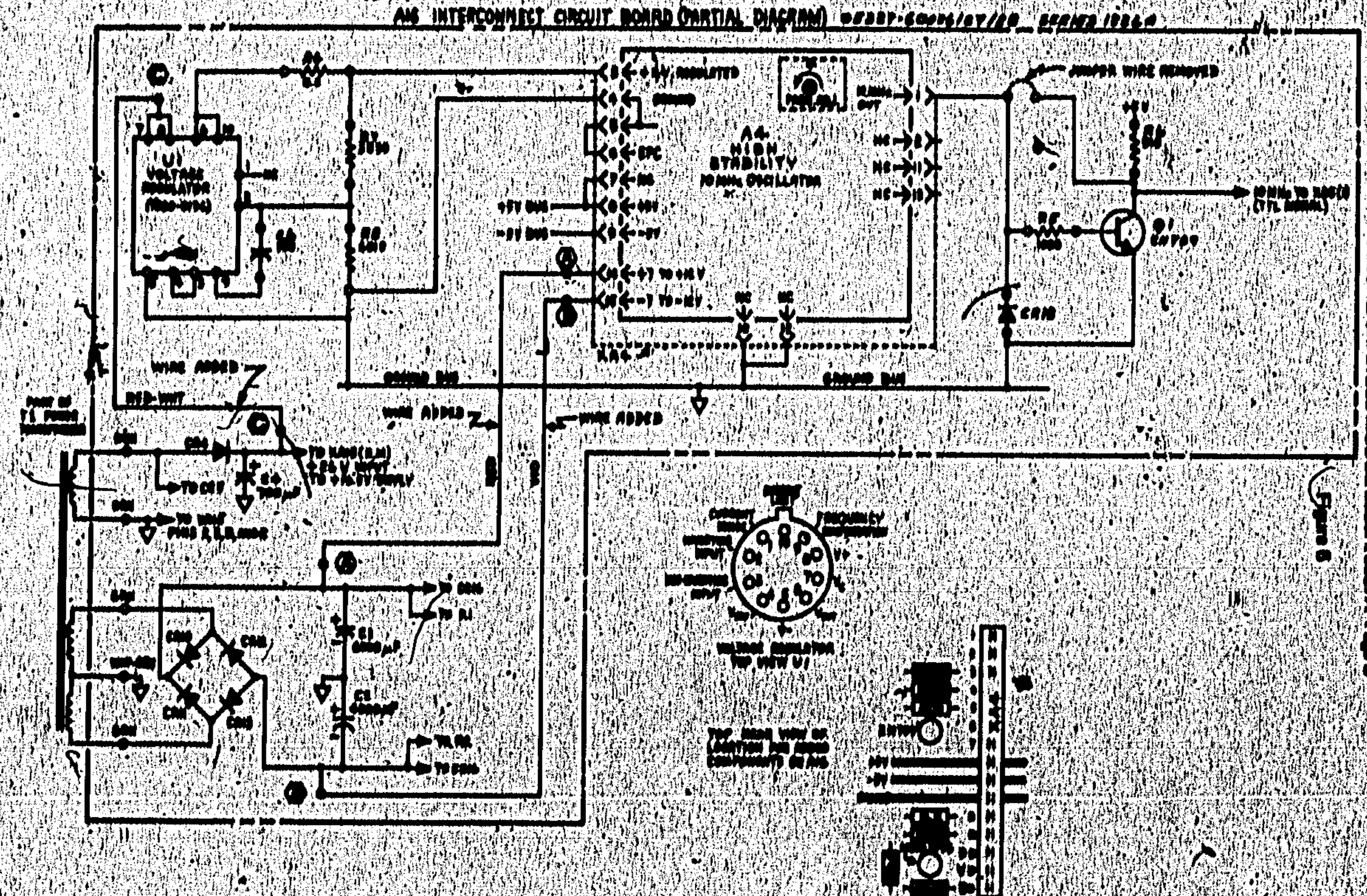

A6 INTERCONNECT CIRCUIT BOARD (PARTIAL DIAGRAM)
JUMPER WIRE REMOVED
WIRE ADDED
GROUND BUS
A4 HIGH STABILITY 10 MHz OSCILLATOR
VOLTAGE REGULATOR TOP VIEW U1

Figure 6

REF DESIG.	DESCRIPTION	PART NUMBER
A7	BOARD: FUNCTION CONTROL	05327-60031
A7C1	C: FXD, 27 PF, 300V	0160-2306
A7C2	C: FXD, 4.7 PF, 500V	0150-0042
A7CR1	DIODE: HOT CARRIER	1901-0535
A7R1	R: FXD, 1.1K, 5%, 0.250W	0683-1125
A7R2	R: FXD, 1.8K, 0.250W	0683-1825
A7R3	R: FXD, 1.8K, 5%, 0.250W	0683-1825
A7R4	R: FXD, 1K, 5%, 0.250W	0683-1025
A7R5	R: FXD, 3.9K, 5%, 0.250W	0683-3925
A7R6	R: FXD, 2.2K, 0.250W	0682-2225
A7R7	R: FXD, 1.1K, 5%, 0.250W	0683-1125
A7R8	R: FXD, 2.2K, 5%, 0.250W	0683-2225
A7R9	R: FXD, 3.3K, 5%, 0.250W	0683-3325
A7R10	R: FXD, 3.3K, 5%, 0.250W	0683-3325
A7R11	R: FXD, 1K, 5%, 0.250W	0683-1025
A7R12	R: FXD, 3.3K, 5%, 0.250W	0683-3325
A7R13	R: FXD, 1.5K, 5%, 0.250W	0683-1525
A7R14	R: FXD, 1.5K, 5%, 0.250W	0683-1525
A7R15	R: FXD, 100 OHM, 0.250W	0683-1015
A7R16	R: FXD, 510 OHM, 0.250W	0683-5115
A7R17	R: FXD, 300 OHM, 0.250W	0683-3015
A7R18	R: FXD, 300 OHM, 0.250W	0683-3015
A7R19	R: FXD, 1K, 5%, 0.250W	0683-1025
A7R20	R: FXD, 1.1K, 5%, 0.250W	0683-1125
A7R21	R: FXD, 1K, 5%, 0.250W	0683-1025
A7R22	R: FXD, 100 OHM, 0.250W	0683-1015
A7R23	R: FXD, 470 OHM, 0.250W	0683-4715
A7R24	R: FXD, 150 OHM, 0.250W	0683-1515
A7R25	R: FXD, 240 OHM, 0.250W	0683-2415
A7R26	R: FXD, 1K, 5%, 0.250W	0683-1025
A7R27	R: FXD, 510 OHM, 0.250W	0683-5115
A7R28	R: FXD, 510 OHM, 0.250W	0683-5115
A7R29	R: FXD, 750 OHM, 0.250W	0683-7515
A7R30	R: FXD, 510 OHM, 0.250W	0683-5115
A7U1	INTEGRATED CIRCUIT	1820-0102
A7U2	INTEGRATED CIRCUIT: ECL DAT SW	1820-0489
A7U3	INTEGRATED CIRCUIT	1820-0147
A7U4	INTEGRATED CIRCUIT	1820-0102
A7U5	INTEGRATED CIRCUIT: DIGITAL	1820-0440
A7U6	INTEGRATED CIRCUIT	1820-0147
A7U7	INTEGRATED CIRCUIT	1820-0489
A7U8	INTEGRATED CIRCUIT: 55	1820-0212
A7U9	INTEGRATED CIRCUIT: ECL DAT SW/	1820-0489
A7U10	INTEGRATED CIRCUIT	1820-0145
A7U11	INTEGRATED CIRCUIT	1820-0200
A7U12	INTEGRATED CIRCUIT: ECL DAT SW	1820-0489
A7U13	INTEGRATED CIRCUIT: ECL CLOCK DR	1820-0252
A7U14	INTEGRATED CIRCUIT	1820-0809
A7U15	INTEGRATED CIRCUIT: DIGITAL	1820-0808
	BD–BLANK	05327-20031

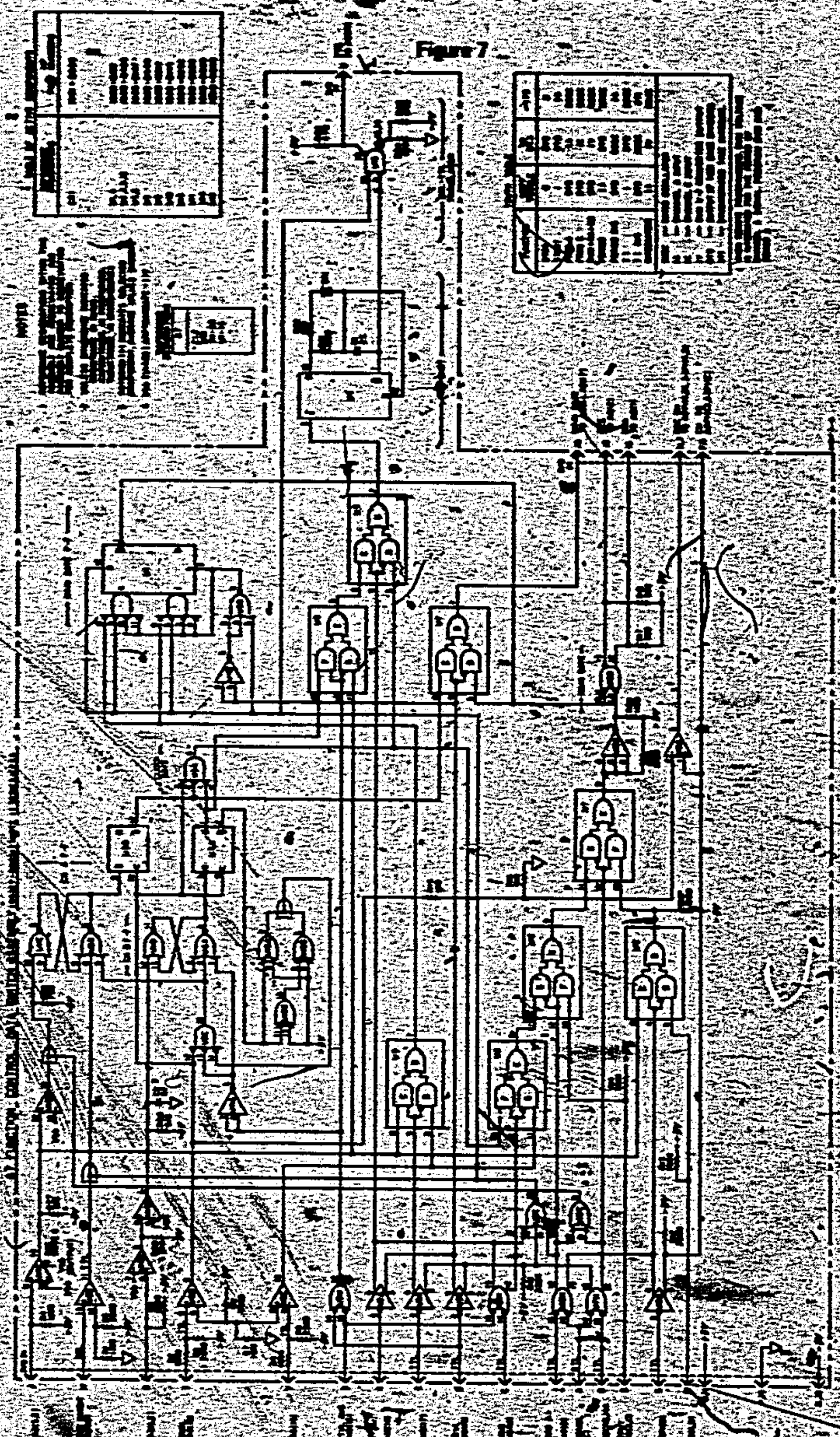
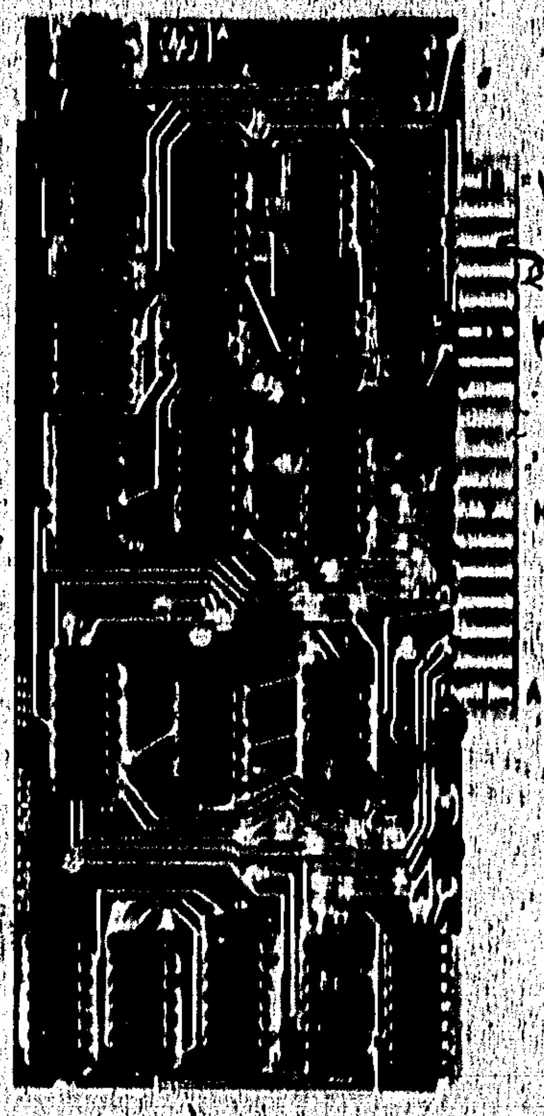


Figure 7

Figure 8



A7 FUNCTION CONTROL OPERATION

This assembly contains the gating, flip-flops, one-shots, and translators necessary to interconnect the oscillator, time base, and input channel signals to the time base and decade counting assemblies. Table I lists the functional interconnections for each function of the counter.

An example of the operation in the FREQ A mode will explain the typical circuit operation. This will be expanded to the other functions. Assuming the start of a new measurement, main gate inhibit (pin 17) has just gone low (at the end of the display time). Upon the arrival of the first subsequent channel A input, channel A flip-flop sets, making U5B(9) High. Upon the next leading edge of the oscillator signal (pin T, TTL levels; U5B(4) ECL levels), U5B sets and arms the oscillator gate U5A. The gated oscillator signal is then connected to the time base input one-shot U4, which generates 50 ns, negative-going pulses to the time base input (pin U).

The time base will return a pulse upon receipt of the 1st and Nth pulse delivered from pin U (N = multiplier setting on front panel). This 1st pulse arriving at pin V is translated from TTL to ECL by U8 and then goes on to toggle (set) main gate flip-flop U1. This opens the main gate (U3B), and the decade counting assembly counts the signal (in this case, input A — see Table I). Upon the arrival of the 2nd time base output pulse, U1 toggles closed, shutting main gate U3B and signaling A6 to start the display cycle (pin 18). A6 returns a High MINH (pin 17) and the main gate flip-flop U1, synchronizer U5, and ITB one-shot U4 are locked closed at the end of the display. MINH goes low and the cycle repeats.

In the period mode, the main gate F-F U1 is toggled by the input A signal so that it is set for exactly one period of A. The counted signal is the oscillator divided by the MULTIPLIER switch setting.

In period average, the input A signal goes to the time base, which generates a pulse on the 1st and Nth pulse. These pulses toggle the main gate, and the oscillator is counted during N periods of A.

In START, the main gate is held open and the input signal, which is scaled by the time base, is counted. The Freq C operation is the same as Freq A, except that the input synchronizer U5B is held on by U10. IC's U2, 6, 7, 8, 9, 10 and 12 are combination TTL/ECL translators and data switches. The function inputs (Freq A, Freq C, etc.) are TTL low true and are pulled up by internal 10k-ohm pullups on the translators. U9(8) is the check signal to Amplifier A2 and A3. In normal it is low; while in check, it is high with negative 10 ns pulses at 10MHz.

In time interval, the operation is similar to period, but U1 is set continuously. MGATE OUT (pin 16) is now controlled by the output of U5B. The following explanation describes how the synchronizer U5A and B work in a time interval mode.

Assuming a display cycle has just been completed, the flip-flops formed by U11 and U6 and U5 sections have been reset. Two conditions can occur.

First — If a channel A signal occurs before a B signal, the A signal will set the channel A flip-flop before the B sets the B flip-flop (see Figure I). When the first leading edge of the oscillator occurs after the A F-F is set, U5B is set, opening the clock gate and instructing A6 that

Table I. Functional Interconnections

FUNCTION	MOFF TOGGLE	TO DCA	ITB
STOP	0	OTB	0
START	1	OTB	IA
FREQ A	OTB	IA	GOSC
FREQ C	OTB	IC	GOSC
DVM (RA-RB)	OTB	IV	GOSC
PERIOD	IA	OTB	GOSC
PERIOD AVG.	OTB	GOSC	IA
T.I.	1	OTB	GOSC
T.I. AVG.	OTB	GOSC	STI

DCA : Decade Counting Assembly
GOSC : Gated Oscillator
IA : Input A Signal
IC : Input C Signal
ITB : Input to Time Base
IV : DVM V-F Converter Output
OTB : Output of Time Base
STI : Synchronized Time Interval

the measurement has started (pin 10). The oscillator signal goes to the time base and is divided, returns, and is sent out through the main gate to A5 for subsequent display. When the B signal occurs, the leading edge of the next clock pulse sets U8A, closing the clock gate.

The U8A $\bar{Q}$ low signal goes back to U8(11) and waits about 50 ns for the falling edge of the oscillator. At this point, U8(10) goes high, resetting the A and B flip-flops, putting lows at the D input of U8A and B. When the clock pulse again rises positive, U8(10) goes low (about the 10 ns after the clock edge) and U8A and B are closed to the "cleared" state.

Second — If a B signal occurs before an A, U8A would be set first, and no counting would occur. Also, it would take about 150 ns for U8A to complete the resetting described above, so if an A signal occurred during this time, it would be ignored. If the B-to-A delay is >150 ns, the A signal would start the interval as described above.

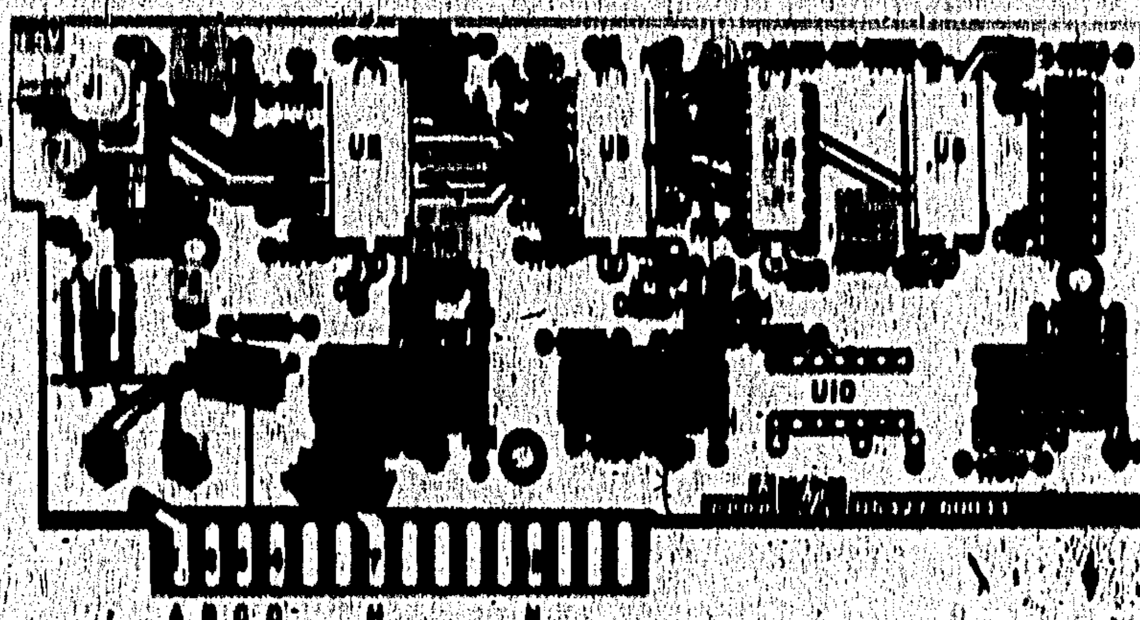
With time interval averaging, the input synchronizers work the same way, but the oscillator (not divided) is counted for the duration of each individual time interval that is being averaged. The first input A signal sets flip-flop U8B, which enables U8A to gate an oscillator pulse to the time base dividers. The dividers are now set to zero, from their previous reset-to-nine state. During this time, a channel B signal was received to complete the first time interval; but this first interval is not counted, since the main gate was closed. The time base output pulse enables the main gate to pass clock pulses for the duration of the time interval. After N intervals, the time base returns a pulse to close the main gate.

A15 HIGH SENSITIVITY PRESCALER ASSEMBLY (05327-60055) SERIES 1248A

REF DESIG.	HP PART NUMBER	DESCRIPTION
A15	05327-60033	BOARD ASSY: HIGH SENSITIVITY PRESCALER
	05327-20033	BOARD: BLANK
A15C1	0180-0229	C: FXD TANT 22 UF 10% 15 VDCW
A15C2	0160-2049	C: FXD CER 5000 PF 100 -20%
A15C3	0160-3879	C: FXD CER 0.01 UF 20% 100VDCW
A15C4	0160-2049	C: FXD CER 5000 PF 100 -20%
A15C5	0180-0229	C: FXD TANT 22UF 10% 15VDCW
A15C6	0160-3879	C: FXD CER 0.01 UF 20% 100VDCW
A15C7 thru A15C27	0160-3878	C: FXD CER 1000 PF 20% 100VDCW
A15C28	0160-3879	C: FXD CER 0.01 UF 20% 100VDCW
A15C29	0160-3878	C: FXD CER 1000 PF 20% 100VDCW
A15CR1	1901-0050	DIODE: SIL 75V
A15CR2	1901-0050	DIODE: SIL 75V
A15CR3 thru CR6	1901-0040	DIODE: SIL 30V
A15F1	2110-0436	FUSE: 1/10 AMP 125V
A15F2	2110-0436	FUSE: 1/10 AMP 125V
A15J1	1250-0836	JACK: RECEPT PC BOARD MT
A15L1	9100-1788	COIL: RF
A15L2	9100-1788	COIL: RF
A15Q1	1854-0345	TRANSISTOR: SIL NPN 2N5179
A15Q2	1854-0091	TRANSISTOR: SIL NPN
A15R1	0683-1025	R: FXD COMP 1000 OHM 5% 1/4W
A15R2	0698-5996	R: FXD COMP 560 OHM 5% 1/8W
A15R3	2100-3353	R: VAR 1000 OHM LIN 10% 1/2W
A15R4	0683-3925	R: FXD COMP 3900 OHM 5% 1/4W
A15R5	0698-3378	R: FXD COMP 51 OHM 5% 1/8W
A15R6	0698-3378	R: FXD COMP 51 OHM 5% 1/8W
A15R7	0698-3111	R: FXD COMP 30 OHM 5% 1/8W
A15R8	0683-1025	R: FXD COMP 1000 OHM 5% 1/4W
A15R9	0683-1015	R: FXD COMP 100 OHM 5% 1/4W
A15R10	2100-3415	R: VAR 200 OHM LIN 10% 1/2W
A15R11	0698-4283	R: FXD COMP 10 OHM 5% 1/8W
A15R12	0683-1505	R: FXD COMP 15 OHM 5% 1/4W
A15R13	0698-3374	R: FXD COMP 20 OHM 5% 1/8W
A15R14	———	N/A
A15R15	0698-5180	R: FXD COMP 2000 OHM 5% 1/8W
A15R16	0698-3378	R: FXD COMP 51 OHM 5% 1/8W
A15R17	0698-3374	R: FXD COMP 20 OHM 5% 1/8W
A15R18	0683-4315	R: FXD COMP 430 OHM 5% 1/4W
A15R19	0698-5180	R: FXD COMP 2000 OHM 5% 1/8W
A15R20	0698-3111	R: FXD COMP 30 OHM 5% 1/8W
A15R21	0698-5996	R: FXD COMP 560 OHM 5% 1/8W
A15R22	0698-4181	R: FXD COMP 56 OHM 5% 1/8W
A15R23	0698-4181	R: FXD COMP 56 OHM 5% 1/8W
A15R24	0698-3111	R: FXD COMP 30 OHM 5% 1/8W
A15R25	0683-1025	R: FXD COMP 1000 OHM 5% 1/4W

A18 HIGH SENSITIVITY PRESCALER ASSEMBLY (05327-60056) SERIES 1248A (Cont'd)

REF DESIG.	HP PART NUMBER	DESCRIPTION
A18R26	0683-1015	R: FXD COMP 100 OHM 5% 1/4W
A18R27	2100-2413	R: VAR 200 OHM LIN 10% 1/2W
A18R28	0698-6283	R: FXD COMP 10 OHM 5% 1/8W
A18R29	0698-5103	R: FXD COMP 430 OHM 5% 1/8W
A18R30	0698-5103	R: FXD COMP 430 OHM 5% 1/8W
A18R31	0683-1505	R: FXD COMP 15 OHM 5% 1/4W
A18R32	----------	N/A
A18R33	0698-3374	R: FXD COMP 20 OHM 5% 1/8W
A18R34	0698-5179	R: FXD COMP 1800 OHM 5% 1/8W
A18R35	0698-3378	R: FXD COMP 51 OHM 5% 1/8W
A18R36	0698-3111	R: FXD COMP 30 OHM 5% 1/8W
A18R37	0698-3378	R: FXD COMP 51 OHM 5% 1/8W
A18R38	0698-3374	R: FXD COMP 20 OHM 5% 1/8W
A18R39	0683-4315	R: FXD COMP 430 OHM 5% 1/4W
A18R40	0698-4181	R: FXD COMP 68 OHM 5% 1/8W
A18R41	0698-5663	R: FXD COMP 180 OHM 5% 1/8W
A18R42	0698-4181	R: FXD COMP 68 OHM 5% 1/8W
A18R43	0698-3111	R: FXD COMP 30 OHM 5% 1/8W
A18R44	0698-3113	R: FXD COMP 100 OHM 5% 1/8W
A18R45	----------	N/A
A18R46	0683-1025	R: FXD COMP 1000 OHM 5% 1/4W
A18R47	0683-3905	R: FXD COMP 39 OHM 5% 1/4W
A18R48	0683-8215	R: FXD COMP 820 OHM 5% 1/4W
A18R49	0683-1025	R: FXD COMP 1000 OHM 5% 1/4W
A18R50	0683-4315	R: FXD COMP 430 OHM 5% 1/4W
A18R51	0683-4315	R: FXD COMP 430 OHM 5% 1/4W
A18R52	0683-4315	R: FXD COMP 430 OHM 5% 1/4W
A18R53	----------	N/A
A18U1	5088-7002	CIRCUIT: INTEGRATED LIMITER
A18U2	1826-0064	CIRCUIT: INTEGRATED LINEAR
A18U3	1826-0065	CIRCUIT: INTEGRATED LINEAR
A18U4	1820-0756 or	CIRCUIT: INTEGRATED DIGITAL
	1820-0558	CIRCUIT: INTEGRATED DIGITAL
A18U5	1820-0714	CIRCUIT: INTEGRATED DIGITAL
A18U6	1820-0498	CIRCUIT: INTEGRATED ECL DATA SW
A18U7	1821-0001	CIRCUIT: INTEGRATED TRANSISTOR ARRAY
A18U8	1821-0001	CIRCUIT: INTEGRATED TRANSISTOR ARRAY
A18U9	1820-0802	CIRCUIT: INTEGRATED MC 10102L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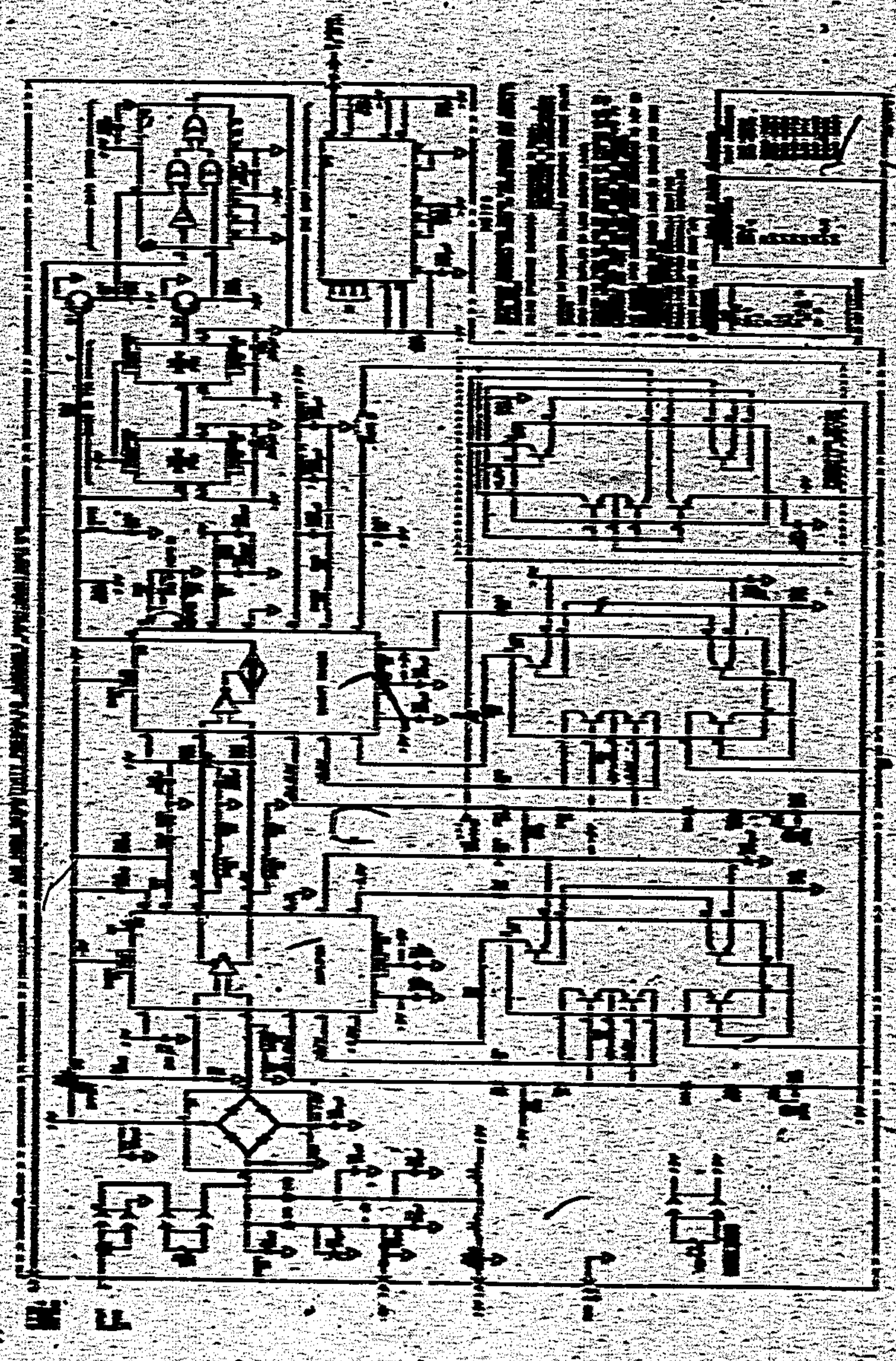

SERVICE NOTE

SUPERSEDES:
None

5326/5327
Listing of PC Boards
All Serials

This Service Note lists the commonality of plug-in boards between all the models of the 5326/27 family of counters. Such information may be useful in shortening repair times by borrowing a board from a good instrument to confirm a diagnosis.

The 5326/27 family use several basic building blocks which are combined to provide the various capabilities. These are summarized below:

5326C - 50 MHz Frequency Period Average, Totalize

5326A - Add Time Interval to 5326C

5326B - Add DVM function to 5326A

5327A/B/C - Same as corresponding 5326, except 550 MHz prescaler is added.

See other side for tabulation of pc boards used in the instruments.

REG/sg/WO

4/72-02

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For more information, call your local HP Sales Office or East [illegible] • Midwest [illegible] • South [illegible] West [illegible]. Or, write: Hewlett-Packard, 1501 Page Mill Road, Palo Alto, California [illegible]. In Europe, 1217 Meyrin-Geneva

Printed in U.S.A.

#	NAME	5326A prefix 1044A & below	5326A prefix 1116A & above	5327A	5326B prefix 1124A & below	5326B prefix 1128A & above	5327B	5326C	5327C
A1	Atten	05326-60003						05326-60030	
A1	Opt 004		05327-60010			05327-60018			
A2	Input Amp	05326-60004							
A3	Input Amp	05326-60004						----------	
A4	OSC	05326-60002							
A5	Time Base	05326-60005							
A6	Sample Rate	05326-60013							
A7	Function	05326-60007/24	05327-60004		05326-60007/24	05327-60004		05326-60045	
A8	Display Support	05326-60009							
A9	Display	05326-60008 (60025 Option 01)							
A10	Right Readout	05326-60011	05327-60002		05326-60023	05327-60006		05326-60036	
A11	Left Readout	05326-60010	05327-60003		05326-60022	05327-60007		05326-60035	
A12	DVM Atten	------------------			05326-60016			----------	
A13	DVM V-H	------------------			05326-60017			----------	
A14	DVM Logic	------------------			05326-60015			----------	
A15	Power Supply Regulator	05326-60001 or 05327-60020							
A17	Direct Amp	-----	05326-60031	-----	-----	05326-60031	----------------		
A18	Prescaler	-------------		05327-60009 or 60020			05327-60009 or 60020		05327-60009 or 60020

SERVICE NOTE

SUPERSEDES:
5326/5327-2

5327A Prefix 1130A and below
5327B Prefix 1140A and below
5327C Prefix 1144A and below

550 MHz INPUT OVERLOAD PROTECTION MODIFICATION

A protection board (HP Part No. 05327-60028) can be installed on the 05327-60009 or 05327-60010 prescaler board assemblies in all 5327A, 5327B, 5327C Counters to protect the amplifier and Schmitt trigger circuit from transients on the input and overly large input voltages and currents. Installation is the same for 05327-60009 and 05327-60010. In this note these boards will be called "A16".

The board, which contains a fuse and additional limiting circuits, is complete; installation requires only small hand tools and a soldering iron.

INSTALLATION

1. Disconnect the AC power line and remove top cover.
2. Remove A16 and detach the RF input cable from the 550 MHz input BNC.
3. 5327B Installation
   a. Attach the female RF connector on the board to the male RF connector on A16 making sure that the fuse and male RF connector on the board are to the component side of A16.
   b. Bring the red and black wires around to the non-component side of A16 and solder the red wire (+5) in the plated through hole of the +5V input pin on A16 P1 (pin 15).
   c. Solder the black wire (-5) to the plated through hole of the -5V input pin on A16P1 (pin 9).
   d. Tilt the protection circuit down (toward the gold contacts on A16) and plug A16 back into the instrument.
   e. Tilt the RF connector and cable so that they clear other components and tighten the connector.
4. 5327A and 5327C Installation
   a. Attach the female RF connector on the board to the male RF connector on A16. Make sure the fuse and RF connector on the board are to the non-component side of A16.
   b. Bring the red and black wires to the non-component side of A16 and solder the red wire (+5) in the plated through hole of the +5 volt input pin on A16P1 (pin 15).
   c. Solder the black wire (-5) to the plated through hole of the -5 volt input pin on A16 P1 (pin 9).
   d. Install A16 with the attached board back into the instrument. Attach the RF connector to the male RF connector on the board.
5. Reconnect the AC power line and adjust A16 as outlined in the maintenance section of the manual under adjustments.
6. Replace the top cover.

Parts List

Qty	Description	HP Part No.
1	Protection Board	05327-60028
1	Blank Board	05327-20028
1	FXD TANT [illegible] 10% 15V	0180-0[illegible]
2	Diode: Silicon	1901-0050
1	Fuse: 0.1 Amp	2110-0[illegible]
1	Connector: RF subminiature	1250-0[illegible]
1	Connector: RF subminiature	1250-1[illegible]
2	Socket: 1 pin, subminiature	1251-[illegible]

LM/[illegible]/WA

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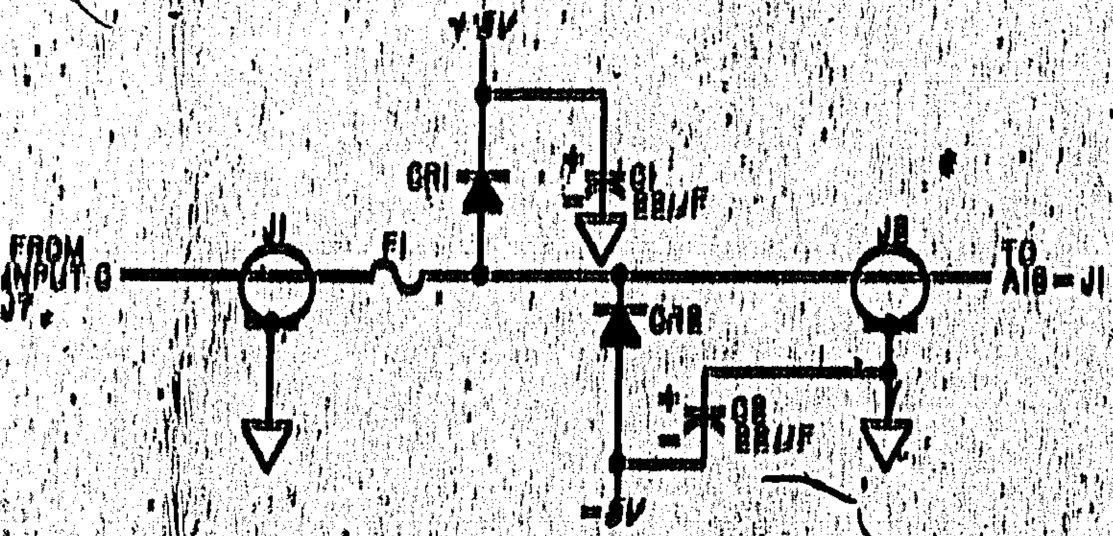

NOTE

With the addition of this protection circuit the maximum input specification is changed from 5V rms to 5V peak.

SERVICE NOTE

SUPERSEDES:

None

5326/5327 Input Attenuator Noise Solution

In the past some problems have been encountered in the field with jumpy marker outputs and/or unexplainable noise on the A and B inputs. This note is to document the solutions available for these problems.

The cause of these problems has been traced to a single source, noisy neon trigger level lights. Some small percentage of the neon bulbs used as trigger level indicators get noisy with age. This noise is coupled back to the markers and channels A and B causing the symptoms.

To solve this problem change the noisy lamp to one that isn't noisy. The lamps involved are A1 DS1 and/ or A1 DS2 HP P/N 2140-0047. These are shown in the 5326/5327 manuals on the A1 schematics and component locators.

This repair may be charged to warranty only if the instrument is in warranty.

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SERVICE NOTE

Supersedes:

None

5326/5327 all models and serial numbers
Extra Insulation for the + and − 5 volt regulators

Here is a solution for a problem we have experienced in 5326 and 5327 Universal Counters. The +5 volt and −5 volt regulators (Q1 and Q2) in these counters have shown more of a tendency to fail than other components in the counter, but no more! Here are the parts and instructions necessary to cure this problem in the field.

PARTS LIST:

Insulator: Kapton	2 ea	0340-0765
Washer #6 size	2 ea	3050-0001
Bushing	2 ea	1200-0081
Heat Sink Compound	1 ea	8500-0169

INSTRUCTIONS:

1. Unplug instrument and remove top and bottom covers.
2. Remove one screw, one nut, and one solder lug holding Q1, and the heat sink to chassis.
3. Apply liberal amounts of heat sink compound (HP Part No. 8500-0169) to both sides of insulator (HP Part No. 0340-0765). Tip Q1 up and slide insulator between Q1 and heat sink lining up hole in insulator with mounting hole in Q1 and hole in heat sink.
4. Secure Q1 to chassis and heat sink by inserting screw first through Q1, then the mica insulator, then the heat sink, and then the chassis. Tighten assembly, making sure that Q1 does not touch the side of the heat sink. From the bottom of the instrument put #6 washer and bushing on the screw, then the solder lug, then the nut. See Figures 1 and 2.

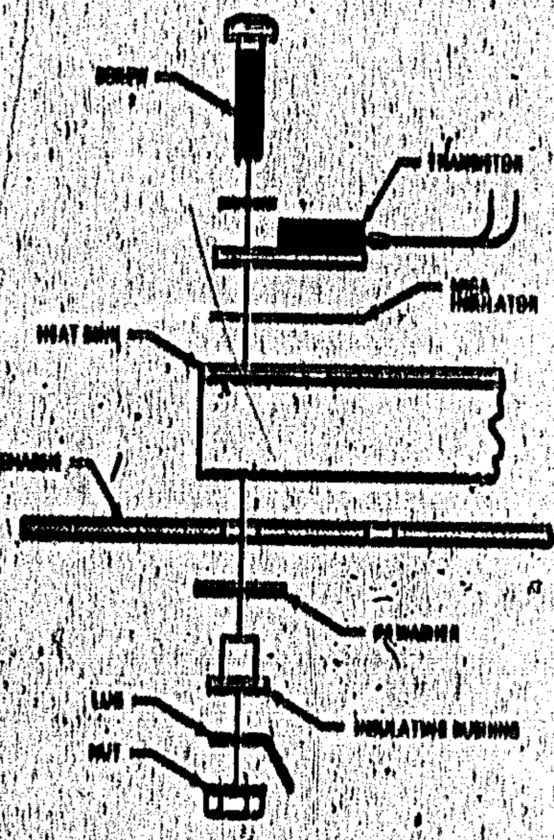

Figure 1. Exploded View

5. Repeat steps 2, 3 and 4 for Q2.
6. Check +5 volt and −5 volt regulation at high and low line voltage. Shake instrument to insure Q1 and Q2 are properly secured.
7. Replace top and bottom covers.

LM/sg/WO

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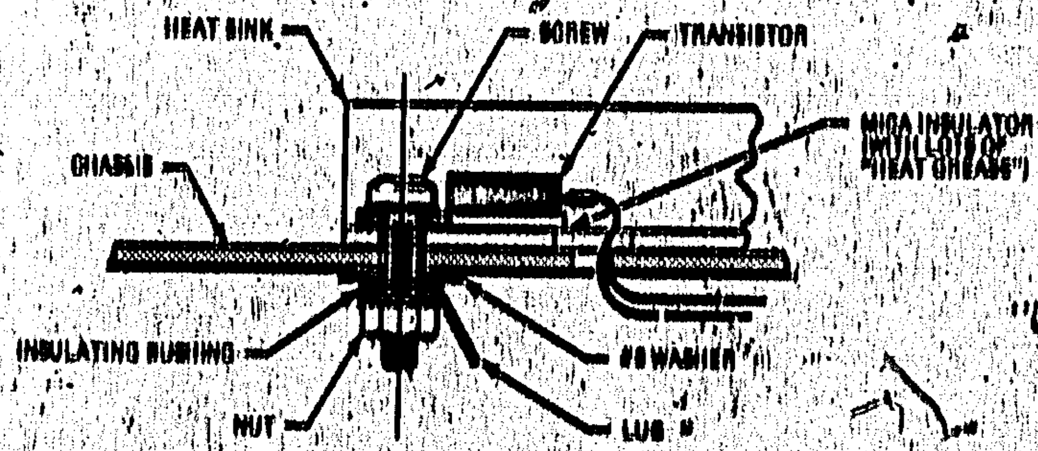

Figure 2. Completed Assembly

SERVICE NOTE

Supersedes:

None

Field Installation of Option 011
For all models of the 5326/5327 Universal Counter

This service note contains instructions and parts lists needed for field installation of the option 011 high stability oscillator. Installation procedures vary with the age of the counter, however all procedures are documented here. For the oldest counters, installation of this option is not recommended because of the high material and labor costs involved. Table 1 below, gives a serial number prefix break down of which procedure to use and/or which counters are not recommended for installation.

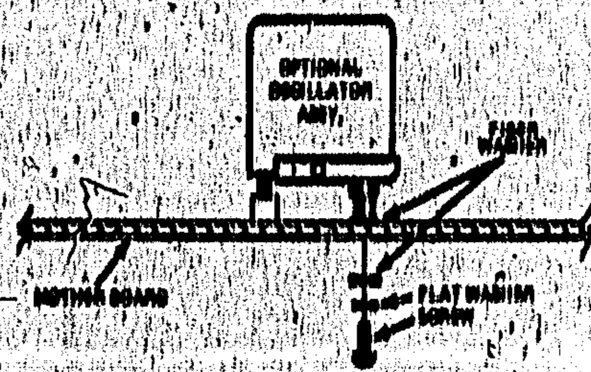

Figure 1

INSTALLATION OF OPTION 011 (When no extra parts are required).

1. Unplug counter and remove top and bottom cover.
2. Remove A4 oscillator board and in its place install the option 011 oscillator assembly.
3. Install 2 screws and washers (see Figure 1) and secure option 011 oscillator assembly.
4. Check oscillator frequency using procedure included with this note

HP Part No.	Qty	Description
10544-60011	1	Crystal Oscillator
3050-0028	[illegible]	No. 6 Fiber Washer
3050-0003	[illegible]	No. 6 Fiber Washer
3050-0016	[illegible]	No. 6 Flat washer, nickel Brass plating
2360-0117	[illegible]	6/32 x 3/8 pan head screw

Table 1. Serial Number Prefix Table

Model	Can not be installed	Extra components required in order to install	No extra components needed
26A	below 1136	1136 to 1324	1340 & above
27A	below 1320	1320 to 1336	1336 & above
26B	below 1136	1136 to 1324	1340 & above
27B	below 1132	1132 to 1320	1324 & above
26C	below 1136	1136 to 1324	1336 & above
27C	below 1136	1136 to 1324	1336 & above

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INSTALLATION OF OPTION 011 (When no extra components must be added).

1. Unplug counter and remove top and bottom covers.
2. Remove A4 crystal assembly and install components using Figure 3, 4, 5 and parts list in Table 2 as reference.
3. Install option 011 crystal assembly in place of the A4 assembly and secure in place with 2 screws - see Figure 2.
4. Check Option 011 frequency as outlined in procedure included with this note.

FREQUENCY ADJUSTMENT PROCEDURE FOR OPTION 011 OSCILLATOR.

NOTE

The counter must have primary power applied for at least 24 hours to allow the oscillator temperature to stabilize.

1. Set controls on oscilloscope as follows:
   CHANNEL A 0.2 V/cm; DC coupled; + up
   SWEEP 0.05 μsec/cm
   TRIGGER: EXT, + slope, AC
   MODE to NORM
   DISPLAY to CHANNEL A
2. Connect a suitable 1 MHz, 5 MHz or 10 MHz frequency standard (such as an HP Cesium Beam) to the EXT input on oscilloscope.

Table 2

Ref. Desig.	HP P/N	Qty	
A10C5	0160-2204	1	C: FXD 100 pf
A10CR10	1910-0016	1	DIODE: Ger
A10Q1	1854-0009	1	Transistor: SI, NPN 2N709
A10R4	0698-0035	1	FXD 0.2 OHM 1/4W
A10R5	0683-1025	1	FXD 1000 OHM 1/4W
A10R6	0683-5115	1	FXD 510 OHM 1/4W
A10R7	0698-3153	1	FXD 3830 OHM 1% 1/8W
A10R8	0757-0420	1	FXD 6810 OHM 1% 1/8W
A10U1	1820-0196	1	IC: Voltage Regulator
	10544-60011	1	Crystal Oscillator
	3050-0032	2	No. 6 Fiber Washer
	3050-0003	2	No. 6 Fiber Washer
	3050-0010	2	No. 6 Flat Washer, nickel, brass plating
	2360-0117	2	6/32 x 3/8 pan hd screw

3. Connect Oscilloscope Channel A to OSC. BNC available on counter rear panel.
4. Adjust oscillator FREQUENCY ADJ for minimum sideways movement of the oscillator signal.

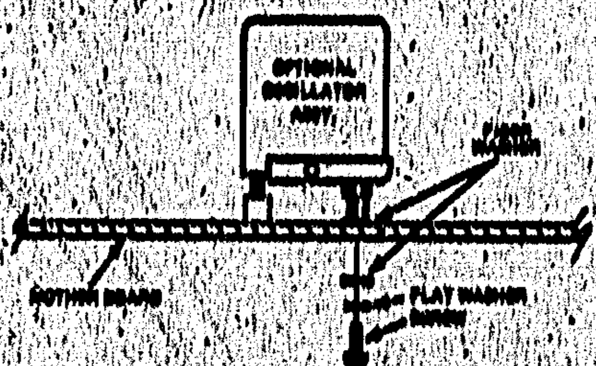
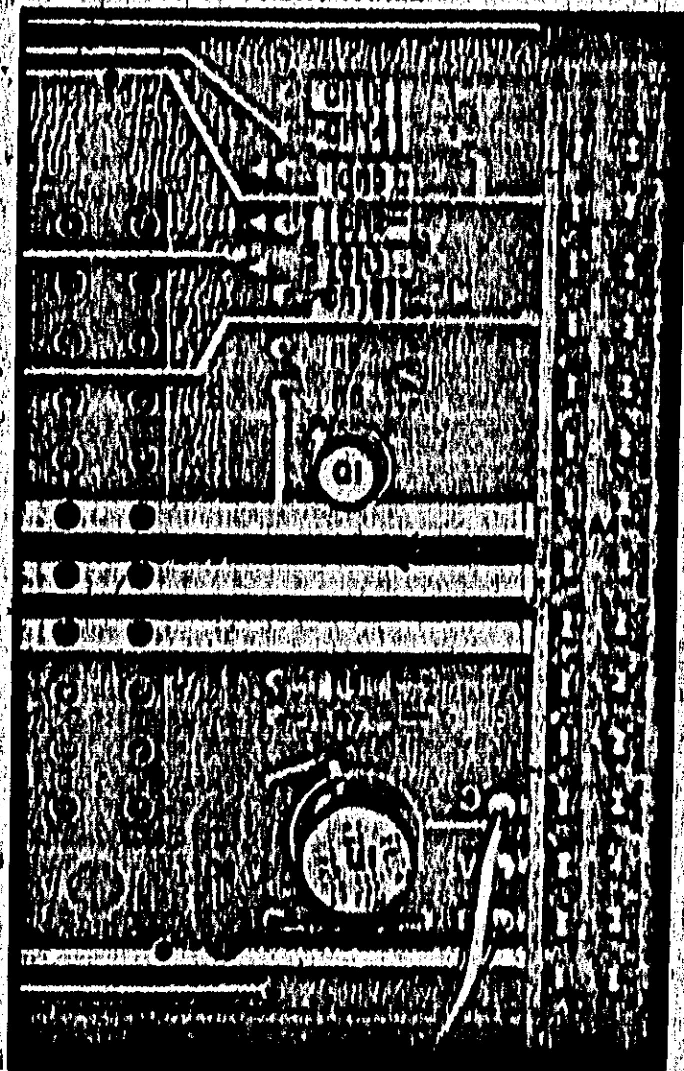


Figure 2

FRONT PANEL



TOP VIEW
OF
A15
Figure 8

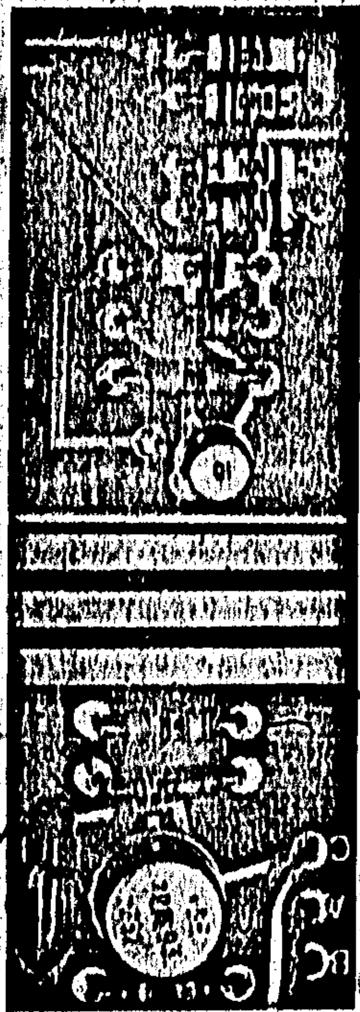


Figure 4

OPTIONS 010 AND 011 A16 INTERCONNECT CIRCUIT BOARD (PARTIAL DIAGRAM) (05327-60026/27/28) SERIES 1224A

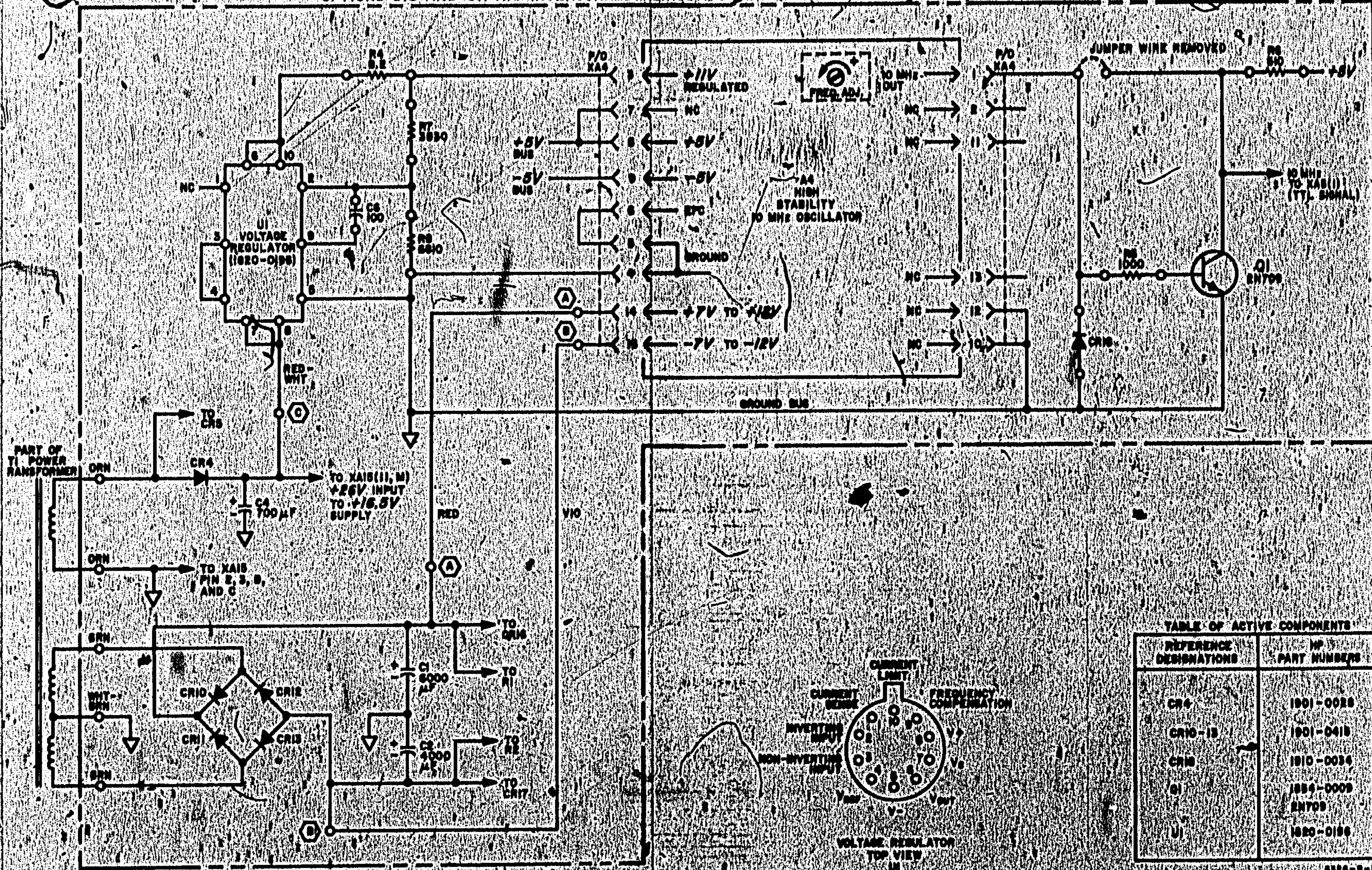


TABLE OF ACTIVE COMPONENTS

REFERENCE DESIGNATIONS	HP PART NUMBERS
CR4	1901-0028
CR10-13	1901-0415
CR16	1910-0034
Q1	1854-0009 2N709
U1	1820-0196

05329-9-11

SERVICE NOTE

Supersedes:

None

Field Installation of Option 010 Model 5326/27 Counters
Serial number prefix 1032 and above

This service note contains installation instructions needed for field installation of the option 010 Temperature Compensated Crystal Oscillator (TCXO) HP Part No. 05327-60030. This option may be installed in any 5326/27 counter with serial number prefix 1032 and above.

Installation Instructions:

1. Unplug counter and remove top cover.
2. Remove the A4 oscillator assembly and install the TCXO in its place.
3. Adjust the frequency of the TCXO using the following procedure.

Frequency Adjustment procedure:

NOTE: This procedure should be performed with the instrument open and the TCXO as near 25°C (approximately room temperature) as possible.

1. Connect a 5245L (or equivalent) to OSC BNC on back of counter.
2. Set 5245L to frequency and 1 second time base.
3. Adjust screw on top of TCXO assembly until 5245L read-out matches the frequency stamped on TCXO.

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SERVICE NOTE

Supersedes:
None

Added protection for the +175 Volt power supply in 5326/5327 Universal Counters

Failures that short the +175 Volt power supply to ground can cause extensive damage inside a counter.

To protect the 5326 and the 5327 model universal counters from these failures, the 175 volt supply is current limited. To provide added protection in applications where it might be needed, this service note contains instructions and parts list for adding a fuse in the 175 volt line.

Instructions:
(For instruments with serial prefix 1312 & above.)

1. Turn off instrument, disconnect power cord and remove top cover.
2. Remove and examine A15 power supply board. If a fuse is present on the board the 175 volt supply is already fused and no further protection is needed. If no fuse is present continue to step 3.
3. Remove the jumper soldered between the two plated-through holes in trace connected to A15 pin 1.
4. Solder fuse holder (P/N 1400-0110) in plated-through holes. Install fuse.
5. Install A15 power supply in counter, replace top cover and check instrument for proper operation.

Serial Prefix below 1312.

1. Turn off instrument, disconnect power cord and remove top cover.
2. Remove A15 power supply board from instrument. Remove A15R6 and clean plated-through holes.
3. Using a razor blade, carefully remove approximately 1/8" of the trace between A15 pin 1 and the plate-through hole for A15R6 that the trace connects to.
4. Install the 15Ω resistor (P/N 0686-1505) in place of A15R6.
5. Bend the pins on the fuse holder (P/N 1400-0110) out at right angles and solder holder to either side of cut trace on A15. Install fuse.

Note

Be sure that the fuse holder is securely held to board by the solder and that no solder bridges the cut in the trace.

6. Install A15 in counter, replace top cover, and check instrument for proper operation.

Parts List

Reference Des.	HP P/N	Qty	Description
F1	2110-0460	1	Fuse: 1/32 amp.
R6	0686-1505	1	R: FXD Comp 15 ohm 5% 1/2W
XF1	1400-0110	1	Body fuse holder

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SERVICE NOTE

Supersedes:
None

NIXIE DRIVER WARNING

For all models of 5326/27 Universal Counters

Batch number 2575 of the nixie driver circuits (P/N 1820-0092) in these counters have been failing at a rate higher than we like. Even though only a small number of the circuits in this batch are weak, all of them have been pulled from the stocking bins. There are, however, some nixie drivers from this batch presently in use in instruments. If they have not failed DO NOT replace them. If they do fail replace them with an 1820-0092 with a batch number other than 2575.

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5326A/5327A-9B
5326B/5327B-9B
5326C/5327C-9B

SERVICE NOTE

Supersedes:
5326A,B,C-9A
5327A,B,C-9A

HP MODEL 5326/5327 FREQUENCY COUNTERS

Serial Numbers:
5326A — 1312A-01906 to 1312A-03000
5326B — 1312A-02141 to 1312A-03015
5326C — 1312A-00451 to 1312A-00675
5327A — 1312A-00396 to 1312A-00590
5327B — 1312A-00546 to 1312A-00945
5327C — 1312A-00546 to 1312A-00695

ADDED PROTECTION TO PREVENT THE +175 VOLT FUSE FROM BLOWING

In order to prevent the +175 volt power supply fuse from blowing, a new limiting resistor (R6-HP/PN 0698-5479), fuse (HP/PN 2110-0487) and fuse adapters (HP/PN 1251-3205) must be added to Regulator Board Assy (A15).

If the +175V fuse is blowing, first check to see if the problem is not caused by short circuits in the instrument, then perform this modification.

PARTS REQUIRED

Quantity	Ref. Desig.	Description	HP Part No.
1	A15R6	Resistor Fixed 8.2Ω 5%	0698-5479
2	—	Mini-Socket	1251-3205
1	A15F1	Fuse (50 mA)	2110-0487

INSTALLATION PROCEDURE

1. Remove A15 Regulator Assy (HP/PN 05327-60020) from instrument.
2. Remove A15R6 (13Ω) and install new value of R6 (8.2Ω 5%).
3. Insert Mini-Sockets into existing fuse holder socket.
4. Insert new 50 mA fuse into modified fuse holder socket.
5. Return instrument to original configuration and ensure +175V supply fuse doesn't fail.
6. Check instrument for proper operation.

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SERVICE NOTE

SUPERSEDES:
None

05327-60029 Prescaler Board

The 05327-60029 550 MHz prescaler board may be substituted for the 05327-60009 board on the 5327A, 5327B, or 5327C.

Either board may have been installed in the counter when shipped from the factory.

If a 5327-60029 board is used to replace a 5327-60009 board in a 5327C with serial number 1040A00?90 and below, it will be necessary to add a 1.5K 1/4 watt resistor (P/N 0683-1525) to the A7 board (P/N 05328-60045) as shown in the diagram below.

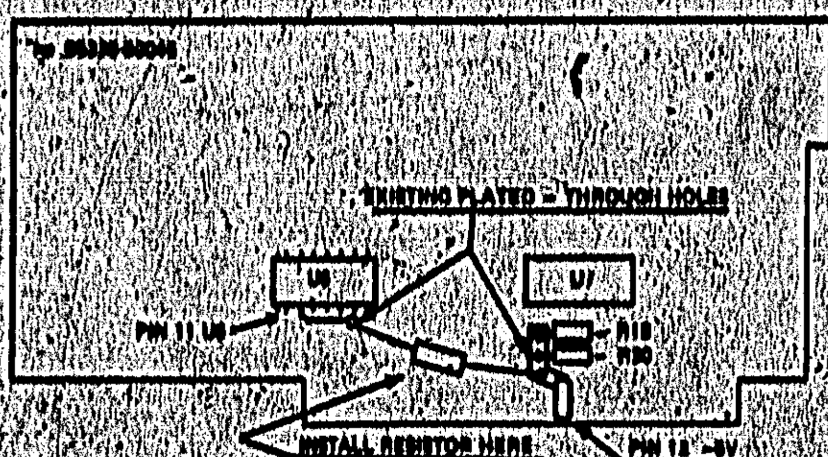
Using insulating spaghetti on the leads, install the resistor in the existing plated-through-holes between pin 11 of U6 and the junction of R19 and R20.

The main difference in the two boards is in U4, the divide-by-5 circuit. In 05327-60029 board, Q2 shifts the MECL output of U3 (0V to -0.6V) to standard ECL levels (-0.8V to -1.6V). U5 is an ECL gate that provides buffering. The output of U4 is standard ECL.

The remaining circuitry is identical to that on the 05327-60009 board. Refer to the description in the Operating and Service Manual.

The adjustment procedure for R1 and R2 are identical on the two boards. The 05327-60029 has an additional potentiometer, R28, which is adjusted as follows:

1. Rotate R28 fully clockwise.
2. If unable to obtain a stable count at 550 MHz, turn R28 slightly counterclockwise.
3. Check for a stable counter reading.



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