Errata

Title & Document Type: 5370A Universal Time Interval Counter Operating & Service Manual

Manual Part Number: 05370-90010

Revision Date: October 1979

HP References in this Manual

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

About this Manual

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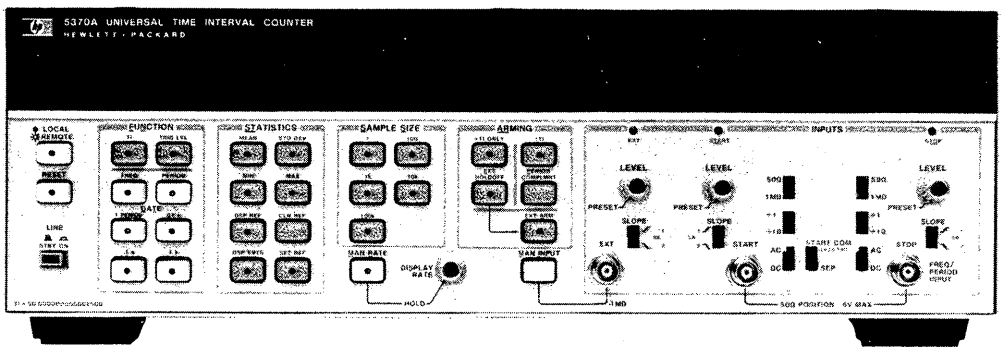
Agilent Technologies

OPERATING AND SERVICE MANUAL

5370A UNIVERSAL TIME INTERVAL COUNTER

GENERAL INFORMATION
INSTALLATION
OPERATING AND PROGRAMMING
PERFORMANCE TESTS
ADJUSTMENTS
REPLACEABLE PARTS
MANUAL CHANGES
SERVICE



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HP 5370A

VOR 1

MANUAL CHANGES

CHANGE DATE: March 31, 1983
(This change supersedes all earlier dated changes.)

*** Make all corrections listed under ERRATA before making other changes.

*** Check following table for your instrument's serial prefix or series number and make listed change(s) to manual.

MANUAL DESCRIPTION

INSTRUMENT: 5370A
Universal Time Interval Counter
Operating and Service Manual
/ Users Manual (3 Sections)

SERIAL PREFIX: 1936A

DATE PRINTED: OCT 1979
HP PART NOS: 05370-90010 / 90012
MICROFICHE NOS: 05370-90011 / 90013

# INDICATES NEW OR REVISED ITEM

> INDICATES ACTION TO BE TAKEN

SERIAL PREFIX OR SERIES NUMBER	MANUAL CHANGE(S)
2004A	1
2008A	2
2012A	2,3
2016A	2,3,4
2018A	2,3,4,5
2024A	2 thru 6
2036A	2 thru 7
2044A	2 thru 8
2116A	2 thru 9
2116A	2 thru 10
2128A	2 thru 11
2132A	2 thru 12
2132A	2 thru 13
2213A	2 thru 14
2217A	2 thru 15
#2311A	2 thru 16

Information for any optional circuit boards described in this manual agrees with the series numbers on the circuit board(s) for the option, which may not be the same as the Serial Prefix Number on the rear of the instrument.

(C5370AX) 9625-9593/9871/9919-10277/10432E/3=10283-10424/4=9635-9922-10415/5=10411/6=10944/7=11272/8=11400E-11274-10818-11352/9=11640/10=12130/11=10909-12079-12161/E=11429-11581-12130/12=13094/13=13595-13618/E=13868/14=13885-13886 15=13927/16=14888

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VOR 2

ERRATA

Page 1-4, paragragh 1-23:
>Change Rack Mount Flange kit from 908 to 913.

Page 3-9, Figure 3-2. Rear Panel Features:
>Change item 5 to read:
FREQ STD OUTPUT jack provides 10 megahertz internal standard signal for external use. Amplitude is 1 volt rms into 50-ohms. FREQ STD select switch 1 when set to INT position, provides output of the internal 10MHz clock. EXT position provides a buffered output of the external time base standard being used.

Page 3-24, Table 3-4. Program Code Set:
>Add to command #10 "NOTE: Intended for use with plus or minus time interval arming mode only."

#Page 3-25, EXAMPLE PROGRAMS:
>Replace the EXAMPLE 3. INPUT SELECTION program with the following program:

```
0: flt 6
1: wrt 703,"FN1
 IN3"
2: red 703,A;
 dsp A;wait 2000
3: wrt 703,"FN3"
4: red 703,A;
 dsp A;wait 2000
5: sto 1
*31746
```

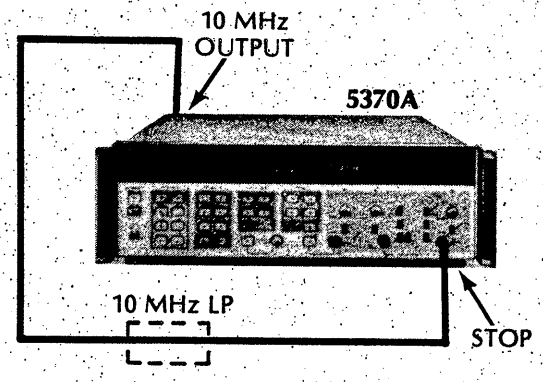
Page 3-26, EXAMPLE 5:
>Add the following directly beneath "EXAMPLE 5":
NOTE: Intended for use with plus or minus time interval arming mode only.

Page 4-28, Table 4-3. Performance Test, Part VI:
>Replace the accuracy test with the one shown below.

VI. ACCURACY

Specification: 10 MHz +-.005 Hz

Connect the 5370A as shown in the following diagram:



VOR 2

ERRATA (cont'd)
Page 4-28, Table 4-3. Performance Test, Part IV:

NOTE
Use of a 10 MHz lowpass filter may be necessary to obtain a stable reading.

Set the 5370A controls as follows:

Power on the 5370A.
FUNCTION ..... FREQ
GATE 1s
STATISTICS ..... MEAN
STOP CHANNEL
IMPEDANCE 50-OHM
ATTENUATION ..... divide by 1
COUPLING ..... DC
SLOPE ..... /
LEVEL ..... PRESET
START COM/SEP ..... SEP

Observe the 5370A display. It should display 10 MHz +-.005 Hz. Mark the results on the test card.

Page 6-6, Table 6-2. A3 Replaceable Parts:
>Change A3S8 and A3S9 under HP and Mfr Part Numbers to 3101-2334.
>Change A3S8 and A3S9 check digit (CD) to 6.

Pages 6-8 through 6-24, Table 6-2. MISCELLANEOUS Replaceable Parts:
>Change HP Part Number of TERMINAL TEST POINT listed under MISCELLANEOUS for circuit board assemblies A6-A9, A11, A13, A14, A16-A19, and A21 from 0360-0535 to 0360-1682 with Mfr Code 28480 and Mfr Part Number 0360-1682.

Page 6-11, Table 6-2. A9 (05370-60009) Replaceable Parts:
>Change A9U13 from 1816-0409 to 1816-1156.

Page 6-15, Table 6-2. A15 (05370-60015) Replaceable Parts;
>Add A15U23*; 05342-80006; IC PROGRAMMED ROM; 28480; 05342-80006. The 05342-80006 and 1816-1155 ROM's are directly interchangeable for replacement purposes in this instrument.
>Add A15U26*; 05342-80007; IC PROGRAMMED ROM; 28480; 05342-80007. The 0534280007 and 1816-1179 are directly interchangeable for replacement purposes in this instrument.

#Page 6-16, Table 6-2. A16 (05370-60016) Replaceable Parts:
>Add C14, C15; 0160-3878; CAPACITOR-FXD 100PF +-20% 200VDC.
>Add R20,R21; 0757-0394; RESISTOR 51.1 1% .12W F TC=0+-100.

Page 6-21 and 6-22, Table 6-2. A19 (05370-60119) Replaceable Parts:
>Change A19L8 to 9140-0142; CD=8; COIL-MLD 2.2UH 10% Q=32; 28480; 9140-0142.
>Change "CD" for A19R17 (0698-7212) to 9.
>Change A19U1 from 1820-0753 to 1820-1179, the preferred replacement part. The 1820-0753 and 1820-1179 are directly interchangeable for replacement purposes in this instrument.

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ERRATA (cont'd)

Page 6-26, Table 6-2. A22 (05370-60122) Replaceable Parts:
>Change A22U19, A22U20 and A22U23 thru A22U27 from 1820-0753 to 1820-1179. The preferred replacement part is 1820-1179, both are directly interchangeable for replacement purposes.
>Change A22TP1-TP4 (0360-0535) to 0360-1682; CD=0; TERMINAL TEST POINT PCB; 28480; 0360-1682.

Page 6-28, Table 6-2. Replaceable Parts:
>Change A23S33 HP and Mfr Part Numbers to 3101-2220; (CD) to 9.
>Change 5061-0077 to 5060-0171; KIT, RACK FLANGE (OPTION 913)

Page 6-29 and 6-30, Table 6-2. Replaceable Chassis Parts:
>Delete S3, 3101-0199, slide switch.
>Add 5061-2071, Option 913 Rack Mount Kit.

Page 6-30, Table 6-2. Replaceable MISCELLANEOUS PARTS:
>Change 0340-0486 in "HP" and "Mfr Part Number" columns to 0340-0833 (CD=9).

#Page 6-31, Figure 6-1. Mechanical Parts:
>Change reference designator MP9 to MP12; and reference designator MP12 to MP9.

Page 7-1, MANUAL CHANGES:
Delete the NOTE in CHANGE 1 (1928).
Add the following NOTE to CHANGE 2 (1848).

NOTE

Instruments with Serial Numbers 1848A00411 through 1848A00490 (except 1848A00417 and 1848A00425) do not include the following change for A3.

Add the following to CHANGE 2 (1848):
Change A19 (05370-60119) series number from 1928 to 1820.
Change A19R17 from 0698-7212 (100 OHMS) to 0698-7205; CD=0; RESISTOR 51.1 OHMS 1% .05W F TC=0/+-100; 24546; C3-1/8-T0O-51R1-G
Change A19L8 from 9140-0142(2.2 UH) to 9100-2265; CD=6; COIL-MLD 10UH 10% Q=60; 28480; 9100-2265.

Page 8-121, Figure 8-29, A19/A20 Schematic Diagrams:
Change SERIES number from 1928 to 1820.
Change R17 from 100 to 51.1 ohms.
Change L8 from 2.2U to 10U.

Page 8-97, Figure 8-17. A24 Line Module Schematic Diagram:
>Change values of C1 and C2 to 3200 pF.
>Change values of L1 and L2 to 465 uH.

Page 8-105, Figure 8-21, A9 (05370-60009) Processor Assembly Schematic Diagram:
>Change the value of R9 to 31.6K.
>Change the value of R12 and R13 to 3.16K

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ERRATA (cont'd)

Page 8-105, Figure 8-21, A9 (05370-60009) Processor Assembly Schematic Diagram:
>Change the following on the A9 Component Locator:

C11 to C13	C13 to C14	C15 to C20	C17 to C16	C20 to C19
C12 to C11	C14 to C12	C16 to C15	C19 to C17	

Page 8-107, Figure 8-22, A11 DISPLAY INTERFACE ASSEMBLY Schematic Diagram:
>Change U5 to U14.
>Change U14 to U5.

Page 8-108, Figure 8-22, Caption:
>Change caption from A22 to A11 DISPLAY INTERFACE ASSEMBLY.

Page 8-113. A15 HP-IB Interface Assembly Schematic Diagram.
>Add inverter (U7A) to the right of U11; with U7A active low input (pin 3) to the left, and output (pin 6) to the right. Connect U7A(3) to U11(12), and U7A(6) to U21D(11).
>Delete the connection between U21D(11) and U17D(11), above the junction of U17D(11), U21C(10) and U17C(9).
>Delete the connection between U1B(8) and U13(6); connect U13(6) to U29(15).

Page 8-117, Figure 8-27. A17 Count Chain Assembly Schematic Diagrams:

>Delete the lines that connect pin 1 of U12, U8, U6, U5, U9 and U11 to P1A($\overline{6}$).

>Delete the lines that connect pin 15 of U12 and U8 to P1A($\overline{3}$).

>Delete the lines that connect pin 15 of U6 and U5 to P1A($\overline{4}$).

>Delete the lines that connect pin 15 of U9 and U11 to P1A($\overline{5}$).

>Connect pin 1 of U12, U8, U6, U5, U9 and U11 to P1A($\overline{3}$).

>Connect pin 15 of U12 and U8 to P1A($\overline{4}$).

>Connect pin 15 of U6 and U5 to P1A($\overline{5}$)

>Connect pin 15 of U9 and U11 to P1A($\overline{6}$).

Page 8-121, Figure 8-29, A19/A20 Schematic Diagram:
>Change value of R17 from 51.1 to 100 ohms.
>Change inductance of L8 from 10U to 2.2U.
>Change SERIES 1820 to SERIES 1928.
>Change the Reference Designator R19 to R69.

Page 8-125, Figure 8-31. A22 Arming Assembly Schematic Diagram:
>Change reference designation of 221-ohm resistor R115 (bottom left, connected between the junction of CR7 and CR8 and -5.2V) to R113.
>Change value of resistors R113 and R117 to 215 ohms.
>Change value of resistor R115 (in parallel with C35) to 90.9K.
>Reverse diodes CR1 and CR3 (upper right) to show the cathodes connected to circuit board common. The anodes connect to the START/STOP EVT OUT lines.

VOR 6

ERRATA (cont'd)

Page 8-125, Figure 8-31. A22 Arming Assembly Schematic Diagram:
>Replace Figure 8-31. with Figures 3. and 4. which are attached to the back of these Manual Changes.
NOTE: Figures 3. and 4. are the latest version of A22 Arming Assembly (05370-60122) Component Locator and Schematic Diagram, respectively.

Page 8-127, Figure 8-32, A23 Front Panel Display Assembly Schematic Diagram:
>Delete connection shown between S26 (EXT ARM) and S32 (MAN INPUT).
>Connect S32 (open terminal) to circuit board common.

#Page 1-2. Table 1-1. HP Model 5370A Specifications:
>Delete under FREQUENCY AND PERIOD MEASUREMENTS the specs for RESOLUTION and ACCURACY.
>Add for FREQUENCY MEASUREMENT:

Least Significant Digit Displayed: 20ps/Gate Time X FREQ

Resolution: +- 100ps/Gate Time X FREQ +- 1.4 Trigger Error/Gate Time X FREQ

Accuracy: +- Resolution +- (Time Base Error) X FREQ

+- 100ps Systematic/Gate Time X FREQ

>Add for PERIOD MEASUREMENT:

Least Significant Digit Displayed: 20ps/Gate Time X PERIOD

Resolution:+-100ps/Gate Time X PERIOD +- 1.4 Trigger Error/Gate Time X PERIOD

Accuracy:+- Resolution +- Time Base Error X PERIOD

+- 100ps Systematic/Gate Time X PERIOD

>Delete ACCURACY spec under TIME INTERVAL MEASUREMENT:

>Add Resolution:
+-100ps rms/sqrt(N) +-Start Trigger Error/sqrt(N) +-Stop Trigger Error/sqrt(N)

>Add Accuracy:
+- Resolution +- Time Base Error X Time Interval
+- Trigger Level Timing Error +- 1ns Systematic

VOR 7

CHANGE 1

In instruments with a 2004A serial number prefix, the HP Model 10544A high stability time base oscillator (formerly Option 001) and associated oven oscillator power supply assembly A7 are supplied in place of the 10 MHz air temperature circuit board oscillator assembly normally used for A69. All references to Option 001 in the Operating and Service Manual should be disregarded.

Page 1-3, Table 1-1, Specifications:
>Change "Specifications" for the TIME BASE to those shown for Option 001.

Page 6-9, Table 6-2, A7 (05370-60007) Replaceable Parts:
>Delete "(A7 USED IN OPTION 001)".

Page 6-28, Table 6-2, A69 and Options, Replaceable Parts:
>Delete A69 (05370-60069) and all replaceable parts for A69.
>Add A69; 10544A; 10 MHz Crystal Oscillator.
>Delete 10544A listing under OPTIONS.

Page 8-101, Figure 8-19, A7 Schematic Diagram:
>Delete "(OPTION 001 ONLY)" in caption and "(OPTION 001)" on top of schematic.

Page 8-129, Figure 8-33, A69 Oscillator Assembly:
>Add SERIAL PREFIX 1936A AND BELOW in captions and at top of 05370-60069.

Page 8-131, Figure 8-34, A69 Oscillator Assembly:
>Add SERIAL PREFIX 2004A in place of OPTION 001 in captions.
>Delete "Option 001" at top schematic diagram.

CHANGE 2

NOTE: INSTRUMENTS WITH SERIAL PREFIX 2008A ARE SUPPLIED WITH AIR TEMPERATURE OSCILLATOR CIRCUIT BOARD ASSEMBLY A69; NOT THE OPTION 001 OSCILLATOR DESCRIBED FOR CHANGE 1.

Page 1-2, Paragraph 1-22, Options:
>Delete Options 907, 908, and 909. The instrument is supplied with the Option 907 front handles. To rack-mount Serial Prefix 2008A instruments (with front handles attached to instrument) use HP Part No. 5020-8874 rack-mount flanges and HP Part No. 2510-0194 #8-32 X 5/8 inch pan-head-pozi screws. If the handles are removed, use HP Part No. 5020-8862 rack-mount flanges and #8-32 X 3/8 inch pan-head-pozi screws (HP Part No. 2510-01930).

CAUTION

The display board will be damaged if the 5/8 inch screws are used to rack-mount an instrument with handles replaced by HP Part No. 5020-8862 Rack-Mount Flanges.

Page 6-29, Table 6-2, Replaceable CHASSIS PARTS:
>Add MP33; 5060-9899; CD=8; HANDLES-FRONT
>Add MP34; 5020-8896; CD=7; TRIM-FRONT HANDLES
>Add MP35; 2510-0195; CD=5; SCREW MACHINE 8-32 X 3/8 FLAT HEAD

CHANGE 3

NOTE: Instruments with Serial Prefix 2012A are supplied with air temperature oscillator circuit board assembly A69; not the Option 001 oscillator for CHANGE 1.

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CHANGE 3 (cont'd)

Page 1-4, Paragraph 1-26:
>Add the following sentence,"A HP Model 10834A Adapter is also supplied to provide an extension for the HP-IB connector."

Page 6-16, Table 6-2, A16 (05370-60016) Replaceable Parts:
>Change A16J1 from 1200-0499 to 1200-0618 (CD=3).

Page 6-24, Table 6-2, A22 (05370-60022) Replaceable Parts:
>Change A22J1 from 1200-0499 to 1200-0618 (CD=3).
>Change A22 "SERIES" number in Table 6-2 and Schematic Diagram to 2012.

Page 6-27, Table 6-2, "A22 MISCELLANEOUS" Replaceable Parts:
>Delete 5000-9043; PIN:P.C. BOARD EXTRACTOR.
>Delete 5040-6843; EXTRACTOR, P.C. BOARD

Page 6-29, Table 6-2, Replaceable CHASSIS PARTS:
>Add MP31; 05370-00016; CD=1; Qty=2; BRACKET-MP32 MTG; 28480; 05370-00016.
>Add MP32; 05370-00017; CD=2; Qty=1; BRACKET-CKT BD HOLD-DOWN; 28480

Page 6-30, Table 6-2, Replaceable MISCELLANEOUS PARTS:
>Add 1200-0617; CD=2; Qty=2; CLIP, RETAINING (for W11 cable plugs)

Page 6-32, Figure 6-1, Mechanical Parts:
>Add part numbers and descriptions for bracket MP31 and MP32.

CHANGE 4

NOTE: Instruments with Serial Prefix 2016A are supplied with air temperature oscillator circuit board assembly A69; not the Option 001 oscillator for CHANGE 1.

Page 6-20 thru 6-22, Table 6-2, A19 and A20 (05370-60119) Replaceable Parts:
>Change A19/A20 "SERIES" number to 2016.
>Add A19R72 and R73; 0698-7205; CD=0; RESISTOR 51.1 1% .05W F TC=0+-100.

Page 6-22, Table 6-2, A21 (05370-60024) Replaceable Parts:
>Change "HP" and "Mfr. Part Number" for A21 to 05370-60124 and CD to 8.
>Change A21 "SERIES" number for 05370-60124 to 2016.
>Add A21R45 and R46; 0757-0395; CD=1; RESISTOR 56.2 1% .125W F TC=0+-100.
>Change A21U1 from 1820-1224 (MC10216P) to 1820-0920 (MC1692L) and CD to 4.
NOTE: These two ECL receivers have a different pinout and are not directly interchangeable.

Page 6-24, Table 6-2, A22 (05370-60022) Replaceable Parts:
>Change "HP" "Mfr. Part Number" for A22 to 05370-60122 and CD=2.
>Change A22 "SERIES" number for 05370-60122 to 2016.
>Change A22R113, R117 to 0757-0400; CD=9; RESISTOR 90.9 1% .125W F TC=0+-100
>Change A22R115 to 0698-0083; CD=8; RESISTOR 1.96K 1% .125W F TC=0+/-100.
NOTE: The 05370-60022 and 05370-60122 circuit board assemblies are electrically equivalent except for the values of R113, R115, and R117. The 05370-60122 arming assembly is compatible with the 05370-60123 front panel display assembly for A23. To use the 05370-60122 arming assembly with the 05370-60023 assembly for A23, resistors A22R113, R115, and R117 must be changed to 215, 90.9K, and 215 ohms (respectively).

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CHANGE 4

Pages 6-27 and 6-28, Table 6-2, A23 (05370-60023) Replaceable Parts:
>Change "HP" and "Mfr. Part Number" for A23 to 05370-60123 and CD=3.
>Change A23 "SERIES" number for 05370-60123 to 2016.
>Change A23R16 to 2100-3849; CD=7; RESISTOR VAR 470K 20% CCWLOG .5W COMP.

Page 8-121, Figure 8-29, A19/A20 START/STOP INTERPOLATOR Assembly Schematic:
>Change A19/A20 "SERIES" number to 2016.
>Add R72 (51.1-ohm) in series between U7(13) and the junction of C7, and R21.
>Add R73 (51.1-ohm) in series between U7(3) and the junction of R22, and R23.

Page 8-123, Figure 8-30, A21 200 MHz Multiplier Assembly Schematic Diagram:
>Change HP Part Number for A21 from 05370-60024 to 05370-60124.
>Change A21 "SERIES" number for 05370-60124 to 2016.
>Add R45 and R46; change connections for U1A,B,C and add U1D; and change tables for "Reference Designations" and "Active Elements" as shown in attached Figure 1.

A21 REFERENCE DESIGNATIONS

C1
CR1, CR2
L1-L16
Q1-Q8
R1-R46
U1-U3

A21 TABLE OF ACTIVE ELEMENTS

REFERENCE DESIGNATIONS	HP PART NUMBER	MFR. PART NUMBER
CR1, CR2	1901-0040	1901-0040
Q1-Q8	1854-0092	1854-0092
U1	1820-0920	MC1692L
U2	1820-1224	MC10216P
U3	1820-0138	LM339N

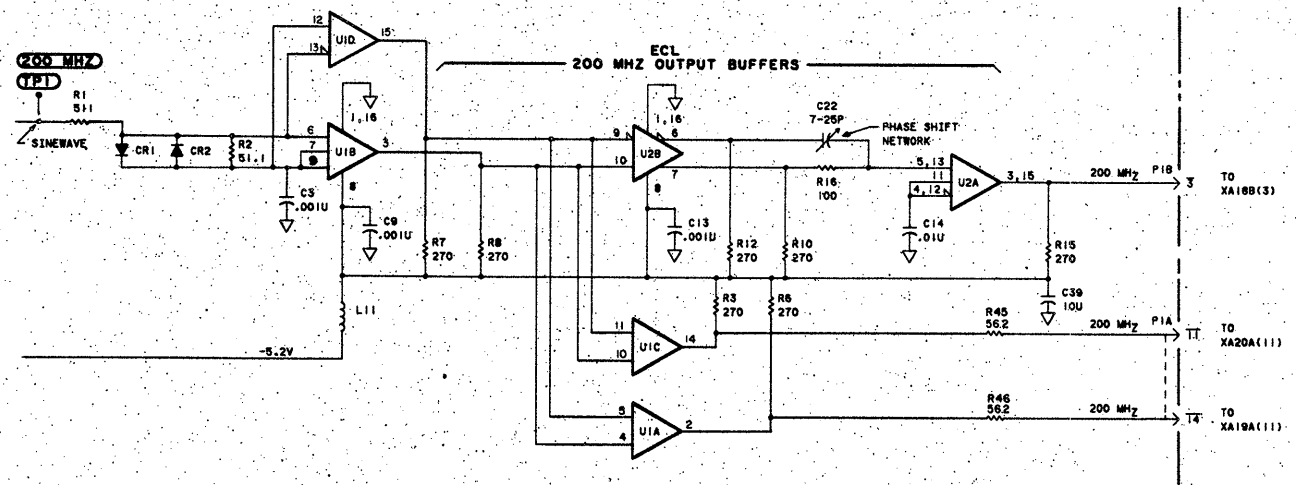

Figure 1. A21 Changes for 05370-60124 200 MHz Multiplier in CHANGE 4

VOR 12

CHANGE 4 (cont'd)
Page 8-125, Figure 8-31, A22 Arming Assembly Schematic Diagram:
>Change HP Part Number for A22 from 05370-60022 to 05370-60122 (SERIES 2016).
>Change R113 and R117 to 90.9 ohms.
>Change R115 to 1960 ohms.
>Change connections to A2J3 and wiring to agree with attached Figure 2.

Page 8-127, Figure 8-32, A23 Front Panel Display Assembly Schematic Diagram:
>Change HP Part Number for A23 from 05370-60023 to 05370-60123 (SERIES 2016).
>Change wiring and values of EXT LEVEL control (R17) and DISPLAY RATE control (R16) as shown in attached Figure 2.

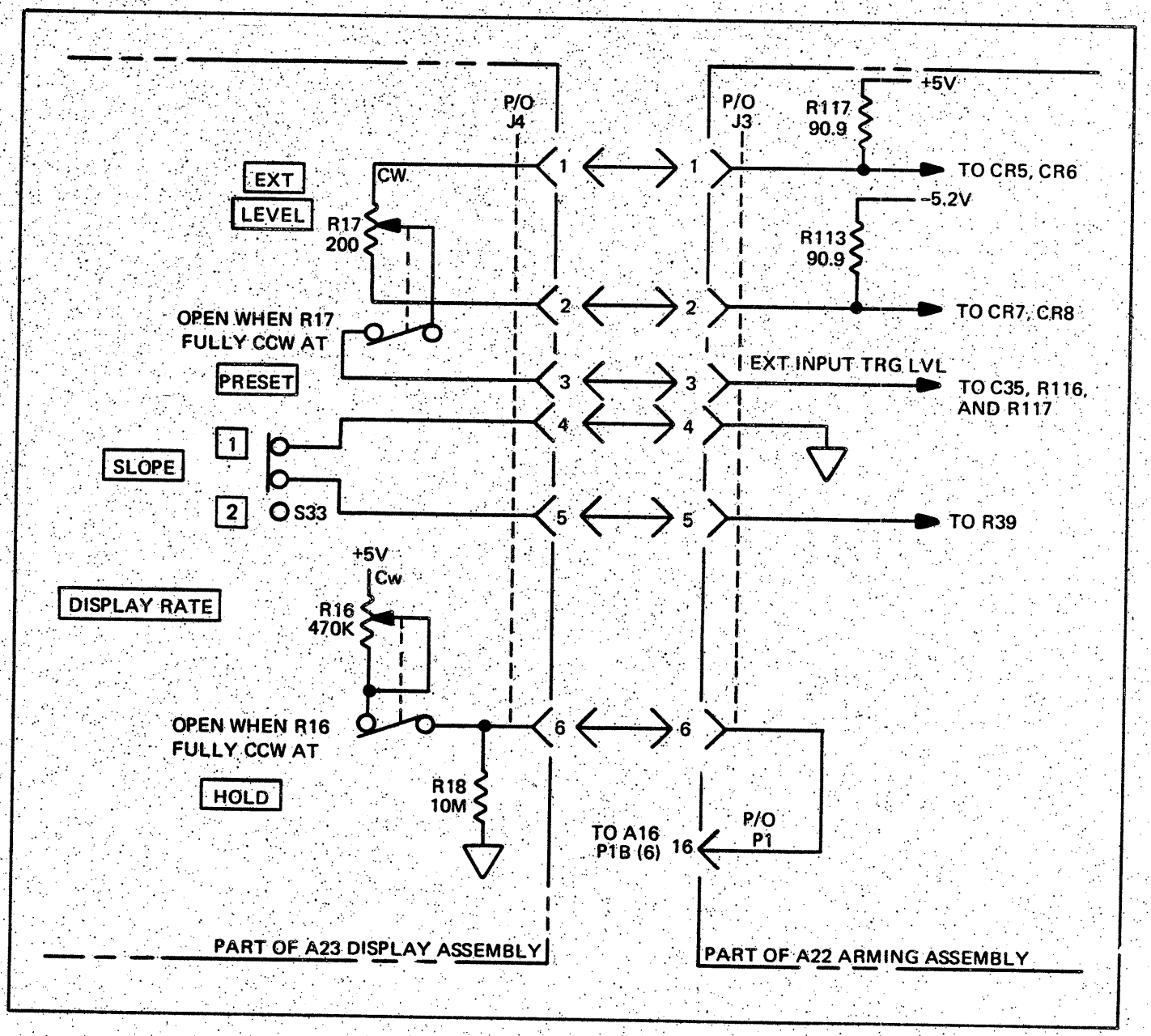

Figure 2. A22 (05370-60122) and A23 (05370-60123) Changes in CHANGE 4

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CHANGE 4 (Cont'd)
NOTE: The 05370-60123 front panel display assembly is compatible with the 05370-60122 arming assembly for A22. To use the 05370-60123 display assembly with the 05370-60022 arming assembly, resistors A22R113, R115, and R117 must be changed to 90.9, 1.96K, and 90.9 ohms (respectively).

CHANGE 5
All 5370A counters with CHANGE 5 are supplied with the HP Model 10544A high stability time base oscillator (formerly Option 001) and associated oven oscillator power supply assembly A7 in place of the 10 MHz air temperature circuit board oscillator assembly normally used for A69. All references to Option 001 in the Operating and Service Manual should be disregarded.

Page 1-3, Table 1-1, Specifications:
>Change "Specifications" for the TIME BASE to those shown for Option 001.

Page 6-9, Table 6-2, A7 (05370-60007) Replaceable Parts:
>Delete "(A7 USED IN OPTION 001)".

Page 6-28, Table 6-2, A69 and Options, Replaceable Parts:
>Delete A69 (05370-60069) and all replaceable parts for A69.
>Add A69; 10544A; 10 MHz Crystal Oscillator.
>Delete 10544A listing under OPTIONS.

Page 8-101, Figure 8-19, A7 Oven Oscillator Power Supply Assembly Schematic:
>Delete "(OPTION 001 ONLY)" in caption and "(OPTION 001)" on top of schematic.

Page 8-129, Figure 8-33, A69 10 MHz Oscillator Assembly Schematic Diagram:
>Add "SERIAL PREFIX 1936A AND BELOW, 2008A, 2012A, OR 2016A" in captions and at top of 05370-60069 schematic.

Page 8-131, Figure 8-34, A69 10 MHz Oscillator Assembly Schematic Diagram:
>Add SERIAL PREFIX 2018A AND ABOVE in place of OPTION 001 in captions.
>Delete "Option 001" at top of schematic diagram.

CHANGE 6
Page 6-11, Table 6-2. A9 (05370-60009) Replaceable Parts:
>Change A9R10 from 0698-7252, 4.64K, to 0698-7236, 1.00K, 1%, .05W.
>Change A9R9 from 0698-7272, 31.6K, to 0698-7268, 21.5K, 1%, .05W.
>Change A9R14 from 0757-0472, 200K, to 0757-0465, 100K, 1%, .12W.
>Change A9 SERIES number to 2024.

Page 8-105, Figure 8-21. A9 Processor Assembly Schematic Diagram:
>Change 05370-60009 Series from 1748 to 2024 (Upper left of schematic).
>Change A9R9 from 31.6K to 21.5K.
>Change A9R10 from 4.64K to 1.00K.
>Change A9R14 from 200K to 100K.

CHANGE 7
The 10544A high stability time base oscillator has been replaced with the field repairable 10811A. A separate Service Manual for the 10811A is included with the 5370A Service Manual.

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CHANGE 7 (Cont'd)
Page 6-28, Table 6-2, A24 (0960-0443) Replaceable Parts:
>Delete A69, 10544-60011, 10 MHz Crystal Oscillator.
>Add A69 10811-60101, 10 MHz Crystal Oscillator.
>Add in description column: 10811A Operating and Service Manual.

Page 8-131, Figure 8-34. A69 10 MHz Oscillator Schematic Diagram:
>Change A69 Model number at top and bottom of diagram to 10811.

CHANGE 8
Page 6-24, Table 6-2, A22 (05370-60122) Replaceable Parts:
>Change series from 2016 to 2044.
>Add A22R122, 0698-3378, 51 ohms 5% .125 W RF.

Page 8-125; Figure 8-31, A22 Arming Assembly Schematic Diagram:
>Change series number from 2016 to 2044.
>Add R122 (51-ohms) between U16(15) and the junction of U19B(11) and R57.

CHANGE 9
Page 6-28, Table 6-2. Replaceable Parts, under Options:
>Change A69 (10811-60101) 10MHz Crystal Oscillator to HP Part No. 10811-60111 (SERIES 2116).

Page 8-131, Figure 8-34. A69 10MHz Oscillator Schematic Diagram:
>Change A69 Series Number to 2116.

CHANGE 10
Page 6-20, Table 6-2. A19 (05370-60119) Replaceable Parts:
>Change A19C15* to 0160-3877, CD5, CAPACITOR-FXD 100 PF +/-20% 200VDC CER.

Page 8-121, Figure 8-29. A19/A20 Start/Stop Interpolator Assembly Schematic:
>Change the value of C15* to 100 pF.

CHANGE 11
Page 6-24. A22 (05370-60122) Replaceable Parts:
>Change series number to 2128.
>Add A22C37 and C38; 0160-3873; CAPACITOR 4.7pF 5% 200V.
>Add A22C39 through C44; 0160-3879; CAPACITOR .01uF 20% 100V.
>Add A22R16, R51, R60, R69 to 0698-3132; RESISTOR 261 1% .125W.
>Change A22R17, R48, R49, R53, R55, R57, R62, R68, R72, and R99 to 0698-7205; RESISTOR 51.1 1% .125W.
>Change A22R47 to 0698-7207; RESISTOR 61.9 1% .05W.
>Change A22R64 and R100 to 2698-7222; RESISTOR 261 1% .05W.
>Change A22R118 through R122 to 0698-7205; RESISTOR 51.1 1W .05W.
>Add A22R123 through R125; 0698-7205; RESISTOR 51.1 1% .05W.
>Add A22R126 and R127; 0698-7223; RESISTOR 287 1% .05W.
>Change A22R86 to 0698-3446; RESISTOR 383 1% .125W.

Page 8-125, Figure 8-31. A22 Arming Assembly Schematic Diagram:
>Add C37 (4.7pF) between pin 1 and pin 3 of U16.
>Add C38 (4.7pF) between pin 1 and pin 3 of U15.
>Add C39 (.01uF) in series between R99 and the node above R99 (left of U29).
>Change R99 to 51.1 ohms.
>Add C40 (.01uF) in series between R68 and the node above R68 (right of U29A).

VOR 13

CHANGE 11 (Cont'd)

Page 8-125, Figure 8-31. A22 Arming Assembly Schematic Diagram (Cont'd):

>Change R64 to 261 ohms.
>Change R68 to 51.1 ohms.
>Add C41 (.01uF) in series between R17 and the node above R17 (left of U5D).
>Change R16 to 261 ohms.
>Change R17 to 51.1 ohms.
>Add C42 (.01uF) in series between R62 and the node above R62 (next to TP5).
>Change R60 to 261 ohms.
>Change R62 to 51.1 ohms.
>Add C43 (.01uF) in series between R53 and the node above R53 (next to TP6).
>Change R51 to 261 ohms.
>Change R53 to 51.1 ohms.
>Add C44 (.01uF) in series between R72 and the node above R72 (next to TP7).
>Change R69 to 261 ohms.
>Change R72 to 51.1 ohms.
>Change the value of R122 to 51.1 ohms.
>Add R123 (51.1-ohms) in series between U20B(11) and the junction of U16(14) and R49.
>Add R124 (51.1-ohms) between pin 14 of U15 and the node to the left of pin 14.
>Add R125 (51.1-ohms) between pin 15 of U15 and the node to the left of pin 15.
>Add R128 (51.1-ohms) from the collector of Q8 to circuit board common.
>Change R100 to 261 ohms (left of U29A).
>Add R126 (287-ohms) between J7 input and circuit board common.
>Add R127 (287-ohms) between J8 input and circuit board common.

NOTE: The following instruments contain A22 board SERIES 2044.(See CHANGE 13)

2128A01271	2128A01281	2128A01286
2128A01273	2128A01282	2128A01289
2128A01274	2128A01283	2128A01290
2128A01278	2128A01285	

NOTE: Instruments with serial Numbers 2128A0291 thru 2128A01350 contain A4 board SERIES 2213.

CHANGE 12

Page 6-5, Table 6-2. A3 (05370-60033) Replaceable Parts:

>Add the following NOTE in A3 BOARD ASSEMBLIES Description column:
"NOTE- The A3 BOARD ASSEMBLY do not include IC's U1 and U2 (1826-0088). These IC's are sold separately and must be ordered by the customer. (Refer to CHASSIS PARTS list)."

Page 6-5, Table 6-2. A4 (05370-60004) Replaceable Parts:

>Add the following NOTE in A4 BOARD ASSEMBLIES Description column:
"NOTE- The A4 BOARD ASSEMBLY do not include IC's U1 and U2 (1826-0290). These IC's are sold separately and must be ordered by the customer. (Refer to CHASSIS PARTS list)."

Page 6-6, Table 6-2. A3 (05370-60033) Replaceable Parts:

>Delete IC's U1 and U2 (1826-0088).

VOR 14

CHANGE 12 (Cont'd)
Page 6-8, Table 6-2. A4 (05370-60004) Replaceable Parts:
>Delete IC's U1 and U2 (1826-0290).

Page 6-29, Table 6-2. CHASSIS PARTS:
>Add A3U1 and A3U2; Qty=2; 1826-0088; IC, LIN 114-BIT WIDE BAND AMPL.
>Add A4U1 and A4U2; Qty=2; 1826-0290; IC, LINEAR.

CHANGE 13
Page 6-6, Table 6-2. A4 (05370-60004) Replaceable Parts:
>Change A4 SERIES to 2213.
>Change R15 and R18 to 0757-1001; RESISTOR 56.2 1% .5W F TC=+-100
>Change R16 and R19 to 2100-1788; RESISTOR 500 10% C TOP ADJ 1TRN

Page 6-24, Table 6-2. A22 (05370-60122) Replaceable Parts:
>Change A22 SERIES to 2044.

Page 6-26, Table 6-2. A22 Replaceable Parts:
>Change R119 and R121 to 0698-3378; RESISTOR 51 5% .125W CC TC=+-270/+540

Page 8-99, Figure 8-18. A4 Input Trigger Assembly Schematic diagram:
>Change SERIES at top of diagram to 2213.
>Change R15 and R18 value to 56 ohms.
>Change R16 and R19 value to 500 ohms.

Page 8-125, Figure 8-31. A22 Arming Assembly Schematic diagram:
>Change A22 SERIES at top of diagram to 2044.
>Change R119 and R121 value to 51 ohms.

CHANGE 14
Page 6-24 thru 6-26, Table 6-2. A22 (05370-60122) Replaceable Parts:
>Change A22 SERIES to 2213.
>Delete C39 and C40.
>Change R68 and R99 to 0698-7216; RESISTOR 147 1% .05W TC=+-100.
>Change R122 thru R125 to 0698-3378; RESISTOR 51 5% .125W TC=-270/+540.

Page 8-125, Figure 8-31. A22 Arming Assembly Schematic Diagram:
>Change SERIES at top of diagram to 2213.
>Delete C39 and C40.
>Connect R99 directly to the junction of R100 and U29A(6).
>Connect R68 directly to pin 2 of U29A.
>Change R99 and R68 value to 147 ohms.

Instruments 2128A1341,2213A1364,2213A1352,2213A1358 and 2213A1359 have CHANGE 15

CHANGE 15
Page 6-22 thru 6-24, Table 6-2. A21 (05370-60124) Replaceable Parts:
>Change A21 SERIES to 2217.
>Change R2 to, 0757-0401; Qty 1; RESISTOR 100 1% .125W F TC=0+-100
>Change R45 and R46 to, 0757-0346; Qty 1; RESISTOR 10 1% .125W F TC=0+-100

VOR 15

CHANGE 15 (cont'd)
Page 8-123, Figure 8-30. A21 200MHz Multiplier Assembly:
>Change A21 SERIES to 2217.
>Change the value of R2 to 100 ohm
>Change the value of R45 and R46 to 10 ohm

#CHANGE 16

Page 6-9 and 6-10, Table 6-2. A8 (05370-60008) Replaceable Parts:
>Change the A8 SERIES from 1748 to 2311.
>Add C27 0160-3879 CAPACITOR-FXD .01UF +-20% 100VDC CER
>Change R8 from 0698-3437 to 0698-3442 RESISTOR 237 1% .125W F TC=0 +-100.
Page 8-103, Figure 8-20. A8 Reference Frequency Buffer Assembly:
>Change the A8 SERIES from 1748 to 2311.
>Change the value for R8 from 133 to 237.
>Add C27 .01U from the emitters of Q4 and Q5 to ground.

VOK 16

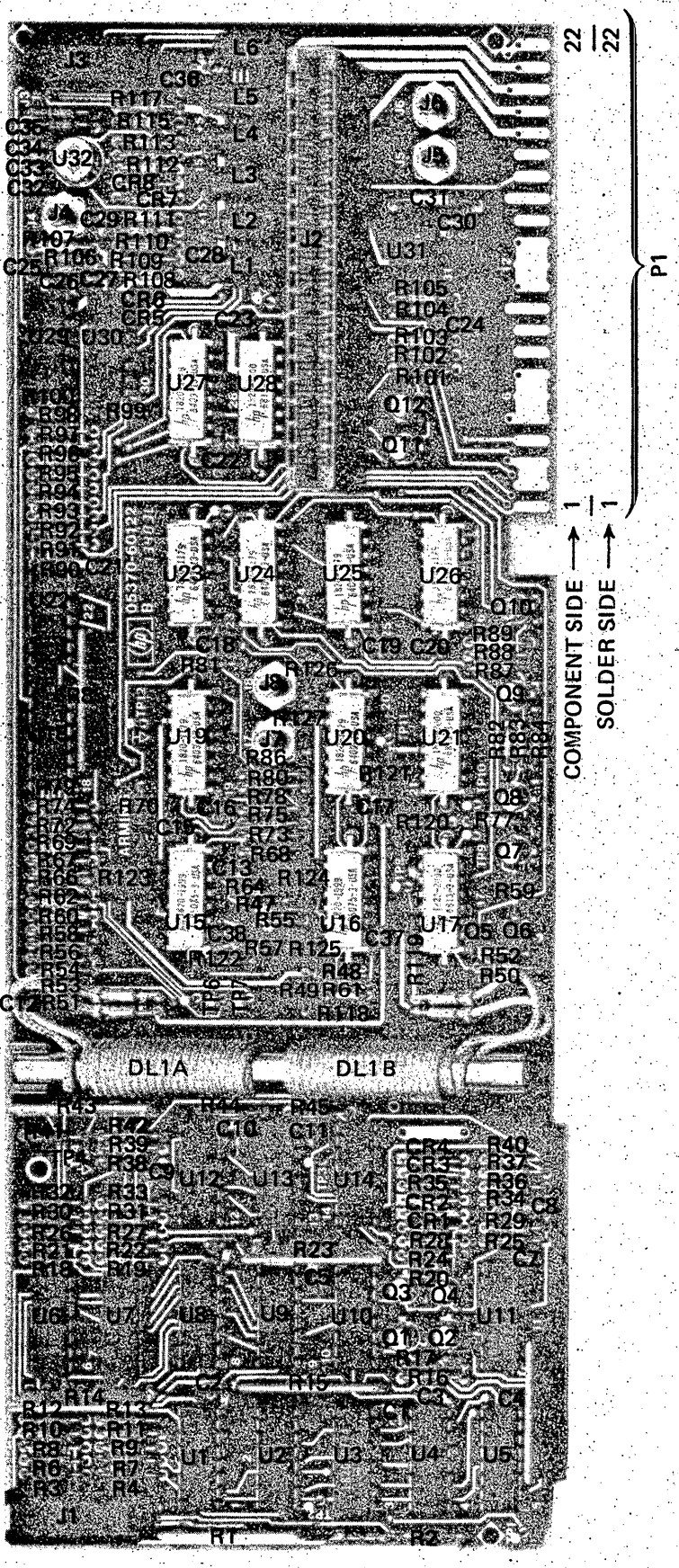

Figure 3. A22 Arming Assembly (05370-60122) Component Locator

VOR 17

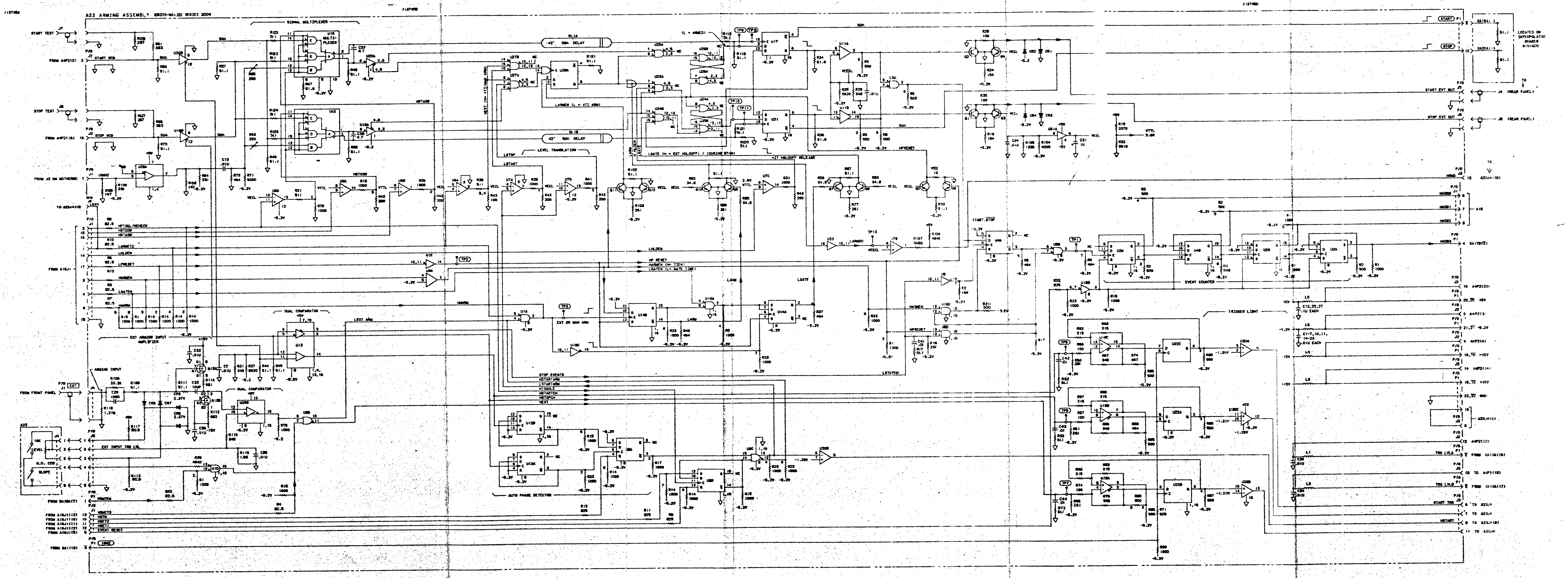

Figure 4. A22 Arming Assembly (05370-60122) Schematic Diagram

VOR 18

CHANGE 15 (cont'd)

Page 8-123, Figure 8-30. A21 200MHz Multiplier Assembly:
>Change A21 SERIES to 2217.
>Change the value of R2 to 100 ohm
>Change the value of R45 and R46 to 10 ohm

#CHANGE 16

Page 6-9 and 6-10, Table 6-2. A8 (05370-60008) Replaceable Parts:
>Change the A8 SERIES from 1748 to 2311.
>Add C27 0160-3879 CAPACITOR-FXD .01UF +-20% 100VDC CER
>Change R8 from 0698-3437 to 0698-3442 RESISTOR 237 1% .125W F TC=0 +-100.

Page 8-103, Figure 8-20. A8 Reference Frequency Buffer Assembly:
>Change the A8 SERIES from 1748 to 2311.
>Change the value for R8 from 133 to 237.
>Add C27 .01U from the emitters of Q4 and Q5 to ground.

VOR 19

5370A
UNIVERSAL TIME INTERVAL COUNTER

OPERATING AND SERVICE MANUAL

SERIAL PREFIX: 1936A

This manual applies directly to HP Model 5370A having serial number prefix 1936A and below.

NEW INSTRUMENTS

This manual, with enclosed "Manual Changes" sheet, applies to HP Model 5370A having serial number prefixes as listed on the "Manual Changes" sheets.

Copyright HEWLETT-PACKARD COMPANY 1979
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MANUAL PART NUMBER 05370-90010
Microfiche Part Number 05370-90011

Printed: OCT 1979

HEWLETT PACKARD

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SAFETY CONSIDERATIONS

GENERAL

This is a Safety Class I instrument. This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus."

OPERATION

BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage and the correct fuse is installed (see Section II). Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided.

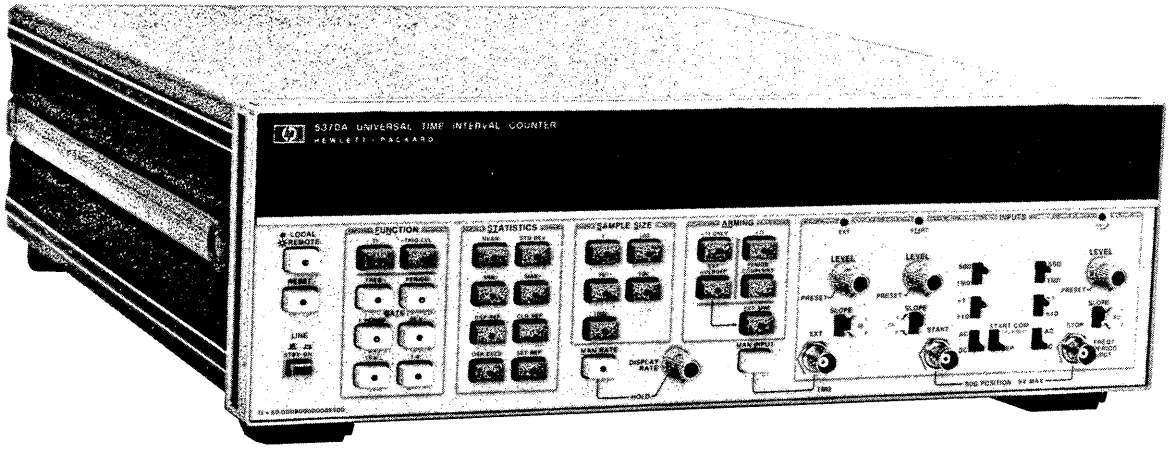
SERVICE

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

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

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

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



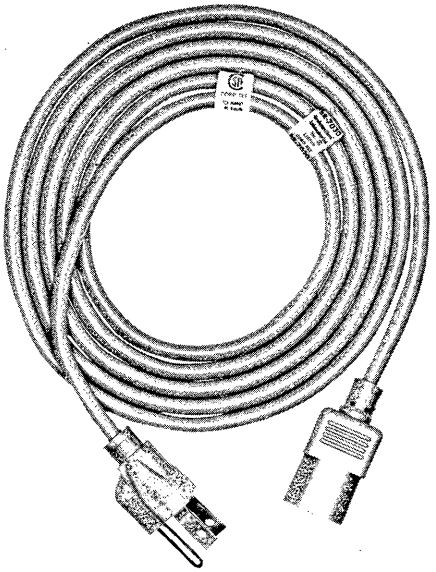


Figure 1-1. HP Model 5370A Universal Time Interval Counter and Accessories Supplied

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual provides information pertaining to the installation, operation, testing, adjustment, and maintenance of the HP Model 5370A Universal Time Interval Counter. *Figure 1-1* shows the 5370A with accessories supplied.

1-3. Packaged with this manual is a Users Manual. This is simply a copy of the first three sections of the operating and service manual. The Users Manual should be kept with the instrument for use by the operator. Additional copies of the Users Manual may be ordered through your nearest Hewlett-Packard Office. The part numbers are listed on the title page of the manual.

1-4. The full manual is divided into eight sections, each covering a particular topic for the operating and service of the HP Model 5370A. The topics by section number are:

Section	Topic
I	General Information
II	Installation
III	Operating and Programming
IV	Performance Tests
V	Adjustments
VI	Replaceable Parts
VII	Manual Changes
VIII	Service

1-5. SPECIFICATIONS

1-6. Instrument specifications are listed in *Table 1-1*. These specifications are the performance standards or limits against which the instrument may be tested.

1-7. INSTRUMENTS COVERED BY MANUAL

1-8. If the serial number of your instrument is lower than the serial number on the title page of this manual, you must modify your manual for agreement with your instrument. Refer to Section VII, Manual Changes, for the information that will adapt this manual to your instrument.

1-9. The 5370A Options 001, 907, 908, and 909 are documented in this manual. The differences are noted in the appropriate locations such as Options in Section I, the Replaceable Parts List in Section VI, and the Schematic Diagrams in Section VIII.

1-10. This instrument has a two-part serial number. The first four digits and the letter comprise the serial number prefix. The last five digits form the sequential suffix that is unique to each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under Serial Prefix on the title page.

1-11. An instrument manufactured after the printing of this manual may have a serial prefix that is not listed on the title page. This unlisted prefix indicates that the instrument is different from those documented in this manual. The manual for this instrument is supplied with a yellow Manual Changes supplement which contains change information that documents the differences.

Table 1-1. HP Model 5370A Specifications

INPUT AMPLIFIERS

SEPARATE INPUTS

Sensitivity: 100 mV p-p, 35 mV rms sine wave times attenuator setting.

Impedance: Selectable 1 MΩ || 30 pF or 50Ω nominal.

Trigger Level: Adjustable from -1.3V to 0.5V with 10 mV displayed resolution.

Trigger Slope: Independent selection of + or - slope.

Attenuators: ÷1 and ÷10 nominal.

Dynamic Range (preset):

50Ω ÷1	100 mV to 1V p-p pulse
÷10	1V to 7V p-p pulse
1 MΩ ÷1	100 mV to 1V p-p pulse
÷10	1V to 10V p-p pulse

Dynamic range for rms sine wave is one-third of the above values.

For precise time interval measurements the input signal (V_S) must be at least 150 mV (but not greater than 700 mV) above or below the trigger voltage (V_{TL}):

$$0.15V < | V_S - V_{TL} | < 0.7V$$

Signal Operating Range:

50Ω ÷1	-2.5V to 1V
÷10	-7V to 7V
1 MΩ ÷1	-2.5V to 1V
÷10	-25V to 10V

Coupling: AC or DC switch selectable.

Minimum Pulse Width: 5 ns

Maximum Input:

50Ω ÷1	±7V DC 7V rms below 5 MHz 3.5V rms (+24 dBm) above 5 MHz
÷10	±7V DC, 7V rms (+30 dBm)
1 MΩ ÷1	±350V DC 250V rms to 20 kHz decreasing to 3.5V rms above 5 MHz
÷10	±350V 250V rms to 20 kHz decreasing to 35V rms above 5 MHz.

COMMON INPUT

All specifications are the same as for separate operation with the following differences:

Impedance: 1 MΩ becomes 500 KΩ shunted by <60 pF. 50Ω same as in separate.

Sensitivity (preset):

50Ω ÷1	200 mV p-p, 70 mV rms
÷10	2V p-p, 700 mV rms
1 MΩ	Same as in separate

Dynamic Range (preset):

50Ω ÷1	200 mV to 2V p-p pulse
÷10	2V to 5V p-p pulse
1 MΩ	Same as in separate

Maximum Input:

50Ω ±5V DC or 5V rms

1 MΩ same as in separate

Attenuators: Becomes ÷2 and ÷20 for 50Ω.

FREQUENCY AND PERIOD MEASUREMENTS

FREQUENCY RANGE: 0.1 Hz to 100 MHz

PERIOD RANGE: 10 ns to 10 seconds

RESOLUTION: $\frac{20 \text{ ps}}{\text{gate time}}$

INTERNAL GATE TIME: 1 period, 0.01, 0.1, 1.0 seconds.

ACCURACY:

$$\frac{100 \text{ ps rms} \pm \text{trigger error}}{\text{gate time}} \pm \text{time base}$$

PERIOD/FREQUENCY STATISTICS: (1 period gate only) mean, standard deviation, maximum, minimum.

Sample Size: 1, 100, 1000, 10,000, 100,000

External Gate Input: 20 ns to 10 s.

TIME INTERVAL MEASUREMENTS

TIME INTERVAL RANGE:

±T.I. Mode -10 seconds to +10 seconds.

+T.I. Only Mode 10 ns to 10 seconds.

TIME INTERVAL STATISTICS: Mean, standard deviation, maximum, minimum.

SAMPLE SIZE: 1, 100, 1000, 10,000, 100,000

MINIMUM TIME BETWEEN MEASUREMENTS: 330 μs (165 μs in the Fast Binary mode).

RESOLUTION: $\frac{\pm 20 \text{ ps}}{\sqrt{\text{sample size}}}$ ±2 ps

Displayed resolution also depends on trigger error.

ACCURACY: Jitter ±700 ps systematic ± time base† ± trigger error/$\sqrt{N}$

JITTER: 35 ps rms typical 100 ps rms maximum. The effect of jitter on the mean of a time interval measurement reduces as the $\sqrt{N}$ increases where N is the number of times averaged.

TRIGGER ERROR:

$$\frac{\sqrt{(150\ \mu V)^2 + e_n^2}}{\text{Input voltage slew rate at trigger points (V/s)}} \text{ sec rms}$$

where 150 μV is the typical input amplifier noise on the 5370A and e_n is the rms noise of the input signal for a 500 MHz bandwidth.

Trigger error due to input signal noise is usually the limiting factor in high resolution frequency measurements at low frequencies. If peak noise amplitude is greater than 10 mV, additional miscounting may occur. (This situation can arise when measuring high-level outputs of broadband synthesized signal sources.)

GENERAL

EXTERNAL GATE

Input Impedance: 1 MΩ || 10 pF nominal.

Slope: Selectable + or -

Level: Continuously adjustable -2V to +2V, preset ØV.

Sensitivity: 100 mV rms

Minimum Pulse Width: 20 ns

External Gate Range: 20 ns to 10 s/sample size

TRIGGER OUTPUTS (rear panel)

Start: Edge going from Ø to -0.7V nominal into 50Ω in sync with the opening of the start channel.

Stop: Ø to 0.7V edge into 50Ω in sync with the closing of the stop channel.

†For time intervals greater than 10 ms the High Stability Time Base Option 001 is recommended.

Table 1-1. HP Model 5370A Specifications (Continued)

FREQUENCY STANDARD INPUT (rear panel)
5 or 10 MHz >1.0V p-p into 1 KΩ. Maximum Input 10V.

FREQUENCY STANDARD OUTPUT (rear panel)
10 MHz
1V p-p into 50Ω in sync with time base chosen (INT or EXT)

DISPLAY: 16 digits + sign, suppressed leading zeros.

DISPLAY RATE: 10 ms to 5 s or hold.

OPERATING TEMPERATURE: 0° to 50°C.

POWER REQUIREMENTS: 100, 120, 220, or 240V ac +5% -10%, 48 to 66 Hz, less than 220 VA.

DIMENSIONS: 425 mm (16¾") wide, 133 mm (5¼") high, 457 mm (18") deep

WEIGHT: 14.55 kg (32 lbs.).

TIME BASE: Crystal Frequency 10 MHz.

STABILITY:
Aging Rate: $<3 \times 10^{-7}$ per month
Short Term: $<2 \times 10^{-9}$ rms for 1 s average
Temperature: $<2 \times 10^{-6}$ 25°C to 35°C
$<5 \times 10^{-6}$ 0°C to 55°C
Line Voltage: $<1 \times 10^{-8}$, ±10% from nominal.

OPTION 001: HIGH STABILITY TIME BASE (HP MODEL 10544A)

Crystal Frequency: 10 MHz

Stability:
Aging Rate: $<5 \times 10^{-10}$* per day
Short Term: $<1 \times 10^{-11}$ for 1 s average
Temperature: $<7 \times 10^{-9}$ 0°C to 50°C
Line Voltage: $<1 \times 10^{-10}$**, ±10% from nominal.

*For oscillator off time less than 24 hours.
**15 minutes after change.

1-12. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to the manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-13. For information concerning a serial number prefix not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-14. HP-IB INTERFACING, AND PROGRAMMING INFORMATION

1-15. Section II of this manual contains instructions for interfacing the Model 5370A with the HP-IB. A brief description of the sequence of events comprising the transfer of data by the HP-IB is provided in Section III, followed by programming information. Information concerning the design criteria of the bus is available in IEEE Standard 488-1975, titled *"IEEE Standard Digital Interface for Programmable Instrumentation"*.

1-16. SAFETY CONSIDERATIONS

1-17. This product is a Safety Class I instrument (provided with a protective earth terminal). Safety information pertinent to the operation and servicing of this instrument is included in appropriate sections of this manual.

1-18. DESCRIPTION

1-19. The Hewlett-Packard Model 5370A Universal Time Interval (T.I.) Counter is capable of making single-shot T.I. measurements with ±20 ps resolution. It uses a phase-locked vernier interpolating technique in which the interpolating oscillators are locked to the time base, thus retaining its basic accuracy at all times. The technique also allows positive, zero, and negative time interval measurements, and a resident microprocessor extends the usefulness of the instrument by offering statistical data such as mean, standard deviation, max, min, etc., for repetitive time intervals.

1-20. Other features include pushbutton user-defined time interval reference for systematic error cancellation; "hysteresis" in arming circuitry eliminates possible random fluctuations between + and - measurements in repetitive time intervals. In addition to time interval, high resolution frequency and period measurements can be made with gates from one period to 1 second. Both time and event information are provided for interrogating complex waveforms.

1-21. The HP 5370A has a sensitive high-speed input amplifier with digital trigger level set, and option for precision crystal oscillator for accurate long T.I. measurements.

1-22. OPTIONS

1-23. The following is a list of equipment and accessory options available with the 5370A. Refer to paragraph 2-21 for field installation of Option 001.

Option	Description
001	High Stability Crystal Oven (10544A)
907	Front Handle Assembly
908	Rack Mount Flange Kit
909	Rack Mount Flange Kit/Front Handle Assembly

1-24. For more information concerning these options, contact your local Hewlett-Packard Sales and Service Office. A list of HP Sales and Service offices is provided at the end of this manual.

1-25. ACCESSORIES SUPPLIED

1-26. The only accessory supplied with the HP Model 5370A is a power cord (HP Part Number 8120-1378) as shown in *Figure 1-1*.

1-27. EQUIPMENT AVAILABLE

1-28. A service accessory kit for the HP Model 5370A is available for convenience of trouble-shooting and repairing the instrument. The service accessory kit contains extender boards and a service aid board. The accessory kit may be obtained from Hewlett-Packard by ordering Service Accessory Kit Part Number 10870A.

1-29. RECOMMENDED TEST EQUIPMENT

1-30. Equipment required to maintain the HP Model 5370A is listed in *Table 1-2*. Other equipment can be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-2. Recommended Test Equipment

Equipment	Required Characteristics	Used For			Recommended HP Model
		Perf. Tests	Adjust.	Trouble-shooting	
Service Kit Consists of:			X	X	10870A
Service Board	No Substitute			X	05370-60014
Extender Board	30 Pin X2			X	5060-0049
Extender Board	22 Pin X2			X	5060-0630
Extender Board	For A22 Arming (No Substitute)			X	05370-60074
Extender Board	For A7 Oscillator Power Supply (6 Pin X2)			X	05370-60076
Extender Board	For Digital Section (A9 through A17)			X	05370-60075
Extender Board	For 5359A Use			X	05359-60078
Extender Board	For Analog Section (A18 through A21)			X	05370-60077
Time Synthesizer	<20 ns Rise Time	X			5359A
Pulse Generator	<5 ns Rise Time		X		8082A
Function Generator	0.1 Hz to 1 MHz	X			3312A
Signal Generator	100 MHz Signal		X		8640B
Frequency Synthesizer	100 MHz Signal	X			8660C
Oscilloscope	200 MHz		X		1725A
Sampling Oscilloscope	1 GHz Bandwidth		X		182C
Sampling Plug-In			X		1810A
Oscilloscope	100 MHz Bandwidth with 50Ω Input			X	180A/1801A/ 1821A
Oscilloscope	100 MHz	X			1740A
Spectrum Analyzer	200 MHz Center Frequency with >100 MHz Bandwidth		X		141T/8552A/ 8554L
Active Probe			X	X	1120A
Probe P.S.			X	X	1122A
Signature Analyzer	No Substitute			X	5004A
DMM	3½ Digit with 0.1% Accuracy		X	X	3435A
Controller	No Substitute	X		X	9825A
Logic Probe				X	545A
Pulser				X	546A
Current Tracer				X	547A
Cables (7)	4' BNC 50Ω Cables (2 matched length within ½")	X	X X	X	11170C
Tuning Wand	Ceramic		X		8730-0013
Tuning Wand	Long Plastic		X		8730-0011

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section provides all information necessary to install the HP 5370A. Covered in this section are initial inspection, power requirements, line voltage selection, interconnection, circuit options, mounting, storage, and repackaging for shipment.

2-3. INITIAL INSPECTION

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the shipment has been checked mechanically and electrically. The contents of the shipment should be as shown in *Figure 1-1*. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard office. Procedures for checking electrical performance are given in Section IV. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping material for the carrier's inspection.

2-5. PREPARATION FOR USE

2-6. Power Requirements

2-7. The HP 5370A requires a power source of 100, 120, 220, or 240V ac, +5%, -10%, 48 to 66 Hz single phase. Power consumption is approximately 200 watts nominal.

WARNING

IF THIS INSTRUMENT IS TO BE ENERGIZED VIA AN AUTOTRANSFORMER FOR VOLTAGE REDUCTION, MAKE SURE THE COMMON TERMINAL IS CONNECTED TO THE EARTHED POLE OF THE POWER SOURCE.

2-8. Line Voltage Selection

CAUTION

BEFORE SWITCHING ON THIS INSTRUMENT, make sure the instrument is set to the voltage of the power source.

2-9. *Figure 2-1* provides instructions for the line voltage and fuse selection. The line voltage selection card and the proper fuse are factory installed for 120V ac operation.

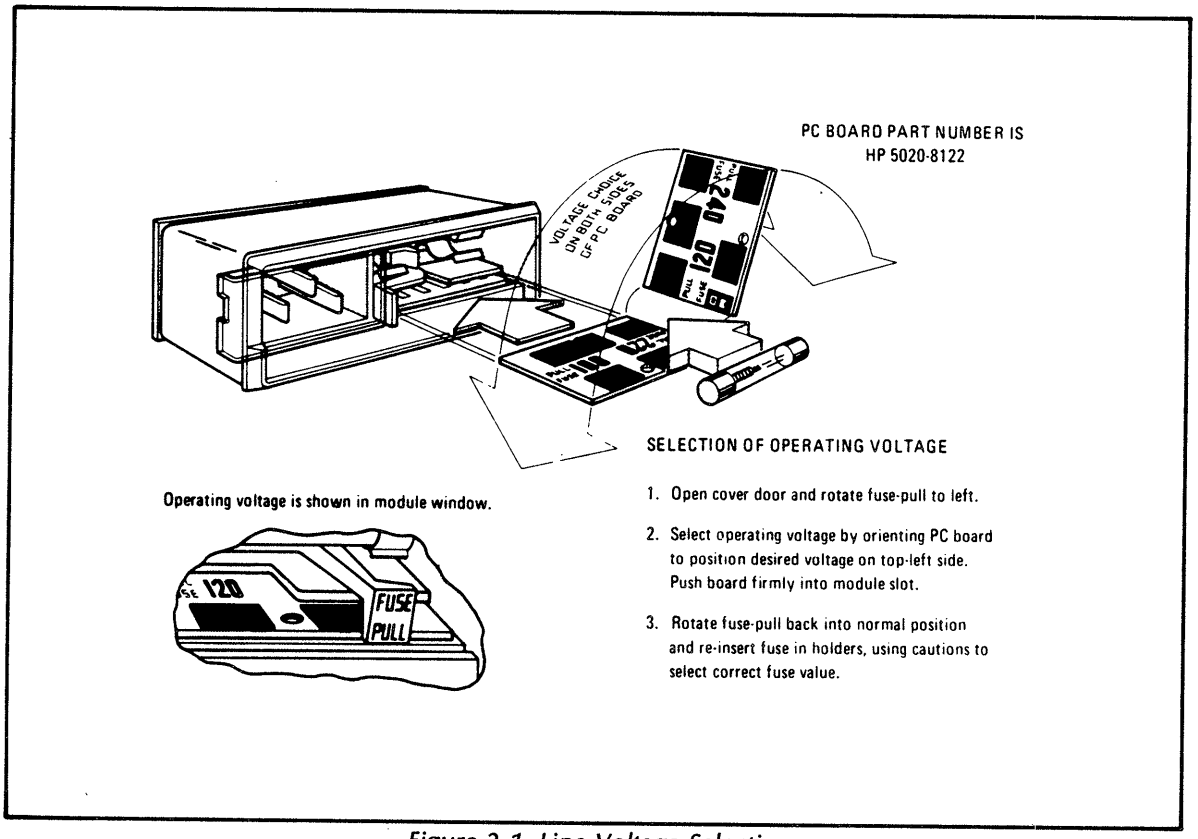


Figure 2-1. Line Voltage Selection

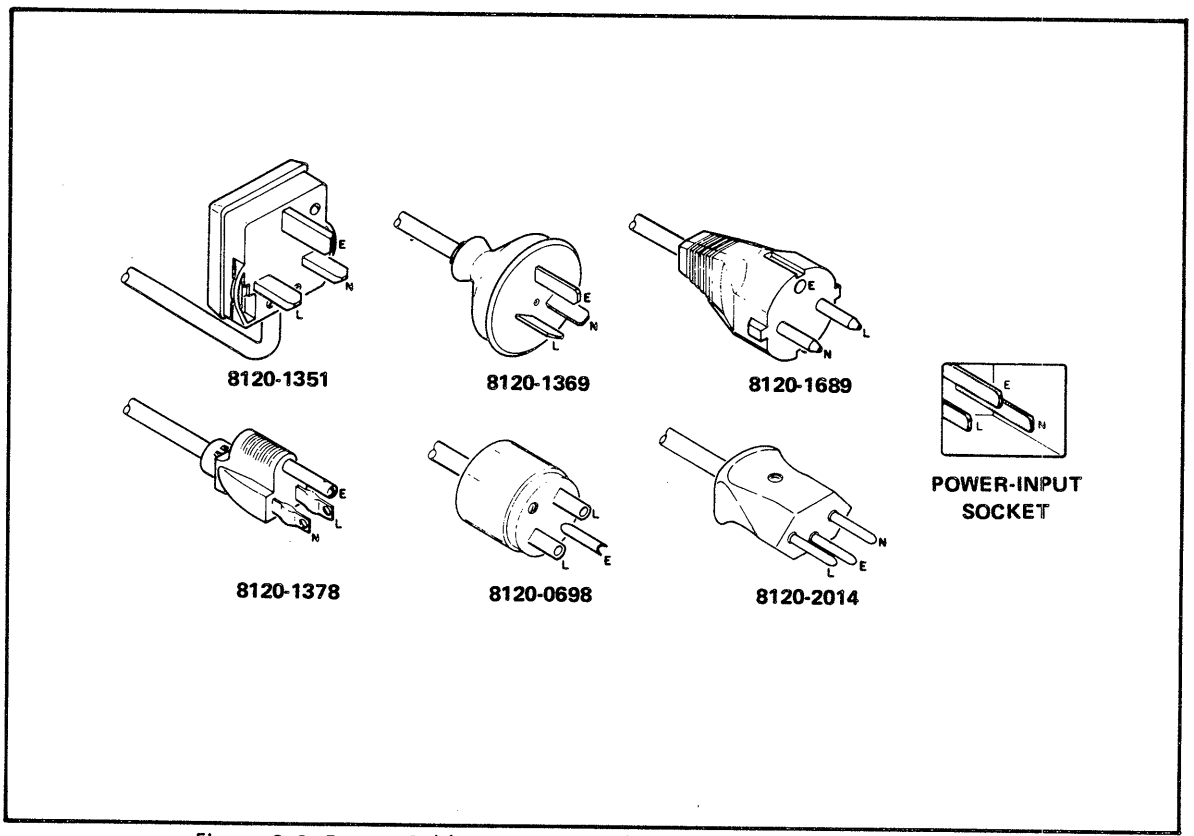


Figure 2-2. Power Cable HP Part Numbers versus Mains Plugs Available

2-10. Power Cable

WARNING

BEFORE SWITCHING ON THIS INSTRUMENT, THE PROTECTIVE EARTH TERMINALS OF THIS INSTRUMENT MUST BE CONNECTED TO THE PROTECTIVE CONDUCTOR OF THE (MAINS) POWER CORD. THE MAINS PLUG SHALL ONLY BE INSERTED IN A SOCKET OUTLET PROVIDED WITH A PROTECTIVE EARTH CONTACT. THE PROTECTIVE ACTION MUST NOT BE NEGATED BY THE USE OF AN EXTENSION CORD (POWER CABLE) WITHOUT A PROTECTIVE CONDUCTOR (GROUNDING).

2-11. The 5370A is shipped with a three-wire power cable. When the cable is connected to an appropriate ac power source, this cable connects the chassis to earth ground. The type of power cable plug shipped with each instrument depends on the country of destination. Refer to *Figure 2-2* for the part numbers of the power cable and plug configurations available.

2-12. Interconnections

2-13. HEWLETT-PACKARD INTERFACE BUS. Interconnection data concerning the rear panel HP-IB connector is provided in *Figure 2-3*. This connector is compatible with the HP 10631A/B/C/D HP-IB Cables. With the HP-IB system, you can interconnect up to 15 (including the controller) HP-IB compatible instruments. The HP-IB cables have identical "piggyback" connectors on both ends so several cables can be connected to a single source without special adapters or switch boxes. You can interconnect system components and devices in virtually any configuration you desire. There must, of course, be a path from the calculator (or other controller) to every device operating on the bus. As a practical matter, avoid stacking more than three or four cables on any one connector. If the stack gets too large, the force on the stack produces leverage which can damage the connector mounting. Be sure each connector is firmly screwed in place to keep it from working loose during use.

2-14. CABLE LENGTH RESTRICTIONS. To achieve design performance with the HP-IB, proper voltage levels and timing relationships must be maintained. If the system cable is too long, the lines cannot be driven properly and the system will fail to perform properly. Therefore, when interconnecting an HP-IB system, it is important to observe the following rules:

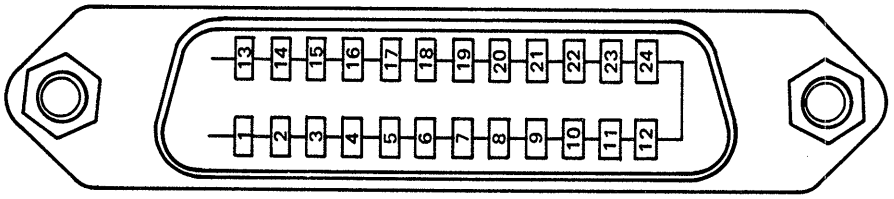
a. The total cable length for the system must be less than or equal to 20 metres (65 feet).

b. The total cable length for the system must be equal to or less than 2 metres (6.6 feet) times the total number of devices connected to the bus.

c. The total number of instruments connected to the bus must not exceed 15.

2-15. 5370A Listen Address

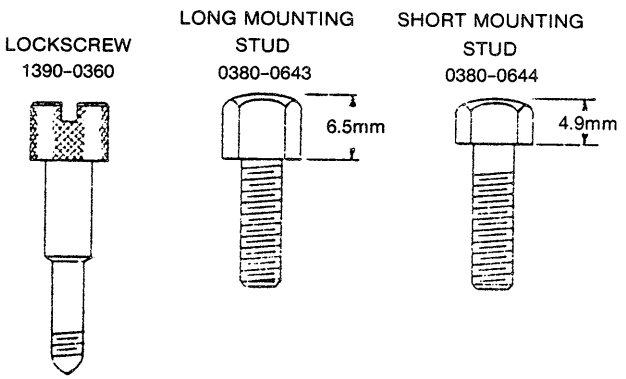
2-16. The 5370A contains a rear panel HP-IB Instrument ADDRESS SELECTION switch. There are five switches designated (5, 4, 3, 2, 1) which are used to select the address. Instructions for setting and changing the listen address are provided in Section III of this manual along with 5370A programming codes.



PIN	LINE	
1	DIO1	
2	DIO2	
3	DIO3	
4	DIO4	
13	DIO5	
14	DIO6	
15	DIO7	
16	DIO8	
5	EOI	
17	REN	
6	DAV	
7	NRFD	
8	NDAC	
9	IFC	
10	SRQ	
11	ATN	
12	SHIELD-CHASSIS GROUND	
18	P/O TWISTED PAIR WITH PIN 6	THESE PINS ARE INTERNALLY GROUNDED
19	P/O TWISTED PAIR WITH PIN 7	
20	P/O TWISTED PAIR WITH PIN 8	
21	P/O TWISTED PAIR WITH PIN 9	
22	P/O TWISTED PAIR WITH PIN 10	
23	P/O TWISTED PAIR WITH PIN 11	
24	ISOLATED DIGITAL GROUND	

CAUTION

The 5370A contains metric threaded HP-IB cable mounting studs as opposed to English threads. Metric threaded HP 10631A, B, C, or D HP-IB cable lockscrews must be used to secure the cable to the instrument. Identification of the two types of mounting studs and lockscrews is made by their color. English threaded fasteners are colored silver and metric threaded fasteners are colored black. DO NOT mate silver and black fasteners to each other or the threads of either or both will be destroyed. Metric threaded HP-IB cable hardware illustrations and part numbers follow.



Logic Levels

The Hewlett-Packard Interface Bus logic levels are TTL compatible, i.e., the true (1) state is 0.0V dc to 0.4V dc and the false (0) state is +2.5V dc to +5.0V dc.

Programming and Output Data Format

Refer to Section III, Operation

Mating Connector

HP 1251-0293; Amphenol 57-30240.

Mating Cables Available

HP 10631A, 1 metre (3.3 ft.), HP 10631B, 2 metres (6.6 ft.),
HP 10631C, 4 metres (13.2 ft.), HP 10631D, 1/2 metre (1.6 ft.).

Cabling Restrictions

1. A Hewlett-Packard Interface Bus System may contain no more than 2 metres (6.6 ft.) of connecting cable per instrument.
2. The maximum accumulative length of connecting cable for any Hewlett-Packard Interface Bus System is 20.0 metres (65.6 ft.).

Figure 2-3. Hewlett-Packard Interface Bus Connection

2-17. HP-IB Description

2-18. A description of the HP-IB is provided in Section III of this manual. A study of this information is necessary if you are not familiar with the HP-IB concept. Additional information concerning the design criteria and operation of the bus is available in IEEE Standard 488-1975, titled *"IEEE Standard Digital Interface for Programmable Instrumentation"*.

2-19. Bench Operation

2-20. The instrument has plastic feet and a foldaway tilt stand for convenience in bench operation. The tilt stand raises the front of the instrument for easier viewing of the control panel. The plastic feet are shaped to make full width modular instruments self-aligning when stacked.

2-21. INSTALLATION OF OPTION 001

2-22. Refer to *Table 2-1* for instructions on installing Option 001. Field installation of Option 001 should be performed by qualified service personnel only.

Table 2-1. Option 001 Installation Instructions

NOTE

Installation of Option 001 should be performed by qualified service personnel only.

Option 001 consists of the following parts:

HP Part Number	Qty.	Description
10544-60011	1	10544A Crystal Oscillator (Oven)
05370-60007	1	Power Supply Assembly for 10544A
2360-0115	2	6-32 × 3/8" Machine Screw

1. Remove the ac power cord from the 5370A.
2. Remove both the top and bottom covers.
3. Install the 05370-60007 Power Supply Assembly into the A7 Motherboard connector (connector next to the 05370-60008 assembly).
4. Remove the standard A69 Oscillator assembly.
5. Install the 10544A into the A69 Motherboard connector.
6. Turn the 5370A on its side and from the bottom of the 5370A, install the two 6-32 Machine screws, through the holes in the motherboard, into the 10544A. These screws prevent the 10544A from dislodging from the motherboard connector.

Installation of Option 001 is now complete. Immediately refer to *Table 5-8* for Oscillator adjustment.

2-23. OPERATING ENVIRONMENT

2-24. Operating and Storage Temperature

2-25. In order for the 5370A to meet the specifications listed in *Table 1-1*, the operating environment must be within the following limits:

Temperature	0° to +50°C
Humidity	<80% relative
Altitude	<15,000 feet

2-26. Cooling System

2-27. A forced air cooling system is used to maintain the operating temperature required by the instrument. The cooling fan is located on the left-side of the rear panel (while looking at the rear panel). When operating the 5370A, choose a location that provides at least 8 cm (3 inches) of clearance at the rear and at least 2 cm (1 inch) for each side. Failure to provide adequate air clearance will result in excessive temperature reducing instrument reliability. The clearances provided by the plastic feet in bench stacking and the filler strip in rack mounting allow air passage across the top and bottom cabinet surfaces.

2-28. STORAGE AND SHIPMENT

2-29. Environment

2-30. The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment:

Temperature	-40°C to +75°C
Humidity	<95% relative
Altitude	<50,000 feet

2-31. Packaging

2-32. ORIGINAL PACKAGING. Containers and materials equivalent to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-33. OTHER PACKAGING. The following general instructions should be used for repackaging with commercially available materials.

a. Wrap the instrument in heavy paper or plastic. (If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.)

b. Use a strong shipping container. A doublewall carton made of 250 pound test material is adequate.

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

d. Seal the shipping container securely.

e. Mark the shipping container FRAGILE to assure careful handling.

SECTION III
OPERATING AND PROGRAMMING

3-1. INTRODUCTION

3-2. This section provides complete operating and programming information needed for the HP Model 5370A Universal Time Interval Counter. This section includes a description of all front and rear panel controls, connectors and indicators, operator's check, operating instructions both manually and remotely, and operator's maintenance.

3-3. OPERATING CHARACTERISTICS

3-4. The following paragraphs describe the operating ranges, resolution, and accuracy for Frequency, Period, and Time Interval modes.

3-5. Frequency Mode

3-6. All frequency measurements are made through the STOP channel input. The frequency range is 0.1 Hz to 100 MHz with a minimum input level of 100 mV p-p, or 35 mV rms sine wave times attenuator setting. The 5370A has 12 digits resolution with a 1-second measurement time. The accuracy is described using the following formula:

$$\text{Accuracy} = \frac{100 \text{ ps rms} \pm \text{trigger error}}{\text{gate time}} \pm \text{time base}$$

3-7. Period Mode

3-8. The 5370A makes period measurements from 10 nanoseconds to 10 seconds with a minimum input signal level of 100 mV p-p, or 35 mV rms sine wave times the attenuator setting. All period measurements are made through the STOP channel input jack. The 5370A gives 12 digits resolution using a 1-second measurement (gate time). The resolution is described using the following formula:

$$\text{Resolution} = \frac{20 \text{ ps}}{\text{gate time}} \quad .$$

The accuracy is the same as for the frequency measurements as described in paragraph 3-6.

3-9. Time Interval Mode

3-10. The 5370A measures time intervals from 10 nanoseconds to 10 seconds in +T.I. ONLY, and -10 seconds to +10 seconds in ±T.I. The minimum input level for a two source T.I. measurement is 100 mV p-p times the attenuator setting. For a one source measurement, the input signal must be input to the START channel input jack, the SEP/COM switch in COM, both attenuators must be set to the same impedance, and the minimum input level is double that for two source measurments. That is 200 mV p-p times the attenuator setting. The resolution is given using the following formula:

$$\text{Resolution} = \frac{\pm 20 \text{ ps}}{\sqrt{\text{sample size}}} \quad \pm 2 \text{ ps}$$

The accuracy is described using the following formula: Accuracy = jitter ±1 ns systematic ± time base $\frac{\pm\text{trigger error}}{\sqrt{N}}$ where jitter equals 35 ps typical, trigger error equals $\frac{\pm 2 \times \text{noise peak voltage}}{\text{Signal Slope V}/\mu\text{s}}$ microseconds and N equals sample size.

3-11. PANEL FEATURES

3-12. Front and rear panel features of the HP Model 5370A are described in *Figure 3-1* and *Figure 3-2*, respectively. These figures contain a description of the controls and connectors. Front panel indicators are described in *Figure 3-3*. Description numbers match the numbers on the illustrations.

3-13. OPERATOR'S CHECKS

3-14. A procedure for verifying the major functions of the HP Model 5370A is provided in *Figure 3-4*. The only accessory needed for the verification procedure is a 4-foot length coaxial BNC cable HP Part Number 10503A or equivalent and a 5 kHz oscilloscope.

3-15. OPERATING INSTRUCTIONS

WARNING

BEFORE THE INSTRUMENT IS SWITCHED ON, ALL PROTECTIVE EARTH TERMINALS, EXTENSION CORDS, AUTOTRANSFORMERS, AND DEVICES CONNECTED TO THE INSTRUMENT SHOULD BE CONNECTED TO A PROTECTIVE EARTH GROUNDED SOCKET. ANY INTERRUPTION OF THE PROTECTIVE EARTH GROUNDING WILL CAUSE A POTENTIAL SHOCK HAZARD THAT COULD RESULT IN PERSONAL INJURY.

WARNING

ONLY FUSES WITH THE REQUIRED RATED CURRENT AND SPECIFIED TYPE SHOULD BE USED. DO NOT USE REPAIRED FUSES OR SHORT CIRCUITED FUSE-HOLDERS. TO DO SO COULD CAUSE A SHOCK OR FIRE HAZARD.

CAUTION

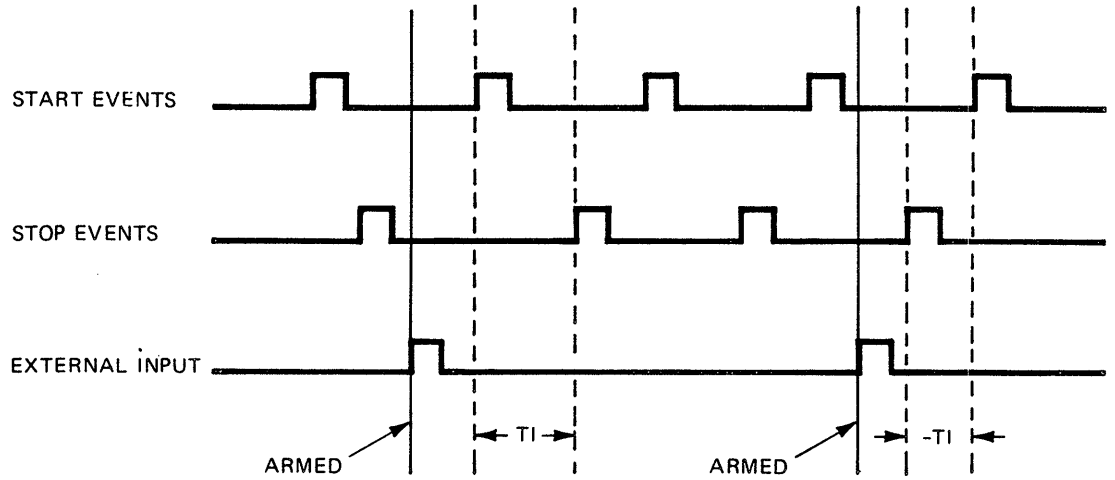
BEFORE THE INSTRUMENT IS TURNED ON, it must be set to the voltage of the power source, or damage to the instrument could result.

3-16. *Figures 3-5, 3-6, 3-7,* and *3-8* show general operating procedures with the HP Model 5370A Universal Time Interval Counter connected in a typical measurement test setup. Many other applications are possible but not shown because the general operating procedure is the same. Description numbers match the group containing the particular designated switch.

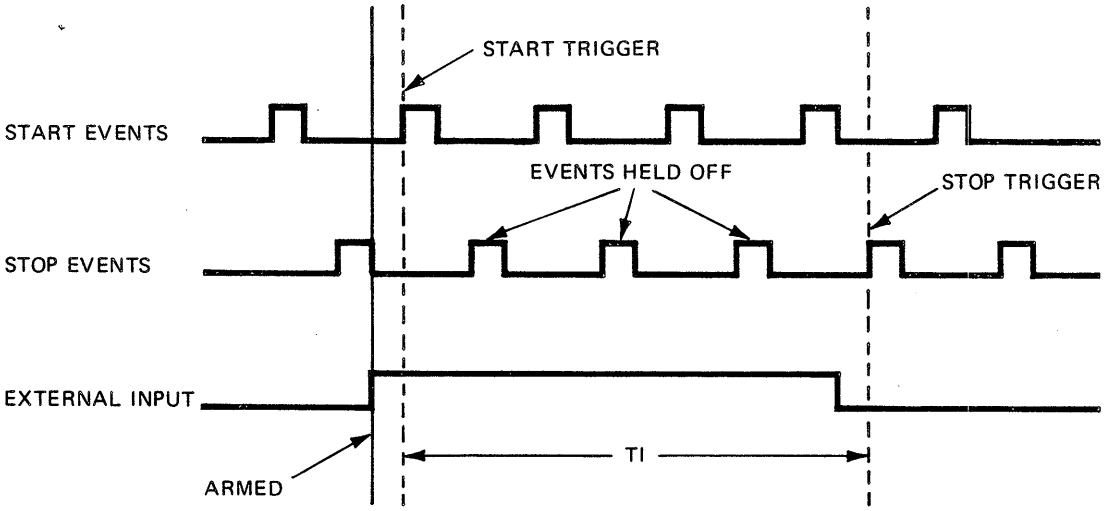
3-17. External Arming/External Holdoff

3-18. The EXTERNAL Input jack (front panel) allows the 5370A to be externally armed and held off. The input works in conjunction with the EXT HOLDOFF, EXT ARM, and MAN INPUT switches. The specifications for the input signal are in *Table 1-1*.

3-19. EXTERNAL ARMING. To operate the counter in the EXTERNAL ARM mode, press the EXT ARM switch on the front panel. The selected trigger edge at the external input then arms the counter. The next START or STOP input pulse begins the measurement as illustrated in the diagram.



3-20. EXTERNAL ARM/EXTERNAL HOLDOFF. To operate the counter in the EXTERNAL HOLDOFF mode, press the EXT HOLDOFF switch on the front panel. The selected trigger edge at the external input then arms the counter. The next START input pulse begins the measurement. The STOP pulses are held off as long as the external input holdoff is present as illustrated in the diagram.

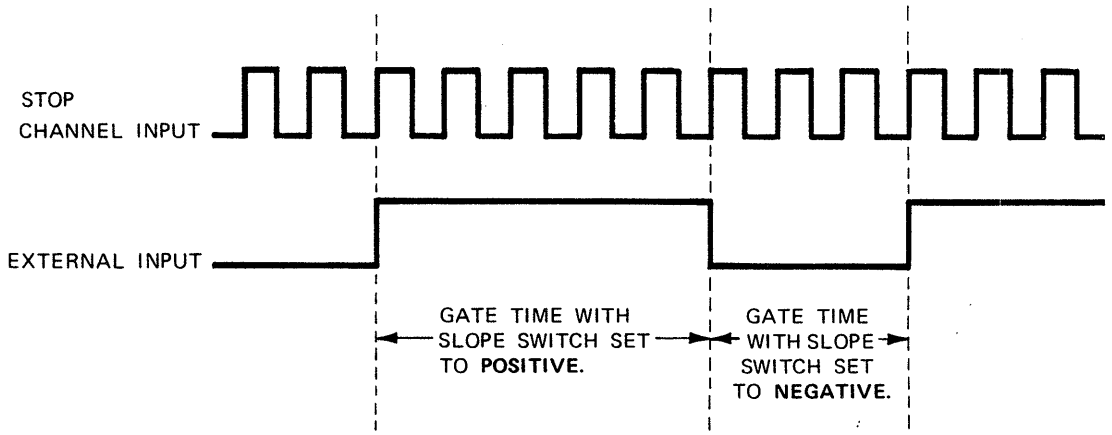


The number of events held off are counted and stored by the 5370A and can be displayed by pressing the DSP EVTS switch on the front panel.

3-21. EXTERNAL GATE. The 5370A may be operated in the External Gate mode for Frequency and Period measurements. To do this, press the EXT HOLDOFF switch on the front panel. The selected trigger edge at the external input then opens the main gate. The next edge then closes the gate. The diagram on page 3-4 illustrates the gate times for external gates with the 5370A front panel SLOPE switch set to *positive* and *negative*, respectively.

NOTE

Regardless of the length of the external gate, the 5370A displays 12 digits.



3-22. Error Messages

3-23. Under certain conditions, the 5370A will display an Error message (number). There are eight messages in all as listed below. Errors 6.n and 7.n pertain to power-up only. The remaining messages occur under certain operating conditions. In remote operation, the error message remains in the Status Byte until the initiation of the next measurement.

ERROR	MESSAGE
Error Ø	A measurement has been completed and the 5370A has not yet been addressed.
Error 1	Indicates an illegal remote command or an undefined function (HP-IB) sent to 5370A.
Error 2	Data out of range (overrange).
Error 3	Illegal key combination (local or HP-IB).
Error 4	Phase-locked-loop out of lock.
Error 5	Undefined key (hardware problem).
Error 6.n	RAM error — processor writes into RAM (checker board pattern) and verifies error in RAM n.
Error 7.n	ROM error — processor computes check sum; error in ROM n.

3-24. OPERATOR'S MAINTENANCE

3-25. The only maintenance the operator should normally perform is replacement of the primary power fuse located within the Line Module Assembly. For instructions on how to change the fuse, refer to Section II, Line Voltage Selection.

CAUTION

Make sure that only fuses with the required rated current and of the slow-blow type are used for replacement. The use of repaired fuses and the short-circuiting of fuse-holders must be avoided.

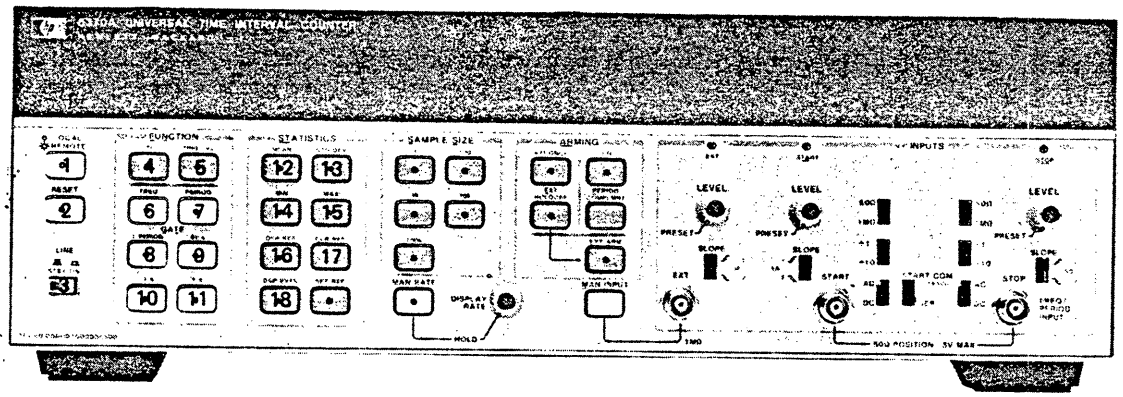
3-26. Power/Warm-Up

3-27. The HP Model 5370A requires a power source of 100, 120, 220, or 240V ac, +5%, -10%, 48 to 66 Hz single phase. The selection of line voltage and input power fuse is described in Section II, paragraph 2-5, Preparation for Use.

3-28. The 5370A has a two-position power switch, STBY and ON. For 5370A Option 001 only, it is important that the instrument remain connected to the power source in the STBY mode when not in use. This supplies power to the crystal oven maintaining a constant oven temperature thus eliminating the need for a warm-up period. When the STBY mode is not used and power is disconnected from the instrument, allow 30 minutes from the application of external power in the ON mode for the instrument (crystal oven) to warm-up.

WARNING

POWER IS ALWAYS PRESENT AT THE LINE SWITCH AND TRANSFORMER, AND UNREGULATED DC IS PRESENT WHENEVER THE LINE CORD IS ATTACHED. UNPLUGGING THE POWER CORD IS NECESSARY TO REMOVE ALL POWER FROM THE INSTRUMENT.



1 LOCAL REMOTE — Returns control from HP-IB to front panel.

2 RESET — Aborts current sample, performs lamp test, clears display, prepares machine to accept new samples and disarms instrument if manually armed. It does not destroy REFERENCE, EVENTS HOLDOFF, or the machine configuration.

3 STBY ON — Supplies power to entire machine in the ON position. Supplies power only to the oscillator oven (Option 001 only) in the STBY (standby) position.

4 T.I. — Time Interval function measures time differences from START channel to STOP channel.

5 TRIG LVL — Measures the voltage of the trigger levels of the START and STOP input channels and simultaneously displays them continuously.

6 FREQ — Measures frequency of the STOP channel signal by taking the reciprocal of a period average. START channel is ignored.

7 PERIOD — Measures a period average of STOP channel input events. START channel is ignored. Input amplifier control switch must be set to SEP.

8 1 PERIOD — Measures one period of the input signal of the STOP channel and displays it as either frequency or period depending on the chosen function. 1 PERIOD is disabled when machine is in Time Interval function.

NOTE

Gate Times 9, 10, and 11 are for frequency and period measurements only.

9 0.01 s — Gate time of 0.01 second is enabled.

10 0.1 s — Gate time of 0.1 second is enabled.

11 1 s — Gate time of 1 second is enabled.

12 MEAN — Causes counter to measure and display the mean estimate which is the sample average from N time interval measurements minus a constant REFERENCE value.

13 STD DEV — Displays the standard deviation estimate for the selected sample size.

14 MIN — Displays the minimum time interval within the sample minus the REFERENCE.

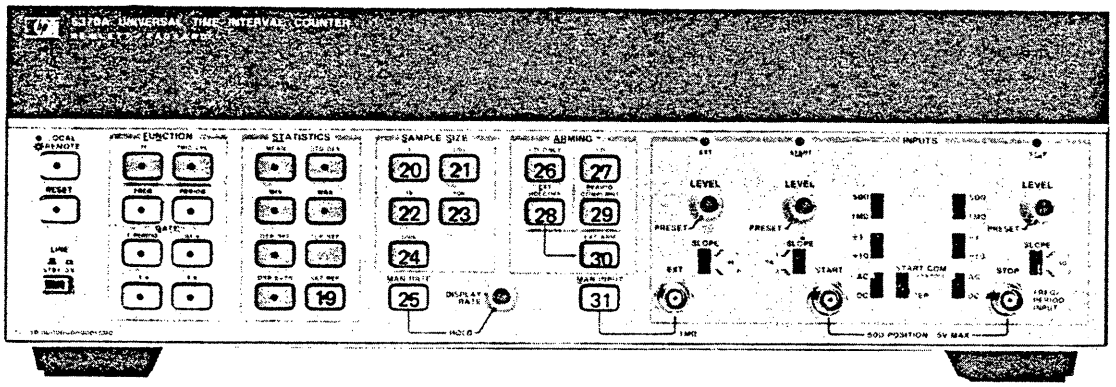
15 MAX — Displays the maximum time interval within the sample minus the REFERENCE.

16 DSP REF — Displays the current value of REFERENCE stored. This value remains constant until changed by switch SET REF or by switch CLR REF. The power-up value of REFERENCE is zero.

17 CLR REF — Sets REFERENCE value to zero.

18 DSP EVTS — Displays the number of events input to the STOP channel which were held off during the sample measurement window. If HOLDOFF signal is not present, it displays the number of samples that have occurred per display cycle.

Figure 3-1. Front Panel Controls, Indicators, and Connectors



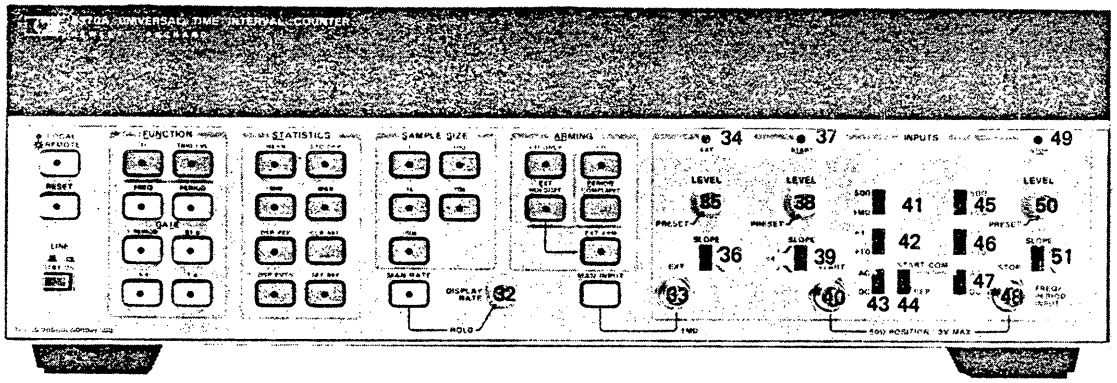
19	**SET REF**	Establishes a new REFERENCE value equal to the average time interval of the latest sample.
20	**1**	Instrument makes one measurement and displays result.
21	**100**	Instrument makes one hundred measurements and displays result.
22	**1K**	Instrument makes one thousand measurements and displays result.
23	**10K**	Instrument makes ten thousand measurements and displays result.
24	**100K**	Instrument makes one hundred thousand measurements and displays result.

NOTE

SAMPLE SIZE operates only with 1 PERIOD GATE. When gates other than 1 PERIOD are selected, SAMPLE SIZE is disabled. When a SAMPLE SIZE is selected, the 5370A automatically goes to 1 PERIOD mode.

25	**MAN RATE**	Initiates a new sample for measurement when DISPLAY RATE control is in HOLD position. Old measurement value remains on display until replaced by new value. Also see DISPLAY RATE 32.
26	**+T.I. ONLY**	In the +T.I. ONLY mode, all STOP channel events are ignored until the arrival of the START event. The counter is armed internally.
27	**±T.I.**	In the ±T.I. mode, START event occurring before STOP event will automatically be assigned as a positive time interval and vice versa as a negative time interval. First incoming signal (either START or STOP) arms the counter.
28	**EXT HOLDOFF**	Used in conjunction with EXT ARM mode switch; it enables the EXTERNAL HOLDOFF signal to inhibit STOP channel input signal.
29	**PERIOD COMPLMNT**	When the PERIOD COMPLMNT switch is activated repeatedly, the measurement will switch from +T.I. to -T.I. or vice versa in a toggle fashion. Period Complement is operational only in the ±T.I. mode. Once a mode is selected, the ±T.I. range holds and the reading will not flicker between the two results. This switch has no effect when the instrument is externally armed, or when the T.I. is less than 10 nanoseconds.
30	**EXT ARM**	In ±T.I. mode, the START and STOP channels are simultaneously armed after the arrival of the EXT input signal. As soon as the channels are armed, the time interval defined by the first event occurring in each channel is measured, regardless of the order of arrival. In +T.I. ONLY mode the START channel is armed after the arrival of the EXT input. Time Interval is defined by the first event in the START channel and the first event in the STOP channel arriving **after** the first event in the START channel.
31	**MAN INPUT**	EXT INPUT signals for EXT ARM and/or EXT HOLDOFF functions can be generated manually through the MAN INPUT switch.

Figure 3-1. Front Panel Controls, Indicators, and Connectors (Continued)



32 **DISPLAY RATE** Determines time between sample measurements. Rotating this control more counter-clockwise will add more time between measurements which in turn, displays previous measurements longer and gives a more stable display.

When the DISPLAY RATE control is in the HOLD position, a new measurement can be initiated in several ways:

1. Pressing MAN RATE (25)
2. Changing functions (4 through 7)
3. Changing gate times (8 through 11)
4. Changing sample size (20 through 24)
5. Changing arming mode (±T.I. to +T.I. or reverse)

33 **J1** Input BNC connector for the EXT HOLDOFF and/or EXT ARM signals with an input load impedance of 1 megohm. See *Table 1-1* for specifications.

34 **EXT** LED indicator which when blinking, indicates that the external signal is triggering.

35 **LEVEL** Trigger level control for the external input signal.

36 **1**
SE
2 This switch setting determines which slope of the external input signal will be used as the triggering slope.

37 49 LED indicators which when blinking, indicate that the START and/or STOP channel is triggering the machine.

38 50 LEVEL controls used in conjunction with attenuator switches 42, 46 to select voltage at which triggering occurs.

39 51 This switch setting determines which slope of the START and STOP channel input signals will be used as the triggering slope.

40 48 Input BNC connectors for the START and STOP channel signal inputs.

41 45 Input impedance switches used to select an input impedance of 50Ω or 1 MegΩ shunted by less than 30 pF.

42 46 Selects attenuation for input signal. Used in conjunction with LEVEL control to set trigger point. Input level is not affected in ÷1 position. Input signal amplitude is reduced by a factor of 10 in ÷10 position.

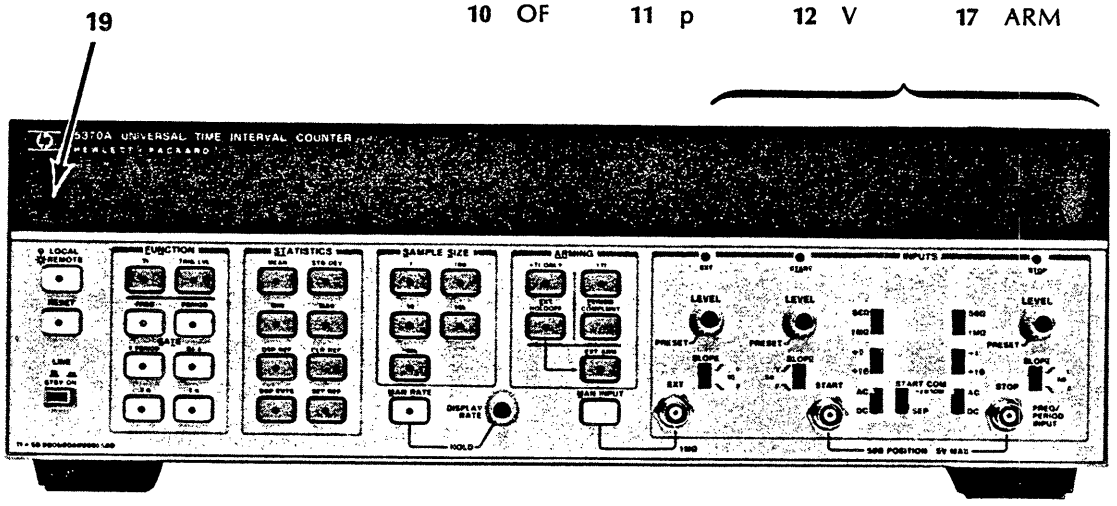
43 47 Coupling switches used to select direct or capacitor coupling for input signal.

44 Input Amplifier Control switch.

a. **START COM** — Operationally connects START and STOP channels in parallel. Used for single source time interval measurement. STOP channel jack is not active. START and STOP input impedance switches must be set to same position.

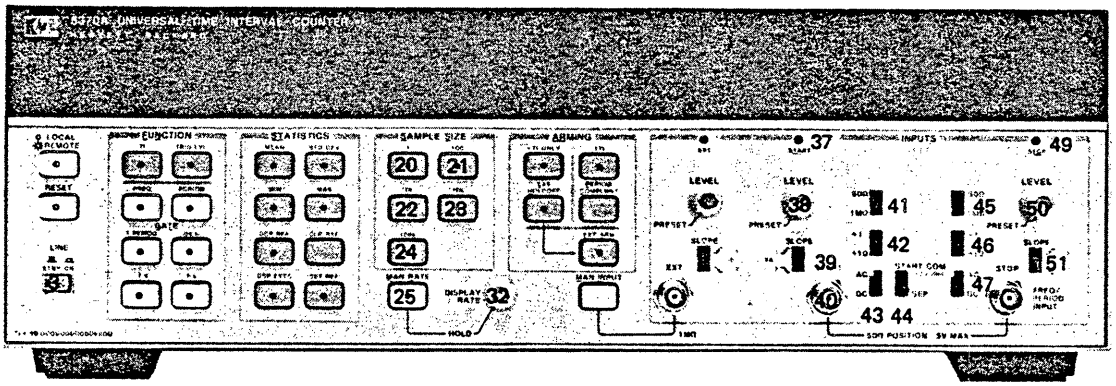
b. **SEP** — Allows independent operation of START and STOP channels.

Figure 3-1. Front Panel Controls, Indicators, and Connectors (Continued)



Number	Symbol	Description
1	*	ASTERISK — Indicates crystal oscillator oven (Option 001) is below operating temperature (cold), as is the case when the 5370A is first plugged into the line supply.
2	k	kilo (10^3)
3	EVT	Events
4	M	Mega (10^6)
5	m	milli (10^{-3})
6	Hz	Hertz
7	μ	Micro (10^{-6})
8	n	nano (10^{-9})
9	s	seconds
10	OF	Overflow
11	p	pico (10^{-12})
12	V	Volts
13	LSTN	Listen — Active when 5370A is programmed to listen.
14	TALK	Active when 5370A is programmed to talk.
15	START	Active when Time Interval measurement is armed by START channel signal input in the ±T.I. mode.
16	STOP	Active when Time Interval measurement is armed by STOP channel signal input in the ±T.I. mode.
17	ARM	Indicates 5370A is armed (ready to measure input signal). ARM light is actually flickering while measuring N samples but so fast as to appear to be continually on. ARM light may not appear lit for single samples of narrow events. Light stays on during measurement time.
18	EXT	Indicates machine is in the EXTernal ARM mode.
19		Oscillator clock loss indicator. Indicates loss of internal clock signal, possibly due to setting of rear panel FREQ STD switch. Once clock signal is returned, the 5370A power may need to be turned off and on again before internal circuits can operate properly.

Figure 3-3. Front Panel Indicators



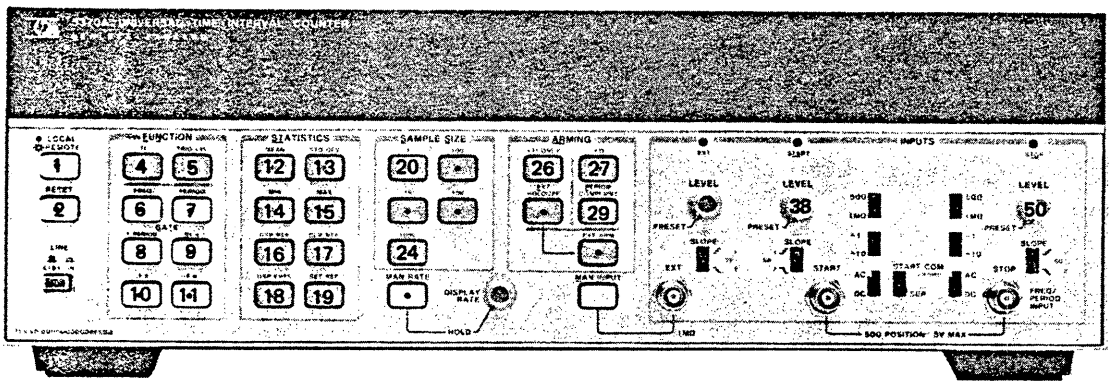
1. Before switching on the instrument, ensure that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and the safety precautions are taken. See Power Requirements, Line Voltage Selection, Power Cables, and associated warnings and cautions in Section II of this manual. Description numbers match the numbers in *Figure 3-1* and *Figure 3-2*.
2. Connect a 4-foot BNC cable, such as HP 10503A, from the rear panel FREQ STD OUTPUT jack to the front panel START input jack 40.
3. Set the rear panel Frequency Select switch to INT.
4. Set the input impedance switches 41 45 to the 50Ω position.
5. Set the attenuator switches 42 46 to the ÷1 position.
6. Set the AC, DC switches 43 47 to the DC position.
7. Set the input slope switches 39 51 to the 1 (positive going slope) position.
8. Set the LEVEL controls 38 50 to the preset position.
9. Set the COM, SEP switch 44 to the START COM position.
10. Adjust DISPLAY RATE 32 to maximum (full cw).
11. Press the LINE switch 3 to turn on the 5370A.

NOTE

When instrument is first turned on, the processor performs a self-check routine on the ROM's and RAM's. If, when power is first applied, or during operation, an error message is displayed, refer to paragraph 3-22 ERROR MESSAGES in this section for error explanation.

12. For the first second after the instrument is turned on, the display will remain blank. For the next second, all segments and decimal points and all annunciator lights (except START, STOP, and ARM) in the display will be lit as well as all LED's in all the front panel switches.
13. After this initial power-up reset, the 5370A will be in the T.I. FUNCTION, MEAN STATISTICS, SAMPLE SIZE 1, and +T.I. ONLY. The display should indicate 100.00 nanoseconds ±1.0 nanosecond with both the START and STOP channel trigger LED's 37 49 flashing. Also, because of the sample size of one, the ARM light will not be visible in the display.
14. Press SAMPLE SIZE 100 switch 21. The least significant digit (LSD) will be one-digit greater (1 picosecond), the ARM light will be visible and flashing and the LED in the MAN RATE switch 25 will be flashing at approximately the same rate as the ARM light. Press SAMPLE SIZE 1K switch 22 and display will have same LSD (1 picosecond) with ARM light and MAN RATE switch flashing about twice per second. Press SAMPLE SIZE 10K 23 and display LSD will be 100 femtoseconds with ARM light flashing about once every four seconds. Press SAMPLE SIZE 100K switch 24 and the ARM light will flash about once every 40 seconds. Press SAMPLE SIZE 1 20.

Figure 3-4. Operators Checks



15. Press STD DEV 13 and ±T.I. switch 27. Display should read less than 100 ps (this reading is the instrument's jitter). Notice that SAMPLE SIZE automatically goes to 100. For STD DEV measurements, SAMPLE SIZE must be ≥100. Press MIN switch 14 and minimum T.I. should be displayed. Press MAX switch 15 and the maximum T.I. should be displayed. Press +T.I. ONLY 26.

16. Press DSP REF switch 16 and three zeros should be displayed. Press SET REF switch 19 and approximately 100 nanoseconds should be displayed. This reference is the MEAN T.I. Press CLR REF switch 17 and six zeros should be displayed (if 99.99X ns is displayed, CLR REF will give five zeros), three zeros on either side of the decimal point. Press DSP EVTS switch 18 and 100 should be in the display. This number corresponds to the SAMPLE SIZE. Notice also EVT is displayed in the right hand side of the window.

17. Press MEAN switch 12 and SAMPLE SIZE 1 switch 20. Press ±T.I. switch 27 and the display should show less than 1 nanosecond. The STOP or START light in the display will also be on. Press PERIOD COMPLMNT switch 29 and the display should be the same except the alternate (STOP or START) light will be on in the display. Press the PERIOD COMPLMNT switch again and the first arming channel light should come back on. This switch operation is identical to a toggle switch.

18. Press TRIG LVL 5. There will be two groups displayed, three digits each, on the left and the right of the display. They indicate the DC trigger level voltage on the START and STOP channel inputs, respectively. Rotate the LEVEL controls 38 50 and note the voltage should change from approximately -1.3 to +0.5 volts. Turn both LEVEL controls fully counterclockwise until they click in the preset position. The display should show zero volts for both inputs.

19. Press FREQ switch 6. Press 0.01 s switch 9 and display should read approximately 10.000 000X MHz. Press 0.1 s switch 10 and display should read approximately 10.000 000 0X MHz. Press 1 s switch 11 and display should read appoximately 10.000 000 0XX MHz. Press 1 PERIOD switch 8.

20. Press PERIOD switch 7. Display should indicate approximately 100 nanoseconds.

21. Press Function switch T.I. 4, 100K SAMPLE SIZE 24, rotate DISPLAY RATE control maximum cw and check the *rear panel* START and STOP outputs 1 and 2 using an oscilloscope. Both signals should be ≥-0.7V (into 50Ω) and approximately 320 μs wide as shown below.

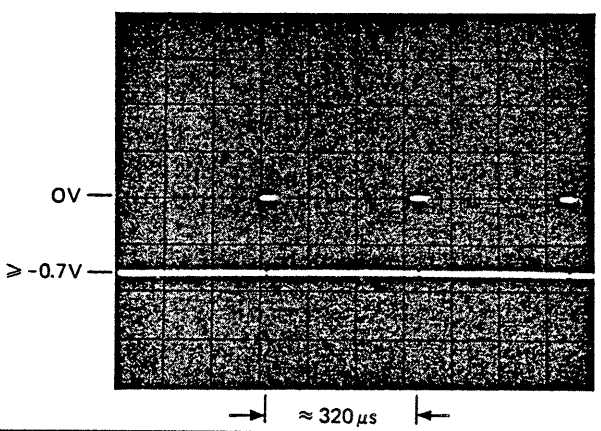
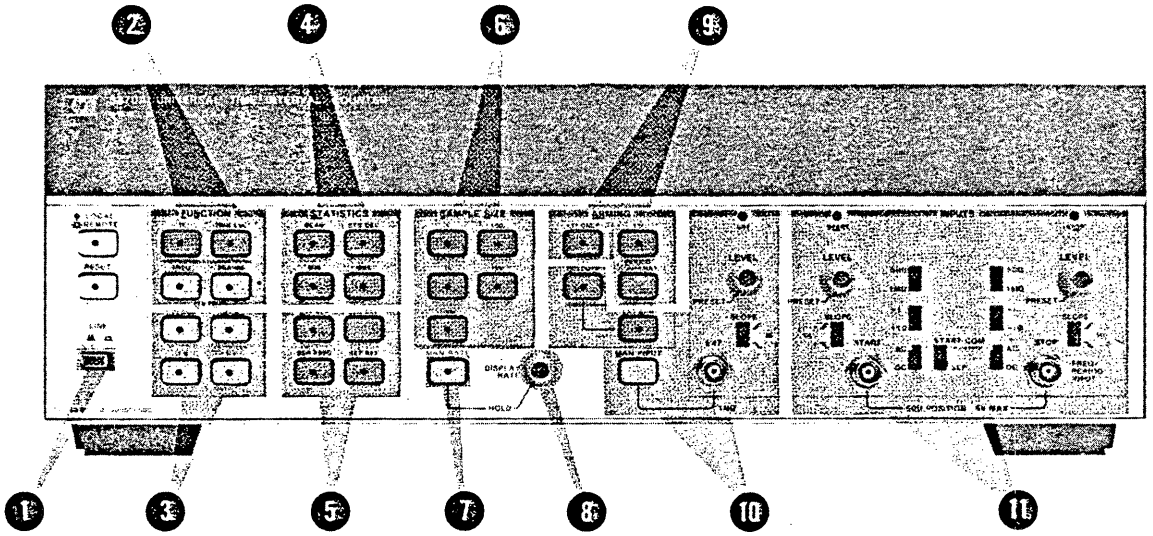


Figure 3-4. Operators Checks (Continued)



NOTE

See *Table 1-1* for specifications on all input signals concerning bandwidth, accuracy, and amplitude.

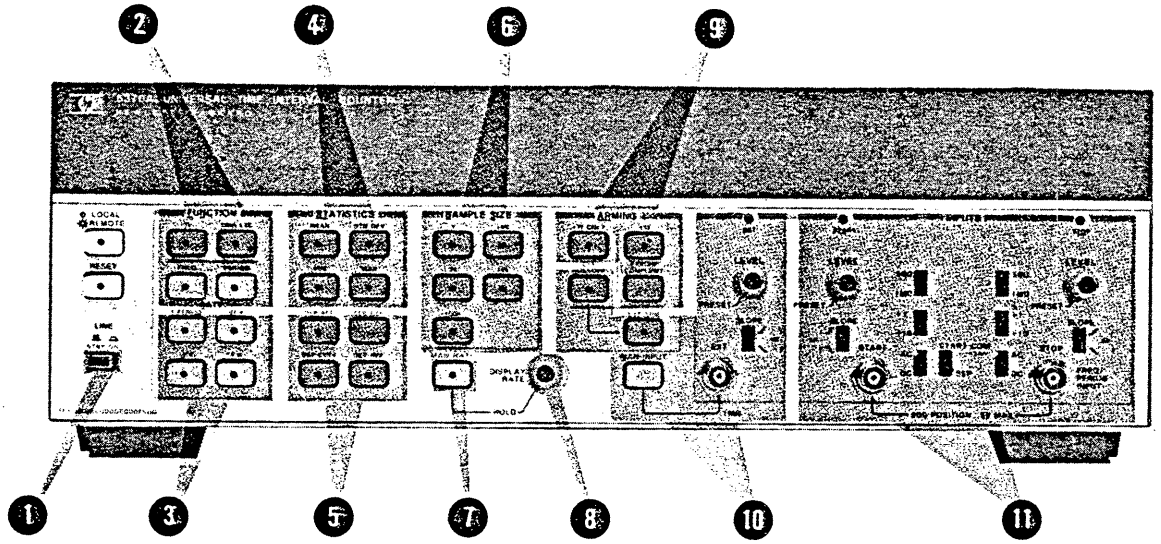
1. Set LINE switch (12) to ON position.

NOTE

All GATE switches are disabled when 5370A is in T.I. FUNCTION.

2. Set START and STOP input impedance, attenuation, and coupling switches to desired position; see specifications in *Table 1-1*.
3. Set START COM/SEP switch (18) to COM position. When COM/SEP switch is set to COM, impedance switches must be set to the same impedance.
4. Connect input signal to START channel input jack.
5. Set START channel slope switch SA (11) to 1 for triggering on positive slope or to 2 for triggering on negative slope.
6. Set STOP channel slope switch SO (11) to 1 for triggering on positive slope or to 2 for triggering on negative slope.
7. Set START LEVEL control to start mesurement at desired voltage level. Press TRIG LVL (trigger level) to display triggering voltage (if desired).
8. Set STOP LEVEL control to stop measurement at desired voltage level. Press T.I. FUNCTION.
9. Press desired STATISTICS (4). When STD DEV is pressed in T.I. FUNCTION, the 5370A automatically goes to SAMPLE SIZE of 100 (unless SAMPLE SIZE is greater than 100). EXT HOLDOFF (10) and DSP EVT (5) will not operate when 5370A is set for ±T.I. ARMING (9).
10. Press desired SAMPLE SIZE (6).
11. Press desired ARMING mode (9). See *Table 1-1* for specifications on EXT input signal used for EXT HOLDOFF and/or EXT ARM.
12. Adjust DISPLAY RATE control (8) for a convenient interval between measurements.
13. If more than one piece of information is desired for a sample, turn DISPLAY RATE control (8) fully counterclockwise until it clicks in the HOLD position. Then press the MAN RATE (manual rate) switch (17) to start measurement. At the end, different statistical information for that one sample can be obtained by pressing the appropriate switches. Press (17) again for a new sample. For measurement of single-shot signal, set input conditioning as desired. Press T.I., MEAN, SAMPLE SIZE 1, EXT ARM MAN INPUT (or use external arming signal via EXT input) and DISPLAY RATE to HOLD. The instrument is now ready for the single-shot signal.

Figure 3-5. One Source Time Interval Measurement



NOTE

See *Table 1-1* for specifications on all input signals concerning bandwidth, accuracy, and amplitude.

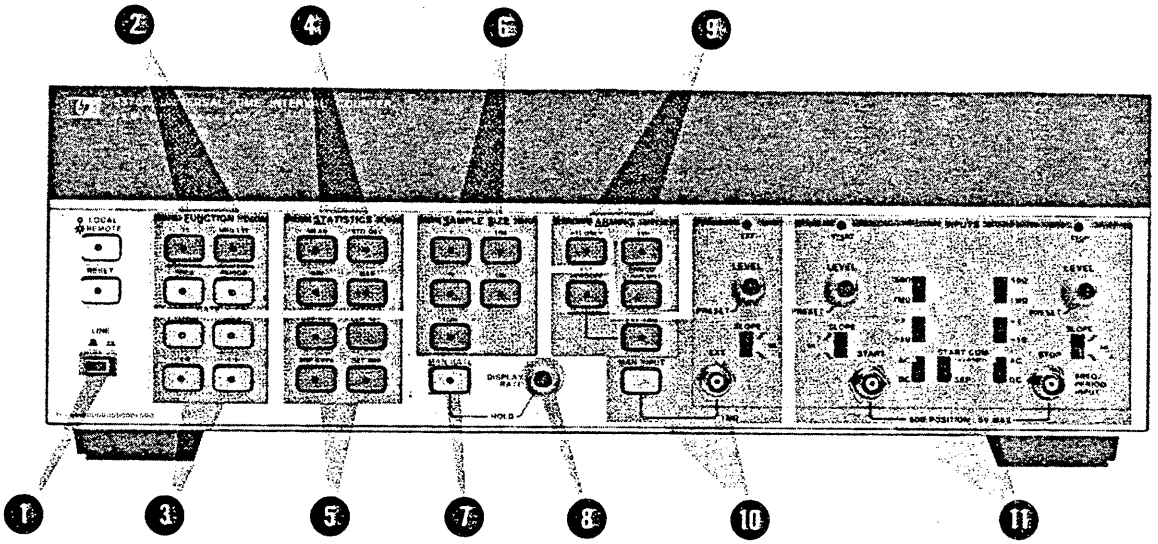
1. Set LINE SWITCH (1) to ON position.

NOTE

All GATE switches are disabled when the 5370A is in T.I. FUNCTION.

2. Set START and STOP input impedance, attenuation, and coupling switches (11) to desired position; see specifications in *Table 1-1*.
3. Set START COM/SEP switch (11) to SEP position.
4. Connect START signal to START input jack and STOP signal to STOP input jack.
5. Set START channel slope switch SA (11) to 1 for triggering on positive slope or to 2 for triggering on negative slope.
6. Set STOP channel slope switch SO (11) to 1 for triggering on positive slope or to 2 for triggering on negative slope.
7. Set START LEVEL control to start measurement at desired voltage level. Press TRIG LVL to display triggering voltage (if desired).
8. Set STOP LEVEL control to stop measurement at desired voltage level. Press T.I. FUNCTION.
9. Press desired STATISTICS (4). When STD DEV is pressed in T.I. FUNCTION, the 5370A automatically goes to SAMPLE SIZE of at least 100. EXT HOLDOFF (10) and DSP EVT (5) will not operate when 5370A is set for ±T.I. ARMING (9).
10. Press desired SAMPLE SIZE (6).
11. Press desired ARMING mode (9). See *Table 1-1* for specifications on EXT input signal used for EXT HOLDOFF and/or EXT ARM. See also paragraphs 3-17 through 3-21.
12. Adjust DISPLAY RATE control (8) for a convenient interval between measurement.
13. For one-shot measurements, see step 13 in *Figure 3-5*.

Figure 3-6. Two Source Time Interval Measurement

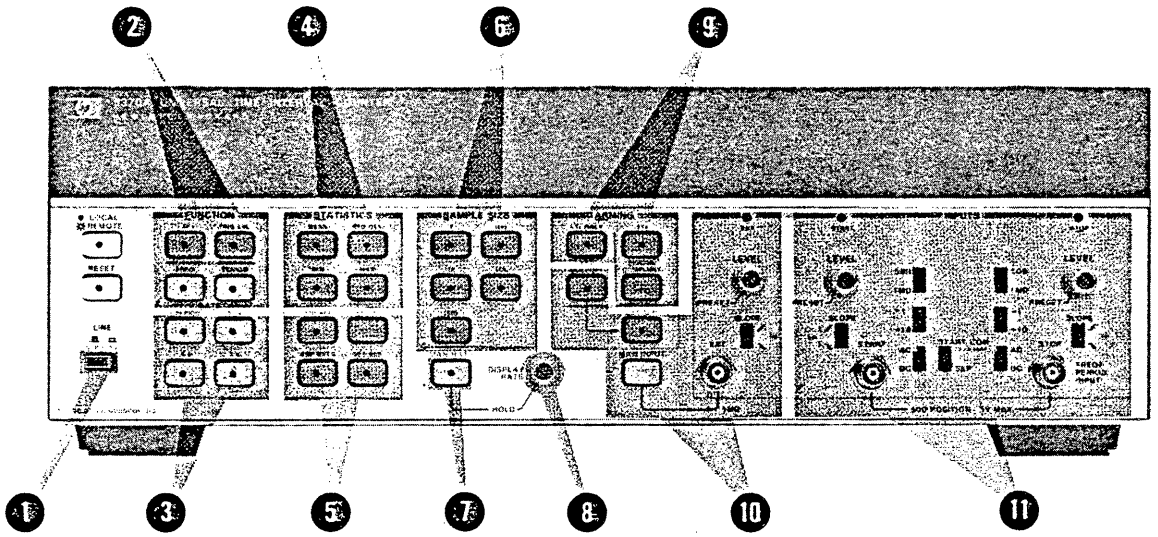


NOTE

See *Table 1-1* for specifications on all input signals concerning bandwidth, accuracy, and amplitude.

1. Set LINE switch (1) to ON position.
2. Set STOP LEVEL control to trigger measurement at desired voltage level. Press TRIG LVL (2) to display actual DC voltage of trigger level. Use PRESET for sine waves.
3. Set START COM/SEP switch (11) to SEP position.
4. Set STOP impedance, attenuation, and coupling switches (10) to desired position; see specifications in *Table 1-1* for details.
5. Connect input signal to STOP channel input jack (11).
6. Press FREQ switch in FUNCTION group (2).
7. Press GATE switch, group (3), for desired integration time or press desired SAMPLE SIZE (6).
8. Press desired STATISTICS switch (4).
9. Adjust DISPLAY RATE control (8) for a convenient interval between measurements. If one-shot measurements are desired, see step 13 in *Figure 3-5.*

Figure 3-7. Frequency Measurements



NOTE

See *Table 1-1* for specifications on all input signals concerning bandwidth, accuracy, and amplitude.

1. Set LINE switch (1) to ON position.
2. Press PERIOD switch in FUNCTION group (2).
3. Set STOP impedance, attenuation, and coupling switches (11) to desired position; see specifications in *Table 1-1* for details.
4. Set STOP LEVEL control to trigger measurement at desired voltage level. Press TRIG LVL, group (2), to display actual DC voltage of trigger level; press PERIOD again. Use PRESET for sine waves.
5. Set START COM/SEP switch (11) to SEP position.
6. Connect input signal to STOP channel input jack (11).
7. Press desired SAMPLE SIZE switch (6) or GATE time switch (3). If STD DEV (standard deviation) is to be displayed, SAMPLE SIZE must be ≥100.
8. Press desired STATISTICS switch (4); statistics can only be performed while machine is in the 1 PERIOD (3) mode.
9. +T.I. is the only ARMING mode (9) usable in the PERIOD function.
10. Press desired switch for EXT ARM and/or EXT HOLDOFF (10). See *Table 1-1* for specifications for External Gate input signal. See also paragraphs 3-17 through 3-21.
11. Adjust DISPLAY RATE control (8) for a convenient interval between measurements. If one-shot measurements are desired, see step 13 in *Figure 3-5*.

Figure 3-8. Period Measurements

Table 3-2. Bus Message Usage

Message	Description	5370A Use	Sample 9825A Statements (5370A Set to Address 03)
Data	Transfers device-dependent information from one device to one or more devices on the Bus.	Input: Accepts program codes. See *Table 3-4* for program code set Output: Sends measurement data. Output format is TI = SD.DDDDDDDDDDESDD	wrt 703, "SS3AR2" red 703, A
Trigger	Causes a group of selected devices to simultaneously initiate a set of device-dependent actions.	Starts a new measurement. Equivalent to the "MR" (manual rate) remote command.	trg 7 or trg 703
Clear	Causes an instrument to be set to a predefined state (a certain range, function, etc.).	Same as front panel reset. Generates lamp test, clears status byte, followed by "MR". Does not set counter to predefined function.	clr 7 or clr 703
Remote	Permits selected devices to be set to remote operation, allowing parameters and device characteristics to be controlled by Bus Messages.	Causes counter to go to remote operation if REN is true and counter is addressed to listen. In absense of program data, remote operation is according to state of front panel settings just prior to going to remote. Locks out all pushbuttons except Local (RTL).	rem 703
Local	Causes selected devices to return to local (front panel) operation.	Returns 5370A to front panel control.	lcl 703
Local Lockout	Disables local (front panel) controls of selected devices	Disables local (RTL) pushbutton.	llo7
Clear Lockout and Local	Returns all devices to local (front panel) control and simultaneously clears the Local Lockout Message.	Returns counter to local (front panel) control and clears the local lockout message.	lcl7
Require Service	Indicates a device's need for interaction with the controller.	Used to flag an error condition or to indicate that measurement is complete. Error message is coded in status byte.	rds (703)→A
Status Byte	Presents status information of a particular device; one bit indicates whether or not the device currently requires service, the other 7 bits (optional) are used to indicate the type of service required.	Bit 8 is set if device is running debug monitor (diagnostic tool). Bit 7 is set if service is requested. Bit 6 is set if oven heater is on. Bit 5 is set if an external time base is used. Bits 1-4 indicate error message if bit 7 is used. Error 0: Measurement is complete and counter is ready to output. Error 1: Illegal remote command. Error 2: Overrange (TI is too long or statistics overflow). Error 3: Undefined routine. Error 4: Out of lock (refers to internal phase lock loop). Error 5: Undefined key (indicates a hardware problem). Error 6: Fault in RAM storage. Error 7: Fault in ROM storage.	rds (703)→A rds (703)→A
Status Bit	A single bit of device-dependent status information which may be logically combined with status bit information from other devices by the controller.	Does not use.	—
Pass Control	Passes bus controller responsibilities from the current controller to a device which can assume the Bus supervisory role.	Does not use	—
Abort	Unconditionally terminates Bus communications and returns control to the system controller.	Clears Talk, Listen, and Serial Poll Enable registers on 5370A HP-IB Interface. Front panel setup does not change.	cli 7

3-35. Setting the Address Switches

3-36. To use the 5370A in an HP-IB system, the first step is to set the rear panel address switches as shown in *Table 3-3*. The leftmost switch sets the counter to the ADDRESSABLE mode or the TALK ONLY mode. ADDRESSABLE mode is used whenever a calculator or other controller is used within the system. TALK ONLY mode is used when the counter is operating under its own control (no controller on bus) and outputs its measured result to another device on the bus, such as a printer.

3-37. The five right-hand switches, A5 through A1, set the talk and listen addresses of the 5370A when it is used in the ADDRESSABLE mode. *Table 3-3* shows the possible address settings and the corresponding ASCII codes for talk and listen.

3-38. The examples listed in this section assume an address setting of 00011, which is a 5-bit binary code for the decimal number three. This number is important when using an HP 9825A calculator, since the calculator addresses the 5370A to talk and listen by using the code 7Ø3. (The "Ø3" being the 5370A address.) The ASCII characters for this same switch setting are "C" for a talk address and "#" for a listen address. These characters are used when the computing controller is an HP 9830A calculator.

3-39. Program Codes

3-40. There are effectively three types of program codes that are used to remotely program the counter's functions. The first type uses two letters of the particular function, e.g., FN for FuNction, and a number associated with the specific function, see *Figure 3-9*. For example, selecting FN3 as the program code programs the frequency function. Notice that for commands such as FN, the front panel controls are numbered 1-N, left to right and then top to bottom.

3-41. Other codes have only two functions, coded Ø and 1. The "Ø" indicates the selected function is **off** or disabled and the "1" indicates **on** or enabled. For example, EAØ is the code for EXT ARM disable.

3-42. The third type of function selection places portions of the front panel to either remote or local operation. For example, program code SR sets the slope switches to remote programming control. Program code SA1 or SA2 must now be programmed to choose the particular slope, positive or negative, for the START channel. These are the basic types of function codes for remote programming. Those that require special consideration are described in *Table 3-4*, Program Code Set.

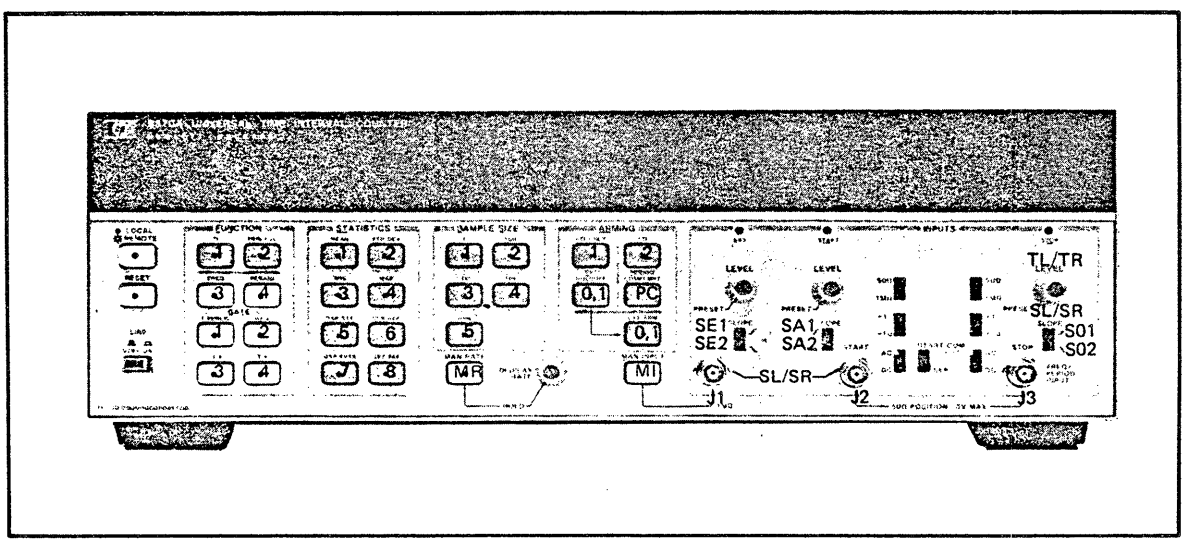
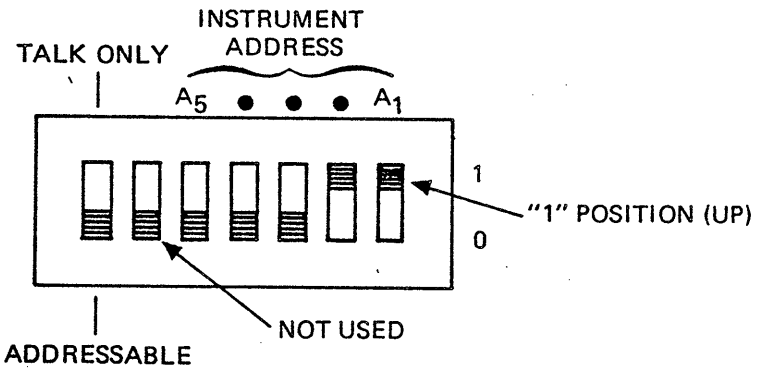


Figure 3-9. Program Codes Relating to Switch Functions

Table 3-3. Address Selection



ASCII CODE CHARACTER		ADDRESS SWITCHES					DECIMAL EQUIV-LENT OF BINARY SWITCH SETTING
LISTEN	TALK	A_5	A_4	A_3	A_2	A_1	
SP	@	0	0	0	0	0	00
!	A	0	0	0	0	1	01
"	B	0	0	0	1	0	02
#	C	0	0	0	1	1	03
$	D	0	0	1	0	0	04
%	E	0	0	1	0	1	05
&	F	0	0	1	1	0	06
'	G	0	0	1	1	1	07
(	H	0	1	0	0	0	08
)	I	0	1	0	0	1	09
*	J	0	1	0	1	0	10
+	K	0	1	0	1	1	11
,	L	0	1	1	0	0	12
—	M	0	1	1	0	1	13
.	N	0	1	1	1	0	14
/	O	0	1	1	1	1	15
Ø	P	1	0	0	0	0	16
1	Q	1	0	0	0	1	17
2	R	1	0	0	1	0	18
3	S	1	0	0	1	1	19
4	T	1	0	1	0	0	20
5	U	1	0	1	0	1	21
6	V	1	0	1	1	0	22
7	W	1	0	1	1	1	23
8	X	1	1	0	0	0	24
9	Y	1	1	0	0	1	25
:	Z	1	1	0	1	0	26
;	[	1	1	0	1	1	27
<	\	1	1	1	0	0	28
=	]	1	1	1	0	1	29
>	~	1	1	1	1	0	30

3-43. Output Formats

3-44. The 5370A can output data in three different formats. Two of the formats are described in detail, in the back of this section, in Examples 2 and 5. Example 2 describes the Display All output format which outputs not only the resultant measurement but all related statistics. Example 5 describes in detail, the Binary Output or Computer Dump format. The third format is the Standard Output format and is described in the following paragraph.

3-45. The standard output byte contains 22 characters per measurement. The characters are arranged as follows:

AAAASD.DDDDDDDDDDESDD

where

A = TI = for Time Interval
FREQ = for Frequency
PER = for Period

S = Sign of measurement or exponent (space for positive and - for negative)
D = Digits
E = Exponent

The output byte is followed by a CR (carriage return) and LF (line feed).

Table 3-4. Program Code Set

Codes shown in **bold face** are start-up conditions. These conditions are set when the instrument powers up on turn-on. They cannot be selected by using the bus commands of Device Clear or Selected Device Clear.

1. **FUNCTION**
   - **FN1 Time Interval**
   - FN2 Trigger Levels
   - FN3 Frequency
   - FN4 Period

2. **GATE TIME** (for FREQUENCY or PERIOD mode)
   - **GT1 Single Period**
   - GT2 0.01 second
   - GT3 0.1 second
   - GT4 1 second

3. **STATISTICS**
   - **ST1 Mean**
   - ST2 Standard Deviation (requires ≥100 sample size)
   - ST3 Minimum
   - ST4 Maximum
   - ST5 Display Reference
   - ST6 Clear Reference (immediate execution)
   - ST7 Display Events
   - ST8 Set Reference (immediate execution)
   - ST9 Display All (In the TIME INTERVAL mode, counter displays and outputs mean, standard deviation, minimum, maximum, reference, and events. In frequency or period and with a gate time selected, counter displays and outputs mean and events. In frequency or period with a sample size selected, counter displays and outputs mean, standard deviation, minimum, maximum, and events. See Example 2 in this section).

4. **SAMPLE SIZE**
   - **SS1 Sample Size = 1**
   - SS2 Sample Size = 100
   - SS3 Sample Size = 1K
   - SS4 Sample Size = 10K
   - SS5 Sample Size = 100K

   See also "SB", Sample Size Binary in this table.

5. **MODE**
   - **MD1 Front Panel Display Rate Control is Functional.** Output only if addressed.
   - MD2 Display Rate Hold Until "MR" command (or GET) (Display Rate control is locked out). Wait until addressed. Changing functions while in MD2 mode causes the first measurement output data to be invalid. With the new function programmed, the first data output will be the previous measurement data in terms of the new function. For example, with 5370A in frequency and a measurement of 1 MHz taken, if a new function was programmed, say Period, then the first output data will be 1 μs (which is the previous Frequency measurement of 1 MHz converted to the new function of Period).
   - MD3 Display Rate Fast (Display Rate control is locked out). Only if addressed.
   - MD4 Display Rate Fast (Display Rate control is locked out). Wait until addressed.

6. **INPUT SELECTION** (see Example 3)
   - **IN1 Input selection for normal time interval operation.** START event = START channel input, STOP event = STOP channel input.

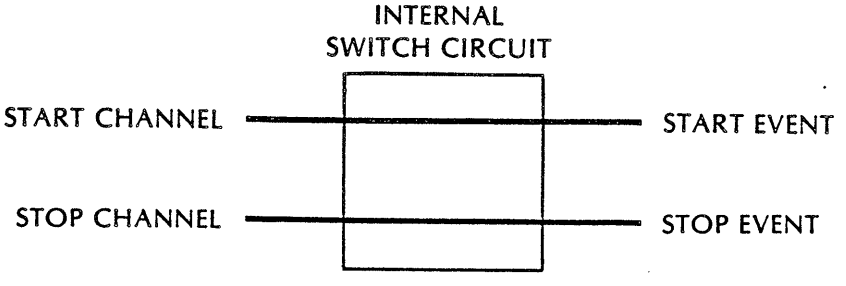
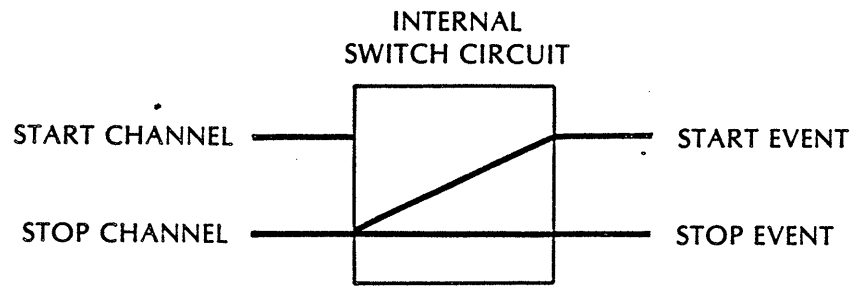
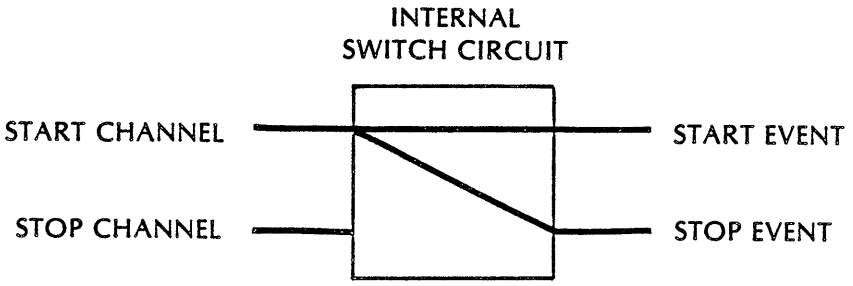


Table 3-4. Program Code Set (Continued)

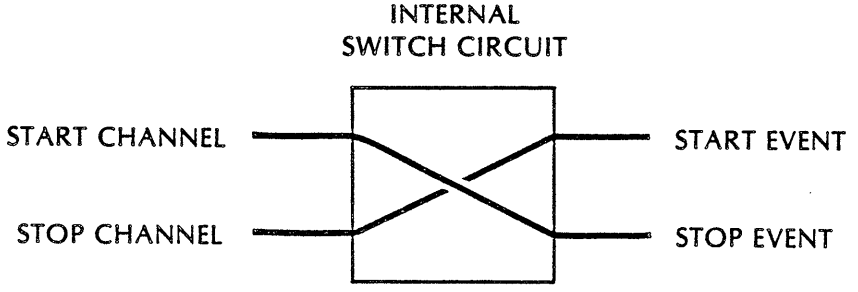
IN2 Normal input selection for frequency or period measurement. START event = STOP channel input, STOP event = STOP channel input.



IN3 Input selection for operator convenience in switching input to different channels. START event = START channel input, STOP event = START channel input.



IN4 Input selection for operator convenience in switching input to different channels. START event = STOP channel input, STOP event = START channel input.



7. **START CHANNEL SLOPE SELECT**
   SA1 Start Channel Slope: Positive
   SA2 Start Channel Slope: Negative
8. **STOP CHANNEL SLOPE SELECT**
   SO1 Stop Channel Slope: Positive
   SO2 Stop Channel Slope: Negative
9. **EXTERNAL ARM SLOPE SELECT**
   SE1 External Arm Slope: Positive
   SE2 External Arm Slope: Negative
10. **ARM SELECT**
    AR1 +T.I. Arming Only
    AR2 ±T.I. Arming

Table 3-4. Program Code Set (Continued)

11. **EXTERNAL HOLDOFF**
    EHØ **External Holdoff Disable**
    EH1 External Holdoff Enable (must also use EA1 and AR1)

12. **EXTERNAL ARM**
    EAØ **External Arm Disable**
    EA1 External Arm Enable

13. **INTERNAL ARM**
    Used with ±T.I. Arm Mode only. Forces counter to arm on either START or STOP channel always, regardless of input phase relation. Disables internal phase detection circuit.
    IA1 Internal Arm Auto
    IA2 Start Channel Arm
    IA3 Stop Channel Arm

The following terse commands have also been defined.

1. MR Manual Rate. Used to initiate a sample of measurements. Typically used with MD2. MR must be sent at least 10 ms after the previous program command. For example, a typical 9825A program should be:
   a. wrt 703, "FN1ST1SS1MD2IN1SA1SO2TRSR"
   b. wait 10; wrt 703 "MR"
2. MI Manual Input. Same operation as front panel MANUAL INPUT. Used to manually arm the counter. Use wtb calculator command.
3. **SL** **Slope Local.** Set slope switches to local (front panel) operation.
4. SR Slope Remote. Sets slope switches to remote operation.
5. **TL** **Trigger Local.** Sets trigger level controls to front panel operation.
6. TR Trigger Remote. Set trigger level controls to remote operation.
7. TE Teach. When addressed to talk, the 5370A transfers all front panel information (or remotely programmed information) from its memory into the controller's memory. See Example 4.
8. PC Period Complement. Performs the same operation as the front panel switch.
9. TBØ Disable Time Interval Binary Output.
10. TB1 Time Interval Binary Output. For short time intervals of <320 μs. Counter does not perform any type of statistical measurement (mean, standard deviation, etc.). Instead, counter outputs raw data: NØ(ST), N1N2(CT1), N1N2(CT2), NØ(CT1), and NØ(CT2) in that order, and places "--------" in display. Measurements occur at up to a 6 kHz rate. See Example 5.

The following binary commands have also been defined.

1. SB Sample Size Binary. Allows a theoretical setting of sample sizes from 1 to 16,777,215. Must be entered in binary form. See Example 6. Use wtb calculator command.
2. LN Learn. Enters program information into 5370A (RAM memory) that was stored into the calculator with an earlier TEACH (TE) command. See Example 4.

The following decimal commands have also been defined.

1. TA Trigger Start. Sets the trigger level of the START channel from 0.50V to -1.30V. See Example 7.
2. TO Trigger Stop. Sets the trigger level of the STOP channel from 0.50V to -1.30V. See Example 7.

NOTE

To output the trigger level setup data from the 5370A to the controller, program the 5370A to Trigger Level function (FN2) and "red (counter talk address)". The output format is as follows:

STA = SD.DD, STO = SD.DD <CR LF>

where

STA = START channel Trigger level
S = Polarity of Trigger voltage
D = Digit value
STO = STOP Channel Trigger level

3-46. EXAMPLE PROGRAMS

3-47. Seven example programs are given as follows:

```
0: wrt 703,"FN3
 GT3MD2"
1: wrt 703,"MR";
 red 703,A;dsp
 A;wait 500
2: gto 1
*1132
```

EXAMPLE 1. TYPICAL MEASUREMENT FORMAT

This program forces the counter to perform a simple frequency measurement (FN3) with a 0.1 s gate time (GT3). The MD2 code prevents the counter from taking a measurement until the MR command is reached. The counter takes a measurement and reads it into the A register. The result is displayed by the calculator. After waiting 500 ms, the program loops back to the next "take a measurement" command (MR) and the process is repeated.

```
0: dim C$[80],
 D$[80]
1: wrt 703,"ST9"
2: red 703,C$,D$
3: prt C$,D$
4: stp
*3899
```

```
TI = 2.16294118
000E-04, STD= 9.
400000000000E-09,
 MIN= 2.16281484
000E-04
MAX= 2.163059570
00E-04, REF= 0.0
000000000E-04,
EVT= 1.000000000
00E+02
```

EXAMPLE 2. DISPLAY ALL STATISTICS

This program allows the counter to display all statistics available for a time interval measurement. Step 0 dimensions two string variables in the calculator to accept the forthcoming data. Step 1 programs the counter to "display all" (ST9). Step 2 causes the counter to read into the two strings, and Step 3 prints the contents of the strings. The result is Mean (T.I.), standard deviation, minimum, maximum, reference and events (in this case, events is the number of samples). The counter automatically selected 100 samples because a standard deviation was programmed. The output format for a Time Interval measurement is as follows:

T.I. = , STD = , MIN = <CR LF>

MAX = , REF = , EVT = <CR LF>

where

T.I. =	Time Interval
STD =	Standard Deviation
MIN =	Minimum
MAX =	Maximum
REF =	Reference
EVT =	Events
<CR LF> =	Carriage Return, Line Feed

```
0: flt 6
1: wrt 703,"FN4
  IN3"
2: red 703,A;
 dsp A;wait 2000
3: wrt 703,"FN3
  IN2"
4: red 703,A;
 dsp A;wait 2000
5: gto 1
*7564
```

EXAMPLE 3. INPUT SELECTION

To demonstrate the input selection feature, connect signals of different frequencies to the input channels and set the START COM/SEP switch to SEP. Program Step 1 causes the counter to make a period measurement on the START channel signal. This is read and displayed in Step 2, along with a 2-second wait. Program Step 3 causes the counter to make a frequency measurement on the STOP channel signal. Step 4 duplicates Step 2, and Step 5 repeats the two measurements.

EXAMPLE 4. TEACH/LEARN

The following program serves as an example of the TEACH/LEARN mode. For demonstration purposes, perform the following steps:

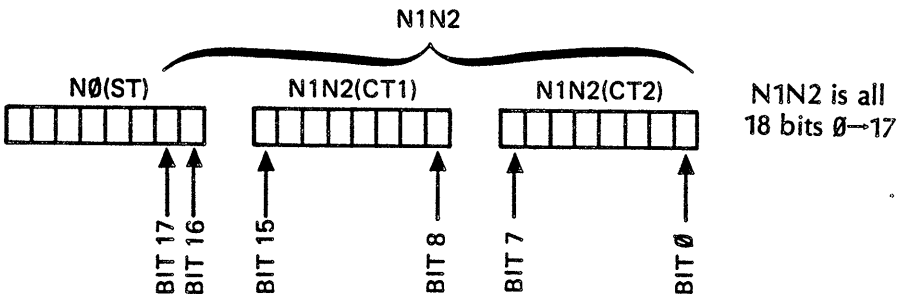
1. Load the program into the 9825A Desk Top Computer.
2. Power up the 5370A.
3. On 5370A, push FREQ, MIN, and SAMPLE SIZE of 1K.
4. On 9825A, push RUN. The 5370A will teach the 9825A.
5. Turn 5370A power off, then on again. The counter will power up in T.I., MEAN, SAMPLE SIZE of 1, and +T.I.
6. On 9825A, push CONTINUE.
7. 5370A will learn from the 9825A and the front panel will indicate FREQ, MIN, and SAMPLE SIZE of 1K.

```
0: dim A$[50]
1: buf "BIN";A$,
 3
2: wtb 703,"te"
3: tfr 703,"BIN"
 ,21
4: if rds("BIN")
 <0;sto +0
5: wrt 703,"mr"
6: dsp "5370A+98
 25A";beep;stp
7: wrt 703,"ln",
 A$[1,21]
8: dsp "9825A+53
 70A";beep;stp
*18671
```

The program sets the dimension of the A$ string variable and names the buffer into which data will be read (BIN). It then specifies size of buffer (A$) and selects the type of buffer: 3 equals fast read/write buffer. Step 2 programs 5370A to the TEACH mode. Step 3 transfers 21 bytes of information into buffer and step 4 ensures transfer is complete before continuing. Step 5 initiates a measurement. Step 6 displays message to indicate "TEACH" is complete. Step 7 generates the "LEARN" function, and step 8 gives a display to indicate the process is complete.

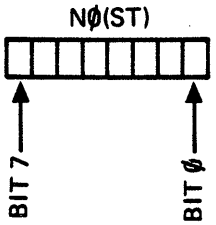
EXAMPLE 5. TIME INTERVAL BINARY OUTPUT (COMPUTER DUMP)

The 5370A outputs raw measurement data in the following order: NØ(ST), N1N2(CT1), N1N2(CT2), NØ(CT1), and NØ(CT2); where CT stands for count and ST stands for status. N1N2 is an 18-bit 2's complement quantity consisting of N1N2(CT1), N1N2(CT2), and the two least signicant bits of NØ(ST).



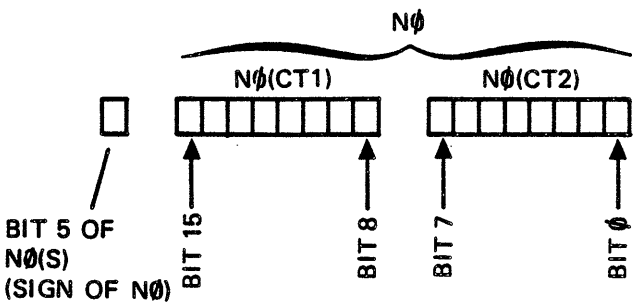
N1N2 actually represents the internal calculation of 257(N1-N2). This is done in preparation of solving the equation: T.I. 5 $[\frac{257}{256}(N1-N2) + N\emptyset]$ ns. The number 257 in 257(N1-N2) is part of the ratio 257/256.

NØ(ST) contains the following status bits:



Bit 7 = Event counter range flag
Bit 6 = End of measurement
Bit 5 = Sign of NØ (High=+)
Bit 4 = Armed flag
Bit 3 = PLL out of lock flag
Bit 2 = NØ range flag
Bit 1 = Bit 17 of N1N2
Bit Ø = Bit 16 of N1N2

NØ is a 16-bit quantity consisting of NØ(CT1) and NØ(CT2). It is expressed in sign-magnitude binary, **not** in 2's complement. To be complete, NØ requires a sign, which is contained in bit 5 of NØ(ST).



These five bytes of data will give the measured time interval when combined in the following equation:

T.I. = [N1N2/256 + NØ] 5 ns

This can be rewritten for the 9825A example shown on the next page, by letting
N1N2 = B
NØ = N
Sign of NØ = Q
∴T.I. = (B/256 + N•Q) 5e-9

9825A EXAMPLE PROGRAM. The following program causes the counter to output in the fast binary output mode, store the five bytes of data in a buffer, perform the calculation, and display the result. Data is entered into the following string variables.

A$[1] = NØ(ST)
A$[2] = N1N2 (CT1)
A$[3] = N1N2(CT2)
A$[4] = NØ(CT1)
A$[5] = NØ(CT2)

```
0: flt 6
1: dim A$[21];
 buf "ti",A$,3
2: wrt 703,"tb1"
3: buf "ti";tfr
 703,"ti",5
4: if rds("ti")<
 0;sto +0
5: num(A$[4])*
 256+num(A$[5])→
 N
6: 1→Q
7: if bit(5,num(
 A$[1]))=0;-1→Q
8: band(num(A$[1
 ]),3)*65536+
 num(A$[2])*256+
 num(A$[3])→B
9: if B>=131072;
 B-262144→B
10: (B/256+N*Q)*
 5e-9→T;dsp T
11: wait 500;
 sto 3
*25017
```

PROGRAM STEP	PURPOSE
Ø:	Sets up floating point format for 6 digits.
1:	Sets up string variable (A$) and specifies its size (21)*. Names buffer into which data will be read (ti) and specifies size of buffer (A$). Selects type of buffer: 3 = fast read/write buffer.
2:	Programs 5370A to "fast binary output" mode (tb1).
3:	Initializes buffer "ti" prior to inputting data. Transfer five bytes of data from 5370A into buffer "ti".
4:	Reads status of transfer. Stays in transfer mode as long as status remains –1. When status goes to "5", program advances to next step.
5:	Sets the two NØ bytes next to each other in their proper binary order and places that value in the variable N.
6:	Assigns variable Q the value of 1.
7:	Examines the sign of NØ bit (bit 5 of NØ(ST)). If bit 5 is Ø, the variable Q is given a negative number.

*In 9825A, always allow for 16 bytes of "overhead", then allow for the number of bytes to be transferred. One sample = 16 + 5 = 21; one hundred samples = 16 + (5 x 100) = 516.

8: Removes bits Ø and 1 from NØ(ST) and positions them and NIN2(CT1) and NIN2(CT2) in their proper binary order. Places that value in the variable B.

9: Tests the NIN2 number to determine if it is positive or negative. If number in B is less than $(2^{18})/2$, go to step 10 If number in B is equal to or greater than $(2^{18})/2$, subtract 2^{18} from B and place result in B. This converts B into a negative number.

10: Performs proper mathematical operation on data and displays result as time interval.

11: Wait half a second and repeat program.

EXAMPLE 6. SAMPLE SIZE BINARY

This program permits the selection of any sample size from 1 to a theoretical maximum of 16, 777, 215. "ST7" causes the counter to display the programmed sample size, assuming the counter is taking measurements. Step 1 indicates that, for this example, 568 samples are being requested. Change this number to change the sample size. Step 2 must always be programmed to allow proper data entry to the counter.

```
0: wrt 703,"FN3
 ST7"
1: 568→S
2: wtb 703,"SB",
 int(S/65536),
 int((S-int(S/
 65536)*65536)/
 256),Smod256
3: stp
*4534
```

EXAMPLE 7. REMOTE TRIGGER LEVELS

This program causes the counter to display its trigger levels (FN2) on the front panel and allows these levels to be set remotely (TR). "TA -1.29" sets the start channel trigger level (TA) to -1.29V; while "TO Ø.23" sets the stop channel trigger level (TO) to Ø.23V. Changing FN2 to FN1 will cause the counter to make a T.I. measurement at the programmed trigger levels.

```
0: wrt 703,"FN2
 TR"
1: wrt 703,"TA
  -1.29"
2: wrt 703,"TO
 0.23"
3: end
*28090
```

This is an alternate program using a variable (T) for entering data.

```
0: wrt 703,"fn2t
 r"
1: -1.29→T
2: fmt f5.2
3: wrt 703,"ta",
 T
4: .23→T;wrt
 703,"to",T
5: end
*18976
```

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The three procedures in this section test the 5370A electrical performance using the specifications of *Table 1-1* as performance standards. The first test is an operation verification which checks all major functions of the 5370A via the front panel controls. The second test is an HP-IB operation verification which checks all major remote controllable functions of the 5370A. The third test is the full performance test which checks all specifications.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance test is listed in *Table 1-2*, Recommended Test Equipment. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models.

4-5. CALIBRATION CYCLE

4-6. The 5370A requires periodic verification of performance. Depending on the use and environmental conditions, the 5370A should be checked using the following performance tests at least every six months.

4-7. OPERATION VERIFICATION

4-8. The abbreviated checks given in *Table 4-1* can be performed to give a high degree of confidence the 5370A is operating properly without performing the complete performance test. The operation verification should be used for incoming QA, routine maintenance and after instrument repair.

4-9. HP-IB OPERATION VERIFICATION

4-10. The 9825A program listed in *Table 4-2* exercises the 5370A through the various operating modes via the HP-IB interface. If the 5370A successfully completes all phases of the verification program, there is a very high probability that the interface and counter are working properly. The HP-IB program is contained on a cassette, HP Part No. 59300-10001.

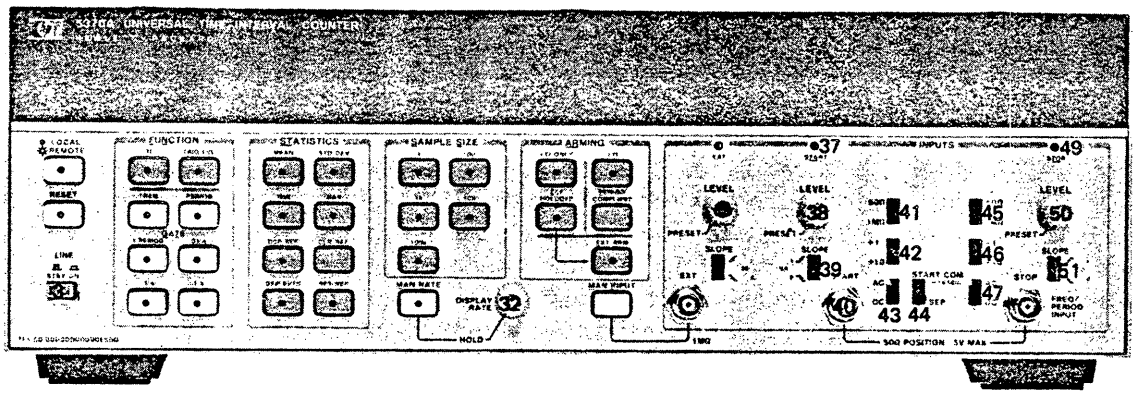
4-11. PERFORMANCE TEST

4-12. The performance test is given in *Table 4-3*. The performance test verifies all specifications listed in *Table 1-1*. All tests can be performed without access to the interior of the instrument.

4-13. TEST RECORD

4-14. Results of the performance tests may be tabulated on the Test Record at the end of *Table 4-3*. The test record lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs or adjustments.

Table 4-1. Operation Verification



1. Before switching on the instrument, ensure that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and the safety precautions are taken. See Power Requirements, Line Voltage Selection, Power Cables, and associated warnings and cautions in Section II of this manual. Description numbers match the numbers in *Figure 3-1* and *Figure 3-2*.

2. Connect a 4-foot BNC cable, such as HP 10503A, from the rear panel FREQ STD OUTPUT jack to the front panel START input jack 40.

3. Set the rear panel Frequency Select switch to INT.

4. Set the input impedance switches 41 45 to the 50Ω position.

5. Set the attenuator switches 42 46 to the ÷1 position.

6. Set the AC, DC switches 43 47 to the DC position.

7. Set the input slope switches 39 51 to the 1 (positive going slope) position.

8. Set the LEVEL controls 38 50 to the preset position.

9. Set the COM, SEP switch 44 to the START COM position.

10. Adjust DISPLAY RATE 32 to maximum (full cw).

11. Press the LINE switch 3 to turn the 5370A on.

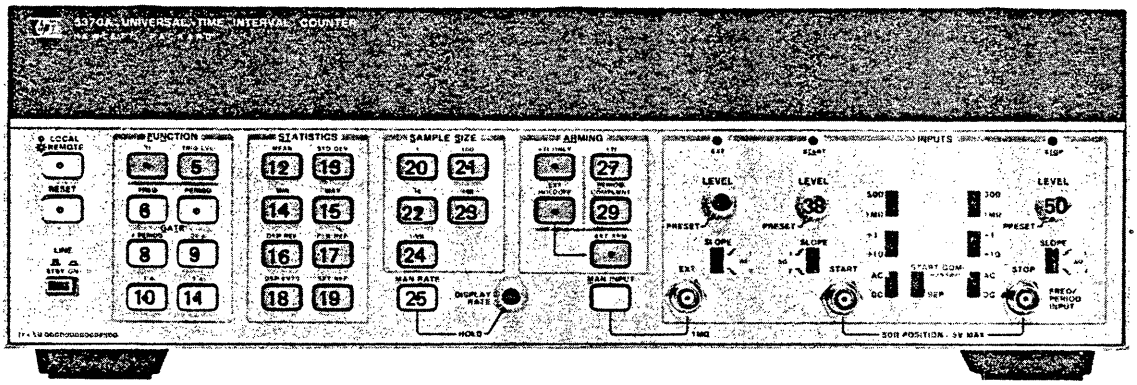
NOTE

When instrument is first turned on, the processor performs a self-check routine on the ROM's and RAM's. If, when power is first applied, or during operation, an error message is displayed, refer to paragraph 3-14 ERROR MESSAGES in Section III for error explanation.

12. For the first second after the instrument is turned on, the display will remain blank. For the next second, all segments and decimal points and all annunciator lights (except START, STOP, and ARM) in the display will be lit as well as all LED's in all the front panel switches.

13. After this initial power-up reset, the 5370A will be in T.I. FUNCTION, MEAN STATISTICS, SAMPLE SIZE 1, and +T.I. ONLY. The display should indicate 100.00 nanoseconds ±1.0 nanosecond with both the START and STOP channel trigger LED's 37 49 flashing. Also, because of the sample size of one, the ARM light will not be visible in the display.

Table 4-1. Operation Verification (Continued)



14. Press SAMPLE SIZE 100 switch 21. The least significant digit (LSD) will be one-digit greater (1 picosecond), the ARM light will be visible and flashing and the LED in the MAN RATE switch 25 will be flashing at approximately the same rate as the ARM light. Press SAMPLE SIZE 1K switch 22 and display will have same LSD (1 picosecond) with ARM light and MAN RATE switch flashing about twice per second. Press SAMPLE SIZE 10K 23 and display LSD will be 100 femtoseconds with ARM light flashing about once every four seconds. Press SAMPLE SIZE 100K switch 24 and the ARM light will flash about once every 40 seconds. Press SAMPLE SIZE 1 20.

15. Press STD DEV 13 and ±T.I. 27. Display should read less than 100 ps (this reading is the instrument's jitter). Notice that SAMPLE SIZE automatically goes to 100. For STD DEV measurements, SAMPLE SIZE must be ≥100. Press MIN switch 14 and minimum T.I. should be displayed. Press MAX switch 15 and the maximum T.I. should be displayed. Press +T.I. only.

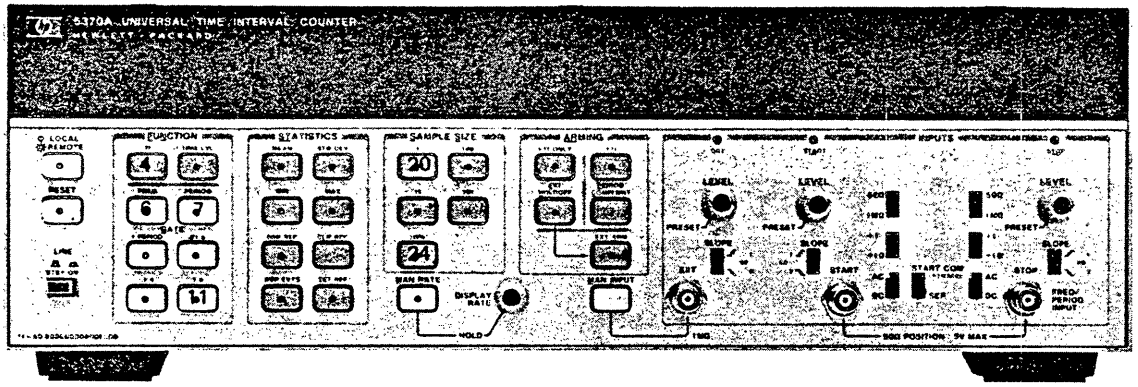
16. Press DSP REF switch 16 and three zeros should be displayed. Press SET REF switch 19 and approximately 100 nanoseconds should be displayed. This reference is the MEAN T.I. Press CLR REF switch 17 and six zeros should be displayed (if 99.99X ns was previously displayed, CLR REF will give five zeros), three zeros on either side of the decimal point. Press DSP EVTS switch 18 and 100 should be in the display. This number corresponds to the SAMPLE SIZE. Notice also EVT is displayed in the right-hand side of the window.

17. Press MEAN switch 12 and SAMPLE SIZE 1 switch 20. Press ±T.I. switch 27 and the display should show less than 1 nanosecond. The STOP or START light in the display will also be on. Press PERIOD COMPLMNT switch 29 and the display should be the same except the opposite (STOP or START) light will be on in the display. Press the PERIOD COMPLMNT switch again and the first light in the display should be on. This switch operation is identical to a toggle switch.

18. Press TRIG LVL 5. There will be two groups displayed, three digits each, on the left and the right of the display. They indicate the dc trigger level voltage on the START and STOP channel inputs, respectively. Rotate the LEVEL controls 38 50 and note the voltage should change from approximately -1.3 to +0.5 volts. Turn both LEVEL controls fully counterclockwise until they click in the preset position. The display should show zero volts for both inputs.

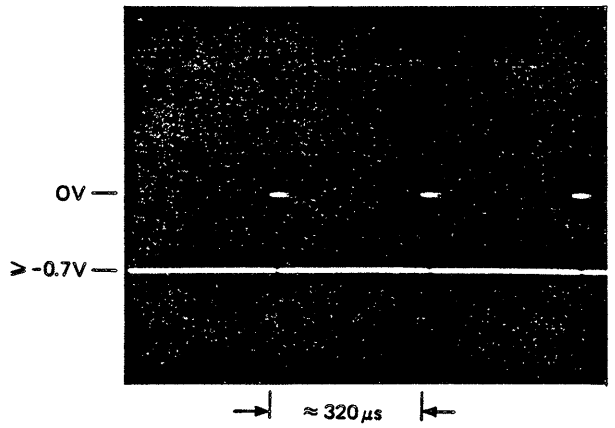
19. Press FREQ switch 6. Press 0.01 s switch 9 and display should read approximately 10.000 000X MHz. Press 0.1 s switch 10 and display should read approximately 10.000 000 0X MHz. Press 1 s switch 11 and display should read approximately 10.000 000 0XX MHz. Press 1 PERIOD switch 8.

Table 4-1. Operation Verification (Continued)



20. Press PERIOD switch 7. Display should indicate approximately 100 nanoseconds.

21. Press T.I. switch. 4, 100K SAMPLE SIZE 24, rotate DISPLAY RATE control maximum cw and check the rear panel START and STOP outputs 1 and 2 using an oscilloscope. Both signals should be nominal -0.7V (into 50Ω) and approximately 360 μs wide as shown below.

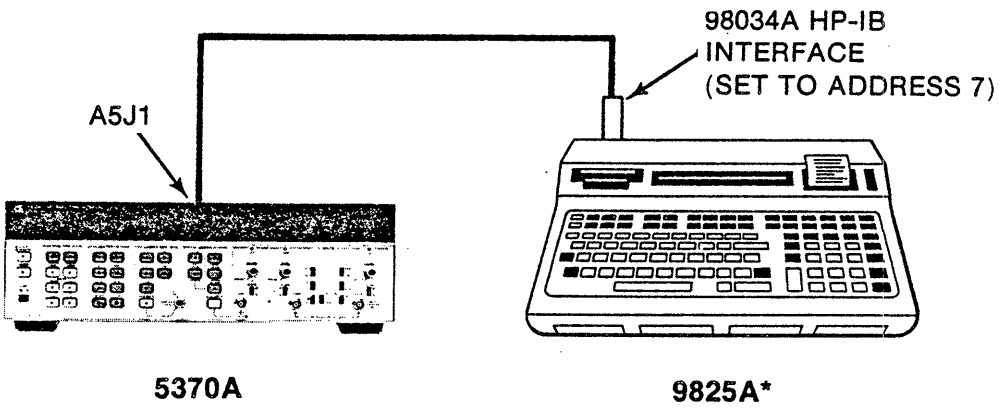


22. To check frequency input sensitivity, press FREQ 6, 1 second gate 11, SAMPLE SIZE 1 20, both input amplifiers to 1 Meg, ÷1, DC, START COM, positive slope, and LEVELS to PRESET. Apply a 0.1 Hz signal at 100 mV amplitude to the START input. The reading should be 0.1 Hz. Apply a 100 MHz signal at 100 mV amplitude and reading should be 100 MHz.

23. If the 5370A is used in a system or via the HP-IB, perform EXAMPLE 1 (TYPICAL MEASUREMENT FORMAT) and EXAMPLE 4 (TEACH/LEARN) in Section III, and Table 4-2 which starts on the next page.

Table 4-2. HP-IB Verification Program

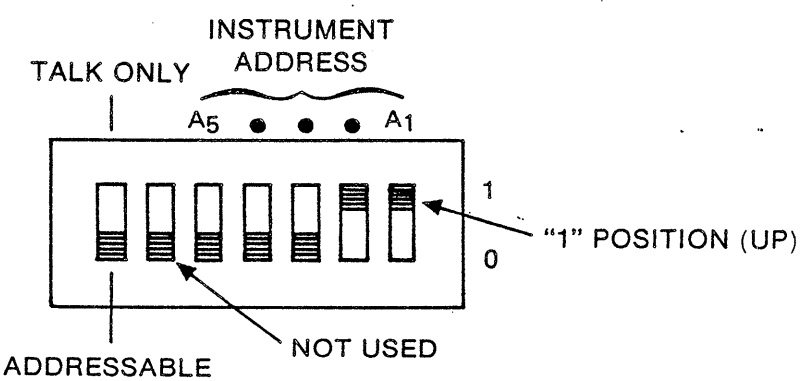
To perform the verification, set up the 5370A as shown below:



*9825A should have either the 98213A General I/O-Extended I/O ROM or the 98214A Plotter-General I/O-Extended I/O ROM.

Perform the following steps:

1. Insert cassette (HP P/N 59300-10001) into the 9825A.
2. Load and run file Ø (type: ldpØ; press [EXECUTE]).
3. Type in model number of the instrument to be tested (example: 5370); push [CONTINUE].
4. Set up counter as described in printout. Push [CONTINUE].
5. Set the 5370A rear panel ADDRESS switch (A5SW1) as follows:



Type in select code 7Ø3; push [CONTINUE].

NOTE

A select code other than 7Ø3 may be used. Remember to set the 5370A rear panel ADDRESS switch to correspond to the chosen select code. Do not use select code 721 (calculators address).

Table 4-2. HP-IB Verification Program (Continued)

6. Always push CONTINUE to advance program.

NOTE

Leave the cassette tape in the calculator.

Because of the length of the test, the program is stored separately in files 14, 15, and 16. At the end of each file, the calculator will ask if you want to repeat one of the tests in that particular file. Answer 1 for yes and Ø for no, then push CONTINUE. If yes, the calculator then asks which test is to be repeated. Enter an appropriate number for tests contained in that particular file (as indicated on the calculator display), then push CONTINUE. The selected test is then repeated. At the end of that particular test, the question of whether or not to repeat a test is asked again. If you want to repeat the same test, simply push . If not, enter Ø and push CONTINUE. The program then automatically loads the next file into calculator memory.

Use the following procedure if it is desired to test a specific check point within a particular file. Load the tape in the normal manner and proceed until the calculator prints the check point 1 information. Type: cont "rpt". Then push RUN. The program will advance to the end of file 14 and ask if any of the tests need to be repeated. If so, use the method described above. If the desired program is on the next file, type Ø and push CONTINUE. The calculator will automatically load file 15 and print the first check point information. Push RECALL button on calculator to recall cont "rpt" statement. Then repeat the process described above.

File 14: Check Points 1 to 10
File 15: Check Points 11 to 16
File 16: Check Points 17 to 22

The HP-IB verification test contains 22 subtests. Each subtest is called a CHECK POINT. Each check point exercises a particular function or mode group as labeled on the 9825A printout. The complete printout is shown on the following pages. To the right of the printout, a brief description and the program codes used are given for each group. The program codes are shown in *italics*.

Table 4-2. HP-IB Verification Program (Continued)

```
5370A UNIVERSAL
TIME INTERVAL
COUNTER HP-IB
Verification
Program


LEAVE 59300-
10001 TAPE IN
THE 9825A !!!


SETUP:
both chans
50 ohms,X1,DC,
all slopes=neg
levels = preset
sep/com=com
display rate=
full cw

Turn 5370A power
off then on.

CONNECT:
10 MHz from rear
panel  to START
jack.


Press CONTINUE.
```

Setup instructions for the 5370A front panel.

```
CHECK POINT 1
5370A front
panel set-up
check. Verify:
*ONLY KEYS LIT:
*      TI
*      MEAN
*      SS=1
*      +TI ONLY
*      MAN RATE
*      (flashing)
*5370A DISPLAY:
*      100.00
*      (approx)
*      ns
```

Checks the 5370A power-up conditions and performs basic Time Interval measurement.

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 2
Program sends
5370A listen
address.
Verify:
Same as above
except LOC/REM
and LSTN are lit
```

Sends "go-to-remote" and "listen" commands to 5370A.

rem "5370A address"

```
CHECK POINT 3
Program sends
5370A talk
address. Verify:
*ONLY KEYS LIT:
*       LOC/REM
*       TI
*       MEAN
*       SS=1
*       +TI ONLY
*       MAN RATE
*       (flashing)
5370A DISPLAY:
*       100.00
*       (approx)
*       ns
*       TALK
```

Addresses the 5370A to make a T.I. measurement and output the data (talk).

red "5370A address"

```
OUTPUT test:
Verify:
Same reading on
calculator
display
as on 5370A
display.
(Available for
10 seconds.)

Press CONTINUE
to perform test.
```

```
CHECK POINT 4
Press LOC/REM on
5370A. Verify:
LOCAL/REMOTE
lamp goes out.
```

Operator verification of proper operation of the front panel LOC/REM function. (No remote codes sent.)

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 5
Program sends
5370A listen
address & sets
local-lockout.
Press LOC/REM on
the 5370A and
verify as per
CHK POINT 2.
```

Programs the 5370A to go-to-remote and activates counter's local-lockout (LLO).

rem "5370A address"; llo7

NOTE

At the beginning of each CHECK POINT (6 through 22) the 9825A sends an "E$" group of commands to the 5370A for initialization. "E$" contains the following commands:

"FN1ST1SS1MO1IN1AR1EHØEAØSLTLTBØ".

```
CHECK POINT 6
TRIG LEVEL test
Program sets
trig lvl funct.
Verify:
ONLY KEYS LIT:
*      LOC/REM
*      TRIG LVL
*5370A DISPLAY:
*      0.00 0.00
*      V
*      LSTN

Press CONTINUE
Verify:
Display voltages
change from
-1.3V to 0.5V
in .01V steps.
```

Programs the START and STOP trigger levels from -1.3V to +0.5V in 10 mV increments.

FN2TR
(to replace the 5370A in remote trigger level operation)
TAXXX (START level)
TOXXX (STOP level)

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 7
TIME INTERVAL
test.

Connect 10MHz
from rear panel
to START jack.


Verify:
ONLY KEYS LIT:
*       LOC/REM
*       TI
*       MEAN
*       SS=1
*       +TI ONLY
*       MAN RATE
*       (flashing)
5370A DISPLAY:
*       100.00
*       (approx)
*       ns
*       LSTN
```

The 5370A is programmed to make a Time Interval measurement.

FN1

```
CHECK POINT 8
FREQUENCY test
Verify:
ONLY KEYS LIT:
*       LOC/REM
*       FREQ
*       1 PERIOD
*       MEAN
*       SS=1
*       +TI ONLY
*       MAN RATE
*       (flashing)
5370A DISPLAY:
*       10.000
*       (approx)
*       MHz
*       LSTN
```

The 5370A is programmed to make a Frequency measurement.

FN3

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 9
PERIOD test
Verify:
ONLY KEYS LIT:
*      LOC/REM
*      PERIOD
*      1 PERIOD
*      MEAN
*      SS=1
*      +TI ONLY
*      MAN RATE
*      (flashing)
5370A DISPLAY:
*      100.00
*      (approx)
*      ns
*      LSTN
```

The 5370A is programmed to make a Period measurement.

FN4

```
CHECK POINT 10
GATE TIME test

For .01s gate
Verify:
ONLY KEYS LIT:
*      LOC/REM
*      PERIOD
*      .01s
*      MEAN
*      +TI ONLY
*      MAN RATE
*      (flashing)
5370A DISPLAY:
*      100.0...0
*      (approx)
*      ns
*      ARM
*      (flashing)
*      LSTN
*Display has 10
 digits
```

The 5370A gate times are programmed in the Period mode.

.01 s *GT2*

Table 4-2. HP-IB Verification Program (Continued)

```
For .1s gate
Verify:
ONLY KEYS LIT:
*       LOC/REM
*       PERIOD
*       .1s
*       MEAN
*       +TI ONLY
*       MAN RATE
*       (flashing)
5370A DISPLAY
*       100.00
*       (approx)
*       ns
*       ARM
*       (flashing)
*       LSTN
*Display has 11
digits
```

0.1 s *GT3*

```
For 1s gate
Verify:
ONLY KEYS LIT:
*       LOC/REM
*       PERIOD
*       1s
*       MEAN
*       +TI ONLY
*       MAN RATE
*       (flashing)
5370A DISPLAY:
*       100.0...0
*       (approx)
*       ns
*       ARM
*       (flashing)
*       LSTN
*Display has 12
digits
```

1 s *GT4*

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 11
SAMPLE SIZE test
Program sends
all sample sizes
Verify:
All sample size
buttons light
sequentially.
*       1
*       100
*       1k
*       10k
*       100k

Press CONTINUE
to perform test.
```

The 5370A sample sizes are programmed in the Time Interval mode.

Sample Size	Program Code
1	SS1
100	SS2
1K	SS3
10K	SS4
100K	SS5

```
CHECK POINT 12
ARMING test

+/- TI test
Verify:
ONLY KEYS LIT
*       LOC/REM
*       TI
*       MEAN
*       SS=1
*       +-TI
5370A DISPLAY:
*       0.00
*       (+-1.00)
*       ns
*       LSTN
*       START or
        STOP
.
```

Programs the 5370A for ±T.I. Arming mode.

AR2

```
CHECK POINT 13
PERIOD
COMPLMNT test
Verify: start
and stop lamps
alternate.

Press CONTINUE
to perform test
```

Exercises the Period Complement function. *"PC"* is sent to the 5370A once every 500 ms a total of 10 times. The arming toggles between START and STOP channels as indicated in the display.

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 14
EXT ARM/MAN
INPUT test.

EXT ARM ENABLE:

SETUP:
Set EXT LEVEL
control just out
of PRESET.

Verify:
ONLY KEYS LIT:
*       LOC/REM
*       TI
*       MEAN
*       SS=1
*       MAN RATE
*       +TI ONLY
*       EXT ARM
5370A DISPLAY:
*Does not change

MAN INPUT test
Verify:
ONLY KEYS LIT:
*       LOC/REM
*       TI
*       MEAN
*       SS=100
*       MAN RATE
*       +TI ONLY
*       EXT ARM
5370A DISPLAY:
*       100.000
*       (approx)
*       ns
*       LSTN

EXT ARM DISABLE
test
Verify:
*EXT ARM light
*goes out after
*continue is
*pushed. Counter
*begins counting


Press CONTINUE
to perform test.
```

CHECK POINT 14 contains three steps as follows:

1 EXT ARM

EA1

2 MAN INPUT

MI

3 EXT ARM DISABLE

EA0

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 15
EXTERNAL HOLDOFF
ENABLE test
Verify:
ONLY KEYS LIT:
*      LOC/REM
*      TI
*      MEAN
*      SS=1
*      MAN RATE
*      EXT
       HOLDOFF
*      EXT ARM
5370A DISPLAY:
*      5.00000
*      (approx)
*      us
*      LSTN
```

Programs the 5370A for EXT HOLDOFF ENABLE

EH1

The 9825A sends a Manual Input *MI* to generate a measurement (≈5 μs)

```
EXTERNAL HOLDOFF
DISABLE test
Verify: EXT
HOLDOFF light
is out.
```

The 9825A sends

EHØ

EXT HOLDOFF DISABLE

```
Return EXT LEVEL
control to
PRESET.
```

```
CHECK POINT 16
STATISTICS test

For STD DEV,
Verify:
ONLY KEYS LIT:
*      LOC/REM
*      TI
*      STD DEV
*      SS=100
*      +TI ONLY
*      MAN RATE
*      (flashing)
5370A DISPLAY:
*      <99.0
*      ps
*      LSTN
*      ARM
*      (flashing)
```

The 8 statistical functions are programmed.

1 Standard Deviation

ST2

Table 4-2. HP-IB Verification Program (Continued)

MIN test Verify: *Same as above *except MIN *light is on and *display= *100.00ns *(approx)	2 Minimum	ST3
MAX test Verify: *Same as above *except MAX *light is on.	3 Maximum	STR
For DSP REF test Verify: *Same as above *except DSP REF *light is on and *display=000.ps	4 Display Reference	ST5
For SET REF test Verify: *Same as above *except DSP REF +and SET REF *lights are on *and display= *100.000ns *(approx)	5 Set Reference	ST8
For CLR REF test Verify: *Same as above *except only *DSP REF light *is on and *display= *000.000ns	6 Clear Reference	ST6
For DSP EVTS test. Verify: *Same as above *except DSP EVTS *light is on and *display=100.EVT	7 Display Events	ST7

Table 4-2. HP-IB Verification Program (Continued)

```
DISPLAY ALL test
Verify:
*Printout lists
*meas data for
*TI(mean),
*STD DEV,
*MIN,MAX,
*REF,EVT
```

8 Display All

ST9

```
Printout:
TI = 9.995400000
00E-08, STD= 6.8
40000000000E-11,
MIN= 9.982000000
00E-08
MAX= 1.000600000
00E-07, REF= 0.0
00000000000E-07,
EVT= 1.000000000
00E+02
```

"Printout" is initiated by the **5370A** and should be formatted exactly as shown here, although actual values may differ.

```
    NOTE
Display will
be erratic.
```

```
SAMPLE SIZE
BINARY test
Verify:
ONLY KEYS LIT:
*      LOC/REM
*      FREQ
*      1PERIOD
*      DSP EVTS
*      MAN RATE
*      +TI ONLY
5370A DISPLAY:
*      12.345
*      k
*      EVTS
*      LSTN
*      ARM

Wait 10 seconds
for display.
```

SAMPLE SIZE BINARY — Counter is programmed to take 12,345 measurement samples in frequency mode. The counter is then programmed to display the number of samples.

FN3
ST7
SB

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 17
MODE test

MODE 1 test
Verify:
ONLY KEYS LIT:
*       LOC/REM
*       TI
*       MEAN
*       SS=100
*       MAN RATE
*       (flashing)
*       +TI ONLY
5370A DISPLAY:
*       100.000
*       (approx)
*       ns
*       LSTN
*       ARM
*       (flashing)

Vary the Display
Rate control and
verify change in
cycle time.

MODE 2 test
Verify:
Counter stops
counting.

Press CONTINUE
three times.
ARM and MAN RATE
will light each
time CONTINUE
is pushed.

MODE 3 test
Verify:
Same as Mode 1
except Display
Rate control has
no effect on
cycle time.

MODE 4 test
Verify:
Counter stops
counting.
```

CHECK POINT 17 exercises the Display Rate modes.

Programs manual Display Rate

MD1
SS2

Programs Display Rate Hold

MD2

MR is sent to the 5370A each time "CONTINUE" is pressed (three times total). *MR* initiates a sample of measurements.

Disables Display Rate control (only if addressed mode).

MD3

Table 4-2. HP-IB Verification Program (Continued)

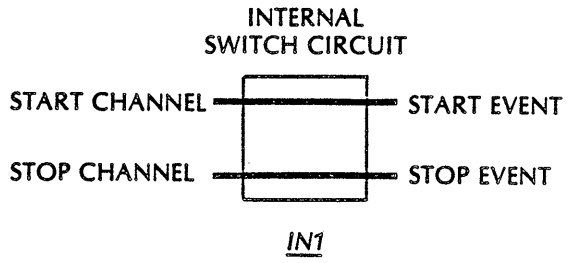
Press CONTINUE three times. ARM and MAN RATE will light each time CONTINUE is pushed. NOTE Return Display Rate control to full cw.	Disables Display Rate control (Wait until Addressed mode). *MD4* *red* is sent to the 5370A each time "CONTINUE" is pressed (three times total).
CHECK POINT 18 SLOPE SELECT test Remove 10MHz from START jack. Ensure all slope switches are down (negative). Set all level controls full cw	Program exercises the three slope controls.
Verify: All trigger lamps toggle when CONTINUE is pushed.	Positive and negative slopes are alternately programmed every 300 ms a total of 10 times. Trigger LED on *SRSA1SO1SE1* Trigger LED of *SA2SO2SE2*
Set all slope switches up (positive). Verify: Trigger lamps stay on.	Trigger LEDs remain on because the 5370A is under remote control.
Press CONTINUE. Verify: All slope lights go out. (Uses SL code.)	When "CONTINUE" is pressed. *SL* (Slope Local) is sent to the counter.
Return all level controls to preset.	

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 19
INPUT SELECTION
test
SETUP:
Connect tee
connector to
START jack.
Connect 10MHz to
one side of tee.
Connect 3-foot
BNC cable
from tee to
STOP jack.
Set COM/SEP
to SEP.
```

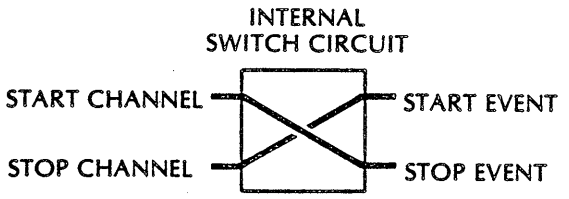
Programs the four various input selection modes.

```
IN1 test
Verify:
5370A DISPLAY:
*       106.00
*       (approx)
*       ns
*       LSTN
```



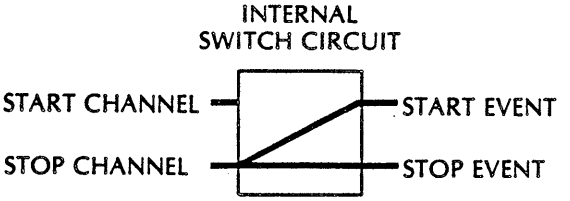
IN1

```
IN4 test
Verify:
5370A DISPLAY:
*       94.00
*       (approx)
*       ns
*       LSTN
```



IN4

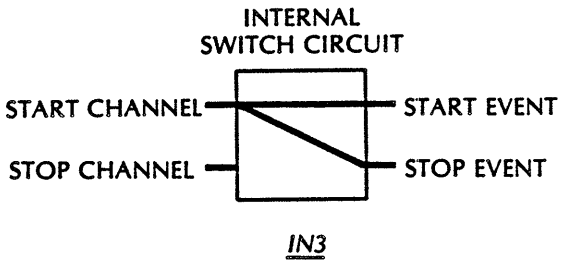
```
IN2 test

SETUP:
Remove tee from
START jack.

Verify:
5370A DISPLAY:
*       100.00
*       (approx)
*       ns
*       LSTN
*       MAN RATE
*       (flashing)
```



IN2

Table 4-2. HP-IB Verification Program (Continued)

```
SETUP:
Remove cable
from STOP jack
and connect to
START jack.

Verify:
Counter does
not count. MAN
RATE does not
flash.


IN3 test

Verify:
5370A DISPLAY:
*      100.00
*      (approx)
*      ns
*      LSTN
*      MAN RATE
*      (flashing)


SETUP:
Remove cable
from START jack
and connect to
STOP jack.

Verify:
Counter does
not count. MAN
RATE does not
flash.
```



IN3

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 20
TEACH/LEARN test

SETUP:
No input signal.

Verify:
ONLY KEYS LIT:
*      LOC/REM
*      FREQ
*      1PERIOD
*      MIN
*      SS=1k
*      MAN RATE
*      +TI ONLY

*Ignore display.


Press CONTINUE
5370A will teach
the 9825A the
front panel
setup.


Turn 5370A power
off then on
again.
The counter will
power up in TI
MEAN,SS=1,and
+TI ONLY.

Press CONTINUE
5370A will learn
from 9825A.
Verify:
*Original setup
*as listed
*above.
```

The 5370A is first preprogrammed. When "CONTINUE" is pressed, the 5370A will TEACH the 9825A the front panel setup.

TE

When "CONTINUE" is pressed again, the 5370A will LEARN from the 9825A.

LN

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 21
TIME INTERVAL
BINARY OUTPUT
test
(computer dump)


SETUP:
Connect 10MHz to
START jack.
Set SEP/COM to
COM.
Set both slope
switches up(pos)


Press CONTINUE
and verify
printout of
approx
1.000000e-07
(100ns).
5370A display =



Printout:
    1.005469e-07


Time Binary
Disable test
(TB0)

Press CONTINUE
Verify:
Display changes
from ------
to 100.00ns.
```

The 5370A is programmed to the Time Interval Binary Output mode.

TB1

Raw measurement data is sent to the 9825A, which then processes and prints the result (measurement value). See *"TB1"* in *Table 3-4.*

Time Interval Binary Output mode is disabled.

TB0

Table 4-2. HP-IB Verification Program (Continued)

```
CHECK POINT 22
INTERNAL ARM
test

IA2 and IA3 test

Verify:
START/STOP lamps
alternate.

Press CONTINUE
to perform test.
```

The 9825A sends alternate Channel Arming commands every 250 ms a total of seven times.

IA2 START ARM
IA3 STOP ARM

```
IA1 test
Verify:
START/STOP lamps
alternate.

Press CONTINUE
to perform test.
```

The 5370A resumes internal Arming.

IA1

```
END OF TEST
```

Table 4-3. Performance Test

I. SELF TEST

Perform steps 1 through 20 of the Operation Verification in *Table 4-1*. Mark the results on the test card. Perform the HP-IB Verification (*Table 4-2*). Mark the results on the test card.

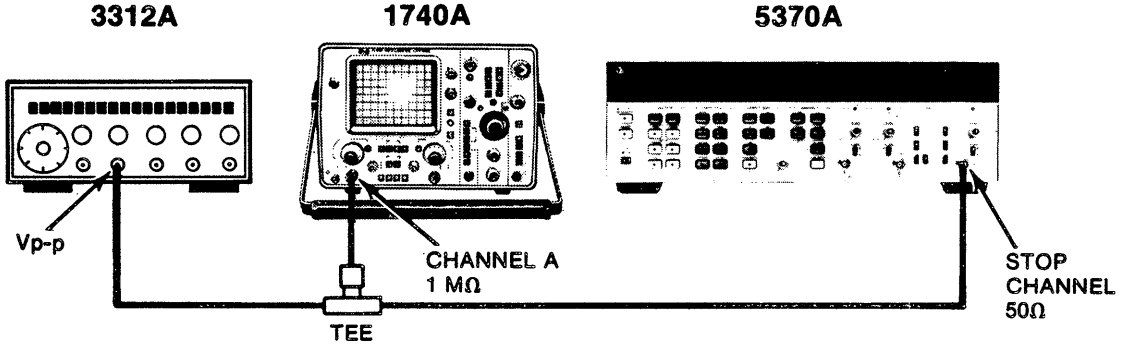
II. FREQUENCY RESPONSE AND SENSITIVITY

Specification: 0.1 Hz to 100 MHz, 100 mV p-p.
Equipment: HP 3312A HP 1740A HP 8660C

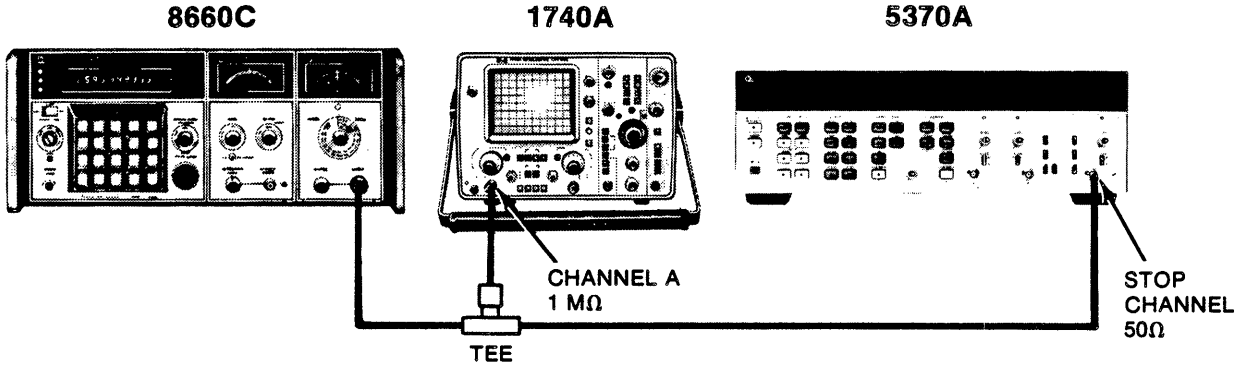
- Set the 5370A front panel controls as follows:

FUNCTION	FREQ
GATE	1 S
START COM/SEP	SEP
STOP CHANNEL	
IMPEDANCE	50Ω
ATTENUATION	÷1
COUPLING	DC
SLOPE	ƒ
TRIGGER LEVEL	PRESET

- Connect the 3312A, 5370A, and 1740A as shown in the following diagram:



- Set the 3312A for a square wave output with no offset.
- Adjust the output of the 3312A from 0.1 Hz to 1 MHz, maintaining a 100 mV p-p signal level. The 5370A should display the correct frequencies. Mark the results on the test card.
- Connect the 8660C, 5370A, and 1740A as shown in the following diagram:



- Vary the 8660C from 1 MHz to 100 MHz maintaining a 100 mV p-p signal level. The 5370A should display the correct frequencies. Mark the results on the test card.

III. PERIOD

Period measuremens are performed by the exact same circuitry which measures frequency. The difference being the way the measurement data is massaged by the microprocessor. For this reason, Period need only be spot checked assuming the 5370A passed Frequency specifications.

Table 4-3. Performance Test (Continued)

- Maintaining the last measurement setup (frequency, 1 MHz to 100 MHz), change the following 5370A front panel controls as follows:

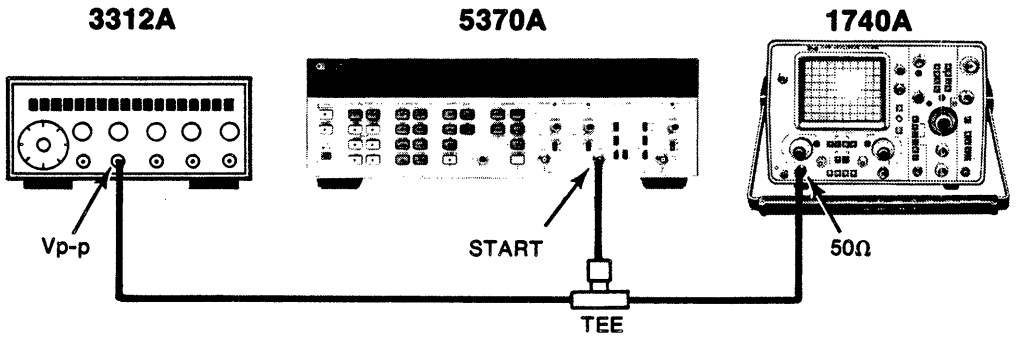
  FUNCTION ..... PERIOD
  GATE ..... 1 PERIOD

- Vary the 8660C from 100 MHz to 1 MHz, maintaining a 100 mV p-p signal level. The 5370A should display the correct periods (10 ns to 1 μs). Mark the results on the test card.

IV. TIME INTERVAL

Specification: -10 second to +10 seconds.
Equipment: HP 3312A HP 1740A

- Connect the 3312A, 1740A, and 5370A as shown in the following diagram:



- Set the 3312A for 0.05 Hz square wave (50-50 duty cycle) output with zero offset. Set the OUTPUT AMPLITUDE to 1V and adjust the vernier to midrange.
- Set the 5370A front panel controls as follows:

  FUNCTION ..... T.I.
  STATISTICS ..... MEAN
  SAMPLE RATE 1
  ARMING ..... ±T.I.
  START CHANNEL
    LEVEL ..... PRESET
    IMPEDANCE ..... 1 MΩ
    ATTENUATION ..... ÷1
    COUPLING ..... DC
    SLOPE ..... ⨍
  START COM/SEP ..... START COM
  STOP CHANNEL
    LEVEL ..... PRESET
    IMPEDANCE ..... 1 MΩ
    ATTENUATION ..... ÷1
    COUPLING ..... DC
    SLOPE ..... ⨍

The 5370A should display approximately 10 seconds. If the 5370A is Armed by the START Channel, as indicated in the display, the reading will be a minus T.I. If the 5370A is Armed by the STOP Channel, the reading will be a positive T.I. Press PERIOD COMPLEMENT to Arm on the opposite channel. This yields the same measurement value but with an opposite sign. Mark the results on the test card.

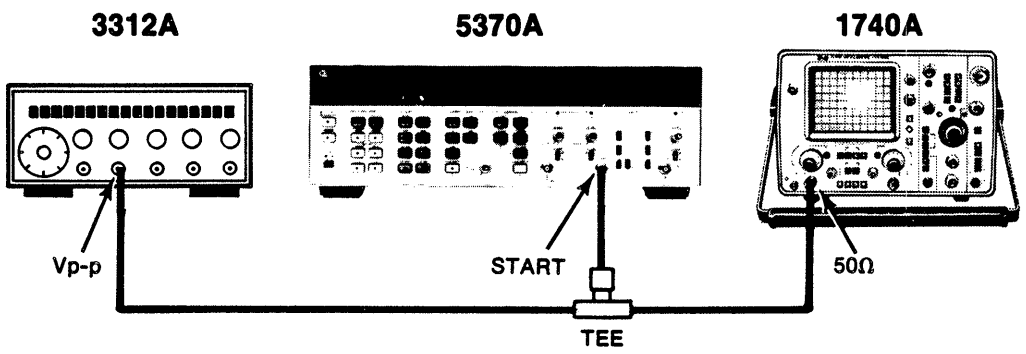
V. COMMON INPUT AND ATTENUATORS

a. Common Input

Specification: 200 mV p-p times attenuator setting
Equipment: HP 3312A HP 8660C HP 1740A

- Connect the 3312A, 1740A, and 5370A as shown in the diagram on the top of the next page.

Table 4-3. Performance Test (Continued)



- Adjust the 3312A for a square wave output of 10 kHz. Reduce the output amplitude to 0V.
- Change the 5370A START COM/SEP to START COM.
- Increase the output level of the 3312A slowly until the 5370A indicates a solid reading of approximately 100 microseconds. The signal level should be below 200 mV p-p. Mark the result on the test card.

b. Attenuators

STOP Channel

Specification: 1V p-p
Equipment: HP 3312A HP1740A

- Connect a cable from the 3312A to the 5370A STOP channel.
- Set the START COM/SEP switch to SEP.
- Set the 5370A FUNCTION to PERIOD.
- Set STOP channel attenuator switch to ÷10.
- Adjust the 3312A output to 10 kHz at ØV. Slowly increase the output amplitude of the 3312A until the 5370A displays a stable count of 100 microseconds. The 3312A output level should be at or below 1V. Mark the result on the test card.

START Channel

Specification: 2V p-p
Equipment: HP 3312A HP 1740A

- Connect the 3312A, 5370A, and 1740A as shown in the following diagram:

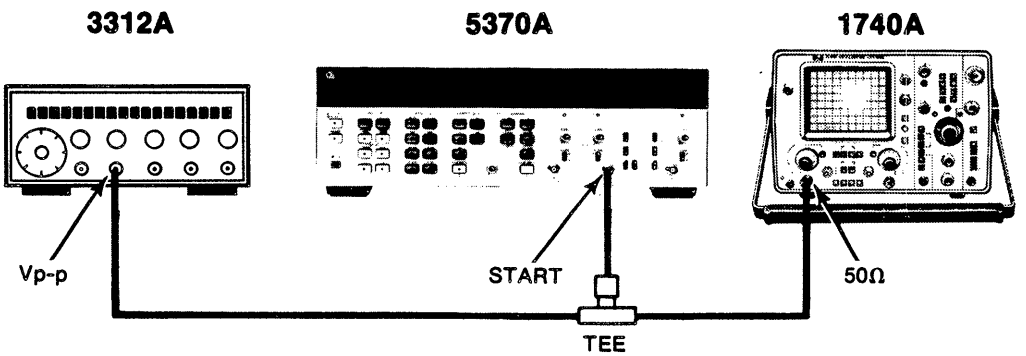


Table 4-3. Performance Test (Continued)

- Set the 5370A controls as follows:

FUNCTION	T.I.
STATISTICS	MEAN
SAMPLE SIZE	1
ARMING	±T.I.
START CHANNEL	
LEVEL	PRESET
IMPEDANCE	1 MΩ
ATTENUATION	÷10
COUPLING	DC
SLOPE	⨍
START COM/SEP	START COM

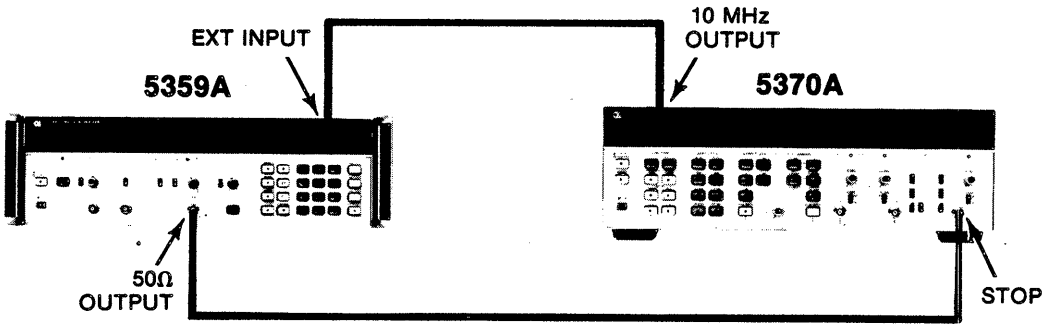
- Adjust the 3312A output to 10 kHz at ØV.
- Slowly increase the 3312A output level until the 5370A displays a stable count of 100 microseconds. The signal level should be at or below 2V p-p. Mark the result on the test card.

VI. ACCURACY

Specification: $\frac{\text{100 ps rms} \pm \text{trigger level}}{\text{gate time}} \pm \text{Time Base}$

Equipment: HP 5359A

- Connect the 5359A and 5370A as shown in the following diagram:



- Set the 5359A controls as follows:

POLARITY	NORM
	POS
AMPLITUDE	MIDRANGE
OFFSET	OFF
FREQ	10 Hz
WIDTH	100 ns
INT/EXT TIME BASE (rear panel)	EXT

- Set the 5370A controls as follows:

FUNCTION	FREQ
GATE	1 s
STATISTICS	MEAN
STOP CHANNEL	
IMPEDANCE	50Ω
ATTENUATION	÷1
COUPLING	DC
SLOPE	⨍
START COM/SEP	SEP

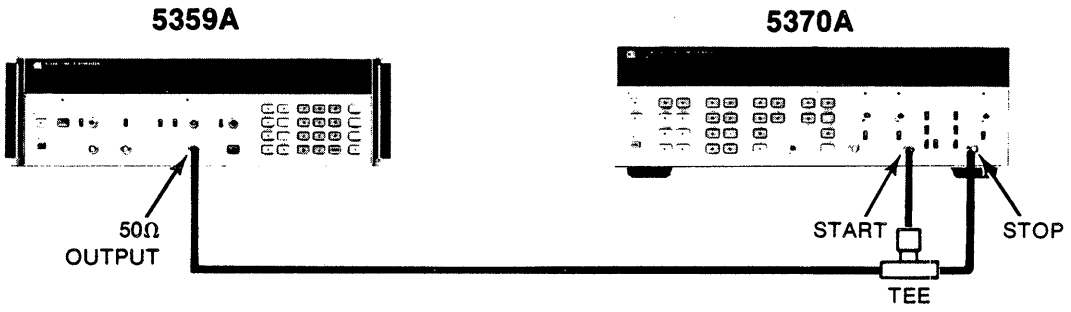
- Observe the 5370A display. It should display 10 Hz $\pm 1 \times 10^{-8}$ Hz. Mark the results on the test card.

Table 4-3. Performance Test (Continued)

VII. MINIMUM PULSE WIDTH

Specification: 5 ns
Equipment: HP 5359A

- Connect the 5359A and 5370A as shown in the following diagram:



- Set the 5370A controls as follows:

FUNCTION	T.I.
STATISTICS	MEAN
ARMING	+T.I. ONLY
BOTH CHANNELS	
ATTENUATION	÷1
COUPLING	DC
SLOPES	⨍
START COM/SEP	SEP
START IMPEDANCE	1 MΩ
STOP IMPEDANCE	50Ω

- Set the 5359A controls as follows:

POLARITY	NORM
	POS
AMPLITUDE	2V
OFFSET	-1V
FREQ	10 kHz
WIDTH	5 ns

- Observe the trigger lights flashing and a reading of 100 microseconds on the 5370A display. Mark the results on the test card.

VIII. JITTER

Specification: 35 ps typical, 100 ps maximum
Equipment: HP 5359A

- Connect the 5359A and 5370A as shown in the following diagram:

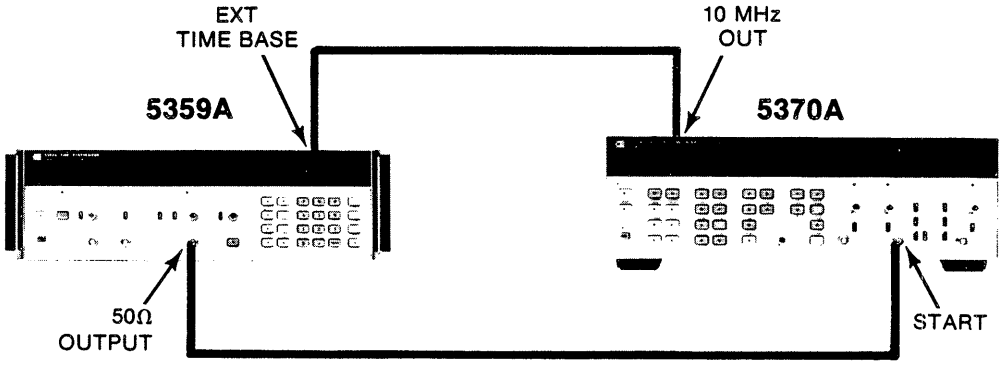


Table 4-3. Performance Test (Continued)

- Set the 5370A controls as follows:

FUNCTION	T.I.
STATISTICS	STD DEV
SAMPLE SIZE	1000
ARMING	±T.I.
BOTH CHANNELS	
LEVELS	PRESET
IMPEDANCE	50Ω
ATTENUATION	÷1
COUPLING	DC
SLOPES	⨍
START COM/SEP	START COM

- Set the 5359A controls as follows:

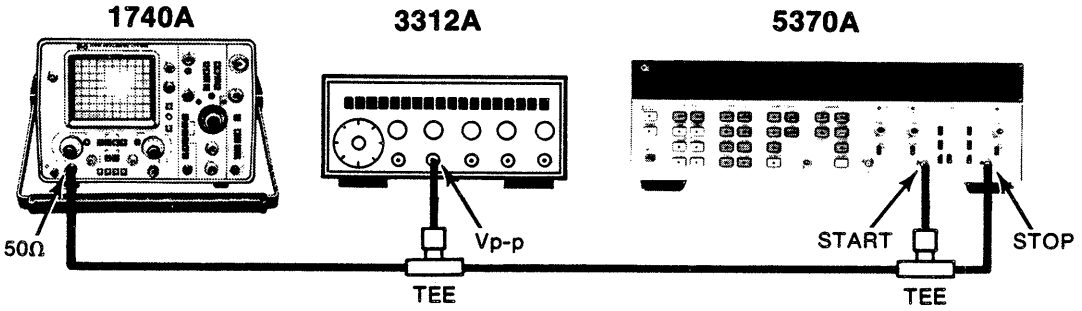
POLARITY	NORM
	POS
AMPLITUDE	2V
OFFSET	-1V
FREQ	10 kHz
WIDTH	10 ns

- Observe a reading of less than 100 ps (35 ps typical). Mark the results on the test card.

IX. DYNAMIC RANGE (PRESET)

Specification: 100 mV to 1V p-p into 50Ω, ÷1
Equipment: HP 3312A HP 1740A

- Connect the 3312A, 1740A, and 5370A as shown in the following diagram:



NOTE

The Dynamic Range is tested in the Time Interval mode while measuring the delay in a 4-foot coaxial cable (HP Part No. 11170C).

- Set the 5370A controls as follows:

FUNCTION	T.I.
STATISTICS	MEAN
SAMPLE SIZE	100
ARMING	±T.I.
START IMPEDANCE	1 MΩ
STOP IMPEDANCE	50Ω
BOTH CHANNELS	
SLOPES	⨍
ATTENUATION	÷1
COUPLING	DC
START COM/SEP	SEP

- Adjust the 3312A to 1 MHz.
- Vary the 3312A output level from 100 mV p-p to 1V p-p. The 5370A should display a constant measurement of approximately 6 nanoseconds with both channel trigger lights flashing. Mark the results on the test card.

THE PERFORMANCE TEST FOR THE 5370A IS NOW COMPLETE.

PERFORMANCE CHECK TEST CARD

HEWLETT-PACKARD MODEL 5370A
UNIVERSAL TIME INTERVAL COUNTER

Test Performed By _____

Serial Number _____

Date _____

DESCRIPTION	CHECK
I. SELF-CHECK	
Operation Verification	_____
HP-IB Verification	_____
II. FREQUENCY RESPONSE AND SENSIVITY	
0.1 Hz to 1 MHz	_____
1 MHz to 100 MHz	_____
III. PERIOD	_____
IV. TIME INTERVAL	
−10 seconds to +10 seconds	_____
V. COMMON INPUT AND ATTENUATORS	
START COMMON/SEP	_____
STOP ATTENUATOR	_____
START ATTENUATOR	_____
VI. ACCURACY	
10 Hz $\pm 1 \times 10^{-8}$ Hz	_____
VII. MINIMUM PULSE WIDTH	
5 ns	_____
VIII. JITTER	
35 ps rms (typical) 100 ps max	_____
IX. DYNAMIC RANGE (PRESET)	
100 mV p-p to 1V p-p	_____

SECTION V
ADJUSTMENTS

5-1. INTRODUCTION

5-2. This section describes the adjustments which will return the 5370A to peak operating condition after repairs are completed or for periodic preventative maintenance. If the adjustments are to be considered valid, the 5370A must have a half-hour warmup and the line voltage must be within +5% to -10% of nominal.

5-3. Generally, only the repaired assembly need be adjusted. The exception is the A3 and the A4 assemblies (05370-60226) which should be adjusted together. The order or sequence in which the assemblies are adjusted is not critical, however, the A3 and A4 input assemblies should be adjusted first.

5-4. The adjustment procedures are listed in numeric order according to the assembly number (A3, A4, A18, A19, etc.). As mentioned, the order of adjustment is not critical, the procedures are in numeric order only for quick and easy reference.

5-5. SAFETY CONSIDERATIONS

5-6. Although the HP Model 5370A has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which MUST be followed to ensure safe operation and to retain the 5370A in safe condition (also see Sections II and III of this manual). Service and adjustments should be performed only by qualified personnel.

WARNING

ANY INTERRUPTION OF THE PROTECTIVE (GROUNDING) CONDUCTOR (INSIDE OR OUTSIDE THE 5370A) OR DISCONNECTION OF THE PROTECTIVE EARTH TERMINAL IS LIKELY TO MAKE THE 5370A DANGEROUS.

5-7. Any adjustment, maintenance, or repair of the opened 5370A with voltage applied should be avoided as much as possible and, when inevitable, should be carried out by a skilled person who is aware of the hazard involved. Capacitors inside the 5370A may still be charged even if the 5370A has been disconnected from its source of supply.

5-8. Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of repaired fuses and the short circuiting of fuseholders must be avoided. Whenever it is likely that the protection offered by fuses has been impaired, the 5370A must be made inoperative and secured against any unintended operation.

WARNING

ADJUSTMENTS DESCRIBED HEREIN ARE PERFORMED WITH POWER SUPPLIED TO THE 5370A WHILE PROTECTIVE COVERS ARE REMOVED. ENERGY AVAILABLE AT MANY POINTS MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

5-9. EQUIPMENT REQUIRED

5-10. The test equipment required for all of the adjustment procedures is listed in *Table 1-2*, Recommended Test Equipment. The test equipment required for the adjustment of each particular assembly is listed at the beginning of the adjustment procedure for that assembly. This listing is a duplicate of the listing in *Table 1-2* and is supplied as a quick reference. The critical specifications of substitute test instruments must meet or exceed the standards listed in *Table 1-2* if the 5370A is to meet the specifications in *Table 1-1*.

5-11. ADJUSTMENT LOCATIONS

5-12. As an adjustment aid, locators are given for each assembly adjustment procedure and appear at the end of each adjustment procedure. These locators are photos and/or simplified illustrations of the assembly showing variable resistors, variable capacitors, test points, etc., needed for adjustment of the assembly.

5-13. Adjustment Procedure

5-14. The adjustment procedures for the assemblies in the 5370A are given in the following tables. *Table 5-1* is for the Input Assemblies (A3, A4); *Table 5-2* is for the DAC/NØ Logic Assembly (A18); *Table 5-3* is for the Interpolator Assemblies (A19, A20); *Table 5-4* is for the 200 MHz Multiplier Assembly (A21); *Table 5-7* is for the Arming Assembly (A22); and *Table 5-8* is for the Crystal Controlled Oscillator (A69).

5-15. ASSEMBLY REMOVAL AND REPLACEMENT

5-16. All of the assemblies, with the exception of the A22 Arming Assembly, can be easily removed from the 5370A by pulling the assembly straight up, out of the motherboard connector. The A22 assembly, in addition to plugging into the motherboard, has an assembly connected to it at a right angle. For this reason, a removal and installation procedure is given in *Table 5-5* and *Table 5-6*, respectively.

Table 5-1. A3/A4 Input Assembly (05370-60226)

NOTE

The 05370-60226 Assembly consists of two boards: the 05370-60033 and the 05370-60004. They should be tested together as a unit.

Equipment:

HP 1725A Oscilloscope
HP 8082A Pulse Generator
HP 182C Mainframe Oscilloscope
HP 1810A 1 GHz Sampling Plug-In
HP 3435A DMM
HP 8640B Signal Generator
HP 10503-6001 BNC Cables (2 matched length ±½")
HP 10503-6001 BNC Cables (5 each)

Accessories:

BNC to miniature female RF connector
Ceramic Tuning Wand

Setup:

NOTE

Setup and bias adjustment performed with no signal input.

1. Set START and STOP LEVEL controls to PRESET, and SLOPE switches to ⊿

NOTE

An adjustment locator for the A3 and A4 assemblies is located on page 5-6.

Table 5-1. A3/A4 Input Assembly (05370-60226) (Continued)

2. Connect DMM between common and the cathode of diode A4CR1. Adjust A4R11 for an indication of Ø volts.

   Test Limit: Ø volts ±50 millivolts

3. Connect DMM between common and the cathode of diode A4CR4. Adjust A4R13 for an indication of Ø volts.

   Test Limit: Ø volts ±50 millivolts

NOTE

Allow a 5-minute warmup before performing the following adjustment procedure.

Bias and Symmetry Adjustment:

NOTE

If A4U2 or A4U1 are replaced, the value of A4R15 or A4R18, respectively, may have to be changed for proper adjustment.

1. Connect a BNC cable from the 8082A Channel A output to the 1725A Channel A input.

2. Set the 8082A Pulse Generator controls as follows:

AMPLITUDE	1.0V to 2.0V range
POLARITY	NEGATIVE COMPLEMENT
OFFSET CHANNEL A	ON
DELAY	2 ns to 5 ns range
DELAY VERNIER	Full CCW
WIDTH	5 ns to 50 ns range
WIDTH VERNIER	midrange
PERIOD	0.1 μ to 1 μ range
PERIOD VERNIER	midrange
TRIGGER	NORM
TRANSITION	minimum

3. Set the 1725A Oscilloscope controls as follows:

CHANNEL A	GND
	0.5V/div
HORIZONTAL DISPLAY	MAIN
VERTICAL DISPLAY	A
INT TRIGGER	A
MAIN TRIGGER	INT
	DC
	+ SLOPE
	AUTO
TIME/DIV	10 ns/div.

4. Adjust the Channel A VERTICAL POSITION control to center the trace on the 1725A screen.
5. Set the 1725A Channel A input to 50Ω.
6. Adjust the 8082A AMPLITUDE VERNIER and OFFSET VERNIER controls to give a waveform from -0.9 volt to +0.9 volt (-1.8 cm to +1.8 cm) on the 1725A screen (as referenced to the zero center line).
7. Connect a BNC cable from the 8082A TRIG OUT to the 1810A TRIG IN.
8. Connect a BNC cable from the 5370A 10 MHz FREQ STD OUTPUT (rear panel) to the 8082A TRIG IN.
9. Connect a BNC cable from 8082A OUTPUT to the 5370A START input.
10. Connect the two matched BNC cables with the miniature female rf connectors between A22J7 and A22J8 of the A20 Arming Assembly to Channels A and B, respectively, of the 1810A plug-in.

Table 5-1. A3/A4 Input Assembly (05370-60226) (Continued)

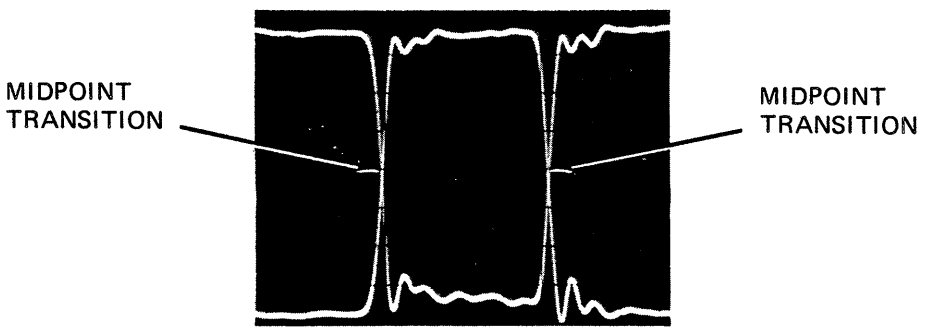
11. Set the 1810A Sampling plug-in controls as follows:

DISPLAY	ALT
	A TRIG
POLARITY	+UP (both channels)
GAIN	20 mV/cm (both channels)
TIME DIV	EXPANDED
	2 ns/cm
TRIGGER	NORM
	+ SLOPE
	EXT
SCAN	SWEEP

12. Set the 5370A controls as follows:

LINE	ON
FUNCTION	T.I.
STATISTICS	MEAN
SAMPLE SIZE	1K
ARMING	±T.I.
INPUTS	50Ω (both channels)
	÷1 (both channels)
	DC (both channels)
	+ SLOPE (both channels)
	START COM
LEVEL	PRESET (both channels)

13. Set the 8082A TRIGGER to EXT and adjust the TRIGGER LEVEL control to midrange (Ø volts).
14. Adjust the 1810A plug-in TRIGGER LEVEL control to sync the two traces.
15. Adjust the 8082A PULSE WIDTH control for a waveform which is 18 ns on the positive half of the cycle.
16. Adjust both the 1810A VERTICAL POSITION controls so both traces are centered on the screen.
17. Set the 1810A MODE control to A, A TRIG.
18. START CHANNEL AMPLIFIER BIAS ADJUSTMENT. Turn A3R44 to its full ccw position. Slowly turn A3R44 clockwise through its full range. Note that the leading pulse edge moves to the left on the oscilloscope display, reaches a maximum left-most position, and then moves back toward the right. Now turn A3R44 back to its full ccw position (leading pulse edge goes back to far right on display). Readjust A3R44, turning clockwise again, until the pulse edge just reaches the maximum left-most position on the screen. STOP ADJUSTING as soon as the waveform stops moving. (Be careful to not turn it more at this point.) The start channel amplifier bias is now adjusted and the pulse edges should have clean, fast rise times and minimum delay.
19. START CHANNEL SCHMITT TRIGGER BIAS ADJUSTMENT. Adjust A4R16 for minimum delay of the leading pulse edge (i.e., the pulse edge moved to the extreme left position on the screen) using the same procedure described for A3R44 in Step 18.
20. START CHANNEL SYMMETRY ADJUSTMENT. While toggling the 5370A START channel SLOPE control between positive and negative, adjust A4R2 until the waveform transitions (pluse edges) cross zero with their midpoints at the same place on the 182C screen as shown below.



POLARITY ADJUSTMENT

Table 5-1. A3/A4 Input Assembly (05370-60226) (Continued)

21. Set the 1810A mode control to B, B TRIG.

22. STOP CHANNEL AMPLIFIER BIAS ADJUSTMENT. Adjust A3R47 using the same procedure described for A3R44 in Step 18.

23. STOP CHANNEL SCHMITT TRIGGER BIAS ADJUSTMENT. Locate A4R19 and turn it to its full *clockwise* position. Now turn it *counterclockwise* until the leading edge of the pulse just reaches its left-most position on the screen. It is now adjusted.

    (Note: this potentiometer acts in just the opposite manner to the others in Step 18 and 19, but yields the same results.)

24. STOP CHANNEL SYMMETRY ADJUSTMENT. While toggling the 5370A STOP Channel SLOPE control between positive and negative, adjust A4R5 until the waveform transitions (pulse edges) cross zero with their midpoints at the same place, as shown in the photo above.

    FINAL CHECK. Switch the 1810A mode control to ALT to display both channels A and B. The pulses should be of the same amplitude with START (A) leading STOP (B) by 800 ps, typically. In no case should this time difference be greater than 1.8 ns.

Sensitivty Adjustment:

25. Connect a BNC cable from 8640B to the 5370A START input.

26. Set the 8640B frequency to 100 MHz at 20 millivolts.

27. Set the 5370A input controls (both channels) as follows:

SEP/START COM	SEP
IMPEDANCE	50Ω
COUPLING	DC
LEVEL	PRESET
ATTENUATION	÷1
SLOPE	+

28. Set 1810A plug-in to A, TRIG A, INT TRIG.

29. Adjust A4R11 for solid triggering on 182C screen.

30. Decrease 8640B amplitude and, while toggling START channel slope control, adjust A4R11 for maximum sensitivity (minimum input which still allows solid triggering as seen on 182C screen).

    Test Limit: 100 MHz @ 30 millivolts (either slope).

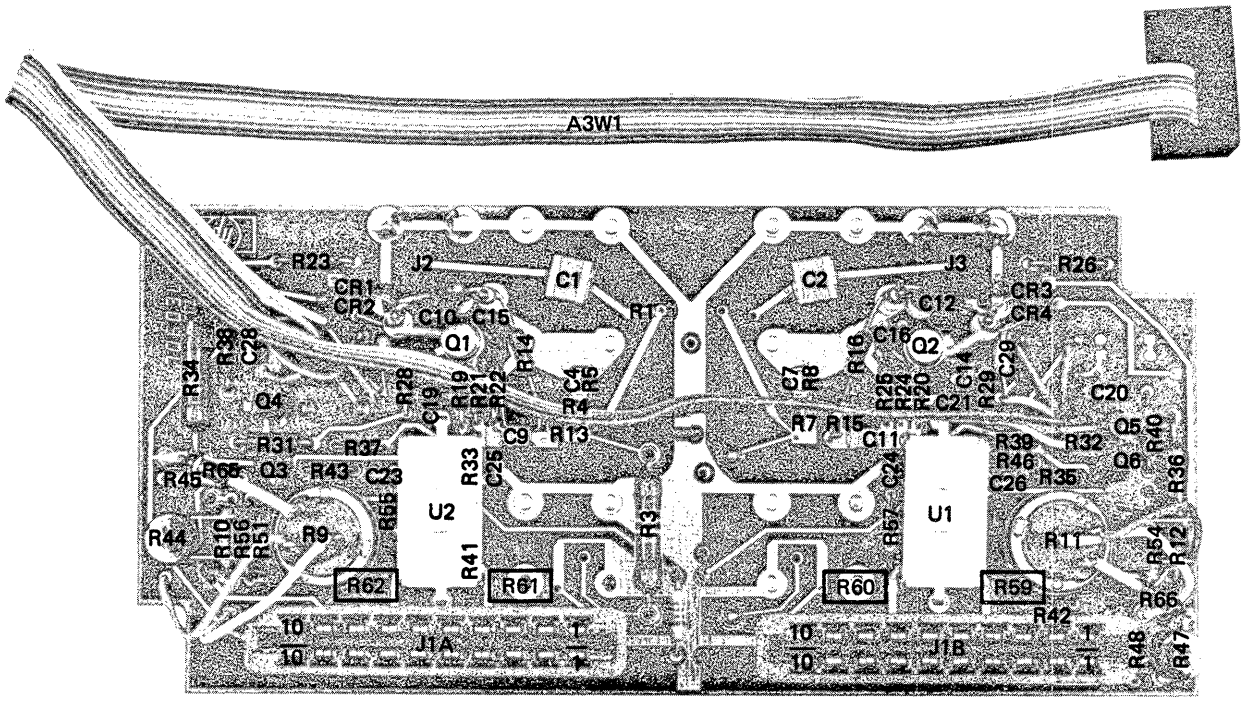
31. Remove BNC cable from START input and connect to STOP input.

32. Repeat steps 25 through 29 adjusting A4R13 in step 28 instead of A4R11.

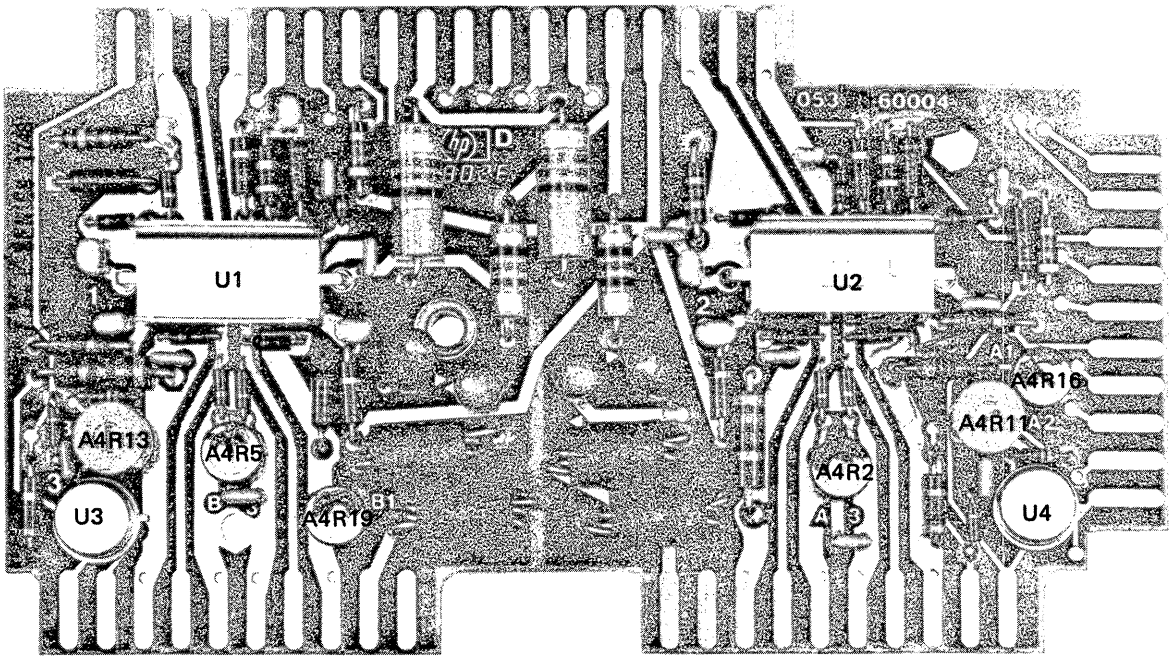
    Test Limit: 100 MHz @ 30 millivolts (either slope).

Adjustment of the 05370-60226 Assembly (A3 and A4 combination) is now complete.

Table 5-1. A3/A4 Input Assembly (05370-60226) (Continued



A3 Adjustment Locator



A4 Adjustment Locator

Table 5-2. A18 DAC/NØ Logic Assembly

Equipment:

HP 3435A DMM

Accessories:

Ceramic Tuning Wand

Setup:

1. Set the 3435A FUNCTION to V dc and the RANGE to AUTO.
2. Turn the power switch of the 5370A to ON and press TRIG LVL function.
3. Set the DIP test switch on the A16 Arming Interface Assembly as shown in the adjustment hookup.
4. Connect the DMM between ground and the Test Points as shown in the adjustment hookup.
5. Adjust the specified pot on A18 to meet the specified test limit voltage as shown in the adjustment hookup.

Adjustment Hookup

Set Test Switch	Connect DMM	Adjust Pot	Test Limit
	TP2	OA	0.000V ±0.005V
	TP3	OO	0.000V ±0.005V
	TP3	GA	-2.560V ±0.005V
	TP2	GO	-2.560V ±0.005V
	TP3	RA	+2.550V ±0.005V
	TP2	RO	+2.550V ±0.005V

6. Set the DIP test switch on the A16 assembly as shown here.

7. Set both the START and STOP LEVEL controls to PRESET.
8. Adjust pot OA until the left display on the 5370A reads Ø.ØØ.
9. Adjust pot OO until the right display on the 5370A reads Ø.ØØ.

NOTE

If OA and/or OO (Steps 8 and/or 9) are adjusted to give a display of Ø.ØØ, all other previous voltages will be different by the amount shown in the display just before step 8.

Adjustments for the A18 assembly are now complete.

Table 5-3. A19/A20 Interpolator Assembly (05370-60119)

NOTE

The A19 Assembly and the A20 Assembly are the same assembly board with the same HP Part Number. This procedure applies to both.

Equipment:

HP 8082A Pulse Generator
HP 1720A Oscilloscope

Accessories:

HP 10013 10:1 Scope Probe (2 each)
HP 05370-60077 Extender Board (for servicing)
HP 10503-6001 4-foot BNC Cable (2 each)

NOTE

An adjustment locator for the A19/A20 assembly is located on page 5-12.

Setup:

A19/A20 Assembly

Anticoincidence Pot (R5) ..... to midrange
Symmetry Pot (R16) ..... to midrange
Balance Pot (R69) ..... to midrange
T.I. Zero Varcap (C3) ..... to minimum C
(Silver semicircle away from delay line and slightly to board)

Pulse Generator

AMPLITUDE ..... 1.0 to 2.0 volt range
POLARITY ..... Negative
..... Compliment
OFFSET ..... to ON
DELAY ..... to DELAY
..... 2 ns to 5 ns range
DELAY VERNIER ..... minimum (CCW)
WIDTH ..... to 5—50 ns range
WIDTH VERNIER ..... to midrange
PERIOD ..... to 0.1 μ to 1 μ
PERIOD VERNIER ..... to midrange
TRIGGER ..... to NORM

1720A Oscilloscope

CHANNEL A ..... to GND
..... to 0.5V/cm
CHANNEL B ..... to DC
..... to 0.05V/cm
HORIZONTAL DISPLAY ..... to MAIN
VERTICAL DISPLAY ..... to A
INT TRIGGER ..... to A
MAIN TRIGGER ..... AUTO
..... +
..... DC
..... INT
HORIZONTAL TIME/DIV ..... to 10 ns/Div

1. Center Channels A and B scope traces to midscreen.
2. Set channels (scope) to 50Ω.
3. Connect BNC cable between pulse generator Channel A output and 1720A Channel A input.
4. Adjust pulse generator amplitude vernier and offset vernier to give a waveform from -2 cm to 2 cm on screen (-1V to +1V). DO NOT ADJUST SCOPE VERTICAL POSITION!
5. Connect the BNC cable from pulse generator Channel A output to 5370A START input.
6. Connect a BNC cable from the 5370A rear panel 10 MHz Output to pulse generator EXT TRIGGER INPUT.

Table 5-3. A19/A20 Interpolator Assembly (05370-60119) (Continued)

Setup:

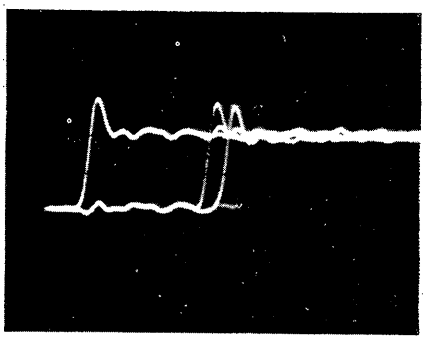
1720A Oscilloscope

VERTICAL DISPLAY	ALT
CHANNEL A	DC
	0.05V/Div
TIME/DIV MAIN	0.2 μ/Div
DELAYED	10 ns/Div

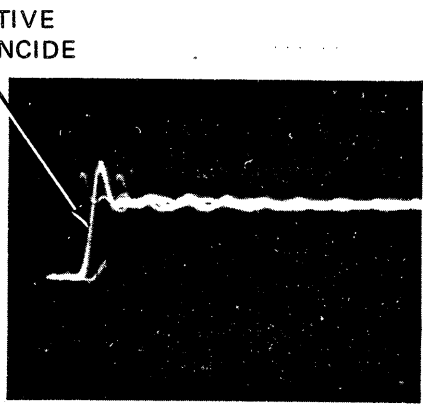
5370A Inputs

BOTH CHANNELS	50Ω
	÷1
	DC
	+ SLOPE
	START COM
TRIGGER LEVELS	PRESET
DISPLAY RATE	maximum (CW)

7. With both Interpolator Assemblies (A19/A20) installed in 5370A, set 5370A line switch to ON.
8. Set pulse generator Trigger Select to EXT TRIG.
9. Adjust pulse generator EXTERNAL INPUT TRIGGER LEVEL fully clockwise (disable trigger).
10. Connect scope probe A to TP10 and scope probe B to TP11 of interpolator board being adjusted.
11. Adjust scope waveforms to overlay each other.
12. Adjust balance pot R69 so the positive edge of Channel A (oscilloscope) coincides with the positive edge of Channel B as shown in the right photo below.

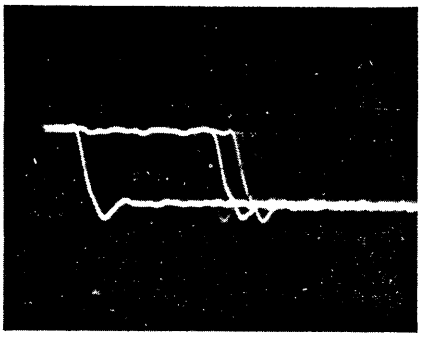


INCORRECTLY ADJUSTED R69

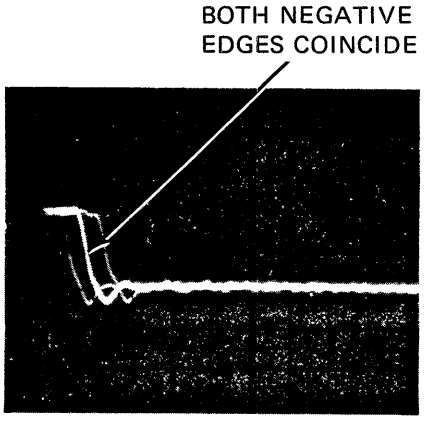


CORRECTLY ADJUSTED R69

13. Adjust symmetry pot R16 so the negative edges of Channel A (oscilloscope) and Channel B coincide as shown in the right photo below.



INCORRECTLY ADJUSTED R16



CORRECTLY ADJUSTED R16

Table 5-3. A19/A20 Interpoltor Assembly (05370-60119) (Continued)

14. Connect scope probe A to A19TP10 and probe B to A20TP10.
15. Press SAMPLE SIZE 10K and ±T.I. (ARMING) on the front panel of the 5370A.
16. Adjust the pulse generator Trigger Level Control to midrange (ØV). Set the oscilloscope HORIZONTAL DISPLAY to MAIN.

NOTE

Adjust only one capacitor (START or STOP). The other capacitor should be at minimum.

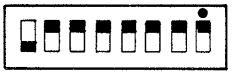
17. Adjust the T.I. Zero variable capacitor (C3) in either the START (A19) or the STOP (A20) interpolator, whichever is necessary, to align the two traces on the oscilloscope.

NOTE

The next adjustment must be made AFTER T.I. Zero adjustment and should be made each time T.I. Zero is changed.

18. Connect scope probe A to TP3 and probe B to TP10 of interpolator board under adjustment. Set the switch (on the A16 assembly) closest to the front of the 5370A down. The switch array from front to back should now be

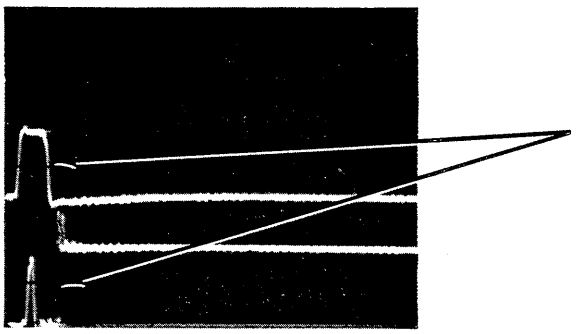
This end toward front panel →



NOTE

Channel A should display a positive pulse and Channel B should display a square wave.

19. Adjust the pulse generator's Delay Vernier slowly until the first positive edge of the square wave comes as close to the negative edge of the pulse as possible as shown below.



PULSE SQUARE WAVE ALIGNMENT

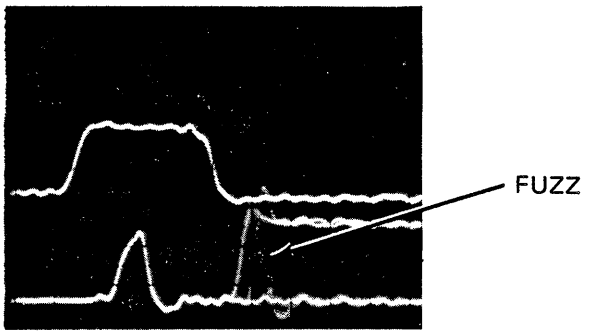
NOTE

Ideal when the first positive half cycle flips in and out of view at random.

Table 5-3. A19/A20 Interpolator Assembly (05370-60119) (Continued)

20. Set the oscilloscope sweep to 10 ns/Div.

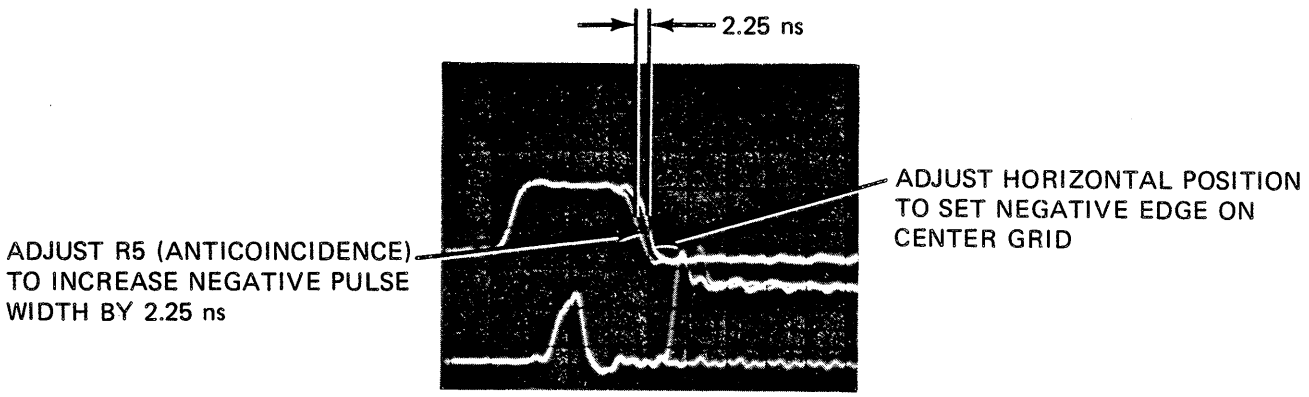
21. Adjust the Anticoincidence pot R5 slowly counterclockwise increasing Channel A pulse width. The first positive slope on the B Channel waveform should fuzz just before disappearance. Adjust the pot where the fuzz is most pronounced. If adjustment will not cause B Channel waveform to fuzz; recenter pot R5 and adjust pulse generator PULSE DELAY VERNIER to move B Channel positive edge as close to A Channel negative edge as possible. Repeat step 22. Because of drift in the test equipment, this step may have to be repeated.



CORRECTLY ADJUSTED R5 (ANTICOINCIDENCE)

22. Adjust oscilloscope Channel A vertical position to center Channel A trace. Adjust Channel B vertical position to move Channel B waveform out of the way. Adjust oscilloscope horizontal position so the center of the negative edge of Channel A waveform is on the center of the scope grid.

23. Adjust Anticoincidence pot R5 to INCREASE pulse width by 2.25 ns as shown below. BE ACCURATE!



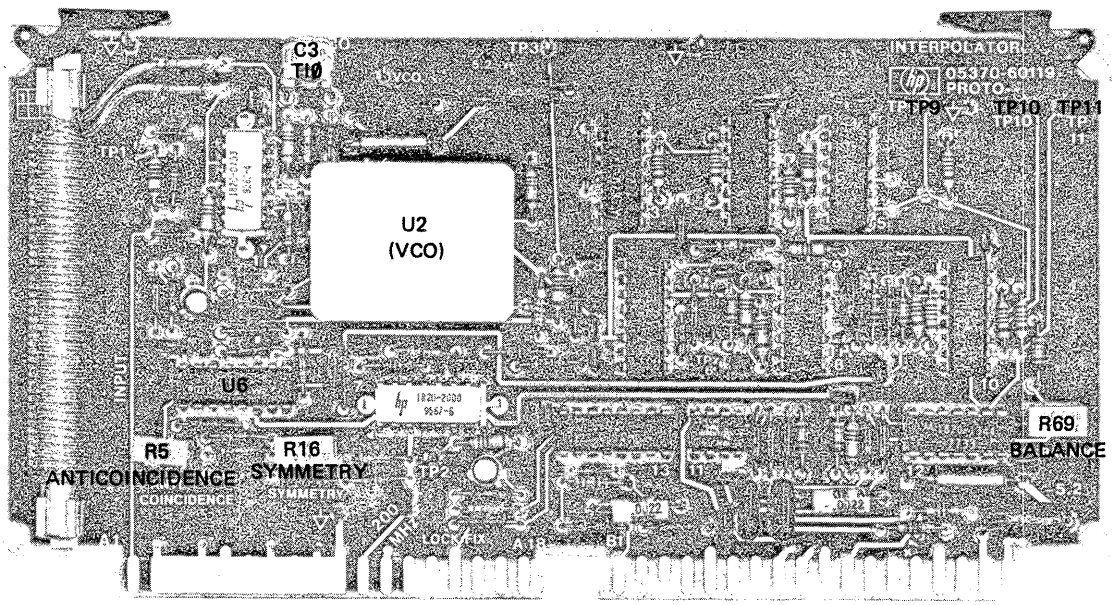
HORIZONTAL ADJUSTMENT

NOTE

If pot runs out of range before 2.25 ns increase can be reached return the negative edge to the center grid and then DECREASE pulse width by 2.25 ns (from center grid). BE ACCURATE!

Adjustments for the 05370-60119 Interpolator Assembly are now complete.

Table 5-3. A19/A20 Interpolator Assembly (05370-60019) (Continued)



A19/A20 Adjustment Locator

Table 5-4. A21 200 MHz Multiplier Assembly

Equipment:

HP 141T/8552A/8554L Spectrum Analyzer
HP 1120A Active Probe
HP 1122A Probe Power Supply

Accessories:

HP 10241A 10:1 Divider Tip
HP 5060-0474 Spanner Tip
HP 8710-0033 Ceramic Tuning Wand
12" Alligator Clip Lead

Setup:

1. Connect 10:1 divider tip and spanner tip to active probe. Connect probe to power supply.

CAUTION

Always set 5370A power to STBY before removing or inserting assembly boards.

2. Remove A19 and A20 assemblies.
3. Set 141T/8552A/8554L Spectrum Analyzer as follows:

STORAGE	STD
PERSISTANCE	MIN
BANDWIDTH	100 kHz
SCAN WIDTH	10 MHz PER DIV
INPUT ATTENUATOR	10 dB
CENTER FREQUENCY	50 MHz
SCAN TIME	2 ms
LOG REF LEVEL DIAL	-10 dBm
LOG REF LEVEL VERNIER	Ø
LOG REF LEVEL SWITCH	LOG
VIDEO FILTER SWITCH	OFF
SCAN MODE SWITCH	INT
SCAN TRIGGER SWITCH	AUTO

4. Connect 1120A Active Probe to spectrum analyzer RF INPUT.
5. Connect probe tip to A21TP3.

NOTE

Make all the following adjustments with ceramic tuning wand only.

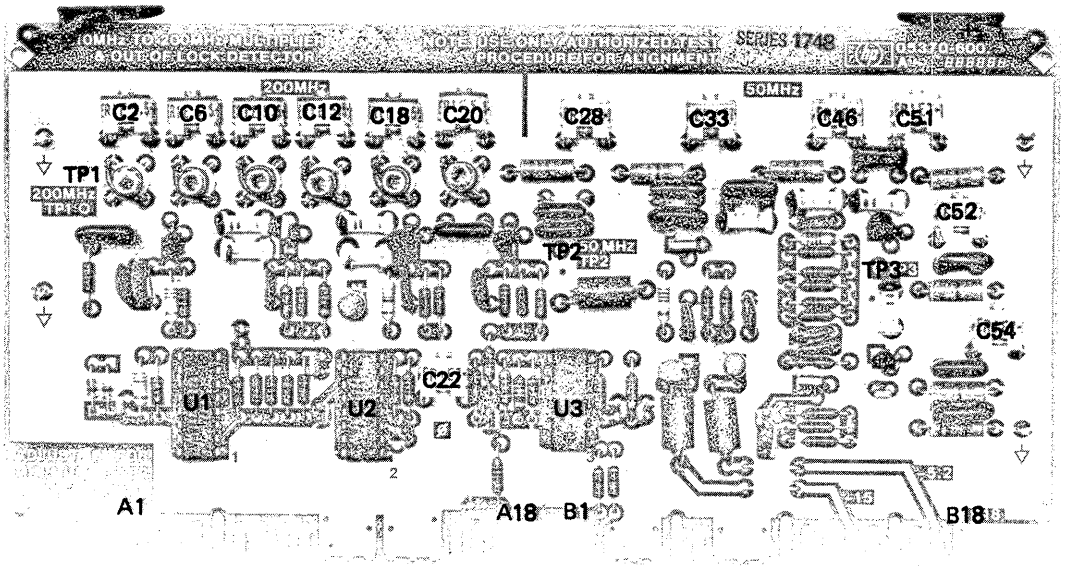
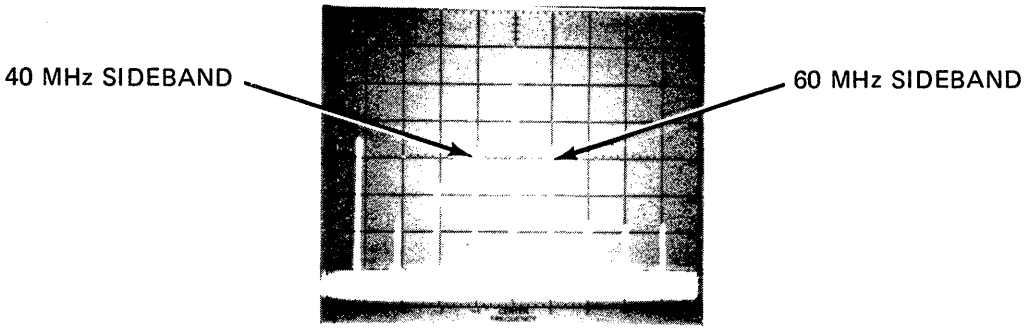


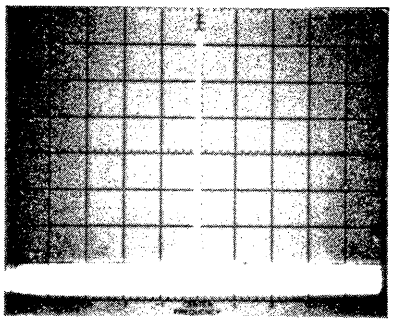
Table 5-4. A21 200 MHz Multiplier Assembly (Continued)

6. Adjust A21C54 for equal amplitude of the 40 MHz and 60 MHz sidebands around the 50 MHz center frequency as shown. Do not readjust C54 during the remaining procedure.



50 MHz Center Frequency Signal

7. Set spectrum analyzer input attenuator to 20 dB and connect probe tip to A21TP2.
8. Adjust A21C52, C51, C46, C33, and C28 to minimize all sidebands around the 50 MHz signal as completely as possible. Repeat adjustment as necessary until sidebands are down 60 dB or more as shown.

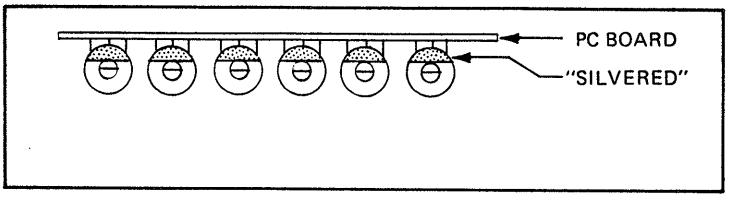


50 MHz Sidebands Adjustment Signal

9. Set spectrum analyzer as follows:

CENTER FREQUENCY	200 MHz
BANDWIDTH	300 kHz
SCAN WIDTH	50 MHz/Div
LOG REF LEVEL DIAL	+10 dBm

10. Connect probe tip to A21TP1. Make sure the probe is grounded. The probe ground connection is critical. Poor ground will give excessive 10 MHz frequency components.
11. Adjust A21C20, C18, C12, C10, C6, and C2 to the prealignment position ("silvered" half of each capacitor adjacent to board ground plane) as shown.



Capacitor Prealignment Position

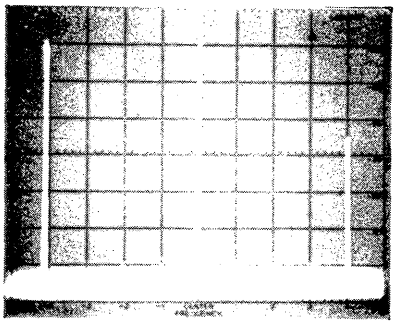
Table 5-4. A21 200 MHz Multiplier Assembly (Continued)

12. Adjust A21C20, C18, C12, C10, C6, and C2 to maximize the amplitude of the 200 MHz center frequency signal.
13. Readjust A21C20, C18, C12, C10, C6, and C2 to minimize all sidebands around the 200 MHz center frequency as completely as possible.

NOTE

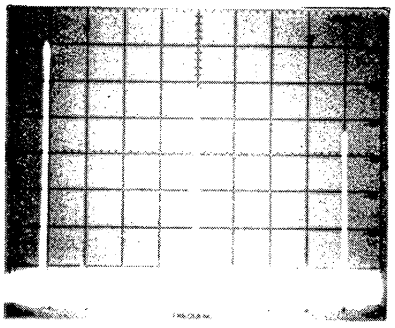
Maintaining the maximum amplitude of the 200 MHz center frequency is not critical at this point and the amplitude of the second harmonic (400 MHz) is not critical.

14. Repeat adjustments as necessary until sidebands are down 65 dB or more as shown.



200 MHz Sideband Adjustment Signal

15. Set spectrum analyzer LOG REF LEVEL VERNIER for 200 MHz center frequency at Ø dB log reference level on display screen.



200 MHz Test Limit Signal

Test Limit

16. Connect probe tip to U1 pin 2 and observe 200 MHz signal amplitude down less than 30 dB.
17. Connect probe tip to U1 pin 14 and observe 200 MHz signal amplitude down less than 30 dB.
18. Connect probe tip to U2 pin 14 and observe 200 MHz signal amplitude down less than 30 dB.

Adjustments for the A21 Multiplier Assembly are now complete.

Table 5-5. A22 Arming Board Removal

To remove the arming board from the 5370A, use the following procedure:

1. Remove top and bottom covers.
2. Remove the two ribbon cables and the three coax cables from the A22 assembly. (Two of these are removed from bottom of instrument.)
3. Lift the arming board by its left side and by its right side using the J3 connector socket until the board just clears the top of its motherboard connector.
4. Push the arming board back and down so that its edge connector rests flush against the back side of the motherboard connector.
5. Hold the left corner of the A4 Trigger board and push the arming board near its J2 connector until the two connectors pull free.
6. Free the left edge of the arming board from its edge support and slide the board to the left to remove from the counter.

Table 5-6. A22 Arming Board Installation

To install the arming board into the 5370A, use the following procedure:

1. Remove the A20 and A21 boards from the counter to allow additional room to work.
2. Lower the arming board into position so that its edge connector rests on top of the motherboard connector and A22J2 rests on top of the A4 board edge connector. The arming board will have to be tilted slightly so that the A4 edge connector can slip between A22J2 and the transistors and coax connectors just below it.
3. Insert the left edge of the arming board into its edge support, and ensure it remains in the support throughout steps 4, 5, and 6.
4. Hold the left corner of the A4 Trigger board, and push the arming board near its J2 connector until A22J2 and A4 edge connector can be maneuvered into their mating positions.
5. From the back side of A22, push the arming board forward until it mates securely to A4. Be sure the A22 edge connector is raised above the motherboard connector or the two boards will not be able to mate.
6. Insert A22 into its motherboard connector.
7. Install A19, A20, the two ribbon cables, and the three coax cables. Replace covers.

NOTE

Removal of the A22 Assembly is not normally necessary for adjustment. However, *Table 5-5* and *5-6* are given in case removal of the A22 Assembly is desired.

Table 5-7. A22 Arming Assembly

Equipment:

HP 10503A Coaxial Cable

Setup:

1. Set 5370A controls as follows:

FUNCTION	T.I.
STATISTICS	MEAN
SAMPLE SIZE	1
ARMING	+T.I. ONLY
START/STOP LEVELS	PRESET
IMPEDANCE	50Ω
ATTENUATORS	÷1
INPUT COUPLINGS	DC
SEP/COM	START COM

2. Adjust pots A22R63 and A22R65 fully clockwise.

3 Connect the coaxial cable between the rear panel FREQ STD OUTPUT jack and the front panel START input jack. Display should indicate 100.00 ns ±0.7 ns.

NOTE

Adjustment loop starts here.

Adjustment:

1. Set 5370A controls as follows:

FUNCTION	PERIOD
STATISTICS	MEAN
SAMPLE SIZE	1K

Test Limit: 5370A display should indicate 100.00 ns ±0.01 ns.

NOTE

No Change in reading will occur until the complete procedure has been followed.

2. Adjust pot A22R65 slightly if display reads high.
3. Adjust pot A22R63 slightly if display reads low.

NOTE

Once beginning adjustment, always adjust same pot.

4. Set 5370A FUNCTION to T.I.
5. Perform step 1.

NOTE

If reading in step 1 is not within specifications, repeat steps 1 through 5.

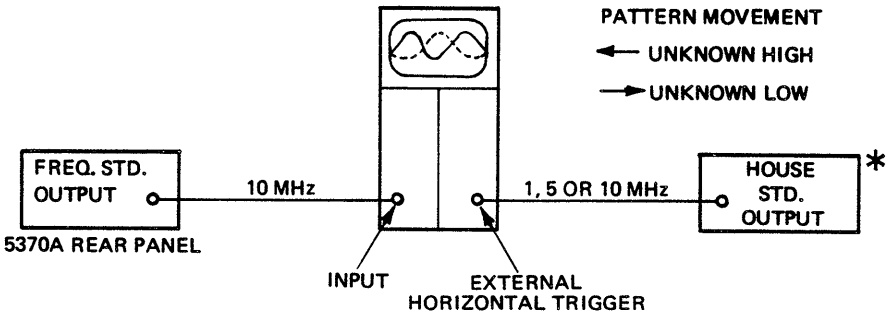
Adjustments for the A22 Arming Assembly are now complete.

Table 5-8. A69 Oscillator (Standard or Option 001)

Every few months, the oscillator should be checked to a house standard. When adjustment is required, use the oscilloscope method shown below. Using the appropriate sweep speed, adjust the oscillator until the movement of the pattern is stopped.

NOTE

Instruments with Option 001 should be connected to the ac supply for at least one hour prior to oscillator frequency/ adjustment. This ensures the 10544A is at operating temperature.



Oscillator Adjustment Interconnections

MOVEMENT	SWEEP SPEED			NOTES
	1 μs/cm	0.1 μs/cm	0.01 μs/cm	
1 cm/s	1×10^{-6}	1×10^{-7}	1×10^{-8}	Time scope trace movement with second hand of watch or clock.
1 cm/10s	1×10^{-7}	1×10^{-8}	1×10^{-9}	
1 cm/100 s	1×10^{-8}	1×10^{-9}	1×10^{-10}	

Sweep movement versus calibration accuracy.

Adjustments for the A69 Oscillator Assembly are now complete.

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* House standard accuracy must be greater than 5×10^{-10}/day

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. *Table 6-1* lists abbreviations used in the parts list and throughout the manual. *Table 6-2* lists all replaceable parts in reference designation order. *Table 6-3* contains the names and addresses that correspond with the manufacturers' code numbers.

6-3. ABBREVIATIONS

6-4. *Table 6-1* lists abbreviations used in the parts lists, schematics, and throughout the manual. In some cases, two forms of the abbreviation are used, one all in CAPITAL letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and upper case letters.

6-5. REPLACEABLE PARTS LIST

6-6. *Table 6-2* is the list of replaceable parts and is organized as follows:

a. Electrical assemblies and their components in alphanumerical order by reference designation.

b. Chassis-mounted parts in alphanumerical order by reference designation.

c. Miscellaneous parts.

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

a. The Hewlett-Packard part number.
b. Part number check digit (CD).
c. The total quantity (Qty) used in the instrument.
d. The description of the part.
e. A typical manufacturer of the part in a five-digit code.
f. The manufacturer's number for the part.

6-8. The total quantity for each part is given only once at the first appearance of the part number in the list.

6-9. ORDERING INFORMATION

6-10. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number (with the check digit), indicate the quantity required, and address the order to the nearest Hewlett-Packard office. The check digit ensures accurate and timely processing of your order.

6-11. To order a part that is not listed in the replaceable parts table, include the instrument model number, 5370A serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-12. PARTS PROVISIONING

6-13. Stocking spare parts for an instrument is often done to ensure quick return to service after

a malfunction occurs. Hewlett-Packard has a Spare Parts Kit available for this purpose. The kit consists of selected replaceable assemblies and components for the 5370A. The contents of the kit and the recommended spares list are based on failure reports and repair data, and parts support for one year. A complementary recommended spares list for the 5370A may be obtained on request and the Spare Parts Kit may be ordered through your nearest Hewlett-Packard office.

6-14. DIRECT MAIL ORDER SYSTEM

6-15. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are:

a. Direct ordering and shipment from the HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local HP office when the orders require billing and invoicing).

6-16. Mail order forms and specific ordering information is available through your local HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

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

ABBREVIATIONS

A	= ampere	HD	= head	NE	= neon	SPST	= single-pole, single-throw
ac	= alternating current	HDW	= hardware	NEG	= negative	SSB	= single sideband
ACCESS	= accessory	HF	= high frequency	nF	= nanofarad	SST	= stainless steel
ADJ	= adjustment	HG	= mercury	NI PL	= nickel plate	STL	= steel
A/D	= analog-to-digital	HI	= high	N/O	= normally open	SQ	= square
AF	= audio frequency	HP	= Hewlett-Packard	NOM	= nominal	SWR	= standing-wave ratio
AFC	= automatic frequency control	HPF	= high pass filter	NORM	= normal	SYNC	= synchronize
AGC	= automatic gain control	HR	= hour (used in parts list)	NPN	= negative-positive-negative	T	= timed (slow-blow fuse)
AL	= aluminum	HV	= high voltage	NPO	= negative-positive zero (zero temperature coefficient)	TA	= tantalum
ALC	= automatic level control	Hz	= hertz	NRFR	= not recommended for field replacement	TC	= temperature compensating
AM	= amplitude modulation	IC	= integrated circuit	ns	= nanosecond	TD	= time delay
AMPL	= amplifier	ID	= inside diameter	NSR	= not separately replaceable	TERM	= terminal
APC	= automatic phase control	IF	= intermediate frequency	nW	= nanowatt	TFT	= thin-film transistor
ASSY	= assembly	IMPG	= impregnated	OBD	= order by description	TGL	= toggle
AUX	= auxiliary	in	= inch	OD	= outside diameter	THD	= thread
AVG	= average	INCD	= incandescent	OH	= oval head	THRU	= through
AWG	= american wire gauge	INCL	= include(s)	OP AMPL	= operational amplifier	TI	= titanium
BAL	= balance	INP	= input	OPT	= option	TOL	= tolerance
BCD	= binary coded decimal	INS	= insulation	OSC	= oscillator	TRIM	= trimmer
BD	= board	INT	= internal	OX	= oxide	TSTR	= transistor
BE CU	= beryllium copper	kg	= kilogram	oz	= ounce	TTL	= transistor-transistor logic
BFO	= beat frequency oscillator	kHz	= kilohertz	Ω	= ohm	TV	= television
BH	= binder head	kΩ	= kilohm	P	= peak (used in parts list)	TVI	= television interference
BKDN	= breakdown	kV	= kilovolt	PAM	= pulse-amplitude modulation	TWT	= traveling wave tube
BP	= bandpass	lb	= pound	PC	= printed circuit	U	= micro (10^{-6}) used in parts list)
BPF	= bandpass filter	LC	= inductance-capacitance	PCM	= pulse-code modulation; pulse-count modulation	UF	= microfarad (used in parts list)
BRS	= brass	LED	= light-emitting diode	PDM	= pulse-duration modulation	UHF	= ultrahigh frequency
BWO	= backward-wave oscillator	LF	= low frequency	pF	= picofarad	UNREG	= unregulated
CAL	= calibrate	LG	= long	PH BRZ	= phosphor bronze	V	= volt
ccw	= counterclockwise	LH	= left hand	PHL	= phillips	VA	= voltampere
CER	= ceramic	LIM	= limit	PIN	= positive-intrinsic-negative	Vac	= volts ac
CHAN	= channel	LIN	= linear taper (used in parts list)	PIV	= peak inverse voltage	VAR	= variable
cm	= centimeter	lin	= linear	pk	= peak	VCO	= voltage-controlled oscillator
CMO	= coaxial	LK WASH	= lockwasher	PL	= phase lock	Vdc	= volts dc
COEF	= coefficient	LO	= low; local oscillator	PLO	= phase lock oscillator	VDCW	= volts, dc, working (used in parts list)
COM	= common	LOG	= logarithmic taper (used in parts list)	PM	= phase modulation	V(F)	= volts, filtered
COMP	= composition	log	= logarithm(ic)	PNP	= positive-negative-positive	VFO	= variable-frequency oscillator
COMPL	= complete	LPF	= low pass filter	P/O	= part of	VHF	= very-high frequency
CONN	= connector	LV	= low voltage	POLY	= polystyrene	Vpk	= volts peak
CP	= cadmium plate	m	= metre (distance)	PORC	= porcelain	Vp-p	= volts peak-to-peak
CRT	= cathode-ray tube	mA	= milliampere	POS	= positive; position(s) (used in parts list)	Vrms	= volts rms
CTL	= complementary transistor logic	MAX	= maximum	POSN	= position	VSWR	= voltage standing wave ratio
CW	= continuous wave	MΩ	= megohm	POT	= potentiometer	VTO	= voltage-tuned oscillator
cw	= clockwise	MEG	= meg (10^6) (used in parts list)	p-p	= peak-to-peak	VTVM	= vacuum-tube voltmeter
D/A	= digital-to-analog	MET FLM	= metal film	PP	= peak-to-peak (used in parts list)	V(X)	= volts, switched
dB	= decibel	MET OX	= metal oxide	PPM	= pulse-position modulation	W	= watt
dBm	= decibel referred to 1 mW	MF	= medium frequency; microfarad (used in parts list)	PREAMPL	= preamplifier	W/	= with
dc	= direct current	MFR	= manufacturer	PRF	= pulse-repetition frequency	WIV	= working inverse voltage
deg	= degree (temperature interval or difference)	mg	= milligram	PRR	= pulse repetition rate	WW	= wirewound
°	= degree (plane angle)	MHz	= megahertz	ps	= picosecond	W/O	= without
°C	= degree Celsius (centrigrade)	mH	= millihenry	PT	= point	YIG	= yttrium-iron-garnet
°F	= degree Fahrenheit	mho	= conductance	PTM	= pulse-time modulation	Zo	= characteristic impedance
°K	= degree Kelvin	MIN	= minimum	PWM	= pulse-width modulation		
DEPC	= deposited carbon	min	= minute (time)	PWV	= peak working voltage		
DET	= detector	′	= minute (plane angle)	RC	= resistance capacitance		
diam	= diameter	MINAT	= miniature	RECT	= rectifier		
DIA	= diameter (used in parts list)	mm	= millimetre	REF	= reference		
DIFF AMPL	= differential amplifier	MOD	= modulator	REG	= regulated		
div	= division	MOM	= momentary	REPL	= replaceable		
DPDT	= double-pole, double-throw	MOS	= metal-oxide semiconductor	RF	= radio frequency		
DR	= drive	ms	= millisecond	RFI	= radio frequency interference		
DSB	= double sideband	MTG	= mounting	RH	= round head; right hand		
DTL	= diode transistor logic	MTR	= meter (indicating device)	RLC	= resistance-inductance-capacitance		
DVM	= digital voltmeter	mV	= millivolt	RMO	= rack mount only		
ECL	= emitter coupled logic	mVac	= millivolt, ac	rms	= root-mean-square		
EMF	= electromotive force	mVdc	= millivolt, dc	RND	= round		
EDP	= electronic data processing	mVpk	= millivolt, peak	ROM	= read-only memory		
ELECT	= electrolytic	mVp-p	= millivolt, peak-to-peak	R&P	= rack and panel		
ENCAP	= encapsulated	mVrms	= millivolt, rms	RWV	= reverse working voltage		
EXT	= external	mW	= milliwatt	S	= scattering parameter		
F	= farad	MUX	= multiplex	s	= second (time)		
FET	= field-effect transistor	MY	= mylar	″	= second (plane angle)		
F/F	= flip-flop	μA	= microampere	S-B	= slow-blow fuse (used in parts list)		
FH	= flat head	μF	= microfarad	SCR	= silicon controlled rectifier; screw		
FOL H	= fillister head	μH	= microhenry	SE	= selenium		
FM	= frequency modulation	μmho	= micromho	SECT	= sections		
FP	= front panel	μs	= microsecond	SEMICON	= semiconductor		
FREQ	= frequency	μV	= microvolt	SHF	= superhigh frequency		
FXD	= fixed	μVac	= microvolt, ac	SI	= silicon		
g	= gram	μVdc	= microvolt, dc	SIL	= silver		
GE	= germanium	μVpk	= microvolt, peak	SL	= slide		
GHz	= gigahertz	μVp-p	= microvolt, peak-to-peak	SNR	= signal-to-noise ratio		
GL	= glass	μVrms	= microvolt, rms	SPDT	= single-pole, double-throw		
GND	= ground(ed)	μW	= microwatt	SPG	= spring		
H	= henry	nA	= nanoampere	SR	= split ring		
h	= hour	NC	= no connection				
HET	= heterodyne	N/C	= normally closed				
HEX	= hexagonal						

NOTE

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

MULTIPLIERS

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

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	05370-60001	0	1	BOARD ASSEMBLY, MOTHER POWER SUPPLY (SERIES 1748)	28480	05370-60001
A1C1	0180-2800	4	2	CAPACITOR-FXD .01F+75-10% 40VDC AL	56289	32DR103G040BB2A
A1C2	0180-2799	0	2	CAPACITOR-FXD .017F+75-10% 20VDC AL	28480	0180-2799
A1C3	0180-2799	0		CAPACITOR-FXD .017F+75-10% 20VDC AL	28480	0180-2799
A1C4	0180-2800	4		CAPACITOR-FXD .01F+75-10% 40VDC AL	56289	32DR103G040BB2A
A1J1	1251-0493	9	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0493
A1K1	0490-0908	6	1	RELAY 4C 24VDC-COIL 5A 115VAC	28480	0490-0908
A1R1	0757-0435	0	2	RESISTOR 3.92K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3921-F
A1R2	0757-0283	6	7	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R3	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1R4	0757-0435	0		RESISTOR 3.92K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3921-F
A1XA6	1251-1365	6	2	CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365
A1XA7	1251-0472	4	1	CONNECTOR-PC EDGE 6-CONT/ROW 2-ROWS	28480	1251-0472
A1XA8	1251-2035	9	2	CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A1XA69	1251-2035	9		CONNECTOR-PC EDGE 15-CONT/ROW 2-ROWS	28480	1251-2035
A1XK1	0490-0907	5	1	SOCKET-RLY 15-CONT DIP-SLDR	28480	0490-0907
				A1 MISCELLANEOUS		
	0380-0336	1	13	SPACER-RVT-ON .312-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
	1530-1098	4	4	CLEVIS 0.070-IN W SLT: 0.454-IN PIN CTR	00000	ORDER BY DESCRIPTION
	7120-4163	7	1	LABEL-WARNING .5-IN-WD 1-IN-LG AL	28480	7120-4163
A2	05370-60002	1	1	BOARD ASSEMBLY, MAIN MOTHER (SERIES 1748)	28480	05370-60002
A2C1	0180-1701	2	8	CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A2C2	0180-1701	2		CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A2C3	0180-1701	2		CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A2C4	0180-1701	2		CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A2C5	0180-1701	2		CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A2C6	0180-1701	2		CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A2C7	0180-1701	2		CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A2C8	0180-1701	2		CAPACITOR-FXD 6.8UF+-20% 6VDC TA	56289	150D685X0006A2
A2J1	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A2R1	0757-0280	3	40	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R2	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R3	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R7	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2XA9A	1251-2026	8	27	CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA9B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA10A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA10B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA11A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA11B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA12A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA12B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA13A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA13B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA14A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA14B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA15A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA15B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA16A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA16B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA17A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA17B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA18A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA18B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA19A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA19B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA20A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA20B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA21A	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA21B	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A2XA22	1251-1365	6		CONNECTOR-PC EDGE 22-CONT/ROW 2-ROWS	28480	1251-1365

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	05370-60033	8	1	BOARD ASSEMBLY, INPUT ATTENUATOR (SERIES 1936)	28480	05370-60033
A3C1	0160-0551	6	2	CAPACITOR-FXD .01UF +100-0% 400VDC CER	28480	0160-0551
A3C2	0160-0551	6		CAPACITOR-FXD .01UF +100-0% 400VDC CER	28480	0160-0551
A3C3				STRAY CAPACITANCE (SEE SCHEMATIC)		
A3C4	0160-4531	0	2	CAPACITOR-FXD 2.2PF +-.25PF 50VDC CER	28480	0160-4531
A3C5				STRAY CAPACITANCE (SEE SCHEMATIC)		
A3C6				STRAY CAPACITANCE (SEE SCHEMATIC)		
A3C7	0160-4531	0		CAPACITOR-FXD 2.2PF +-.25PF 50VDC CER	28480	0160-4531
A3C8				STRAY CAPACITANCE (SEE SCHEMATIC)		
A3C9	0160-0552	7	2	CAPACITOR-FXD 100PF +-5% 400VDC CER	28480	0160-0552
A3C10	0150-0072	5	2	CAPACITOR-FXD 200PF +-5% 1KVDC CER	72982	838-X5E-201J-1KV
A3C11	0160-0552	7		CAPACITOR-FXD 100PF +-5% 400VDC CER	28480	0160-0552
A3C12	0150-0072	5		CAPACITOR-FXD 200PF +-5% 1KVDC CER	72982	838-X5E-201J-1KV
A3C13	0160-3879	7	171	CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C17				STRAY CAPACITANCE (SEE SCHEMATIC)		
A3C18				STRAY CAPACITANCE (SEE SCHEMATIC)		
A3C19	0160-3876	4	10	CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A3C20	0160-0576	5		CAPACITOR, FXD .1 UF ±20% 50VDC CER	28480	0160-0576
A3C21	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A3C22	0160-0576	5	38	CAPACITOR, FXD .1 UF ±20% 50VDC CER	28480	0160-0576
A3C23	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C24	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C25	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C26	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A3C27	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A3C28	0160-4084	8		CAPACITOR, FXD .1 UF +-20% 50VDC CER	28480	0160-4084
A3C29	0160-4084	8		CAPACITOR, FXD .1 UF +-20% 50VDC CER	28480	0160-4084
A3CR1	1901-0376	6	6	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR2	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR3	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3CR4	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A3J1A	1251-2034	8	2	CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS	28480	1251-2034
A3J1B	1251-2034	8		CONNECTOR-PC EDGE 10-CONT/ROW 2-ROWS	28480	1251-2034
A3J2	1250-1163	0	2	CONNECTOR-RF BNC FEM PC 50-OHM	28480	1250-1163
A3J3	1250-1163	0		CONNECTOR-RF BNC FEM PC 50-OHM	28480	1250-1163
A3MP1	5020-3440	7	1	SPRING:DETENT	28480	5020-3440
A3MP2	1460-0603	6	6	SPRING, DETENT	28480	1460-0603
A3MP3	05345-40002	8	4	GUIDE	28480	05345-40002
A3Q1	1855-0225	5	2	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0225
A3Q2	1855-0225	5		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0225
A3Q3	1854-0215	1	11	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q5	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q6	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3R1	0698-8382	6	1	RESISTOR 25 5% .25W C TC=0+-150	28480	0698-8382
A3R2				NOT ASSIGNED		
A3R3	0757-0072	1	2	RESISTOR 49.9 1% .5W F TC=0+-100	28480	0757-0072
A3R4	0698-8881	0	2	RESISTOR 900K 5% .3W C TC=0+-200	28480	0698-8881
A3R5	0698-8880	9	2	RESISTOR 100K 5% .15W C TC=0+-150	28480	0698-8880
A3R6	0757-0072	1		RESISTOR 49.9 1% .5W F TC=0+-100	28480	0757-0072
A3R7	0698-8881	0		RESISTOR 900K 5% .3W C TC=0+-200	28480	0698-8881
A3R8	0698-8880	9		RESISTOR 100K 5% .15W C TC=0+-150	28480	0698-8880
A3R9	2100-3616	6	2	RESISTOR-VAR W/SW 5K 20% LIN SPST-NO	01121	GS1N1128502MZ
A3R10	0698-3160	8	2	RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3R11	2100-3616	6		RESISTOR-VAR W/SW 5K 20% LIN SPST-NO	01121	GS1N1128502MZ
A3R12	0698-3160	8		RESISTOR 31.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3162-F
A3R13	0698-8381	5	2	RESISTOR 50 5% .1W C TC=0+-200	28480	0698-8381
A3R14	0683-5115	6	2	RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R15	0698-8381	5		RESISTOR 50 5% .1W C TC=0+-200	28480	0698-8381
A3R16	0683-5115	6		RESISTOR 510 5% .25W FC TC=-400/+600	01121	CB5115
A3R17	0683-1055	5	2	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A3R18	0683-1055	5		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A3R19	0698-8615	8	3	RESISTOR 75K 1% .05W F TC=0+-100	28480	0698-8615
A3R20	0683-1125	0	9	RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A3R21	0757-0420	3	7	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R22	0698-6241	2	2	RESISTOR 750 5% .125W CC TC=-330/+800	01121	BB7515
A3R23	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R24	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R25	0698-6241	2		RESISTOR 750 5% .125W CC TC=-330/+800	01121	BB7515

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R26	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A3R27				NOT ASSIGNED		
A3R28	0698-8615	8		RESISTOR 75K 1% .05W F TC=0+-100	28480	0698-8615
A3R29	0698-8615	8		RESISTOR 75K 1% .05W F TC=0+-100	28480	0698-8615
A3R30				NOT ASSIGNED		
A3R31	0683-1525	4	1	RESISTOR 1.5K 5% .25W FC TC=-400/+700	01121	CB1525
A3R32	0698-5178	2	5	RESISTOR 1.5K 5% .125W CC TC=-350/+857	01121	BB1525
A3R33	0698-3113	1	4	RESISTOR 100 5% .125W CC TC=-270/+540	01121	BB1015
A3R34	0757-0802	5	2	RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A3R35	0698-3113	1		RESISTOR 100 5% .125W CC TC=-270/+540	01121	BB1015
A3R36	0757-0802	5		RESISTOR 162 1% .5W F TC=0+-100	28480	0757-0802
A3R37	0698-3378	0	12	RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A3R38*	0683-1025	9	2	RESISTOR 1K 5% .25W FC TC=-400/+600 *FACTORY SELECTED PART	01121	CB1025
A3R39	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A3R40*	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600 *FACTORY SELECTED PART	01121	CB1025
A3R41	0698-3113	1		RESISTOR 100 5% .125W CC TC=-270/+540	01121	BB1015
A3R42	0698-3113	1		RESISTOR 100 5% .125W CC TC=-270/+540	01121	BB1015
A3R43	0698-6984	0	2	RESISTOR 470 5% .125W CC TC=-330/+800	01121	BB4715
A3R44	2100-1788	9	4	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A3R45	0683-2415	3	1	RESISTOR 240 5% .25W FC TC=-400/+600	01121	CB2415
A3R46	0698-6984	0		RESISTOR 470 5% .125W CC TC=-330/+800	01121	BB4715
A3R47	2100-1788	9		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A3R48	0698-5564	0	1	RESISTOR 240 5% .125W CC TC=-330/+800	01121	BB2415
A3R49				NOT ASSIGNED		
A3R50				NOT ASSIGNED		
A3R51	0683-1125	0		RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A3R52	0683-1125	0		RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A3R53	0683-1125	0		RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A3R54	0683-1125	0		RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A3R55	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A3R56	0683-4715	0	4	RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A3R57	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A3R58	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A3R59*	0698-7218	5	6	RESISTOR 178Ω 1% .05W F TC=0±100 *FACTORY SELECTED PART	24546	C3-1/8-TO-178R-G
A3R60*	0698-7218	5		RESISTOR 178Ω 1% .05W F TC=0±100 *FACTORY SELECTED PART	24546	C3-1/8-TO-178R-G
A3R61*	0698-7218	5		RESISTOR 178Ω 1% .05W F TC=0±100 *FACTORY SELECTED PART	24546	C3-1/8-TO-178R-G
A3R62*	0698-7218	5		RESISTOR 178Ω 1% .05W F TC=0±100 *FACTORY SELECTED PART	24546	C3-1/8-TO-178R-G
A3R63	0698-0083	8	4	RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R64	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R65	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3R66	0698-0083	8		RESISTOR 1.96K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1961-F
A3S1	05345-60100	9	6	LEVER/SLIDE ASSEMBLY	28480	05345-60100
A3S2	05345-60100	9		LEVER/SLIDE ASSEMBLY	28480	05345-60100
A3S3	05345-60101	0	1	SLIDE ASSEMBLY, P.C. SWITCH	28480	05345-60101
A3S4	05345-60100	9		LEVER/SLIDE ASSEMBLY	28480	05345-60100
A3S5	05345-60100	9		LEVER/SLIDE ASSEMBLY	28480	05345-60100
A3S6	05345-60100	9		LEVER/SLIDE ASSEMBLY	28480	05345-60100
A3S7	05345-60100	9		LEVER/SLIDE ASSEMBLY	28480	05345-60100
A3S8	3101-1596	0	2	SWITCH-SL DPDT MINTR 1A 125VAC PC	28480	3101-1596
A3S9	3101-1596	0		SWITCH-SL DPDT MINTR 1A 125VAC PC	28480	3101-1596
A3U1	1826-0088	7	2	IC, LIN 114-BIT WIDE BAND AMPL	28480	1826-0088
A3U2	1826-0088	7		IC, LIN 114-BIT WIDE BAND AMPL	28480	1826-0088
A3W1	8120-2461	5	1	CABLE ASSY 26AWG 16-CNDCT	28480	8120-2461
				A3 MISCELLANEOUS		
	0360-0642	0	4	TERMINAL-STUD SGL-PIN PRESS-MTG	12615	383-3958
	0380-0519	2	2	SPACER-RND .125-IN-LG .259-IN-ID	28480	0380-0519
	0590-0043	2	2	NUT-HEX-DBL-CHAM 1/4-32-THD .375-IN-THK	00000	ORDER BY DESCRIPTION
	1200-0475	0	195	CONNECTOR-SGL CONT SKT .016-IN-BSC-SZ	28480	1200-0475
	1251-2229	3	4	CONNECTOR-SGL CONT SKT .033-IN-BSC-SZ	28480	1251-2229
A4	05370-60004	3	1	BOARD ASSEMBLY, INPUT TRIGGER (SERIES 1748)	28480	05370-60004
A4C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C8	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C9	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C10	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C11	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C12	0180-0428	8	4	CAPACITOR-FXD 68UF+-20% 6VDC TA	28480	0180-0428
A4C13	0180-0428	8		CAPACITOR-FXD 68UF+-20% 6VDC TA	28480	0180-0428
A4C14	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C15	0180-0428	8		CAPACITOR-FXD 68UF+-20% 6VDC TA	28480	0180-0428
A4C16	0180-0428	8		CAPACITOR-FXD 68UF+-20% 6VDC TA	28480	0180-0428
A4C17	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C18	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A4C20	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C21	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A4C22	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C23	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C24	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C25	0160-3876	4		CAPACITOR-FXD 47PF +-20% 200VDC CER	28480	0160-3876
A4C26	0160-2599	6	1	CAPACITOR-FXD 680PF +-10% 200VDC CER	28480	0160-2599
A4CR1	1902-0074	3	4	DIODE-ZNR 7.15V 5% DO-7 PD=.4W TC=+.047%	28480	1902-0074
A4CR2	1902-0074	3		DIODE-ZNR 7.15V 5% DO-7 PD=.4W TC=+.047%	28480	1902-0074
A4CR3	1902-3036	3	2	DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A4CR4	1902-3036	3		DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A4L1	9100-1788	6	39	CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A4L2	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A4L3	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A4L4	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A4L5	9100-1620	5	2	COIL-MLD 15UH 10% Q=65 .155DX.375LG-NOM	28480	9100-1620
A4L6	9100-1620	5		COIL-MLD 15UH 10% Q=65 .155DX.375LG-NOM	28480	9100-1620
A4L7	9100-0549	5	2	COIL-MLD 22UH 10% Q=70 .225DX.57LG-NOM	28480	9100-0549
A4L8	9100-0549	5		COIL-MLD 22UH 10% Q=70 .225DX.57LG-NOM	28480	9100-0549
A4R1	0698-5178	2		RESISTOR 1.5K 5% .125W CC TC=-350/+857	01121	BB1525
A4R2	2100-1788	9		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A4R3	0698-5178	2		RESISTOR 1.5K 5% .125W CC TC=-350/+857	01121	BB1525
A4R4	0698-5178	2		RESISTOR 1.5K 5% .125W CC TC=-350/+857	01121	BB1525
A4R5	2100-1788	9		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A4R6	0698-5178	2		RESISTOR 1.5K 5% .125W CC TC=-350/+857	01121	BB1525
A4R7	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A4R8	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A4R9	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A4R10	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A4R11	2100-3216	2	2	RESISTOR-TRMR 10K 10% C TOP-ADJ 4-TRN	32997	3339H-1-103
A4R12	0698-8623	8	2	RESISTOR 560K 5% .125W CC TC=-600/+1137	01121	BB5645
A4R13	2100-3216	2		RESISTOR-TRMR 10K 10% C TOP-ADJ 4-TRN	32997	3339H-1-103
A4R14	0698-8623	8		RESISTOR 560K 5% .125W CC TC=-600/+1137	01121	BB5645
A4R15*	0757-0062	9	20	RESISTOR 510 2% .25W F TC=0+-100 *FACTORY SELECTED PART	19701	MF52C1/4-T0-511-G
A4R16	2100-1984	7	2	RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	73138	82PR100
A4R17	0698-7239	0	2	RESISTOR 1.33K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1331-G
A4R18*	0757-0062	9		RESISTOR 510 2% .25W F TC=0+-100 *FACTORY SELECTED PART	19701	MF52C1/4-T0-511-G
A4R19	2100-1984	7		RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	73138	82PR100
A4R20	0698-7239	0		RESISTOR 1.33K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1331-G
A4R21	0686-6815	1	2	RESISTOR 680 5% .5W CC TC=0+529	01121	EB6815
A4R22	0757-0279	0	6	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R23	0686-6815	1		RESISTOR 680 5% .5W CC TC=0+529	01121	EB6815
A4R24	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A4R25	0683-1125	0		RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A4R26	0683-1125	0		RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A4R27*	0683-5105	4		RESISTOR 51 5% .25W FC TC=-400/+500 *FACTORY SELECTED PART	01121	CB5105
A4R28	0683-1125	0		RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A4R29*	0683-5105	4		RESISTOR 51 5% .25W FC TC=-400/+500 *FACTORY SELECTED PART	01121	CB5105
A4R30	0683-1125	0		RESISTOR 1.1K 5% .25W FC TC=-400/+700	01121	CB1125
A4R31	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A4R32	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A4R33	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A4R34	0683-4715	0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A4R35	0683-2425	5	2	RESISTOR 2.4K 5% .25W FC TC=-400/+700	01121	CB2425
A4R36	0683-2425	5		RESISTOR 2.4K 5% .25W FC TC=-400/+700	01121	CB2425
A4R37				NOT ASSIGNED		

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R38				NOT ASSIGNED		
A4R39	0698-3111	9	2	RESISTOR 30 5% .125W CC TC=-270/+540	01121	BB3005
A4R40	0698-3111	9		RESISTOR 30 5% .125W CC TC=-270/+540	01121	BB3005
A4R41	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A4R42	0683-1615	3	2	RESISTOR 160 5% .25W FC TC=-400/+600	01121	CB1615
A4R43	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A4R44	0683-1615	3		RESISTOR 160 5% .25W FC TC=-400/+600	01121	CB1615
A4U1	1826-0290	3	2	IC, LINEAR	28480	1826-0290
A4U2	1826-0290	3		IC, LINEAR	28480	1826-0290
A4U3	1826-0021	8	2	OP AMP GP TO-99	27014	LM310H
A4U4	1826-0021	8		OP AMP GP TO-99	27014	LM310H
				A4 MISCELLANEOUS		
	0380-0059	5	1	SPACER-RVT-ON .25-IN-LG .152-IN-ID	00000	ORDER BY DESCRIPTION
	1200-0475	0		CONNECTOR-SGL CONT SKT .016-IN-BSC-SZ	28480	1200-0475
A5	05370-60005	4	1	BOARD ASSEMBLY, HP-IB CONVERTER	28480	05370-60005
A5J1	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A5J2	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A5J3	1251-3283	1	1	CONNECTOR 24-PIN F MICRORIBBON	28480	1251-3283
A5S1	3101-1973	7	2	SWITCH-SL 7-1ADIP-SLIDE-ASSY .1A 50VDC	28480	3101-1973
				A5 MISCELLANEOUS		
	0380-0643	3	2	STANDOFF-HEX .255-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	1200-0485	2	1	SKT-IC,14 PIN; PC MTG; RT ANGL; CONT	28480	1200-0485
	1530-1098	4		CLEVIS 0.070-IN W SLT; 0.454-IN PIN CTR	00000	ORDER BY DESCRIPTION
	2190-0017	4	2	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
A6	05370-60006	5	1	BOARD ASSEMBLY, POWER SUPPLY CONTROL (SERIES 1748)	28480	05370-60006
A6C1	0180-0491	5	11	CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A6C2	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A6C3	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A6C4	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A6C5	0160-2208	4	4	CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A6C6	0160-2208	4		CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A6C7	0160-2208	4		CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A6C8	0160-2208	4		CAPACITOR-FXD 330PF +-5% 300VDC MICA	28480	0160-2208
A6CR1	1902-0522	6	2	DIODE-ZNR 1N5340B 6V 5% PD=5W IR=1UA	04713	1N5340B
A6CR2	1902-0522	6		DIODE-ZNR 1N5340B 6V 5% PD=5W IR=1UA	04713	1N5340B
A6CR3	1902-0632	9	2	DIODE-ZNR 1N5354B 17V 5% PD=5W TC=+75%	04713	1N5354B
A6CR4	1902-0632	9		DIODE-ZNR 1N5354B 17V 5% PD=5W TC=+75%	04713	1N5354B
A6CR5	1902-0074	3		DIODE-ZNR 7.15V 5% DO-7 PD=.4W TC=+.047%	28480	1902-0074
A6CR6	1902-0074	3		DIODE-ZNR 7.15V 5% DO-7 PD=.4W TC=+.047%	28480	1902-0074
A6CR7	1902-0783	1	2	DIODE-ZNR 16.2V 5% DO-15 PD=1W TC=+.066%	28480	1902-0783
A6CR8	1902-0783	1		DIODE-ZNR 16.2V 5% DO-15 PD=1W TC=+.066%	28480	1902-0783
A6DS1	1990-0620	0	9	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A6DS2	1990-0620	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A6DS3	1990-0620	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A6DS4	1990-0620	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A6F1	2110-0423	8	3	FUSE 1.5A 125V FAST-BLO .281X.093	28480	2110-0423
A6F2	2110-0454	5	2	FUSE 7A 125V FAST-BLO .281X.093	28480	2110-0454
A6F3	2110-0454	5		FUSE 7A 125V FAST-BLO .281X.093	28480	2110-0454
A6F4	2110-0423	8		FUSE 1.5A 125V FAST-BLO .281X.093	28480	2110-0423
A6Q1	1853-0036	2	4	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A6Q2	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A6Q3	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A6Q4	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A6R1	0811-2490	7	2	RESISTOR .1 3% 5W PW TC=0+-50	28480	0811-2490
A6R2	0811-2490	7		RESISTOR .1 3% 5W PW TC=0+-50	28480	0811-2490
A6R3	0811-3475	0	2	RESISTOR .4 1% 3W PW TC=0+-90	28480	0811-3475
A6R4	0811-3475	0		RESISTOR .4 1% 3W PW TC=0+-90	28480	0811-3475
A6R5	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R7	0698-3444	1	2	RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R8	0698-3444	1		RESISTOR 316 1% .125W F TC=0+-100	24546	C4-1/8-T0-316R-F
A6R9	0698-3258	5	1	RESISTOR 5.36K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5361-F
A6R10	0757-0442	9	20	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R11	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R12	0698-3279	0	1	RESISTOR 4.99K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4991-F
A6R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R14	0757-0438	3	5	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A6R15	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A6R16	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A6R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R18	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A6R19	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R20	0757-0446	3	3	RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A6R21	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A6R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A6R23	0811-1219	6	2	RESISTOR 250 5% 3W PW TC=0+-20	28480	0811-1219
A6R24	0811-1219	6		RESISTOR 250 5% 3W PW TC=0+-20	28480	0811-1219
A6U1	1820-0477	6	4	OP AMP GP 8-DIP-P	27014	LM301AN
A6U2	1820-0477	6		OP AMP GP 8-DIP-P	27014	LM301AN
A6U3	1820-0477	6		OP AMP GP 8-DIP-P	27014	LM301AN
A6U4	1820-0477	6		OP AMP GP 8-DIP-P	27014	LM301AN
A6U5	1826-0316	4	1	V REF TO-5	27014	LH0070-1H
				A6 MISCELLANEOUS		
	0360-0535	0	91	TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	5000-9043	6	5	PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2	5	EXTRACTOR, P.C. BOARD	28480	5040-6843
				(A7 USED IN OPTION 001)		
A7	05370-60007	6	1	BOARD ASSEMBLY, OSCILLATOR POWER SUPPLY (SERIES 1748)	28480	05370-60007
A7C1	0160-0128	3	1	CAPACITOR-FXD 2.2UF +-20% 50VDC CER	28480	0160-0128
A7C2	0180-2730	9	1	CAPACITOR-FXD 1700UF+75-10% 30VDC AL	28480	0180-2730
A7C3	0160-0576	5	5	CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A7C4	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A7C5	0180-1746	5	13	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X9020B2
A7CR1	1901-0366	4	1	DIODE-FW BRDG 400V 1A	28480	1901-0366
A7CR2	1901-0028	5	1	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A7CR3	1902-3172	8	1	DIODE-ZNR 11V 2% DO-7 PD=.4W TC=+.062%	28480	1902-3172
A7F1	2110-0423	8		FUSE 1.5A 125V FAST-BLO .281X.093	28480	2110-0423
A7Q1	1854-0071	7	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7R1	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A7R2	0757-0726	2	1	RESISTOR 511 1% .25W F TC=0+-100	24546	C5-1/4-T0-511R-F
A7U1	1826-0147	9	2	IC 7812 V RGLTR TO-220	04713	MC7812CP
				A7 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	2360-0055	1	1	SCREW-MACH 6-32 .188-IN-LG BDG-HD-SLT	00000	ORDER BY DESCRIPTION
	2420-0014	0	1	NUT-HEX-DBL-CHAM 6-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
A8	05370-60008	7	1	BOARD ASSEMBLY, FREQUENCY BUFFER (SERIES 1748)	28480	05370-60008
A8C1	0160-2055	9	10	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C2	0160-3877	5	4	CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A8C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C7	0140-0234	0	2	CAPACITOR-FXD 500PF +-1% 300VDC MICA	72136	DM15F501F0300WV1C
A8C8	0140-0234	0		CAPACITOR-FXD 500PF +-1% 300VDC MICA	72136	DM15F501F0300WV1C
A8C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C11	0160-2236	8	1	CAPACITOR-FXD 1PF +-.25PF 500VDC CER	28480	0160-2236
A8C12	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A8C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C15	0160-3046	0	4	CAPACITOR-FXD 250PF +-1% 100VDC MICA	28480	0160-3046
A8C16	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A8C17	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A8C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C19	0160-2240	4	1	CAPACITOR-FXD 2PF +-.25PF 500VDC CER	28480	0160-2240
A8C20	0160-2197	0	2	CAPACITOR-FXD 10PF +-5% 300VDC MICA	28480	0160-2197
A8C21	0160-3046	0		CAPACITOR-FXD 250PF +-1% 100VDC MICA	28480	0160-3046
A8C22	0160-3046	0		CAPACITOR-FXD 250PF +-1% 100VDC MICA	28480	0160-3046
A8C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A8C24	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A8C25	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8C26	0160-2197	0		CAPACITOR-FXD 10PF +-5% 300VDC MICA	28480	0160-2197
A8CR1	1901-0535	9	1	DIODE-SCHOTTKY	28480	1901-0535
A8CR2	1901-0040	1	6	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8DS1	1990-0620	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A8L1	9100-0348	2	5	COIL-MLD 1UH 1% Q=50 .155DX.375LG-NOM	28480	9100-0348
A8L2	9100-0348	2		COIL-MLD 1UH 1% Q=50 .155DX.375LG-NOM	28480	9100-0348
A8L3	9100-0348	2		COIL-MLD 1UH 1% Q=50 .155DX.375LG-NOM	28480	9100-0348
A8L4	9100-0348	2		COIL-MLD 1UH 1% Q=50 .155DX.375LG-NOM	28480	9100-0348
A8L5	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A8L6	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A8Q1	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A8Q2	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A8Q3	1854-0009	1	3	TRANSISTOR NPN 2N709 SI TO-18 PD=300MW	04713	2N709
A8Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A8Q5	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A8Q6	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q7	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A8Q8	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8R1	1810-0080	6	10	NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A8R2	0757-0413	4	1	RESISTOR 392 1% .125W F TC=0+-100	24546	C4-1/8-T0-392R-F
A8R3	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A8R4	0757-1093	8	2	RESISTOR 3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3001-F
A8R5	0698-3443	0	1	RESISTOR 287 1% .125W F TC=0+-100	24546	C4-1/8-T0-287R-F
A8R6	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R7	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A8R8	0698-3437	2	6	RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A8R9	0757-0394	0	25	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A8R10	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A8R11	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R12	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R13	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R14	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R15	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R16	0757-0346	2	6	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A8R17	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A8R20	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R21	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A8R22	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A8U1	1820-0803	2	3	IC GATE ECL OR-NOR TPL	04713	MC10105P
A8U2	1820-0803	2		IC GATE ECL OR-NOR TPL	04713	MC10105P
A8U3	1820-0802	1	6	IC GATE ECL NOR QUAD 2-INP	04713	MC10105P
A8U4	1820-0803	2		IC GATE ECL OR-NOR TPL	04713	MC10105P
A8U5	1820-1224	3	7	IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216P
A8U6	1820-1224	3		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216P
				A8 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	5000-9043	6		PIN;P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
A9	05370-60009	8	1	BOARD ASSEMBLY, PROCESSOR (SERIES 1748)	28480	05370-60009
A9C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C11	0180-0106	9	13	CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000682
A9C12	0160-3651	3	2	CAPACITOR-FXD 68PF +-10% 200VDC CER	28480	0160-3651
A9C13	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000682
A9C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C15	0160-2743	2		CAPACITOR-FXD 33PF +-10% 200VDC CER	28480	0160-2743
A9C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C17	0160-3651	3		CAPACITOR-FXD 68PF +-10% 200VDC CER	28480	0160-3651
A9C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A9C19	0160-2743	2		CAPACITOR-FXD 33PF +-10% 200VDC CER	28480	0160-2743

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9L1	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A9Q1	1854-0560	9	1	TRANSISTOR NPN SI DARL PD=310MW	04713	MPS A12
A9R1	1810-0164	7	8	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A9R2	1810-0164	7		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A9R3	1810-0164	7		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A9R4	0698-7205	0	11	RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A9R5	0698-7252	7	5	RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-G
A9R6	1810-0164	7		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A9R7	0698-7246	9	1	RESISTOR 2.61K 1% .05W F TC=0+-100	24546	C3-1/8-T0-2611-G
A9R8	0757-0405	4	2	RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A9R9	0698-7272	1	1	RESISTOR 31.6K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3162-G
A9R10	0698-7252	7		RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-G
A9R11	0698-7236	7	28	RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A9R12	0698-7248	1	2	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A9R13	0698-7248	1		RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A9R14	0757-0472	5	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A9R15	0698-7252	7		RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-G
A9R16	0698-7260	7	3	RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A9R17	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A9R18	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A9R19	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A9R20	0698-7252	7		RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-G
A9R21	0698-7188	8	2	RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A9R22	0698-7196	8	2	RESISTOR 21.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-21R5-G
A9R23	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A9R24	0698-7196	8		RESISTOR 21.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-21R5-G
A9R25	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A9R26	0698-7188	8		RESISTOR 10 1% .05W F TC=0+-100	24546	C3-1/8-T00-10R-G
A9R27	0698-7252	7		RESISTOR 4.64K 1% .05W F TC=0+-100	24546	C3-1/8-T0-4641-G
A9R28	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A9R29	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A9R30	0698-7260	7		RESISTOR 10K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1002-G
A9S1	3101-1973	7		SWITCH-SL 7-1ADIP-SLIDE-ASSY .1A 50VDC	28480	3101-1973
A9U1	1820-1081	0	2	IC DRVR TTL BUS DRVR QUAD 1-INP	04713	MC8T26AP
A9U2	1820-1081	0		IC DRVR TTL BUS DRVR QUAD 1-INP	04713	MC8T26AP
A9U3				NOT ASSIGNED		
A9U4	1820-1202	7	6	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A9U5	1818-0135	8	3	IC NMOS 1K RAM STAT 360-NS 3-S	04713	MCM68A10L
A9U6	1820-1199	1	6	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A9U7	1820-1197	9	7	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A9U8	1818-0135	8		IC NMOS 1K RAM STAT 360-NS 3-S	04713	MCM68A10L
A9U9	1820-1204	9	5	IC GATE TTL LS NAND DUAL 4-INP	01295	SN74LS20N
A9U10	1818-0135	8		IC NMOS 1K RAM STAT 360-NS 3-S	04713	MCM68A10L
A9U11	1820-1196	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A9U12	1820-1368	6	3	IC DRVR TTL BUS DRVR HEX 1-INP	01295	SN74366N
A9U13	1816-0409	5	1	IC TTL 256-BIT PROM 50-NS 0-C	34371	HPROM-8256-5D
A9U14	1820-1368	6		IC DRVR TTL BUS DRVR HEX 1-INP	01295	SN74366N
A9U15	1820-1209	4	1	IC BFR TTL LS NAND QUAD 2-INP	01295	SN74LS38N
A9U16	1820-1368	6		IC DRVR TTL BUS DRVR HEX 1-INP	01295	SN74366N
A9U17	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A9U18	1820-1480	3	1	IC MICPROC NMOS 8-BIT	04713	MC6800L
A9U19	1820-1804	5	1	IC BFR NMOS CLOCK DRVR	04713	MPQ6842
A9U20	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
				A9 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0403-0189	2	16	EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	0403-0189
	1200-0473	8	4	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
	1200-0474	9	1	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
	1200-0552	4	1	SOCKET-IC 40-CONT DIP-SLDR	28480	1200-0552
	1200-0565	9	11	SOCKET-IC 24-CONT DIP-SLDR	28480	1200-0565
	1480-0116	8	16	PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
A10				NOT ASSIGNED		
A11	05370-60011	2	1	BOARD ASSEMBLY, DISPLAY INTERFACE (SERIES 1832)	28480	05370-60011
A11C1	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A11C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A11C4	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A11C5	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11C6	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A11C7	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A11C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C16	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A11C17	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000B2
A11C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A11C19	0180-0230	0	2	CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A11C20	0180-1702	3	1	CAPACITOR-FXD 180UF+-20% 6VDC TA	56289	150D187X0006R2
A11J1	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A11J2	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A11J3	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A11L1	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A11L2	9100-3060	1	1	COIL 260UH 15%	28480	9100-3060
A11L3	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A11Q1	1853-0326	3	16	TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q2	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q3	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q4	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q5	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q6	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q7	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q8	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q9	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q10	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q11	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q12	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q13	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q14	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q15	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11Q16	1853-0326	3		TRANSISTOR PNP SI PD=1W FT=50MHZ	04713	MPS-U51
A11R1				NOT ASSIGNED		
A11R1	0698-3435	0	13	RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R2				NOT ASSIGNED		
A11R2	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R3	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A11R4				NOT ASSIGNED		
A11R4	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R5	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R6	0698-3155	1	12	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A11R6	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A11R7	1810-0055	5	2	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A11R7	1810-0141	0	2	NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0141
A11R8	0698-7218	5	16	RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R9	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R10	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R11	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A11R12	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R13	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R14	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R15	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A11R16	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R17	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R18	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R19	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A11R20	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R21	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R22	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A11R23	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A11R24	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R25	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A11R26	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R27	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R28	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R29	1810-0141	0		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0141
A11R30	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R31	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R32	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R33	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R34	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R35	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11R36	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R37	0698-7218	5		RESISTOR 178 1% .05W F TC=0+-100	24546	C3-1/8-T0-178R-G
A11R38	1810-0176	1	13	NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A11R39	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A11R40	0757-0416	7	15	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A11R41	0698-3132	4	12	RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A11R42	0757-0469	0	2	RESISTOR 150K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1503-F
A11R43	0757-0469	0		RESISTOR 150K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1503-F
A11U1	1820-0799	5	6	IC DRVR TTL NAND DUAL 2-INP	01295	SN75452BP
A11U2	1816-1089	9	3	IC TTL 64-BIT RAM STAT 80-NS 3-S	27014	DM74LS189N
A11U3	1820-0799	5		IC DRVR TTL NAND DUAL 2-INP	01295	SN75452BP
A11U4	1816-1089	9		IC TTL 64-BIT RAM STAT 80-NS 3-S	27014	DM74LS189N
A11U5	1820-0468	5	2	IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7445N
A11U6	1820-0799	5		IC DRVR TTL NAND DUAL 2-INP	01295	SN75452BP
A11U7	1816-1089	9		IC TTL 64-BIT RAM STAT 80-NS 3-S	27014	DM74LS189N
A11U8	1820-0799	5		IC DRVR TTL NAND DUAL 2-INP	01295	SN75452BP
A11U9	1820-1885	2	3	IC RGTR TTL LS D-TYPE QUAD	27014	DM74LS173N
A11U10	1820-0799	5		IC DRVR TTL NAND DUAL 2-INP	01295	SN75452BP
A11U11	1820-1428	9	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS158N
A11U12	1820-0799	5		IC DRVR TTL NAND DUAL 2-INP	01295	SN75452BP
A11U13	1820-1885	2		IC RGTR TTL LS D-TYPE QUAD	27014	DM74LS173N
A11U14	1820-0468	5		IC DCDR TTL BCD-TO-DEC 4-TO-10-LINE	01295	SN7445N
A11U15	1820-1204	9		IC GATE TTL LS NAND DUAL 4-INP	01295	SN74LS20N
A11U16	1820-1207	2	4	IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A11U17	1820-1443	8	9	IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A11U18	1820-1204	9		IC GATE TTL LS NAND DUAL 4-INP	01295	SN74LS20N
A11U19	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A11U20	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A11U21	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A11U22	1820-1112	8	11	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A11U23	1820-1989	7	1	IC CNTR TTL LS BIN DUAL 4-BIT	07263	74LS393PC
A11U24	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A11U25	1820-0269	4	2	IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A11U26	1820-1204	9		IC GATE TTL LS NAND DUAL 4-INP	01295	SN74LS20N
A11U27	1820-1423	4	1	IC MV TTL LS MONOSTBL RETRIG DUAL	01295	SN74LS123N
				A11 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0360-1682	0	2	TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
A12	05370-60212	5	1	BOARD ASSEMBLY, ROM (SERIES 1824)	28480	05370-60212
A12C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C10	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A12C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A12C12	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A12C13	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A12C14	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A12L1	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A12L2	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A12L3	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A12R1				NOT ASSIGNED		
A12R2				NOT ASSIGNED		
A12R3	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-TO-51R1-F
A12R4				NOT ASSIGNED		
A12R5	1810-0164	7		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A12R6	0698-3155	1	1	RESISTOR 4.6K 1% .125W	24546	C4-1/8-TO-4641-F
A12R7	1810-0055	5	1	NETWORK-RES 9-PIN	28480	1810-0055
A12U1	1818-0554	5	1	IC NMOS 8192-BIT ROM 450-NS 3-S	34649	C2708 PROGRAMMED
A12U2	1818-0555	6	1	IC NMOS 8192-BIT ROM 450-NS 3-S	34649	C2708 PROGRAMMED
A12U3	1818-0561	3	1	IC NMOS 8192-BIT ROM 450-NS 3-S	01295	TMS2708JL PROGRAMMED
A12U4	1818-0557	8	1	IC NMOS 8192-BIT ROM 450-NS 3-S	28480	1818-0557
A12U5	1818-0558	9	1	IC NMOS 81920BIT ROM 450-NS 3-S	28480	1818-0558
A12U6	1818-0559	0	1	IC NMOS 8192-BIT ROM 450-NS 3-S	28480	1818-0559
A12U7	1818-0752	5	1	IC NMOS 8192-BIT ROM 450-NS 3-S	01295	TMS2708JL PROGRAMMED
A12U8	1818-0561	4	1	IC NMOS 8192-BIT ROM 450-NS 3-S	28480	1818-0561
A12U9	1820-1255	0	5	IC INV TTL HEX 1-INP	01295	SN74368N
A12U10	1820-1255	0		IC INV TTL HEX 1-INP	01295	SN74368N
A12U11	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A12U12	1820-1216	3	5	IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A12U13	1820-1419	8	5	IC COMPTR TTL LS MAGTD 4-BIT	01295	SN74LS85N
A12U14	1826-0147	9		IC 7812 V RGLTR TO-220	04712	MC7812CP

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				A12 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0403-0189	2		EXTR-PC 8D BLK POLYC .062-BD-THKNS	28480	0403-0189
	1200-0565	9		SOCKET-IC 24-CONT DIP-SLDR	28480	1200-0565
	1205-0219	0	1	HEAT SINK SGL TO-66-PKG	28480	1205-0219
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
A13				NOT ASSIGNED		
A14	05370-60014	5	1	BOARD ASSEMBLY, SERVICE INTERFACE (SERIES 1748)	28480	05370-60014
A14C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C11	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A14C12	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A14C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C14	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A14C15	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C18	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A14C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C20	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A14C22	0160-0576	5		CAPACITOR-FXD .1UF +-20% 50VDC CER	28480	0160-0576
A14C23	0160-2743	2		CAPACITOR-FXD 33PF +-10% 200VDC CER	28480	0160-2743
A14C24	0160-2743	2		CAPACITOR-FXD 33PF +-10% 200VDC CER	28480	0160-2743
A14C25	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000682
A14C26	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000682
A14C27	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A14CR1	1902-0033	4	1	DIODE-ZNR 1N823 6.2V 5% DO-7 PD=.4W	24046	1N823
A14L1	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A14L2	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A14L3	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A14L4	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A14R1	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A14R2	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A14R3	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A14R4	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R5	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R6	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R7	0698-0085	0	7	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A14R8	0757-0279	0		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A14R9	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A14R10	0757-0317	7	3	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A14R11	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A14R12	0757-0424	7	4	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A14R13	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A14R14	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A14R15	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A14R16	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A14R17				NOT ASSIGNED		
A14R18				NOT ASSIGNED		
A14R19	0698-0082	7	10	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A14R20	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A14S1	3101-1277	4	3	SWITCH-TGL SUBMIN SPDT .5A 120VAC PC	28480	3101-1277
A14S2	3101-1277	4		SWITCH-TGL SUBMIN SPDT .5A 120VAC PC	28480	3101-1277
A14S3	3101-1277	4		SWITCH-TGL SUBMIN SPDT .5A 120VAC PC	28480	3101-1277
A14U1	1820-1419	8		IC COMPTR TTL LS MAGTD 4-BIT	01295	SN74LS85N
A14U2	1820-1419	8		IC COMPTR TTL LS MAGTD 4-BIT	01295	SN74LS85N
A14U3	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A14U4	1820-1195	7	17	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A14U5	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A14U6	1820-1207	2		IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A14U7	1820-1419	8		IC COMPTR TTL LS MAGTD 4-BIT	01295	SN74LS85N
A14U8	1820-1419	8		IC COMPTR TTL LS MAGTD 4-BIT	01295	SN74LS85N
A14U9	1820-1204	9		IC GATE TTL LS NAND DUAL 4-INP	01295	SN74LS20N
A14U10	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A14U11	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A14U12	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A14U13	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A14U14	1820-1414	3	1	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS12N
A14U15	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A14U16	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A14U17	1820-1198	0	2	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A14U18	1826-0188	8	4	CONV 8-B-D/A 16-DIP-C	04713	MC1408L-8
A14U19	1826-0188	8		CONV 8-B-D/A 16-DIP-C	04713	MC1408L-8
A14U20	1826-0207	2	2	OP AMP WB 8-DIP-P	27014	LM318N
A14U21	1826-0207	2		OP AMP WB 8-DIP-P	27014	LM318N
				A14 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0403-0189	2		EXTR-PC 8D BLK POLYC .062-BD-THKNS	28480	0403-0189
	1200-0519	3	13	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
A15	05370-60015	6	1	BOARD ASSEMBLY, HP-IB INTERFACE (SERIES 1748)	28480	05370-60015
A15C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A15C12	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A15DS1	1990-0620	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A15DS2	1990-0620	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A15DS3	1990-0620	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A15DS4	1990-0620	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584, BENT LEADS
A15L1	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A15R1	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A15R2	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A15R3	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A15R4	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A15R5	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A15R6	1810-0164	7		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A15R7	1810-0164	7		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A15R8	1810-0164	7		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0164
A15U1	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A15U2	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A15U3	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A15U4	1820-1211	8	1	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
A15U5	1820-1207	2		IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A15U6	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A15U7	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A15U8	1820-1885	2		IC RGTR TTL LS D-TYPE QUAD	27014	DM74LS173N
A15U9	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A15U10	1820-1255	0		IC INV TTL HEX 1-INP	01295	SN74368N
A15U11	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A15U12	1820-1198	0		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A15U13	1820-1255	0		IC INV TTL HEX 1-INP	01295	SN74368N
A15U14	1820-1206	1	1	IC GATE TTL LS NOR TPL 3-INP	01295	SN74LS27N
A15U15	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A15U16	1820-1282	3	2	IC FF TTL LS J-K BAR POS-EDGE-TRIG	01295	SN7473109AN
A15U17	1820-1144	6	3	IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A15U18	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A15U19	1820-1282	3		IC FF TTL LS J-K BAR POS-EDGE-TRIG	01295	SN7473109AN
A15U20	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A15U21	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A15U22	1820-1997	7	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	SN74LS374PC
A15U23	1816-1154	9	1	ROM, 32 X 8	01295	SN74S188N PROGRAMMED
A15U24	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A15U25	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	SN74LS374PC

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15U26	1816-1155	0	1	ROM, 32 X 8	01295	SN74S188N PROGRAMMED
A15U27	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A15U28	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	34335	SN74LS374PC
A15U29	1820-1689	4	4	IC UART TTL QUAD	04713	MC3446P
A15U30	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A15U31	1820-1689	4		IC UART TTL QUAD	04713	MC3446P
A15U32	1820-1689	4		IC UART TTL QUAD	04713	MC3446P
A15U33	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A15U34	1820-1689	4		IC UART TTL QUAD	04713	MC3446P
A15U35	1820-0904	4	1	IC COMPTR TTL L MAGTD 5-BIT	07263	93L24PC
A15U36	1820-1144	6		IC GATE TTL LS NOR QUAD 2-INP	01295	SN74LS02N
A15U37	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
				A15 MISCELLANEOUS		
	0360-1682	0		TERMINAL-STUD SGL-TUR PRESS-MTG	28480	0360-1682
	0403-0189	2		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	0403-0189
	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
A16	05370-60016	7	1	BOARD ASSEMBLY, ARM INTERFACE (SERIES 1748)	28480	05370-60016
A16C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C4	0180-0374	3	1	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A16C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A16C12	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A16C13	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A16CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A16J1	1200-0499	8	2	SOCKET-IC 18-CONT DIP-SLDR	28480	1200-0499
A16L1	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A16L2	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A16R1	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A16R2	0757-0407	6	2	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A16R3	0698-3152	8	4	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A16R4	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A16R5	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A16R6	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A16R7	0698-3456	5	1	RESISTOR 287K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2873-F
A16R8	0698-3446	3	3	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A16R9	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A16R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R11	0757-0439	4	2	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A16R12	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A16R13	0757-0407	6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A16R14	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A16R15	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A16R16	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A16R17	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A16R18	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A16R19	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A16S1	3101-1856	5	1	SWITCH-SL 8-1ADIP-SLIDE-ASSY .1A 50VDC	28480	3101-1856
A16U1	1826-0138	8	8	COMPARATOR GP QUAD 14-DIP-P	04713	MLM339P
A16U2	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A16U3	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A16U4	1820-1207	2		IC GATE TTL LS NAND 8-INP	01295	SN74LS30N
A16U5	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A16U6	1820-1199	1		IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A16U7	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A16U8	1820-1202	7		IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A16U9	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A16U10	1820-0269	4		IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A16U11	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A16U12	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A16U13	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A16U14	1820-1216	3		IC DCDR TTL LS 3-TO-8-LINE 3-INP	01295	SN74LS138N
A16U15	1820-1439	2	9	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16U16	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74N
A16U17	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
A16U18	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A16U19	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
A16U20	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A16U21	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
A16U22	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
				A16 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0403-0189	2		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	0403-0189
	1200-0473	8		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0473
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
A17	05370-60017	8	1	BOARD ASSEMBLY, COUNT CHAIN (SERIES 1832)	28480	05370-60017
A17C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C6	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C9	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000682
A17C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C12	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A17C13	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A17C14	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A17C15	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A17C16	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000682
A17C17	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A17C18	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A17C19				CAPACITOR, FXD .0001 UF		
A17C20	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A17C21	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C22	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C23	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A17C24	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A17DS1	1990-0486	6	2	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
A17L1	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A17L2	9100-2248	5	6	COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
A17L3	9100-2248	5		COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
A17L4	9100-2248	5		COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
A17L5	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A17R1	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A17R2	0698-5999	5	1	RESISTOR 4.7K 5% .125W CC TC=-350/+857	01121	BB4725
A17R3	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A17R4	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A17R5	0757-0374	6	1	RESISTOR 475K 1% .5W F TC=0+-100	28480	0757-0374
A17R6	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A17R7	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A17R8	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A17R9	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A17R10	0698-7249	2	12	RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R11	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R12	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R13	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R14	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R15	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R16	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R17	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R18	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R19	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R20	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R21	0698-7249	2		RESISTOR 3.48K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3481-G
A17R22	0698-7243	6	13	RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R23	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R24	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R25	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R26	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R27	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R28	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R29	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R30	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A17R31	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R32	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R33	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R34	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R35	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R36	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R37	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R38	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R39	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R40	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R41	0698-7229	8	21	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A17R42	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R43	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A17R44	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R45	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A17R46	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R47	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R48	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A17R49	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R50	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A17R51	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A17R52	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A17R53	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R54	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R55	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R56	0698-7207	2	5	RESISTOR 61.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-61R9-G
A17R57	0698-7207	2		RESISTOR 61.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-61R9-G
A17R58	0698-7207	2		RESISTOR 61.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-61R9-G
A17R59	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R60	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R61	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A17R62	1810-0176	1		NETWORK-RES 5-PIN-SIP .15-PIN-SPCG	28480	1810-0176
A17U1	1820-1212	9	2	IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
A17U2	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A17U3	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A17U4	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A17U5	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
A17U6	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
A17U7	1820-1441	6	6	IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A17U8	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A17U9	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
A17U10	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A17U11	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
A17U12	1820-1439	2		IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE	01295	SN74LS258N
A17U13	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A17U14	1820-0586	8	1	IC INV TTL L HEX 1-INP	01295	SN74L04N
A17U15	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A17U16	1820-1212	9		IC FF TTL LS J-K NEG-EDGE-TRIG	01295	SN74LS112N
A17U17	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A17U18	1820-1441	6		IC ADDR TTL LS BIN FULL ADDR 4-BIT	01295	SN74LS283N
A17U19	1820-1443	8		IC CNTR TTL LS BIN ASYNCHRO	01295	SN74LS293N
A17U20	1820-1052	5	2	IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A17U21	1826-0138	8		COMPARATOR GP QUAD 14-DIP-P	04713	MLM339P
A17U22	1826-0138	8		COMPARATOR GP QUAD 14-DIP-P	04713	MLM339P
A17U23	1826-0138	8		COMPARATOR GP QUAD 14-DIP-P	04713	MLM339P
A17U24	1820-0817	8	4	IC FF ECL D-M/S DUAL	04713	MC10131P
A17U25	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A17U26	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A17U27	1820-1225	4	13	IC FF ECL D-M/S DUAL	04713	MC10231P
A17U28	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A17U29	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A17U30	1820-0601	0	1	IC GATE ECL OR-NOR QUAD 2-INP	04713	MC10101P
A17U31	1820-1224	3		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216P
				A17 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0403-0189	2		EXTR-PC 8D BLK POLYC .062-8D-THKNS	28480	0403-0189
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
A18	05370-60118	0	1	BOARD ASSEMBLY, DAC INTERFACE (SERIES 1836)	28480	05370-60118
A18C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C2	0160-2308	5	3	CAPACITOR-FXD 36PF +-5% 300VDC MICA	28480	0160-2308
A18C3	0160-2308	5		CAPACITOR-FXD 36PF +-5% 300VDC MICA	28480	0160-2308
A18C4	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C5	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A18C6	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A18C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C8	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A18C9	0160-2308	5		CAPACITOR-FXD 36PF +-5% 300VDC MICA	28480	0160-2308
A18C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C13	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A18C14	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C15	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A18C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C18	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A18C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A18C20	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A18C21	0121-0059	7	1	CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304324 2/8PF NPO
A18C22	0180-1746	5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A18CR1	1902-0057	2	1	DIODE-ZNR 6.49V 5% DO-7 PD=.4W TC=+.029%	28480	1902-0057
A18CR2	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A18K1	0490-1063	6	1	RELAY-REED 2A 500MA 50VDC 5VDC-COIL 10VA	28480	0490-1063
A18L1	9100-2285	0	2	COIL-MLD 560UH 10% Q=30 .095DX.25LG-NOM	28480	9100-2285
A18L2	9100-2285	0		COIL-MLD 560UH 10% Q=30 .095DX.25LG-NOM	28480	9100-2285
A18L3	9100-0346	0	4	COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A18L4	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A18L5	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A18L6	9100-2248	5		COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
A18L7	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A18L8	9100-2248	5		COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
A18L9	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A18L10	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A18Q1	1853-0015	7	3	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A18Q2	1853-0015	7		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A18R1	0698-3150	6	14	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R2	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R3	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R4	2100-3350	5	7	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A18R5	2100-3350	5		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A18R6	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R7	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R8	2100-3350	5		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A18R9	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R10	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R11	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R12	0757-0401	0	16	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A18R13	0757-0278	9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A18R14	0757-0274	5	2	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A18R15	2100-3350	5		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A18R16	0757-0274	5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A18R17	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A18R18	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R19	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R20	2100-3350	5		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A18R21	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R22	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R24	0757-0421	4	15	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A18R25	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R26	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A18R27	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A18R28	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R29	2100-3350	5		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A18R30	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R31	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A18R32	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A18R33	0757-0424	7		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A18R34	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R35	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R36	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A18R37	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A18R38	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R39	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R40	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A18R41	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A18R42				NOT ASSIGNED		
A18R43	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A18R44	1810-0123	8	2	NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0123
A18R45	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A18R46	0757-0276	7	12	RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A18R47	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A18R48	1810-0050	0	1	NETWORK-RES 12-PIN-SIP .15-PIN-SPCG	28480	1810-0050
A18R49	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A18R50	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A18R51	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A18R52	1810-0055	5		NETWORK-RES 9-PIN-SIP .15-PIN-SPCG	28480	1810-0055
A18R53	1810-0123	8		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0123
A18R54				NOT ASSIGNED		
A18R55	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A18U1	1820-1255	0		IC INV TTL HEX 1-INP	01295	SN74368N
A18U2	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A18U3	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A18U4	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A18U5	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A18U6	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A18U7	1820-1195	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS175N
A18U8	1826-0188	8		CONV 8-B-D/A 16-DIP-C	04713	MC1408L-8
A18U9	1826-0188	8		CONV 8-B-D/A 16-DIP-C	04713	MC1408L-8
A18U10	1820-1325	5	1	SWITCH ANLG QUAD 14-DIP-P	01928	CD4066AE
A18U11	1826-0161	7	1	OP AMP GP QUAD 14-DIP-P	04713	MLM324P
A18U12	1826-0138	8		COMPARATOR GP QUAD 14-DIP-P	04713	MLM339P
A18U13	1820-1313	1	2	MULTIPLXR ANLG TRIPLE 16-DIP-P	01928	CD4053BE
A18U14	1820-1313	1		MULTIPLXR ANLG TRIPLE 16-DIP-P	01928	CD4053BE
A18U15	1820-1224	3		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216P
A18U16	1820-0796	2	1	IC GATE ECL NOR QUAD 2-INP	04713	MC1662L
A18U17	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A18U18	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A18U19	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
				A18 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0403-0189	2		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	0403-0189
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
A19	05370-60119	1	1	BOARD ASSEMBLY, INTERPOLATOR (SERIES 1928)	28480	05370-60119
A19C1	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C3	0121-0105	4	1	CAPACITOR-V TRMR-CER 9-35PF 200V PC-MTG	52763	304324 9/35PF N650
A19C4	0160-2204	0	2	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A19C5	0160-0145	4	1	CAPACITOR-FXD 82PF +-2% 100VDC MICA	28480	0160-0145
A19C6	0180-0116	1	2	CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A19C7	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C8	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C9	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C10	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C11	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C12	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C13	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C14	0160-0154	5	3	CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A19C15*	0160-2743	2	5	CAPACITOR-FXD 33PF +-10% 200VDC CER	28480	0160-2743
A19C16	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C17	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C18	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C19	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C20	0140-0198	5	2	CAPACITOR-FXD 200PF +-5% 300VDC MICA	72136	DM15F201J0300WV1CR
A19C21	0140-0198	5		CAPACITOR-FXD 200PF +-5% 300VDC MICA	72136	DM15F201J0300WV1CR
A19C22	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A19C23	0160-2204	0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A19C24	0160-0154	5		CAPACITOR-FXD 2200PF +-10% 200VDC POLYE	28480	0160-0154
A19C25	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C26	0160-0182	9	1	CAPACITOR-FXD 47PF +-5% 300VDC MICA	28480	0160-0182
A19C27	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C28	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C29	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A19C30	0180-0116	1		CAPACITOR-FXD 6.8UF+-10% 35VDC TA	56289	150D685X9035B2
A19C31	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A19CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A19DL1	05370-80002	3	1	DELAY LINE ASSEMBLY, 10	28480	05370-80002
A19L1	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A19L2	9140-0142	8	1	COIL-MLD 2.2UH 10% Q=32 .095DX.25LG-NOM	28480	9140-0142
A19L3	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A19L4	9100-2269	0	1	COIL-MLD 27UH 10% Q=45 .095DX.25LG-NOM	28480	9100-2269
A19L5	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A19L6	9100-2248	5		COIL-MLD 120NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2248
A19L7	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A19L8	9100-2265	6	1	COIL-MLD 10UH 10% Q=60 .095DX.25LG-NOM	28480	9100-2265
A19L9	9100-0346	0		COIL-MLD 50NH 20% Q=40 .095DX.25LG-NOM	28480	9100-0346
A19L10	9100-2276	9	3	COIL-MLD 100UH 10% Q=50 .095DX.25LG-NOM	28480	9100-2276
A19L11	9100-2276	9		COIL-MLD 100UH 10% Q=50 .095DX.25LG-NOM	28480	9100-2276
A19L12	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A19Q1	1854-0009	1		TRANSISTOR NPN 2N709 SI TO-18 PD=300MW	04713	2N709
A19Q2	1854-0009	1		TRANSISTOR NPN 2N709 SI TO-18 PD=300MW	04713	2N709
A19R1	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A19R2	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A19R3	0698-7205	0		RESISTOR 51.1 1% .05W F TC=0+-100	24546	C3-1/8-T00-51R1-G
A19R4	0698-3428	1	2	RESISTOR 14.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-14R7-F
A19R5	2100-3350	5		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A19R6	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A19R7	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A19R8	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R9	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A19R10	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R11	0698-7207	2		RESISTOR 61.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-61R9-G
A19R12	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2151-F
A19R13	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R14	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A19R15	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A19R16	2100-3352	7	1	RESISTOR-TRMR 1K 10% C SIDE-ADJ 1-TRN	28480	2100-3352
A19R17	0698-7212	0		RESISTOR 100 1% .05W F TC=0+-100	24546	C3-1/8-T00-100R-G
A19R18	0698-7207	2		RESISTOR 61.9 1% .05W F TC=0+-100	24546	C3-1/8-T00-61R9-G
A19R19	0698-7243	6		RESISTOR 1.96K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1961-G
A19R20	0757-1108	6	1	RESISTOR 300 1% .125W F TC=0+-100	24546	C4-1/8-T0-301-F
A19R21	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A19R22	0698-3447	4	1	RESISTOR 422 1% .125W F TC=0+-100	24546	C4-1/8-T0-422R-F
A19R23	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A19R24				NOT ASSIGNED		
A19R25				NOT ASSIGNED		
A19R26	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A19R27	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A19R28	0698-3435	0		RESISTOR 38.3 1% .125W F TC=0+-100	24546	C4-1/8-T0-38R3-F
A19R29	0698-3446	3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A19R30	0698-3428	1		RESISTOR 14.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-14R7-F
A19R31				NOT ASSIGNED		
A19R32	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A19R33	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A19R34	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A19R35	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A19R36	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A19R37	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R38	0757-0446	3		RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A19R39	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R40				NOT ASSIGNED		
A19R41	0698-7236	7		RESISTOR 1K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1001-G
A19R42	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A19R43	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R44	0698-3442	9	8	RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R45	0757-0284	7	3	RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A19R46	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R47	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A19R48	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A19R49	0757-0446	3		RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A19R50	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R51	0757-0420	3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A19R52	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A19R53	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A19R54	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R55	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R56	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R57	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A19R58	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R59	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A19R60	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A19R61	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A19R62	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R63	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R64	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R65	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R66	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R67	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A19R68	0698-3442	9		RESISTOR 237 1% .125W F TC=0+-100	24546	C4-1/8-T0-237R-F
A19R69	2100-3351	6	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A19R70	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A19R71	0698-3151	7	1	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A19U1	1820-0753	1	8	IC GATE ECL DUAL 3-INP	28480	1820-0753
A19U2	5088-7009	4	1	VCO STARTABLE	28480	5088-7009
A19U3	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A19U4	1820-0817	8		IC FF ECL D-M/S DUAL	04713	MC10131P
A19U5	1820-1632	7	1	IC CNTR ECL BIN ASYNCHRO POS-EDGE-TRIG	04713	MC10178P
A19U6	1820-0806	5	2	IC GATE ECL OR-NOR DUAL 4-5-INP	04713	MC10109P
A19U7	1820-2000	5	4	IC FF MIXER 16-DIP	28480	1820-2000
A19U8	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A19U9	1820-1482	5	1	IC GATE ECL NOR DUAL 3-INP	04713	MC10211P
A19U10	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A19U11	1820-0493	6	1	OP AMP GP 8-DIP-P	27014	LM307N
A19U12	1820-1344	8	1	PL LOOP 14-DIP-C	04713	MC12040L
A19U13	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
				A19 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	0403-0189	2		EXTR-PC BD BLK POLYC .062-BD-THKNS	28480	0403-0189
	1200-0475	0		CONNECTOR-SGL CONT SKT .016-IN-BSC-SZ	28480	1200-0475
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	2110-0269	0	4	FUSEHOLDER-CLIP TYPE,25D-FUSE	28480	2110-0269
	2190-0124	4	1	WASHER-LK INTL T NO. 10 .195-IN-ID	28480	2190-0124
	2950-0078	9	1	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	28480	2950-0078
A20	05370-60119	1		BOARD ASSEMBLY, INTERPOLATOR SAME AS A19, USE PREFIX A20	28480	05370-60119
A21	05370-60024	7	1	BOARD ASSEMBLY, 200 MHZ MULTIPLIERR (SERIES 1748)	28480	05370-60024
A21C1	0140-0209	9	4	CAPACITOR-FXD 5PF +-10% 500VDC MICA	72136	DM15C050K0500WV1CR
A21C2	0121-0036	0	7	CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A21C3	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C6	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A21C7	0160-2238	0	4	CAPACITOR-FXD 1.5PF +-.25PF 500VDC CER	28480	0160-2238
A21C8	0160-2247	1	2	CAPACITOR-FXD 3.9PF +-.25PF 500VDC CER	28480	0160-2247
A21C9	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C10	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A21C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C12	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A21C13	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C15	0160-2238	0		CAPACITOR-FXD 1.5PF +-.25PF 500VDC CER	28480	0160-2238
A21C16	0160-2247	1		CAPACITOR-FXD 3.9PF +-.25PF 500VDC CER	28480	0160-2247
A21C17	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A21C18	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A21C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C20	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A21C21	0140-0209	9		CAPACITOR-FXD 5PF +-10% 500VDC MICA	72136	DM15C050K0500WV1CR
A21C22	0121-0165	6	7	CAPACITOR-V TRMR-CER 7-25PF 350V PC-MTG	52763	304324 7/25PF N300
A21C23	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C26	0140-0201	1	2	CAPACITOR-FXD 12PF +-5% 500VDC MICA	72136	DM15C120J0500WV1CR
A21C27	0140-0209	9		CAPACITOR-FXD 5PF +-10% 500VDC MICA	72136	DM15C050K0500WV1CR
A21C28	0121-0165	6		CAPACITOR-V TRMR-CER 7-25PF 350V PC-MTG	52763	304324 7/25PF N300
A21C29	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C30	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C31	0140-0201	1		CAPACITOR-FXD 12PF +-5% 500VDC MICA	72136	DM15C120J0500WV1CR
A21C32	0140-0209	9		CAPACITOR-FXD 5PF +-10% 500VDC MICA	72136	DM15C050K0500WV1CR
A21C33	0121-0165	6		CAPACITOR-V TRMR-CER 7-25PF 350V PC-MTG	52763	304324 7/25PF N300
A21C34	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C35	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491

See introduction to this section for ordering information
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Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21C36	0140-0145	2	5	CAPACITOR-FXD 22PF +-5% 500VDC MICA	72136	DM15C220J0500WV1CR
A21C37	0150-0059	8	2	CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0150-0059
A21C38	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A21C39	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A21C40	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C41	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C42	0150-0059	8		CAPACITOR-FXD 3.3PF +-.25PF 500VDC CER	28480	0150-0059
A21C43	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A21C44	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A21C45	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A21C46	0121-0165	6		CAPACITOR-V TRMR-CER 7-25PF 350V PC-MTG	52763	304324 7/25PF N300
A21C47	0140-0145	2		CAPACITOR-FXD 22PF +-5% 500VDC MICA	72136	DM15C220J0500WV1CR
A21C48	0160-2238	0		CAPACITOR-FXD 1.5PF +-.25PF 500VDC CER	28480	0160-2238
A21C49	0160-2238	0		CAPACITOR-FXD 1.5PF +-.25PF 500VDC CER	28480	0160-2238
A21C50	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A21C51	0121-0165	6		CAPACITOR-V TRMR-CER 7-25PF 350V PC-MTG	52763	304324 7/25PF N300
A21C52	0121-0165	6		CAPACITOR-V TRMR-CER 7-25PF 350V PC-MTG	52763	304324 7/25PF N300
A21C53	0140-0145	2		CAPACITOR-FXD 22PF +-5% 500VDC MICA	72136	DM15C220J0500WV1CR
A21C54	0121-0165	6		CAPACITOR-V TRMR-CER 7-25PF 350V PC-MTG	52763	304324 7/25PF N300
A21C55	0140-0145	2		CAPACITOR-FXD 22PF +-5% 500VDC MICA	72136	DM15C220J0500WV1CR
A21C56	0160-3046	0		CAPACITOR-FXD 250PF +-1% 100VDC MICA	28480	0160-3046
A21CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A21CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A21L1	05255-6019	2	6	COIL ASSEMBLY, 200 MHZ	28480	05255-6019
A21L2	05255-6019	2		COIL ASSEMBLY, 200 MHZ	28480	05255-6019
A21L3	05255-6019	2		COIL ASSEMBLY, 200 MHZ	28480	05255-6019
A21L4	05255-6019	2		COIL ASSEMBLY, 200 MHZ	28480	05255-6019
A21L5	05255-6019	2		COIL ASSEMBLY, 200 MHZ	28480	05255-6019
A21L6	05255-6019	2		COIL ASSEMBLY, 200 MHZ	28480	05255-6019
A21L7	9140-0095	0	6	COIL 270NH 10% Q=45 .155DX.375LG-NOM	28480	9140-0095
A21L8	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A21L9	9140-0095	0		COIL 270NH 10% Q=45 .155DX.375LG-NOM	28480	9140-0095
A21L10	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A21L11	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/4B
A21L12	9140-0095	0		COIL 270NH 10% Q=45 .155DX.375LG-NOM	28480	9140-0095
A21L13	9140-0095	0		COIL 270NH 10% Q=45 .155DX.375LG-NOM	28480	9140-0095
A21L14	9140-0095	0		COIL 270NH 10% Q=45 .155DX.375LG-NOM	28480	9140-0095
A21L15	9140-0095	0		COIL 270NH 10% Q=45 .155DX.375LG-NOM	28480	9140-0095
A21L16	9100-0348	2		COIL-MLD 1UH 1% Q=50 .155DX.375LG-NOM	28480	9100-0348
A21Q1	1854-0092	2	8	TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A21Q2	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A21Q3	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A21Q4	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A21Q5	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A21Q6	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A21Q7	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A21Q8	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A21R1	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A21R2	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A21R3	0757-0269	8	8	RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A21R4	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A21R5	0757-0269	8		RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A21R6	0757-0269	8		RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A21R7	0757-0269	8		RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A21R8	0757-0269	8		RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A21R9	0757-0405	4		RESISTOR 162 1% .125W F TC=0+-100	24546	C4-1/8-T0-162R-F
A21R10	0757-0269	8		RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A21R11	0757-0433	8	1	RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A21R12	0757-0269	8		RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A21R13	0757-0444	1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A21R14	0757-0414	5	1	RESISTOR 432 1% .125W F TC=0+-100	24546	C4-1/8-T0-432R-F
A21R15	0757-0269	8		RESISTOR 270 1% .125W F TC=0+-100	24546	C4-1/8-T0-271-F
A21R16	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A21R17	0757-0441	8	3	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A21R18	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A21R19	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R20	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A21R21	0757-0415	6	1	RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A21R22	0698-4002	9	2	RESISTOR 5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A21R23	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R24	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A21R25	0757-0444	1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A21R26	0757-1093	8		RESISTOR 3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3001-F
A21R27	0757-0441	8		RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A21R28	0757-0199	3	2	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A21R29	0757-0440	7	2	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A21R30	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A21R31	0757-0199	3		RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A21R32	0757-0430	5	2	RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
A21R33	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R34	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R35	0757-0430	5		RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
A21R36	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R37	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R38	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R39	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R40	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R41	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R42	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21P43	0757-0442	9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A21R44	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A21U1	1820-1224	3		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216P
A21U2	1820-1224	3		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216P
A21U3	1826-0138	8		COMPARATOR GP QUAD 14-DIP-P	04713	MLM339P
				A21 MISCELLANEOUS		
	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
	1480-0116	8		PIN-GRV .062-IN-DIA .25-IN-LG STL	28480	1480-0116
	8159-0005	0	2	WIRE 22AWG W PVC 1X22 80C	28480	8159-0005
A22	05370-60022	5	1	BOARD ASSEMBLY, ARMING (SERIES 1820)	28480	05370-60022
A22C1-			4			
A22C28	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A22C29	0160-3878	6		CAPACITOR-FXD 1000PF +-20% 100VDC CER	28480	0160-3878
A22C30	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A22C31	0180-0230	0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A22C32	0160-3877	5		CAPACITOR-FXD 100PF +-20% 200VDC CER	28480	0160-3877
A22C33	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A22C34	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A22C35	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A22C36	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A22CR1	1901-0050	3	4	DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A22CR2	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A22CR3	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A22CR4	1901-0050	3		DIODE-SWITCHING 80V 200MA 2NS DO-35	28480	1901-0050
A22CR5	1902-3003	4	2	DIODE-ZNR 2.37V 2% DO-7 PD=.4W TC=-.074%	28480	1902-3003
A22CR6	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A22CR7	1901-0376	6		DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A22CR8	1902-3003	4		DIODE-ZNR 2.37V 2% DO-7 PD=.4W TC=-.074%	28480	1902-3003
A22DL1A	05370-80001	2	2	DELAY LINE ASSEMBLY, 3	28480	05370-80001
A22DL1B	05370-80001	2		DELAY LINE ASSEMBLY, 3	28480	05370-80001
A22J1	1200-0499	8		SOCKET-IC 18-CONT DIP-SLDR	28480	1200-0499
A22J2	1251-2026	8		CONNECTOR-PC EDGE 18-CONT/ROW 2-ROWS	28480	1251-2026
A22J3	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A22J4	1250-0835	1	5	CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A22J5	1250-0835	1		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A22J6	1250-0835	1		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A22J7	1250-0835	1		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A22J8	1250-0835	1		CONNECTOR-RF SMC M PC 50-OHM	28480	1250-0835
A22L1	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A22L2	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A22L3	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A22L4	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A22L5	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A22L6	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHM@ 180 MHZ	02114	VK200 20/48
A22Q1	1854-0345	8	10	TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q2	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q3	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q4	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q5	1854-0246	8	2	TRANSISTOR NPN SI PD=350MW FT=250MHZ	04713	SPS 233
A22Q6	1854-0246	8		TRANSISTOR NPN SI PD=350MW FT=250MHZ	04713	SPS 233
A22Q7	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q8	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q9	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q10	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A22Q11	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q12	1854-0345	8		TRANSISTOR NPN 2N5179 SI TO-72 PD=200MW	04713	2N5179
A22Q13	1855-0334	7	1	TRANSISTOR-DUAL N-CHAN D-MODE SI	17856	DN377
A22R1	1810-0030	6	4	NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A22R2	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A22R3	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R4	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R5	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A22R6	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R7	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R8	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R9	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R10	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R11	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R12	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R13	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R14	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A22R15	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A22R16	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A22R17	0757-0399	5	5	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A22R18	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A22R19	0698-3150	6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A22R20	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A22R21	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A22R22	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R23	1810-0030	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0030
A22R24	0757-0284	7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A22R25	0757-0200	7	2	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A22R26	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A22R27	0757-0200	7		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A22R28	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A22R29	0698-3445	2	7	RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A22R30	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A22R31	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A22R32	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A22R33	0698-0085	0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A22R34	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A22R35	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A22R36	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A22R37	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A22R38	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A22R39						
A22R40	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A22R41	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A22R42	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A22R43	1810-0045	3	2	NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0045
A22R44	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R45	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R46				NOT ASSIGNED		
A22R47	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A22R48	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R49	1810-0045	3		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0045
A22R50	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R51	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A22R52	0757-0346	2		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A22R53	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A22R54	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A22R55	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R56	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A22R57	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R58	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A22R59	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A22R60	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A22R61	0757-0276	7		RESISTOR 61.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A22R62	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A22R63	2100-2413	9	2	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	30983	ET50X201
A22R64	0698-7215	2	2	RESISTOR 133 1% .05W F TC=0+-100	24546	C3-1/8-T0-133R-G
A22R65	2100-2413	9		RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	30983	ET50X201
A22R66	0698-7210	7	2	RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-G
A22R67	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A22R68	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A22R69	0698-3437	2		RESISTOR 133 1% .125W F TC=0+-100	24546	C4-1/8-T0-133R-F
A22R70	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R71	0698-4002	9		RESISTOR 5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5001-F
A22R72	0757-0399	5		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A22R73	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A22R74	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A22R75	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A22R76				NOT ASSIGNED		
A22R77	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A22R78	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A22R79	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A22R80	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R81	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A22R82	0698-7201	6	4	RESISTOR 34.8 1% .05W F TC=0+-100	24546	C3-1/8-T00-34R8-G
A22R83	0698-7201	6		RESISTOR 34.8 1% .05W F TC=0+-100	24546	C3-1/8-T00-34R8-G
A22R84	0698-7201	6		RESISTOR 34.8 1% .05W F TC=0+-100	24546	C3-1/8-T00-34R8-G
A22R85	1810-0080	6		NETWORK-RES 8-PIN-SIP .125-PIN-SPCG	28480	1810-0080
A22R86	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R87	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A22R88	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R89	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A22R90	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A22R91	0757-0421	4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A22R92	0698-3441	8	7	RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A22R93	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A22R94	0698-0082	7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A22R95	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A22R96	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A22R97	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A22R98	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A22R99	0698-7210	7		RESISTOR 82.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-82R5-G
A22R100	0698-7215	2		RESISTOR 133 1% .05W F TC=0+-100	24546	C3-1/8-T0-133R-G
A22R101	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R102	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R103	0698-3132	4		RESISTOR 261 1% .125W F TC=0+-100	24546	C4-1/8-T0-2610-F
A22R104	0698-5808	5	1	RESISTOR 4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4001-F
A22R105	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A22R106	0698-3152	8		RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A22R107	0698-3155	1		RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A22R108	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R109	0698-7201	6		RESISTOR 34.8 1% .05W F TC=0+-100	24546	C3-1/8-T00-34R8-G
A22R110	0699-0088	5	1	RESISTOR 1.21M 1% .125W F TC=0+-100	28480	0699-0088
A22R111	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A22R112	0757-0419	0	2	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A22R113	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A22R114	0757-0419	0		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A22R115	0757-0464	5	1	RESISTOR 90.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-9092-F
A22R116	0698-3445	2		RESISTOR 348 1% .125W F TC=0+-100	24546	C4-1/8-T0-348R-F
A22R117	0698-3441	8		RESISTOR 215 1% .125W F TC=0+-100	24546	C4-1/8-T0-215R-F
A22R118	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A22R119	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A22R120	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A22R121	0698-3378	0		RESISTOR 51 5% .125W CC TC=-270/+540	01121	BB5105
A22TP1-A22TP14	0360-0535	0		TERMINAL TEST POINT PCB	00000	ORDER BY DESCRIPTION
A22U1	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A22U2	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A22U3	1820-0794	0	1	IC FF ECL D-M/S	04713	MC1670L
A22U4	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A22U5	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A22U6	1826-0138	8		COMPARATOR GP QUAD 14-DIP-P	04713	MLM339P
A22U7	1826-0138	8		COMPARATOR GP QUAD 14-DIP-P	04713	MLM339P
A22U8	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A22U9	1820-0805	4	1	IC GATE ECL EXCL-OR/NOR TPL 2-INP	04713	MC10107P
A22U10	1820-0802	1		IC GATE ECL NOR QUAD 2-INP	04713	MC10102P
A22U11	1826-0624	7	1	IC CONV V/FREQ 14-DIP-P	28480	1826-0624
A22U12	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A22U13	1820-0624	5	2	IC COMPTR ECL A/D DUAL	04713	MC1651L
A22U14	1820-1225	4		IC FF ECL D-M/S DUAL	04713	MC10231P
A22U15	1820-1999	9	2	IC MULTIPLEXER 16-DIP	28480	1820-1999
A22U16	1820-1999	9		IC MULTIPLEXER 16-DIP	28480	1820-1999
A22U17	1820-2000	5		IC FF MIXER 16-DIP	28480	1820-2000
A22U18	1820-1224	3		IC RCVR ECL LINE RCVR TPL 2-INP	04713	MC10216P
A22U19	1820-0753	1		IC GATE ECL DUAL 3-INP	28480	1820-0753
A22U20	1820-0753	1		IC GATE ECL DUAL 3-INP	28480	1820-0753
A22U21	1820-2000	5		IC FF MIXER 16-DIP	28480	1820-2000
A22U22	1820-1399	3	1	IC FF ECL D-TYPE COM CLOCK HEX	04713	MC10176P
A22U23	1820-0753	1		IC GATE ECL DUAL 3-INP	28480	1820-0753
A22U24	1820-0753	1		IC GATE ECL DUAL 3-INP	28480	1820-0753
A22U25	1820-0753	1		IC GATE ECL DUAL 3-INP	28480	1820-0753

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A22U26	1820-0753	1		IC GATE ECL DUAL 3-INP	28480	1820-0753
A22U27	1820-0753	1		IC GATE ECL DUAL 3-INP	28480	1820-0753
A22U28	1820-2000	5		IC FF MIXER 16-DIP	28480	1820-2000
A22U29	1820-0624	5		IC CIMPTR ECL A/D DUAL	04713	MC1651L
A22U30	1820-1052	5		IC XLTR ECL ECL-TO-TTL QUAD 2-INP	04713	MC10125L
A22U31	1826-0208	3	1	OP AMP GP 8-DIP-P	27014	LM310N
				A22 MISCELLANEOUS		
	1200-0475	0		CONNECTOR-SGL CONT SKT .016-IN-BSC-SZ	28480	1200-0475
	2110-0269	0		FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
	5000-9043	6		PIN;P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
A23	05370-60023	6	1	BOARD ASSEMBLY, DISPLAY/FRONT PANEL (SERIES 1848)	28480	05370-60023
A23C1	0180-0106	9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A23C2	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A23C3	0160-3879	7		CAPACITOR-FXD .01UF +-20% 100VDC CER	28480	0160-3879
A23DS1-A23DS16	1990-0540	3	16	DISPLAY-NUM-SEG 1-CHAR .43-H	28480	5082-7650
A23DS17-A23DS46	1990-0533	4	30	LED-VISIBLE LUM-INT=15MCD IF=20MA-MAX	28480	5082-4658
A23DS47	1990-0487	7	3	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A23DS48	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A23DS49	1990-0487	7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A23DS50	1990-0670	0	27	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS51	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS52	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS53	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS54	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS55	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS56	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS57	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS58	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS59	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS60	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS61	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS62	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS63	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS64	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS65	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS66	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS67				NOT ASSIGNED		
A23DS68	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS69	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS70	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS71				NOT ASSIGNED		
A23DS72	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS73				NOT ASSIGNED		
A23DS74				NOT ASSIGNED		
A23DS75	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS76	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS77	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS78	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS79	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS80	1990-0670	0		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	1990-0670
A23DS81				NOT ASSIGNED		
A23DS82	1990-0486	6		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4684
A23J1	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A23J2	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A23J3	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A23J4	1200-0519	3		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0519
A23R1	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R2	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R3	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R4	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R5	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R6	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R7	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R8	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R9	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R10	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R11	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R12	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R13	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R14	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A23R15	0698-7229	8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A23R16	2100-3677	9	1	RESISTOR, 470K, DISPLAY RATE	28480	2100-3677
A23R17	2100-3676	8	1	RESISTOR, 10K EXT LEVEL	28480	2100-3676
A23S1- A23S30	5060-9436	7	30	SWITCH, PUSHBUTTON	28480	5060-9436
A23S33	3101-0574	2	1	SWITCH-SL DPDTMINTR 1A 120VAC PC	28480	3101-0574
A23U1	1820-0174	0	1	IC INV TTL HEX	01295	SN7404N
A23U2	1820-0539	1	1	IC BFR TTL NAND QUAD 2-INP	01295	SN7437N
A23XA1- A23XA16	1200-0679	6	16	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0679
				A23 MISCELLANEOUS		
	05328-40003	8	3	SPACER, LED, LONG	28480	05328-40003
	05341-20037	3	1	BLOCK, ANNUNCIATOR	28480	05341-20037
	05341-40001	3	1	BLOCK, ANNUNCIATOR	28480	05341-40001
	05370-40001	8	1	BLOCK, ANNUNCIATOR	28480	05370-40001
A24	0960-0443	1	1	LINE MODULE, FILTERED	28480	0960-0443
A69	05370-60069	0	1	BOARD ASSEMBLY, 10 MHZ OSCILLATOR (SERIES 1748)	28480	05370-60069
A69C1	0121-0036	0		CAPACITOR-V TRMR-CER 5.5-18PF 350V	52763	304324 5.5/18PF NPO
A69C2	0140-0145	2		CAPACITOR-FXD 22PF +-5% 500VDC MICA	72136	DM15C220J0500WV1CR
A69C3	0180-0491	5		CAPACITOR-FXD 10UF+-20% 25VDC TA	28480	0180-0491
A69C4	0160-0161	4	1	CAPACITOR-FXD .01UF +-10% 200VDC POLYE	28480	0160-0161
A69L1	9100-2276	9		COIL-MLD 100UH 10% Q=50 .095Dx.25LG-NOM	28480	9100-2276
A69L2	9100-1788	6		CHOKE-WIDE BAND ZMAX=680 OHMS 180 MHZ	02114	VK200 20/4B
A69Q1	1853-0015	7		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A69R1	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A69R2	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A69R3	0757-0397	3	1	RESISTOR 68.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-68R1-F
A69R4	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A69R5	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A69R6	0757-0401	0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A69R7	0698-4037	0	1	RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A69R8	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A69R9	0757-0416	7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A69U1	1820-0806	5		IC GATE ECL OR-NOR DUAL 4-5-INP	04713	MC10109P
A69Y1	0410-0423	2	1	CRYSTAL-QUARTZ FREQ=10.0 MHZ +-4.5 PPM	28480	0410-0423
				A69 MISCELLANEOUS		
	0380-0311	2	4	STANDOFF-RVT-ON .5-IN-LG 6-32THD	00000	ORDER BY DESCRIPTION
	0400-0009	9	1	GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
	5000-9043	6		PIN:P.C. BOARD EXTRACTOR	28480	5000-9043
	5040-6843	2		EXTRACTOR, P.C. BOARD	28480	5040-6843
	05345-00021	7	1	COVER, METAL	28480	05345-00021
				OPTIONS		
	10544A	6	1	OSCILLATOR, OVEN CONTROLLED (OPTION 001)	28480	10544A
	5061-0089	0	2	KIT, FRONT HANDLE (OPTION 907)	28480	5061-0089
	5061-0077	6	2	KIT, RACK FLANGE (OPTION 908)	28480	5061-0077
	5061-0083	4	2	KIT, RACK FLANGE/HANDLE (OPTION 909)	28480	5061-0083

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
B1	3160-0209	4	1	FAN-TBAX 32-CFM 105-125V 50/60-HZ	23936	8500C
	3160-0214	1	1	FAN GRILLE .157-THK	28480	3160-0214
C1	0180-2800	4	2	CAPACITOR-FXD .01F+75-10% 40VDC AL	56289	32DR103G040BB2A
C2	0180-2799	0	2	CAPACITOR-FXD .017F+75-10% 20VDC AL	28480	0180-2799
C3	0180-2799	0		CAPACITOR-FXD .017F+75-10% 20VDC AL	28480	0180-2799
C4	0180-2800	4		CAPACITOR-FXD .01F+75-10% 40VDC AL	56289	32DR103G040BB2A
CR1	1906-0216	3	4	DIODE-FW BRDG 400V 15A	27777	VL447
CR2	1906-0216	3		DIODE-FW BRDG 400V 15A	27777	VL447
CR3	1906-0216	3		DIODE-FW BRDG 400V 15A	27777	VL447
CR4	1906-0216	3		DIODE-FW BRDG 400V 15A	27777	VL447
F1 (115V INPUT)	2110-0083	6	1	FUSE 2.5A 250V FAST BLOW 1.25X.25 UL	28480	2110-0083
F1 (230V INPUT)	2110-0094	9	1	FUSE 1.25A 250V FAST BLOW 1.25X.25 UL IEC	28480	2110-0094
A24	0960-0443	1	1	LINE MODULE, FILTERED	28480	0960-0443
MP1	5060-9804	3	2	STRAP HANDLE ASSEMBLY	28480	5060-9804
MP2	5060-9880	5	1	COVER, SIDE ASSEMBLY	28480	5060-9880
MP3	5060-9847	4	1	COVER, BOTTOM ASSEMBLY	28480	5060-9847
MP4	5060-9835	0	1	COVER, TOP ASSEMBLY	28480	5060-9835
MP5	1205-0335	1	1	HEAT SINK TO-3-PKG	28480	1205-0335
MP6	5040-6928	4	1	STRIP, DIVIDER	28480	5040-6928
MP7	5040-7202	9	1	TRIM, TOP	28480	5040-7202
MP8	5040-7222	3	2	FOOT, NON-SKID	28480	5040-7222
MP9	5040-7221	2	4	FOOT, REAR	28480	5040-7221
MP10	5040-7219	8	2	STRAP, HANDLE, CAP-FRONT	28480	5040-7219
MP11	5040-7220	1	2	STRAP, HANDLE, CAP-REAR	28480	5040-7220
MP12	5040-7201	8	2	FOOT(STANDARD)	28480	5040-7201
MP13	7120-7001	8	1	LABEL, ERROR MESSAGE	28480	7120-7001
MP14	1460-1345	5	2	TILT STAND SST	28480	1460-1345
MP15	0905-0655	1	1	GASKET RECT VINYL-FM .5-THK 3-OD 1.8-WD	28480	0905-0655
MP16	5001-0439	8	2	TRIM, FRONT SIDE	28480	5001-0439
MP17	5020-8837	6	4	STRUT, CORNER	28480	5020-8837
MP18	05370-00013	8	1	SUPPORT, MB CENTER	28480	05370-00013
MP19	05370-00006	9	1	SHIELD, OSC.	28480	05370-00006
MP20	5020-8804	7	1	FRAME, REAR	28480	5020-8804
MP21	5020-8803	6	1	FRAME, FRONT	28480	5020-8803
MP22	05370-00008	1	2	BRACKET, MB EDGE	28480	05370-00008
MP23	05370-00011	6	1	BOARD GUIDE, MB FRONT	28480	05370-00011
MP24	05370-00002	5	1	PANEL, SUB-FRONT	28480	05370-00002
MP25	05370-00004	7	1	PANEL, REAR	28480	05370-00004
MP26	05370-00005	8	1	CHASSIS, POWER SUPPLY	28480	05370-00005
MP27	05370-00007	0	1	BULKHEAD, BOARD SUPPORT	28480	05370-00007
MP28	05370-00009	2	1	BRACKET, MB FRONT	28480	05370-00009
MP29	05370-20205	2	1	WINDOW	28480	05370-20205
MP30	05370-00001	4	1	PANEL, DRESS, FRONT	28480	05370-00001
Q1	1854-0669	9	2	TRANSISTOR NPN 2N6057 SI TO-3 PD=150W	04713	2N6057
Q2	1854-0669	9		TRANSISTOR NPN 2N6057 SI TO-3 PD=150W	04713	2N6057
Q3	1853-0411	7	2	TRANSISTOR PNP 2N6050 SI DARL TO-3	28480	1853-0411
Q4	1853-0411	7		TRANSISTOR PNP 2N6050 SI DARL TO-3	28480	1853-0411
S1	3101-1720	2	1	SWITCH-PB DPDT 4A 250VAC	28480	3101-1720
S2	3103-0032	1	1	SWITCH-THRM FXD +194F 3A OPN-ON-RISE	28480	3103-0032
S3	3101-0199	7	1	SWITCH-SL DPDT MINTR .5A 125VAC/DC	28480	3101-0199
T1	9100-3056	5	1	TRANSFORMER, POWER	28480	9100-3056
W1	05370-60401	4	1	CABLE ASSEMBLY, PS XSTR	28480	05370-60401
W2	05370-60402	5	1	CABLE ASSEMBLY, POWER SWITCH	28480	05370-60402
W3	05370-60403	6	1	CABLE ASSEMBLY, START	28480	05370-60403
W4	05370-60404	7	1	CABLE ASSEMBLY, EXT T IN	28480	05370-60404
W5	05370-60405	8	1	CABLE ASSEMBLY, TO REAR PANEL SWI	28480	05370-60405
W6	05370-60406	9	1	CABLE ASSEMBLY, 10 MHZ OUTPUT	28480	05370-60406
W7	05370-60407	0	1	CABLE ASSEMBLY, 10 MHZ TB	28480	05370-60407
W8	05370-60408	1	1	CABLE ASSEMBLY, REAR PANEL	28480	05370-60408
W9	05370-60409	2	1	CABLE ASSEMBLY, 10 MHZ AZ	28480	05370-60409
W10	05370-60410	5	1	CABLE ASSEMBLY, STOP	28480	05370-60410
W11	8120-2463	7	1	CABLE ASSY 26AWG 18-CNDCT	28480	8120-2463
W12	8120-2462	6	6	CABLE ASSY 26AWG 16-CNDCT	28480	8120-2462
W13	8120-2462	6		CABLE ASSY 26AWG 16-CNDCT	28480	8120-2462
W14	8120-2462	6		CABLE ASSY 26AWG 16-CNDCT	28480	8120-2462
W15	8120-2462	6		CABLE ASSY 26AWG 16-CNDCT	28480	8120-2462

See introduction to this section for ordering information
*Indicates factory selected value

Table 6-2. Replaceable Parts (Continued)

Reference Designation	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
W16	8120-2462	6		CABLE ASSY 26AWG 16-CNDCT	28480	8120-2462
W17	8120-2462	6		CABLE ASSY 26AWG 16-CNDCT	28480	8120-2462
W18	8120-1378	1	1	CORD, LINE	28480	8120-1378
				MISCELLANEOUS PARTS		
	0340-0486	8	4	INSULATOR-COVER NYLON	28480	0340-0486
	0340-0596	1	4	INSULATOR-XSTR RUBBER	28480	0340-0596
	0370-0914	0	1	BEZEL-PB KNOB,.490LG,.330W,.165HI,JADE	28480	0370-0914
	0370-0970	8	1	PUSHBUTTON .230X.390X.413 IN HI JADE	28480	0370-0970
	0370-1005	2	4	KNOB-BASE-PTR 3/8 JGK .125-IN-ID	28480	0370-1005
	0490-0861	0	1	RELAY RETAINER SST	28480	0490-0861
	0510-1148	2	17	RETAINER-PUSH ON KB-TO-SHFT EXT	28480	0510-1148
	0535-0010	7	2	NUT-HEX DBL-CHAM M7 X 0.75 2.26MM-THK	00000	ORDER BY DESCRIPTION
	1200-0523	9	14	LOCK-DUAL INLINE PKG INLINE PKG	52072	CA-16-200-DL
	1410-1035	5	2	BUSHING-PNL .136-ID .312-LG 1/4-32-THD	28480	1410-1035
	7120-8535	5	1	LABEL, INFO (FOR POWER MODULE)	28480	7120-8535
	7120-4301	5	2	LABEL, INFO	28480	7120-4301
	7122-0097	2	1	PLATE-SERIAL .5-IN-WD 1.25-IN-LG AL	28480	7122-0097
	5040-0170	6	8	GUIDE:PLUG-IN PC BOARD	28480	5040-0170
	5040-6937	5	3	WINDOW CLIP	28480	5040-6937
	5041-0244	7	1	KEY CAP -5.5M	28480	5041-0244
	5041-0253	8	9	KEY CAP 1/2	28480	5041-0253
	5041-0310	8	2	KEY CAP, BLANK	28480	5041-0310
	5041-0319	7	18	KEY CAP, LGT PIPE	28480	5041-0319
	5061-1942	6	1	COVER, SIDE ASSY, PERFORATED	28480	5061-1942
	05370-00014	9	1	DIFFUSER #1	28480	05370-00014
	05370-00015	0	1	DIFFUSER #2	28480	05370-00015
	0460-0600		1	FOAM, TOP COVER	28480	0460-0600

See introduction to this section for ordering information
*Indicates factory selected value

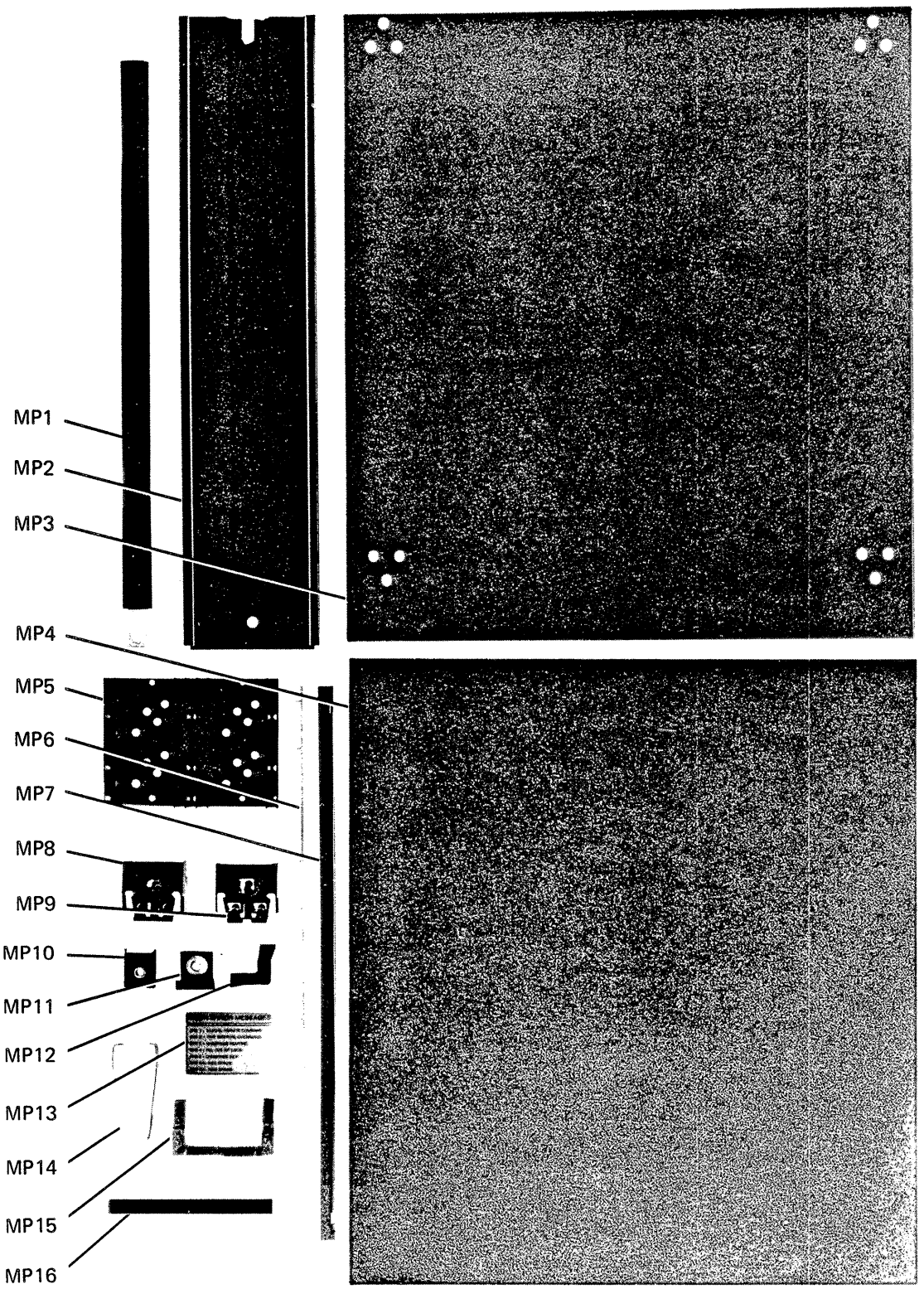


Figure 6-1. Mechanical Parts

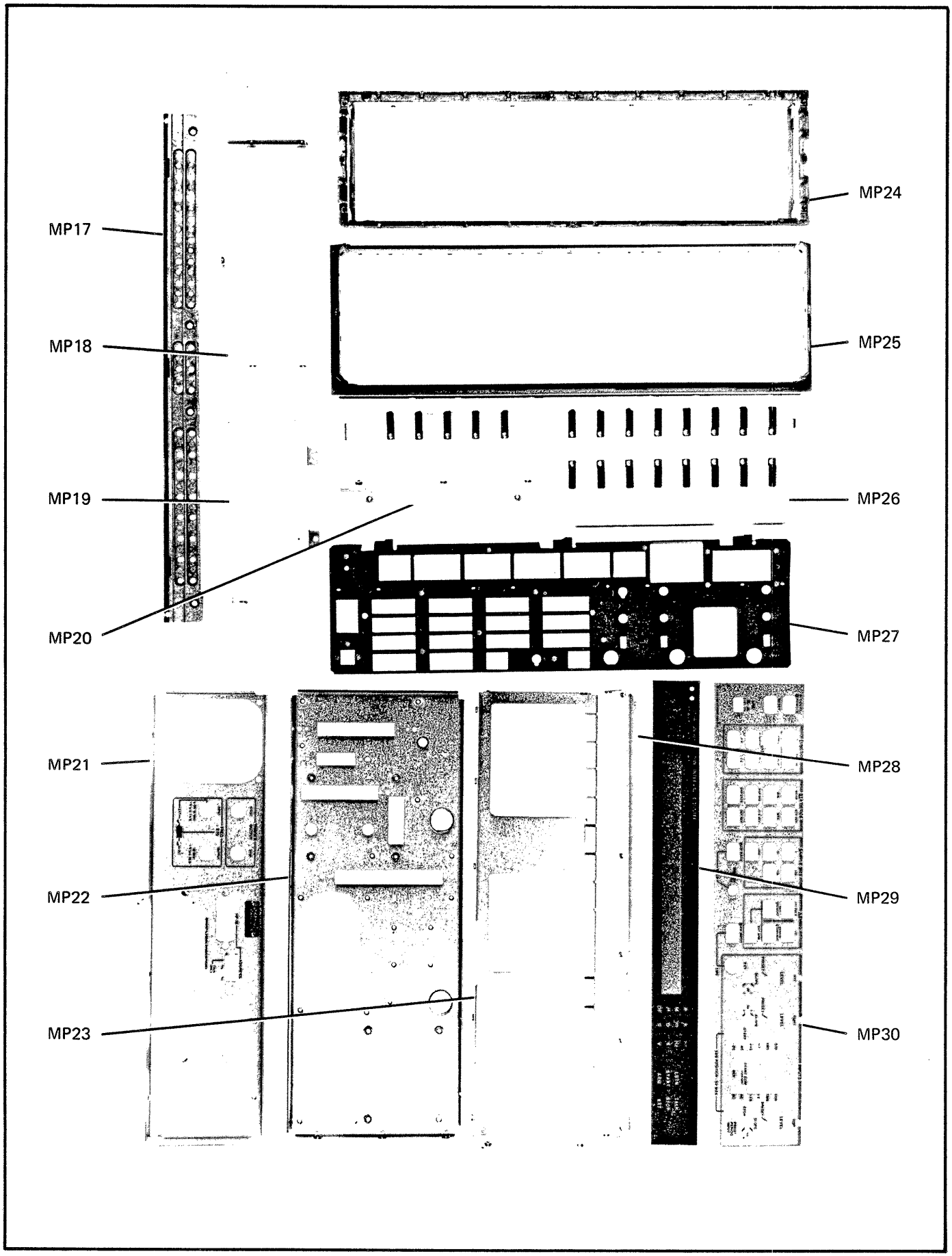


Figure 6-1. Mechanical Parts (Continued)

Table 6-3. Manufacturer's Code List

MFR. NO.	MANUFACTURER NAME ADDRESS	ZIP CODE
00000	Any Satisfactory Supplier	
01121	Allen-Bradley Company, Milwaukee, WI	53204
01295	Texas Instrument Inc. Semiconductor Component Division, Dallas, TX	75222
0192B	RCA Corporation Solid State Division, Somerville, NJ	08876
02114	Ferroxcube Corporation, Saugerties, NY	12477
03888	KDI Pyrofilm Corporation, Whippany, NJ	07981
04713	Motorola Semiconductor Products, Phoenix, AZ	85062
07263	Fairchild Semiconductor Division, Mountain View, CA	94042
12615	U.S. Terminals, Incorporated, Cincinnati, OH	45243
17856	Siliconix, Incorporated, Santa Clara, CA	95054
19701	Mepco/Electra Corporation, Mineral Wells, TX	76067
23936	Pamotor Division, William J. Purdy, Burlingame, CA	94010
24046	Transitron Electronic Corporation, Wakefield, MA	01880
24546	Corning Glass Works (Bradford), Bradford, PA	16701
27014	National Semiconductor Corportion, Santa Clara, CA	95051
27777	Varo Semiconductor Incorporated, Garland, TX	75040
28480	Hewlett-Packard Company, Corporate Headquarters, Palo Alto, CA	94304
30983	Mepco/Electra Corporation, San Diego, CA	92121
32997	Bourns, Incorporated, Trimpot Products Division, Riverside, CA	92507
34335	Advanced Micro Devices, Incorporated, Sunnyvale, CA	94086
34371	Harris Semiconductor Division, Harris-Intertype, Melbourne, FL	32901
34649	Intel Corporation, Mountain View, CA	95051
52072	Circuit Assembly Corporation, Costa Mesa, CA	92626
52763	Stettner-Trush, Incorporated, Cazenovia, NY	13035
56289	Sprague Electric Company, North Adams, MA	01247
71400	Bussman Manufacturing Division of McGraw-Edison Co., St. Louis, MO.	63107
72136	Electro Motive Corporation, Sub IEC, Willimantic, CT	06226
72982	Erie Technological Products, Incorporated, Erie, PA	16512
73138	Beckman Instruments Incorporated, Helipot Division, Fullterton, CA	92634

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This manual applies directly to 5370A instruments having serial prefix 1936. This section contains information for adapting this manual to older 5370A instruments (lower serial prefix). If the prefix of the instrument is higher than 1936, refer to the yellow "Manual Changes" sheet supplied with this manual. If the prefix of the instrument is lower than 1936, follow the instructions in the next paragraph.

7-3. MANUAL CHANGES

7-4. If your instrument's serial number prefix is lower than 1936, this manual must be modified to correctly apply to your instrument. To determine which changes must be made to this manual, locate your instrument's serial number prefix in *Table 7-1* and make the indicated changes.

Table 7-1. Manual Backdating

IF YOUR 5370A HAS SERIAL PREFIX	THEN MAKE THE FOLLOWING CHANGES TO THIS MANUAL:
1928	1
1848	1,2
1836	1,2,3
1832	1,2,3,4
1824	1,2,3,4,5
1820	1,2,3,4,5,6
1812 (excluding 1812A00111 through 1812A00130)	1,2,3,4,5,6,7
1812A00111 through 1812A00130	1,2,3,4,5,6,7,8
1748	1,2,3,4,5,6,7,8,9

CHANGE 1 (1928)

NOTE

Instruments with Serial Numbers 1848A00411 through 1848A00490 (except 1848A00417 and 1848A00425) include the following changes.

Page 6-5, Table 6-2, A3 Replaceable Parts:
Change A3 (05370-60033) series number from 1936 to 1748.
Change A3C28 and C29 from 0160-4084 to 0160-0576; CD=4; CAPACITOR-FXD .1 UF +-20% 50VDC CER; 28480; 0160-0576.

Page 8-100, Figure 8-19, A3 Schematic Diagram:
Change A3 series number (top of diagram) from 1936 to 1748.

CHANGE 2 (1848)

Page 6-5, Table 6-2, A3 Replaceable Parts:
Change A3 series number from 1928 to 1748.

Page 6-6, Table 6-2, A3 Replaceable Parts:
Change A3R59*, R60*, R61*, and R62* from 0698-7218 (178Ω) to 0683-5105; CD=4; RESISTOR 51 5% .25W FC TC=400/+500; 01121; CB5105.

Page 8-100, Figure 8-19, A3 Schematic Diagram:
Change A3 series number (top of diagram) from 1928 to 1748.
Change R59*, R60*, R61*, and R62* from 178Ω to 51Ω.

CHANGE 3 (1836)

Page 6-26, Table 6-2, A23 (05370-60023) Replaceable Parts:
Change series from 1848 to 1748.

Change the Replaceable Parts data for A23DS47 through DS82 to the following:

Reference Designation	HP Part Number	√	Qty.	Description	Mfr. Code	Mfr. Part Number
A23 DS47-DS49	1990-0487	7	3	LED-VISIBLE LUM-INT=1 MCD IF=20 MA-MAX	28480	5082-4584
A23 DS50-DS66	1990-0670	0	27	LED-VISIBLE LUM-INT=1 MCD IF=20 MA-MAX	28480	1990-0670
A23 DS67				NOT ASSIGNED		
A23 DS68-DS70	1990-0670	0		LED-VISIBLE LUM-INT=1 MCD IF=20 MA-MAX	28480	1990-0670
A23 DS71				NOT ASSIGNED		
A23 DS72	1990-0670	0		LED-VISIBLE LUM-INT-1 MCD IF=20 MA-MAX	28480	1990-0670
A23 DS73, DS74				NOT ASSIGNED		
A23 DS75-DS81	1990-0670	0		LED-VISIBLE LUM-INT=1 MCD IF=20 MA-MAX	28480	1990-0670
A23 DS82	1990-0486	6		LED-VISIBLE LUM-INT=1 MCD IF=20 MA-MAX	28480	1990-0486

Page 8-75, Figure 8-27, A23 Schematic Diagram:
Change A23 series number (top of diagram) from 1848 to 1748.

Page 6-13, Table 6-2, A12 (05370-60212) Replaceable Parts:
Change A12 from SERIES 1848 to SERIES 1824.
Change A12U6 from 1818-0887 to 1818-0559; CD=7; IC 2708 8192-BIT ROM NMOS; 28480; 1818-0559.
Change A12U7 from 1818-0888 to 1818-0752; CD=5; IC 2708 8192-BIT ROM NMOS; 28480; 1818-0752.
Change A12U8 from 1818-0889 to 1818-7561; CD=8; IC 2708 8192-BIT ROM NMOS; 28480; 1818-7561.

CHANGE 3 (1836) (Continued)
Page 8-29, Figure 8-7, A12 Assembly Troubleshooting Flowchart:
Change the following SIG SETs to the following signatures:

(1) Data Lines	Signatures
P1A(3)	74U6
P1A(4)	44FU
P1A(5)	UUP8
P1A(6)	F02U
P1A(7)	UF69
P1A(8)	9642
P1A(9)	APHC
P1A(10)	26C7

(3) ROM Outputs	Signatures
U1(9)	4P97
U1(10)	9PAC
U1(11)	5C6A
U1(13)	F2PH
U1(14)	50PA
U1(15)	2FPH
U1(16)	80F3
U1(17)	1HFC

(10) ROM Outputs	Signatures
U6(9)	114P
U6(10)	6296
U6(11)	338A
U6(13)	F321
U6(14)	18UU
U6(15)	7A02
U6(16)	92AF
U6(17)	F842

(11) ROM Outputs	Signatures
U7(9)	502P
U7(10)	9936
U7(11)	81C5
U7(13)	8128
U7(14)	11A3
U7(15)	F8CP
U7(16)	F120
U7(17)	880H

(12) ROM Outputs	Signatures
U8(9)	P937
U8(10)	0CAF
U8(11)	U1H3
U8(13)	4P90
U8(14)	8UPP
U8(15)	HPFP
U8(16)	8P80
U8(17)	99U6

Page 8-57, Figure 8-18, A12 Schematic Diagram:
Change the series number (top of diagram) from 1848 to 1824.

CHANGE 4 (1832)
Page 6-28, Table 6-2, Replaceable CHASSIS PARTS:
Change CR1, 2, 3, and 4 from 1906-0216 to 1906-0032; CD 1; Qty. 4; DIODE-FW BRDG 200V 12A; 04713; MDA980-3.

Page 6-30, Table 6-3, Manufacturers Code List:
Delete 18546; VARO SEMICONDUCTOR INC; GARLAND, TX; 75040.

Page 6-18, Table 6-2, A18 (05370-60118) Replaceable Parts:
Change A18 series number from 1836 to 1812.
Delete A18C22; 0180-1746; CD 5; CAPACITOR-FXD 15 UF 10% 20VDCW TA; 56289; 150D156X9020B2.

Page 8-67, Figure 8-23, A18 (05370-60118) Schematic Diagram:
Change A18 series number (top of diagram) from 1836 to 1812.
Delete 15 μF fixed capacitor A18C22.

CHANGE 5 (1824)

Page 6-11, Table 6-2, A11 (05370-60011) Replaceable Parts:
Change A11 series number from 1832 to 1748.

Page 6-13, Table 6-2, A11 Replaceable Parts:
Delete test point terminal HP Part No. 0360-0535 from end of A11 parts listing.

Pages 6-17 and 6-18, A17 (05370-60017) Replaceable Parts:
Change A17 series number from 1832 to 1748.
Delete resistor network A17R62 HP Part No. 1810-0176.

Page 8-55, Figure 8-17, A11 (05370-60011) Schematic Diagram:
Change series number (top of diagram) from 1832 to 1748.

Page 8-65, Figure 8-22, A17 (05370-60017) Schematic Diagram:
Change A17 series number (top of diagram) from 1832 to 1748.
Delete Resistors R62A, B, C, and D located at the following points:

R62A	Pin 15 of U12, U8 and P1A($\overline{6}$)
R62B	Pin 15 of U6, U5 and P1A($\overline{5}$)
R62C	Pin 15 of U9, U11 and P1A($\overline{4}$)
R62D	Pin 1 of U12, U8, U6, U5, U9, U11 and P1A($\overline{3}$)

CHANGE 6 (1820)

Page 6-13, Table 6-2, A12 (05370-60212) Replaceable Parts:
Change A12 series number from 1824 to 1748.
Change A12U3 from 1818-0750 to 1818-0556; CD 8; IC 2708 8192-BIT ROM NMOS; 34649; C2708.
Change A12U7 from 1818-0752 to 1818-0560; CD 8; IC 2708 8192-BIT ROM NMOS; 34649; C2708.

Page 8-57, Figure 8-18, A12 (05370-60212) Schematic Diagram:
Change A12 series number (top of diagram) from 1824 to 1748.

Page 8-9, Figure 8-7, A12 Assembly Troubleshooting Flowchart:
Change "SIG SET" 1, 3, 7, and 11 to the following:

① Data Lines	Signatures
P1A(3)	8FUC
P1A(4)	64AC
P1A(5)	47C2
P1A(6)	C99P
P1A(7)	3CF0
P1A(8)	HF60
P1A(9)	PP6F
P1A(10)	U9P9

③ ROM Outputs	Signatures
U1(9)	1UF9
U1(10)	5A15
U1(11)	9UH4
U1(13)	6744
U1(14)	9454
U1(15)	P853
U1(16)	CPA4
U1(17)	1HFC

⑦ ROM Outputs	Signatures
U3(9)	3PA5
U3(10)	28A3
U3(11)	H4U1
U3(13)	AH61
U3(14)	8CF6
U3(15)	U575
U3(16)	CUHA
U3(17)	8571

⑪ ROM Outputs	Signatures
U7(9)	6P49
U7(10)	A751
U7(11)	CUH2
U7(13)	CU4U
U7(14)	2UF4
U7(15)	U6H9
U7(16)	UU47
U7(17)	880H

CHANGE 7 (1812) (Excluding 1812A00111 through 1812A00130)

Page 6-23, Table 6-2, A22 (05370-60022) Replaceable Parts:
Change series number in Description column of Arming Board Assembly from 1820 to 1812.

Page 6-25, Table 6-2, A22 (05370-60022) Replaceable Parts:
Add resistors A22R46 and A22R76; 0757-0394; CD Ø; RESISTOR 51.1 1% .125W F TC=0+-100; 24546; C4-1/8-TO-51R1-F.

Page 6-26, Table 6-2, A22 (05370-60022) Replaceable Parts:
Delete Resistors A22R118, A22R119, A22R120, and A22R121.

Page 8-73, Figure 8-26, A22 Schematic Diagram:
Change the series number (top of diagram) from 1820 to 1748.
Delete resistor R118 (51Ω) between TP8 and circuit common.
Delete resistor R119 (51Ω) and connect circuit trace with TP8 and U17(13).
Delete resistor R120 (51Ω) between TP8 and circuit common.
Delete resistor R121 (51Ω) and connect circuit trace with TP11 and U21(13).
Add resistor R46 (51.1) between TP8 and circuit common.
Add resistor R76 between TP11 and circuit common.

CHANGE 8 (1812A00111 through 1812A00130)

Page 6-20, Table 6-2, A19 Replaceable Parts:
Change A19C15* (33 PF) from 0160-2743 to A19C15; 0160-3879; CD 7; CAPACITOR-FXD .01UF +-20% 100VDC CER; 28480; 0160-3879.

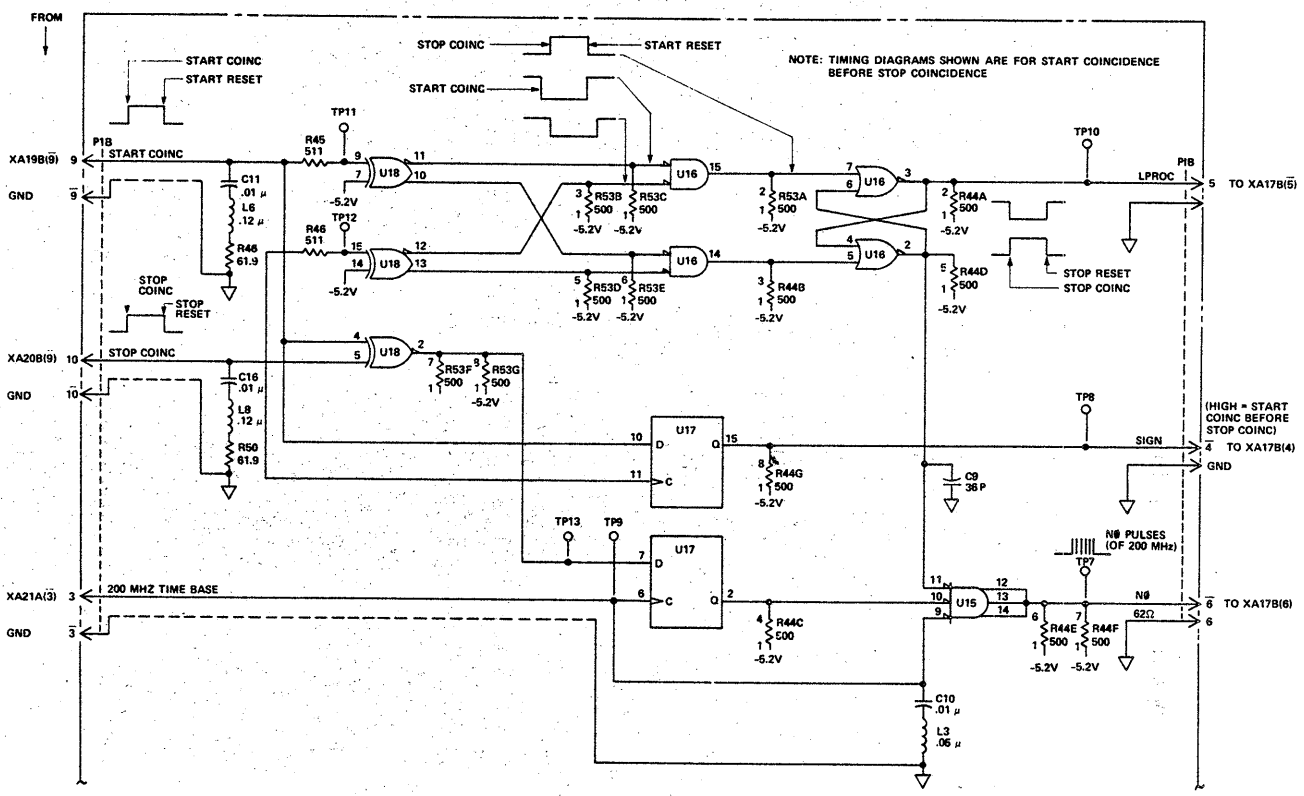
Page 6-21, Table 6-2, A19 Replaceable Parts:
Add resistor A19R40; 0757-0397; CD 3; Qty 2; RESISTOR 68.1 1% .125W F TC=0+-100; 24546; C4-1/8-TO-68R1-F.

Page 8-69, Figure 8-24, A19/A20 Schematic Diagram:
Change the series number (top of diagram) from 1820 to 1812.
Add resistor R40 between C15 and circuit common.
Remove asterisk (*) from C15 and change C15 value from 33PF to .01 UF.
Remove the following note from the bottom of the page:

NOTE: Asterisk (*) indicates Factory Selected Part, average value shown.

CHANGE 9 (1748)

7-5. There are two major circuit differences between serial prefix 1812A and 1748A. These are the A18 and the A19/A20 assemblies. *Figure 7-1* shows the change between the A18 assemblies 05370-60018 (prefix 1748A) and 05370-60118 (prefix 1812A). *Figure 7-2* shows the difference between the A19/A20 assemblies 05370-60019 (prefix 1748A) and 05370-60119 (prefix 1812A).

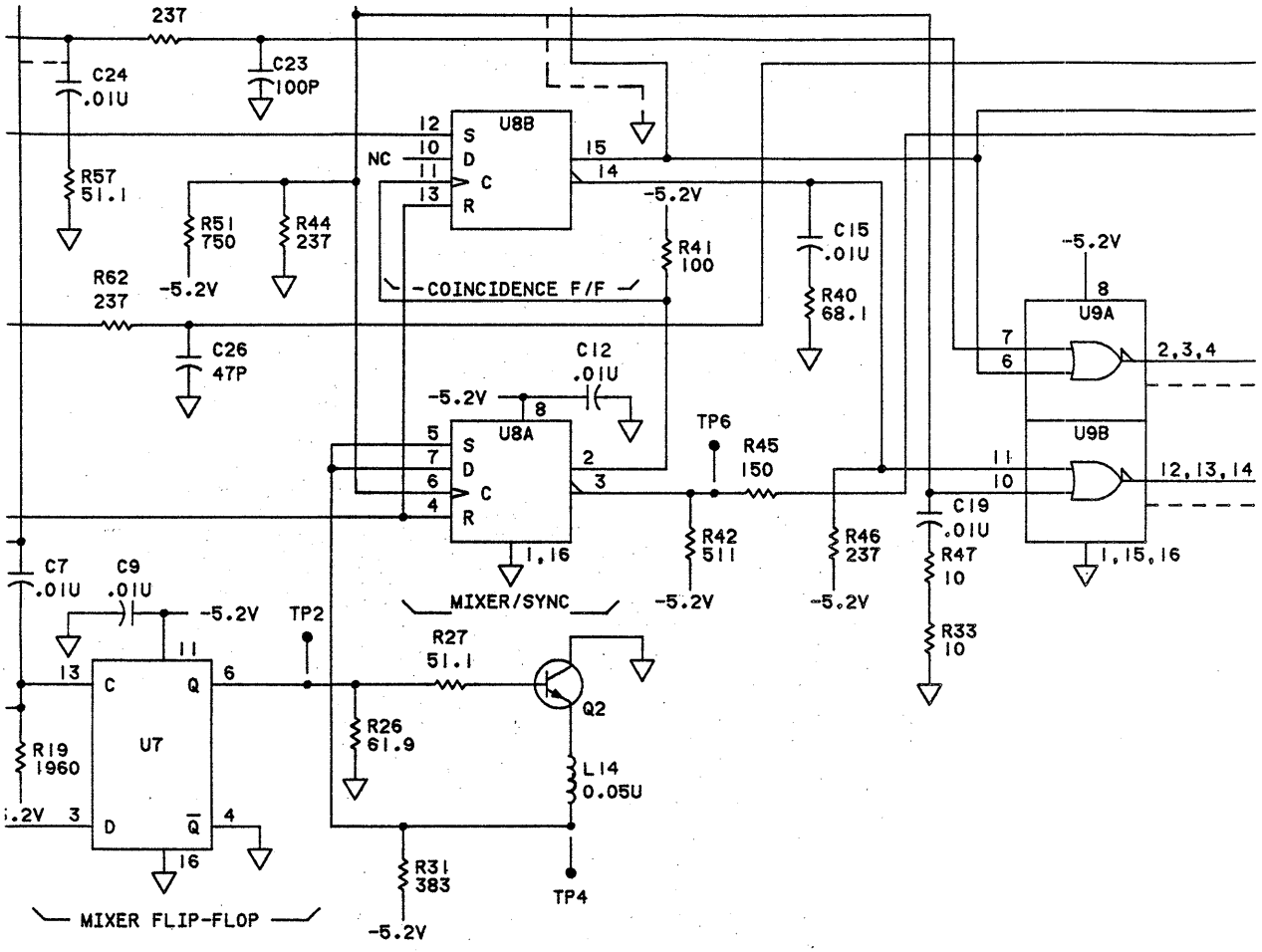


The schematic above is NØ portion (right side of the schematic) of the A18 assembly. Substitute this for the right side of the schematic in *Figure 8–23*. Notice the inputs and outputs of the assembly board are the same.

Also make the changes, listed below, to the parts list on page 6–20.

Change A18U15 to 1820–1482
Change A18U16 to 1820–0802
Change A18U18 to 1820–0805
Delete A18U19

Figure 7–1. A18 Assembly Series 1748



The schematic above is the center portion of the A19/A20 assembly for series 1748A. Substitute this for the same portion of the schematic in *Figure 8-24*. This action will change the A19/A20 schematic (05370-60119 Series 1812A) to match the 05370-60019 (Series 1748A) assembly.

Also make the following changes to the parts list on pages 6-20 and 6-21.

Page 6-20 Delete C31
Page 6-21 Delete U13

Figure 7-2. A19 Assembly Series 1748

SECTION VIII
SERVICE

WARNING

LINE VOLTAGE IS EXPOSED WITHIN THE 5370A EVEN WHEN THE POWER SWITCH IS IN THE STBY POSITION. REMOVAL OF THE POWER CORD IS REQUIRED TO FULLY UNPOWER THE 5370A.

8-1. INTRODUCTION

8-2. This section contains the information needed to service the HP Model 5370A. The information includes recommended test equipment, schematic diagram notes, safety considerations, 10870A service accessory kit, signal descriptions, cable destinations, new logic symbols, replacing front panel lights, pushbutton switch removal, block diagram theory, detailed theory, troubleshooting, microprocessor address mapping, and schematic diagrams. This section also includes a cross-reference table, *Table 8-1*, to aid the correlation of assembly reference designations with their HP part numbers.

Table 8-1. Assembly Designations

Reference Designation	Description	HP Part Number
A1	Power Supply/Motherboard Assembly	05370-60001
A2	Main Motherboard Assembly	05370-60002
A3	Input Attenuator Assembly	05370-60033
A4	Input Trigger Assembly	05370-60004
A5	HP-IB Input Connector Assembly	05370-60005
A6	Power Supply Control Assembly	05370-60006
A7	Oven Oscillator Power Supply Assembly (Option 001)	05370-60007
A8	Reference Frequency Buffer Assembly	05370-60008
A9	Processor Assembly	05370-60009
A10	NOT USED	—
A11	Display Interface Assembly	05370-60011
A12	ROM Assembly	05370-60212
A13	NOT USED	—
A14	Service Aid Assembly (Part of Service Accessory Kit Part Number 10870A)	05370-60014
A15	HP-IB Interface Assemby	05370-60015
A16	Arming Interface Assembly	05370-60016
A17	Count Chain Assembly	05370-60017
A18	DAC/NØ Logic Assembly	05370-60118
A19	Start Interpolator Assembly	05370-60119
A20	Stop Interpolator Assembly	05370-60119
A21	200 MHz Multiplier Assembly	05370-60024
A22	Arming Assembly	05370-60022
A23	Front Panel Display Assembly	05370-60023
A69	10 MHz Oscillator Assembly	05370-60069
A69	10 MHz Oscillator Assembly (Option 001)	10544A

8-3. THEORY OF OPERATION

8-4. There are two theories of operation. The first is a block theory. That is, an overview of the 5370A is presented. The block theory is assembled to follow the block diagram in *Figure 8-16*. The second is a detailed theory. It describes in detail, the circuit operation of all assemblies. All reference is made to the schematic diagrams located at the end of this section.

8-5. TROUBLESHOOTING

8-6. The troubleshooting is located near the end of this section right before the schematic diagrams. Use the flowchart in *Figure 8-7* to isolate the problem to the particular assembly. The troubleshooting that follows *Figure 8-7* is used to locate the faulty component. The troubleshooting refers to mapping and signature analysis techniques. An explanation of the purpose and use of mapping in troubleshooting is provided in paragraphs 8-260 through 8-265.

8-7. RECOMMENDED TEST EQUIPMENT

8-8. Test equipment and test equipment accessories required to maintain the 5370A are listed in *Table 1-2*. Equipment other than that listed may be used if it meets the listed critical specifications.

8-9. SCHEMATIC DIAGRAM NOTES

8-10. *Figure 8-1* shows the symbols used on the schematic diagrams. *Figure 8-1* also shows the method for assigning reference designators, assembly numbers, and subassembly numbers.

8-11. Reference Designations

8-12. Assemblies such as printed circuit boards are assigned numbers in sequence, A1, A2, etc., as shown in *Table 8-1*. As shown in *Figure 8-1*, subassemblies within an assembly are given a subordinate A number. For example, rectifier subassembly A1 has the complete designator A15A1. For individual components, the complete designator is determined by adding the assembly number and subassembly number, if any. For example, CR1 on the rectifier assembly is designated A25A1CR1.

8-13. Identification Markings on Printed Circuit Boards

8-14. HP printed circuit boards (see *Figure 8-1*) have four identification numbers; an assembly part number, a series number, a revision letter, and a production code. The assembly part number has 10 digits (such as 05370-60024) and is the primary identification. All assemblies with the same part number are interchangeable. When a production change is made on an assembly that makes it incompatible with previous assemblies, a change in part number is required. The series number (such as 1848) is used to document minor electrical changes. As changes are made, the series number is incremented. When replacement boards are ordered, you may receive a replacement with a different series number. If there is a difference between the series number marked on the board and the schematic in this manual, a minor electrical difference exists. If the number on the printed circuit board is lower than that on the schematic, refer to Section VII for backdating information. If it is higher, refer to the yellow looseleaf manual change sheets for this manual. If the manual change sheets are missing, contact your local HP Sales and Service Office. See the listing on the back cover of this manual.

8-15. Revision letters (A, B, etc.) denote changes in printed circuit layout. For example, if a capacitor type is changed (electrical value may remain the same) and requires different spacing for its leads, the printed circuit board layout is changed and the revision letter is incremented to the next letter. When a revision letter changes, the series number is also usually changed. The production code is the four-digit, seven-segment number used for production purposes.

SYMBOLS

DANGEROUS VOLTAGE, EXCEEDS 1000 VOLTS

FRONT PANEL LABEL

REAR PANEL LABEL

INTERIOR AND PC BOARDS LABEL

WIPER MOVES TOWARD "CW" WHEN CONTROL IS ROTATED CLOCKWISE

OR PROTECTIVE CONDUCTOR TERMINAL

CIRCUIT COMMON

IDENTIFIED COMMON

OR CHASSIS TERMINAL

KNOB CONTROL

SCREWDRIVER ADJUST

MAIN SIGNAL PATH

FEEDBACK PATH

OR OR TEST POINT

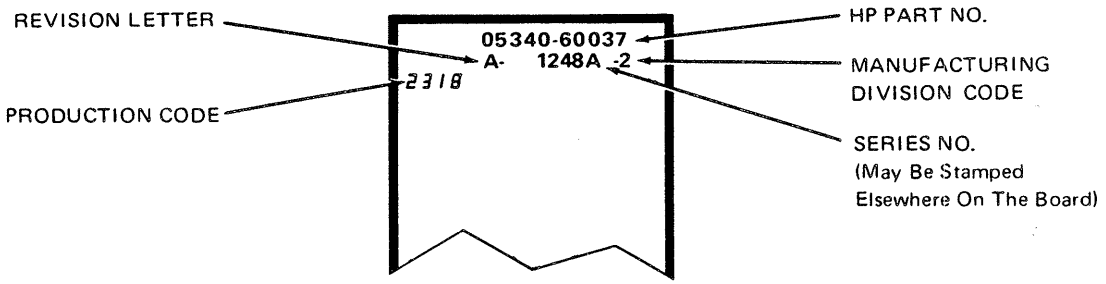
INSTRUCTION MANUAL REFERENCE

ALTERNATING CURRENT

DIRECT CURRENT

ALTERNATING OR DIRECT CURRENT

PRINTED CIRCUIT BOARD IDENTIFICATION



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

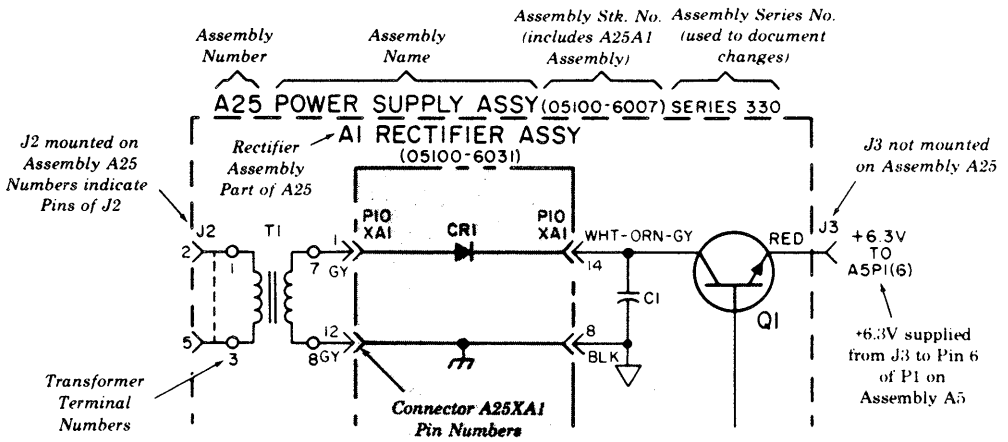


Figure 8-1. Schematic Diagrams Notes

8-16. SAFETY CONSIDERAIONS

8-17. Although the 5370A has been designed in accordance with international safety standards, this manual contains information, cautions, and warnings which must be followed to insure safe operation and to retain the 5370A in safe operating condition (also see Sections II, III, V). Service and adjustments should be performed only by qualified service personnel.

WARNING

ANY INTERRUPTION OF THE PROTECTIVE (GROUNDING) CONDUCTOR (INSIDE OR OUTSIDE THE 5370A) OR DISCONNECTION OF THE PROTECTIVE EARTH TERMINAL IS LIKELY TO MAKE THE 5370A DANGEROUS.

8-18. Any adjustment, maintenance, and repair of the opened 5370A under voltage should be avoided as much as possible and, when inevitable, should be carried out only by a skilled person who is aware of the hazard involved. Capacitors inside the 5370A may still be charged even if the 5370A has been disconnected from its source of power.

WARNING

LINE VOLTAGE IS EXPOSED WITHIN THE 5370A EVEN WHEN THE POWER SWITCH IS IN STBY. REMOVAL OF THE POWER CORD IS NECESSARY TO FULLY UNPOWER THE 5370A.

8-19. Make sure that only fuses with the required rated current and of the specified type (normal blow, time delay, etc.) are used for replacement. The use of repaired fuses and the short-circuiting of fuseholders must be avoided. Whenever it is likely that this protection has been impaired, the 5370A must be made inoperative and be secured against any unintended operation.

WARNING

THE SERVICE INFORMATION IS OFTEN USED WITH POWER SUPPLIED AND PROTECTIVE COVERS REMOVED FROM THE 5370A. ENERGY AVAILABLE AT MANY POINTS MAY, IF CONTACTED, RESULT IN PERSONAL INJURY.

CAUTION

Series pass transistor cases on rear panel have voltage on them and require insulators between them and the heatsink. Power supply damage is inevitable if transistor cases are shorted to the chassis.

8-20. SERVICE ACCESSORY KIT 10870A

8-21. The 10870A Service Accessory Kit contains seven special extender boards and a Service Aid PC assembly (*Figure 8-2*) designed to aid in troubleshooting the 5370A. The following paragraphs describe equipment supplied, replaceable parts and operation.

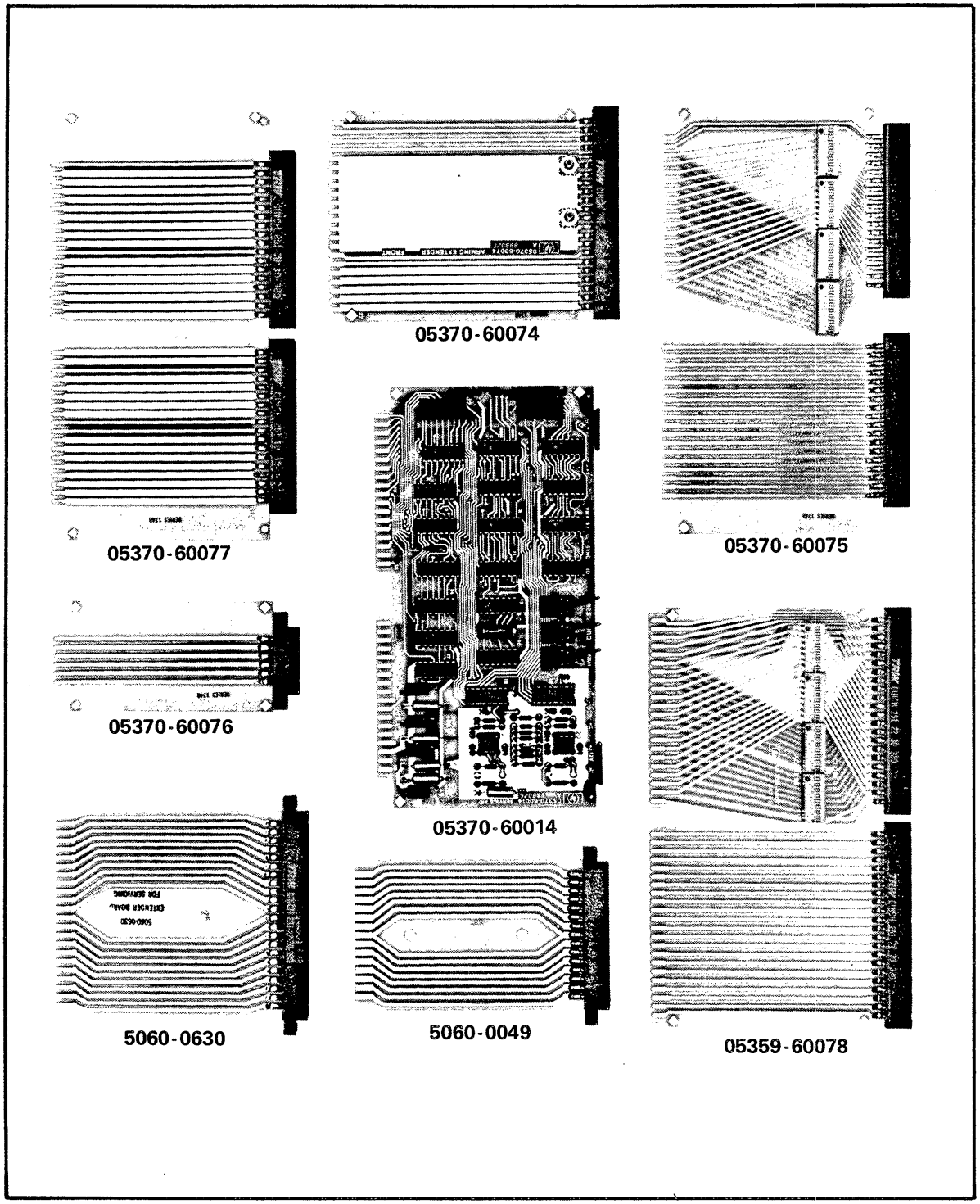


Figure 8-2. 10870A Service Accessory Kit

8-22. Equipment Supplied

8-23. *Table 8-2* lists the boards contained in the 10870A Service Accessory Kit with their general description and usage.

Table 8-2. 10870A Kit Contents

HP PART NUMBER	DESCRIPTION
05370-60014	Service Aid Board (HP 5370A A14 Assembly)
5060-0049	Extender Board (15 pin × 2) for A8 Reference Frequency Buffer Assembly
5060-0630	Extender Board (22 pin × 2) for A6 Power Supply Assembly
05370-60074	Extender Board for 5370A A22 Arming Assembly
05370-60075	Extender Board for Digital Section (except 5359A A16)
05370-60076	Extender Board (6 pin × 2) for A7 Oscillator Power Supply (for 5359A/5370A Options 001)
05730-60077	Extender Board for Analog Section (5370A A9 through A21 Assemblies) (5359A A24 Assembly)
05359-60078	Extender Board for 5359A A16 Processor Interface Assembly

8-24. Replaceable Parts

8-25. HP part numbers and information for ordering replaceable parts are located in Section VI, A14 replaceable parts list.

8-26. Using Extender Board 05370-60075

8-27. The 05370-60075 Extender Board is used to troubleshoot the digital section of the 5370A. The four switch packs (32 switches) open the lines between the extended pc board and the instrument's motherboard. Using *Figure 8-3* for reference, the switches open the following lines:

SW1 switches a through h open the data lines LDØ through LD7, respectively.

SW2

a. opens L(R/W) line
b. opens MEM CLK line
c. opens LIRQ line
d. opens LNMI line
e. opens H RUN line
f. opens HEN line
g. opens HRDY line
h. opens L RST line

SW3 SW3 (a through h) open address lines LAØ through LA7, respectively.

SW4 SW4 (a through h) open address lines LA8 through LA15, respectively.

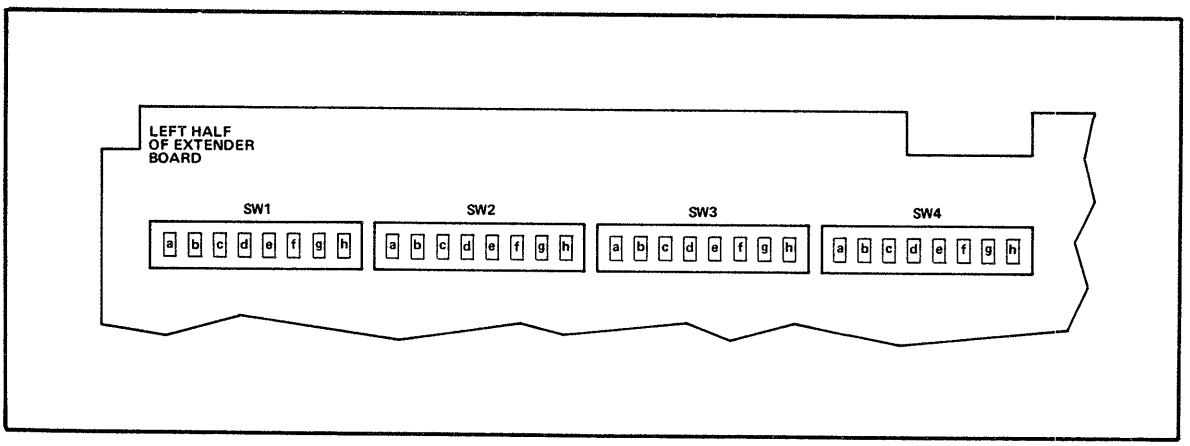


Figure 8-3. 05370-60075 Partial View

8-28. Theory of Operation (05370-60014)

8-29. INTRODUCTION. The following paragraphs contain the theory of operation for the 05370-60014 Service Aid Assembly. Block theory is first given according to the Block Diagram in *Figure 8-4,* followed by detailed theory which is in reference to the 05370-60014 schematic. The 05370-60014 schematic is located in *Figure 8-24.*

8-30. BLOCK THEORY. The 05370-60014 can be divided into two main sections. The first main section is called the breakpoint section. It contains four comparators and four registers (latches) which are used via the HP-IB to halt the microprocessor program routine at a particular preprogrammed address. The second main section contains two DAC's which are connected to the address bus. Their outputs are converted by two operational amplifiers and fed to test points.

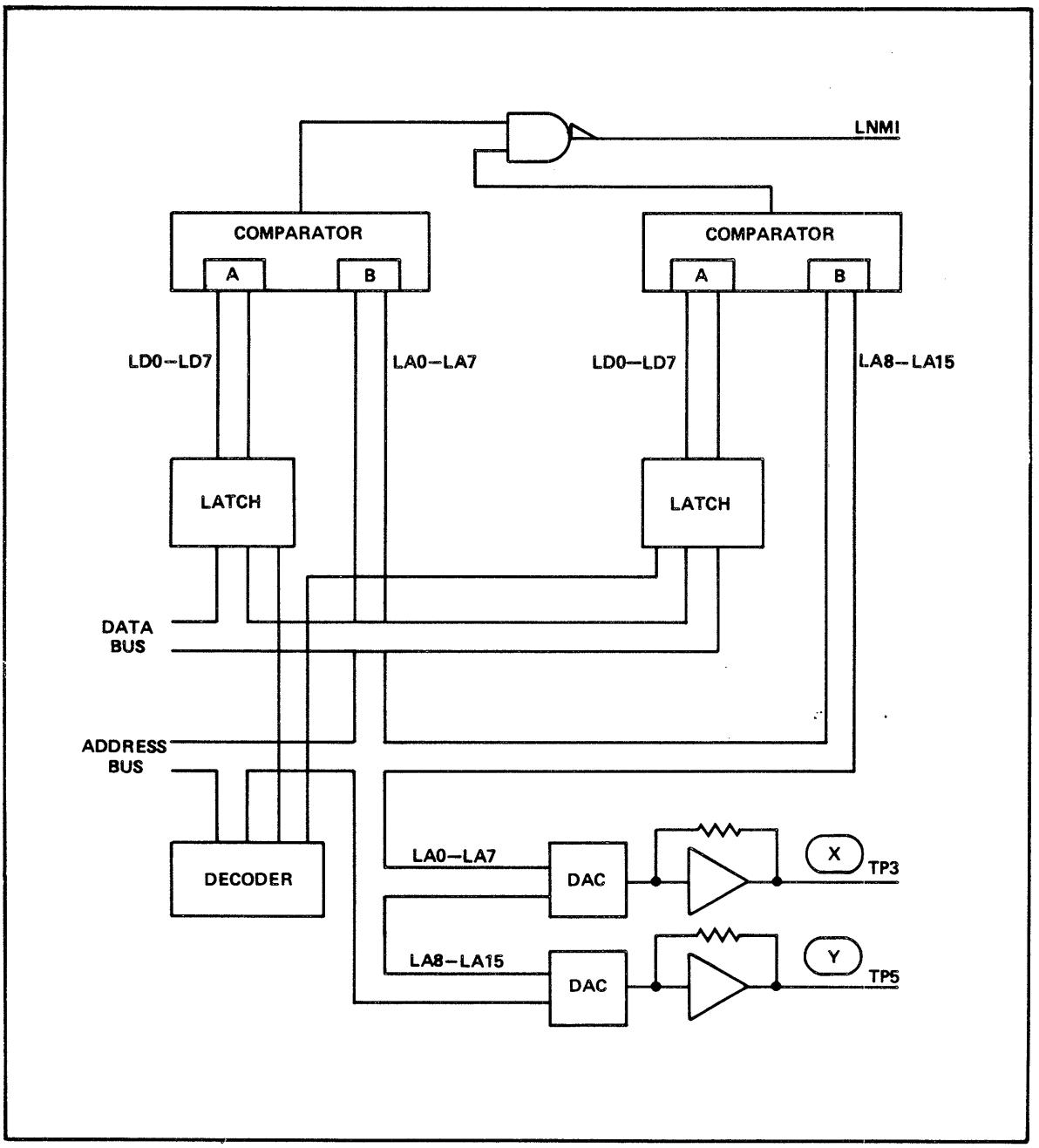


Figure 8-4. 05370-60014 Block Diagram

8-31. DETAILED THEORY (05370-60014). Integrated circuits U16, U13, and U17 form three Set-Reset latches with inverted outputs and are used to debounce the NMI, IRQ, and RES switches. These outputs go directly to the control lines on the instrument's internal bus. U15A, U9A, and U6 form the decode logic which decodes the address of the 05370-60014 assembly. Their outputs enable the breakpoint decoder U3. Three outputs of U3 are being used. U3(15) enables registers (latches) U5 and U4 to latch the information on the D (pins 4, 13, 5, 12) inputs. The Q outputs (pins 2,15,7,10) connect to U2 and U1 comparators, where they are compared to the low order address lines (LAØ through LA7). U3(14) enables registers U10 and U11 to latch the information on the D (pins 4,13,5,12) inputs. The Q outputs (pins 2,15,7,10) connect to U8 and U7 comparators, where they are compared to the high order address lines (LA8 through LA15). The final output of U3 (pin 13) enables register U12 to latch the data from the lower order data lines (LDØ through LD3). U12 Q outputs (2, 15) select on which cycle (read or write) the breakpoint occurs. U12(2) high is write cycle and U12(15) high is read cycle. U15C(8) is the NANDing of VMA and clock $\phi 2$, and used for the strobe input on the HP 5004A Signature Analyzer.

8-32. The DAC section consists mainly of U18, U19, U20, U21, and CR1. The +15V supply is fed through current limiting resistors R11 and R12 to voltage reference CR1. R5 and R9 set the current which enters U18 and U19. Resistors R13, R14, and R15 form a divider which produces 5.12V at TP4 used to adjust an oscilloscope for mapping. U19 is connected to the lower order address lines and U18 is connected to the higher order address lines. The outputs are connected to op-amps U21 and U20, respectively. The op-amps translate the DAC current mode output to a voltage mode. These voltages are used to drive the X and Y axis of an oscilloscope to MAP the microprocessor's program address.

8-33. SIGNAL DESCRIPTIONS

8-34. *Table 8-3* is a list of the signals used in the 5370A. The list is in alphabetical order and includes the mnemonics for cross-reference with the schematic diagrams. A description of the function of each signal and the source and destination are included in the table.

Table 8-3. Signal Descriptions

MNEMONIC	FROM	TO	LOGIC	DESCRIPTION
DAC CTL	XA16B(3)	XA18A($\overline{5}$)	TTL	DAC Control — This line is decoded on the A16 assembly. It is the write clock for the DAC control registers. It latches the data to be used to control the start and stop trigger levels.
DAC STAT	XA16B(5)	XA18A($\overline{7}$)	TTL	DAC Status — This signal is decoded on the A16 assembly. It is the read clock for the DAC Status register on the A18 assembly.
DBE	XA9B($\overline{4}$)	Instrument Bus	TTL	Data Bus Enable — This input is the control input of the microprocessor's data bus. The data bus is enabled when this input is high. When the input signal is low, the data bus is a high impedance.
ERMD	XA22(2)	XA17A(3)	ECL	ECL Armed — This is the status line for the Arm flip-flop. It also passes through a TTL translator and lights the ARM LED in the front panel.
EXT TRIG	A22J3(11)	A23J4	TTL	External Trigger — This is a signal used to light the front panel external trigger LED.
HARMEN	A16J1	A22J1	ECL	High Arm Enable — This signal enables the A22 arming assembly to make a measurement.
H DAC	Rear Panel	A15J1(4)	TTL	High Data Accept — Signal which, when high, indicates to the transmitting device that data has been accepted by the receiver.
HEXT	A1/A2	XA17B(18)	TTL	High External — This line is connected to the rear panel INT/EXT Time Base switch. It tells the microprocessor whether the machine is in Internal (high) or External (low) time base.
HMNRM	A16J1	A22J1(9)	TTL	High Manual Arm — Signal is HIGH when machine is in manual arm or in +T.I. only without external arm, where the 5370A ARMS itself.
HN3BØ→B2	A22J1	A16J1(6,7,8)	ECL	High N3 bit Ø through bit 2 — These are three of the four low-order bits of the event counter.
HN3B3	XA17B(2)	XA16B(7)	TTL	High N3 bit 3 — This is the fourth low order bit of the event counter and the clock to the higher order bits.
HN3RST	A16J1(5)	A22J1(5)	TTL	High N3 Reset — A high on this line resets the Event (N3) counters.

Table 8-3. Signal Descriptions (Continued)

MNEMONIC	FROM	TO	LOGIC	DESCRIPTION
HPTOGL/ CHECK	A16J1(2)	A22J1(2)	TTL	High Toggle/Check — HPTOGL is a decode of the front panel Period Complement pushbutton. This pulsed signal toggles the machine's arming from one channel to the other. When this signal is a level (high) instead of a pulse, the input multiplexers on the A22 assembly select the 10 MHz calibration signal.
HRFD	Rear Panel	A15J1(3)	TTL	High Ready for Data — This signal, when high, indicates to the HP-IB that the listening device is ready to receive data.
HRMCT3	A16J1(13)	A22J1(13)	ECL	High Arm Control 3 — This signal controls the slope of the external arm signal to be used.
HRMD	A22J3(10)	A23J4(10)	TTL	High Armed — This signal is sent to the front panel to light the ARM LED indicator when the instrument is armed.
HRMEN	A16J1(9)	A22J1(9)	TTL	High Arm Enable — When HRMEN is high, it enables the Arm.
HRMT Slope	XA18A($\overline{1}$)	XA22A(1)	TTL	High Remote Slope — This signal, when high, disables the local slope control and enables the remote slope control.
H RUN	XA9A(15)	Instrument Bus	TTL	High Run — The H RUN signal is the inverted Bus Available signal. The H RUN signal will normally be in the high state. When activated, it will go to the low state indicating that the microprocessor has stopped and that the address bus is available.
HSET1 HSET2	A16J1(12) A16J1(11)	A22J1(12) A22J1(11)	TTL TTL	High Set 1,2 — These two signals set or reset a flip-flop to determine whether the Start or Stop channel signal will be used to Arm the 5370A.
HSTART	A22J3(8)	A23J4(8)	TTL	High Start — This line is used to light the START and STOP annunciator LED's in the front panel display. A high lights the START and a low lights the STOP.
HSTASW	A16J1(16)	A22J1(16)	ECL	High Start Switch — Used to control the input signal multiplexer for the START channel. A high causes the START channel to be gated through the START multiplexer. A low causes the STOP channel to be gated through the START multiplexer.
HSTD	A16J1(10)	A22J1(10)	TTL	High Standard — When HSTD is high, it disables the automatic phase detector on the A22 board.

Table 8-3. Signal Descriptions (Continued)

MNEMONIC	FROM	TO	LOGIC	DESCRIPTION
HSTOSW	A16J1(15)	A22J1(15)	ECL	High Stop Switch — Used to control the input signal multiplexer for the STOP channel. A high causes the STOP channel to be gated through the STOP multiplexer. A low causes START channel to be gated through the STOP multiplexer.
LAØ through LA15	XA9A($\overline{3}$ through $\overline{18}$)	Instrument Bus	TTL	Low Address Bus — The address bus is a unidirectional, 16 line bus from the A9 assembly used to address all memory (ROM and RAM) and peripheral devices.
LARMCT2	A16J1(1)	A22J1(1)	TTL	Low Arm Control 2 — Signal used to control whether the Arm comes from either the START or STOP channel, or whether it comes from the manual or external input. When the signal is low, the ARM comes from the START or STOP channel. With the signal high, the ARM comes from the manual or external input.
LARMRST	A16J1(17)	A22J1(17)	TTL	Low Arm Reset — A low pulse signal which is the master reset for the arming assembly.
LATN	Rear Panel	A15J1(7)	TTL	Low Attention — Active low signal which places the HP-IB in the "Command Mode".
LDAV	Rear Panel	A15J1(2)	TTL	Low Data Valid — Active low signal which, when true (low), indicates that data on the DIO lines is stable and available to be accepted by the receiving device.
LDIO1 through LDIO8	Rear Panel	A15J2 Pins (5 through 12)	TTL	Low Data Input/Output — Mnemonic abbreviation referring to the eight data lines of the HP-IB. These lines are active low.
LDØ through LD7	XA9A (3 through 10)	Instrument Bus	TTL	Low Data Bus — The data bus is a bidirectional, eight-line bus used for transferring data to and from the memory and peripheral devices. The bus is active low. All devices on the bus are three-state.
LEOI	Rear Panel	A15J1(1)	TTL	Low End or Identify — This signal (active low) is used to indicate the end of a multiple byte message on the Bus. It is also used in parallel polling.
LGATEN	A16J1(4)	A22J1(4)	TTL	Low Gate Enable — Signal used for external hold-off or for measuring frequency with a gate time. When this signal is low, the A22 assembly is enabled for external hold off or a gate time mode in frequency operation.

Table 8-3. Signal Descriptions (Continued)

MNEMONIC	FROM	TO	LOGIC	DESCRIPTION
LHLDEN	A16J1(14)	A22J1(14)	TTL	Low Hold Off Enable — Signal selects whether or not the machine is in ±T.I. or +T.I. only. With the signal low, the 5370A is in +T.I. only.
LHLT	Instrument Bus	XA9B($\overline{6}$)	TTL	Low Halt — This level-sensitive input is normally in the high state. In low state, all activity in the microprocessor is halted.
LIFC	Rear Panel	A15J1(5)	TTL	Low Interface Clear — When LIFC is set (low) all talkers and listeners on the HP-IB are unaddressed, and controllers go to the inactive state. Only the system controller can activate this line.
LINZ	(Troubleshooting Aid)	XA9B($\overline{3}$)	TTL	Low Initialize — This input is provided as a troubleshooting aid and is used to reset the microprcessor clock state machine.
LIRQ	Instrument Bus	XA9A(13)	TTL	Low Interrupt Request — LIRQ is a normally high, level-sensitive input of the microprocessor. When LIRQ goes low, the microprocessor is requested to do an interrupt sequence. At that time, if the interrupt mask bit in the Condition Code Register is not set, the machine will begin an interrupt sequence.
LNMI	Instrument Bus	XA9A(14)	TTL	Low Non-Maskable Interrupt — A negative going edge on this input requests a nonmask interrupt sequence be generated in the microprocessor. As with LIRQ, the microprocessor completes the current instruction before recognizing the LNMI signal. However, the interrupt mask bit in the Condition Code Register has no effect on LNMI.
LOCK FIX	XA18A(10, $\overline{10}$)	XA19A($\overline{15}$) XA20A($\overline{15}$)	NA	Lock Fix — This signal is used to force the A19/A20 Interpolator assemblies to phase-lock with the reference. This signal is active upon power-up and when the phase-locked loop is out of lock.
LOLRST	XA16B($\overline{6}$)	XA17A($\overline{9}$)	TTL	Low Out-of-Lock Reset — This line is used to reset the Out-of-Lock flip-flop (flag) on the A17 assembly.
LOOL	XA21A($\overline{18}$)	XA17B(1)	TTL	Low Out-of-Lock — This is the out-of-lock line from the A21 assembly. When it goes low, it sets the out-of-lock flip-flop on the A17 board. The flip-flop then lights the out-of-lock LED on the A17 board and sets the out-of-lock status bit for the microprocessor.

Table 8-3. Signal Descriptions (Continued)

MNEMONIC	FROM	TO	LOGIC	DESCRIPTION
LOVEN	XA2A($\overline{1}$)	XA17A($\overline{18}$)	TTL	Low Oven — This line drives (through the microprocessor) the oven indicator on the front panel. When the line is low, the front panel indicator lights and indicates that the oscillator oven is below operating temperature (cold). This is the normal case when the instrument is first connected to the line supply.
LPCRST	XA16B($\overline{4}$)	XA17A($\overline{7}$)	ECL	Low Pulse Counter Reset — A Low Pulse on this line resets all the counters on the A17 assembly.
LPOLRST	XA16B($\overline{6}$)	XA17A($\overline{9}$)	ECL	Low Pulse Out-of-Lock Reset — This line is a power-up reset pulse used to reset the Out-of-Lock flip-flop during power on.
LPORST	XA16B($\overline{5}$)	XA17A($\overline{8}$)	ECL	Low Pulse Overrange Reset — This is the reset for the overrange flip-flop (flag) on the A17 assembly.
LPORØST	XA16B($\overline{5}$)	XA17A($\overline{8}$)	ECL	Low Pulse Overrange NØ Reset — The NØ counter flag is reset when overrange occurs. Overrange is the condition when bit 17 of the NØ count chain becomes active. At this point, the flag is reset. The number of times the counter overranges is kept in software.
L PROC	XA18B(5)	XA17A($\overline{5}$)	ECL	Low Process — This signal is a status signal for the microprocessor. When low, it indicates to the microprocessor that the measurement has been completed.
LREN	Rear Panel	A15J1(16)	TTL	Low Remote Enable — This line is used to enable Bus compatible instruments to respond to commands from the controller or another talker. It can be issued only by the system controller.
LRMMASK	XA16B(9)	XA11B($\overline{5}$)	TTL	Low Remote Mask — This line is active in remote operation. It masks all the front panel pushbuttons with the exception of the Local/Remote switch.
LRST	XA9A(18)	(Troubleshooting Aid)	TTL	Low Reset — This is the main reset for the 5370A. It is used to initialize the microprocessor.
L(R/W)	XA9A(11)	Instrument Bus	TTL	Low Read/Write — (L(R/W) is the inverted R/W signal from the microprocessor. This output tells the memory devices if the microprocessor is in a Read (low) or a Write (high) state.

Table 8-3. Signal Descriptions (Continued)

MNEMONIC	FROM	TO	LOGIC	DESCRIPTION
LSRQ	Rear Panel	A15J1(6)	TTL	Low Service Request — This signal line is set true (low) when the 5370A requests service from the HP-IB controller.
LVMA	XA92A(2)	Instrument Bus	TTL	Low Valid Memory Address — This is an active low signal which when low, indicates to the peripheral devices that there is a valid address on the address bus.
MAN ARM	XA11B($\overline{3}$)	XA16B($\overline{8}$)	TTL	Manual Arm — This line is a decode from the front panel manual arm pushbutton. When this line goes low, an interrupt is generated and the microprocessor puts the machine in the manual arm mode.
$\phi 2$	XA9B($\overline{5}$)	Instrument Bus	TTL	Phase Two — The second phase of the two phase clock which runs the microprocessor. The amplitude runs between V_{cc} and common.
SIGN	XA18B($\overline{4}$)	XA17B(4)	ECL	Sign — This line is a status line for the microprocessor. It indicates the sign of NØ. When this line is high, the sign of NØ is positive.
START DAC	XA16B(1)	XA18A($\overline{3}$)	TTL	Start DAC — This line is decoded on the A16 Assembly. It is the write clock for the Start DAC registers. It latches the data to be used by the Start D-to-A converter.
START TRG	A22J3(9)	A23J4(9)	TTL	Start Trigger — This is a signal used to light the front panel start channel trigger LED.
STOP DAC	XA18B(2)	XA18A($\overline{4}$)	TTL	Stop DAC — This signal is decoded on the A16 assembly. It is the write clock for the Stop DAC registers. It latches the data to be used by the Stop D-to-A converter.
STOP TRG	A22J3(7)	A23J4(7)	TTL	Start Trigger — This is a signal used to light the front panel stop channel trigger LED.
S RATE	XA16B(6)	XA22A(16)	NA	Sample Rate — This line goes to the sample pot on the front panel.
TRGLVLA TRGLVLB	XA18A(16) XA18A(17)	XA22A($\overline{2}$) XA22A($\overline{3}$)	NA	Trigger Levels A and B — These signals are from the A18 DAC's. They are passed through a filter on the A22 assembly and sent to the A4 board. These signals are then used as the remote trigger levels.

8-35. CABLES

8-36. *Table 8-4* lists the 18 cables used in the 5370A. They are listed in numerical order with a brief description and destination. Also refer to *Figure 8-15,* Top Internal View.

Table 8-4. Cable Destinations

CABLE NO.	HP PART NO.	DESCRIPTION	FROM	TO
W1	05370-60401	Rear Panel Power Transistor Wire Harness	Rear Panel Q1 through Q4	A1 Motherboard
W2	05370-60402	Front Panel STBY/ON SW1 Wire Harness	Front Panel STBY/ON SW1	A1 Motherboard
W3	05370-60403	Coax Cable	A22J5	Rear Panel J4
W4	05370-60404	Coax Cable	Front Panel J1	A22J4
W5	05370-60405	Rear Panel SW3 Wire Harness	Rear Panel SW3	A1J4
W6	05370-60406	Coax Cable	A1J2 (A8(4))	Rear Panel J7
W7	05370-60407	Coax Cable	A1J1	A2J2
W8	05370-60408	Coax Cable	Rear Panel J6	Rear Panel SW3(1)
W9	05370-60409	Coax Cable	A1J3	A2J3
W10	05370-60410	Coax Cable	A22J6	Rear Panel J5
W11	8120-2463	Ribbon Cable, 26 AWG 18 Conductor	A16J1	A22J1
W12	8120-2462	Ribbon Cable, 26 AWG 16 Conductor	A5J1	A15J1
W13	8120-2462	Ribbon Cable, 26 AWG 16 Conductor	A5J2	A15J2
W14	8120-2462	Ribbon Cable, 26 AWG 16 Conductor	A11J1	A23J1
W15	8120-2462	Ribbon Cable, 26 AWG 16 Conductor	A11J2	A23J2
W16	8120-2462	Ribbon Cable, 26 AWG 16 Conductor	A11J3	A23J3
W17	8120-2462	Ribbon Cable, 26 AWG 16 Conductor	A22J3	A23J4
W18	8120-1378	Power Cord	— — —	Rear Panel Line Module (A24)

8-37. LOGIC SYMBOLS

8-38. Logic symbols used in this manual conform to the American National Standard ANSI Y32.14-1973 (IEEE Std. 91-1973). This standard supersedes MIL-STD-806B. Logic symbols are described in the following paragraphs.

8-39. Logic Concepts

8-40. The binary numbers 1 and Ø are used in pure logic where 1 represents true, yes, or active and Ø represents false, no, or inactive. These terms should not be confused with the physical quantity (e.g., voltage) that may be used to implement the logic, nor should the term "active" be confused with a level that turns a device on or off. A truth table for a relationship in logic shows (implicitly or explicitly) all the combinations of true and false input conditions and the result (output). There are only two basic logic relationships, AND and OR. The following illustrations assume two inputs (A and B), but these can be generalized to apply to more than two inputs.

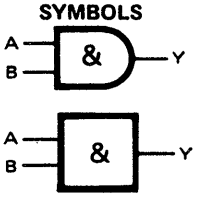
AND Y is true if and only if A is true and B is true (or more generally, if all inputs are true).
Y=1 if and only if A=1 **and** B=1
Y=A•B

OR Y is true if and only if A is true or B is true (or more generally, if one or more input(s) is (are) true).
Y=1 if and only if A=1 **or** B=1
Y=A+B

TRUTH TABLE

A	B	Y
1	1	1
1	0	0
0	1	0
0	0	0

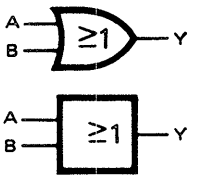
EQUIVALENT SYMBOLS



TRUTH TABLE

A	B	Y
1	1	1
1	0	1
0	1	1
0	0	0

EQUIVALENT SYMBOLS



8-41. Negation

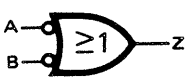
8-42. In logic symbology, the presence of the negation indication symbol O provides for the presentation of logic function inputs and outputs in terms *independent* of their physical values, the Ø-state of the input or output being the 1-state of the symbol referred to by the symbol description.

EXAMPLE 1

TRUTH TABLE

A	B	Z
1	1	0
1	0	1
0	1	1
0	0	1

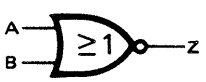
EXAMPLE 2



TRUTH TABLE

A	B	Z
1	1	0
1	0	1
0	1	1
0	0	1

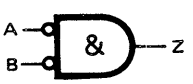
EXAMPLE 3



TRUTH TABLE

A	B	Z
1	1	0
1	0	0
0	1	0
0	0	1

EXAMPLE 4



TRUTH TABLE

A	B	Z
1	1	0
1	0	0
0	1	0
0	0	1

EXAMPLE 1 says that Z is *not* true if A is true *and* B is true or that Z is true if A *and* B are *not* both true. $\overline{Z} = AB$ or $Z = \overline{AB}$. This is frequently referred to as NAND (for NOT AND).

EXAMPLE 2 says that Z is true if A is *not* true *or* if B is *not* true. $Z = \overline{A} + \overline{B}$. Note that this truth table is identical to that of Example 1. The logic equation is merely a DeMorgan's transformation of the equations in Example 1. The symbols are equivalent.

EXAMPLE 3 $\overline{Z} = A+B$ or $Z = \overline{A} + \overline{B}$ and,

EXAMPLE 4 $Z = \overline{A \bullet B}$, also share common truth tables and are equivalent transformations of each other. The NOT OR form (Example 3) is frequently referred to as NOR.

NOTE

In this manual the logic negation symbol is NOT used.

8-43. Logic Implementation and Polarity Indication

8-44. Devices that can perform the basic logic functions, AND and OR, are called gates. Any device that can perform one of these functions can also be used to perform the other if the relationship of the input and output voltage levels to the logic variables 1 and Ø is redefined suitably.

8-45. In describing the operation of electronic logic devices, the symbol H is used to represent a "high level", which is a voltage within the more-positive (less-negative) of the two ranges of voltages used to represent the binary variables. L is used to represent a "low level", which is a voltage within the less-positive (more-negative) range.

8-46. A function table for a device shows (implicitly or explicitly) all the combinations of input conditions and the resulting output conditions.

8-47. In graphic symbols, inputs or outputs that are active when at the high level are shown without polarity indication. The polarity indicator symbol ▷ denotes that the active (one) state of an input or output *with respect to the symbol to which it is attached* is the low level.

NOTE

The polarity indicator symbol " ▷ " is used in this manual.

EXAMPLE 5 assume two devices having the following function tables.

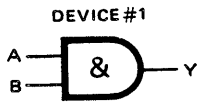
DEVICE #1
FUNCTION TABLE

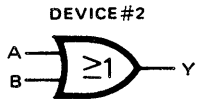
A	B	Y
H	H	H
H	L	L
L	H	L
L	L	L

DEVICE #2
FUNCTION TABLE

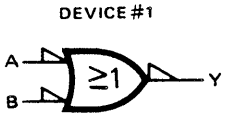
A	B	Y
H	H	H
H	L	H
L	H	H
L	L	L

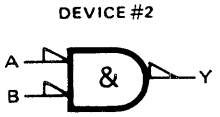
POSITIVE LOGIC by assigning the relationship H=1, L=Ø at both input and output, Device #1 can perform the AND function and Device #2 can perform the OR function. Such a consistent assignment is referred to as positive logic. The corresponding logic symbols would be:





NEGATIVE LOGIC alternatively, by assigning the relationship H=Ø, L=1 at both input and output, Device #1 can perform the OR function and Device #2 can perform the AND function. Such a consistent assignment is referred to as negative logic. The corresponding logic symbols would be:





8-48. MIXED LOGIC. The use of the polarity indicator symbol (◺) automatically invokes a mixed-logic convention. That is, positive logic is used at the inputs and outputs that *do not* have polarity indicators, negative logic is used at the inputs and outputs that *have* polarity indicators.

EXAMPLE 6
FUNCTION TABLE

A	B	Z
H	H	L
H	L	H
L	H	H
L	L	H

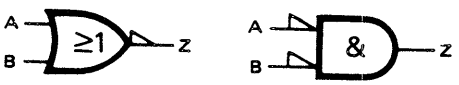
This may be shown either of two ways:

Note the equivalence of these symbols to examples 1 and 2 and the fact that the function table is a positive-logic translation (H=1, L=Ø) of the NAND truth table, and also note that the function table is the negative-logic translation (H=Ø, L=1) of the NOR truth table, given in Example 3.

EXAMPLE 7
FUNCTION TABLE

A	B	Z
H	H	L
H	L	L
L	H	L
L	L	H

This may be shown either of two ways:



Note the equivalence of these symbols to examples 3 and 4 and the fact that the function table is a positive-logic translation (H=1, L=Ø) of the NOR truth table, and also note that the function table is the negative-logic translation (H=Ø, L=1) of the the NAND truth table, given in Example 1.

8-49. It should be noted that one can easily convert from the symbology of positive-logic merely by substituting a polarity indicator (◺) for each negative indicator (○) while leaving the distinctive shape alone. To convert from the symbology of negative-logic, a polarity indication (◺) is substituted for each negation indicator (○) and the OR shape is substituted for the AND shape or vice versa.

8-50. It was shown that any device that can perform OR logic can also perform AND logic and vice versa. DeMorgan's transformation is illustrated in Examples 1 through 7. The rules of the transformation are:

1. At each input or output having a negation (○) or polarity (◺) indicator, delete the indicator.
2. At each input or output not having an indicator, add a negation (○) or polarity (◺) indicator.
3. Substitute the AND symbol ⊐ for the OR symbol ⊃ or vice versa.

These steps do not alter the assumed convention; positive-logic stays positive, negative-logic stays negative, and mixed-logic stays mixed.

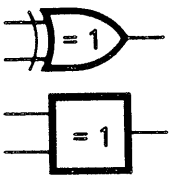
8-51. The choice of symbol may be influenced by these considerations: (1) The operation being performed may best be understood as AND or OR. (2) In a function more complex than a basic gate, the inputs will usually be considered as inherently active high or active low (e.g., the J and K inputs of a J-K flip-flop are active high and active low, respectively). (3) In a chain of logic, understanding and the writing of logic equations are often facilitated if active low or negated outputs feed into active low or negated inputs.

8-52. Other Symbols

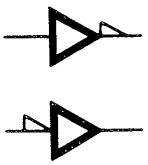
8-53. Additional symbols are required to depict complex logic diagrams, as follows:

Dynamic input activated by transition from a low level to a high level. The opposite transition has no effect at the output.

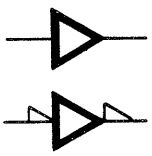
Dynamic input activated by transition from a high level to a low level. The opposite transition has no effect at the output.



Exclusive OR function. The output will assume its indicated active level if and only if one and only one of the two inputs assumes its indicated active level.



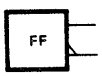
Inverting function. The output is low if the input is high and it is high if the input is low. The two symbols shown are equivalent.



Noninverting function. The output is high if the input is high and it is low if the input is low. The two symbols shown are equivalent.

OUTPUT DELAY. The output signal is effective when the input signal returns to its opposite state.

EXTENDER. Indicates when a logic function increases (extends) the number of inputs to another logic function.



FLIP-FLOP. A binary sequential element with two stable states: a set (1) state and a reset (Ø) state. Outputs are shown in the 1 state when the flip-flop is set. In the reset state the outputs will be opposite to the set state.

RESET. A 1 input will reset the flip-flop. A return to Ø will cause no further effect.

SET. A 1 input will set the flip-flop. A return to Ø will cause no further action.

TOGGLE. A 1 input will cause the flip-flop to change state. A return to Ø will cause no further action.

J INPUT. Similar to the S input except if both J and K (see below) are at 1, the flip-flop changes state.

K INPUT. Similar to the R input (see above).

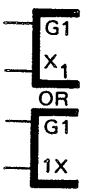
D INPUT (Data). Always dependent on another input (usually C). When the C and D inputs are at 1, the flip-flop will be set. When the C is 1 and the D is Ø, the flip-flop will reset.

Address symbol has multiplexing relationship at inputs and demultiplexing relationship at outputs.

8-54. Dependency Notation "C" "G" "V" "F"

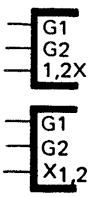
8-55. Dependency notation is a way to simplify symbols for complex IC elements by defining the existence of an AND relationship between inputs, or by the AND conditioning of an output by an input without actually showing all the elements and interconnections involved. The following examples use the letter "C" for control and "G" for gate. The dependent input is labeled with a number that is either prefixed (e.g., 1X) or subscripted (e.g., X_1). They both mean the same thing. The letter "V" is used to indicate an OR relationship between inputs or between inputs and outputs with this letter (V). The letter "F" indicates a connect-disconnect relationship. If the "F" (free dependency) inputs or outputs are active (1) the other usual normal conditions apply. If one or more of the "F" inputs are inactive (Ø), the related "F" output is disconnected from its normal output condition (it floats).

The input that controls or gates other inputs is labeled with a "C" or a "G", followed by an identifying number. The controlled or gated input or output is labeled with the same number. In this example, "1" is controlled by "G1".



When the controlled or gated input or output already has a functional label (X is used here), that label will be prefixed or subscripted by the identifying number.

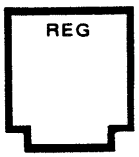
If a particular device has only one gating or control input then the identifying number may be eliminated and the relationship shown with a subscript.



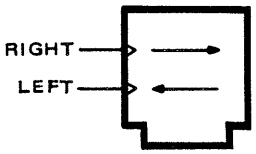
If the input or output is affected by more than one gate or control input, then the identifying numbers of each gate or control input will appear in the prefix or subscript, separated by commas. In this example "X" is controlled by "G1" and "G2".

8-56. Control Blocks

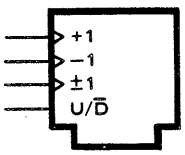
8-57. A class of symbols for complex logic are called control blocks. Control blocks are used to show where common control signals are applied to a group of functionally separate units. Examples of types of control blocks follow.



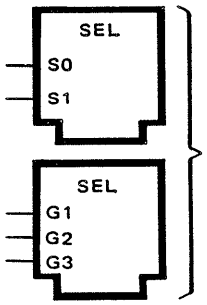
Register control block. This symbol is used with an associated array of flip-flop symbols to provide a point of placement for common function lines, such as a common clear.



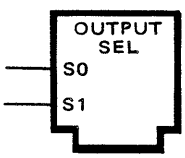
Shift register control block. These symbols are used with any array of flip-flop symbols to form a shift register. An active transition at the inputs causes left or right shifting as indicated.



Counter control block. The symbol is used with an array of flip-flops or other circuits serving as a binary or decade counter. An active transition at the +1 or −1 input causes the counter to increment one count upward or downward, respectively. An active transition at the +1 input causes the counter to increment one count upward or downward depending on the input at an up/down control.



Selector control block. These symbols are used with an array of OR symbols to provide a point of placement for selection (S) or gating (G) lines. The selection lines enable the input desingated Ø, 1, ...n of each OR function by means of a binary code where SØ is the least significant digit. If the 1 level of these lines is low, polarity indicators (◺) will be used. The gating lines have an AND relation with the respective input of each OR function: G1 with the inputs numbered 1, G2 with the inputs numbered 2, and so forth. If the enabling levels of these lines is low, polarity indicators (◺) will be used.



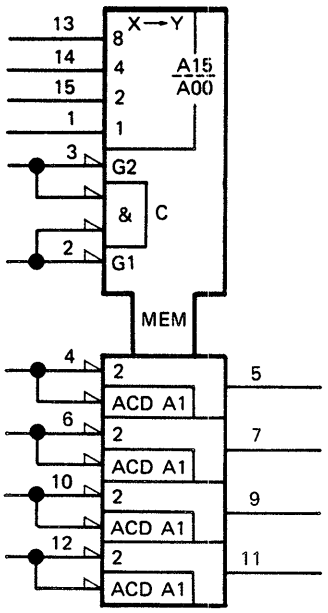
Output selector control block. This symbol is used with a block symbol having multiple outputs to form a decoder. The selection lines enable the output designated Ø, 1, ...n of each block by means of a binary code where SØ is the least significant digit. If the 1 level of these lines is low, polarity indicators (◺) will be used.

8-58. Complex Logic Devices

8-59. Logic elements can be combined to produce very complex devices that can perform more difficult functions. A control block symbol can be used to simplify understanding of many complex devices. The more complex devices which are used in the 5370A are explained in the next pages. They are organized in numerical order by their HP part number.

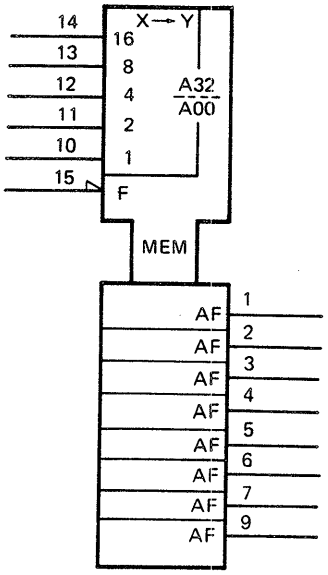
RANDOM ACCESS MEMORY (RAM)
1816-1089
DM74LS189
A11U2, A11U4, A11U7

This memory has an array of 64 flip-flop memory cells in a matrix to provide 16 words of 4 bits each. Information present at the data inputs (pins 4, 6, 10, 12) is written into memory by holding both the memory enable (pin 2) and the write enable (pin 3) LOW while addressing the desired word location determined by the BCD input at pins 1, 15, 14, and 13. The complement of the information written into memory is read out at the four outputs (pins 5, 7, 9, and 11), by holding memory enable (pin 2) LOW and the write enable (pin 3) HIGH.



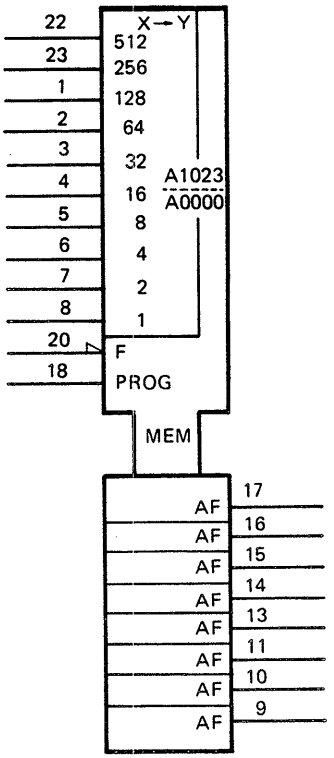
READ ONLY MEMORY (ROM)
1816-1154
SN74L188N
A15U23

Address selection is determined by the five upper inputs which are decoded into 32 possible addresses (A00 through A31) corresponding to the weighing modifiers at the inputs. Input modifier F (pin 15) gates the outputs. Stored data will be read from the selected memory address if F is active (LOW). The output data (pins 1-7 and 9) are active HIGH.



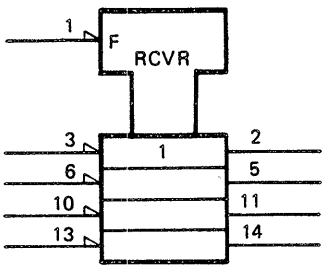
READ ONLY MEMORY (ROM)
1818-0554
C2708
A12U1

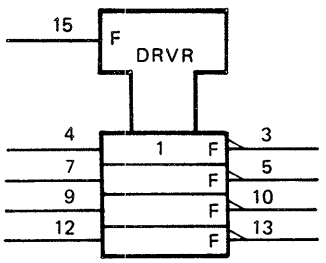
The A12U1 ROM is operationally the same as the previous ROM except for 1024 possible address locations instead of 32.



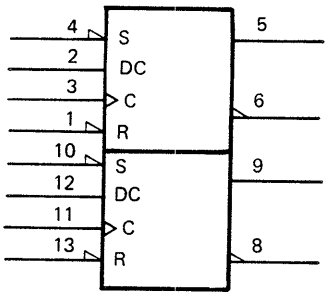
QUAD BUS DRIVER/RECEIVER
1820-1081
8T26
A9U1, A9U2

The bus driver/receiver consists of four pairs of inverting logic gates and two buffered common enable inputs (pins 1 and 15). A LOW on the input enable (pin 1) enables the receiver gates. A HIGH on the bus enable (pin 15) input allows input data to be transferred to the output of the driver, and a LOW forces the output to a high impedance state.



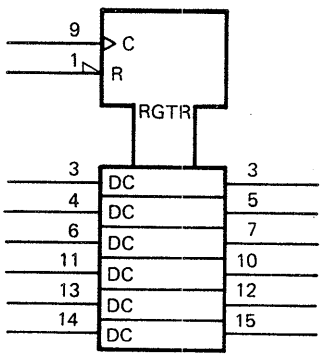


DUAL D-TYPE FLIP-FLOP
1820-1112
SN74LS74N
A11U22, A15U1, U15U3, A15U6, A15U9, A15U15, A15U18, A15U27, A15U37, A16U13, A16U16



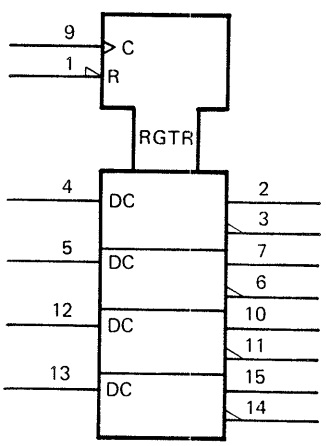
The dual D-type flip-flop consists of two independent D-type flip-flops. The information present at the data (D_C) input is transferred to the active-high and active-low outputs on a low-to-high transition of the clock (C) input. The data input is then locked out and the outputs do not change again until the next low-to-high transition of the clock input. The set (S) and reset (R) inputs override all other input conditions: when (S) is low, the active-high output is forced high; when reset (R) is low, the active-high output is forced low. Although normally the active-low output is the complement of the active-high output, simultaneous low inputs at the set and reset will force both the active-low and active-high outputs to go high at the same time on some D-type flip-flops. This condition will exist only for the length of time that both set and reset inputs are held low. The flip-flop will return to some indeterminate state when both the set and reset inputs are returned to the high state.

HEX/QUAD D-TYPE FLIP-FLOPS
1820-1196
SN74LS174N
A9U11, A15U11



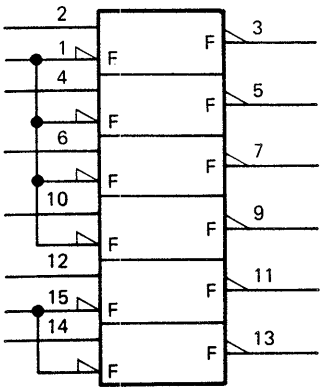
Information at the D inputs is transferred to the outputs on the positive-going edge of the clock pulse (pin 9). Clock triggering occurs at a particular voltage level. The hex FFs have single outputs, the quad FFs have complementary outputs.

1820-1195
SN74LS175N
A14U4, A14U5, A14U10, A14U11, A14U12, A16U2, A16U3, A16U5, A16U7, A16U9, A16U11, A18U2, A18U3, A18U4, A18U5, A18U6, A18U7



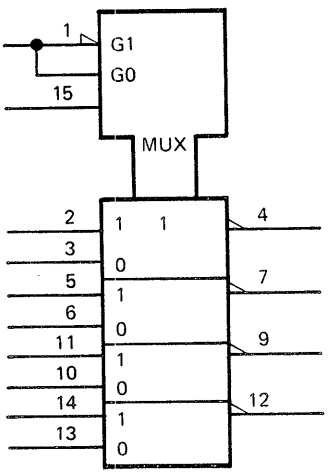
HEX INVERTER
1820-1255
74368
A15U10, A15U13, A18U1

This hex inverter converts standard TTL to THREE-STATE outputs. All six outputs are controlled from common inputs (pins 1 and 15). With both pins 1 and 15 LOW, the inverted input is present at the ouptut. When either pin 1 or 15 is HIGH, the output is in a THREE-STATE condition.



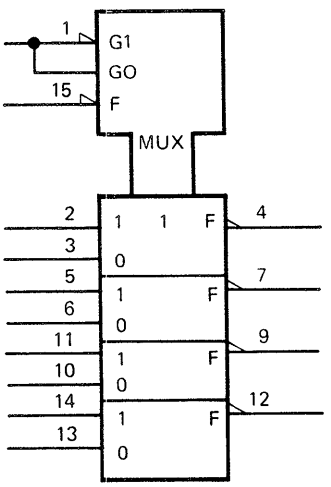
2-LINE to 1-LINE DATA
SELECTOR/MULTIPLEXER
1820-1428
74LS158
A11U11

This quad two input multiplexer selects one of two word inputs and outputs the data when enabled. The level at pin 1 selects the input word. The outputs are LOW when pin 15 is LOW.



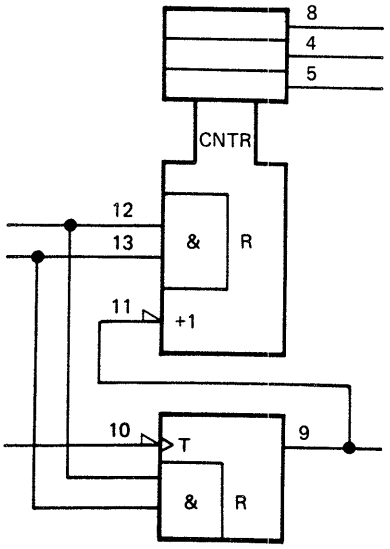
2-LINE TO 1-LINE DATA
SELECTOR/MULTIPLEXER
1820-1439
SN74LS258N
A16U15, A16U17, A16U19, A16U21

This quad two input multiplexer selects one of two word inputs and outputs the data when enabled. When pin 15 is LOW, the level at pin 1 selects the input word. The outputs are LOW. When pin 15 is HIGH, the outputs are off (high impedance).



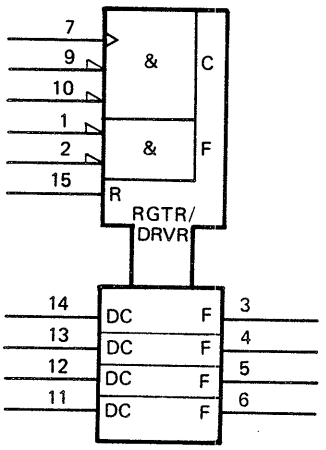
4-BIT BINARY COUNTER
1820-1443
SN74LS293N
A11U17, A11U23

This binary counter has four master-slave flip-flops and gating for which the count cycle length is divide-by-eight. The counter has a gated zero reset. To use the maximum count length, the pin 11 input is connected to the pin 9 output. The input count pulses are applied to the pin 10 input.



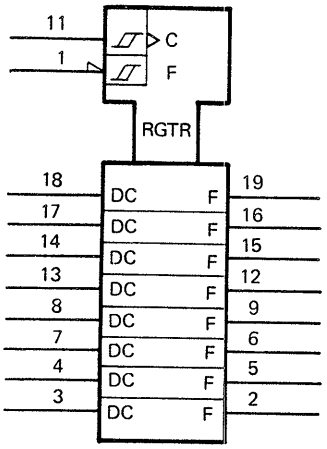
4-BIT D-TYPE REGISTER
1820-1885
74LS173
A11U9, A11U13, A15U8

When both data enable inputs (pins 9 and 10) are LOW, the data at the inputs (DC) is loaded into the flip-flops on the next positive edge (transition) of the clock (pin 7). When both output controls (pins 1 and 2) are LOW, the data is present at the outputs (pins 3, 4, 5, 6). When either of the output controls are HIGH, the outputs (pins 3, 4, 5, 6) are high impedance (THREE-STATE).



8-BIT D-TYPE FLIP-FLOP
1820-1997
74LS374
A15U22, A15U25, A15U28

Information present at the DC inputs is transferred to the F outputs on the positive going edge of the clock (pin 11). A LOW at RESET (pin 1) will reset the flip-flops and all outputs (pins 2, 5, 6, 9, 12, 15, 16, 19) will be low.



8-60. REPLACING FRONT PANEL LIGHTS

8-61. For the purpose of replacement, the front panel lights can be divided into three catagories: 1) seven-segment display and annunciator LED's; 2) pushbutton switch and clock loss LED's; and 3) trigger light LED's. Replacement procedures are given under separate headings for each type.

8-62. Seven-Segment Display and Annunciator LED's

8-63. To replace an LED of this type, first remove the red display window by sliding the three plastic slide clamps to the left. The window is now free to remove. To replace any of the seven-segment displays, insert an IC puller over the top and bottom of the LED display and pull out.

8-64. To replace an annunciator LED, first remove the top cover and the red display window. Remove the frosted plastic sheet that covers the annunciator block. Gently place the tips of a pair of needle-nose pliers over the LED while applying a soldering iron to the solder connections on the rear of the A23 Display/Pushbutton Switch board. Remove the LED. When replacing the new LED, be sure to insert the cathode (the shorter lead) into the pc hole with the square pad.

8-65. Pushbutton Switch and Clock Loss LED's

8-66. There are two methods of replacing these LED's. The first method involves removing the front panel and using heat-shrink tubing to extract the LED. The second method requires the A23 Display/Pushbutton Switch board be removed from the instrument. Neither of these procedures is overly difficult or time consuming; however, Method 1 is preferred if the heat-shrink tubing is available. See paragraph 8-69 under Method 1 for clock loss LED replacement.

8-67. METHOD 1. To replace a pushbutton switch LED, first remove the front panel by removing the hardward associated with the three input jacks, the three LEVEL controls, and the MAN RATE control. Also remove nut from backside of A23 Display Pushbutton Switch board, near left side of the instrument. The pushbutton can now be removed using an IC puller.

NOTE

The pushbuttons can be removed with the front panel on if the IC puller is modified by breaking it in half and filing down both sides of the blade's wide portion just before it tapers down to the narrow tip area. Insert the tip between pushbutton and front panel and place tip of puller under backside of pushbutton. Hold opposite side of pushbutton with finger and pull forward.

8-68. Once the pushbutton is removed, replace heat-shrink tubing that is about 1/8" ID (HP P/N 0890-0983) over the replacement (new) LED and use a heat gun to shrink tubing around LED. Pull tubing off of LED and insert through the middle of the front panel switch and securely over the faulty LED. Heat the LED solder connection of rear side of the A23 board and remove LED. Use a toothpick to clear solder holes. Place tubing over new LED and insert into place. Short lead of LED (cathode) goes into hole with square pad. Solder in place.

8-69. The Clock Loss LED can also be replaced using the heat-shrink tubing method as outlined above. The front panel need not be removed. If tubing is not available, use Method 2. Be sure to retain the spacing insulator when installing the new LED.

8-70. METHOD 2. This method requires removing the A23 Display/Pushbutton Switch board. The procedure is outlined under *Pushbutton Switch Removal*. Once the board is removed and disassembled, remove the specific switch for access to the LED and remove the LED in the normal manner.

8-71. Trigger Light LED's

8-72. Remove the front panel by removing the hardware associated with the three input jacks, the three LEVEL pots, and the MAN RATE control. Also, remove nut from back side of A23 Display/Pushbutton Switch board, near left side of the instrument. Gently hold the LED with a pair of needle-nose pliers while heating the solder connections on the rear side of A23. Remove the LED. At this point, the large plastic spacer will come free. Tilt the counter and shake until spacer falls out. This part was used when the board was loaded prior to wave soldering and is no longer required. The new LED can be properly positioned by hand during replacement.

8-73. PUSHBUTTON SWITCH REMOVAL

8-74. The following procedure outlines the steps necessary to disassemble the instrument for the removal of the pushbutton switches.

1. Remove the top and bottom covers.
2. Remove right and left side covers (2 screws each).
3. Remove trim strip along top of front panel frame.
4. Remove four screws from top of front panel frame.
5. Disconnect the four ribbon cables from the A23 board.
6. Disconnect the three coax cables and two ribbon cables on A22 Arming board (see A22 Arming board removal in Section V).
7. Remove the A22 Arming board and A4 Trigger board.
8. Remove the two screws that hold each of the four side struts to the front panel frame.
9. Slide the front panel assembly forward and free of the instrument. (The power switch remains in place.)
10. Place the assembly face down on the table; and using a pair of long-nose pliers, removal all retainer clips holding the A23 board in place.
11. Remove the nut on the left side of the A23 board.
12. Leave the assembly face down and lift the A23 board straight up. The front panel has spacers on the studs, and they will fall out if this is turned upside down.
13. Cut away that part of the red switch stud that has been heat staked to the back side of the board.
14. Remove faulty switch and insert new switch into place.
15. Using a soldering iron with special tip (HP Part Number T-142886), heat-stake new switch to back side of the board.

8-75. BLOCK DIAGRAM THEORY

8-76. Introduction

8-77. The HP Model 5370A is a Time Interval counter using the digital interpolating technique (refer to *Figure 8-16*). For a typical Time Interval measurement, the start and stop signals enter the input assembly, pass through the arming assembly, and enter the Start and Stop Interpolator assemblies. Pulse bursts from these two interpolators plus a third coincident burst go into the count chain assembly. Events are counted in the arming and arming interface assembly. With these four counts, Time Interval, Frequency, and Period measurement can be mathematically derived using the following equation:

$$TI = 5 \frac{257}{256}(N1-N2) + N\emptyset \text{ nanoseconds}$$

$$FREQ = \frac{EVENTS}{TI}$$

$$PERIOD = \frac{TI}{EVENTS}$$

where TI is the Time Interval in nanoseconds, NØ is a 200 MHz reference count between coincidences, N1 is the Start Interpolator count, N2 is the Stop Interpolator count and events is the number of Stop channel input pulses (**events** is used for frequency and period when used with a gate time measurement). An explanation of the equation and the NØ, N1, and N2 counts follows in the next paragraphs.

8-78. The 5370A uses a dual vernier interpolation technique for resolution improvement beyond the 5 ns uncertainty imposed by a 200 MHz basic clock. Two vernier oscillators, each started by the START and STOP pulses, generate bursts of N1 and N2, respectively, each burst being terminated by the coincidence signals C1 and C2. These coincidence signals are used to gate the main 200 MHz clock to generate a third burst NØ. The frequency of the two vernier oscillators are the same, namely 199.22179 MHz (period ≈ 5.02 ns) which is synthesized from the 200 MHz clock through phase-locking technique by the ratio 256:257.

8-79. The burst N1 is proportional to the time between START signal and the clock pulse arriving after it. In the same manner, N2 is proportional to the time between STOP signal and the clock pulse arriving after it. The resolution of these time intervals is given by 5/256 ns or around 20 ps which is the period difference between main and vernier clocks. The time interval is given by

$$TI = 5 \frac{257}{256}(N1-N2) + N\emptyset \text{ ns}$$

In time interval holdoff, or frequency/period mode, the number of events held off is measured in addition to the time interval of occurrence. Frequency and Period are given by:

$$FREQ = \frac{EVENTS}{TI}$$

$$PERIOD = \frac{TI}{EVENTS}$$

The 200 MHz burst NØ occurs between the ending of N1 and the ending of N2. It is a signed number and is + when N1 finishes before N2 and negative vice versa. No restriction is made on the order of occurrences of the START and STOP pulses using the above formula for TI computation.

8-80. Interpolating Technique

8-81. For simplicity, the Interpolating Technique is explained assuming a positive time interval measurement (start pulse arrives before the stop pulse). The explanation in the following paragraphs refer to *Figure 8-5.*

8-82. In +TI ONLY the 5370A is armed internally by the microprocessor. When the start pulse first arrives, the start interpolator VCO momentarily stops oscillation for a duration determined by a fixed delay line. Oscillating again starts *in phase* with the trailing edge of the delay output. This establishes a definite phase relationship needed for comparison to the reference oscillator. The output of the start interpolator oscillator (VCO) is used in two places. First, it goes to the Count Chain Assembly where the pulses are counted as N1. And second, it is mixed with the 200 MHz reference on the Start Interpolator assembly by a D-type flip-flop. When a positive edge of the start oscillator occurs at the same time as a positive edge of the 200 MHz reference, the mixer sends a positive transition to the DAC/NØ assembly. This signal is called START COINCIDENCE, and it starts the accumulation of the 200 MHz reference count (NØ). This coincidence pulse also gates off the output of the START Interpolator oscillator (N1). N1 has not been accumulated and NØ has started to accumulate.

8-83. The same thing happens with the stop interpolator. The stop pulse arrives and momentarily stops the stop interpolator VCO from oscillating. The output of the stop interpolator starts again *in phase* with the trailing edge of the delay output. The output of the stop VCO is used in two places. First, it goes to the Count Chain Assembly where the pulses are counted as N2. And second, it is mixed with the 200 MHz reference on the Stop Interpolator assembly by a D-type flip-flop. When a positive edge of the stop VCO occurs at the same time as a positive edge of the 200 MHz reference, the mixer sends a positive transition to the DAC/NØ assembly. This signal is called STOP COINCIDENCE, and it stops the accumulation of the 200 MHz reference count (NØ). This coincidence pulse gates off the output of the stop interpolator VCO (N2) and also sets the LPROC line low, signaling the microprocessor that the measurement has been completed.

8-84. The Equation

8-85. The microprocessor now has the three variables NØ, N1, and N2 to process the data into a meaningful result. N2 is subtracted from N1. This result is the net time error in terms of ≈5.02 nanosecond periods. This cannot be added to NØ (5.00 nanosecond periods) without a common denominator. To produce a common denominator, the N1–N2 is multiplied by $\frac{257}{256}$. This factor ($\frac{257}{256}$) is the exact ratio between 5.00 nanoseconds and 5.0195763 (≈5.02) nanoseconds. Now the two can be added to produce the number of 5.00 nanosecond periods accumulated between the start and stop input pulses. To turn this number of counts into a unit of time, it is multiplied by 5×10^{-9}, since each count represents one period of the oscillator. This result, which is the time interval in seconds, is then displayed and the sequence begins again. The NØ count may be either positive or negative in value, because even though the start pulse arrives before the stop pulse, the stop coincidence may occur before the start coincidence. For this reason, the sign of NØ is also fed to the microprocessor.

8-86. Typical Instrument Operation

8-87. On power-up, the microprocessor checks the ROM's, RAM's, PLL's, lights the front panel indicators and all segments of all readouts. It then sets the 5370A in TI, SAMPLE SIZE 1, MEAN, +TI ONLY, and arms the counter. The 5370A remains in a wait loop until a start pulse arrives.

8-88. With an input signal, and for SAMPLE SIZE of 1; NØ, N1, and N2 counts accumulate. When the accumulation is complete, the DAC/NØ assembly signals the microprocessor (LPROC) to process the data and display the information requested by the keyboard. The microprocessor periodically examines the keyboard for any change in key selection.

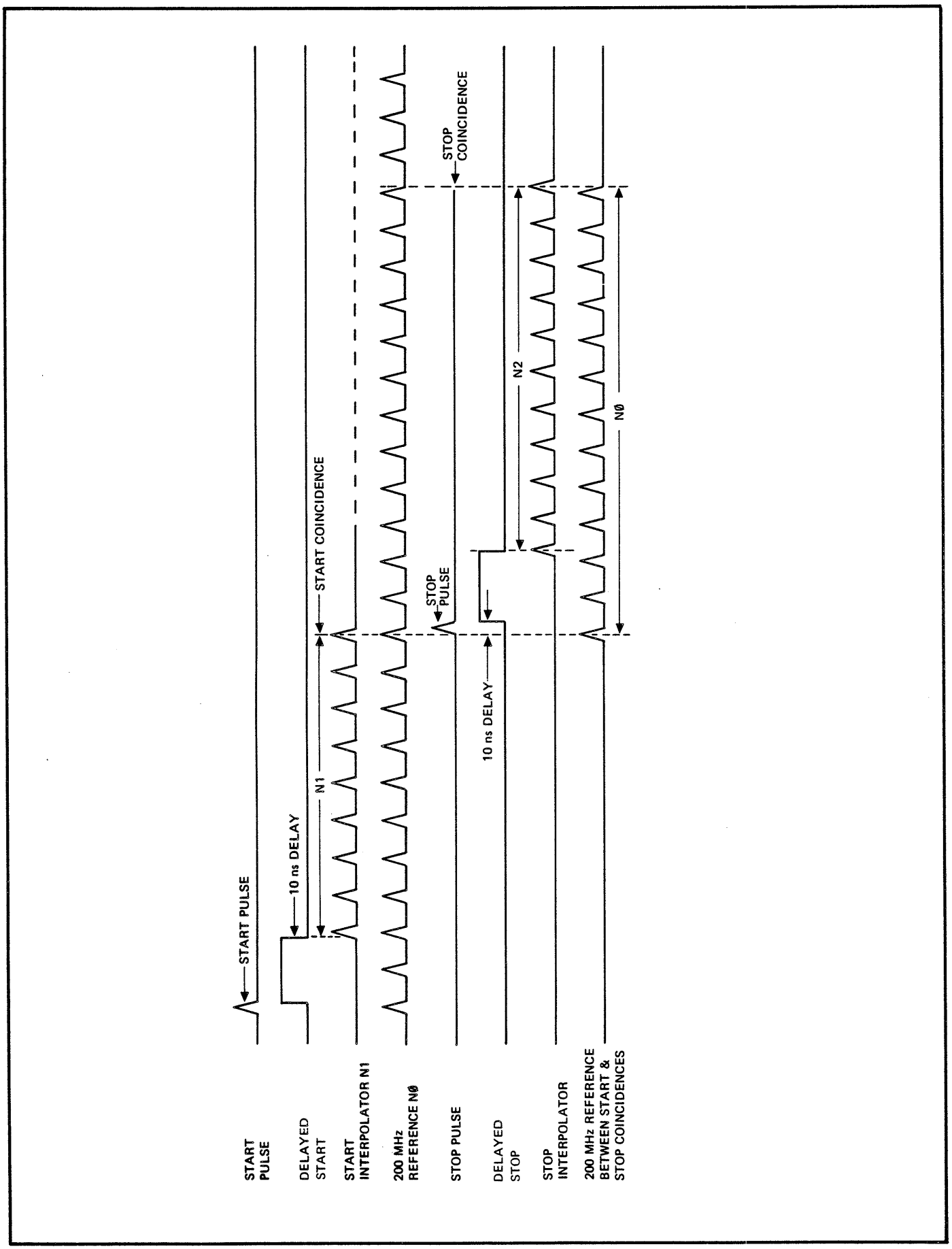


Figure 8-5. Interpolator Timing Diagram

8-89. For a SAMPLE SIZE >1, the microprocessor does not send data to the display until all samples are complete. After each sample, the microprocessor performs an intermediate computation, which takes approximately 330 microseconds, and stores the data into RAM. Because the LPROC goes low for each intermediate computation, the microprocessor can count these clocks for comparison to the number of samples programmed by the keyboard. The microprocessor ends the measurement when the sample size is complete and performs the final computation. The microprocessor then writes to the display RAMs the information requested by the keyboard.

8-90. A1, A6 Power Supply Motherboard/Power Supply Control Assemblies

8-91. The Power Supply Motherboard/Power Supply Control Assemblies (A1, A6) supply all dc power for the instrument, except for the Option 001 Oven Oscillator. The ac line voltage enters through the Power Module (correct selection of line input voltage determined by Power Module card) to the Power Transformer primary windings and to the instrument fan. The secondaries of the power transformer are rectified and filtered and sent to the Power Relay. A separate transformer secondary supplies power to the Oven Oscillator Power Supply (A7) (Option 001).

8-92. When the front panel ON-STANDBY switch is activated, ac power is sent to the fan and unregulated dc is sent to the Power Relay, enabling the four unregulated dc voltages to the Power Supply Control Assembly (A6). The A6 assembly then converts the four unregulated dc voltages +10V, +20V, -20V, and -10V (fused at the input) to +5V, +15V, -15V, and -5.2V for distribution throughout the instrument. These voltages are supplied by four, separate linear series-pass regulators which are referenced to a single +10.0V precision reference IC (A6U5).

8-93. A3 and A4 Input Assemblies

8-94. The input configuration consists of an Input Attenuator Assembly (A3) and an Input Trigger Assembly (A4). These two assemblies contain the controls which determine the type of coupling, the input impedance, the trigger slope and the trigger level. The trigger level and the slope selection can be selected either manually by front panel controls or remotely by HP-IB. The START and STOP signals are amplified and conditioned and then sent to the ARMING assembly (A22) at the rate at which they are input to the machine.

8-95. A5 HP-IB Connector Assembly

8-96. The A5 Assembly provides the interconnection between A15 and the interface bus. Switch S1 is used to select the address code for the instrument.

8-97. A8 Reference Frequency Buffer Assembly

8-98. The Reference Frequency Buffer Assembly (A8) receives 10 MHz from either of two sources. The first source is the internal crystal time base. The second source is the EXTernal frequency input (5 or 10 MHz) from the rear panel connector J6. Whichever 10 MHz signal is selected is shaped and sent to four buffers and a signal monitor. The monitor is an LED and a one-shot multivibrator triggered by the 10 MHz signal. When the LED indicator is on, the selected source signal is present.

8-99. A9 Processor Assembly

8-100. The Processor Assembly (A9) contains the microprocessor, clock logic and driver circuits, RAM and RAM Address Decode logic, and Address and Data Buffers. The Address Bus contains 16 lines which can address up to 65K locations. They are one direction (out only). The data bus contains 8 lines. These are bidirectional (Input and Output) to the A9 Assembly.

8-101. The third bus is the control bus. The lines are mainly microprocessor inputs with the exception of three. The R/W (Read/Write) line is an output to the RAMs. The VMA (Valid Memory Address) line is used for decoding. And the BA (Bus Available) line used to tell assemblies on the Address Bus, the bus is not being used by the microprocessor. The remaining control lines enable the microprocessor to keep track of the status of the rest of the machine. For example, these lines enable the machine to use the HP-IB and lets the microprocessor know when a key is pressed or when a measurement has been completed. The RAMs are used to store data such as which key is active or the results of previous measurements.

8-102. The 10 MHz is present from the A8 Frequency Buffer Assembly to run the Microprocessor Clock State Machine, which generates all necessary processor clocks.

8-103. A11 Display Interface Assembly

8-104. The Display Interface Assembly (A11) allows the microprocessor (A9) to communicate with the display and keyboard. The A11 Assembly is connected directly to the machine's internal processor bus. All logic for decoding and driving, and the latch and RAM for the key data and display data, respectively, are located on the A11 assembly. The RAMs store the previous measurement result during the current measurement cycle. This data is sent to the Display/Control Panel Assembly (A23).

8-105. A12 ROM Assembly

8-106. The ROM Assembly (A12) contains all the program routines (firmware) for the Microprocessor. They contain all the instructions for the microprocessor to enable it to perform all front panel functions.

8-107. A15 HP-IB Interface Logic Assembly

8-108. The HP-IB Interface Logic Assembly (A15) serves as an interface between the 5370A and an external controller via the HP Interface Bus. The A15 assembly consists of seven interface registers (which are used by the microprocessor for interpreting commands and data, sending status, sending data, interpreting interrupts, etc.), two command decoding ROMs, and source and acceptor handshake circuitry.

8-109. A16 Arming Interface Assembly

8-110. The Arming Interface Assembly (A16) contains the Address Decoder, Input/Output Registers, and Selector/Multiplexers needed for control interface between the Arming Assembly (A22), DAC/NØ Assembly (A18), and the Processor Assembly (A9).

8-111. A17 Count Chain Assembly

8-112. The Count Chain Assembly (A17) accumulates (counts) the N1 signal (Start Interpolator VCO output between the start input pulse and the VCO and 200 MHz reference coincidence), the N2 count (Stop Interpolator VCO output between the stop input pulse and the VCO and 200 MHz reference coincidence), and NØ (200 MHz reference burst between N1 and N2). Other inputs to the A17 Assembly are LPROC from the DAC/NØ Logic Assembly (A18) which indicates both Interpolators (A19, A20) have completed a measurement cycle; and the Sign input also from the DAC/NØ Logic Assembly, indicating a start coincidence first (sign is High) or stop coincidence first (sign is Low).

8-113. N1 and N2 counts enter a subtractor where the result is N1–N2. This count then enters a shift and add block where it is effectively multiplied by 257 giving the result 257•(N1–N2). This number along with NØ and the sign enter a multiplexer where it is then output to the processor (A9) via the data bus.

8-114. A18 DAC/NØ Logic Assembly

8-115. Between the time of the Start Coincidence and the Stop Coincidence, the 200 MHz reference frequency, from the 200 MHz Multiplier Assembly (A21), is gated to the Count Chain Assembly by the A18 assembly. This 200 MHz burst is sent to the Count Chain Assembly as the NØ count. The DAC/NØ Logic Assembly also keeps track of which coincidence occurred first. This allows the DAC/NØ Logic Assembly to assign a positive (Start Coincidence first) or a negative (Stop Coincidence first) sign to the Time Interval.

8-116. The DAC/NØ Assembly tells the processor, via the Count Chain board (A17), when the measurement has been completed (both Start and Stop Coincidences occurred). The DAC/NØ Logic Assembly contains the logic which allows the START and STOP input LEVEL control to be program set remotely via the HP-IB or to be monitored and displayed in DC volts. It also contains the logic which allows the input slopes to be remotely programmed.

8-117. The Lock Fix output from the DAC/NØ Logic Assembly to the Interpolator Assemblies (A19, A20) is active on power-up. When active, it gives the phase detectors on the Interpolators an indication that the VCO frequency is high. As a result, the VCO frequency is pulled low. When Lock Fix goes inactive, it releases the phase detectors which then lock the VCOs to the correct frequency. This is performed to insure that the VCOs lock to the correct sideband of the 200 MHz reference when the instrument is first turned on.

8-118. A19 and A20 Interpolator Assemblies

8-119. The two interpolators (A19 Start Interplator, A20 Stop Interpolator) are exactly the same. For this reason, only the START Interpolator will be discussed. The Interpolators are basically phase changeable, oscillation interruptible, phase-lock-loop oscillators.

8-120. The START and STOP output triggers from the Arming Assembly (A22) are input to the START (A19) and STOP (A20) Interpolators, respectively. When an input trigger arrives, it goes to two delayed one-shot flip-flops and to the enable of the coincidence output gate. The VCO is inhibited from oscillating for about 10 nanoseconds after the arrival of the input trigger after which it is allowed to oscillate in a normal condition, but phase coherent to the trigger, and at its normal frequency of 199.2218 MHz, as controlled by the VCO tuning voltage. The VCO output is then passed to the counters on the Count Chain Assembly (A17) through the output gate.

8-121. At the same time, the coincidence flip-flop is held in the set condition for about 35 nanoseconds after the arrival of the input trigger, after which the set enable goes inactive. During this 35 nanoseconds, the Q output of the coincidence flip-flop goes low which disables the gated coincidence output and breaks the feedback loop to the Frequency-Phase detector. Also during the 35 nanoseconds, the Q output of the coincidence flip-flop is high which holds the ÷256 divider in reset and enables the N1 output gate.

8-122. After the 35 nanosecond delay, the coincidence flip-flop is released from the set condition. With the next low to high output from the Mixer/Synchronizer, which signifies a phase coincidence of the 200 MHz reference and the VCO, a low is clocked to the Q and a high to the Q outputs of the coincidence flip-flop. This sends a phase coincident signal to the DAC/NØ Logic Assembly (A18), enables the divided VCO and the Mixer reference to the Frequency/Phase detector, which then allows the VCO to be frequency corrected if needed, releases the reset on the VCO divider, and disables the gated N1 output.

8-123. The counter now has an N1 count in the Count Chain Assembly (A17), and a START COINCIDENCE signal in the DAC/NØ Logic Assembly (A18). The same operation is performed in the Stop Interpolator (A20) which gives an N2 count in the Count Chain Assembly and a STOP COINCIDENCE signal in the DAC/NØ Logic Assembly.

8-124. A21 200 MHz Multiplier Assembly

8-125. The 200 MHz Multiplier Assembly (A21) multiplies the 10 MHz input to 200 MHz. This is accomplished by two cascaded multipliers (X5 and X4) and filter stages. The 200 MHz is then buffered, sent to the interpolators (A19, A20), and phase adjusted and sent to the DAC Assembly (A18). There is also a separate voltage comparator circuit which compares each VCO tuning voltage from the two interpolators with fixed reference voltages. When either VCO tuning voltage is outside designed limits, a signal is sent to the A17 Count Chain Assembly where it is latched as a status bit.

8-126. A22 Arming Assembly

8-127. The arming assembly is responsible for gating the input START and STOP signals to the Start (A19) and Stop (A20) Interpolator Assemblies. This gating can be controlled either internally, externally, or remotely. The Arming Assembly is also responsible for driving the START, STOP, and EXT trigger lights on the front panel, sending a START and a STOP EVENT signal coincident with the START and STOP gate opening to the rear panel jacks J4 and J5, and for partially counting the number of STOP EVENTS ignored in the case of EXT ARM/EXT HOLDOFF or frequency or period gate times.

8-128. In normal operation, the Arming Assembly gates one input signal to each interpolator board. Further input signals are then held off from passing to the interpolators by the processor until the processor is ready for the next sample of input signals.

8-129. The operation is basically the same when using an EXT ARMing input signal. The EXT ARM signal is applied to the machine via J1 on the front panel. Front panel controls allow the operator to select triggering on either the positive or the negative slope. A level control selects the voltage where triggering occurs.

8-130. A23 Display/Control Panel Assembly

8-131. The Display/Control Panel Assembly (A23) contains the seven-segment LED displays, the LED annunciators, and the keyboard.

8-132. A69 10 MHz Oscillator Assembly

8-133. The standard A69 Assembly is a room temperature 10 MHz crystal oscillator. It consists of a crystal controlled oscillator stage and an output buffer stage. The 10 MHz output is sent to the A8 Reference Frequency Buffer Assembly. An Optional (Option 001) 10 MHz Oscillator is available. This is an oven temperature controlled crystal oscillator with higher stability. Included with this option is the Oven Oscillator Power Supply Assembly (A7) which provides unregulated +25 volts to power the oven and regulated +11 volts and +12 volts to power the oven controller and oscillator amplifier, respectively.

8-134. DETAILED THEORY

8-135. The detailed theory of operation is provided in the following paragraphs and listed in numerical order according to assembly number. Each assembly theory refers to its associated schematic diagram located at the end of this section.

8-136. A3 Input Attenuator

8-137. The Input Attenuator consists of two identical input channels. The channels are completely separate with each channel having ac or dc coupling, an attenuator network, selectable 50Ω or 1 MΩ impedance, level control, slope selection, and high frequency amplifier.

8-138. The circuit theory describes only START channel, since STOP channel is analogous. The signal entering J2 is sent directly through S1 or through coupling capacitor C1, which blocks the signal's dc component. S4 selects R3 for 50Ω input impedance and R4 and R5 for 1 MΩ input impedance. When S3 is in the START COM position and S4 in set to 50Ω, the two channels are connected together and R1 maintains the 50Ω input for each channel. In SEP, the inputs are isolated from each other, R1 is bypassed, and the impedance switches can be set separately. S5 switch passes the signal directly in ÷1 or attenuates the signal by 10, in ÷10, through divider network R4 and R5.

8-139. The conditioned signal is then routed to the amplifier U2 through one of two paths, depending on the frequency. Frequencies below 10 MHz, including dc, pass through the FET impedance converter (source follower). Higher frequencies are bypassed around the FET through C9. The FET's input is protected at low frequencies by R1, CR1, and CR2. The amplifier U2 has differential inputs and outputs and has a gain (single ended) of about 3. One input accepts the signal and the other accepts the dc level (–1.3V to +0.5V) from the front panel LEVEL pot (via A4U4). The amplifier is biased by five current sources: Q3, Q4, R44, R51, and R56. R44 adjusts the amplifier bias.

8-140. The counter may be triggered on either slope of the input signal. The SLOPE switch, S8, determines this by controlling the output polarities of U2. If S8 is placed to +, the outputs of U2 are 180° out of phase with their respective inputs. When S8 is placed to –, the outputs of U2 are in phase with their respective inputs.

8-141. A4 Input Trigger

8-142. The Input Trigger Assembly provides additional amplification of the input signals before they are sent to the Arming Assembly (A22). The differential output of A3 enters the board on pin P1A(4) and P1A(7) and goes to the inputs of U2. R2 adjusts the trigger output of U2 for a 50% duty cycle with a sine wave input. The amplifier has a gain of about 3.5 and contains a Schmitt trigger, which shapes the lower frequencies into fast-rise time square waves. R15, R21, R28, R31, and R32 are current source resistors for U2, while R16 adjusts the bias.

8-143. The trigger output of U2(13) is a negative pulse about –0.7V in amplitude. The pulse width depends on the input signal and on the setting of R2. Pulse amplitude is controlled by the trigger current source at U2(14).

8-144. U3 is a buffer amplifier, which accepts dc levels from the front panel LEVEL control. R11 corrects for offset voltages in A3U2 when the slope switch position is changed. The output of U4 also connects to U2's current source and turns off the amplifier when the signal level exceeds +3.5V dc.

8-145. A6 Power Supply

8-146. The A1, A6 assemblies provide +5V, –5.2V, +15V, and –15V for distribution throughout the 5370A. These four supplies are derived in a similar fashion. For this reason, only one of the supplies (+5V) will be discussed.

8-147. The Power Transformer (T1) is connected to the AC supply whenever the 5370A is connected to the line. This is done to provide power (from the 16V ac secondary winding) to the Oscillator Oven Power Supply, A7 (which is supplied with Option 001), to maintain the crystal oven at a constant temperature even though the 5370A is in the standby mode. The four remaining secondaries are rectified, filtered and sent to relay K1 which, when energized by the front panel power switch, connects the supplies with the Regulator Assembly A6 to be regulated and distributed.

8-148. The unregulated dc enters the A6 board, which is fused at each of the four inputs, and is routed to the collector of the series pass transistor (all four series pass transistors are power darlingtons). The +20V unregulated (used for the +15V supply) is sent to a precision regulator (U5) which is the reference supply (10.0V) for the four controlling op amps U1, U2, U3, and U4. The output is from the emitter of the series pass transistor. It is current limited by A6Q2 and R2. In a normal state, Q2 is turned off. As the current through R2 increases, the voltage drop across R2 increases. As the voltage drop approaches the bias voltage of A6Q2, A6Q2 starts to turn on. When A6Q2 turns on, it pulls current away from the base of the power transistor turning it less on.

8-149. Diode CR2 is a 6V zener used to clamp the +5V supply in case the power transistor shorts. CR2 will withstand enough current to open the fuse F2. R7 and DS3 are a monitor to quickly show if the supply is present. R13 is a base current limiter for the power darlington.

8-150. The controller is an op amp connected as a linear voltage comparator. The plus (reference) input (U2 pin 3) is set at +5.05 volts by the resistor voltage divider of R12 and R14. The minus (sense) input is connected to the output of the supply. As the supply varies, the output U2(6) varies to hold the supply at +5.05V. The supply is slightly higher than 5.00V to compensate for the voltage drop throughout the 5370A motherboard traces.

8-151. A7 Oven Oscillator Power Supply (Option 001)

8-152. The A7 assembly provides various voltages for operation of the optional crystal oven. The 16V ac coming from T1, enters the board on pins P1(3, 4) and is rectified and filtered by bridge rectifier CR1 and capacitor C2. This unregulated +25V first goes through 1.5A F1 to the crystal oven circuit and second through isolation diode CR2 to two regulators. The first regulator is zener diode CR3 with its current limit resistor R2. This produces +11V for the oven control circuits. C3 improves transient response. The second regulator is U1. Its +12V output powers the oscillator circuits. C4 and C5 provide additional filtering. The oven monitor circuit is made of Q1, C1, and R1. The input signal at pin $\overline{4}$ (from A69) has a variable duty cycle with a frequency of about 3 kHz. When the oven is cold, this signal has a long duty cycle. This long duty cycle allows C1 to charge and turn on Q1 which activates the LOVEN line. As the oven warms toward operating temperature, the duty cycle shortens. As the temperature reaches operating level, the duty cycle is such that C1 can no longer bias Q1 on. At this point, Q1 turns off and the LOVEN line is pulled high by the A17 assembly. R1 helps to turn off Q1.

8-153. A8 Reference Frequency Buffer

8-154. The A8 Assembly buffers the reference frequency from either of the two inputs and provides four outputs for instrument operation. The internal input (pin $\overline{14}$) is from the A69 Oscillator assembly, the external input is from the rear panel J6. The selection is made by the rear panel FREQ STD switch S3.

8-155. With the FREQ STD switch in INT position, CR2 is forward biased and U2A(5) is at -0.7 volt which is a low. This gives a low at U2A(2) and a high at U2A(3) which connects to U2C(12), U3D(13), and U2B(11), U3C(11), respectively. With this, U2C and U3D are enabled allowing the internal reference frequency to pass, and U3C and U2B are disabled inhibiting the external reference frequency. If the switch S3 were in the EXT position, U2A(5) would be high and the above state would be reversed allowing the external reference frequency to pass and the internal reference frequency to be inhibited.

8-156. The internal frequency passes through high pass filter R21 and C26 to the input of U6B(9, 10, 11). U6B is a buffer connected as a Schmitt trigger to convert the input 10 MHz sine wave to a 10 MHz square wave. The square wave then passes through two stages (U6C and U6A) of buffering to gate U2C. The resistors R22 (a through f) are tied to -5.2V to improve the rise and fall times of the square wave.

8-157. The external frequency passes through high pass filter R15 and C12 to the base of Q7. Q7 is operated in the nonlinear range by bias components R14 and R13 to provide harmonics of the external input. This allows an input of either 10 MHz or 5 MHz. The input signal and harmonics are amplified and applied to tank circuit C15 and L2. This is a 10 MHz tank circuit which shunts all harmonics except 10 MHz. The 10 MHz passes through coupling capacitor C11 to the base of Q9. The circuit of Q9 is the same as the circuit of Q7 with C22 and L4 as the 10 MHz tank. The 10 MHz pass through C20. C21 and L3 form a third 10 MHz tank used to shunt any unwanted harmonic to ground. The 10 MHz is then shaped by U5B and buffered by U5A and U5C and output to gate U2B(9).

8-158. The gated output is sent to four circuits on the board. It enters a one-shot U1A and U1B where it is monitored. LED DS1 remains lit as long as 10 MHz is present. The 10 MHz passes through two buffers U4C and U3B and sent to the time base and auto zero, respectively. The 10 MHz is buffered by U3A and sent to U4B(11) and U4A(5). U4B buffers the 10 MHz and applies it to differential amplifier Q4 and Q5. The output goes to a tapped tank circuit (L1, R5, C7 and C8) and out to the rear panel jack J7. U4A buffers the 10 MHz which is then amplified by differential amplifier Q1 and Q2 and translated to TTL levels by translator Q3.

8-159. A9 Microprocessor

8-160. The A9 Microprocessor (MPU) Assembly contains, in ROM, the operating algorithm of the 5370A. This assembly controls the measurement cycle, performs numerical computations for time interval measurements, and interfaces with many of the other assemblies. The A9 MPU assembly uses the Motorola 6800 MPU (U18). The application in the 5370A is described in the following paragraphs.

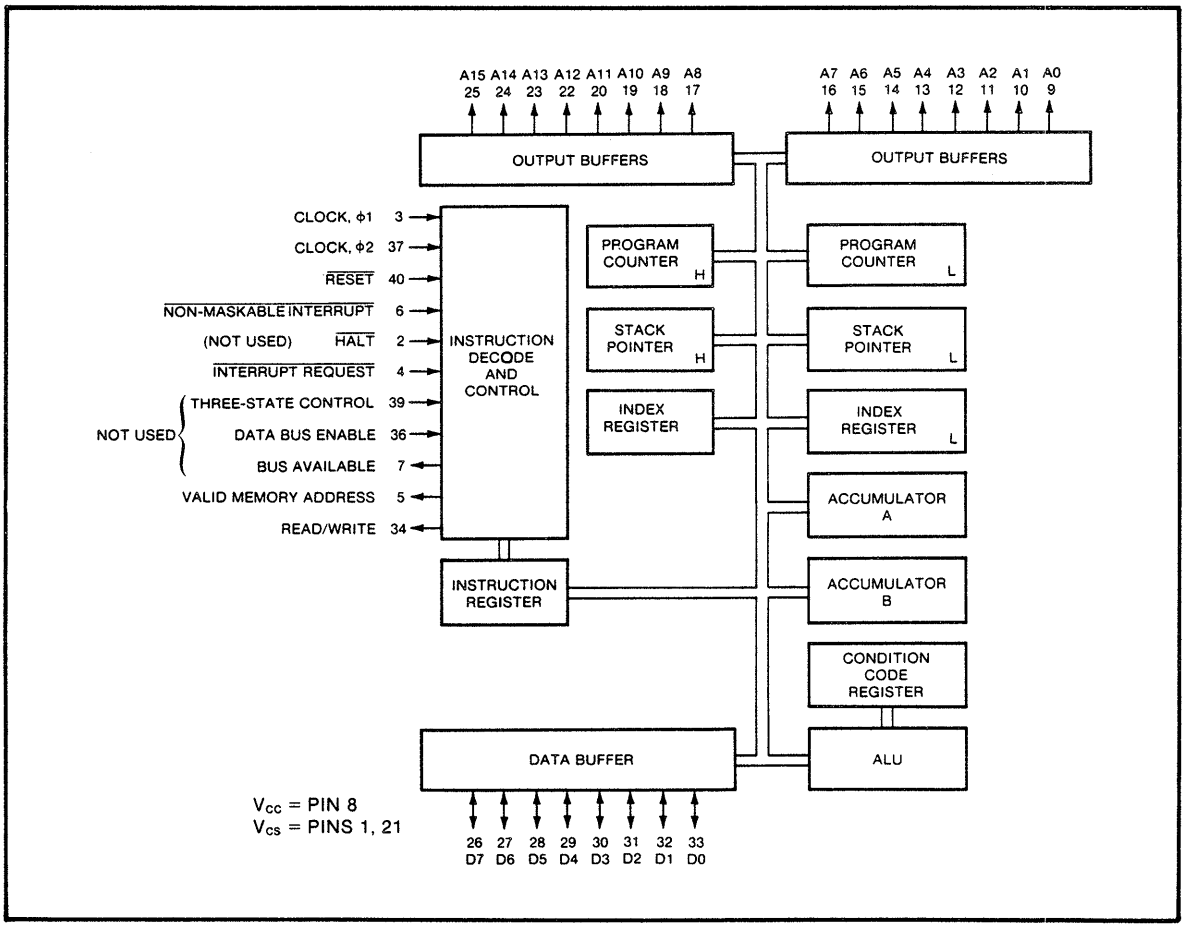


Figure 8-6. U18 Expanded Block Diagram

8-161. The 5370A uses U18 for control and computation purposes. An expanded block diagram of U18 is shown in *Figure 8-6*. The 16-bit address bus allows the MPU to address up to 65K memory locations. The data bus is 8 bits wide and is bidirectional. Data on the bus is read into the internal MPU registers when the Read/Write control line (pin 34) is high. Data from internal registers drives the data bus when the Read/Write control is low. All operations are synchronized to a two-phase nonoverlapping 1.25 MHz clock, $\phi 1$ and $\phi 2$. Each instruction requires at least two clock cycles for execution. The 5370A uses the following additional 6800 control lines:

1. $\overline{\text{RESET}}$ — This input is used to reset and start the MPU from a power-down condition, resulting from a power failure or an initial start-up of the processor. If a positive edge is detected on the input, this will signal the MPU to begin the reset sequence. This will start execution of a routine to initialize the processor from its reset condition. All the higher order address lines will be forced high. For the restart, the last two (FFFE, FFFF) locations in memory will be used to load the program counter. During the restart routine, the interrupt mask bit is set and must be reset before MPU can be interrupted by $\overline{\text{IRQ}}$.

2. $\overline{\text{NONMASKABLE INTERRUPT (NMI)}}$ — A low-going edge on this input requests that a nonmask-interrupt sequence be generated within the processor. As with the $\overline{\text{INTERRUPT REQUEST}}$ signal, the processor will complete the current instruction that is being executed before it recognizes the $\overline{\text{NMI}}$ signal. The interrupt mask-bit in the Condition Code Register has no effect on $\overline{\text{NMI}}$. The Index Register, Program Counter, Accumulators, and Condition Code Register are stored away on the stack. At the end of the cycle, a 16-bit address will be loaded that points to a vectoring address which is located in memory locations FFFC and FFFD. An address loaded at these locations causes the MPU to branch to a nonmaskable interrupt routine in memory. $\overline{\text{NMI}}$ has a high impedance pullup internal resistor, however, a 3 KΩ external resistor to V_{CC} should be used for wire-OR and optimum control in interrupts. Inputs IRQ and $\overline{\text{NMI}}$ are hardware interrupt lines that are sampled during $\phi 2$ and will start the interrupt routines on $\phi 1$ following the completion of an instruction.

3. $\overline{\text{INTERRUPT REQUEST (IRQ)}}$ — This level sensitive input requests that an interrupt sequence be generated within the machine. The processor will wait until it completes the current instruction that is being executed before it recognizes the request. At that time, if the interruppt mask bit in the Condition Code Register is not set, the machine will begin an interrupt request by setting the interrupt mask bit high so that no further interrupts may occur. At the end of the cycle, a 16-bit address will be loaded that points to a vectoring address which is located in memory locations FFF8 and FFF9. An address loaded at these locations cause the MPU to branch to an interrupt routine in memory. The $\overline{\text{HALT}}$ line must be in the high state for interrupts to be recognized. The $\overline{\text{IRQ}}$ has a high impedance internal pullup; however, a 3 KΩ external resistor to V_{CC} should be used for wire-OR and optimum control of interrupts.

4. Valid Memory Address (VMA) — This output indicates to peripheral devices that there is a valid address on the address bus. In normal operation, this signal should be utilized for enabling peripheral interfaces. This signal is not three-state. One standard TTL load and 30 pF may be directly driven by this active high signal.

5. Read/$\overline{\text{Write}}$ (R/$\overline{\text{W}}$) — This TTL compatible output signals the peripherals and memory devices whether the MPU is in a Read (high) or Write (low) state. The normal standby state of this signal is Read (high). Three-State Control going high will turn Read/Write to the off (high impedance) state. Also, when the processor is halted, it will be in the off state. The output is capable of driving one standard TTL load and 130 pF.

8-162. The MPU (U18) is driven by a two-phase clock, $\phi 1$ at U18(3) and $\phi 2$ at U18(37). As shown in *Figure 8-21*, the two-phase clock is derived from the 1.25 MHz output from U13(5). This output is fed through U20, U19, and U17A which is an asynchronous nonoverlap clock circuit. This circuit is needed because the 6800 MPU requires nonoverlapping clocks. The NPN transistors of U19 are used to pull the clock lines down and the PNP transistors of U19 are used to pull

the clock lines up. These transistors are tied together and are driven by the outputs of U20(6, 11). Their output, $\phi 1$ and $\phi 2$, is fed back through inverters U20A and U20C to the input of U20D and U20B, respectively. Resistors R25, R27 in the top half of the circuit and R23, R20 in the lower half of the circuit prevent ringing. This allows a guaranteed nonoverlapping clock generation without the use of timing elements.

8-163. The address bus is from the MPU and is inverted by U12, U14, and U16. These drive the address bus which goes off the board. They also drive RAM's U10, U8, and U5. The data bus is connected to the RAMs and drivers U1 and U2. These drivers are bidirectional. R1 and R2 are pull-up resistors for the data bus.

8-164. There is a switch pack on the A9 assembly which contains seven (A through G) individual single-throw, single-pole switches. Switch 1A (S1A) is the receiver enable, S1B is the transmit enable, S1C enables the ROM (U3, not present in the 5370A at this time), S1D is used to disable the RAM's (U5, U8, and U10), S1E is a master disable for the data bus, S1F and S1G are used to put an instruction on the A9 data bus (clear B) which enables the 6800 MPU to freerun for troubleshooting purposes.

8-165. A11 Display Interface

8-166. The A11 assembly transfers data from the processor to the display, and from the keyboard back to the processor. Both the keyboard and display operate using a timeshare technique.

8-167. Before information can be exchanged, the A11 assembly must be addressed. Address decoding is done by U15, U16, U18A and B, U19, U21B, and U24C. U16(8) decodes the assembly enable address. The four gates U15, U18A and B, and U21B then determine which register or RAM receives the information. U18B(8) address enables registers U9 and U13. When they are enabled, they output their data onto the microprocessor's data bus. U9 contains the scan information for the display and keyboard. U13 contains the code which tells the microprocessor which key has been depressed. U15(8) address enables RAM U7. U7 stores annunciator and keyboard LED information. U10 and U12 are output drivers for the LEDs. U18A(6) address enables RAMs U2 and U4. These RAMs store the segment information for the display readouts. U1, U3, U6, and U8 are output drivers for the display segments. U2, U4, and U7 are location addressed through multiplexer U11 by either counter U17 or by microprocessor address lines AØ through A3. If the RAMs are to read out their data to the display, the location address is from U17. If the RAMs are to write (store new data), the location address is from AØ through A3. U21B(8) enable U11 to select the proper addressing.

8-168. U23 is a dual 4-bit binary counter which divides $\phi 2$ by 256. The output at pin 3 goes through gate U20B and clocks U17(10). U17's binary coded output at pins 4, 5, and 8 drive decade decoders U5 and U14. U5 and U14 decode the binary input and drive transistors Q1 through Q16. Each of the 16 transistors drive a display digit and pushbutton column on the A23 assembly. The output of U17 also drives RAMs U2, U4, and U7 through multiplexer U11.

8-169. U27A is a monostable flip-flop designed to toggle at 10 MHz. The output is buffered by U25D and sent to the A22 assembly. U27B is a one-shot. When the scan clock is present at U27B(9), the outputs at pins 5 and 12 are high and low, respectively. If the clock should ever stop, the outputs change state. U27B(5) going to the low state, disables U26A and U26B. Their outputs at pins 6 and 8 go high disabling decoders U5 and U14. This blanks the display preventing any digits from being enabled when there is no clock. U27B(12) going high enables U25C. U25C(8) then drives the CLOCK LOSS LED in the front panel display indicating to the user the loss of the microprocessor clock.

8-170. A12 ROM

8-171. The A12 assembly contains all the microprocessor operating instructions. The voltages needed by the assembly are -5.2V, +5.0V, and +12V. The +12V is supplied by U14 which is connected to +15V.

8-172. Except for the enable lines, all inputs and outputs of ROMs U1 through U8 are connected in parallel. The enable lines are connected to one-of-eight address decoder U12. The address location of the ROM is selected by processor address lines AØ through A9. The particular ROM is then selected by address lines A10, A11, and A12. The output of the ROM goes to buffers U9 and U10. Buffers U9 and U10 are enabled by the NANDing of address lines A13, A14, and A15, and control lines HEN, $\phi 2$, and LVMA.

8-173. A15 HP-IB Interface

8-174. INTERFACE REGISTERS. There are seven interface registers on A15 which are used by the A9 processor to communicate with the device controlling the HP interface bus. A register is selected by the microprocessor when the microprocessor sends that particular register's address. This address is decoded by one-of-eight decoder U2. Decoder U2 is enabled by the NANDing of address lines LA2 through LA8, LA13, LA14, HEN, and the $\phi 2$ clock, all coming from the A9 processor. A particular register is selected by decoding the two least-significant address lines of the microprocessor, LAØ and LA1, in addition to the read/write line, LR/HW also from A9. The following table shows which register is selected for each combination of the three inputs to U2, provided U2 is enabled as previously described.

U2(1)	U2(2)	U2(3)	U2 OUTPUT GOES LOW	ENABLED REGISTER
0	0	0	U2(15)	U13 STATE IN
1	0	0	U2(14)	U8 COMMAND IN
0	1	0	U2(13)	U10 INTERRUPT IN
1	1	0	U2(12)	U28 DATA IN
0	0	1	U2(11)	— — —
1	0	1	U2(10)	U11 CONTROL OUT
0	1	1	U2(9)	U25 STATUS OUT
1	1	1	U2(8)	U22 DATA OUT

8-175. State In buffer U13 is read when the microprocessor wants to determine the state of the interface. Listen flip-flop U19B, Talk flip-flop U16B, Serial Pole flip-flop U19A, Remote flip-flop U16A, and Service Request flip-flop U1B are all buffered by U13. Buffer U13 is enabled by U2(15) going low.

8-176. Command In register U8 is read by the microprocessor whenever an addressed command or universal command is sent by the controller.

8-177. Interrupt In buffer U10 is read by the microprocessor in response to an interrupt. The output of the interrupt buffer indicates why the A15 assembly generated the interrupt (LIRQ low).

8-178. Data In register U28 stores programming codes which have been sent over the HP-IB by the controller. Data In register U28 is clocked by Data flip-flop U6B. After one byte of ASCII program data has been clocked into U28, an interrupt is generated by A15 and the microprocessor reads U10 Interrupt In buffer to find out why the interrupt was generated. Since U10(9) is low, the microprocessor knows that program data is ready to be read from U28. The microprocessor then reads U28. If the byte completes a code (for example, the "5" of the code "SR5"), the microprocessor executes the code and then continues executing the operating program. If the byte does not complete a code, the microprocessor waits until the completed code has been sent.

8-179. Control Out register U11 is used by the microprocessor to control the HP-IB board. For example, in response to a front panel reset, the microprocessor returns the A15 to local control by setting U11(5) low then high, which resets the remote flip-flop U16A. On power-up, U11(15) is set low then high which resets Serial Poll flip-flop U19A, Talk flip-flop U16B, and Listen flip-flop U19B. When measurement data is sent to the HP-IB, the microprocessor sets U11(2) low which sets the EOI control line of the HP-IB low after the final byte of the data message is sent (i.e., after CR, LF).

8-180. Status Out register U25 is used by the microprocessor to send a status byte to the controller when the serial poll mode is ordered by the controller. The microprocessor sends octal 120 (01010000) to indicate that it has pulled on SRQ (bit 7) and that a measurement has been completed (bit 5).

8-181. Data Out register U22 is used by the microprocessor to output measurement data, one byte at a time, to the HP-IB. U22 is clocked by the Address Decoder U2(7) and is enabled by Serial Poll flip-flop U19A(6) being set low (not serial poll mode).

8-182. COMMAND DECODING ROMs. Decoding ROMs U23 and U26 decode bytes sent over the data lines of the HP-IB. The acceptor handshake operates when LATN (J1 pin 7) is low (address information is being sent) or when the Listen flip-flop U19B(9) has been sent. Decoding ROM U23 is enabled only during the acceptor handshake cycle. The outputs of the ROMs generate interrupts, set or reset various control flags, and are read by the microprocessor via Command In register U8.

8-183. During the acceptor handshake, U7C(12) goes low for one period of the $\phi 2$ clock just prior to the HDAC signal going high, thus enabling U23 (U26 is always enabled). The byte on the data lines of the HP-IB appears at the inputs to U23 and U26. The ROM outputs change accordingly.

8-184. If the Unlisten command is given, U26(1) goes low and U23(2) goes high to clock Listen flip-flop U19B, causing it to be reset. If a talk address other than the 5370A's talk address is sent, U23(1) goes high to clock into the U16B Talk flip-flop the output of Address Comparator U35. Since the 5370A talk address was not sent, U35(14) is low and the U16B Talk flip-flop is set low. If the 5370A's listen address is sent, U23(2) goes high to clock a high from U35(14) into Listen flip-flop U19B.

8-185. Now that the 5370A is addressed to listen, the following occurs when program data is sent. When program data appears at the inputs to ROM's U23 and U26, U23(5) goes low to set the Data flip-flop U6B. When U23(5) returns high, Data In register U28 is clocked and the data byte is stored in U28. At the same time U23(5) goes low, U23(6) goes low which resets Interrupt flip-flop U9B and causes LIRQ (the output of U12D) to go low and interrupt the microprocessor. The microprocessor reads Interrupt In buffer U10, then determines that program data is in U28, and reads U28. When U28 is read (U28 pin 1 goes low), the Data flip-flop U6B is reset in preparation for the next byte.

8-186. Consider what occurs when an addressed command or universal command is sent by the controller. If a command is sent, U23(4) goes low which set Command flip-flop U6A(4). When U23(4) returns high, it clocks into Command In register U8, the decoded outputs from U28 as follows:

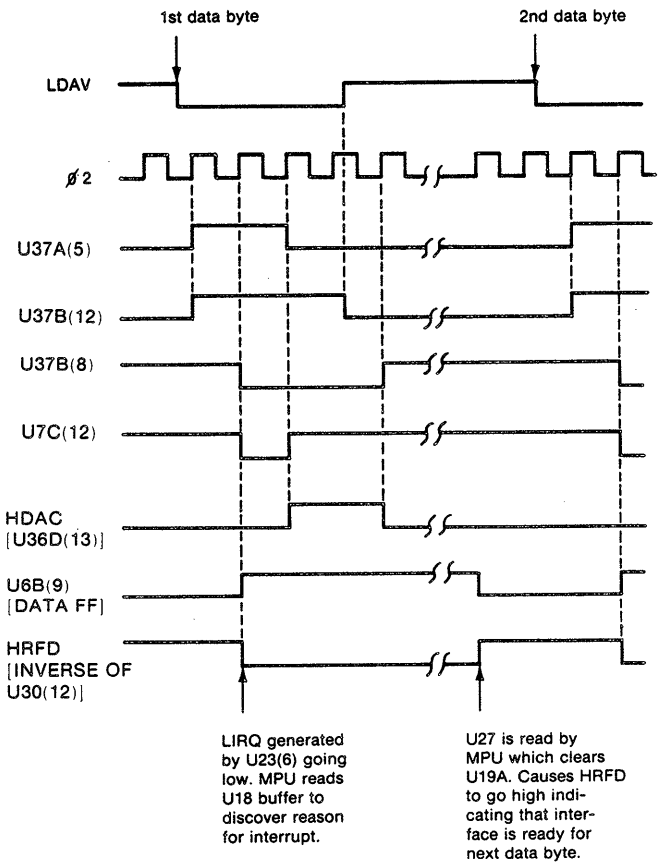
COMMAND	U26(4)	U26(5)	U26(6)	U19(9)	
LLO (Local lockout)	0	0	0	1	Universal Commands
DCL (device clear)	1	0	0	1	
GTL (go to local)	0	0	1	0	Addressed Commands
SDC (selected device clear)	1	0	1	0	
GET (group execute trigger)	0	1	1	0	

8-187. At the same time that U23(4) goes low, U23(6) goes low. This sets Interrupt flip-flop U9B and causes LIRQ to go low, which interrupts the microprocessor. The microprocessor reads Interrupt In buffer U10, determines that a command code is in U8, and reads U8. The microprocessor determines which command was sent according to the table, and acts accordingly.

8-188. When the serial poll enable is sent, U26(2) goes high and U23(3) goes high to clock Serial Poll flip-flop U19A to the high state. When the serial poll disable signal is sent, U26(3) goes low and U23(3) goes high to clock U19A to the low state.

8-189. ACCEPTOR HANDSHAKE. The acceptor handshake is enabled by U33A(2) low (LATN control line of bus is low, indicating address information is being sent) or U33A(1) low (the 5370A has been addressed to listen). When the talking device puts data on the HP-IB data bus and pulls LDAV low indicating data valid, the acceptor handshake causes HDAC to go high (indicating that the data has been read into U28). After the data in U28 has been read by the microprocessor, the acceptor handshake causes HRFD to go high, indicating that U28 has been read by the microprocessor and that the microprocessor is ready to receive the next data byte.

8-190. A timing diagram of a typical acceptor handshake is shown here:

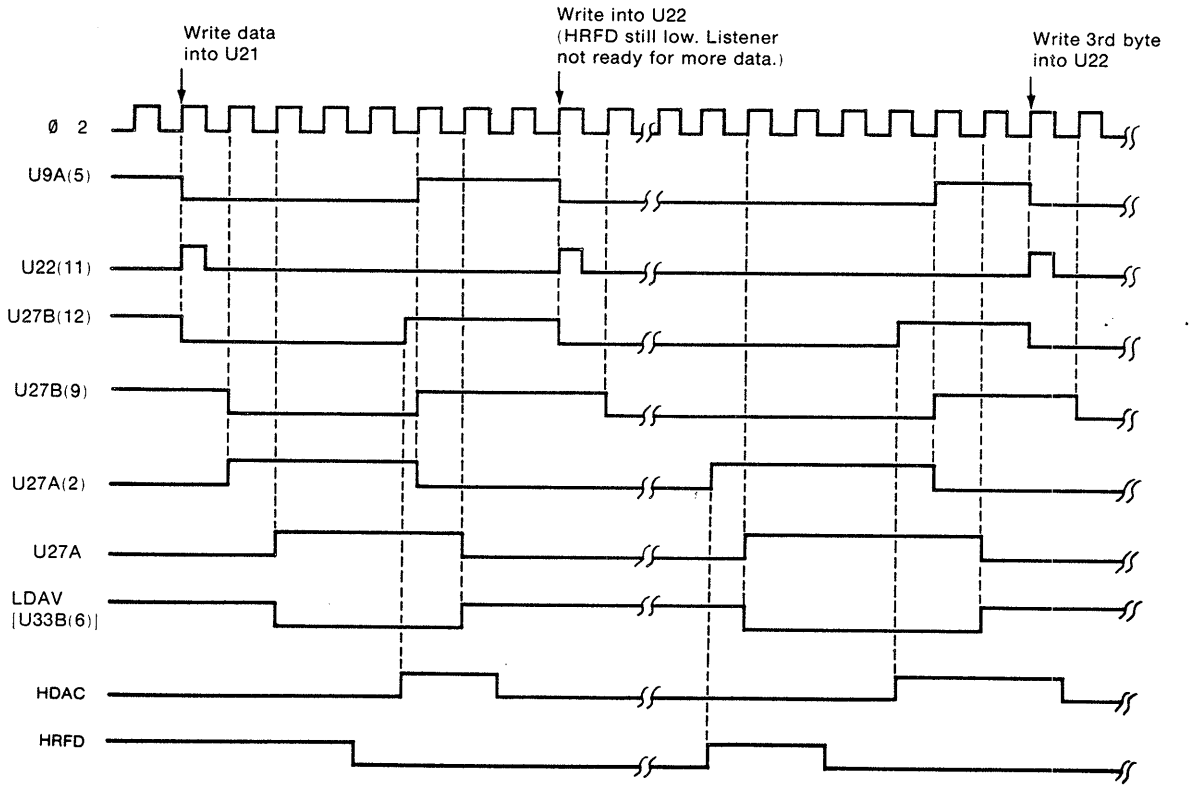


The talker places a data byte on the eight data lines, and after allowing for settling, pulls LDAV low to indicate to the listener (5370A in this case) that there is valid data on the data bus. The first positive transition of the $\phi 2$ clock after LDAV goes low, clocks a high into flip-flop U37A(5). This causes the input to U37B(12) to go high. On the next clock, U37B(9) goes high and U37B(8) goes low. U37B(9) high and U37A(5) high cause U7C(12) to go low enabling ROM U23. When ROM U23 is enabled, Data flip-flop U6B(9) is set high and U30A(12) goes high (HRFD goes low) which clocks the data into Data In register U28. At the same time, LIRQ goes low to interrupt the microprocessor. The next $\phi 2$ clock causes U37A(5) to return low, thus disabling U23. Since U37A(5) is low and U37B(8) is low, HDAC goes high, indicating to the talking device that the

data has been accepted (read into U28) and may be removed from the data lines. The talker then removes the data from the bus and takes LDAV high to indicate that there is not valid data on the bus. U37B(12) goes low when LDAV goes high. On the next positive transition of $\phi 2$, the low at the input to U37B is clocked into the output, causing U37B(9) to go low and U37B(8) to go high. This causes HDAC to return low. After the microprocessor reads the Interrupt In register U10 and determines that data is stored in U28, the U28 Data In register is read by the microprocessor. This causes the U6B data flag to be reset and also causes HRFD to go high, indicating that the Data In register has been read and is ready for another data byte. The handshake process than repeats as described.

8-191. SOURCE HANDSHAKE. The source handshake controls the LDAV control line of the HP-IB in response to the state of the HDAC and HRFD control lines which are controlled by the acceptor handshake circuitry in the listening device. When the 5370A operating program finishes a measurement, the microprocessor reads State In buffer U13 to see if the counter has been addressed to talk, the microprocessor reads Interrupt In buffer U10 to determine the state of Data Ready flip-flop U9A. If U9A(5) is high, then the previous data byte has been accepted by the listener and a new data byte may be written into Data Out register U22. When a data byte has been written into U22, U9A(5) is reset low and the source handshake logic sets LDAV low, two $\phi 2$ periods later. When the listener sets HDAC high, U9A(5) goes high on the next positive transition of the $\phi 2$ clock. Since the listener has accepted the data, a new data byte is written into U22. However, LDAV will not go low again until the listener sets HRFD high to indicate that it is ready for more data. Data Out register U22 is always enabled if the Serial Poll flip-flop U19A is set low. The output data bus drivers U29, 31, 32, and the source handshake circuits however, are only enabled in Talk mode and LATN set high.

8-192. A timing diagram of a typical source handshake is shown here:



Since U9A(5) is high, the microprocessor clocks data into U22. This clock also resets U9A(5) low. U9A(5) going low causes the input to flip-flop U27B to go low, and U27B's output goes low on the next $\phi 2$ clock positive transition. Since U27B(9) is low and HRFD is high, the input to flip-flop U27A(2) goes high and the U27A(5) output goes high on the next clock. When U27A(5) goes high, LDAV at U33B(6) goes low. Sometime later the listener sets HDAC high to indicate that the data has been accepted. HDAC going high causes the U37B(12) flip-flop input to go high and the U27B(9) output goes high on the next clock positive transition. Since U27B(9) is high and U27A(5) is high, U12(6) goes high and sets the Data Ready flip-flop U9A(5) high. When U9A(5) goes high, U27A(2) input goes low and causes the U27A(5) flip-flop output to go low on the next clock. This causes LDAV to return high. After LDAV goes high, the listener resets HDAC low in preparation for the next handshake cycle. Since U9A(5) is high, the microprocessor writes the second data byte into U22. U22(11) going high resets U9A(5) to a low which sets the U27B(9) flip-flop output low. However, the source handshake logic cannot indicate the presence of the second data byte (by pulling LDAV low) until the listener sets HRFD high. When HRFD finally goes high, the output of U27A(5) goes high on the first clock after HRFD goes high. U27A(5) going high sets LDAV low. When the listener senses LDAV low, it sets HRFD low and the process continues as previously described.

8-193. A16 Arming Interface

8-194. The A16 assembly contains the address decoder, input/output registers and selector-multiplexers needed for control interface between the A22 Arming assembly and the A9 Processor assembly.

8-195. The upper 13 (out of 17) bits of the event counter are made of U20, U22, U18, and U13B. The first four are on the A22 assembly. The overrange bit U13B(9) is used by the microprocessor to keep track of the total count. The remaining count data (first 12 bits) goes to multiplexers U19 and U17. This data is then output to the microprocessor data bus as determined by the multiplexer select pins 1 and 15. Program clocking data is sent over the microprocessor data bus and written into storage registers U2, U7, U3, U9, U5, and U11. U6, U4, and U8A and B decode the assembly address and U12 and U14 decode the write and read clocks, respectively.

8-196. U12 generates the write clocks for the six registers U2, U7, U3, U9, U5, and U11. U12 also generates clocks for the DAC on the A8 assembly. When the processor needs to communicate with the A22 Arming assembly, bytes of data are placed on data lines LDØ→LD7. Following this, the A16 assembly is addressed, and U12 generates the clocks needed to latch the information into the registers (U2, U7, U3, U9, U5, U11). This information is now latched on the register's outputs and sent to the Arming board.

8-197. Multiplexers U19, U17, U21, and U15 are used to send data from the assembly back to the microprocessor. Data, such as the lower 12 bits of the Event counter and I/O flags, is present on the inputs of these four multiplexers. The read address decoder U14 generates the clocks necessary to enable the four multiplexers which then pass the data onto the microprocessor data bus. The data enabled through is selected by address line LAØ. For example, consider what must happen to place the event counter data onto the data bus. First, address line LAØ goes low, selecting the "1" inputs (U19(1), U17(1)). At the same time, U14(13) goes low to enable the outputs of U19 and U17. This places the eight lower order bits (1 byte) of the event counter onto the bus. The microprocessor then latches this byte and addresses the multiplexers for the second byte by placing LAØ high (this selects the data at the multiplexers Ø input) and U14(3) low to enable the data onto the data bus.

8-198. U16A and B and U10B generate an Interrupt Request whenever the Manual Arm or Return-To-Local buttons on the front panel are pressed. When an Interrupt Request is generated in the instrument, the microprocessor addresses each assembly to determine which assembly generated the request. Consider what happens when the A16 assembly generates an Interrupt

Request. When either the Manual Arm or Return-To-Local button is depressed, U18C(8) clocks a low to U16A(4) which sets U16A(5) high. This high goes to multiplexer U15(14). It also causes U10B(6) to go low generating an LIRQ. When the microprocessor sees the LIRQ, it addresses the assemblies until it finds the assembly which sent the interrupt. In the case of the A16 assembly, the microprocessor addresses address decoder U14(9) which causes two things to happen. First, it sets U16B(10) and clocks U16A(3) thereby resetting the Interrupt Request, and second, multiplexers U21(15) and U15(15) are enabled to output onto the data bus. When the microprocessor reads the data byte, the IRQ bit (bit 8) at U15(12) is set, indicating to the microprocessor that the A16 assembly generated the interrupt. The data byte also indicates why the interrupt was generated. In this case, bit 2 (Manual Arm) or bit 3 (Return-To-Local) would have been set.

8-199. The Sample Rate (SR), as determined by the front panel SR control, is monitored by the microprocessor through comparator U1D. During a measurement routine, a low is written into U9(12). This corresponds to a high at U9(10) and a low at U10C(8). The low at U10C(8) turns on CR1 and holds C4 at a discharged state. At the end of the measurement, a high is written into U9(10) which corresponds to a high at U10C(8). This high at U10C(8) turn CR1 off and allows C4 to charge. The rate at which C4 charges is determined by the setting of the SR control on the front panel. While C4 is charging, the microprocessor is continually monitoring the output of U1D(13) for a low, through multiplexer U15(4). When U1D(13) does go low, the SR period has been reached and the microprocessor initiates the next measurement cycle. R7 prevents U1D from oscillating and combination R8 and R15A translate the ECL output to TTL for U15.

8-200. A17 Count Chain

8-201. The A17 assembly contains count chains, adders, and output selector-multiplexers for three 200 MHz signals NØ, N1, and N2. The count chains accumulate NØ, N1, and N2 counts. The adders subtract the N2 count from the N1 count and multiply this difference by 257. The multiplexers control the transfer of the count data from the assembly to the microprocessor data bus.

8-202. N1 enters the assembly and is buffered by U31B and input to high-speed counters U27 and U24. Their binary output is translated from ECL to TTL by U21A, C, D, and U20A and input to adder U18 and counter U19. U19 and U16B complete the 9-bit N1 count chain. Their outputs are input to adders U13 and U10. N2 enters the assembly and is buffered by U31C and input to ECL counters U28 and U25. Their binary output is *inverted* and translated to TTL by U21B, U22D, and C, and U20C and input to adder U18 and counter U17. U17 and U16A complete the 9-bit N2 count chain. Their outputs are *inverted* and input to adders U13 and U10. N1 and $\overline{N2}$ are added together by U18, U13, and U10. However, because N2 is inverted (1's complement), it is effectively subtracted from N1 by the adders. The result (N1–N2) is a 9-bit binary number plus its sign. The lower eight bits (U18 and U13) connect to the A inputs of adders U15 and U7 and to multiplexers U12 and U8. The ninth bit is input to the lowest order B input at U15(6). The remaining seven B inputs are jumpered together and connect to the sign of quantity N1–N2 coming from U10(1). The sign also connects to multiplexer U9(5).The configuration of adders U15 and U7 effectively multiply the quantity N1–N2 by 257 to yield 257·(N1–N2). This binary number is then output to the microprocessor data bus through multiplexers U12 and U8.

8-203. NØ enters the assembly at P1B(6) and is buffered by U31A and input to high-speed counters U29 and U26. Their binary outputs are translated from ECL to TTL by U22A and B, U23D and U20D and input to multiplexer U6. The fourth bit of NØ is input to U4(10) as the clock for the remaining 13-bit counter U4, U3, U2, and U1B. The binary output is transferred to the microprocessor data bus through multiplexers U6, U5, and U9. U1A is connected as an R-S flip-flop and used to detect an out-of-lock condition of the VCOs on the A19 and A20 Interpolator Assemblies.

8-204. A18 DAC/NØ Logic

8-205. The DAC/NØ Logic Assembly contains two individual circuits. The first is the DAC portion. This is shown on the left side of *Figure 8-28*. The second is NØ Logic portion. This is shown on the right side of *Figure 8-28*. For this reason, the theory is in two parts; the first part discussing the DAC and the second discussing the NØ logic.

8-206. DAC. The DAC contains the circuitry to convert digital information into an analog voltage for remote trigger level programming. Digital information for the DAC comes from two places. The first place is the A9 Processor Assembly. This is the DAC *data* information from the eight data lines (P1A pins 1 through 8). The second place is the A16 Arming Interface Assembly. This is the DAC *control* information which controls the DAC operation (P1A pins $\overline{3}$, $\overline{4}$, $\overline{5}$, $\overline{7}$). U2 and U5 are the storage latches for the START DAC. U3 and U6 are the storage latches for the STOP DAC. U4 and U7 are the storage latches for the DAC control data. U1 is the Status Out latch used to store the present status of the DACs for use by the microprocessor. U8 and U9 are 8-bit DACs corresponding to 256 possible output levels. Their output is a current source which is converted by U11 into a voltage. Relay K1 then passes this voltage to the front end.

8-207. The DAC can be used in two modes. Under local control, it is used as an analog-to-digital converter (ADC); under remote control, it is used as a DAC. Therefore, it can be used to read *or* set the trigger levels of the front end. When used as a DAC, K1 is closed and the voltage goes directly to the front end. When used as an ADC, K1 is open and the output of the DAC is compared with the trigger level voltage from the front end by comparators U12C and U12D. The microprocessor ramps the DACs one-bit at a time until the comparator changes state. At that point, the voltages compare within one-bit (10 mV). The range is +2.55V to -2.56V. The summing of the minus voltage is done by Q1 and Q2. When Q1 is turned on, -2.56V is added to U8(4) output. If U8 input is 0, the result is -2.56V. If U8 gets the largest input of hexadecimal FF (1111 1111), U8(4) output of +2.55V is summed with -2.56V to yield -10 mV. When Q1 is off, and there is a 0 at U8's input, the output is 0V. With hexadecimal FF at the input, the output is +2.55V.

8-209. NØ. The purpose of the NØ portion is to determine which coincidence occurs first, generate a 200 MHz burst NØ, and inform the processor that the measurement has been completed. U19A tells the processor which coincidence occurs first. If the START coincidence occurs first, U19A(10) is high. When the STOP coincidence occurs at U19A(1), the high at pin 10 is clocked to the output at pin 15 indicating the START coincidence came first. If the STOP coincidence comes first, a low from U19A(10) is clocked to the output U19A(15).

8-210. U15 buffers the 200 MHz time base for use by U17 as a clock, and as the clock for the NØ counting circuits on the A17 assembly. U17, U18, and U16 operate as an exclusive OR. Their function is to allow the 200 MHz (NØ) to pass through U16C between START and STOP coincidences regardless of which came first. The following is a description of this exclusive OR function assuming the START coincidence occurs first. In the waiting condition, U17A(7) and U17B(10) are low. Their Q and $\overline{Q}$ outputs are low and high, respectively. Following this to U16B, pin 7 is low, pin 6 is high, and pin 3 is low. U16A pin 4 is high, pin 5 is low, and pin 2 is low. U16D pins 12 and 13 are low, and pin 15 is high preventing the 200 MHz from passing through U16C. At the same time, U18A pins 4 and 5 are low, and pin 2 is high holding U19B in the reset condition with $\overline{Q}$ high and Q low. U18A pins 7 and 6 are high, and pin 3 is low. When the START coincidence arrives, U17A(7) goes high. This high is clocked through, making U17A Q high and $\overline{Q}$ low. This causes U18A(2) to go low, no longer holding U19B in reset. U16B(3) goes low, U16A(2) goes high, and U16C(10) goes low enabling the 200 MHz to pass through.

8-211. When the STOP coincidence arrives, U17B(10) goes high. This high is clocked through making U17B Q high and $\overline{Q}$ low. This causes U16A(2) to go low and U16D(15) to go high, stopping the 200 MHz clock through U16C. It also causes U18B(3) to go high placing U19B in the set condition. In this set condition, U19B goes low signaling the microprocessor that the measurement process has been completed.

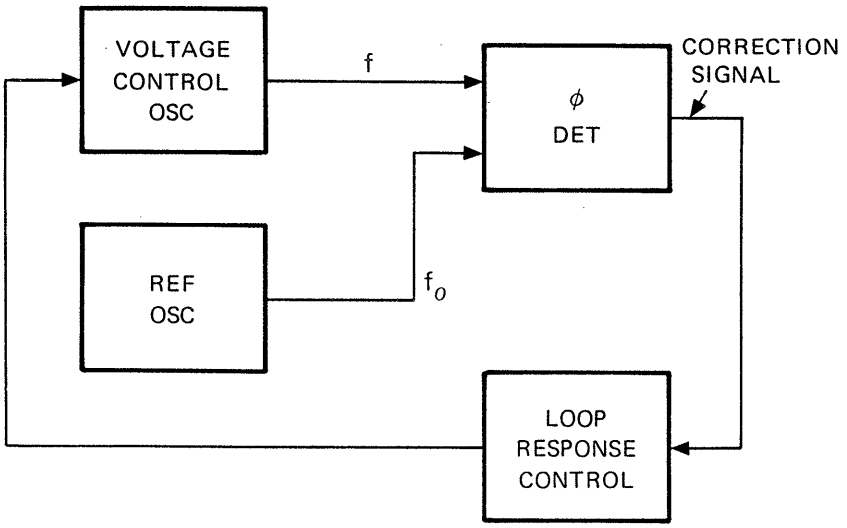
8-212. A19/A20 Interpolators

8-213. The purpose of the interpolator boards is to provide the N1 counts for the start channel and the N2 counts for the stop channel. These counts are combined with the NØ counts in a mathematical equation that equals the time interval of the input signal. The NØ counts are gated with the "coincidence" pulses which are also generated on the start and stop interpoator boards when the phase of the startable oscillator equals that of the reference oscillator. The overall block diagram theory describes how these signals combine to form a time interval measurement.

8-214. Since the start and stop interpolators are identical circuits, the text discribes the circuit operation in terms of the start interpolator only. The board contains a restartable oscillator that is phase locked to the negative edge of the start pulse. It is this oscillator that produces the N1 counts. The oscillator is stable to the stability specifications of the 10 MHz internal standard. This is done by multiplying the standard up to 200 MHz on the A21 board and then using it as a reference frequency for the phase-lock-loop (PLL) on the A19 board. The PLL controls the stability of the restartable oscillator, which is actually a VCO. The N1 pulses are produced during the time between the negative edge of the start pulse and when phase coincidence occurs between the oscillator and the 200 MHz reference.

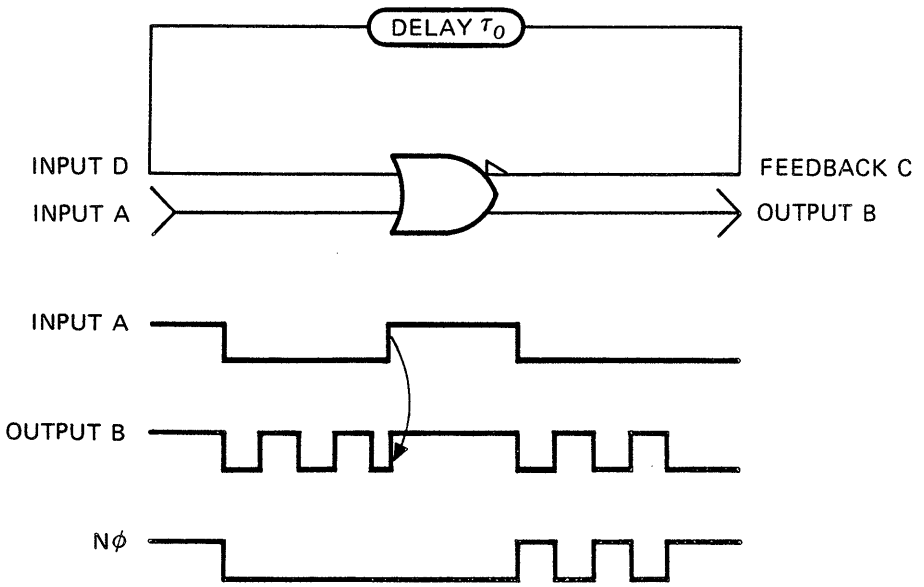
8-215. Because of the unusual operation of this circuit, the theory will be presented in a series of building block relating to simplified diagrams of the circuit. The schematic details are described at the end of this presentation.

8-216. THE PHASE-LOCK-LOOP. It is a common technique to control an oscillator's frequency by phase locking it to a standard reference signal. The following diagram shows the simplest example of locking an oscillator to a reference of the same frequency. In this loop, the phase detector monitors the phase difference between the two oscillators and generates a correction signal proportional to the difference. This signal is then filtered and used to change the frequency of the voltage controlled oscillator (VCO). For this type of loop, regardless of the initial phase of the VCO, the ultimate phase of the VCO is totally predictable: it will eventually be in phase with the reference. In other words, the very mechanism which allows the frequency to be controlled destroys the initial phase relationship. The 5370A requires that the VCO be phase related to the start signal.



A Simple Phase-Lock-Loop

8-217. THE STARTABLE OSCILLATOR. There is a class of oscillators called startable oscillators which, at a given signal, begins to oscillate at a predictable phase and at a preset frequency. A simple example is as follows:



A Simple Startable Oscillator With Input and Output Signals

8-218. In the oscillator, input A is initially high, feedback signal C is, therefore, low as is input D. The condition is stable. At a given signal, input A makes a HI-LO transition. This causes C to go high, and later D to go high. This, in turn, causes C to go low, and later D to go low. The condition is never stable and oscillation will continue whose half-period is equal to the external delay plus the gate propagation delay. This oscillation will be in phase with the external signal which makes the HI-LO transition of A. The frequency of oscillation, however, is determined only by circuit parameters which may vary with temperature and other environmental factors.

8-219. Since phase is simply the integration of frequency, it is therefore impossible to maintain the initial phase information indefinitely if the frequency cannot be made precise (relative to a frequency standard for example); because any frequency error, however small, will eventually accumualte through integration to give large phase errors. It is, of course, possible to make such an oscillator into a VCO by inserting a voltage controlled delay (such as a varactor diode) and lock the oscillator to the reference signal by a typical phase-lock-loop. Now the frequency can be made very precise. Unfortunately, this defeats the whole purpose of the startability of the oscillator since the loop will eventually force the oscillator to oscillate at a fixed phase which has no relation to the initial phase generated by the oscillator start signal.

8-220. The 5370A overcomes this dilemma of not being able to obtain simultaneously lockable frequency and indefinite initial phase preservation. The technique uses:

1. A startable oscillator whose frequency can be locked to a given reference frequency standard while maintaining indefinitely its initial phase with predetermined precision.
2. A method of phase-locking which maintains indefinitely the initial phase relationship between the reference oscillator signal and the oscillator being locked.

8-221. IMPLEMENTING THE TECHNIQUE. The A19 Interpolator Assembly uses an oscillator that oscillates with a period of 5.02 ns. This signal is locked to a reference signal of 200 MHz (5 ns period). The two frequencies are therefore locked by the ratio of 100:100.4. Under quiescent conditions, the operation is that of an ordinary synthesizer phase-lock-loop which generates a signal whose period of oscillation is 5.02 ns from a reference oscillator whose period is 5.00 ns. The VCO of this loop, however, is a startable oscillator. More accurately, it is a restartable oscillator in the sense that its oscillation can be momentarily stopped and then resumed at a constant phase with respect to a given "start" signal to the VCO. The phase-lock-loop, meanwhile, undergoes a change so that instead of pulling the VCO back to its original phase, it locks the VCO to the reference at the new phase which is maintained indefinitely to a precision of ±1/256 of the period.

8-222. PRINCIPLE OF OPERATION. The quiescent condition of the loop can be represented by the following block diagram. The VCO (1) is a startable oscillator consisting of an inverting gate and external delay. The input A to the gate is low and the oscillator runs at period T which is approximately twice the delay. The oscillation frequency is controlled by the varactor (8) shunting the feedback signal.

8-223. A voltage across the varactor controls the capacitance which in turn controls the frequency of the oscillator. The output of VCO (1) is fed to two channels:

a. To mixer (2) generating a beat frequency with the reference oscillator. The output of mixer (2) is a signal at the difference frequency f_0-f where f_0 is 200 MHz and f is the VCO frequency.

b. To frequency scaler (or divider) (3). The output of divider (3) is at frequency f/256.

8-224. The two signals at frequencies f_0-f and f/256, respectively, are fed through inverting gates (5) and (4) to the input of a phase detector (6) The particular phase detector (6) monitors the LO-HI transitions of the two inputs and produces appropriate pulses at the output which are proportional to the time differences of the LO-HI transitions. The detector output pulses are filtered and integrated, producing a voltage signal to control the VCO frequency via the varactor diode.

8-225. Under locked condition, the two signals DV and MX to the phase detector input are of the same frequency and in phase. Hence, the VCO frequency (f) can be expressed by:

$$f/256 = f_0 - f$$

$$\text{or } f = \frac{f_0}{1.004}$$

where $f_0 = 200$ MHz

Proof: $f/256 = f_0 - f$

$f/256 + f = f_0$

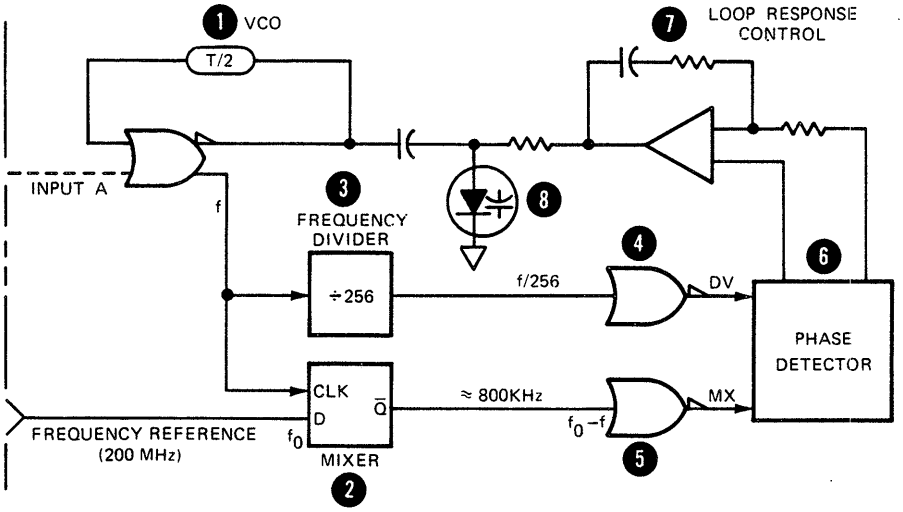
$f\,(1/256 + 1) = f_0$

$$f = \frac{f_0}{1/256 + 1}$$

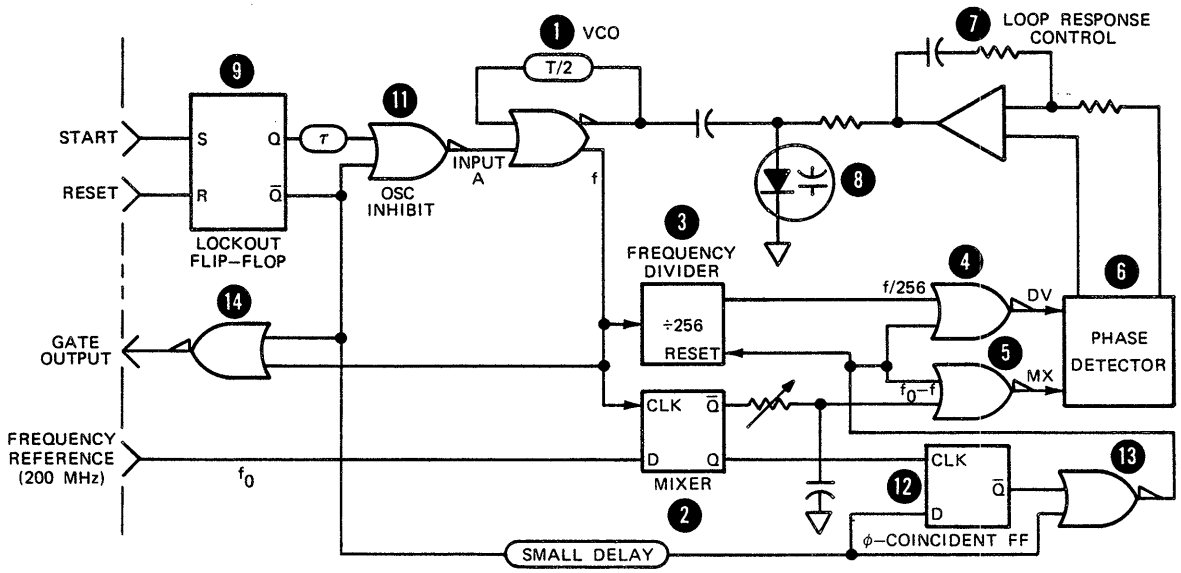
$f = f_0/1.004$

$(1.003906249 \approx 1.004)$

As long as the input A is held low, this locked condition remains. The operation is that of a typical synthesizer loop.



8-226. The next diagram shows the block form of the interpolating phase-lock-loop. An input pulse sets lockout flip-flop (9). The time difference τ of the arrival of Q and $\overline{Q}$ to oscillator inhibit gate (11) generates at pulse of duration τ which stops the oscillation of VCO (1) within $\frac{T}{2}$ (τ is designed to be longer than T/2). After τ, the inhibit signal is removed and the oscillation once again commences, but now in phase with the removal of the inhibit, which in turn is precisely τ in time after the input. Therefore, the phase of the new oscillation is directly related to the time of arrival of the input and is independent of the phase of the oscillation prior to the input arrival. The goal is, of course, to maintain this new phase while still frequency locked to the reference.



8-227. The new phase of the oscillator is immediately translated to a new phase of the beat frequency through the mixer. But this new phase is momentarily withheld from the phase detector through the signal S, which goes high as gate (13) senses the arrival of the input through $\overline{Q}$ of lockout flip-flop (9). The signal S causes both DV and MX to go low, disabling the phase detector. The same signal also resets the divider (3) and holds it at 00.

8-228. Meanwhile, the new beat frequency signal from the mixer (2) reaches a natural LO-HI transition, signifying that the VCO and the reference are phase coincident. This transition clocks

the phase coincidence flip-flop (12) to the low state ($\overline{Q}$ high). Through gate (13), signal S goes low, allowing the divider to start counting from 6 to 1, 2, ..., etc. The other inputs to gates (4) and (5) are both low at this point since the divider had been reset and held at reset, and also the mixer (2) has just made a LO-HI transition at Q (HI-LO at $\overline{Q}$). The removal of signal S causes both DV and MX to rise simultaneously. The phase detector, which always monitors LO-HI transitions from both inputs, accepts this as a satisfactory phase-lock condition and produces no significant correction pulses at its output and, therefore, does not cause any frequency change of the VCO. From this point on, the loop acts precisely the same as the quiescent condition before the input arrival. The mixer continues to produce the beat frequency f_0–f, the divider continues to generate the divided frequency f/256, and the phase detector continues to monitor these two signals and make small corrections to ensure that they are in phase. Since the divider has been adjusted in phase with the new mixer output phase, phase locking will continue at the new mixer phase. This insures that the VCO will continue to oscillate at its new phase. Should the lock-out flip-flop be reset at this point, the VCO would not shift phase nor would the quiescent lock condition be affected. However, if the lock-out flip-flop is reset, the loop is ready for another input to change the phase of the VCO once again, if desired. The output of the VCO can be obtained at gate (14) which suppresses all oscillations prior to the arrival of the input and after the arrival of an external system reset.

8-229. This following explanation refers to the schematic diagram in *Figure 8-29*. The A19 and A20 assemblies are the same. For this reason, only the A19 (START) assembly is discussed.

8-230. The input signal from the A22 assembly enters the A19 board at P1A(1) and is input to the first of two gates at U1(16). The inverted output is fed directly to the second gate U1(6). The non-inverting output goes through a 10 ns delay, then into the second gate at U1(8). This generates a 10 ns pulse from U1(4), which enters U2(3), gets inverted, and then NORed with the feedback through the delay line by gate B (which is internal to U2). The signal is then buffered and output at U2(11) and U2(13). The signal from U2(13), at a frequency of approximately 199.22 MHz, is divided by 256 by U3, U4, and U5. The output of U5(2) is approximately 780 kHz and is input to the detector inhibit U10(4). The signal from U2(11) goes to mixer U7(13) and is mixed with the 200 MHz reference at U7(3). The output of the mixer U7(6) is the difference, or beat frequency, between the 199.22 MHz and the 200 MHz reference. This difference is approximately 780 kHz.

8-231. The output of mixer U7(6) is used in two places. First, U13A(7, 5) synchronizes the signal with the VCO (U2) output at U13A(6). U13A(3) then goes to detector inhibit U19(7). And second, U8A(7) synchronizes the signal with the VCO output for use as the check for coincidence flip-flop U8B(11). U8B(14) enables U9B(11) to pass N1. U8B(15) resets the frequency divider U3, U4, and U5; generates the coincidence signal through U9A(2, 3, 4); and enables the detector inhibit U10(6, 5). U6 delays the input signal for about 35 ns. After this delay, U8B is ready for the next positive clock transition from the mixer U8A. A transition will come within a 257/200 MHz period. The output at U8B(15) is thereby removed on the first transition, enabling the inputs to the phase detector U2, relocking the loop and allowing the counter to begin counting from zero. U10 employs feedback from U12(12, 3) which generates an extra pulse to guarantee parity of the inputs during disabling. The outputs of U10 are wire ORed and input to the phase detector U12 which develops a phase error signal. The error signal is integrated and filtered and used to tune the VCO.

8-232. There are two outputs on the Interpolator assembly. The coincidence output consists of the NORed outputs of both the anticoincidence one-shot and the coincidence flip-flop by U9A. The N1 count is the NORed outputs of the VCO and the coincidence flip-flop U8B(14).

8-233. A21 200 MHz Multiplier

8-234. The A21 assembly multiplies the 10 MHz crystal oscillator output to 200 MHz which is used by the Interpolator assemblies and DAC/NØ assembly. There are two multiplier-amplifier-filter networks. The first multiplies the 10 MHz by 5 to give 50 MHz. The second multiplies the 50 MHz by 4 to give 200 MHz. The 200 MHz is then buffered and output.

8-235. The 10 MHz enters the assembly on pin P1B8. C41 and R44 are the termination load. The signal is coupled to 10 MHz amplifer Q6 through C40. R43, R42, and R41 are the bias resistors for Q6. L16 and C56 are tuned to 10 MHz and are the collector load. The amplified 10 MHz is coupled through C50 to X5 multiplier Q8. Q8 generates harmonics of the 10 MHz. L15, C55, and C54 comprise a tank tuned to 50 MHz. C54 is adjusted to peak the tank at 50 MHz. The 50 MHz is coupled to amplifier Q7 through C49. Q7 amplifies the 50 MHz signal which is filtered three times before the next amplifier stage. The first filter network is L14, C53, and C52. The signal is then coupled through C48 to the second filter network; L13, C47, and C51. C42 couples the signal to the third filter network which is L12, C36, and C46. The 50 MHz signal is coupled through C37 and amplifier by Q5. The 50 MHz is filtered two more times before going to the X4 multiplier Q4. The first filter is made of L9, C31, and C33. The second filter is made of L7, C26, and C28.

8-236. The 50 MHz is coupled through C21 to X4 multiplier Q4. Q4 generates harmonics of the 50 MHz and tuned circuit L6 and C20 resonates at the 200 MHz harmonic. The 200 MHz output of Q4 is coupled through C21 to amplifier-filter circuit Q3, L5, and C18. This signal is coupled through C15 to filter circuit L4 and C12. C16 then couples the 200 MHz to amplifier-filter Q2, L3, and C10. The output is coupled through C7 to filter circuit L2 and C6. The 200 MHz signal is coupled through C8 to the final amplifier-filter circuit Q1, L1, and C12.

8-237. The 200 MHz is then coupled through C1 to TP1. The signal at this point is a sine wave. The following circuitry squares, isolates and buffers the 200 MHz signal. The signal passes through R1 which limits the load on amplifier circuit Q1. The signal is limited in both polarities by CR1 and CR2 and applied to the input of Schmitt trigger U1B(9, 10, 11). The squared output at U1B(6, 7) goes to three isolating buffers. U1A buffers the 200 MHz for the A19 assembly. U1C buffers the 200 MHz for the A20 assembly. U2 is a two stage buffer, phase-shifter network. U2B buffers the 200 MHz and outputs the signal (pins 6 and 7) to phase-shifter C22 an R16. This network allows adjustment of the phase of the 200 MHz to compensate for lead-length variations between instruments. The phase-adjusted signal is then buffered by U2A and output to the A18 assembly.

8-238. U3 and its associated circuitry comprise the Lock Status Detector. U3 is a quad comparator. U3D and B are used for the START VCO and U3A and C are used for the STOP VCO. The incoming VCO signal is a dc level and should be between -10V and -3V. Levels outside this range indicate an out-of-lock condition. R22 and R19 set the low limit of -10V at the input of U3D(10) and A(6). R25 and R26 set the high limit of -3V at the input of U3B(5) and C(9). Filters R29-C29 and R30-C30 ensure a pure dc level at the inputs of the comparators, preventing any false triggering. The outputs are tied together and filtered by R23-C23.

8-239. A22 Arming Assembly

8-240. The arming assembly is responsible for gating the input START and STOP signals to the Start (A19) and Stop (A20) Interpolator assemblies. This gating can be controlled either internally, externally, or remotely. The Arming assembly is also responsible for driving the START, STOP, and EXT trigger lights on the front panel, sending a START and a STOP EVENT signal coincident with the START and STOP gate opening to the rear panel jack J4 and J5, and for partially counting the number of STOP EVENTS ignored in the case of EXT ARM/EXT HOLDOFF or frequency or period gate times. The detailed theory is divided into four sections according to their functions. They are: 1) External Arm Input; 2) Trigger Light; 3) Arming Main Signal Path; and 4) Arming Phase Detector.

8-241. EXTERNAL ARM INPUT. The External Arm Input signal comes from the front panel J1 and enters the assembly at J4. The signal is amplified by Q13 and input to comparator U29B(12). U29B(16) is connected to the front panel External Input Trigger Level which allows the selection of the dc trigger level. When the front panel level control is preset, U29B(16) is grounded. The output of U29B(15) goes into U9B(9) where it is exclusive ORed with the front panel external input slope switch. U9B(11) drives the trigger light circuitry. U9B(10) goes to U1A(4) and generates the arm selection. U1A(5) is the LARMCT2 from A16J1. This signal controls the internal or external arm condition. The external arm comes through U1A and is wire ORed with the manual arm signal which comes from the microprocessor in response to the pushing of the front panel Manual Input button. The output of U1A(2) goes to U14B, , and causes the arm signal which arms the channels.

8-242. TRIGGER LIGHT. The trigger light circuitry is composed of three identical blocks, one for each trigger light. For this reason, only the External Arm trigger light circuitry is discussed. The HEXT signal comes from U9B(11) and enters U18A(4). U18A(5) is biased by the output of flip-flop U22B(3). The output of U18A(2) goes to the D input of U22B(6). With the 10 Hz clock present at U22B(9), the high at U22B(6) is clocked through to U22B(3). This signal is buffered by U30D and sent to the front panel EXT TRIG annunciator. This signal is also fed back to the comparator U18A(5) making the output go low producing a toggle output at U30D(13).

8-243. MAIN SIGNAL PATH. The two input signals come from the A4 assembly. The START signal goes to buffer U20B(16) and the STOP signal goes to buffer U19B(16). The inverted outputs of these buffers go to dual comparator U13(11) and U13(5). The outputs of the comparator drive the auto phase detector and the trigger light drivers. U13(3) provides the STOP EVENTS signal for events counter U3A, U4B, and U2A and B. The noninverted outputs of U20B(11) and U19B(11) are input to signal multiplexers U16(14) and U15(14). The multiplexers select either the internal 10 MHz signal used for calibration or the external START and STOP input signal. The multiplexers also select which paths the START and STOP input signals will take. For example, if HPTOGL/HCHECK goes high, U6D(13) enables U15B(12) and U16B(12) to pass the internal 10 MHz to the START and STOP arming circuits, respectively. The controlling of the signal paths is dependent on the state of signals HSTASW and HSTOSW. If, for instance, both of these signals are high, the START and STOP input signals pass straight through multiplexers U16 and U15, respectively. And if both HSTASW and HSTOSW are low, the START and STOP signals are routed through U15 and U16, respectively.

8-244. The main measurement signal comes out of U16(3) and U15(3), goes through a delay and into the clock input of U17(13) and U21(13). The inverted outputs (U17 and U21 pin 4) are the trigger signals to the A19 and A20 Interpolator assemblies, respectively. Outputs U16(1) and U15(1) go to inverted inputs U20A(8) and U19A(8). U20A and U19A are inverting buffers. The noninverted signal from U20A(2, 3) and U19A(2, 3) go to U25A(7), and U24B(14), respectively. The arm signal arrives from U14B(14) through an ECL to EECL translator (Q9 and Q10) and is labeled LARM. The LARM signal is wire ORed with the output U28(6) which is the arm signal for ±T.I. The ORed signal then enters U23A(7) and U25A(8); U23A and U25A are the gates that allow the ARM to go through. The actual ARM pulse comes from U25A(2, 3) and is stored in latch U26A and B. The ARM signal exits the latch at U26A(12, 13) and enters U17(3). The output U17(6) is fedback into U24(16). In +T.I., the STOP channel cannot be armed until after the START channel has had an event. The STOP channel works essentially the same as the START channel.

8-245. U24B is functionally similar to U25A. U24B requires that the input from the STOP channel multiplexer be in the low state and not in the external gate mode, or that the external gate be true and an event from the START channel. The STOP channel cannot be armed until after the START channel has had an event. The ARM signal from U24B(12, 13) is latched in U24A and U25B. The output of this flip-flop U25B(12, 13) goes into U21(3). The STOP channel is not fedback into the signal path. The START channel is fedback through a translator Q5 and Q6 into the set input of U28(12) and to the reset inputs of flip-flops U26 and U24A and U25B.

8-246. Up to this point, the +T.I. ONLY arm has been discussed. The ±T.I. arm comes from U28A but it still goes through U25A just like the +T.I. arm. In ±T.I., U23A arms the STOP channel instead of U24B. The three inputs into U23A are: (1) the ARM signal from U28A(6) to U23A(7); (2) the input into U23A(8) from the qualifier that tells whether it is in +T.I. ONLY or ±T.I.; and (3) U23A(6) input from the STOP channel qualifier. The output U23A(2, 3) enters the STOP channel flip-flop U24A and U25B through U24A(8). The ARM flip-flop now is U28A. The D input, U28A(2), comes from translator Q12 and Q11 and is the HARMEN signal from the processor (buffered by U9A). Gates U27A and U27B select the signal. The START channel signal from U20A(4, 5), the ±T.I. signal U27B(16) and the "select Start Channel as ARM source" signal (U27B(15)) is input to START channel gate U27B. The inputs into U27A are the same except for the "select Stop Channel as ARM source" signal. The START and STOP channel selection signals, LSTART and LSTOP, come from translators U7A(7) and U7D(13), respectively. The EXTERNAL GATE signal comes from U14A.

The positive-going edge arms the instrument, the negative-going edge arms the gate. The signal out of U14A(2) is translated by Q7 and Q8 and labeled LGATE. LGATE enables the STOP channel to arm after the START channel. In actual operation, the EXTERNAL GATE or EXTERNAL HOLDOFF mode is the leading edge of the EXTERNAL ARM signal. This signal comes in and clocks U14B(11) which generates the arm signal going to U25A. This enables the START channel signal to run through U25A which causes a START channel event. The signal out of the START channel flip-flop U17(6) goes to U24B. The STOP channel signal cannot go through U24B until U14A is clocked (at the trailing-edge of the external arm signal). Its output U14A(2) gets translated by Q7and Q8 and goes to U24B.

8-247. The noninverted outputs of U17(6) and U21(6) go to ECL comparators U11A(6) and U11A(12), respectively, and are translated to ECL. U11A(1) and U11B(14) go through translators Q2 and Q4 for START and Q1 and Q3 for STOP, and then go to the back panel as START EVT OUT and STOP EVT OUT. U11A(2) and U11B(15) go into inverted inputs U5A(5) and U5A(4), respectively. U5A(2) signal is essentially a START but not STOP signal, i.e., there has been a START channel event but not a STOP channel event. U5A(2) goes to U4A(7). U4A enables the counter and synchronizes the signal out of U5A(2) with the LSTOPCH signal from U13(3). TP1 is a pulse burst that is made up of the number of events that occurred between the START channel opening and the START or the STOP channel event. U3A, U4B, U2B, and U2A make up the EVENT counter.

8-248. ARMING PHASE DETECTOR. The Arming Phase Detector consists of 3 parts: 1) the phase detector itself which is made up of U12A, U12B, and U8A; 2) a flip-flop U8B which determines the initial condition and; 3) U9C, an exclusive OR gate that acts as a selection device. The inputs to the phase detector from U13(14) and U13(2) go to U12B(11) and U12A(6), respectively. The actual detection is done at U12A and U12B. The signal from U12B(14) goes to U8A(7) and the signal from U12A(3) goes to U8(6). If the START signal comes first, the output of U8A goes high when the STOP signal comes. If the STOP signal comes first, the output of U8A is low. The inverter output U8(3) enters U9C(15). U8B disables the the Phase Detector when HSTO is sent. If U8B is set, the Phase Detector is enabled, and if U8B is clocked by HTOGGLE, the output U8B(14) toggles. U8B(14) is exclusive ORed with U8A(3) by U9C(13) whose output gets translated by U30B and eventually is sent to the front panel controls.

8-249. A23 Front Panel Display

8-250. The A23 assembly contains the circuits necessary to display the measurement data and to allow the user to program the operation of the instrument. The display is made of 16 digit-LEDs and 30 annunciator-LEDs. The data entry keyboard has 30 keys including LOCAL/REMOTE and RESET.

8-251. STROBING TECHNIQUE. A strobing technique is used both to display the measurement data and to monitor the keyboard. Strobing means that only one digit of the displayed number or one column of keys is on at any time. One digit is displayed and then removed; then the next digit is displayed and then removed; then the next digit is displayed and removed. This process continues until all digits have been displayed. The strobing process occurs at a faster rate than the eye can detect, so the display appears continuously lit. The keyboard is monitored the same way; one column at a time.

8-252. Input lines LSØ through LS15 enable the digits (pins 3 and 14), the columns of switch-indicator LEDs, and the columns of annunciator LEDs. Input lines DDØ through DD7 enable the digit segments. Input lines LDSØ through LDS7 enable the columns of keyboard switches. Input lines LANØ through LAN3 enable the rows of switch-indicator LEDs and annunciator LEDs except for annunciators START, STOP, ARM, and EXT. Output lines DØ through D5 monitor the rows of keyboard switches. U1 and U2 drive annunciators START, STOP, ARM, and EXT, and also trigger lights EXT, START, and STOP as determined by their inputs at J4.

8-253. A69 10 MHz Oscillator

8-254. The A69 assembly is a voltage controlled 10 MHz oscillator. U1A operates like an amplifier with positive feedback. The positive feedback path is from the noninverted output of U1A(15) through C1, C2, and crystal Y1. Negative feedback establishes the input bias for U1A. This path is through R8 and R7. The trimmer capacitor C1, provides frequency adjustment of the oscillator.

8-255. The inverted output of U1A(14) is fed to buffer U1B(7). The buffer provides isolation between the oscillator and the output stage, Q1. The outputs of U1B(2) and (3) switch from about 4.0 to 4.75 volts. When one output is 4.0V, the other is 4.75V. Level shifter Q1 converts the output of U1B to an approximate TTL level.

8-256. A69 Option 001 10 MHz Oscillator (Oven)

8-257. This unit is a 10 MHz crystal oscillator whose frequency stability is temperature regulated by an internal oven. The unit incorporates an AGC circuit and is also capable of phase locking to an external standard. Before phase locking can occur, however, the two signals must be within one cycle of each other.

8-258. TROUBLESHOOTING

8-259. Troubleshooting for the 5370A consists of microprocessor address mapping, flowcharts, waveform analysis, and signature analysis. A trouble isolation flowchart is given in *Figure 8-7* and should be used to isolate a problem to the defective assembly. Assembly troubleshooting may then be used to locate the faulty component(s). Assembly troubleshooting is in numerical order and follows the isolation flowchart.

8-260. MICROPROCESSOR ADDRESS MAPPING

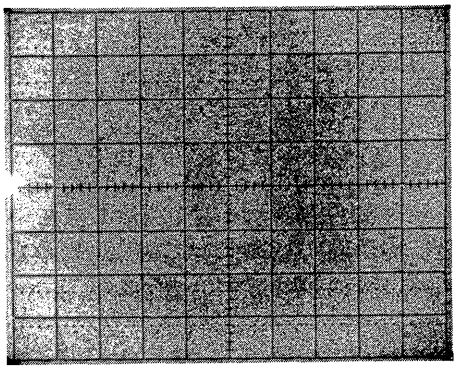
8-261. The accessory Service Aid board (A14) contains two DACs that monitor the processor's address lines. The DACs produce an analog voltage that corresponds to the state of these lines. The purpose of mapping is not to make a detailed examination of the processor's algorithm, but instead, to provide a quick and easy check of the processor to determine if it is working properly or if it has stopped in some loop.

8-262. Setup Procedure for Mapping

8-263. The following procedure outlines the proper method and oscilloscope setup.

1. Set HORIZONTAL MAGNIFIER to X10. Set both scope inputs to dc.
2. Set HORIZONATAL DISPLAY (gain or external sensitivity) to EXT.
3. Connect BNC cable to HORIZONTAL INPUT and connect BNC-to-alligator clip leads to other end of BNC cable.
4. Connect both black and red clip leads to A14 common (⏚) terminal.

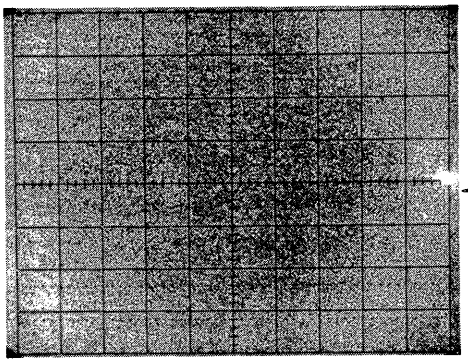
5. Use HORIZONTAL POSITION control to place display dot on left-most graticule line.



NOTE

Display dot on left-most graticule.

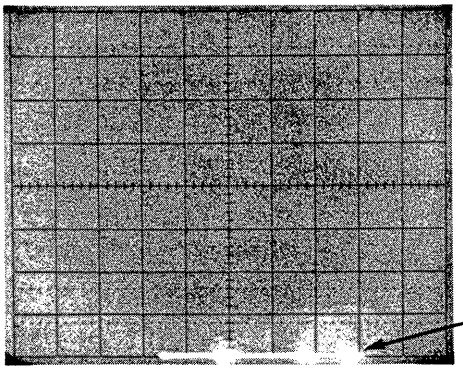
6. Connect red clip lead to A14 "5.12V" terminal and use HORIZONTAL DISPLAY control (horizontal gain) to place display dot to right-side of graticule.



NOTE

Display dot on right-most graticule.

7. Connect red clip lead to A14 "X" terminal and use VERTICAL control to place horizontal line to bottom of display.

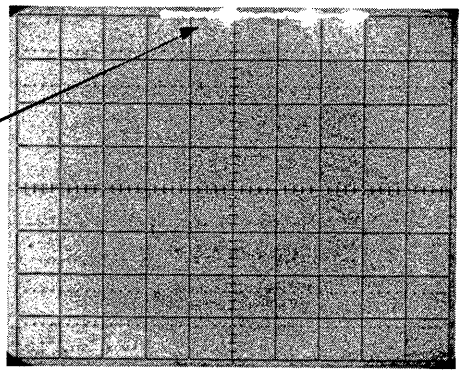


NOTE

Display line on bottom graticule.

8. Connect BNC cable to VERTICAL INPUT jack and connect BNC-to-alligator clip leads to other end of cable.
9. Connect black clip lead to A14 common (⏚) test point and red clip to A14 "5.12V" terminal.

10. Set VOLTS/DIV control to 0.5V/DIV and use VOLTS/DIV vernier (not the vertical position control) to bring horizontal line to top of graticule.



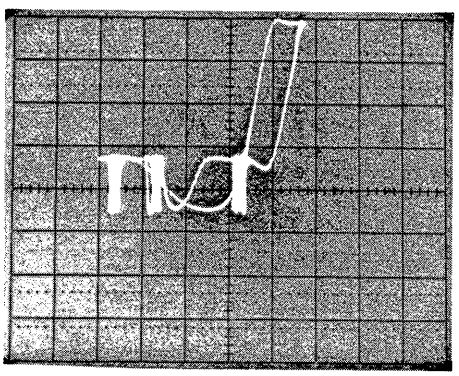
11. Connect the red lead of the vertical cable of A14 "Y" terminal. The oscilloscope is now ready to display processor maps.

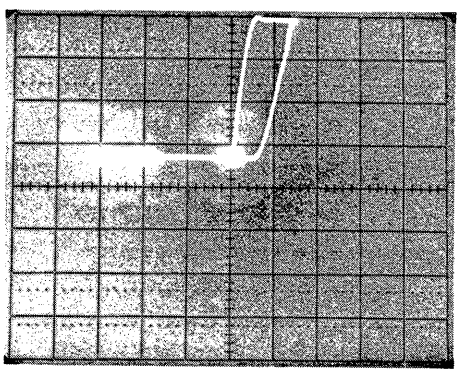
8-264. Common Map Patterns

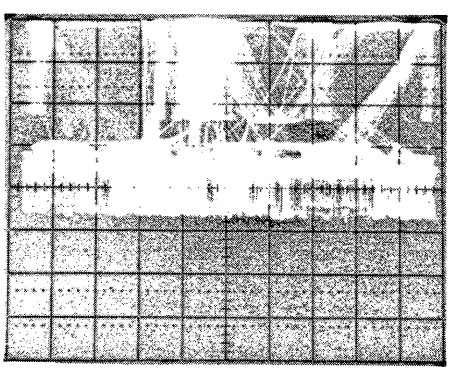
8-265. The following figures show most of the counter's "normal" map patterns.

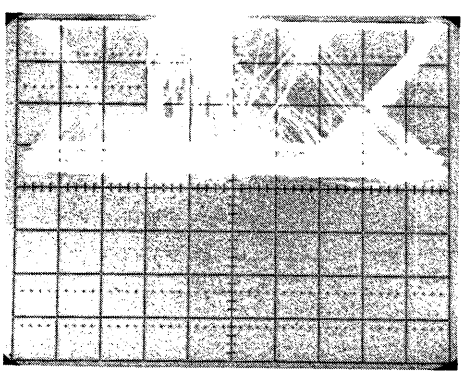
NOTE

The microprocessor used in this instrument has undergone some changes by the manufacturer. The newer type used in most instruments is shown in the two-left figures shown below. The figures to the right show the same map but without the "tails" caused by a "glitch" at each address. The type shown on the left will be, by far, the more common type. Notice that even though the shape may change slightly, the pattern remains the same.

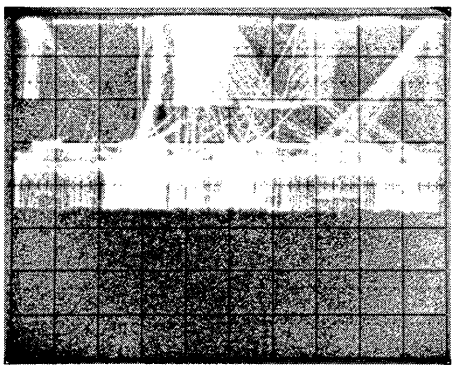




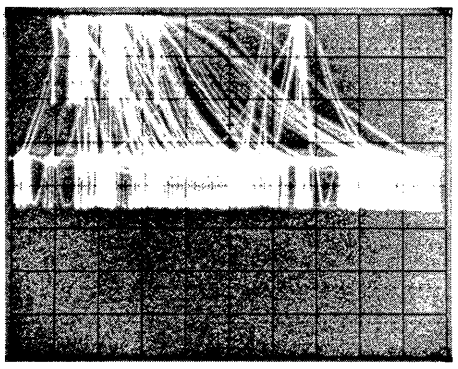




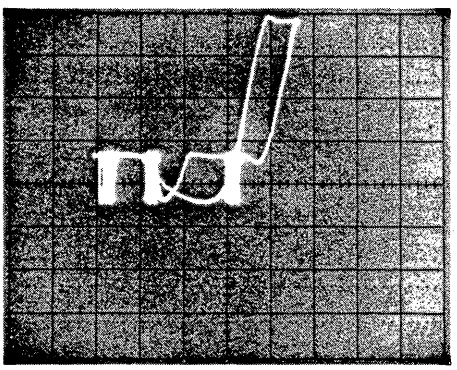
1. This map shows the processor in normal operation with an input signal. It indicates that the processor is working and the front end boards are operational. Although there could be some measurement error in the front end, it is highly unlikely a problem exists in the processor section. If a problem exists and this map is present, a problem could exist in the display boards (A11 and A23), the count chain (A17), the NØ part of A18, or, as mentioned, one of the analog boards. If this map should appear with no input signal connected, it indicates the LPROC line is stuck low (A17 or A18). This picture is actually flashing between two program routines: 1) measurement computation; and 2) display rate and interface.



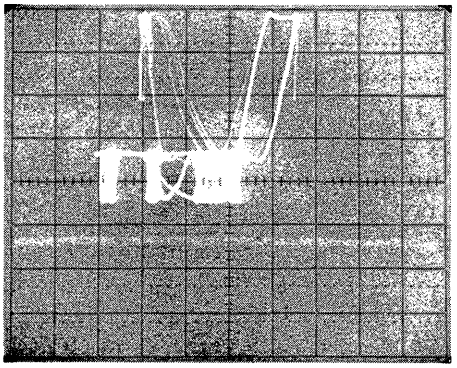
2. This map shows the same measurement as the previous picture but at a sample size of 100K. The flashing seen in the first picture is slowed as the sample size is increased. As shown below, the processor now stays in the measurement and computation routine longer.



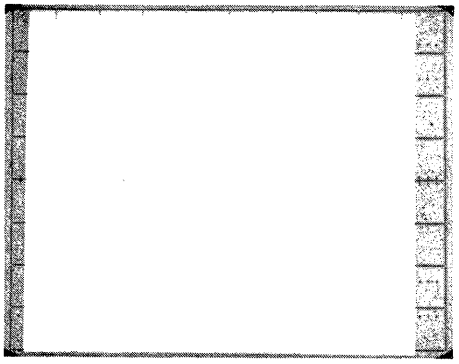
3. This map is an excellent indication of two things: first, that the processor has gone through all of its power up diagnostics and is working properly; and second, the counter is waiting to be triggered. The problem could be in any one of the front end boards, including the Arming Interface board, A16. The map is also an indication of no input signal.



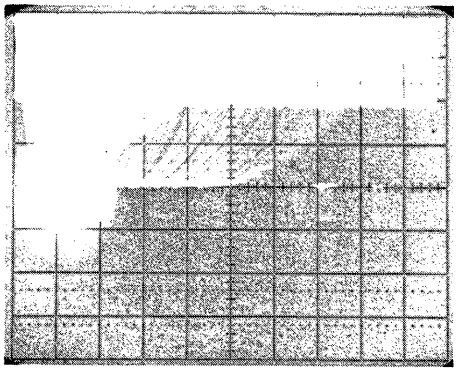
4. This map is similar to the previous one except, in this case, the counter has received a start signal but not a stop. The additional portion in the upper left is the Count Chain board (A17) counting NØ pulses. There is also a horizontal line (barely visible in the photo) that advances from the top of the graticule to the bottom. This is the processors index register.



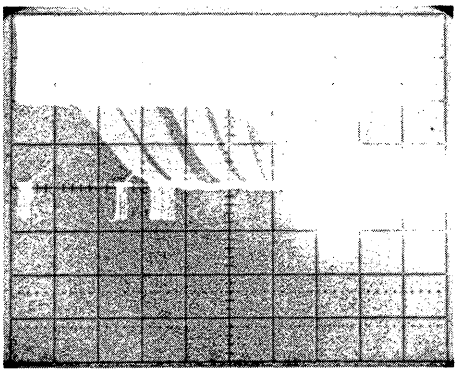
5. When the processor is set to the freerun condition for use with signature analysis, it presents a display as seen in the figure below. Freerun is achieved by setting the A9 Processor switches to LLLLLHH. However, it is possible to get the same map under normal setup conditions if the processor "crashes" because of a failure or if a test probe slips during troubleshooting.



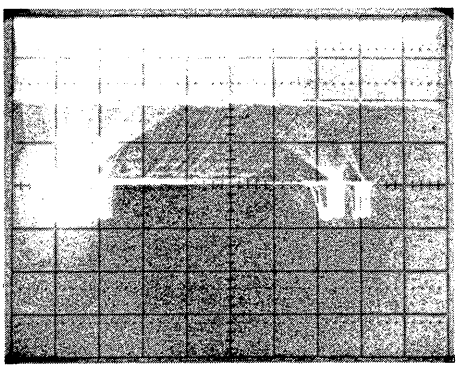
6. When the A16 Arming Interface service switches are set to LHHHHHLLL and power up RES on A14 is pushed, the processor is in a loop always/write mode and provides test patterns for signature analysis. The map of this condition is shown below.



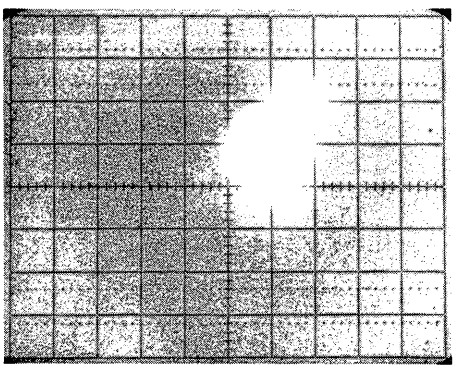
7. When the A16 service switches are set to LHHLHHLL and A14 power up RES is pushed, the processor performs a loop always/read function, again for signature analysis. The "read" amp is shown below.



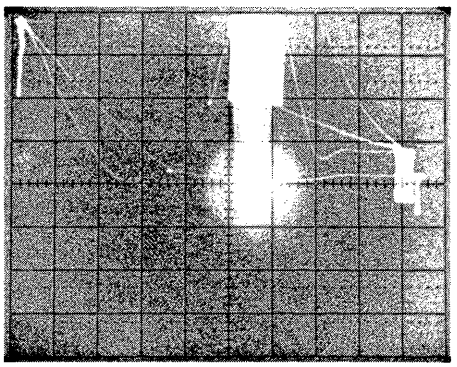
8. This map is simply a combination of the previous two. It is generated by setting the A16 service switches to LHHLHLLL and pushing A14 power up RES switch.



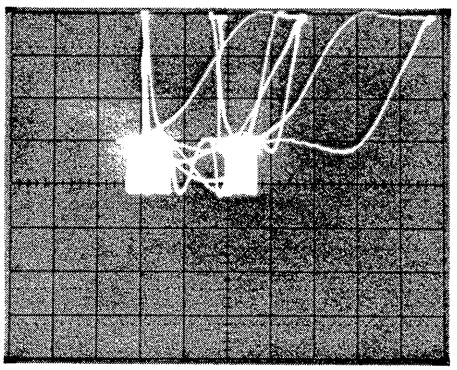
9. The map shows the processor performing the loop-always/display-test loop. This routine is initiated by setting the A16 service switches to LHHHLHLL and pushing A14 power up RES switch. The map shows the 2- to 3-second wait loop that exists between display updates. Under normal power up conditions, the wait loop is also entered to provide time for the lamp-test display. The faint line near the top of the graticule is actually a dot that is visually strobing across the display. Another map will briefly flash on the CRT when the counter's display is updated.



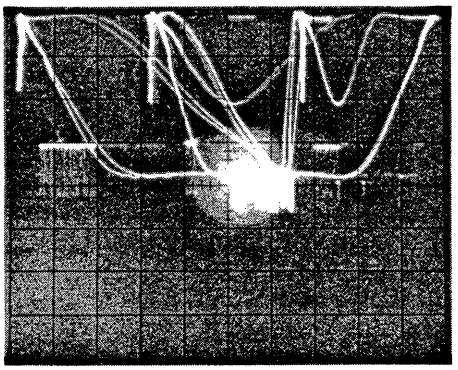
10. Pressing the front panel RES button places the processor in a loop that produces the characteristic map shown below.



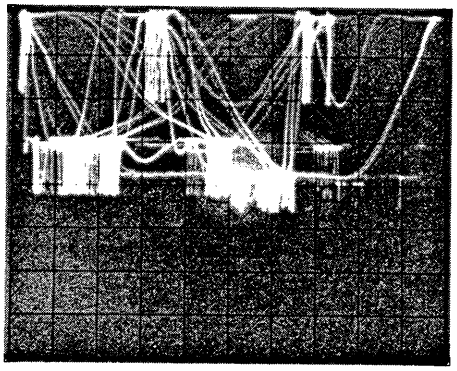
11. This is a map of the "Display Rate Hold" routine. If this map is displayed at an inappropriate time, it could indicate a processor problem or a problem on the Arming Interface board (A16), the Arming board (A22), or Display/Pushbutton board (A23). This would include the interconnecting cable.



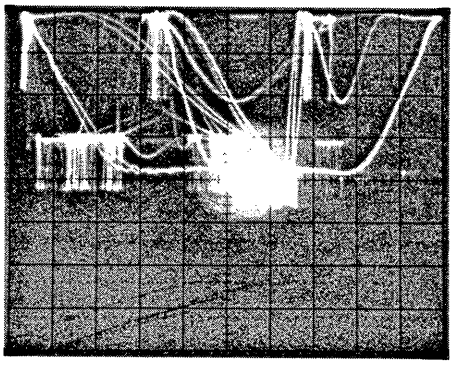
12. These following three maps show the trigger level routine, which is entered when the TRIG LVL button is pushed. The first map was taken with both LEVEL controls in the PRE-SET position (0V). The second map shows the LEVEL controls set to -1.3V, and the third map shows both controls set to +0.5V. All three maps are essentially the same. Some areas are more intense than others, indicating that the processor is completing its routine faster and therefore entering the those program locations more often.



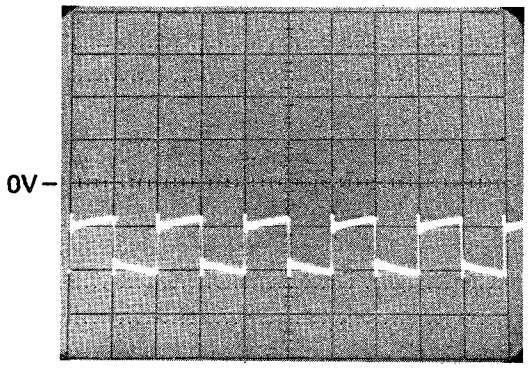
0 Volts



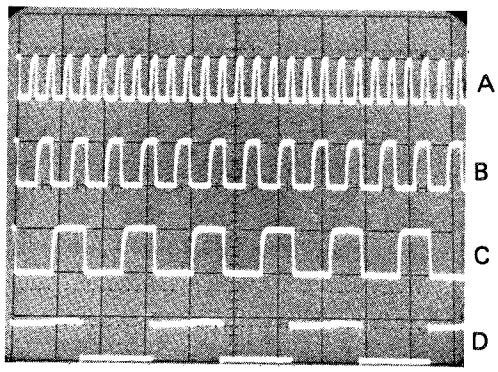
-1.3 Volts



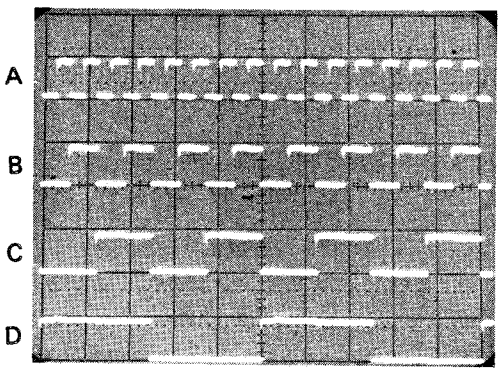
+0.5 Volts



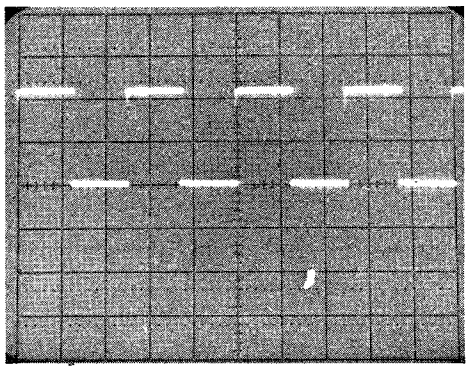
1



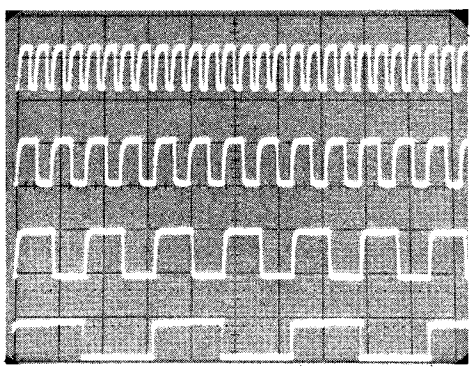
2



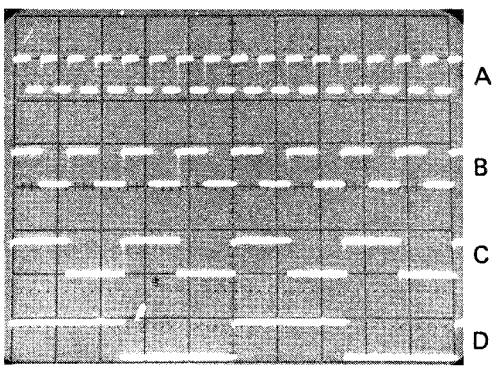
3



4

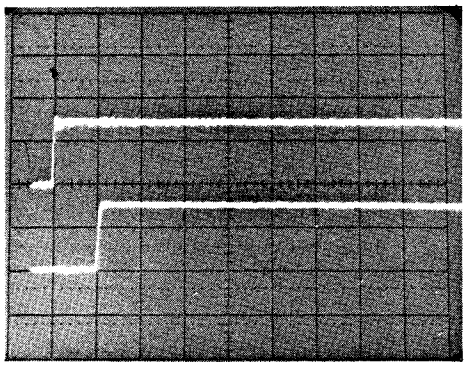


5

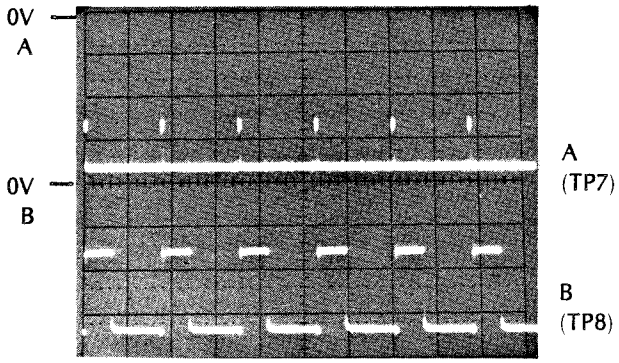


6

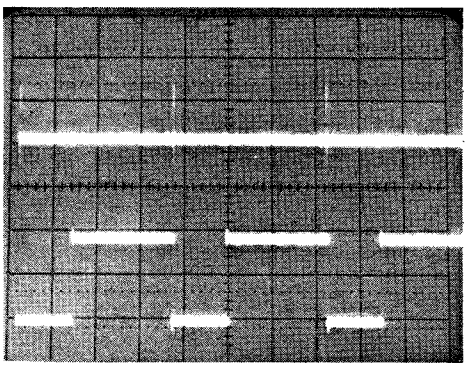
Part of Figure 8-7. Troubleshooting Assembly Isolation Flowchart



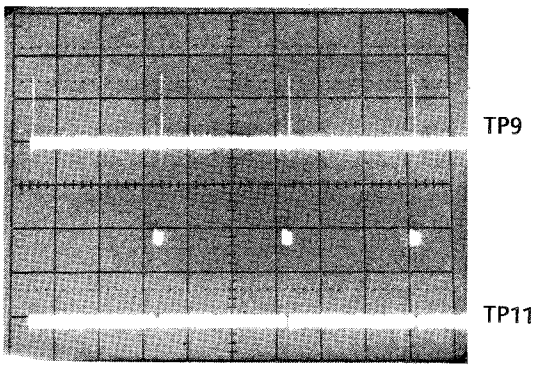
7



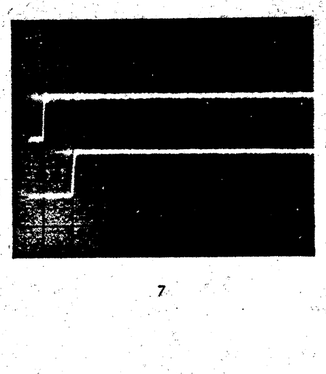
8



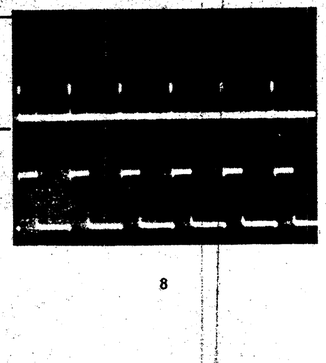
9



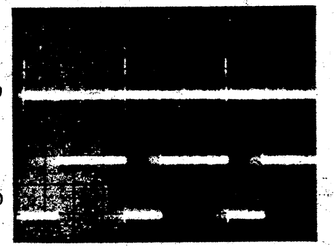
10



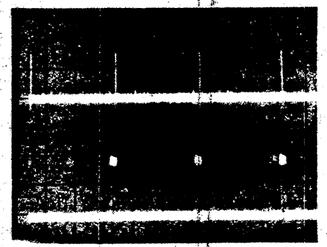
7



8



9



10

EXTENDER BOARD FOR PROCESSOR SECTION

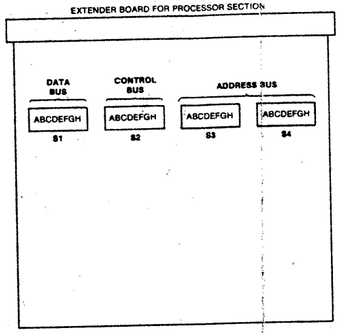


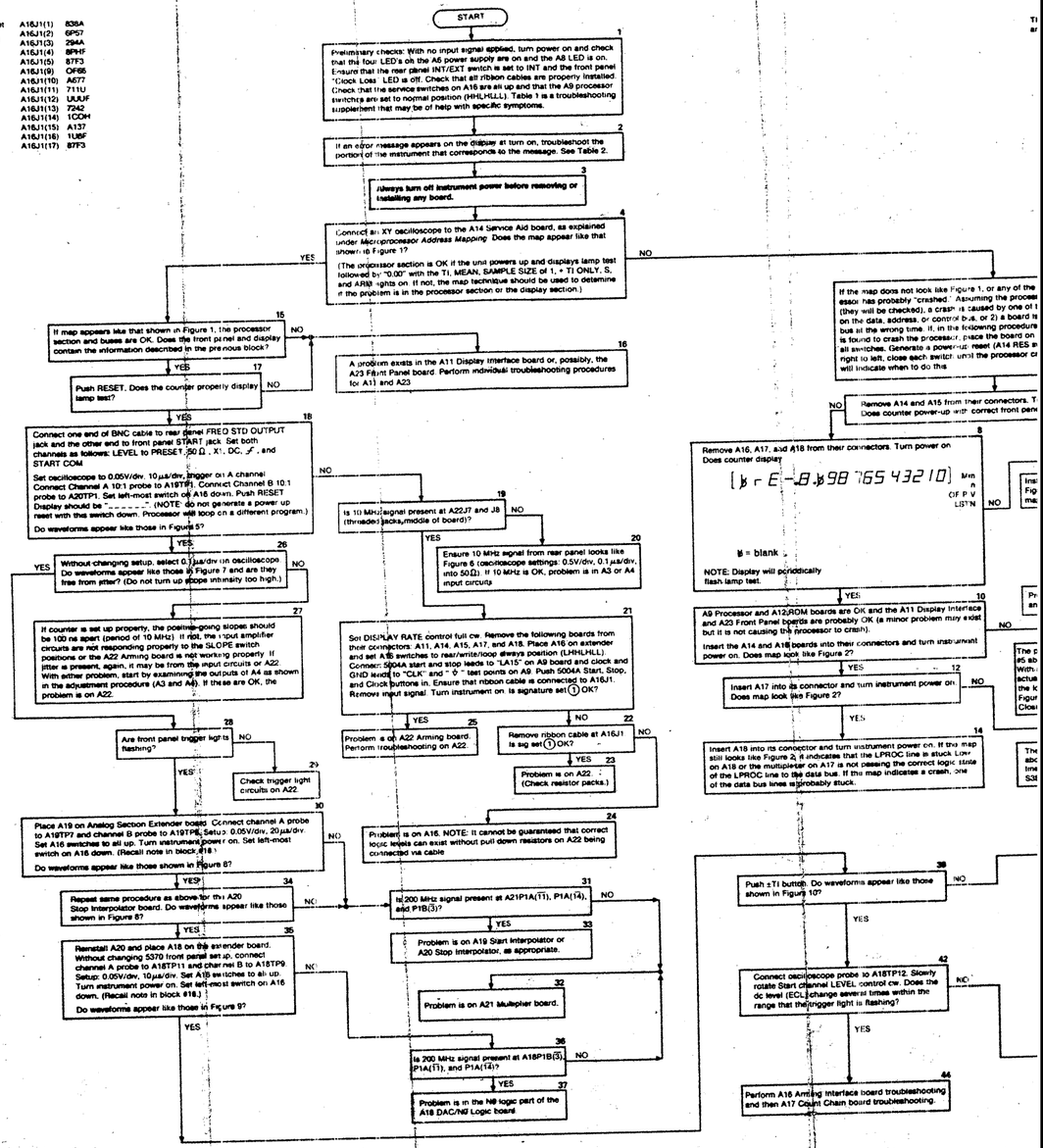
Table 1. Troubleshooting Hints

1.	If pushing one of the front panel pushbuttons does not activate the selected function, as indicated by the light staying on, the problem is either a bad switch or a problem on the A11 Display Interface board. This is assuming the processor is working properly, that the selected key function is legal, and that the pushbutton LED is good, which can be checked with lamp test.
2.	If the counter works in the ±TI Arming mode but not in one of the other arming modes, including external arming, the problem is on A16, A22, or possibly on A18. Perform the A16 Arming Interface troubleshooting first and then the A22 Arming board troubleshooting.
3.	If the counter is working but gives erratic displays, the Overall Troubleshooting Flowchart should be able to isolate the problem to the board level. Also, see hint #4 below.
4.	If the counter works correctly in the TI mode but not in FREQ or PERIOD mode, the problem may be caused by the automatic calibrate routine (see A22 Arming board troubleshooting) or a problem exists in the Event Counter circuits, which are located on A22 and A16.
5.	If the counter powers up correctly with no input signal applied but the ARM light is not lit, check the A16 Arming Interface board and A22 Arming board. This is especially true if the counter will not make a measurement.

Table 2. Error Messages

Err 1:	Illegal Remote Command. Programmer has entered a nonvalid program code.
Err 2:	Time Interval Overrange. Typically, measurement has accumulated more counts than the software can handle in its arithmetic computations, because of operating conditions. If an actual problem exists, it may be because the internal circuits are receiving a start signal but not a stop signal (see Figure 11), or a problem may exist in the A17 Count Chain board (probably in the N9 count circuit).
Err 3:	Undefined Routine. For possible future use.
Err 4:	PLL Out of Lock. 1) One of the oscillator circuits on A19 or A20 is not phase locked. Interpolator "VCO" test point should be between -3V and -6V. (A21 board may be bad or no 10 MHz signal to it.) 2) the out-of-lock detector on A21 Multiplier board is bad. 3) The out-of-lock flip-flop on A17 Count Chain board is bad. 4) The multiplexer that passes the lock information on A17 is bad.
Err 5:	Undefined Key. A hardware problem, probably on the A11 Display Interface board.
Err 6.N:	RAM Error. When the instrument is turned on, a diagnostic routine checks the RAMs. If a RAM is bad, Err 6.N is displayed. The "N" is a number that refers to the specific RAM at fault. For example, if Err 6.3 is displayed, replace the third RAM from the left.
Err 7.N:	ROM Error. When the instrument is turned on, a diagnostic routine checks the ROMs. If a ROM is bad, Err 7.N is displayed. The "N" is a number that refers to the specific ROM at fault. For example, if Err 7.4 is displayed, replace the fourth ROM from the left. Err 7.9 indicates one of the ROMs is missing or not being enabled.

Sig Set ①		
	A16J1(1)	838A
	A16J1(2)	6P57
	A16J1(3)	294A
	A16J1(4)	8PHF
	A16J1(5)	87F3
	A16J1(9)	OP86
	A16J1(10)	A677
	A16J1(11)	711U
	A16J1(12)	UUUF
	A16J1(13)	7342
	A16J1(14)	1C0H
	A16J1(15)	A137
	A16J1(16)	1U8F
	A16J1(17)	87F3



Figu

NOTE

The numbered corners at top of each block are for reference purposes and do not represent an order of flow

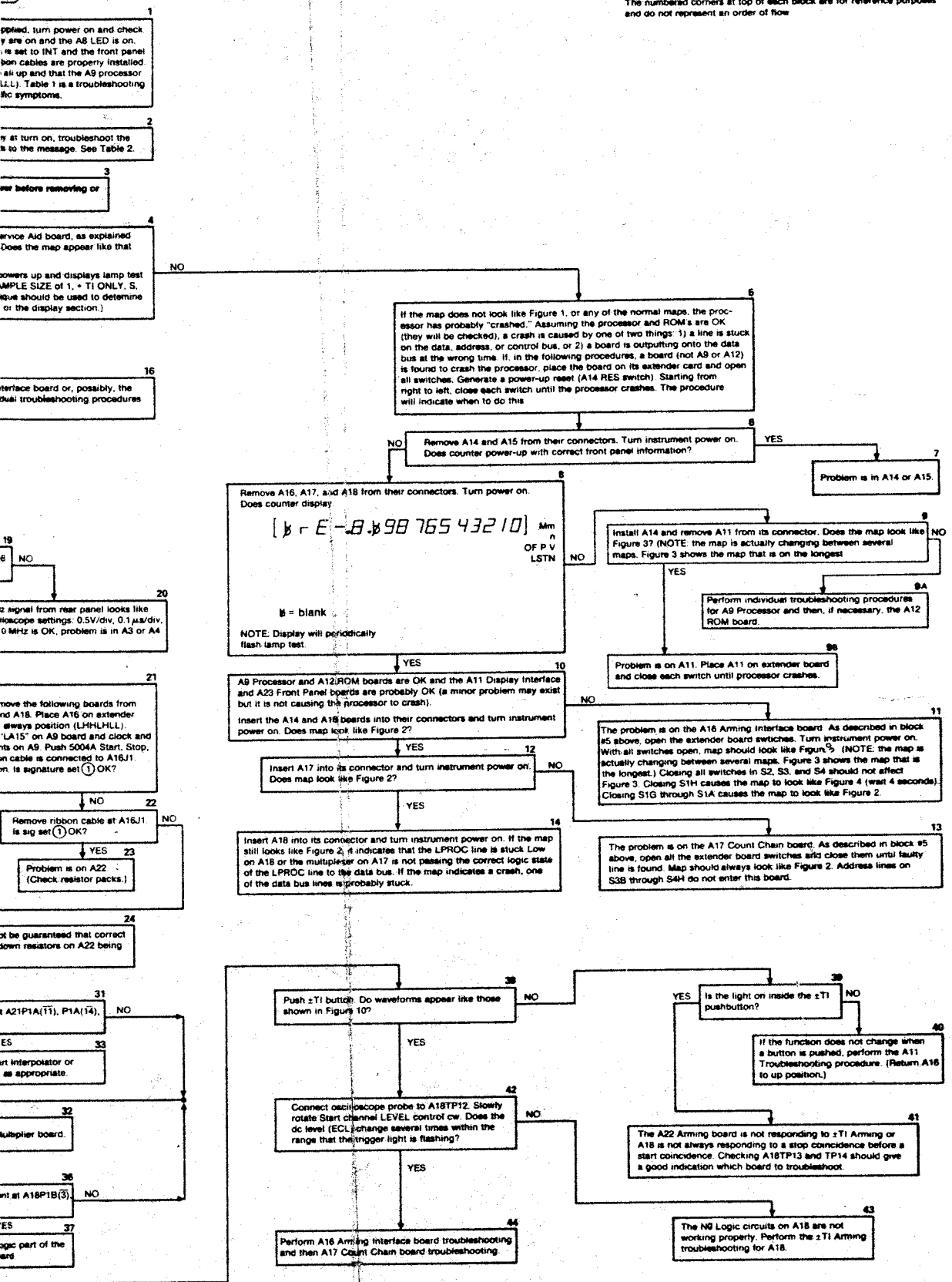


Figure 8-7. Trouble Isolation Flowchart

8-266. A3/A4 INPUT ATTENUATOR/INPUT TRIGGER TROUBLESHOOTING

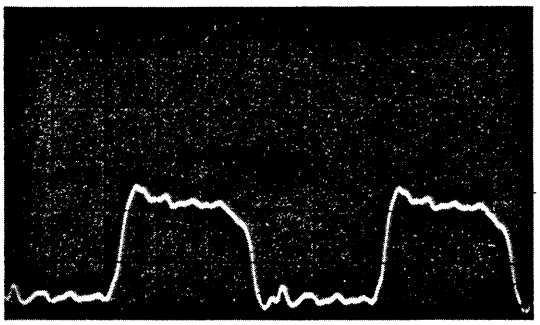
8-267. To troubleshoot the combination A3/A4 assembly, connect a coax cable from the rear panel 10 MHz output to the front panel START input and set the 5370A front panel controls as follows:

FUNCTION ..... T.I.
STATISTICS ..... MEAN
SAMPLE SIZE 1
ARMING ..... +T.I. ONLY
BOTH CHANNELS
  IMPEDANCE 50Ω
  ATTENUATION ..... ÷1
  COUPLING ..... DC
  LEVELS ..... PRESET
START SLOPE ..... ⨍
STOP SLOPE ..... ⨏
START COM/SEP ..... START COM

The following waveforms should appear at the designated points using an HP 1740A oscilloscope. These signals have a dc offset such that they can only be seen if they are inverted by the oscilloscope. To do this, move the probe to Channel B of the oscilloscope and press B Invert.

0.05B/div., 20 ns/div.

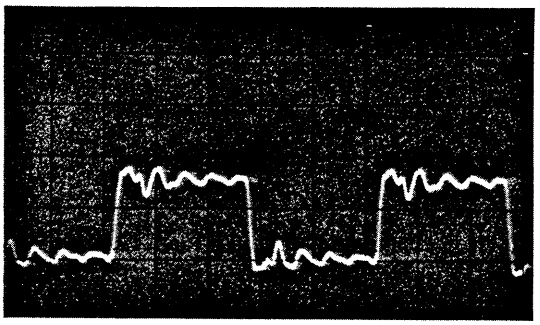
A4U1(4)
A4U2(4)



OV

0.05V/div., 20 ns/div.

A4U1(13)
A4U2(13)



OV

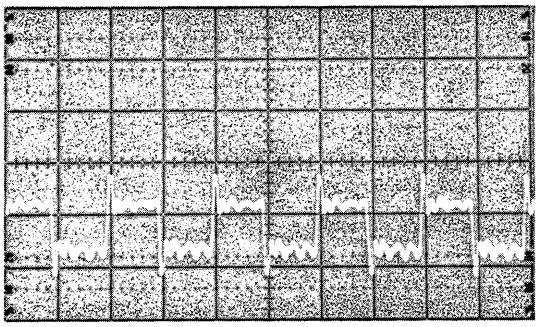
8-268. A8 REFERENCE FREQUENCY BUFFER TROUBLESHOOTING

8-269. Begin troubleshooting the A8 assembly by first placing the assembly on an extender board (i.e., 5060-0049 extender board found in the 10870A service accessory kit). The following seven photos show wave shapes which appear at designated points throughout the circuit. The first five are those wave shapes of the internal 10 MHz clock with the rear panel FREQ STD switch in INT. The last two show wave shapes found in the circuitry used to shape and develop the external time base input. For the last two photos, an external 10 MHz is applied to the rear panel jack J6 with the FREQ STD switch in EXT position. All wave shapes were taken using an HP 1720A oscilloscope with an HP 10017A probe. No special 5370A front panel setup is necessary.

REAR PANEL FREQ STD SWITCH **INT**
USE 10 DIVIDER PROBE HP 10017A

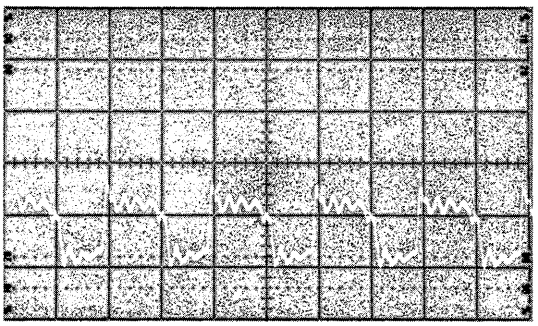
0.1V/div., 50 ns/div.

TP INT
U2C(13)



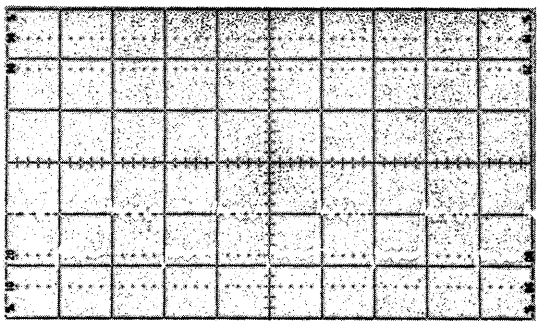
0.1V/div., 50 ns/div.

U1(6)



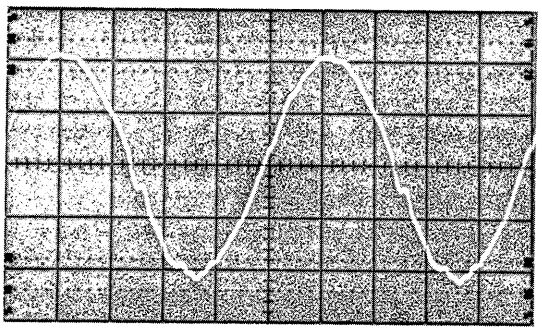
0.1V/div., 50 ns/div.

U4(14)
U3(2, 3)



0.1V/div., 20 ns/div.

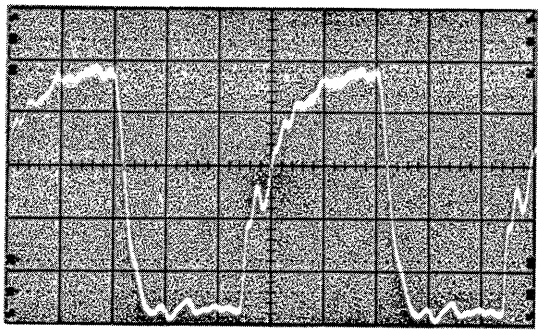
10 MHz EXT OUTPUT (Junction of C7 and C8)



OV

0.1V/div., 20 ns/div.

10 MHz CLK (Collector of Q3)

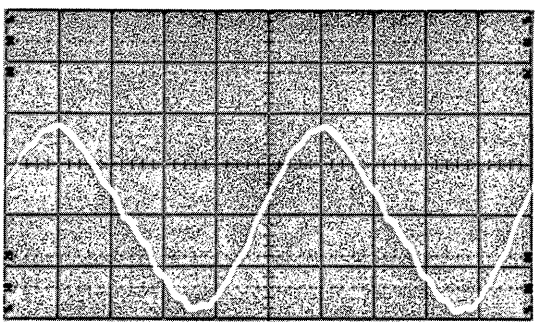


OV

REAR PANEL FREQ STD SWITCH **EXT** WITH 10 MHz INPUT AT REAR PANEL J6

0.2V/div., 20 ns/div.

A8P1A($\overline{8}$)



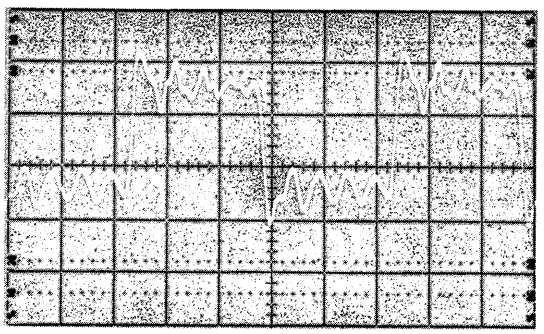
OV

The last signal has a dc offset such that it can only be seen if it is inverted by the oscilloscope. To do this, move the probe to Channel B and press B Invert.

.05V/div., 20 ns/div.

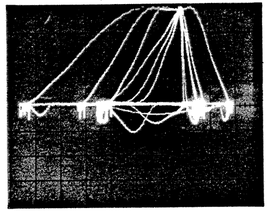
TP EXT

U2B(9)

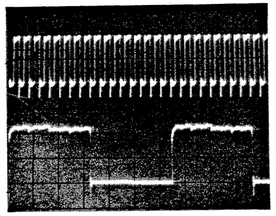


OV

.02V/Div., 2 μs/Div., 10:1 Probe

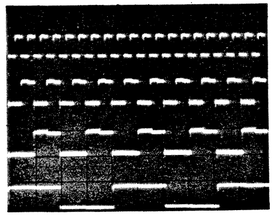


1



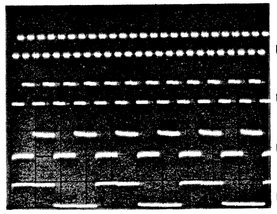
2

0.5V/div., 50 ms/div., 10:1 Probe



3

0.5V/div., 1 ms/div., 10:1 Probe



4

① CLOCK/ROM Signatures

U11(2)	00UP (H level)
(3)	00UP (H level)
(4)	000U
(5)	000U
(6)	0066
(7)	0066
(9)	00UP
(10)	003F
(11)	003F
(12)	0000 (L level)
(13)	0000 (L level)
(14)	00UP (H level)
(15)	00UP
U13(5)	0070
(6)	009P
(7)	0078
(9)	0082
U17(2)	008P
U20(2)	0070
(3)	008P
(5)	0070
(6)	0070
(9)	008P
(11)	0070

② ADDRESS BUS

P1A3	UUUF
4	FFFU
5	8487
6	P760
7	1U5H
8	0355
9	U75A
10	6F99
11	7792
12	6322
13	37C6
14	6U2C
15	4FC9
16	486C
17	9UP2
18	0001

③ PROCESSOR FREE-RUN

U18(9)	UUUU
10)	FFFF
(11)	8484
(12)	P763
(13)	1U5P
(14)	0356
(15)	U759
(16)	8F9A
(17)	7791
(18)	6321
(19)	37C5
(20)	6U28
(22)	4FCA
(23)	4868
(24)	9UP1
(25)	0002

④ RAM/ROM Select Logic

U7(6)	328F
U9(5)	PACH
U9(6)	C72P
U6(2)	9UP1
U6(4)	0002

Ⓕ Partial Data Bus Driver/Receiver Check

U4(1)	0000 (toggling)
(2)	PACH
(3)	PACH
(4)	0003 (H level)
(5)	0003 (H level)
(6)	PACP
(8)	0003 (toggling)
(9)	PACP
(10)	0000 (toggling)
(11)	0003 (H level)
(12)	0003 (toggling)
(13)	0003 (H level)

⑥ Data Bus Driver Logic

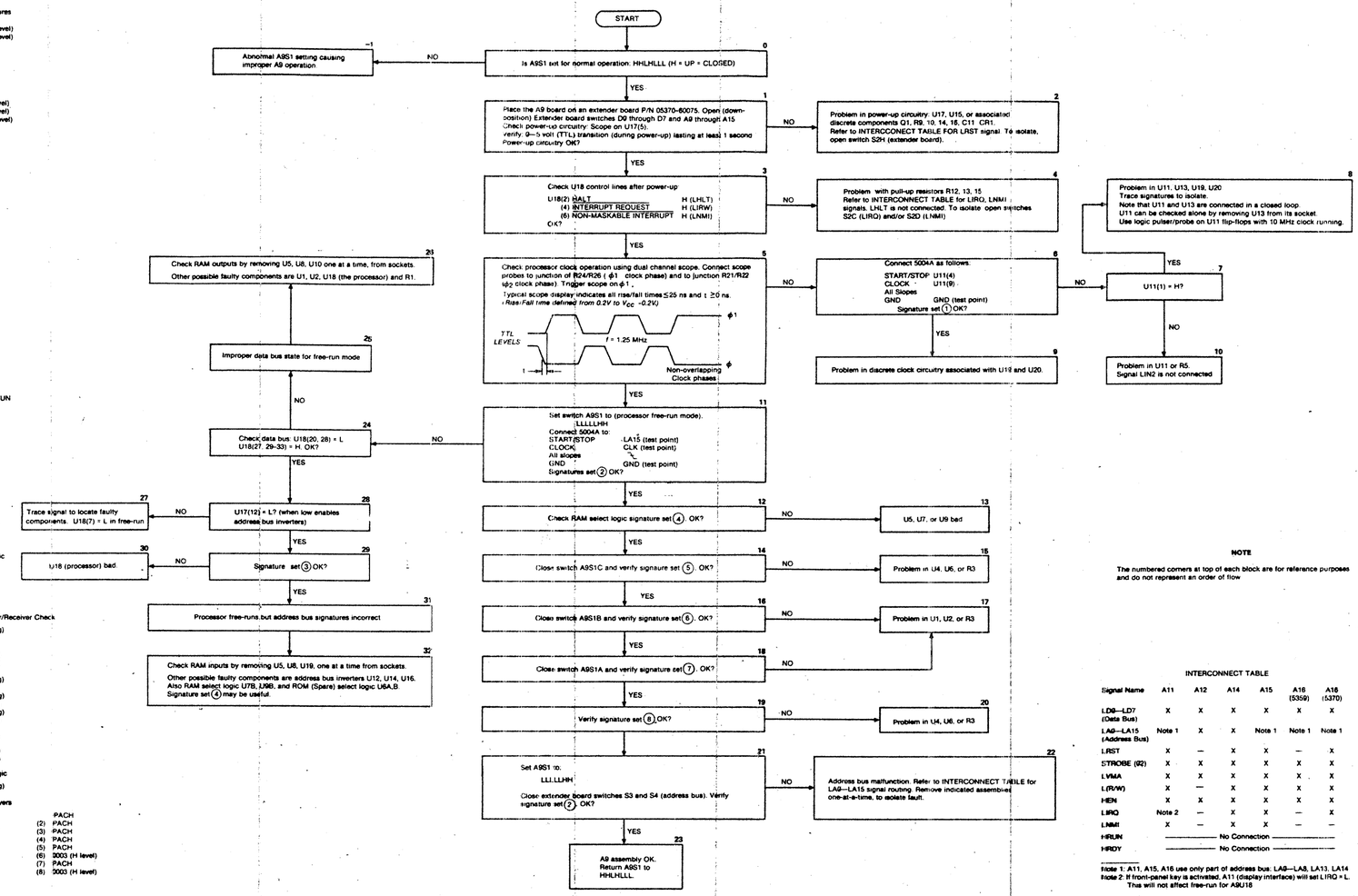
U6(8)	0000 (toggling)
U6(9)	0003 (toggling)

⑦ Data Bus Receiver Logic

U4(12)	0003 (toggling)

⑧ Data Bus Receiver/Drivers

R1(1)	PACP		PACH
(2)	PACP	(2)	PACH
(3)	PACP	(3)	PACH
(4)	PACP	(4)	PACH
(5)	PACP	(5)	PACH
(6)	0000 (L level)	(6)	0003 (H level)
(7)	PACP	(7)	PACH
(8)	0000 (L level)	(8)	0003 (H level)



NOTE

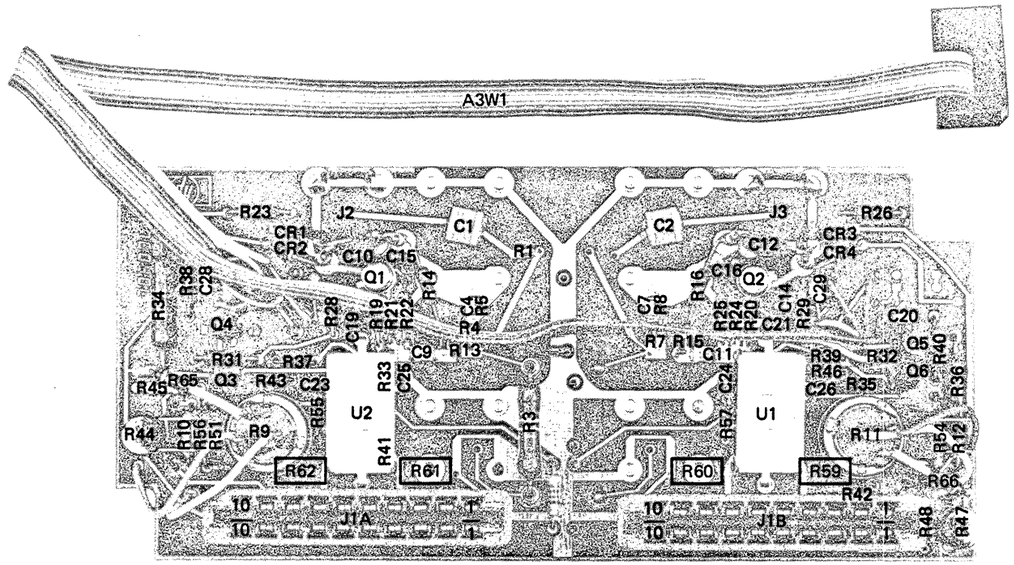
The numbered corners at top of each block are for reference purposes and do not represent an order of flow.

INTERCONNECT TABLE

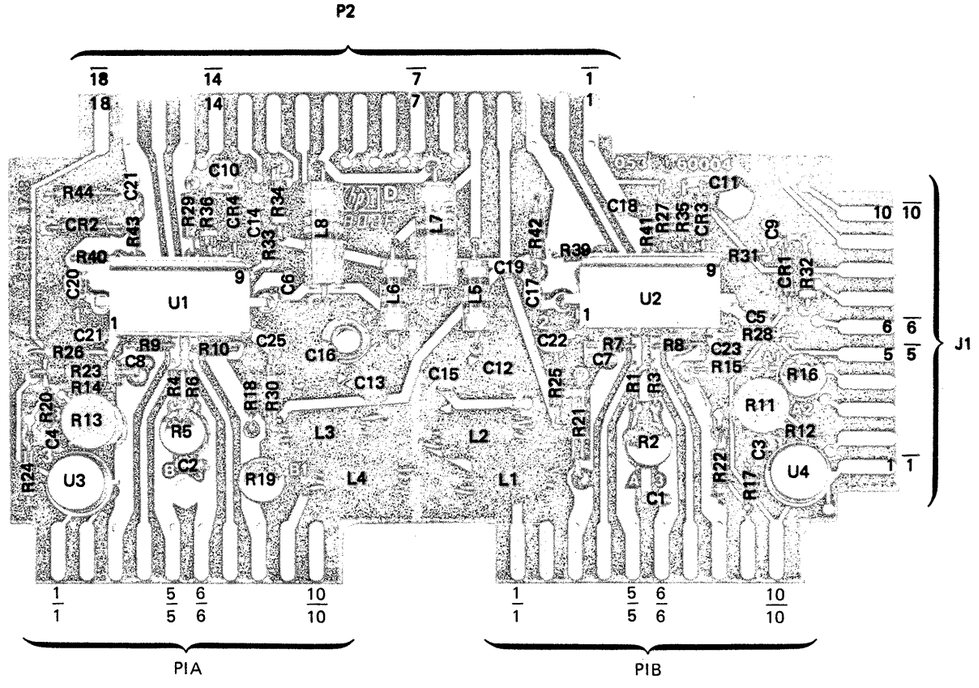
Signal Name	A11	A12	A14	A15	A16 (5359)	A16 (5370)
LD0—LD7 (Data Bus)	X	X	X	X	X	X
LA8—LA15 (Address Bus)	Note 1	X	X	Note 1	Note 1	Note 1
LRST	X	—	X	X	—	X
STROBE (02)	X	X	X	X	X	X
LVMA	X	X	X	X	X	X
L(R/W)	X	—	X	X	X	X
HEN	X	X	X	X	X	X
LIRQ	Note 2	—	X	X	—	X
LNMI	X	—	X	X	—	—
HRUN	No Connection					
HRDY	No Connection					

Note 1: A11, A15, A16 use only part of address bus: LA8—LA8, LA13, LA14
Note 2: If front-panel key is activated, A11 (display interface) will set LIRQ = L. This will not affect free-run for A9U18

Figure 8-8. A9 Assembly Troubleshooting Flowchart



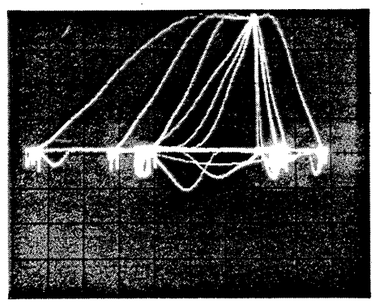
A3



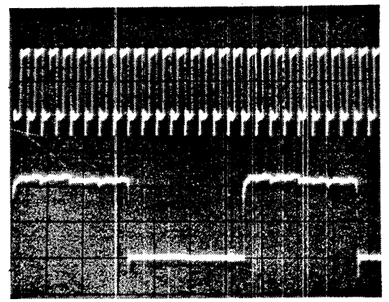
A4

8-70

.02V/Div., 2 μs/Div., 10:1 Probe

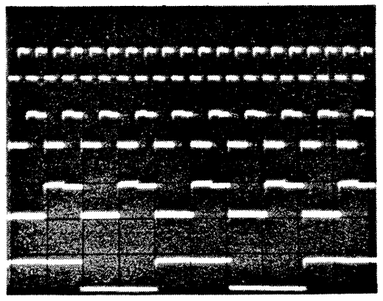


1



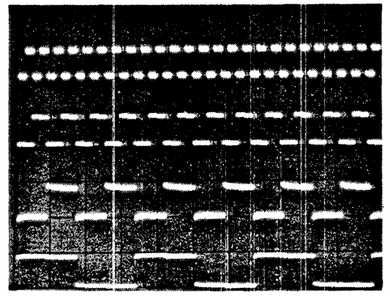
2

0.5V/div., 50 ms/div., 10:1 Probe

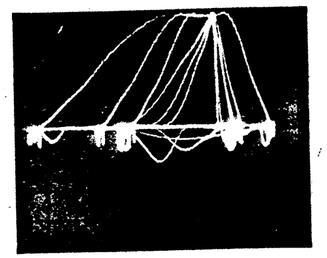


3

0.5V/div., 1 ms/div., 10:1 Probe

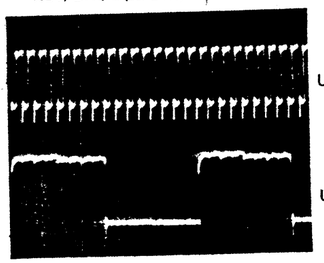


4



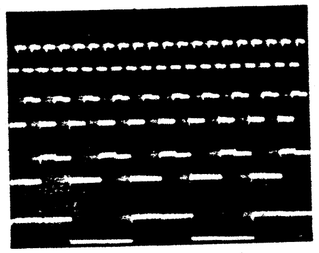
1

.02V/Div., 2 μs/Div., 10:1 Probe



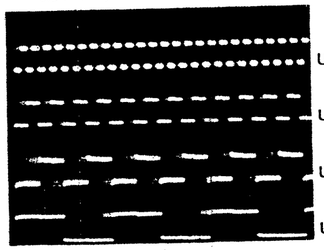
2

0.5V/div., 50 ms/div., 10:1 Probe



3

0.5V/div., 1 ms/div., 10:1 Probe



4

Sig set

① U15(8) 6177
U18(6) 54C9
U18(8) 839F
U21(8) 1713

② U19(2) 30U2
U19(8) AU96
U19(12) C540
U16(8) 8H4C
U19(4) 0U3C
U19(6) HFCU
U16(1) 576C

Input Lines (Check only if sig set ② is bad).
P1A(3) 87P9
P1A(4) 9C76
P1A(5) 10A3
P1A(6) F5P9
P1A(7) 122U
P1A(8) 2HP6
P1A(9) UP62
P1A(10) 2APF
P1A(11) UCA2
P1A(16) 3UP7
P1A(17) 3UP7
P1A(16) 22HH (High)
P1A(2) 75C6
P1A(11) 979H
P1A(1) 22HH

③ U5(1) PHP8
U5(2) 50UP
U5(3) 7356
U5(4) 36H2
U5(5) PCH0
U5(6) UP90
U5(7) U51A
U5(9) 0458

U14(1) 464C
U14(2) F5P3
U14(3) 3H77
U14(4) 8FH9
U14(5) 65A4
U14(6) 0H9U
U14(7) UU68
U14(9) 5UF6

④ U5(15) 5H21
U5(14) 19H6
U5(13) HP66
U17(8) 7A70

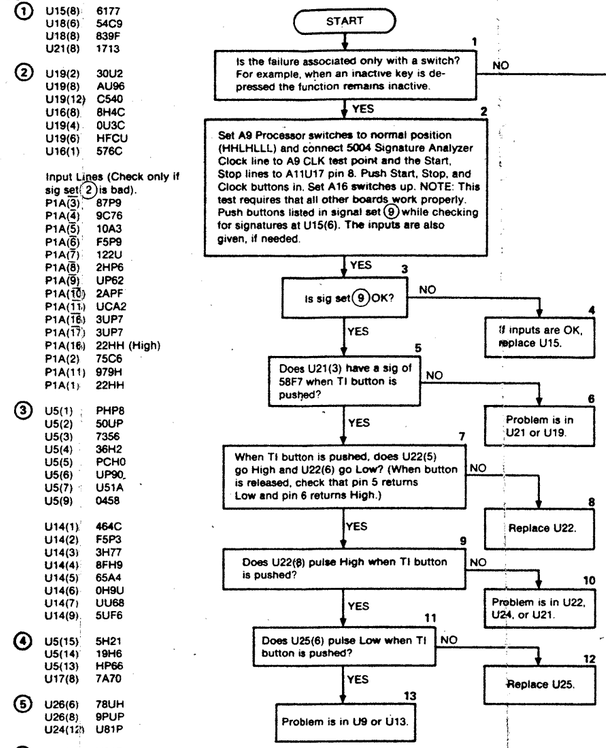
⑤ U26(6) 78UH
U26(8) 9PUP
U24(12) U81P

⑥ U11(4) U81P
U11(7) 5F08
U11(9) 9CC8
U11(12) HU4U

⑦ U11(4) H3FU
U11(7) 17P3
U11(9) 3522
U11(12) 287P

Input Lines (check only if sig set ⑦ is bad).
U11(14) 3110
U11(13) 2F4F
U11(5) 0P8H
U11(2) FAA1

⑧ U2(5) 721C
U2(7) 15P2
U2(11) CC77
U2(9) CFF1
U4(5) C757
U4(7) 092U
U4(11) 6H72



⑧ cont'd

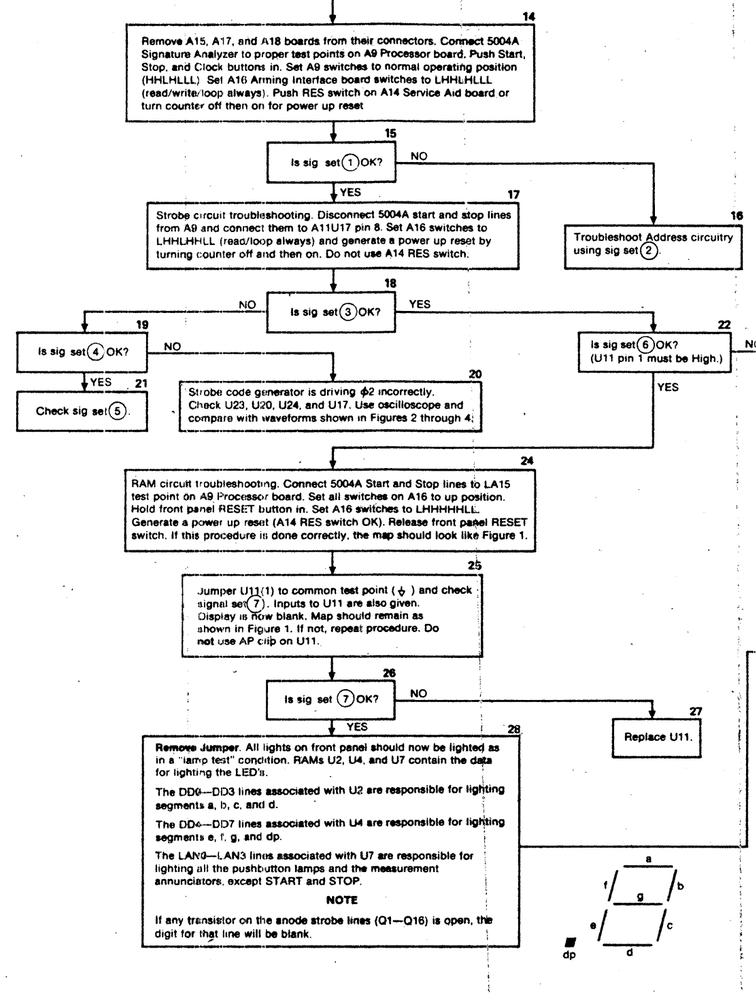
U4(9)	52A2
U7(5)	5272
U7(7)	5FPP
U7(11)	1HC3
U7(9)	FFP8

⑨

KEY	IC	SIG
TI	U15(6)	U686
PERIOD	U15(6)	H290
DIS REF	U15(6)	U138
SET REF	U15(6)	C4CF

U15 Inputs (check only if sig set ⑨ is bad).

KEY	IC	SIG
TI	U15(4)	PHP8
PERIOD	U15(5)	50UP
DIS REF	U15(2)	7356
SET REF	U15(1)	36H2



The numbered co
and do not repres

In case two lines are stu
method is provided. Set
generate a power up res
switches to LHHHHHLL

Display should be as fol

To check RAM signatur
lines to A11U17(8). Che

Figure 8-9. A11 Asse

NOTE

The numbered corners at top of each block are for reference purposes and do not represent an order of flow.

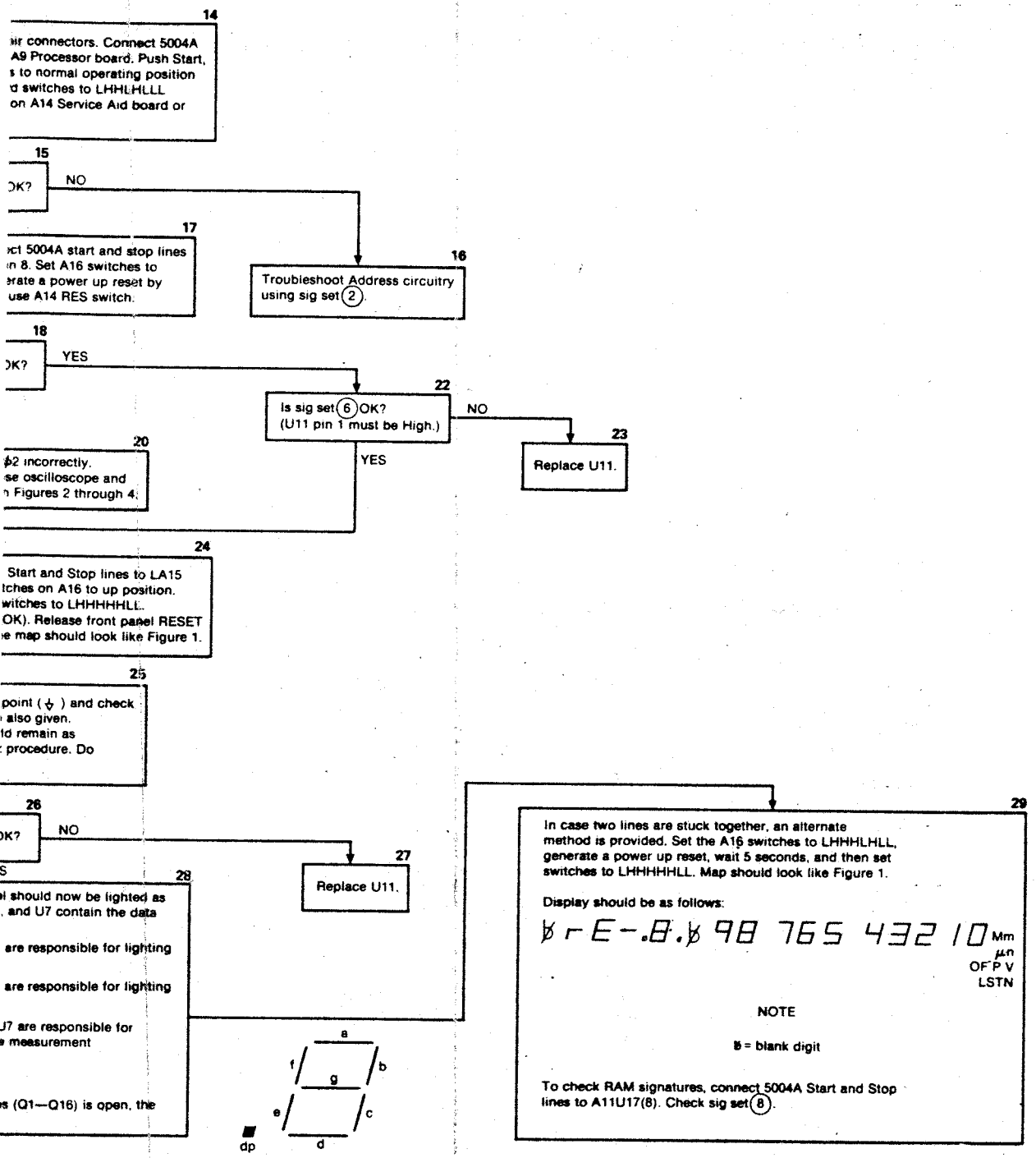
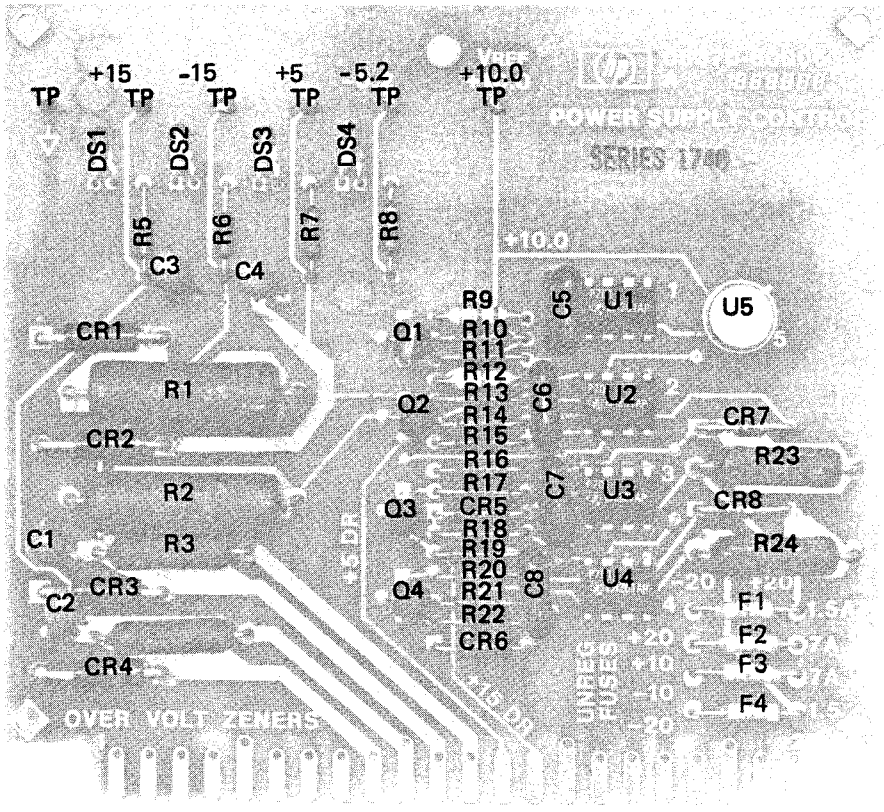
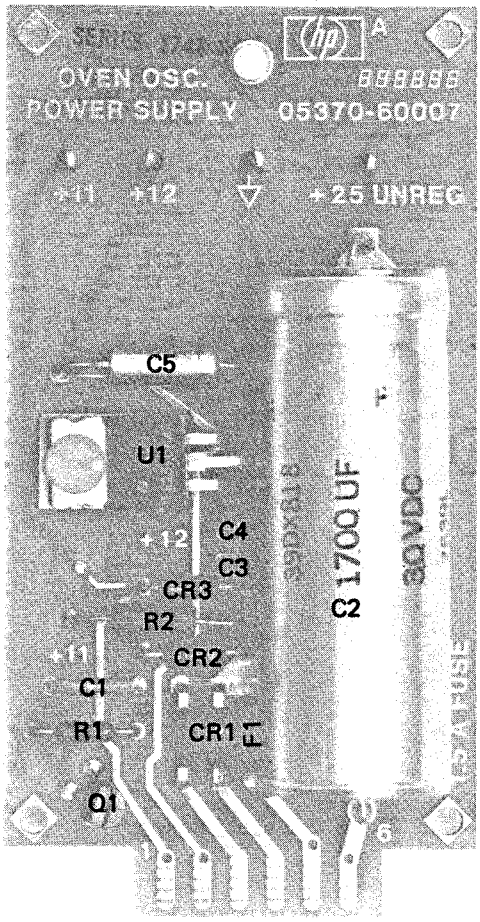


Figure 8-9. A11 Assembly Troubleshooting Flowchart


+15
-15
+5
-5.2
+10.0
TP
DS1
DS2
DS3
DS4
R5
R6
R7
R8
C3
C4
CR1
R1
CR2
R2
C1
R3
CR3
C2
CR4
OVER VOLT ZENERS
Q1
Q2
Q3
Q4
R9
R10
R11
R12
R13
R14
R15
R16
R17
CR5
R18
R19
R20
R21
R22
CR6
C5
C6
C7
C8
U1
U2
U3
U4
U5
CR7
R23
CR8
R24
F1
F2
F3
F4


OVEN OSC.
POWER SUPPLY
05370-60007
+11
+12
+25 UNREG
C5
U1
+12
C4
C3
CR3
R2
C2
+11
CR2
C1
R1
CR1
F1
Q1
1700 UF
50 VDC

A7

ig set

(1)

Data Lines	SIG
P1A(3)	H9A4
P1A(4)	A526
P1A(5)	98F7
P1A(6)	5A33
P1A(7)	FHPH
P1A(8)	413F
P1A(9)	1C42
P1A(10)	20F1

(2)

U13 Inputs	SIG
pin 10	486C
pin 12	9UP2
pin 13	HIGH
pin 15	HIGH
pin 9	LOW
pin 11	LOW
pin 14	HIGH
pin 1	HIGH

(3) With all ROMs installed

ROM Outputs	SIG
U1(9)	2445
U1(10)	F235
U1(11)	0112
U1(13)	41U1
U1(14)	F2HC
U1(15)	HC3P
U1(16)	71U4
U1(17)	UUAA

(4)

TP1	U219 (U12 pin 15)
TP2	7CA1 (U12 pin 14)
TP3	P254 (U12 pin 13)
TP4	2756 (U12 pin 12)
TP5	CU29 (U12 pin 11)
TP6	59C9 (U12 pin 10)
TP7	98H1 (U12 pin 9)
TP8	32U8 (U12 pin 7)

(5)

U1(9)	7CF4
U1(10)	6744
U1(11)	U7PF
U1(13)	7FH4
U1(14)	1APU
U1(15)	7571
U1(16)	68C4
U1(17)	5827

(6)

U2(9)	807H
U2(10)	C178
U2(11)	3PU6
U2(13)	0F4P
U2(14)	7755
U2(15)	7H72
U2(16)	2UU8
U2(17)	5AP7

(7)

U3(9)	519F
U3(10)	H27A
U3(11)	2P28
U3(13)	36AU
U3(14)	711U
U3(15)	0UAF
U3(16)	CUHA
U3(17)	8571

(8)

U4(9)	U046
U4(10)	HA17
U4(11)	U7C0
U4(13)	43P6
U4(14)	1P87
U4(15)	H9FH
U4(16)	06H4
U4(17)	0A19

(9)

U5(9)	CFA0
U5(10)	C0U5
U5(11)	0807
U5(13)	FCA4
U5(14)	H479
U5(15)	9PUP
U5(16)	A38P
U5(17)	99H9

(10)

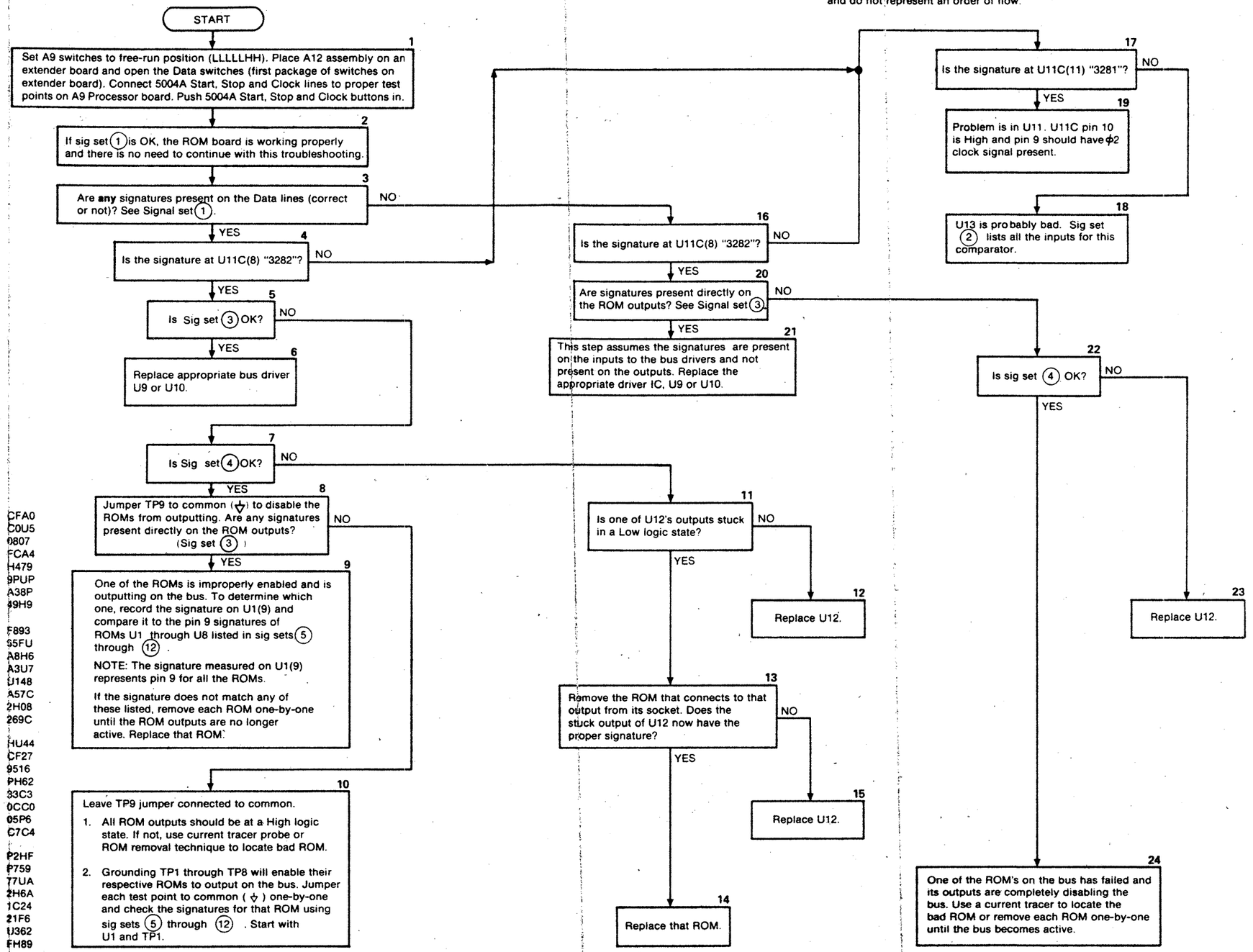
U6(9)	F893
U6(10)	95FU
U6(11)	A8H6
U6(13)	A3U7
U6(14)	U148
U6(15)	A57C
U6(16)	2H08
U6(17)	269C

(11)

U7(9)	HU44
U7(10)	CF27
U7(11)	9516
U7(13)	PH62
U7(14)	33C3
U7(15)	0CC0
U7(16)	05P6
U7(17)	C7C4

(12)

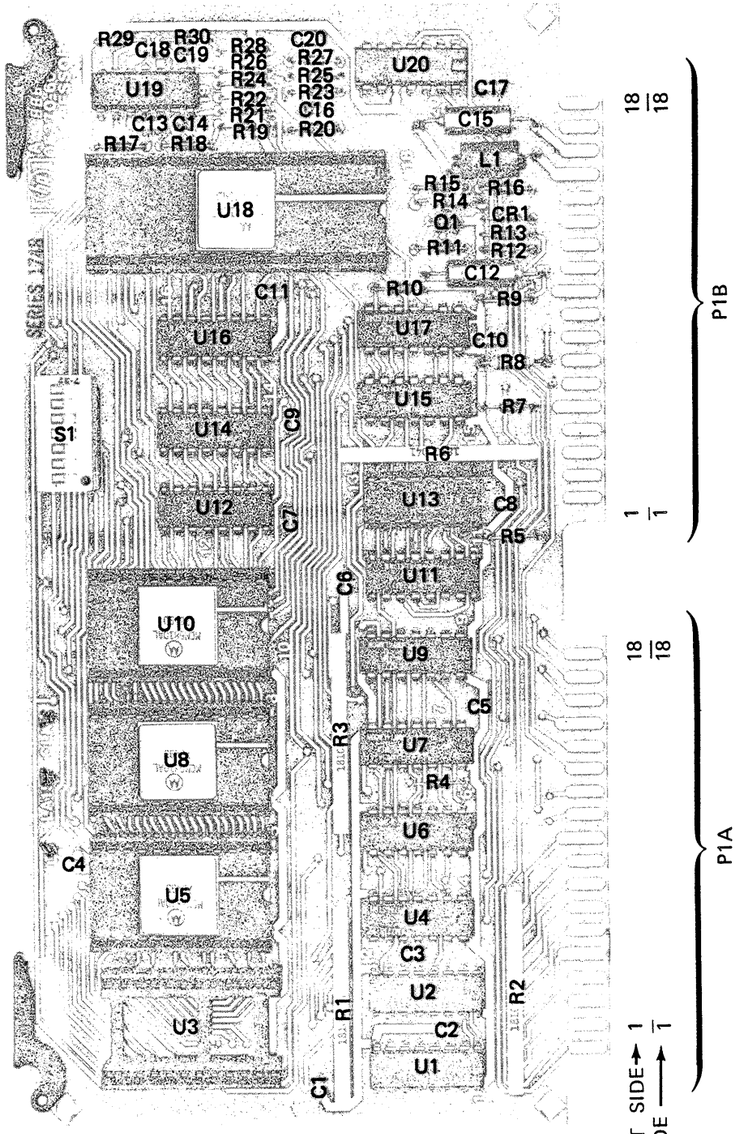
U8(9)	P2HF
U8(10)	P759
U8(11)	77UA
U8(13)	2H6A
U8(14)	1C24
U8(15)	21F6
U8(16)	U362
U8(17)	FH89



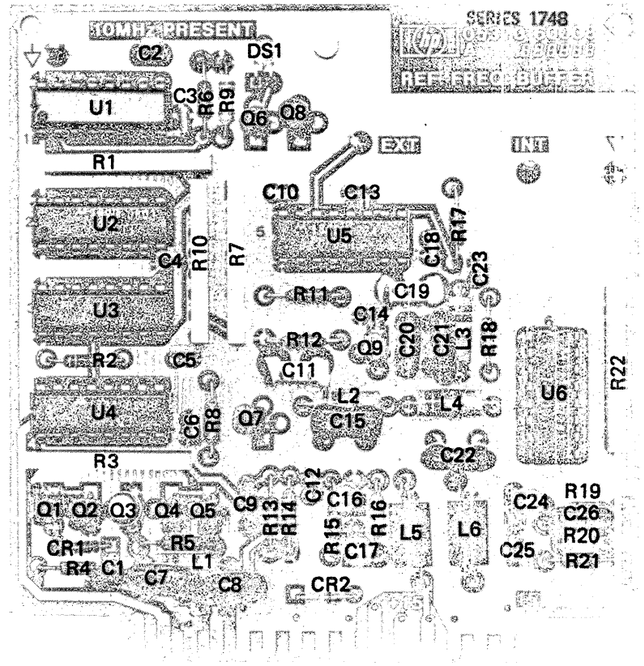
NOTE

The numbered corners at top of each block are for reference purposes and do not represent an order of flow.

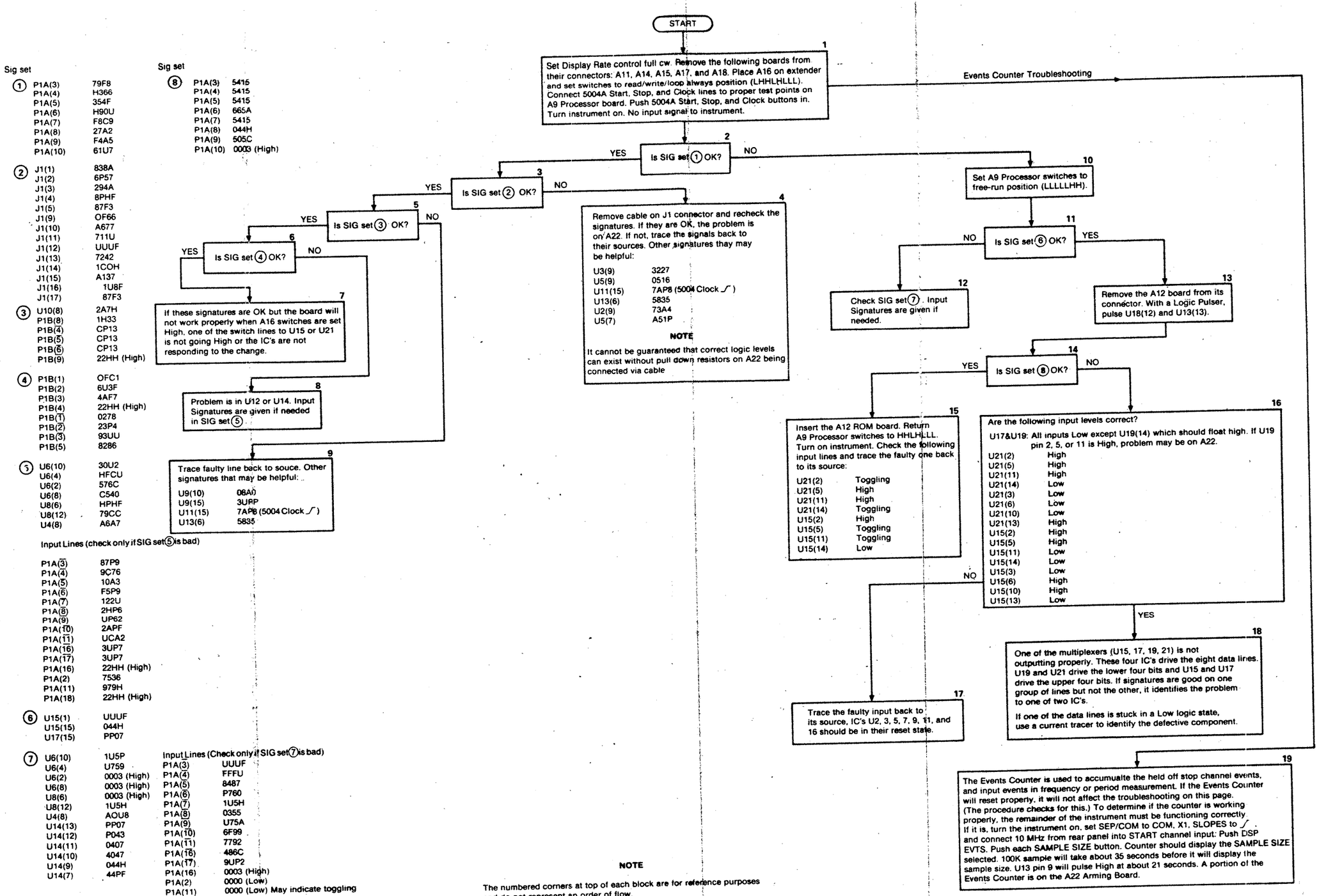
Figure 8-10. A12 Assembly Troubleshooting Flowchart


R29
C18
R30
C19
R28
R26
R24
R22
R21
C20
R27
R25
R23
C16
R19
R20
U19
C13
C14
R17
R18
U20
C17
C15
L1
R15
R16
R14
CR1
Q1
R13
R11
R12
C12
U18
C11
R10
R9
U16
U17
C10
R8
U15
R7
S1
U14
C9
R6
U12
U13
C8
C7
R5
U11
C6
U10
U9
C5
R3
U8
U7
R4
U6
C4
U5
U4
C3
U2
R2
R1
U3
C2
U1
C1
18/18
1/1
P1B
P1A
COMPONENT SIDE → 1
CIRCUIT SIDE → 1
SERIES 1748

A9


10MHz PRESENT
SERIES 1748
REFERENCE BUFFER
C2
DS1
U1
C3
R6
R9
Q6
Q8
EXT
INT
R1
C10
C13
U2
U5
C4
R10
R7
C18
R17
C23
R11
C19
U3
C14
R12
Q9
C20
C21
L3
R18
R2
C5
C11
L2
L4
U6
R22
U4
C6
R8
Q7
C15
R3
C22
Q1
Q2
Q3
Q4
Q5
C9
R13
R14
C12
C16
R16
C24
R19
C26
R20
R15
L5
L6
C25
R21
CR1
R5
C17
R4
C1
C7
L1
C8
CR2

A8



Sig set

① P1A(3) 79F8
P1A(4) H366
P1A(5) 354F
P1A(6) H90U
P1A(7) F8C9
P1A(8) 27A2
P1A(9) F4A5
P1A(10) 61U7

② J1(1) 838A
J1(2) 6P57
J1(3) 294A
J1(4) 8PHF
J1(5) 87F3
J1(9) OF66
J1(10) A677
J1(11) 711U
J1(12) UUUF
J1(13) 7242
J1(14) 1COH
J1(15) A137
J1(16) 1U8F
J1(17) 87F3

③ U10(8) 2A7H
P1B(8) 1H33
P1B(4) CP13
P1B(5) CP13
P1B(6) CP13
P1B(9) 22HH (High)

④ P1B(1) OFC1
P1B(2) 6U3F
P1B(3) 4AF7
P1B(4) 22HH (High)
P1B(1) 0278
P1B(2) 23P4
P1B(3) 93UU
P1B(5) 8286

⑤ U6(10) 30U2
U6(4) HFCU
U6(2) 576C
U6(8) C540
U8(6) HPHF
U8(12) 79CC
U4(8) A6A7

Input Lines (check only if SIG set ⑤ is bad)

P1A(3) 87P9
P1A(4) 9C76
P1A(5) 10A3
P1A(6) F5P9
P1A(7) 122U
P1A(8) 2HP6
P1A(9) UP62
P1A(10) 2APF
P1A(11) UCA2
P1A(16) 3UP7
P1A(17) 3UP7
P1A(16) 22HH (High)
P1A(2) 7536
P1A(11) 979H
P1A(18) 22HH (High)

⑥ U15(1) UUUF
U15(15) 044H
U17(15) PP07

⑦ U6(10) 1U5P
U6(4) U759
U6(2) 0003 (High)
U6(8) 0003 (High)
U8(6) 0003 (High)
U8(12) 1U5H
U4(8) AOU8
U14(13) PP07
U14(12) P043
U14(11) 0407
U14(10) 4047
U14(9) 044H
U14(7) 44PF

Input Lines (Check only if SIG set ⑦ is bad)

P1A(3) UUUF
P1A(4) FFFU
P1A(5) 8487
P1A(6) P760
P1A(7) 1U5H
P1A(8) 0355
P1A(9) U75A
P1A(10) 6F99
P1A(11) 7792
P1A(16) 486C
P1A(17) 9UP2
P1A(16) 0003 (High)
P1A(2) 0000 (Low)
P1A(11) 0000 (Low) May indicate toggling
P1A(18) 0003 (High)

Sig set

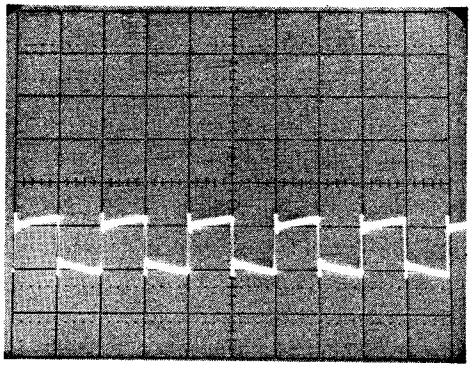
⑧ P1A(3) 5415
P1A(4) 5415
P1A(5) 5415
P1A(6) 665A
P1A(7) 5415
P1A(8) 044H
P1A(9) 505C
P1A(10) 0003 (High)

NOTE

The numbered corners at top of each block are for reference purposes and do not represent an order of flow.

Figure 8-11. A16 Assembly Troubleshooting Flowchart

0V



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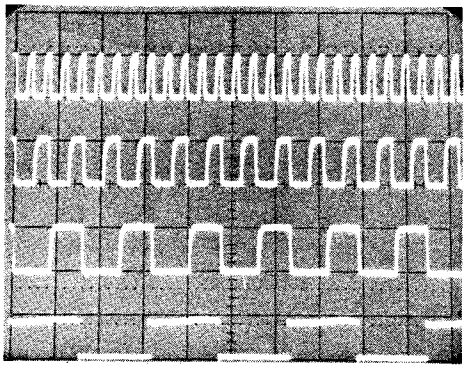
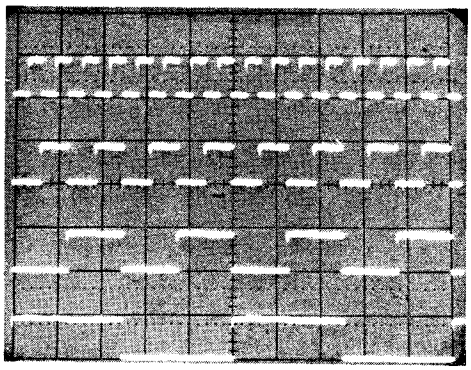
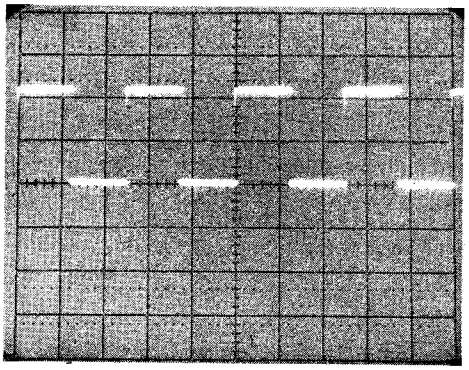


2

A
B
C
D

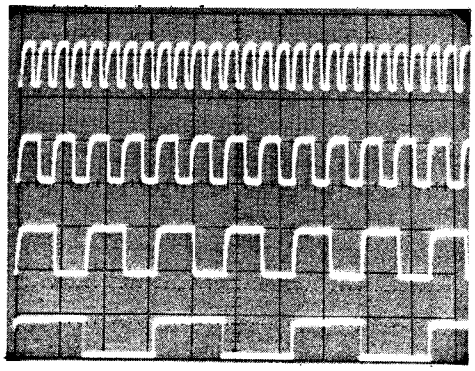


3



4

A
B
C
D



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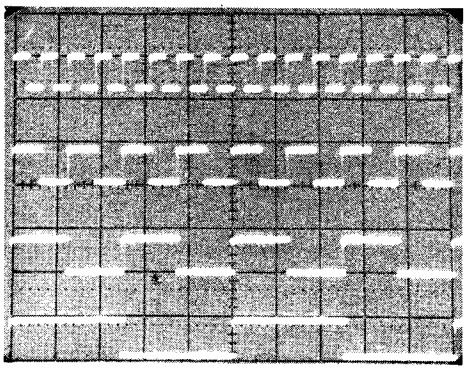
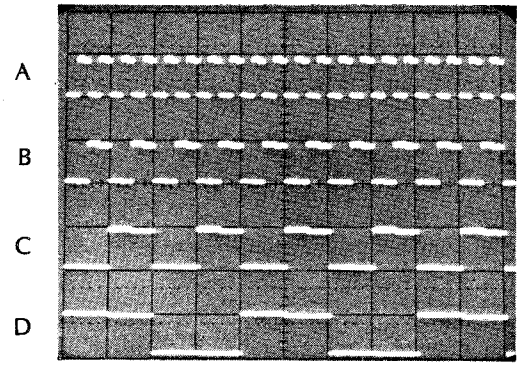
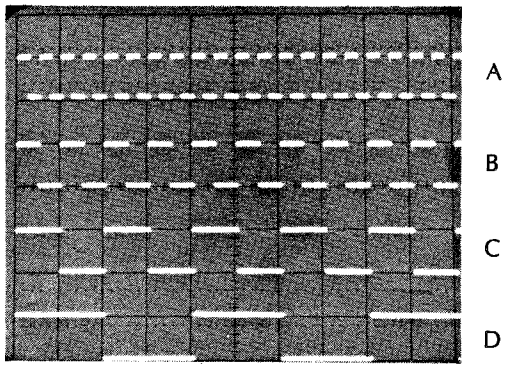


6

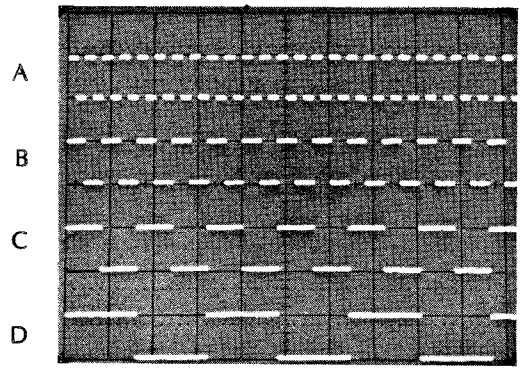
Part of Figure 8-12. A17 Assembly Troubleshooting Flowchart



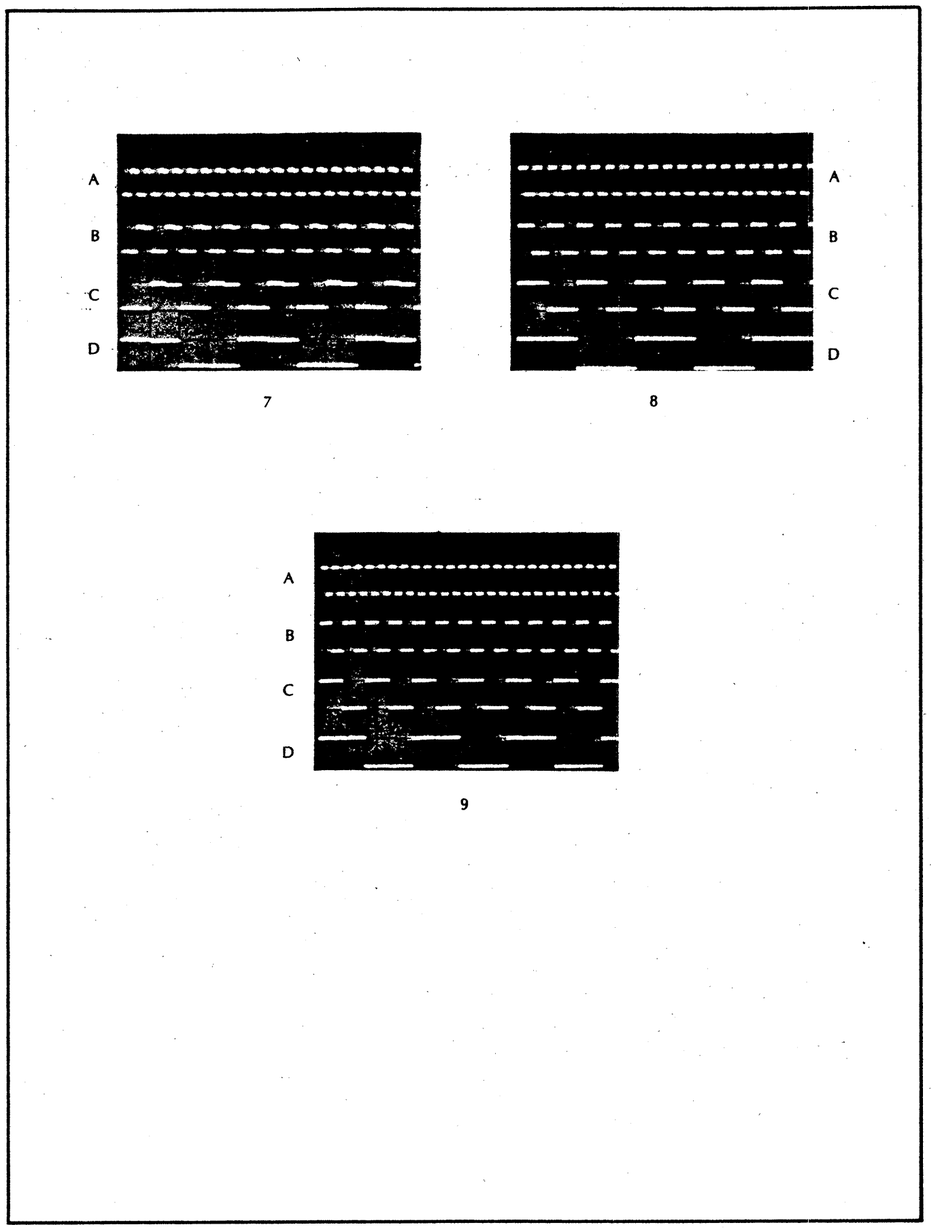
7



8



9



NOTE

Before *changing any part, it is advisable to pulse U14(9) and/or U1(14) and recheck the signature.* (Noise pulses generated by probing or movement of electrical connections can affect the counter circuits

Sig set:

① U12(4) 2U1H
U12(7) P17U
U12(9) 5PC3
U12(12) 6570

② U12(2), 556H
U12(5) 9C0U
U12(11) 24F3
U12(14) 1U00

③ U8(4) 8299
U8(7) 1U1A
U8(9) 2H8H
U8(12) FU73

④ U8(2) U8P9
U8(5) 656A
U8(11) 57UH
U8(14) C503

⑤ U12(4) 8114
U12(7) 0AH2
U12(9) 4499
U12(12) 81UH

⑥ U12(3) UC64
U12(6) 70A2
U12(10) 3PP9
U12(13) UC8H

⑦ U15(6) AP09
U15(2) 61HF

NOTES

1. The numbered corners at the top of each block are for reference purposes and do not represent an order of flow.
2. The counter circuits on the left of the schematic are ECL. Most of the level translation is done with the aid of resistor circuits. The translation is not complete until the signal has passed through the entire circuit.
3. Most the the figures in this procedure show waveforms on a four-channel oscilloscope. The purpose is to show the timing relation. This is not necessary in troubleshooting. Waveforms may be examined individually for proper amplitude and period

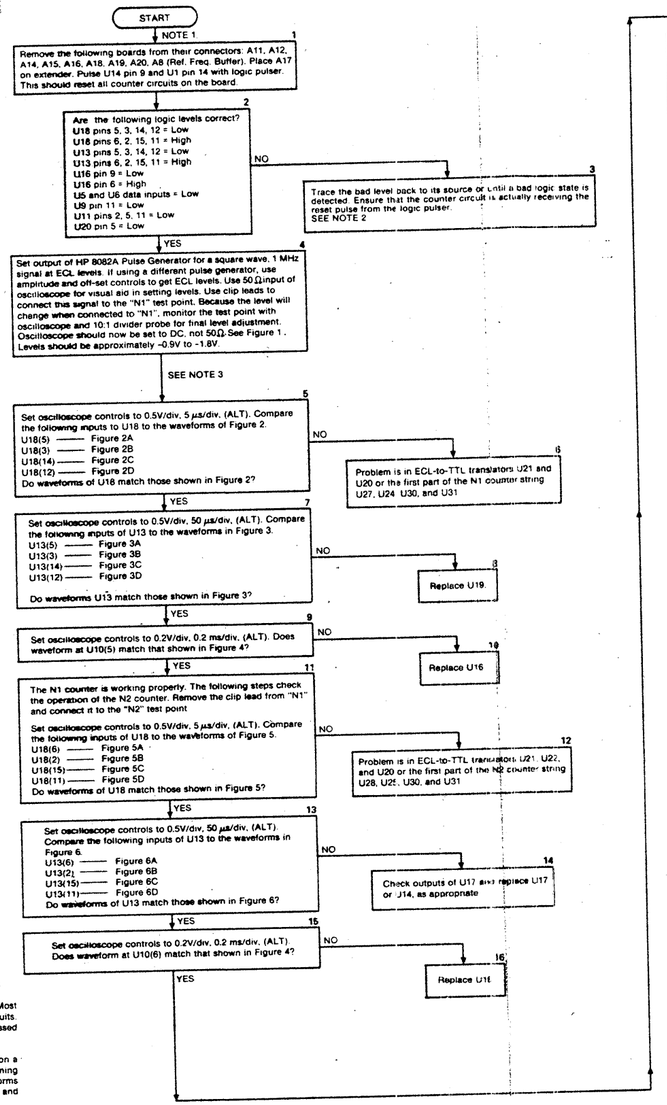


Figure 8-12. A17 Assembly Troubleshoot

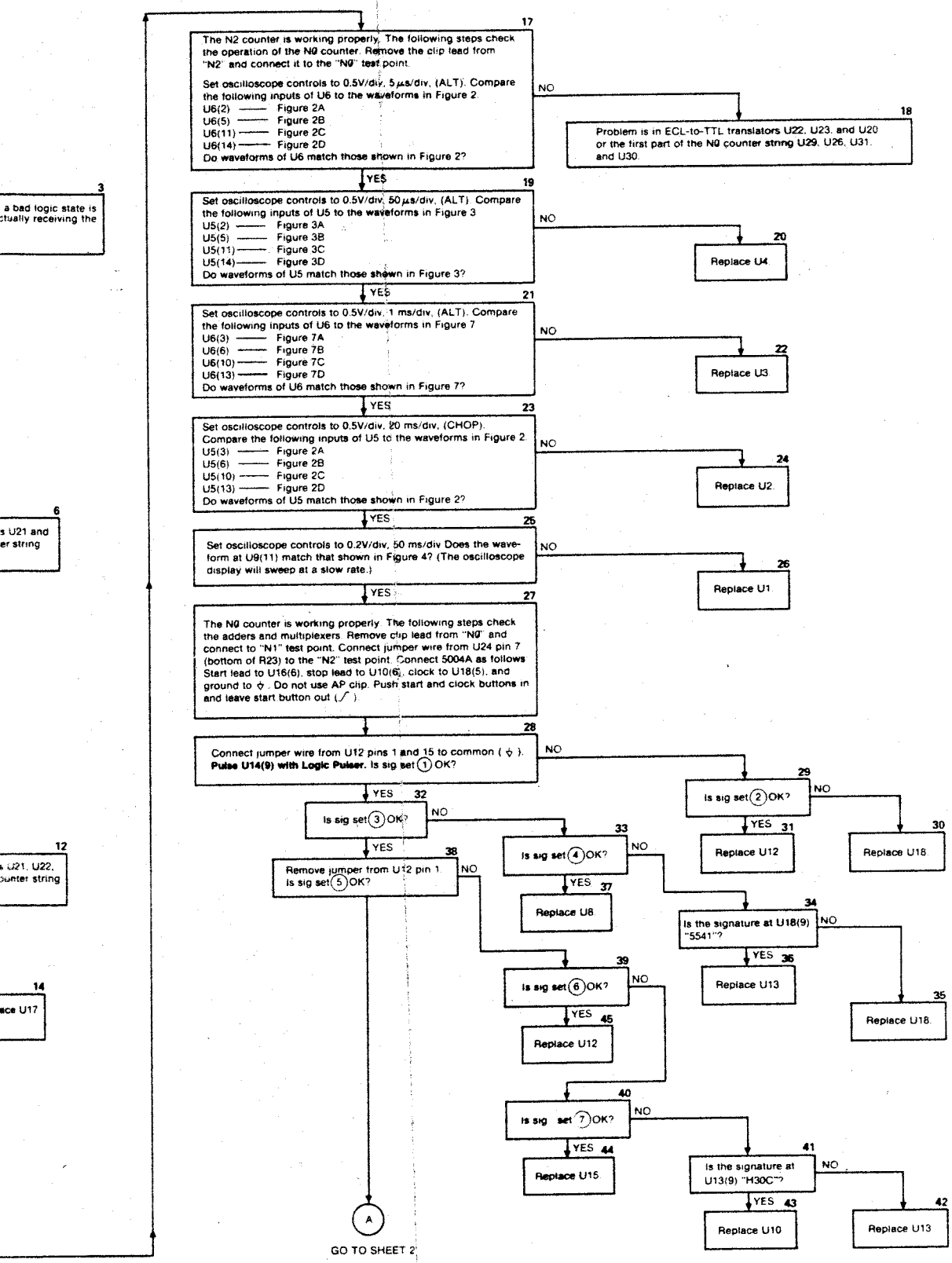
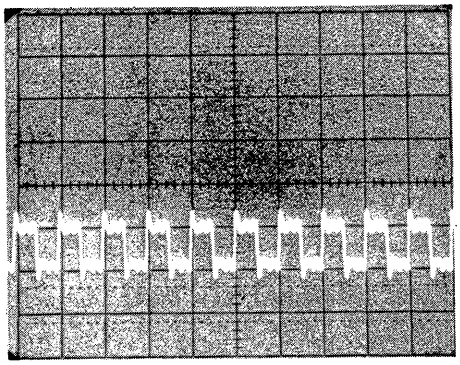


Figure 8-12. A17 Assembly Troubleshooting Flowchart (Sheet 1 of 2)

USE 10 DIVIDER PROBE

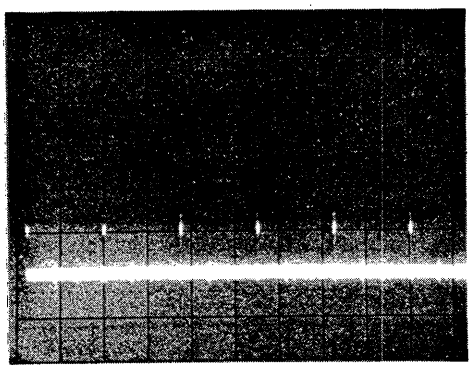
0.1V/div., 0.1 μs/div.

U5D(12)



1

0.1V/div., 20 μs/div.

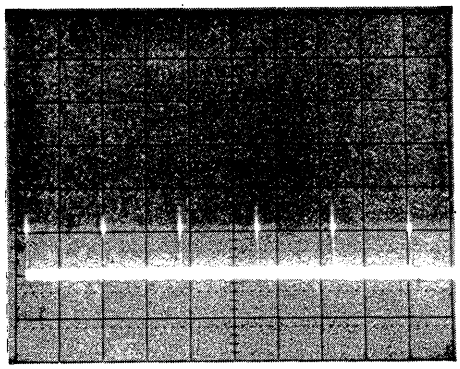


U4A(7)

2

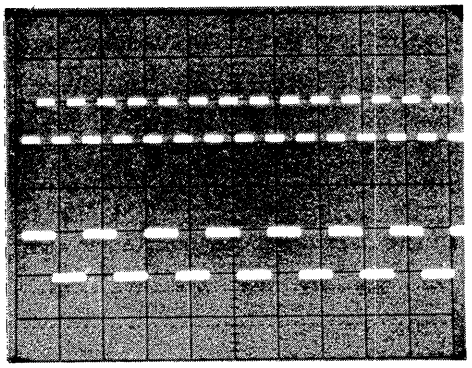
0.1V/div., 20 μs/div.

U5D(13)



3

0.1V/div., 01. ms/div.

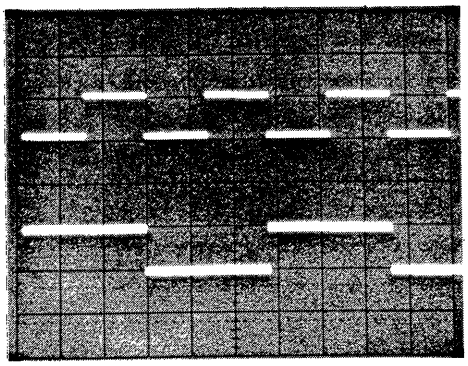


U3A(2)

U4B(15)

4

0.1V/div., 0.1 ms/div.



U2B(15)

U2A(2)

5

8-78

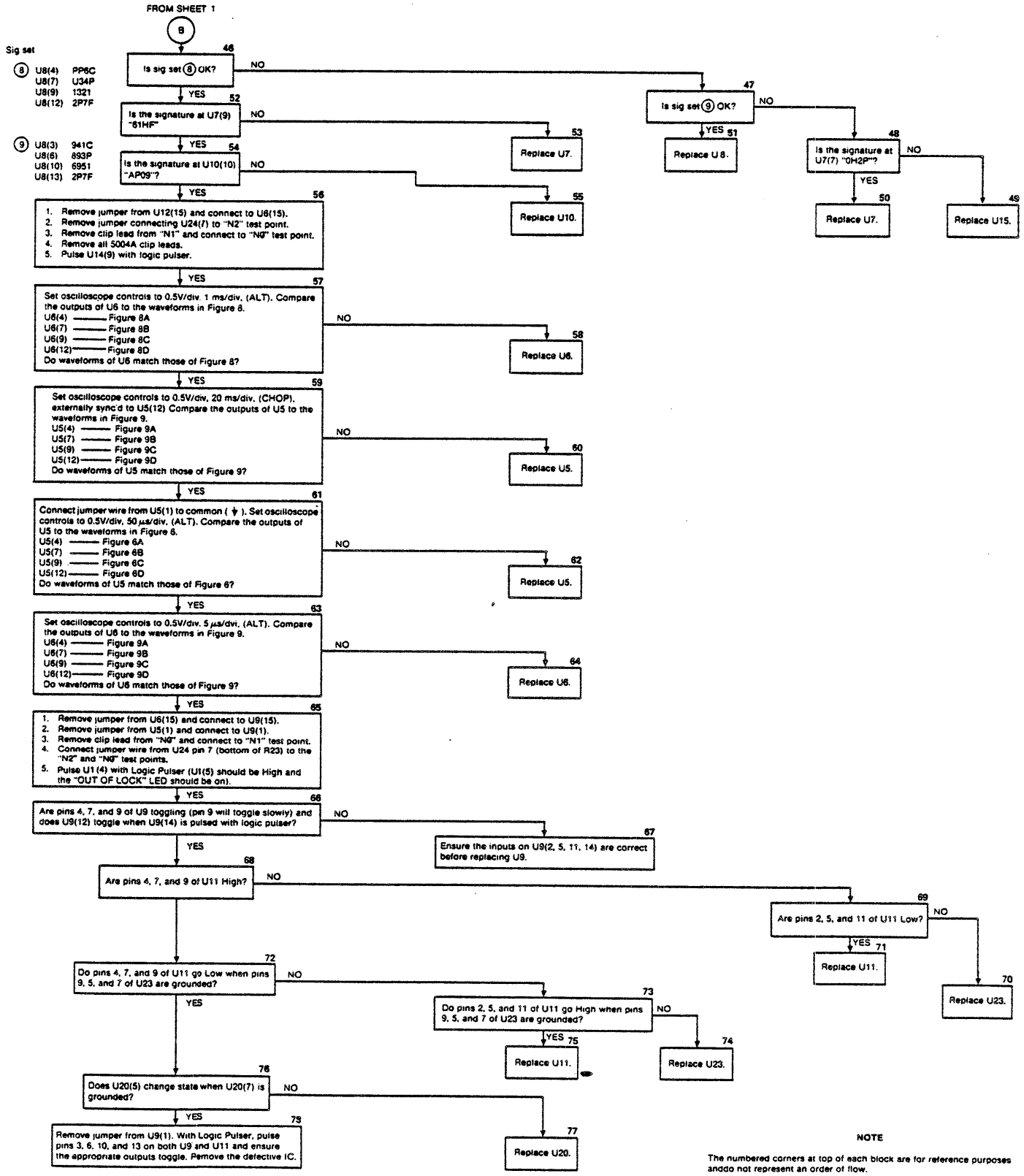


Figure 8-12. A17 Assembly Troubleshooting Flowchart
(Sheet 2 of 2)

8-270. A18 DAC/NØ LOGIC TROUBLESHOOTING

8-271. This board is divided into two main parts: the DAC section and the NØ Logic section. With the exception of U10, the DAC section is used only when the TRIG LVL button is pushed or when the DAC is remotely programmed to directly control the input amplifier circuits, including trigger level. The NØ logic, however, is always used during frequency, period, and time interval measurements.

8-272. DAC Circuit Troubleshooting

8-273. Begin troubleshooting the DAC section by placing the A16 Arming Interface service switches to the write/loop-always position (LHHHHLLL). Set up a 5004A Signature Analyzer. Generate a power-up reset and check for the following signatures. On the 5004A, push the Start, Stop, and Clock buttons in. Connect pod leads to A9 test points with Start, Stop leads going to the "LA15" test point. Replace any IC with a bad signature.

U5(11)	H245	U2(11)	5390	U6(11)	CF07	U3(11)	07CH
U5(6)	A310	U2(6)	H3C3	U6(6)	74U4	U3(6)	AU05
U5(14)	9190	U2(14)	0432	U6(14)	F0FH	U3(14)	74U0
U5(3)	08H3	U2(3)	C2A2	U6(3)	95AP	U3(3)	19AC
		U2(9)	686F			U3(9)	77U3
U7(11)	HF4A	U4(11)	764U	U1(1)	5616 (High)		
U7(6)	2A2P	U4(6)	7587				
U7(14)	5616 (High)	U4(7)	2391				
U7(3)	9138	U4(14)	28CC				
U7(9)	17H8	U4(3)	F026				

The following input signatures are given, if needed.

P1A(1)	U95A
P1A(2)	A267
P1A(3)	FCA5
P1A(4)	H49A
P1A(5)	8A53
P1A(6)	A8H6
P1A(7)	1342
P1A(8)	FPU1

8-274. Use the DAC adjustment procedure, *Table 5-1*, to troubleshoot the remainder of the DAC circuit. If the levels are significantly in error, the DAC, current source transistor, or operational amplifier for that channel is faulty. If when the A16 service switch is in its normal position (all up) the front panel trigger level readout is jumpy as the LEVEL pot is turned, it is an indication that the DAC for that channel is bad or the LEVEL pot is bad. (K1 should be open unless trigger levels are remotely programmed.) TP5 and TP4 should be continuously variable from -1.3V to +0.5V dc. If all the above checks properly, the problem is in U11 operational amplifier or U1 output buffer.

8-275. NØ Logic State Troubleshooting For +T.I. Only Arming

8-276. With all boards installed and no input signal, set both SLOPE switches to the $\_f^-$ position and turn power on. The circuit should be static and set to the following ECL logic states (H=-0.7V, L=-1.4V). Use oscilloscope with at least 200 MHz bandwidth.

U17(2)	Low	U16(3)	Low	TP8	200 MHz
U17(3)	High	U16(15)	High	TP9	Low
U17(15)	Low	U18(2)	High	TP10	200 MHz
U17(14)	High	U18(3)	Low	TP11	High
U16(2)	Low				

8-277. Place oscilloscope probe on TP9. Push the start channel slope switch down and then up. This action should set the flip-flops such that NØ pulses (200 MHz) are present at TP9. If NØ pulses are present, the count chain circuits will overflow after about 10 seconds and an error 02 message will be displayed on the front panel. To repeat the test, push RESET and toggle the start slope switch again, then proceed to the next test. If the NØ pulses are *not* present, check the following static ECL levels during the 10-second period. (One way to overcome the 10-second limitation is to ground TP9.)

U17(2)	High	U16(15)	Low
U17(3)	Low	U18(2)	Low
U17(15)	Low	U18(3)	Low
U17(14)	High	TP9	200 MHz (not grounded)
U16(2)	High	TP11	High
U16(3)	Low		

8-278. Once the start channel has been triggered, using the stop slope switch to trigger, the stop channel will pulse the circuit back to its original state. To check this, set oscilloscope to 2 ms/div. and monitor TP11 while repeating the procedure of using the start and stop slope switches. TP11 should pulse low, although it may not be possible to see it everytime. If the pulse appears at TP11, go on to the +T.I. troubleshooting. However, if the pulse is *not* present, the circuit can be checked statically by the following method: jumper TP11 to common (TP15), push RESET, toggle the start and stop slope switches *once*, check the following points:

U17(2)	High	U16(3)	Low
U17(3)	Low	U16(15)	High
U17(15)	High	U18(2)	Low
U17(14)	Low	U18(3)	High
U16(2)	Low	TP9	Low
		TP12	High

8-279. NØ Logic Static Troubleshooting For +T.I. Arming

8-280. Before beginning this troubleshooting, ensure that the circuit works properly in +T.I. ONLY, then proceed as follows. With all boards installed and no input signal, set both slope switches to the ⨍ position and turn power on. Push +T.I.. If START light comes on, push PERIOD COMPLMNT to get STOP light. Connect oscilloscope of at least 200 MHz bandwidth to TP9 and toggle the stop channel slope switch twice. This action should set the flip-flops such that NØ pulses (200 MHz) are present at TP9. (The pulses may appear after the first toggle of the slope switch.) TP12 should be low for minus sign.

8-281. If the NØ pulses are present, the count chain circuits will overflow after about 10 seconds and an error 02 message will be displayed on the front panel. To repeat the test, push RESET, and toggle the stop slope switch again, then proceed to the next test. If the NØ pulses are *not* present, check the following static ECL levels during the 10-second period. (One way to overcome the 10-second limitation is to ground TP9.)

U17(2)	Low	U16(3)	High
U17(3)	High	U16(15)	Low
U17(15)	High	U18(2)	Low
U17(14)	Low	U18(3)	Low
U16(2)	Low	TP9	200 MHz (not grounded)
		TP12	Low

8-282. Once the stop channel has been triggered, using the start slope switch to trigger the start channel will pulse the circuit back to its original state. To check this, set oscilloscope to 2 ms/div., and monitor TP11 while repeating the procedure using the stop and start slope switches. TP11 should pulse Low, although it may not be possible to see it everytime. If the pulse is *not* present,

the circuit can be checked statically by the following method: jumper TP11 to common, push RESET, toggle the stop and start slope switches as previously mentioned, and check the following points.

U17(2)	High	U16(3)	Low
U17(3)	Low	U16(15)	High
U17(15)	High	U18(2)	Low
U17(14)	Low	U18(3)	High
U16(2)	Low	TP9	Low
		TP12	Low

8-283. A19/A20 START/STOP INTERPOLATOR TROUBLESHOOTING

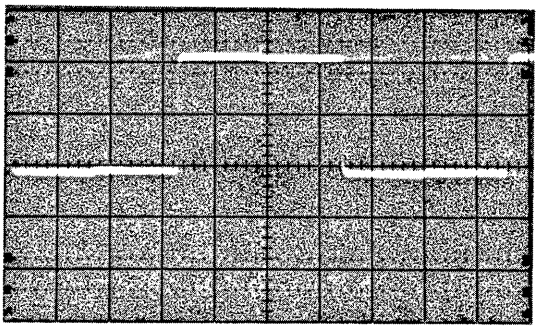
8-284. The A19 and A20 assemblies are identical. This troubleshooting information applies directly to both. Before troubleshooting either assembly, place the defective assembly on an extender board (i.e., 05370-60077 extender board found in the 10870A service accessary kit).

8-285. The first five wave shapes were photographed without a signal applied to the front end and the 5370A power-up conditions set. The remaining photographs were taken with a 10 MHz signal input supplied from the rear panel 10 MHz output jack.

With the 5370A power ON and the defective A19 and A20 assembly on an extender board, observe the following five wave shapes at the designated points:

0.02V/div., 0.2 μs/div.

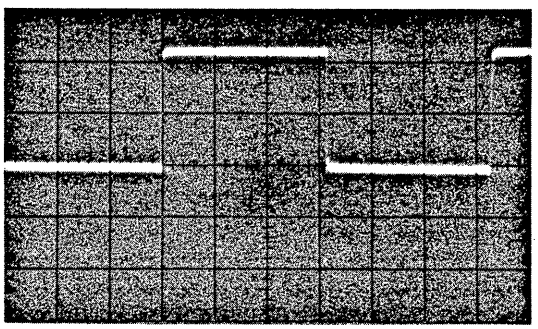
TP9



0V

0.02V/div., 0.2 μs/div.

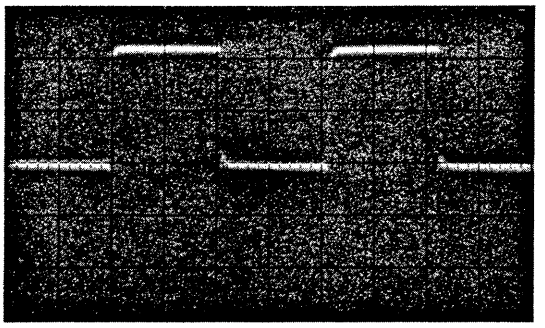
TP10



0V

0.02V/div., 0.1 μs/div.

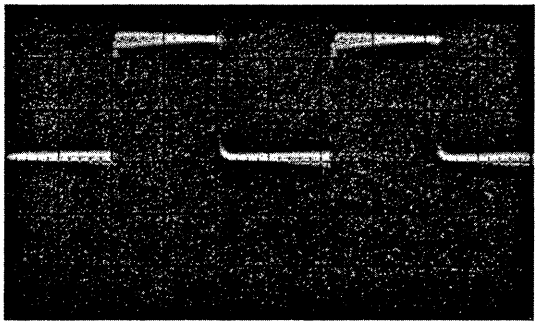
TP11



0V

0.02V/div., 0.1 μs/div.

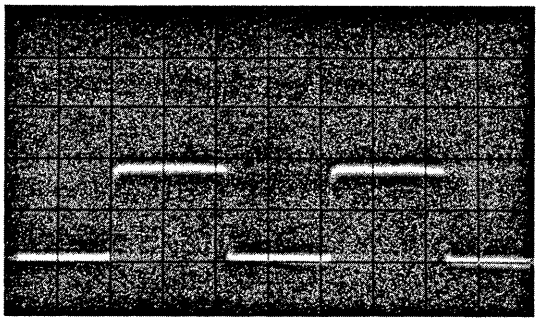
TP6



0V

0.02V/div., 0.1 μs/div.

TP2



0V

To observe the remain wave shapes:

1. Connect a coax cable from the rear panel 10 MHz output to the front panel START input.
2. Set the switches on the A16 Arming Interface assembly as follows:

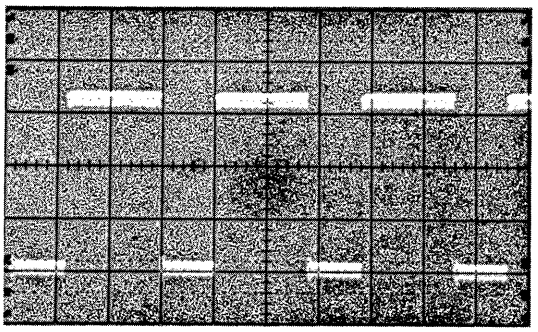
3. Set the 5370A front panel input switches as follows:

BOTH CHANNELS
- IMPEDANCE 50Ω
- ATTENUATION ..... ÷1
- COUPLING ..... DC
- SLOPES ..... ⨍

START COMP/SEP ..... START COM

0.01V/div., 10 μs/div.

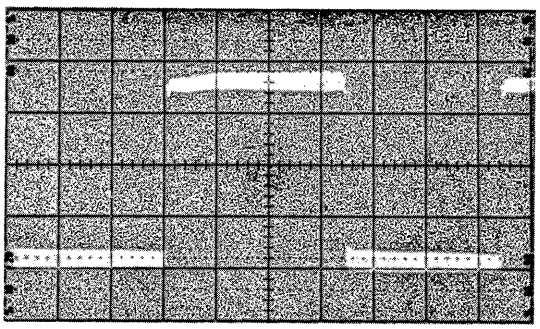
TP1



0V

0.01V/div., 0.2 μs/div.

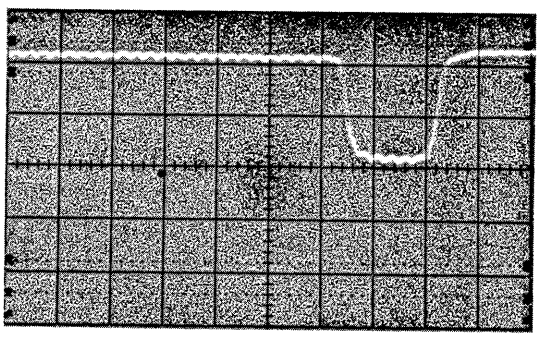
TP2



0V

0.02V/div., 20 ns (delayed sweep)

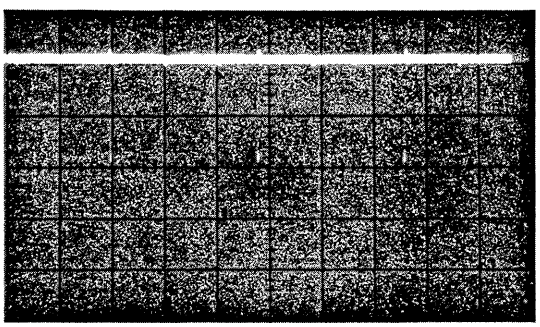
TP3



0V

0.02V/div., 10 μs/div.

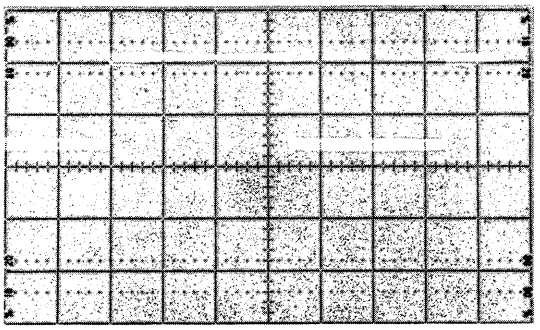
TP3



0V

0.02V/div., 0.2 μs/div.

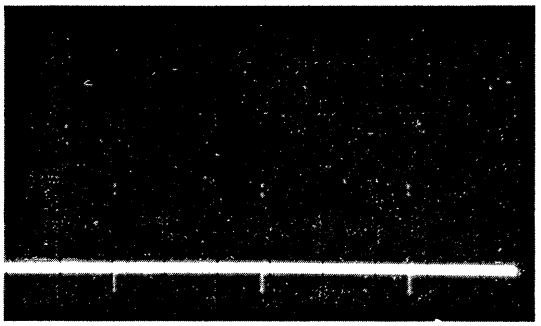
TP4



0V

0.02V/div., 10 μs/div.

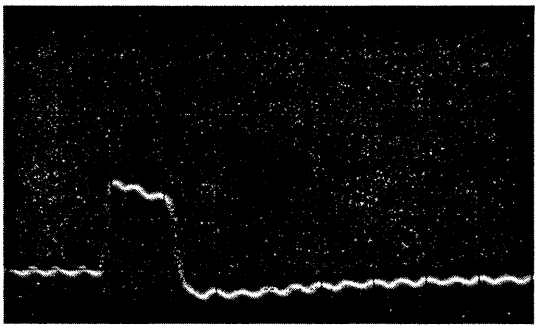
U1(4)



0V

0.02V/div., 10 ns (delayed sweep)

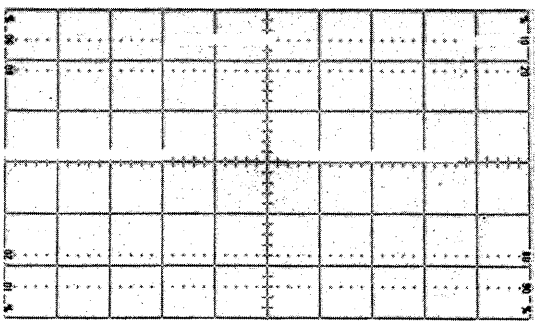
U1(4)



0V

0.02V/div., 5 μs/div.

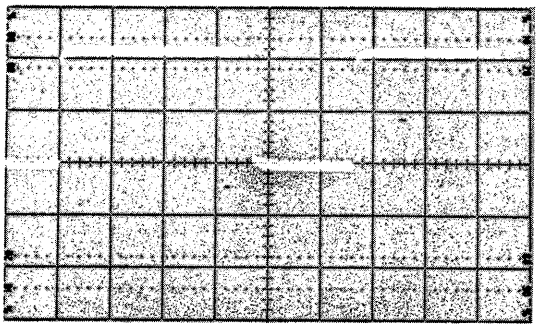
U6(14)



0V

0.02V/div., 5 μs/div.

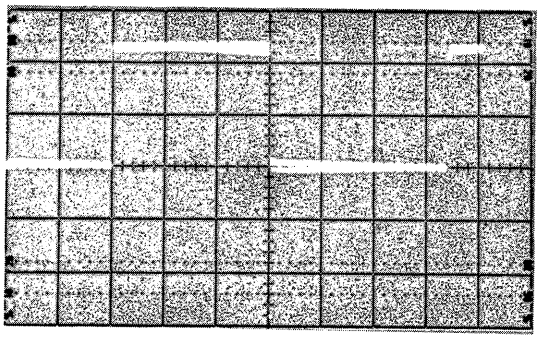
U8(2)



0V

0.02V/div., 0.2 μs/div.

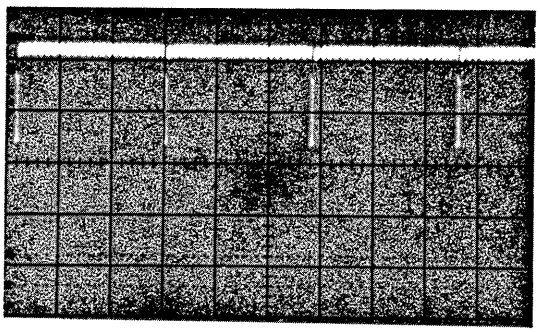
TP6



0V

0.02V/div., 10 μs/div.

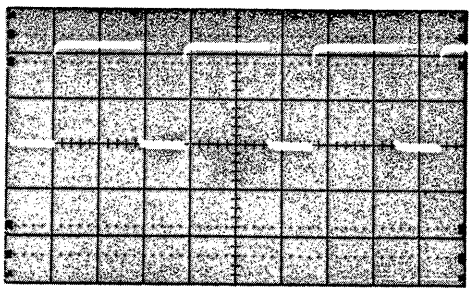
TP7



0V

0.02V/div., 10 μs/div.

TP8



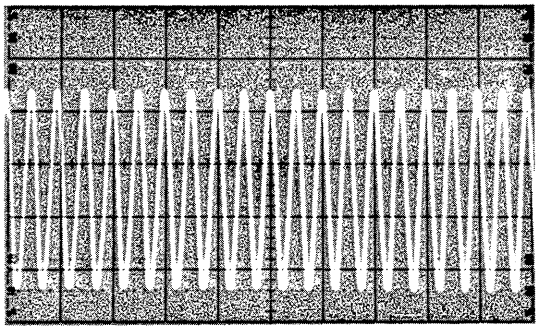
0V

8-286. A21 200 MHz MULTIPLIER TROUBLESHOOTING

8-287. Begin troubleshooting the A21 assembly by placing the assembly on an extender board (i.e., 05370-60077 extender board found in the 10870A service accessory kit). The following five photos show wave shapes which appear at designated points throughout the circuit. All wave shapes were taken using an HP 1720A (275 MHz) oscilloscope and 10020A resistive dividers with a 20:1 tip. No special 5370A front panel setup is necessary.

0.1V/div., 10 ns/div., 50Ω

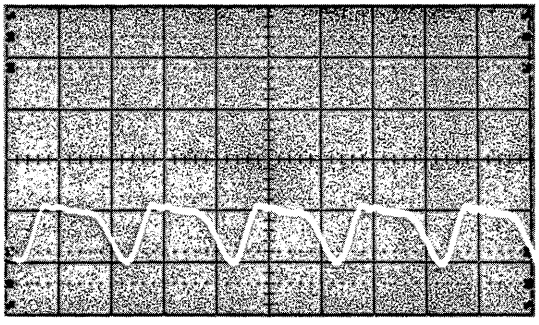
TP1
(200 MHz)



OV

0.1V/div., 10 ns/div., 50Ω

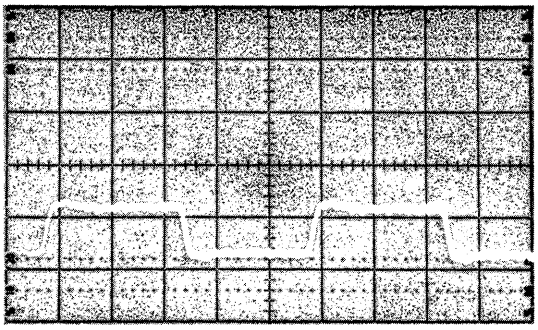
TP2
(50 MHz)



OV

0.05V/div., 20 ns/div.

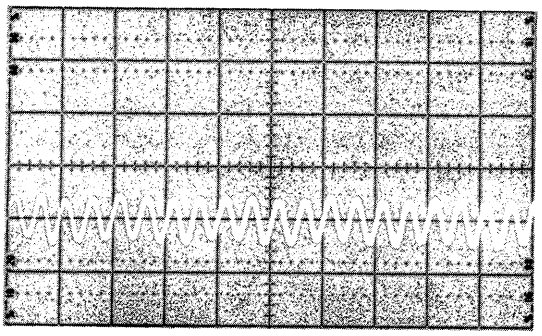
10 MHz INPUT
P1B($\overline{8}$)



OV

0.02V/div., 10 ns/div.

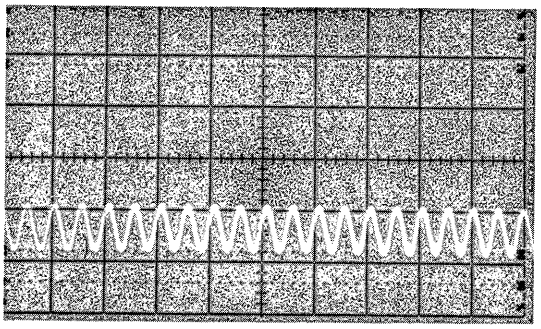
U2A(3, 15)



0V

0.02V/div., 10 ns/div.

200 MHz
U1(14)
U1(2)



0V

The following dc bias voltages for transistors Q1 through Q8 were measured with an HP 3465A Digital Multimeter. They were measured with the 5370A A8 assembly removed.

NOTE

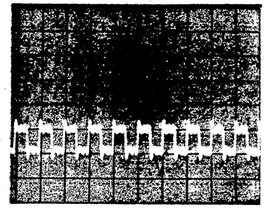
All of the collectors are at ground (0V).

	Base	Emitter
Q1	-14.9V	-15.0V
Q2	-12.0V	-12.7V
Q3	-7.9V	-8.5V
Q4	-8.5V	-9.1V
Q5	-7.6V	-8.2V
Q6	-7.5V	-8.1V
Q7	-7.6V	-8.2V
Q8	-7.5V	-8.1V

USE 10 DIVIDER PROBE

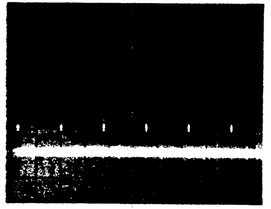
0.1V/div., 0.1 μs/div.

U5D(12)



1

0.1V/div., 20 μs/div.

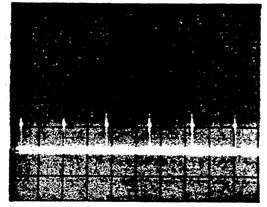


U4A(7)

2

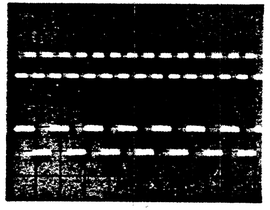
0.1V/div., 20 μs/div.

U5D(13)



3

0.1V/div., 01. ms/div.

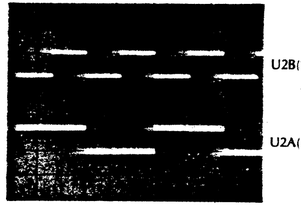


U3A(2)

U4B(15)

4

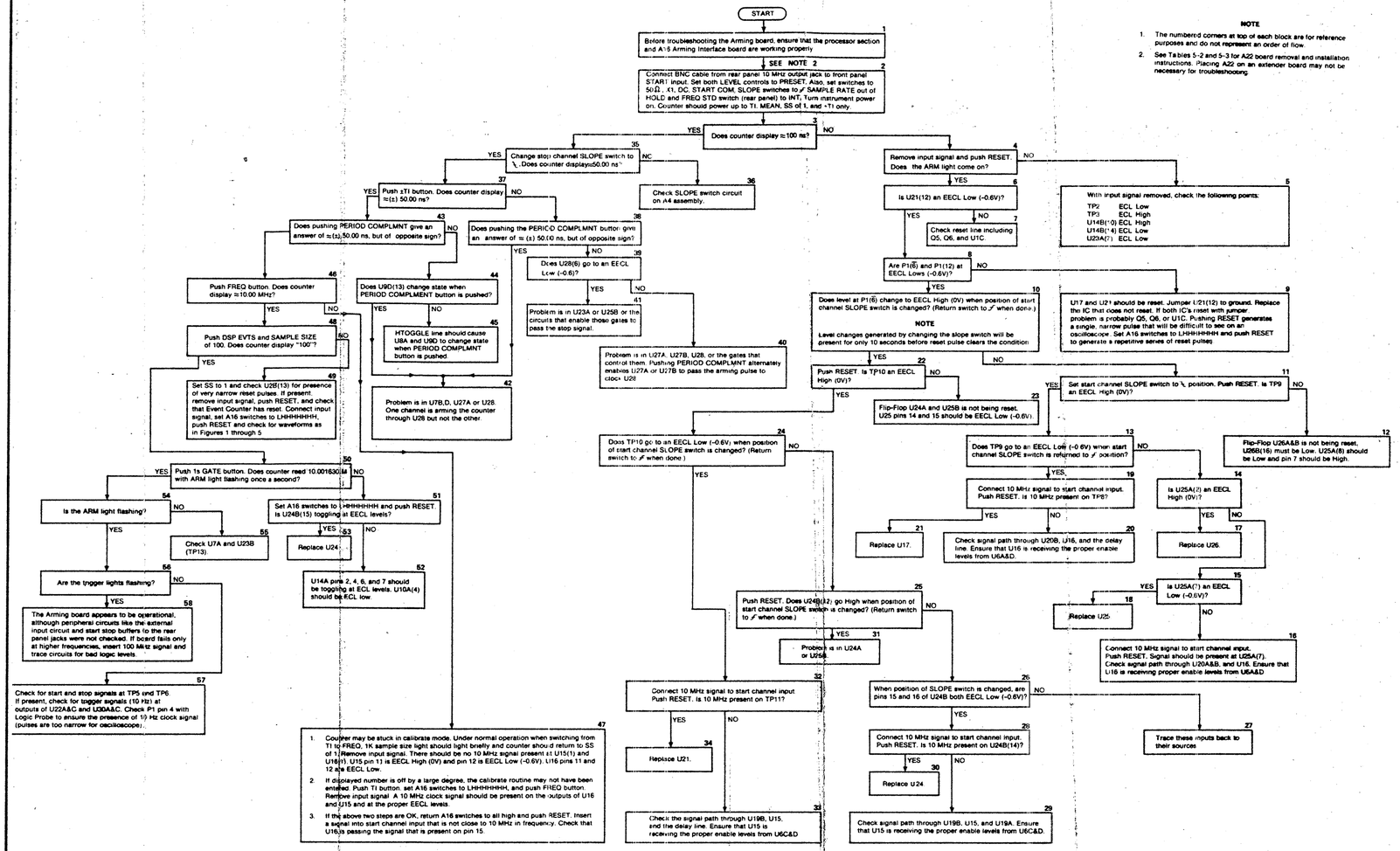
0.1V/div., 0.1 ms/div.



U2B(15)

U2A(2)

5



NOTE

1. The numbered corners at top of each block are for reference purposes and do not represent an order of flow.
2. See Tables 5-2 and 5-3 for A22 board removal and installation instructions. Placing A22 on an extender board may not be necessary for troubleshooting.

Figure 8-13. A22 Assembly Troubleshooting Flowchart

8-288. A23 FRONT PANEL TROUBLESHOOTING

8-289. Digit LED Displays

8-290. There is no circuitry on the front panel board, other than the LEDs themselves, that affect the operation of the display. The control circuitry is found on the A11 Display Interface board.

8-291. To replace a bad display LED, start by sliding the three tabs on the display window to the left. Pull the top of the window forward and lift the window clear. Remove the faulty LED with a pair of IC tongs. The displays are in sockets and are not soldered in.

8-292. Pushbutton Switch LEDs

8-293. As with the digit display LEDs, there is no circuitry on the front panel board that affects the LEDs of the pushbutton switches. The control circuitry is found on the A11 Display Interface board.

8-294. To test for a bad lamp, push the front panel RESET button. All front panel pushbutton lights should now be on. If only one pushbutton LED is out, the LED is bad and should be changed. However, if an entire column (vertical) or row (horizontal) of LEDs is out, the problem is on the A11 Display Interface board.

8-295. Pushbutton Switches

8-296. To check for proper contact closure of the front panel switches, place the A11 Display Interface board on an extender board and check for proper signatures at A11U15 pin 6.

SETUP:

A16 Arming Interface switches to normal position (all up). A9 Processor switches to normal position (HHLHLLL) or to freerun position (LLLLLHH). Connect 5004A Signature Analyzer Clock to A9 CLK test point and Start, Stop to A11U17(8). Push 5004A Start, Stop, and Clock buttons in. Turn 5370A instrument power on.

8-297. Check for signatures at A11U15 pin 6 for each key. If no key is depressed, pin 6 should be Low. If a signature is present, it indicates a key is stuck closed. Compare the signature to those listed to determine in which column the faulty key is located.

5004A Probe at A11U15(6)

Column #1

T.I.
FREQ
1 PERIOD
0.1 s
} 6U86

Column #2

TRIG LVL
PERIOD
0.01s
1 s
} H290

Column #3

MEAN
MIN
DSP REF
DSP EVTS
} U138

Column #4

STD DEV
MAX
CLR REF
SET REF
} C4CF

Column #5

1
1K
100K
MAN RATE
} 69CP

Column #6

100
10K
} 7FUP

Column #7

+T.I. ONLY
EXT HOLDOFF
} 7774

Column #8

±T.I.
PERIOD COMPLMNT
EXT ARM
} 8636

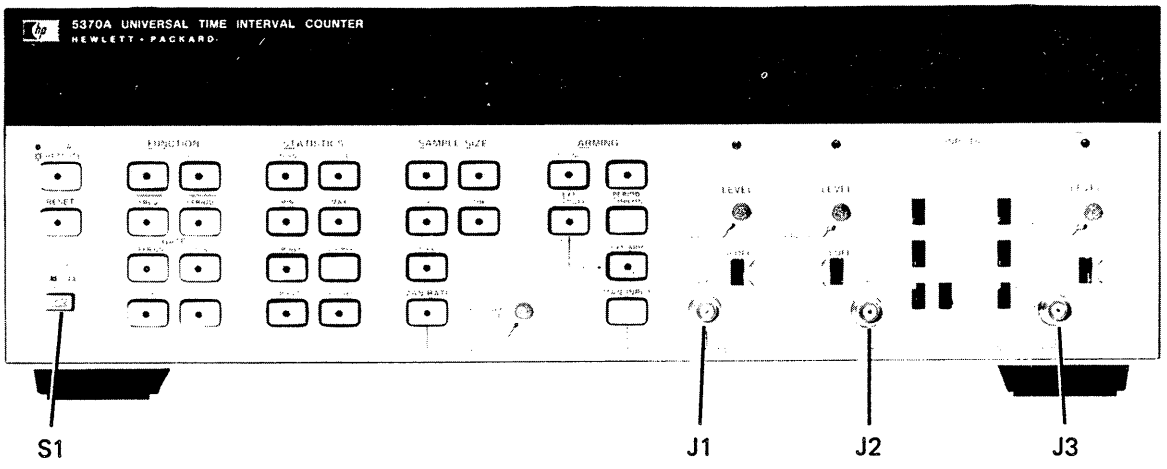
Other Keys

TP	Key	SIG/Logic State
A11U15(6)	RESET	7774
A11J3(10)	LOCAL/REMOTE	Low with Key in
A11J2(9)	MAN INPUT	Low with Key in

8-298. Annunciator LEDs

8-299. If when pushing front panel reset, one of the following annunciators do not light, replace that LED: *, K, evt, M, m, Hz, μ, n, s, OF, p, V, LDTN, TALK.

8-300. The remaining LEDs are driven by circuitry on the A23 Front Panel board. During a power up reset, the Start and Stop LEDs will not light. Once power up reset has finished, the ARM light should be on. Push the ±T.I. button to cause the Start or Stop light to appear. Then push PERIOD COMPLMNT for Stop or Start.



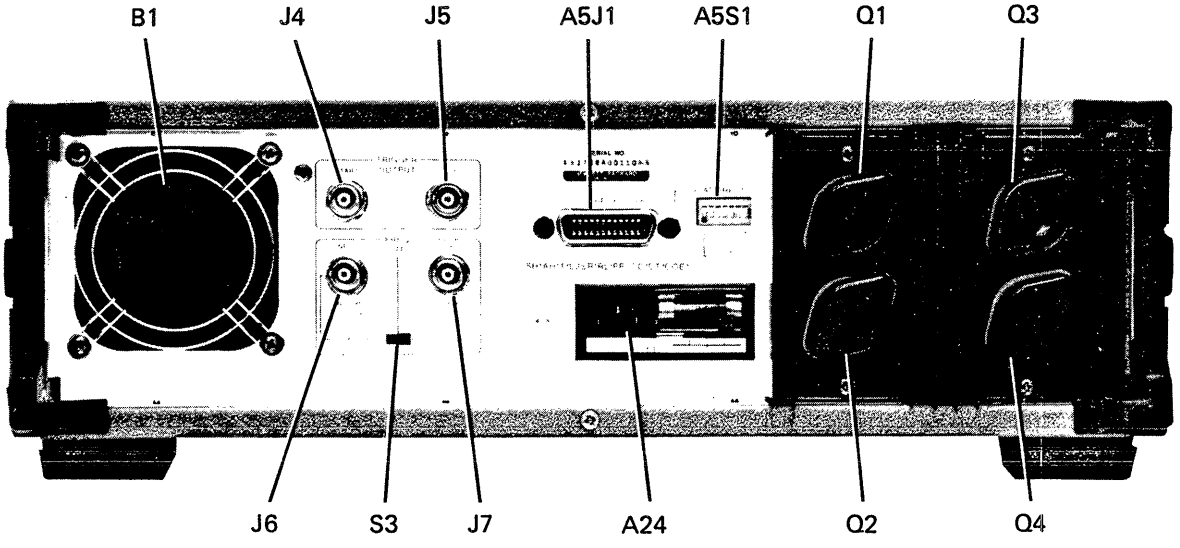


Figure 8-14. Front and Rear Panel Designations

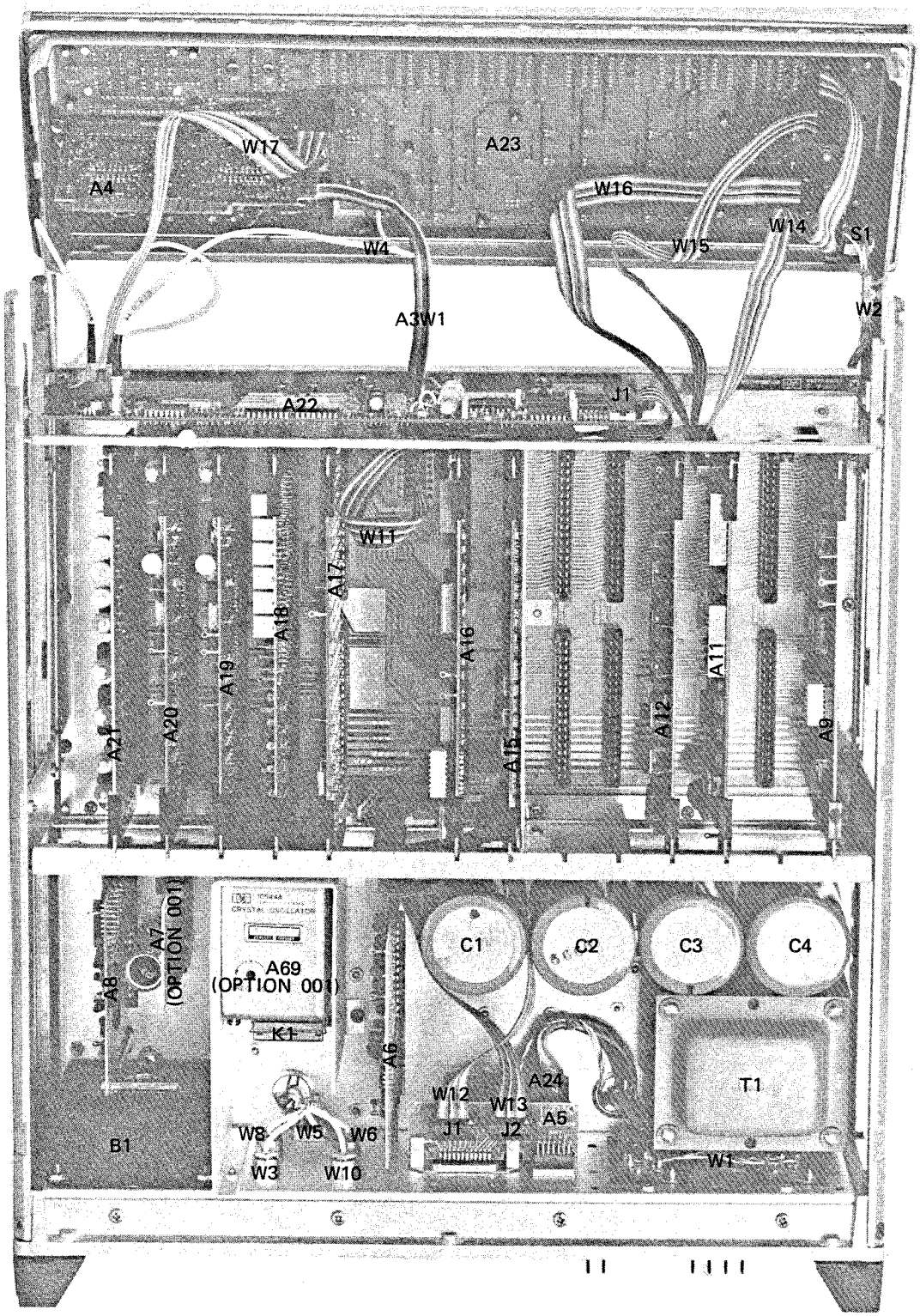
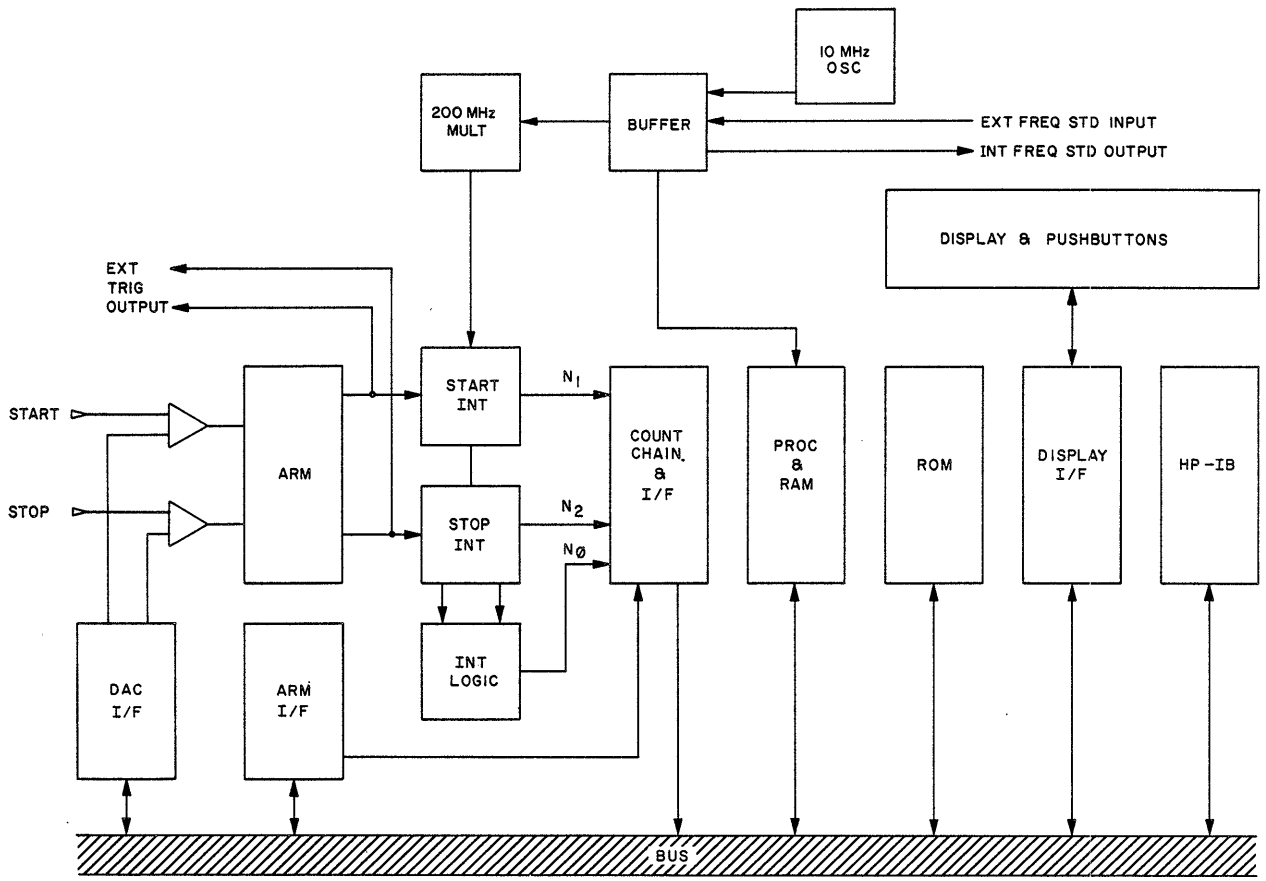


Figure 8-15. Top Internal View



5370A SIMPLIFIED BLOCK DIAGRAM

Part of Figure 8-16. Simplified Block Diagram

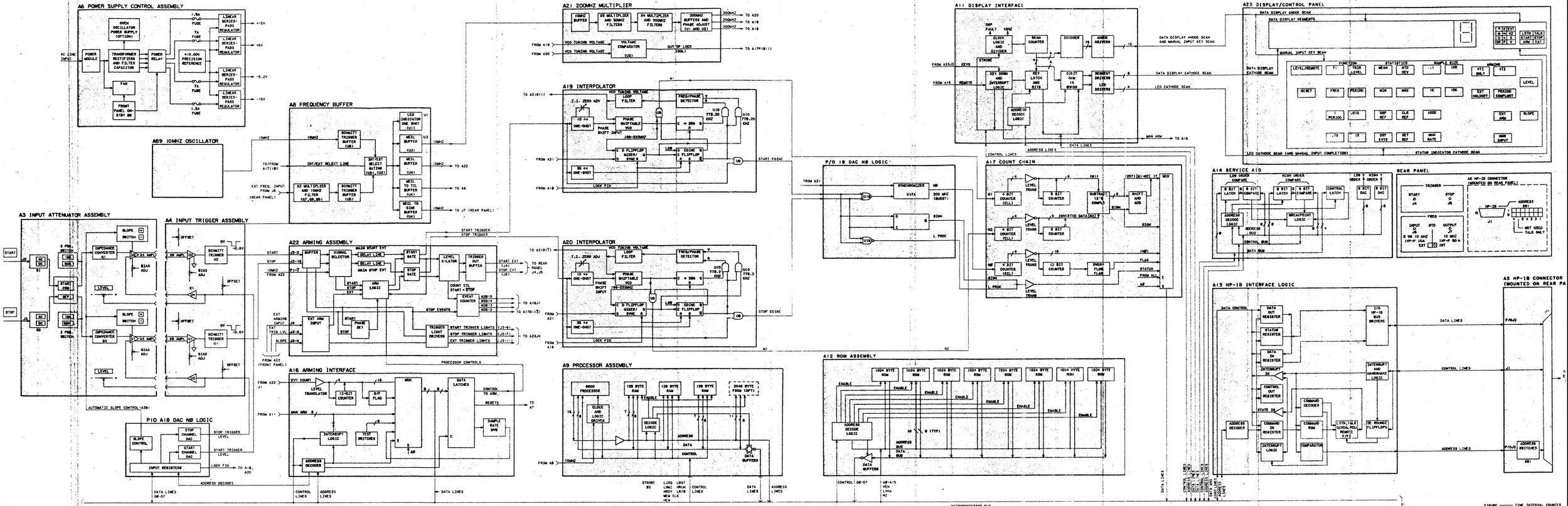
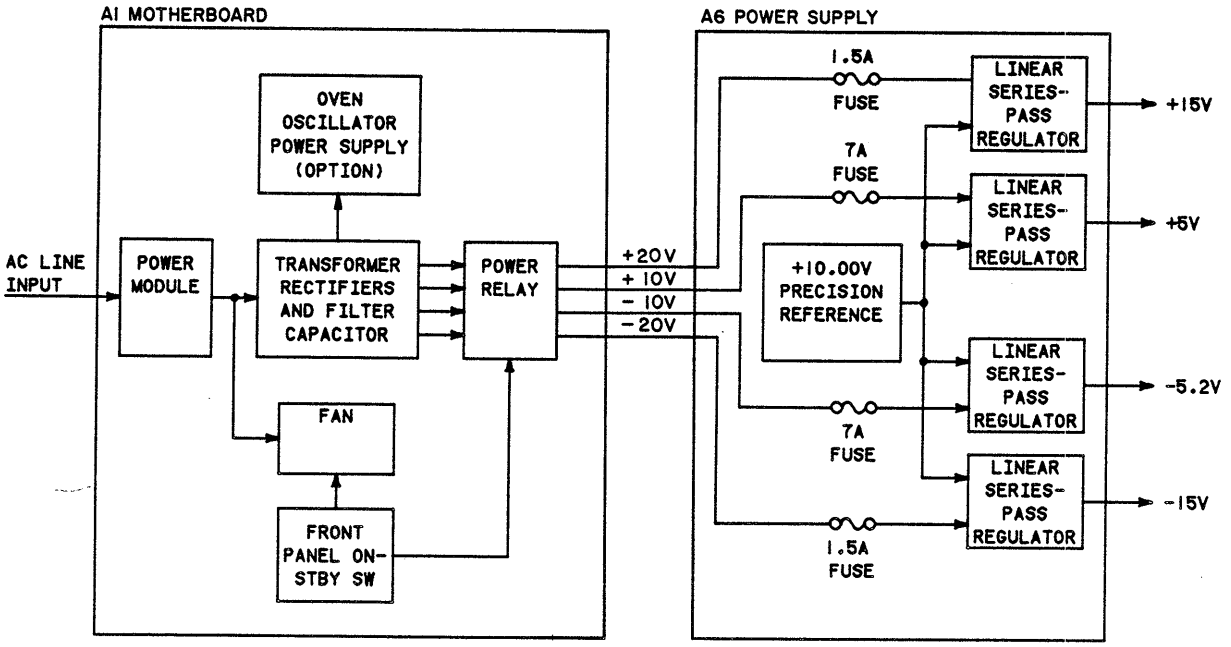


Figure 8-16. Simplified/Overall Block Diagr

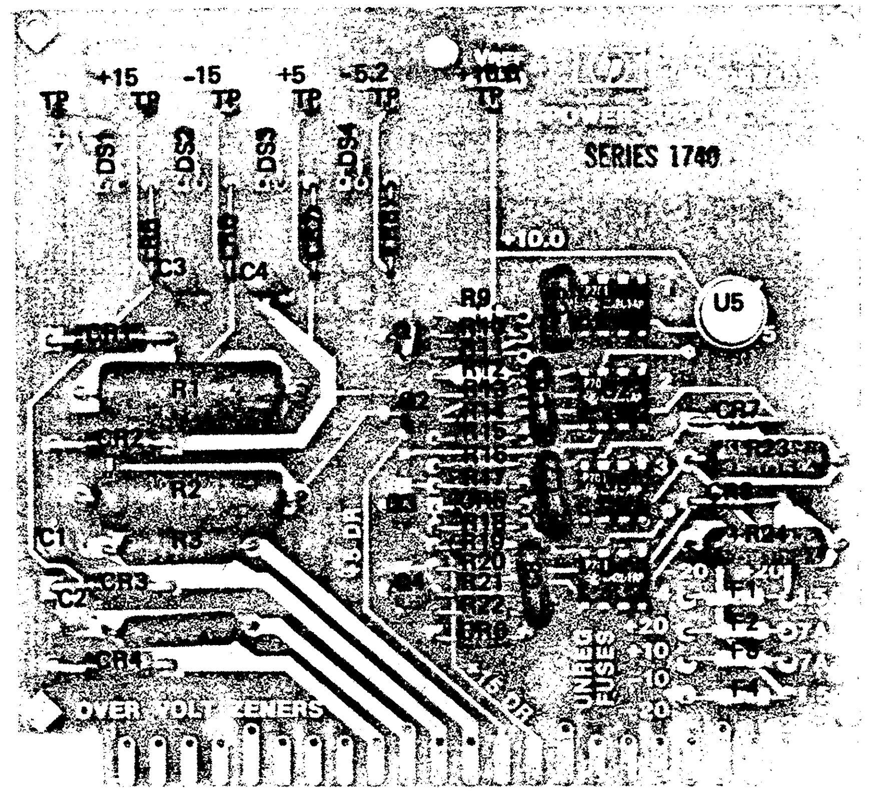


A1 POWER SUPPLY MOTHERBOARD ASSEMBLY
A6 POWER SUPPLY CONTROL ASSEMBLY

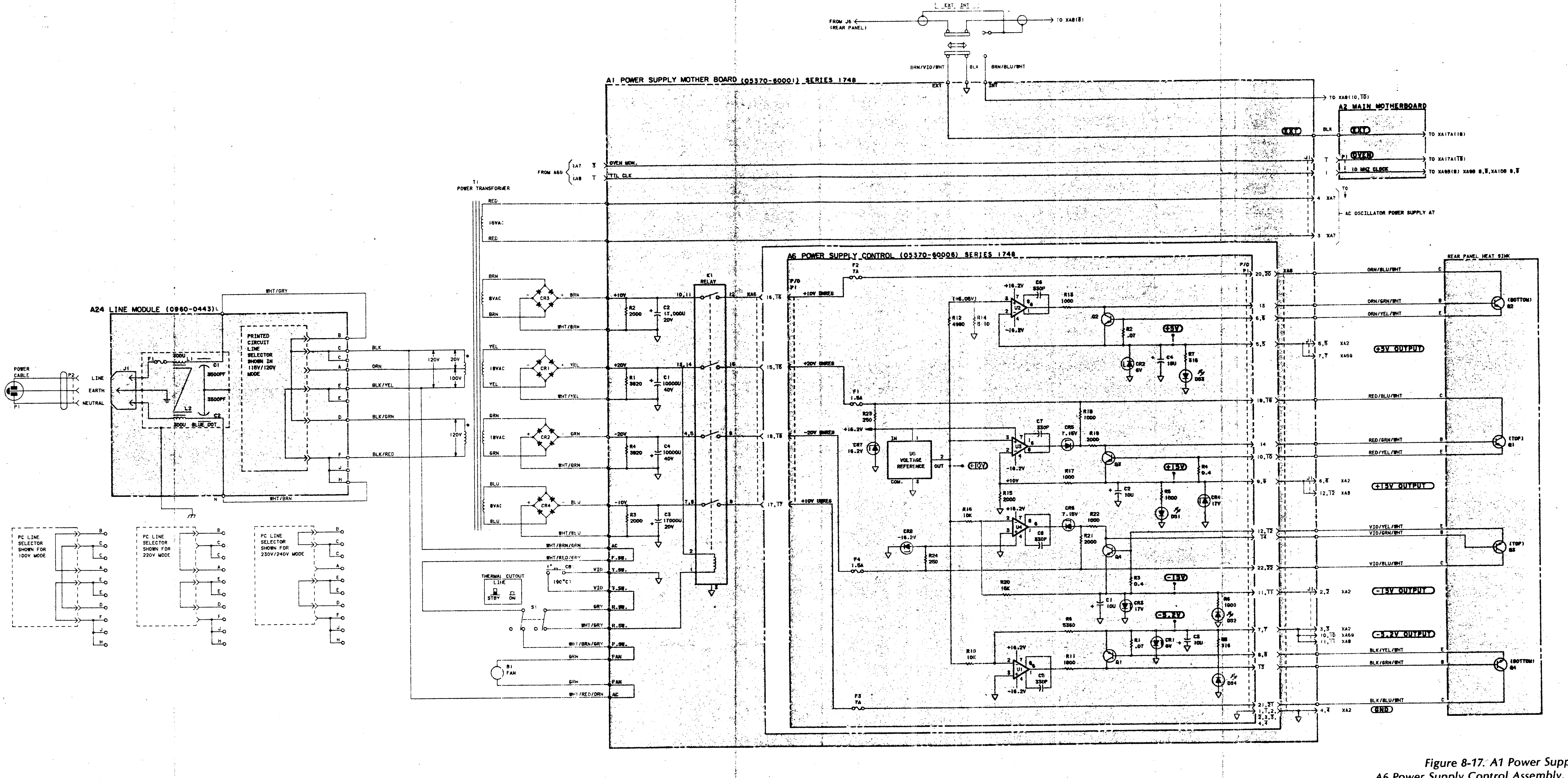
The Power Supply Motherboard/Power Supply Control Assemblies (A1, A6) supply all DC power for the instrument, except for the Option 001 Oven Oscillator. The AC line voltage enters through the Power Module (correct selection of line input voltage determined by Power Module card) to the Power Transformer primary windings and to the instrument fan. The secondaries of the power transformer are rectified and filtered and sent to the Power Relay. A separate transformer secondary supplies power to the Oven Oscillator Power Supply (A7) (Option 001).

When the front panel ON-STANDBY switch is activated, AC power is sent to the fan and unregulated DC is sent to the Power Relay, enabling the four unregulated DC voltages to the Power Supply Control Assembly (A6). The A6 assembly then converts the four unregulated DC voltages +10V, +20V, -20V, and -10V (fused at the input) to +5V, +15V, -15V, and -5.2V for distribution throughout the instrument. These voltages are supplied by four, separate linear series-pass regulators which are referenced to a single +10.0V precision reference IC (A6U5).

Part of Figure 8-17. A1 Power Supply Motherboard, A6 Power Supply Control Assemblies



A6



NOTES:

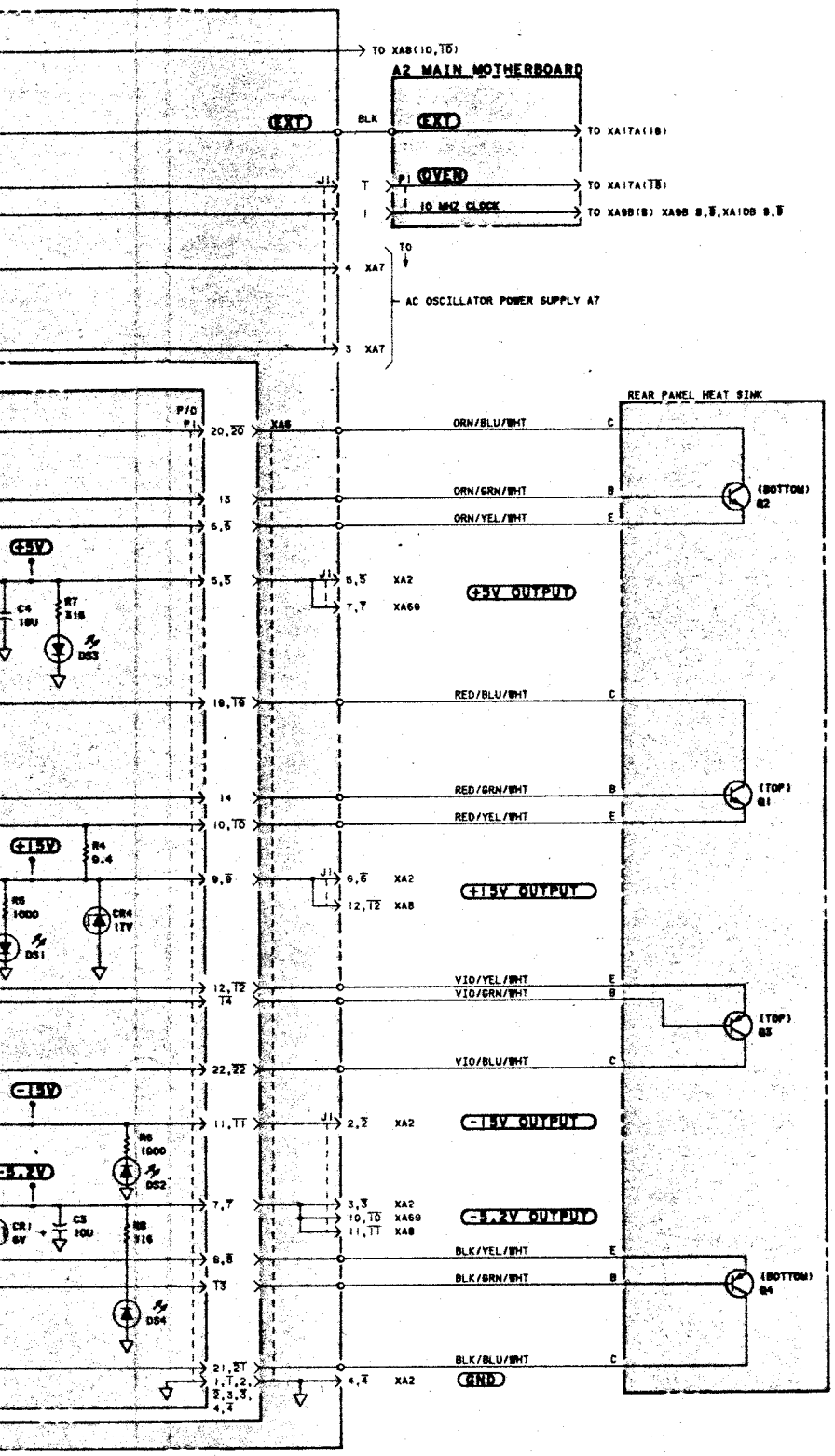
1. REFERENCE DESIGNATIONS THIS ASSEMBLY ARE ABBR ADD ASSEMBLY NUMBER TO ATION FOR COMPLETE DES
2. UNLESS OTHERWISE INDIC RESISTANCE IN OHMS CAPACITANCE IN FARAD INDUCTANCE IN HENRIE
3. ASTERISK (*) INDICATES COMPONENT, AVERAGE VAL

A1 Reference Designations	A2 Reference Designations	A[illegible] D[illegible]
C1, C4 J1 K1 R1, R4	C1, C8 J1 R1, R8	

A6 TABLE OF ACTIVE ELEME

Reference Designations	HP Part Number	
CR1, CR2	1902-0522	
CR3, CR4	1902-0632	
CR5, CR6	1902-0074	
CR7, CR8	1902-0783	
DS1–DS4	1990-0620	
Q1, Q4	1853-0036	
Q2, Q3	1854-0215	
U1–U4	1820-0477	
U5	1826-0316	

Figure 8-17. A1 Power Supply/Motherboard Ass
A6 Power Supply Control Assembly, A24 Line Module As



NOTES:

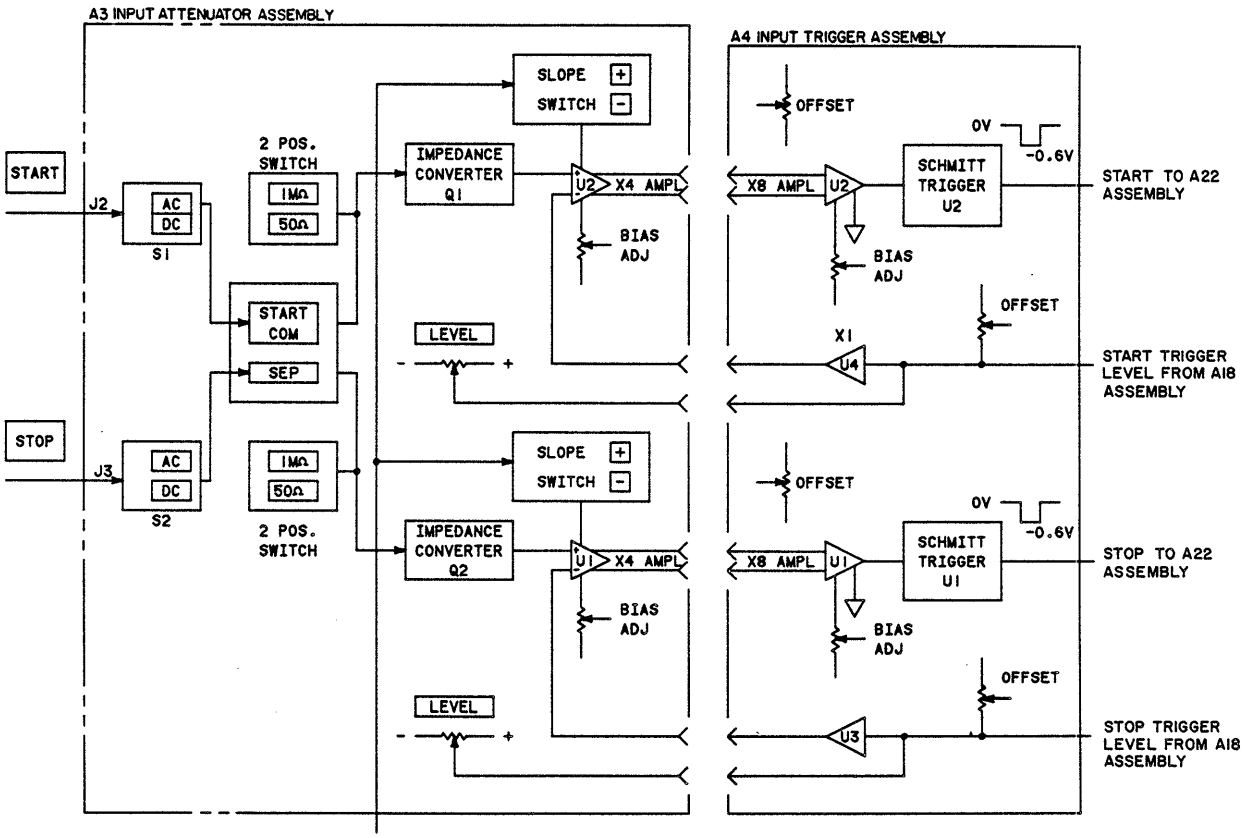
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED ADD ASSEMBLY NUMBER TO ABBREVIATION FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED:
   RESISTANCE IN OHMS
   CAPACITANCE IN FARADS
   INDUCTANCE IN HENRIES.
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

A1 Reference Designations	A2 Reference Designations	A6 Reference Designations
C1, C4 J1 K1 R1, R4	C1, C8 J1 R1, R8	C1, C8 CR1, CR8 DS1, DS4 F1, F4 Q1, Q4 R1, R24 U1, U5

A6 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
CR1, CR2	1902-0522	1N5340B
CR3, CR4	1902-0632	1N5354B
CR5, CR6	1902-0074	1902-0074
CR7, CR8	1902-0783	1902-0783
DS1-DS4	1990-0620	5082-4584
Q1, Q4	1853-0036	1853-0036
Q2, Q3	1854-0215	2N3904
U1-U4	1820-0477	LM301AN
U5	1826-0316	LH0070-1H

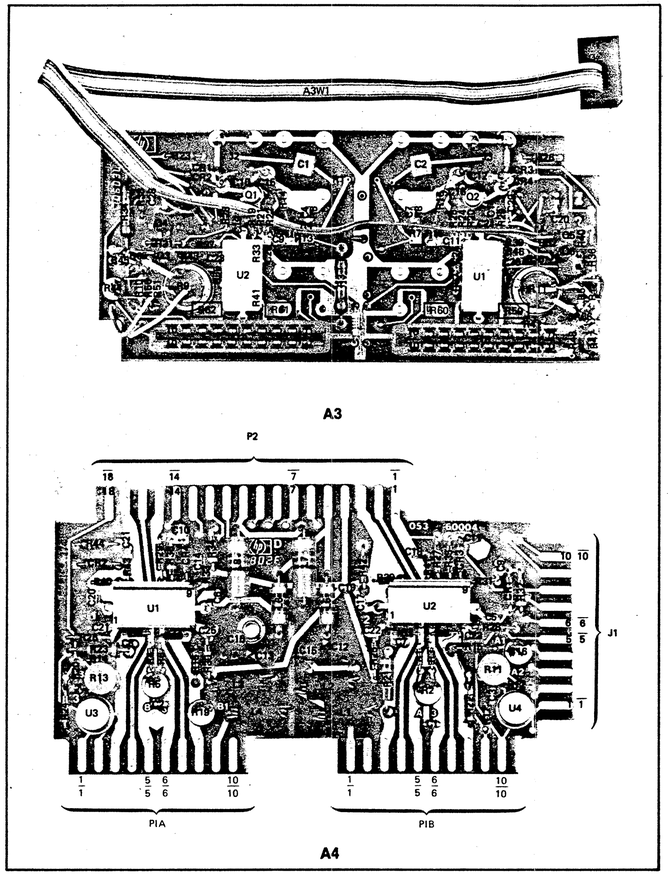
Figure 8-17. A1 Power Supply/Motherboard Assembly, A6 Power Supply Control Assembly, A24 Line Module Assembly



A3 AND A4 INPUT ASSEMBLIES

The input configuration consists of an Input Attenuator Assembly (A3) and an Input Trigger Assembly (A4). These two assemblies contain the controls which determine the type of coupling, the input impedance, the trigger slope and the trigger level pot. The trigger level and the slope selection can be selected either manually by front panel controls or remotely by HP-IB. The START and STOP signals are amplified and conditioned and then sent to the ARMING assembly (A22) at the rate at which they are input to the machine.

Part of Figure 8-18. A3 and A4 Input Assemblies



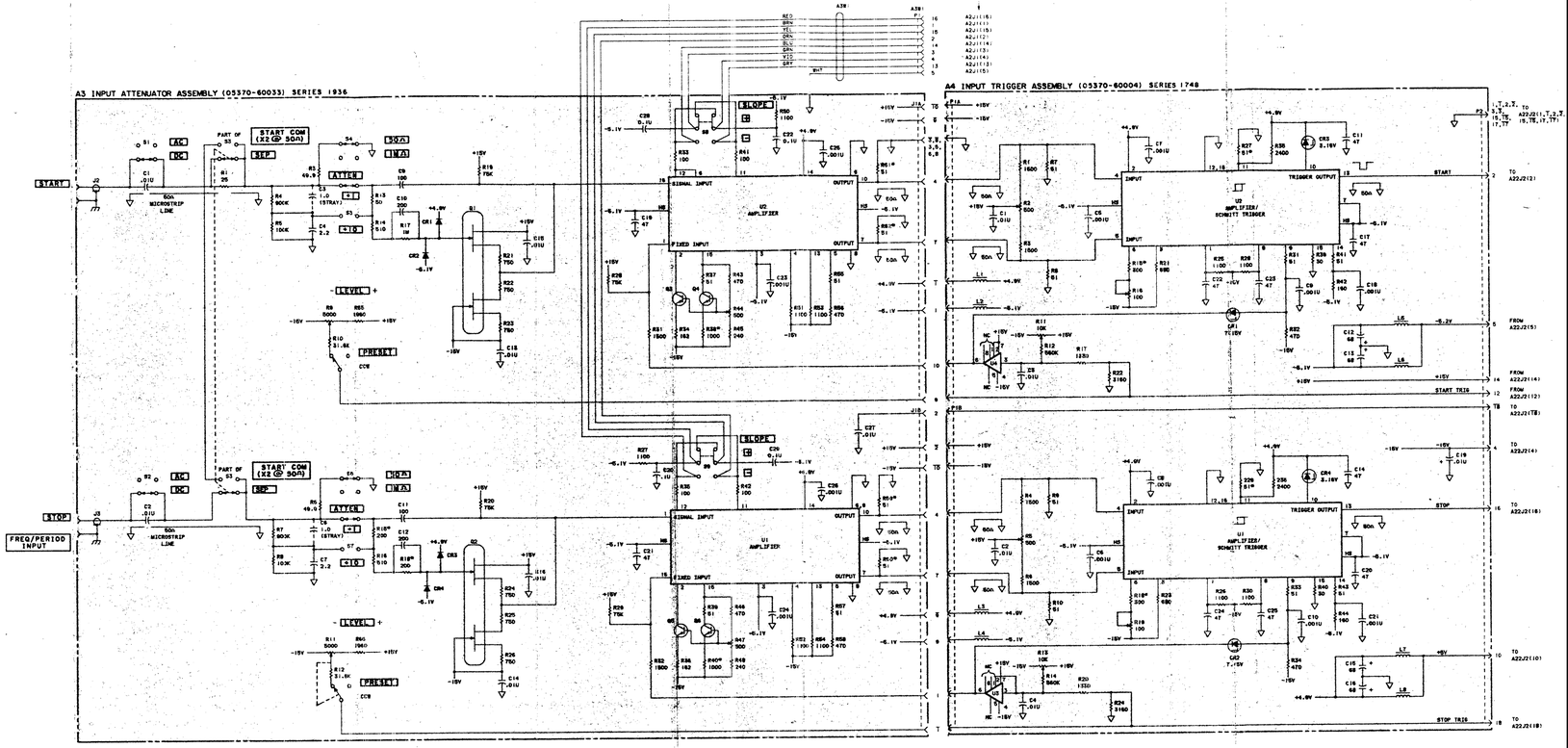
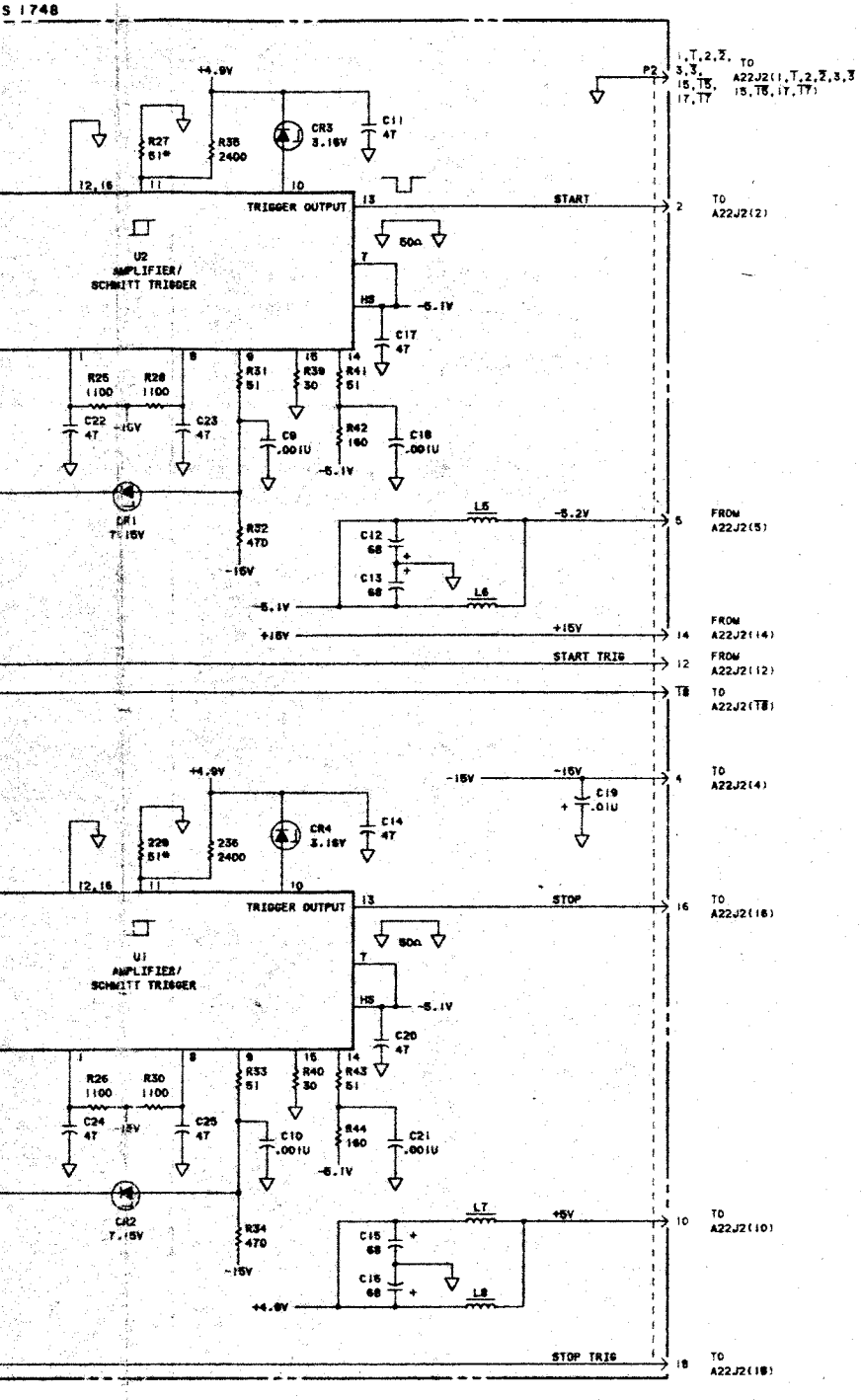


Figure 8-18. A3 Input Attenuator A



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 FARADS
INDUCTANCE IN HENRIES

A3 Reference Designations

C1, C29
CR1, CR4
J1, J3
Q1, Q6
R1, R66
S1, S9
U1, U2

Deleted: R2, R27, R30, R49, R50

A3 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
CR1-CR4	1901-0376	1901-0376
Q1, Q2	1855-0225	1855-0225
Q3-Q6	1854-0215	2N3904
U1, U2	1826-0088	1826-0088

A4 Reference Designations

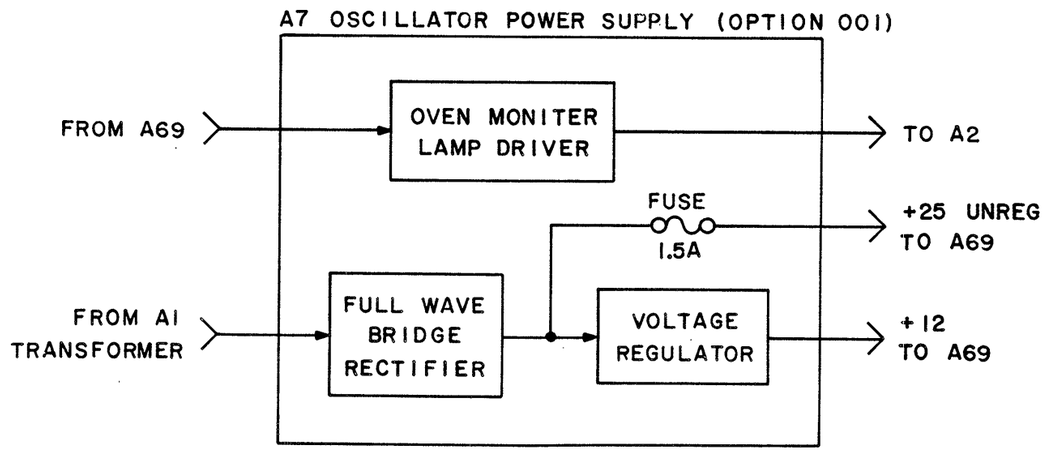
C1, C26
CR1, CR4
L1, L8
R1, R44
U1, U4

Deleted: R37, R38

A4 TABLE OF ACTIVE ELEMENTS

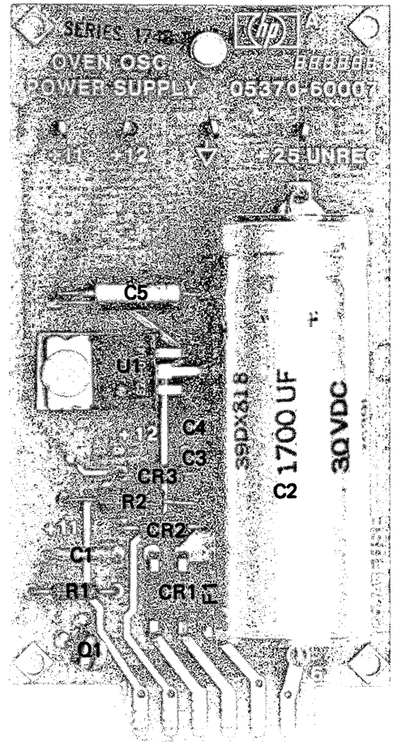
Reference Designations	HP Part Number	Mfr Part Number
CR1, CR2	1902-0074	1902-0074
CR3, CR4	1902-3036	1902-3036
U1, U2	1826-0290	1826-0290
U3, U4	1826-0021	LM310H

Figure 8-18. A3 Input Attenuator Assembly, A4 Input Trigger Assembly



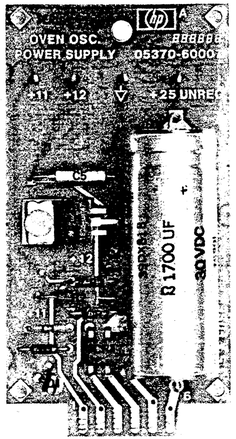
A7 OSCILLATOR POWER SUPPLY ASSEMBLY

The A7 Assembly is supplied with Option 001 to provide the voltages needed by the Optional Crystal Oven (10544A). The 16V ac from power transformer T1 is rectified, filtered and regulated by the assembly. There is also an oven monitor circuit which lights an indicator in the front panel display whenever the crystal oven is below operating temperature as is the case when the instrument is first connected to the ac power.

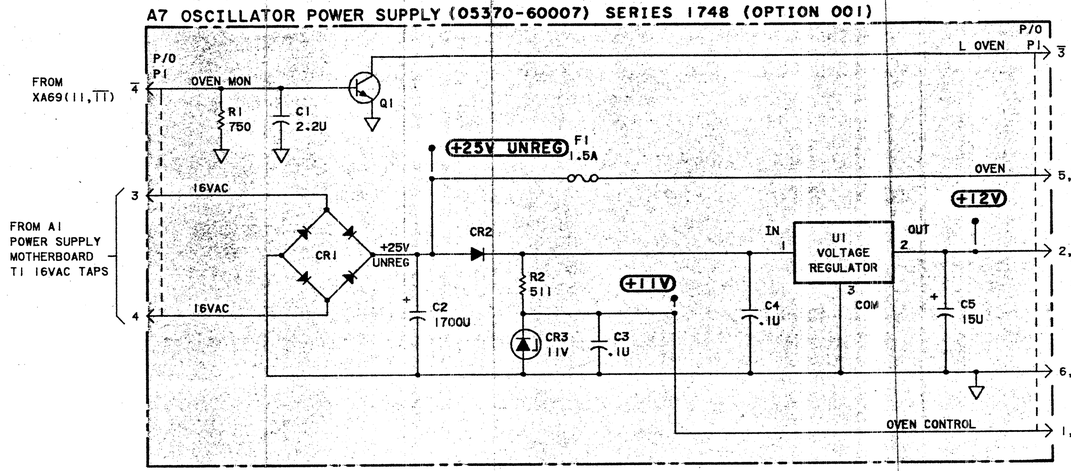


A7

Part of Figure 8-19. A7 Oscillator Power Supply Assembly



A7



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 FARADS
   INDUCTANCE IN HENRIES
3. ASTERISK: (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

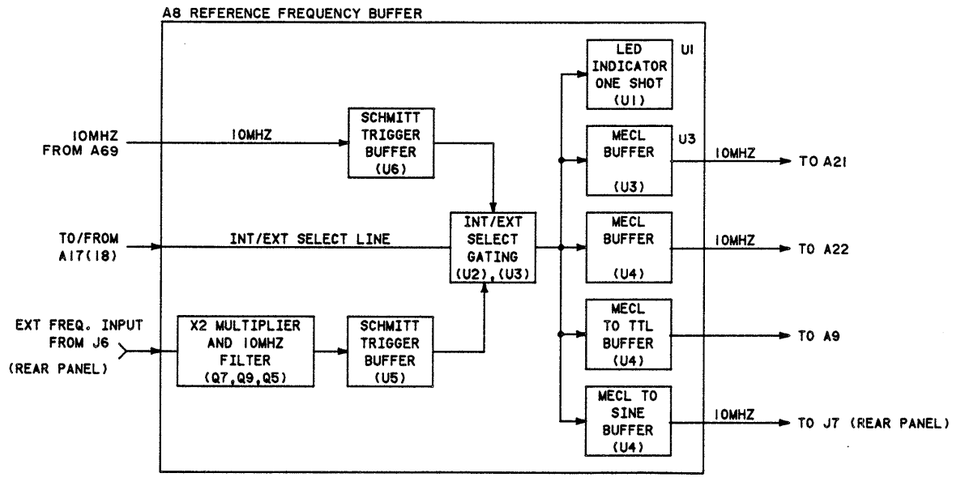
A7 Reference Designations

C1, C5
CR1, CR3
F1
Q1
R1, R2
U1

A7 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
CR1	1901-0366	1901-0366
CR2	1901-0028	1901-0028
CR3	1902-3172	1902-3172
Q1	1854-0071	1854-0071
U1	1826-0147	MC7812CP

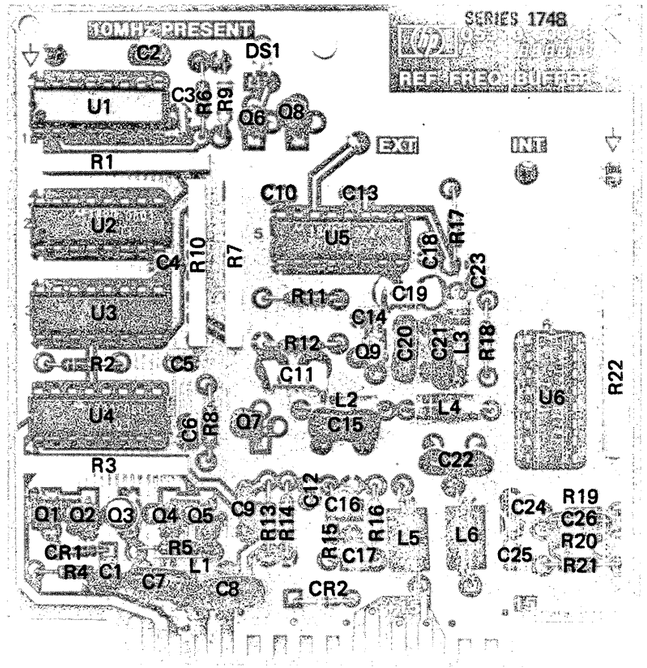
Figure 8-19. A7 Oven Oscillator Power Supply Assembly (Option 001 Only)



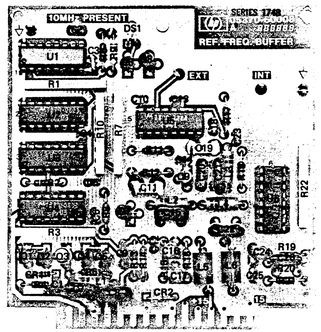
A8 REFERENCE FREQUENCY BUFFER ASSEMBLY

The Reference Frequency Buffer Assembly (A8) receives 10 MHz from either of two sources. The first source is the internal crystal time base. The second source is the EXTernal frequency input (5 or 10 MHz) from the rear panel connector J6. Whichever 10 MHz signal is selected is shaped and sent to four buffers and a signal monitor. The monitor is an LED and a oneshot multivibrator triggered by the 10 MHz signal. When the LED indicator is on, the selected source signal is present.

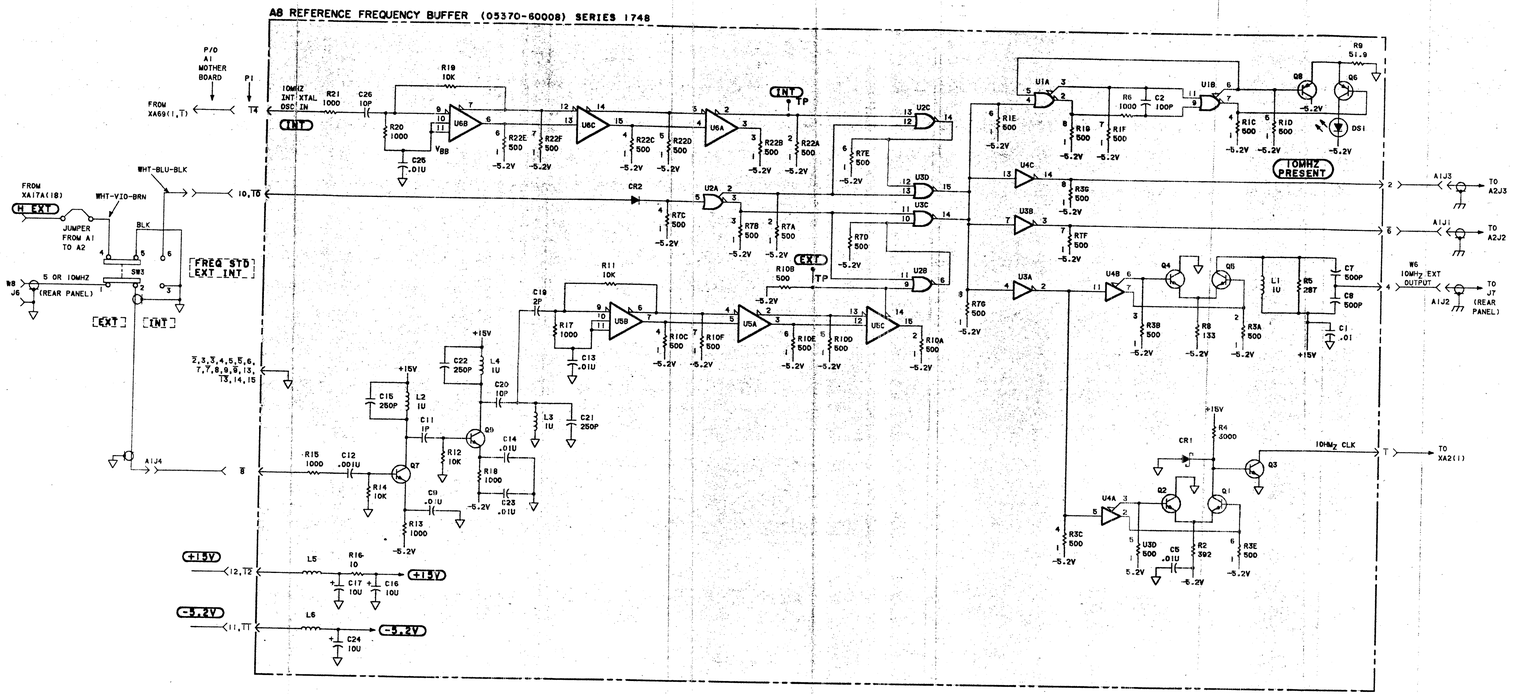
Part of Figure 8-20. A8 Reference Frequency Buffer Assembly



A8



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 FARADS
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

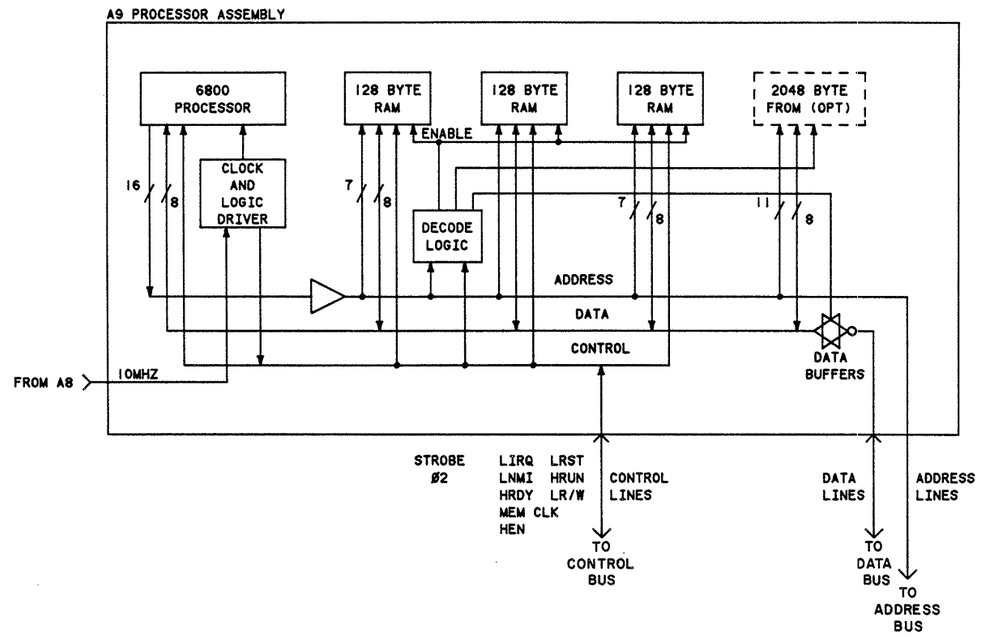
A8 Reference Designations

C1, C26
CR1, CR2
DS1
L1, L6
Q1, Q8
R1, R22
U1, U6

A8 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
CR1	1901-0535	1901-0535
CR2	1901-0040	1901-0040
DS1	1990-0620	5082-4584
Q1,Q2,Q4,Q5,Q7	1854-0215	2N3904
Q3	1854-0009	1854-0009
Q6, Q8	1853-0036	1853-0036
U1-U4	1820-0803	MC10105P
U5, U6	1820-1224	MC10216P

Figure 8-20. A8 Reference Frequency Buffer Assembly

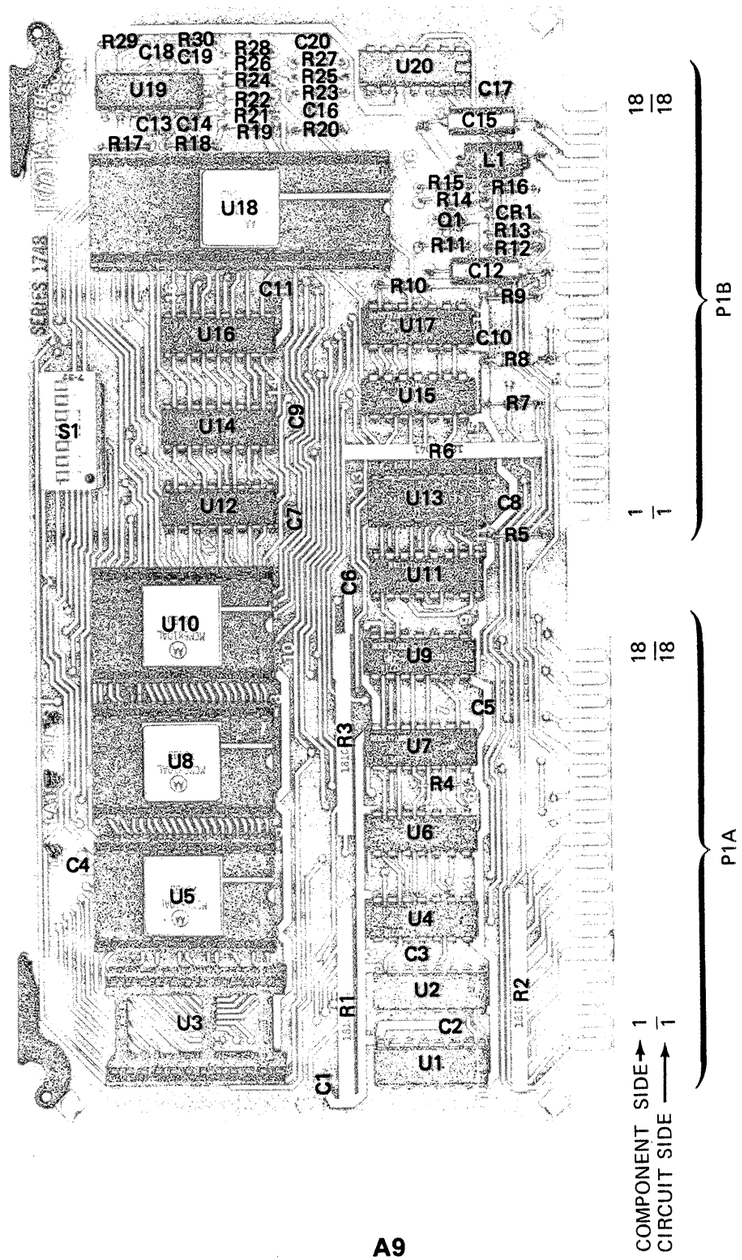


A9 PROCESSOR ASSEMBLY

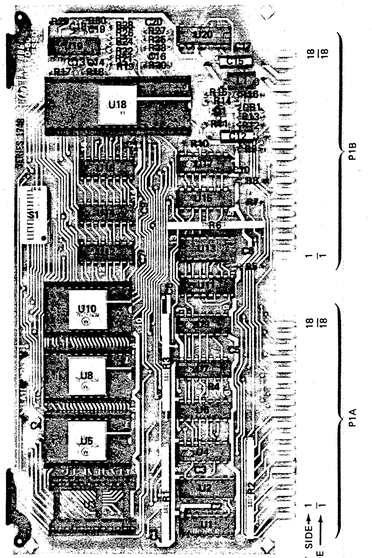
The Processor Assembly (A9) contains the microprocessor, clock logic and driver circuits, RAM and RAM Address Decode logic, and Address and Data Buffers. The Address Bus contains 16 lines which can address up to 65K locations. They are one direction (out only). The data bus contains 8 lines. These are bidirectional (Input and Output) to the A9 Assembly.

The third bus is the control bus. The lines are mainly microprocessor inputs with the exception of three. The R/W (Read/Write) line is an output to the RAMs. The VMA (Valid Memory Address) line is used for decoding. And the BA (Bus Available) line used to tell assemblies on the Address Bus, the bus is not being used by the microprocessor. The remaining control lines enable the microprocessor to keep track of the status of the rest of the machine. For example, these lines enable the machine to use the HP-IB and lets the microprocessor know when a key is pressed or when a measurement has been completed. The RAMs are used to store data such as which key is active or the results of previous measurements.

The 10 MHz is present from the A8 Frequency Buffer Assembly to run the Microprocessor Clock State Machine, which generates all necessary processor clocks.



Part of Figure 8-21. A9 Processor Assembly



A9

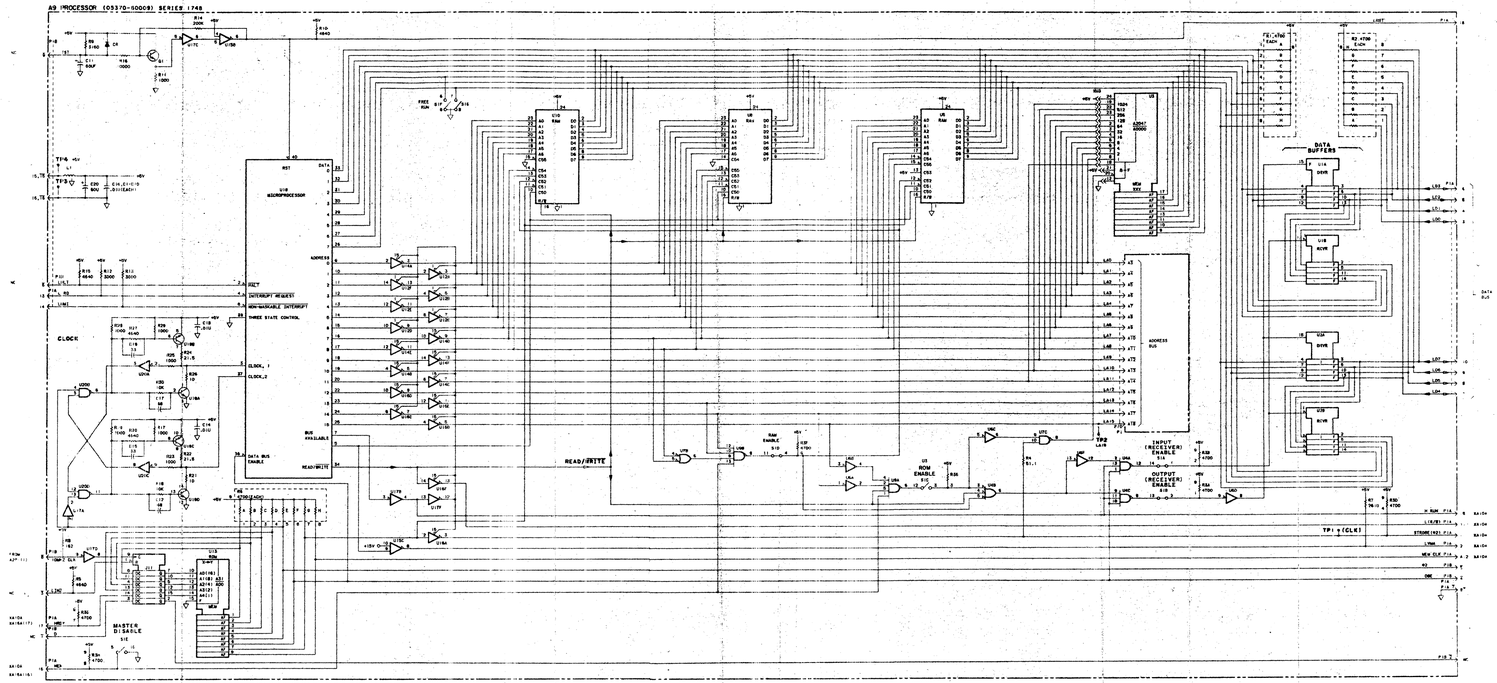
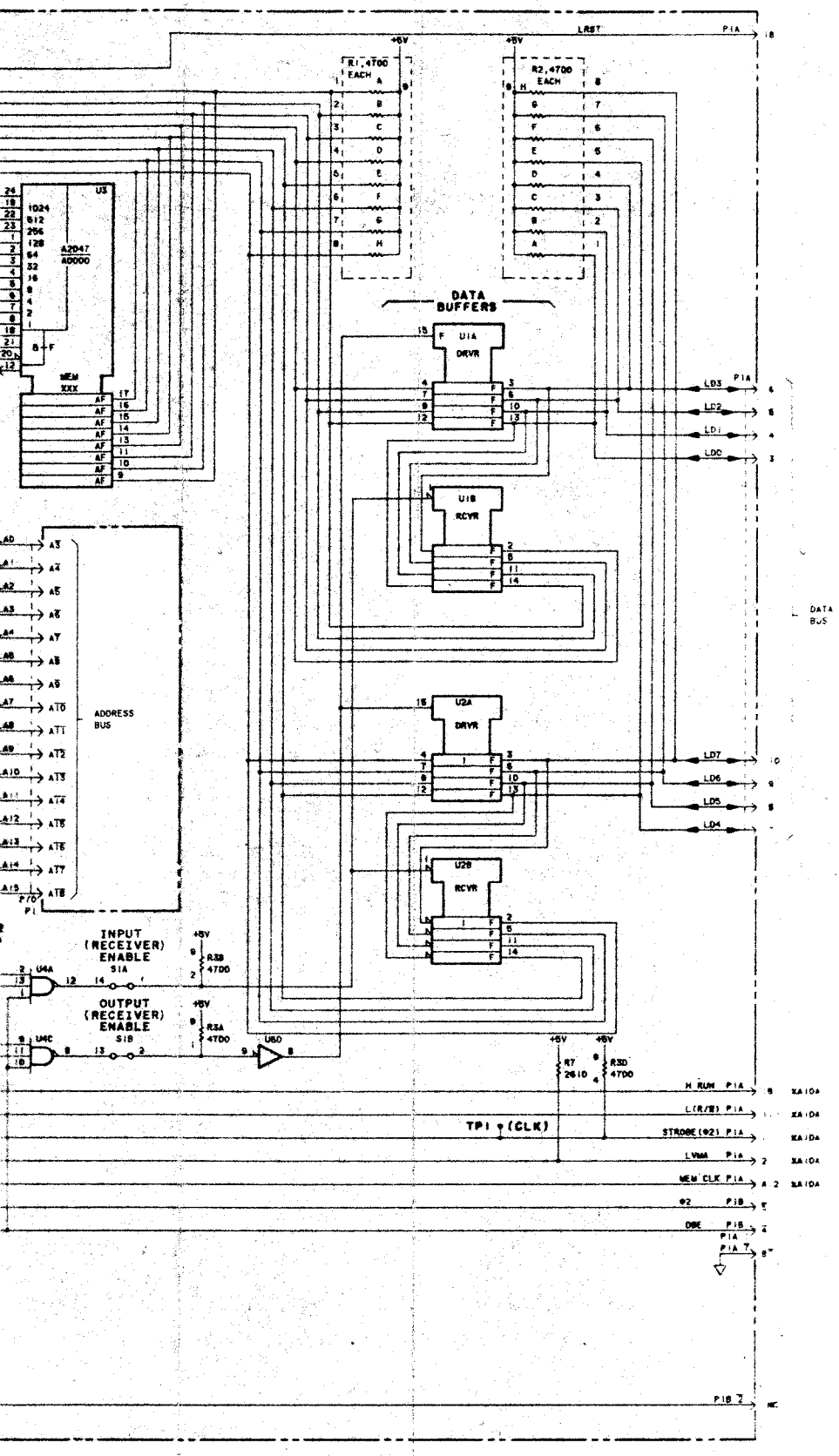


Figure 8-21. A9 Processor Ass



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 FARADS
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT AVERAGE VALUES SHOWN

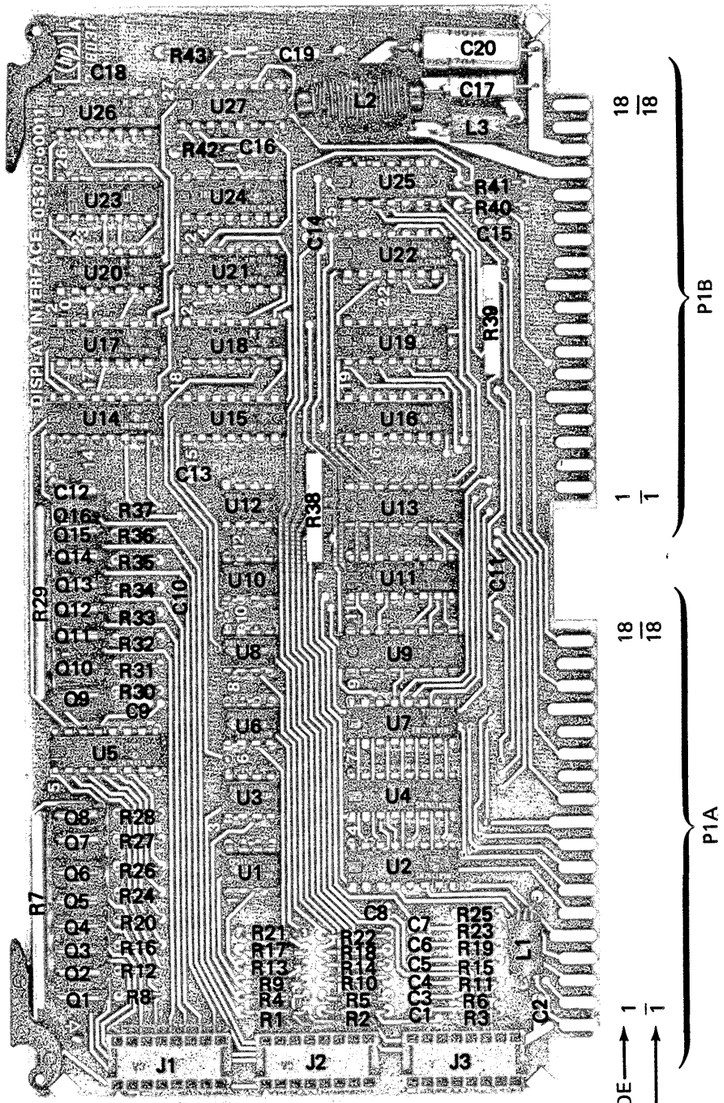
A9 Reference Designations

C1, C19
CR1
L1
Q1
R1, R30
S1
U1, U20

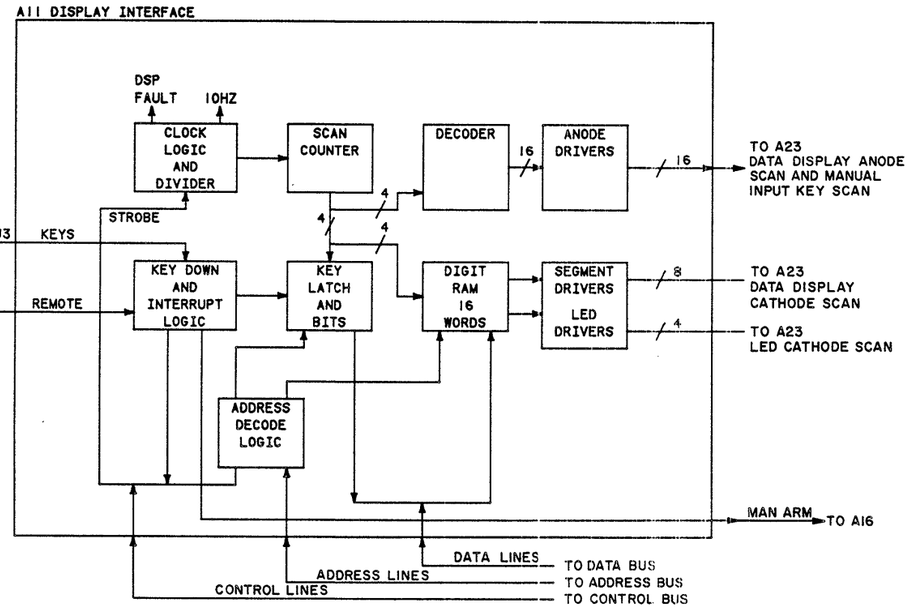
A9 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
CR1	1901-0040	1901-0040
Q1	1854-0560	MPSA12
U1, U2	1820-1081	MC8T26AP
U4	1820-1202	SN74LS10N
U5, U8, U10	1818-0135	MCM68A10L
U6, U17	1820-1199	SN74LS04N
U7, U20	1820-1197	SN74LS00N
U9	1820-1204	SN74LS20N
U11	1820-1196	SN74LS174N
U12, U14, U16	1820-1368	SN74366N
U13	1820-0409	HPROM-8256-5D
U15	1820-1209	SN74LS38N
U18	1820-1490	MC6800L
U19	1820-1804	MPQ6842

Figure 8-21. A9 Processor Assembly



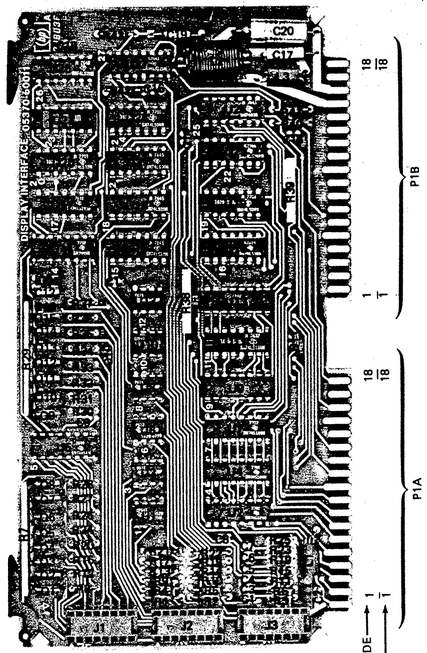
A11



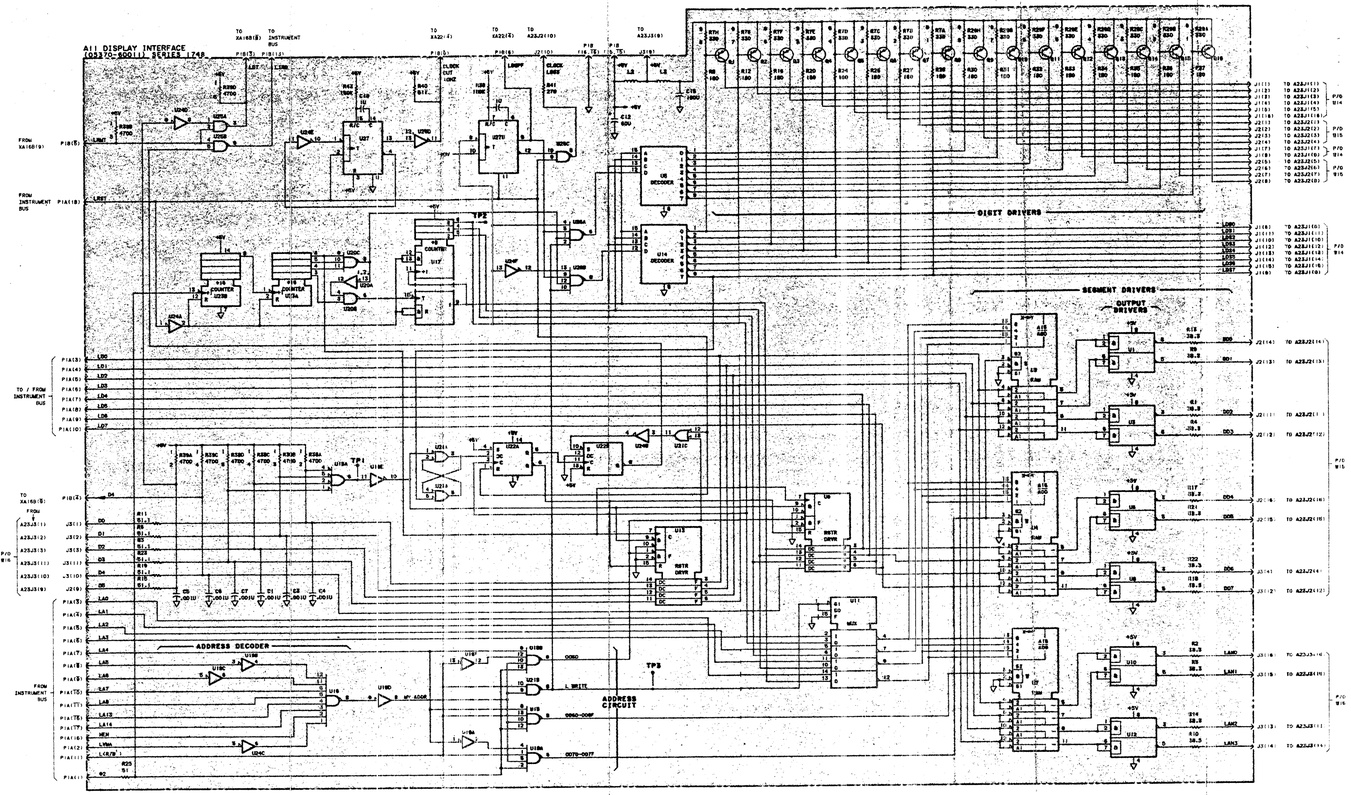
A11 DISPLAY INTERFACE ASSEMBLY

The Display Interface Assembly (A11) allows the microprocessor (A9) to communicate with the display and keyboard. The A11 Assembly is connected directly to the machine's internal processor bus. All logic for decoding and driving, and the latch and RAM for the key data and display data, respectively, are located on the A11 assembly. The RAMs store the previous measurement result during the current measurement cycle. This data is sent to the Display/Control Panel Assembly (A23).

Part of Figure 8-22. A11 Display Interface Assembly



A11



NOTES:
1. REFERENCE DESIGNATIONS WITHIN THIS ASSEMBLY ARE ABBREVIATED. ADD ASSEMBLY NUMBER TO ARRIVE AT ITEM FOR COMPLETE DESCRIPTION.
2. UNLESS OTHERWISE INDICATED RESISTANCE IN ohms
CAPACITANCE IN FARADS
INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

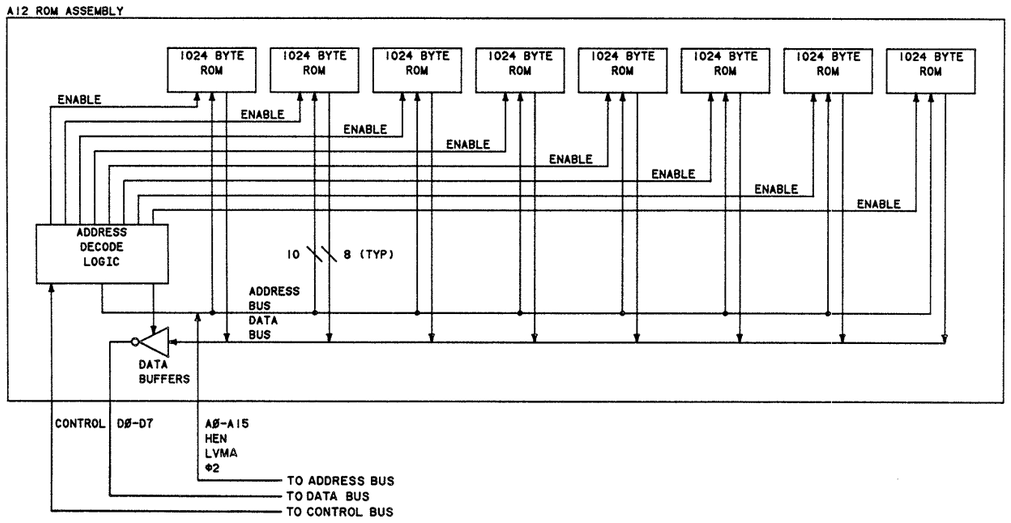
A11 Reference Designations

C1, C20	
J1, J2	
L1, L3	
Q1, Q16	
R1, R43	
U1, U27	

A11 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
Q1-Q16	1853-0036	MPS-U51
U1,U3,U6,U8, U10,U12	1820-0709	SN74S288*
U2, U7	1816-1089	SN74S472
U4, U14	1820-0468	SN7446A
U5, U13	1820-1855	SN74LS139N
U11	1820-1428	SN74LS158N
U15, U16 U26	1820-1204	SN74LS20N
U18	1820-1907	SN74LS00N
U19	1820-1197	SN74LS02N
U19, U24	1820-1196	SN74LS04N
U20	1820-1202	SN74LS10N
U21	1820-1197	SN74LS02N
U22	1820-1112	SN74LS74N
U23	1820-1989	TMS2532JC
U25	1820-0422	SN74LS08N
U27	1820-1423	SN74LS123N

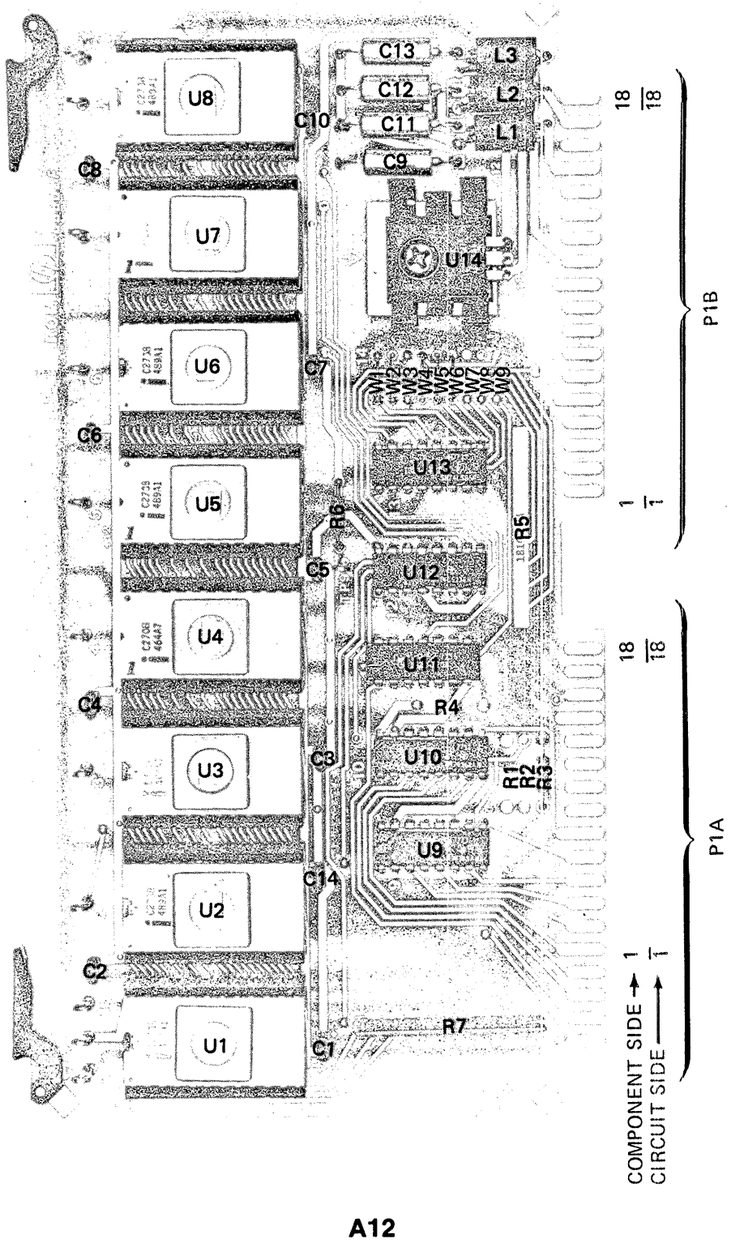
Figure 8-22. A11 Display Interface Assembly



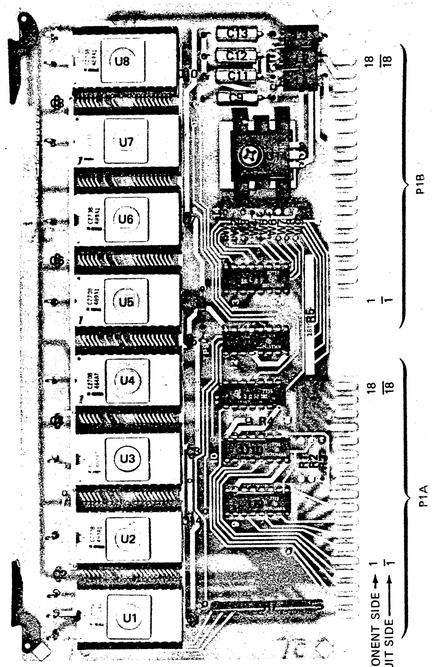
A12 ROM ASSEMBLY

The ROM Assembly (A12) contains all the program routines (firmware) for the Microprocessor. They contain all the instructions for the microprocessor to enable it to perform all front panel functions.

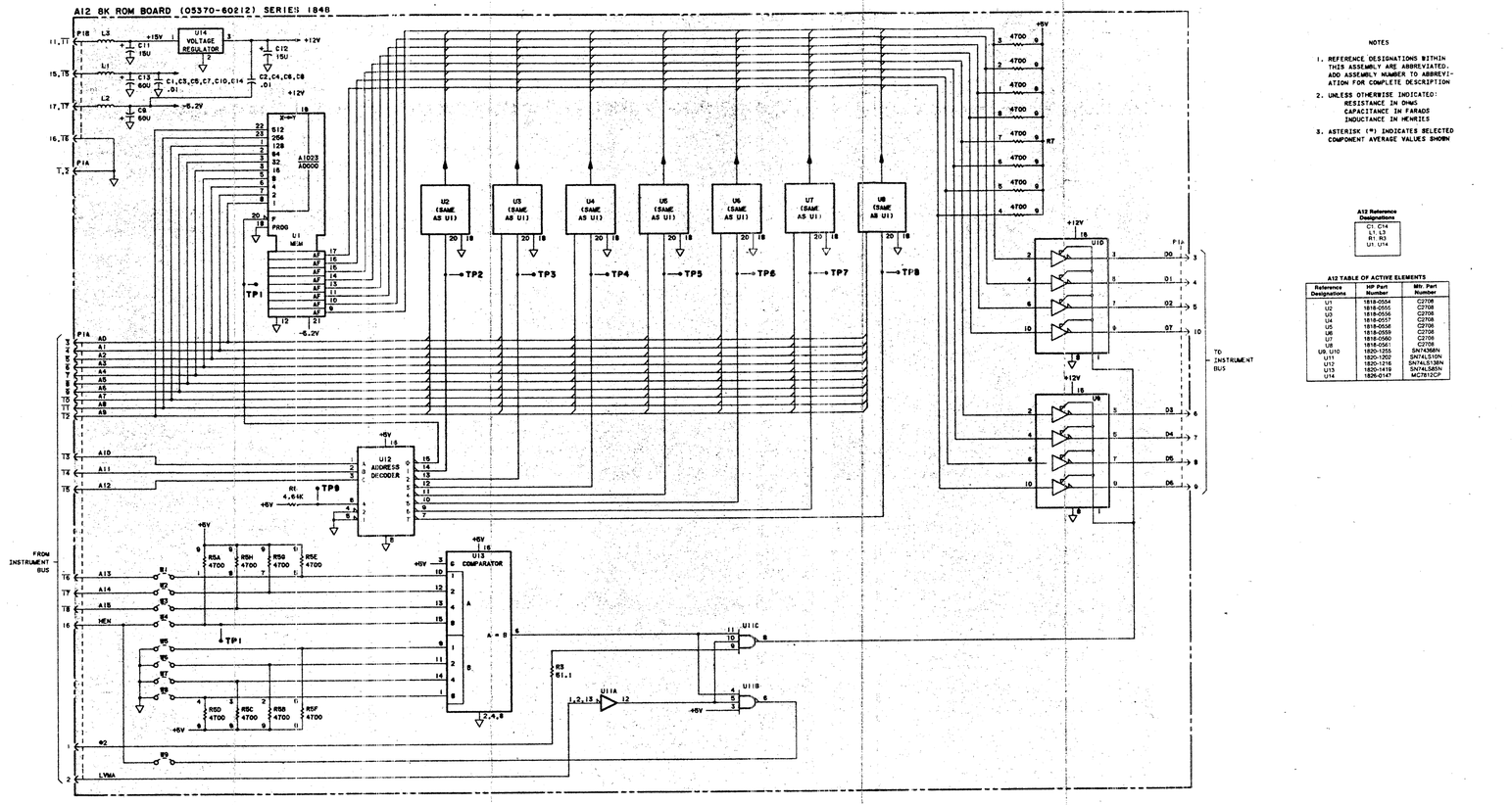
Part of Figure 8-23. A12 ROM Assembly



A12



A12



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 FARADS INDUCTANCE IN MICROHENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT AVERAGE VALUES SHOWN

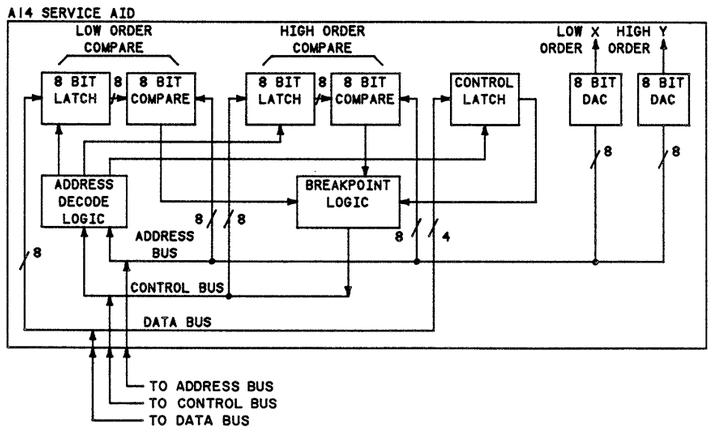
A12 Reference Designations

C1, C14	
L1, L2	
R1, R3	
U1, U14	

A12 TABLE OF ACTIVE ELEMENTS

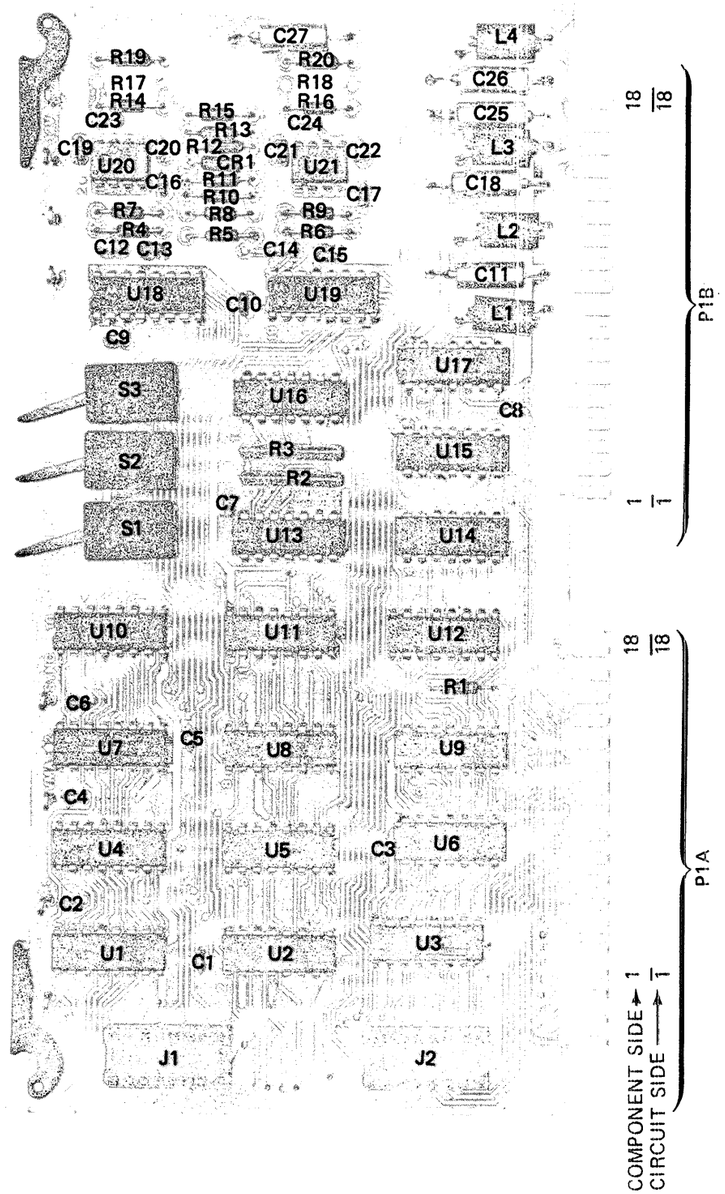
Reference Designations	HP Part Number	Mfr. Part Number
U1	1818-0554	C2708
U2	1818-0555	C2708
U3	1818-0556	C2708
U4	1818-0557	C2708
U5	1818-0558	C2708
U6	1818-0559	C2708
U7	1818-0560	C2708
U8	1818-0561	C2708
U9, U10	1820-1255	SN74S86N
U11	1820-1202	SN74LS10N
U12	1820-1216	SN74LS138N
U13	1820-1418	SN74LS85N
U14	1826-0147	MC7812CP

Figure 8-23. A12 ROM Assembly



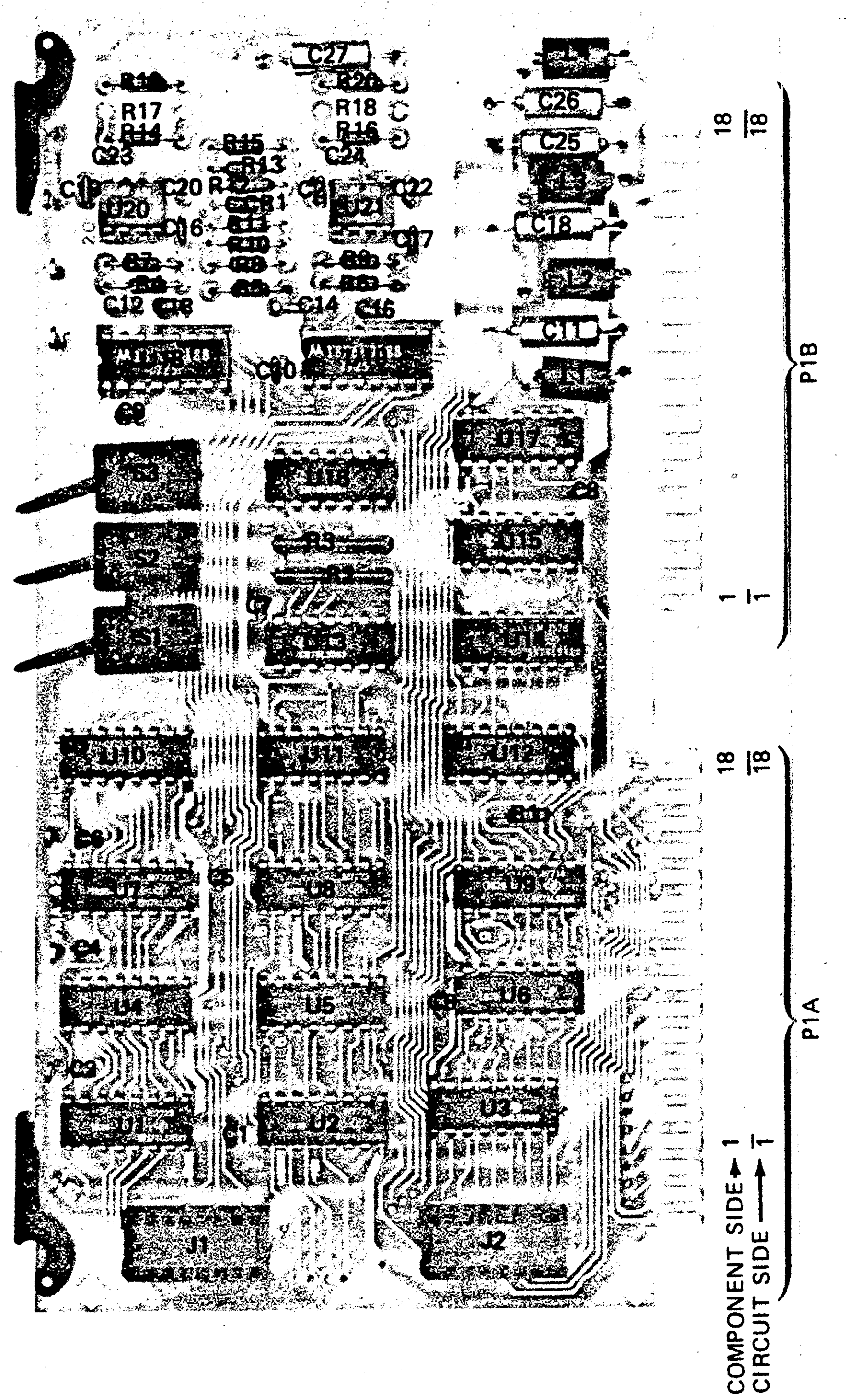
A14 SERVICE AID ASSEMBLY

The A14 assembly can be divided into two sections. The first section is the breakpoint section. It contains four comparators and four latches which are used via the HP-IB to halt the mirocprocessor program routine at a particular preprogrammed address. The second section contains two DACs which are connected to the address bus. Their outputs are fed to test points X and Y and used for mapping.

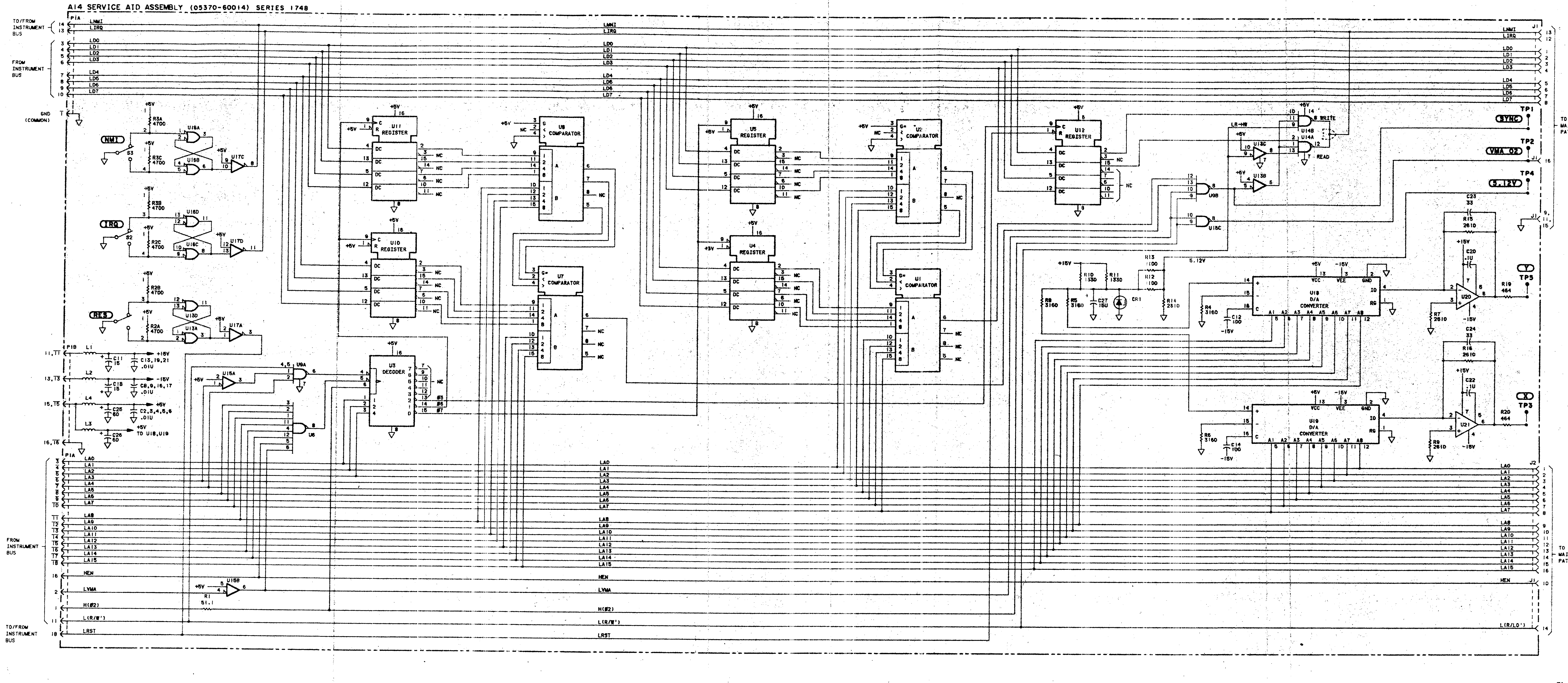


A14

Part of Figure 8-24. A14 Service Aid Assembly



A14



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 FARADS
   INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.

A14 Reference Designations
C1-C28
CR1
L1-L4
R1-R20
S1-S3
U1-U21

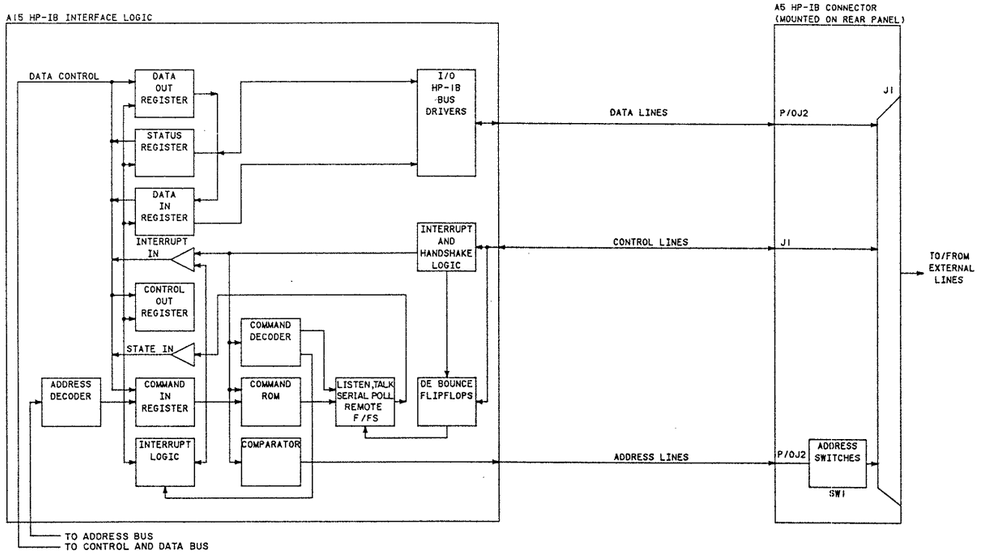
A14 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
CR1	1902-0033	1N823
U1,U2,U7,U8	1820-1419	SN74LS85N
U3	1820-1216	SN74LS138N
U4, U5, U10, U11, U12	1820-1195	SN74LS175N
U6	1820-1207	SN74LS30N
U9	1820-1204	SN74LS20N
U13,U15,U16	1820-1197	SN74LS00N
U14	1820-1414	SN74LS12N
U17	1820-1198	SN74LS03N
U18, U19	1826-0188	MC1408L-8
U20, U21	1826-0207	LM318N

Figure 8-24. A14 Service Aid Assembly (Part of Service Accessory Kit P/N 10870A)

A5 HP-IB CONNECTOR ASSEMBLY

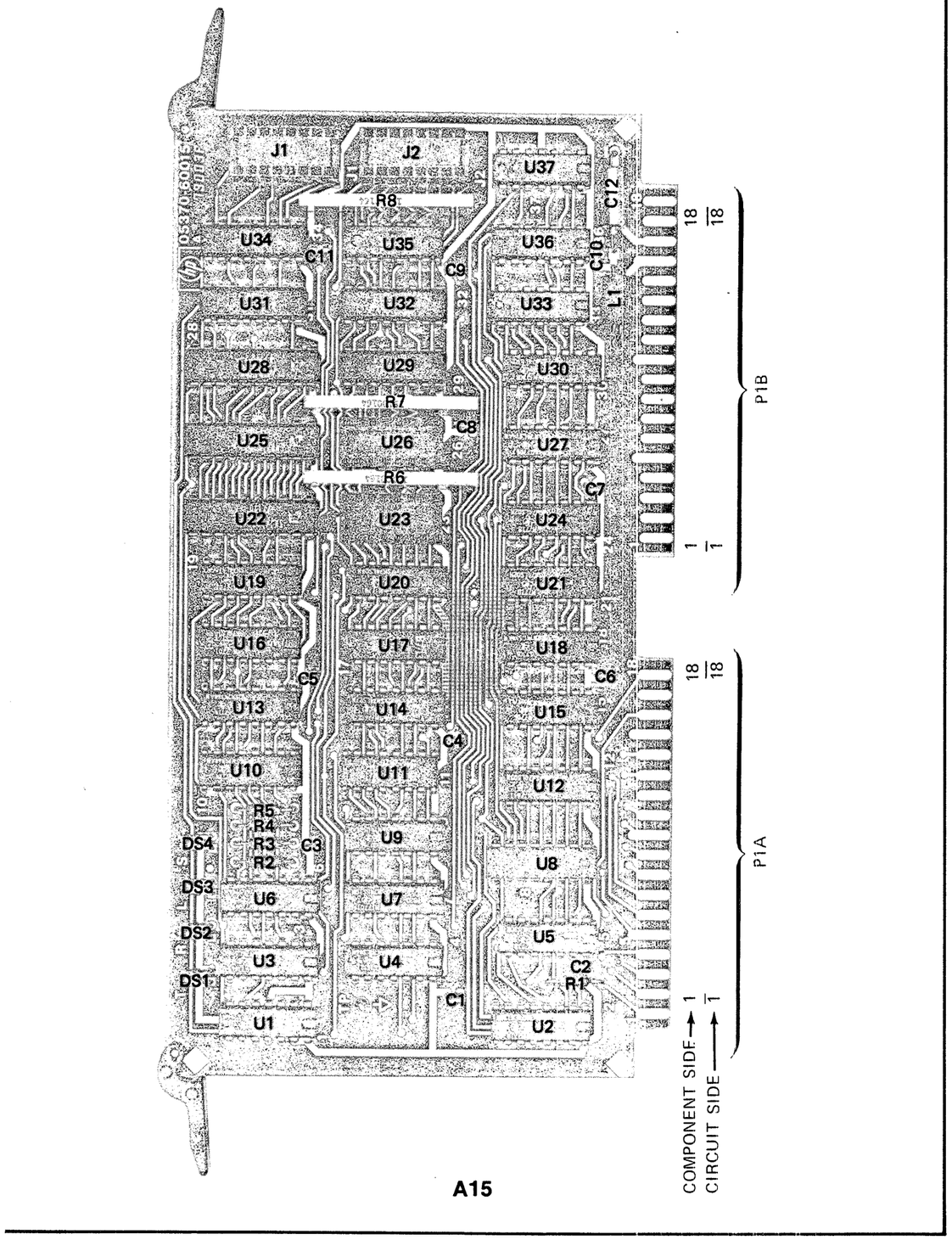
The A5 assembly provides the interconnection between A15 and the interface bus. Switch S1 is used to select the address code for the instrument.

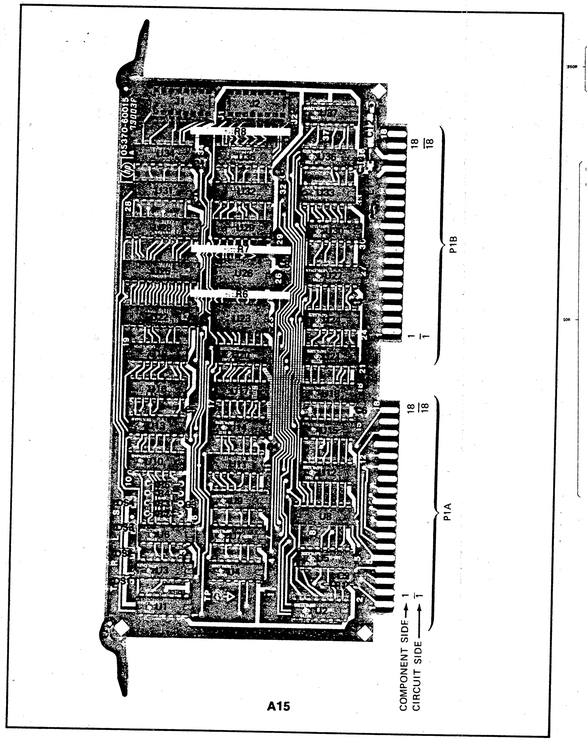


A15 HP-IB INTERFACE LOGIC ASSEMBLY

The HP-IB Interface Logic Assembly (A15) serves as an interface between the 5370A and an external controller via the HP Interface Bus. The A15 assembly consists of seven interface registers (which are used by the microprocessor for interpreting commands and data, sending status, sending data, interpreting interrupts, etc.), two command decoding ROMs, and source and acceptor handshake circuitry.

Part of Figure 8-25. A15 HP-IB Interface Logic Assembly





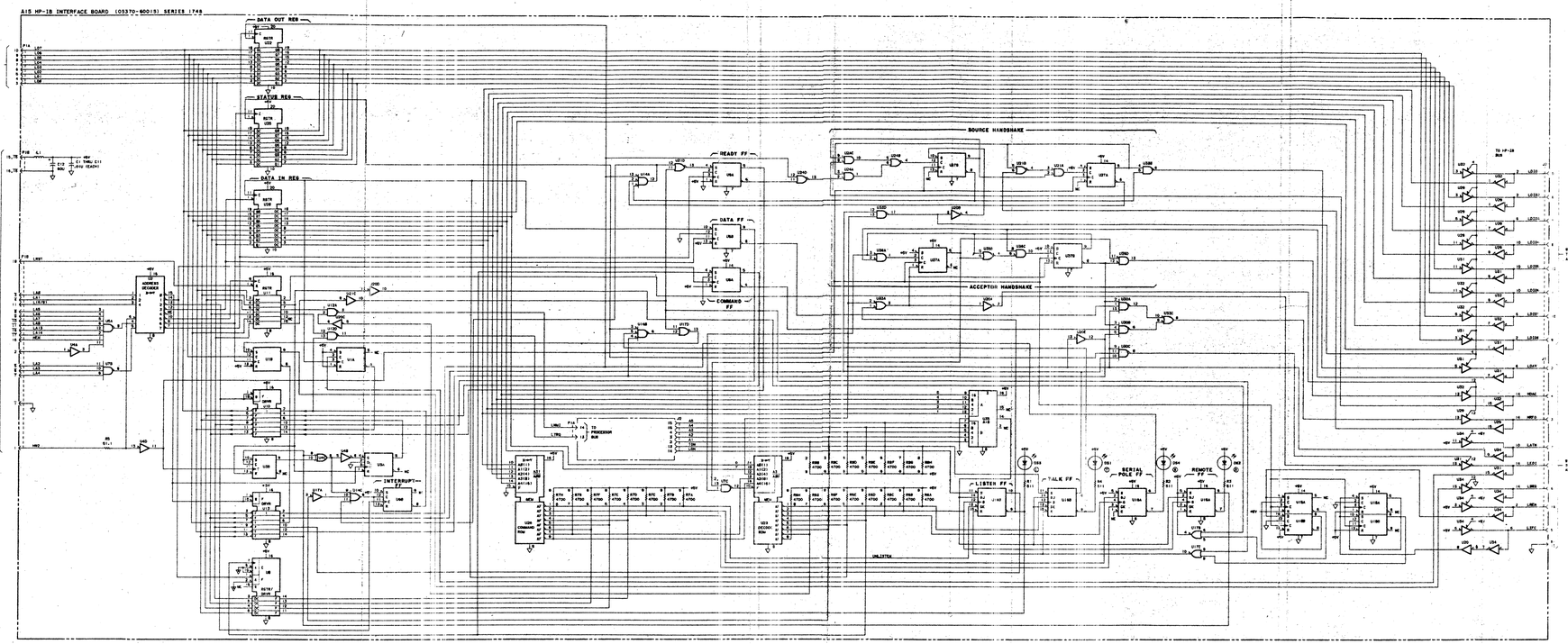
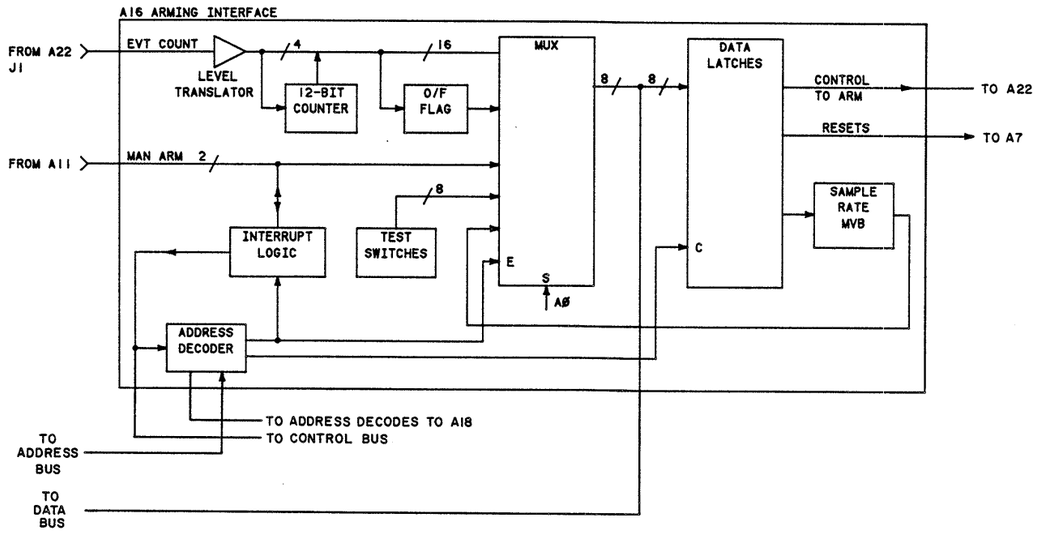
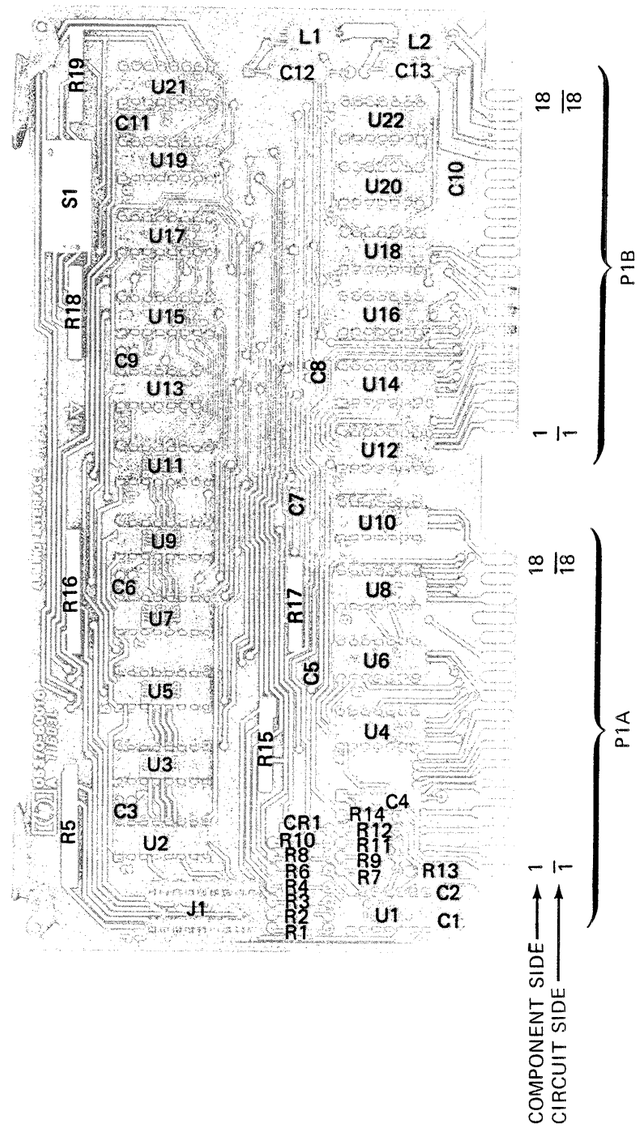


Figure 8-25. A15 HP-IB Interface Assembly



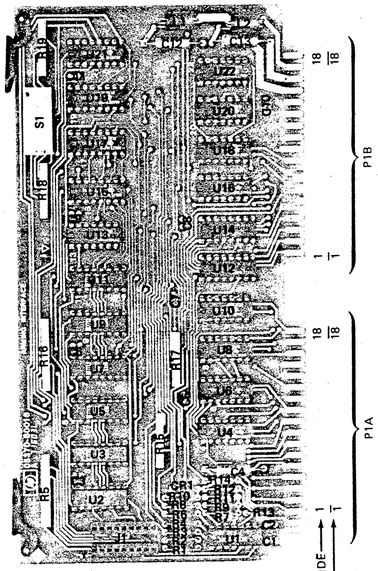
A16 ARMING INTERFACE ASSEMBLY

The Arming Interface Assembly (A16) contains the Address Decoder, Input/Output Registers, and Selector/Multiplexers needed for control interface between the Arming Assembly (A22), DAC/NØ Assembly (A18), and the Processor Assembly (A9).



A16

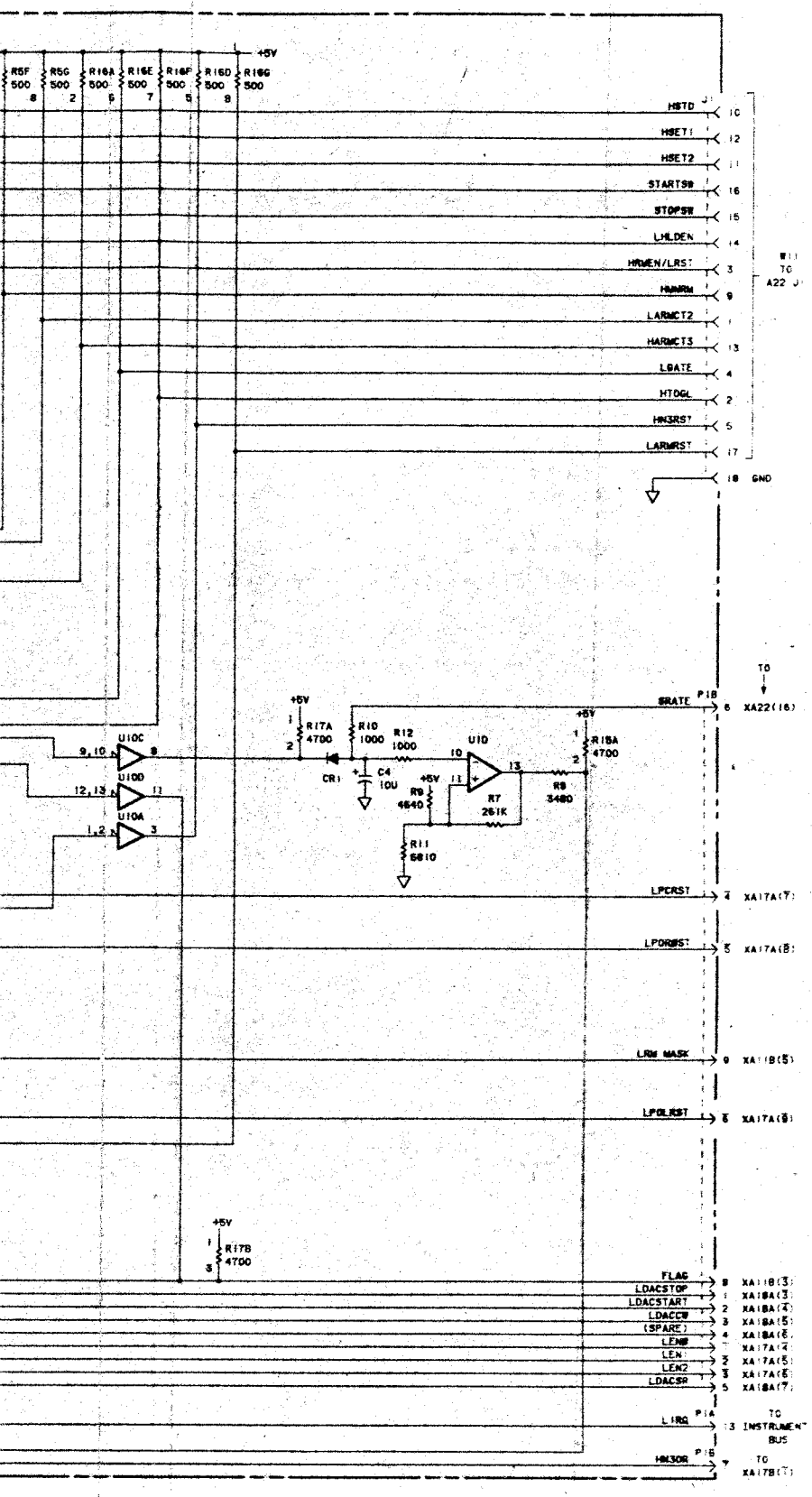
Part of Figure 8-26. A16 Arming Interface Assembly



A16

A16 ARMING INTERFACE ASSEMBLY (5370 60016) SERIES 1748

Figure 8



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 FARADS INDUCTANCE IN HENRIES
3. ASTERISK(*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN

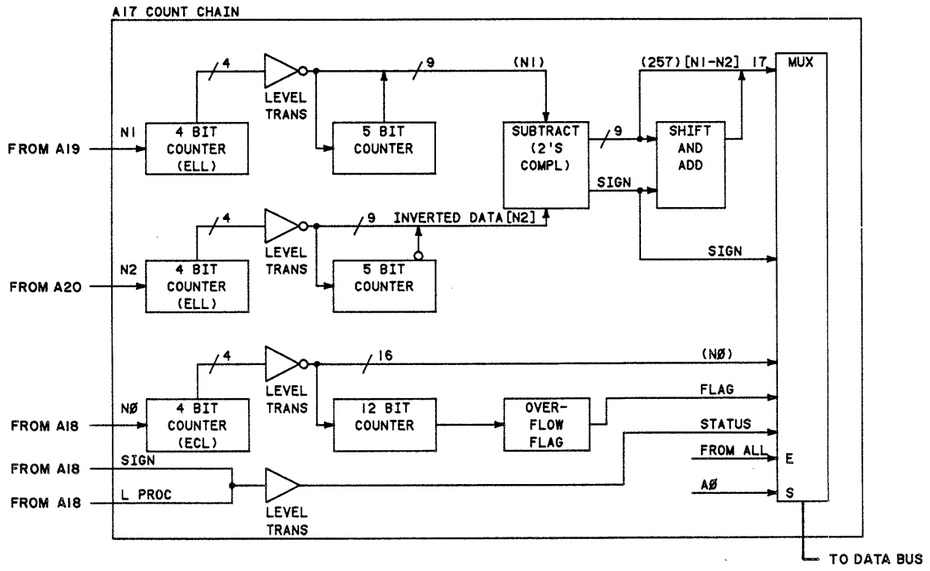
A16 Reference Designations

C1, C13
CR1
J1
L1, L2
R1, R19
S1
U1, U22

A16 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
CR1	1901-0040	1901-0040
U1	1826-0138	LM339N
U2,U3,U5,U7	1820-1195	SN74LS175N
U9, U11		
U4	1820-1207	SN74LS30N
U6	1820-1199	SN74LS04N
U8	1820-1202	SN74LS10N
U10	1820-0269	SN7403N
U12, U14	1820-1216	SN74LS138N
U13, U16	1820-1112	SN74LS74N
U15,U17,U19,U21	1820-1439	SN74LS258N
U18, U20, U22	1820-1443	SN74LS293N

Figure 8-26. A16 Arming Interface Assembly

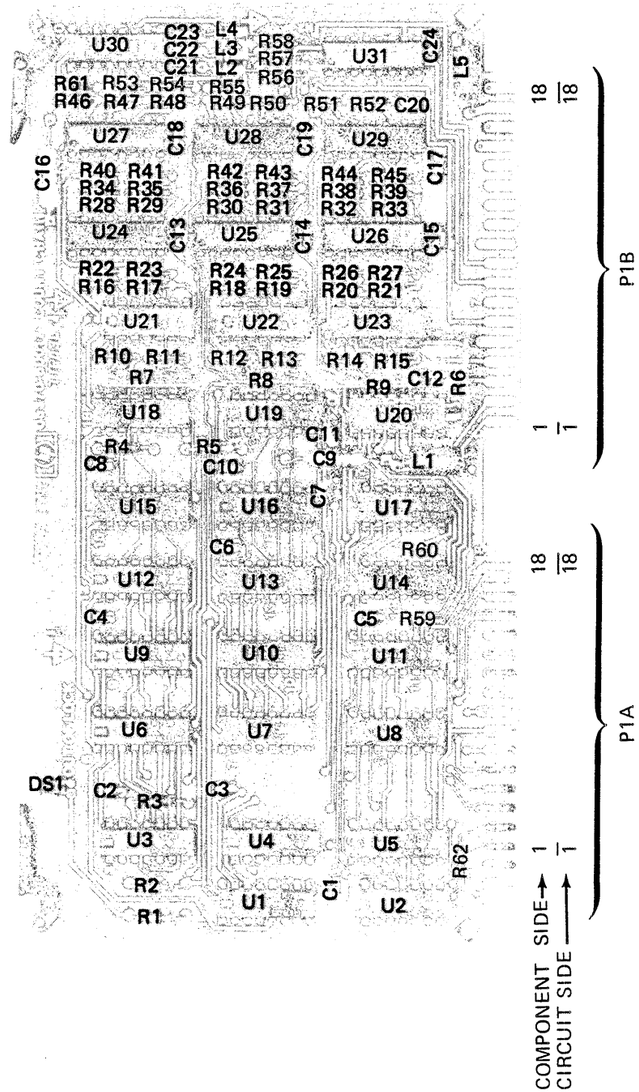


A17 COUNT CHAIN ASSEMBLY

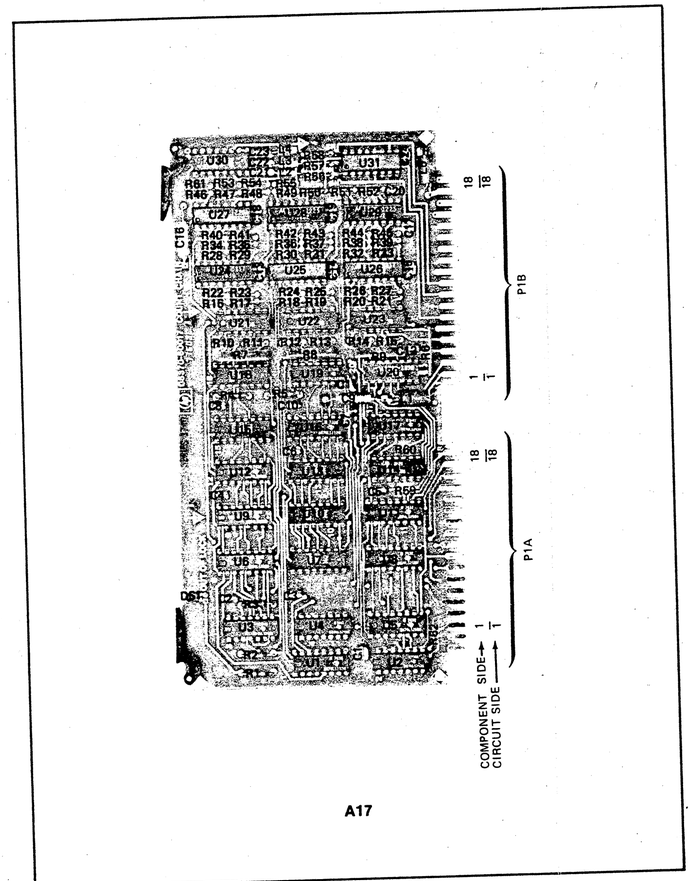
The Count Chain Assembly (A17) accumulates (counts) the N1 signal (Start Interpolator VCO output between the start input pulse and the VCO and 200 MHz reference coincidence), the N2 count (Stop Interpolator VCO output between the stop input pulse and the VCO and 200 MHz reference coincidence), and NØ (200 MHz reference burst between N1 and N2). Other inputs to the A17 Assembly are LPROC from the DAC/NØ Logic Assembly (A18) which indicates both Interpolators (A19, A20) have completed a measurement cycle; and the Sign input also from the DAC/NØ Logic Assembly, indicating a start coincidence first (sign is High) or stop coincidence first (sign is Low).

N1 and N2 counts enter a subtractor where the result is N1–N2. This count then enters a shift and add block where it is effectively multiplied by 257 giving the result 257•(N1–N2). This number along with NØ and the sign enter a multiplexer where it is then output to the processor (A9) via the data bus.

Part of Figure 8-27. A17 Count Chain Assembly



A17



A17

A17 COUNT CHAIN ASSEMBLY(05370-60017) SERIES 1832

ECL LOGIC

TTL LOGIC

N1 COUNTER

N2 COUNTER

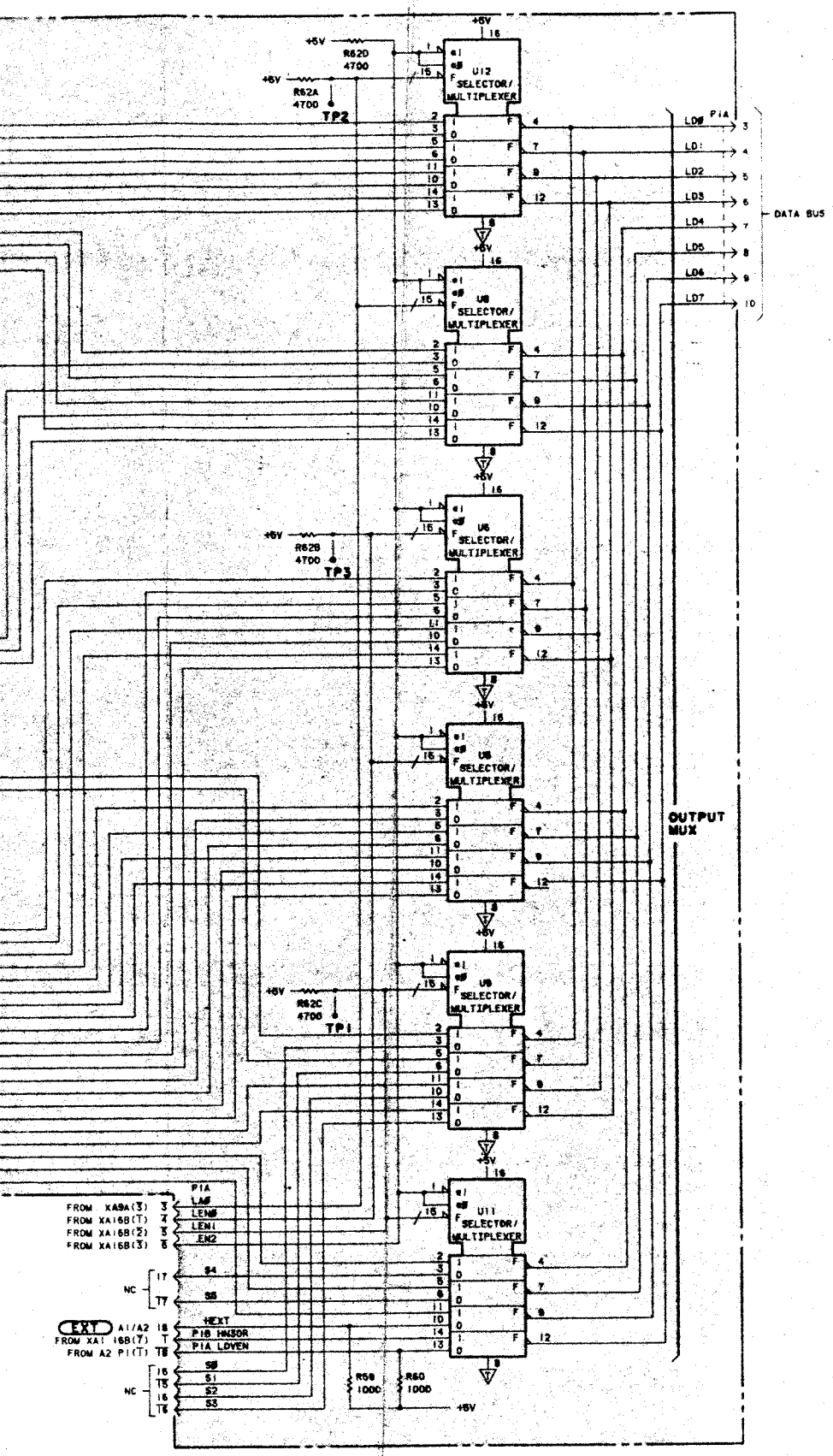
N3 COUNTER

SUBTRACT (2'S COMPLEMENT)

SHIFT ADDER

OVERFLOW FLAG

OUT OF LOCK



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 FARADS.
   INDUCTANCE IN HENRIES.
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
4. ON U21, U22 AND U23 VCC IS +5V AND IS CONNECTED TO PIN 3 AND GROUND IS -5V AND IS CONNECTED TO PIN 12.

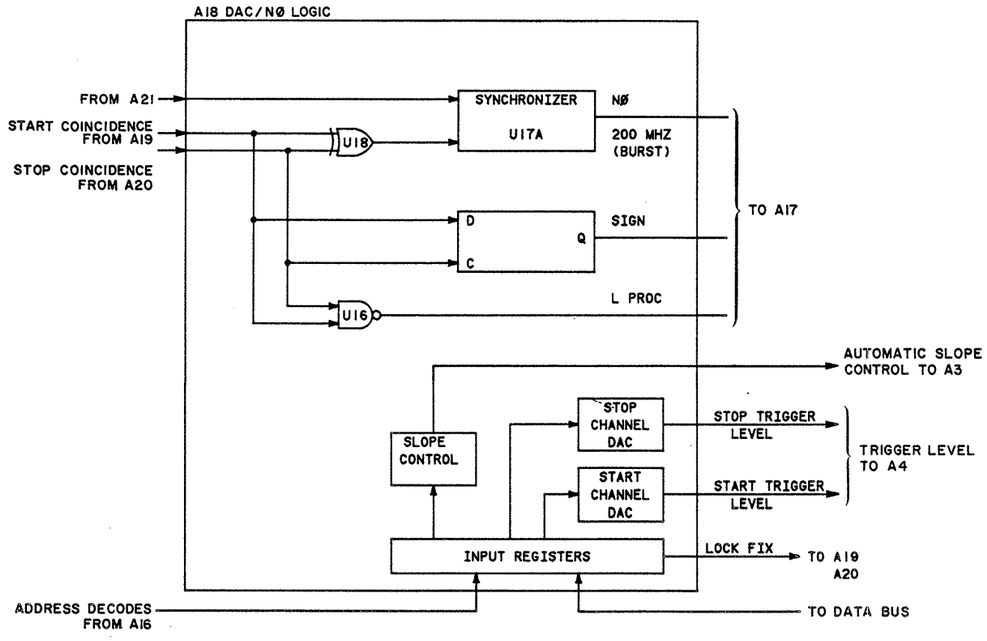
A17 Reference Designations

C1, C24
DS1
*L1, L5
R1, R61
U1, U31

A17 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
DS1	1990-0486	5082-4684
U1, U16	1820-1212	SN74LS112N
U2,U3,U4, U17, U19	1820-1443	SN74LS293N
U5,U6,U9, U11, U12	1820-1439	SN74LS258N
U7,U8,U10, U13,U15,U18	1820-1441	SN74LS283N
U14	1820-0586	SN74L04N
U20	1820-1052	MC10125L
U21,U22,U23	1826-0138	LM339N
U24,U25,U26	1820-0817	MC10131P
U27,U28,U29	1820-1225	MC10231P
U30	1820-0801	MC10101P
U31	1820-1224	MC10216P

Figure 8-27. A17 Count Chain Assembly

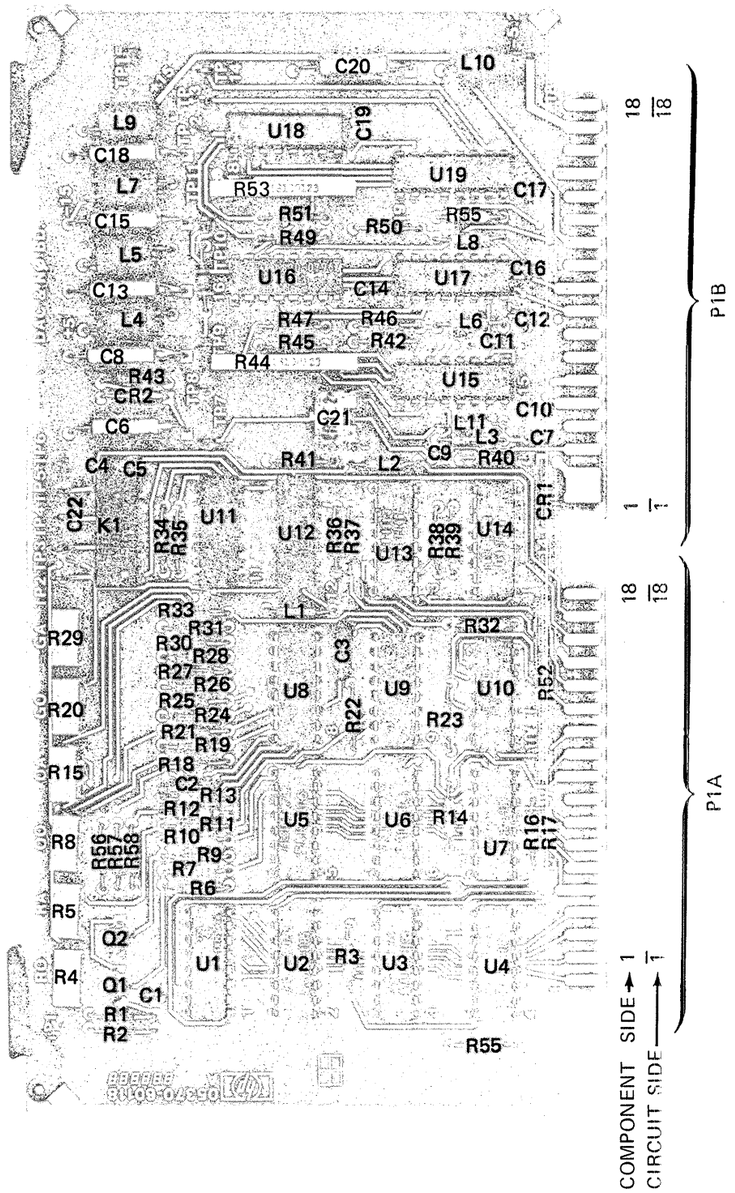


A18 DAC/NØ LOGIC ASSEMBLY

Between the time of the Start Coincidence and the Stop Coincidence, the 200 MHz reference frequency, from the 200 MHz Multiplier Assembly (A21), is gated to the Count Chain Assembly by the A18 Assembly. This 200 MHz burst is sent to the Count Chain Assembly as the NØ count. The DAC/NØ Logic Assembly also keeps track of which coincidence occurred first. This allows the DAC/NØ Logic Assembly to assign a positive (Start Coincidence first) or a negative (Stop Coincidence first) sign to the Time Interval.

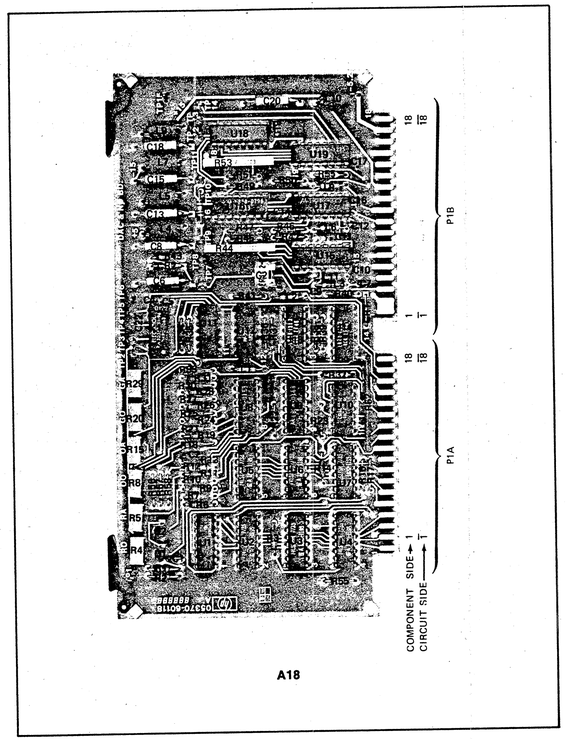
The DAC/NØ Assembly tells the processor, via the Count Chain board (A17), when the measurement has been completed (both Start and Stop Coincidences occurred). The DAC/NØ Logic Assembly contains the logic which allows the START and STOP input LEVEL control to be program set remotely via the HP-IB or to be monitored and displayed in DC volts. It also contains the logic which allows the input slopes to be remotely programmed.

The Lock Fix output from the DAC/NØ Logic Assembly to the Interpolator Assemblies (A19, A20) is active on power-up. When active, it gives the phase detectors on the Interpolators an indication that the VCO frequency is high. As a result, the VCO frequency is pulled low. When Lock Fix goes inactive, it releases the phase detectors which then lock the VCOs to the correct frequency. This is performed to insure that the VCOs lock to the correct sideband of the 200 MHz reference when the instrument is first turned on.



A18

Part of Figure 8-28. A18 DAC/NØ Logic Assembly



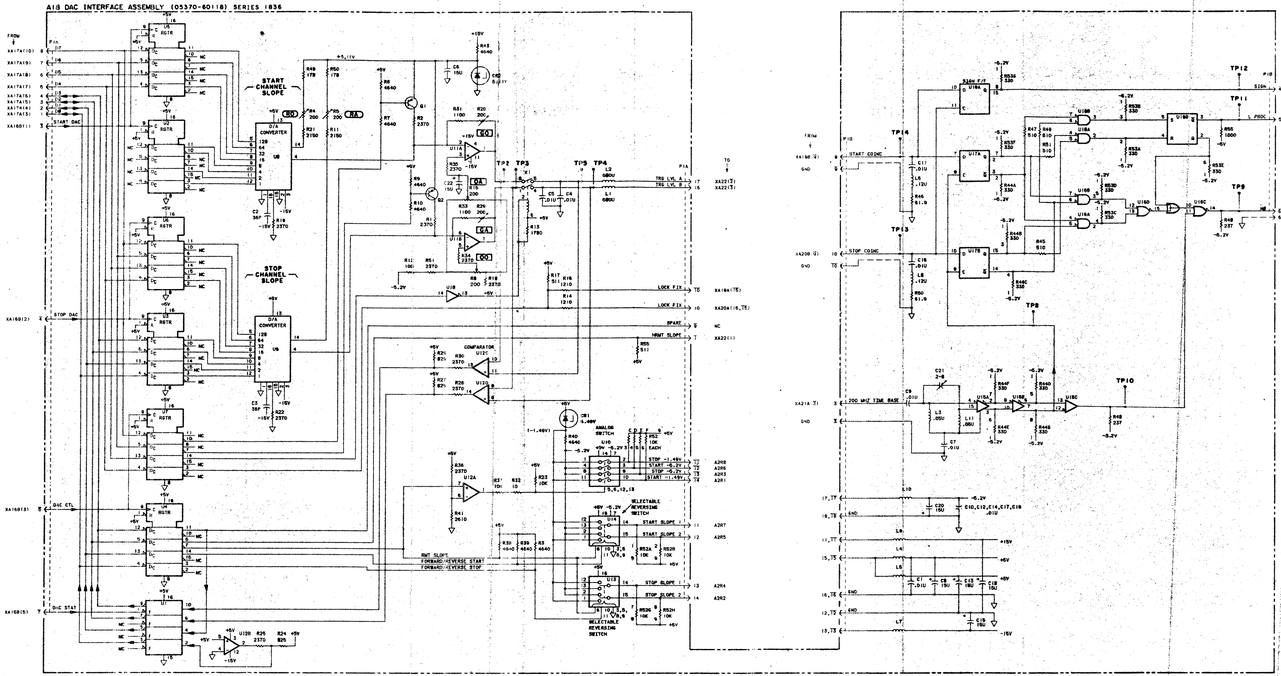
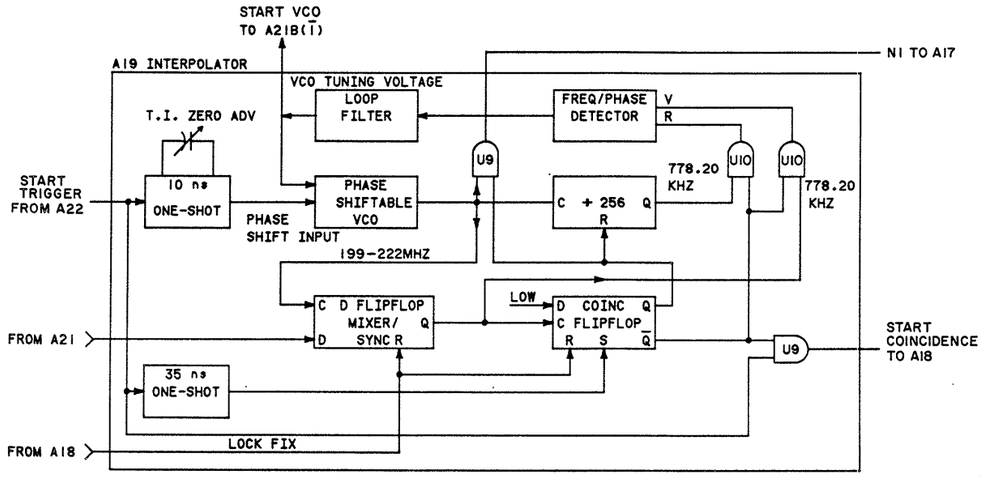


Figure 8-28. DAC/NØ Logic Assembly



A19 AND A20 INTERPOLATOR ASSEMBLIES

The two interpolators (A19 Start Interplator, A20 Stop Interpolator) are exactly the same. For this reason, only the START Interpolator will be discussed. The Interpolators are basically phase changeable, oscillation interruptible, phase-lock-loop oscillators.

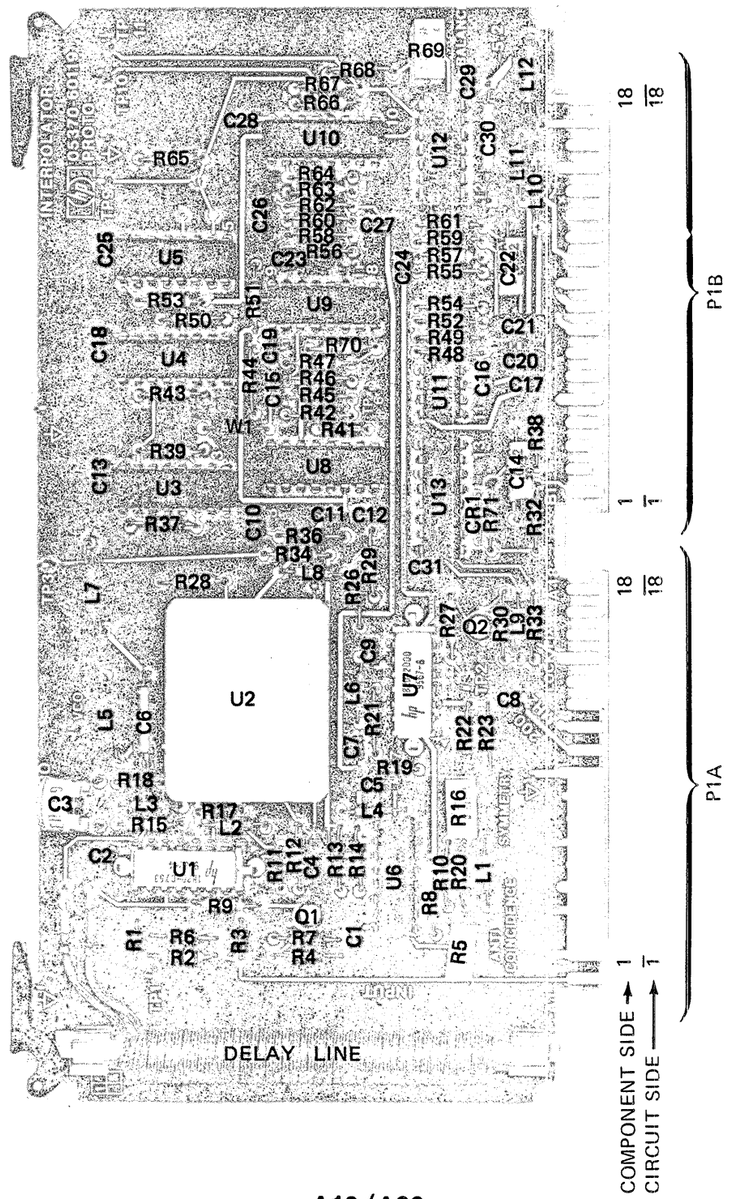
The START and STOP output triggers from the Arming Assembly (A22) are input to the START (A19) and STOP (A20) Interpolators, respectively. When an input trigger arrives, it goes to two delayed one-shot flip-flops and to the enable of the coincidence output gate. The VCO is inhibited from oscillating for about 10 nanoseconds after the arrival of the input trigger after which it is allowed to oscillate in a normal condition, but phase coherent to the trigger, and at its normal frequency of 199.2218 MHz, as controlled by the VCO tuning voltage. The VCO output is then passed to the counters on the Count Chain Assembly (A17) through the output gate.

At the same time, the coincidence flip-flop is held in the set condition for about 35 nanoseconds after the arrival of the input trigger, after which the set enable goes inactive. During this 35 nanoseconds, the Q output of the coincidence flip-flop goes low which disables the gated coincidence output and breaks the feedback loop to the Frequency-Phase detector. Also during the 35 nanoseconds, the Q output of the coincidence flip-flop is high which holds the ÷256 divider in reset and enables the N1 output gate.

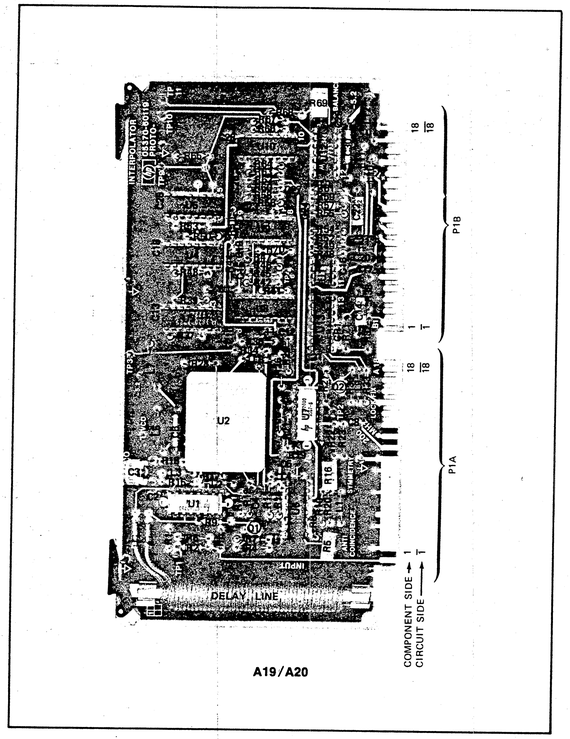
After the 35 nanosecond delay, the coincidence flip-flop is released from the set condition. With the next low to high output from the Mixer/Synchronizer, which signifies a phase coincidence of the 200 MHz reference and the VCO, a low is clocked to the Q and a high to the Q outputs of the coincidence flip-flop. This sends a phase coincident signal to the DAC/NØ Logic Assembly (A18), enables the divided VCO and the Mixer reference to the Frequency/Phase detector, which then allows the VCO to be frequency corrected if needed, releases the reset on the VCO divider, and disables the gated N1 output.

The counter now has an N1 count in the Count Chain Assembly (A17), and a START COINCIDENCE signal in the DAC/NØ Logic Assembly (A18). The same operation is performed in the Stop Interpolator (A20) which gives an N2 count in the Count Chain Assembly and a STOP COINCIDENCE signal in the DAC/NØ Logic Assembly.

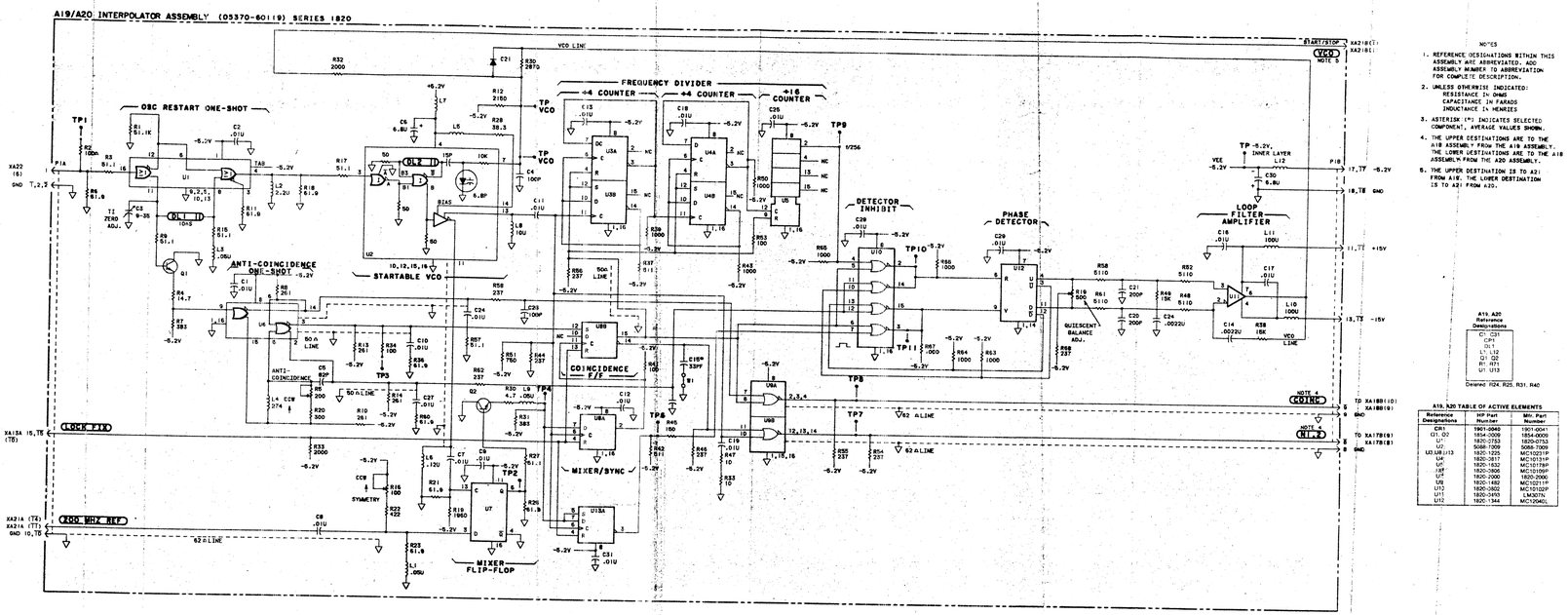
Part of Figure 8-29. A19 and A20 Interpolator Assembly



A19/A20



A19/A20



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 FARADS INDUCTANCE IN HENRIES
3. ASTERISK (*) INDICATES SELECTED COMPONENT, AVERAGE VALUES SHOWN.
4. THE UPPER DESTINATIONS ARE TO THE A19 ASSEMBLY FROM THE A19 ASSEMBLY. THE LOWER DESTINATIONS ARE TO THE A19 ASSEMBLY FROM THE A20 ASSEMBLY.
5. THE UPPER DESTINATION IS TO A2: FROM A19. THE LOWER DESTINATION IS TO A2: FROM A20.

A19, A20 Reference Designations

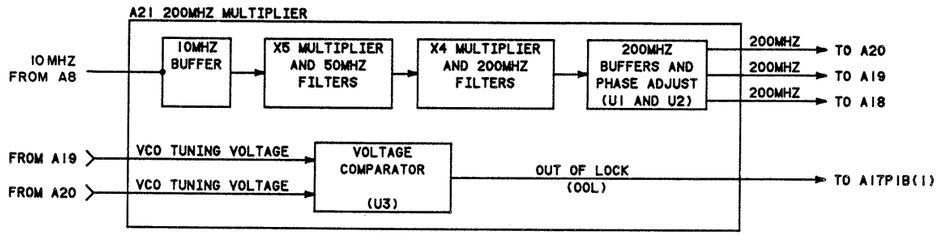
C: C31
CR1
L: L11, L12
Q1, Q2
R: R71
U13

Deleted: R24, R25, R31, R40

A19, A20 TABLE OF ACTIVE ELEMENTS

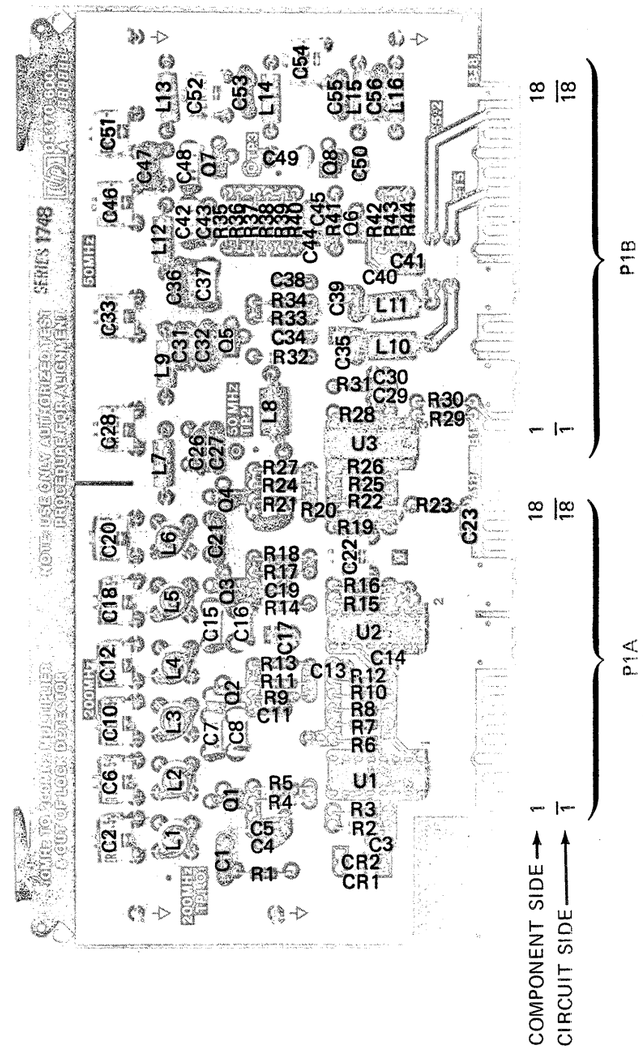
Reference Designation	HP Part Number	Mfr. Part Number
CR1	1901-0040	1901-0041
Q1, Q2	1854-0071	1854-0053
U1	1820-1733	MC10179P
U2	5088-7009	5088-7009
U3,U8,U13	1820-1225	MC10231P
U4	1820-2817	MC10131P
U5	1820-1632	MC10179P
U6*	1820-2806	MC10109P
U7	1820-2900	1820-2900
U9	1820-1662	MC10211P
U10	1820-3452	MC10216P
U11	1820-2493	LM307N
U12	1820-1344	MC12040L

Figure 8-29. A19 Start Interpolator Assembly, A20 Stop Interpolator Assembly



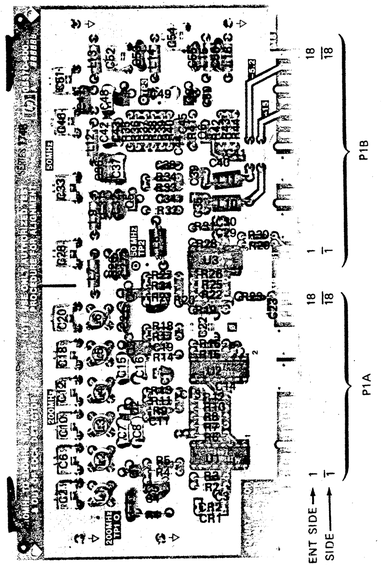
A21 200 MHz MULTIPLIER ASSEMBLY

The 200 MHz Multiplier Assembly (A21) multiplies the 10 MHz input to 200 MHz. This is accomplished by two cascaded multipliers (X5 and X4) and filter stages. The 200 MHz is then buffered, sent to the interpolators (A19, A20), and phase adjusted and sent to the DAC Assembly (A18). There is also a separate voltage comparator circuit which compares each VCO tuning voltage from the two interpolators with fixed reference voltages. When either VCO tuning voltage is outside designed limits, a signal is sent to the A17 Count Chain Assembly where it is latched as a status bit.



A21

Part of Figure 8-30. A21 200 MHz Multiplier Assembly



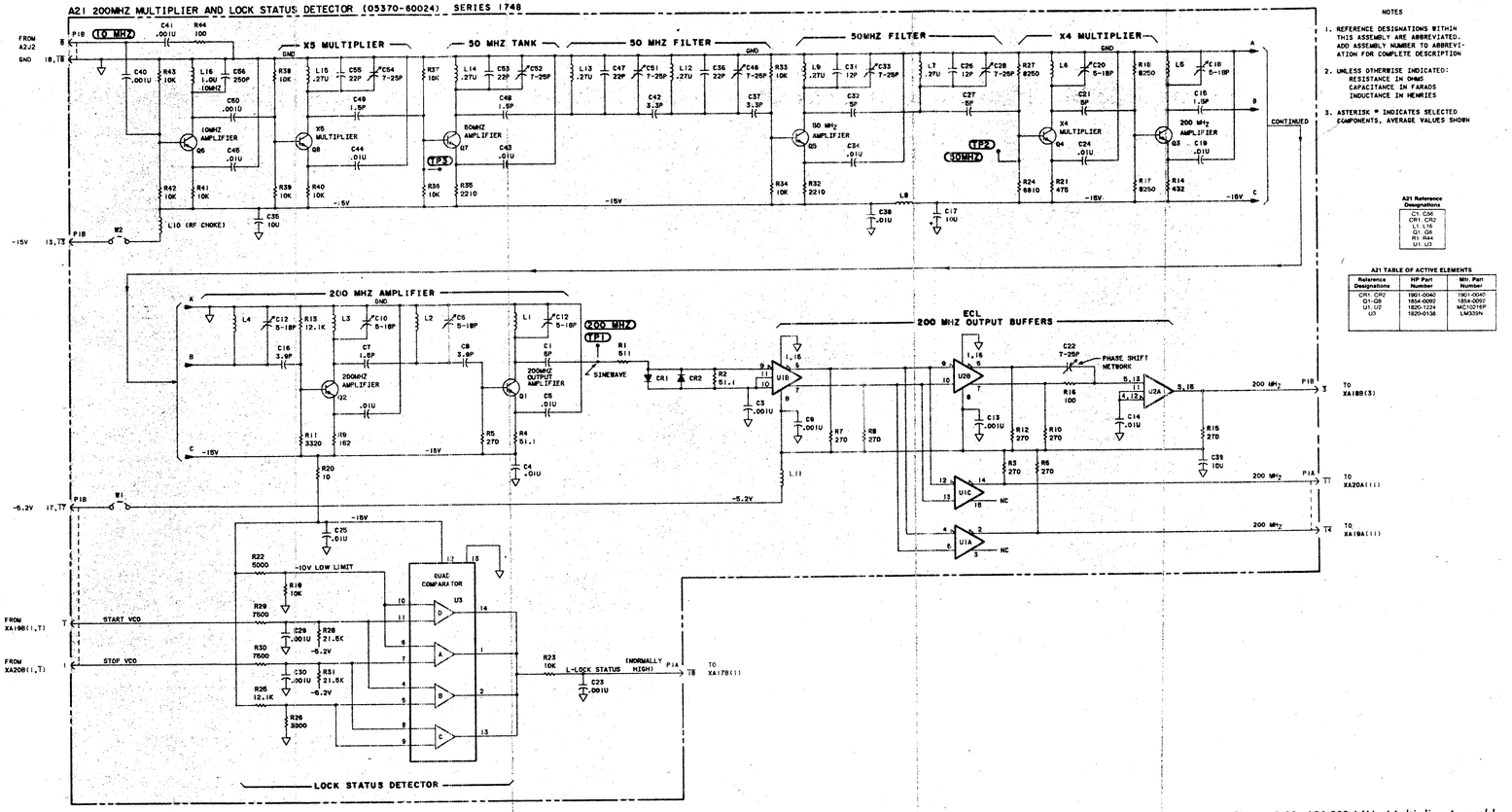
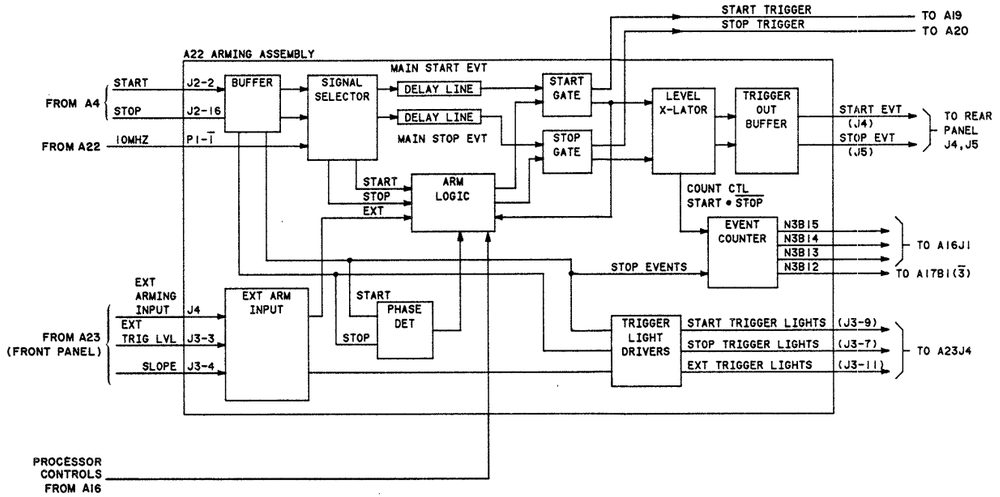


Figure 8-30. A21 200 MHz Multiplier Assembly



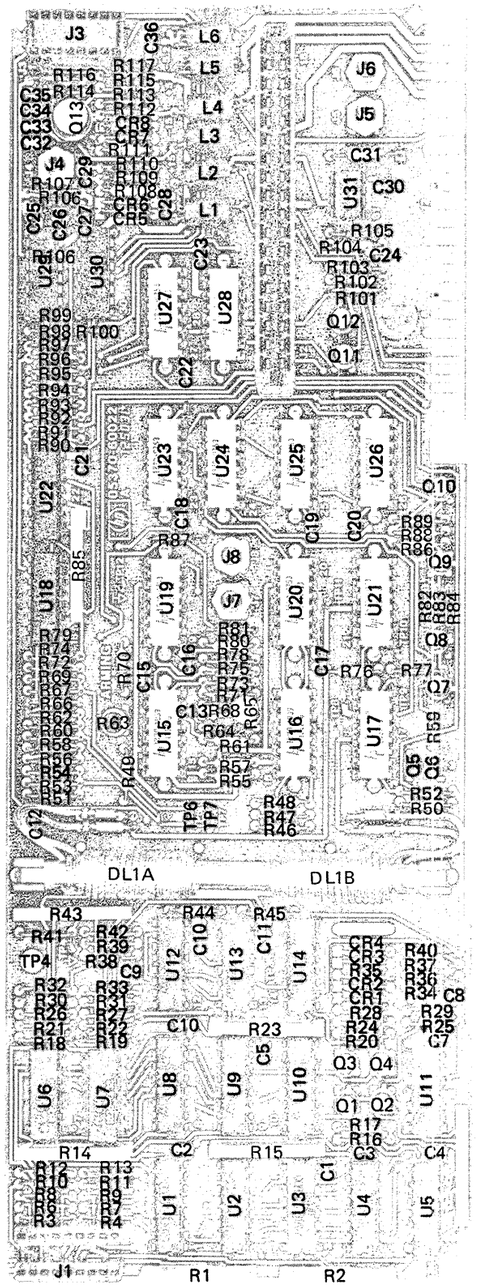
A22 ARMING ASSEMBLY

The arming assembly is responsible for gating the input START and STOP signals to the Start (A19) and Stop (A20) Interpolator Assemblies. This gating can be controlled either internally, externally, or remotely. The Arming Assembly is also responsible for driving the START, STOP, and EXT trigger lights on the front panel, sending a START and a STOP EVENT signal coincident with the START and STOP gate opening to the rear panel jacks J4 and J5, and for partially counting the number of STOP EVENTS ignored in the case of EXT ARM/EXT HOLDOFF or frequency or period gate times.

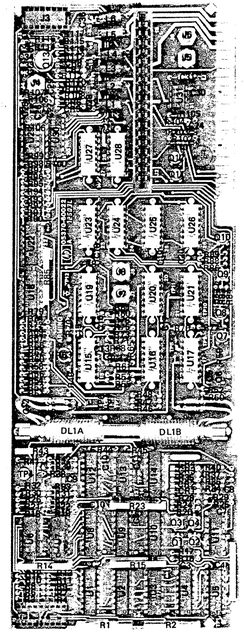
In normal operation, the Arming Assembly gates one input signal to each interpolator board. Further input signals are then held off from passing to the interpolators by the processor until the processor is ready for the next sample of input signals.

The operation is basically the same when using an EXT ARMing input signal. The EXT ARM signal is applied to the machine via J1 on the front panel. Front panel controls allow the operator to select triggering on either the positive or the negative slope. A level control selects the voltage where triggering occurs.

Part of Figure 8-31. A22 Arming Assembly



A22



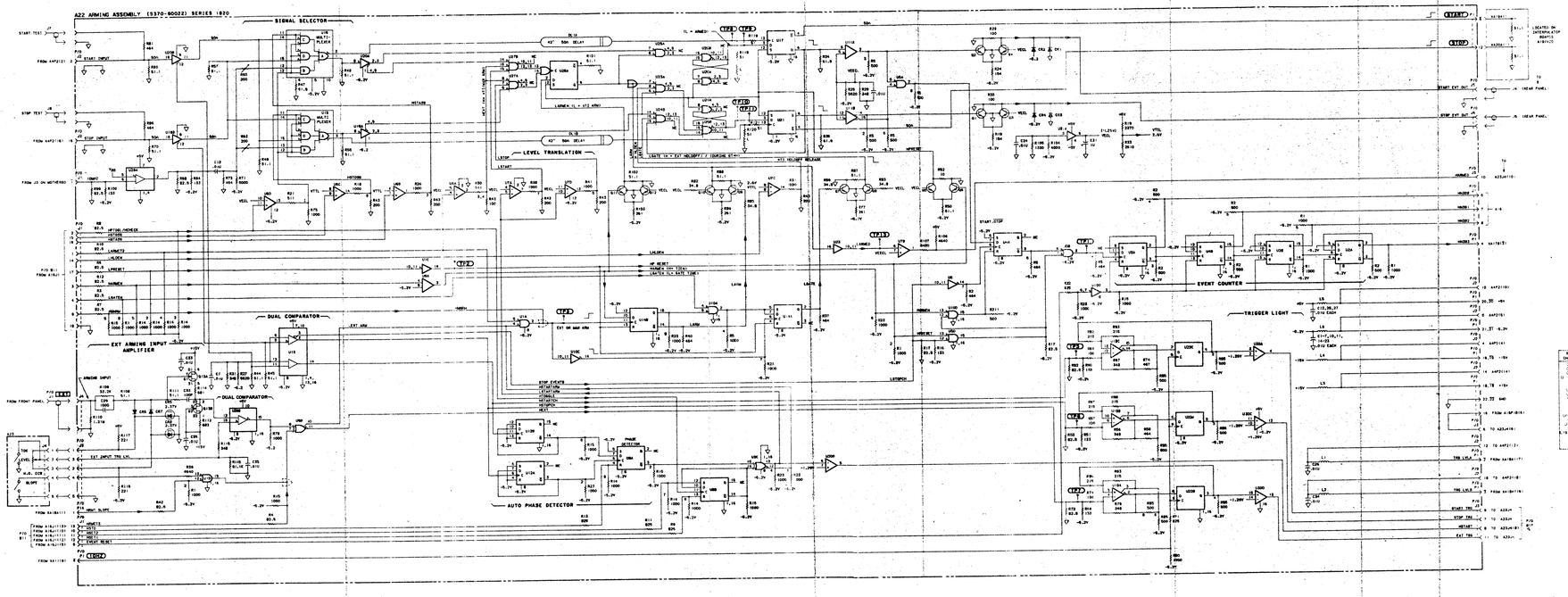
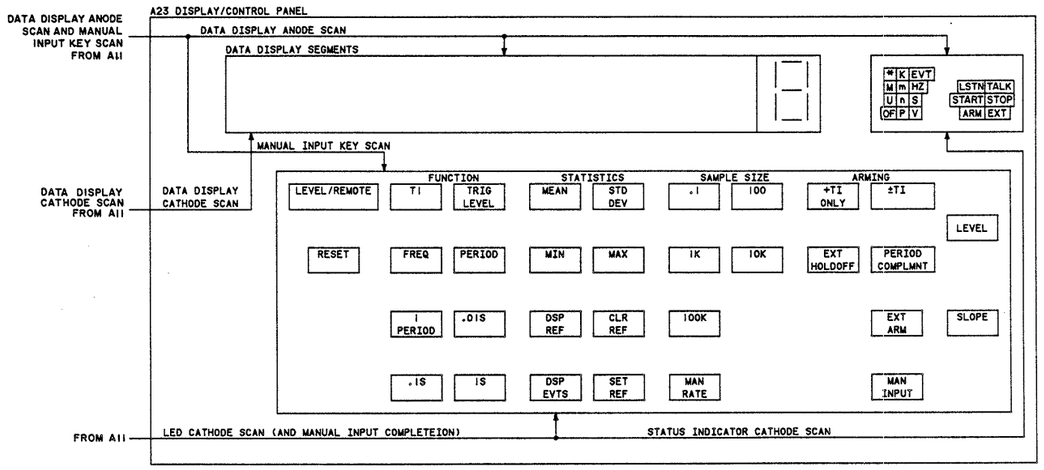
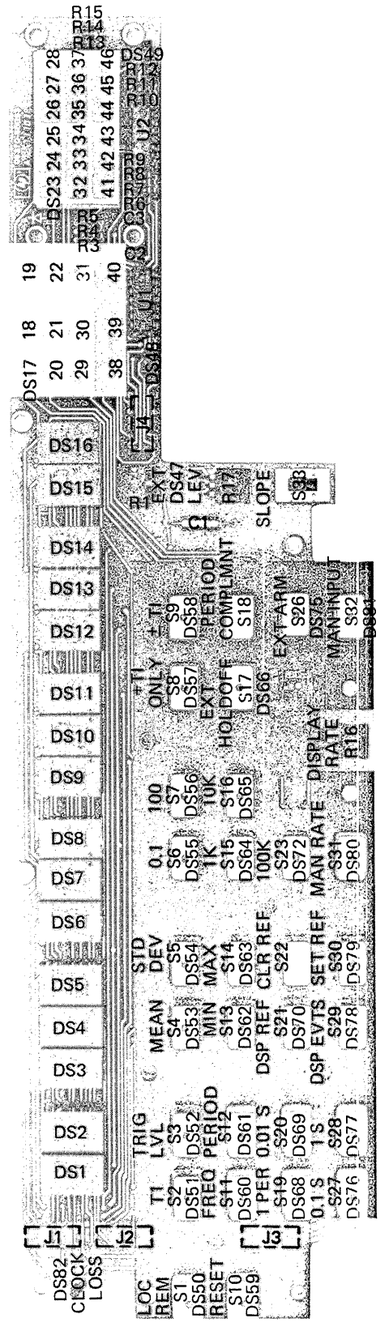


Figure 8-31. A22 Arming Assembly

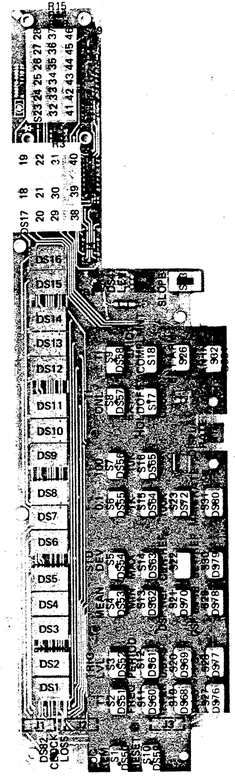


A23 DISPLAY/CONTROL PANEL ASSEMBLY

The Display/Control Panel Assembly (A23) contains the seven-segment LED displays, the LED annunciators, and the keyboard.



Part of Figure 8-32. A23 Display/Control Panel Assembly



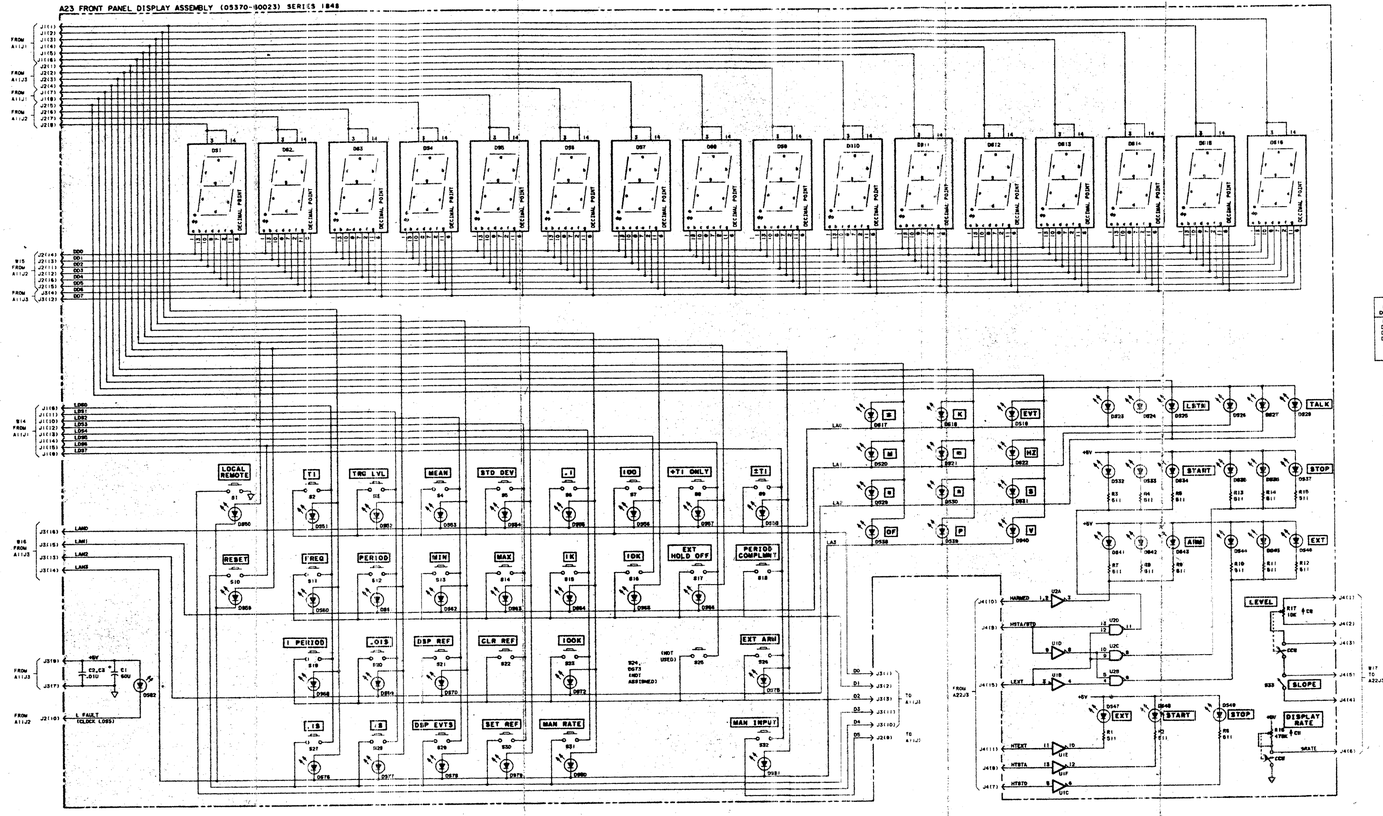
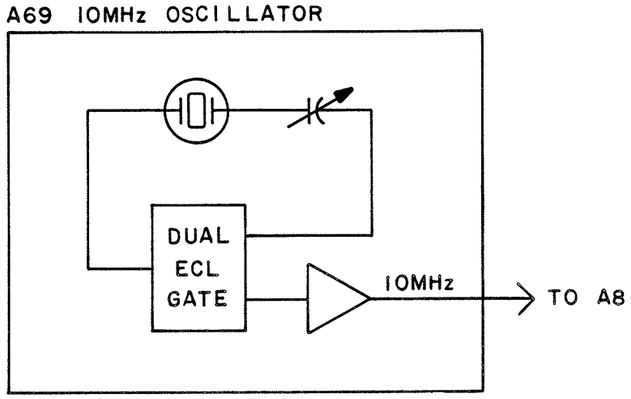


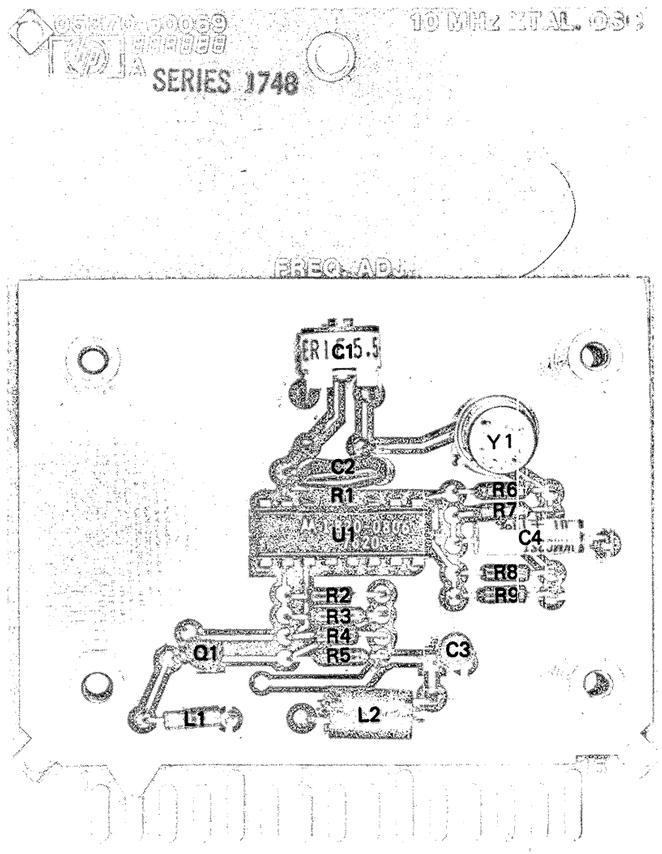
Figure 8-32. A23 Front Panel Display Assembly



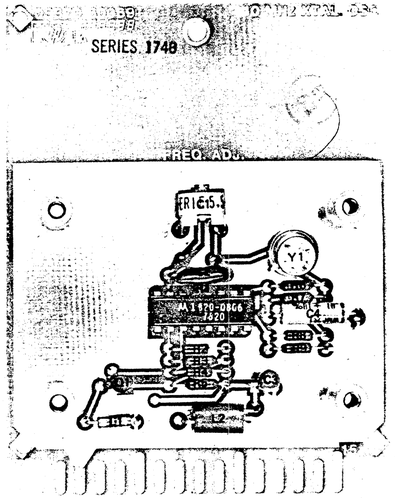
A69 10 MHz OSCILLATOR ASSEMBLY

The standard A69 Assembly is a room temperature 10 MHz crystal oscillator. It consists of a crystal controlled oscillator stage and an output buffer stage. The 10 MHz output is sent to the A8 Reference Frequency Buffer Assembly. An Optional (Option 001) 10 MHz Oscillator is available. This is an oven temperature controlled crystal oscillator with higher stability. Included with this option is the Oven Oscillator Power Supply Assembly (A7) which provides unregulated +25 volts to power the oven and regulated +11 volts and +12 volts to power the oven controller and oscillator amplifier, respectively.

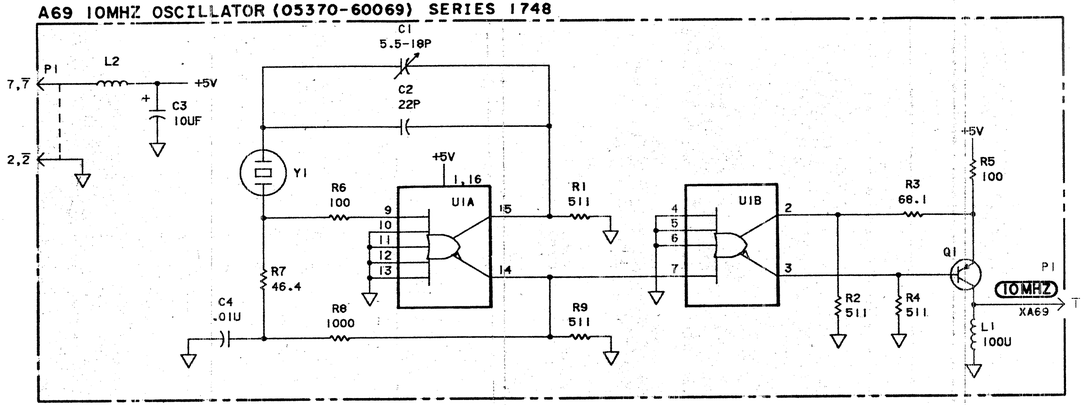
Part of Figure 8-33. A69 10 MHz Oscillator Assembly



A69



A69



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 FARADS
   INDUCTANCE IN HENRIES.
3. ASTERISK (*) INDICATES SELECTED COMPONENT. AVERAGE VALUES SHO

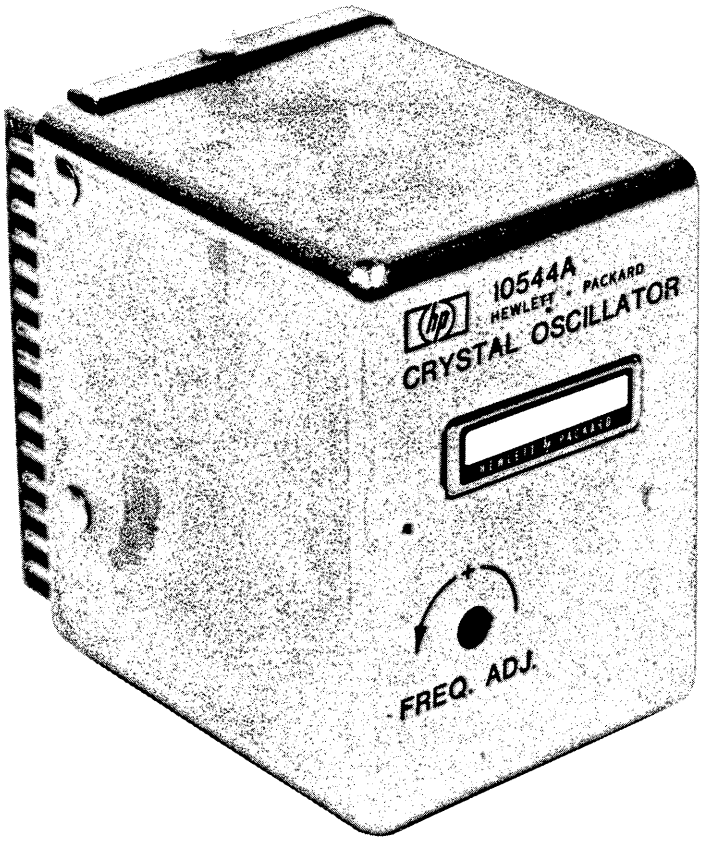
A69 Reference Designations

C1, C4
L1, L2
Q1
R1, R9
U1
Y1

A69 TABLE OF ACTIVE ELEMENTS

Reference Designations	HP Part Number	Mfr. Part Number
Q1	1853-0015	1853-001
U1	1820-0806	MC10109
Y1	0410-0423	0410-042

Figure 8-33. A69 10 MHz Oscillator Asse



NOTE

This assembly is held in place by two screws located on the bottom of A16 Motherboard.

Part of Figure 8-34. A69 10 MHz Oscillator (10544A) Option 001 Component Locator

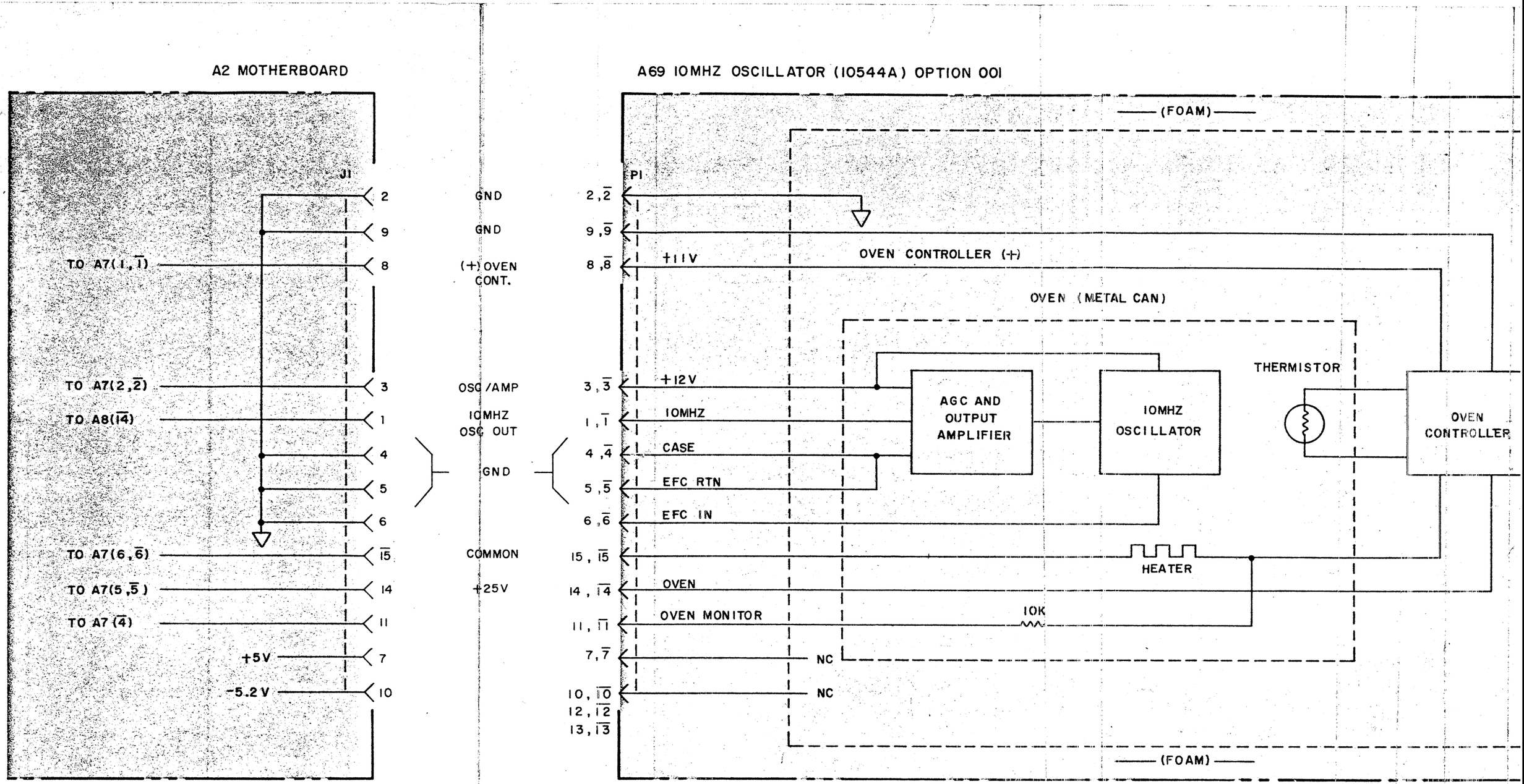


Figure 8-34. A69 10 MHz Oscillator (Mode 1