HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

7970B/7970C

DIGITAL MAGNETIC TAPE UNITS

Serial Numbers Covered

This manual applies directly to HP 7970B/7970C Digital Magnetic Tape Units having serial numbers prefixed 1329. Units with higher serial number prefixes will be covered by updating supplements. Units with serial numbers prefixed 1323 and below are covered by a backdating appendix located at the back of this manual.

Options Covered

This manual covers options 006, 007, 012, 013, 014, 015, 016, 017, and 023 as well as the standard HP 7970B/7970C Digital Magnetic Tape Units.

07970-90383

PRINTED: AUG 1973

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HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

PART 1

7970B/7970C

DIGITAL MAGNETIC TAPE UNITS

OPERATION AND GENERAL INFORMATION

Serial Numbers Prefixed: 1329

Note

This manual may be backdated to cover earlier versions of the tape unit by incorporating appropriate backdating information from appendix A.

07970-90383

PRINTED: AUG 1973

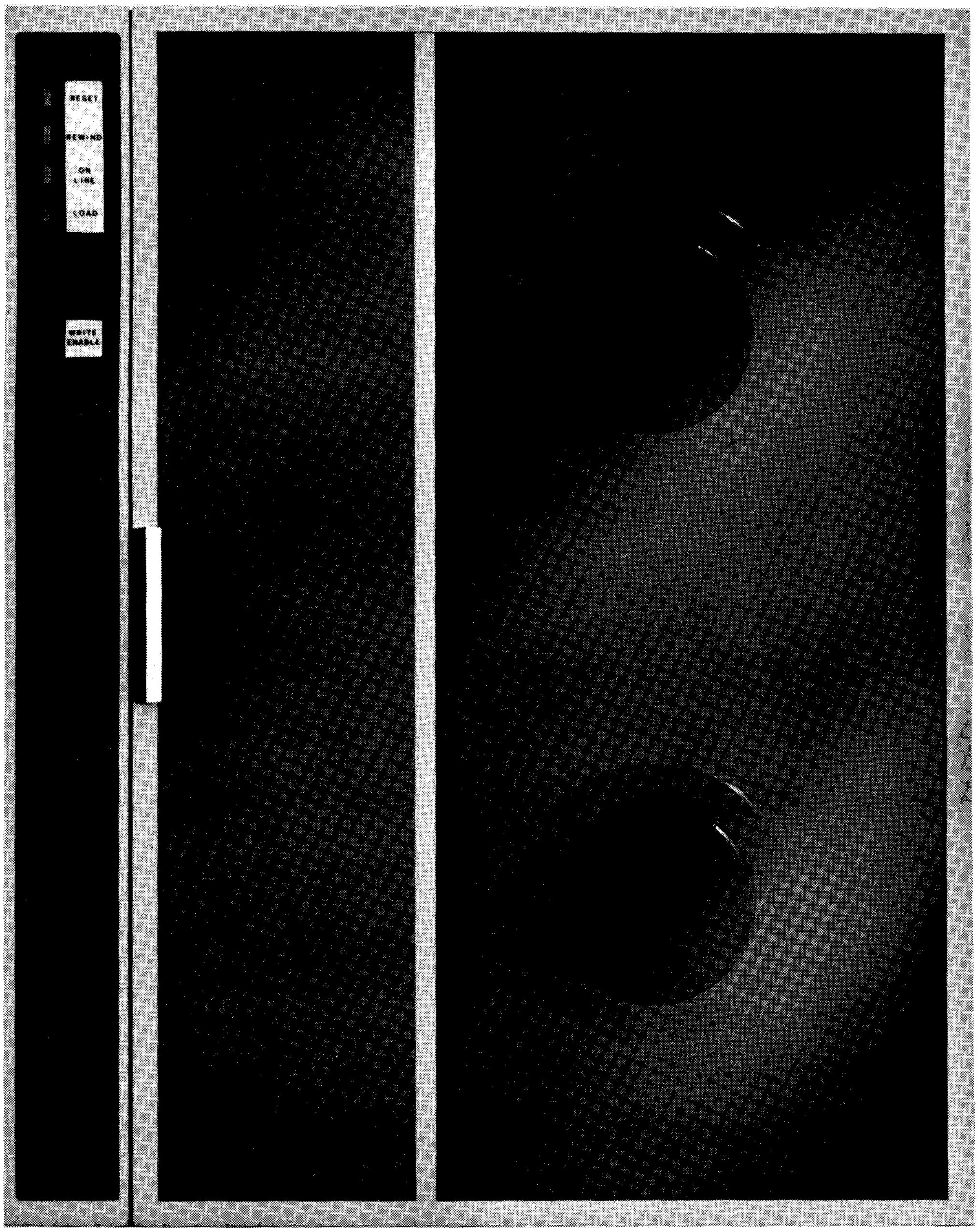

Figure 1-1. Hewlett-Packard 7970B/7970C Digital Magnetic Tape Units

HEWLETT hp PACKARD

7970B/7970C
DIGITAL MAGNETIC TAPE UNITS
OPERATING AND SERVICE MANUAL

UPDATING SUPPLEMENT

10 APR 1974

MANUAL IDENTIFICATION

Manual Serial No. Prefix: 1329

Manual Printed: Aug 1973

Manual Part No.: 07970-90383

Microfiche Part No.: 07970-90820

SUPPLEMENT DESCRIPTION

The purpose of this supplement is to adapt the manual to equipment containing production improvements made subsequent to the printing of the manual and to correct manual errors. Enter the new information (or the Change Number, if more convenient) into the appropriate places in the manual, identified at left. For any given instrument serial number prefix all change steps noted for prior serial number prefixes must be incorporated in addition to those for the given prefix.

INSTRUMENT CHANGES

Serial No. Prefix	Change
All (Errata)	1 thru 8, 9 thru 15, 20 thru 22, 27 thru 34, 41 thru 47, 54, 55, 60, 66 thru 70
~~1343~~	~~16~~ DELETED
1344	17 thru 19
~~1348~~	~~23 thru 26~~ DELETED
*1350	35 thru 40
1408	23 thru 26
1410	56 thru 59
1411	61 thru 65

ASSEMBLY CHANGES

Ref Des	Description	HP Part No.	Series	Changes
~~A19~~	~~Transformer Assy~~	~~07970-60471~~	~~1343~~	~~16~~ DELETED
A21	Power Regulator PCA	07970-61010	1344	17 thru 19
A16	Control and Status PCA	07970-61080	1348	23 thru 26
A15	Read Preamplifier PCA	07970-62297	1350	35 thru 40
A15	Read Preamplifier PCA	07970-60500	1350	35 thru 40
A12	Density Select PCA	07970-62087	1330	48 thru 50
A12	Density Select PCA	07970-62088	1330	51 thru 53
A6	Capstan Servo PCA	07970-62172	1410	56 thru 59
A19	Transformer Assy	07970-60471	1411	61 thru 65

Changes 1 through 6 dated 8 August 1973.
Changes 7 and 8 dated 3 October 1973.
Changes 9 through 16 dated 9 October 1973.
Changes 17 through 22 dated 17 October 1973.
Changes 23 through 32 dated 9 November 1973.
Changes 33 through 40 dated 14 December 1973.
Changes 41 through 45 dated 9 January 1974.
Changes 46 through 54 dated 1 February 1974.
Changes 55 through 65 dated 15 February 1974.
Changes 66 through 70 dated 10 April 1974.

*NOTICE: Instrument serial number prefix 1350 is applicable to low speed units only.

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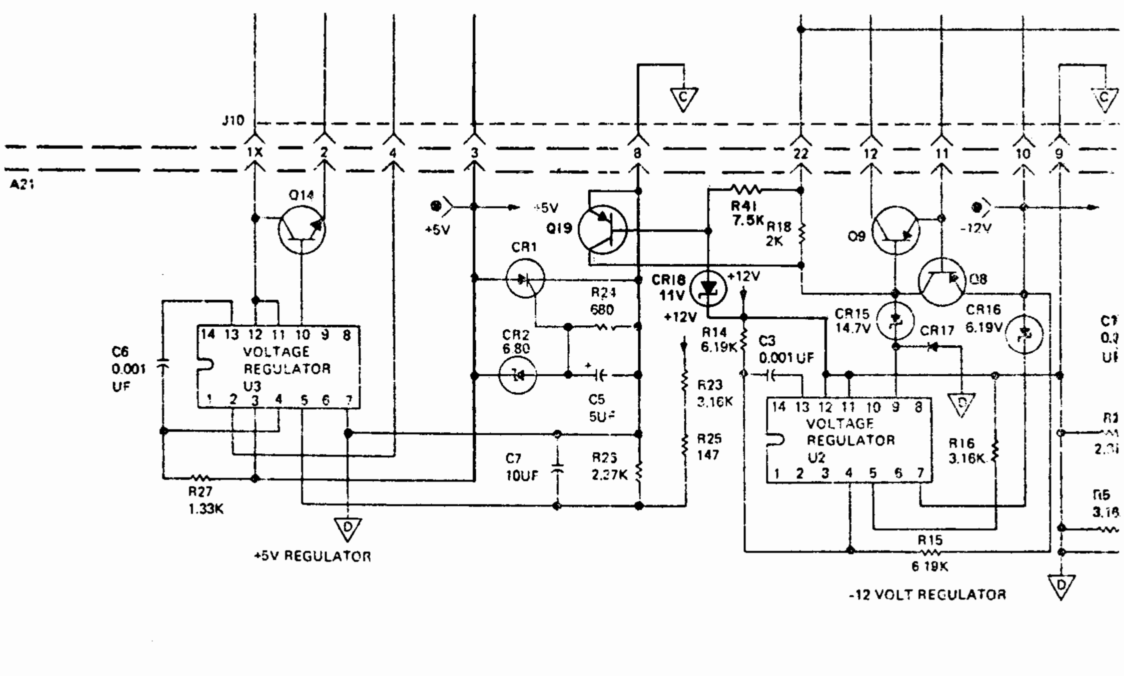
Printed in U.S.A.

CHANGE	DESCRIPTION
1	Part 5, page 3-5. Delete reference to 07970-62012 PC assembly for 21-45 ips tape units and substitute the 07970-62035 PC assembly parts list attached at the back of this supplement.
2	Part 5, page 3-7. Change item 1 part no. from 07970-62003 to 07970-62060.
3	Part 5, page 3-11. Delete reference to 07970-62005 PC assembly for 21-45 ips tape units and substitute the 07970-62061 PC assembly parts list attached at the back of this supplement.
4	Part 5, page 4-5, figures 4-3 and 4-4. Delete reference to 07970-62012 PCA for 21-45 ips tape units and substitute the 07970-62035 PCA component location and schematic diagrams attached at the back of this supplement.
5	Part 5, page 4-7. Replace page 4-7 with page 4-7 attached at the back of this supplement.
6	Part 5, page 4-9, figure 4-6 and 4-7. Delete reference to 07970-62005 PCA for 21-45 ips tape units and substitute the 07970-62061 component location and schematic diagrams attached at the back of this supplement.
~~7~~	~~Part 3, page 3-5. Change the description for item 6 (10-209 ips entry) to 4.64K. Change the description for item 6 (21-45 ips entry) to 17.1K.~~ SUPERCEDED
~~8~~	~~Part 3, page 4-5, figure 4-4. Change the value of the following resistors to 4.64K: R1, R5, R9, R13, R17, R21, R25, R29, and R33.~~ SUPERCEDED
9	Part 3, page 2-1, paragraph 2-10. Change threshold level specification for high-speed read mode to 1.0 volt ±1%.
10	Part 1, page 1-5, paragraph 1-32. After item c, add the following note: The 5080-4525 test tape is applicable for both 7-track and 9-track tape units. Refer to part 2, page 3-3 for test operating instructions.
11	Part 3. On pages 3-13, 3-15, 3-19, and 3-23, change the part no. for C12 (and C112) from 0160-3449 to 0160-3457.
12	Part 5. On pages 3-13, 3-15, 3-19, and 3-23, change the part no. for C12 (and C112) from 0160-3449 to 0160-3457.
13	Part 2, page 6-36, figure 6-13. Add identification for C21 to the right of K1.
14	Part 2, page 6-37. Make the following changes to the replaceable parts list. a. Delete CR10, Q21, R64, and R107. b. Change R16 and R35 value to 1K; change mfr. part no. to 0757-0280. c. Change R39 and R41 value to 464K. d. Change R65 to R53. ~~e. Change R108 to part no. 0757-0280, 1K.~~ DELETED f. Add R109, part no. 0757-0280, 1K. g. Add note to parts list indicating that Q3 and Q7 are 1853-0328 for PCA series 1321; Q4 and Q8 are 1853-0282 for PCA series 1321.

CHANGE	DESCRIPTION
15	Part 2, page 7-11, figure 7-10. Change connector J6 position diagrams to show the dummy plug in the lower right corner position for 10-18 ips operation.
~~16~~	~~Part 2, page 6-47. Change item 28 part no. from 3101-0003 to 3101-0646.~~ DELETED
17	Part 2, page 6-41. Add the following components to the replaceable parts list. a. 1902-3171, Diode, zener, 11V, 5%, 400 mW, (CR18) b. 0757-0440, Resistor, fxd film, 7.5K, 1%, 1/8W, (R41) c. 1853-0036, Transistor, PNP, Si, 2N3906, (Q19)
18	Part 2, page 7-3/7-4, figure 7-1. Make the following changes to PCA part no. 07970-61010. a. Change series number to 1344-42. b. Add identification for Q19 immediately below that for CR3. c. Add identification for R41 below that for Q19 and CR5. d. Add identification for CR18 between that for R40 and Q13.
19	Part 2, page 7-3/7-4, figure 7-2. In the area of the schematic for Power Regulator A21, add the circuit for Q19, R41, and CR18 shown below. Change series number to 1344.



20	Part 2, page 7-9, figure 7-7. Show C21 to the right of K1.
21	Change 14, step g this supplement (change dated 9 October 73). Part no. for Q4 and Q8 for PCA series 1321 should read 1854-0282.

CHANGE	DESCRIPTION
22	Change 15, this supplement (change dated 9 October 1973), should read "Part 2, page 7-11, figure 7-10. Change connector J6 position diagram to show the dummy plug in the lower right corner position for 10-18 ips operation with 07970-60140 capstan assembly."
23	Part 2, page 6-49, figure 6-18. a. Add resistor with index no. 6 between Q1 and Q2. b. Delete resistor index no. 9 and replace with resistor index no. 10.
24	Part 2, page 6-51. a. Index no. 6, change units per assembly from 1 to 2. b. Delete entire entry for index no. 9. c. Index no. 10, change units per assembly from 1 to 2.
25	Part 2, page 7-7/7-8, figure 7-5. a. Add resistor R113 above R110. b. Change PCA series code to 1348.
26	Part 2, page 7-7/7-8, figure 7-6. a. Change resistor R22 from 38.3K to 46.4K. b. Add resistor R113, 21.5K between the base of Q2 and U21D, pin 11. c. Change series code to 1348.
27	Part 2, page 6-47/6-48. Change part number of index no. 2 to 0362-0394.
~~28~~	~~Change 7 of this supplement, first sentence should read: "Part 3, page 3-5. Change the description for item 6 (10-20.9 ips entry) to 4.64K."~~ SUPERCEDED
29	Change 14 of this supplement. Step "a" should read: "Delete CR10, Q21, R64, R107, and R108." Delete step "e".
30	Part 3, page 3-11. Add R43 reference designation to description for index no. 18.
31	Part 3, page 4-9/4-10, figure 4-6. Change PCA part no. from 07970-60550 to 07970-62171. Change PCA series code to 1218.
32	Part 3, page 4-9/4-10, figure 4-7. Change PCA series code from 1128 to 1218 for PCA part no. 07970-62171.
33	Page US-3, change 19.of this supplement, errata. Delete connection between common and R16.
34	Part 2, page 7-3/7-4, figure 7-1, 07970-61020 PCA. Add "NOTE 1" to the right of F5 and at the bottom of the PCA diagram, add the following: NOTE 1: CONNECTION LABELED 25 IPS A AND B IS APPLICABLE ONLY TO THE HP 7970A AND THEN ONLY WHEN USING A 07970-60020 POWER REGULATOR PCA.
35	Part 1, page 1-6, table 1-3. Change WRITE HEAD to READ HEAD CROSSTALK to read: $<$5% (of read signal) for 12.6 ips to 45 ips and $<$8% (of read signal) for 12.5 ips and under.

CHANGE	DESCRIPTION
36	Part 3, Title page. Add part number 07970-62297, Series 1350 to the Printed-Circuit Assemblies list and change the series code of PCA 07970-60500 from 1318 to 1350.
37	Part 3, page 3-5. Make the following corrections to the parts list.

a. First three entries should read as follows:

3-2-	07970-60500	READ PREAMPLIFIER PC ASSEMBLY A15,10-20.9 ips
3-2-	07970-62297	READ PREAMPLIFIER PC ASSEMBLY A15,10-20.9 ips
3-2-	07970-62000	READ PREAMPLIFIER PC ASSEMBLY A15,21-45 ips

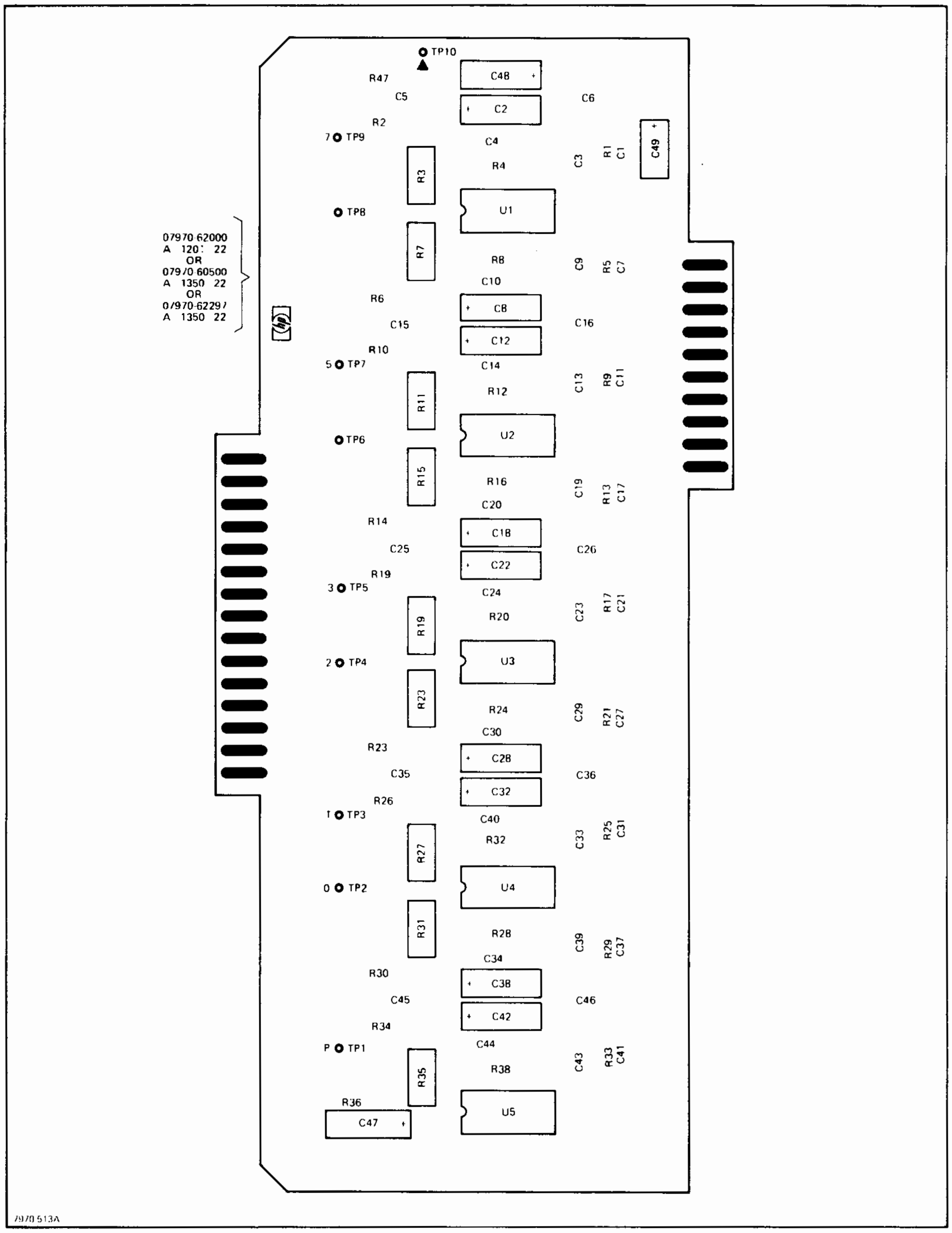
b. Entries for figure 3-2, index numbers -5 and -6 should read as follows:

-5	0140-0210	CAPACITOR, fxd, 270 pF(C1,C7,C11,C17,C21,C27, C31, C37, C41) (21-45 ips)	9
-5	0160-0363	CAPACITOR, fxd, 620 pF(C1, C7,C11,C17,C21,C27, C31,C37,C41) (10-20.9 ips) (07970-60500 PCA)	9
-5	0160-0911	CAPACITOR, fxd, 4700 pF(C1,C7,C11,C17,C21,C27 C31,C37,C41) (10-20.9) (07970-62297 PCA)	9
-6	0698-3136	RESISTOR, fxd, 17.8k, 1%, 1/8W(R1,R5,R9,R13,R17, R21,R25,R29,R33) (21-45 ips)	9
-6	0698-3155	RESISTOR, fxd, 4.64k, 1%, 1/8W (R1,R5,R9,R13,R17, R21,R25,R29,R33) (10-20.9 ips) (07970-62297 PCA)	9
-6	0757-0439	RESISTOR, fxd, 6.81k, 1%, 1/8W (R1,R5,R9,R13,R17, R21,R25,R29,R33) (10-20.9 ips) (07970-60500 PCA)	9

c. Entry for figure 3-2, index number 10 for part no. 0757-0399 should read as follows:

-10	0757-0399	RESISTOR, fxd, 82.5 ohms, 1/8W (R2,R6,R10,R14, R18,R22,R26,R30,R34) (10-20.9) (07970-62297 and 07970-60500 PCA's)	9

CHANGE	DESCRIPTION
38	Part 3, page 4-4, figure 4-3 (sheet 1 of 2). Delete this figure. It is incorrect. Part 3, page 4-5/4-6, figure 4-3 (sheet 2 of 2). Delete this figure (it is incorrect) and replace it with the figure shown below:



CHANGE	DESCRIPTION
39	Part 3, page 4-5/4-6, figure 4-4.

a. At the top left of the schematic, the part number/series code block should read as follows:

READ PREAMPLIFIER PC ASSEMBLY A15
07970-62000, SERIES 1201
07970-60500, SERIES 1350
07970-62297, SERIES 1350

b. The note 1, SPEED CRITICAL COMPONENTS table should read as follows:

SPEED (ips)	C1,C7,C11,C17,C21, C27,C31,C37,C41	R1,R5,R9,R13,R17, R21,R25,R29,R33	R2,R6,R10,R14,R18, R22,R26,R30,R34	ASSEMBLY
10-20.9	4700 PF	4.64K	82.5 OHMS	07970-62297
10-20.9	620 PF	6.81K	82.5 OHMS	07970-60500
21-45	270 PF	17.8K	100 OHMS	07970-62000

40 Changes 7, 8, and 28 of this supplement are superceded by changes 35 through 39.

41 Read Modules. Part 3, page 2-3, paragraph 2-16, third sentence. Change "40 percent" to "46 percent". In paragraph 2-16c, first sentence, change range figures from "35 and 45 percent" to "40 and 46 percent".

42 Read Modules. Part 3, page 2-4, paragraph 2-28, first sentence. Change "40 percent" to "46 percent". In paragraph 2-28d, first sentence, change "40 percent" to "46 percent".

43 Read/Read Modules. Part 5, page 2-2, paragraph 2-16, third sentence. Change "40 percent" to "46 percent". In paragraph 2-16c, change range figures from "35 and 45 percent" to "40 and 46 percent".

44 Read/Read Modules. Part 5, page 2-5/2-6, paragraph 2-28, first sentence. Change "40 percent" to "46 percent". In paragraph 2-28d, first sentence, change "40%" to "46 percent".

45 On the face of this supplement, page US-1, under "Instrument Changes", the entry for serial prefix 1343 (change 16) has been deleted. Under "Assembly Changes", the entry for A19, series code 1343, change 16 has been deleted. Disregard change 16 of this supplement. Administrative change.

46 Change 35, this supplement, errata. First sentence was corrected to read: "Part 1, page 1-6, table 1-3."

47 Change 14, this supplement, errata. Step e is marked to avoid misinterpretation when the change is incorporated. Page US-1 has also been altered to avoid misinterpretation as have changes 7, 8, 16, and 28.

48 Density Select Switch, (Read Module). Part 3, page 3-3, figure 3-1. Change PCA A12A1 series code from B-1013A-42 to 1330. In the table on page 3-3 the DESCRIPTION for index number 3-1-4 should read: "DENSITY SELECT PC ASSEMBLY A12A1."

49 Density Select Switch, (Read Module). Part 3, page 4-3, figure 4-1. Change the series code of Density Select PC Assembly A12A1 (part no. 07970-60090) from 1040-42 to 1330.

CHANGE	DESCRIPTION
50	Density Select Switch, (Read Module). Part 3, page 4-3, figure 4-2. The information at the upper left of the schematic should read: DENSITY SELECT ASSEMBLY A12 (A12A1) 07970-60090 SERIES 1330. Break the connection from A9P1 pin 7 to ground "P" and enter the notation "N/C." On the Control Switch Assembly A11 break the connection shown from A9P1 pin 7 to ground "P" on that assembly.
51	Density Select Switch, (Read/Read Module). Part 5, page 3-2, figure 3-1. Change PCA A12A1 series code from A-1039-42 to 1330. In the table on page 3-2 the DESCRIPTION for index number 3-1-4 should read: "DENSITY SELECT PC ASSEMBLY, read/read A12A1."
52	Density Select Switch, (Read/Read Module). Part 5, page 4-3/4-4, figure 4-1. The HP logo block illustrated in the parts location drawing should read: 07970-62006 1330-42
53	Density Select Switch, (Read/Read Module). Part 5, page 4-3/4-4, figure 4-2. The information in the lower left of the schematic should read: DENSITY SELECT ASSEMBLY A12 (A12A1) 07970-62006 SERIES 1330. Break the connection from A9P1 pin 7 to ground "P" and enter the notation "N/C." On the Control Switch Assembly A11 break the connection shown from A9P1 pin 7 to ground "P" on that assembly.
54	Page US-1, Instrument serial prefix 1408 is added which incorporates A16 Control and Status PCA series code 1348 changes. Administrative change.
55	Pages US-1, US-7, and US-8 this supplement. Instrument serial number prefix 1348 deleted. Administrative change. Changes numbered 46, 47, 54 wording corrected.
56	Capstan Servo. Part 2, page 6-32, figure 6-12. Change PCA series code on the figure from 1322 to 1410.
57	Capstan Servo. Part 2, page 6-33, table 6-3. a. Change PCA series code, under Reference Designation A9, from 1322 to 1410. b. Change the part numbers for Q5 and Q6 from 1854-0576 to 1854-0490. Change the Mfr Code from 80131 to 04713 (Motorola). Mfr. Part Number is to be SJ2376 (2N3773).
58	Capstan Servo. Part 2, page 6-53. Add the following in numerical sequence in the table: 1854-0490 | 04713 | 2N3773
59	Capstan Servo. Part 2, page 7-11/7-12, figure 7-10. Change series code block from 1322 to 1410.
60	Part 2, page 6-8, index number 6-1-122, errata. The DESCRIPTION column figure reference should read: (see figure 6-17 for details).
61	Transformer Assembly. Part 2, page 6-47/6-48. Change figure index number 6-17-28 part number from 3101-0003 to 3101-0646. (Power switch change.)

CHANGE	DESCRIPTION
62	Transformer Assembly. Part 2, page 6-47/6-48. Change item 6-17-18 part number from 2110-0303 to 2110-0380. Change the description rating from 2A to 2.5A.
63	Transformer Assembly. Part 2, page 6-54, table 6-1. Delete part number 2110-0303 from the table and add: 2110-0380 | 71400 | MDA 2-1/2
64	Transformer Assembly. Part 2, page 7-3/7-4, figure 7-2. Change F2 rating in assembly A19 from 2ATT to 2-1/2ATT.
65	Transformer Assembly. Part 2, page 6-4, figure 6-1. Nomenclature on F2 in lower left of figure now to read 2-1/2 AMPS. All figures showing this view now to have F2 at 2-1/2 AMPS.
66	Capstan Servo. Part 2, page 1-1, paragraph 1-13, last sentence. Capstan Servo PCA should read A6, not A9.
67	Capstan Servo. Part 2, page 3-3, make the following corrections.

a. Paragraph 3-27, last part of the first sentence should read:
. . . and measuring fast forward, reverse, start and stop characteristics.

b. Paragraph 3-28, last part of the first sentence should read:
. . . across the 1.5 ohm 1 percent resistance (comprised of R21 and R22 in parallel).

c. Paragraph 3-29, fourth sentence should read:
For the following tests reference frequencies are based on using the signal that will be available from the . . . .

68 Capstan Servo. Part 2, page 3-3, replace paragraphs 3-30 through 3-33 with the following paragraphs.

3-30. START MEASUREMENT. Capstan start (and stop) measurements are made for both forward and reverse tape motion. To make these measurements it is necessary to apply rapidly alternating active and inactive conditions (squarewave signal) of the $\overline{\text{FWD}}$ (or $\overline{\text{REV}}$) signal to the capstan servo PCA. This produces repetitious start (and stop) ramps for oscilloscope display. Time duration of the active and inactive levels of the $\overline{\text{FWD}}$ (or $\overline{\text{REV}}$) signal must be greater than the 100 percent time of the start ramp to be measured. (The start ramp time is variable, depending on tape speed.) Start ramp delay time is measured observing the tachometer output. The capstan tachometer voltage will reverse polarity when direction (forward/reverse) is changed. The oscilloscope is synchronized for these measurements on the forward (or reverse) command to start the sweep. The start ramp 90 percent time measurement is made by observing the bi-polar ramp generator slope output (refer to the adjustment procedure) or by observing the output from a preamplifier channel while reading a tape (forward only). (There will be no observable difference in the preamplifier output waveforms if forward and reverse are used but forward only should be used.) The tape to be read may be any previously recorded tape, preferably at 800 cpi, as this provides the best resolution where measurements from preamplifier outputs are required. Wavelength accuracy is not a factor in this test. Do not make measurements during the read-after-write operation. The stop-ramp time measurement is described in paragraph 3-32. Start and stop

CHANGE	DESCRIPTION
68 (cont.)	distance calculation steps are described in paragraphs 3-31 and 3-33 respectively. Proceed as follows:

a. Start ramp delay time, the time (following a forward or reverse command) required for the capstan tachometer voltage to reach a value that is greater than 0 Vdc but less than 3 percent of the value reached at normal drive speed, is measured as described below.

(1) Connect the oscilloscope probe to the TACH test point on the capstan servo PCA.

(2) Synchronize the oscilloscope sweep on the negative edge of the $\overline{\text{FWD}}$ signal at TP9 on the control and status PCA (for start ramp delay time in forward tape motion) or at TP5 ($\overline{\text{REV}}$ signal) of the control and status PCA (for reverse).

(3) See tape speeds and times listed in step 3-30, b, (3). Adjust oscilloscope sweep speed and vertical deflection then measure start ramp delay time for forward, then reverse tape motion. It is the time interval between the start of the oscilloscope sweep and the time the ramp waveform reaches 3 percent of its steady-state value. (About 0.25 divisions up if the full 8 vertical division of the oscilloscope face were used.) Start ramp delay time, for both forward and reverse tape motion, should be 0.5 ± 0.5 ms.

b. Start ramp 90 percent time may be measured as outlined in steps (1) through (3) below (similar to the adjustment procedure) or by the method outlined in step (4) below.

(1) Connect the oscilloscope probe to the FWD/REV test point on the capstan servo PCA.

(2) Synchronize the oscilloscope sweep on the negative edge of the $\overline{\text{FWD}}$ signal at TP9 on the control and status PCA.

(3) With alternate active/inactive forward (synchronous speed forward) commands applied adjust sweep speed and vertical deflection to measure the start ramp 90 percent time. Also, measure the start ramp 90 percent time for synchronous speed reverse tape motion. The start ramp 90 percent time is the time interval on the start ramp, from 0 volts to 90 percent of the steady-state value. (See the adjustment procedure.) This time is dependent on tape speed. Values for some common tape speeds are listed below. Tolerances are ±0.2 ms for forward tape motion and ±0.3 ms for reverse tape motion. For any unlisted speeds, use the following equation to derive start ramp 90 percent time:

$$T \text{ (in ms)} = \left(\frac{0.375}{\text{TAPE SPEED (in ips)}} - 0.001\right)$$

CHANGE | **DESCRIPTION**

68 (cont.)

(Stop-ramp time should be within ±0.5 ms of the start ramp time.)

TAPE SPEED (in ips)	T (in ms)
12.5	26.1
18.75	17.1
22.5	14.1
25.0	12.6
37.5	8.1
45.0	6.6

(4) The start/stop envelope may also be observed (probe on preamplifier channel 3 output) to measure start-ramp 90 percent time. The time measured is the time (following a $\overline{\text{FWD}}$ command) required for the analog output of any preamplifier track (usually preamplifier channel 3) to reach 90 percent of the peak-to-peak (or 0-to-peak) value established while reading an all "1's" tape under steady-state drive conditions. The time is a function of tape speed. Time limits in step (3) above also apply. The measurement should be made for forward tape motion only. The oscilloscope is synchronized on $\overline{\text{FWD}}$ command test point TP9 on the control and status PCA.

3-31. START DISTANCE. Start distance is calculated as follows:

a. Determine start ramp time. This is the time required to accelerate the tape from zero ips to the drive speed. It is determined by subtracting the measured start ramp delay time (paragraph 3-30, a.) from the start ramp 90 percent time (paragraph 3-30, b.).

b. Determine start balance time. This is the time difference between the start ramp 90 percent time measured and the specified start time for the tape speed involved. This period of time is allowed to provide a balance in tape distance as it offsets the time delay at full drive speed represented by the stop-ramp delay time.

c. One-half of the start-ramp time plus the start balance time (both in milliseconds) multiplied by the tape speed in inches per second equals the start distance (in inches x 10^{-3}). Specification is 0.187 ± 0.020 inch.

3-32. STOP MEASUREMENT. Stop measurements (for both forward and reverse) are made as follows.

a. To measure stop ramp delay time, the setup is made as for the start ramp 90 percent time (envelope measurement, paragraph 3-30, b, (4)). The stop ramp delay time is the time (following removal of a forward command) required for the analog output of any preamplifier to fall to a peak-to-peak (or 0-to-peak) value that is less than 100 percent but greater than 97 percent of the value

CHANGE	DESCRIPTION
68 (cont.)	established under steady-state drive conditions while reading an all "1's" tape. Specification is 0.5 ± 0.5 ms. b. To measure the stop ramp 90 percent time, the setup is made as for the start ramp delay time (paragraph 3-30,a.). The stop ramp 90 percent time (following removal of the forward or reverse command) is the time required for the capstan tachometer voltage to reach a level between 3 percent of normal drive speed value and 0 Vdc. The specification is a function of tape speed. (See speeds and times in paragraph 3-30, b, (3)). The stop ramp time should be within ±0.5 ms of the start ramp time. 3-33. STOP DISTANCE. Stop distance is calculated as follows. a. Determine stop ramp delay time (paragraph 3-32, a). b. Determine stop ramp time. This is the time required to decelerate the tape to zero ips from the drive speed. It is determined by subtracting the measured stop ramp delay time (paragraph 3-32, a) from the measured stop ramp 90 percent time (paragraph 3-32, b). c. The stop-ramp delay time plus one-half the stop ramp time (both in milliseconds) multiplied by the tape speed in inches per second equals the stop distance (in inches x 10^{-3}). Specifications is 0.187 ± 0.020 inch.
69	Capstan Servo. Part 2, page 5-6, paragraph 5-35 c. Replace the note after step c with the following note. Note: On HP 180 Oscilloscopes, the full vertical spacing is 8-divisions. If the full vertical face is used there is a scale mark at 7.2 divisions up from the bottom which may be used to measure the time at the 90 percent level.
70	Capstan Servo. Part 2, page 5-6, table 5-1. Add the following note at the bottom of the table. Note: Tolerance for 90% time using the forward command is ±0.2 ms. Stop ramp time should be within ±0.5 ms of the applicable start ramp time.

Read Preamplifier PC Assembly Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	07970-62035	1	PE/NRZI PREAMP ASSY.21-45 IPS	28480 28480	07970-62035 07970-62074
C1	0180-1704	9	C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C2	0160-2201	9	C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C3	0160-2208	9	C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C4 NOTE:2	0160-2220	9	C:FXD MICA 1200 PF 5% 300 V	28480	0160-2220
C4 NOTE:1	0140-0200	12	C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C5	0180-0376	9	C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C6	0160-2055	25	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C7	0160-2250	9	C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C8	0160-3534	9	C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C9	0180-0291	9	C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
C10	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C11	0160-2201		C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C12	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C13 NOTE:2	0160-2220		C:FXD MICA 1200 PF 5% 300 V	28480	0160-2220
C13 NOTE:1	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C14	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C15	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C16	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C17	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C18	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
C19	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C20	0160-2201		C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C21	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C22 NOTE:1	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C22 NOTE:2	0160-2220		C:FXD MICA 1200 PF 5% 300 V	28480	0160-2220
C23	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C24	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C25	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C26	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C27	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
C28	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C29	0160-2201		C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C30	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C31 NOTE:1	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C31 NOTE:2	0160-2220		C:FXD MICA 1200 PF 5% 300 V	28480	0160-2220
C32	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C33	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C34	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C35	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C36	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
C37	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C38	0160-2201		C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C39	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C40 NOTE:2	0160-2220		C:FXD MICA 1200 PF 5% 300 V	28480	0160-2220
C40 NOTE:1	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C41	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C42	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C43	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C44	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C45	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
C46	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C47	0160-2201		C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C48	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C49 NOTE:2	0160-2220		C:FXD MICA 1200 PF 5% 300 V	28480	0160-2220
C49 NOTE:1	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C50	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C51	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C52	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C53	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C54	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
C55	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C56	0160-2201		C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C57	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C58 NOTE:2	0160-2220		C:FXD MICA 1200 PF 5% 300 V	28480	0160-2220
C58 NOTE:1	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C59	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C60	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C61	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C62	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C63	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS

Read Preamplifier PC Assembly Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
C64	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C65	0160-2201		C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C66	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C67	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C67					
C68	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C69	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C70	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C71	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C72	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
C73	0180-1704		C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C74	0160-2201		C:FXD MICA 51 PF 5%	72136	RDM15E510J1C
C75	0160-2208		C:FXD MICA 330 PF 5% 300VDCW	28480	0160-2208
C76	0140-0200		C:FXD MICA 390 PF 5%	72136	RDM15F391-J3C
C77	0180-0376		C:FXD ELECT 0.47 UF 10% 35VDCW	56289	150D474X9035A2-DYS
C78	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C79	0160-2250		C:FXD CER 5.1 PF 500VDCW	72982	301-000-C0H0-519E
C80	0160-3534		C:FXD MICA 510 PF 5% 100VDCW	00853	RDM15F511J1C
C81	0180-0291		C:FXD ELECT 1.0 UF 10% 35VDCW	56289	150D105X9035A2-DYS
C82	0180-0228	2	C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
C83	0180-0228		C:FXD ELECT 22 UF 10% 15VDCW	56289	150D226X9015B2-DYS
C84	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C85	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C86	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C87	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C88	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C89	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C90	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C91	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C92	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C93	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C94	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C95	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C96	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C97	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C101	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C102	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
Q1	1853-0036	2	TSTR:SI PNP	80131	2N3906
Q2	1853-0036		TSTR:SI PNP	80131	2N3906
Q3	1855-0370	9	TSTR:FET DUAL N-CHANNEL	28480	1855-0370
Q4	1855-0370		TSTR:FET DUAL N-CHANNEL	28480	1855-0370
Q5	1855-0370		TSTR:FET DUAL N-CHANNEL	28480	1855-0370
Q6	1855-0370		TSTR:FET DUAL N-CHANNEL	28480	1855-0370
Q7	1855-0370		TSTR:FET DUAL N-CHANNEL	28480	1855-0370
Q8	1855-0370		TSTR:FET DUAL N-CHANNEL	28480	1855-0370
Q9	1855-0370		TSTR:FET DUAL N-CHANNEL	28480	1855-0370
Q10	1855-0370		TSTR:FET DUAL N-CHANNEL	28480	1855-0370
Q11	1855-0370		TSTR:FET DUAL N-CHANNEL	28480	1855-0370
R1	0757-0440	9	R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R2	2100-1972	7	R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R3	0757-0394	9	R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R4	0698-0082	9	R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R5	2100-2707	9			
R6	0757-0317	9	R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R7	0757-0278	9	R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R8	0757-0458	18	R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R9	0698-3434	9	R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R10	0757-0280	12	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R11	0757-0438	9	R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R11	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R12	0757-0401	18	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R13	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R14	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R16	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R17	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R18	2100-2707				
R19	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R20	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R21	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R22	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R23	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R24	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R25	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R26	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401

Read Preamplifier PC Assembly Replaceable Parts (Continued)

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R27	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R28	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R29	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R30	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R31	2100-2707				
R32	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R33	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R34	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R35	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R36	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R37	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R38	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R39	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R40	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R41	2100-1972		R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R42	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R43	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R44	2100-2707				
R45	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R46	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R47	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R48	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R49	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R50	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R51	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R52	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R53	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R54	2100-1972		R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R55	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R56	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R57	2100-2707				
R58	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R59	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R60	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R61	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R62	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R63	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R64	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R65	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R66	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R67	2100-1972		R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R68	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R69	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R70	2100-2707				
R71	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R72	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R73	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R74	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R75	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R76	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R77	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R78	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R79	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R80	2100-1972		R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R81	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R82	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R83	2100-2707				
R84	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R85	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R86	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R87	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R88	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R89	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R90	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R91	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R92	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R93	2100-1972		R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R94	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R95	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R96	2100-2707				
R97	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R98	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R99	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R100	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R101	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280

Read Preamplifier PC Assembly Replaceable Parts (Continued)

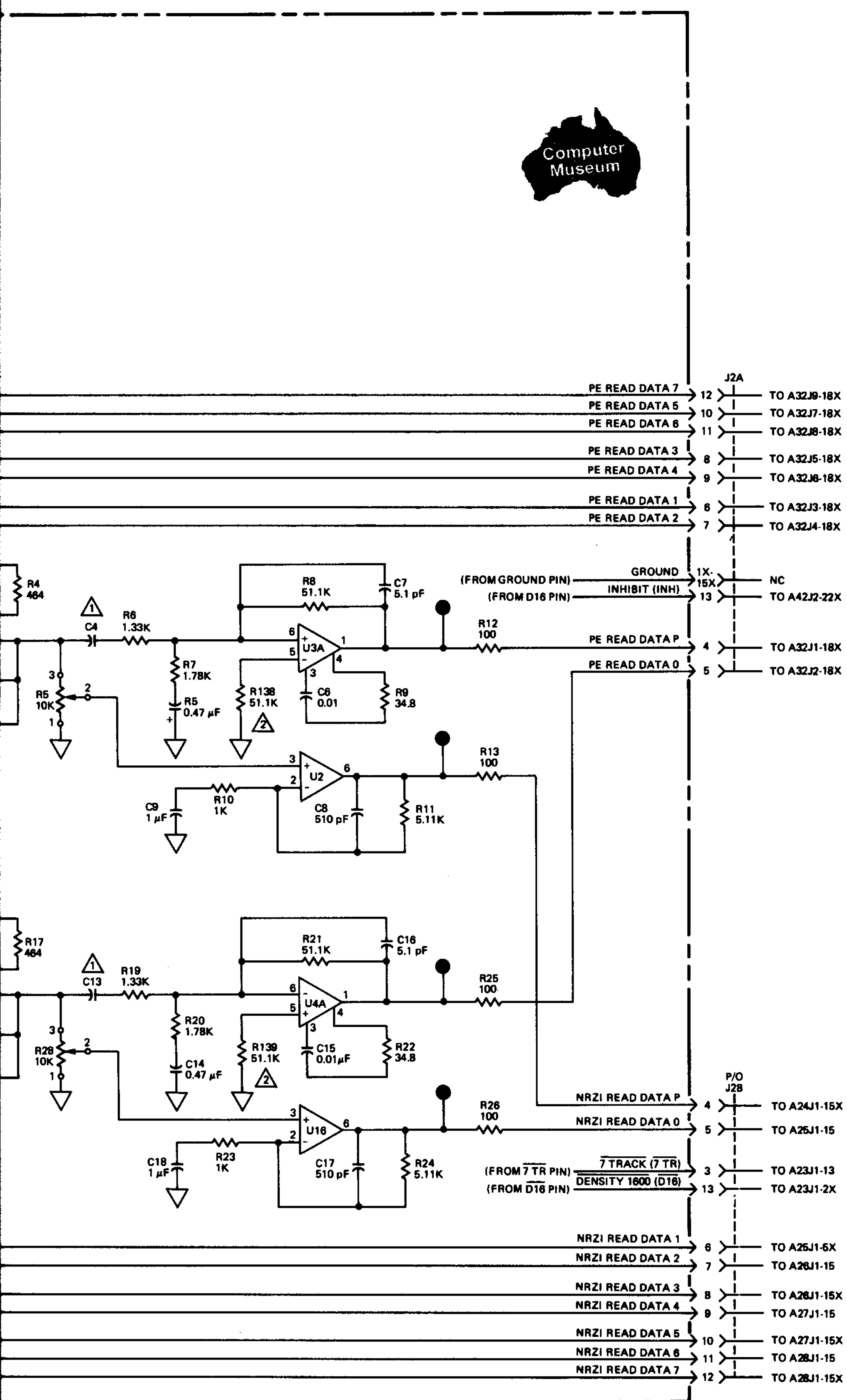
Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R102	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R103	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R104	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R105	0757-0440		R:FXD MET FLM 7.50K OHM 1% 1/8W	28480	0757-0440
R106	2100-1972		R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R107	0757-0394		R:FXD MET FLM 51.1 OHM 1% 1/8W	28480	0757-0394
R108	0698-0082		R:FXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082
R109	2100-2707				
R110	0757-0317		R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R111	0757-0278		R:FXD MET FLM 1.78K OHM 1% 1/8W	28480	0757-0278
R113	0698-3434		R:FXD MET FLM 34.8 OHM 1% 1/8W	28480	0698-3434
R114	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R115	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R116	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R117	0757-0401		R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R118	0683-1005	2	R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
R119	0683-1005		R:FXD COMP 10 OHM 5% 1/4W	01121	CB 1005
R120	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R121	0757-0442	4	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
R122	0683-2235	2	R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
R123	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R124	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R125	0757-0279	2	R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
R126	0757-0279		R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
R127	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
R128	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
R129	0757-0442		R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
R130	0683-2235		R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
R131	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R132	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R133	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R134	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R135	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R136	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R137	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R138	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R139	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R140	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R141	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R142	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R143	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R144	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R145	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
R146	0757-0458		R:FXD MET FLM 51.1K OHM 1% 1/8W	28480	0757-0458
U1	1820-0054	1	IC:TTL QUAD 2-INPT NAND GATE	01295	SN7400N
U2	1826-0068	9	INTEGRATED CIRCUIT	28480	1826-0068
U3	1826-0044	9	INTEGRATED CIRCUIT	28480	1826-0044
U4	1826-0044		INTEGRATED CIRCUIT	28480	1826-0044
U5	1826-0068		INTEGRATED CIRCUIT	28480	1826-0068
U6	1826-0044		INTEGRATED CIRCUIT	28480	1826-0044
U7	1826-0044		INTEGRATED CIRCUIT	28480	1826-0044
U8	1826-0068		INTEGRATED CIRCUIT	28480	1826-0068
U9	1826-0044		INTEGRATED CIRCUIT	28480	1826-0044
U10	1826-0044		INTEGRATED CIRCUIT	28480	1826-0044
U11	1826-0068		INTEGRATED CIRCUIT	28480	1826-0068
U12	1826-0044		INTEGRATED CIRCUIT	28480	1826-0044
U13	1826-0044		INTEGRATED CIRCUIT	28480	1826-0044
U14	1826-0068		INTEGRATED CIRCUIT	28480	1826-0068
U15	1826-0044		INTEGRATED CIRCUIT	28480	1826-0044
U16	1826-0068		INTEGRATED CIRCUIT	28480	1826-0068
U17	1826-0068		INTEGRATED CIRCUIT	28480	1826-0068
U18	1826-0068		INTEGRATED CIRCUIT	28480	1826-0068
U19	1826-0068		INTEGRATED CIRCUIT	28480	1826-0068

Read Control PC Assembly Replaceable Parts

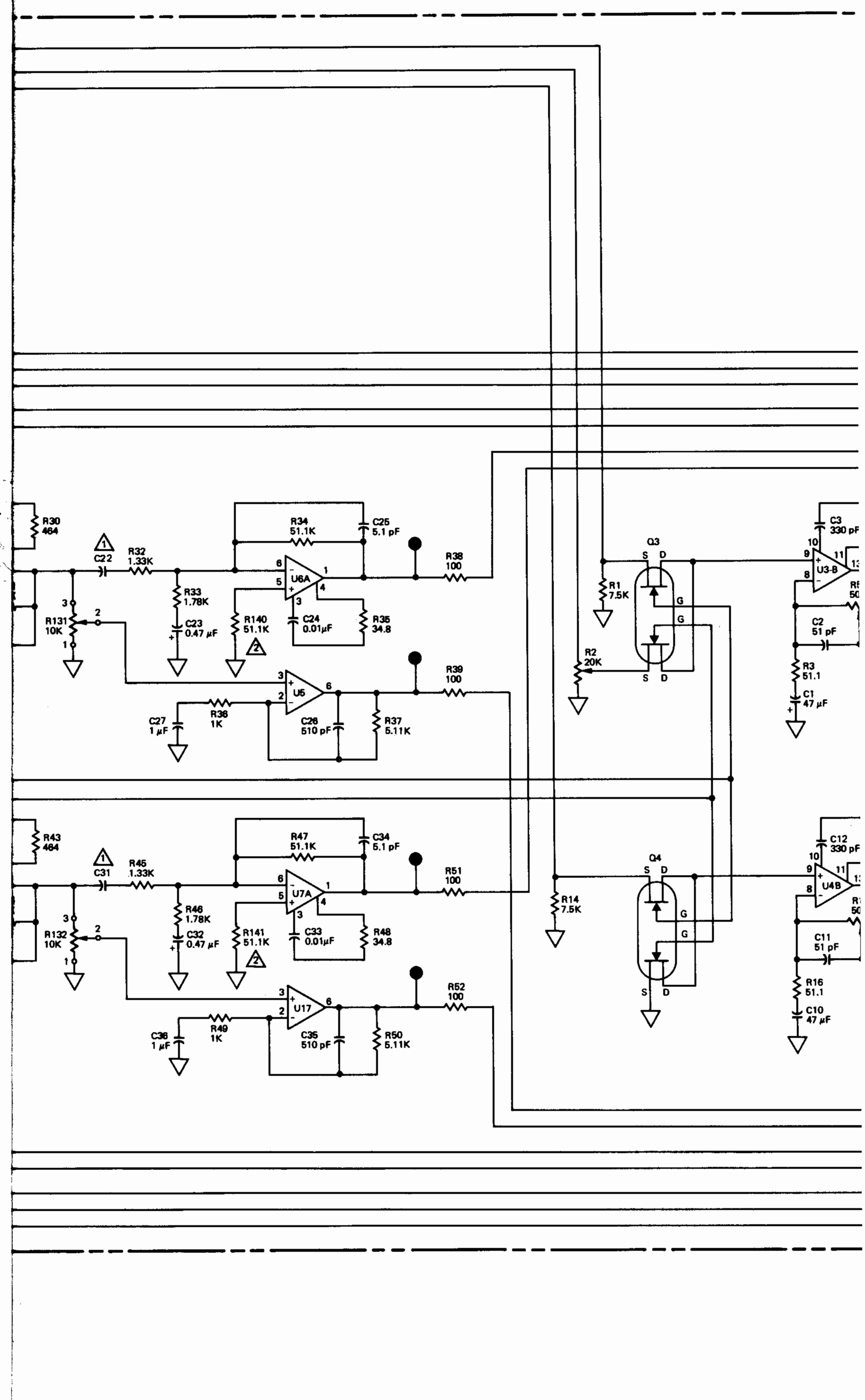
Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
	07970-62061	1	NRZI READ CONTROL PC ASSY.21-45 IPS	28480	07970-62061
C1	0160-2055	8	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C2	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C3	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C4	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C5	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C6	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C7	0180-1704	1	C:FXD ELECT 47 UF 10% 6VDCW	28480	0180-1704
C8	0160-0161	1	C:FXD MY 0.01 UF 10% 200VDCW	56289	192P10392-PTS
C9	0160-2307	1	C:FXD MICA 47 PF 5%	28480	0160-2307
C10	0140-0193	9	C:FXD MICA 82 PF 5%	28480	0140-0193
C11	0160-2209	1	C:FXD MICA 360 PF 5%	72136	RDM15F361J3C
C12	0180-1701	2	C:FXD ELECT 6.8 UF 20% 6VDCW	28480	0180-1701
C13	0180-1701		C:FXD ELECT 6.8 UF 20% 6VDCW	28480	0180-1701
C14	0180-0210	2	C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
C15	0180-0210		C:FXD ELECT 3.3 UF 20% 15VDCW	56289	150D335X0015A2-DYS
C16	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C17	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
CR1	1901-0040	13	DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR2	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR6	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR7	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR8	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR9	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR11	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR12	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR13	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
Q1	1853-0036	2	TSTR:SI PNP	80131	2N3906
Q2	1854-0071	5	TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
Q3	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
Q4	1853-0036		TSTR:SI PNP	80131	2N3906
Q5	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
Q6	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
Q7	1854-0071		TSTR:SI NPN(SELECTED FROM 2N3704)	28480	1854-0071
Q8	1854-0270	3	TSTR:SI NPN	80131	2N4265
Q9	1853-0015	1	TSTR:SI PNP	80131	2N3640
Q10	1854-0270		TSTR:SI NPN	80131	2N4265
Q11	1854-0270		TSTR:SI NPN	80131	2N4265
R1	0683-6825	2	R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
R2	0683-2225	5	R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
R3	0683-1025	5	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
R4	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
R5	0683-2235	1	R:FXD COMP 22K OHM 5% 1/4W	01121	CB 2235
R6	0683-3325	3	R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
R7	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
R8	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
R9	0683-6825		R:FXD COMP 6800 OHM 5% 1/4W	01121	CB 6825
R10	0757-0428	9	R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R11	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
R12	0698-3132	2	R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132
R13	0757-0280	1	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R14	0683-3335	1	R:FXD COMP 33K OHM 5% 1/4W	01121	CB 3335
R15	0757-0401	1	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R16	0757-1094	1	R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
R17	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
R18	0757-0418	3	R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
R19	0683-3325		R:FXD COMP 3300 OHM 5% 1/4W	01121	CB 3325
R20	0757-0439	1	R:FXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439
R21	0757-0443	1	R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
R22	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
R23	0683-1235	1	R:FXD COMP 12K OHM 5% 1/4W	01121	CB 1235
R24	0683-2225		R:FXD COMP 2.2K OHM 5% 1/4W	01121	CB 2225
R25	0757-0199	1	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
R26	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R27	0698-3438	1	R:FXD MET FLM 147 OHM 1% 1/8W	28480	0698-3438
R28	0698-3132		R:FXD FLM 261 OHM 1% 1/8W	28480	0698-3132

Read Control PC Assembly Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R30	0683-8235	3	R:FXD COMP 82K OHM 5% 1/4W	01121	EB 8235
R31	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
R32	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
R33	0683-6815	1	R:FXD COMP 680 OHM 5% 1/4W	01121	CB 6815
R34	0683-2725	1	R:FXD COMP 2700 OHM 5% 1/4W	01121	CB 2725
R35	0757-0442	1	R:FXD MET FLM 10.0K OHM 1% 1/8W	28480	0757-0442
R36	0757-0444	1	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
R37	0683-8235		R:FXD COMP 82K OHM 5% 1/4W	01121	EB 8235
R38	0683-8235		R:FXD COMP 82K OHM 5% 1/4W	01121	EB 8235
R39	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R40	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
R41	0683-1525	1	R:FXD COMP 1500 OHM 5% 1/4W	01121	CB 1525
R42	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R43	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R44	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R45	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R46	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R47	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
R48	0757-0428		R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
U1	1820-0348	1	IC:DTL DUAL 4-INPT NAND BUFFER	04713	MC844P
U2	1820-0069	1	IC:TTL DUAL 4-INPT POS NAND GATE	01295	SN7420N
U3	1820-0376	1	IC:TTL HS DUAL 4-INPT NAND BUFFER	01295	SN74H40N
U4	1820-0349	1	IC:DTL QUAD 2-INPT NAND GATE RL=2K	04713	MC849P
U5	1820-0088	2	IC:DTL MONOSTABLE MULTIVIBRATOR	04713	MC851P
U6	1820-0088		IC:DTL MONOSTABLE MULTIVIBRATOR	04713	MC851P
U7	1820-0256	1	IC:DTL QUAD 2-INPUT POWER GATE	04713	MC858P



Read Preamplifier PCA, Schematic Diagram


R30
464
R32
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C22
R33
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C23
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R131
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R34
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C25
5.1 pF
U6A
R140
51.1K
C24
0.01µF
R35
34.8
R38
100
U5
R39
100
C27
1 µF
R36
1K
C26
510 pF
R37
5.11K
Q3
R1
7.5K
R2
20K
C3
330 pF
U3-B
C2
51 pF
R3
51.1
C1
47 µF
R43
464
C31
R45
1.33K
R46
1.78K
C32
0.47 µF
R132
10K
R47
51.1K
C34
5.1 pF
U7A
R141
51.1K
C33
0.01µF
R48
34.8
R51
100
U17
R52
100
C36
1 µF
R49
1K
C35
510 pF
R50
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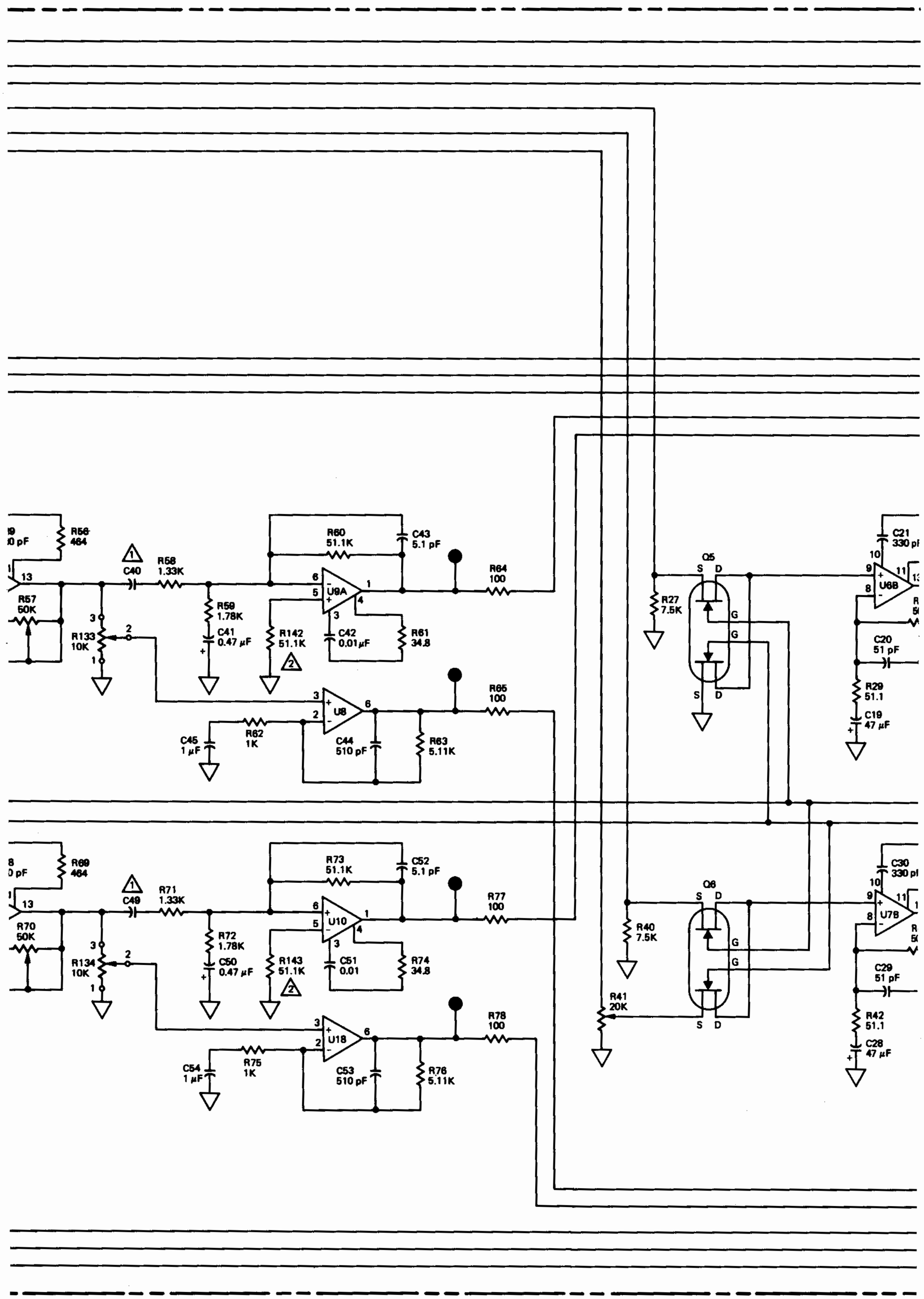
R16
51.1
C10
47 µF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R58
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R60
51.1K
C43
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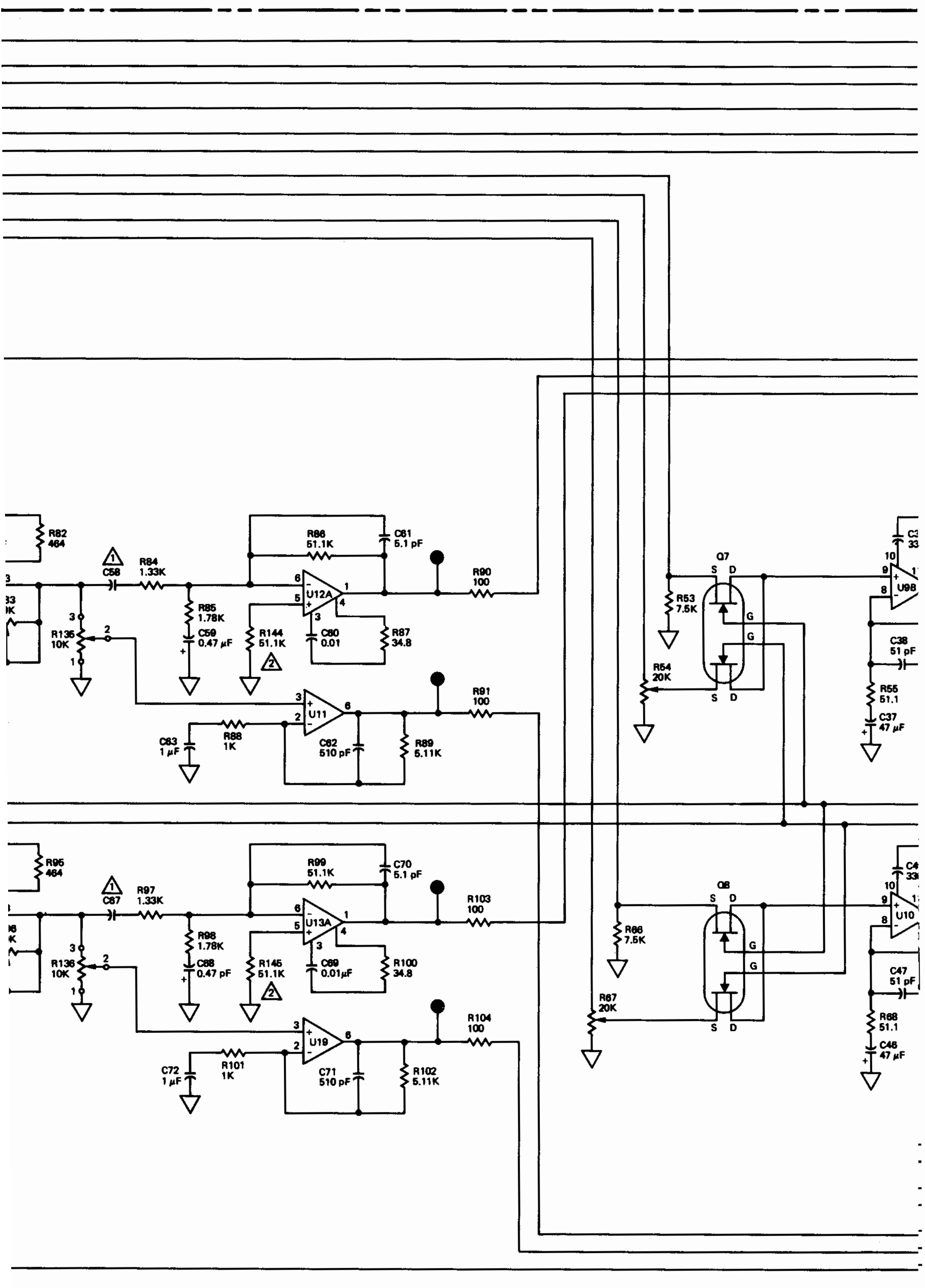
R64
100
U9A
R57
50K
R133
10K
R59
1.78K
C41
0.47 µF
R142
51.1K
C42
0.01µF
R61
34.8
U8
C45
1 µF
R62
1K
C44
510 pF
R63
5.11K
R65
100
Q5
R27
7.5K
C21
330 pF
U6B
C20
51 pF
R29
51.1
C19
47 µF
R69
464
C49
R71
1.33K
R73
51.1K
C52
5.1 pF
U10
R77
100
R70
50K
R134
10K
R72
1.78K
C50
0.47 µF
R143
51.1K
C51
0.01
R74
34.8
U18
C54
1 µF
R75
1K
C53
510 pF
R76
5.11K
R78
100
Q6
R40
7.5K
R41
20K
C30
330 pF
U7B
C29
51 pF
R42
51.1
C28
47 µF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C58
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C59
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R86
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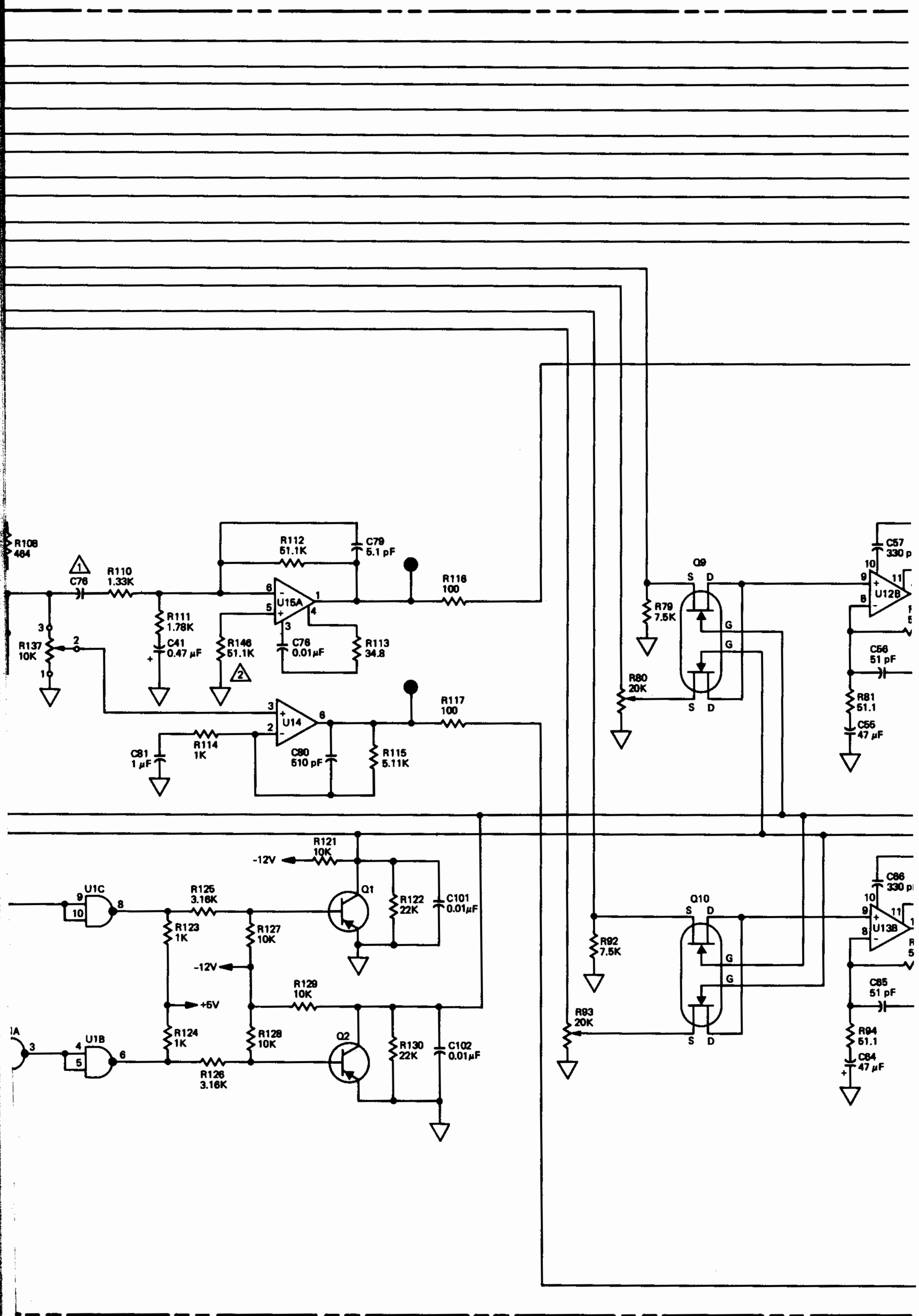
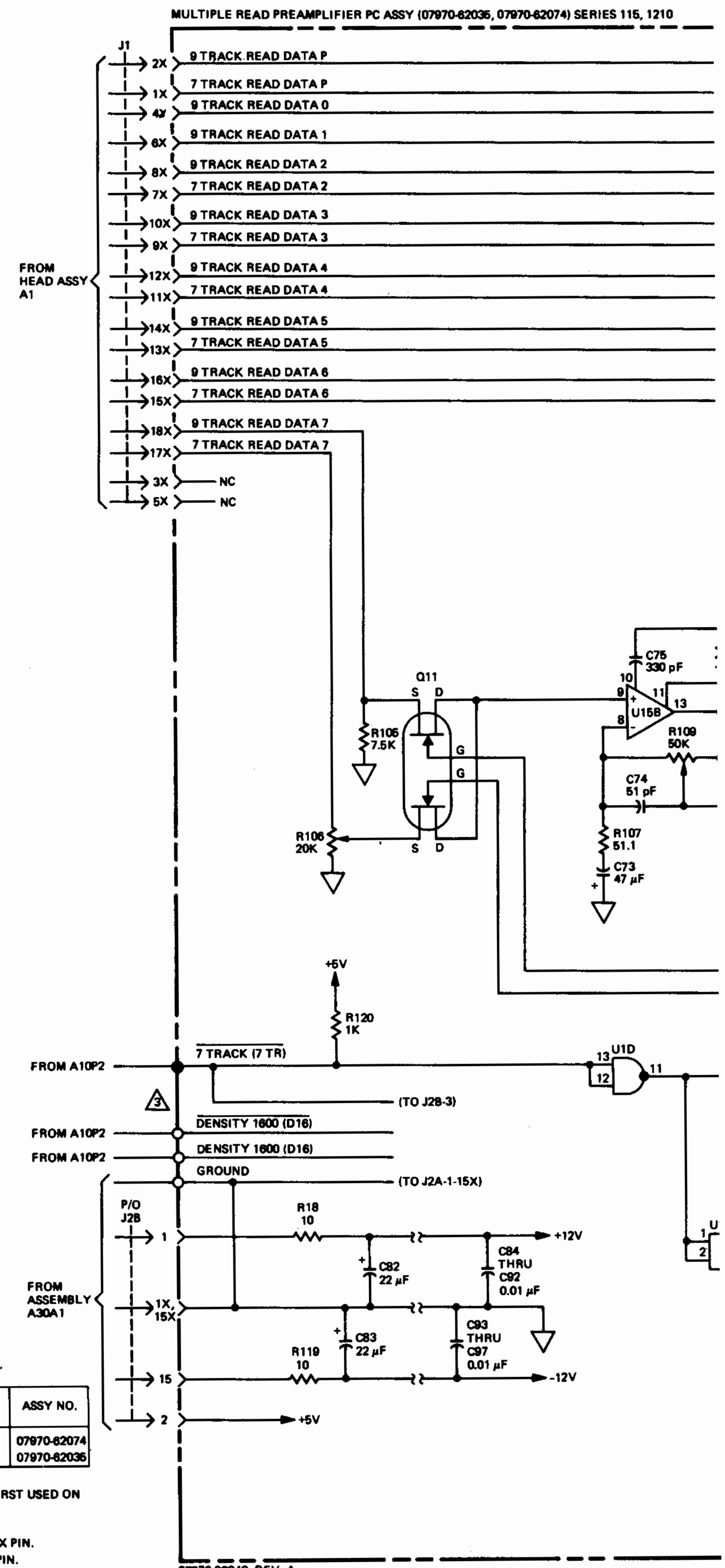
C61
5.1 pF
U12A
R144
51.1K
C60
0.01
R87
34.8
R90
100
R136
10K
U11
R88
1K
C63
1 µF
C62
510 pF
R89
5.11K
R91
100
Q7
R53
7.5K
R54
20K
U9B
C38
51 pF
R55
51.1
C37
47 µF
R95
464
C67
R97
1.33K
R98
1.78K
C68
0.47 pF
R99
51.1K
C70
5.1 pF
U13A
R145
51.1K
C69
0.01µF
R100
34.8
R103
100
U19
R101
1K
C72
1 µF
C71
510 pF
R102
5.11K
R104
100
Q8
R66
7.5K
R67
20K
U10
C47
51 pF
R68
51.1
C46
47 µF


R108
464
R110
1.33K
C76
R111
1.78K
C41
0.47 μF
R137
10K
R112
51.1K
C79
5.1 pF
U15A
R146
51.1K
C76
0.01μF
R113
34.8
R116
100
U14
R114
1K
C81
1 μF
C80
510 pF
R115
5.11K
R117
100
Q9
R79
7.5K
R80
20K
C57
330 p
U12B
C56
51 pF
R81
51.1
C55
47 μF
R121
10K
-12V
U1C
R125
3.16K
R123
1K
R127
10K
Q1
R122
22K
C101
0.01μF
-12V
+5V
R129
10K
U1B
R124
1K
R128
10K
Q2
R130
22K
C102
0.01μF
R126
3.16K
Q10
R92
7.5K
R93
20K
C86
330 p
U13B
C85
51 pF
R94
51.1
C84
47 μF



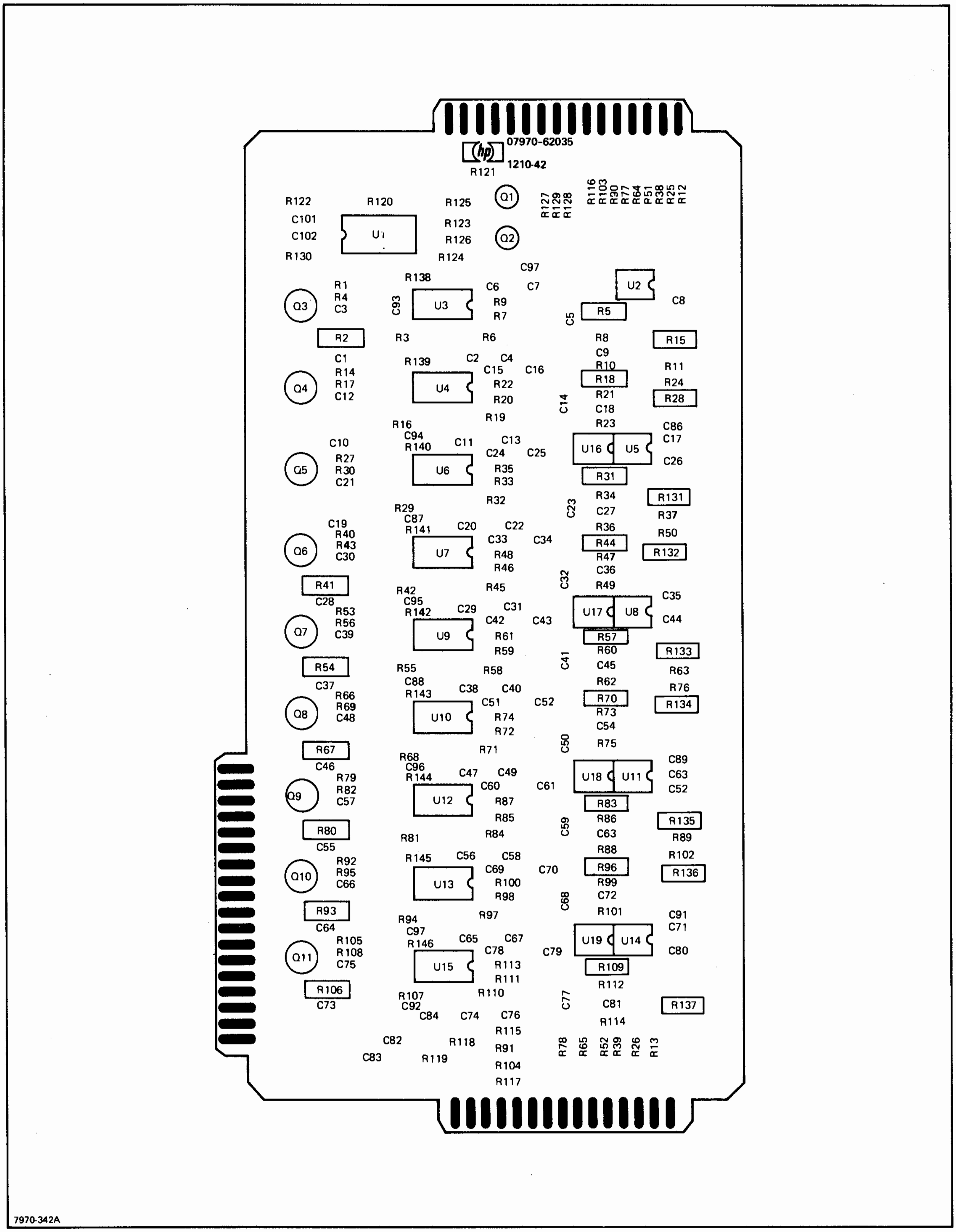
NOTES:

1. SPEED CRITICAL COMPONENTS.

SPEED IPS	C4, C13, C22, C31, C40, C49, C58, C67, C76	ASSY NO.
10-20.9 IPS	1200 PF	07970-62074
21-45 IPS	390 PF	07970-62036

2. RESISTORS R138 THRU R146 FIRST USED ON SERIES 1210.

3. o INDICATES A FEMALE MOLEX PIN.
   • INDICATES A MALE MOLEX PIN.



Read Preamplifier PCA, Parts Location Diagram

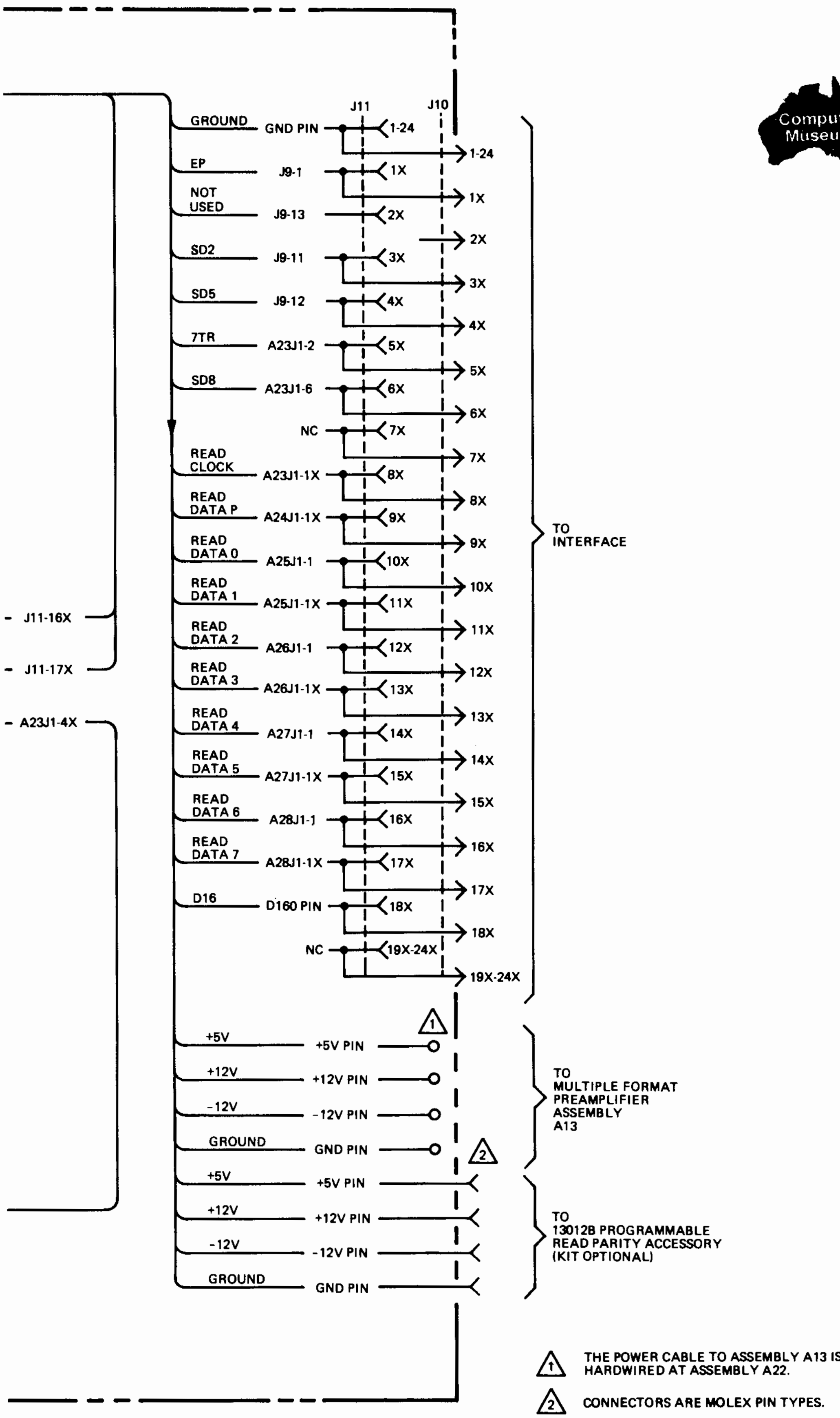
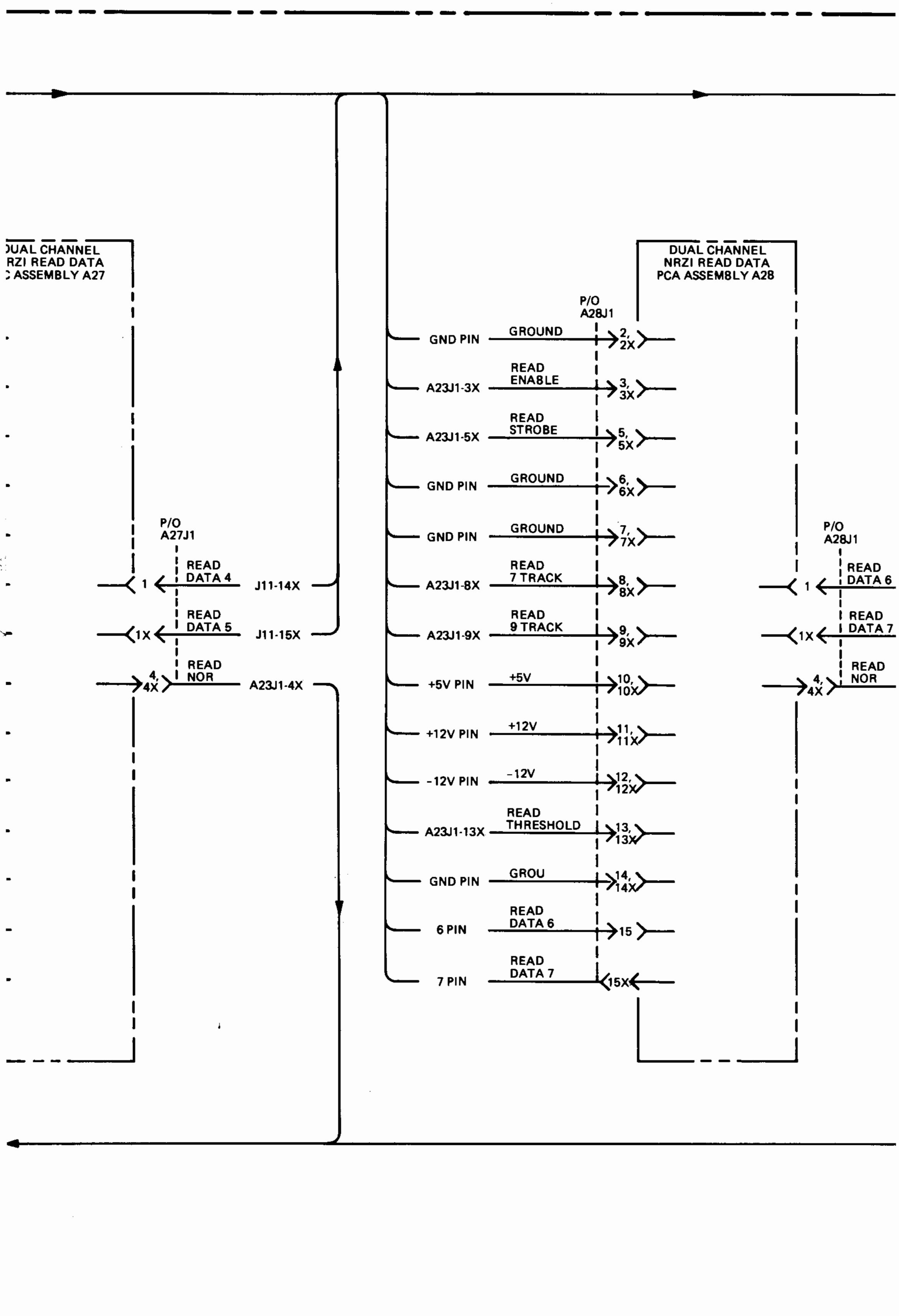
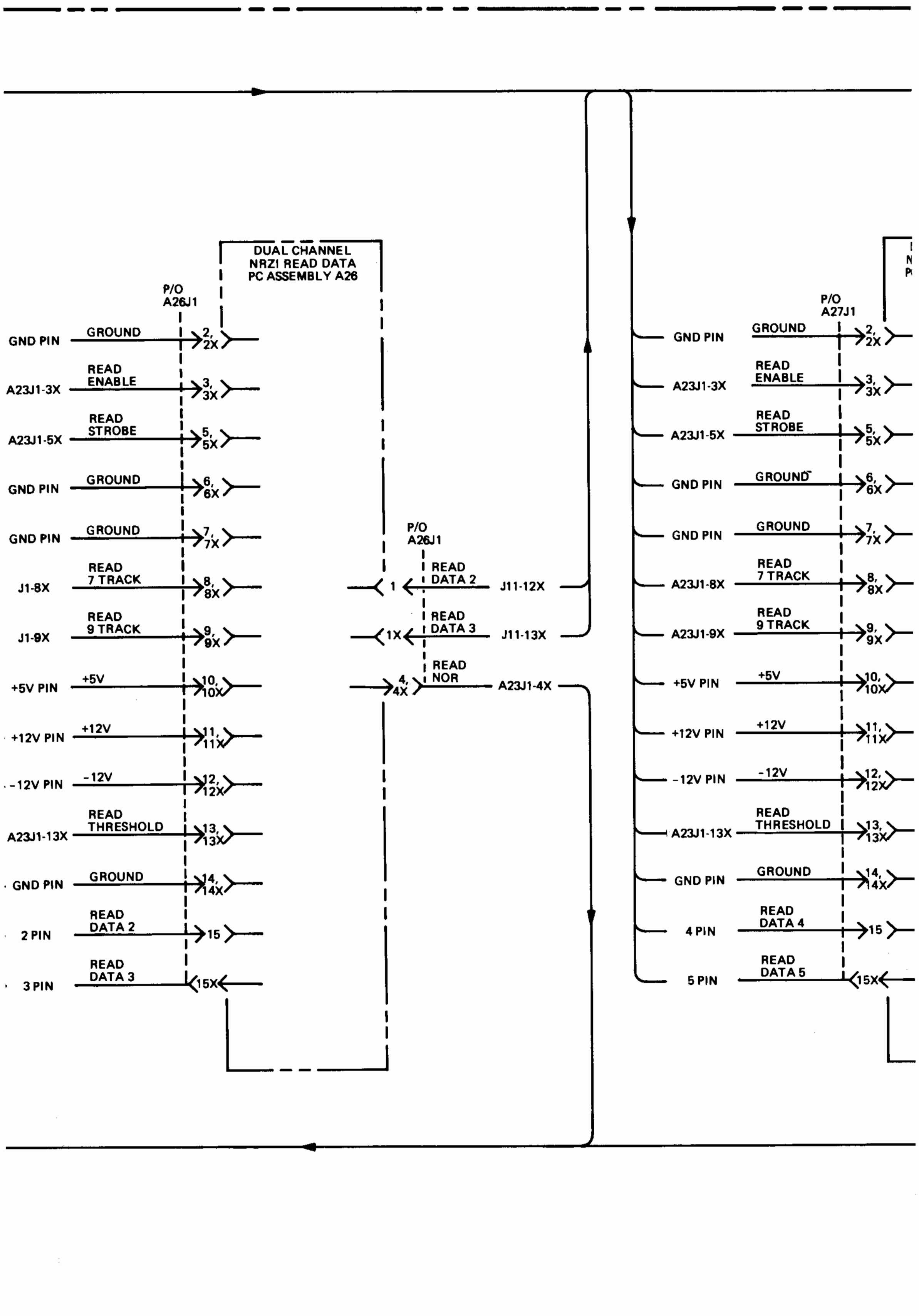
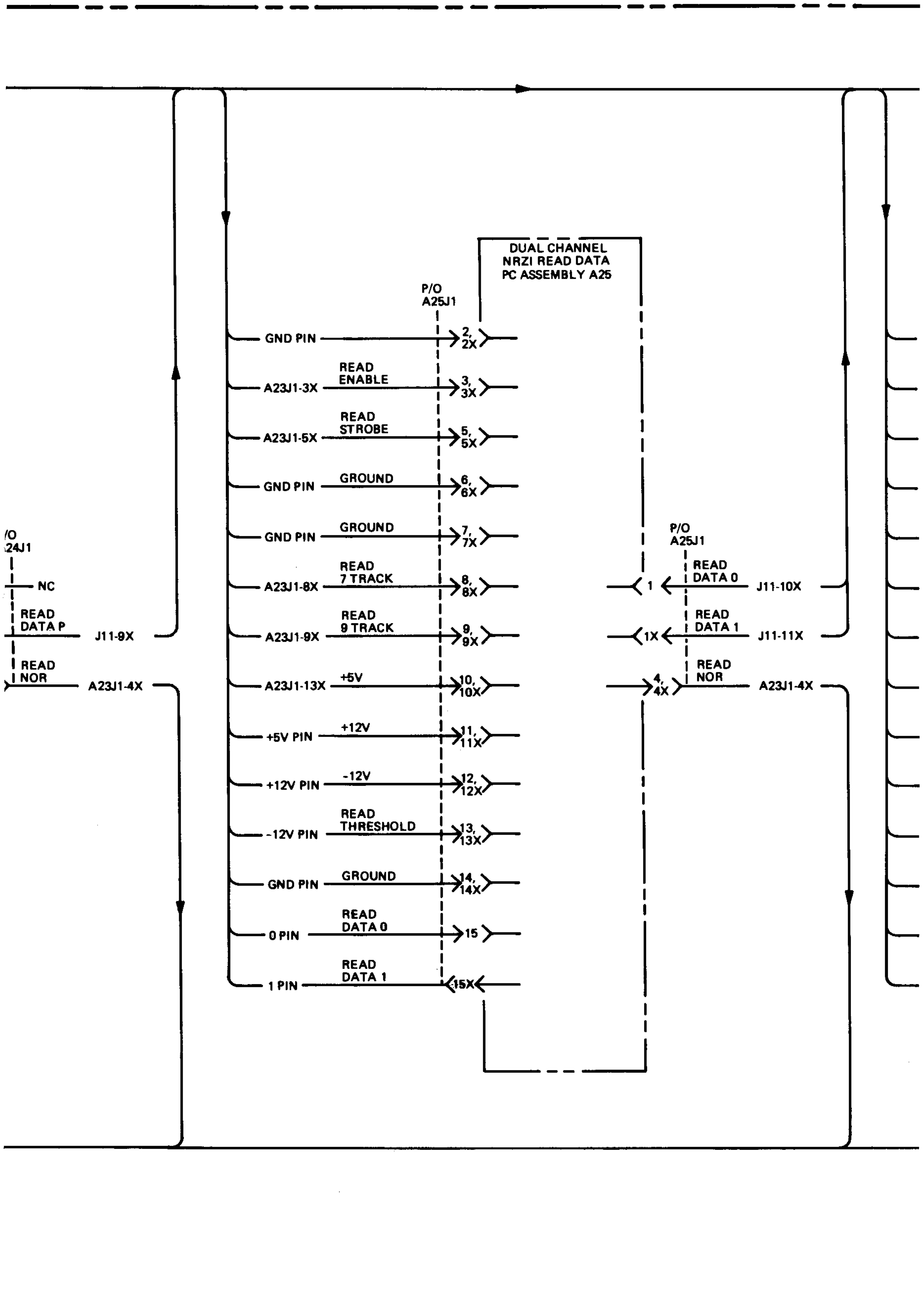


Figure 4-5. Read/Read Assembly A18, Schematic Diagram

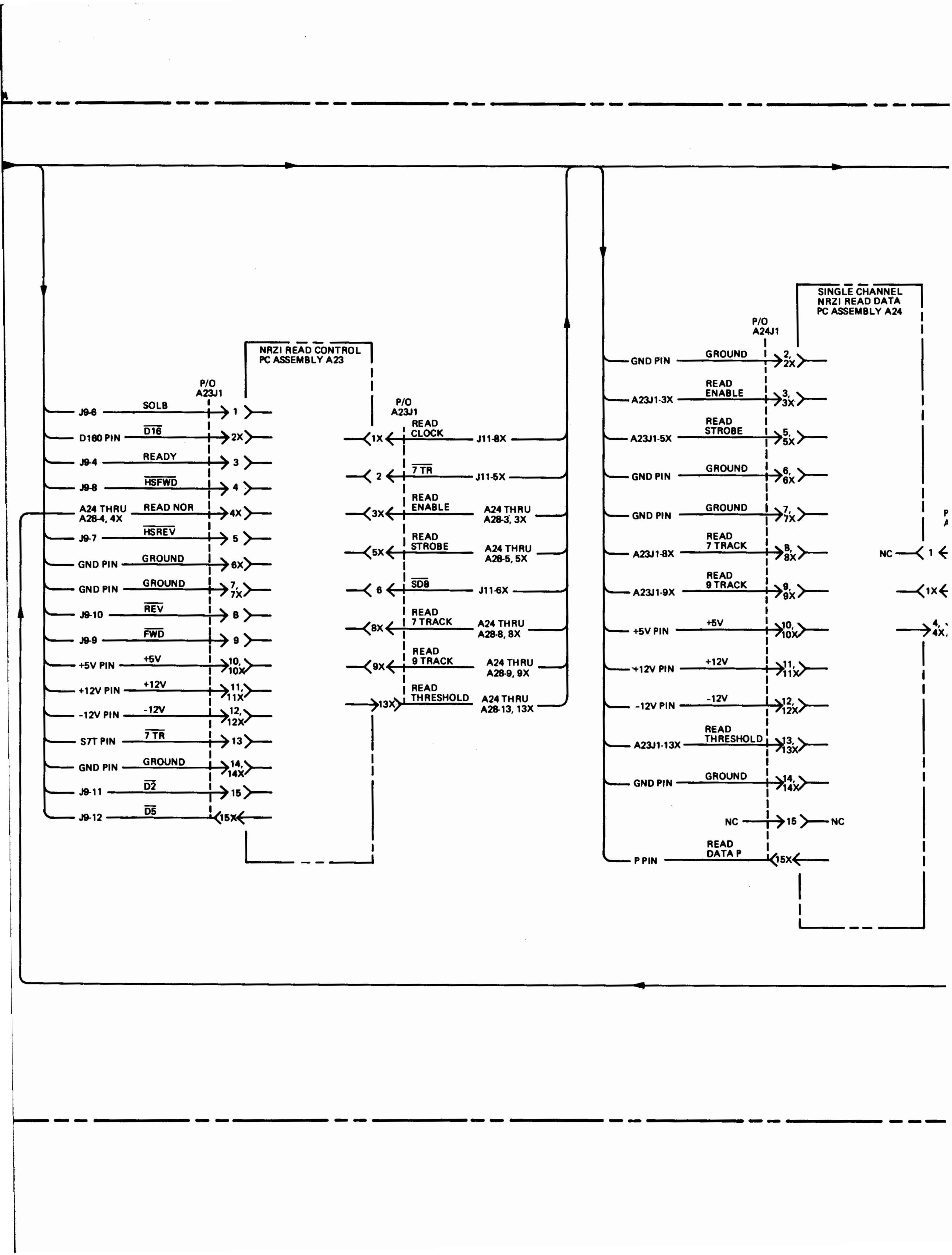


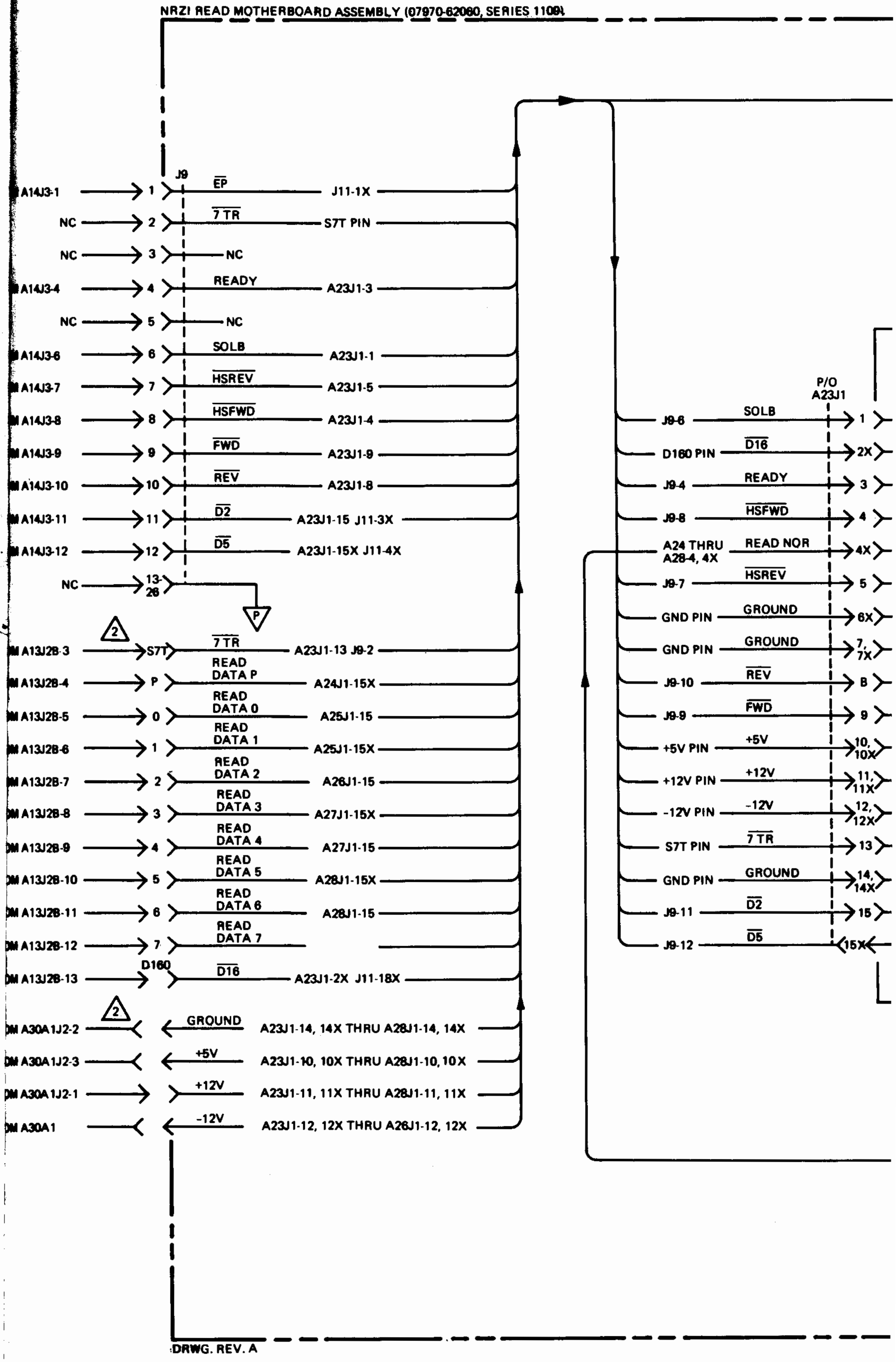
DUAL CHANNEL
NRZI READ DATA
ASSEMBLY A27
P/O
A27J1
READ
DATA 4
J11-14X
READ
DATA 5
J11-15X
READ
NOR
A23J1-4X
DUAL CHANNEL
NRZI READ DATA
PCA ASSEMBLY A28
P/O
A28J1
GND PIN
GROUND
A23J1-3X
READ
ENABLE
A23J1-5X
READ
STROBE
GND PIN
GROUND
GND PIN
GROUND
A23J1-8X
READ
7 TRACK
A23J1-9X
READ
9 TRACK
+5V PIN
+5V
+12V PIN
+12V
-12V PIN
-12V
A23J1-13X
READ
THRESHOLD
GND PIN
GROU
6 PIN
READ
DATA 6
7 PIN
READ
DATA 7
P/O
A28J1
READ
DATA 6
READ
DATA 7
READ
NOR

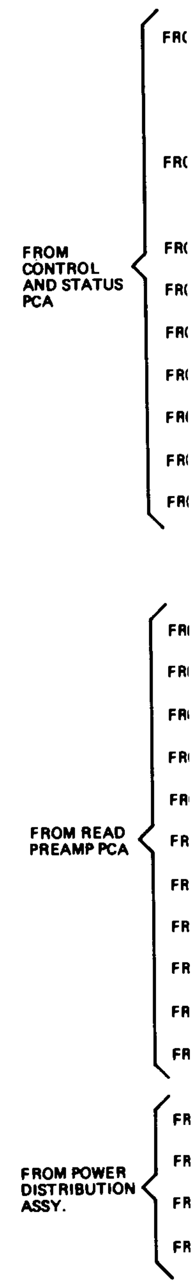

DUAL CHANNEL NRZI READ DATA PC ASSEMBLY A26
P/O A26J1
GND PIN
GROUND
A23J1-3X
READ ENABLE
A23J1-5X
READ STROBE
J1-8X
READ 7 TRACK
J1-9X
READ 9 TRACK
+5V PIN
+5V
+12V PIN
+12V
-12V PIN
-12V
A23J1-13X
READ THRESHOLD
2 PIN
READ DATA 2
3 PIN
READ DATA 3
READ DATA 2
J11-12X
READ DATA 3
J11-13X
READ NOR
A23J1-4X
P/O A27J1
A23J1-8X
A23J1-9X
4 PIN
READ DATA 4
5 PIN
READ DATA 5

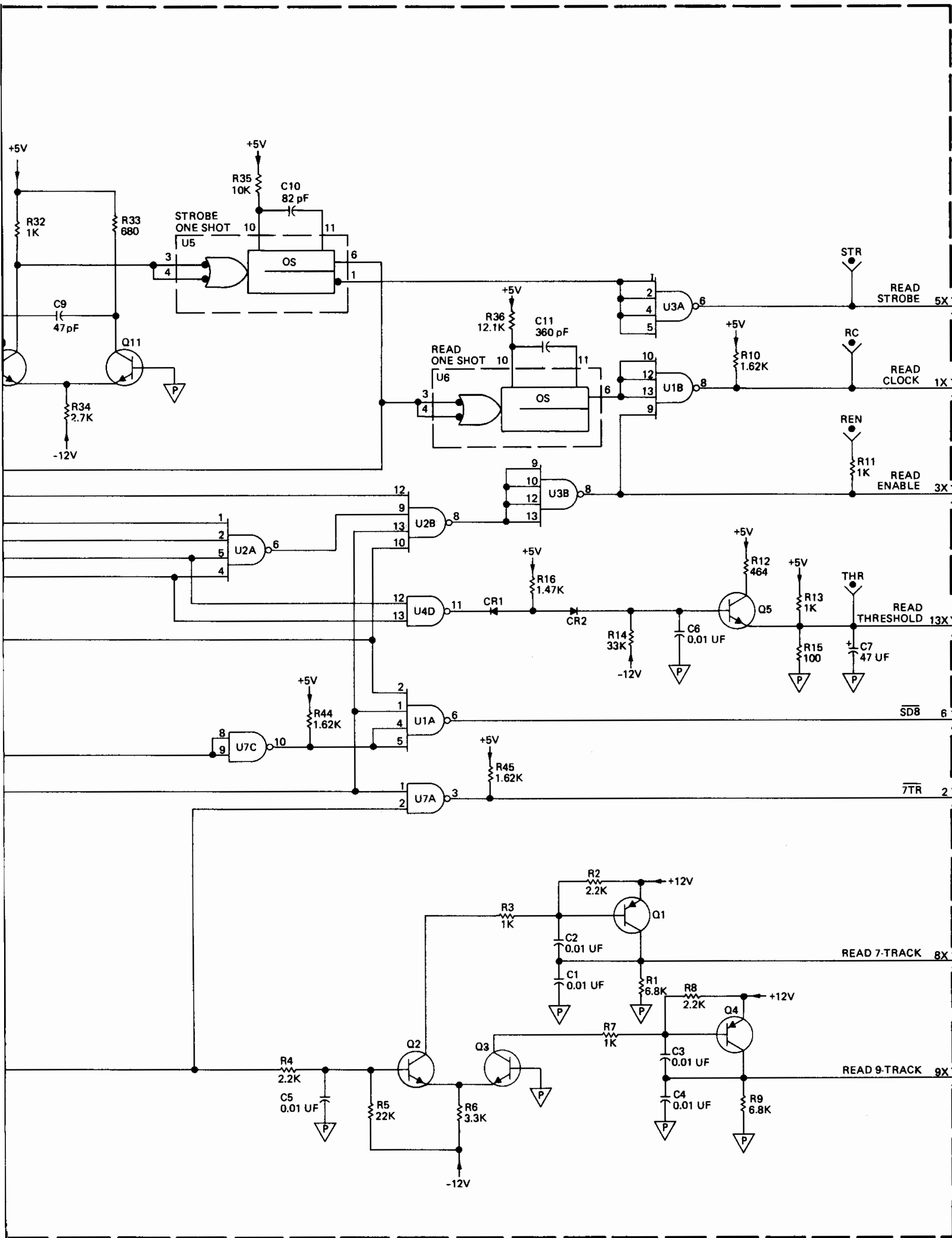


DUAL CHANNEL
NRZI READ DATA
PC ASSEMBLY A25
P/O
A25J1
GND PIN
2, 2X
A23J1-3X
READ ENABLE
3, 3X
A23J1-5X
READ STROBE
5, 5X
GND PIN
GROUND
6, 6X
GND PIN
GROUND
7, 7X
A23J1-8X
READ 7 TRACK
8, 8X
A23J1-9X
READ 9 TRACK
9, 9X
A23J1-13X
+5V
10, 10X
+5V PIN
+12V
11, 11X
+12V PIN
-12V
12, 12X
-12V PIN
READ THRESHOLD
13, 13X
GND PIN
GROUND
14, 14X
0 PIN
READ DATA 0
15
1 PIN
READ DATA 1
15X
/O
24J1
NC
READ DATA P
J11-9X
READ NOR
A23J1-4X
P/O
A25J1
1
READ DATA 0
J11-10X
1X
READ DATA 1
J11-11X
4, 4X
READ NOR
A23J1-4X

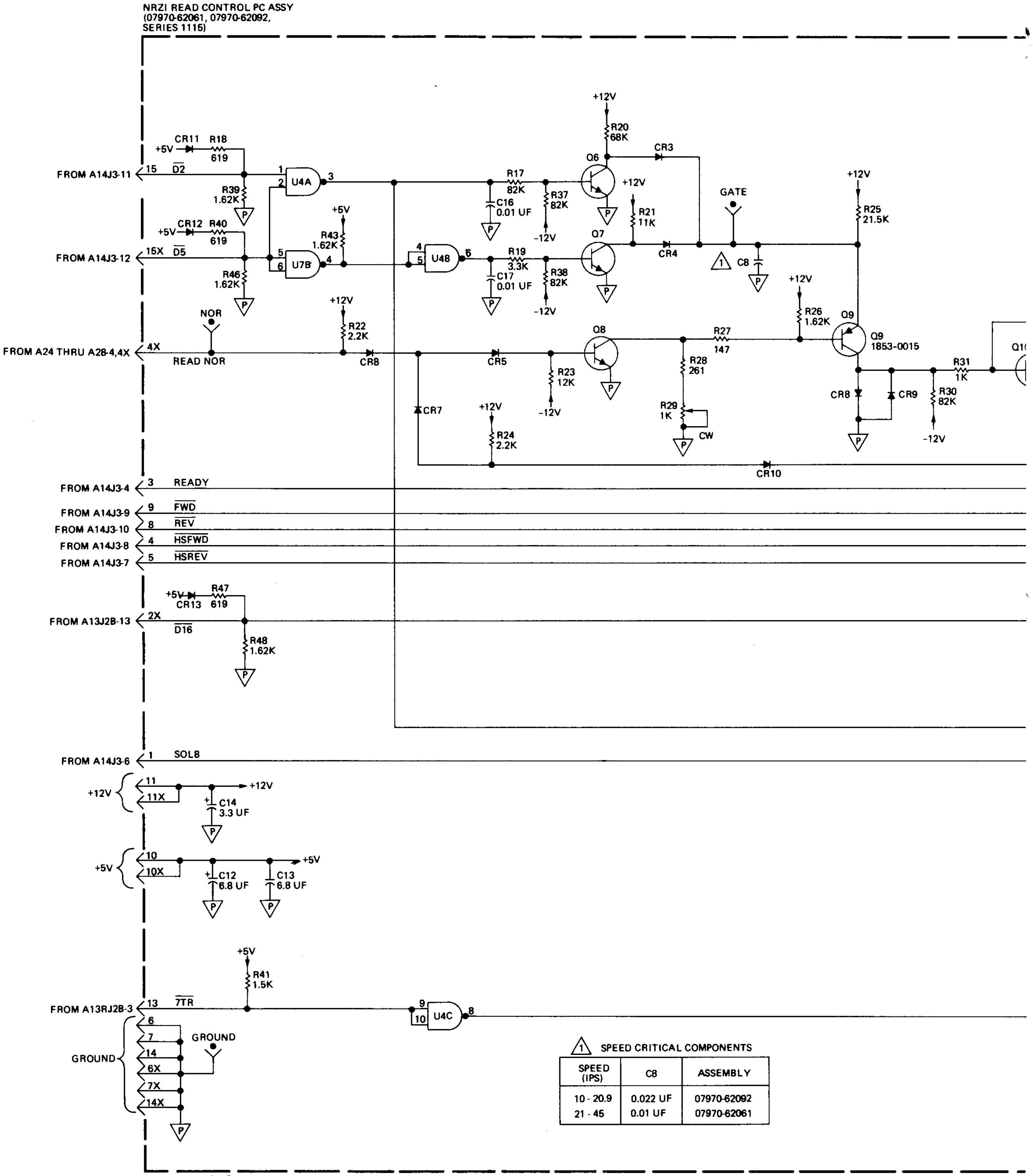

NRZI READ CONTROL PC ASSEMBLY A23
P/O A23J1
J9-6 SOLB 1
D160 PIN D16 2X
J9-4 READY 3
J9-8 HSFWD 4
A24 THRU A28-4, 4X READ NOR 4X
J9-7 HSREV 5
GND PIN GROUND 6X
GND PIN GROUND 7, 7X
J9-10 REV 8
J9-9 FWD 9
+5V PIN +5V 10, 10X
+12V PIN +12V 11, 11X
-12V PIN -12V 12, 12X
S7T PIN 7 TR 13
GND PIN GROUND 14, 14X
J9-11 D2 15
J9-12 D5 15X
P/O A23J1
1X READ CLOCK J11-8X
2 7 TR J11-5X
3X READ ENABLE A24 THRU A28-3, 3X
5X READ STROBE A24 THRU A28-5, 5X
6 SD8 J11-6X
8X READ 7 TRACK A24 THRU A28-8, 8X
9X READ 9 TRACK A24 THRU A28-9, 9X
13X READ THRESHOLD A24 THRU A28-13, 13X
SINGLE CHANNEL NRZI READ DATA PC ASSEMBLY A24
P/O A24J1
GND PIN GROUND 2, 2X
A23J1-3X READ ENABLE 3, 3X
A23J1-5X READ STROBE 5, 5X
GND PIN GROUND 6, 6X
GND PIN GROUND 7, 7X
A23J1-8X READ 7 TRACK 8, 8X
A23J1-9X READ 9 TRACK 9, 9X
+5V PIN +5V 10, 10X
+12V PIN +12V 11, 11X
-12V PIN -12V 12, 12X
A23J1-13X READ THRESHOLD 13, 13X
GND PIN GROUND 14, 14X
NC 15 NC
P PIN READ DATA P 15X
NC 1
1X
4, 4X


NRZI READ MOTHERBOARD ASSEMBLY (07970-62060, SERIES 1109)
J9
EP
J11-1X
7 TR
S7T PIN
NC
READY
A23J1-3
SOLB
A23J1-1
HSREV
A23J1-5
HSFWD
A23J1-4
FWD
A23J1-9
REV
A23J1-8
D2
A23J1-15 J11-3X
D5
A23J1-15X J11-4X
A14J3-1
A14J3-4
A14J3-6
A14J3-7
A14J3-8
A14J3-9
A14J3-10
A14J3-11
A14J3-12
A13J2B-3
A13J2B-4
A13J2B-5
A13J2B-6
A13J2B-7
A13J2B-8
A13J2B-9
A13J2B-10
A13J2B-11
A13J2B-12
A13J2B-13
READ DATA P
A24J1-15X
READ DATA 0
A25J1-15
READ DATA 1
A25J1-15X
READ DATA 2
A26J1-15
READ DATA 3
A27J1-15X
READ DATA 4
A27J1-15
READ DATA 5
A28J1-15X
READ DATA 6
A28J1-15
READ DATA 7
D160
D16
A23J1-2X J11-18X
A23J1-13 J9-2
GROUND
A23J1-14, 14X THRU A28J1-14, 14X
+5V
A23J1-10, 10X THRU A28J1-10, 10X
+12V
A23J1-11, 11X THRU A28J1-11, 11X
-12V
A23J1-12, 12X THRU A26J1-12, 12X
A30A1J2-2
A30A1J2-3
A30A1J2-1
A30A1
P/O A23J1
J9-6
D160 PIN
J9-4
J9-8
A24 THRU A28-4, 4X
READ NOR
J9-7
GND PIN
J9-10
J9-9
+5V PIN
+12V PIN
-12V PIN
S7T PIN
J9-11
J9-12
DRWG. REV. A


FROM CONTROL AND STATUS PCA
FROM READ PREAMP PCA
FROM POWER DISTRIBUTION ASSY.

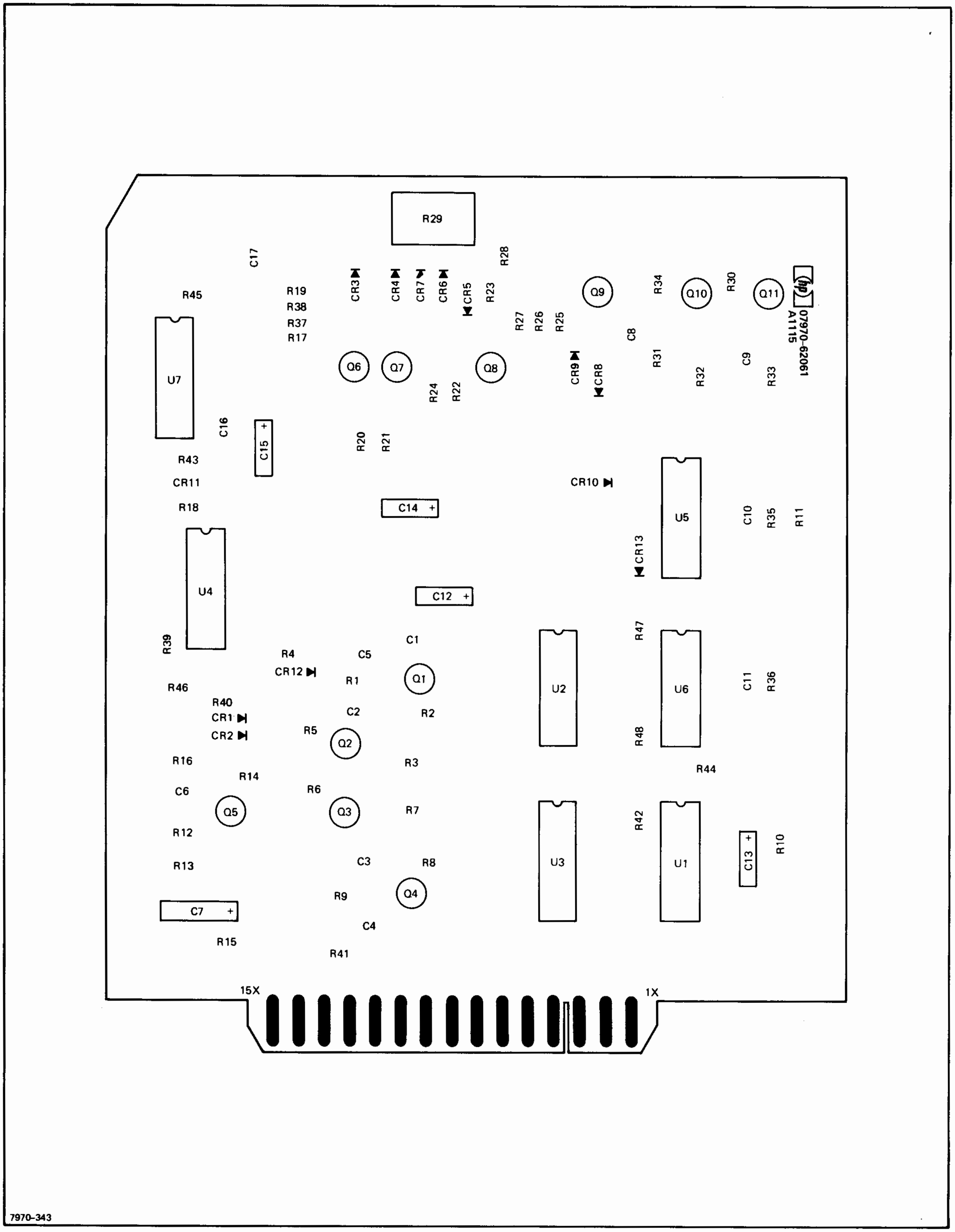


STROBE ONE SHOT
U5
OS
READ ONE SHOT
U6
OS
R35 10K
C10 82 pF
R32 1K
R33 680
C9 47pF
Q11
R34 2.7K
-12V
+5V
R36 12.1K
C11 360 pF
U3A
U1B
U3B
U2B
U2A
U4D
U1A
U7C
U7A
STR
READ STROBE
5X
TO A24 THRU A28-5,5X
RC
R10 1.62K
READ CLOCK
1X
TO INTERFACE
REN
R11 1K
READ ENABLE
3X
TO A24 THRU A28-3,3X
R12 464
R13 1K
THR
Q5
READ THRESHOLD
13X
TO A24 THRU A28-3,13X
R16 1.47K
CR1
CR2
R14 33K
C6 0.01 UF
R15 100
C7 47 UF
R44 1.62K
SD8
6
TO INTERFACE
R45 1.62K
7TR
2
TO INTERFACE
R2 2.2K
+12V
R3 1K
Q1
C2 0.01 UF
C1 0.01 UF
READ 7-TRACK
8X
TO A24 THRU A28-8,8X
R1 6.8K
R8 2.2K
Q4
R7 1K
Q2
Q3
C3 0.01 UF
C4 0.01 UF
READ 9-TRACK
9X
TO A24 THRU A28-9,9X
R9 6.8K
R4 2.2K
C5 0.01 UF
R5 22K
R6 3.3K

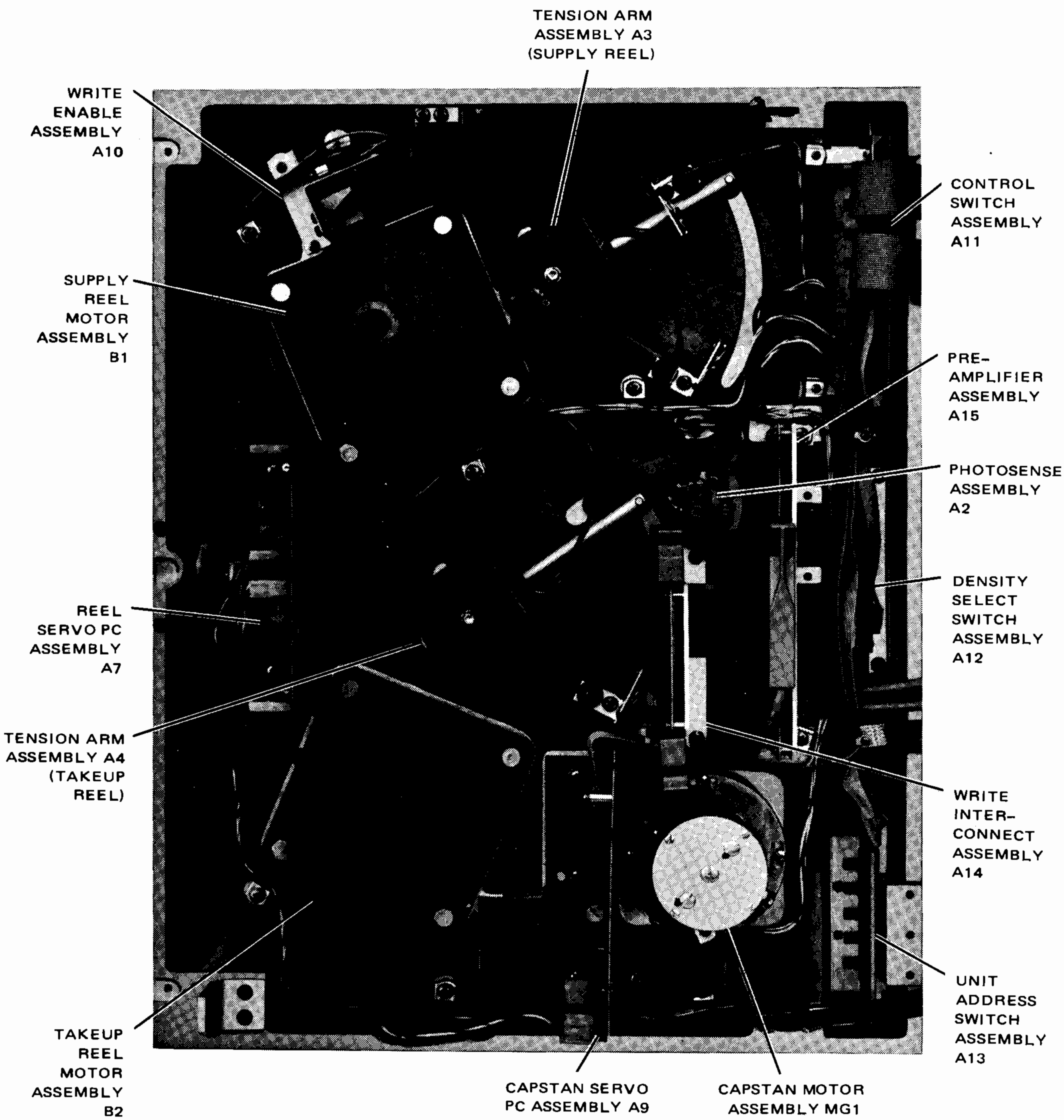


SPEED CRITICAL COMPONENTS

SPEED (IPS)	C8	ASSEMBLY
10 - 20.9	0.022 UF	07970-62092
21 - 45	0.01 UF	07970-62061



Read Control PCA, Parts Location Diagram



7970-375

Figure 1-2. Tape Unit Assemblies, Main Casting (Rear View)

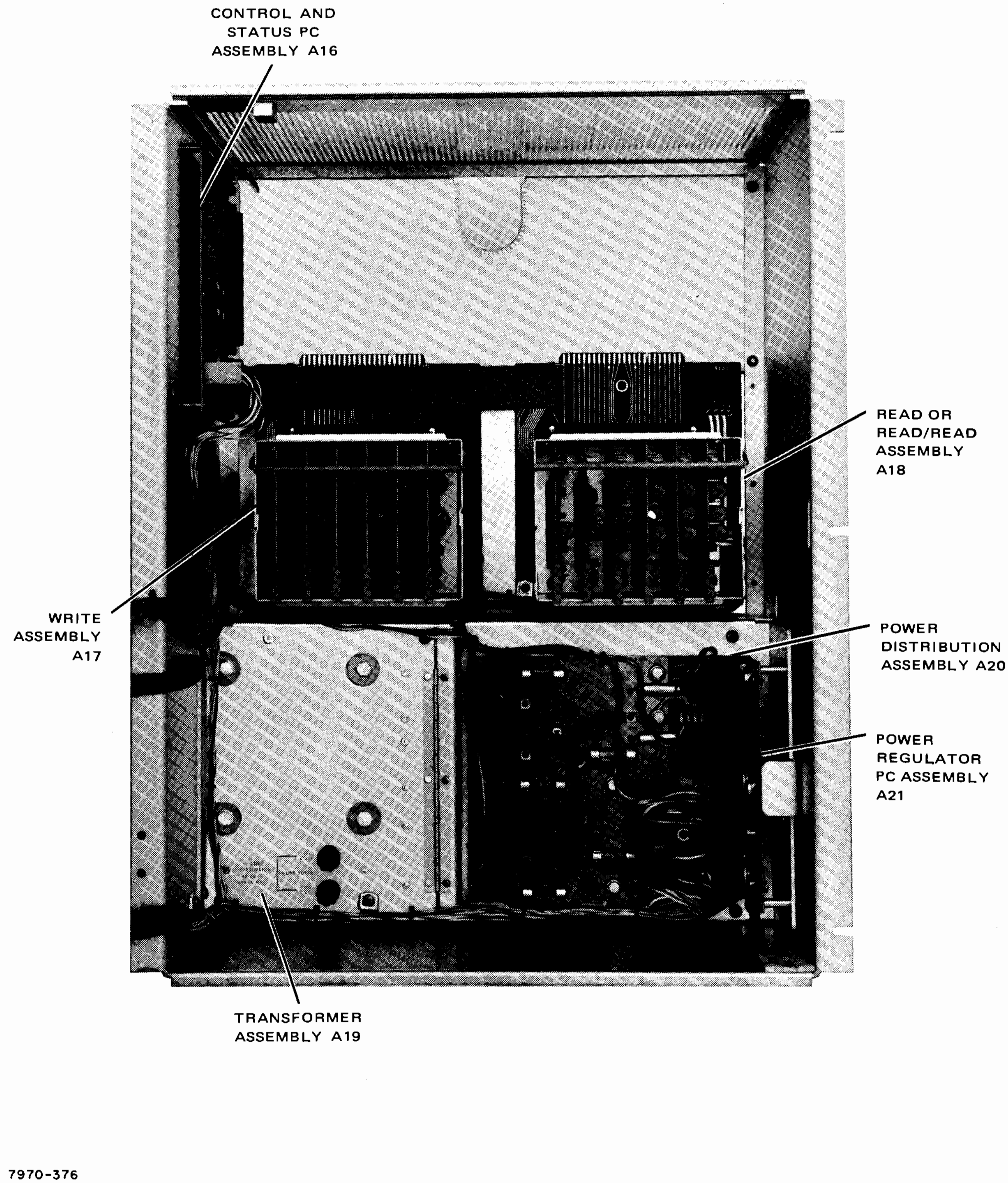


Figure 1-3. Tape Unit Housing Assemblies

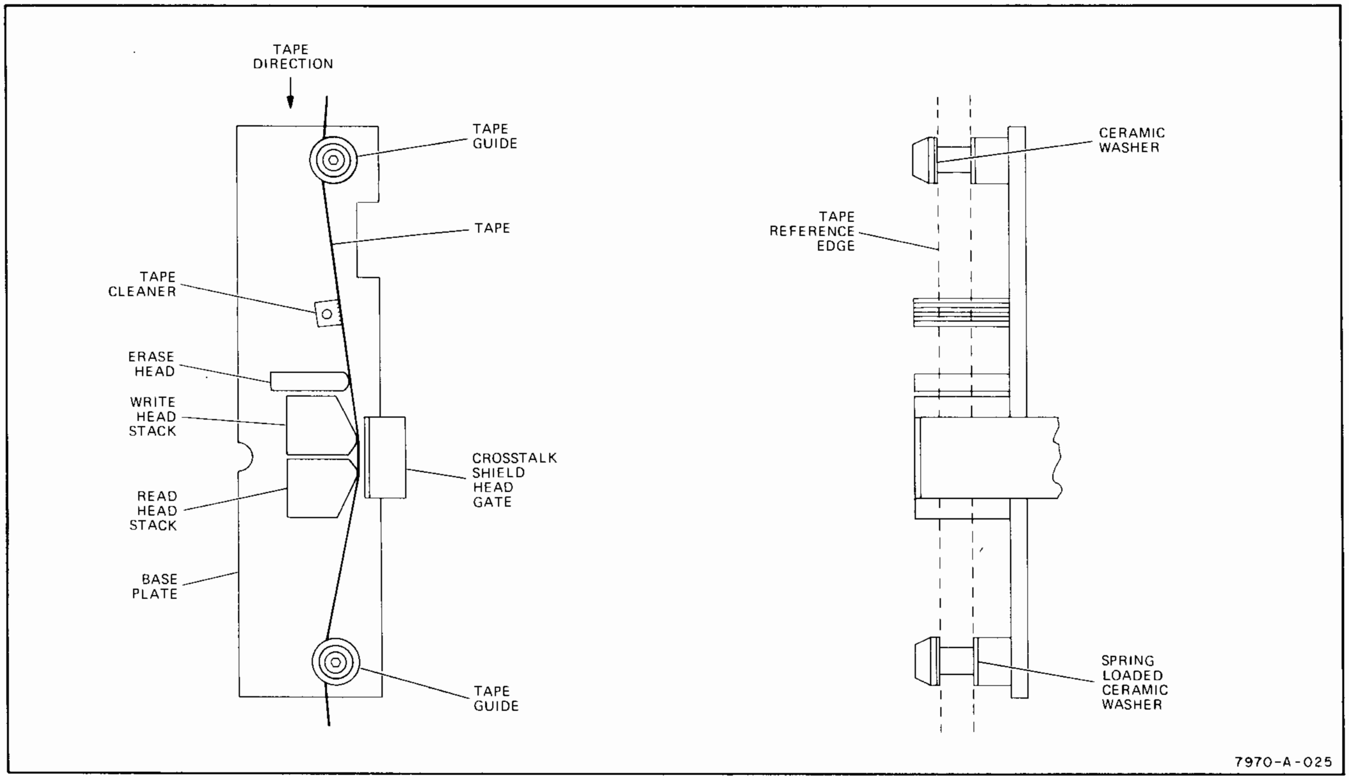


Figure 1-4. Magnetic Tape Head Assembly

1-29. ACCESSORIES FURNISHED.

1-30. The following accessories are furnished with the standard tape unit:

PART NUMBER	DESCRIPTION	QTY
07970-00580	Rack Mounting Bracket	1
2190-0034	. Lockwasher, number 10	7
2680-0103	. Screw, number 10-32, 0.500 inch	3
2680-0116	. Screw, number 10-32, 0.375 inch	4
2680-0129	. Screw, number 10-32, 0.312 inch	4
3050-0002	. Washer, Flat	7
8120-1348	AC Power Cable	1
1490-0738	Magnetic Tape Reel	1
07970-60420	Extender Board	1
07970-61090	Interface Connector	3

1-31. ACCESSORIES AVAILABLE.

1-32. The following accessories are available for the tape unit at extra cost:

a. HP 13190A Multiunit Cable (12.5 feet).

b. HP 13190B Multiunit Cable (20 feet).

c. Transport Test Tape, part number 5080-4525 (for seven-track application).

d. Transport Test Tape, part number 5080-4526 (for nine-track application).

e. 200 BPI Reference Amplitude Test Tape, part number 5080-4547 (for read only systems).

f. Write Test Tape, part number 9162-0025 (standard computer grade tape: 3M777 or Memorex MRX 111 on 10.5 inch reels).

g. Master Alignment Tape, part number 9162-0027.

h. HP 13191A Control and Status Test Board.

i. HP 13193A Read Test Board.

j. HP 13192A Write Test Board.

k. HP 13012A Read Parity for seven- and nine-tracks.

l. HP 13014A Write Parity for seven- and nine-tracks.

m. Rack Mounting Kit, part number 07970-62118.

Table 1-3. Specifications

TAPE SPEED

10 to 45 ips

REEL DIAMETER

Up to 10.50 inches (266,7 mm)

TAPE (Computer Grade)

Width: 0.5 inches (12, 7 mm)
Thickness: 1.5 mils

TAPE TENSION

8.5 oz, nominal

REWIND SPEED

160 ips

FAST FORWARD

160 ips

INSTANTANEOUS SPEED VARIATION

±3% (measured bit-to-bit)

LONG-TERM SPEED VARIATION

±1%

FAST FORWARD, FAST REVERSE, START/STOP CHARACTERISTICS

Distance: 40 inches, nominal start (25 ips)
69 inches, nominal start (37.5 and 45 ips)
31 inches, nominal stop (37.5 and 45 ips)

Time: 0.7 second, maximum

START/STOP TIMES

15 ms (at 25 ips)
10 ms (at 37.5 ips)
8.33 ms (at 45 ips)

START/STOP TAPE TRAVEL

0.187 ± 0.020 inch (4,7625 ± 0.508 mm)

REEL MOTOR BRAKING

Dynamic

RECORDING MODE

NRZI (industry compatible)

MAGNETIC HEAD ASSEMBLY

Standard: seven- or nine-track, erase, write and read
Gap Scatter (Measured Optically):
Read Stack: 150 μin., maximum
Write Stack: 150 μin., maximum

SKEW

Static Skew: The per channel one-shot deskewing technique is utilized in the write (forward) and read (forward and reverse) circuitry effectively eliminating static skew.

Dynamic Skew: ±200 μin. (read after write), maximum

HEAD GUIDE SPACING

Industry compatible

WRITE HEAD TO READ HEAD CROSSTALK

<5% (of read signal)

READ HEAD CHANNEL TO READ HEAD CHANNEL CROSSTALK

<-30 dB

BEGINNING-OF-TAPE AND END-OF-TAPE REFLECTIVE STRIP DETECTION

Photoelectric, industry compatible

OPERATING ENVIRONMENT

Ambient Temperature: +32° to +131°F (0° to 55°C)
Relative Humidity: 20 to 80% (non-condensing)
Altitude: 10,000 ft (3.048 m)

POWER REQUIREMENTS

115 or 230 (±10%) Vac
48 to 66 Hz, single phase
400 VA, maximum (on high line)

DIMENSIONS

Height: 24 inches (609,6 mm)
Width: 19 inches (482,6 mm)
Depth: 12 inches (304,8 mm) (rack space)
Overall Depth: 15.75 inches (391 mm)

WEIGHT

130 lb maximum (56.7 kilograms)

TRANSPORT MOUNTING

Vertical: Standard 19 inches (482,6 mm) Retma rack

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains installation information and post-installation checkout procedures. Also included in this section is information pertaining to unpacking, inspection, claims for damage, and site selection.

2-3. UNPACKING AND INSPECTION.

2-4. If the shipping carton is damaged upon receipt, request that the carrier's agent be present when the unit is unpacked. Inspect the unit for damage (cracks, broken parts, etc). If the unit is damaged and fails to meet specifications, notify the carrier and the nearest Hewlett-Packard Sales and Service Office immediately. (Sales and Service Offices are listed at the back of this manual.) Retain the shipping container and the packing material for the carrier's inspection. The Hewlett-Packard Sales and Service Office will arrange for the repair or replacement of the damaged unit without waiting for any claims against the carrier to be settled.

2-5. When unpacking the unit, retain all packing materials and hardware for future use. The following procedures describe how to unpack the unit in order to save all packing materials.

a. Using a sharp knife or similar tool, cut the top seal of the outer shipping box.

b. Remove the six toro pads isolating the inner shipping box.

c. Cut the top seal of the inner shipping box and remove accessory cartons or filler carton.

d. Remove accessory liner and top pad.

e. Remove plastic sheet from face of unit.

CAUTION

The unit weighs approximately 130 pounds. Two persons are required to lift the unit from the shipping container.

f. Remove unit from inner shipping box.

g. Remove the two number 10-32 screws and washers that secure the tape unit casting to the housing.

2-6. SITE SELECTION.

2-7. The tape unit is designed for operation at sites that are not subject to excessive shocks, excessive vibration, or wide ranges of ambient temperatures. The unit should be located so as to provide access to both front and rear sections of the cabinet with sufficient room for the maximum swing radius of the cover door and the transport. Convection cooling is provided by perforated panels in the top, bottom, and rear lower panels. No forced air ventilation is required where the exterior ambient temperature does not exceed 131°F and no other heat generating equipment is housed in the cabinet.

2-8. INSTALLATION.

2-9. Installation of the tape unit is limited to mounting the unit in a standard 19-inch rack and connecting interface cabling. The weight of the transport in the open position must be considered and ballast may be required to prevent the rack from tipping. The following procedures describe the installation of the unit in a 19-inch rack.

a. Remove protective covering from accessory kit and locate four number 10-32 flat-head screws (part number 2680-0116) and rack mounting bracket (part number 07970-00580).

b. Attach the rack mounting bracket to the left rail of the rack with the four number 10-32 flat-head screws. Orient the rack mounting bracket so that the upper and lower flanges face the inside of the rack. These flanges form a cradle to hold the left (hinged) side of the tape unit.

c. Place the tape unit into position and using three number 10-32, 0.5-inch machine screws (part number 2680-0103), three flat washers, and three lockwashers, attach the right side of the transport housing to the 19-inch rack.

d. Using the remaining four number 10-32, 0.312-inch machine screws (part number 2680-0129), flat washers, and lockwashers, secure the left side of the transport housing to the rack mounting bracket.

WARNING

The tape unit power cable is equipped with a three-wire connector. Do not defeat the ground connection by using an adapter or breaking the grounding pin of the connector. Isolating the unit from ground creates a hazardous condition which may result in death or serious injury.

e. Connect the female polarized connector of power cable W1 to the male power connector of the tape unit. Route the power cable to the site power outlet.

2-10. CABLES AND CONNECTORS.

2-11. There are three interface mating connectors. Each is specifically associated with:

a. Control and Status.

b. Write Data.

c. Read Data.

The male portions of these connectors are presented to the interface cables, via supplied mating connectors, as etched sections of printed-circuit assemblies. These assemblies are located within the rear section of the tape unit. (See figure 2-1.

2-12. Three female mating connectors are supplied; each has a 48-pin (24 active line) capability. These mating connectors are intended to be directly connected to the users interfacing cables. Strain relief hardware is also provided. Tables 2-1, 2-2, and 2-3 list the pin assignments and line names. These lines are described in tables 2-4, 2-5, and 2-6.

2-13. The suggested maximum cable length is 20 feet from connector pin to connector pin. The interfacing cable should employ one set of twisted pairs for each input/output (I/O) line function, with one of the pair being used for the active I/O line, the other being used for terminal grounding at both ends of the cable to reduce the magnitude of intercable crosstalk. Unless otherwise specified, all wires should be 26 AWG, minimum, not less than one twist per inch, with a minimum insulation thickness of 0.01 inch. Figure 2-2 shows interface connector details and describes fabrication of an interface cable.

2-14. MULTIPLE UNIT INSTALLATION.

2-15. The three interface connector boards are manufactured with parallel connectors. This allows up to four tape units to be utilized from one controller. Figure 2-3 shows a typical multiple unit installation. HP 13190A and 13190B Multiunit Cable Accessory Kits are available for multiple unit installation.

2-16. The unit select address is operator selectable from the operator control panel, (if the tape unit has the unit select option). Otherwise, the unit address is jumper selectable on the control and status PC assembly.

2-17. INPUT/OUTPUT LINE TRANSMITTERS AND RECEIVERS.

2-18. The tape unit interface I/O transmitter and receiver electrical parameters are shown and described in figure 2-4.

2-19. WAVEFORM AND EVENT TIMING.

2-20. Figures 2-5 and 2-6 show the write and read timing. The read-after-write verification time is approximately 6.0 milliseconds or:

$$\frac{\text{Head Spacing}}{\text{Velocity}}$$

2-21. CHECKOUT PROCEDURES.

2-22. After the unit is installed and interface connections are completed, visually inspect the installation. Ensure that the power source is adequate and that all cables are properly anchored. Refer to section III for a description of all operating controls and indicators. Perform the checkout procedures described in section III to ensure that the unit is operational.

2-23. RESHIPMENT.

2-24. If the tape unit or any part of the unit is to be shipped to Hewlett-Packard for service or repair, attach a tag to the item identifying the owner and indicating the service or repair to be accomplished. Include the information shown on the model plate and serial number of the unit.

2-25. When packing the unit for shipment, observe the following precautions and use the original packing materials.

a. Ensure that the two number 10-32, 0.5-inch machine screws (part number 2680-0103) and washers (part number 3050-0002) are installed in the holes provided in the casting. These screws prevent the casting from opening away from the housing.

b. Ensure that the inner carton is in good condition and that the liner (part number 9220-1660) is in position at the bottom of the inner carton. The slots in the liner allow the use of a shipping sling.

c. Place the unit into the inner carton with the reel cover facing up. Ensure that the casting weight is evenly distributed over the liner surface. If a shipping sling is used to lower the unit into the carton, be sure the webbing is located at the slots of the inner liner.

d. Place the plastic sheet over the unit to protect the window surface.

e. Place the top pad into position. If the unit is to be shipped without accessories, fill the remaining space with a filler carton (part number 9211-1647) or other similar filler. Do not fill this space with loose fill. Solid mass is required for adequate protection.

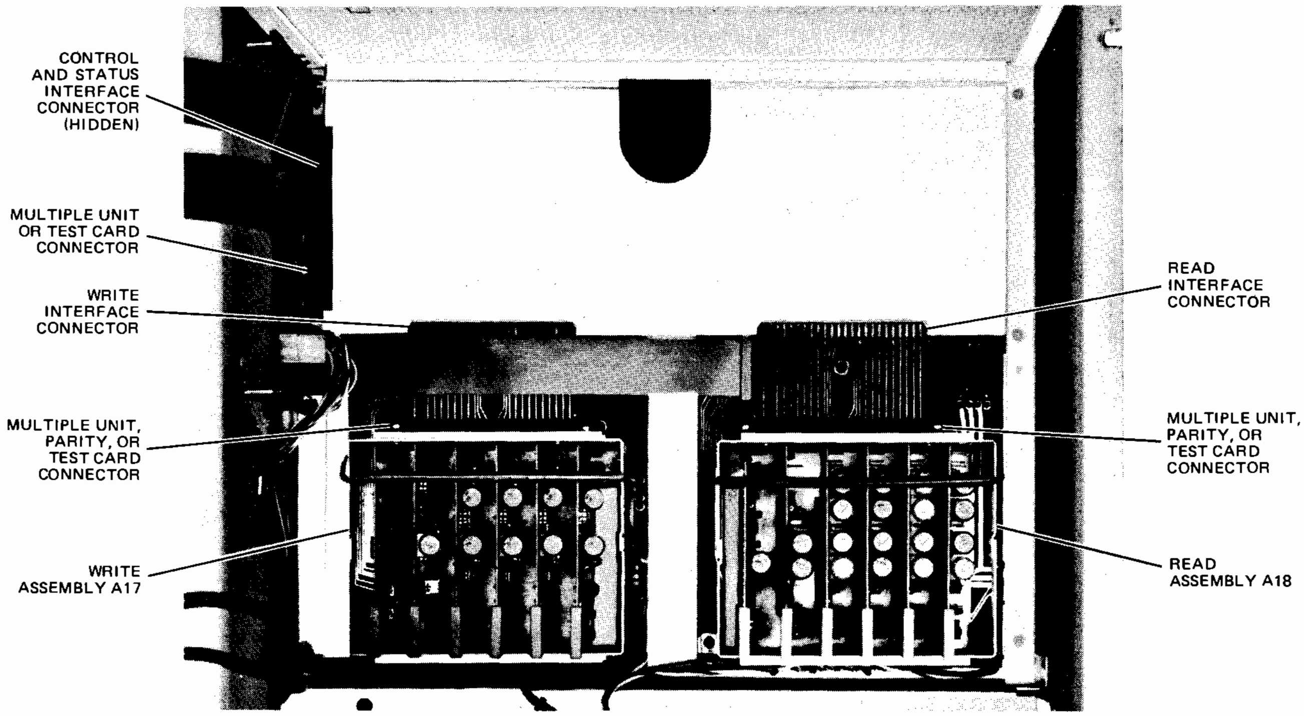


Figure 2-1. Tape Unit Interface Connectors

Table 2-1. Control and Status Connector

ACTIVE PIN	GROUND PIN	SIGNAL NAME	MNEMONIC
1X (A)	1	On-Line Status	SL
2X (B)	2	Load Point Status	SLP
3X (C)	3	Rewind Status	SRW
4X (D)	4	End of Tape Status	SET
5X (E)	5	Ready Status	SR
6X (F)	6	File Protect Status	SFP
7X (H)	7	Density 800 Status	SD8
8X (J)	8	Density 556 Status	SD5
9X (K)	9	Density 200 Status	SD2
10X (L)	10	Select Unit 3	CS3
11X (M)	11	Select Unit 2	CS2
12X (N)	12	Select Unit 1	CS1
13X (P)	13	Select Unit 0	CS0
14X (R)	14	Rewind Command	CRW
15X (S)	15	Off-Line Command	CL
16X (T)	16	Forward Command	CF
17X (U)	17	Reverse Command	CR
18X (V)	18	High Speed Command	CH
19X (W)	19	Set Write Command	WSW
20X (X)	20	Reserved for Options and Spares	--------
through	through	↕	--------
24X (BB)	24	Reserved for Options and Spares	--------

Table 2-2. Write Data Connector

ACTIVE PIN		GROUND PIN	SIGNAL NAME		MNEMONICS	
1X	(A)	1	Reserved for Options		--------	
2X	(B)	2	Reserved for Options		--------	
3X	(C)	3	Reserved for Options		--------	
4X	(D)	4	Reserved for Options		--------	
5X	(E)	5	Reserved for Options		--------	
6X	(F)	6	Write Status		SW	
7X	(H)	7	Write Reset		WRS	
8X	(J)	8	Write Clock		WC	
			IBM CHANNEL DESIGNATIONS			
			NINE-TRACK	SEVEN-TRACK	NINE-TRACK	SEVEN-TRACK
9X	(K)	9	Write Data P	Write Data C	WDP	WDC
10X	(L)	10	Write Data 0	-------------------	WD0	--------
11X	(M)	11	Write Data 1	-------------------	WD1	--------
12X	(N)	12	Write Data 2	Write Data B	WD2	WDB
13X	(P)	13	Write Data 3	Write Data A	WD3	WDA
14X	(R)	14	Write Data 4	Write Data 8	WD4	WD8
15X	(S)	15	Write Data 5	Write Data 4	WD5	WD4
16X	(T)	16	Write Data 6	Write Data 2	WD6	WD2
17X	(U)	17	Write Data 7	Write Data 1	WD7	WD1
18X	(V)	18	Reserved for Options and Spares		--------	
through		through	↕		--------	
24X	(BB)	24	Reserved for Options and Spares		--------	

Table 2-3. Read Data Connector

ACTIVE PIN		GROUND PIN	SIGNAL NAME		MNEMONICS	
1X	(A)	1	Reserved for Options and Spares		--------	
2X	(B)	2	Reserved for Options and Spares		--------	
3X	(C)	3	Reserved for Options and Spares		--------	
4X	(D)	4	Reserved for Options and Spares		--------	
5X	(E)	5	Reserved for Options and Spares		--------	
6X	(F)	6	Reserved for Options and Spares		--------	
7X	(H)	7	Reserved for Options and Spares		--------	
8X	(J)	8	Read Clock		RC	
			IBM CHANNEL DESIGNATIONS			
			NINE-TRACK	SEVEN-TRACK	NINE-TRACK	SEVEN-TRACK
9X	(K)	9	Read Data P	Read Data C	RDP	RDC
10X	(L)	10	Read Data 0	-------------------	RD0	--------
11X	(M)	11	Read Data 1	-------------------	RD1	--------
12X	(N)	12	Read Data 2	Read Data B	RD2	RDB
13X	(P)	13	Read Data 3	Read Data A	RD3	RDA
14X	(R)	14	Read Data 4	Read Data 8	RD4	RD8
15X	(S)	15	Read Data 5	Read Data 4	RD5	RD4
16X	(T)	16	Read Data 6	Read Data 2	RD6	RD2
17X	(U)	17	Read Data 7	Read Data 1	RD7	RD1
18X	(V)	18	Reserved for Options and Spares		--------	
through		through			--------	
24X	(BB)	24	Reserved for Options and Spares		--------	

Table 2-4. Detailed Description of I/O Lines, Status, and Motion Control Connector

I/O LINE	DESCRIPTION	SIGNAL TYPE	SIGNAL DIRECTION
STATUS			
a. ON-LINE (SL = STATUS ON-LINE)	Acknowledges that the selected tape unit has been manually placed in an on-line condition.	Level	Output
b. READY (SR = STATUS READY)	Indicates that the tape unit is selected, is on-line, the initial loading sequence is complete, and the tape unit is not rewinding.	Level	Output
c. LOAD POINT (SLP = STATUS LOAD POINT)	Indicates that the tape unit is selected, is on-line, and the tape is positioned at the load point reflective strip.	Level	Output
d. DENSITY STATUS (SD = STATUS DENSITY) NOTE: Three individual lines SD2, SD5, and SD8	Indicates the manual setting of a tape unit density switch: 220, 556, 800 CPI. Only one density at a time can be asserted from a selected and on-line tape unit.	Level	Output
e. REWIND (SRW = REWIND STATUS)	Indicates that the selected and on-line tape unit is engaged in a rewind operation. This status remains true until the tape is positioned at the load point reflective strip.	Level	Output
f. FILE PROTECT (SFP = STATUS FILE PROTECT)	Indicates that the selected and on-line tape unit is not write enabled (write ring is not present in the file reel).	Level	Output
g. END-OF-TAPE (SET = STATUS END OF TAPE)	Indicates that an end-of-tape reflective strip has passed under the photosense head of a selected and on-line tape unit. Assertion is maintained until cancellation of the end-of-tape condition by the passage of the reflective strip in the reverse direction.	Level	Output
FUNCTION COMMANDS			
a. SELECT (CS = COMMAND SELECT) NOTE: Four individual lines for units 0, 1, 2, and 3	Selects a particular on-line tape unit from a group connected to a common interface cable.	Level	Input to tape unit
b. OFF-LINE (CL = COMMAND OFF-LINE)	Assertion of this line clears the write condition and terminates the on-line condition of the selected tape unit. Assertion should be maintained until acknowledged by the negation of the on-line status.	Level	Input to tape unit

Table 2-4. Detailed Description of I/O Lines, Status, and Motion Control Connector (Continued)

I/O LINE	DESCRIPTION	SIGNAL TYPE	SIGNAL DIRECTION
FUNCTION COMMANDS (Continued)			
c. SET WRITE (WSW = WRITE SET WRITE)	The assertion transition of CF causes the WSW line to be sampled following a 20 μs maximum delay period. Assertion transition of the WSW line enables the setting of the selected and on-line tape unit's write condition, provided the tape unit is ready and write enabled. Negation of the WSW line enables the clearing of the tape unit's write condition. The desired logic level of WSW shall be maintained for not less than 20 μs after the assertion edge of CF.	Level	Input to tape unit
MOTION COMMANDS			
a. FORWARD (CF = COMMAND FORWARD)	Providing the tape unit is selected, and ready, this command causes tape to be driven in the forward direction.	Level	Input to tape unit
b. REVERSE (CR = COMMAND REVERSE)	When asserted, clears the write condition and causes the tape to be driven in the reverse direction, provided that the tape unit is selected, and ready. Load point status inhibits the response to this command.	Level	Input to tape unit
c. REWIND (CRW = COMMAND REWIND)	Clears the write command on the selected tape unit and initiates a rewind operation, provided that the tape unit is ready, and not at load point. Tape is positioned at load point at the end of this operation. Assertion should be maintained until acknowledged by rewind status. (Minimum 2 μs.)	Level	Input to tape unit
d. HIGH SPEED (CH = COMMAND HIGH SPEED)	When asserted with forward or reverse on a selected and ready tape unit, will cause tape speed to accelerate to 160 ips.	Level	Input to tape unit

Table 2-5. Detailed Description of I/O Lines, Write Data Connector

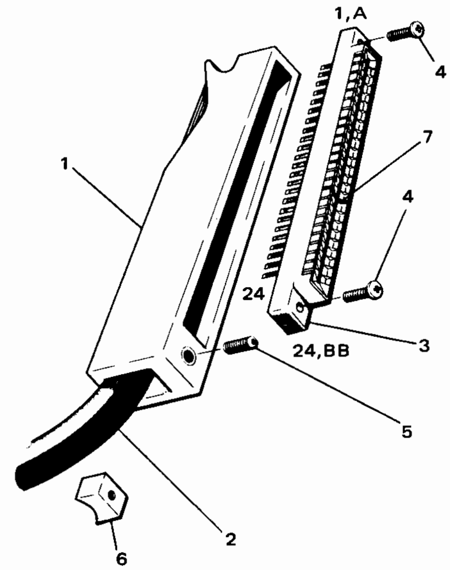
I/O LINE	DESCRIPTION	SIGNAL TYPE	SIGNAL DIRECTION
STATUS			
a. WRITE STATUS (SW = STATUS WRITE)	Indicates that the selected tape unit is write enabled and current is flowing in the write and erase heads.	Level	Output from tape unit
DATA TRANSMISSION			
a. WRITE DATA (WD = WRITE DATA) WD0 thru WD7, WDP NOTE: Refer to write data connector for channel designation.	These lines (any one of nine lines) receive data to be recorded on tape as a character and must be electrically stable at assertion transition time of write clock and for 2 μs, minimum, thereafter.	Level	Input
b. WRITE CLOCK (WC = WRITE CLOCK)	The assertion transition of this pulse causes the character, represented by the write data lines, to be written on tape. The tape unit must be in the write condition and the assertion of the write clock must be maintained for a minimum of 2 μs.	Level	Input
c. WRITE RESET (WRS = WRITE RESET)	The assertion transition causes the LRCC character to be written on tape, provided the unit is in the write mode. Assertion must be maintained for a minimum of 2 μs.	Pulse	Input

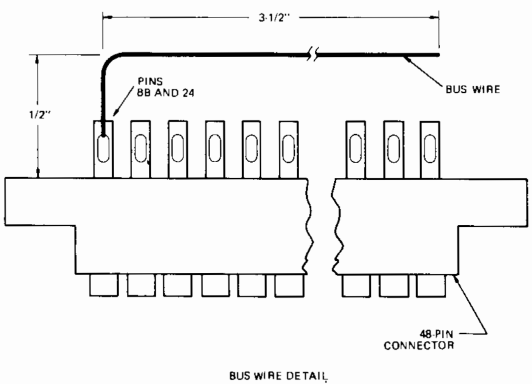
Table 2-6. Detailed Description of I/O Lines, Read Data Connector

I/O LINE	DESCRIPTION	SIGNAL TYPE	SIGNAL DIRECTION
READ DATA TRANSMISSION			
a. READ DATA (RD = READ DATA) RD0 thru RD7, RDP NOTE: Refer to read data connector for channel designation.	These lines (any one of nine lines) detected characters read from the tape and present them to the interface. The read data lines are settled at the assertion transition time of read clock, and remain settled until 1 μs, maximum, before the next read clock.	Level	Output
b. READ CLOCK (RC = READ CLOCK)	Indicates that a character has been read from tape and is present on the read data lines. Assertion time is 2μs, minimum, 3μs, maximum.	Pulse	Output

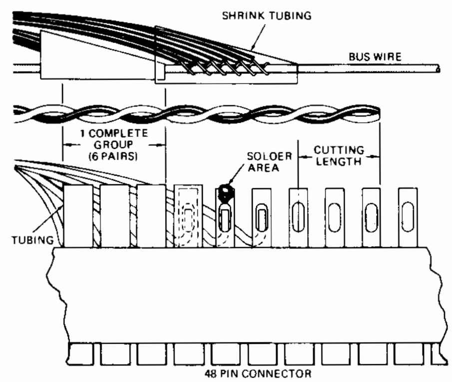
CABLE AND CONNECTOR PARTS

ITEM	DESCRIPTION	HP PART NO.
1	Connector hood	02116-4001
2	Cable, 24 twisted pair	8120-1700 or equivalent
3	Connector, 48-pin	1251-2518
4	Self-tapping screw	0624-0098
5	Setscrew	3030-0009
6	Cable clamp	02116-4003
7	Polarizing Key	1215-1115





BUS WIRE DETAIL



CABLE FABRICATION

To fabricate the interconnect cable refer to the above information and proceed as follows:

a. Insert approximately 10 inches of cable (2) into connector hood (1).

b. Strip the outer jacket of the cable back 5 inches.

c. Prepare a bus wire from 22-gauge bare-copper wire and solder it to pins BB and 24 of the connector (3) as shown in bus wire detail above.

d. Divide the 24 twisted pairs into groups of six pairs each.

e. Starting at the end of the 48-pin connector nearest pins BB and 24, connect the first six pairs as follows:

(1) Solder the six signal (white) wires to the respective pins on the connector and insulate each pin with shrink tubing as shown above.

(2) Solder the six ground (black) wires to the bus wire and insulate with shrink tubing as shown above.

f. Repeat steps (1) and (2) with the remaining groups of wires until all wires are soldered to the connector and insulated.

g. Trim off any excess bus wire and install the 48-pin connector (3) in the connector hood (1) using the two self-tapping screws (4).

h. Install cable clamp (6) and tighten in place with the setscrew (5).

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Figure 2-2. Interconnection Cable Fabrication

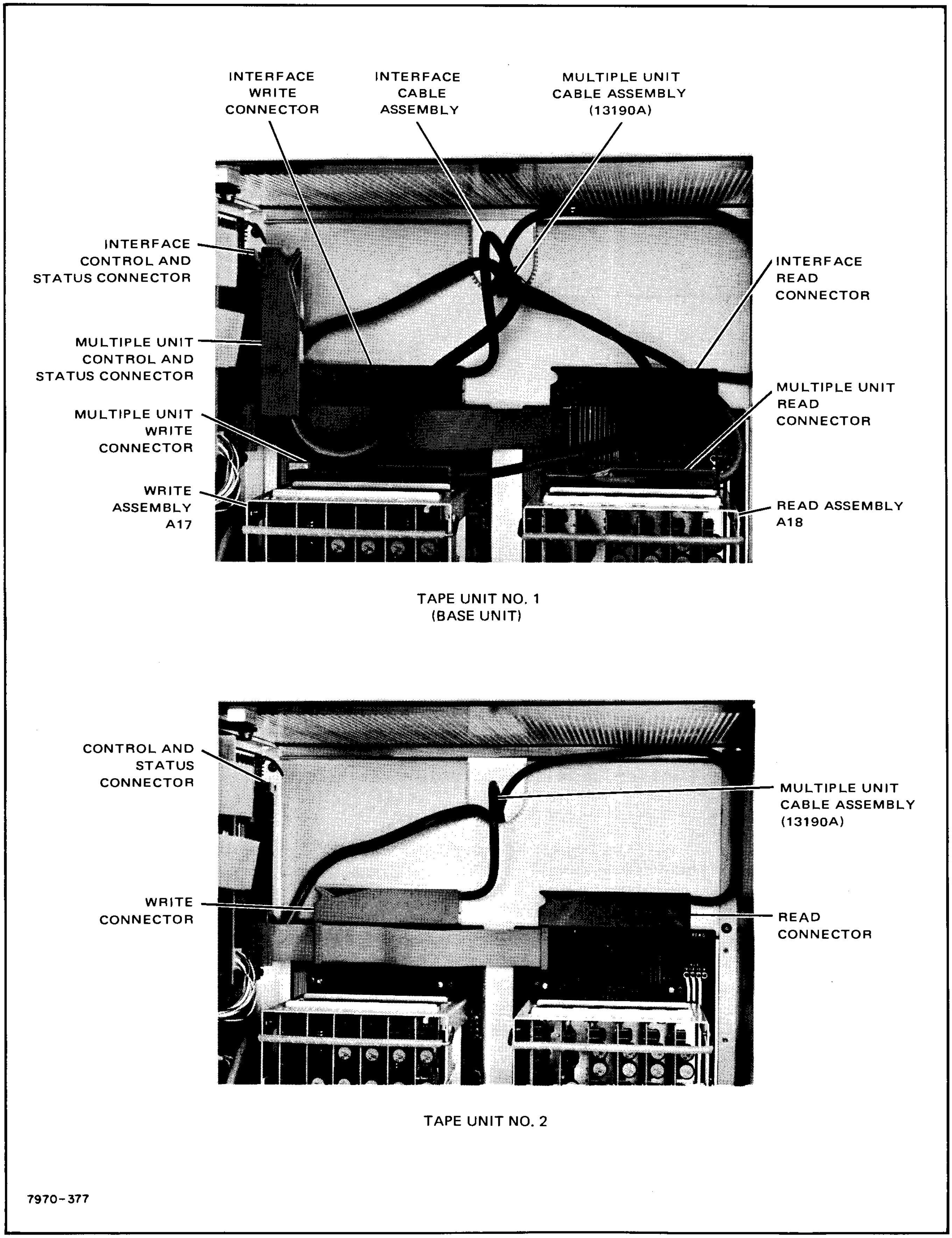


Figure 2-3. Multiple Unit Installation

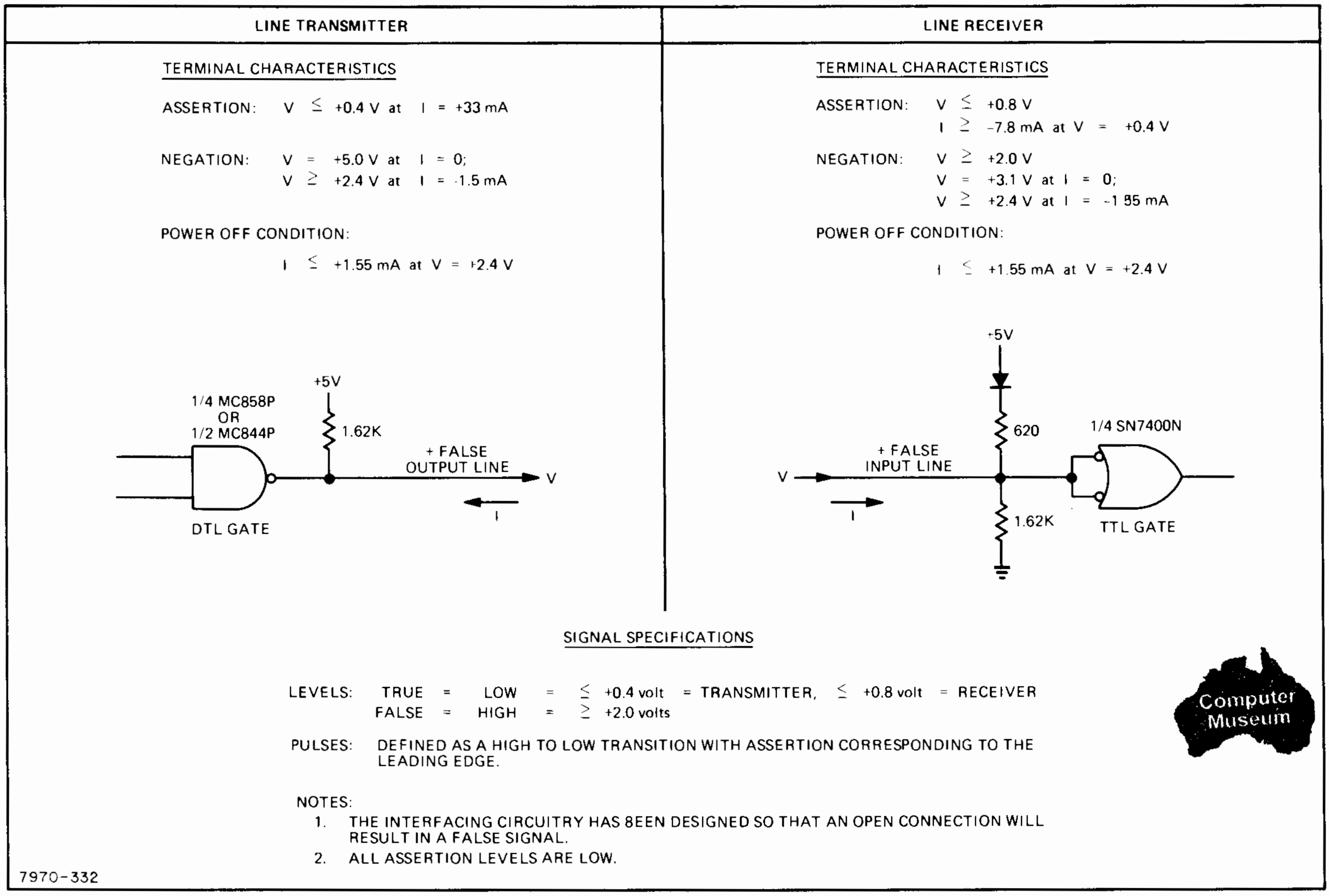


Figure 2-4. Electrical Parameters of the I/O Line Transmitters and Receivers

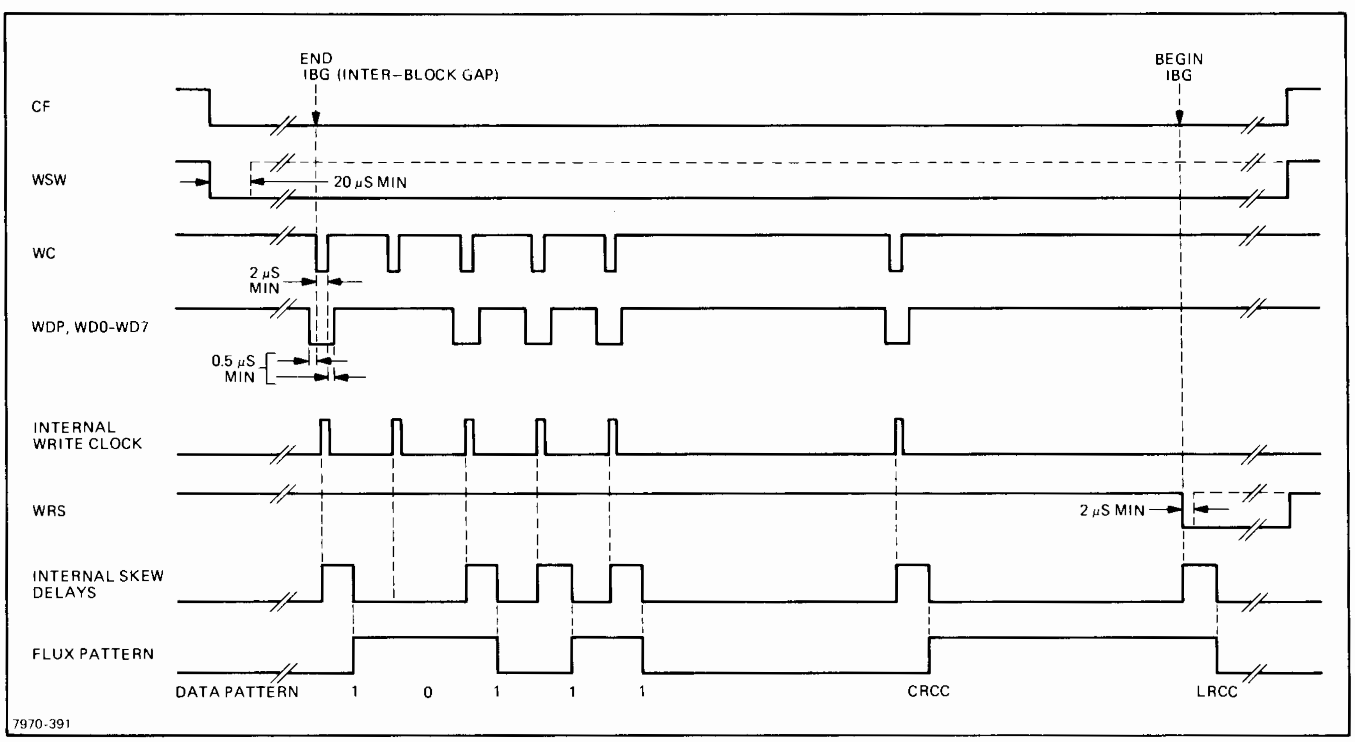


Figure 2-5. Write Waveforms

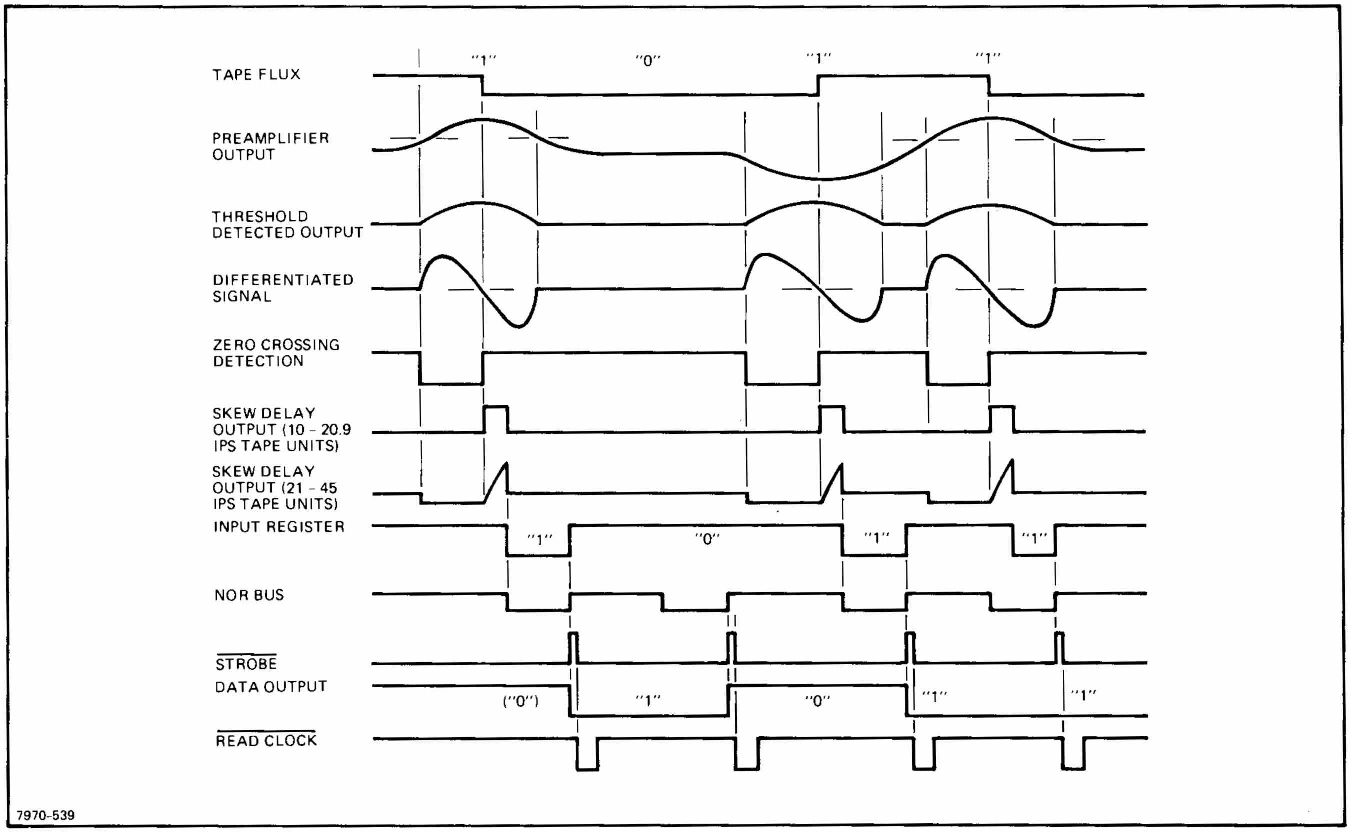


Figure 2-6. Read Waveforms

SECTION III
OPERATION

3-1. INTRODUCTION.

3-2. This section describes all operating controls and indicators of the tape unit. Information pertaining to magnetic tape, operation of the unit, checkout procedures, and operator maintenance is also included.

3-3. The tape unit will normally function as a peripheral unit of a computer. The operator will apply power to the unit, load tape, select density (optional), select unit address (optional), and place the unit on-line. The operator must also correct for power failure and unload the tape. The operator may rewind manually if required.

3-4. The write/read functions and the on-line tape control functions are computer programmable. The capability to handle seven or nine tracks, read-after-write, or read-only are dependent upon unit equipped head options and associated logic.

3-5. Operator control of off-line functions is limited to the built-in manual controls, equipment options, and user interfaced provisions.

3-6. OPERATING CONTROLS AND INDICATORS.

3-7. Figure 3-1 shows the location of operating controls and indicators, and table 3-1 defines the controls and indicators.

3-8. SELECTION AND CARE OF TAPE.

3-9. TAPE SELECTION.

3-10. Use computer grade tape, 0.5-inch wide and 1.5-mils thick.

3-11. CARE OF MAGNETIC TAPE.

3-12. Tape and reel should be handled carefully. Avoid unnecessary handling of tape to minimize tape contamination. Tape should be kept in the supplier's container when not is use, preferably stacked on end. Avoid exposure to strong magnetic fields or excessive heat (such as temporary storage in direct sunlight). When handling reels, support the reel at the hub flange to minimize reel warpage.

3-13. TAPE STORAGE.

3-14. Store tape at operating room temperature (60° to 80°F, 15° to 25°C, 60% humidity) with reels on edge in the original boxes, book-shelf style. If reels are stored flat, avoid stacking. Run the tape occasionally to preserve its resistance to storage conditions. If tape is stored in an environment different from the using environment, allow 12 to 24 hours for the tape to reach environmental conditions before using.

3-15. INSTALLATION/REMOVAL OF WRITE ENABLE RING.

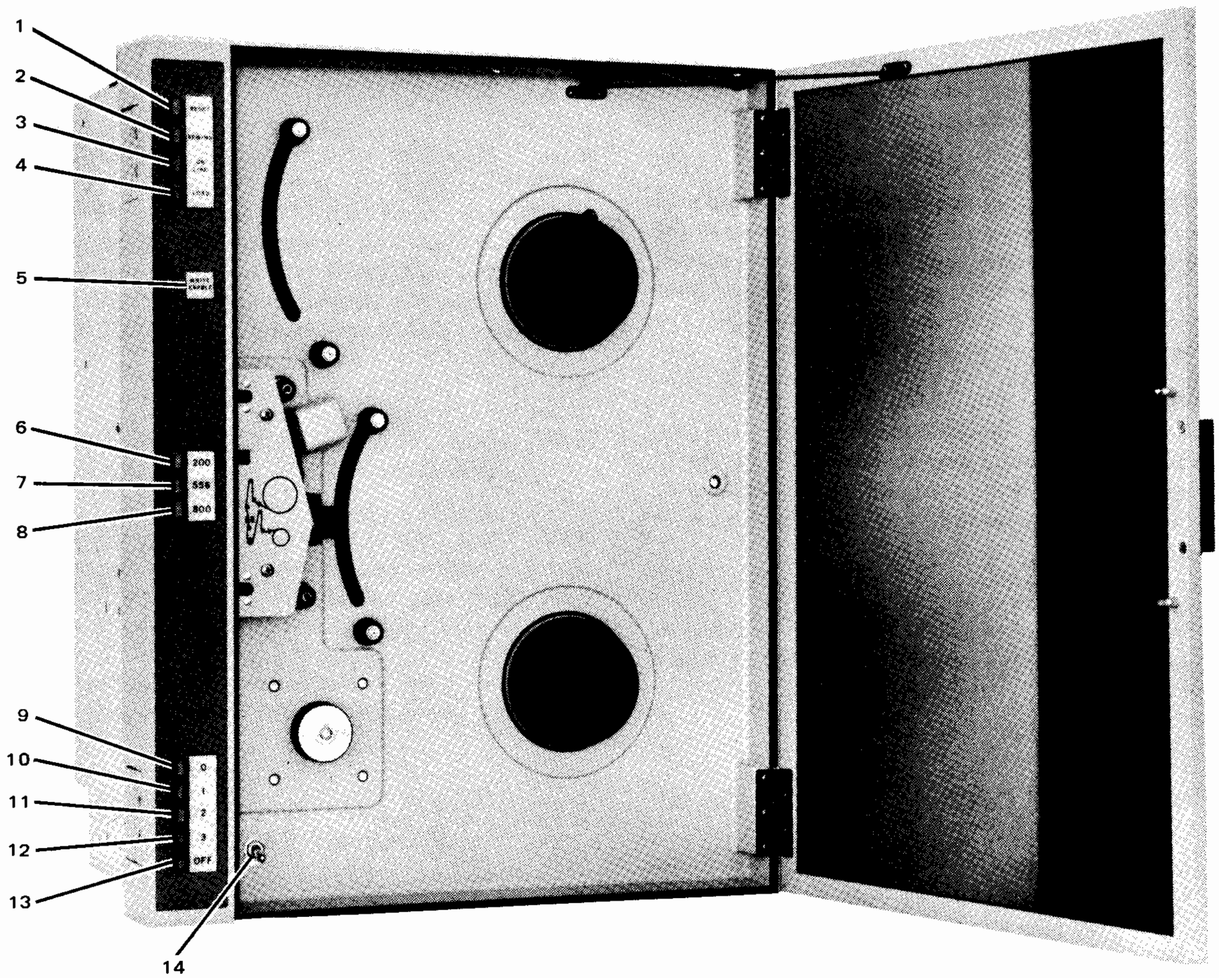
3-16. The write enable assembly is part of the write/read optional feature. Loaded tape reels from the tape supplier come fitted with a write enable ring. For write/read operation, the write enable ring is installed. For read-only operation, the write enable ring is removed. With the write enable ring removed, no inadvertent recording on the tape is possible. This, in essence, is a file protect feature.

3-17. INSTALLATION OF BOT AND EOT PHOTOSENSE TABS.

3-18. Install EOT (end-of-tape) and BOT (beginning-of-tape; also called load point) tabs as indicated in figure 3-2. The ten-feet (tab to end-of-tape) requirement is minimum. Handle tape with clean hands and avoid excessive handling in recording area. BOT and EOT tabs are installed by the tape supplier. However, if the tabs come loose or if new tabs are required because of tape breakage, they may be installed by the operator. Use IBM tabs (part number 352407) or equivalent. These tabs are made with a pressure-sensitive adhesive which is attached to the shiny side (non-oxide) of the tape.

3-19. TAPE REEL INSTALLATION.

3-20. Check supply reel before installing. Examine reel for warpage or accumulation of dust. Clean reel if dirty. Do not use damaged or warped reel. Open cover door and verify that transport area is clean. Pull supply hub locking lever outward. Handle supply reel by the hub flange, position on hub, press firmly and seat reel to hub. Keep even pressure on reel flange and seat quick disconnect lever.



1. RESET CONTROL AND INDICATOR
2. REWIND CONTROL AND INDICATOR
3. ON LINE CONTROL AND INDICATOR
4. LOAD CONTROL AND INDICATOR
5. WRITE ENABLE INDICATOR
6. 200 BPI DENSITY CONTROL AND INDICATOR
7. 556 BPI DENSITY CONTROL AND INDICATOR
8. 800 BPI DENSITY CONTROL AND INDICATOR
9. UNIT ADDRESS 0 CONTROL AND INDICATOR
10. UNIT ADDRESS 1 CONTROL AND INDICATOR
11. UNIT ADDRESS 2 CONTROL AND INDICATOR
12. UNIT ADDRESS 3 CONTROL AND INDICATOR
13. UNIT ADDRESS OFF CONTROL AND INDICATOR
14. POWER SWITCH

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Figure 3-1. Tape Unit Controls and Indicators

Table 3-1. Tape Unit Controls and Indicators

CONTROLS AND INDICATORS	TYPE	FUNCTIONS
RESET	Momentary pushbutton switch with indicator.	a. Press to: (1) Stop tape travel in any mode. (2) Remove unit from on-line status. (3) Halt load point search if operator loads beyond load point.
		b. Lamp illuminates indicating that unit is in manual mode.
REWIND	Momentary pushbutton switch with indicator.	a. Rewind places unit in rewind mode. Tape rewinds at 160 ips until BOT tab is sensed. The photosense signal to motion control logic initiates a load point search; tape stops at BOT reflective strips and LOAD lamp illuminates.
		b. Lamp illuminates indicating that unit is in rewind mode.
		c. Operational only from RESET. RESET indicator stays illuminated. Will override a Load command.
		d. Rewind is terminated by pressing RESET, or by logic when BOT tab is sensed.
		e. To unload tape: When tape is at load point, press REWIND pushbutton and hold momentarily until tape passes BOT tab and release.
ON-LINE	Momentary pushbutton switch with indicator.	a. Switches unit to on-line status when: (1) Tape has completed a BOT search or search has been stopped by a Reset command. (2) ON-LINE pushbutton is pressed.
		b. Lamp illuminates indicating that unit is available to processor.
LOAD	Momentary pushbutton switch with indicator.	a. Press pushbutton and release: (1) Establishes tape tension. (2) Logic initiates load point (BOT) search.
		b. Press RESET to terminate load point search. (Rewind will override load point search.)

Table 3-1. Tape Unit Controls and Indicators (Continued)

CONTROLS AND INDICATORS	TYPE	FUNCTIONS
LOAD (Continued)		c. When transport stops at load point, unit will go to on-line status if ON-LINE pushbutton has been pressed during LOAD operation.
		d. Places reel motors under control of the tension arm photo-sense circuits.
		e. Lamp illuminates, indicating that tape is at load point.
		f. WRITE ENABLE indicator will also be illuminated if that operational feature is installed (and supply reel is fitted with a write enable ring).
WRITE ENABLE	Indicator	a. Available with write option package.
		b. When LOAD is pressed, indicator illuminates indicating that write enable ring is installed in supply reel.
		c. Enables power to be applied to write system.
DENSITY SELECT	Interlocked pushubtton switches with indicators.	a. Optional feature.
		b. Allows selection of read densities: 200, 556, and 800 cpi.
		c. Indicator illuminates indicating density selected.
		d. When unit is not equipped with a density select option, logic will normally be set for 800 cpi.
ADDRESS SELECT	Interlocked pushbutton switches with indicators.	a. Optional feature.
		b. When one of four switches is pressed and the indicator is illuminated, the unit is assigned an address which must be selected by the processor to control the tape unit if the unit is in on-line status.
		c. When the OFF switch is pressed, all four address switches are disabled and the OFF indicator is illuminated.
		d. In OFF position unit will not respond to any incoming signal.
Power	ON-OFF toggle switch.	a. Applies ac voltage to transformer primary circuit.
		b. Switches both sides of the ac line.

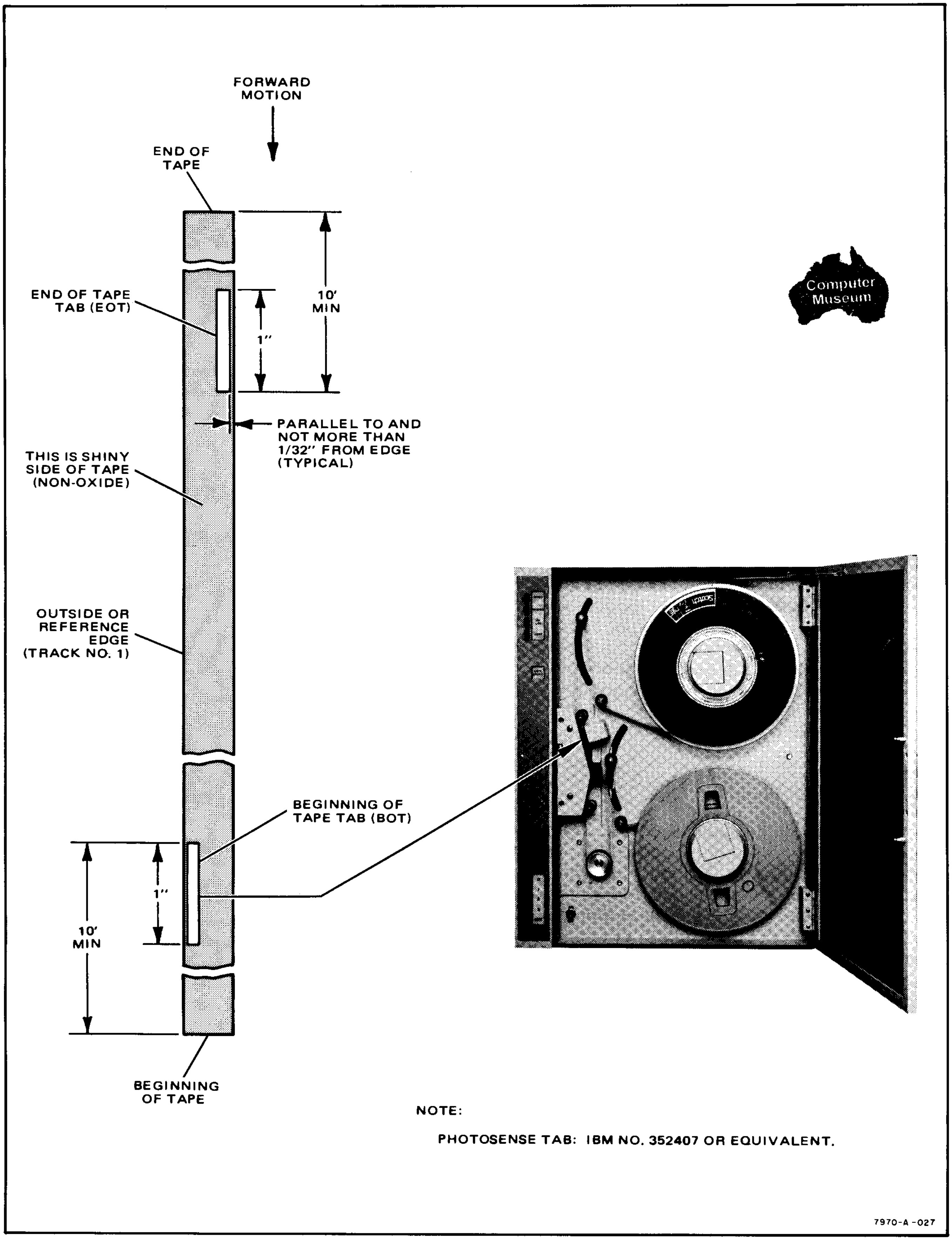


Figure 3-2. Installation of Photosense Tabs

3-21. TAPE THREADING PROCEDURE.

3-22. To thread tape proceed as follows:

a. Verify that tape path is clean.

b. Install tape supply reel.

c. Thread tape as shown in figure 3-3. (Verify that tape is installed between tape guide flanges.)

d. Work two turns of tape on takeup reel.

e. Set power switch to ON.

f. Close cover door.

g. Press LOAD pushbutton and release. Motion control logic will initiate a load point search (BOT tab). Tape will stop at load point and LOAD pushbutton will illuminate.

Note

If the tape unit is tensioned with the load point reflective tab under the photosense head, Drive Ready condition is not set. (Drive Ready is a result of load point search being satisfied.) With the tape unit in this condition, pressing the LOAD pushbutton gates Load Point and On-Line status to the interface without a Ready status. However, ON-LINE and LOAD POINT will be indicated on the front panel. Ensure the load point reflective tab is not positioned under the photosense head when tape is tensioned. The tab should be before the photosense head or on the supply reel.

3-23. OPERATION.

3-24. The tape unit is designed for processor (computer) controlled operation. However, manual controls are provided to bring the unit to on-line status, to restart after a power failure, to position tape for addition of photosense tabs, and as a service aid during repair or checkout. The controls that the operator will normally use are located on the control panel.

Note

In multiple unit installations, do not power down more than one unit at a time. If power is removed from more than one unit, circuit loading may cause intermittent operation.

3-25. ON-LINE READ-ONLY OPERATION.

3-26. To operate the unit in read-only mode, proceed as follows:

a. Remove write enable ring from supply reel.

b. Install supply reel.

c. Thread tape and place tape at load point.

d. If unit is equipped with a density select option, press density selection.

e. If unit is equipped with an address select option, press address pushbutton.

f. Press ON-LINE pushbutton. Unit is now in ready status under processor control.

g. To stop unit, press RESET.

h. Press ON-LINE to place unit under control of processor.

i. Press address select OFF pushbutton to remove unit from processor control without disturbing unit logic. To place unit under processor control again, press unit address select pushbutton.

3-27. ON-LINE WRITE-READ OPERATION.

3-28. To operate the unit in write-read mode, proceed as follows:

a. Install write enable ring to supply reel.

b. The rest of this procedure is identical to the read only operation. Refer to paragraph 3-26 (steps "b" through "i").

3-29. REWIND.

3-30. High-speed rewind can be initiated during any tape function by pressing RESET and then pressing REWIND. To stop rewind at any tape position, press RESET. To resume rewind, press REWIND. Fast rewind will continue until the load point tab is sensed and passed. Unit logic will automatically go into load point search and stop at load point.

3-31. RESTART AFTER POWER FAILURE.

3-32. After a power failure during a read, write, or read-after-write operation, the unit will be off-line. To resume interrupted function, proceed as follows:

a. Open cover door.

b. Verify that tape is on guides.

c. Press LOAD.

d. Close cover door.

e. Press RESET.

f. Press ON-LINE.

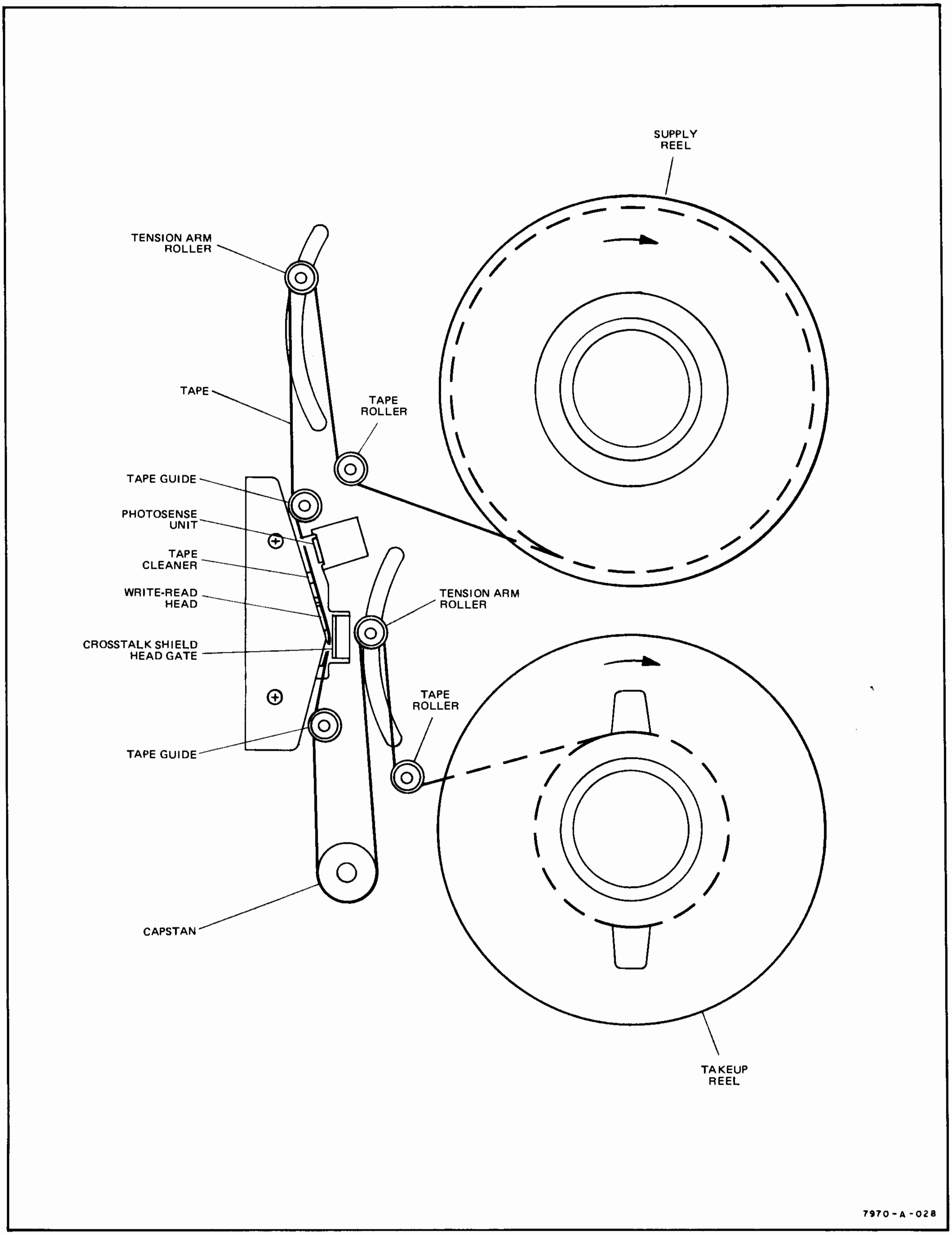


Figure 3-3. Tape Threading

3-33. REV, FWD, and +160 CAPSTAN SERVO TOGGLE SWITCHES.

Note

These switches are for service only.

3-34. To use the REV (reverse), FWD (forward), and +160 (high-speed forward at 160 ips) switches proceed as follows:

a. Open cover door.

b. Install tape supply reel.

c. Thread tape.

d. Set power switch to ON.

e. Tension tape.

f. Release transport latch.

g. Close cover door and swing transport open.

h. Operate service switches as desired.

i. Leave all switches in OFF position before assuming normal operation.

3-35. CHECKOUT PROCEDURES.

3-36. The following performance checks may be used for incoming inspection or as an overall performance checkout after making adjustments or repair. Off-line performance checks should be performed as soon as the unit is installed to determine that the unit is in proper working order. No test equipment is required. On-line performance checks will ensure that the unit will respond to external commands. On-line performance checks will depend upon unit application. On-line refers to a unit that is connected to a controlling device such as a computer, plotter, or key-to-tape system. An on-line unit is addressable by the controlling device and requires a minimum amount of operator intervention.

3-37. OFF-LINE PERFORMANCE CHECKS.

3-38. Off-line performance checks consist of a visual mechanical check and a motion control checkout procedure. The mechanical check is performed prior to applying power to the unit. The motion control checkout procedures require operating power and must be performed by a qualified system level maintenance technician or a Hewlett-Packard Service Representative.

3-39. MECHANICAL CHECK.

3-40. Perform mechanical check as follows:

a. Open and close cover door and verify that detents hold firmly.

b. Swing cover door open and verify that hinges are free and that the door stop bracket prevents the cover door opening more than approximately 105 degrees.

c. Press upper control panel pushbuttons and verify that the RESET, REWIND, ON-LINE, and LOAD pushbuttons press freely and bottom.

d. Press density select and address select pushbuttons and verify that the mechanical interlocks are working properly.

e. Release the transport latch and swing the transport out.

f. Verify that all cable connectors are securely seated.

g. Verify that all motion and data cards are securely seated.

h. Verify that there is unobstructed airflow for instrument cooling.

i. Slowly open and close transport and note that wire harnesses, wire cable, and ribbon cables fold properly.

j. Verify that select jumper is connected to the proper pin. The proper pin connection is as follows:

(1) Tape units equipped with unit (address) select option: connect select jumper to pin labeled OFF.

(2) Tape units not equipped with unit (address) select option: connect select jumper to pin labeled 0 (or any pin desired, 0 to 3).

k. Close and latch transport.

l. Open/close cover door and note that it rests snuggly against rubber seal.

3-41. MOTION CONTROL CHECKOUT PROCEDURE.

3-42. Perform the motion control checkout procedure as follows:

a. Check 115-230 Vac slide switch for proper line voltage, and connect ac power.

b. Verify that manual control switches located on the capstan servo PCA are in the OFF position (switch levers down).

c. Set power switch to ON. The following pushbutton indicators will illuminate: RESET, unit select, and density select.

d. Remove write enable ring and place a reel of tape on the supply hub (with BOT and EOT tabs attached). Reel should be seated firmly to the hub when the quick disconnect hub is latched.

e. Verify that empty reel on the takeup hub is properly seated.

f. Thread tape and verify that tape is inserted between tape guide flanges.

g. Press LOAD pushbutton and hold. Tape will move until tape tension arms are centered and proper tape tension is established.

h. Release LOAD pushbutton. Motion control logic initiates a load point search. Tape will move forward at 20 ips and will stop at load point. LOAD indicator will illuminate.

i. Close cover door.

j. Press density select pushbuttons, one at a time, and note indicators. Pushbutton selected will illuminate and go dark when the next pushbutton is selected and illuminates.

k. Press address select pushbuttons: 0, 1, 2, 3, and OFF and note indicators. Leave one address selected. The 0 pushbutton indicator will illuminate and go dark when 1 pushbutton is pressed, etc. Note that all address select pushbuttons are dark, except OFF, when OFF pushbutton is pressed.

l. Press ON-LINE pushbutton and release. ON-LINE pushbutton indicator will illuminate; The tape unit is now ready for processor control. The on-line condition negates the REWIND and LOAD pushbutton circuits. A substantial number of logic functions are initiated by the ON-LINE pushbutton. However, the following logic functions must occur before the unit is gated to on-line status.

(1) The On-Line signal is and-gated with a Load Complete signal to generate a Ready signal (RDY).

(2) The RDY signal is "and" gated with a Select-On Line-Address (SOLA) signal to generate a Status Ready (SR) signal for the processor. (SR indicates that tape unit is selected, is on-line, the initial loading sequence is complete, and the tape is not rewinding.)

m. Press REWIND pushbutton; press LOAD pushbutton and observe transport response. No response should be observed.

n. Press RESET pushbutton. ON-LINE indicator will go dark and RESET pushbutton will illuminate. Unit is now in off-line status. Manual controls are operative.

o. Check REWIND and capstan manual controls as follows:

(1) Open cover door and release transport latch.

(2) Close cover door.

(3) Swing transport open.

(4) Set capstan servo FWD switch to ON (up). Observe that tape moves in forward direction.

(5) Set FWD switch to OFF. Observe that motion stops.

(6) Set capstan servo +160 (ips) switch to ON (up). Observe that tape winds onto takeup reel at high speed. Allow approximately 100 feet of tape to wind on takeup reel.

(7) Set +160 switch to OFF. Observe that tape motion stops.

(8) Set capstan servo REV switch to ON (up). Observe that tape moves in reverse direction. Set REV switch to OFF. Observe that tape movement stops.

p. Press REWIND pushbutton (control panel). Observe that tape winds onto supply reel at high speed.

q. Press RESET pushbutton. Observe that tape movement stops. REWIND pushbutton will go off and RESET indicator will illuminate.

r. Press REWIND pushbutton. Observe that transport goes into fast rewind. RESET indicator is off and REWIND indicator is illuminated. The tape will rewind past the load point tab, stop, and move forward at 20 ips to the load point. At this point, tape will stop and the LOAD indicator will illuminate.

s. Hold REWIND pushbutton down until EOT tab passes photosense unit and then release pushbutton. Observe that tape winds off the takeup reel. Observe that REWIND pushbutton goes dark. The following pushbutton indicators will illuminate: RESET, density select, and address select.

t. Remove supply reel and install write enable ring.

u. Install supply reel. Observe that WRITE ENABLE indicator is illuminated.

v. Return unit to original configuration.

3-43. ON-LINE PERFORMANCE CHECKS.

3-44. On-line performance checks consist of exercising the unit using external commands. The on-line performance checks must be performed by a qualified technician. The controlling device must be able to exercise the unit transport circuits, the read data circuits, and the write data circuits (units equipped with write data modules). Tape units interfaced to a computer may be exercised with the controller diagnostic. If a controlling device is not available, on-line performance checks may be simulated using the test board accessories. (HP 13191A Control and Status Test Board Accessory, HP 13192A Write Test Board Accessory, and HP 13193A Read Test Board Accessory.) The following procedures describe the use of the test accessories to simulate on-line performance checks.

3-45. TRANSPORT PERFORMANCE CHECKS (SIMULATED ON-LINE).

3-46. The following procedures describe transport performance checks using the HP 13191A Control and Status Test Board Accessory to simulate on-line conditions.

a. Check the 115/230 Vac slide switch for proper line voltage and connect power.

b. Verify that manual control switches on the capstan servo PCA are in the off position (switch levers down).

c. Ensure that power switch is in the OFF position. Install the control and status test board accessory as described in the manual supplement for the test board accessory.

d. Set all switches of the test board accessory in the down position.

e. Load the transport with a reel of scratch tape equipped with BOT and EOT tabs. The tabs should be positioned to allow at least 3 minutes of high-speed operation between tabs.

f. Place the unit on-line by pressing the tape unit ON-LINE pushbutton switch. The LOAD and ON-LINE indicators of the tape unit will illuminate, the SL, SLP, and SR indicators of the test board accessory will illuminate. If the reel of tape installed was not equipped with a write enable ring, the SFP indicator will illuminate indicating a file protect status.

g. Set the CH (high-speed) switch of the test board in the up position.

h. Set the CRW (rewind) switch of the test board in the center (off) position.

i. Set the CF (forward) switch of the test board in the up position. Tape moves forward at 160 ips (high-speed forward). Tape stops at EOT tab and SET indicator of test board illuminates.

j. Set the CF switch in the down position, press the RESET pushbutton of the tape unit, and rewind the tape by pressing the REWIND pushbutton. Tape will rewind past BOT tab, stop, move forward to search load point (BOT tab), and stop at the BOT tab. At this point, the LOAD indicator will illuminate.

k. Place the tape unit back on-line by pressing the ON-LINE pushbutton. The ON-LINE indicator will illuminate.

l. Set the CH (high-speed) switch in the down position.

m. Set the CF (forward) switch in the up position. Tape moves forward at synchronous speed. Tape stops at EOT tab and SET indicator of test board illuminates.

n. Repeat steps "j" and "k."

o. Set the PROG-MAN switch in the PROG position (up).

p. Set the CRW (rewind) switch in the down position.

q. Set the CF (forward) switch in the up position. Tape starts and stops at synchronous speed until EOT tab is detected. SET indicator of test board illuminates and tape rewinds to load point.

r. Set all switches of the test board in the down position, press the RESET pushbutton of the tape unit and press the REWIND pushbutton to remove the scratch tape. Set the tape unit power switch in the OFF position.

3-47. READ DATA PERFORMANCE CHECK (SIMULATED ON-LINE).

3-48. The following procedures describe read data performance checks using the HP 13193A Read Test Board Accessory to simulate on-line conditions. The transport performance checks must be performed prior to performing these procedures.

a. Ensure that tape unit power switch is in the OFF position. Install the read test board accessory as described in the manual supplement for the test board accessory.

b. Ensure that all switches of the control and status test board accessory have been set in the down position.

c. Set the RD BL switch of the read test board to the off position (right).

d. Select desired parity (odd or even) by placing the read test board parity select switch in the appropriate position.

e. Determine the synchronous speed of the tape unit and place the HI-LO switch (speed range) of the read test board in the appropriate position (HI position for 20.1 to 45 ips units or LO position for 10 to 20 ips units).

f. Load the tape unit with a reel of prerecorded tape.

g. Place the unit on-line by pressing the ON-LINE pushbutton.

h. Set the RD BL switch of the read test board to RD BL (left) position. Tape moves forward at synchronous speed, stopping and starting between data blocks.

Note

Ensure that the 10 clock period delay adjustment has been made as described in paragraph 36, steps "e" and "h" of read test board manual supplement.

i. Set the ERROR STOP-NORM switch of the read test board to the STOP position. If the prerecorded tape contains errors, the tape unit will stop when an error is detected and the error or errors will be displayed by the read test board.

j. Set the ERROR STOP-NORM switch of the read test board in the NORM position. The tape will continue forward at synchronous speed stopping and starting between data blocks, until EOT tab is detected or RD BL switch is returned to the off position (right).

k. Press the tape unit RESET pushbutton to place the unit off-line and rewind the tape by pressing the REWIND pushbutton.

l. Remove the pre-written tape and remove power to the unit by placing the power switch in the OFF position.

3-49. WRITE DATA PERFORMANCE CHECK (SIMULATED ON-LINE).

3-50. The following procedures describe write data performance checks using the HP 13192A Write Test Board Accessory to simulate on-line conditions. The transport performance and read data performance checks must be performed prior to performing the write data performance checks.

a. Ensure that tape unit power switch is in the OFF position. Install the write test board accessory as described in the write test board accessory manual supplement.

b. Set all switches of the control and status test board accessory in the down position.

c. Set the RD BL switch of the read test board accessory to the OFF (right) position.

d. Select the desired parity (odd or even) by placing the parity select switches of the read and write test board accessories in the appropriate positions.

e. Determine synchronous speed of the tape unit and place the HI-LO switch (speed range) of the read test board accessory in the appropriate position to (HI position for 20.1 to 45 ips or LO position for 10 to 20 ips).

f. Load the unit with a reel of blank tape equipped with a write enable ring.

g. Ensure that WCF lead (P1) from the write test board is connected to the CF terminal of the control and status test board.

h. Place the unit on-line by pressing the ON-LINE pushbutton.

i. Set the ERROR STOP-NORM switch of the read test board in the NORM position.

j. Set the XTALK-BLOCK switch of the write test board in the BLOCK position

k. Set the WSW switch of the control and status test board in the up position.

l. Rotate the PCF control fully counterclockwise.

m. Adjust the clock rate of the write test board as described in the write test board manual supplement.

n. Set the RD BL switch of the read test board accessory to the RD BL position (left). Tape moves forward at synchronous speed.

o. Set the CF switch of the control and status test board in the up position.

p. Rotate PCF control of the control and status test board clockwise until start-stop action begins.

q. Observe the read test board indicators for error indications.

r. Rotate PCF control of the control and status test board fully counterclockwise and set the CF switch in the down position.

s. Set the RD BL switch of the read test board in the off position (right).

t. Set the WSW switch of the control and status test board in the down position.

u. Press the tape unit RESET pushbutton to place the unit off-line and rewind the tape by pressing the REWIND pushbutton.

3-51. OPERATOR MAINTENANCE.

3-52. Operator maintenance is confined to simple preventive maintenance procedures. Periodic maintenance and mechanical/electrical checkout procedures should be performed on a scheduled basis by a qualified technician. These procedures require test equipment normally available in a well-equipped test facility. If a system-level maintenance technician is not available, a Hewlett-Packard Service Representative should be contacted.

3-53. The preventive maintenance schedule is contained in table 3-2. The operator should only perform the 8-hour interval procedure as indicated. However, the operator should keep an hourly operating log so that the equipment will be checked, adjusted, and serviced at the indicated intervals.

3-54. The preventive maintenance schedule listed in table 3-3 describes the routines to be performed on a scheduled basis by a maintenance technician.

Table 3-2. Operator Preventive Maintenance Schedule

MAINTENANCE INTERVAL (HOURS)	MAINTENANCE ROUTINE
8	1. Clean tape path components. 2. Visually inspect tape drive components.
1000	1. Perform 8-hour routine. 2. Notify maintenance technician that 1000-hour maintenance routine is due.
2000	1. Perform 8-hour routine. 2. Notify maintenance technician that 2000-hour maintenance routine is due.
4000	1. Perform 8-hour routine. 2. Notify maintenance technician that 4000-hour maintenance routine is due.

Table 3-3. Service Preventive Maintenance Schedule

MAINTENANCE INTERVAL (HOURS)	MAINTENANCE ROUTINE
1000	1. Clean tape transport. 2. Check reel holddown assembly. (Refer to part 2.) 3. Check EOT/BOT photosense head assembly. (Refer to part 2.) 4. Check write enable assembly. (Refer to part 2.) 5. Check power supply. (Refer to part 2.) a. Regulated voltages. b. 20/40 volt switch circuit. 6. Check capstan servo. (Refer to part 2.) a. Off-set adjustments. b. Tape speed. c. Start/stop ramp. 7. Check reel servo adjustments. (Refer to part 2.) 8. Check all tape motion functions. (Refer to part 2.) 9. Check tension arm photosense masks. (Refer to part 2.) 10. Check data electronics. (Refer to parts 3, 4 or 5.) a. Read preamplifier gain. b. Read skews. c. Read character gate. d. Write skews.
2000	1. Perform 1000-hour routine. 2. Replace BOT/EOT photosense lamp. 3. Replace tension arm photosense lamp.
4000	1. Perform 2000-hour routine. 2. Replace capstan pulley. 3. Replace tension arm springs and pins. 4. Replace reel motor brushes. 5. Replace capstan motor brushes.

3-55. Perform the 8-hour procedure as follows:

a. Run tape and visually check for tape scraping on reel flanges, tape guide flanges, or uneven travel on the capstan. If tape reel flange scraping is observed, verify that the reel is properly seated on the hub. Notify maintenance technician if condition persists.

b. Remove tape reels.

c. Set power switch to OFF.

d. Push head gate inward and hold to clean write/read heads.

Note

Clean tape path components with cotton-tipped applicators (part number 8520-0023, or equivalent) and lint-free wipers moistened with one of the following cleaners:

1. Head Cleaner (HP 8500-1251).
2. Genesolve D (Allied Chemical).
3. Freon TF (Dupont).

Use cleaners sparingly and avoid contaminating bearings. Be alert to any mechanical malfunction to prevent possible damage to recorded data.

e. Clean heads and check for scratches.

f. Release head gate to operating position.

g. Clean tape cleaner.

h. Clean photosense head.

i. Clean stationary guides and rollers. Verify that moving rollers are revolving freely.

j. Clean capstan. (Use solvents on rubber capstan sparingly.)

k. Clean transport area.

Note

Cover door is fitted with plexiglas. Brush away any heavy residue with a soft-bristle brush and clean gently with a wiper and commercial glass cleaner.

l. Set power switch to ON.

m. Install tape reels.

n. Thread tape.

o. Tension tape and position at load point.

p. Make density selection.

q. Make address selection.

r. Place unit on-line.

3-56. FUSE REPLACEMENT.

3-57. AC LINE FUSES.

3-58. The two ac line fuses are located on the interior, rear panel. For 115 Vac operation, a 4 ATT fuse is required (TT: super time lag). For 230 Vac operation, a 2 ATT fuse is required.

3-59. SECONDARY VOLTAGE FUSES.

3-60. The secondary voltage fuses are mounted to the power supply PCA. Fuse values are placarded at or near the fuse clip. Place a small screwdriver under the metal end of the fuse and pry outward to remove fuse. Use caution not to damage fuse clip.

Table 3-4. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A	= assembly	K	= relay	TB	= terminal board
B	= motor, synchro	L	= inductor	TP	= test point
BT	= battery	M	= meter	U	= integrated circuit, non-repairable assembly
C	= capacitor	P	= plug connector	V	= vacuum tube, photocell, etc.
CB	= circuit breaker	Q	= semiconductor device other than diode or integrated circuit	VR	= voltage regulator
CR	= diode	R	= resistor	W	= jumper wire
DL	= delay line	RT	= thermistor	X	= socket
DS	= indicator	S	= switch	Y	= crystal
E	= Misc electrical parts	T	= transformer	Z	= tuned cavity, network
F	= fuse				
FL	= filter				
J	= receptacle connector				

ABBREVIATIONS

A	= amperes	gra	= gray	PCA	= printed-circuit assembly
ac	= alternating current	grn	= green	PWB	= printed-wiring board
Ag	= silver	H	= henries	phh	= phillips head
Al	= aluminum	Hg	= mercury	pk	= peak
ar	= as required	hr	= hour(s)	p-p	= peak-to-peak
adj	= adjust	Hz	= hertz	pt	= point
assy	= assembly	hdw	= hardware	prv	= peak inverse voltage
b	= base	hex	= hexagon, hexagonal	PNP	= positive-negative-positive
bp	= bandpass	ID	= inside diameter	pwv	= peak working voltage
bpi	= bits per inch	IF	= intermediate frequency	porc	= porcelain
blk	= black	in.	= inch, inches	posn	= position(s)
blu	= blue	I/O	= input/output	pozi	= pozidrive
brn	= brown	int	= internal	rf	= radio frequency
brs	= brass	incl	= include(s)	rdh	= round head
Btu	= British thermal unit	insul	= insulation, insulated	rms	= root-mean-square
Be Cu	= beryllium copper	impgrg	= impregnated	rwv	= reverse working voltage
cpi	= characters per inch	incand	= incandescent	rect	= rectifier
coll	= collector	ips	= inches per second	r/min	= revolutions per minute
cw	= clockwise	k	= kilo (10^3), kilohm	RTL	= resistor-transistor logic
ccw	= counterclockwise	lp	= low pass	s	= second
cer	= ceramic	m	= milli (10^{-3})	SB, TT	= slow blow
com	= common	M	= mega (10^6), megohm	Se	= selenium
crt	= cathode-ray tube	My	= Mylar	Si	= silicon
CTL	= complementary-transistor logic	mfr	= manufacturer	scr	= silicon controlled rectifier
cath	= cathode	mom	= momentary	sst	= stainless steel
Cd pl	= cadmium plate	mtg	= mounting	stl	= steel
comp	= composition	misc	= miscellaneous	spcl	= special
conn	= connector	met. ox.	= metal oxide	spdt	= single-pole, double-throw
compl	= complete	mintr	= miniature	spst	= single-pole, single-throw
dc	= direct current	n	= nano (10^{-9})	Ta	= tantalum
dr	= drive	nc	= normally closed or no connection	td	= time delay
DTL	= diode-transistor logic	Ne	= neon	Ti	= titanium
depc	= deposited carbon	no.	= number	tgl	= toggle
dpdt	= double-pole, double-throw	n.o.	= normally open	thd	= thread
dpst	= double-pole, single-throw	np	= nickel plated	tol	= tolerance
em	= emitter	NPN	= negative-positive-negative	TTL	= transistor transistor logic
ECL	= emitter-coupled logic	NPO	= negative-positive zero (zero temperature coefficient)	U(μ)	= micro (10^{-6})
ext	= external	NSR	= not separately replaceable	V	= volt(s)
encap	= encapsulated	NRFR	= not recommended for field replacement	var	= variable
elctlt	= electrolytic	OD	= outside diameter	vio	= violet
F	= farads	OBD	= order by description	Vdcw	= direct current working volts
FF	= flip-flop	orn	= orange	W	= watts
flh	= flat head	ovh	= oval head	ww	= wirewound
flm	= film	oxd	= oxide	wht	= white
fxd	= fixed	p	= pico (10^{-12})	WIV	= working inverse voltage
filh	= fillister head	PC	= printed circuit	yel	= yellow
G	= giga (10^9)				
Ge	= germanium				
gl	= glass				
gnd	= ground(ed)				

HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

PART 2

7970B/7970C

DIGITAL MAGNETIC TAPE UNIT

TAPE TRANSPORT

Printed-Circuit Assemblies:

07970-60481, Series 1101
07970-61010, Series 1323
07970-61020, Series 1229
07970-61080, Series 1042
07970-61150, Series 1049
07970-62172, Series 1322
07970-62173, Series 1329
07970-62086, Series 1013
07970-62089, Series 1206

07970-90383

PRINTED: AUG 1973

SECTION I
DESCRIPTION

1-1. INTRODUCTION.

1-2. This section describes the transport for the Hewlett-Packard 7970B/7970C Digital Magnetic Tape Units and provides a functional description of the transport circuits. Speed critical assemblies are defined and optional assemblies are described.

1-3. PHYSICAL DESCRIPTION.

1-4. The tape unit consists of a transport casting assembly and a sheet metal housing assembly. The housing assembly contains the power supply, the power distribution assembly, the control and status assembly, and interfacing provisions. The read and write modules are also contained in the housing assembly.

1-5. The transport casting assembly consists of all tape moving assemblies, reel motors, capstan servo motor, tension arm assemblies and the circuits associated with these assemblies. The magnetic tape head assembly, photosense assembly, write interconnect assembly, and read preamplifier assembly are also mounted to the transport casting assembly. All standard and optional switch assemblies are mounted to the transport casting assembly. All assemblies are accessible and all circuits will operate with the transport assembly open.

1-6. SPEED CRITICAL ASSEMBLIES.

1-7. The tape unit will operate at tape speeds between 10 ips and 45 ips. The actual tape speed of the unit is specified when the unit is ordered. The following are limited or critical to tape speed:

a. Reel Motor Assembly.

b. Capstan Motor Assembly.

c. Capstan Servo PC Assembly.

d. Magnetic Tape Head Assembly.

e. Read Modules.

f. Write Modules.

1-8. REEL MOTORS.

1-9. Reel Motors B1/B2, part number 07970-60170, are used on tape units with tape speed ranges between 10 ips and 37.5 ips. Reel Motors B1/B2, part number 07970-60171, are used on tape units with tape speed ranges between 37.6 and 45 ips.

1-10. CAPSTAN MOTOR ASSEMBLY.

1-11. Capstan Motor Assembly MG1, part number 07970-60140, is used on tape units with tape speed ranges between 10 ips and 37.5 ips. Capstan Motor Assembly MG1, part number 07970-60141, is used on tape units with tape speed ranges between 37.6 ips and 45 ips.

Note

Capstan Motor Assembly MG1, part number 07970-60140, may be used on tape units operating at 45 ips. However, program restrictions must be maintained.

1-12. CAPSTAN SERVO PRINTED-CIRCUIT ASSEMBLY.

1-13. The capstan servo PCA is equipped with a dummy connector that functions as a strapping network. The dummy connector is installed in one of six positions, depending upon the speed range of the tape unit and capstan motor assembly used. See figure 7-10, Capstan Servo PCA A9 Schematic Diagram, for details of dummy connector.

CAUTION

Ensure that dummy connector is installed in the proper position prior to applying power to the unit. Attempting to operate the unit without the connector installed or with the connector in the wrong position may result in damage to the unit.

1-14. MAGNETIC TAPE HEAD ASSEMBLY.

1-15. The magnetic tape head assembly consists of tape guides, a tape cleaner, and, depending upon configuration, read, write, and erase heads. The tape head assembly is speed critical; refer to section VI for part numbers and speed ranges of the magnetic tape head assembly.

1-16. READ MODULES.

1-17. The read modules are described in detail in part 3 or part 5 of this manual.

1-18. WRITE MODULES.

1-19. The write modules are described in detail in part 4 of this manual.

1-20. BASIC AND OPTIONAL ASSEMBLIES.

1-21. The tape unit is available in a variety of configurations. Regardless of tape speed, the following assemblies are basic and applicable to all tape units.

a. Transformer Assembly.

b. Photosense Assembly.

c. Tension Assemblies (two).

d. Capstan Assembly.

e. Reel Motor Assemblies (two).

f. Reel Servo Printed-Circuit Assembly.

g. Capstan Servo Printed-Circuit Assembly.

h. Control and Status Printed-Circuit Assembly.

i. Power Distribution Assembly.

j. Power Regulator Printed-Circuit Assembly.

1-22. The control switch assembly is a basic assembly; however, if the tape unit is equipped with write data circuits, the control switch assembly will contain the write enable indicator.

1-23. The following assemblies are optional and, depending upon the use of the tape unit, may or may not be a part of the tape unit.

a. Write Enable Assembly.

b. Density Select Assembly.

c. Unit Select Assembly.

SECTION II
THEORY OF OPERATION

2-1. INTRODUCTION.

2-2. This section provides an overall functional description of the tape transport and description of the transport circuits. Block diagrams are included to aid in understanding the operation of the transport circuits.

2-3. OVERALL FUNCTIONAL DESCRIPTION.

2-4. The tape transport controls the movement of magnetic tape, provides power for read and write data circuits, and supplies status signals to the interface. Off-line commands (High-Speed, Reverse, Forward, Rewind, and Off-Line) are generated by the interface. The off-line and on-line commands are processed by the control and status circuits and result in controlling signals for the capstan servo, reel servo, and data circuits. Status signals for the interface and front panel indicators are also provided by the control and status circuits. Figure 2-1 is a functional block diagram of the tape transport circuits.

2-5. At initial power-on, the capstan motor circuit is open, and the reel servo motors are shorted. When the LOAD switch is pressed, the capstan motor and reel motor circuits are completed. When tape tension is established, the tension arms swing away from the tension limit switches. With tape tensioned, the capstan and reel motor returns are maintained. When the LOAD switch is released, the control and status circuits initiate a load point search. During load point search, the reel servo circuit operates with voltage feedback and the capstan servo pulls tape forward at 20 ips.

2-6. When the load point tab is detected by the photosense assembly, the control and status circuits terminate the load point search, and tape motion stops. The control and status circuits provide a load point status to the interface, and the front panel LOAD indicator illuminates.

2-7. Pressing the ON-LINE switch establishes interface control of the tape unit. Except for RESET, the front panel controls have no control of the tape unit. Pressing RESET releases the interface control and allows front panel control of the tape unit.

2-8. When the tape unit is under interface control and data is being processed, the tape unit pulls tape at synchronous speed as required. The reel servo circuits operate with voltage feedback and tension is maintained. When the end-of-tape tab is detected, the control and status circuits provide the interface with an end-of-tape (EOT) status.

2-9. A Rewind command generated by the interface will initiate the rewind sequence. The control and status circuits place the capstan servo circuits in a high-speed reverse mode and switch the reel servo feedback circuits. The capstan rewinds tape at 160 ips and the reel servo operates with current feedback. When the trailing edge of the beginning-of-tape (BOT) tab is detected, the control and status circuits terminate the rewind mode, and after a one-second delay, establish a load point search mode.

2-10. Pressing RESET releases the tape unit from interface control. Pressing REWIND in this condition rewinds the tape on the supply reel. When the tape is run-off of the take-up reel, the tension arms contact the tension arm limit switches, the capstan motor circuit is broken and the reel motors are shorted. This provides dynamic braking of the reel motors.

2-11. CIRCUIT DESCRIPTIONS.

2-12. The following paragraphs describe the power supply circuits, control and status circuits, capstan servo circuits and reel servo circuits of the tape transport. Block Diagrams of the circuits are provided as an aid in understanding the operation of the circuits. Refer to section VII for detailed schematic diagrams of the tape transport.

2-13. POWER SUPPLY AND POWER DISTRIBUTION CIRCUITS.

2-14. The power supply of the tape transport consists of a power transformer, three center-tapped bridge rectifiers, filter capacitors, and bleeder resistors. (See figure 7-2.) The primary circuit of the power supply transformer includes a switch that allows selection of 115 or 230 Vac operation, a power on-off switch, and a line filter/power connector. When 115 Vac power is selected, the two primary windings of the power transformer are in parallel and fuse F1 provides overload protection. When 230 Vac power is selected, the two primary windings of the power transformer are in series, and fuse F2 is placed in series with the primary winding to provide overload protection.

2-15. The power distribution circuits are on the power distribution PCA. The assembly contains secondary fuses and connectors for power distribution. The assembly also contains a printed-circuit connector for the power regulator printed-circuit assembly. Silicon diodes in the ±20 volt circuits and the ±12 volt distribution circuits provide circuit protection.

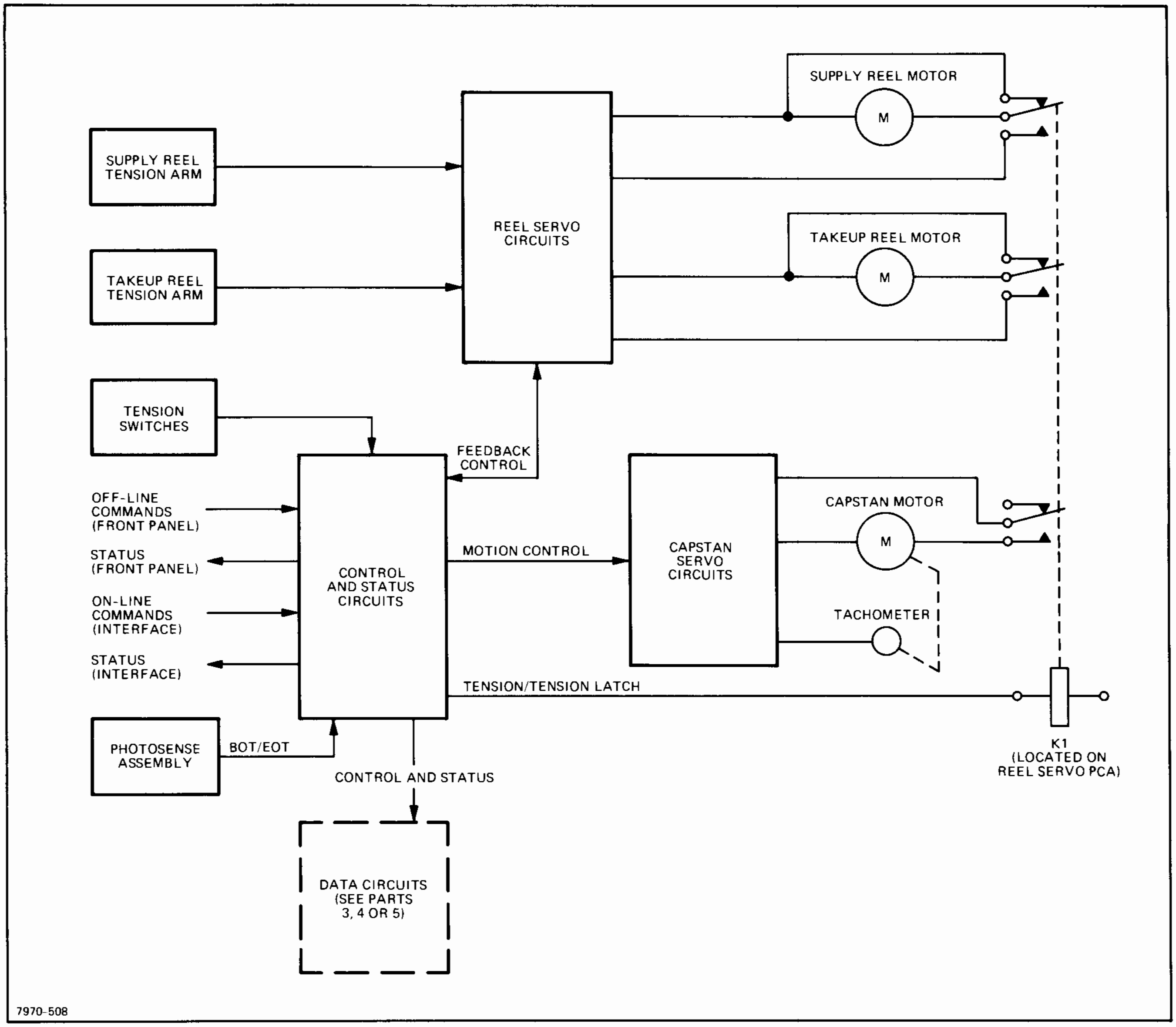


Figure 2-1. Tape Transport Functional Block Diagram

2-16. Unregulated power from the power supply is distributed to the power regulator printed-circuit assembly and to heatsink-mounted power transistors. Unregulated ±40 volts (57.5 volts nominal) from the power supply is routed through heatsink-mounted resistors to the power regulator printed-circuit assembly. Regulated power (+5V, +12V, and -12V) from the regulator-controlled transistors (heatsink-mounted) are distributed to the transport circuits and data circuits by the power distribution printed-circuit assembly.

2-17. Unregulated ±20 volts (22.5 volts nominal) from the power supply is provided for the reel servo circuit. Steering diodes CR1 and CR2 allows the ±20/40 volt lines to switch from 22.5 volts dc to 57.5 volts dc.

2-18. POWER REGULATOR CIRCUITS.

2-19. The power regulator printed-circuit assembly contains a +12 volt regulator circuit, a -12 volt regulator circuit, and a +5 volt regulator circuit. (See figure 2-2.) The power regulator printed-circuit assembly also contains a reel servo voltage switching circuit and a delay circuit. These circuits are described with related circuits.

2-20. +12 VOLT REGULATOR. The +12 volt regulator uses an integrated circuit voltage regulator with an internal temperature compensated voltage reference. Regulation is obtained by dividing the output voltage (R3, R4, and R5)

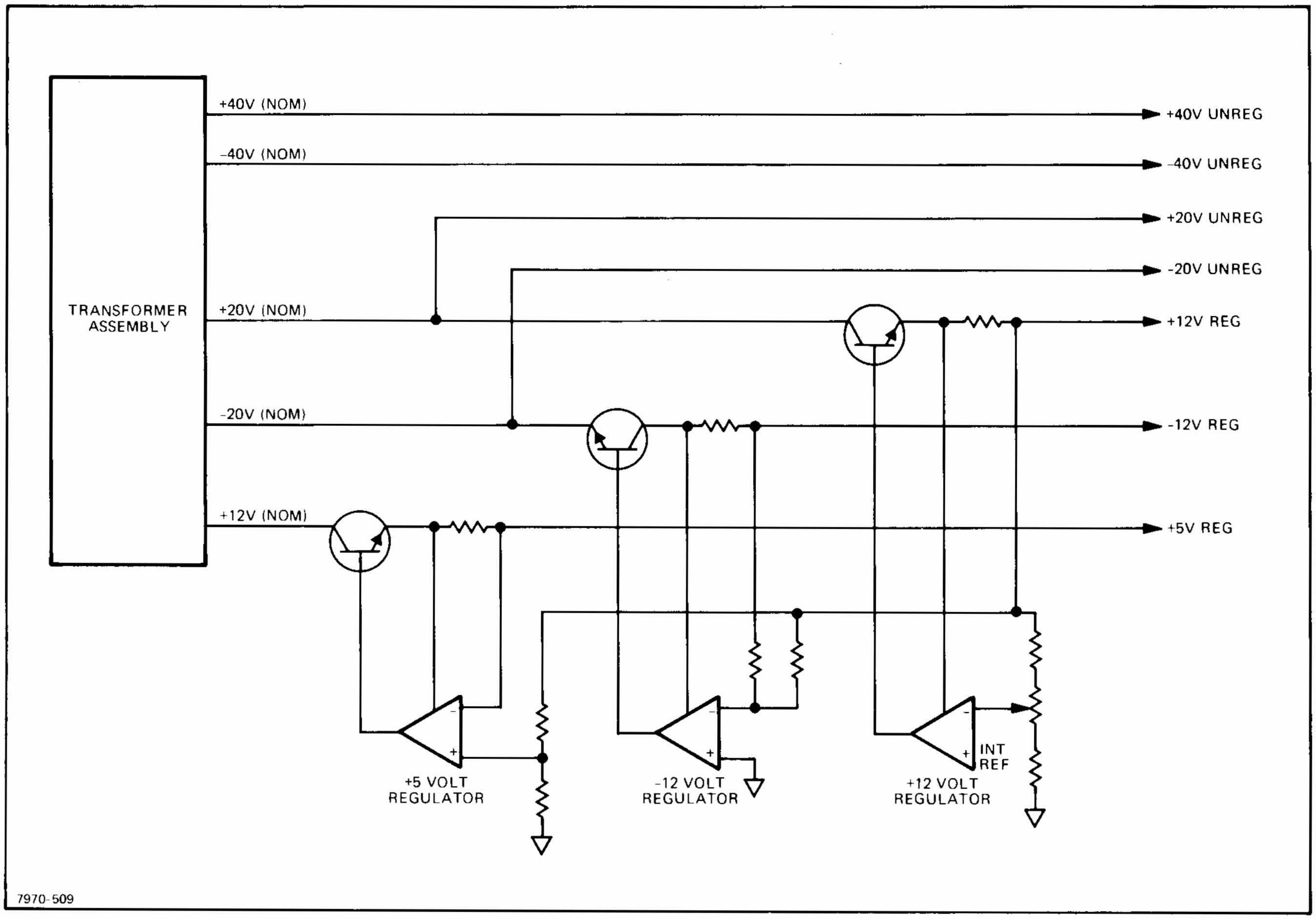


Figure 2-2. Power Supply Voltage Regulators, Simplified Diagram

and comparing the divided voltage with the internal reference. The output voltage of the +12 volt regulator is adjustable by variable resistor R4. Series pass transistor Q2 (located on a heatsink external of the regulator) is protected by current limiting. The current foldback knee is set to approximately 2.8 amperes by R1 and R2. Short circuit current is set to approximately 1.3 amperes by R7 and R8 (located on heatsink external to the regulator).

2-21. -12 VOLT REGULATOR. The -12 volt regulator uses an integrated circuit voltage regulator. The reference for the -12 volt regulator is derived from the regulated +12 volt source. Current limiting of the -12 volt regulator is set at 1.2 amperes as determined by R9 and R20. Diode CR14 protects the -12 volt regulator against excessive common mode voltage. Diode CR17 limits the output voltage to -14.7 volts in the event that the +12 volt reference is lost.

2-22. +5 VOLT REGULATOR. The +5 volt regulator uses an integrated circuit voltage regulator. The reference for the +5 volt regulator is generated from the +12 volt regulator output using R23, R25, and R26. Current limit of the +5 volt regulator is approximately 4.0 amperes controlled by current sense resistor R6, located external of the regulator on a heatsink. In the event of an over-voltage, silicon controlled rectifier CR1 conducts and shorts the +5 volt supply. The 4 ampere short circuit current will blow fuse F5 which is in series with the +10 volt unregulated supply.

2-23. CONTROL AND STATUS CIRCUITS.

2-24. The control and status circuits process commands from the front panel controls and interface and generate controlling signals for the tape transport and data circuits. The control and status circuits also generate status signals for the interface and front panel indicators.

2-25. After power is applied, the tape is not tensioned, limit switch W2S1 is open and the capstan and reel servo circuits are disabled (figure 2-3). The capstan and reel servo circuits are disabled because relay K1 is deenergized and because ground voltage is supplied to the Tape Tension signal line through the B contacts of deenergized relay K1. Ground voltage supplied to Q4, on the control and status PCA, results in an inactive output from the LDFD FF to the capstan servo circuit.

Also, ground voltage supplied to Q22 on the capstan servo PCA holds switch Q20 on the capstan servo PCA closed, grounding the input to motor drive amplifiers Q2, Q4, and Q6. Ground voltage applied to Q19 on the reel servo amplifier PCA, by the Tape Tension signal and through the normally closed contacts of the LOAD switch, cause it to close switches Q16, Q17, and Q20 on the reel servo amplifier PCA. With the inputs to the reel servo amplifiers grounded, the reel motors are disabled. Relay K1 is also kept deenergized through the normally closed contacts of the LOAD switch and Q13 on the reel servo amplifier PCA. When the LOAD switch is pressed, +5 volts is supplied through R9 and R103 to activate the Tension signal to Q13 and Q19 on the reel servo amplifier PCA. The high input to Q13 energizes relay K1. (Once energized, K1 remains energized, through R109, CR11, and Q13, until tension is lost.) Pressing the LOAD switch also applies a high input to Q19 on the reel servo amplifier PCA. Nand gate Q19 holds Q16, Q17, and Q20 open if either of its inputs are high. With K1 energized, both inputs to Q19 are high causing switches Q16, Q17, and Q20 on the reel servo amplifier PCA to open. Thus, both requirements for enabling the reel servos (K1 energized and switches Q16 and Q17 open) are met and the reel servos tension the tape. Thus, with K1 energized and Q20 on the reel servo amplifier PCA open, Q22 on the capstan servo PCA (through Q21) opens Q20 on the capstan servo PCA and enables the amplifier. With tape tension established, tension arm switch W2S1 closes, supplying a high input to terminal D of the Load Forward FF and to Q19 to the reel servo amplifier PCA.

2-26. When the LOAD switch is released, the load point search sequence is initiated. Load Latch (U1A and U2A) is set. The output of the load latch is gated with REW (false) to clock the Load Forward flip-flop (U12A). The LFWD signal is gated with DELAY to provide the capstan servo with the load point search command.

2-27. The DELAY signal is generated by a delay circuit located on the power regulator printed-circuit assembly. The delay circuit provides a one-second delay when changing from a high speed operation to a synchronous or load point search mode.

2-28. When the load point tab is detected (BOT), the Load Forward flip-flop is cleared by LP through U16D and U13B. Pressing RESET will also clear the Load Forward flip-flop. When Load Forward is cleared, tape load point search motion will stop. The edge transition of $\overline{\text{LDFD}}$ clocks Load Complete flip-flop U12B. Except for a rewind condition, Load Complete remains set during normal operation of the tape transport.

2-29. Rewind flip-flop U6B is cleared by pressing the REWIND switch when the unit is off-line, or by interface command $\overline{\text{REW}}$ when the unit is on-line. When the Rewind flip-flop is cleared, the Rewind Status flip-flop (U4B and U3A) is set. This provides rewind status $\overline{\text{SRW}}$ to the interface and rewind status to the control switch assembly to illuminate the REWIND indicator.

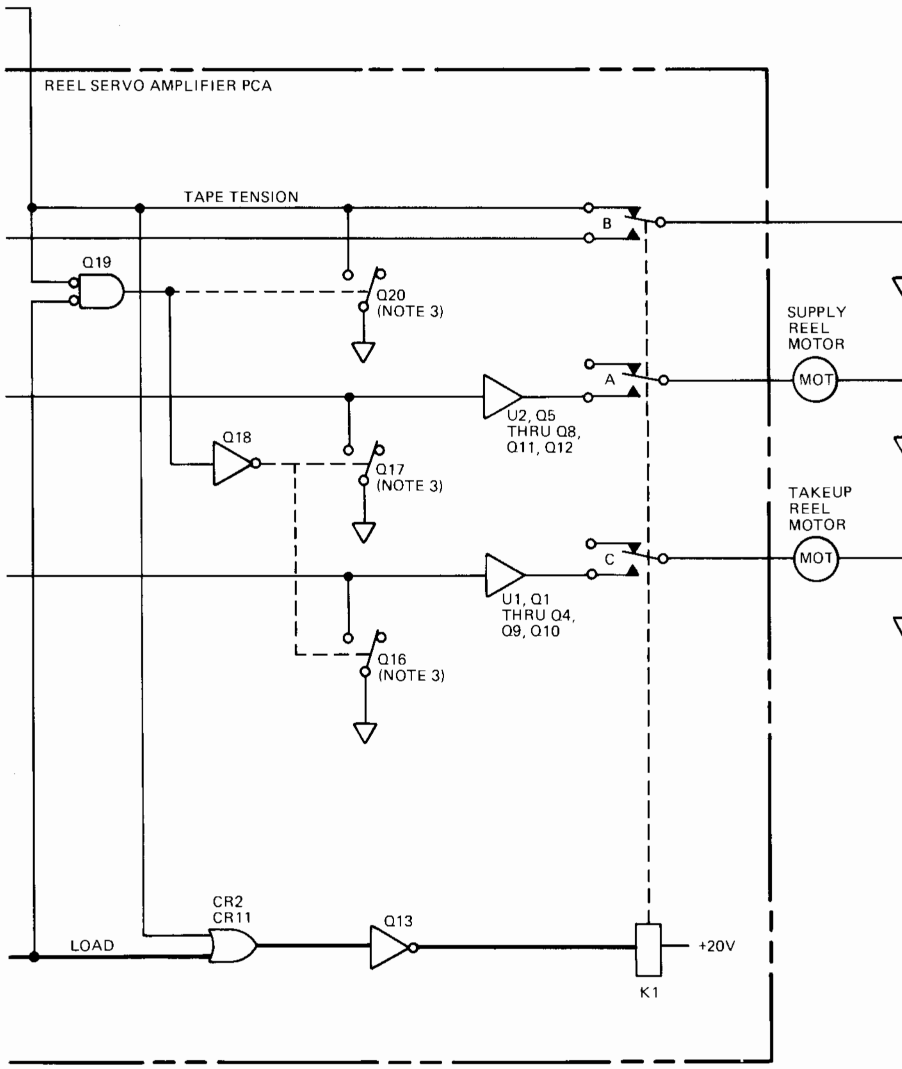
2-30. When the trailing edge of the load point tab is detected during rewind the Load Point flip-flop is set and the Rewind flip-flop is set through the rewind clock input (U6B-11). Load point also gates U3B to prevent rewind commands from clearing the Rewind flip-flop. With the Rewind flip-flop set, the Load Forward flip-flop is set through gate U13A. This starts the load point search mode.

2-31. The control and status printed-circuit assembly contains a unit select network that allows up to four units to be controlled by one interface. The network consists of a jumper (W1) and 5 connecting pins (OFF, 0, 1, 2, 3). The position of the jumper determines the unit to be selected by the interface. If the units connected to the interface are equipped with the unit select switch option, the jumper must be in the OFF position. With the jumper in the OFF position the select match circuitry of the control and status printed-circuit assembly is disabled. If the tape units are not equipped with the unit select switch option, the jumper must be connected to positions 0 through 3 depending upon unit designation.

2-32. The unit select command from the interface ($\overline{\text{CS0}}$, $\overline{\text{CS1}}$, $\overline{\text{CS2}}$ or $\overline{\text{CS3}}$) is gated with ON-LINE to generate SOLA and SOLB (selected and on-line). The SOLA condition allows status signals to be supplied to the interface. The SOLB condition is gated with COMP (load sequence completed) to generate EXT (external control). The EXT condition allows interface commands to be processed. The OFF-LINE command from the interface does not require the EXT condition. The OFF-LINE command is gated with the unit select command to clear the On-Line latch (U1D and U2B).

2-33. The Rewind command ($\overline{\text{REW}}$) from the interface is gated with EXT to clear (assert) the Rewind flip-flop (U6B), provided that tape is not at load point. The forward, reverse, and high-speed ($\overline{\text{FWD}}$, $\overline{\text{REV}}$ and $\overline{\text{HIGH SPEED}}$) are gated to provide motion commands to the tape transport servos and data circuits.

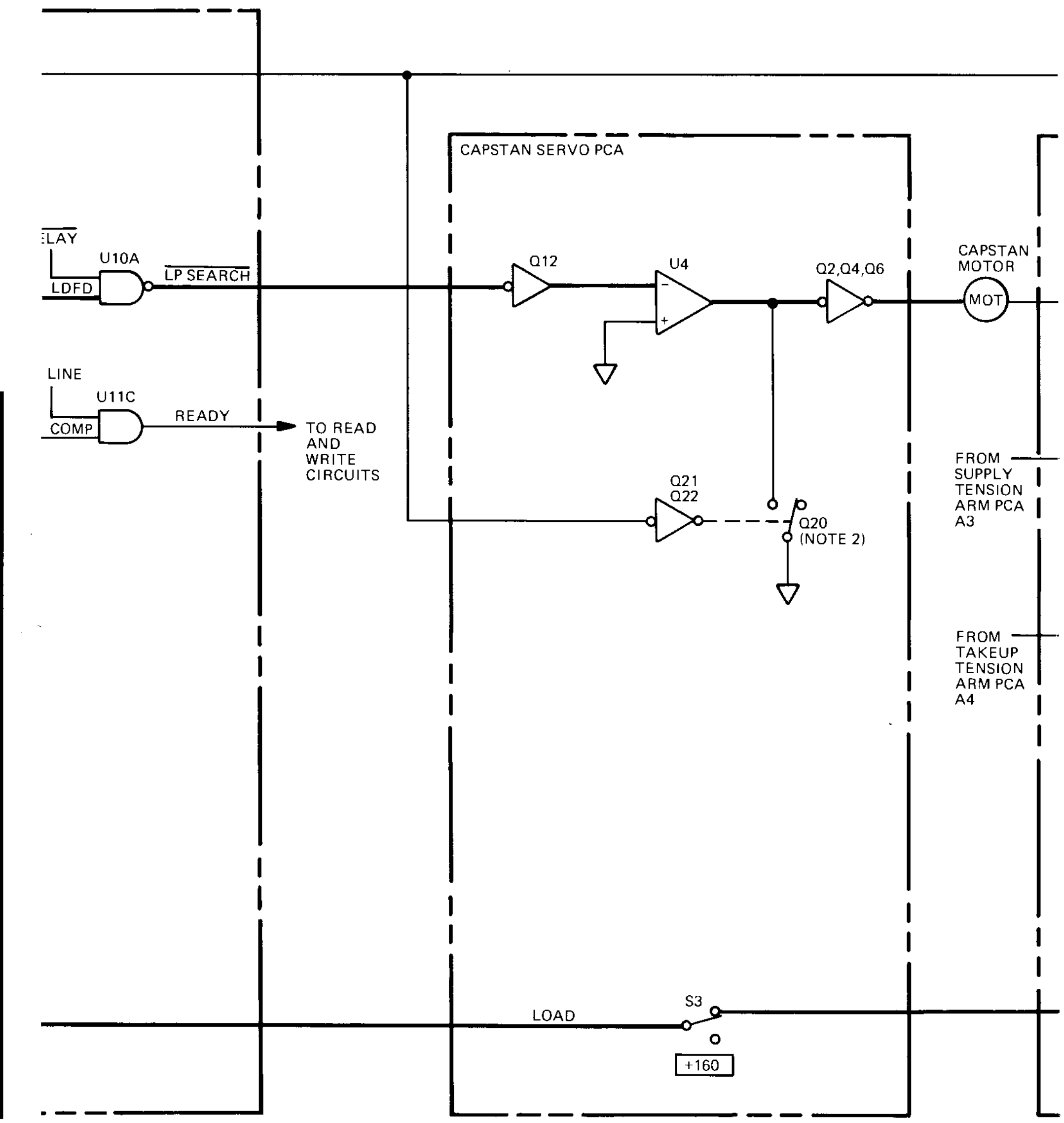
2-34. All status signals to the interface are gated with SOLA. The load point status ($\overline{\text{SLP}}$) indicates that the tape unit is at load point (load point tab under photosense head). The end-of-tape status ($\overline{\text{SET}}$) indicates that the tape is at or beyond the end-of-tape tab. The rewind status ($\overline{\text{SRW}}$) indicates that the tape is rewinding or in an automatic load point search operation. The ready status ($\overline{\text{SR}}$) indicates that the tape unit is selected, on-line, and that the load sequence is complete (not rewinding and not in a load point search mode). The on-line status ($\overline{\text{SL}}$) and file protect status ($\overline{\text{SFP}}$) indicate that the unit is on-line, and that the tape reel installed on the supply reel hub is not equipped with a write enable ring.



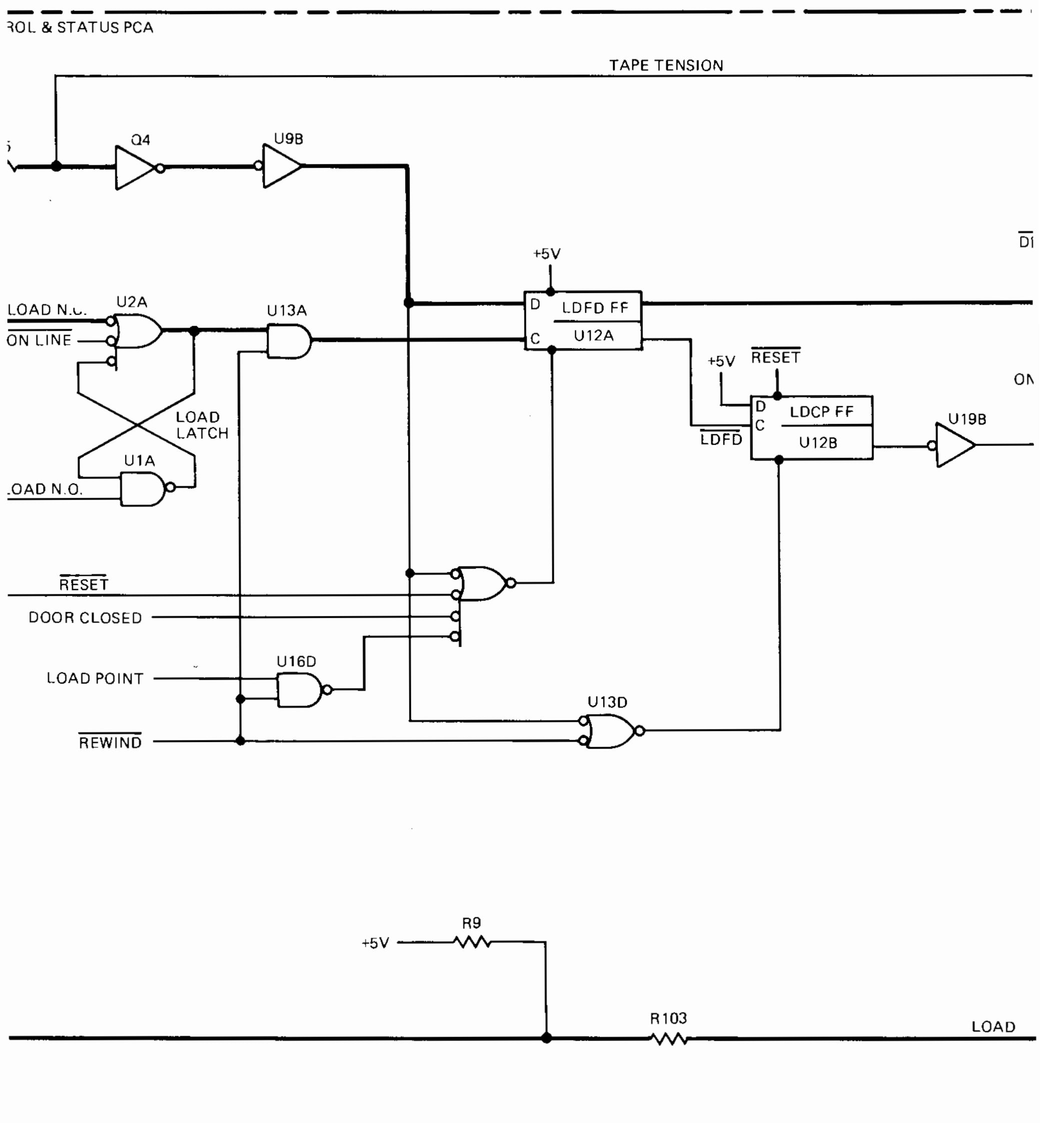
NOTES:

1. WHEN THERE IS NO TAPE TENSION, SWITCH W2S1 IS HELD OPEN, AS SHOWN, BY UPPER TENSION ARM.
2. SWITCH Q20, ON THE CAPSTAN SERVO PCA, CLOSES WHENEVER THE TAPE TENSION SIGNAL IS INACTIVE (GND OR OPEN CIRCUIT).
3. SWITCHES Q16, Q17, & Q20 ON THE REEL SERVO PCA, CLOSE WHENEVER BOTH THE LOAD & TAPE TENSION SIGNALS ARE SIMULTANEOUSLY INACTIVE (GND OR OPEN CIRCUIT).

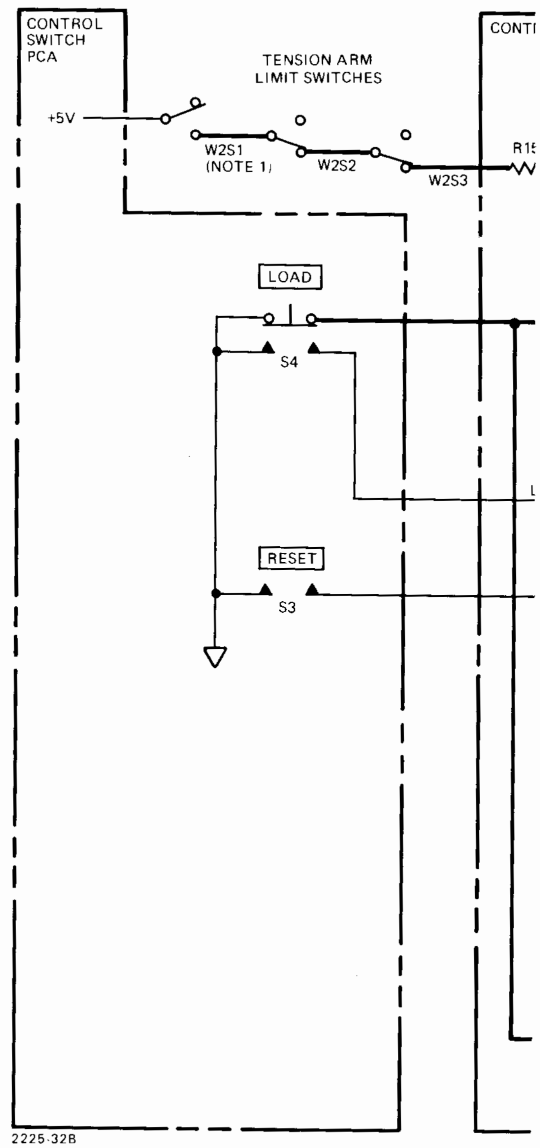
Figure 2-3. Load Function, Simplified Logic Diagram



ELAY
U10A
LDFD
LP SEARCH
LINE
U11C
COMP
READY
TO READ AND WRITE CIRCUITS
CAPSTAN SERVO PCA
Q12
U4
Q2,Q4,Q6
CAPSTAN MOTOR
MOT
Q21 Q22
Q20 (NOTE 2)
FROM SUPPLY TENSION ARM PCA A3
FROM TAKEUP TENSION ARM PCA A4
LOAD
S3
+160



ROL & STATUS PCA
TAPE TENSION
Q4
U9B
+5V
DI
LOAD N.C.
U2A
U13A
LDFD FF
U12A
ON LINE
+5V
RESET
ON
LOAD
LATCH
LDCP FF
U12B
U19B
LDFD
U1A
LOAD N.O.
RESET
DOOR CLOSED
U16D
LOAD POINT
U13D
REWIND
R9
+5V
R103
LOAD


CONTROL SWITCH PCA
CONTI
TENSION ARM LIMIT SWITCHES
+5V
W2S1 (NOTE 1)
W2S2
W2S3
R1
LOAD
S4
RESET
S3
2225-32B

2-35. The one-second delay (generated on the power regulator printed-circuit assembly) following a high-speed reverse command prevents additional high speed commands from being processed by the control and status circuits. The delay also prevents the load point search from occurring for one-second following a rewind operation.

2-36. CAPSTAN SERVO CIRCUITS.

2-37. The capstan servo circuits control the speed and direction of tape motion across the magnetic head assembly. The capstan servo consists of a capstan motor/tachometer and a capstan servo printed-circuit assembly. The servo circuit employs current and velocity feedback. The velocity feedback is provided by the magnetic moving coil tachometer attached to the capstan motor shaft. Current feedback is provided by a pair of sensing resistors in the capstan motor return circuit. Figure 2-4 is a block diagram of the capstan servo circuit.

2-38. Motion commands from the control and status printed-circuit assembly control switching circuits and a bipolar ramp generator. The output of the ramp generator and high-speed control signals control the capstan closed-loop servo amplifier. The capstan servo amplifier consists of an integrated circuit servo preamplifier (U4) and a capstan power amplifier (Q1 through Q6).

2-39. The forward and reverse switching circuits contain temperature compensated zener diodes that provide a basic reference voltage for forward and reverse speeds. When a $\overline{\text{FWD}}$ command from the control and status circuits of FWD service switch S2 is placed in the on position (up), Q7 is reverse biased. Bias current for CR6 is then provided through R33 to establish a -6.2 volt reference for the ramp generator (U2 and U3). A $\overline{\text{REV}}$ command or placing the REV service switch in the on position (up) will provide bias current for CR2 through R27. CR2 will provide a +6.2 volt reference for the ramp generator. The forward and reverse reference voltages at the output of U3 are independently adjustable to control the forward or reverse speeds.

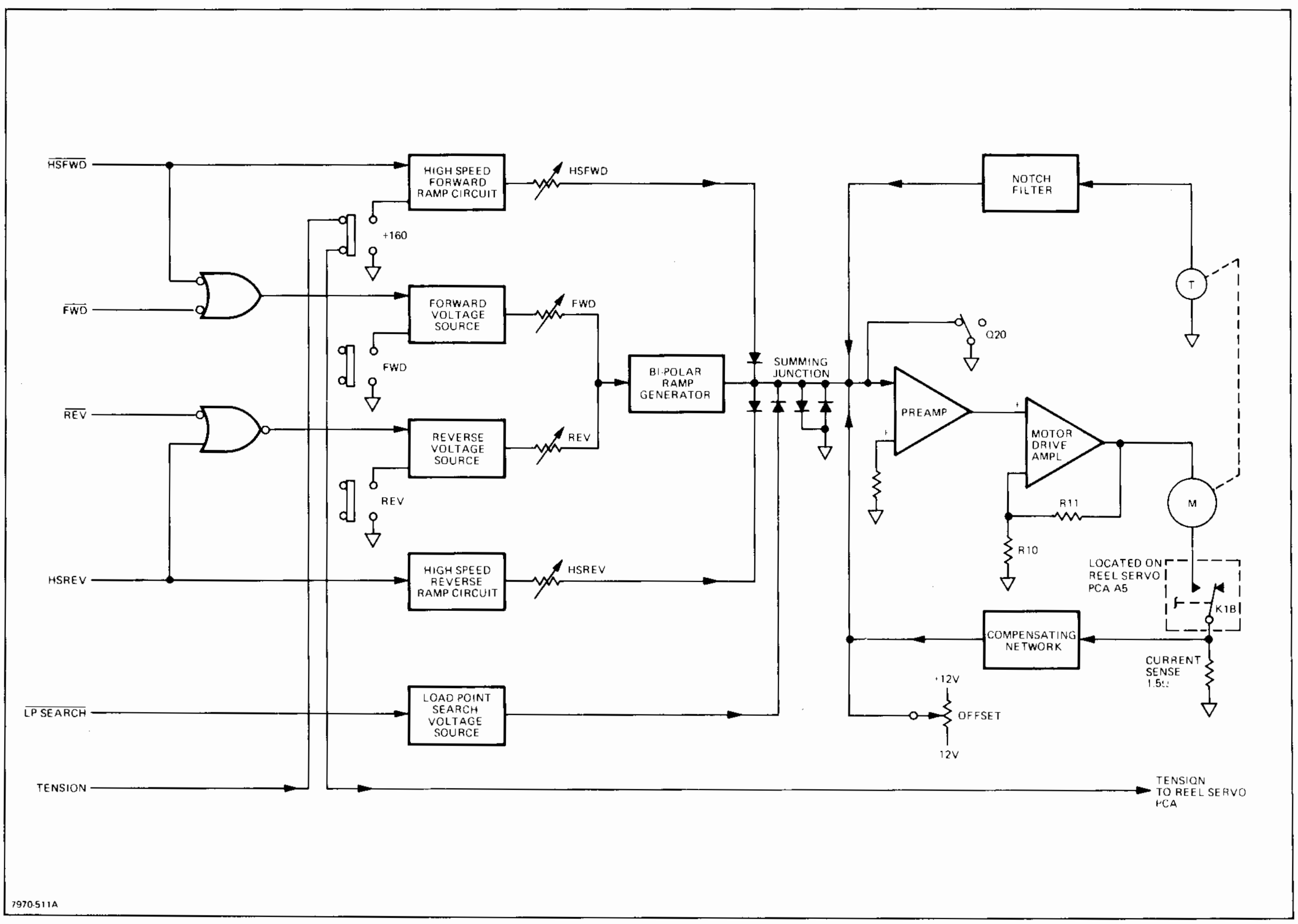


Figure 2-4. Capstan Servo, Block Diagram

2-40. The bi-polar ramp generator consists of two integrated circuit operational amplifiers (U2 and U3), a symetrical 8-volt clipping network (CR7 through CR11), and a ramp control network (R42/C28).

2-41. Operational amplifier U2 initially operates as a saturating comparator when a forward or reverse command is given or removed. Near the end of a ramp-up or ramp-down U2 changes from a saturating comparator to a linear amplifier with the non-inverting input at 0-volts.

2-42. The output of U2 is held to 8 volts by a symetrical clipping network (CR7 through CR11) which establishes current for the ramp control network. The slope of the ramp is determined by the current through R42 (RAMP control) into integrating capacitor C28. Feedback through R66 nulls the reference input voltage to U2 and the output voltage of the ramp generator (U3-6) is held steady by the ratio determined by R66 (R35 + R34) or R66 (R29 + R28).

2-43. When the Forward or Reverse command is removed, the current through R66 drives operational amplifier U2 into saturation and the ramp integrates the 0 volts. As the output of the ramp generator (U3-6) approaches 0 volts, U2 reverts to a linear amplifier and the output of the ramp generator is maintained at 0 volts.

2-44. A $\overline{\text{High-Speed Forward}}$ command ($\overline{\text{HSFWD}}$) from the control and status circuits or placing the +160 service switch in the on position (up) will allow CR12 and CR13 to conduct and reverse bias Q8. With Q8 reverse biased, C25 is charged through R49. The exponential voltage at the base of Q9 rises to +12 volts but is clipped at +6 volts when Q9 saturates. When the $\overline{\text{HSFWD}}$ command is removed or the +160 service switch is placed in the off position (down), U1B conducts placing U1B-4, CR12, and CR13 at 0 volts. This allows Q8 to conduct and C25 discharges through R48. The threshold caused by the base emitter turn-on voltage of Q9 and the diode drop across CR14 results in a delay of approximately 100 ms before motion starts or stops.

2-45. A $\overline{\text{High-Speed Reverse}}$ command ($\overline{\text{HSREV}}$) or placing the -160 service switch in the on position, (up) will cause the high-speed reverse ramp circuit to function the same as the high-speed forward ramp circuit, except that voltage polarities are reversed. Capacitor C26 is charged through R56 and discharged through R54 and R55.

2-46. The LOAD command from the control and status circuits does not control a ramp circuit. The load switch of the capstan servo is a single step input to the capstan servo amplifier resulting in a nominal 20 ips tape motion.

2-47. The outputs of the bi-polar ramp generator, high-speed forward ramp generator, high-speed reverse ramp generator and load switch form a summing junction at the input of the capstan servo preamplifier (U4). Diodes CR17 and CR18 provide clipping to protect the amplifier from overload. The preamplifier drives the capstan motor power amplifier (Q1 through Q6). The dc gain of the power amplifier is 10 volts per volt determined by R10 and R11. The power amplifier is operated in class B with Q6 providing negative current for forward motion and Q5 providing positive current for reverse motion.

2-48. A notch filter in the velocity feedback circuit from the tachometer is selected to attenuate the mechanical response of the motor-tachometer combination. A compensating network in the current feedback circuit is also selected depending upon synchronous speed of the tape unit.

2-49. Transistor switch Q22 senses the presence of tape tension. While the tape is tensioned, Q22 is on, keeping switch Q20 off. However, when tension is lost Q22 turns off, allowing Q20 to turn on and switch the input of motor drive amplifiers Q2, Q4, and Q6 to ground. This disables the capstan servo. The capstan motor circuit is completed through the B contacts of relay K1 on the reel servo amplifier PCA when K1 is energized. Relay K1 is energized when the LOAD pushbutton is pressed. Once energized, it remains energized until tension is removed.

2-50. REEL SERVO CIRCUITS.

2-51. The reel servo circuits consist of a tension circuit, a voltage switching circuit, a delay circuit, voltage/current feedback switches, tension arm photosense circuits, preamplifiers, motor power amplifiers, and reel motors. Figure 2-5 is a block diagram of the reel servo circuit.

2-52. At initial power-on, the tension circuit is disabled. The normally closed contacts of LOAD pushbutton switch prevent Q13 of the tension circuit from conducting. Pressing the LOAD control allows Q13 to conduct, energizing relay K1. With K1 energized, the capstan and reel servo motor circuits are completed. As tape is tensioned and the tension arms swing away from the limit switches, power through the limit switches maintain a forward bias of Q13. When power is removed, or tape tension is lost, the relay contacts short across the reel motor windings to provide dynamic breaking.

2-53. The voltage switching circuit is located on the power regulator printed-circuit assembly. During a high-speed operation forward or reverse, power to the motor power amplifiers is switched from 22.5 volts to 57.5 volts (nominal).

2-54. During a high-speed reverse operation (rewind), the $\overline{\text{HSREV}}$ command from the control and status circuits is gated with TENSION. When both reel motors approach full r/min, the motor voltage exceeds the break-down voltage of CR4. The condition established by the gating of $\overline{\text{HSREV}}$ and Tension allows current through CR4 to forward bias Q5. Voltage switch Q6/Q7 conducts placing +57.5 volts on the +20/40 line. Diode CR2 on the power distribution printed-circuit assembly is back-biased preventing +57.5 volts from entering the +20 volts line.

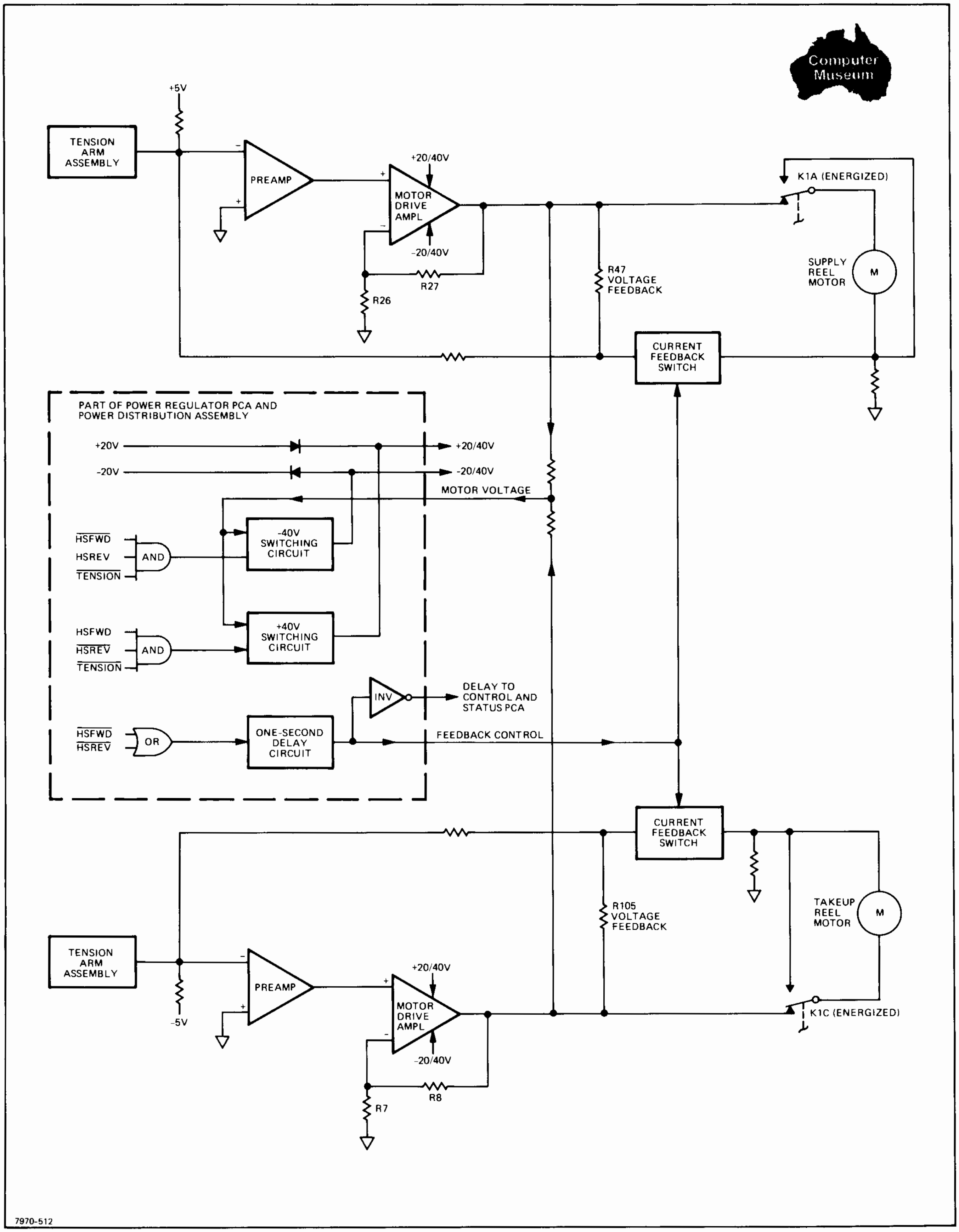


Figure 2-5. Reel Servo, Block Diagram

2-55. During a high-speed forward operation, the voltage switching circuits function the same as in the fast reverse operation. $\overline{\text{HSFWD}}$ is gated with tension to allow motor voltage to switch the -40 volt switch (Q12/Q13).

2-56. The delay circuit is located on the power regulator printed-circuit assembly. The delay circuit provides an additional one-second delay following the end of a high-speed command. The one-second delay prevents further high-speed commands from the interface from being processed during the one-second period. The one-second delay is also used to switch the reel servo operating mode from voltage feedback to current feedback. The additional one-second following a high speed operation allows the reel servo to operate in a current feedback mode until reels are slowed.

2-57. During normal operation, U5A-3 and U5B-4 rest at 0 volts. A $\overline{\text{HSFWD}}$ or $\overline{\text{HSREV}}$ command from the control and status circuits will cut-off U5A or U5B and base current for Q15 is supplied through R28 or R29. When Q15 conducts, capacitor C8 immediately discharges through Q15 causing Q16 and Q18 to be cut-off. Feedback control to the reel servo changes from approximately +8 volts to approximately -8 volts. The negative potential also reverse biases Q17 and the DELAY line switches to +5 volts.

2-58. When the high-speed command ($\overline{\text{HSFWD}}$ or $\overline{\text{HSREV}}$) is removed and Q15 loses base current, capacitor C8 is then charged through R33 (one-second time constant). When C8 is charged to +5V, Q16 and Q18 conduct and the feedback control changes from -8V to +8V. The DELAY switches to 0 volts.

2-59. The reel servo tension arm assemblies contain dual element photo-conductors that are illuminated by a lamp shining through a slotted disc. The slot is in the form of a spiral attached to the tension arm. As the arm moves, the slot exposes different areas of the photo-conductor. As a result, the output of the photo-conductor is proportional to the position of the tension arm.

2-60. The reel servo preamplifier is an integrated operational amplifier that amplifies the position error of the tension arm. The tension arm photo-conductor output is single-ended, therefore, an off-set is provided by R39 or R41. The preamplifier drives a class B motor drive amplifier. The motor power amplifier has a gain of 10 volts per volt.

2-61. When operating in a normal mode (synchronous or load speed), the servo operates with voltage feedback. The +8 volts from the feedback switching network (feedback control) back-biases the feedback FET switch (Q14 and Q15). Feedback is then provided through R47 and R105. During a high-speed operation, the feedback control changes to -8 volts. The feedback FET switch is forward biased and feedback is current through the switch.

SECTION III
PERFORMANCE CHECKOUT

3-1. INTRODUCTION.

3-2. This section provides checkout instructions to verify that the tape unit conforms to published performance specifications. The test procedure assumes that the following general conditions apply at all times unless specific instructions to the contrary are stated as part of a test routine.

3-3. TEST EQUIPMENT REQUIRED.

3-4. For the purpose of this procedure, it is presumed that the person conducting the test will be using either a computer or an off-line test set that is capable of meeting the following requirements. It is also presumed that operating instructions for the equipment is provided by documentation applicable to the equipment.

a. Provides all standard functional commands.

b. Responds to all status outputs.

3-5. An HP 13191A Control and Status Test Board is available as a service accessory and will meet the needs for all adjustments. Computer operation is also suitable. The following electronic test instruments (or equivalent) are also required:

a. HP 140A Oscilloscope with HP 1421A Time Base Generator.

b. HP 1421A Dual-Trace Preamplifier (for HP 140A).

c. HP 5245L Counter with HP 5265A Digital Voltmeter Plug-In.

3-6. In addition to the listed test equipment, a transport test tape HP part number 5080-4525 that generates various signals for accurate speed measurements is required.

3-7. CHECKOUT PROCEDURES.

3-8. Performance checkout procedures for the tape unit consist of:

a. Preliminary Power-Off Checks.

b. Operator Control Checks.

c. Service Switches and Accessory Checks.

d. Tape Path Evaluation.

e. Power Supply Voltage Checks.

f. Tape Speed and Capstan Servo Checks.

g. Transport Function, Motion, and Status Checks.

3-9. PRELIMINARY POWER-OFF CHECKS.

3-10. Preliminary power-off checks are performed as follows:

a. Tape Rollers: The tape rollers must operate freely and have no end play.

b. Head Crosstalk Shield: The head crosstalk shield should operate freely and should have clearance between face of head and shield (room to slip a punched card thickness without binding).

c. Tension Arm Limit Switches: The three limit switches associated with the tension arms must operate when the arm is approximately 1/8 inch from the rubber stop. The roller on the switch arm should be approximately on the center of the arm when the arm is fully against the stop. There should be positive travel of the switch lever beyond the point at which it actuates the microswitch. The check can be made audibly if ambient noise level permits, or with an ohmmeter if room noise is too high.

d. Write Enable Sensing: The write enable sensing finger nominal location dimensions should be as follows:

(1) The distance between the outside surface of the write enable sensing finger and the outside flange diameter of the reel turntable should be 3/32-inch (nominal).

(2) In the file protected position (inoperative), the dimension between the outer tip of the sensing finger and the outer face of the reel turntable should be 3/16-inch (nominal) above the turntable surface.

(3) In the write enable position (with solenoid energized) the outer tip of the sensing finger should be 1/16-inch below the turntable surface.

(4) The sensing finger must not touch the turntable under any condition.

e. Reel Retaining Knob: With the locking lever released, the reel should slip over the rubber grip ring easily, and it should be possible to easily rotate the reel. When the lever is closed, positive resistance should be felt as the rubber is compressed. In the locked position, it should not be possible to move the reel by hand. If slippage is suspected, place a piece of masking tape on the reel, and another on the hub. A mark placed in alignment on both pieces of tape should not become misaligned by more than 1/8 inch in 16 hours of operation. To correct tape reel slippage, release locking lever and loosen the pozidrive screw, rotate the reel retainer knob clockwise, and tighten the screw. Repeat until tape reel mounts firmly and does not slip.

3-11. OPERATOR CONTROL CHECKS.

3-12. Verify position of 115/230 volt selector switch; connect unit to appropriate power source and check the following operating modes.

3-13. TAPE LOADING AND WRITE ENABLE. Place a reel of tape (with write enable ring) on unit and thread with the power switch on. After threading tape, press LOAD and verify that the following takes place.

a. Tape tension is established. RESET indicator illuminates.

b. WRITE ENABLE indicator illuminates.

c. Tape moves forward at 20 ips to load point tab (BOT tab).

d. LOAD indicator illuminates.

3-14. ON-LINE TRANSFER AND RESET. Place the control and status PC assembly unit select jumper in the OFF pin (this is not the same as OFF on unit select option) and load tape. Following completion of a load sequence with tape positioned at load point (LOAD indicator on), press ON-LINE and verify that unit will respond to external commands. Pressing ON-LINE while load point search is in process will also result in ON-LINE operation upon completing the search (LOAD indicator is ON). While ON-LINE, the unit will not respond to local controls with the exception of RESET.

3-15. DYNAMIC BRAKING AND RECOVERY FROM POWER FAILURE. Place unit in rewind mode after tape is well into take-up reel. When full rewind speed is reached, turn power switch off to simulate power failure. Tape should stop without any damage to tape. Proceed with recovery to on-line status by following normal load sequence. Except that when tape unit goes into the load point search mode, load point tab may be simulated by pressing the RESET button. This can then be followed by an on-line command.

3-16. REWIND OPERATION. The REWIND control is operational only while the unit is in the reset state which permits local control. The rewind command will override the load command and will return the tape to the load point position (LOAD indicator on with tape stopped). Rewind may be terminated prior to load point by pressing RESET. Transfer to on-line is also possible immediately following this sequence.

3-17. SERVICE SWITCHES AND ACCESSORY CHECKS.

3-18. There are three service switches incorporated in the capstan servo card. These together with the REWIND and LOAD controls provide a means of operating all five drive modes for service and/or adjustment purposes. There is no capability for cyclic drive operation.

3-19. The HP 13191A Control and Status Test Board is available for use with the tape unit. With this test board it is possible to completely adjust and verify the performance of the control and status function of a tape unit under off-line conditions. Complete operating details are included with the test board. The HP 13191A Control and Status Test Board provides normal drive modes as well as cyclic programming which is suitable for adjustment of the capstan start/stop ramp. The board also includes status indicator lamps to verify all normal status functions. The test board is installed in the connector of the tape unit control and status PCA.

3-20. TAPE PATH EVALUATION.

3-21. With undamaged tape threaded on the tape unit and with the unit in the appropriate operating mode, evaluate the following characteristics of the tape path.

a. Capstan Height: Capstan height should be such that the tape is guided equal distance in from the outer and inner edge of the capstan. The air escape grooves provide a means for judging.

b. Tension Position: Arms should be aligned with the centering marks on the rear of the casting. Position is acceptable provided the arm is not out of location by more than the diameter of the arm.

c. Tape Tracking Over the Tape Guides: Tracking over the guides should be smooth with no evidence of edge forces anywhere in the tape path. Transverse reflected light may be used to assist in judging. Light reflections across the 1/2-inch width of the tape should not be bent due to points of stress.

d. Photosense Position: Face of photosense head assembly should be parallel to the path of the tape and positioned 1/8 inch from the tape.

3-22. POWER SUPPLY VOLTAGE CHECKS.

3-23. Both regulated and unregulated supplies should be checked for the following specifications.

3-24. REGULATED SUPPLY VOLTAGES. Regulated voltages will remain within tolerances over a primary voltage range of ±10 percent. DC voltages and tolerances are to be as specified below. The peak-to-peak ripple values are nominal and minor variances may be expected. Ripple is stated under tension-only conditions.

a. The +5 volt supply must be +5.000 ± 0.050 Vdc.

b. The ±12 volt supplies must be 12.000 ± 0.360 Vdc.

3-25. UNREGULATED SUPPLY VOLTAGES. Unregulated supply voltages are a direct function of line voltage. The following table of nominal values should be judged only at a line voltage of 115 volts. RMS ripple values are nominal and apply at 60 Hz.

a. ±40 Vdc: Nominal value is ±57.5 volts; ripple of 150 mv p-p (sawtooth).

b. +20 Vdc: Nominal value is +22.5 volts; ripple of 600 mv p-p (sawtooth).

c. -20 Vdc: Nominal values is -22.5 volts; ripple of 300 mv p-p (sawtooth).

d. +10 Vdc: Nominal value is +12 volts; ripple of 900 mv p-p (sawtooth).

3-26. TAPE SPEED AND CAPSTAN SERVO CHECKS.

3-27. The tape speed and capstan servo checks consist of measuring capstan motor offset current, measuring long term speed variation (tape units capable of reading data), measuring start and stop time and distance, measuring instantaneous speed variations, and measuring fast forward, reverse, start and stop. Included is a dynamic tape skew check for tape units equipped with read and write electronic circuits.

3-28. CAPSTAN MOTOR OFFSET CURRENT. Connect a suitable dc voltmeter or oscilloscope across the 3 ohm 1 percent resistor (R21 or R22). The return side of the resistors is connected to pin 2 of CJ-1. With the tape under tension but no tape motion, the voltage should not exceed the following referenced to 0 Vdc.

a. Maximum acceptable operating limit: ±100 mv dc at 25°C.

b. Adjustment recommended if greater than: ±80 mv dc.

3-29. LONG TERM SPEED VARIATION. Measure the tape speed accuracy over any interval greater than one second and under each of the five drive speeds. The principle of measurement requires that a tape having highly accurate bit-to-bit distances be read, and that the output of the read preamplifier be connected to a suitable counter. HP part number 5080-4525 Transport Test Tape provides frequencies accurately spaced to better than 0.1 percent. For the following tests reference frequencies are based on using the signal that will be availabel from the channel 3 preamplifier of nine-track units and channel 6 preamplifier of seven-track units. This has a bit-to-bit spacing of 0.00150 inch and will produce a frequency of 10,000 Hz when reproduced at a tape speed of 30.000 ips. Frequencies for other speeds are in direct ratio to the change in speed relation to 30 ips. Example: 60 ips would produce 20,000 Hz. Use this principle and check the following:

a. High-Speed Forward: 160 ips, basic frequency is 53,333 Hz.

(1) Maximum acceptable operating limit: ±1050 Hz (±2 percent).

(2) Adjustment recommended if greater than: ±800 Hz (±1.5 percent).

b. Rewind (High-Speed Reverse): Checked identically to the limits applicable to high-speed forward, except that the rewind mode is used.

c. Forward and Reverse Drive: Frequency depends on tape speed and must be calculated for speeds other than 25 ips and 37.5 ips which are tabulated below. Maximum acceptable operating limit is based on ±1 percent with adjustment recommended if speed error is +0.8 percent or greater.

(1) The 25 ips drive nominal frequency is 8,333 Hz. Acceptable limits are ±83 Hz; adjustment is required if greater than ±65 Hz.

(2) The 37.5 ips drive nominal frequency is 12,500 Hz. Acceptable limits are ±125 Hz; adjustment is recommended if greater than ±100 Hz.

d. Load Point Search: 20 ips; basic frequency is 6,667 Hz.

(1) Maximum acceptable limit is ±1330 Hz (±20 percent).

(2) No adjustment is provided.

3-30. START MEASUREMENT. Start measurements (both forward and reverse) are made as follows. Measurement of the characteristics defined requires that the tape unit be driven with commands that are adjustable to periods greater than the specified start/stop times and that there be a provision to synchronize an oscilloscope sweep directly from these commands (both start and stop). The tape to be read may be any previously recorded tape, preferably at 800 cpi, as this provides the best resolution where measurements from preamplifier outputs are required. Wavelength accuracy is not a factor in this test. Do not make measurements during read-after write operation.

Note

The definitions apply for both forward and reverse directions. The capstan tachometer voltage will reverse polarity when direction is changed; however, there will be no observable difference in the preamplifier output waveforms.

a. Start-Ramp Delay Time: The time (following a start command) required for the capstan tachometer voltage to reach a value that is greater than 0 Vdc but less than 3 percent of the value reached at normal drive speed. Specification is 0.5 ± 0.5 ms.

b. Start-Ramp 100 Percent Time: The time (following a start command) required for the analog output of any preamplifier track to first reach 100 percent of the peak-to-peak (or 0-to-peak) value established while reading an all "1's" tape under steady state drive conditions. This is a function of tape speed; the following limits apply with the capstan ramp adjustment being made during the forward start mode only.

(1) The 25 ips start-ramp 100 percent time should be 14.5 ± 0.2 ms for forward ramp, ±0.3 ms for reverse ramp.

(2) The 37.5 ips start-ramp 100 percent time should be 9.5 ± 0.2 ms for forward ramp, ±0.3 ms for reverse ramp.

3-31. START DISTANCE. Start distance is calculated as follows. Measurement of the characteristics defined requires that the tape unit be driven with commands that are adjustable to periods greater than the specified start/stop times and that there be a provision to synchronize an oscilloscope directly from these commands (both start and stop). The tape to be read may be any previously recorded tape, preferably at 800 cpi as this provides the best resolution where measurements fram preamplifier outputs are required. Wavelength accuracy is not a factor in this test. Do not make measurements during the read-after-write operation.

Note

The definitions apply for both forward and reverse directions. The capstan tachometer voltage will reverse polarity when direction is changed; however, there will be no observable difference in the preamplifier output waveforms.

a. Start-Ramp Time: This is the time required to accelerate the tape from zero ips to the drive speed. It is determined by subtracting the start delay time (measured) from the start-ramp 100 percent time (also measured).

b. Start Balance Time: This is the time difference between the start-ramp 100 percent time and the specified start time for the tape speed involved. This period of time is allowed to provide a balance in tape distance as it offsets the time delay at full drive speed represented by the stop-ramp delay time.

c. One-half of the start-ramp time plus the start balance time (both in milliseconds) multiplied by the tape speed in inches per second equals the start distance (in inches x 10^{-3}). Specifications 0.187 ± 0.020 inch.

3-32. STOP MEASUREMENT. Stop measurements (both forward and reverse) are made as follows:

a. Stop-Ramp Delay Time: The time (following a stop command) required for the analog output of any preamplifier to fall to a peak-to-peak (or 0-to-peak) value that is less than 100 percent but greater than 97 percent of the value established under steady-state drive conditions while reading in all "1's" tape. Specification is 0.5 ± 0.5 ms.

b. Stop-Ramp 100 Percent Time: The time (following a stop command) required for the capstan tachometer voltage to reach a level between 3 percent of normal drive speed value and 0 Vdc. Specification is a function of tape speed and must not exceed a time that is at least 0.2 ms less than the specified stop time for the tape speed involved.

3-33. STOP DISTANCE. Stop distance is calculated as follows:

a. Determine stop-ramp delay time.

b. Determine Stop-Ramp Time: This is the time required to decelerate the tape to zero ips from the drive speed. It is determined by subtracting the stop-ramp delay time (measured) from the stop-ramp 100 percent time (also measured).

c. The stop-ramp delay time plus one-half the stop ramp time (both in milliseconds) multiplied by the tape speed in inches per second equals the stop distance (in inches x 10^{-3}). Specification is 0.187 ±0.020 inch.

3-34. INSTANTANEOUS SPEED VARIATION. Instantaneous speed variation is a measurement of the short term departure of the tape velocity from its long term average speed. Measurement is made as follows:

a. Write a length of all "1's" tape at 800 cpi and rewind as required to be in position to reproduce this section of tape.

b. Connect oscilloscope to any convenient preamplifier output, position so that waveform is centered on screen, and adjust main sweep sync for positive slope and to trigger at the zero crossover.

c. Use the delayed sweep feature to position the delayed sweep at the next zero axis crossover (this corresponds to one bit-to-bit distance) with the delayed sweep auto triggered from a main (delaying) sweep.

d. Adjust delayed sweep rate to permit good resolution of the time shift band at the zero axis crossover. During this evaluation the vertical gain and the delaying sweep time may be adjusted to optimize the resolution. If the correct point is being observed, it will be the waveform that is coming from top left of screen to bottom right with the slope depending on the gain and delayed sweep speed.

e. Observe the jitter band under conditions in step "d" in microseconds peak-to-peak time displacement and multiply by tape speed to determine this distance in microinches. This value must not exceed the following limits which are based on ±3 percent instantaneous speed variation:

(1) 800 cpi must not exceed ±37.5 microinches (75 microinches peak-to-peak).

(2) 556 cpi must not exceed ±54 microinches (108 microinches peak-to-peak).

(3) 200 cpi must not exceed ±150 microinches (300 microinches peak-to-peak).

Note

The above values apply to both the forward and reverse modes.

3-35. DYNAMIC TAPE SKEW. Dynamic tape skew is that variation in tape velocity which generates a differential time position between the two outermost tracks on the tape. Measurement is made as follows:

a. Write a length of all "1's" tape. Rewind as required to reproduce this section of tape.

b. Use dual-trace oscilloscope and connect to preamplifier output of the two outside tracks (channels 4 and 5). Use chopped mode (triggered by channel A) with the main sweep synchronized for positive slope triggered at zero axis crossover. (Use negative slope in reverse direction.)

c. Adjust both channel gains and positions to superimpose the two waveforms (amplitude only; there will be varying degrees of time difference due to static skew characteristics).

d. Use the delayed sweep feature to present the next (one bit-to-bit distance later) zero axis crossover on the delayed sweep. The delayed sweep must be on internal sync, triggered on the negative slope. (Use positive slope in reverse direction.) The earliest of the two tracks will sync the delayed sweep and the other will arrive later and will have jitter that represents the time differential in microseconds peak-to-peak. Again gains must be adjusted as high as possible (both the same) and the delayed sweep trigger set for maximum stability of the stable waveform. There will be a considerable dead zone in the delaying sweep adjustment. Use the first operating position as the sweep is moved out from minimum delay position. There is no significance to the time differential between the stable and unstable waveforms. This does not represent static skew. The difference is a function of oscilloscope gain and position settings.

e. Measure the peak-to-peak time band of the unstable waveform as it crosses the zero axis. Convert this to microinches peak-to-peak for the tape speed involved. Worst case must not exceed ±50 microinches (100 microinches peak-to-peak) and applies to forward or reverse mode.

3-36. FAST FORWARD/REVERSE START/STOP CHARACTERISTIC. Fast forward and fast reverse characteristics are measured by synchronizing an oscilloscope with the appropriate drive command, and observing the dc output of the tachometer using the TACH test point on the capstan servo printed-circuit assembly.

CAUTION

Do not issue sequential fast drive commands without allowing time to reach full speed or to return to zero speed. Failure to observe this precaution may cause excessive power dissipation in the reel servo amplifier circuitry. Minimum time between commands should be 1 second or the sum of the start and stop times (whichever is greater).

3-37. Fast forward/reverse start or stop times are measured by observing the time (following a start or stop command) required for the tachometer output to either reach its maximum value (for start time) or to fall to zero (for stop time). Nominal times are from 400 to 700 milliseconds. Typically, the value will be 600 milliseconds.

3-38. Fast forward/reverse start or stop distances are determined by the time required for the ramp to move from one state to the other. This time is nominally 500 milliseconds. One-half of this time multiplied by 160 ips equals the nominal start/stop distance of 40 inches.

3-39. TRANSPORT FUNCTION, MOTION, AND STATUS CHECKS.

3-40. The following checks cover the I/O lines in the status and motion command connector. Use appropriate off-line test equipment to verify proper performance as indicated.

3-41. FUNCTION COMMANDS. Select, $\overline{CS}$: The control and status PC assembly includes a jumper that can serve to establish unit identification where the front panel select option is not present. If no select function is desired, the jumper can be placed in the off position which will permit response to controller commands, when unit is in on-line with load sequence completed, and is not rewinding. Verify the following conditions to check the select ($\overline{\text{CS}}$) line:

a. Unit responds to commands with jumper connected to OFF.

b. Unit responds to 0 through 3 positions when corresponding $\overline{\text{CS0}}$ through $\overline{\text{CS3}}$ is selected by the controlling device.

c. When front panel select option is included, place internal jumper in the off position and verify that response to pushbuttons 0 through 3 is same as in step "b" above. When the front panel OFF pushbutton is pressed, unit must not respond to any commands from the controlling device.

3-42. Verify that the off-line ($\overline{\text{CL}}$) line clears the write condition and returns the selected tape unit to the reset condition.

3-43. MOTION COMMANDS. Verify that the following external commands will place the selected and on-line tape unit in the corresponding drive mode:

a. Forward ($\overline{\text{CF}}$): Tape drives forward.

b. Reverse ($\overline{\text{CR}}$): Tape drives reverse then stops at load point tab.

c. Rewind ($\overline{\text{CRW}}$): Tape unit enters rewind mode, remains on-line.

d. High Speed ($\overline{\text{CH}}$): Tape unit will respond only when this is combined with either a forward or reverse command. When so combined, tape will drive at 160 ips speed. $\overline{\text{CH}}$ with $\overline{\text{CR}}$ will drive reverse past load point.

CAUTION

Do not issue sequential fast drive commands without allowing time to reach full speed or to return to zero speed. Failure to observe this precaution may cause excessive power dissipation in the reel servo amplifier circuitry. Minimum time between commands should be 1 second or the sum of the start and stop times (whichever is greater).

3-44. STATUS OUTPUTS. Verify that the following status outputs are true (low assertion) when a selected and ready tape unit is in the condition indicated.

a. On-Line ($\overline{\text{SL}}$): True when selected tape unit has been manually placed on-line.

b. Ready ($\overline{\text{SR}}$): True when selected unit is on-line, tape loading cycle is completed, and tape unit is not in rewind mode.

c. Load Point ($\overline{\text{SLP}}$): True when selected tape unit has tape positioned at the load point reflective strip.

d. Density ($\overline{\text{SD2}}$, $\overline{\text{SD5}}$, or $\overline{\text{SD8}}$): Verify that selected tape unit will display the density selected by the tape unit density switch if this option is present. Without this option, the tape unit will be set at 800 cpi but there will be no $\overline{\text{SD8}}$ output.

e. Rewind ($\overline{\text{SRW}}$): Verify that this status remains true as long as the selected unit is in the rewind mode. Must remain true until tape is repositioned at load point tab.

f. File Protect ($\overline{\text{SFP}}$): True when selected unit is not write-enabled.

g. End-of-Tape ($\overline{\text{EOT}}$): True when selected unit has moved end-of-tape tab beyond photosense head. Will remain true until tab again passes photosense head in the reverse direction.

SECTION IV
REPAIR AND REPLACEMENT

4-1. INTRODUCTION.

4-2. This section provides repair and replacement procedures for the tape transport of the HP 7970B/7970C Digital Magnetic Tape Units.

4-3. REPAIR.

4-4. The etched printed-circuit assemblies (PCA's) used are of the plated-through type consisting of metal bonded to both sides of an insulating material. The metallic conductors are extended through the component holes by a plating process. Soldering can be performed on either side of the PCA with equally good results. Table 4-1 lists recommended tools and materials for use in repairing etched PCA's. The following are recommendations and precautions pertinent to PCA repair work.

a. Avoid unnecessary component substitution; it can result in damage to the PCA circuit board and/or adjacent components.

b. Do not use a high-power soldering iron. Excessive heat may lift a conductor or damage the board.

CAUTION

Do not use a sharp metal object such as an awl or twist drill to remove solder. Sharp objects may damage the plated-through conductor.

c. Use a suction device (table 4-1) or wooden toothpick to remove solder from component mounting holes.

d. After soldering, remove excess flux from the solder areas and apply a protective coating to prevent contamination and corrosion.

Table 4-1. Printed-Circuit Assembly Repair Equipment

ITEM	USE	DESCRIPTION	RECOMMENDED MODEL
Soldering Tool	Soldering and unsoldering	Wattage rating: 47-1/2 to 56-1/2W Tip Temp: 850°to 900°F	Ungar #776 Handle with Ungar #4037 Heating Unit*
Soldering Tip*	Soldering and unsoldering	Shape: pointed	Ungar #PL111*
Suction Device	Removes molten solder from connection		Soldapullt by Edsyn Co., Arleta, California
Resin (Flux) Solvent	Removes excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Aceton Lacquer Thinner Isopropyl Alcohol (100% dry)
Solder	Component replacement, printed-circuit board repair, and wiring connections	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective Coating	Contamination and corrosion protection	Good electrical insulation, corrosion-prevention properties	Krylon R** #1302 Humiseal Protective Coating, Type 1B12 by Columbia Technical Corp., Woodside 77, New York

*For working on etched boards; for general purpose work, use Ungar #1237 Heating Unit (37.5W, tip temp of 750° to 800°F) and Ungar #PL113 1/8-inch chisel tip.

**Kryton, Inc., Norristown, Pennsylvania

4-5. The following procedures are recommended when component replacement is necessary.

a. Remove defective component from board.

b. If component was unsoldered, remove solder from mounting holes with a suction device (table 4-1) or a wooden toothpick.

c. Shape the leads of replacement component to match mounting hole spacing.

d. Insert component leads into mounting holes and position component as original was positioned. Do not force leads into mounting holes; sharp lead ends may damage plated-through conductor.

Note

Although not recommended when both sides of the PCA are accessible, axial lead components such as resistors and tubular capacitors can be replaced without soldering. Clip ends of defective component near body. Straighten leads left in board. Wrap leads of replacement component one turn around original leads. Solder wrapped connection and clip off excess leads.

4-6. REPLACEMENT.

4-7. The 7970B/7970C is of modular design. All major transport assemblies are easily accessible for repair or replacement. The following paragraphs describe replacement of critical transport assemblies. Refer to section VI for detailed views of mechanical assemblies.

4-8. TAPE ROLLER AND BEARING ASSEMBLY.

4-9. The tape rollers are precision referenced to a step on the mounting shaft. The bearings are very critical to preloading. When replacing the tape roller and bearing assemblies refer to section V for adjustment procedures to properly preload the bearings.

4-10. CAPSTAN (10 - 37.5 IPS UNITS ONLY).

4-11. The capstan replacement requires that the capstan motor assembly be removed from the transport. The position of the capstan is referenced to the mounting surface of the capstan motor assembly. The following procedures describe capstan replacement.

a. Disconnect capstan motor and tachometer connectors from capstan servo printed-circuit assembly.

b. Remove four socket-head screws securing the capstan motor assembly to the transport casting.

c. Loosen two socket-head set-screws holding the capstan to the motor shaft and remove capstan.

d. Place the capstan on the motor shaft and using a scale with 1/64-inch graduations, position the front edge (top) of the capstan 1-1/32 (±1/64) inch from the motor mounting surface. (See figure 4-1.)

e. Tighten capstan set-screws and reinstall capstan motor assembly.

f. Reconnect capstan motor and tachometer connectors to capstan servo printed-circuit assembly.

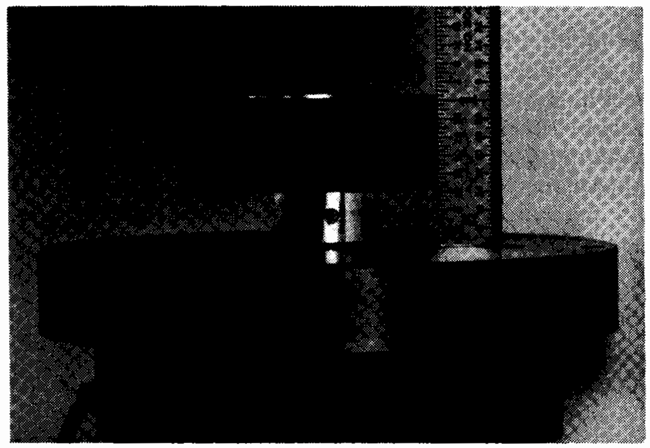


Figure 4-1. Capstan Position

4-12. CAPSTAN (37.6 - 45 IPS UNITS ONLY).

4-13. The capstan replacement for 37.6 - 45 ips units is the same as the 10 - 37.5 ips units except that a single screw secures the capstan to the motor shaft. The capstan position on the shaft is not adjustable.

4-14. REEL HOLDDOWN ASSEMBLY.

4-15. The replacement of the reel holddown assembly is not critical; however, an adjustment of the reel retaining knob must be made to ensure that the tape reel mounts firmly and does not slip. Refer to section V for a description of the reel retaining knob adjustment.

4-16. TENSION ARM ASSEMBLY.

4-17. The replacement of the tension arm assembly is not critical; however, the tape rollers are critical to preloading. The following procedures describe replacing the tension arm assembly.

a. Disconnect the tension arm photosense connector from the reel servo assembly.

b. Using retaining ring pliers, remove outer retaining ring holding tape roller to tension arm. (See figure 6-6.)

c. Note the positions of the shims and washers and remove the shims, washers, and tape roller from tension arm shaft.

d. Remove the tension arm spring.

e. Remove the three screws and washers that secure the tension arm to the transport casting.

f. Mount the new tension arm assembly and reassemble in reverse order of disassembly.

g. Perform adjustment procedures described in section V.

4-18. PHOTOSENSE ASSEMBLY.

4-19. The photosense assembly (EOT/BOT) position relative to the tape path is critical. The following procedures describe replacing the EOT/BOT photosense assembly.

a. Loosen (do not remove) the two screws that secure the photosense assembly to the transport housing.

b. Remove the photosense assembly from the housing.

c. Note the color-coding of the wires attached to the photosense assembly and remove the wires.

d. Strip and solder the wires to the new photosense assembly in the same positions noted in step "c."

e. Inspect the photosense insulator remaining on the transport. If the insulator is damaged, remove and replace with a new insulator (HP part number 07970-01176).

f. Place the new photosense assembly into position and tighten the screws just enough to allow the position of the photosense assembly to be shifted.

g. Thread a reel of tape on the transport and position the photosense assembly 1/8-inch from the tape. Ensure that the face of the assembly is parallel to the tape path.

h. Tighten the photosense mounting screws.

4-20. MAGNETIC HEAD ASSEMBLY.

4-21. The magnetic head assembly contains all critical tape path components. Use extreme care in handling the assembly. The following procedures describe replacing the magnetic head assembly.

a. Disconnect the magnetic head assembly connectors from the read preamplifier assembly and write interconnect assembly (units equipped with write data modules).

b. Remove the two screws that secure the read preamplifier assembly to the transport casting.

c. Position the read preamplifier assembly to allow access to the magnetic head assembly.

d. Remove the three hex-head screws that secure the magnetic head assembly to the transport casting.

e. Carefully remove the magnetic head assembly.

CAUTION

The magnetic head assembly contains all critical tape path elements. Do not allow the guides, cleaner, or head assemblies to contact the transport casting. Use extreme care in positioning the magnetic head assembly as not to scratch the head surface or misalign the tape path elements.

f. Carefully place the new head assembly into position and secure it to the transport casting with mounting hardware.

g. Replace the read preamplifier assembly and reconnect the magnetic head assembly connectors.

4-22. REEL SERVO PRINTED-CIRCUIT ASSEMBLY.

4-23. The reel servo printed-circuit assembly replacement is not critical; however, the mounting bracket of the assembly also serves as a heatsink. Prior to installing a new or repaired reel servo printed-circuit assembly, ensure that the transport mounting surface and the assembly mounting surface are well coated with a thermal-compound.

4-24. CAPSTAN SERVO PRINTED-CIRCUIT ASSEMBLY.

4-25. The capstan servo printed-circuit assembly replacement is not critical; however, the assembly contains a strapping network in the form of a dummy DIP connector. The position of this connector on the assembly is very critical. If the unit is operated with the connector removed or in the wrong position, damage to the unit may result. Refer to figure 7-10, Capstan Servo Assembly Schematic Diagram to determine correct position of the connector.

4-26. The mounting bracket of the capstan servo printed-circuit assembly also serves as a heatsink. Prior to installing a new or repaired capstan servo assembly, ensure that the transport mounting surface and the assembly mounting surface are well coated with a thermal compound.

SECTION V

ADJUSTMENT PROCEDURES

5-1. INTRODUCTION.

5-2. This section provides adjustment procedures for the tape transport of the HP 7970B/7970C Digital Magnetic Tape Units. The adjustment procedures consist of mechanical adjustments, power supply adjustments, capstan servo adjustments, and reel servo adjustments.

5-3. TEST EQUIPMENT REQUIRED.

5-4. The following test equipment or equipment with equivalent capacity is required to perform the adjustments.

a. A means of dynamically operating the tape unit at drive rates specified in the procedure. The HP 13191A Control and Status Test Board is available as a service accessory and will meet the needs for all adjustments. Computer operation is also suitable.

b. HP 140A Oscilloscope.

c. HP 1421A Time Base and Delay Generator (for HP 140A).

d. HP 1402A Dual-Trace Amplifier (for HP 140A).

e. HP 5245L Counter.

f. HP 5265A Digital Voltmeter Plug-In (for HP 5245L).

5-5. In addition to the listed test equipment, Transport Test Tape HP part number 5080-4525 is required.

5-6. MECHANICAL ADJUSTMENTS.

5-7. Transport mechanical adjustments consists of tape roller, reel servo arm, write enable switch, and reel retaining knob adjustments.

5-8. TAPE ROLLER.

5-9. All tape rollers are precision referenced to the step in the shaft on which they are mounted. Under no circumstances should any adjusting shims be placed between the inner bearing and this step. Shimming is done at the outer end of the roller. Assembly should consist of one shim next to the bearing, then the preload washer, followed by shims to remove all end play. Proper preload will exist when there is one shim beyond the number required to just remove the end play. Shim thickness is 0.005 inch, nominal.

5-10. Tape roller loading is critical. Tape roller loading must be performed whenever the tape roller is dismantled or repaired. The exploded tape roller assembly is illustrated in figure 5-1. To obtain the proper tape roller loading, proceed as follows:

a. Assure that brass nut (figure 5-1, 8) is torqued to 5 inch-pounds.

b. Install assembly components as indicated in figure 5-1. Use Retaining Ring Pliers (Waldes 18-23; Industrial Retaining Ring Corp P100; or equivalent). Avoid distorting retaining ring.

c. Check tape roller bearing assembly (6) end-play. Add/remove flat washers (3 or 2) until end-play is just removed.

d. Spin bearing assembly and check for drag. The tape roller must spin freely. If the tape roller does not spin freely, loading is excessive; recheck end-play clearance.

5-11. TENSION ARM.

5-12. The tension arm adjustments consist of properly positioning the photosense assembly relative to the photosense mask and positioning the limit switches relative to the tension arm.

5-13. TENSION ARM PHOTOSENSE. This adjustment is critical. Adjust as required to assure that the tension arm photosense mask does not touch the photosense lamp and cell assembly. There should be a nominal clearance of 0.010 inch minimum between the cell and the outer side of the mask.

5-14. TENSION ARM LIMIT SWITCHES. The limit switch mounting bracket pivots on the screw that mounts the tension arm rubber stop. The hole for the adjacent screw is elongated to provide limit switch positioning adjustment; this screw locks the mounting bracket in position after completion of the adjustment. Mounting holes for the microswitch are also elongated, providing slight additional limit switch adjustment movement. To position the limit switch, rotate the bracket and/or adjust height position to achieve the following conditions:

a. When arm is fully against bumper, the roller on the microswitch should be approximately at the high point of the arm diameter without being over center.

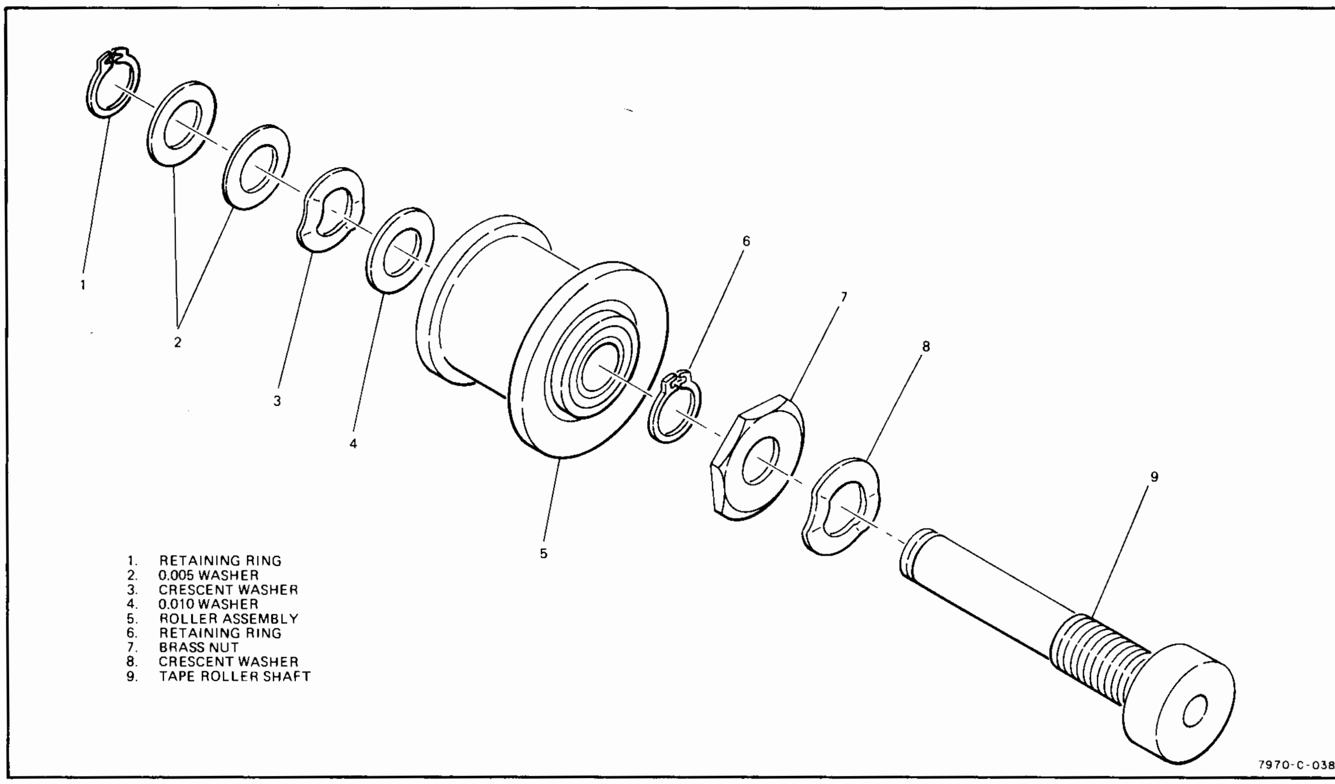


Figure 5-1. Tape Roller and Bearing Assembly, Exploded View

b. When the arm is within 1/8 inch of the bumper stop, the microswitch must operate. Also there must be further positive movement of the switch arm between the point at which the switch closes and the tension arm is in full stopped condition against the rubber bumper.

c. Verify that all screws are tight prior to final confirmation of "a" and "b." Repeat adjustment for all three limit switches. If background noise permits, switch operation can be checked audibly; otherwise connect a suitable ohmmeter across the switch terminals. If ohmmeter is used, verify that power is not applied to the tape unit.

5-15. WRITE ENABLE SWITCH.

5-16. The write enable switch must be positioned to assure clearance when operated with a reel that does not have the write enable ring installed (reel is file protected) and to assure both retraction and operating clearance when used with a reel that has the write enable ring installed. These conditions will be established when the proper dimensional relationships exist between the write enable sensing finger and the outer face of the reel turntable. To obtain these required dimensional relationships, perform the adjustment procedure in the order indicated. (See figure 5-2.)

a. Loosen switch S1 mounting screws.

b. Manually place the sensing finger even with the edge of the turntable. With power removed, adjust the position S1 until an audible click indicates that switch S1 is closed.

c. Tighten switch S1 mounting screws.

d. Apply power and manually place the sensing finger even with the turntable. Verify that the solenoid energizes and completely retracts the sensing finger.

e. Adjust the reel turntable flange diameter clearance as follows:

(1) Loosen write enable assembly mounting screws.

(2) Position the write enable assembly so that the sensing finger will clear the reel flange diameter throughout solenoid travel.

(3) Tighten write enable assembly mounting screws.

5-17. REEL RETAINING KNOB.

5-18. This adjustment is made during manufacture but may require some correction during the life of the tape unit.

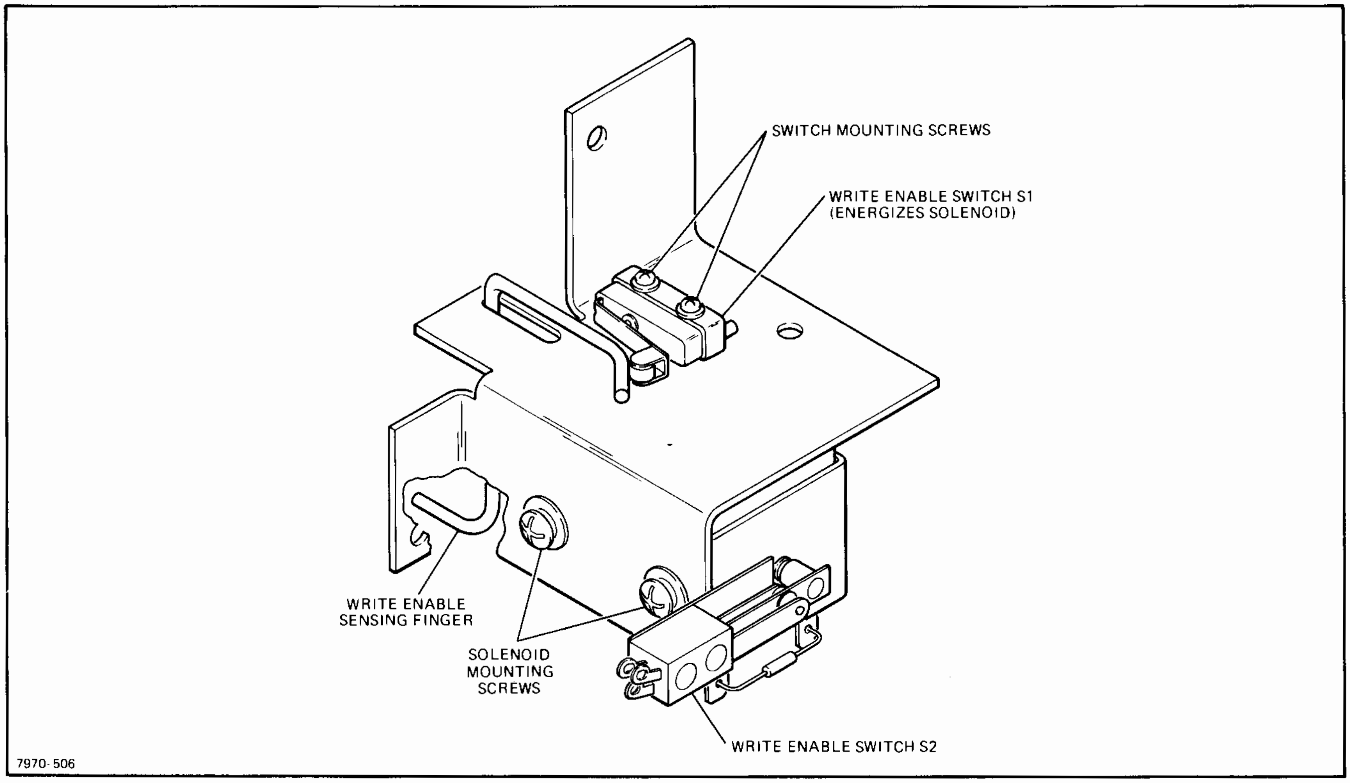


Figure 5-2. Write Enable Assembly

When the locking lever is working properly, it should be possible to place the reel over the rubber with a minimum of interference. When the locking lever is closed, positive resistance should be encountered as the rubber is compressed. In the locked position, it should not be possible to move the reel by hand. If slippage is suspected, place a piece of masking tape on the reel, another on the hub. A mark placed in alignment on both pieces of tape should not become misaligned by more than 1/8 inch in 16 hours of operation. To correct tape reel slippage, release locking lever and loosen the pozidrive screw, rotate the reel retainer knob clockwise, and tighten screw. Repeat until tape reel mounts firmly and does not slip.

5-19. ELECTRICAL ADJUSTMENTS.

5-20. The electrical adjustments of the tape unit are very critical and must be performed in the following sequence:

a. Power supply adjustments.

b. Capstan motor offset current adjustment.

c. Capstan servo forward and reverse drive speed adjustments.

d. Capstan servo high-speed forward adjustment.

e. Capstan servo high-speed reverse adjustment.

f. Capstan servo ramp slope adjustment.

g. Reel servo adjustments.

5-21. POWER SUPPLY ADJUSTMENTS.

5-22. Only one adjustment is provided for the three regulated supplies. The adjustment control is located in the circuitry for the +12 volt supply but is adjusted to establish the value of the +5 volt supply, which is held to a tighter operating tolerance. The value of the +12 and -12 volt supplies is established by a precision resistor network. The control is located on the power regulator printed-circuit assembly. Voltage is correctly adjusted when the following conditions are met:

a. +5 ± 0.050 Vdc. (Adjust to ±0.010 Vdc when adjustment is required.)

b. +12 ± 0.360 Vdc.

c. -12 ± 0.360 Vdc.

Note

Final reel servo adjustments must be made after the capstan servo adjustments. The capstan speed must be within tolerance in order to properly adjust the reel servo. However, tension must be maintained in order to make the capstan servo adjustments. If the tape unit does not maintain tension, perform the reel servo adjustments initially, complete the capstan servo adjustments, and repeat the reel servo adjustments.

5-23. CAPSTAN MOTOR OFFSET CURRENT ADJUSTMENT.

5-24. Prior to making the capstan motor offset current adjustment, verify that the power supply voltages have been adjusted. Figure 5-3 shows the location of the capstan motor offset adjustment variable resistor.

5-25. Connect a suitable dc voltmeter (capable of resolution to ±5 mv dc) across a 3-ohm resistor (R21 or R22) connected in series with the capstan motor. The common side of the resistance is associated with pin 2 of CJ1 and the high or motor side is associated with pin 2 of CJ2.

5-26. Load the tape transport and be sure tape is stopped. Adjust OFFSET control until voltmeter reading is minimum. An acceptable minimum is any value which is between +0.100 Vdc and -0.100 Vdc. Typical adjustment at room ambient temperature (25°C) will be in the order of ±0.080 Vdc.

5-27. CAPSTAN SERVO FORWARD AND REVERSE DRIVE SPEED ADJUSTMENTS.

5-28. Prior to performing the servo forward and reverse drive speed adjustment, ensure that power supply voltages

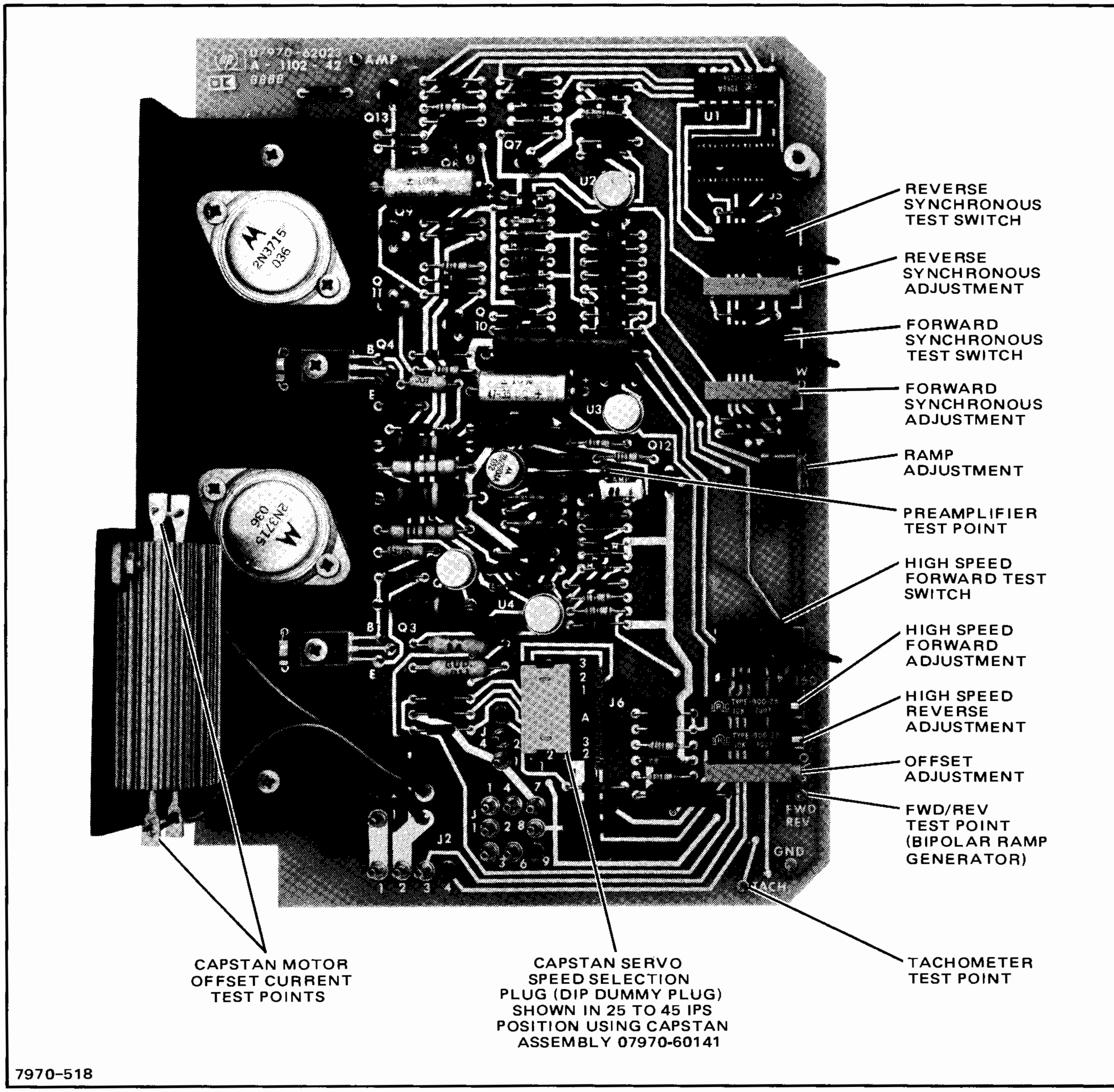


Figure 5-3. Capstan Servo PC Assembly, Test Points and Adjustments

and offset current are within tolerance. Figure 5-3 shows the location of service switches and forward and reverse drive adjustment potentiometers.

5-29. Accurate adjustment is based on reading (into a counter) data bits that have been recorded with high average accuracy. The 5080-4525 Test Tape has bit-to-bit accuracy of better than 0.1 percent when measured over 2000 bits or more. In using this tape, it is important to recognize that there are two data bits for each cycle counted when the counter is connected to the preamplifier analog output signal, and also that the frequency at other than the specified tape speeds may be calculated on a direct ratio basis. The signal used for the following adjustments appears in preamplifier channel 3 of nine-track units and preamplifier channel 6 of seven-track units. The test tape provides a signal of 10,000 Hz at a tape speed of 30 ips and has a bit-to-bit distance of 0.0015 inch.

a. Load test tape and place unit in forward drive mode using FWD service switch (S2).

b. Adjust the FWD synchronous control (R34) until counter indication is correct for the tape speed involved. The values for speeds of 25 ips and 37.5 ips will follow. Values for other speeds may be readily calculated by direct ratio to speed and application of the percentage tolerances indicated.

c. For 25 ips speeds, the counter indication should be 8,333 ± 16 Hz when adjustment is completed. No adjustment is necessary as long as counter indication is within ±65 Hz.

d. For 37.5 ips speeds, the counter indication should be 12,500 ± 25 Hz. No adjustment is necessary if reading is within ±100 Hz.

e. Repeat steps "a" and "b" with unit in reverse drive mode.

5-30. CAPSTAN SERVO HIGH-SPEED FORWARD ADJUSTMENT.

5-31. The high-speed forward adjustment principles and requirements are the same as the forward and reverse drive adjustment. Ensure that all previous adjustments are within tolerance.

a. Load the test tape on the transport and connect a counter to the appropriate channel preamplifier output.

b. Place unit in high-speed forward mode with the high-speed forward (+160) service switch (figure 5-3), and use the high-speed forward (+160) adjustment (R53) to adjust speed until counter indicates 53,333 ± 100 Hz. No adjustment is required if counter indicates between 52,533 and 54,133.

Note

If high-speed forward is required for seven-track tape units equipped with parity options and having normal drive speeds less than 15 ips, high-speed mode must not exceed a factor of 12 times the normal drive speed.

5-32. CAPSTAN SERVO HIGH-SPEED REVERSE ADJUSTMENT.

5-33. The high-speed reverse adjustment is identical to the high-speed forward adjustment, except that the local REWIND control is used to place the unit in the high-speed reverse mode and the high-speed reverse (-160) adjustment variable resistor (R60, figure 5-3) is used.

5-34. CAPSTAN SERVO RAMP SLOPE ADJUSTMENT.

5-35. The ramp slope adjustment determines the start and stop distances for both forward and reverse drive modes. The following procedure describes how to adjust the slope of the bi-polar ramp generator on the capstan servo PC assembly. This adjustment sets the start distance to 0.1875 inch. The top of the ramp is rounded, therefore, the 90% point of the voltage waveform is used. (See figure 5-4.)

a. Operate the tape unit in a forward-stop-forward mode.

b. Connect an oscilloscope to the FWD/REV test point on the capstan servo PC assembly. Sync the oscilloscope with the negative going edge of the forward command. (Test point 9 of the control and status PC assembly or test point CF of the control and status test board.)

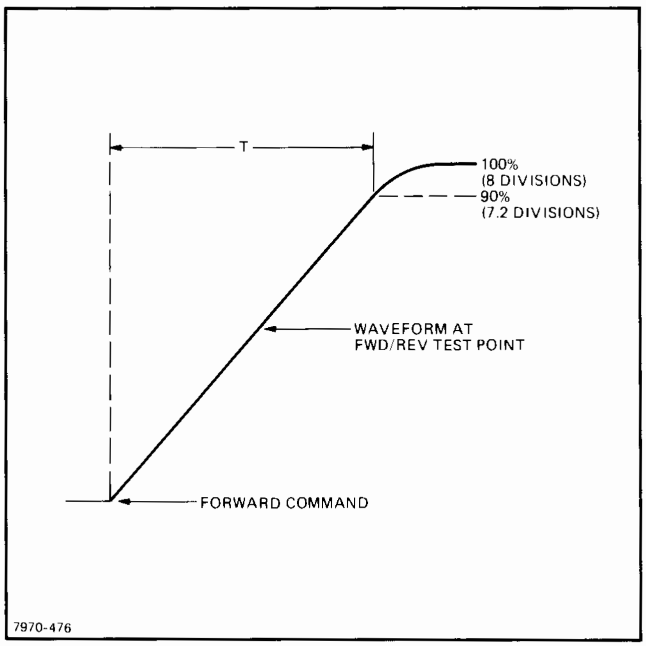


Figure 5-4. Start/Stop Ramp Time

c. Adjust the capstan servo PC assembly RAMP control (See figure 5-3.) to obtain the time listed in table 5-1 for tape unit synchronous speed. Use the vertical gain vernier control of the oscilloscope to expand the waveform so that the 90% point may be conveniently measured.

Note

On HP 180 Oscilloscopes, the vertical spacing is a special horizontal time scale at 7.2 divisions which may be used to measure the time at the 90% level.

Table 5-1. Capstan Servo Start/Stop Time

SPEED (IPS)	TIME (90%)
12.5	26.1 ms
18.75	17.1 ms
22.5	14.1 ms
25	12.6 ms
37.5	8.1 ms
45	6.6 ms

5-36. REEL SERVO ADJUSTMENTS.

5-37. Load a short length of tape onto the transport and bring to load point. The following adjustments determine the peak deflections of the tension arms. The amount of deflection desired is a function of the synchronous speed. At the highest speed (45 ips) the deflection is set so the tension arms deflect to the outer marks located on the back side of the casting, both in forward and reverse drive modes. At lower speeds the amount of deflection is smaller (i.e., at 25 ips the deflection is about half (25/45) the amount at 45 ips). Due to non-linearity of the tension arm transducer the swing of the tension arm may be unsymmetrical in the forward and reverse drive modes. (This will mean the tension arm will not be centered when there is no tape motion and is normal.) With the supply reel loaded with approximately 200 feet of tape, rotate the supply (upper) variable resistor (R106) fully clockwise and run the tape unit in the forward mode. Rotate the supply (lower) variable resistor counterclockwise for the proper deflection. Stop tape motion and put in reverse drive and make sure the amount of deflection is the same as in forward drive. If not, readjust the mask position until symmetrical swings of the proper amount are achieved. Repeat procedure for the takeup reel with approximately 200 feet of tape on the takeup reel.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section provides information for ordering replacement parts for the tape transport of the HP 7970B/7970C Digital Magnetic Tape Units.

6-3. This section contains assembly parts lists, supporting illustrations, ordering information, and a part number cross reference.

6-4. ASSEMBLY PARTS LIST.

6-5. The assembly parts list presents a breakdown of all replaceable parts of the tape transport. The information contained in the lists are under the following headings:

a. FIGURE & INDEX NO.

b. PART NUMBER.

c. DESCRIPTION.

d. UNITS PER ASSY.

6-6. FIGURE AND INDEX NUMBER.

6-7. The figure and index number column identifies the figure that illustrates each listed item and the index number that identifies the item on the illustration.

6-8. PART NUMBER.

6-9. The part number column provides the Hewlett-Packard part number for each item listed in the assembly parts list.

6-10. DESCRIPTION.

6-11. The description column describes the items within the equipment. An indented column arrangement is used to show the relationship between a part and the parts next higher assembly. The top assembly of each listing appears in indention 1. Primary subassemblies (of the top assembly) and attaching parts appear in indention 2. This method of indention is continued through indention 3, 4, etc, until all replaceable parts are listed. Attaching parts are listed immediately following the part they attach. Attaching parts are identified by the abbreviation (AP) enclosed in parenthesis at the end of the description.

6-12. Reference designation and manufacture information (if applicable) is also included in the description column.

6-13. UNITS PER ASSEMBLY.

6-14. The quantity shown in the units per assembly column reflects the total quantity of a part required by the next higher assembly of that part. This quantity is not necessarily the total used for the complete equipment. The abbreviation AR is used to indicate usage as required of a particular item. The abbreviation REF is used to indicate that the quantity of an item used per assembly is listed in the next higher assembly of the assembly parts list.

6-15. ORDERING INFORMATION.

6-16. To order replacement parts, address the order or inquiry to the local Hewlett-Packard Sales and Service Office. (Refer to the list at the end of this manual for addresses.) Specify the following information for each part ordered.

a. Identification of the unit, kit, or assembly containing the part.

b. Hewlett-Packard part number for each part.

c. Description of each part.

d. Circuit reference designation (if applicable).

6-17. PART NUMBER CROSS REFERENCE.

6-18. Table 6-1 at the end of this section provides a cross reference between Hewlett-Packard part numbers and manufacturer's part numbers.

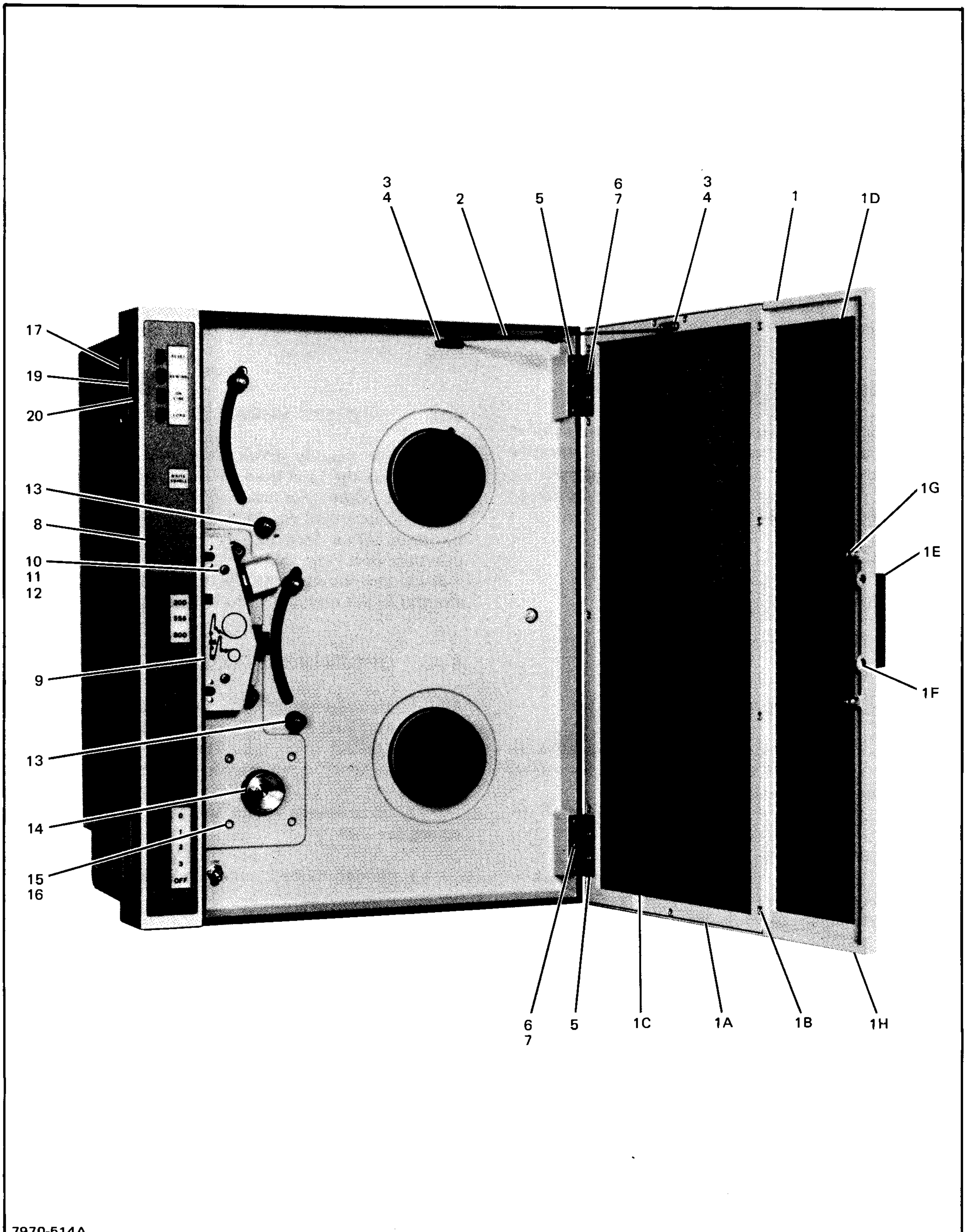


Figure 6-1. 7970B/7970C Digital Magnetic Tape Unit (Sheet 1 of 3)

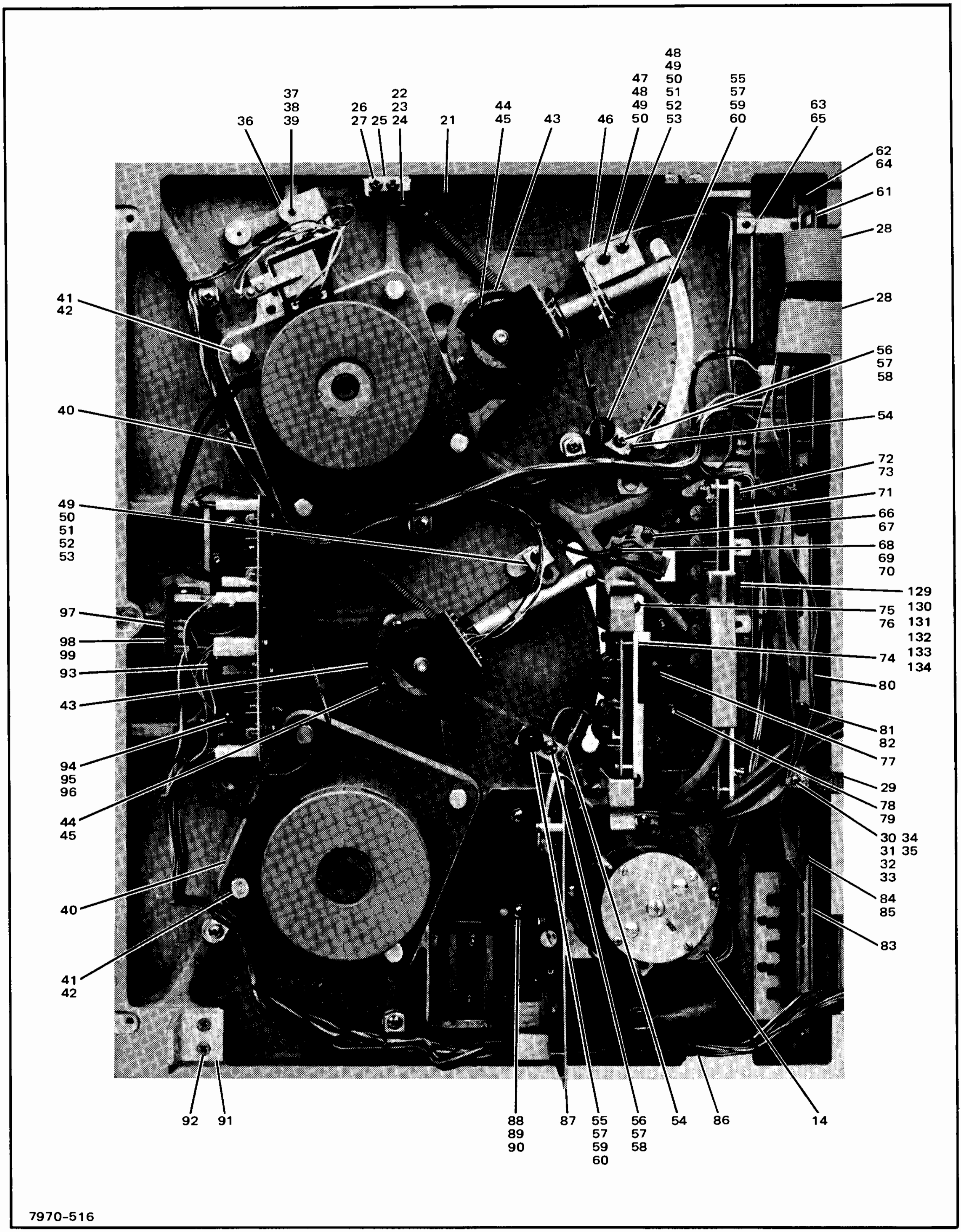


Figure 6-1. 7970B/7970C Digital Magnetic Tape Unit (Sheet 2 of 3)

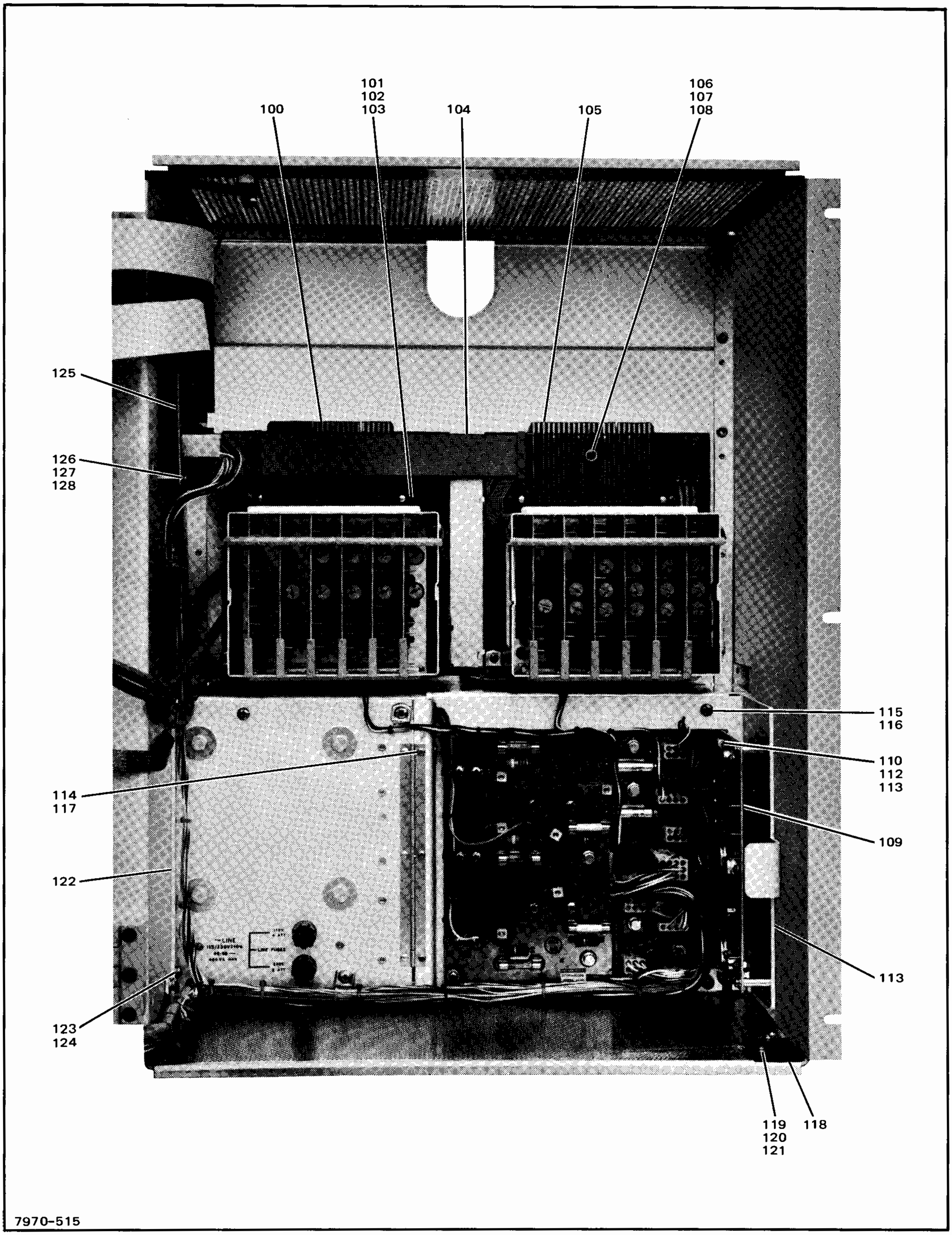


Figure 6-1. 7970B/7970C Digital Magnetic Tape Unit (Sheet 3 of 3)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-1-		7970B/7970C DIGITAL MAGNETIC TAPE UNIT	REF
-1	07970-60160	. COVER DOOR ASSEMBLY	1
-1A	07970-20830	. INSERT, cover door	1
-1B	2200-0139	. SCREW, no. 4-40, 0.25-inch, pozi (AP)	12
-1C	07970-20832	. WINDOW, cover door	1
-1D	07970-01186	. PANEL, cover door	1
-1E	07970-20831	. HANDLE, cover door	1
-1F	0624-0208	. SCREW, tapping, no. 6-32, 0.5-inch, pozi (AP)	2
-1G	0510-1107	. FASTENER, panel	2
-1H	07970-20829	. FRAME, cover door	1
-2	07970-60010	. . HINGE ASSEMBLY, door stop	1
-3	2190-0003	. . . WASHER, lock, helical (AP)	4
-4	2200-0139	. . . SCREW, no. 4-40, 0.25-inch, pozi (AP)	4
-5	07970-20480	. . HINGE, cover door	2
-6	2190-0003	. . . WASHER, lock, helical (AP)	10
-7	2200-0139	. . . SCREW, no. 4-40, 0.25-inch, pozi (AP)	10
-8	07970-01000	. PANEL, switch cover (unit address, density select, write enable equipped units only)	1
	07970-01010	. PANEL, switch cover (density select and write enable equipped units only)	1
	07970-01020	. PANEL, switch cover (unit address and write enable equipped units only)	1
	07970-01030	. PANEL, switch cover (write enable equipped units only)	1
	07970-01040	. PANEL, switch cover (unit address and density select equipped units only)	1
	07970-01050	. PANEL, switch cover (density select equipped units only)	1
	07970-01060	. PANEL, switch cover (unit select equipped units only)	1
	07970-01070	. PANEL, switch cover (basic unit only)	1
	07970-01160	. PANEL, switch cover (read/read units only)	1
-9	07970-00130	. COVER, head assembly	1
-10	3050-0065	. . WASHER, flat (AP)	2
-11	2190-0034	. . WASHER, lock, helical (AP)	2
-12	2680-0103	. . SCREW, no. 6-32, 0.5-inch, pozi (AP)	2
-13	07970-60130	. TAPE ROLLER AND BEARING ASSEMBLY (see figure 6-2 for details and attaching parts)	2
-14	07970-60140	. CAPSTAN MOTOR ASSEMBLY MG1, 10 - 37.5 ips (see figure 6-3 for details)	1
	07970-60141	. CAPSTAN MOTOR ASSEMBLY MG1, 37.6 - 45 ips (see figure 6-4 for details)	1
-15	2190-0429	. . WASHER, lock, helical (AP)	4
-16	3030-0047	. . SCREW, no. 10-32, 0.625-inch, socket head (AP)	4
-17	07970-20070	. HINGE BLOCK, mounting	2
-18	07970-01204	. . SPACER, hinge	2
-19	07970-20470	. HINGE, transport	2
-20	2680-0104	. . SCREW, no. 10-32, 0.5-inch, pozi (AP)	5
-21	07970-62106	. DOOR STOP ASSEMBLY	1
-22	2190-0034	. . WASHER, lock, helical (AP)	2
-23	2190-0420	. . WASHER, flat (AP)	2
-24	2190-0475	. . WASHER, nylon (AP)	2
-25	07970-20120	. BLOCK, door stop	1
-26	2190-0034	. . WASHER, lock, helical (AP)	2
-27	2680-0065	. . SCREW, no. 10-32, 1.25-inches, pozi (AP)	2
-28	07970-60890	. RIBBON CABLE ASSEMBLY W5	2
-29	07970-00510	. GROUND STRAP	1
-30	2190-0416	. . WASHER, flat (AP)	1
-31	0380-0013	. . SPACER (AP)	1

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-1-32	2190-0003	. . WASHER, lock, helical (AP)	1
-33	2190-0008	. . WASHER, lock, external (AP)	1
-34	07970-00610	. . GUIDE, cable (AP)	1
-35	2200-0125	. . SCREW, no. 4-40, 1.5-inches, pozi (AP)	1
-36	07970-62122	. WRITE ENABLE ASSEMBLY A10 (refer to part 4 for details)	1
-37	2190-0416	. . WASHER, flat (AP)	3
-38	2190-0003	. . WASHER, lock, helical (AP)	3
-39	2200-0125	. . SCREW, no. 4-40, 1.5-inches, pozi (AP)	3
-40	07970-60170	. REEL MOTOR ASSEMBLY B1/B2, 10 - 37.5 ips (see figure 6-5 for details)	2
	07970-60171	. REEL MOTOR ASSEMBLY B1/B2 (see figure 6-5 for details)	2
-41	2190-0432	. . WASHER, lock, helical (AP)	4
-42	0570-0082	. . SCREW, no. 5/16-18, 1-inch (AP)	4
-43	07970-60181	. TENSION ARM ASSEMBLY A3/A4 (see figure 6-6 for details)	2
-44	2190-0034	. . WASHER, lock, helical (AP)	3
-45	2680-0105	. . SCREW, no. 10-32, 0.625-inch, pozi (AP)	3
-46	07970-01190	. BRACKET, limit switch, upper	1
-47	0380-1012	. . SPACER (AP)	1
-48	2190-0420	. . WASHER, flat (AP)	2
-49	2190-0034	. . WASHER, lock, helical (AP)	2
-50	2680-0111	. . SCREW, no. 10-32, 1.0-inch, pozi (AP)	2
-51	07970-01191	. . WASHER, bumper	1
-52	4320-0256	. . EXTRUSION, rubber	1
-53	07970-20834	. . GUIDE, bumper	1
-54	07970-00120	. BRACKET, limit switch, lower	2
-55	0380-0016	. . SPACER (AP)	1
-56	3050-0002	. . WASHER, flat (AP)	1
-57	2190-0034	. . WASHER, lock, helical (AP)	2
-58	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP)	1
-59	2680-0103	. . SCREW, no. 6-32, 0.5-inch, pozi (AP)	1
-60	0403-0163	. . BUMPER, stop (AP)	1
-61	07970-62089	. CONTROL SWITCH ASSEMBLY A11 (see figure 6-7 for details)	1
-62	2190-0034	. . WASHER, lock, helical (AP)	2
-63	2190-0003	. . WASHER, lock, helical (AP)	1
-64	2680-0129	. . SCREW, no. 10-32, 0.132-inch, pozi (AP)	2
-65	2200-0143	. . SCREW, no. 4-40, 0.375-inch, pozi (AP)	1
-66	07970-61150	. PHOTOSENSE HEAD ASSEMBLY A2 (see figure 6-8 for details)	1
-67	07970-01176	. . INSULATOR, photosense	1
-68	3050-0105	. . WASHER, flat (AP)	2
-69	2190-0003	. . WASHER, lock, helical (AP)	2
-70	2200-0141	. . SCREW, no. 4-40, 0.312-inch, pozi (AP)	2
-71	07970-60500	. READ PREAMPLIFIER ASSEMBLY A15, 10 - 20.9 ips (refer to part 3)	1
	07970-62000	. READ PREAMPLIFIER ASSEMBLY A15, 21 - 45 ips (refer to part 3)	1
	07970-62001	. READ/READ PREAMPLIFIER ASSEMBLY A15, 10 - 20.9 ips (refer to part 5)	1
	07970-62012	. READ/READ PREAMPLIFIER ASSEMBLY A15, 21 - 45 ips (refer to part 5)	1
-72	2190-0034	. . WASHER, lock, helical (AP)	2
-73	2680-0103	. . SCREW, no. 6-32, 0.5-inch, pozi (AP)	2
-74	07970-60300	. WRITE INTERCONNECT ASSEMBLY A14 (refer to part 4)	1
	07970-62165	. WRITE INTERCONNECT ASSEMBLY A14 10 - 20.9 ips (refer to part 4)	1
	07970-60300	. WRITE INTERCONNECT ASSEMBLY A14 21 - 45 ips (refer to part 4)	1
-75	2190-0034	. . WASHER, lock, helical (AP)	2
-76	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP)	2

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-1-77	07970-60580	. MAGNETIC TAPE HEAD ASSEMBLY A1, 9-track, write/read, 21 - 45 ips . . . (see figure 6-9 for details)	1
	07970-60581	. MAGNETIC TAPE HEAD ASSEMBLY A1, 7-track, write/read, 21 - 45 ips . . . (see figure 6-9 for details)	1
	07970-60582	. MAGNETIC TAPE HEAD ASSEMBLY A1, 9-track, read, 21 - 45 ips . . . . (see figure 6-9 for details)	1
	07970-60583	. MAGNETIC TAPE HEAD ASSEMBLY A1, 7-track, read, 21 - 45 ips . . . . (see figure 6-9 for details)	1
	07970-60584	. MAGNETIC TAPE HEAD ASSEMBLY A1, 7-track, write/read, 10 - 20.9 ips . . (see figure 6-9 for details)	1
	07970-62031	. MAGNETIC TAPE HEAD ASSEMBLY A1, 9-track, write/read, 10 - 20.9 ips . . (see figure 6-9 for details)	1
	07970-60586	. MAGNETIC TAPE HEAD ASSEMBLY A1, 7-track, read, 10 - 20.9 ips . . . . (see figure 6-9 for details)	1
	07970-60587	. MAGNETIC TAPE HEAD ASSEMBLY A1, 9-track, read, 10 - 20.9 ips . . . . (see figure 6-9 for details)	1
	07970-60588	. MAGNETIC TAPE HEAD ASSEMBLY A1, 7/9-track, read/read, 10 - 20.9 ips . . (see figure 6-9 for details)	1
	07970-60589	. MAGNETIC TAPE HEAD ASSEMBLY A1, 7/9-track, read/read, 21 - 45 ips . . (see figure 6-9 for details)	1
-78	2190-0034	. . WASHER, lock, helical (AP)	3
-79	3030-0038	. . SCREW, no. 10-32, 0.5-inch, socket head (AP)	3
-80	07970-62087	. DENSITY SELECT SWITCH ASSEMBLY A12, read, write/read (refer to part 3) .	1
	07970-62088	. DENSITY SELECT SWITCH ASSEMBLY A12, read/read (refer to part 5) . . .	1
-81	2190-0034	. . WASHER, lock, helical (AP)	2
-82	2680-0129	. . SCREW, no. 10-32, 0.132-inch, pozi (AP)	2
-83	07970-62086	. UNIT ADDRESS SWITCH ASSEMBLY A13 (see figure 6-10 for details) . . .	1
-84	2190-0034	. . WASHER, lock, helical (AP)	2
-85	2680-0129	. . SCREW, no. 10-32, 0.132-inch, pozi (AP)	2
-86	07970-60600	. TRANSPORT HARNESS ASSEMBLY W2 (see figure 6-11 for details and . . . attaching parts)	1
-87	07970-62172	. CAPSTAN SERVO PC ASSEMBLY A9 (see figure 6-12 for details)	1
-88	2190-0034	. . WASHER, lock, helical (AP)	3
-89	2190-0312	. . WASHER, fiber (AP)	3
-90	2680-0101	. . SCREW, no. 10-32, 0.438-inch, pozi (AP)	3
-91	07970-20680	. GUIDE, lifter	1
-92	2680-0118	. . SCREW, no. 10-32, 0.5-inch, pozi (AP)	2
-93	07970-62024	. REEL SERVO PC ASSEMBLY A7 (see figure 6-13 for details)	1
-94	2190-0312	. . WASHER, fiber (AP)	3
-95	2190-0034	. . WASHER, lock, helical (AP)	3
-96	2680-0101	. . SCREW, no. 10-32, 0.438-inch, pozi (AP)	3
-97	1390-0228	. PANEL FASTENER	1
-98	2190-0034	. . WASHER, lock, helical (AP)	2
-99	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP)	2
-100	07970-60230	. WRITE ASSEMBLY A17 (refer to part 4)	1
-101	2190-0085	. . WASHER, lock, helical (AP)	5
-102	3050-0016	. . WASHER, flat (AP)	5
-103	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	5
-104	07970-60900	. RIBBON CABLE ASSEMBLY (write/read units only)	1
	07970-60890	. RIBBON CABLE ASSEMBLY (read units only)	1
-105	07970-60390	. READ ASSEMBLY A18 (refer to part 3)	1
	07970-62003	. READ/READ ASSEMBLY A18 (refer to part 5)	1
-106	2190-0085	. . WASHER, lock, helical (AP)	5
-107	3050-0016	. . WASHER, flat (AP)	5
-108	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	5

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-1-109	07970-61010	. POWER REGULATOR PC ASSEMBLY A21 (see figure 6-14 for details)	1
-110	3050-0227	. . WASHER, flat (AP)	2
-111	2190-0085	. . WASHER, lock, helical (AP)	2
-112	2200-0141	. . SCREW, no. 4-40, 0.312-inch, pozi (AP)	2
-113	07970-61051	. POWER DISTRIBUTION ASSEMBLY A20 (see figure 6-15 for details)	1
-114	2190-0034	. . WASHER, lock, helical (AP)	2
-115	2190-0004	. . WASHER, lock, helical (AP)	3
-116	2680-0129	. . SCREW, no. 10-32, 0.132-inch, pozi (AP)	2
-117	2200-0141	. . SCREW, no. 4-40, 0.312-inch, pozi (AP)	3
-118	07970-00561	. PAD, lifter, nylon	1
-119	2190-0416	. . WASHER, flat (AP)	2
-120	2190-0004	. . WASHER, lock, helical (AP)	2
-121	2200-0141	. . SCREW, no. 4-40, 0.312-inch, pozi (AP)	2
-122	07970-60471	. TRANSFORMER ASSEMBLY A19 (see figure 6-16 for details)	1
-123	2190-0034	. . WASHER, lock, helical (AP)	9
-124	2680-0129	. . SCREW, no. 10-32, 0.132-inch, pozi (AP)	9
-125	07970-61080	. CONTROL AND STATUS PC ASSEMBLY A16 (see figure 6-17 for details) . .	1
-126	3050-0016	. . WASHER, flat (AP)	4
-127	2190-0085	. . WASHER, lock, helical (AP)	4
-128	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	4
-129	07970-61030	. COVER DOOR INTERLOCK SWITCH ASSEMBLY	1
-130	3101-0877	. . SWITCH	1
-131	2680-0129	. . SCREW, machine, no. 10-32, 3/16 inch	2
-132	2190-0034	. . LOCKWASHER, no. 10.	2
-133	3050-0002	. . WASHER, plain, no. 10.	2
-134	07970-00200	. BRACKET, mounting	1

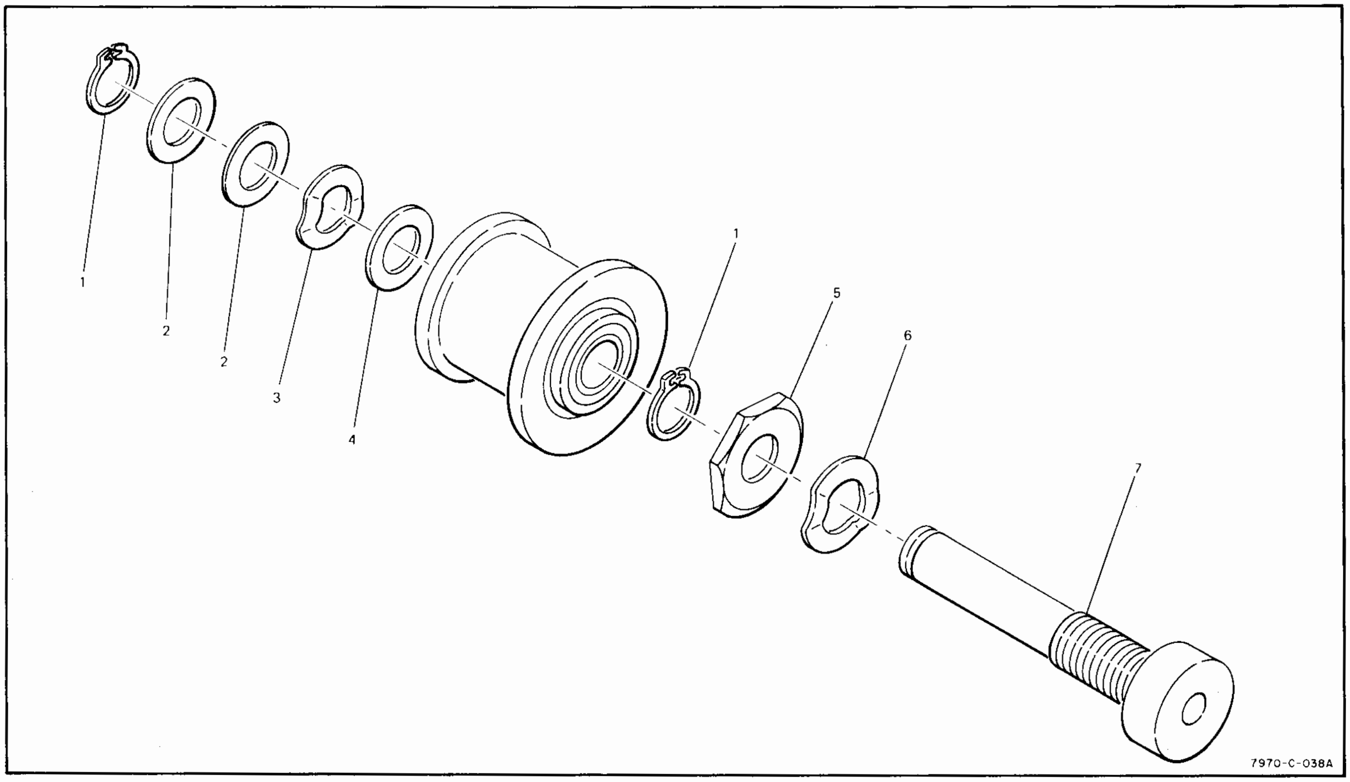
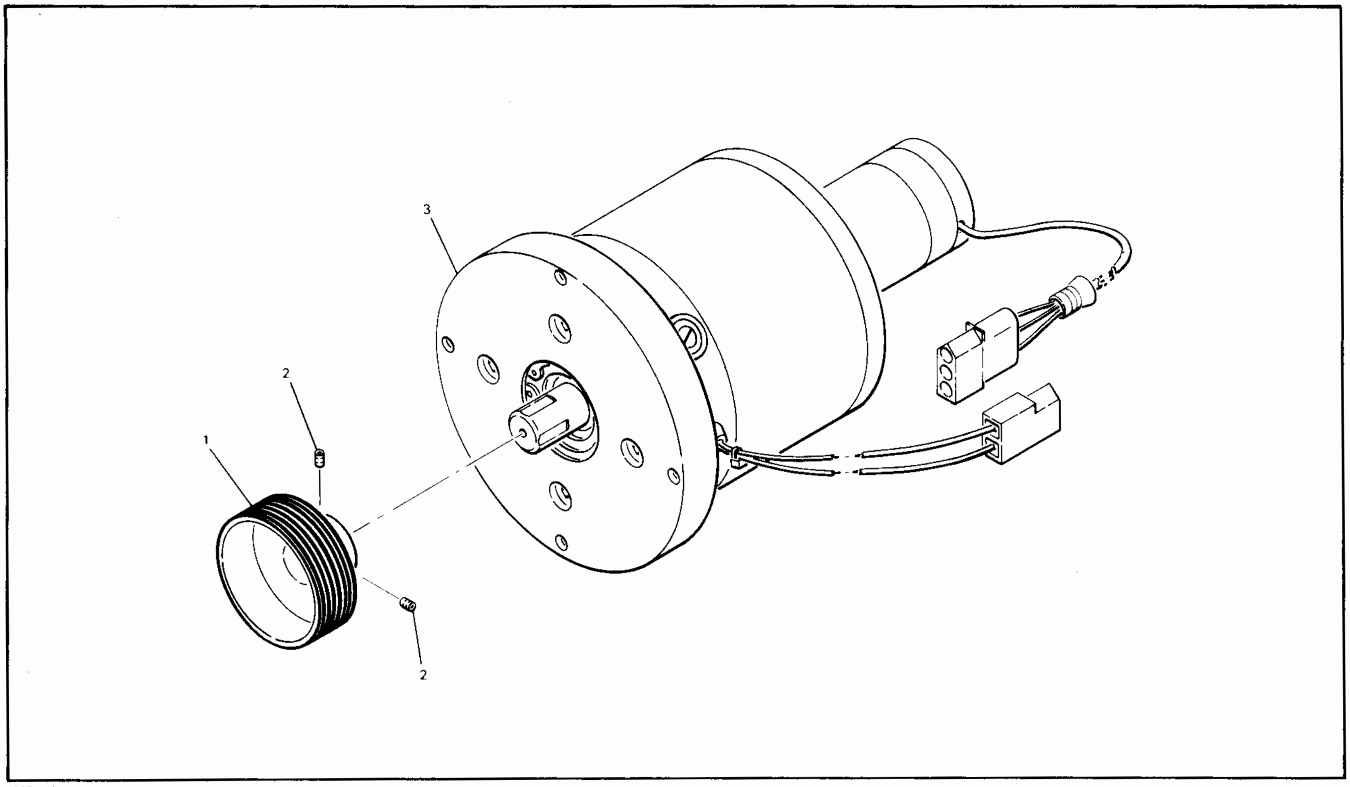


Figure 6-2. Tape Roller and Bearing Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-2-	07970-60130	TAPE ROLLER AND BEARING ASSEMBLY	REF
-1	0510-0238	. RING, retaining (AP)	2
-2	2190-0181	. WASHER, flat, 0.005-inch (AP)	AR
-3	3050-0253	. WASHER, crescent (AP)	1
-4	3050-0032	. WASHER, shim, 0.010-inch (AP)	1
-5	2950-0036	. NUT, no. 25-38, 0.4375-inch (AP)	1
-6	3050-0424	. WASHER, crescent (AP)	1
-7	07970-20460	. SHAFT, tape roller	REF



2225-110

Figure 6-3. Capstan Motor Assembly MG1, 10 - 37.5 ips

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-3-	07970-60140	CAPSTAN MOTOR ASSEMBLY MG1, 10 - 37.5 ips	REF
-1	07970-20390	. CAPSTAN	1
-2	3030-0329	. . SETSCREW, no. 4-40, 0.125-inch, stl (AP)	2
-3	3140-0705	. CAPSTAN MOTOR SUBASSEMBLY	1

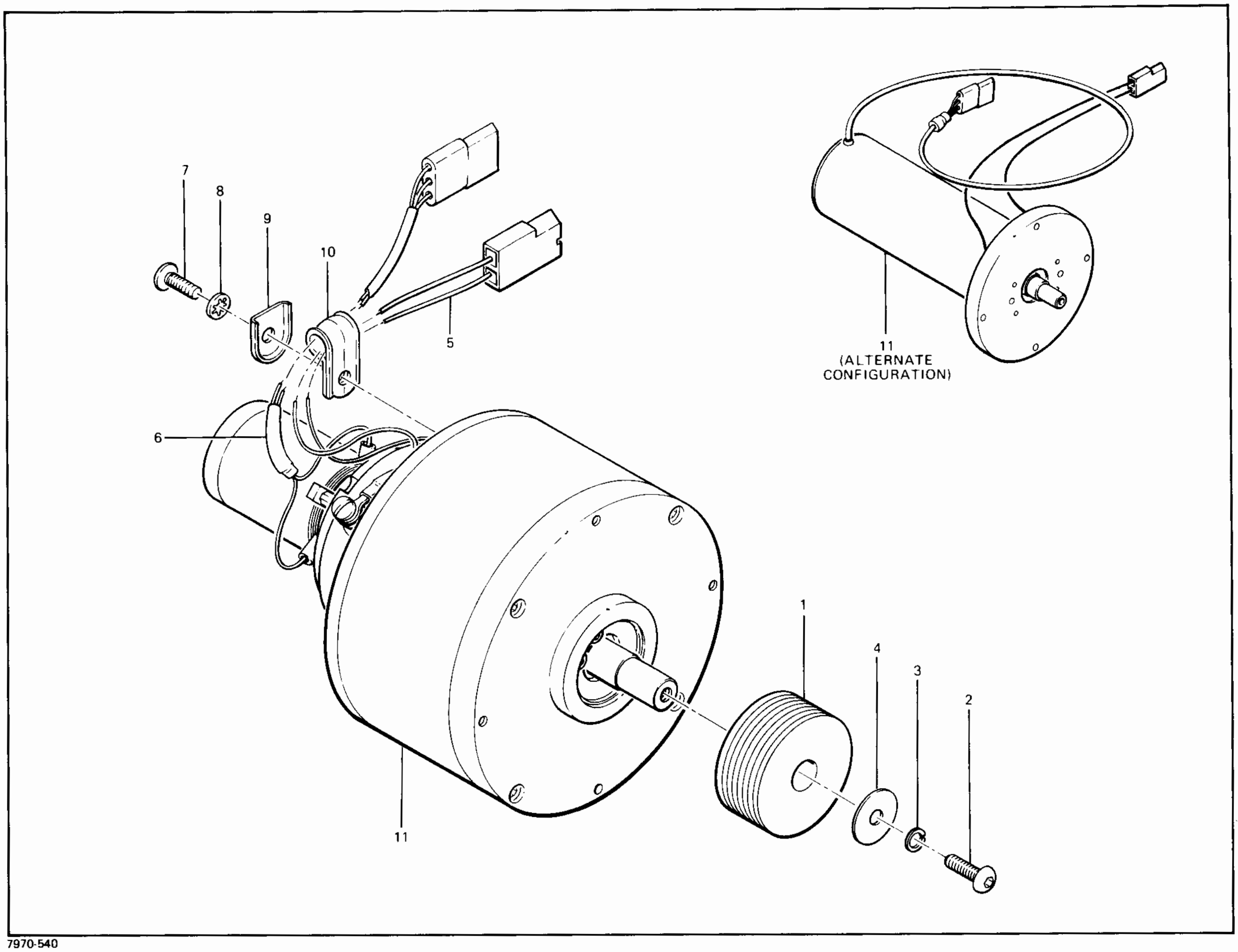


Figure 6-4. Capstan Motor Assembly MG1, 37.6 - 45 ips

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-4-	07970-60141	CAPSTAN MOTOR ASSEMBLY MG1, 37.6 - 45 ips	REF
-1	07970-20391	. CAPSTAN	1
-2	3030-0425	. . SCREW, no. 10-32, 0.5-inch, socket head	1
-3	2190-0483	. . WASHER, lock	1
-4	3050-0232	. . WASHER, flat	1
-5	07970-62160	. LEAD ASSEMBLY, capstan motor	1
-6	07970-62161	. CABLE ASSEMBLY, capstan motor	1
-7	2360-0201	. . SCREW, no. 6-32, 6.5-inch (AP)	1
-8	2190-0007	. . WASHER, lock (AP)	1
-9	2190-0452	. . WASHER, clamp (AP)	1
-10	1400-0292	. . CLAMP, cable	1
-11	3140-0748	. CAPSTAN MOTOR ASSEMBLY	1

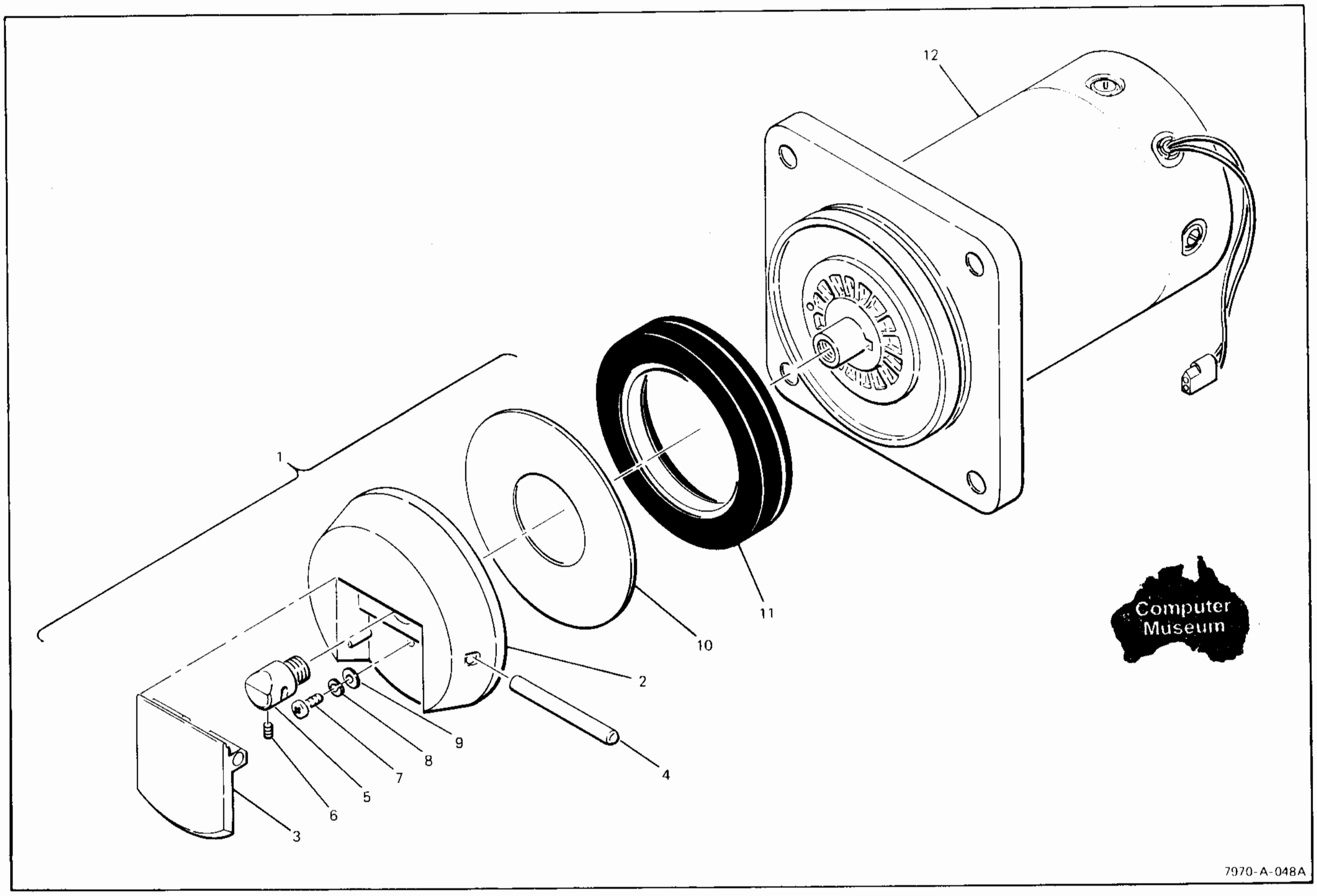


Figure 6-5. Reel Motor Assembly B1/B2

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-5-	07970-60170	REEL MOTOR ASSEMBLY B1/B2, 10 - 37.5 ips	REF
	07970-60171	REEL MOTOR ASSEMBLY B1/B2, 37.6 - 45 ips	REF
-1	07970-61040	. REEL HOLDDOWN ASSEMBLY	1
-2	07970-40070	. . BODY, holddown	1
-3	07970-40090	. . HANDLE, holddown	1
-4	07970-20440	. . PIN, holddown	1
-5	07970-20700	. . STUD, holddown	1
-6	3030-0196	. . SETSCREW, no. 4-40, 0.188-inch, socket head (AP)	1
-7	2200-0153	. . SCREW, no. 4-40, 0.875-inch, pozi (AP)	1
-8	2190-0003	. . WASHER, lock, helical (AP)	1
-9	3050-0105	. . WASHER, brass (AP)	1
-10	3050-0729	. . WASHER, flat (AP)	1
-11	07970-40080	. RING, reel retaining	1
-12	07970-62267	. REEL MOTOR SUBASSEMBLY (used on 07970-60170)	1
	07970-62266	. REEL MOTOR SUBASSEMBLY (used on 07970-60171)	1

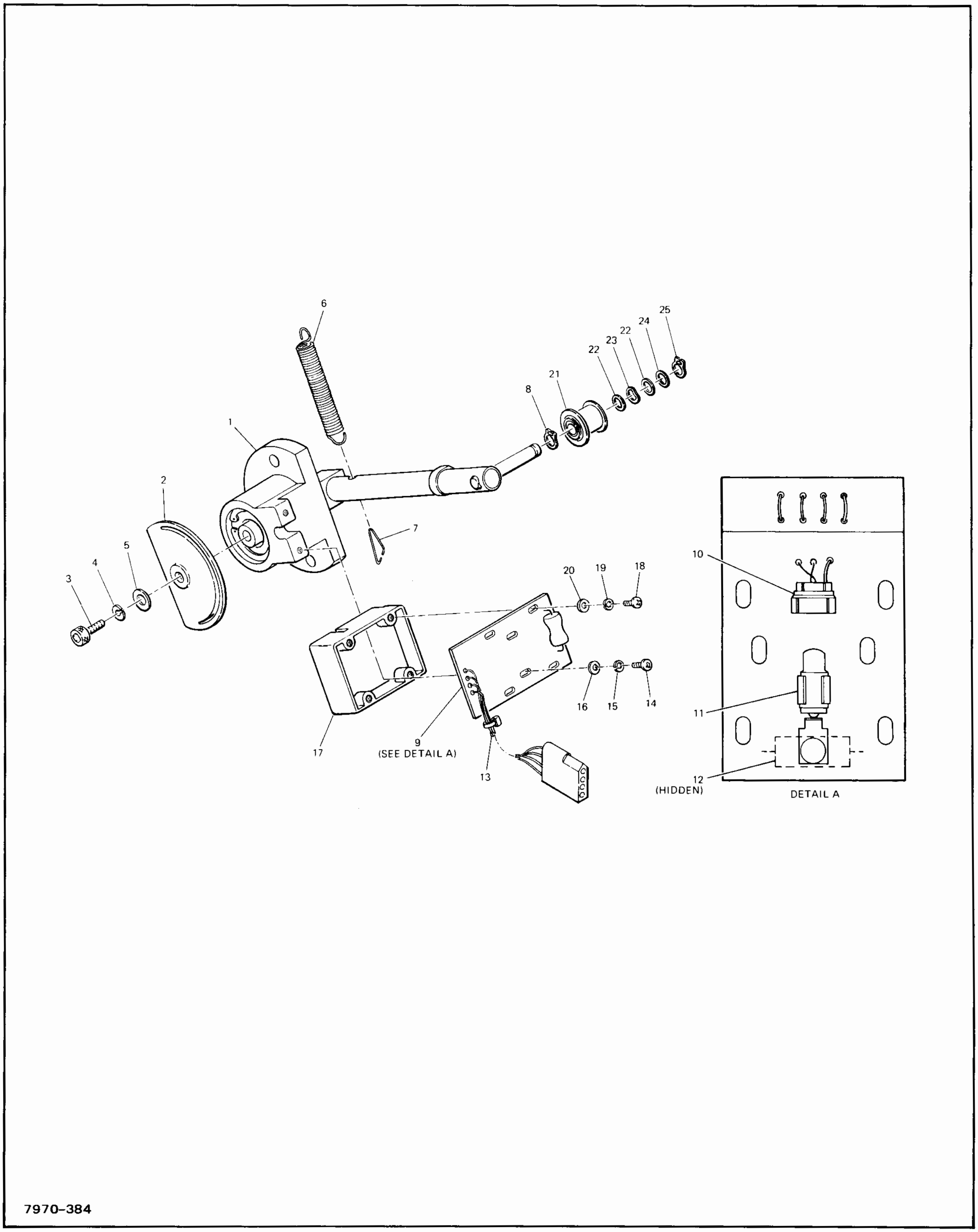


Figure 6-6. Tension Arm Assembly A3/A4

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-6-	07970-60181	TENSION ARM ASSEMBLY A3/A4	REF
-1	07970-62108	. TENSION ARM SUBASSEMBLY	1
-2	07970-00380	. PHOTOCELL SHADE	1
-3	3030-0038	. . SCREW, no. 10-32, 0.500-inch, socket head (AP)	1
-4	2190-0034	. . WASHER, lock, helical (AP)	1
-5	3050-0002	. . WASHER, flat (AP)	1
-6	1460-1181	. SPRING, extension	1
-7	1460-1250	. SPRING, tension arm	1
-8	0510-0238	. RING, retaining	1
-9	07970-60481	. TENSION ARM PC ASSEMBLY A1	1
-10	1990-0307	. . PHOTOCONDUCTOR, dual, cadmium sulfide (Q1)	1
-11	2140-0351	. . LAMP, incandescent, 6V, 2A (DS1)	1
-12	0698-3620	. . RESISTOR, fxd, 100 ohms, 5%, 2W (R1)	1
-13	07970-60870	. . WIRING HARNESS, tension arm (W1)	1
-14	2200-0141	. . SCREW, no. 4-40, 0.312-inch, pozi (AP)	2
-15	2190-0005	. . WASHER, lock (AP)	2
-16	3050-0105	. . WASHER, flat (AP)	2
-17	07970-40203	. . HOOD, tension arm	1
-18	2200-0141	. . . SCREW, no. 4-40, 0.312-inch, pozi (AP)	4
-19	2190-0005	. . . WASHER, lock, helical (AP)	4
-20	3050-0105	. . . WASHER, flat (AP)	4
-21	07970-60130	. ROLLER ASSEMBLY, tension arm	1
-22	3050-0032	. . WASHER, brass (AP)	2
-23	3050-0253	. . WASHER, crescent	1
-24	2190-0181	. . WASHER, flat (AP)	1
-25	0510-0238	. . RING, retaining (AP)	1

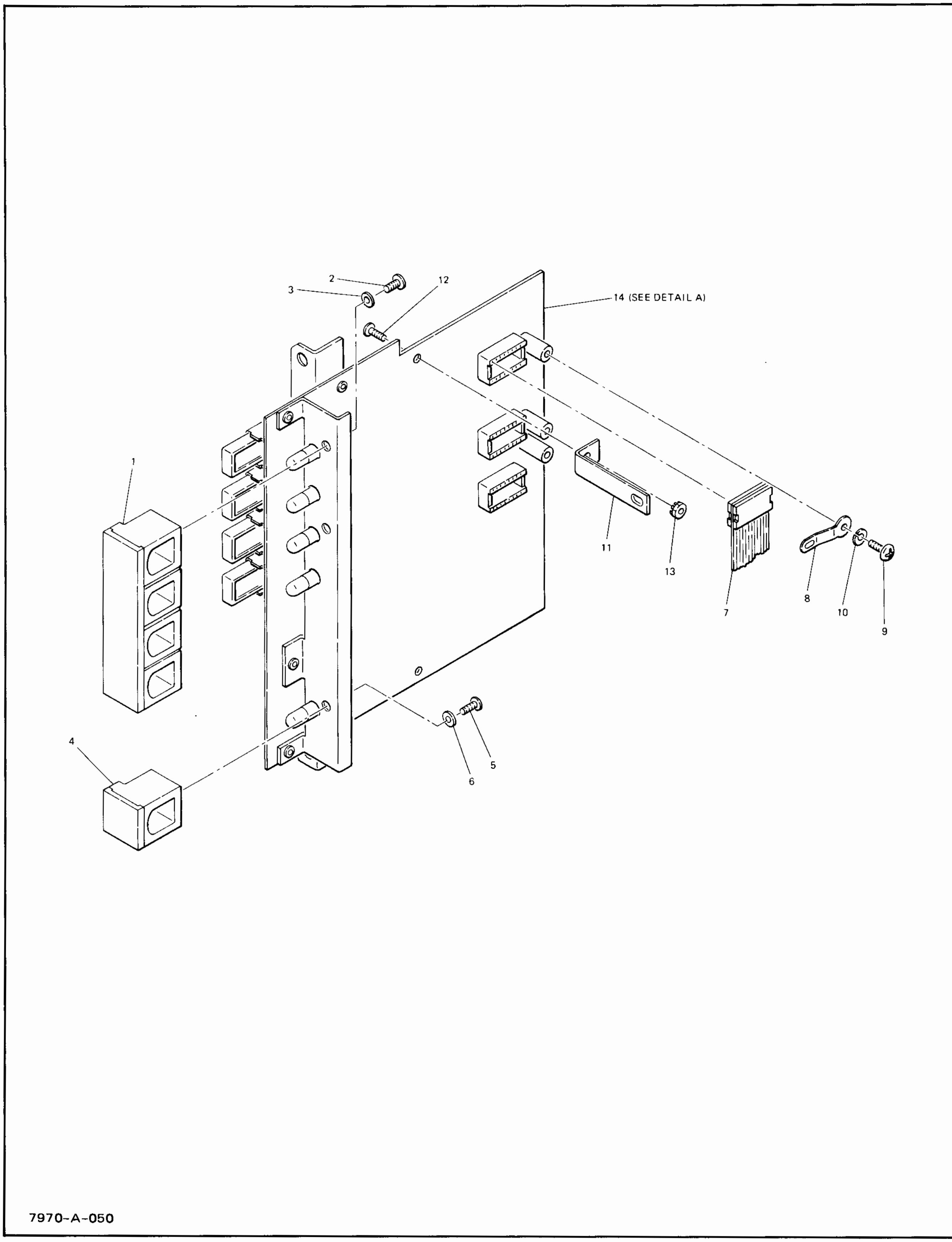


Figure 6-7. Control Switch Assembly A11 (Sheet 1 of 2)

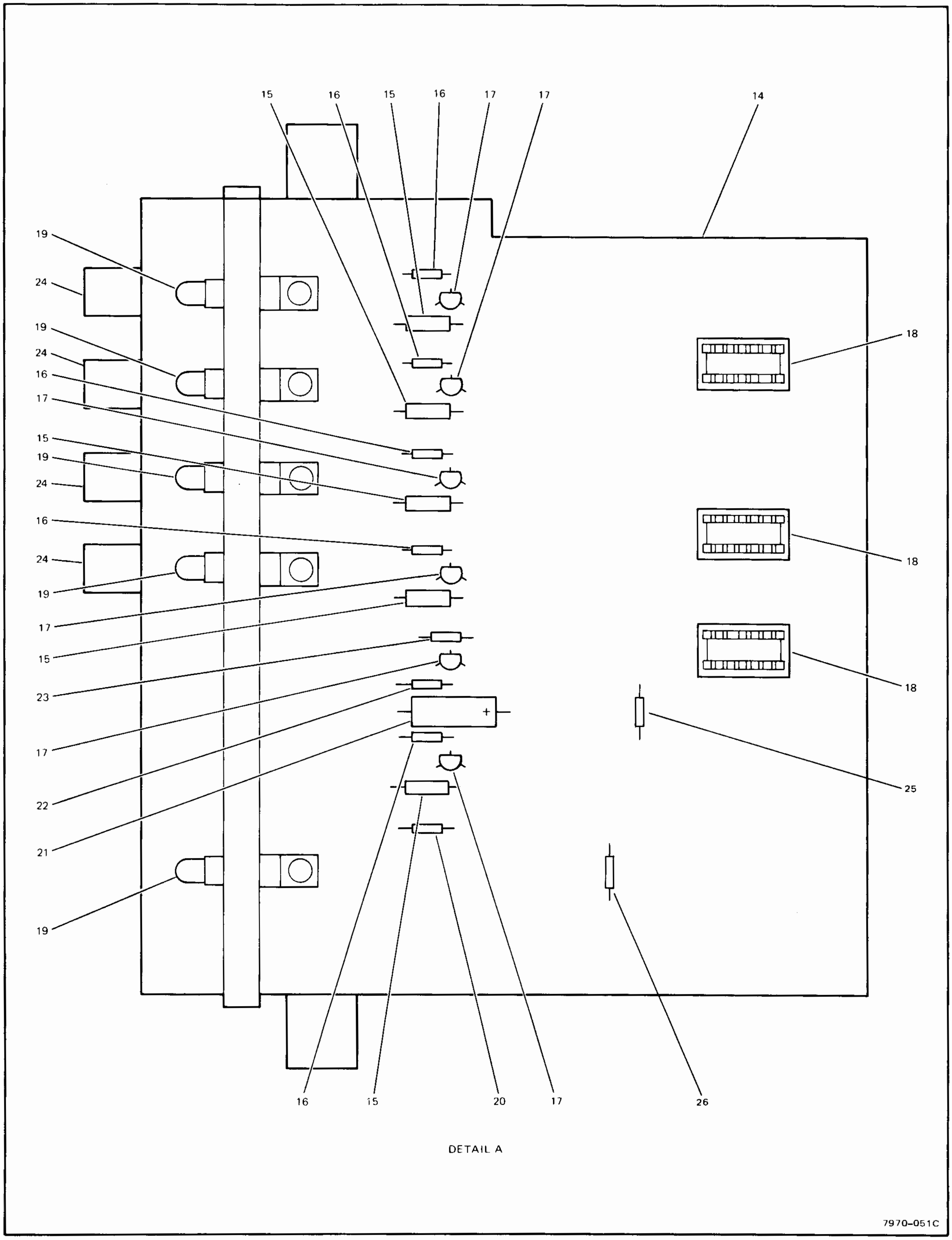


Figure 6-7. Control Switch Assembly A11 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	1 2 3 4 5 DESCRIPTION	UNITS PER ASSY
6-7-	07970-62089	CONTROL SWITCH ASSEMBLY A11	REF
-1	07970-60340	. LENS BLOCK ASSEMBLY, control switch	1
-2	0624-0077	. . SCREW, tapping, no. 4-40, 0.312-inch, pozi (AP)	2
-3	2190-0416	. . WASHER, flat (AP)	2
-4	07970-60960	. LENS BLOCK ASSEMBLY, write enable	1*
-5	0624-0077	. . SCREW, tapping, no. 4-40, 0.312-inch, pozi (AP)	1*
-6	2190-0416	. . WASHER, flat (AP)	1*
-7	07970-60610	. CABLE, capstan	1
-8	07970-00620	. . CLAMP, connector (AP)	1
-9	2360-0193	. . SCREW, no. 6-32, 0.250-inch, pozi (AP)	1
-10	2190-0085	. . WASHER, lock, helical (AP)	1
-11	07970-00310	. BRACKET, angle	2
-12	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	1
-13	2420-0001	. . NUT, hex, no. 6-32 (AP)	1
-14	07970-60080	. CONTROL SWITCH PC ASSEMBLY	1
-15	0686-2215	. . RESISTOR, fxd, 220 ohms, 5%, 1/2W (R6, R7, R8, R9, R10)	5
-16	0683-3315	. . RESISTOR, fxd, 330 ohms, 5%, 1/2W (R1, R2, R3, R4, R5)	5
-17	1854-0215	. . TRANSISTOR, NPN, Si, 2N3904 (Q1, Q2, Q3, Q4, Q5, Q6)	6
-18	1200-0426	. . SOCKET, integrated circuit, 14 pin	3
-19	2140-0209	. . LAMP, 14V, 0.08A (DS1, DS2, DS3, DS4, DS5)	5
-20	0683-6815	. . RESISTOR, fxd, 680 ohms, 5%, 1/4W (R11)	1
-21	0180-0061	. . CAPACITOR, fxd, 100 μF, 16V (C1)	1
-22	0683-3925	. . RESISTOR, fxd, 3.9k, 1/4W (R12)	1
-23	0683-1035	. . RESISTOR, fxd, 10k, 1/4W (R13)	1
-24	Ref. Only	. . SWITCH ASSEMBLY (S1 thru S4) (not field replaceable)	1
-25	1902-0041	. . DIODE, breakdown, 5.11V (CR1)	1
-26	0698-0090	. . RESISTOR, fxd, 464 ohms, 1%, 1/2W (R14)	1

*Used only in write configuration.

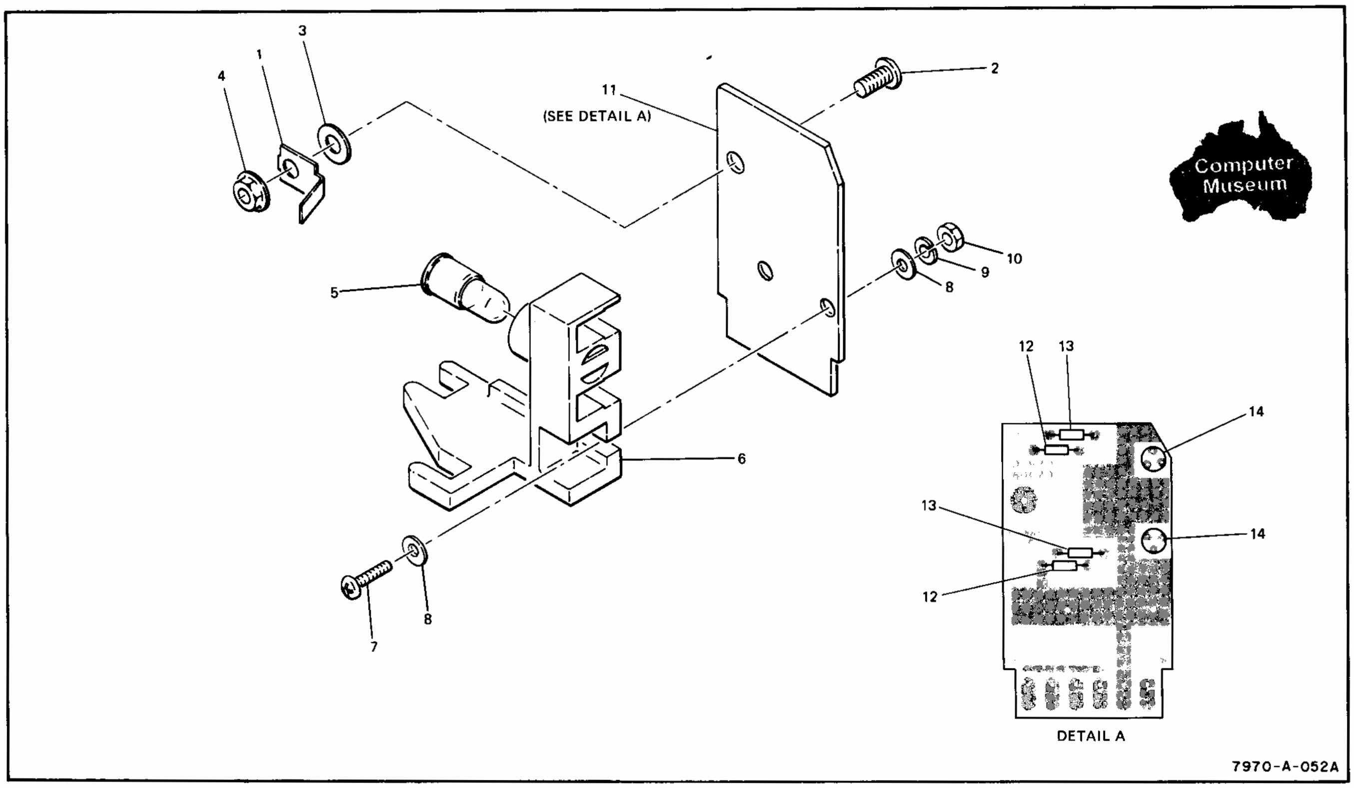


Figure 6-8. Photosense Head Assembly A2

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-8-	07970-61150	PHOTOSENSE HEAD ASSEMBLY A2	REF
-1	07970-00010	. CONTACT, lamp	1
-2	2200-0139	. . SCREW, no. 4-40, 0.25-inch, pozi (AP)	1
-3	3050-0105	. . WASHER, flat (AP)	1
-4	2260-0009	. . NUT, kep, no. 4-40 (AP)	1
-5	2140-0203	. LAMP, incandescent, 5V (DS1)	1
-6	Ref Only	. CASTING, photosense (not field replaceable)	1
-7	0520-0129	. . SCREW, no. 2-56, 0.312-inch, pozi (AP)	2
-8	2190-0417	. . WASHER, flat (AP)	4
-9	2190-0040	. . WASHER, lock, helical (AP)	2
-10	0610-0001	. . NUT, hex, no. 2-56 (AP)	2
-11	Ref Only	. PHOTOSENSE HEAD PC ASSEMBLY A1 (not field replaceable)	1
-12	0698-7027	. . RESISTOR, fxd, 10M, 10%, 1/8W (R2, R4)	2
-13	0698-5999	. . RESISTOR, fxd, 4.7k, 5%, 1/8W (R1, R3)	2
-14	1990-0087	. . PHOTOTRANSISTOR, Si (Q1, Q2)	2

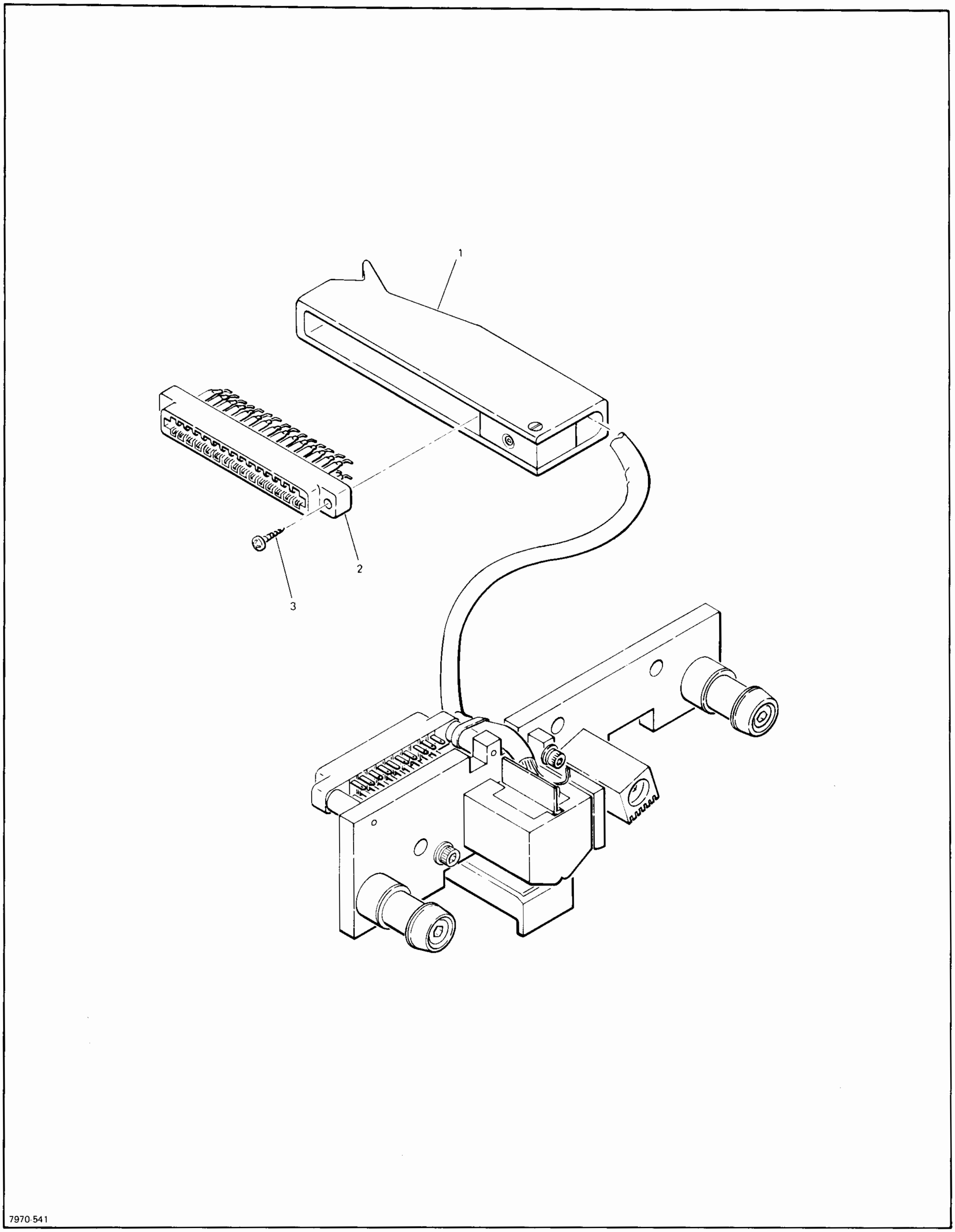


Figure 6-9. Magnetic Head Assembly A1

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-9-	07970-60580	MAGNETIC TAPE HEAD ASSEMBLY A1, 9-track, write/read, 20.1 - 45 ips . .	REF
	07970-60581	MAGNETIC TAPE HEAD ASSEMBLY A1, 7-track, write/read, 20.1 - 45 ips . .	REF
	07970-60582	MAGNETIC TAPE HEAD ASSEMBLY A1, 9-track, read only, 20.1 - 45 ips . .	REF
	07970-60583	MAGNETIC TAPE HEAD ASSEMBLY A1, 7-track, read only, 20.1 - 45 ips . .	REF
	07970-60584	MAGNETIC TAPE HEAD ASSEMBLY A1, 7-track, write/read, 10 - 20 ips. . .	REF
	07970-62031	MAGNETIC TAPE HEAD ASSEMBLY A1, 9-track, write/read, 10 - 20 ips. . .	REF
	07970-60586	MAGNETIC TAPE HEAD ASSEMBLY A1, 7-track, read only, 10 - 20 ips . . .	REF
	07970-60587	MAGNETIC TAPE HEAD ASSEMBLY A1, 9-track, read only, 10 - 20 ips . . .	REF
	07970-60588	MAGNETIC TAPE HEAD ASSEMBLY A1, 7/9-track, read/read, 10 - 20 ips . .	REF
	07970-60589	MAGNETIC TAPE HEAD ASSEMBLY A1, 7/9-track, read/read, 20.1 - 45 ips . .	REF
-1	1251-2874	. CONNECTOR HOOD ASSEMBLY	1
-2	1251-0159	. CONNECTOR, printed-circuit, 30 contact	1
-3	0624-0098	. . SCREW, tapping, 4-40, 0.438-inch, pozi (AP)	2

NOTE

Head assemblies must be returned to factory for repair or refurbishment.

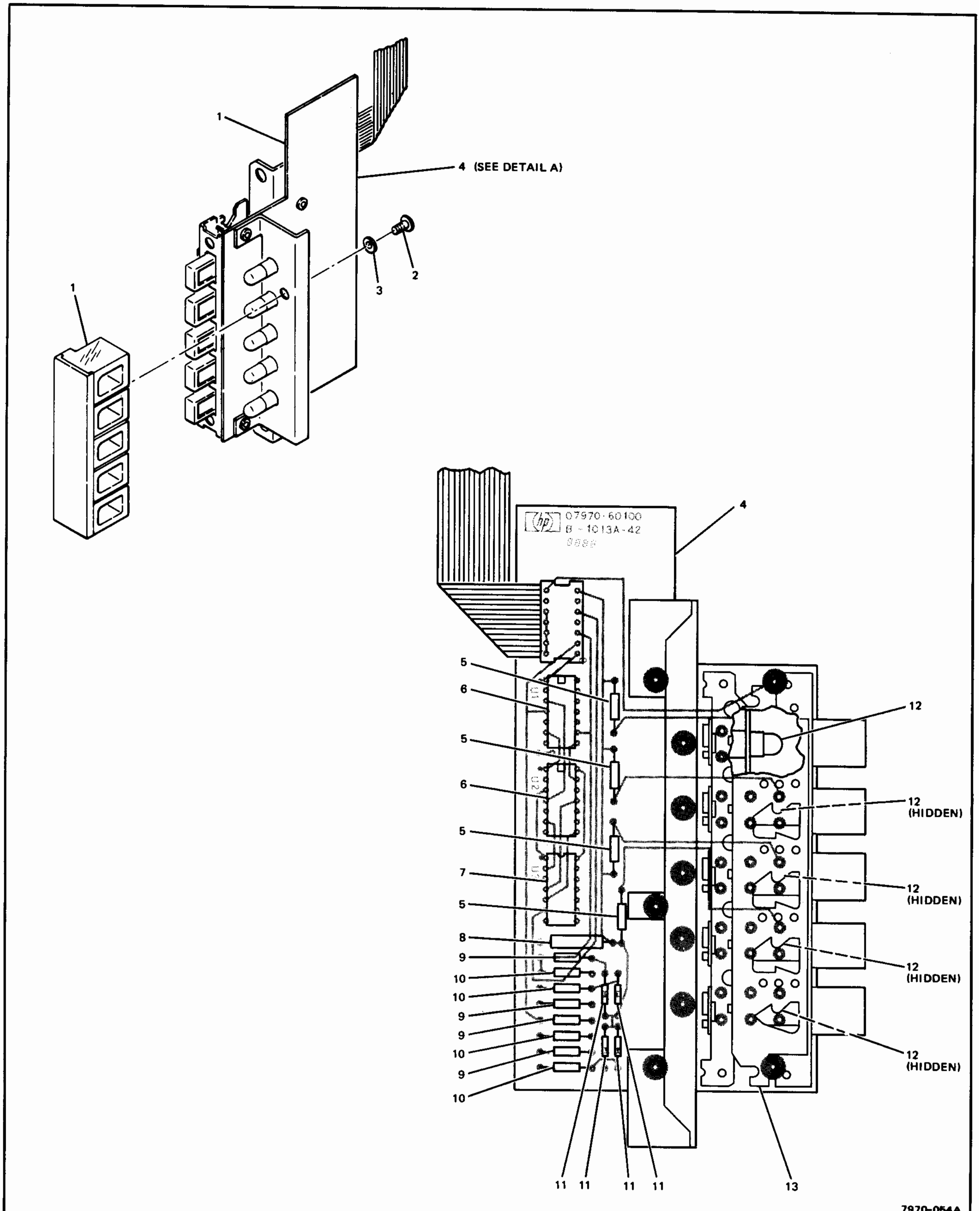


Figure 6-10. Unit Address Switch Assembly A13

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-10-	07970-62086	UNIT ADDRESS SWITCH ASSEMBLY A13	REF
-1	07970-60360	. LENS BLOCK ASSEMBLY, unit address switch	1
-2	0624-0077	. . SCREW, tapping, no. 4-40, 0.312-inch, pozi (AP)	1
-3	2190-0416	. . WASHER, flat (AP)	2
-4	07970-60100	. UNIT ADDRESS PC ASSEMBLY	1
-5	0757-0280	. . RESISTOR, fxd, 1k, 1%, 1/8W (R1, R2, R3, R4)	4
-6	1820-0054	. . INTEGRATED CIRCUIT, 7400N (U1, U2)	2
-7	1820-0348	. . INTEGRATED CIRCUIT, 844 (U3)	1
-8	0160-0161	. . CAPACITOR, fxd, My, 0.01 μF, 10% (C1)	1
-9	0757-0428	. . RESISTOR, fxd, 1.62k, 1%, 1/8W (R6, R8, R10, R12)	4
-10	0757-0418	. . RESISTOR, fxd, 619 ohms, 1%, 1/8W (R5, R7, R9, R11)	4
-11	1901-0040	. . DIODE, Si (CR1, CR2, CR3, CR4)	4
-12	2140-0209	. . LAMP, 14V, 0.08A (DS1 thru DS5)	5
-13	Ref. Only	. . SWITCH ASSEMBLY (S1 thru S5) (not field replaceable)	1

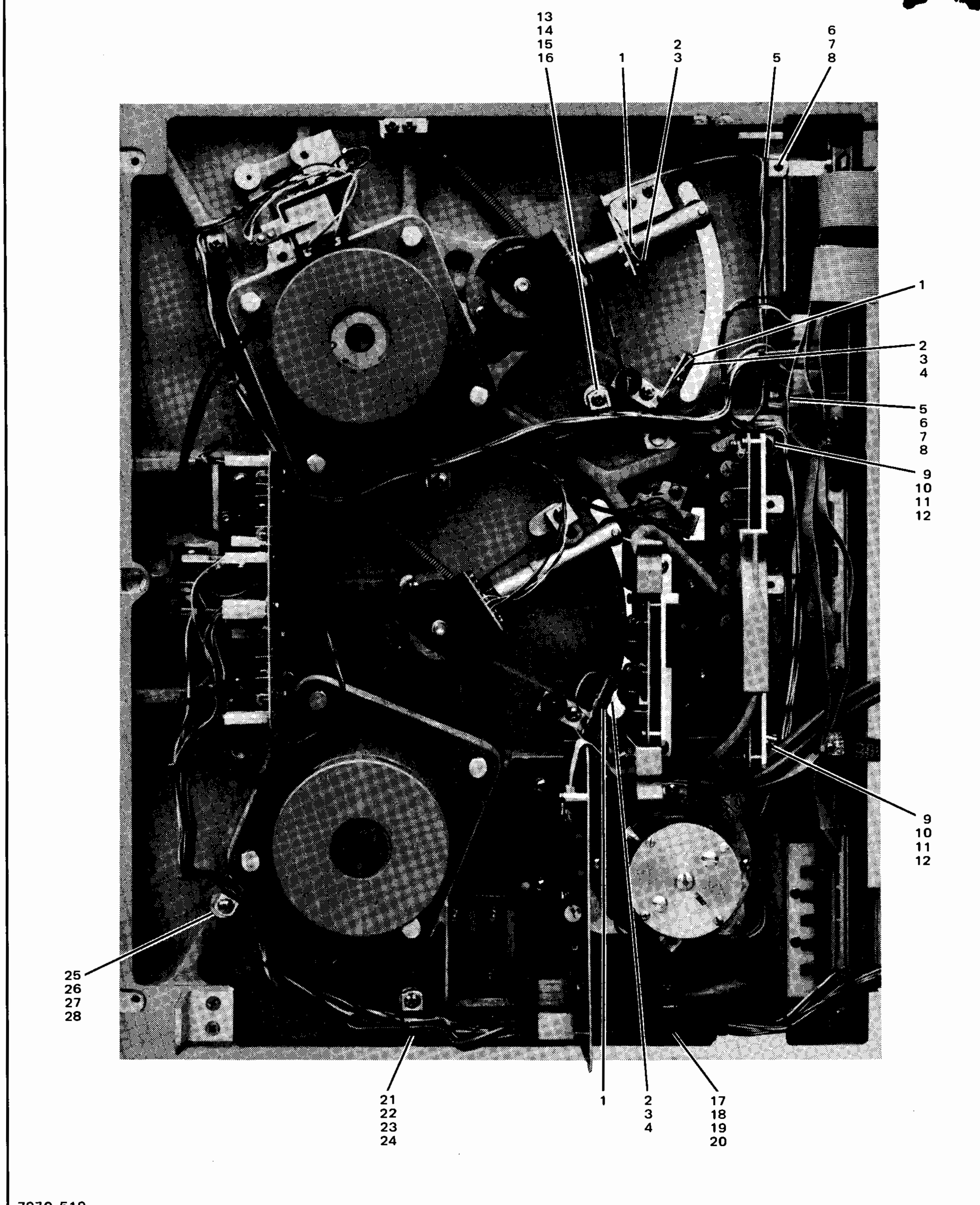


Figure 6-11. Transport Harness Assembly W2 (Sheet 1 of 2)

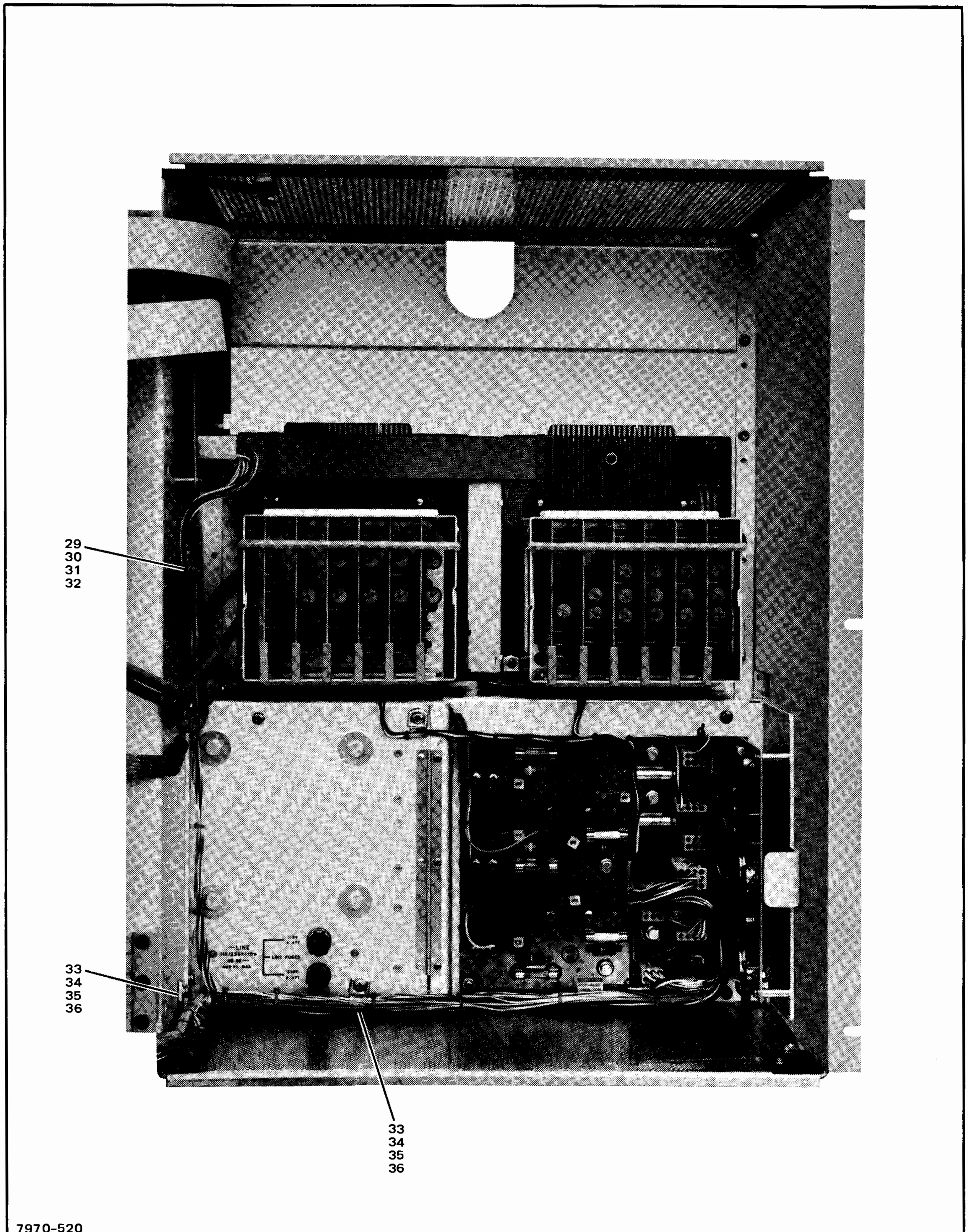


Figure 6-11. Transport Harness Assembly W2 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-11-	07970-60600	TRANSPORT HARNESS ASSEMBLY W2	REF
-1	3102-0009	. SWITCH, sensing, spdt (S1, S2, S3)	3
-2	0520-0131	. . SCREW, no. 2-56, 0.438-inch, pozi (AP)	2
-3	2190-0014	. . WASHER, lock (AP).	2
-4	0610-0001	. . NUT, hex, no. 2-56 (AP)	2
-5	1400-0302	. CLAMP, cable, 0.125-inch	2
-6	2200-0147	. . SCREW, no. 4-40, 0.5-inch, pozi (AP).	1
-7	2190-0003	. . WASHER, lock, helical (AP)	1
-8	2190-0451	. . WASHER, D-type (AP)	1
-9	1400-0292	. CLAMP, cable, 0.25-inch	2
-10	2680-0103	. . SCREW, no. 10-32, 0.5-inch, pozi (AP)	1
-11	2190-0034	. . WASHER, lock, helical (AP)	1
-12	2190-0453	. . WASHER, D-type (AP)	1
-13	1400-0292	. CLAMP, cable, 0.25-inch (read/write units)	1
	1400-0291	. CLAMP, cable, 0.187-inch (read only units)	1
-14	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP) (read only units)	1
	2680-0101	. . SCREW, no. 10-32, 0.438-inch, pozi (AP) (read/write units)	1
-15	2190-0034	. . WASHER, lock, helical (AP)	1
-16	2190-0453	. . WASHER, D-type (AP)	1
-17	1400-0294	. CLAMP, cable, 0.5-inch.	2
-18	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP).	1
-19	2190-0034	. . WASHER, lock, helical (AP)	1
-20	2190-0453	. . WASHER, D-type (AP)	1
-21	1400-0293	. CLAMP, calbe, 0.375-inch	1
-22	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP)	1
-23	2190-0034	. . WASHER, lock, helical (AP)	1
-24	2190-0453	. . WASHER, D-type (AP)	1
-25	1400-0187	. CLAMP, cable, 0.312-inch	1
-26	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP)	1
-27	2190-0034	. . WASHER, lock, helical (AP)	1
-28	2190-0453	. . WASHER, D-type (AP)	1
-29	1400-0292	. CLAMP, cable, 0.25-inch	1
-30	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP)	1
-31	2190-0034	. . WASHER, lock, helical (AP)	1
-32	2190-0453	. . WASHER, D-type (AP)	1
-33	1400-0296	. CLAMP, cable, 0.625-inch	1
-34	2680-0099	. . SCREW, no. 10-32, 0.375-inch, pozi (AP).	1
-35	2190-0034	. . WASHER, lock, helical (AP)	1
-36	2190-0453	. . WASHER, D-type (AP)	1

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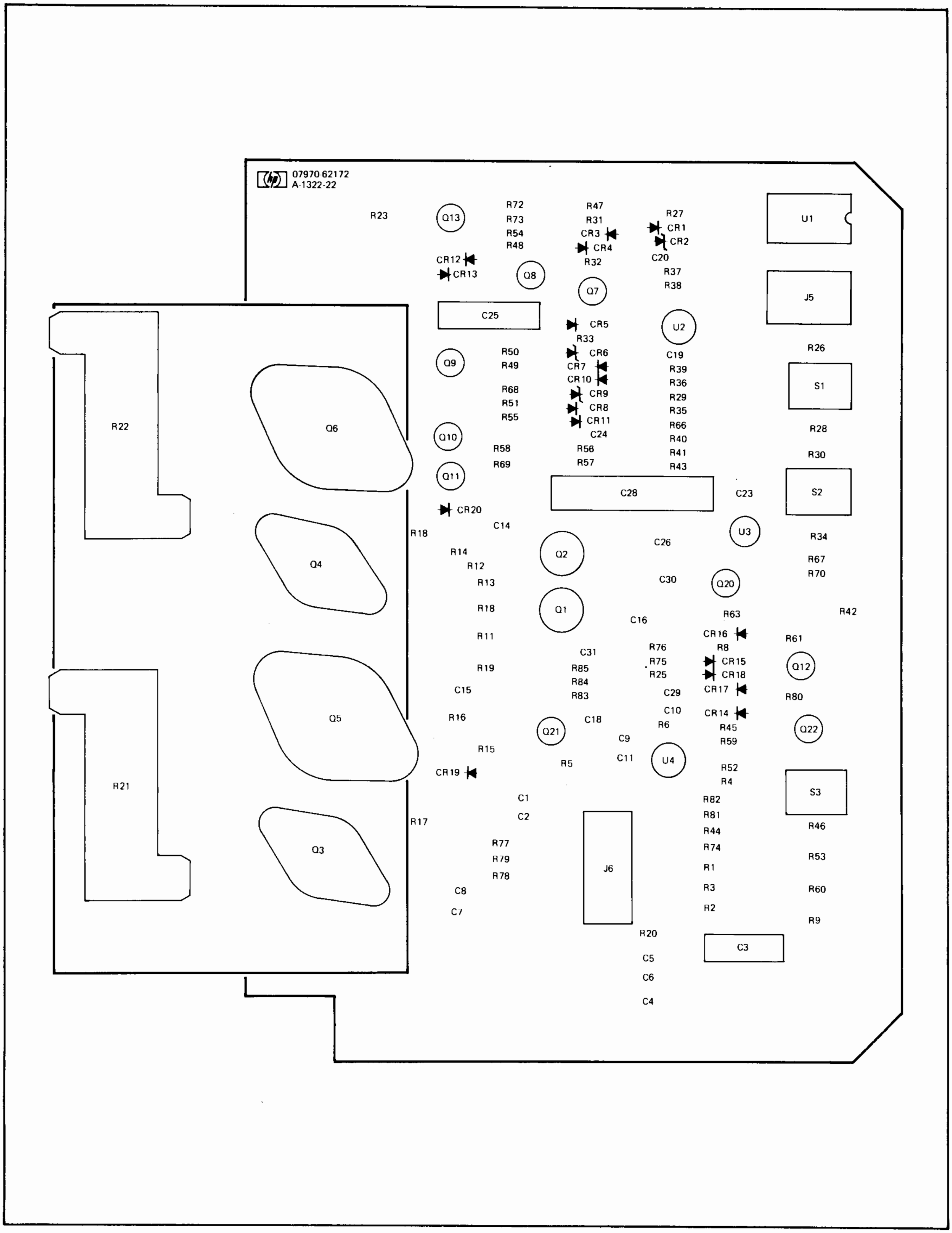


Figure 6-12. Capstan Servo PC Assembly A9

Table 6-3. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A9	C7970-62172	1	CAPSTAN SERVO PCA (SERIES 1322)	28480	07970-62172
C1	0160-2151	2	C:FXD MY 0.011 UF 5%	28480	0160-2151
C2	0160-2151		C:FXD MY 0.011 UF 5%	28480	0160-2151
C3	0160-2414	1	C:FXD MY 0.022 UF 5% 200VDCW	28480	0160-2414
C4	C150-0121	6	C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
C5	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C50BIS-CML
C6	C150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C508IS-CML
C7	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C508IS-CML
C8	0150-0121		C:FXD CER 0.1 UF +80-20% 50VDCW	56289	5C508IS-CML
C9	0160-2055	4	C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C10	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C11	C160-2207	1	C:FXD MICA 300 PF 5%	28480	0160-2207
C14	0160-0153	2	C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
C15	0160-0153		C:FXD MY 0.001 UF 10% 200VDCW	56289	192P10292-PTS
C16	0160-0165	1	C:FXD MY 0.056 UF 10% 200VDCW	56289	192P56392-PTS
C18	0160-2250	1	C:FXD CER 5.1 PF 500VDCW	72982	301-000-COHO-519E
C19	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C20	0160-2199	2	C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
C23	0160-2199		C:FXD MICA 30 PF 5% 300VDCW	28480	0160-2199
C24	0160-2055		C:FXD CER 0.01 UF +80-20% 100VDCW	56289	C023F101F103ZS22-CDH
C25	0180-0097	2	C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
C26	0180-0097		C:FXD TANT. 47 UF 10% 35VDCW	56289	150D476X9035S2-DYS
C28	C160-3387	1	C:FXD MY 0.39 UF 10% 80VDCW	56289	192P3949R8PTS
C29	0160-3536	1	C:FXD MICA 620 PF 5% 100VDCW	00853	RDM15F621JIC
C30	0160-0174	1	C:FXD CER 0.47 UF +80-20% 25VDCW	56289	5C1187S-CML
C31	0160-2224	1	C:FXD MICA 1800 PF 5%	28480	0160-2224
CR1	1901-0040	15	DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR2	1902-0033	2	DIODE:BREAKDOWN 6.2V	04713	1N823
CR3	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR4	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR5	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR6	1902-0033		DIODE:BREAKDOWN 6.2V	04713	1N823
CR7	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR8	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR9	1902-0048	1	DIODE:BREAKDOWN 6.81V 5%	04713	SZ10939-134
CR10	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR11	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR12	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR13	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR14	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR15	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR16	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR17	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR18	1901-0040		DIODE:SILICON 50 MA 30 WV	07263	FDG1088
CR19	1901-0026	2	DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
CR20	1901-0026		DIODE:SILICON 0.75A 200PIV	04713	SR1358-8
Q1	1854-0053	1	TSTR:SI NPN	80131	2N2218
Q2	1853-0012	1	TSTR:SI PNP	80131	2N2904A
Q3	1853-0323	1			
Q4	1854-0399	1	TSTR:SI NPN	80131	2N4912
Q5	1854-0576	2			
Q6	1854-0576				
Q7	1853-0036	4	TSTR:SI PNP	80131	2N3906
Q8	1854-0215	5	TSTR:SI NPN	80131	2N3904
Q9	1854-0215		TSTR:SI NPN	80131	2N3904
Q10	1853-0036		TSTR:SI PNP	80131	2N3906
Q11	1853-0036		TSTR:SI PNP	80131	2N3906
Q12	1854-0215		TSTR:SI NPN	80131	2N3904
Q13	1854-0215		TSTR:SI NPN	80131	2N3904
Q20	1853-0322	1	TSTR:SI PNP	80131	2N2946A
Q21	1853-0036		TSTR:SI PNP	80131	2N3906
Q22	1854-0215		TSTR:SI NPN	80131	2N3904
R1	0698-3152	2	R:FXD MET FLM 3.48K OHM 1% 1/8W	28480	0698-3152
R2	0698-3152		R:FXD MET FLM 3.48K OHM 1% 1/8W	28480	0698-3152
R3	0698-3202	1	R:FXD MET FLM 1.74K OHM 1% 1/8W	28480	0698-3202
R4	0757-C290	1	R:FXD MET FLM 6.19K OHM 1% 1/8W	28480	0757-0290
R5	0683-1015	2	R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
R6	C683-1015		R:FXD COMP 100 OHM 5% 1/4W	01121	CB 1015
R8	0683-1055	1	R:FXD COMP 1 MEGOHM 5% 1/4W	01121	CB 1055
R9	2100-1972	3	R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R10	0757-0797	1	R:FXD MET FLM 90.9 OHM 1% 1/2W	28480	0757-0797
R11	0698-3637	1	R:FXD MET OX 820 OHM 5% 2W	28480	0698-3637

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
R12	0757-0401	1	R:FXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401
R13	0761-0058	2	R:FXD MET OX 750 OHM 5% 1W	28480	0761-0058
R14	0683-1025	2	R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
R15	0761-0058		R:FXD MET OX 750 OHM 5% 1W	28480	0761-0058
R16	0683-1025		R:FXD COMP 1000 OHM 5% 1/4W	01121	CB 1025
R17	0698-3113	2	R:FXD CARBON 100 OHM 5% 1/8W	28480	0698-3113
R18	0698-3113		R:FXD CARBON 100 OHM 5% 1/8W	28480	0698-3113
R19	0757-0198	1	R:FXD MET FLM 100 OHM 1% 1/2W	28480	0757-0198
R20	0683-1035	2	R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
R21	0811-2966	2	R:FXD WW 30 OHM 1.0% 50W	28480	0811-2966
R22	0811-2966		R:FXD WW 30 OHM 1.0% 50W	28480	0811-2966
R23	0683-1035		R:FXD COMP 10K OHM 5% 1/4W	01121	CB 1035
R25	0698-3260	1	R:FXD MET FLM 464K OHM 1% 1/8W	28480	0698-3260
R26	0757-0280	5	R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R27	0757-0419	2	R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
R28	2100-1972		R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R29	0757-0443	3	R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
R30	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R31	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R32	0757-0444	1	R:FXD MET FLM 12.1K OHM 1% 1/8W	28480	0757-0444
R33	0757-0419		R:FXD MET FLM 681 OHM 1% 1/8W	28480	0757-0419
R34	2100-1972		R:VAR WW 20K OHM 10% 1W	28480	2100-1972
R35	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
R36	0757-0447	4	R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
R37	0757-0441	1	R:FXD MET FLM 8.25K OHM 1% 1/8W	28480	0757-0441
R38	0698-3456	1	R:FXD MET FLM 287K OHM 1% 1/8W	28480	0698-3456
R39	0698-0083	1	R:FXD MET FLM 1.96K OHM 1% 1/8W	28480	0698-0083
R40	0757-0289	1	R:FXD MET FLM 13.3K OHM 1% 1/8W	28480	0757-0289
R41	0698-0085	1	R:FXD MET FLM 2.61K OHM 1% 1/8W	28480	0698-0085
R42	2100-1762	1	R:VAR WW 20K 5% 1W	75042	CT-106-4
R43	0698-3446	1	R:FXD MET FLM 383 OHM 1% 1/8W	28480	0698-3446
R44	0757-0465	1	R:FXD MET FLM 100K OHM 1% 1/8W	28480	0757-0465
R45	0757-0463	1	R:FXD MET FLM 82.5K OHM 1% 1/8W	28480	0757-0463
R46	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
R47	0757-0428	1	R:FXD MET FLM 1.62K OHM 1% 1/8W	28480	0757-0428
R48	0757-0443		R:FXD MET FLM 11.0K OHM 1% 1/8W	28480	0757-0443
R49	0757-0447		R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
R50	0757-0418	4	R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
R51	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
R52	0698-3153	2	R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
R53	2100-2850	2	R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R54	0757-0279	1	R:FXD MET FLM 3.16K OHM 1% 1/8W	28480	0757-0279
R55	0757-0424	1	R:FXD MET FLM 1.10K OHM 1% 1/8W	28480	0757-0424
R56	0757-0447		R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
R57	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
R58	0757-0418		R:FXD MET FLM 619 OHM 1% 1/8W	28480	0757-0418
R59	0698-3153		R:FXD MET FLM 3.83K OHM 1% 1/8W	28480	0698-3153
R60	2100-2850		R:VAR WW 10K OHM 10% 1W	28480	2100-2850
R61	0757-0199	4	R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
R63	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
R66	0757-0447		R:FXD MET FLM 16.2K OHM 1% 1/8W	28480	0757-0447
R67	0757-0438	6	R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R68	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
R69	0757-0199		R:FXD MET FLM 21.5K OHM 1% 1/8W	28480	0757-0199
R70	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R72	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R73	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R74	0757-0466	1	R:FXD MET FLM 110K OHM 1% 1/8W	28480	0757-0466
R75	0757-0470	1	R:FXD MET FLM 162K OHM 1% 1/8W	28480	0757-0470
R76	0698-3457	1	R:FXD MET FLM 316K OHM 1% 1/8W	28480	0698-3457
R77	0698-3151	2	R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
R78	0698-3151		R:FXD MET FLM 2.87K OHM 1% 1/8W	28480	0698-3151
R79	0757-0317	1	R:FXD MET FLM 1.33K OHM 1% 1/8W	28480	0757-0317
R80	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R81	0757-0403	1	R:FXD MET FLM 121 OHM 1% 1/8W	28480	0757-0403
R82	0757-1094	1	R:FXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094
R83	0757-0438		R:FXD MET FLM 5.11K OHM 1% 1/8W	28480	0757-0438
R84	0757-0416	1	R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416
R85	0757-0280		R:FXD MET FLM 1K OHM 1% 1/8W	28480	0757-0280
S2	3101-1213		SWITCH:TOGGLE DPST-DB SUB-MINIATURE	81640	T8001
S3	3101-1213		SWITCH:TOGGLE DPST-DB SUB-MINIATURE	81640	T8001
U1	1820-0256	1	IC:DTL QUAD 2-INPUT POWER GATE	04713	MC858P
U2	1820-0223	3	INTEGRATED CIRCUIT:OPERATIONAL AMPL.	28480	1820-0223
U3	1820-0223		INTEGRATED CIRCUIT:OPERATIONAL AMPL.	28480	1820-0223
U4	1820-0223		INTEGRATED CIRCUIT:OPERATIONAL AMPL.	28480	1820-0223

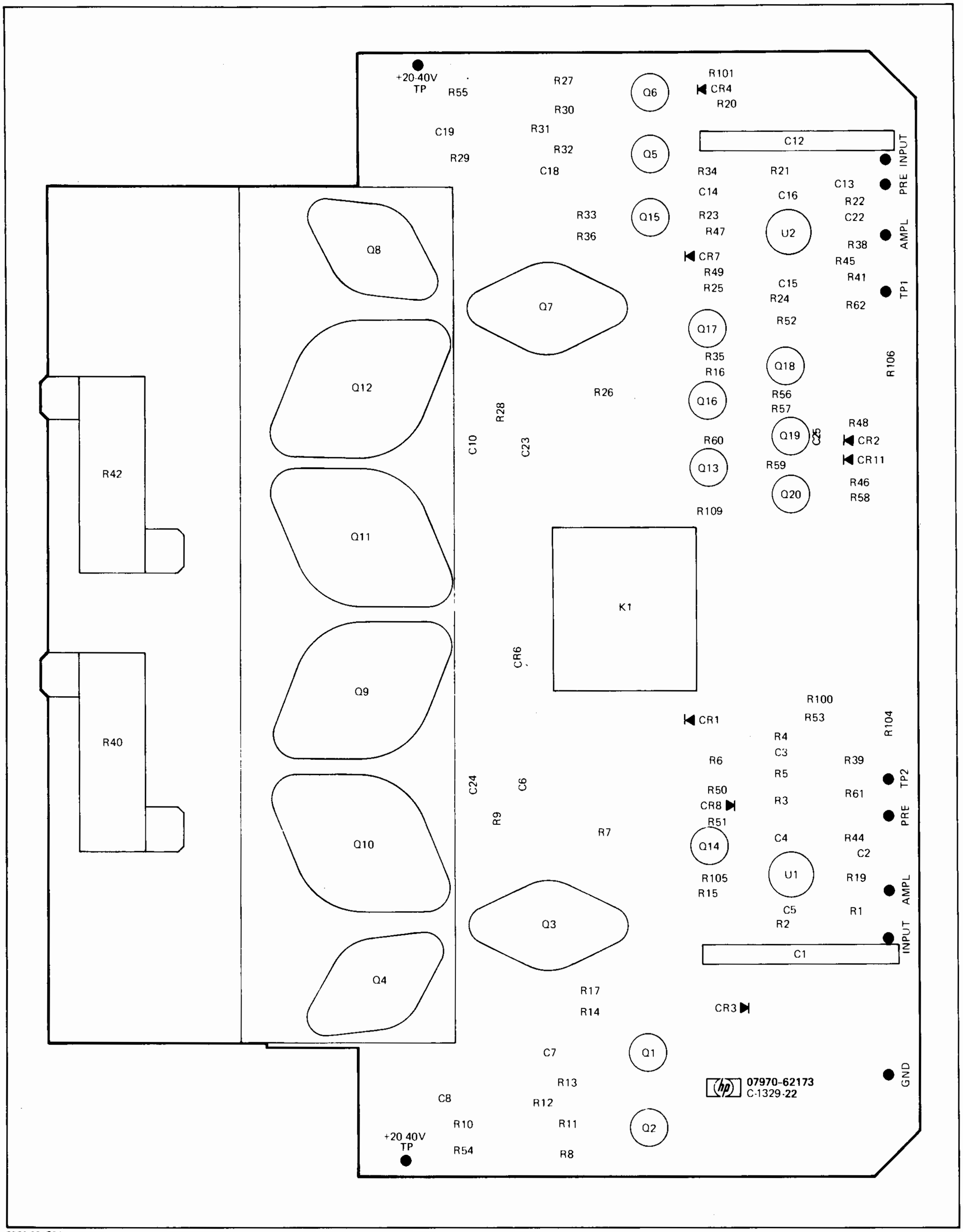
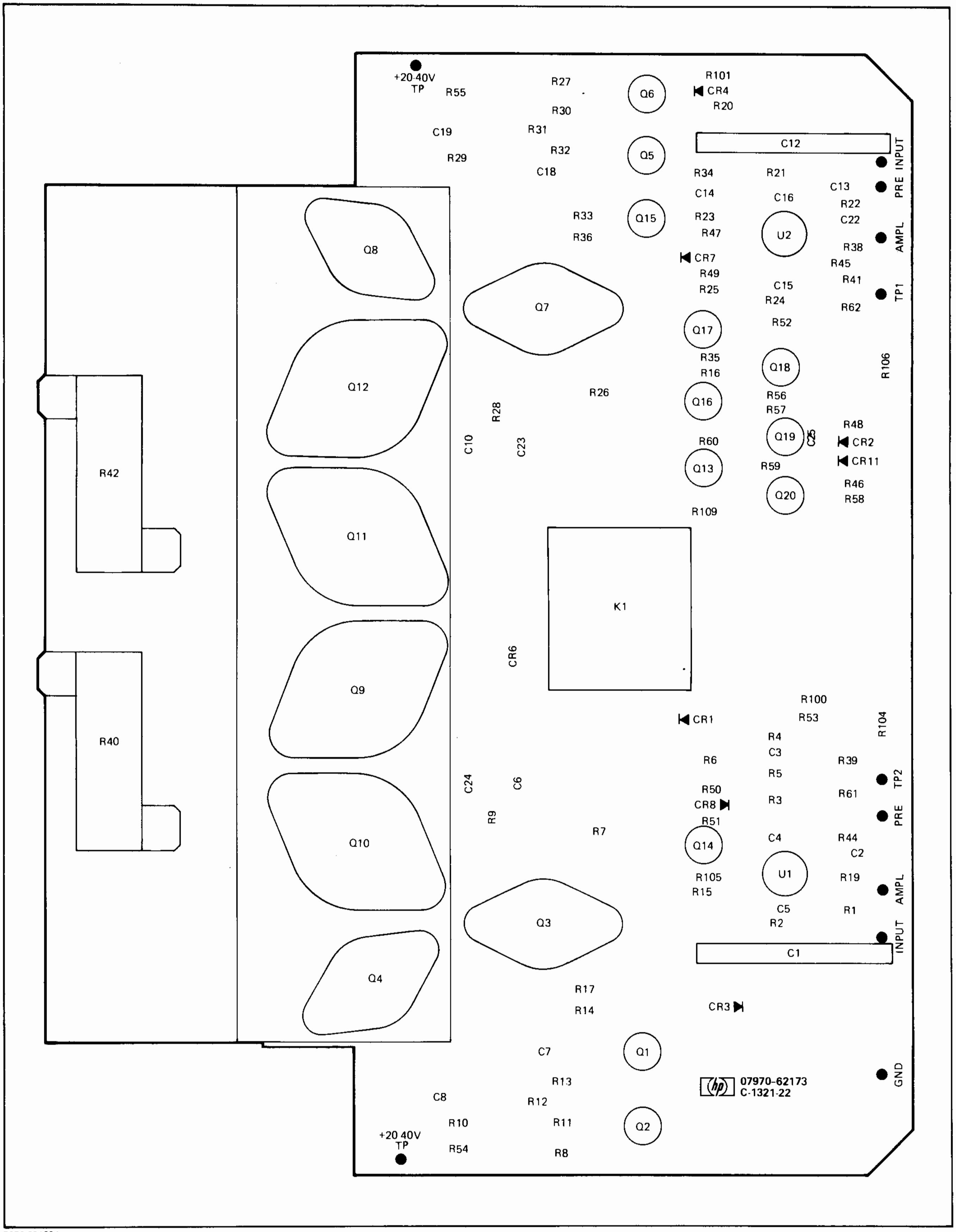


Figure 6-13. Reel Servo PC Assembly A7 (Sheet 1 of 2)



7970-62173A

Figure 6-13. Reel Servo PC Assembly A7 (Sheet 2 of 2)

REFERENCE DESIGNATION	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.
	07970-62173	Reel Servo PCA	28480	07970-62173
C1, 12	0160-0380	Capacitor, Fxd, My, 0.22 µF, 10%, 200 VDCW	28480	0160-0380
C2, 3, 13, 14	0160-2055	Capacitor, Fxd, Cer, 0.01 µF, +80 -20%, 100 VDCW	36289	C023F101F103ZS22-CD
C4, 5, 15, 16	0160-2199	Capacitor, Fxd, Mica, 30 pF, 5%, 300 VDCW	28480	0160-2199
C6, 10, 23, 24	0160-2128	Capacitor, Fxd, My, 0.33 µF, 20%, 200 VDCW	56289	225P33402Y-PWM
C7, 8, 18, 19	0160-0154	Capacitor, Fxd, Mica, 0.0022 µF, 10%, 200 VDCW	56289	192P22292-PTS
C21, 22	0150-0121	Capacitor, Fxd, 0.1 µF, +80 -20%, 50 VDCW	56289	5C50BIS-CML
C25	0160-0127	Capacitor, Fxd, Cer, 1 µF, 25V	56289	5C13CS-CML
CR1, 2, 5, 7, 8	1901-0040	Diode, Si, 30 mA, 30 WV	07263	FDG1088
CR3, 4	1902-0048	Diode, Breakdown, 6.81V, 5%	04713	SZ10939-134
CR6	1901-0364	Diode, Si, 200 PIV	28480	1901-0364
CR10	1902-3024	Diode, Breakdown, 2.87V, 5%	04713	SZ10939-158
K1	0490-0891	Relay, 3 PDT, 10A, 24 VDC	77342	KUP14D15
Q1, 5	1854-0022	Transistor, Si, NPN	07263	S17843
Q2, 6	1853-0080	Transistor, Si, PNP	80131	2N4888
Q3, 7	1853-0323	Transistor, Si, PNP	80131	2N4900
Q4, 8	1854-0399	Transistor, Si, NPN	80131	2N4912
Q9 thru Q12	1854-0490	Transistor, Si, NPN	28480	1854-0490
Q13, 19, 20, 21	1854-0215	Transistor, Si, NPN	80131	2N3904
Q14, 15	1855-0056	Transistor, Si, FET	80131	2N4342
Q16, 17	1853-0322	Transistor, Si, PNP	80131	2N2946A
Q18	1853-0036	Transistor, Si, PNP	80131	2N3906
R1, 5, 6, 20, 24, 25	0698-3458	Resistor, Fxd, Flm, 348k ohms, 1%, 1/8W	28480	0698-3458
R2, 21	0698-3159	Resistor, Fxd, Flm, 26.1k ohms, 1%, 1/8W	28480	0698-3159
R3, 4, 22, 23	0683-1015	Resistor, Fxd, Comp, 100 ohms, 5%, 1/4W	01121	CB1015
R7, 26	0757-0797	Resistor, Fxd, Flm, 90.9 ohms, 1%, 1/2W	28480	0757-0797
R8, 27	0698-3637	Resistor, Fxd, Ox, 820 ohms, 5%, 2W	28480	0698-3637
R9, 10, 15, 28, 29, 34, 100, 101	0683-1025	Resistor, Fxd, Comp, 1000 ohms, 5%, 1/4W	01121	CB1025
R11, 13, 30, 32	0761-0058	Resistor, Fxd, Met Ox, 750 ohms, 5%, 1W	28480	0761-0058
R12, 31	0757-0401	Resistor, Fxd, Flm, 100 ohms, 1%, 1/8W	28480	0757-0401
R14, 17, 33, 36	0698-3113	Resistor, Fxd, Carbon, 100 ohms, 5%, 1/8W	28480	0698-3113
R16, 35	0757-0280	Resistor, Fxd, Flm, 3.16k ohms, 1%, 1/8W	28480	0757-0279
R19, 38, 54, 55	0683-1035	Resistor, Fxd, Comp, 10k ohms, 5%, 1/4W	01121	CB1035
R39, 41	0698-3260	Resistor, Fxd, Flm, 464 ohms, 1%, 1/8W	28480	0698-3260
R40, 42	0811-2048	Resistor, Fxd, WW, 0.25 ohm, 1%, 25W	28480	0811-2048
R44, 45	0686-1035	Resistor, Fxd, Comp, 10k ohms, 5%, 1/2W	01121	EB1035
R46, 59	0757-0279	Resistor, Fxd, Flm, 3.16k ohms, 1%, 1/8W	28480	0757-0279
R47, 105	0757-0289	Resistor, Fxd, Flm, 13.3k ohms, 1%, 1/8W	28480	0757-0289
R48, 65	0757-0278	Resistor, Fxd, Flm, 1.78k ohms, 1%, 1/8W	28480	0757-0278
R49, 51	0757-0465	Resistor, Fxd, Flm, 100k ohms, 1%, 1/8W	28480	0757-0465
R50	0757-0458	Resistor, Fxd, Flm, 51.1k ohms, 1%, 1/8W	28480	0757-0458
R52	0686-2225	Resistor, Fxd, Comp, 2200 ohms, 5%, 1/2W	01121	EB2225
R56	0757-0403	Resistor, Fxd, Flm, 121 ohms, 1%, 1/8W	28480	0757-0403
R57, 58	0757-1094	Resistor, Fxd, Flm, 1.47k ohms, 1%, 1/8W	28480	0757-1094
R60, 64	0757-0438	Resistor, Fxd, Flm, 5.11k ohms, 1%, 1/8W	28480	0757-0438
R61, 62	0698-3456	Resistor, Fxd, Flm, 287k ohms, 1%, 1/8W	28480	0698-3456
R104, 106	2100-1759	Resistor, Var, WW, 2k ohms, 5%, 1W	28480	2100-1759
R107	0698-3438	Resistor, Fxd, Flm, 147 ohms, 1%, 1/8W	28480	0698-3438
R108	0698-3440	Resistor, Fxd, Flm, 196 ohms, 1%, 1/8W	28480	0698-3440
U1, 2	1820-0223	Integrated Circuit	28480	1820-0223

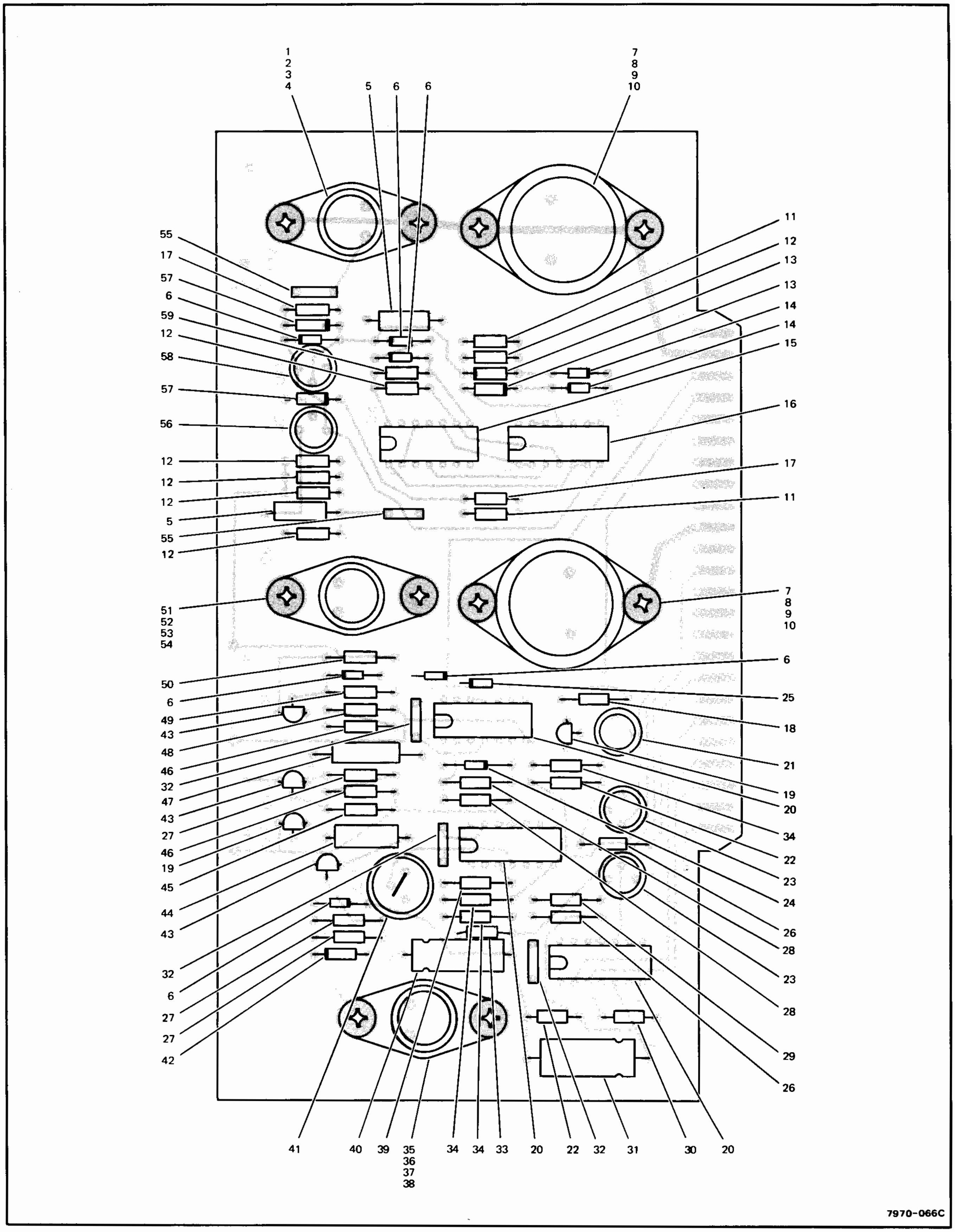


Figure 6-14. Power Regulator PC Assembly A21

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-14-	07970-61010	POWER REGULATOR PC ASSEMBLY A21	REF
-1	1854-0072	. TRANSISTOR, NPN, Si, 2N3054 (Q12)	1
-2	0340-0180	. . INSULATOR, transistor, mica	1
-3	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi	2
-4	2420-0001	. . NUT, hex, no. 6-32	2
-5	0683-3325	. RESISTOR, fxd, 3.3k, 5%, 1/4W (R10, R20)	2
-6	1901-0040	. DIODE, Si (CR9, CR10, CR11, CR12, CR13, CR17)	6
-7	1854-0063	. TRANSISTOR, NPN, Si (Q7, Q13)	2
-8	1200-0077	. . INSULATOR, transistor	1
-9	2360-0197	. . SCREW, no. 6-32, 0.375-inch, pozi	2
-10	2420-0001	. . NUT, hex, no. 6-32	2
-11	0683-1015	. RESISTOR, fxd, 100 ohms, 5%, 1/4W (R12, R22)	2
-12	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R7, R9, R11, R21, R28, R29)	6
-13	1902-3171	. DIODE, zener, Si (CR4, CR6)	2
-14	1901-0025	. DIODE, Si (CR3, CR5)	2
-15	1820-0348	. INTEGRATED CIRCUIT, type 844 (U4)	1
-16	1820-0256	. INTEGRATED CIRCUIT (U5)	1
-17	0683-2425	. RESISTOR, fxd, 2.4k, 5%, 1/4W (R8, R19)	2
-18	0686-2025	. RESISTOR, fxd, 2k, 5%, 1/2W (R18)	1
-19	1853-0036	. TRANSISTOR, PNP, Si, 2N3906 (Q8, Q18)	2
-20	1820-0439	. INTEGRATED CIRCUIT, voltage regulator (U1, U2, U3)	3
-21	1853-0027	. TRANSISTOR, PNP, Si, 2N3245 (Q9)	1
-22	0698-3150	. RESISTOR, fxd, 2.37k, 1%, 1/8W (R2, R26)	2
-23	1854-0039	. TRANSISTOR, NPN, Si, EIA, 2N3053 (Q1, Q14)	2
-24	1902-0049	. DIODE, zener, 6.19V (CR16)	1
-25	1902-2303	. DIODE, zener, 14.7V (CR15)	1
-26	0698-3438	. RESISTOR, fxd, 147 ohms, 1%, 1/8W (R1, R25)	2
-27	0757-0438	. RESISTOR, fxd, 5.11k, 1%, 1/8W (R30, R31, R35)	3
-28	0757-0290	. RESISTOR, fxd, 6.19k, 1%, 1/8W (R14, R15)	2
-29	0757-1094	. RESISTOR, fxd, 1.47k, 1%, 1/8W (R6)	1
-30	0757-0317	. RESISTOR, fxd, 1.33k, 1%, 1/8W (R27)	1
-31	0180-0059	. CAPACITOR, fxd, 10 μF, 25 Vdcw (C7)	1
-32	0160-3456	. CAPACITOR, fxd, 0.001 μF, 10%, 250 Vdcw (C1, C3, C6)	3
-33	0683-6815	. RESISTOR, fxd, 680 ohms, 5%, 1/4W (R24)	1
-34	0757-0279	. RESISTOR, fxd, 3.16k, 1%, 1/8W (R5, R23, R16)	3
-35	1884-0088	. THYRISTOR, 2N3228 (CR1)	1
-36	0340-0180	. . INSULATOR, transistor, mica	1
-37	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi	2
-38	2420-0001	. . NUT, hex, no. 6-32, 0.312-inch	2
-39	0698-0084	. RESISTOR, fxd, 2.15k, 1%, 1/8W (R3)	1
-40	0180-0172	. CAPACITOR, fxd, 5 μF, 15 Vdcw (C5)	1
-41	2100-1773	. RESISTOR, var, ww, 1k, 5%, 1W (R4)	1

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-14-42	1902-0048	. DIODE, zener, 6.8V, 1N3210 (CR2)	1
-43	1854-0215	. TRANSISTOR, NPN, Si, 2N3904 (Q15, Q16, Q17)	3
-44	0757-0198	. RESISTOR, fxd, 100 ohms, 1%, 1/2W (R32)	1
-45	0757-0465	. RESISTOR, fxd, 100k, 1%, 1/8W (R33)	1
-46	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R34, R36)	2
-47	0180-0228	. CAPACITOR, fxd, 22 μF, 10%, 15 Vdcw (C8)	1
-48	0757-0458	. RESISTOR, fxd, 51.1k, 1%, 1/8W (R37)	1
-49	0757-0458	. RESISTOR, fxd, 51.1k, 1%, 1/8W (R38)	1
-50	0757-0419	. RESISTOR, fxd, 681 ohms, 1%, 1/8W (R39)	1
-51	1853-0052	. TRANSISTOR, PNP, Si, 2N3740 (Q6)	1
-52	0340-0180	. . INSULATOR, transistor, mica	1
-53	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi	2
-54	2420-0001	. . NUT, hex, no. 6-32, 0.312-inch	2
-55	0160-2055	. CAPACITOR, fxd, 0.01 μF, 100 Vdcw (C2, C4)	2
-56	1854-0022	. TRANSISTOR, NPN, Si (Q5)	1
-57	1902-3311	. DIODE, zener, 38.5V (CR7, CR8)	2
-58	1853-0080	. TRANSISTOR, PNP, Si, 2N4888 (Q11)	1
-59	0683-4715	. RESISTOR, fxd, 470 ohms, 5%, 1/4W (R13)	1
-60	1902-0040	. DIODE, silicon (CR14)	1
-61	0757-0441	. RESISTOR, fxd, 8.25k, 1%, 1/8W (R40)	1

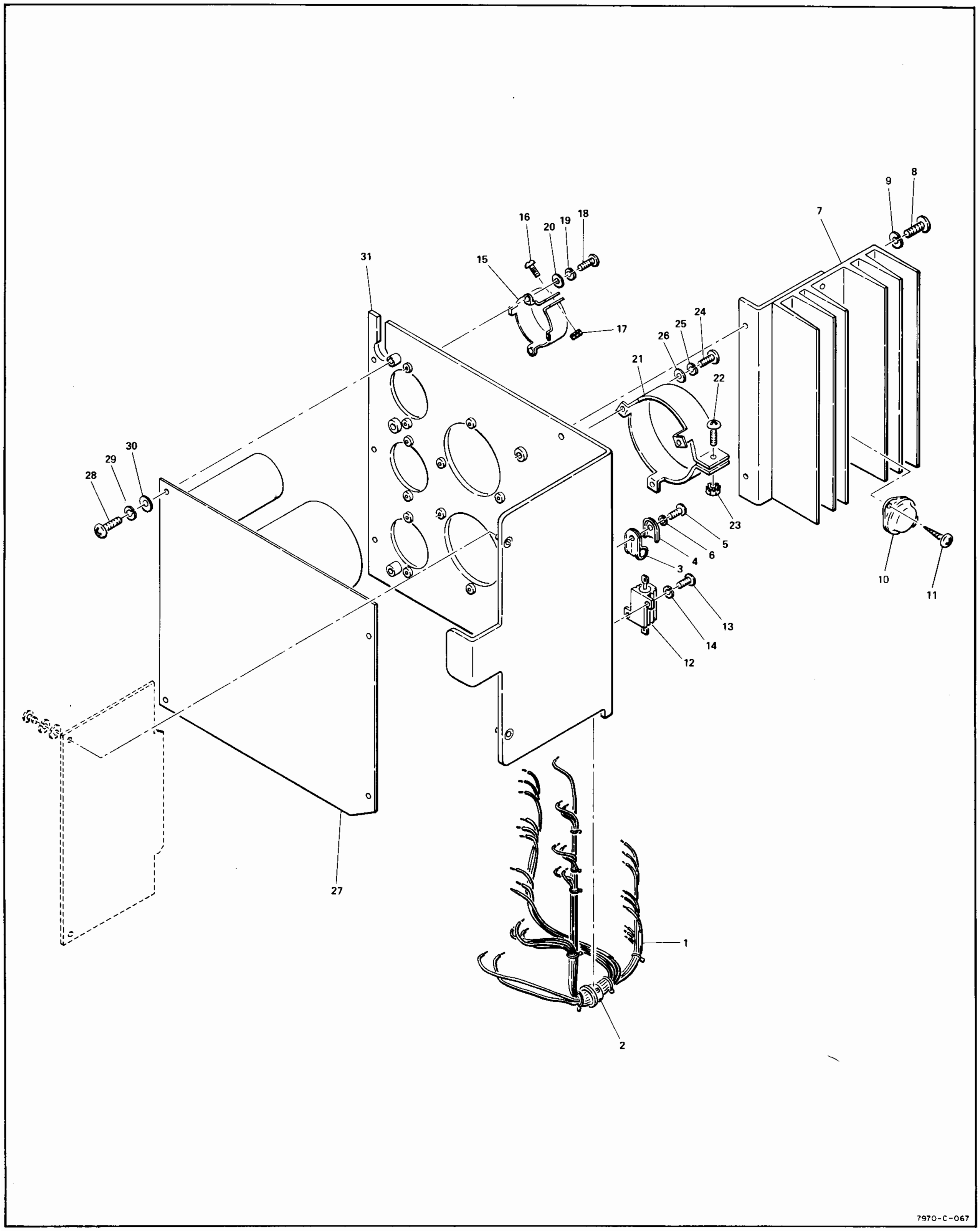


Figure 6-15. Power Distribution Assembly A20

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-15-	07970-61051	POWER DISTRIBUTION ASSEMBLY A20	REF
-1	07970-60650	. WIRING HARNESS, power supply (W1)	1
-2	0400-0056	. . BUSHING, snap, nylon (AP)	1
-3	1400-0187	. . CLAMP, cable (AP)	1
-4	2190-0453	. . WASHER (AP)	1
-5	2680-0101	. . SCREW, no. 10-32, 0.438-inch, pozi (AP)	1
-6	2190-0034	. . WASHER, lock, helical (AP)	1
-7	07970-60442	. HEAT DISSIPATOR ASSEMBLY, transistor (contains XQ1, XQ2, and XQ3)	1
-8	2680-0101	. . SCREW, no. 10-32, 0.438-inch, pozi (AP)	2
-9	2190-0034	. . WASHER, lock, helical (AP)	2
-10	1854-0063	. TRANSISTOR, NPN, Si (Q1, Q2, Q3)	3
-11	0624-0062	. . SCREW, tapping, no. 6-20, 0.625-inch, pozi (AP)	2
-12	0811-2180	. RESISTOR, fxd, ww, 12k, 5%, 5W (R1, R2)	2
-13	2200-0141	. . SCREW, no. 4-40, 0.312-inch, pozi (AP)	2
-14	2190-0071	. . WASHER, lock (AP)	2
-15	0160-2149	. CLAMP, capacitor	3
-16	2360-0201	. . SCREW, no. 6-32, 0.500-inch, pozi (AP)	1
-17	2420-0001	. . NUT, hex, no. 6-32 (AP)	1
-18	2200-0143	. . SCREW, no. 4-40, 0.375-inch, pozi (AP)	2
-19	2190-0003	. . WASHER, lock, helical (AP)	2
-20	3050-0105	. . WASHER, brass (AP)	2
-21	0180-1970	. CLAMP, capacitor	2
-22	2360-0201	. . SCREW, no. 6-32, 0.500-inch, pozi (AP)	1
-23	2420-0001	. . NUT, hex, no. 6-32 (AP)	1
-24	2200-0143	. . SCREW, no. 4-40, 0.375-inch, pozi (AP)	3
-25	2190-0003	. . WASHER, lock, helical (AP)	3
-26	3050-0105	. . WASHER, brass (AP)	3
-27	07970-61020	. POWER DISTRIBUTION PC ASSEMBLY A1 (see figure 6-16 for details)	1
-28	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	4
-29	2190-0085	. . WASHER, lock, helical (AP)	4
-30	3050-0227	. . WASHER, flat (AP)	4
-31	07970-00280	. CHASSIS, power distribution assembly	1

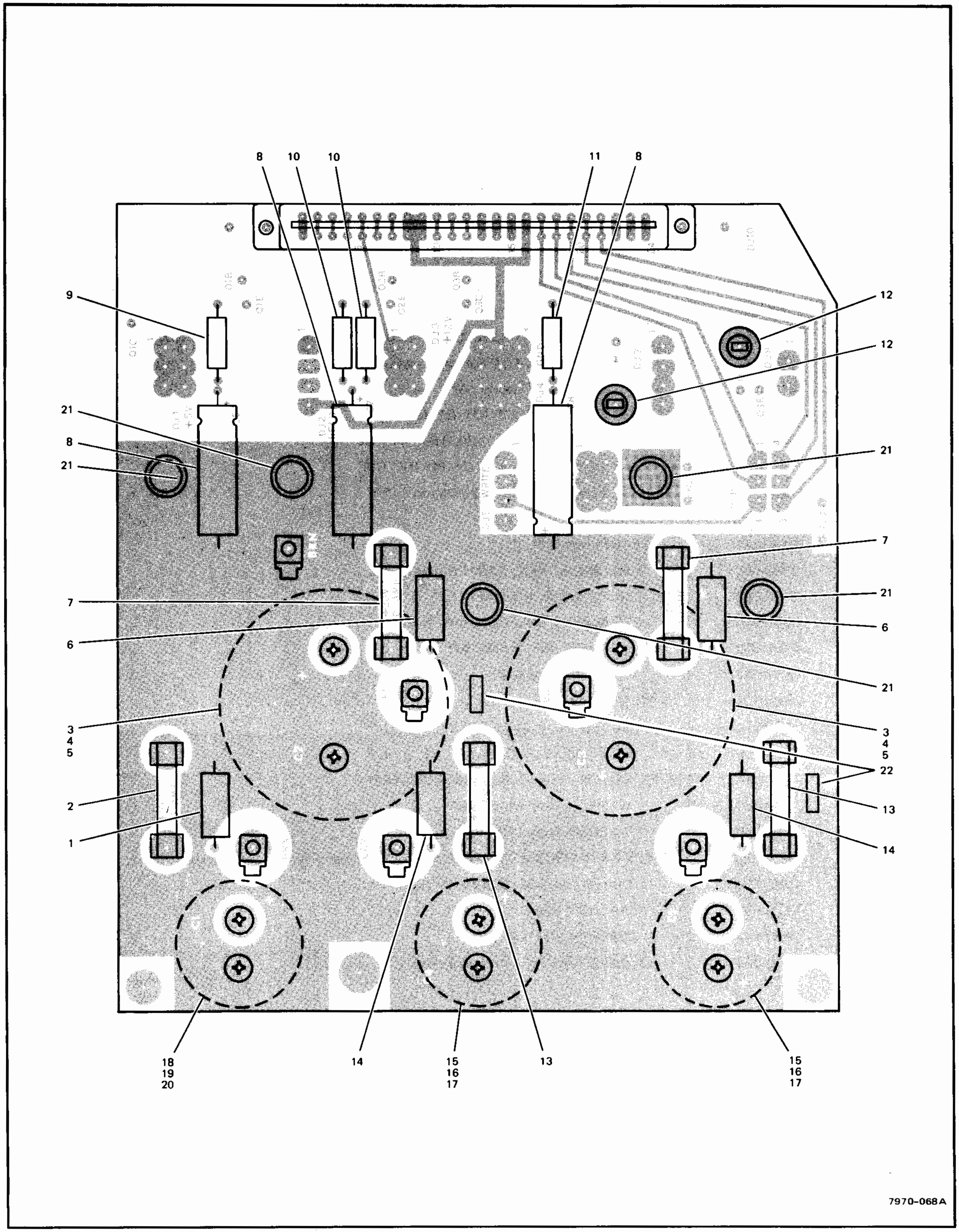


Figure 6-16. Power Distribution PC Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-16-	07970-61020	POWER DISTRIBUTION PC ASSEMBLY	REF
-1	0698-3629	. RESISTOR, fxd, 270 ohms, 5%, 2W (R1).	1
-2	2110-0003	. FUSE, 3A, 250V (F5)	1
-3	0180-2327	. CAPACITOR, fxd, 24,000 μF, 30 Vdcw (C2, C3)	2
-4	2680-0128	. . SCREW, no. 10-32, 0.25-inch, pozi (AP)	2
-5	2190-0012	. . WASHER, lock (AP)	2
-6	0698-3635	. RESISTOR, fxd, 680 ohms, 5%, 2W (R2, R3)	2
-7	2110-0051	. FUSE, ceramic body, 10A, 250V (F2, F3)	2
-8	0180-0104	. CAPACITOR, fxd, 200 μF, 15 Vdcw (C6, C7, C8)	3
-9	0812-0045	. RESISTOR, fxd, ww, 0.15 ohm, 5%, 3W (R6)	1
-10	0811-0666	. RESISTOR, fxd, ww, 1 ohm, 5%, 2W (R7, R8)	2
-11	0811-1665	. RESISTOR, fxd, ww, 0.56 ohm, 5%, 2W (R9)	1
-12	1901-0630	. DIODE, Si (CR1, CR2)	2
-13	2110-0303	. FUSE, slo blo, 2A, 250V (F1, F4).	2
-14	0764-0043	. RESISTOR, fxd, 2.7k, 5%, 2W (R4, R5)	2
-15	0180-2325	. CAPACITOR, fxd, 1500 μF, 75 Vdcw (C4, C5)	2
-16	2660-0128	. . SCREW, no. 10-32, 0.25-inch, pozi (AP)	2
-17	2190-0012	. . WASHER, lock (AP).	2
-18	0180-2326	. CAPACITOR, fxd, 10,000 μF, 15 Vdcw (C1)	1
-19	2680-0128	. . SCREW, no. 10-32, 0.25-inch, pozi (AP)	2
-20	2190-0012	. . WASHER, lock (AP).	2
-21	1901-0415	. DIODE, Si (CR3, CR4, CR5, CR6, CR7)	5
-22	1901-0026	. DIODE, Si (CR8, CR9)	2

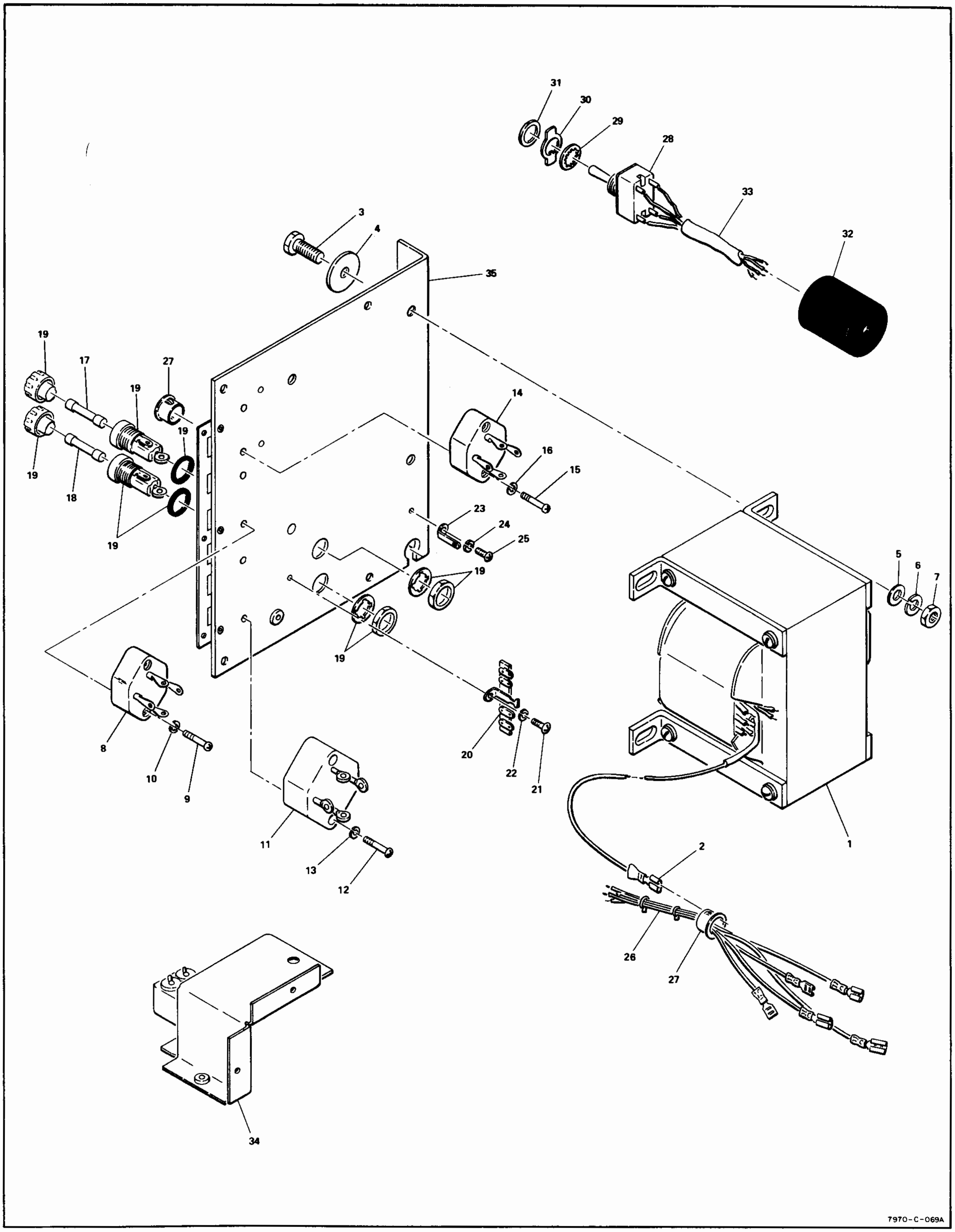


Figure 6-17. Transformer Assembly A19

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-17-	07970-60471	TRANSFORMER ASSEMBLY A19	REF
-1	9100-3120	. TRANSFORMER, power (T1)	1
-2	1251-2550	. . CONNECTOR (P1)	1
-3	0570-0108	. . SCREW, no. 1/4-20, 0.750-inch (AP)	4
-4	3050-0723	. . WASHER, flat (AP)	4
-5	3050-0099	. . WASHER, brass (AP)	4
-6	2190-0032	. . WASHER, lock, helical (AP)	4
-7	2950-0004	. . NUT, hex, no. 1/4-20 (AP)	4
-8	1906-0007	. DIODE ASSEMBLY, full wave bridge rectifier (CR1)	1
-9	2200-0151	. . SCREW, no. 4-40, 0.750-inch, pozi (AP)	2
-10	2190-0061	. . WASHER, lock, helical (AP)	2
-11	1901-0161	. DIODE ASSEMBLY, full wave bridge rectifier (CR2)	1
-12	2200-0153	. . SCREW, no. 4-40, 0.875-inch, pozi (AP)	2
-13	2190-0061	. . WASHER, lock, helical (AP)	2
-14	1906-0008	. DIODE ASSEMBLY, full wave bridge rectifier (CR3)	1
-15	2200-0151	. . SCREW, no. 4-40, 0.750-inch, pozi (AP)	2
-16	2190-0061	. . WASHER, lock, helical (AP)	2
-17	2110-0365	. FUSE, slo blo, 4A, 250V (F1)	1
-18	2110-0303	. FUSE, slo blo, 2A, 250V (F2)	1
-19	1400-0084	. FUSEHOLDER, 3 AG fuse, extractor post type (XF1, XF2)	2
-20	0360-1590	. TERMINAL STRIP, lug type (TB1)	1
-21	2200-0139	. . SCREW, no. 4-40, 0.250-inch, pozi (AP)	1
-22	2190-0061	. . WASHER, lock, helical (AP)	1
-23	0360-0043	. TERMINAL LUG, 5 stud (E1)	1
-24	2200-0139	. . SCREW, no. 4-40, 0.250-inch, pozi (AP)	1
-25	2190-0061	. . WASHER, lock, helical (AP)	1
-26	07970-60920	. WIRING HARNESS, power transformer (W2)	1
-27	0400-0056	. . BUSHING, snap, nylon	2
-28	3101-0003	. SWITCH, dpst (S1)	1
-29	2190-0102	. . WASHER, lock (AP)	1
-30	7122-0006	. . PLATE, indicator ON-OFF (AP)	1
-31	2950-0035	. . NUT, hex, no. 15/32-32 (AP)	1
-32	1401-0083	. CAP, protective	1
-33	8120-1496	. CABLE, shielded (W1)	1
-34	07970-60461	. CONNECTOR BRACKET, line power (includes FL/J1 and S2)	1
-35	07970-00211	. PANEL, power transformer	1

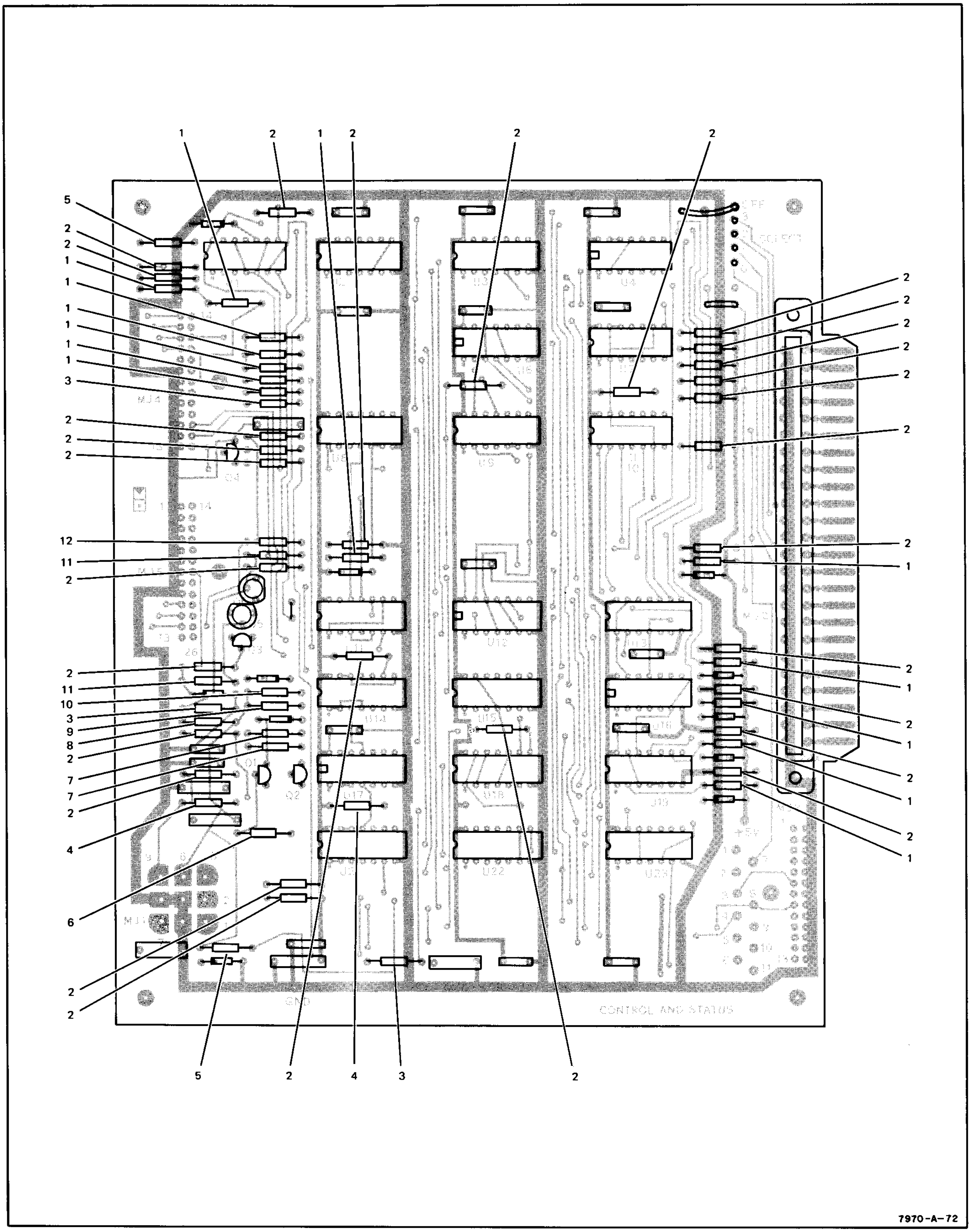


Figure 6-18. Control and Status PC Assembly A16 (Sheet 1 of 2)

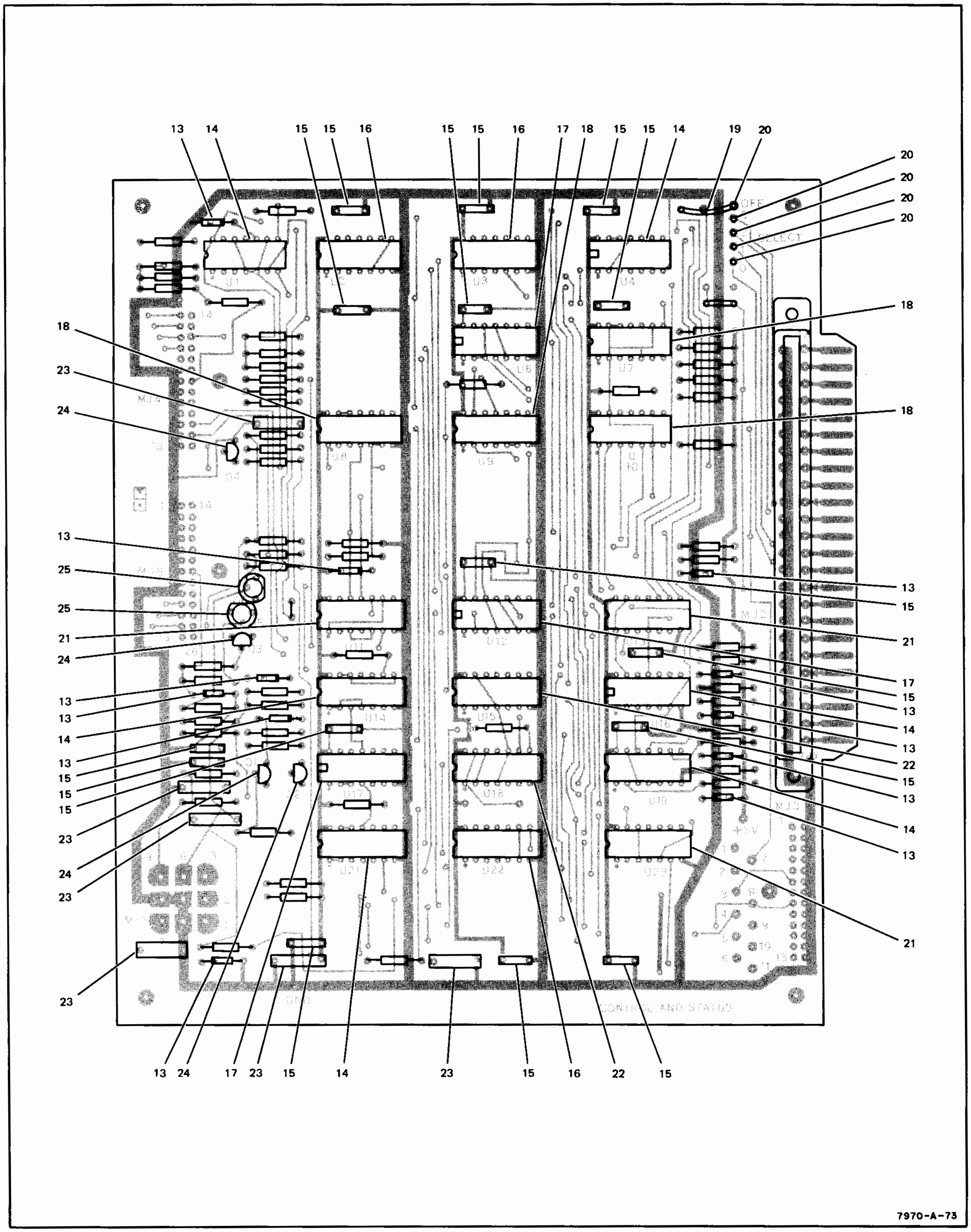


Figure 6-18. Control and Status PC Assembly A16 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-18-	07970-61080	CONTROL AND STATUS PC ASSEMBLY A16	REF
-1	0757-0418	. RESISTOR, fxd, 619 ohms, 1%, 1/8W (R1, R2, R3, R4, R5, R9, R27, R41, R42, R44, R46, R48, R103)	13
-2	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R7, R8, R10, R11, R12, R14, R17, R28, R29, R31 thru R40, R43, R45, R47, R49, R50, R51, R100, R101, R102)	28
-3	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R13, R24, R30)	3
-4	0698-0084	. RESISTOR, fxd, 2.15k, 1%, 1/8W (R18, R23)	2
-5	0757-0439	. RESISTOR, fxd, 6.81k, 1%, 1/8W (R6, R112)	2
-6	0757-0199	. RESISTOR, fxd, 21.5k, 1%, 1/8W (R110)	1
-7	0757-0421	. RESISTOR, fxd, 825 ohms, 1%, 1/8W (R19, R21)	2
-8	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R26)	1
-9	0698-3161	. RESISTOR, fxd, 38.3k, 1%, 1/8W (R22)	1
-10	0698-3162	. RESISTOR, fxd, 46.4k, 1%, 1/8W (R20)	1
-11	0698-3446	. RESISTOR, fxd, 383 ohms, 1%, 1/8W (R16, R25)	2
-12	0757-0401	. RESISTOR, fxd, 100 ohms, 1%, 1/8W (R15)	1
-13	1901-0040	. DIODE, Si (CR2 thru CR11, CR100)	11
-14	1820-0054	. INTEGRATED CIRCUIT, type 7400N (U1, U4, U14, U16, U19, U21)	6
-15	0160-2055	. CAPACITOR, fxd, 0.01 μF (C1, C2, C4, C6 thru C17)	13
-16	1820-0069	. INTEGRATED CIRCUIT, type 7420N (U2, U3, U22)	3
-17	1820-0077	. INTEGRATED CIRCUIT, type 7474N (U6, U12, U17)	3
-18	1820-0256	. INTEGRATED CIRCUIT (U7, U8, U9, U10)	4
-19	1200-0063	. RECEPTACLE (P/O W1)	1
-20	0360-0124	. TERMINAL, pin, PC board (X1, X2, X3, X4, X5)	5
-21	1820-0141	. INTEGRATED CIRCUIT (U11, U13, U23)	3
-22	1820-0348	. INTEGRATED CIRCUIT, type 844 (U15, U18).	2
-23	0150-0121	. CAPACITOR, fxd, 0.1 μF, 50 Vdcw (C3, C5, C20, C21, C22, C23)	6

Table 6-1. Part Number Cross Reference

HP PART NUMBER	MFR CODE	MFR PART NUMBER
0050-1647	28480	0050-1647
0150-0121	56289	5C50BIS-CML
0160-0153	56289	192P10292-PTS
0160-0161	56289	192P10392-PTS
0160-0165	56289	192P56392-PTS
0160-0174	56289	5C11B7S-CML
0160-0380	28480	0160-0380
0160-2055	56289	C023F101F103ZS22-CDH
0160-2128	56289	225P33402Y-PWM
0160-2149	56289	4586-97A
0160-2151	28480	0160-2151
0160-2199	28480	0160-2199
0160-2207	28480	0160-2207
0160-2224	28480	0160-2224
0160-2250	72982	301-000-COHO-519E
0160-2414	28480	0160-2414
0160-3387	56289	192P3949R8PTS
0160-3456	56289	C067F251F102KE12-CDH
0160-3536	00853	RDM15F621JIC
0180-0059	28480	0180-0059
0180-0097	56289	150D476X9035S2-DYS
0180-0104	56289	30D207G015DF4-DSM
0180-0172	56289	30D505G015BA2-DSM
0180-0228	56289	150D226X9015B2-DYS
0180-1970	56289	4586-2D
0180-2325	90201	CGS152U075BD3L
0180-2326	90201	CGS103U015BD3L
0180-2327	90201	CGS243U030ED3L
0340-0164	28480	0340-0164
0340-0180	28480	0340-0180
0360-0043	00000	OBD
0360-0124	28480	0360-0124
0360-1590	71785	SPECIAL OBD
0380-0013	00000	OBD
0380-0016	00000	OBD
0400-0056	28520	SB-500-6
0403-0163	00000	OBD
0490-0890	77342	27E046
0490-0891	77342	KUP14D15
0510-0238	79136	5100-18-C
0510-1107	78553	P116-625-6-495
0520-0129	00000	OBD
0520-0131	00000	OBD
0570-0082	00000	OBD
0570-0108	00000	OBD
0610-0001	00000	OBD
0624-0062	00000	OBD
0624-0098	00000	OBD
0683-1015	01121	CB 1015
0683-1025	01121	CB 1025
0683-1025	01121	CB 1025
0683-1035	01121	CB 1035
0683-3315	01121	CB 3315
0683-3325	01121	CB 3325
0683-4715	01121	CB 4715
0683-5125	01121	CB 5125
0683-6815	01121	CB 6815
0686-1035	01121	EB 1035
0686-2215	01121	EB 2215
0698-0083	28480	0698-0083

HP PART NUMBER	MFR CODE	MFR PART NUMBER
0698-0084	28480	0698-0084
0698-0085	28480	0698-0085
0698-3113	28480	0698-3113
0698-3150	38480	0698-3150
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0698-7027	01121	BB 1061
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0757-0199	28480	0757-0199
0757-0278	28480	0757-0278
0757-0280	28480	0757-0280
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0811-2180	28480	0811-2180
0811-2966	28480	0811-2966
0812-0045	28480	0812-0045
1200-0063	28480	1200-0063

Table 6-1. Part Number Cross Reference (Continued)

HP PART NUMBER	MFR CODE	MFR PART NUMBER
1200-0077	16037	112
1200-0426	01295	IC-014ST-7519
1251-2550	00779	42844-1
1251-2874	23880	8018-15
1390-0228	94222	44-1-11-0
1400-0084	75915	342014
1400-0187	95987	5/16-6B
1400-0291	95987	3/16-6B
1400-0292	95987	1/4-6B
1400-0293	95987	3/8-6B
1400-0294	95987	1/2-6B
1400-0296	95987	5/8-6B
1400-0302	95987	1/8-6B
1401-0083	77969	3276 MODIFIED
1460-1035	00000	OBD
1460-1181	00000	OBD
1460-1250	00000	OBD
1820-0054	01295	SN7400N
1820-0069	01295	SN7420N
1820-0077	01295	SN7474N
1820-0141	04713	MC3001P
1820-0223	28480	1820-0223
1820-0256	04713	MC858P
1820-0348	04713	MC844P
1820-0439	07263	U6E7723393
1853-0012	80131	2N2904A
1853-0027	07263	S1554S
1853-0036	80131	2N3906
1853-0052	80131	2N3740
1853-0080	80131	2N4888
1853-0204	80131	2N4920
1854-0022	07263	S17843
1854-0039	80131	2N3053
1854-0045	04713	2N956
1854-0053	80131	2N2218
1854-0063	80131	2N3055
1854-0072	80131	2N3054
1854-0215	80131	2N3904
1854-0264	80131	2N3715
1854-0347	80131	2N4923
1854-0490	28480	1854-0490
1855-0052	80131	2N4360
1884-0088	86684	2N3228
1901-0025	07263	FD 2387
1901-0040	07263	FDG1088
1901-0161	28480	1901-0161
1901-0364	28480	1901-0364
1901-0415	28480	1901-0415
1901-0630	28480	1901-0630
1902-0033	04713	1N823
1902-0048	04713	SZ10939-134
1902-3171	28480	1902-3171
1902-3311	28480	1902-3311
1906-0007	04713	MDA952-3
1906-0008	04713	MDA-952-1
1990-0087	03508	2N5777
1990-0307	28480	1990-0307
2100-1759	28480	2100-1759
2100-1762	75042	CT-106-4
2100-1773	28480	2100-1773

HP PART NUMBER	MFR CODE	MFR PART NUMBER
2100-1972	28480	2100-1972
2100-2850	28480	3100-2850
2110-0003	75915	312003
2110-0051	71400	ABC-10AMP
2110-0303	71400	MDX-2A
2110-0365	71400	MDA-4 AMP
2140-0203	71744	CM8-428
2140-0209	03508	382
2140-0351	00000	L328
2190-0003	28480	2190-0003
2190-0004	00000	OBD
2190-0005	00000	OBD
2190-0007	28480	2190-0007
2190-0008	00000	OBD
2190-0012		
2190-0014	28480	2190-0014
2190-0032		
2190-0034	28480	2190-0034
2190-0040	00000	OBD
2190-0061	00000	OBD
2190-0071	78189	1804-00
2190-0085	00000	OBD
2190-0102	28480	2190-0102
2190-0149	00000	OBD
2190-0181	00000	OBD
2190-0312	00000	OBD
2190-0416	00000	OBD
2190-0417	00000	OBD
2190-0420	00000	OBD
2190-0429	00000	OBD
2190-0432	00000	OBD
2190-0451	95987	D6-128
2190-0452	95987	D6-140
2190-0453	95987	D6-191
2190-0475	08289	NY-10-030
2190-0483	00000	OBD
2200-0125	00000	OBD
2200-0139	00000	OBD
2200-0141	00000	OBD
1854-0053	80131	2N2218
1854-0063	80131	2N3055
1854-0072	80131	2N3054
1854-0215	80131	2N3904
1854-0264	80131	2N3715
1854-0347	80131	2N4923
1854-0490	28480	1854-0490
1855-0052	80131	2N4360
1884-0088	86684	2N3228
1901-0025	07263	FD 2387
1901-0040	07263	FDG1088
1901-0161	28480	1901-0161
1901-0364	28480	1901-0364
1901-0415	28480	1901-0415
1901-0630	28480	1901-0630
1902-0033	04713	1N823
1902-0048	04713	SZ10939-134
1902-3171	28480	1902-3171
1902-3311	28480	1902-3311
1906-0007	04713	MDA952-3
1906-0008	04713	MDA-952-1

Table 6-1. Part Number Cross Reference (Continued)

HP PART NUMBER	MFR CODE	MFR PART NUMBER
1990-0087	03508	2N5777
1990-0307	28480	1990-0307
2100-1759	28480	2100-1759
2100-1762	75042	CT-106-4
2100-1773	28480	2100-1773
2100-1972	28480	2100-1972
2100-2850	28480	2100-2850
2110-0003	75915	312003
2110-0051	71400	ABC-10AMP
2110-0303	71400	MDX-2A
2110-0365	71400	MDA-4 AMP
2140-0203	71744	CM8-428
2140-0209	03508	382
2140-0351	00000	L328
2190-0003	28480	2190-0003
2190-0004	00000	OBD
2190-0005	00000	OBD
2190-0007	28480	2190-0007
2190-0008	00000	OBD
2190-0012		
2190-0014	28480	2190-0014
2190-0032		
2190-0034	28480	2190-0034
2190-0040	00000	OBD
2190-0061	00000	OBD
2190-0071	78189	1804-00
2190-0085	00000	OBD
2190-0102	28480	2190-0102
2190-0149	00000	OBD
2190-0181	00000	OBD
2190-0312	00000	OBD
2190-0416	00000	OBD
2190-0417	00000	OBD
2190-0420	00000	OBD
2190-0429	00000	OBD
2190-0432	00000	OBD
2190-0451	95987	D6-128
2190-0452	95987	D6-140
2190-0453	95987	D6-191
2190-0475	08289	NY-10-030
2190-0483	00000	OBD
2200-0125	00000	OBD
2200-0139	00000	OBD
2200-0141	00000	OBD
2200-0143	00000	OBD
2200-0145	00000	OBD
2200-0147	00000	OBD
2200-0151	00000	OBD
2200-0153	00000	OBD

HP PART NUMBER	MFR CODE	MFR PART NUMBER
2200-0166	00000	OBD
2260-0002	00000	OBD
2260-0009	00000	OBD
2360-0193	00000	OBD
2360-0195	00000	OBD
2360-0197	00000	OBD
2360-0201	00000	OBD
2360-0210	00000	OBD
2420-0001	78189	OBD
2680-0065	00000	OBD
2680-0099	00000	OBD
2680-0101	00000	OBD
2680-0103	0000	OBD
2680-0104	00000	OBD
2680-0105	00000	OBD
2680-0118	00000	OBD
2680-0128	0000	OBD
2680-0129	0000	OBD
2950-0004	00000	OBD
2950-0035	00000	OBD
2950-0036	73734	9006
3030-0038		
3030-0047	0000	OBD
3030-0196	00000	OBD
3030-0310	0000	OBD
3030-0329	0000	OBD
3030-0401	0000	OBD
3030-0425	0000	OBD
3050-0002	00000	OBD
3050-0016	00000	OBD
3050-0032	00000	OBD
3050-0065	0000	OBD
3050-0099	00000	OBD
3050-0105	28480	3050-0105
3050-0227	80120	AN960AC-6
3050-0232	00000	OBD
3050-0253	28480	3050-0253
3050-0424	78189	3515-14-12
3050-0723	00000	OBD
3050-0729	00000	OBD
3101-0003	04009	81024-GT
3101-0846	82389	75061-A-30A
3101-1213	81640	T8001
3102-0009	80207	2LMW-E
3140-0705	28480	3140-0705
3140-0748	28480	3140-0748
3980-0062	28480	3980-0062
4320-0237	00000	OBD
7122-0006	18911	827-228F3
8120-1496	70903	2258-4
9100-3120	28480	9100-3120

SECTION VII
MAINTENANCE DIAGRAMS

This section contains schematic and parts location diagrams for the tape transport of the HP 7970B/7970C Digital Magnetic Tape Unit.

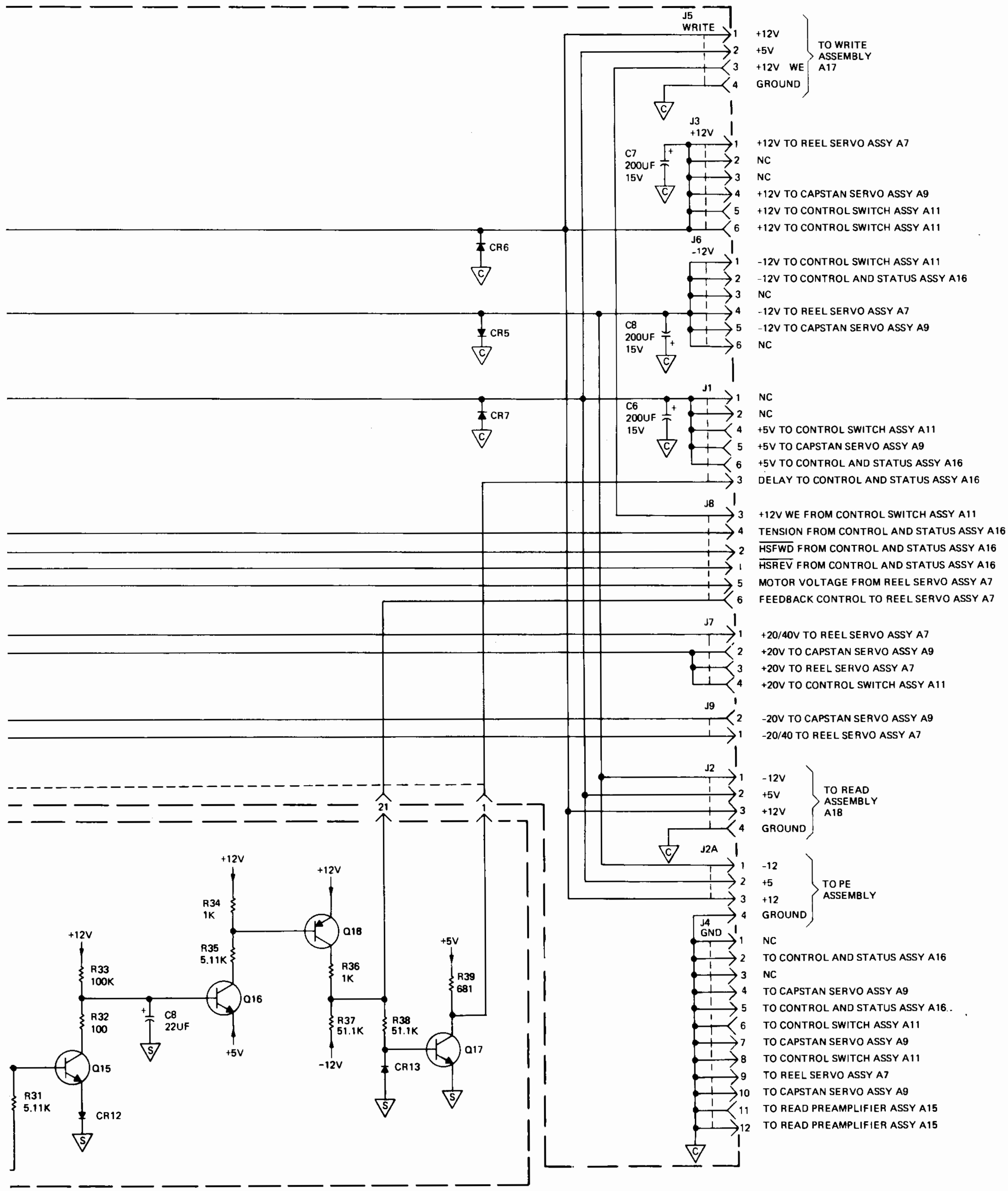
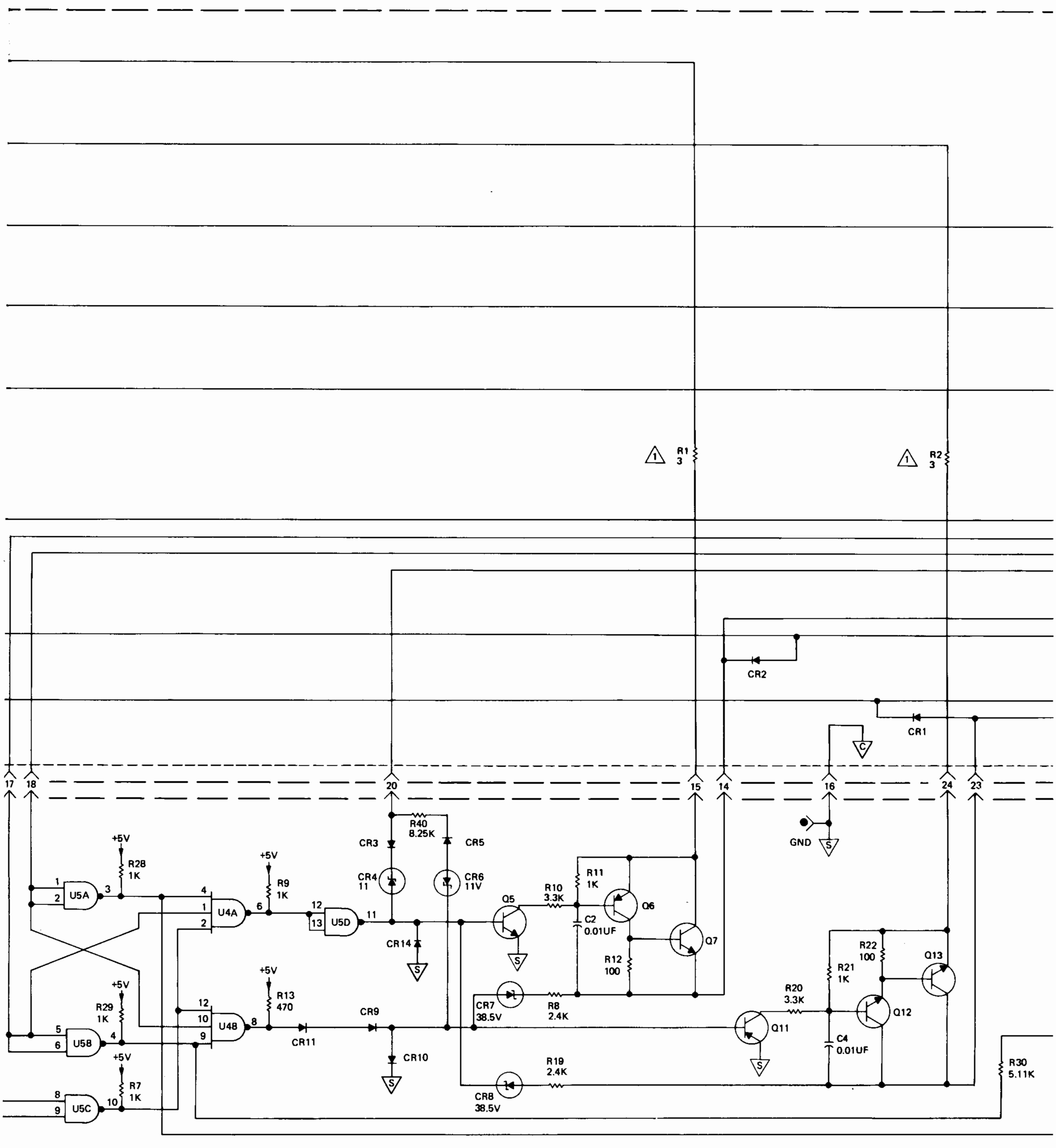
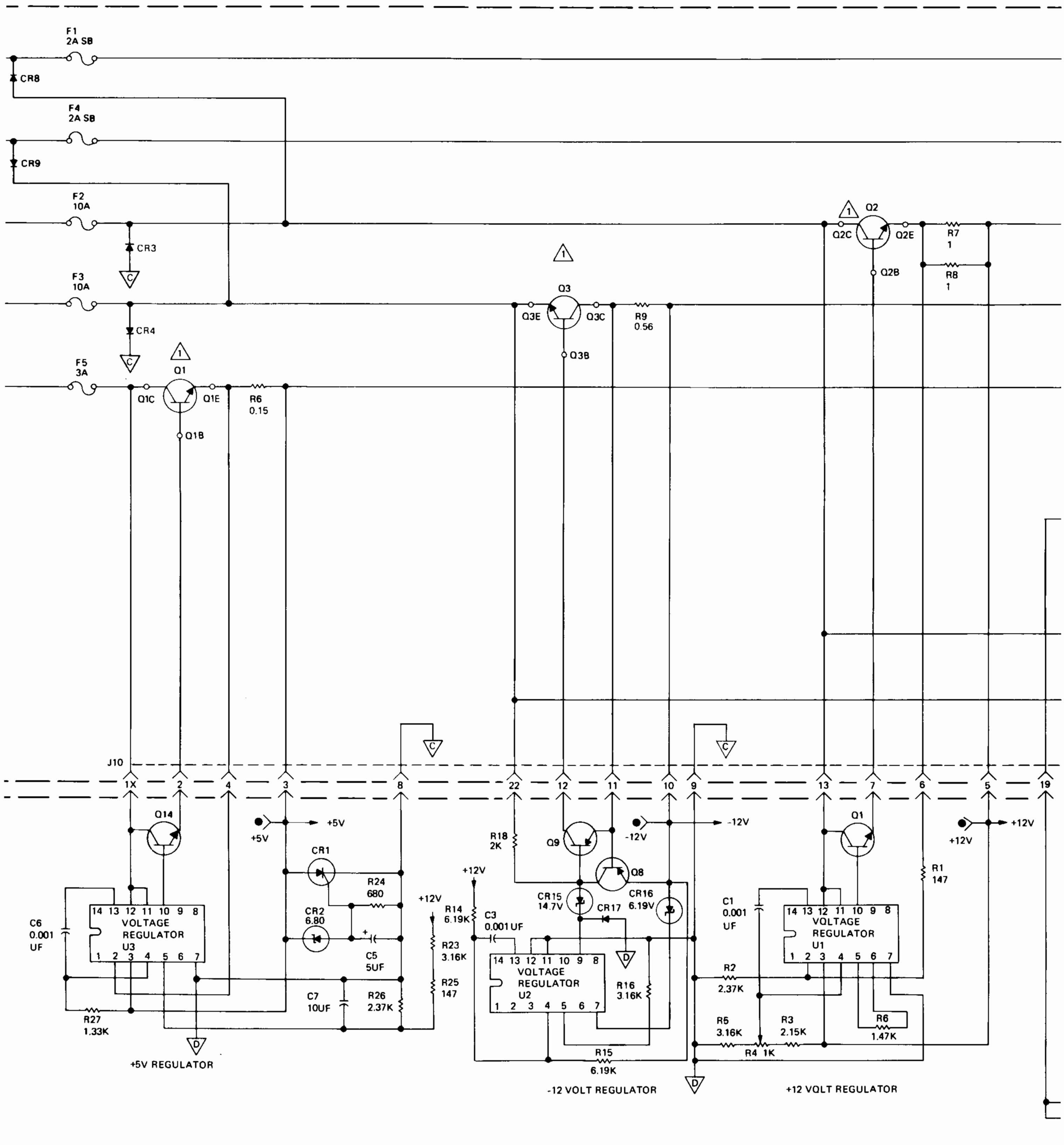


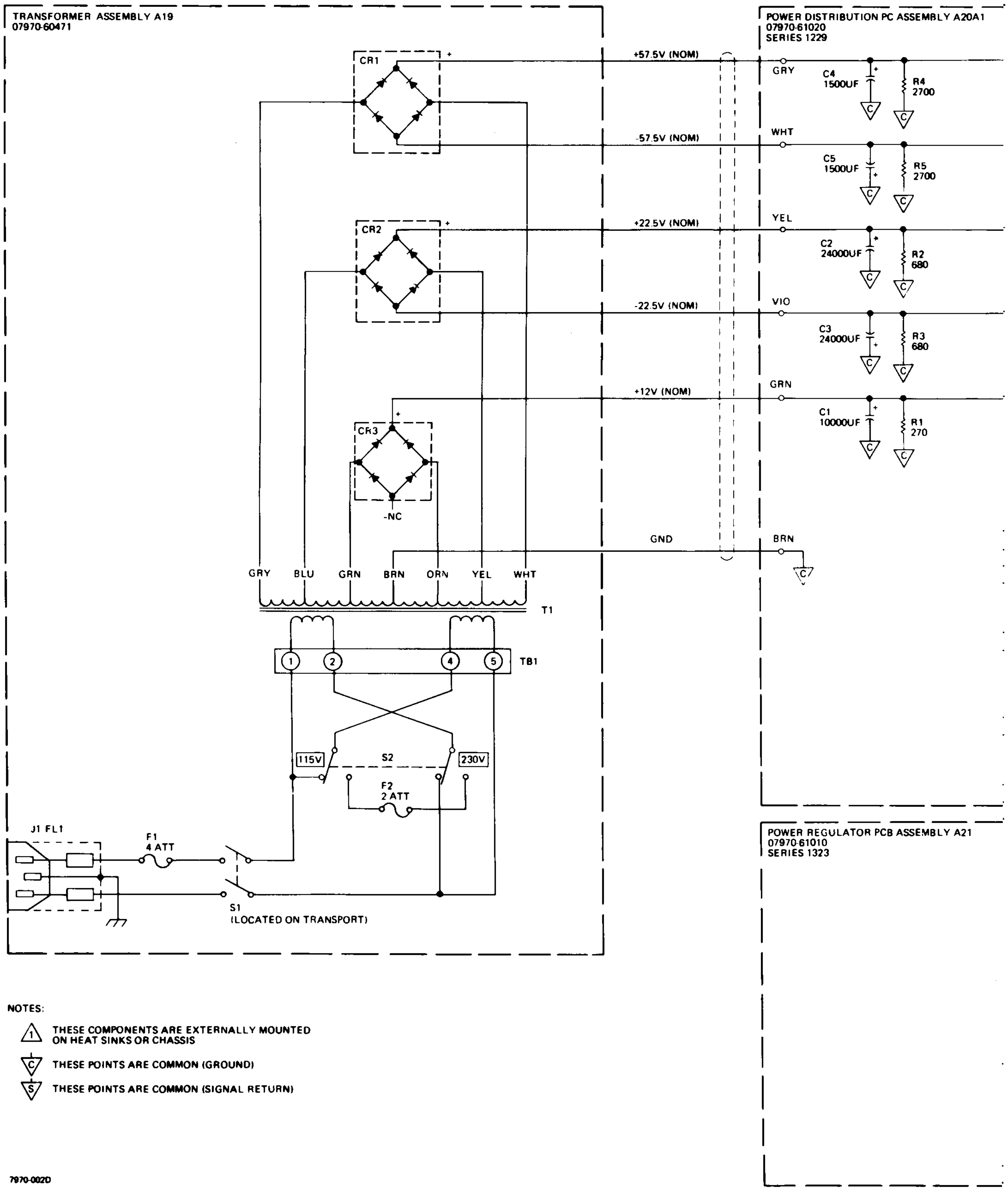
Figure 7-2. Power Supply and Distribution Assemblies A19, A20, and A21, Schematic Diagrams



R1
3
R2
3
CR2
CR1
17
18
20
15
14
16
24
23
GND
R40
8.25K
CR3
CR5
CR4
11
CR6
11V
+5V
R28
1K
R9
1K
U5A
U4A
U5D
Q5
R10
3.3K
R11
1K
Q6
C2
0.01UF
Q7
R12
100
CR14
R22
100
R21
1K
Q13
R20
3.3K
Q12
CR7
38.5V
R8
2.4K
Q11
C4
0.01UF
R29
1K
U5B
U4B
R13
470
CR11
CR9
CR10
R19
2.4K
CR8
38.5V
R30
5.11K
R7
1K
U5C



F1 2A SB
CR8
F4 2A SB
CR9
F2 10A
CR3
F3 10A
CR4
F5 3A
Q1
Q1C
Q1E
Q1B
R6 0.15
Q3
Q3E
Q3C
Q3B
R9 0.56
Q2
Q2C
Q2E
Q2B
R7 1
R8 1
J10
1X 2 4 3 8 22 12 11 10 9 13 7 6 5 19
Q14
+5V
CR1
R24 680
CR2 6.80
C5 5UF
C7 10UF
R26 2.37K
+12V
R23 3.16K
R25 147
C6 0.001 UF
VOLTAGE REGULATOR U3
R27 1.33K
+5V REGULATOR
R18 2K
Q9
Q8
-12V
CR15 14.7V
CR17
CR16 6.19V
R14 6.19K
C3 0.001 UF
VOLTAGE REGULATOR U2
R16 3.16K
R15 6.19K
-12 VOLT REGULATOR
C1 0.001 UF
VOLTAGE REGULATOR U1
R1 147
R2 2.37K
R5 3.16K
R4 1K
R3 2.15K
R6 1.47K
+12 VOLT REGULATOR



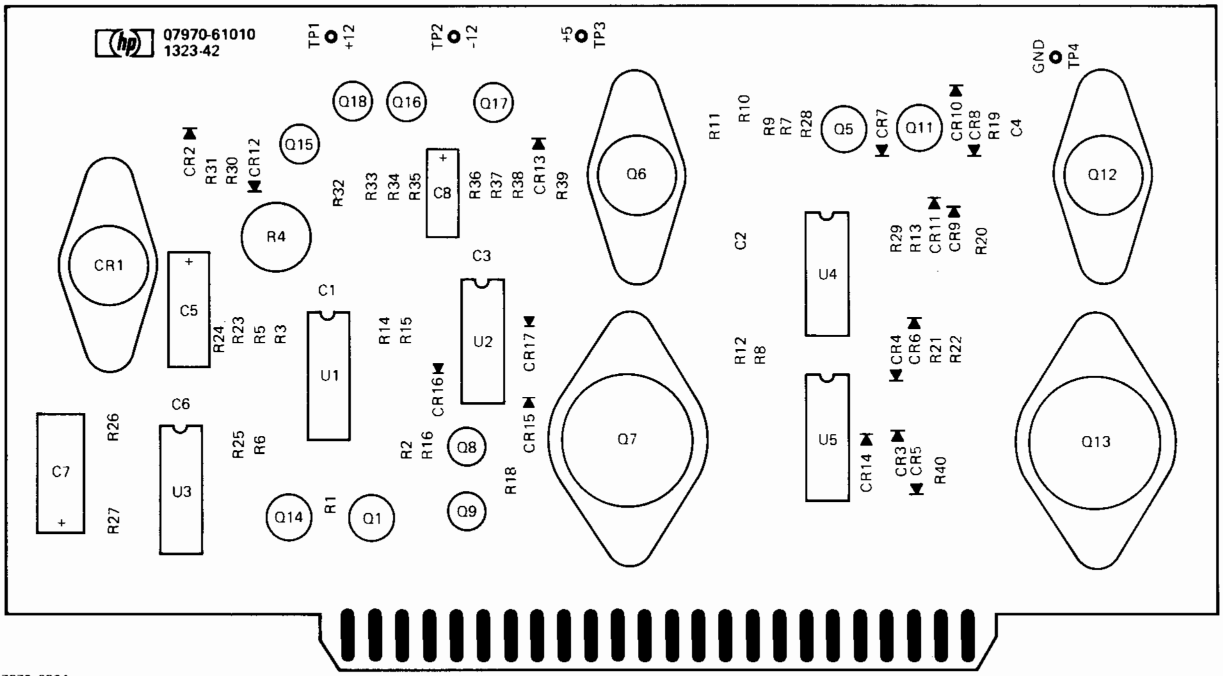
NOTES:

1. THESE COMPONENTS ARE EXTERNALLY MOUNTED ON HEAT SINKS OR CHASSIS

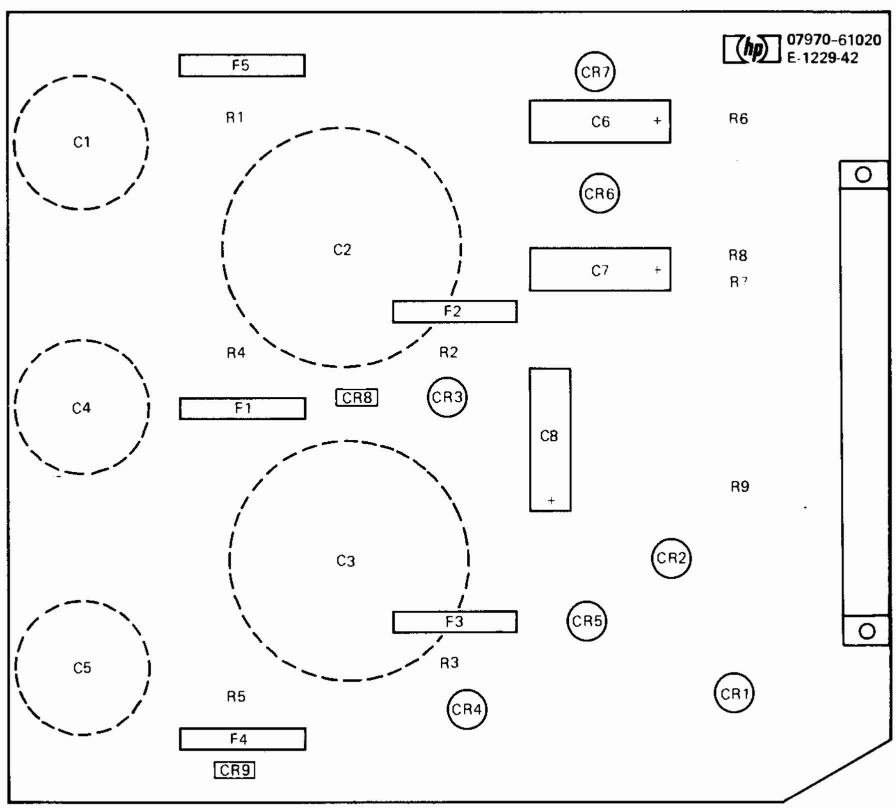
C THESE POINTS ARE COMMON (GROUND)

S THESE POINTS ARE COMMON (SIGNAL RETURN)

7970-002D



7970-396A



7970-395A

Figure 7-1. Power Distribution PC Assembly A20 and Power Regulator PC Assembly A21, Parts Location Diagrams

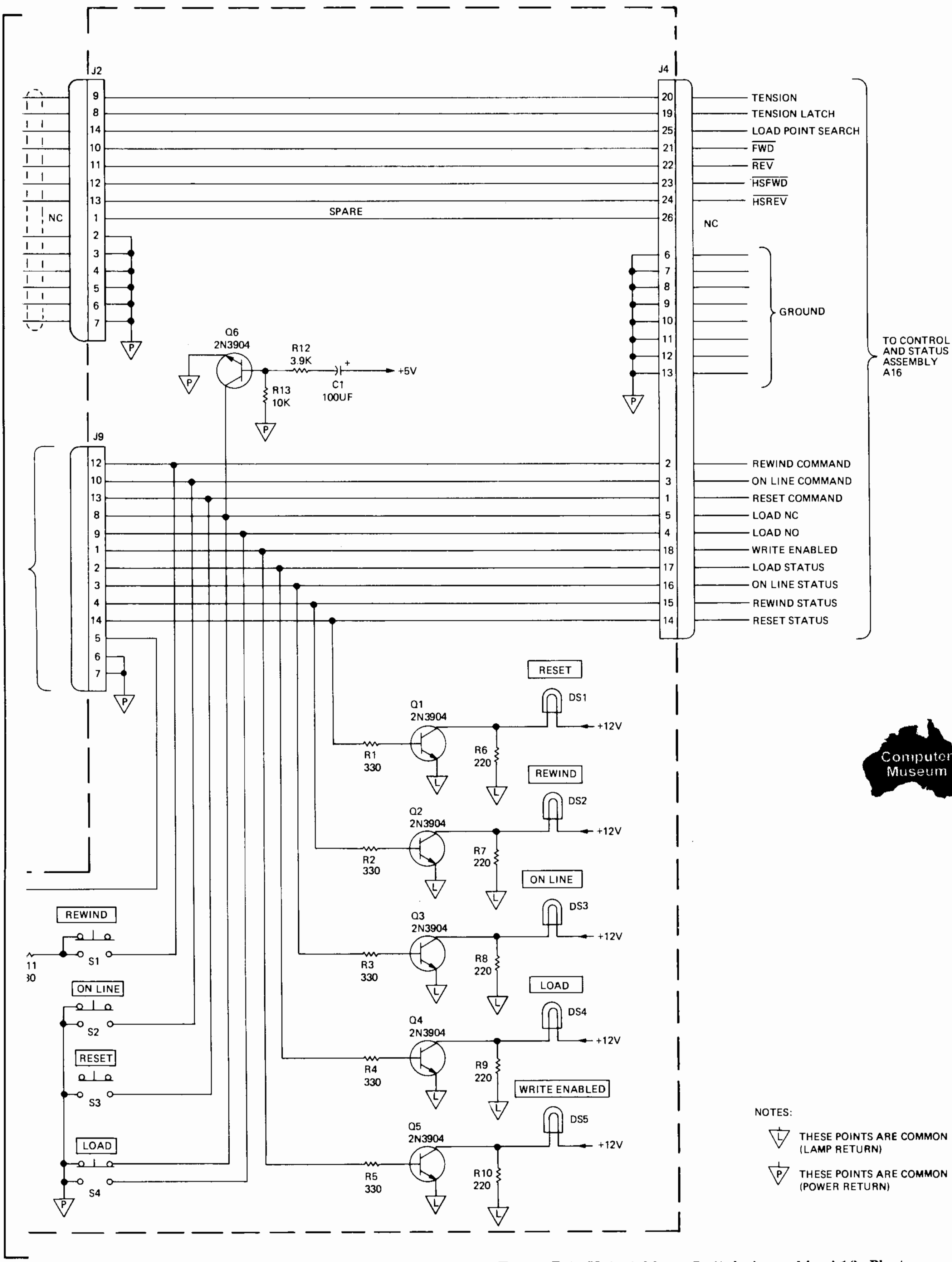
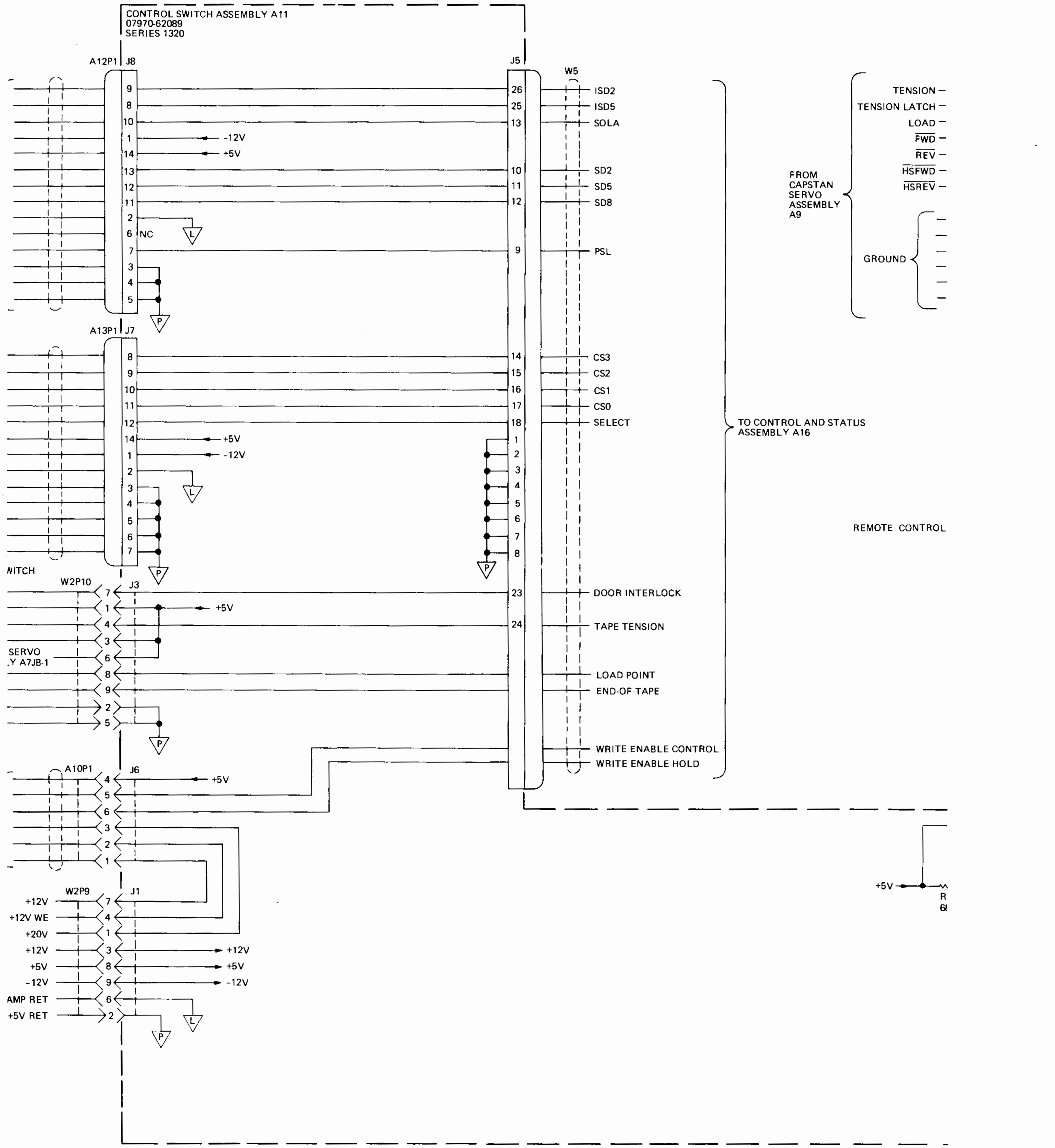
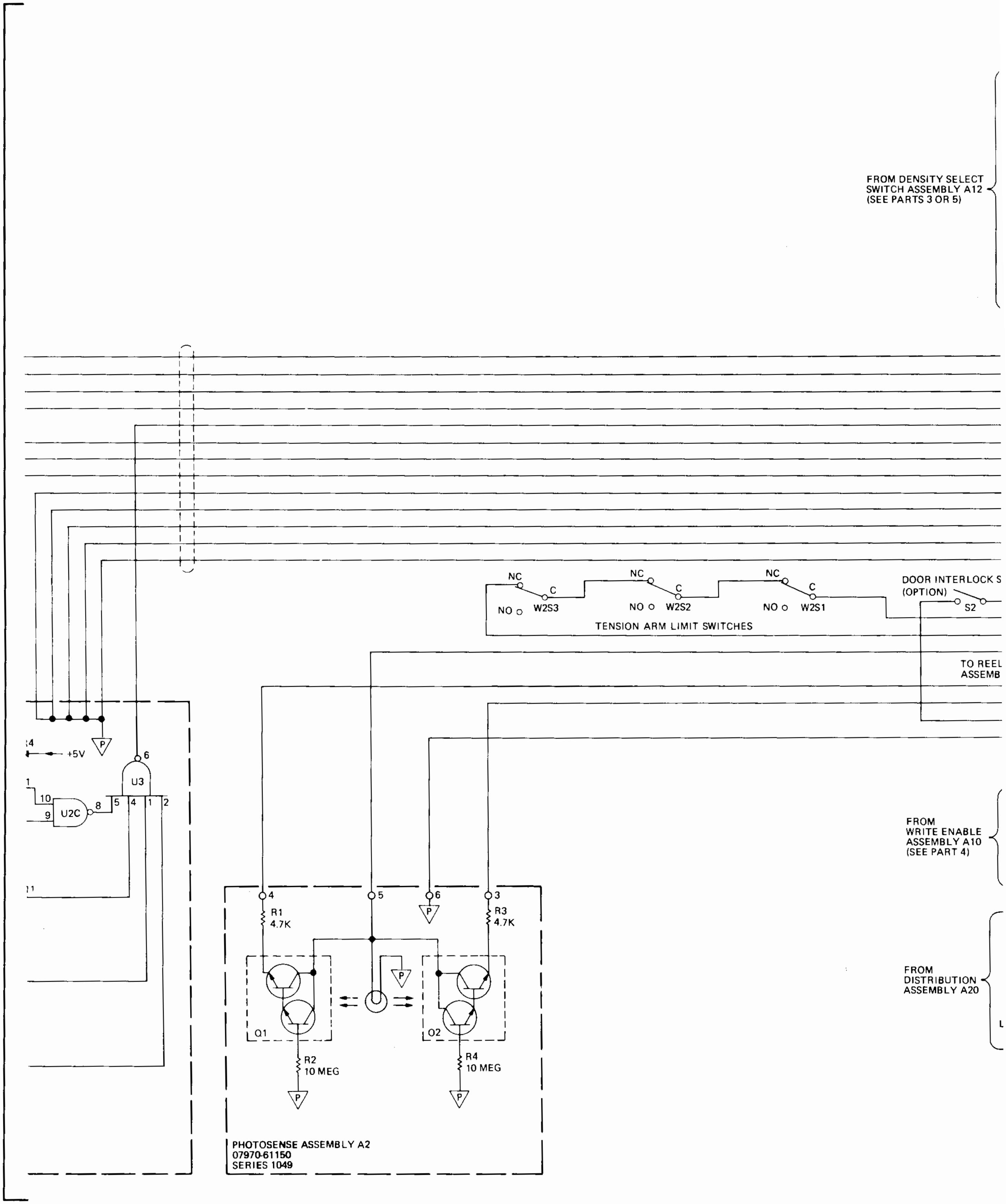
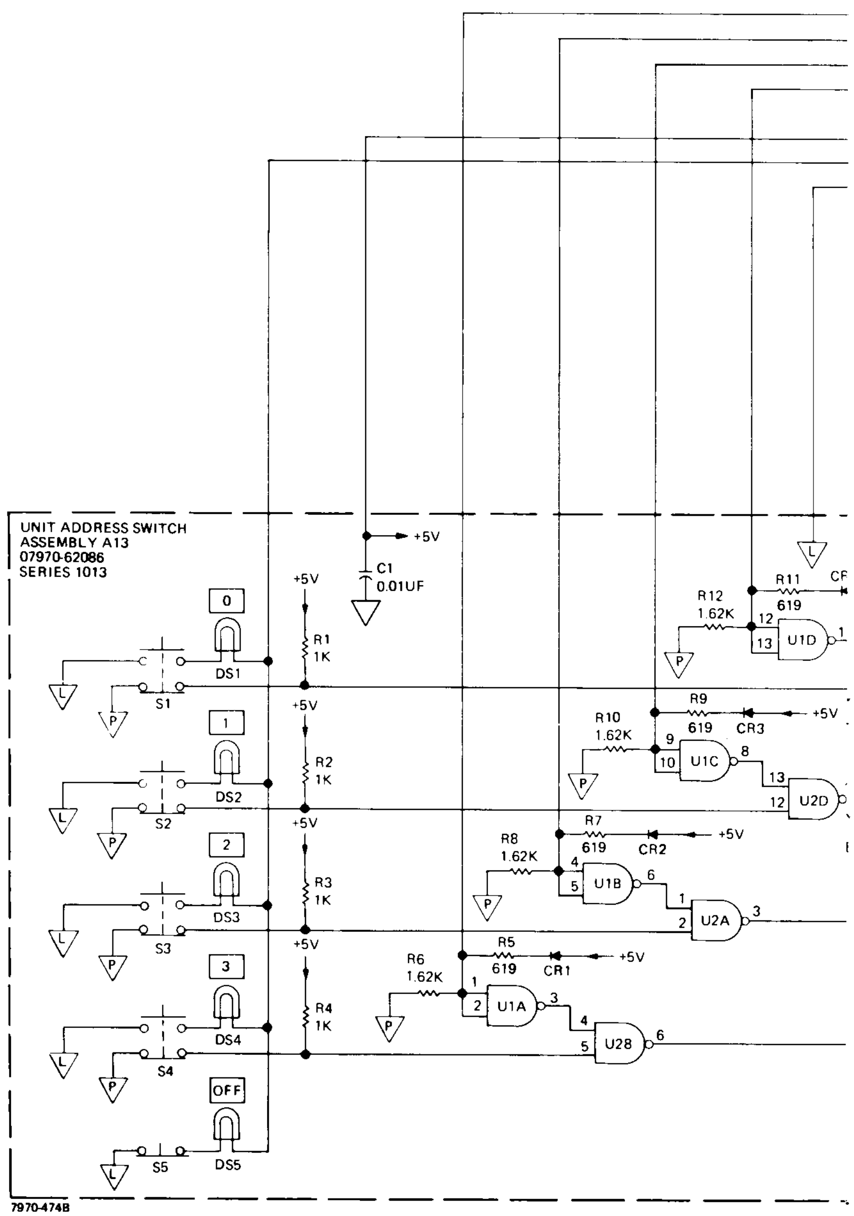


Figure 7-4. Unit Address Switch Assembly A13, Photosense Assembly A2, and Control Switch Assembly A11, Schematic Diagrams



CONTROL SWITCH ASSEMBLY A11
07970-62089
SERIES 1320
A12P1
J8
J5
W5
ISD2
ISD5
SOLA
-12V
+5V
SD2
SD5
SD8
NC
PSL
TENSION
TENSION LATCH
LOAD
FWD
REV
HSFWD
HSREV
FROM CAPSTAN SERVO ASSEMBLY A9
GROUND
A13P1
J7
CS3
CS2
CS1
CS0
SELECT
TO CONTROL AND STATUS ASSEMBLY A16
REMOTE CONTROL
W2P10
J3
DOOR INTERLOCK
TAPE TENSION
SERVO
Y A7JB-1
LOAD POINT
END-OF-TAPE
WRITE ENABLE CONTROL
WRITE ENABLE HOLD
A10P1
J6
W2P9
J1
+12V
+12V WE
+20V
+5V
-12V
AMP RET
+5V RET


FROM DENSITY SELECT SWITCH ASSEMBLY A12 (SEE PARTS 3 OR 5)
NC
C
NO
W2S3
W2S2
W2S1
TENSION ARM LIMIT SWITCHES
DOOR INTERLOCK S
(OPTION)
S2
TO REEL ASSEMB
+5V
U3
U2C
FROM WRITE ENABLE ASSEMBLY A10 (SEE PART 4)
R1 4.7K
R3 4.7K
R2 10 MEG
R4 10 MEG
Q1
Q2
FROM DISTRIBUTION ASSEMBLY A20
PHOTOSENSE ASSEMBLY A2
07970-61150
SERIES 1049


UNIT ADDRESS SWITCH
ASSEMBLY A13
07970-62086
SERIES 1013
+5V
C1
0.01UF
0
1
2
3
OFF
DS1
DS2
DS3
DS4
DS5
S1
S2
S3
S4
S5
R1
1K
R2
1K
R3
1K
R4
1K
R5
619
R6
1.62K
R7
619
R8
1.62K
R9
619
R10
1.62K
R11
619
R12
1.62K
CR1
CR2
CR3
U1A
U1B
U1C
U1D
U2A
U2D
U28
7970-474B

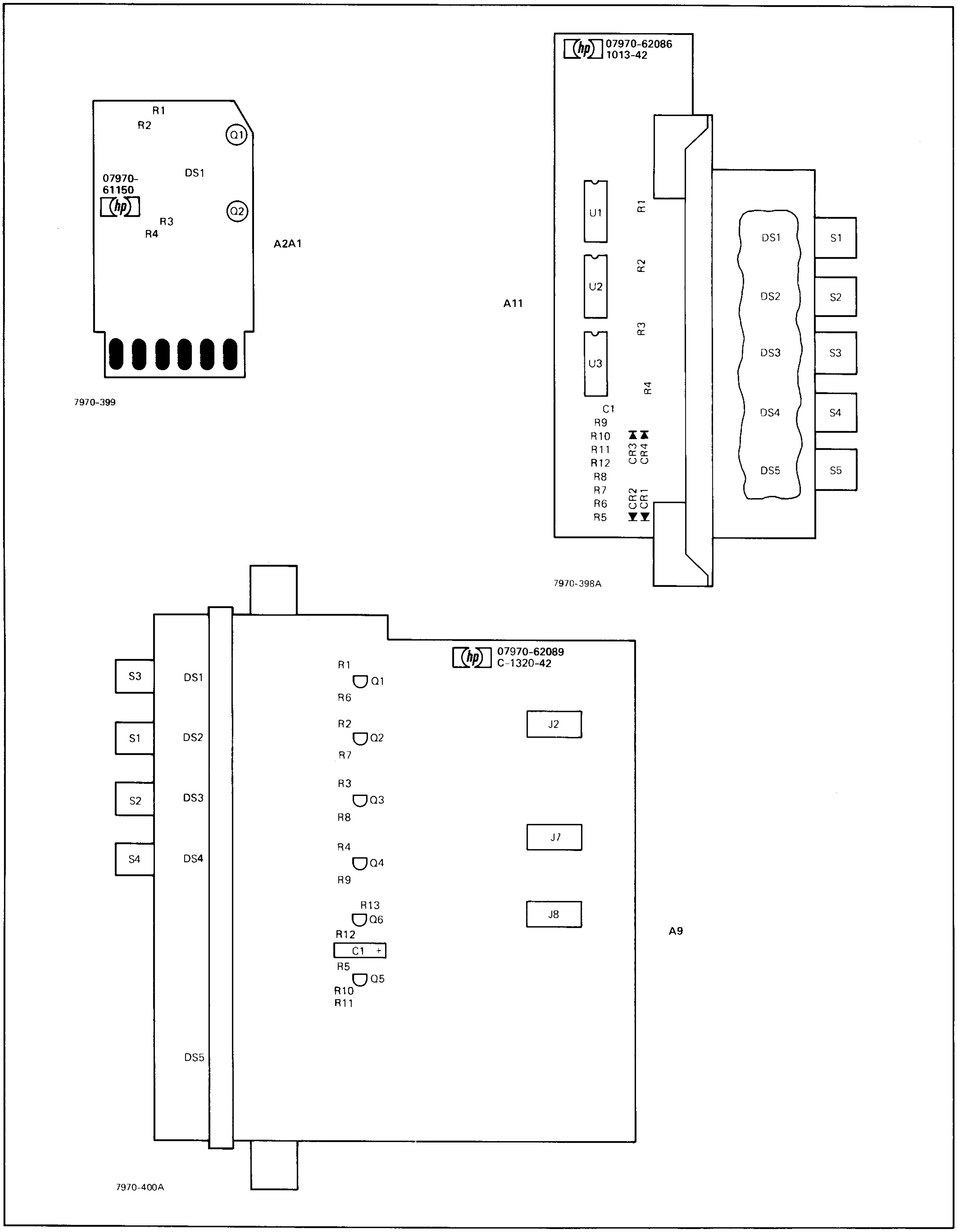


Figure 7-3. Unit Address Switch Assembly A13, Photosense Assembly A2, and Control Switch Assembly A11, Parts Location Diagrams

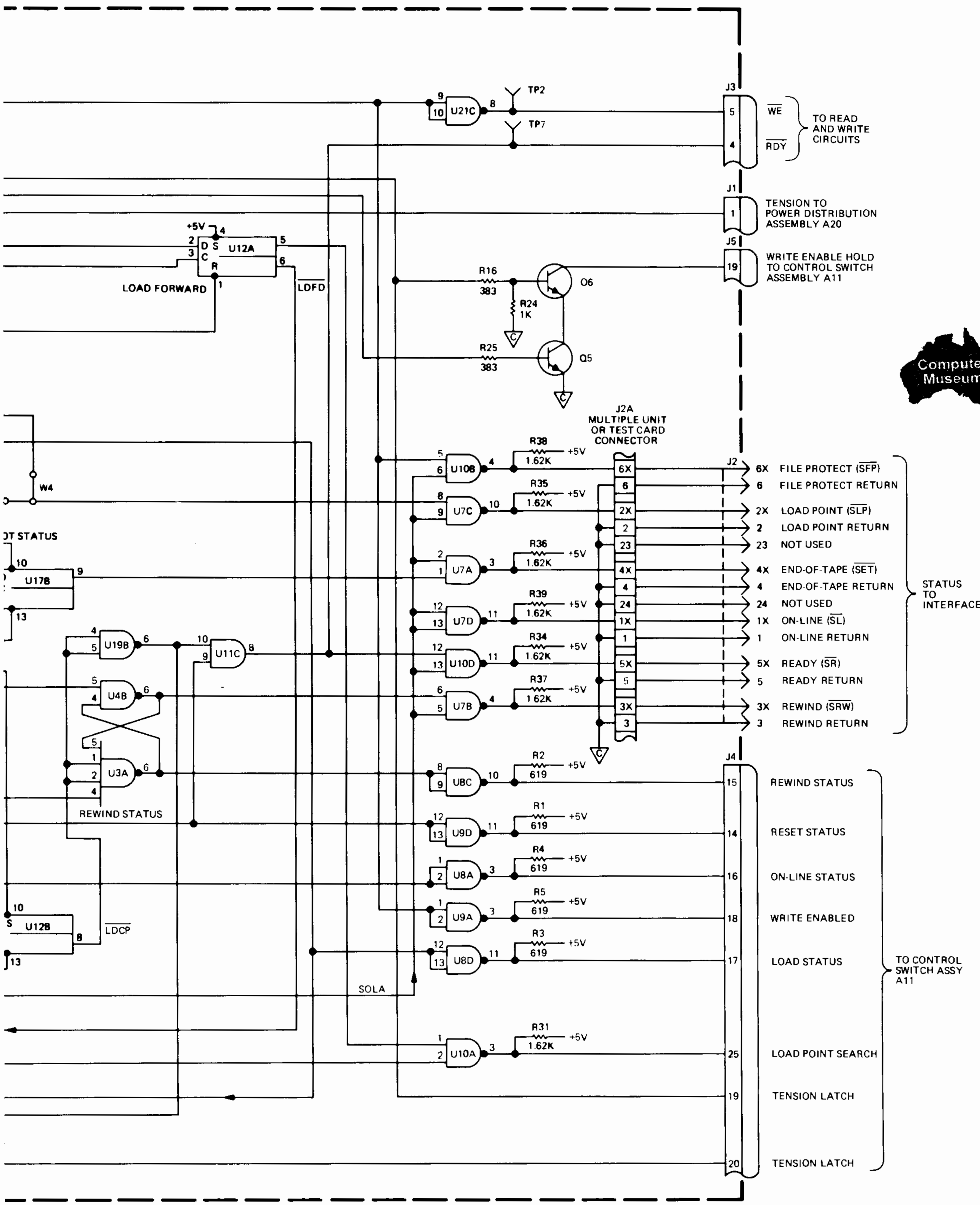
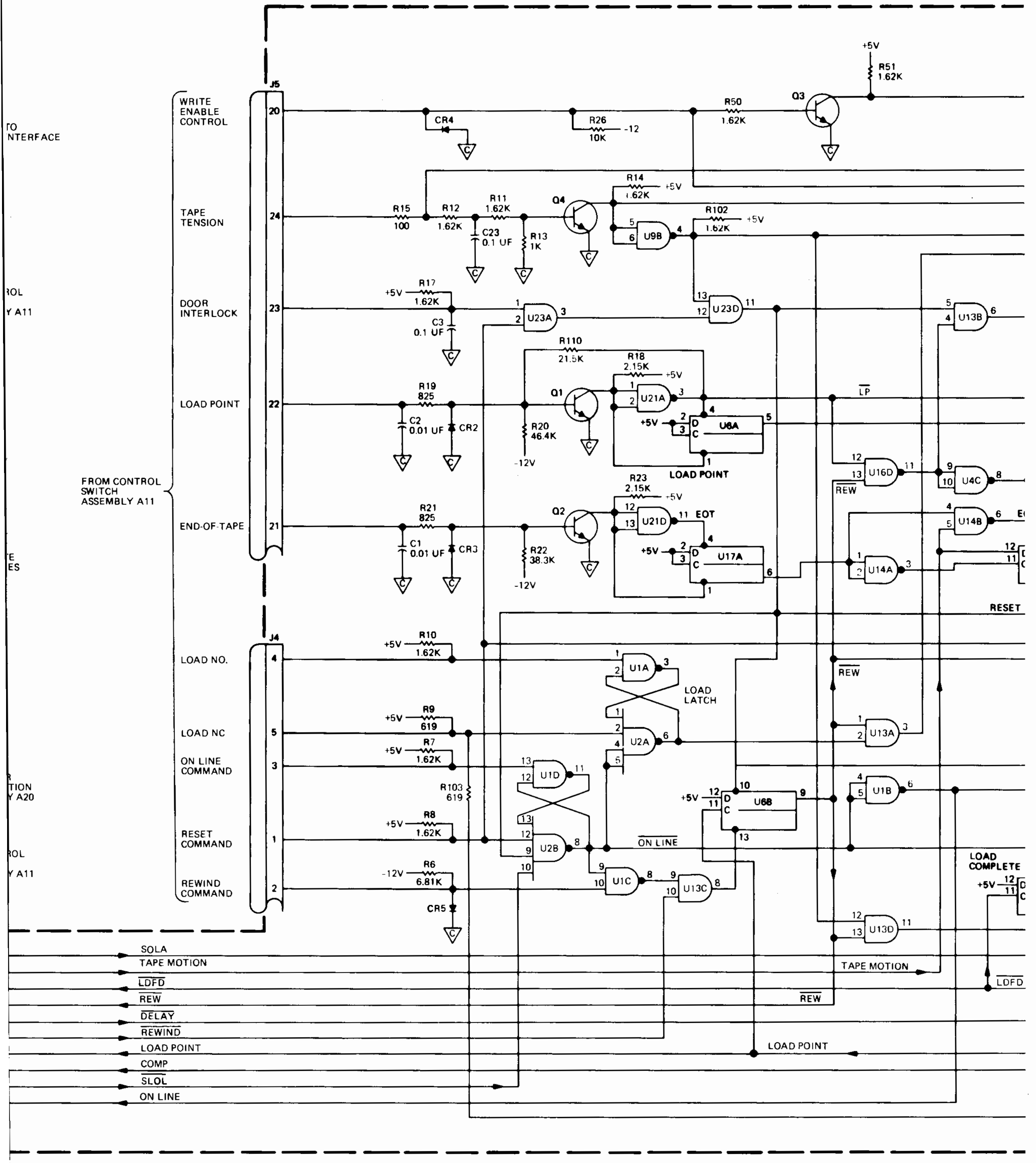
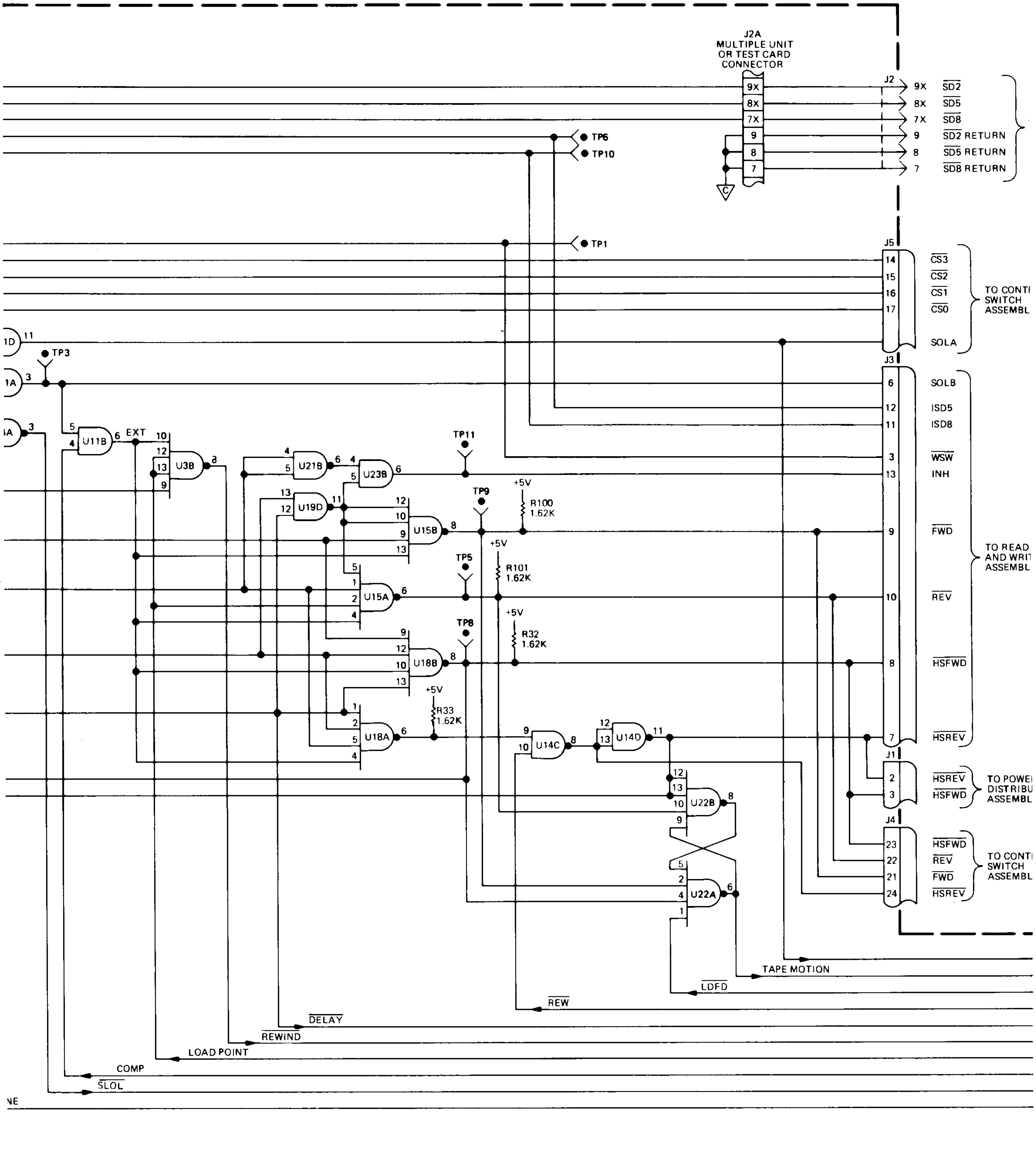
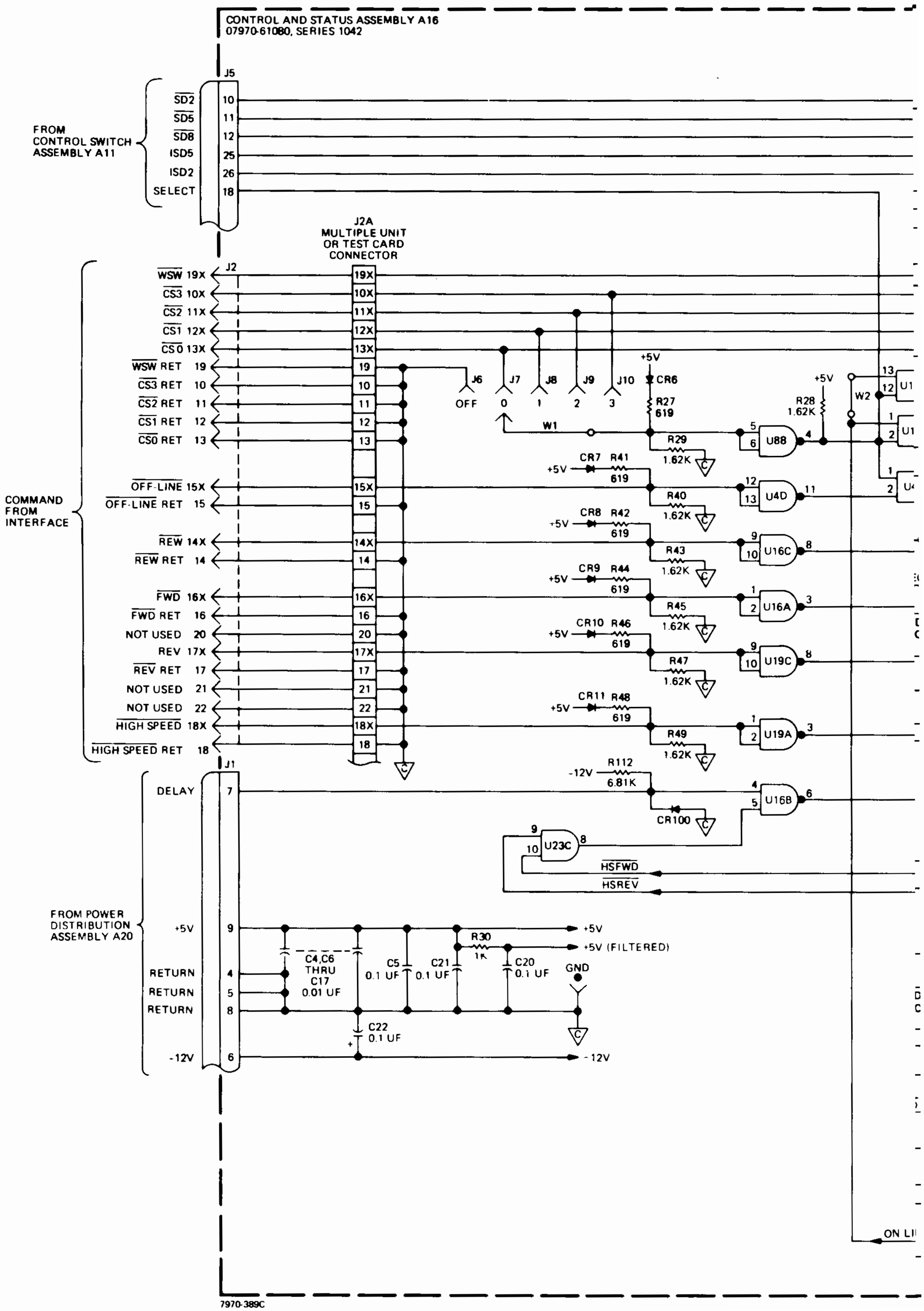


Figure 7-6. Control and Status PC Assembly A16, Schematic Diagram



TO INTERFACE
WRITE ENABLE CONTROL
TAPE TENSION
DOOR INTERLOCK
LOAD POINT
END-OF-TAPE
FROM CONTROL SWITCH ASSEMBLY A11
LOAD NO.
LOAD NC
ON LINE COMMAND
RESET COMMAND
REWIND COMMAND
J5
J4
LOAD LATCH
LOAD POINT
EOT
RESET
LP
REW
ON LINE
LOAD COMPLETE
SOLA
TAPE MOTION
LDFD
REW
DELAY
REWIND
LOAD POINT
COMP
SLOL
ON LINE


J2A
MULTIPLE UNIT
OR TEST CARD
CONNECTOR
J2
9X
8X
7X
9
8
7
SD2
SD5
SD8
SD2 RETURN
SD5 RETURN
SD8 RETURN
TP6
TP10
TP1
J5
CS3
CS2
CS1
CS0
SOLA
TO CONTI
SWITCH
ASSEMBL
TP3
J3
SOLB
ISD5
ISD8
WSW
INH
FWD
REV
HSFWD
HSREV
TO READ
AND WRI
ASSEMBL
EXT
U11B
U3B
U21B
U23B
U19D
U15B
U15A
U18B
U18A
U14C
U14D
U22B
U22A
TP11
TP9
TP5
TP8
+5V
R100
1.62K
R101
1.62K
R32
1.62K
R33
1.62K
J1
TO POWEI
DISTRIBU
ASSEMBL
J4
TO CONTI
SWITCH
ASSEMBL
TAPE MOTION
LDFD
REW
DELAY
REWIND
LOAD POINT
COMP
SLOL



CONTROL AND STATUS ASSEMBLY A16
07970-61080, SERIES 1042
J5
FROM CONTROL SWITCH ASSEMBLY A11
SD2 10
SD5 11
SD8 12
ISD5 25
ISD2 26
SELECT 18
J2A MULTIPLE UNIT OR TEST CARD CONNECTOR
J2
COMMAND FROM INTERFACE
WSW 19X
CS3 10X
CS2 11X
CS1 12X
CS0 13X
WSW RET 19
CS3 RET 10
CS2 RET 11
CS1 RET 12
CS0 RET 13
OFF-LINE 15X
OFF-LINE RET 15
REW 14X
REW RET 14
FWD 16X
FWD RET 16
NOT USED 20
REV 17X
REV RET 17
NOT USED 21
NOT USED 22
HIGH SPEED 18X
HIGH SPEED RET 18
J6 OFF
J7 0
J8 1
J9 2
J10 3
W1
+5V
CR6
R27 619
R29 1.62K
U8B
R28 1.62K
W2
CR7 R41 619
R40 1.62K
U4D
CR8 R42 619
R43 1.62K
U16C
CR9 R44 619
R45 1.62K
U16A
CR10 R46 619
R47 1.62K
U19C
CR11 R48 619
R49 1.62K
U19A
-12V R112 6.81K
U16B
CR100
U23C
HSFWD
HSREV
J1
DELAY 7
FROM POWER DISTRIBUTION ASSEMBLY A20
+5V 9
RETURN 4
RETURN 5
RETURN 8
-12V 6
C4,C6 THRU C17 0.01 UF
C5 0.1 UF
C21 0.1 UF
R30 1K
C20 0.1 UF
C22 0.1 UF
GND
+5V
+5V (FILTERED)
-12V
ON LI
7970-389C

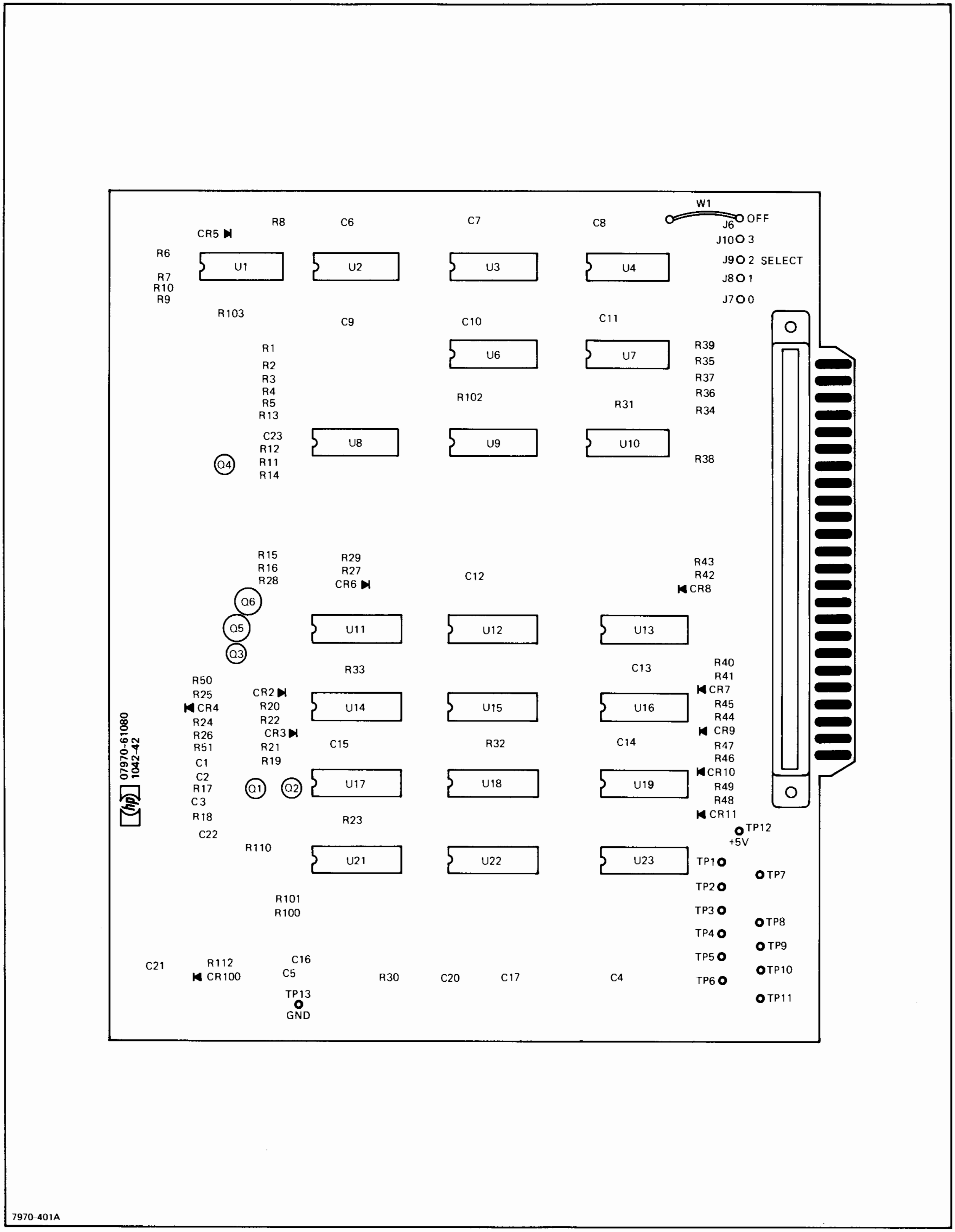


Figure 7-5. Control and Status PC Assembly A16, Parts Location Diagram

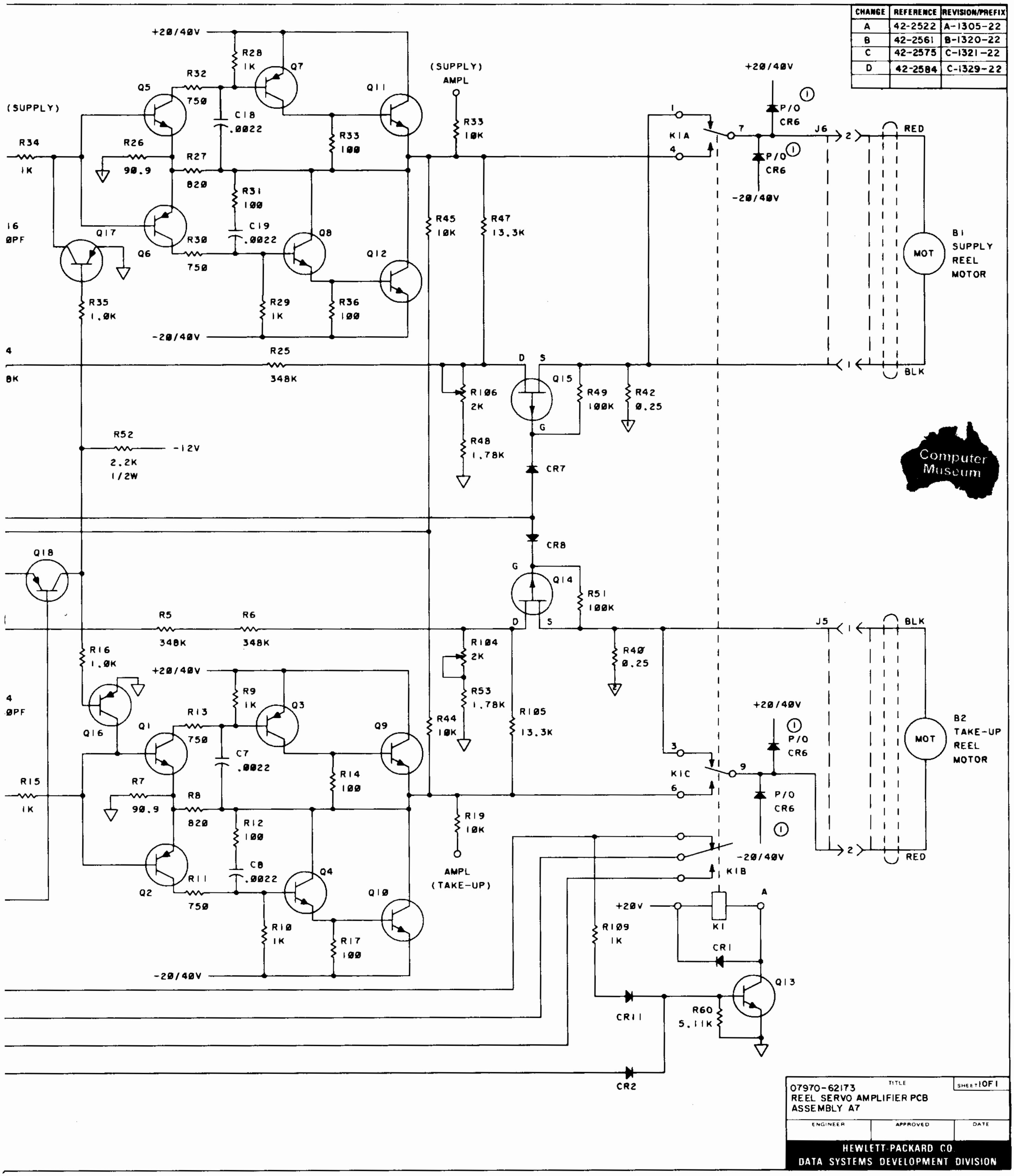
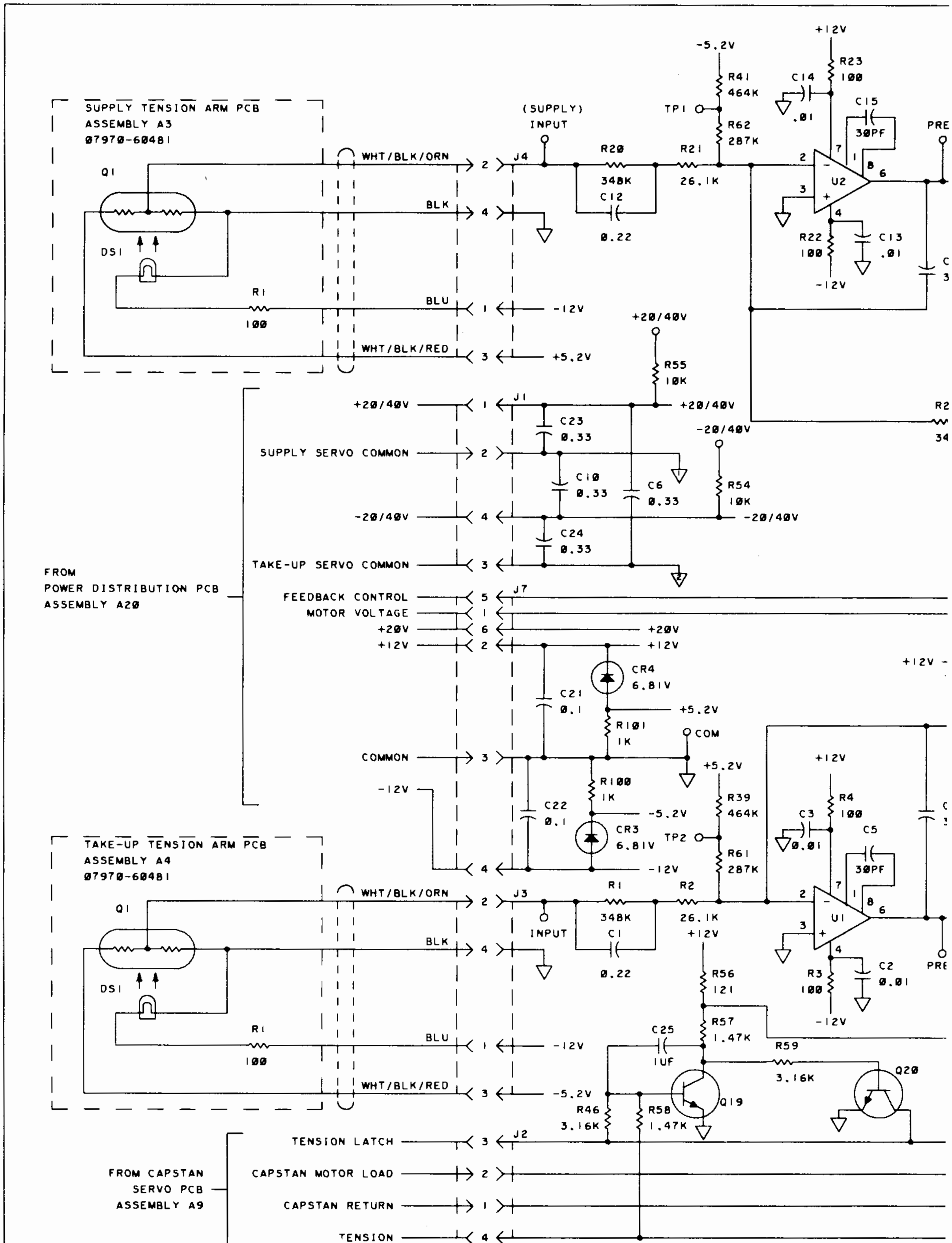


Figure 7-8. Reel Servo Assemblies A3/A4 and A7, Schematic Diagram



NOTE: 1. CR6 IS AN ENCAPSULATED BRIDGE CIRCUIT.
2. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCES ARE IN OHMS, ALL CAPACITANCE ARE IN MICROFARADS.
3. COMMON (SUPPLY SERVO RETURN)
4. COMMON (TAKE-UP SERVO RETURN)

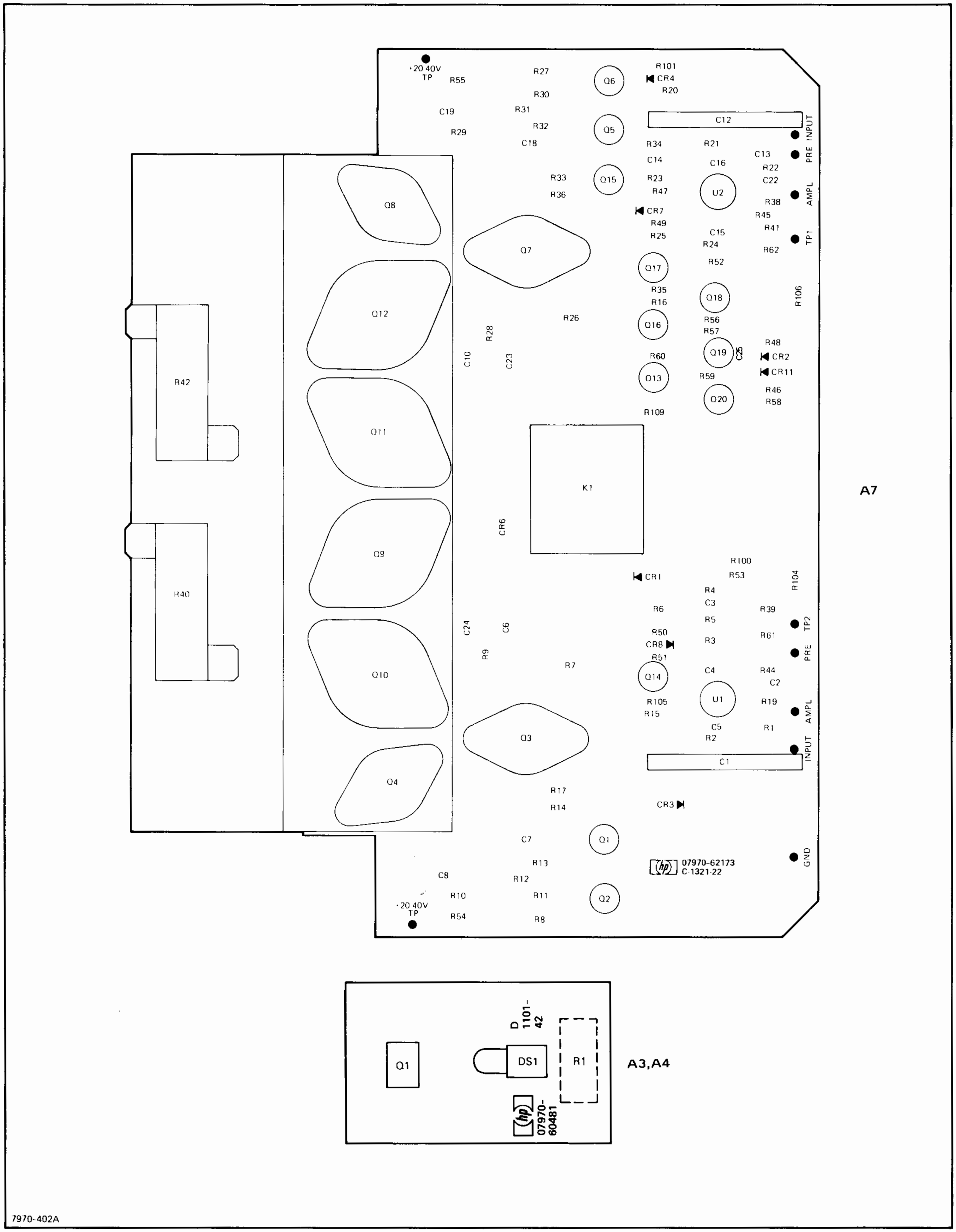
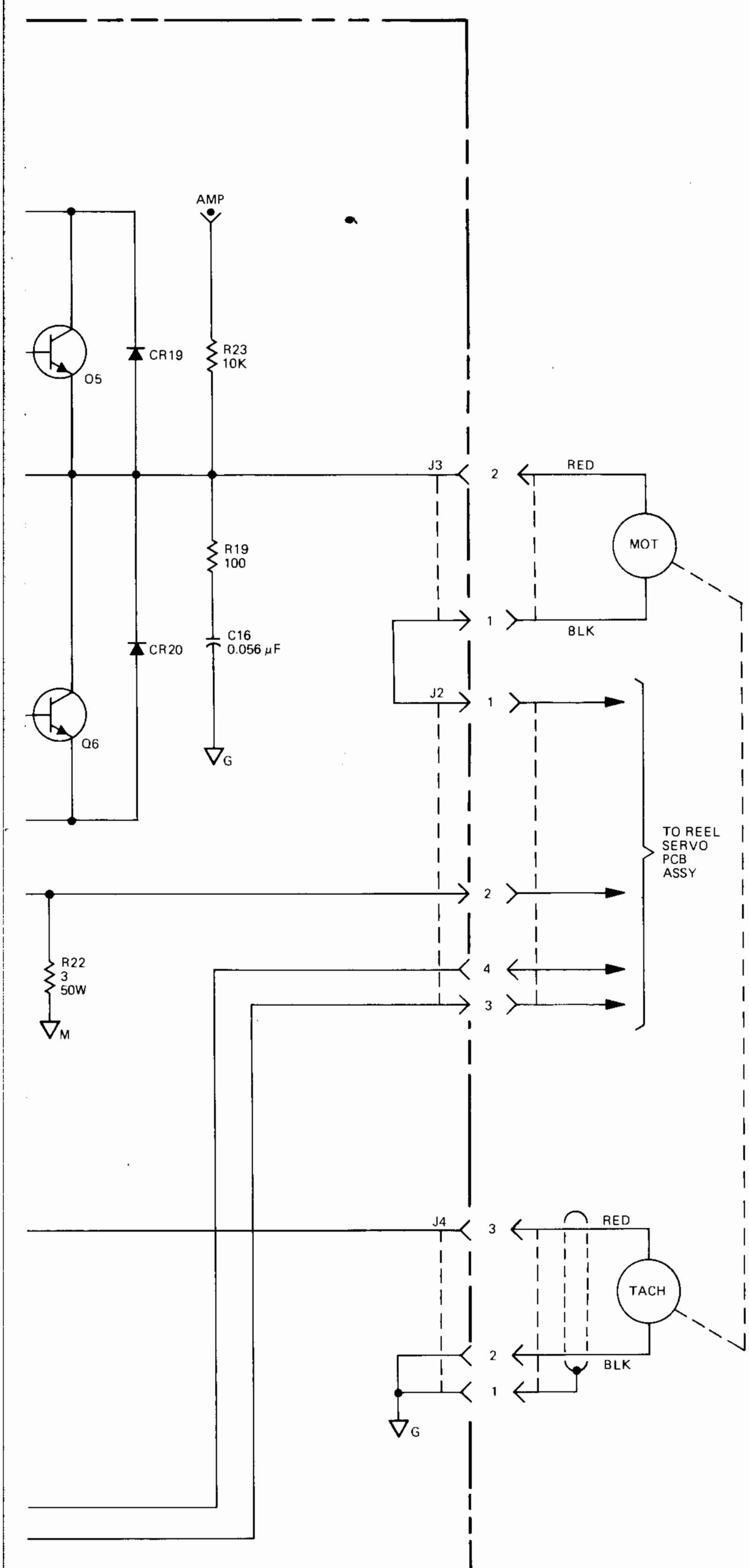
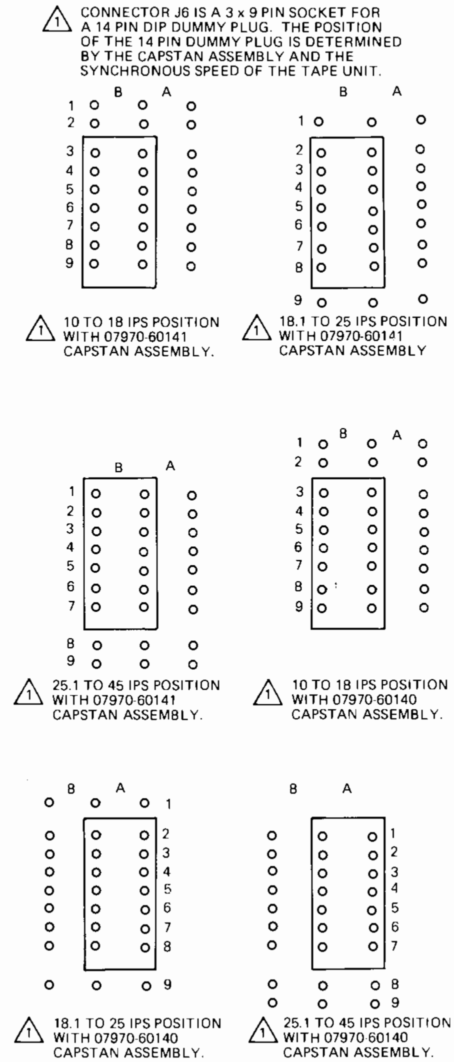


Figure 7-7. Reel Servo Assemblies A3/A4 and A7, Parts Location Diagram





NOTES:

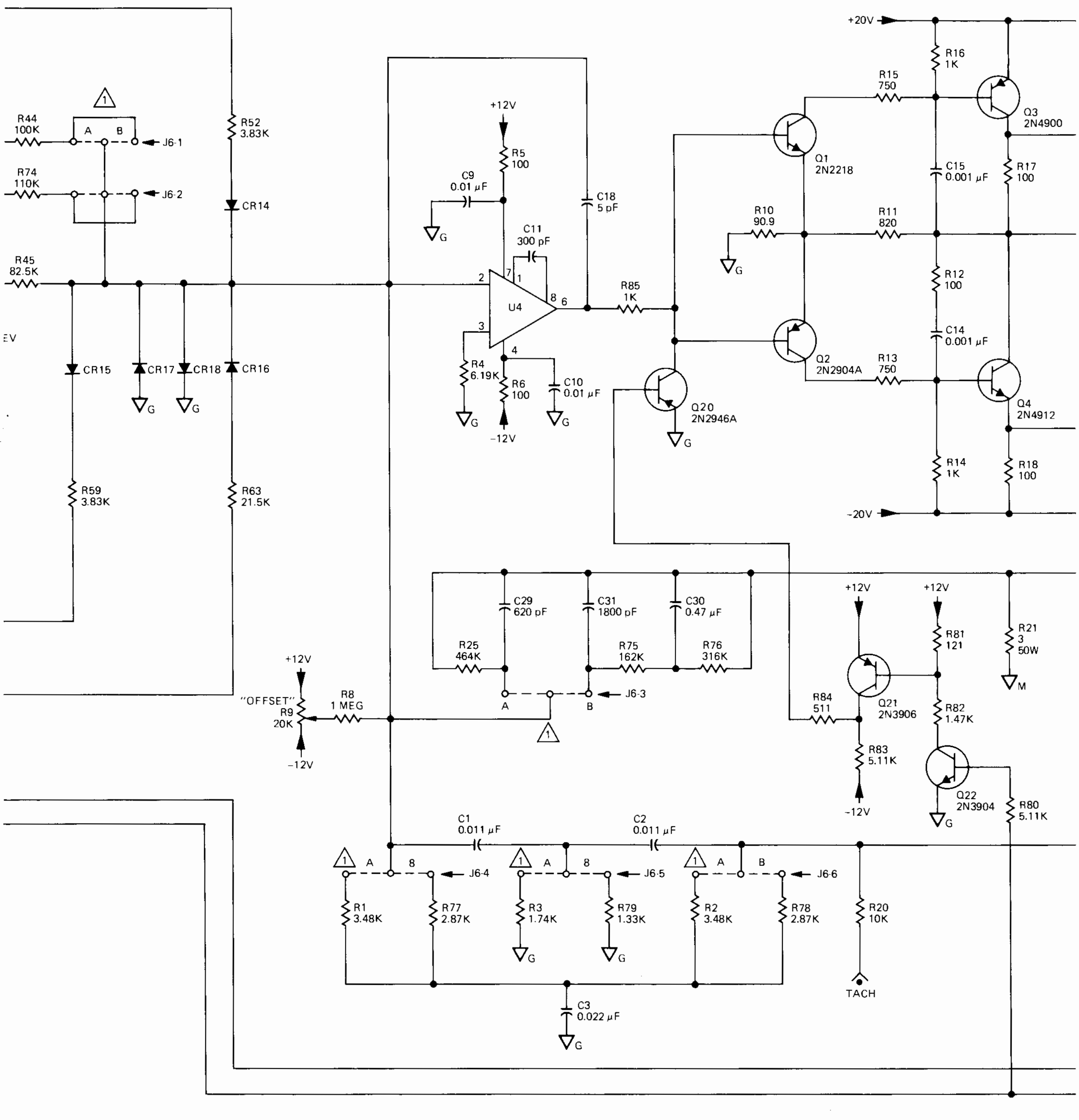
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS.

G ANALOG RETURN (±12V)

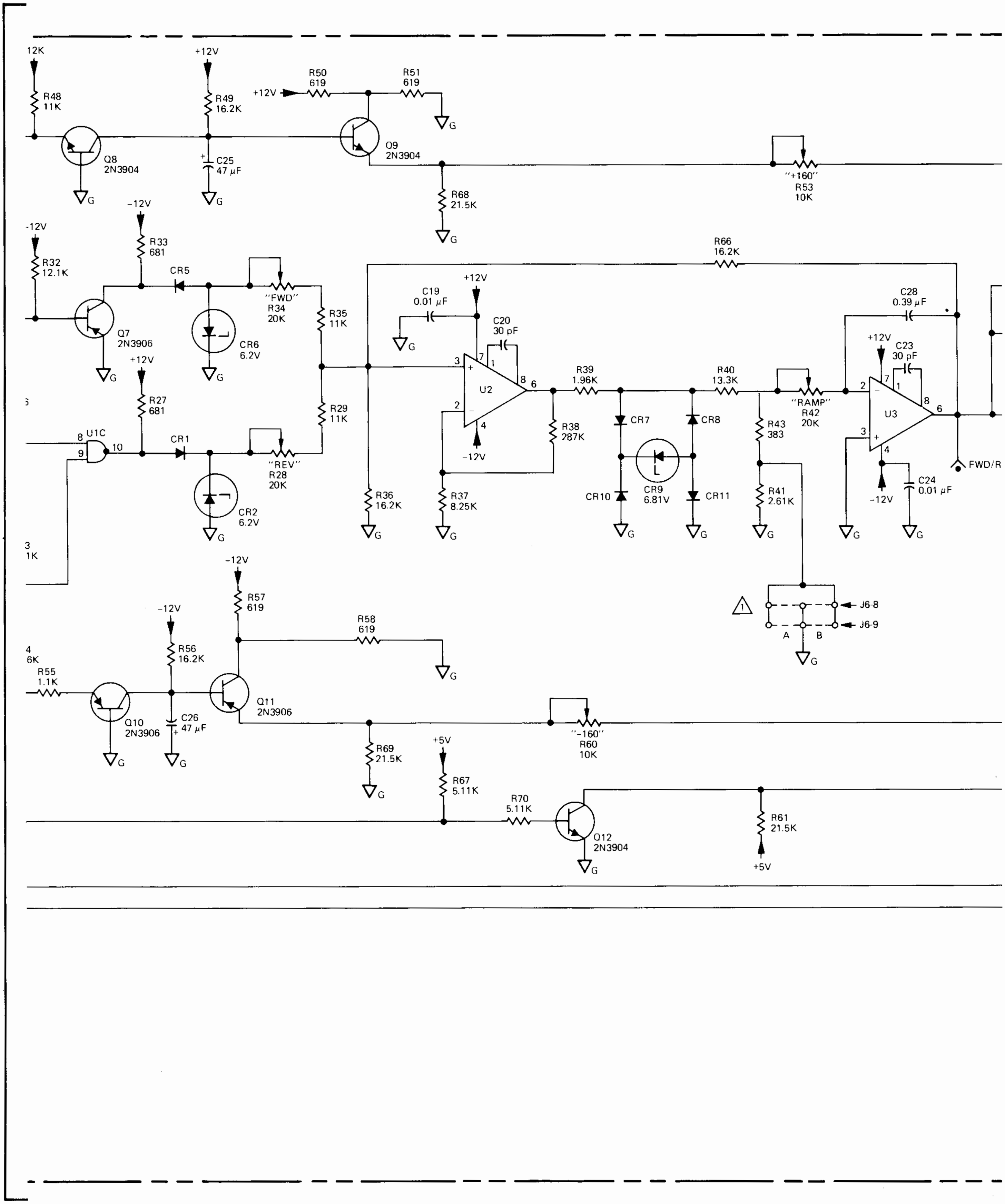
M MOTOR RETURN (±20V)

D DIGITAL RETURN (±5V)

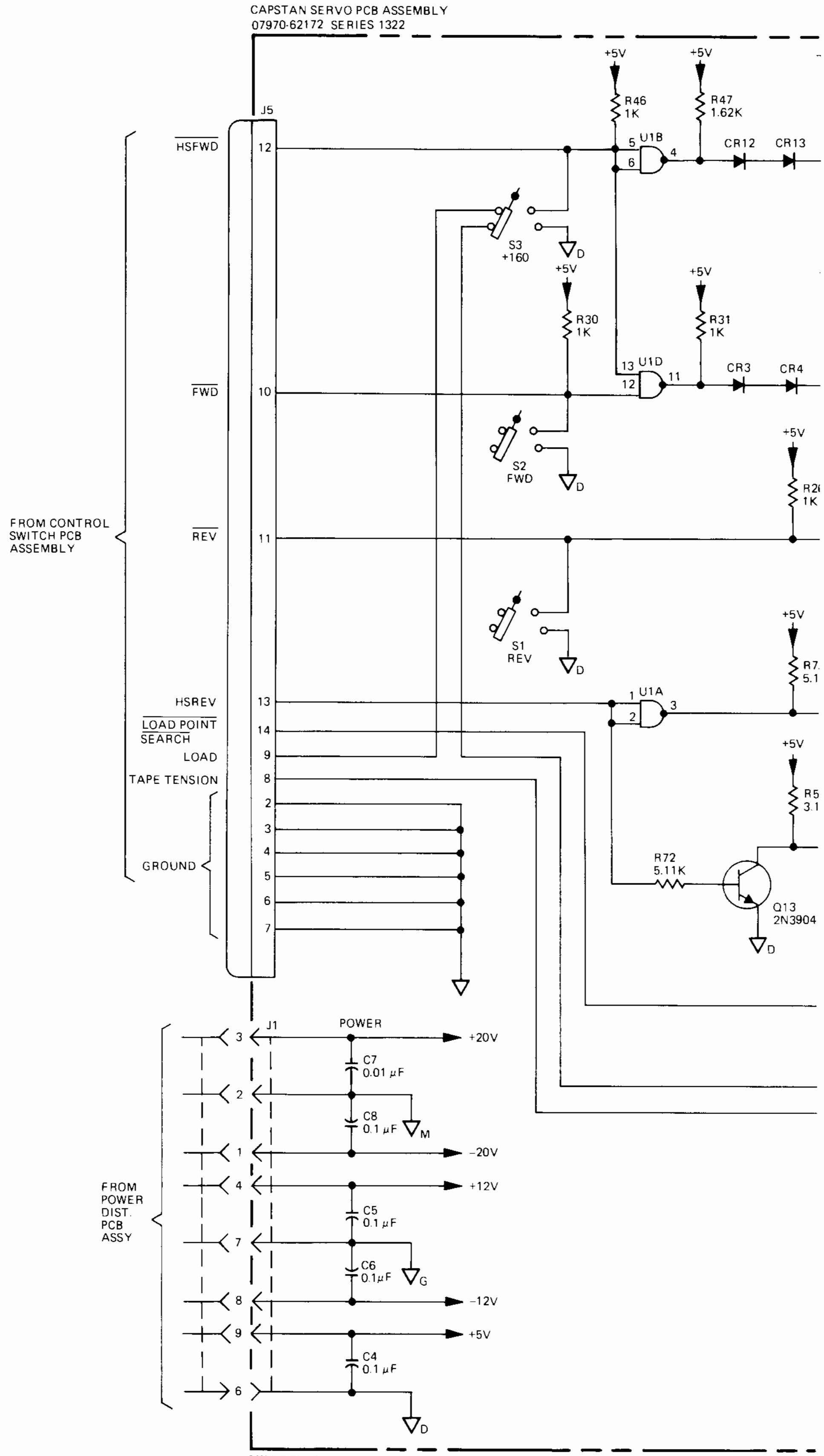
Figure 7-10. Capstan Servo PC Assembly A6, Schematic Diagram



R44
100K
A
B
J6-1
R74
110K
J6-2
R45
82.5K
R52
3.83K
CR14
CR15
CR17
CR18
CR16
R59
3.83K
R63
21.5K
+12V
R5
100
C9
0.01 μF
C18
5 pF
C11
300 pF
U4
R85
1K
R4
6.19K
R6
100
C10
0.01 μF
-12V
+20V
R16
1K
R15
750
Q3
2N4900
Q1
2N2218
C15
0.001 μF
R17
100
R10
90.9
R11
820
R12
100
C14
0.001 μF
Q2
2N2904A
R13
750
Q4
2N4912
Q20
2N2946A
R14
1K
R18
100
-20V
C29
620 pF
C31
1800 pF
C30
0.47 μF
R25
464K
R75
162K
R76
316K
J6-3
"OFFSET"
R9
20K
R8
1 MEG
R84
511
Q21
2N3906
R81
121
R82
1.47K
R83
5.11K
R21
3
50W
Q22
2N3904
R80
5.11K
C1
0.011 μF
C2
0.011 μF
J6-4
J6-5
J6-6
R1
3.48K
R77
2.87K
R3
1.74K
R79
1.33K
R2
3.48K
R78
2.87K
R20
10K
TACH
C3
0.022 μF



R48
11K
+12V
R49
16.2K
R50
619
R51
619
Q8
2N3904
C25
47 μF
Q9
2N3904
R68
21.5K
"+160"
R53
10K
-12V
R33
681
R32
12.1K
CR5
"FWD"
R34
20K
R35
11K
Q7
2N3906
CR6
6.2V
R66
16.2K
C19
0.01 μF
C20
30 pF
C28
0.39 μF
C23
30 pF
U2
U3
R39
1.96K
R40
13.3K
"RAMP"
R42
20K
R27
681
U1C
CR1
"REV"
R28
20K
R29
11K
R38
287K
CR7
CR8
R43
383
CR2
6.2V
R36
16.2K
R37
8.25K
CR10
CR9
6.81V
CR11
R41
2.61K
C24
0.01 μF
FWD/R
R57
619
R58
619
J6-8
J6-9
A
B
R56
16.2K
R55
1.1K
Q10
2N3906
C26
47 μF
Q11
2N3906
R69
21.5K
"-160"
R60
10K
+5V
R67
5.11K
R70
5.11K
Q12
2N3904
R61
21.5K
G



CAPSTAN SERVO PCB ASSEMBLY
07970-62172 SERIES 1322
FROM CONTROL SWITCH PCB ASSEMBLY
HSFWD
FWD
REV
HSREV
LOAD POINT SEARCH
LOAD
TAPE TENSION
GROUND
J5
S3 +160
S2 FWD
S1 REV
R46 1K
R47 1.62K
U1B
CR12
CR13
R30 1K
R31 1K
U1D
CR3
CR4
U1A
R72 5.11K
Q13 2N3904
+5V
FROM POWER DIST. PCB ASSY
J1
POWER
+20V
C7 0.01 μF
C8 0.1 μF
-20V
+12V
C5 0.1 μF
C6 0.1μF
-12V
+5V
C4 0.1 μF
DWG REV. A

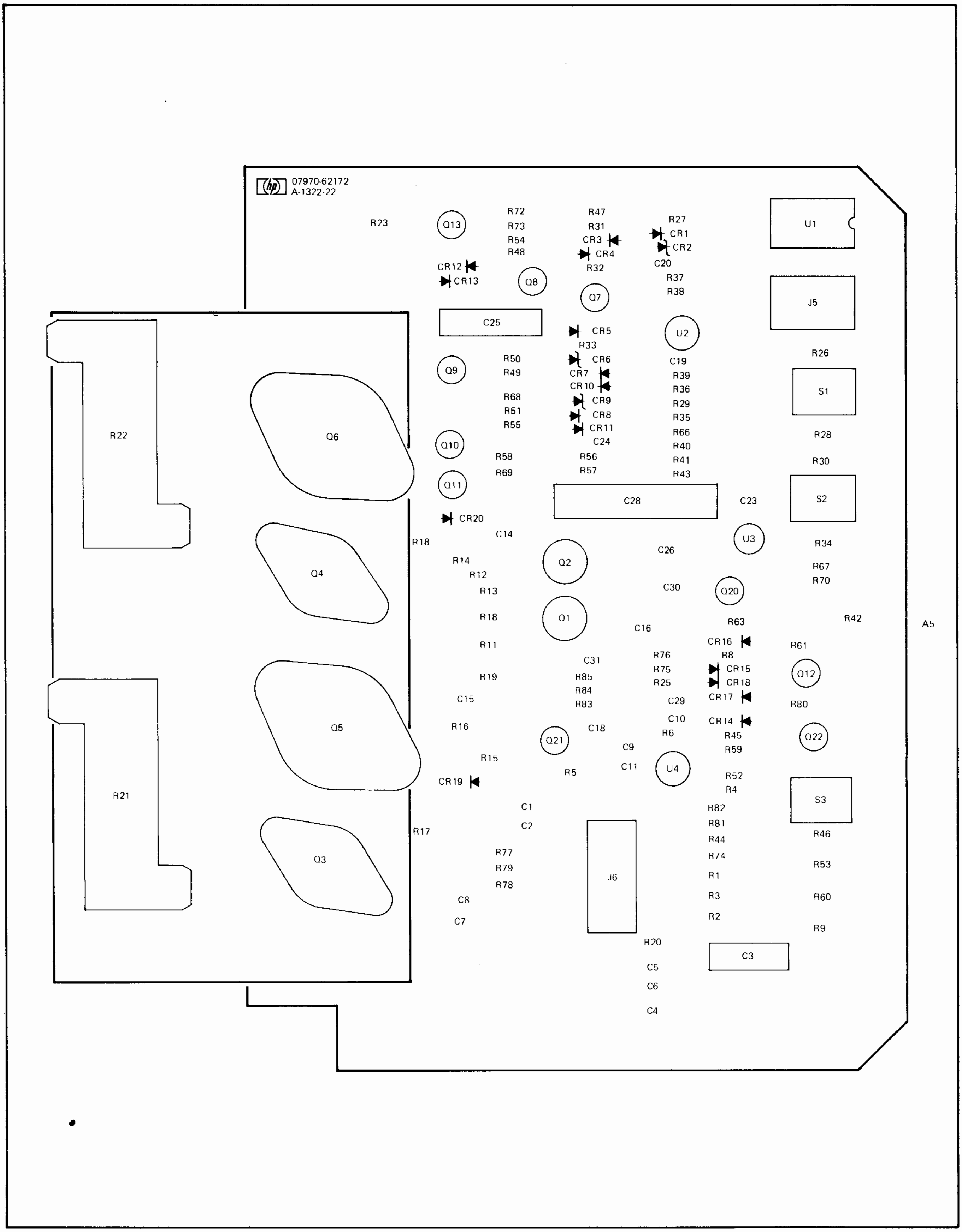


Figure 7-9. Capstan Servo PC Assembly A6, Parts Location Diagram

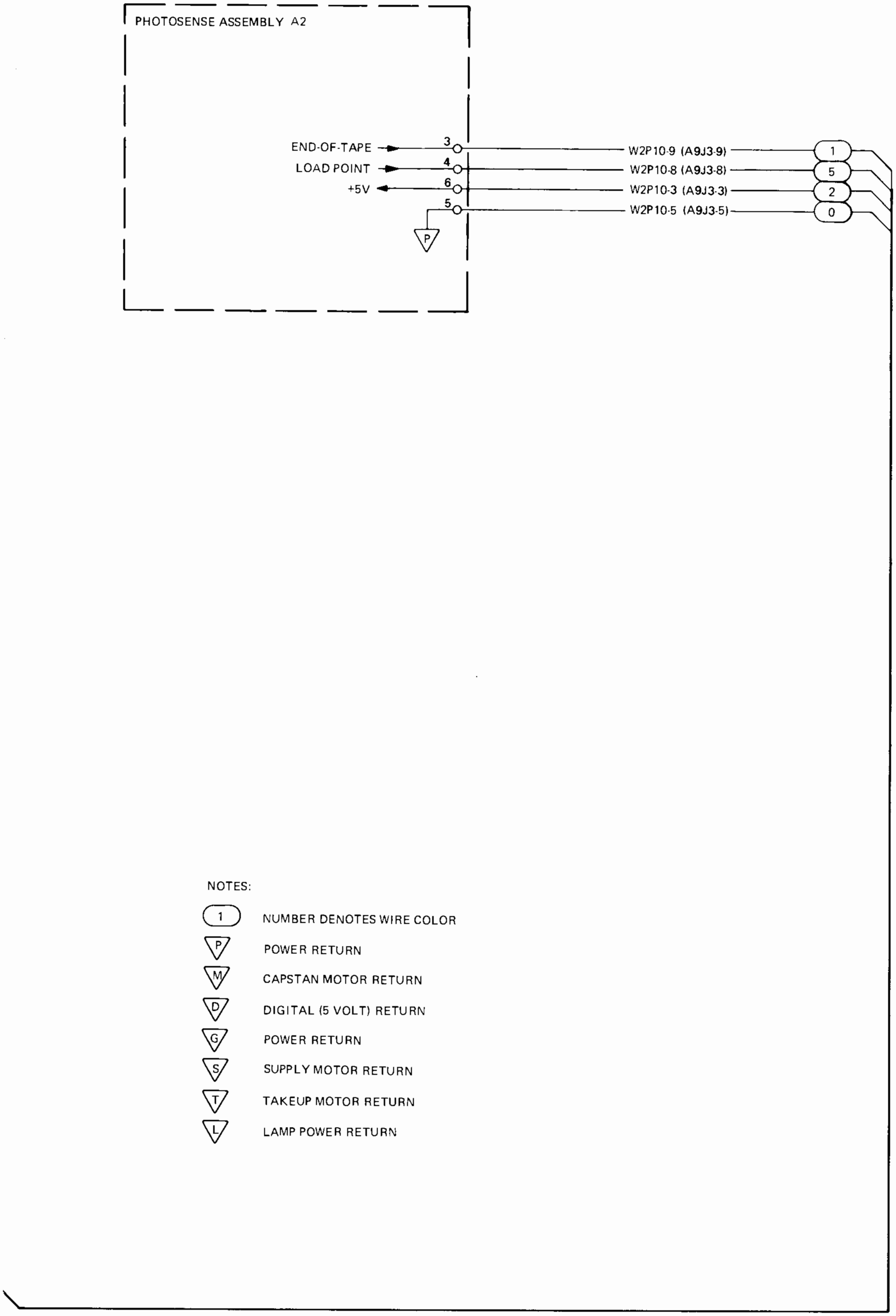
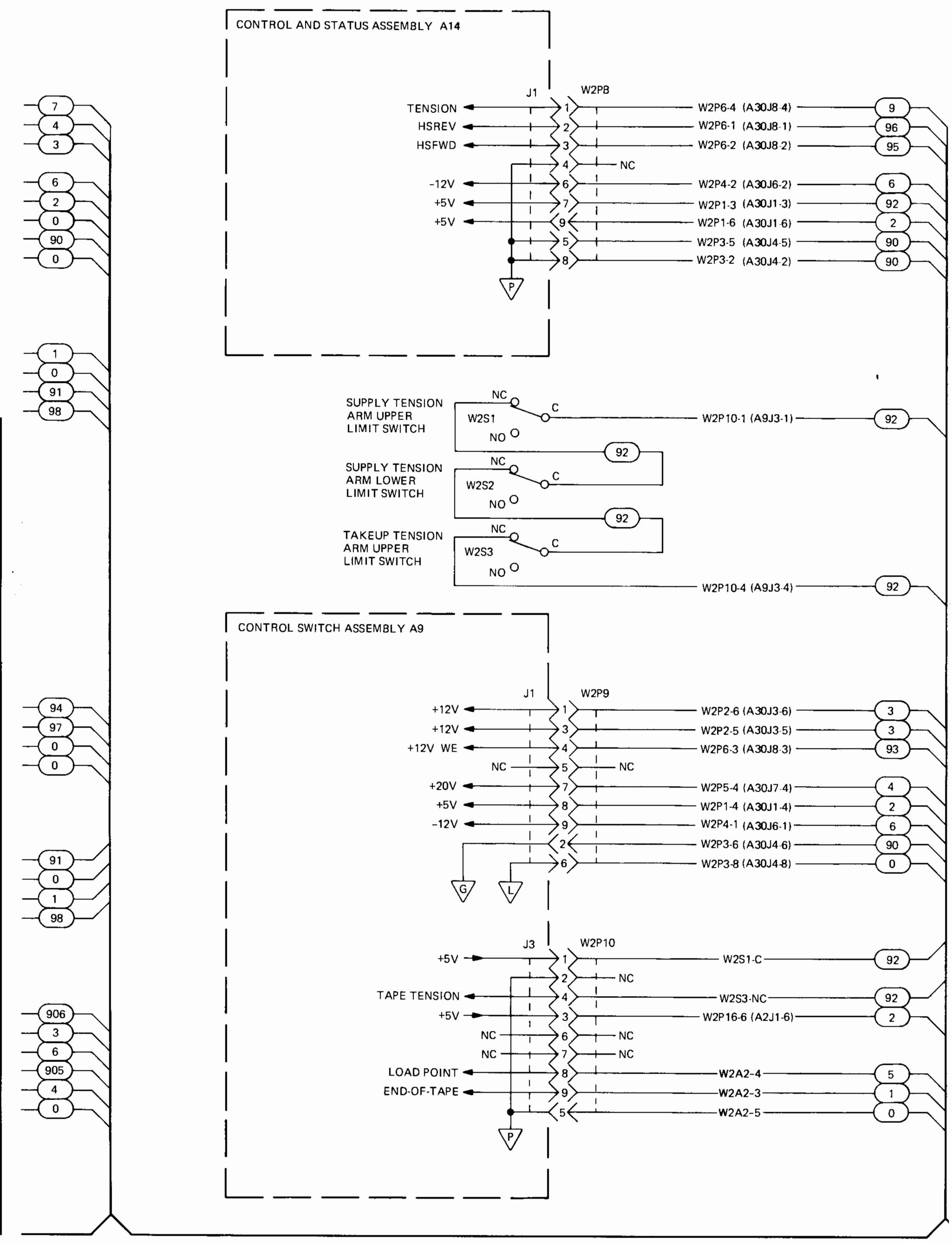
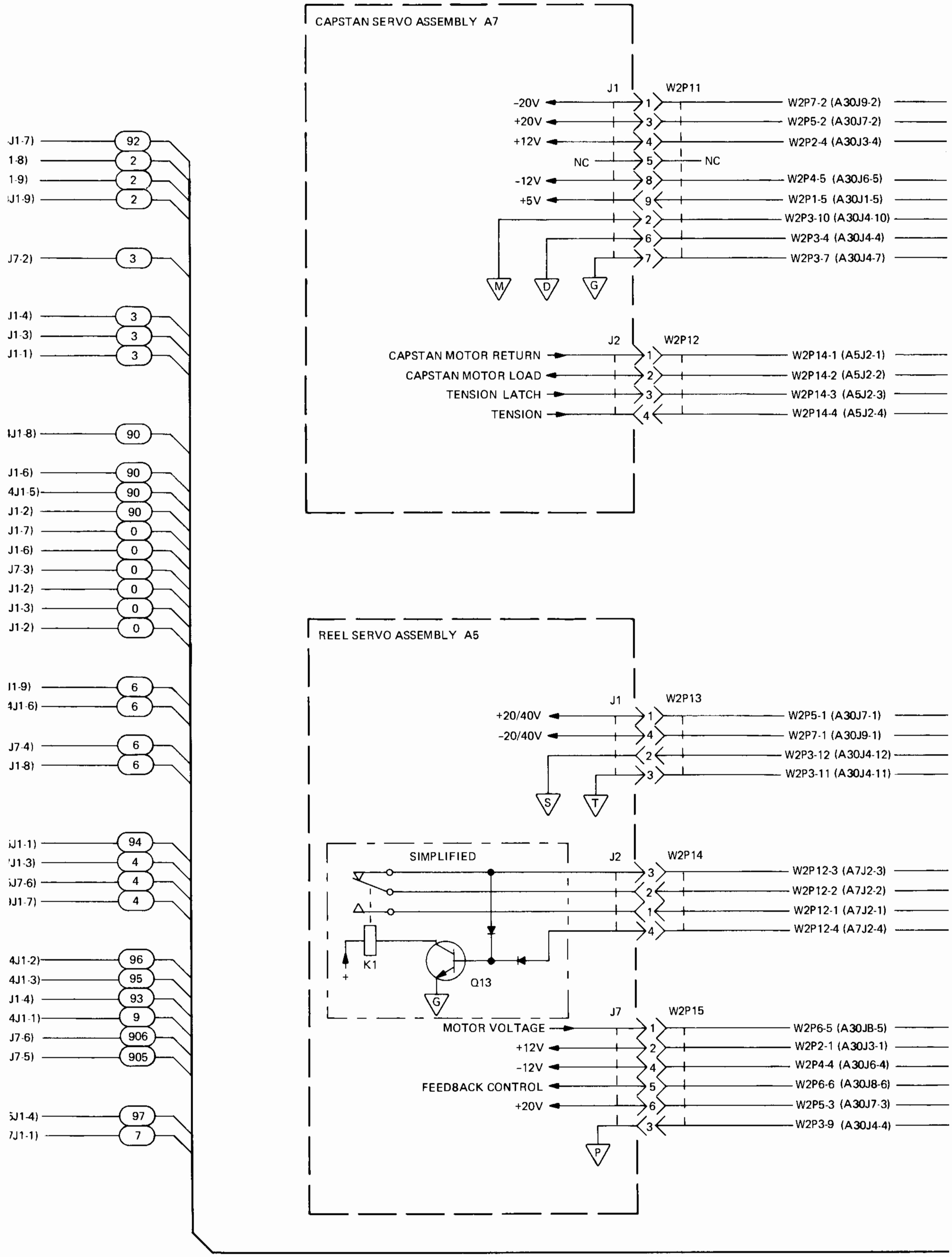
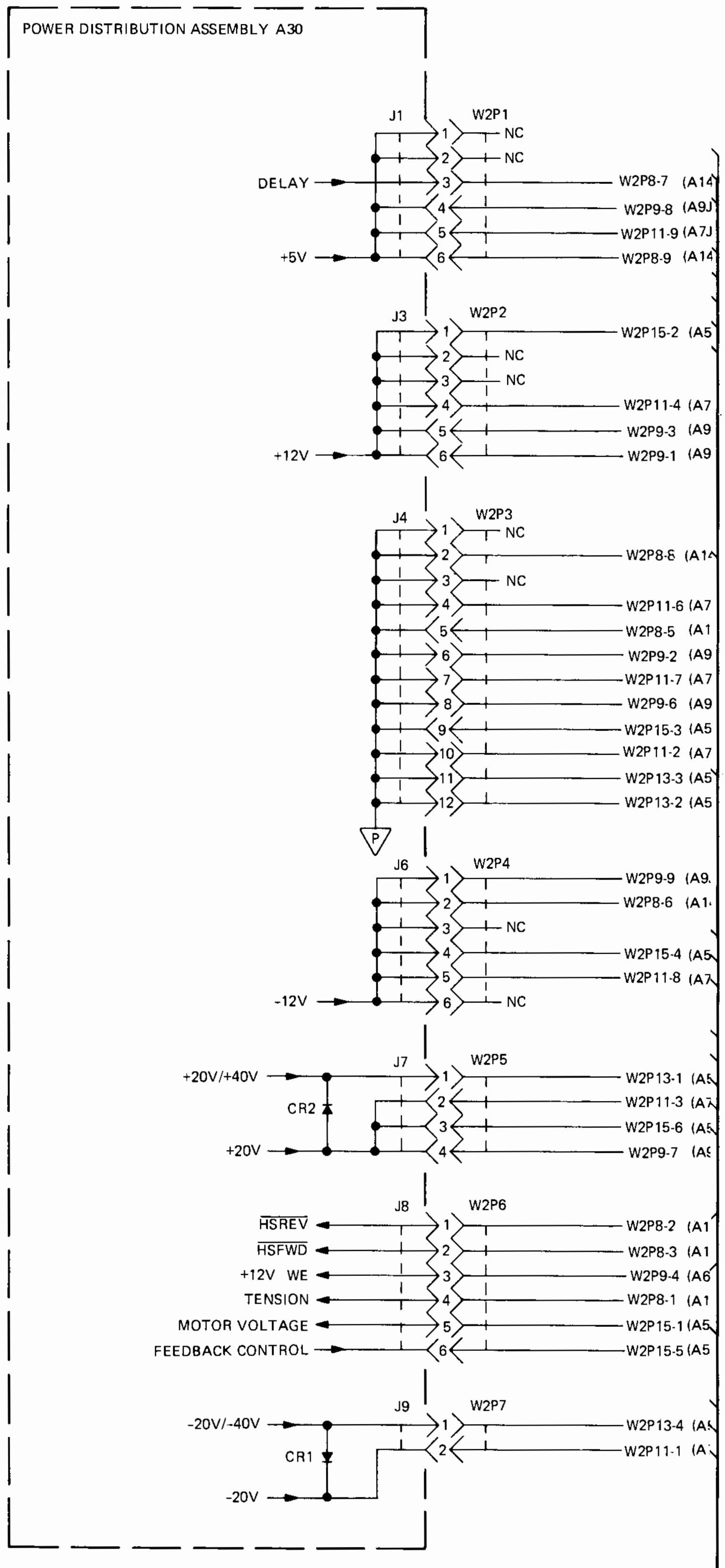


Figure 7-11. Cable Assembly W2, Wiring Diagram



CONTROL AND STATUS ASSEMBLY A14
J1
W2PB
TENSION
HSREV
HSFWD
-12V
+5V
+5V
NC
W2P6-4 (A30J8-4)
W2P6-1 (A30J8-1)
W2P6-2 (A30J8-2)
W2P4-2 (A30J6-2)
W2P1-3 (A30J1-3)
W2P1-6 (A30J1-6)
W2P3-5 (A30J4-5)
W2P3-2 (A30J4-2)
SUPPLY TENSION ARM UPPER LIMIT SWITCH
W2S1
SUPPLY TENSION ARM LOWER LIMIT SWITCH
W2S2
TAKEUP TENSION ARM UPPER LIMIT SWITCH
W2S3
W2P10-1 (A9J3-1)
W2P10-4 (A9J3-4)
CONTROL SWITCH ASSEMBLY A9
W2P9
+12V
+12V
+12V WE
+20V
+5V
-12V
W2P2-6 (A30J3-6)
W2P2-5 (A30J3-5)
W2P6-3 (A30J8-3)
W2P5-4 (A30J7-4)
W2P1-4 (A30J1-4)
W2P4-1 (A30J6-1)
W2P3-6 (A30J4-6)
W2P3-8 (A30J4-8)
J3
W2P10
+5V
TAPE TENSION
+5V
LOAD POINT
END-OF-TAPE
W2S1-C
W2S3-NC
W2P16-6 (A2J1-6)
W2A2-4
W2A2-3
W2A2-5


CAPSTAN SERVO ASSEMBLY A7
J1
W2P11
-20V
+20V
+12V
NC
-12V
+5V
NC
W2P7-2 (A30J9-2)
W2P5-2 (A30J7-2)
W2P2-4 (A30J3-4)
W2P4-5 (A30J6-5)
W2P1-5 (A30J1-5)
W2P3-10 (A30J4-10)
W2P3-4 (A30J4-4)
W2P3-7 (A30J4-7)
M
D
G
J2
W2P12
CAPSTAN MOTOR RETURN
CAPSTAN MOTOR LOAD
TENSION LATCH
TENSION
W2P14-1 (A5J2-1)
W2P14-2 (A5J2-2)
W2P14-3 (A5J2-3)
W2P14-4 (A5J2-4)
REEL SERVO ASSEMBLY A5
J1
W2P13
+20/40V
-20/40V
W2P5-1 (A30J7-1)
W2P7-1 (A30J9-1)
W2P3-12 (A30J4-12)
W2P3-11 (A30J4-11)
S
T
SIMPLIFIED
J2
W2P14
K1
Q13
G
W2P12-3 (A7J2-3)
W2P12-2 (A7J2-2)
W2P12-1 (A7J2-1)
W2P12-4 (A7J2-4)
J7
W2P15
MOTOR VOLTAGE
+12V
-12V
FEEDBACK CONTROL
+20V
P
W2P6-5 (A30JB-5)
W2P2-1 (A30J3-1)
W2P4-4 (A30J6-4)
W2P6-6 (A30J8-6)
W2P5-3 (A30J7-3)
W2P3-9 (A30J4-4)
J1-7) 92
1-8) 2
1-9) 2
J1-9) 2
J7-2) 3
J1-4) 3
J1-3) 3
J1-1) 3
J1-8) 90
J1-6) 90
4J1-5) 90
J1-2) 90
J1-7) 0
J1-6) 0
J7-3) 0
J1-2) 0
J1-3) 0
J1-2) 0
I1-9) 6
4J1-6) 6
J7-4) 6
J1-8) 6
J1-1) 94
J1-3) 4
J7-6) 4
J1-7) 4
4J1-2) 96
4J1-3) 95
J1-4) 93
4J1-1) 9
J7-6) 906
J7-5) 905
J1-4) 97
J1-1) 7


POWER DISTRIBUTION ASSEMBLY A30
J1
W2P1
NC
NC
DELAY
+5V
W2P8-7 (A14
W2P9-8 (A9J
W2P11-9 (A7J
W2P8-9 (A14
J3
W2P2
W2P15-2 (A5
NC
NC
W2P11-4 (A7
W2P9-3 (A9
W2P9-1 (A9
+12V
J4
W2P3
NC
W2P8-8 (A1
NC
W2P11-6 (A7
W2P8-5 (A1
W2P9-2 (A9
W2P11-7 (A7
W2P9-6 (A9
W2P15-3 (A5
W2P11-2 (A7
W2P13-3 (A5
W2P13-2 (A5
P
J6
W2P4
W2P9-9 (A9
W2P8-6 (A1
NC
W2P15-4 (A5
W2P11-8 (A7
-12V
NC
J7
W2P5
+20V/+40V
CR2
+20V
W2P13-1 (A5
W2P11-3 (A7
W2P15-6 (A5
W2P9-7 (A9
J8
W2P6
HSREV
HSFWD
+12V WE
TENSION
MOTOR VOLTAGE
FEEDBACK CONTROL
W2P8-2 (A1
W2P8-3 (A1
W2P9-4 (A6
W2P8-1 (A1
W2P15-1 (A5
W2P15-5 (A5
J9
W2P7
-20V/-40V
CR1
-20V
W2P13-4 (A
W2P11-1 (A

HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

PART 3

7970B/7970C

DIGITAL MAGNETIC TAPE UNIT

READ MODULES

Printed-Circuit Assemblies:

07970-60390, Series 1014
07970-60500, Series 1318
07970-62166, Series 1218
07970-62168, Series 1218
07970-62170, Series 1218
07970-62171, Series 1218
07970-62167, Series 1218
07970-60570, Series 1218
07970-62000, Series 1201
07970-62187, Series 1040

07970-90383

PRINTED: AUG 1973

7970B/7970C PART 3
READ MODULES

SECTION I
DESCRIPTION

1-1. INTRODUCTION.

1-2. This section describes the read modules of the HP 7970B/7970C Digital Magnetic Tape Units. A functional description and circuit description is also included to aid in servicing the read modules.

1-3. PHYSICAL DESCRIPTION.

1-4. The read modules consist of the read magnetic head assembly, a read preamplifier printed-circuit assembly, a read assembly and an optional density select assembly. The magnetic head assembly is a seven- or nine-track, read or read-while-write, NRZI head. Channel scrambling is accomplished in the head assembly wiring. From the reference edge of the tape (edge facing the operator) the nine-track channel designations are 5, 7, 3, P, 2, 1, 0, 6, and 4. The seven-track channel designations are 7, 6, 5, 4, 3, 2, and P.

1-5. The read preamplifier is located near the head assembly. The preamplifier contains nine identical channels. Seven-track units do not use channels 0 and 1.

1-6. The read assembly consists of a card cage assembly (motherboard) that contains a read control printed-circuit assembly, a single-channel read data printed-circuit assembly and three or four dual-channel read data printed-circuit assemblies. Seven-track units will have three dual-channel read data printed-circuit assemblies and nine-track units will have four dual-channel printed-circuit assemblies.

1-7. The optional density select switch assembly allows the operator to select read densities of 200, 556 or 800 cpi. The option consists of a three-button, interlocked switch assembly with indicators and a printed-circuit assembly that contains line-drivers. Units not equipped with the density select switch option are hard-wired to read data at a tape packing density of 800 cpi.

1-8. FUNCTIONAL DESCRIPTION.

1-9. Information to be read from the magnetic tape has been recorded in NRZI (non-return-to-zero-ones inverted) form, in seven or nine tracks. A "one" bit is represented by a flux reversal and a "zero" bit is represented by the absence of a flux reversal. The character bytes are recorded at a density of 200, 556, or 800 character bytes per inch (cpi).

1-10. As the tape moves across the read head, tracks that contain a flux reversal ("one" bit) generate an analog signal from the head. The coding of information on the tape is such that every byte contains a flux reversal in at least one of the tracks. All bits that make up a character byte may not arrive at the head at the same time. The read data circuits detect the flux transitions in each track and produce a parallel digital output with all bits of the character byte presented simultaneously.

1-11. The recovery of the data is accomplished by generating a fixed-time window or character gate. Starting with the first detected flux reversal, all remaining bits must arrive during the character gate. At the end of the character gate time, a read strobe pulse samples the contents of all input registers, transfers the data to the output registers and conditions the input registers for the next data byte.

1-12. CIRCUIT DESCRIPTION.

1-13. Each of the seven- or nine-track low level analog outputs from the read head are independently amplified by an integrated-circuit preamplifier located on the preamplifier printed-circuit assembly. The gain of each preamplifier is adjustable.

1-14. The amplified analog signal representing data from the tape is processed by the read data circuits and the read control circuits. The following paragraphs describe the operation of these circuits. Figure 1-1 is a timing diagram showing the relationship of generated signals and data.

1-15. READ CONTROL CIRCUITS.

1-16. The read control circuits consist of a density select circuit, a read enable circuit, a threshold generator, a skew gate circuit, and a character gate generator. Figure 1-2 is a block diagram of the read control circuits.

1-17. The read enable circuit is controlled by commands from the tape unit control and status circuits. When the read enable circuit is satisfied, the Read Enable signal conditions the read data input and output registers. The Read Enable signal is also gated with the character gate generator output to provide the "not" Read Clock signal ($\overline{RC}$).

1-18. The threshold generator circuit establishes the bias level for the threshold circuits of the read data circuits. Two threshold levels are used. When reading tape previously recorded, the threshold is 22 percent of the nominal peak amplitude. When reading data that has just been written by the write head (read-while-write), the threshold is increased to 40 percent of the nominal peak amplitude. In a read-while-write mode the signal level on tape produces a higher output than tape that has been written and wound on a reel. This effect is primarily due to self erasure from adjacent tape on the pack. Also, when writing data it is important that tape imperfections do not result in marginal signal amplitudes.

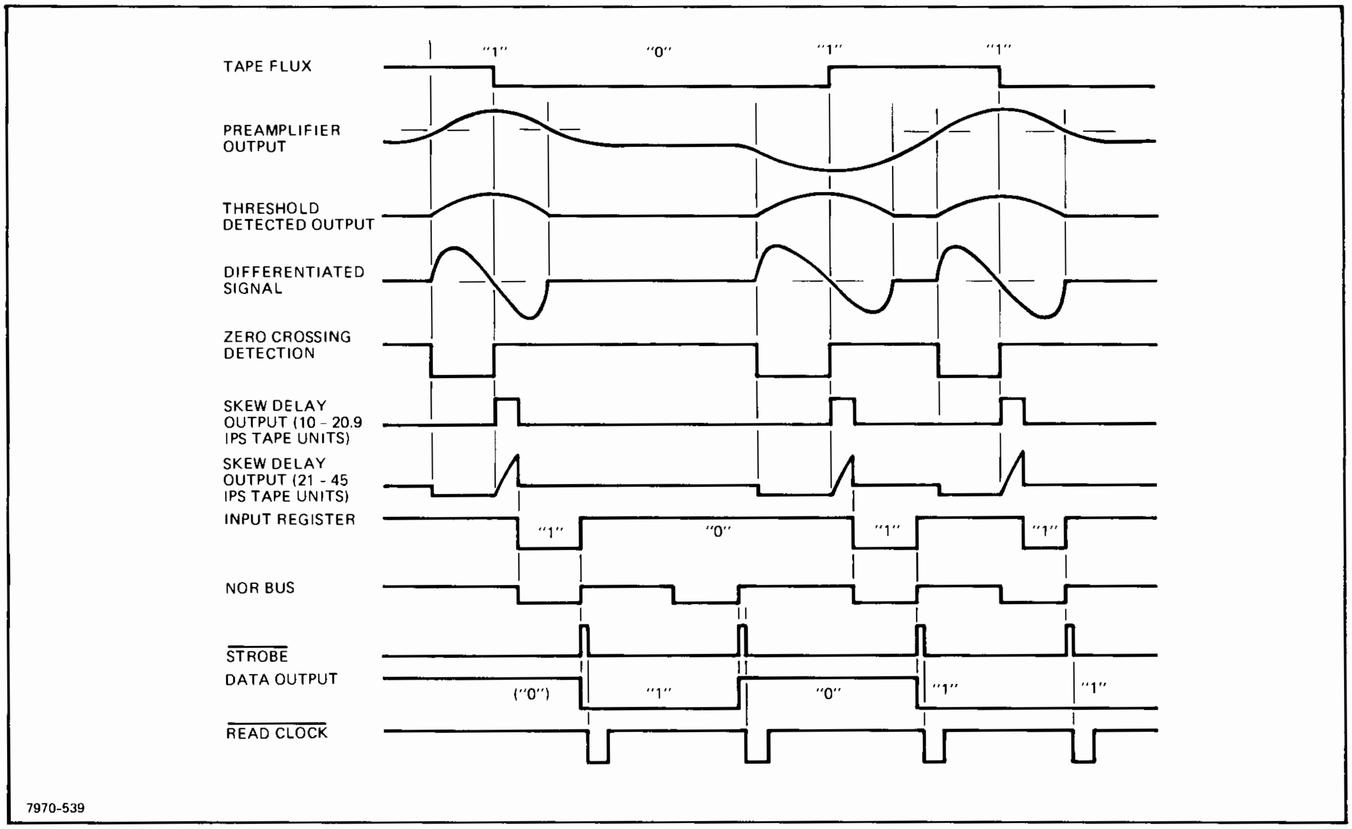


Figure 1-1. Read Data Circuits Timing Diagram

1-19. The skew gate circuit provides a voltage for the skew delay circuit of the read data circuits. The purpose of skew delay is to compensate for channel-to-channel time differentials introduced in the read system. There are two major sources of interchannel time displacements (static skew). One source is due to non-perfect alignment of individual track gaps in the read head (gap scatter) and the centerlines of the head may be tipped with respect to the tape edge (azimuth misalignment). As a result, certain bits of the byte will be detected before the others. Since the tape speed is constant, the effects of delaying each track so that all outputs occur simultaneously when reading an "all ones" alignment tape, is the same as mechanically aligning the read stack. When reading in a reverse mode, the earliest tracks become the later tracks and a different set of compensating delays are required. The second source of static skew is differential phase delays in the individual data channels. The phase response of the head varies from track-to-track because of inductance variance. The overall analog channel bandwidths may be different and reflect differential phase delays at operating frequency.

1-20. During a read forward operation the skew delay voltage is through Q4 of the read control printed-circuit assembly. During a read reverse operation, Q4 is cut off, and skew delay voltage is through Q1. When changing direction, the voltage sources (Q1 and Q4) do not switch simultaneously; there is a time lag in the switching to prevent the absence of a skew delay voltage.

1-21. The character gate generator provides a "not" Read Strobe ($\overline{\text{STROBE}}$) pulse and a clock pulse that is gated with tape unit status to provide a "not" Read Clock ($\overline{\text{RC}}$) pulse. The first "one" bit detected by the read data circuits conditions the "nor" bus (low) and starts the character gate generator. The width of the character gate is 40 percent of the nominal byte-to-byte spacing and is automatically controlled by the density status input from the tape unit density select switch assembly. Tape units not equipped with the density select switch are hard-wired so that the character gate operates a 40 percent of 800 cpi byte-to-byte spacing.

1-22. The output of the character gate generator is coupled to a strobe one-shot through a schmitt-trigger. The trailing edge of the character gate triggers the strobe one-shot, generating the "not" Read Strobe ($\overline{\text{STROBE}}$) pulse. The "not" Read Strobe pulse is an 800 nanosecond pulse used by the read data circuits to sample the output register and set the input register for the next data byte.

1-23. The trailing edge of the "not" Read Strobe pulse triggers the clock one-shot. The output of the clock one-shot is a 3-microsecond pulse that is gated with Read Enable to generate the "not" Read Clock ($\overline{\text{RC}}$) pulse. The read clock pulse indicates that a data byte has been recovered and is on the read data interface lines.

1-24. READ DATA CIRCUITS.

1-25. The analog outputs from the preamplifiers are directly coupled to seven or nine identical data channels located in the read data assembly. Figure 1-3 is a block diagram of the read data circuits. The analog signal from a given

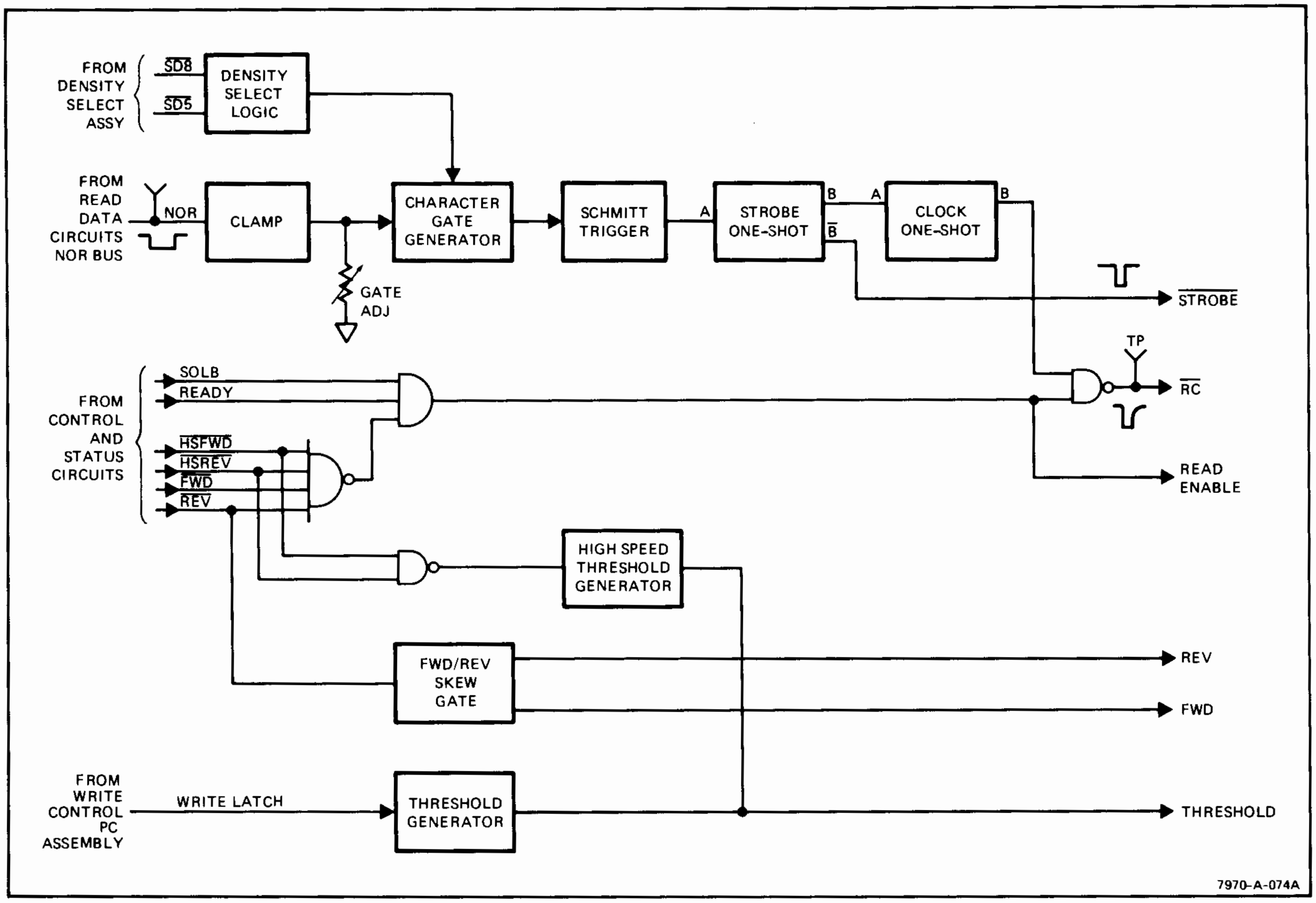


Figure 1-2. Read Control Circuits, Simplified Logic Diagram

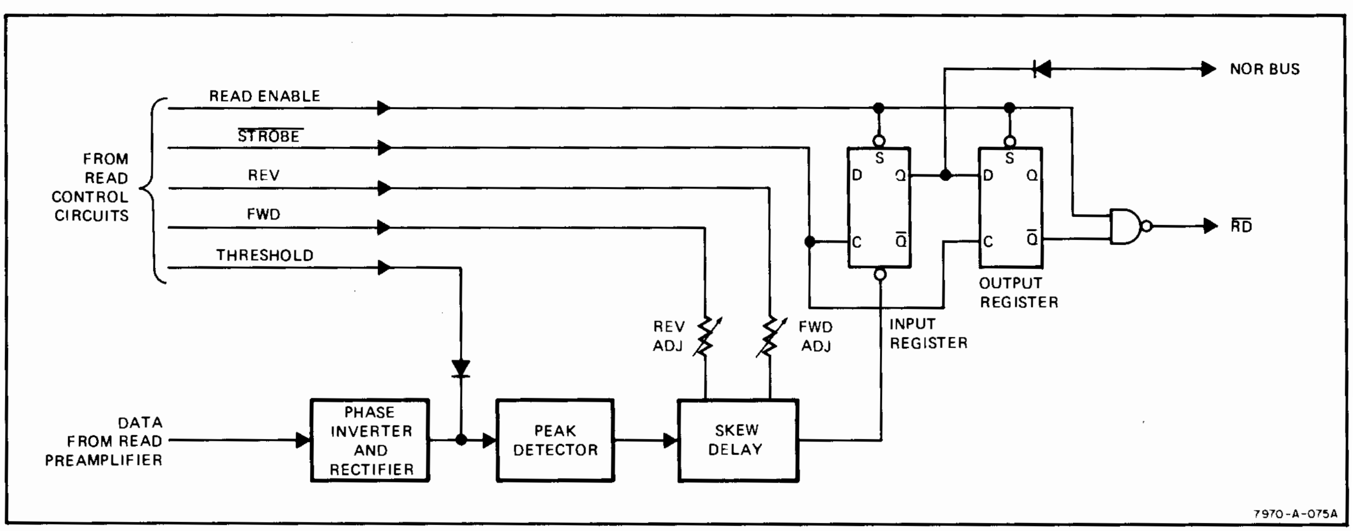


Figure 1-3. Read Data Circuit, Simplified Logic Diagram

channel is phase inverted, fullwave rectified, and threshold clipped so that only the portion of the signal that exceeds the threshold level is processed. This prevents noise or minor tape imperfections from generating erroneous responses.

1-26. The portion of the signal exceeding the threshold level is differentiated and the zero-crossing representing the peak amplitude of data is detected by a high-gain amplifier (10-20.9 ips tape units) or a Schmitt trigger circuit (21-45 ips tape units). The positive-going edge of the trigger output therefore represents the peak of the analog input signal, independent of signal amplitude.

1-27. The positive-going signal triggers the skew delay pulse generator. When the skew delay generator times-out, a short duration negative-going pulse directly clears the input register.

1-28. When the input register is cleared by the detected "one" bit, the input register outputs are set (Q output is low and $\overline{Q}$ output is high). With the input register cleared, the "nor" bus is activated. The "nor" bus is normally at a positive potential; however, when the "nor" bus is activated by the first "one" bit detected, the bus goes low (near 0-volts). When the "nor" bus goes low, the read control character gate is activated. The Q output of the input register (low) is also applied to the output register.

1-29. When the character gate times-out, the leading edge of "not" Read Strobe ($\overline{\text{STROBE}}$) clocks the input register contents to the output register and resets the input register. This transfers the data bit to the output register and prepares the input register for the next data byte. The output of the output register is gated with Read Enable to provide the interface with the read data bit.

SECTION II
MAINTENANCE

2-1. INTRODUCTION.

2-2. This section provides maintenance information for the read modules of the HP 7970B/7970C Digital Magnetic Tape Units. Maintenance information consists of performance checkout procedures and adjustment procedure. Prior to performing any maintenance to the read modules, ensure that the transport is functioning properly. (Refer to part 2.)

2-3. TEST EQUIPMENT REQUIRED.

2-4. In addition to the equipment required for transport maintenance (refer to part 2), the following tapes and test items are required to perform maintenance procedures described in this section.

a. Master Alignment Tape (all "1's", full-width at 800 cpi), part number 9162-0027.

b. Reference Amplitude Test Tape (all "1's", full-width at 200 cpi), part number 5080-4547. This tape is recommended for read-only units.

Note

The HP 13193A Read Test Board is available as an accessory. When used in conjunction with the HP 13191A Control and Status Test Board and the HP 13192A Write Test Board, maintenance procedures can be performed without the aid of an interfaced computer.

2-5. PERFORMANCE TEST PROCEDURES.

2-6. The following test procedures verify that the read data circuits conform to published specifications. The test procedures described assume the use of an on-line computer or the use of off-line test accessories. Prior to performing the test procedures, ensure that all transport adjustments have been made. (Refer to part 2.)

2-7. READ PREAMPLIFIER GAIN TEST.

2-8. For read-after-write units, write an alternate "ones" and "zeros" data pattern at 800 cpi. Measure the peak-to-peak output voltage at the preamplifier test points. The voltage should be 6.4 ± 0.3 volts p-p. For read only units, load the Reference Amplitude Test Tape HP part number 5080-4547. Note the signal level indicated on the test tape label. Measure the peak-to-peak output voltage at the preamplifier test points. The measured voltage should be within ±0.3 volt of level indicated on the test tape label. (Typically 85 percent of 6.4V p-p.)

2-9. READ THRESHOLD LEVEL TEST.

2-10. Use oscilloscope and check dc voltage level on the threshold test point on the read control card. Values should be as follows:

a. During read-after-write mode: +1.27 ±0.060 volts dc.

b. During read only mode: +0.450 ±0.010 volt dc.

c. During high-speed read: 1.7 volts dc ±1%.

2-11. READ HEAD STATIC SKEW TEST.

2-12. Read head static skew is measured optically during head manufacturing and is also verified electrically on special test facilities. When installed on the tape transport, certain electrical and mechanical considerations enter as factors. These may modify the static skew to a minor degree. Measurement may be used as additional information for analysis of field performance. The electronic read de-skewing effectively eliminates this factor in normal operation. Measurement is as follows:

a. Use the master alignment tape as the source of data.

b. Connect channel A of the oscilloscope to the P (parity) track preamplifier output and adjust the sweep to synchronize near the zero axis crossover on the positive slope.

c. Channel B of the oscilloscope will be connected to the various skew test points on the read cards. Channels will be used in alternate mode.

d. With the delayed sweep operated under a sweep rate of 2 microseconds/cm, adjust the delay to display the positive-going step at the start of the channel P skew delay ramp on the center of the oscilloscope. This will be the zero time reference for all other measurements. Adjust channel B gain as required to obtain good resolution.

e. Without making any further adjustments to the oscilloscope time base, move the channel B probe to each skew delay test point in sequence and note its relative position to the center of the oscilloscope. Signals to the left of center are early, and may be noted as "plus" with those to the right noted as "minus" as they are later than the signal from track P.

f. When all measurements have been completed in the forward direction; the same sequence can be repeated for the reverse. It will be necessary to readjust the time delay for positioning track P to center.

g. Review data taken and determine the two tracks that are the earliest (largest plus number) and latest (largest minus number). The time differential between them (sum of the two times) converted to microinches for the tape speed involved is the read head static skew. This number should not exceed 225 microinches.

Note

For readings between 200 and 225 microinches, correct for the electronic time delay variation in the peak detection circuitry. This may be measured by repeating steps "a" through "f" except that the oscilloscope channel A probe must be connected to the preamplifier output corresponding to the skew test point on the oscilloscope channel B probe. These figures must be subtracted from the normal readings (taken with channel P as the only sync) to determine the true head skew. Under these conditions, a true head skew in excess of 200 microinches is higher than normal but will not cause any practical problems.

2-13. COMPENSATED STATIC READ SKEW TEST.

2-14. Compensated static read skew is a measure of the degree to which the electronic time delays are effective in eliminating the read head static skew. The termination of each track skew delay is the fall (or negative-going trailing edge) of the positive-going ramp visible at the SKEW testpoints on each read card. With perfect compensation these will all coincide. As a matter of practical consideration this seldom happens except during the period of adjustment with a specific master alignment tape. When comparisons are made using alignment tapes other than the one used for adjustment, or where the same tape is subject to possible damage, it is not uncommon to see a time difference of several microseconds depending on tape speed. Considering only a ±1 percent error in the alignment tapes and complete stability of the skew delay, there could be a difference of 25 microinches between two tapes (allowing a time difference from 2.5 microseconds at 10 ips to 0.5 microsecond at 50 ips). Evaluate compensated skew using the following procedure.

a. Use channel A of the oscilloscope for the master reference for all skew measurements. Connect probe to the skew test point for channel P read card.

b. Sync the main sweep to the negative slope of the channel A waveform and set sweep speed to display two bit-to-bit distances. This will result in a negative-going trailing edge at the center of the oscilloscope and another at the right side. If there is time asymmetry in the master tape (some tapes have this and some do not), there will be double trailing edges in the center of the screen with the time difference corresponding to the recorded pulse asymmetry on the tape. If this is visible, refer to the note following step "e." Use the variable setting of the main sweep to position pulses as stated. This will assure the visibility of write time asymmetry on the master tape.

c. The delayed sweep will be used to position the next sequential bit in the center of the screen. Use the internal sync, positive slope position on the delayed sweep, and adjust the trigger level for a stable waveform. The delayed sweep should be adjusted (from the ccw position) only as far as required to permit the delayed sweep to internally trigger on the next pulse.

d. Establish final positioning of the P track reference point (negative-going trailing edge) at the center of the screen by use of the sweep positioning controls. Be sure that the delayed sweep remains correctly calibrated since correct time differences in microseconds will be required. Some positioning can also be done with the trigger level.

e. Use channel B of the oscilloscope and the chopped mode to observe the relative position of all other tracks. Note these positions and determine the earliest and latest tracks. The maximum difference should be 30 microinches or less. If displays are between 30 and 50 microinches, check the write/read skew for the unit. If this skew results in the difference being less than 25 microinches, no adjustment should be made unless there is agreement between two master skew tapes showing that the same relative error exists between the same tracks. If this occurs it can be presumed that the unit adjustments have remained stable (write/read skew within ±1 percent since last adjustment), but the previous read skew adjustment was made with a bad master alignment tape.

Note

Skew measurements can become somewhat difficult if significant write time asymmetry exists. This asymmetry will be observed on some master alignment tapes as well as tapes generated by the tape units. No special steps can be taken when reading the master alignment tape, but when writing tapes for check of write/read skew it is important that all write pulses start with the same relative flux polarities on tape. This can be assured if there is a sequence of reverse/stop/forward drive commands prior to a skew measurement. The forward command assures complete write reset conditions as the WSW line is made true.

g. Measurement of compensated static read skew in the reverse direction may be made by the same technique (steps "a" through "e"). Evaluation of this area becomes somewhat complex, as the magnetic characteristics of the pulse waveforms in the reverse direction will not necessarily be symmetrical with the forward direction waveform. This is true for alignment tapes as well as for tapes written on the tape unit.

2-15. READ CHARACTER GATE, STROBE, AND READ CLOCK TEST.

2-16. The read character gate is initiated by the first "1" bit to complete a read skew delay period. The fall of read skew delay provides a trigger at the "nor" bus, causing it to move in a negative direction. This fall triggers the read character gate period which is nominally 40 percent of the bit-to-bit period for each density. Termination of the gate will cause the "nor" bus to move in a positive direction, which does two things. It sets the data levels at the read outputs and initiates the leading edge of the read strobe pulse. The read strobe trailing edge then generates the read clock output. The strobe delay time provides an interval for the read data outputs to settle before the read clock output occurs. Measure these characteristics as follows:

a. Generate an appropriate data pattern, starting with an all "1's" program under read-after-write conditions.

b. Sync the scope on the NOR test point with the negative slope. Then adjust the main sweep rate so that the next negative-going edge occurs 10 division later. (Each division now is 10 percent of the bit-to-bit period.)

c. Observe that the positive-going edge (end of gate) occurs between 35 and 45 percent of the bit-to-bit period. If the density select option is included, check for all three densities using appropriate clock rates.

2-17. Strobe pulse delay and read clock relationships to data are measured as follows:

a. Generate a data pattern that will move a single bit through all data channels in sequence. This will provide a data output pattern and will exercise each read channel in terms of initiating a read strobe.

b. Connect oscilloscope channel A to the data output of any read channel using the negative sync and auto triggering mode.

c. Remove the read data connector to establish standard measurement conditions. (Various lengths of cables and associated capacity will effect measurement.)

d. Set sweep speed to 0.2 microsecond/division and establish a stable pattern for the leading edge of data (for both negative and positive sync).

e. Using the alternate triggered by A mode, connect oscilloscope channel B to the read clock test point on the read control card.

f. Observe the time difference between the leading edge of data and the leading edge of clock. The clock delay must be between 0.5 and 1.5 microseconds.

g. Observe the pulse width of the read clock. This should be between 2 and 3 microseconds.

h. The read clock output should be continuous. (Verifies that read strobe is being initiated by each read channel.)

2-18. ADJUSTMENT PROCEDURES.

2-19. The adjustment procedures for the read modules consist of preamplifier gain adjustments, forward static skew adjustments, reverse static skew adjustments, and read character gate adjustments. Prior to performing the read data adjustment procedures, ensure that all transport adjustments have been made and that all adjustments are within tolerance.

2-20. PREAMPLIFIER GAIN ADJUSTMENTS.

2-21. The gain/bandwidth characteristics of the preamplifier will cause small changes in phase that will effect the static skew compensation if the preamplifier gain control is adjusted. Therefore, it must be adjusted prior to the read static skew compensation, and if changed, the read static skew adjustment should be rechecked. Adjustment is made as follows:

a. Read-Only Units; preferred method where a read-after-write equipped tape unit is available:

(1) Load the write test tape and place the tape unit in write mode and write a full reel of all "1's" data at 200 cpi density. Do not rewind.

(2) Transfer the test tape to the read only tape unit.

(3) Read the tape in reverse.

(4) Adjust preamplifier gain variable resistors for an average peak-to-peak output of 6.4 ±0.2 volts.

b. Read-Only Units; method utilizing a reference amplitude test tape.

(1) Load the test tape (HP 5080-4547).

(2) Operate the tape unit in read mode.

(3) Adjust preamplifier gain variable resistors to obtain the average peak-to-peak output voltage specified on the test tape reel tolerance specifications, ±0.2 volt p-p.

c. Read/Write Units:

(1) Load the transport with the write test tape and place the tape unit in write mode. Write all "1's" at 200 cpi.

(2) Connect an oscilloscope to each preamplifier test point and adjust each preamplifier for an output of 6.4V (peak-to-peak).

2-22. FORWARD STATIC SKEW COMPENSATION ADJUSTMENTS.

2-23. The techniques for rapid adjustment and for evaluating the need for adjustment differ. Figure 2-1 shows poor skew alignment and proper skew alignment. To adjust static skew compensation proceed as follows:

a. Load the Master Alignment Tape, HP part number 9162-0027, and place the tape unit in synchronous forward mode for the adjustment operation. Preset all skew delay controls fully ccw (minimum delay).

b. Perform the compensated static skew test (paragraph 2-13) to determine which channel is lagging.

c. Adjust FWD skew delay control of channel 2 until it is slightly lagging the channel determined in step "b." Channel 2 will be reference channel for remaining adjustments.

d. Connect the oscilloscope channel A probe to the FWD SKEW test point of the reference channel (2). Connect the oscilloscope channel B probe to each FWD SKEW test point in succession and algebraically add oscilloscope channels A and B.

e. Adjust the oscilloscope sweep to display at least one full bit time (leading edge of one bit to the leading edge of the next), with the oscilloscope vertical deflection at approximately 2 V/cm.

f. Adjust each channel skew delay variable resistor for a maximum displayed amplitude.

2-24. REVERSE STATIC SKEW COMPENSATION ADJUSTMENTS.

2-25. Reverse static skew compensation is accomplished in exactly the same manner as that used for forward skew except for the use of reverse drive mode and adjustment of reverse skew controls. The same SKEW test points are used for both adjustments.

2-26. When considering the need for readjustment, it must be recognized that there are small differences in the master skew tapes. For example, if there is an observed difference of 1 microsecond between channels, this would correspond to 25 microinches at a tape speed of 25 ips. If the previous adjustment had been made with one master tape and checked with another, and if both master tapes were accurate to ±1 percent (±12.5 microinches), this small difference could occur even with complete stability of adjustment of the part of the electrical and mechanical factors involved in the tape unit.

2-27. READ CHARACTER GATE ADJUSTMENTS.

2-28. The read character gate is adjusted to allow a period equal to 40 percent of the bit-to-bit distance for all of the read bits in a character to be placed in the output register. At the end of this period a read strobe occurs which sets all read data lines. One microsecond later, a read clock is generated which lasts 2 to 3 microseconds as an output signal. The read character gate is adjusted as follows:

a. Load the tape unit with the Master Alignment Tape, HP part number 9162-0027 (or any all "ones" 800 cpi tape), place the unit in synchronous forward operation, and select 800 cpi operation (seven-track units only).

b. Synchronize the oscilloscope (negative slope) to the NOR test point on the read control card. (The first data bit of a character will start the gate time when this line goes to ground.)

c. Observe the bit-to-bit time (negative-going edge to negative-going edge). The low (or ground) portion of this signal represents the character gate time.

d. Using the read control gate control (R29), adjust the $\overline{\text{NOR}}$ (ground portion) of the signal to 40 percent of the nominal bit-to-bit time. Ensure that the bit-to-bit time is consistent with the data transfer rate.

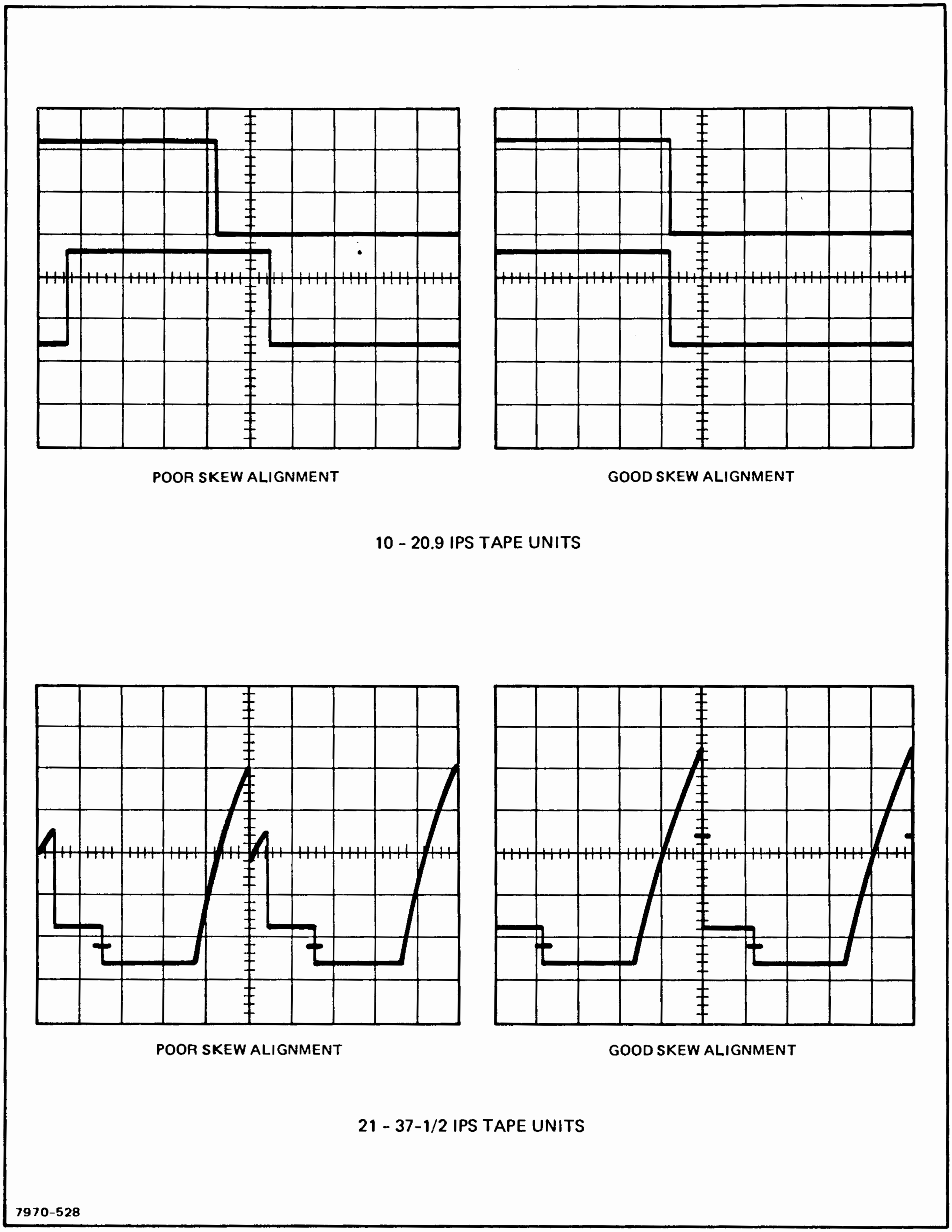


Figure 2-1. Skew Alignment Waveforms

SECTION III
REPLACEABLE PARTS

3-1. INTRODUCTION.

3-2. This section provides information for ordering replacement parts for the read modules of the HP 7970B/7970C Digital Magnetic Tape Units.

3-3. This section contains assembly parts list, supporting illustrations, ordering information, and a part number cross reference.

3-4. ASSEMBLY PARTS LISTS.

3-5. The assembly parts lists represent a breakdown of all replaceable parts of the read modules. The information contained in the lists are under the following headings:

a. FIGURE & INDEX NO.

b. PART NUMBER.

c. DESCRIPTION.

d. UNITS PER ASSY.

3-6. FIGURE AND INDEX NUMBER.

3-7. The figure and index number column identifies the figure that illustrates each listed item and the index number that identifies the item on the illustration.

3-8. PART NUMBER.

3-9. The part number column provides the Hewlett-Packard part number for each item listed in the assembly parts list.

3-10. DESCRIPTION.

3-11. The description column describes the items within the article. An indented column arrangement is used to show the relationship between a part and the next higher assembly. The top assembly of each listing appears in indention 1. Primary subassemblies (of top assembly) and attaching parts appear in indention 2. This method of indention is continued through indention 3, 4, etc, until all replaceable parts are listed. Attaching parts are listed immediately following the part they attach. Attaching parts are identified by the abbreviation (AP) enclosed in parentheses at the end of the description.

3-12. Reference designation and manufacture information (if applicable) is also included in the description column.

3-13. UNITS PER ASSEMBLY.

3-14. The quantity shown in the units per assembly column reflects the total quantity of a part required by the next higher assembly of that part. This quantity is not necessarily the total used for the complete equipment. The abbreviation AR is used to indicate usage as required of a particular item. The abbreviation REF is used to indicate that the quantity of an item used per assembly is listed in the next higher assembly of the group assembly parts list.

3-15. ORDERING INFORMATION.

3-16. To order replacement parts, address the order or inquiry to the local Hewlett-Packard Sales and Service Office. (Refer to the list at the end of this manual for addresses.) Specify the following information for each part ordered.

a. Identification of the unit, kit, or assembly containing the part.

b. Hewlett-Packard part number for each part.

c. Description of each part.

d. Circuit reference designation (if applicable).

3-17. PART NUMBER CROSS REFERENCE.

3-18. Table 3-1 at the end of this section provides a cross reference between Hewlett-Packard part numbers and manufacturer's part numbers.

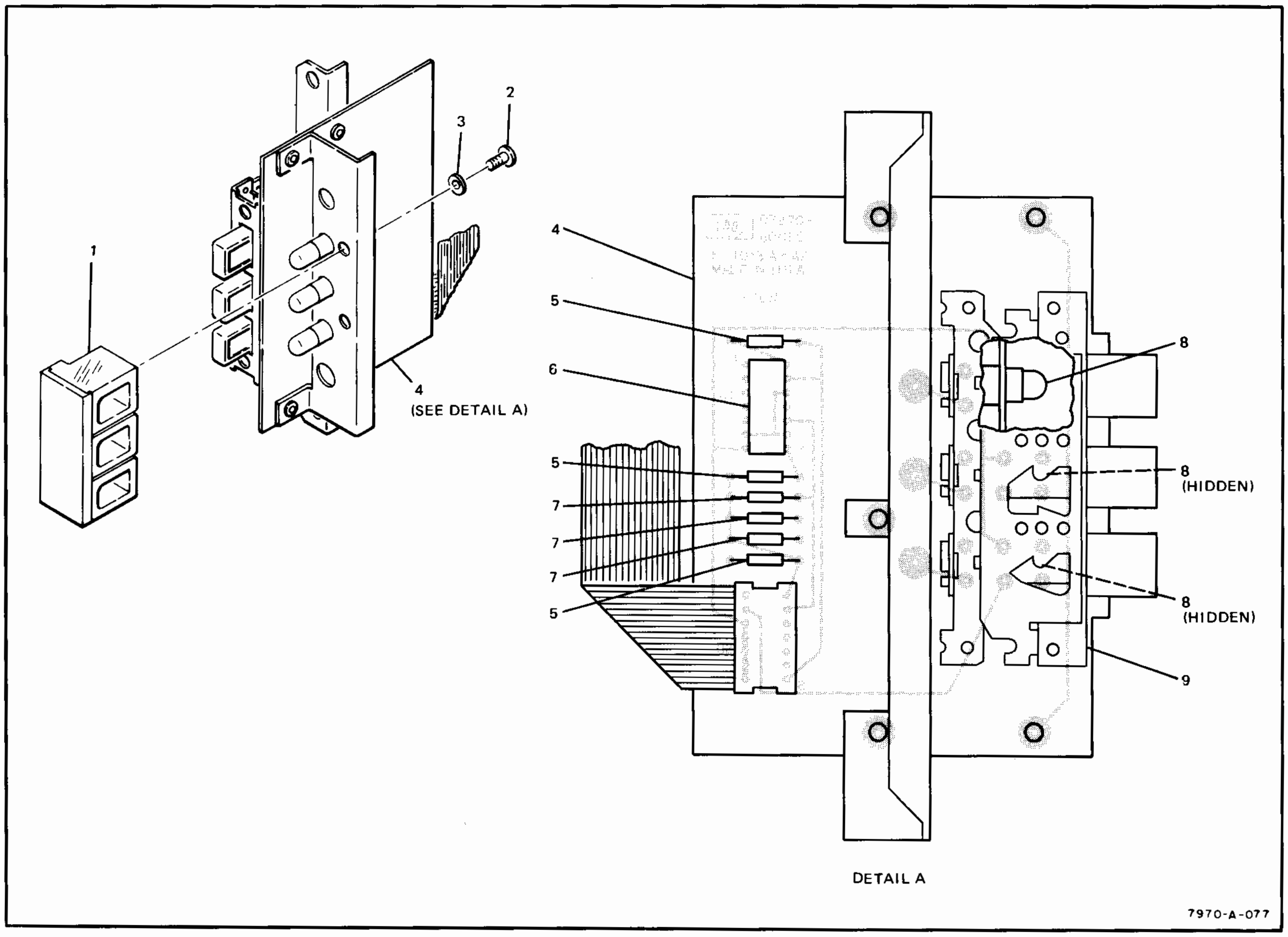
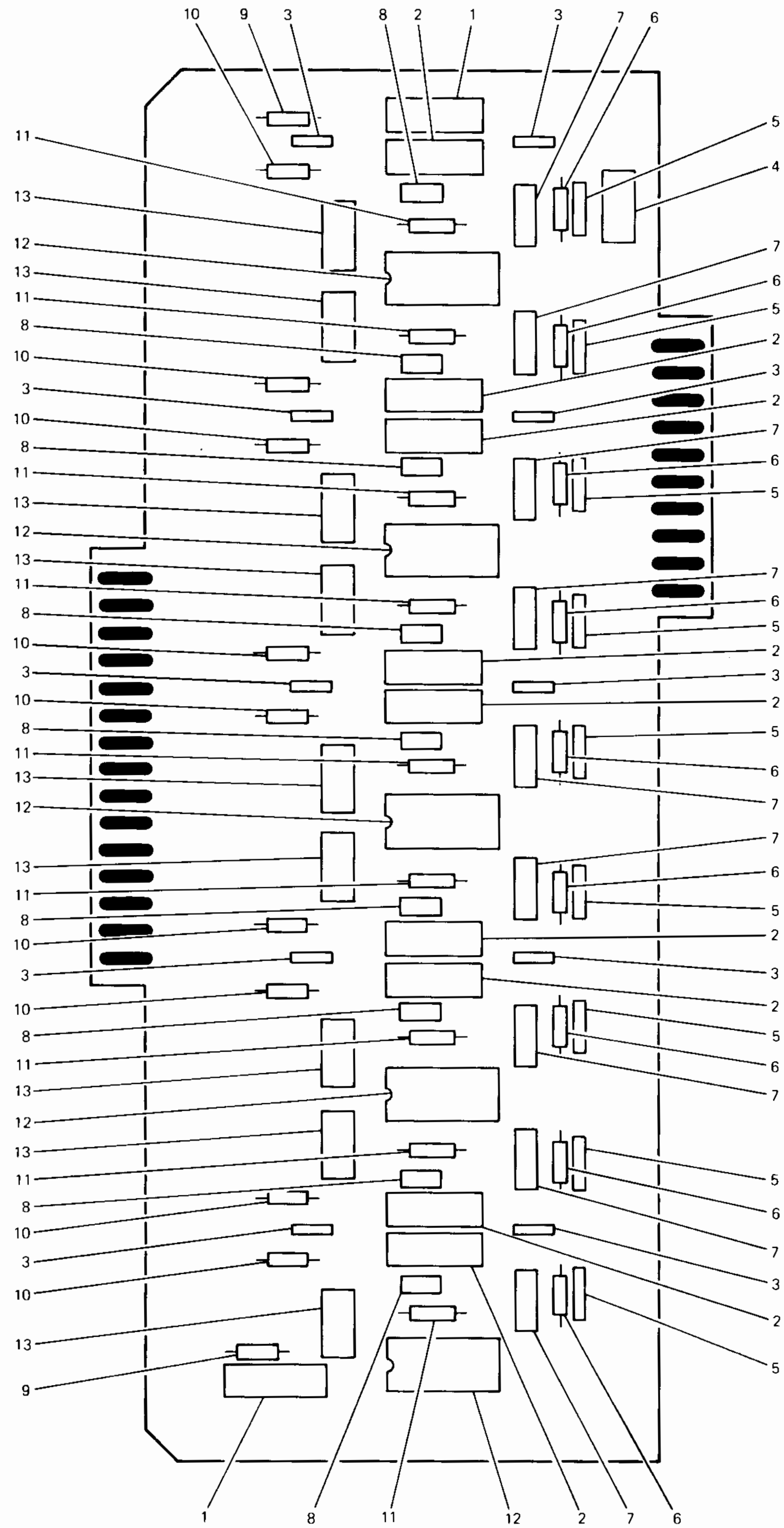


Figure 3-1. Density Select Switch Assembly A12

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-1-	07970-62087	DENSITY SELECT SWITCH ASSEMBLY A12	REF
-1	07970-60350	. LENS BLOCK ASSEMBLY, density select switch	1
-2	0624-0077	. . SCREW, no. 4-40, 0.312-inch pozi (AP)	2
-3	2190-0416	. . WASHER, flat (AP)	2
-4	07970-60090	. DENSITY SELECT PC ASSEMBLY A1	1
-5	0757-0419	. . RESISTOR, fxd, 681 ohms, 1%, 1/8W (R1, R2, R3)	3
-6	1820-0256	. . INTEGRATED CIRCUIT (U1)	1
-7	0757-0428	. . RESISTOR, fxd, 1.62k, 1%, 1/8W (R4, R5, R6)	3
-8	2140-0209	. . LAMP, 14V, 0.08A (DS1, DS2, DS3)	3
-9	3101-0847	. . SWITCH ASSEMBLY (S1, S2, S3) (not field replaceable)	1



7970-522

Figure 3-2. Read Preamplifier PC Assembly A15

FIGURE & INDEX NO.	PART NUMBER	1 2 3 4 5 DESCRIPTION	UNITS PER ASSY
3-2-	07970-60500	READ PREAMPLIFIER PC ASSEMBLY A15, 10 - 20 ips	
3-2-	07970-62000	READ PREAMPLIFIER PC ASSEMBLY A15, 21 - 45 ips	
-1	0180-0228	. CAPACITOR, fxd, 22 μF (C47, C48)	2
-2	0180-1704	. CAPACITOR, fxd, 47 μF (C2, C8, C12, C18, C22, C28, C32, C38, C42)	9
-3	0160-2055	. CAPACITOR, fxd, 0.01 μF (C5, C6, C15, C16, C25, C26, C35, C36, C45, C46)	10
-4	0180-0291	. CAPACITOR, fxd, 1.0 μF (C49)	1
-5	0160-0157	. CAPACITOR, fxd, 4700 pF (C1, C7, C11, C17, C21, C27, C31 C37, C41) (10 - 20 ips)	9
-5	0140-0210	. CAPACITOR, fxd, 270 pF (C1, C7, C11, C17, C21, C27, C31, C37, C41) (21 - 45 ips)	9
-6	0698-3155	. RESISTOR, fxd, 4.7k, 1%, 1/8W (R1, R5, R9, R13, R17, R21, R25, R29, R33) (10 - 20 ips)	9
-6	0698-3136	. RESISTOR, fxd, 4.64k, 1%, 1/8W (R1, R5, R9, R13, R17, R21, R25, R29, R33) (21 - 45 ips)	9
-7	0160-2225	. CAPACITOR, fxd, 2000 pF (C3, C9, C13, C19, C23, C29, C33, C39, C43)	9
-8	0160-2200	. CAPACITOR, fxd, 43 pF (C4, C10, C14, C20, C24, C30, C34, C40, C44)	9
-9	0757-0346	. RESISTOR, fxd, 10.0 ohms, 1/8W (R36, R37)	2
-10	0757-0399	. RESISTOR, fxd, 82.5 ohms, 1/8W (R2, R6, R10, R14, R18, R22, R26, R30, R34) (10 - 20 ips)	9
-10	0757-0401	. RESISTOR, fxd, 100 ohms, 1/8W (R2, R6, R10, R14, R18, R22, R26, R30, R34) (21 - 45 ips)	9
-11	0757-0462	. RESISTOR, fxd, 75k, 1%, 1/8W (R4, R8, R12, R16, R20, R24, R28, R32, R38)	9
-12	1826-0044	. INTEGRATED CIRCUIT, operational amplifier (U1 thru U5)	5
-13	2100-3251	. RESISTOR, var, 500 ohms, 1/2W (R3, R7, R11, R15, R19, R23, R27, R31, R35)	9

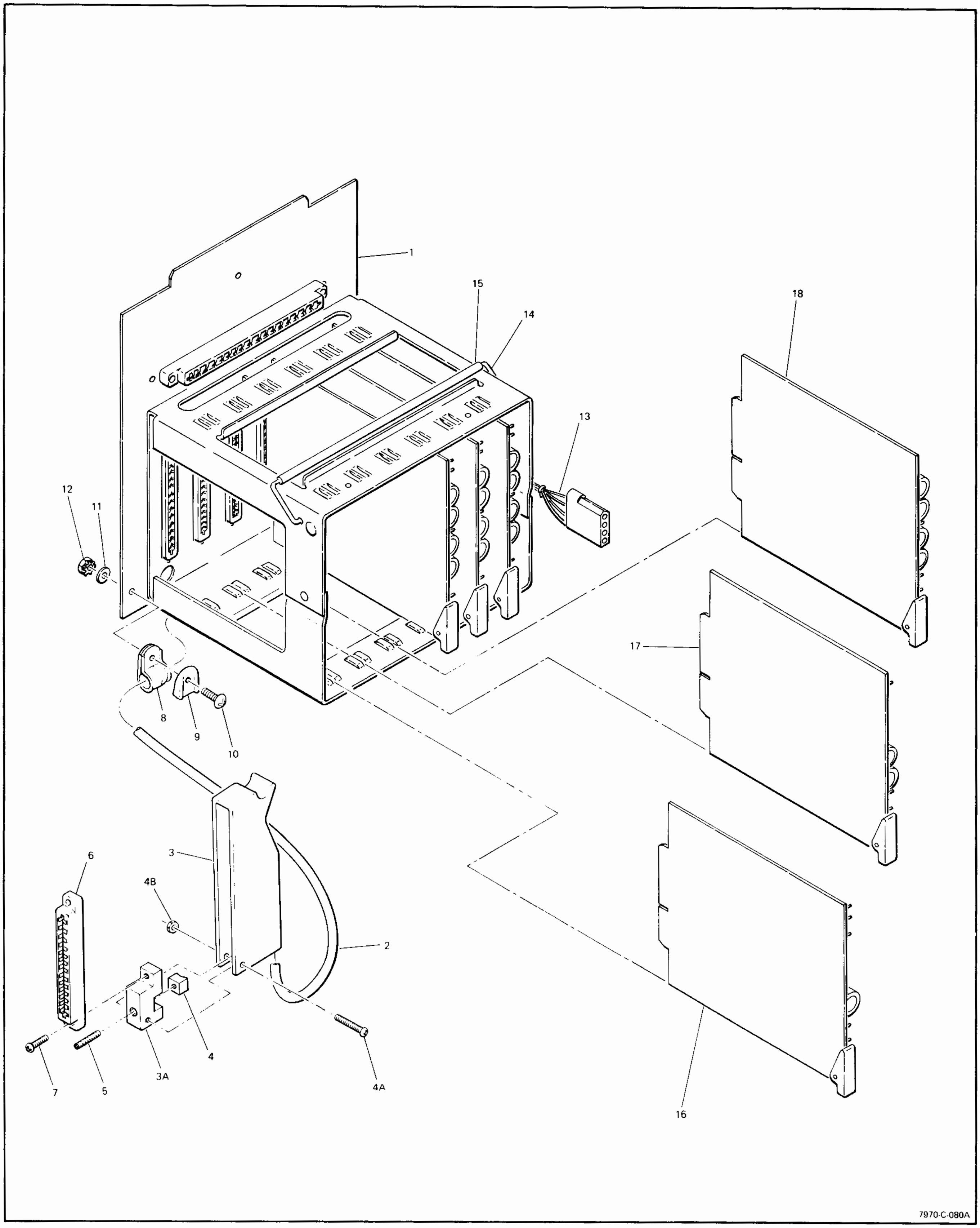


Figure 3-3. Read Assembly A18

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-3-	Reference Only	READ ASSEMBLY A18	REF
-1	07970-60390	. READ MOTHERBOARD ASSEMBLY	1
-2	8120-1523	. . CABLE, unshielded, 24 conductor	3.5 ft
-3	07970-40204	. . HOLDER, connector	1
-3A	5040-6072	. . . BLOCK, mounting	1
-4	5040-6003	. . CLAMP, cable, connector holder	1
-4A	2200-0091	. . . SCREW, no. 4-40, 0.562-inch, pozi (AP)	1
-4B	2260-0001	. . . NUT, hex, no. 4-40 (AP)	1
-5	3030-0143	. . . SCREW, set, no. 6-32, 0.500-inch, socket head (AP)	1
-6	1251-0159	. . CONNECTOR, printed circuit, 30 contact	1
-7	0624-0098	. . . SCREW, tapping, no. 4-40, 0.438-inch, pozi (AP)	2
-8	1400-0440	. . CLAMP, cable, 0.250-inch diameter (AP)	1
-9	2190-0452	. . . WASHER "D" (AP)	1
-10	2360-0199	. . . SCREW, no. 6-32, 0.438-inch, pozi (AP)	1
-11	3050-0227	. . . WASHER, flat (AP)	1
-12	2420-0001	. .. . NUT, hex, no. 6-32 (AP)	1
-13	07970-60430	. . CABLE ASSEMBLY, read power	1
-14	07970-00470	. . RETAINING SPRING, PC board	1
-15	1400-0795	. . TIE, cable, spiral, 0.250-inch diameter	6 in.
-16	--------	. READ CONTROL PC ASSEMBLY A18A1 . . . . (See figure 3-4 for details.)	1
-17	--------	. READ DATA PC ASSEMBLY, single channel A18A2 . . . . (See figures 3-5, 3-6 for details.)	1
-18	--------	. READ DATA PC ASSEMBLY, dual channel A18A3 thru A18A6 . . . . . . (See figures 3-7, 3-8 for details.)	3 or 4*

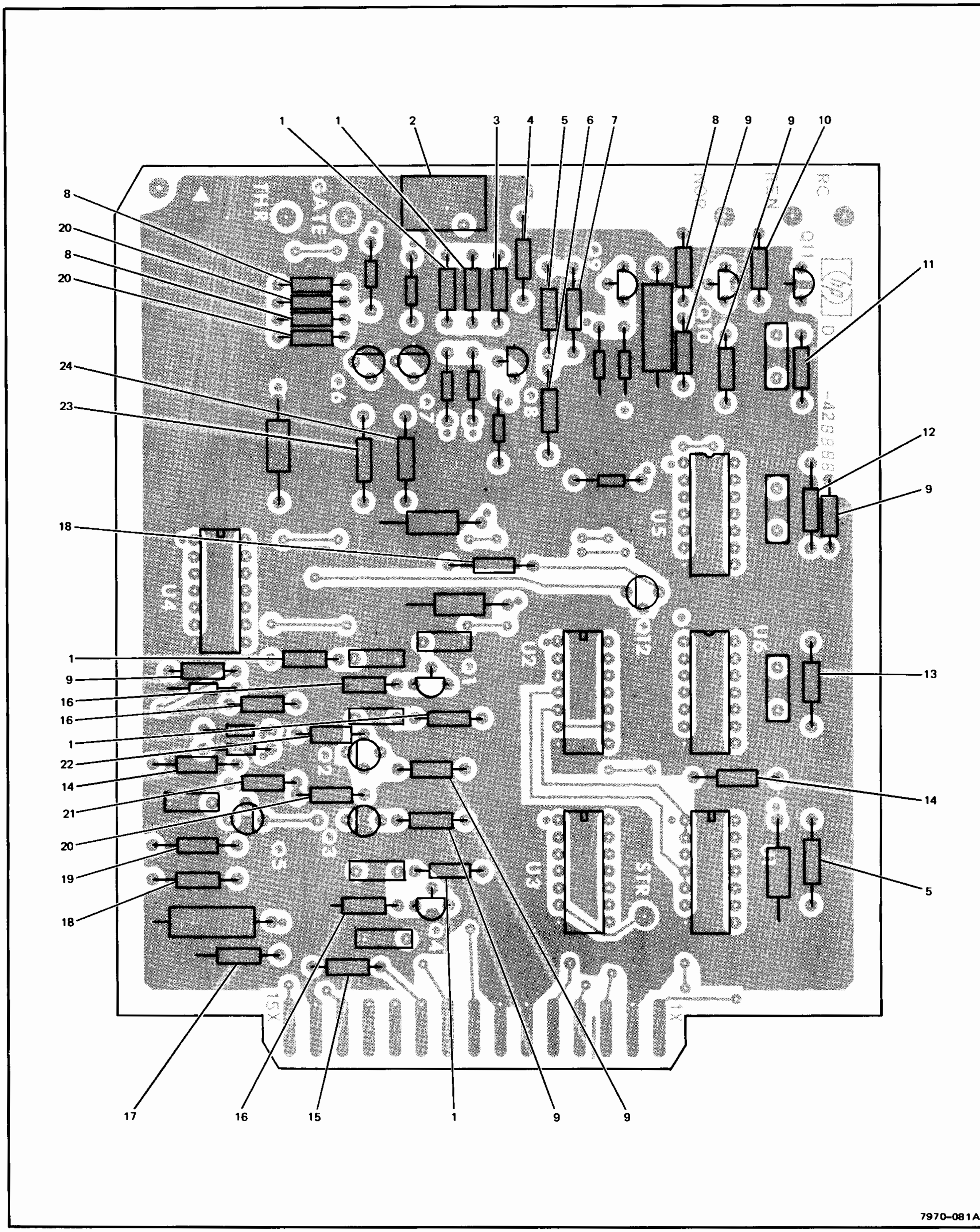


Figure 3-4. Read Control PC Assembly (Sheet 1 of 2)

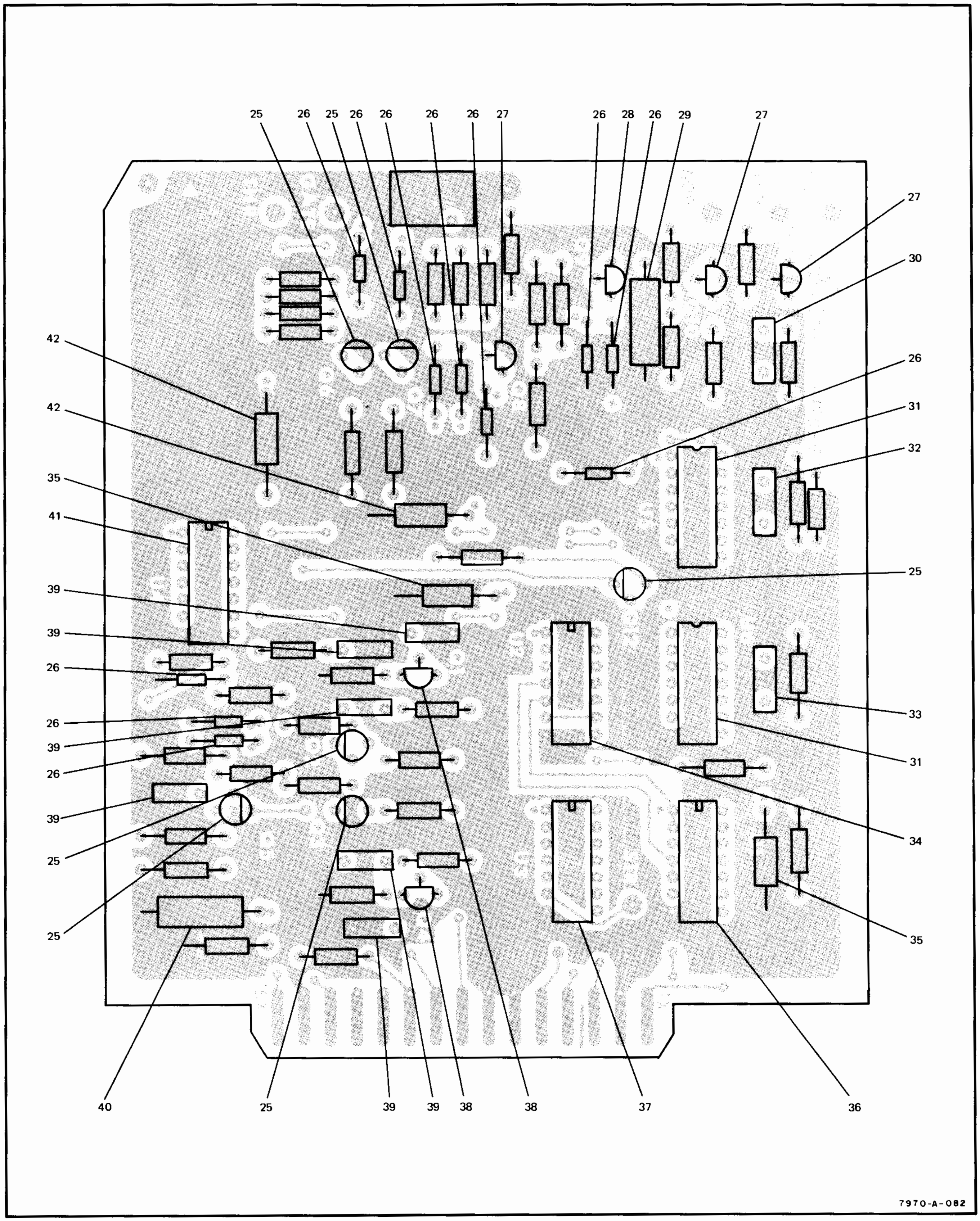


Figure 3-4. Read Control PC Assembly (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-4-	07970-62170	READ CONTROL PC ASSEMBLY A18A1, 10 - 20.9 ips	REF
4-	07970-62171	READ CONTROL PC ASSEMBLY A18A1, 21 - 45 ips	REF
-1	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R2, R4, R8, R22, R29)	5
-2	2100-1758	. RESISTOR, var, ww, 1k, 5%, 1W (R29)	1
-3	0683-1235	. RESISTOR, fxd, 12k, 5%, 1/4W (R23)	1
-4	0698-3132	. RESISTOR, fxd, 261 ohms, 1%, 1/8W (R28)	1
	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R43)	1
-5	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R10, R26)	2
-6	0698-3438	. RESISTOR, fxd, 147 ohms, 1%, 1/8W (R27)	1
-7	0757-0199	. RESISTOR, fxd, 21.5k, 1%, 1/8W (R25)	1
-8	0683-8235	. RESISTOR, fxd, 82k, 5%, 1/4W (R30, R37, R38)	3
-9	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R3, R7, R11, R31, R32, R39)	6
-10	0683-2725	. RESISTOR, fxd, 2.7k, 5%, 1/4W (R34)	1
-11	0683-6815	. RESISTOR, fxd, 680 ohms, 5%, 1/4W (R33)	1
-12	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R35)	1
-13	0757-0444	. RESISTOR, fxd, 12.1k, 1%, 1/8W (R36)	1
-14	0757-1094	. RESISTOR, fxd, 1.47k, 1%, 1/8W (R16, R42)	2
-15	0683-1525	. RESISTOR, fxd, 1.5k, 5%, 1/4W (R41)	1
-16	0683-6825	. RESISTOR, fxd, 6.8k, 5%, 1/4W (R1, R9, R40)	3
-17	0757-0401	. RESISTOR, fxd, 100 ohms, 1%, 1/8W (R15)	1
-18	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R13)	1
-19	0698-0082	. RESISTOR, fxd, 464 ohms, 1%, 1/8W (R12)	1
-20	0683-3325	. RESISTOR, fxd, 3.3k, 5%, 1/4W (R6, R17, R19)	3
-21	0683-3335	. RESISTOR, fxd, 33k, 5%, 1/4W (R14)	1
-22	0683-2235	. RESISTOR, fxd, 22k, 5%, 1/4W (R5)	1
-23	0757-0439	. RESISTOR, fxd, 6.81k, 1%, 1/8W (R20)	1
-24	0757-0443	. RESISTOR, fxd, 11k, 1%, 1/8W (R21)	1
-25	1854-0071	. TRANSISTOR, NPN, Si, 2N3494 (Q2, Q2, Q5, Q6, Q7, Q12)	6
-26	1901-0040	. DIODE, Si (CR1 thru CR11)	11
-27	1854-0270	. TRANSISTOR, NPN, Si, 2N4265 (Q8, Q10, Q11)	3
-28	1853-0015	. TRANSISTOR, PNP, Si, 2N3640 (Q9)	1
-29	0160-0162	. CAPACITOR, fxd, 0.022 μF, 10% (C8) (10 - 20.9 ips)	1
-29	0160-0161	. CAPACITOR, fxd, 0.01 μF, 10% (C8) (21 - 45 ips)	1
-30	0160-2307	. CAPACITOR, fxd, 47 pF, 5%, 300 Vdcw (C9)	1
-31	1820-0088	. INTEGRATED CIRCUIT, type 851 (U5, U6)	2
-32	0140-0193	. CAPACITOR, fxd, 82 pF, 5%, 300 Vdcw (C10)	1
-33	0160-2209	. CAPACITOR, fxd, 360 pF, 5%, 300 Vdcw (C11)	1
-34	1820-0069	. INTEGRATED CIRCUIT, type 7420N (U2)	1
-35	0180-1701	. CAPACITOR, fxd, 6.8 μF, 20%, 6 Vdcw (C12, C13)	2
-36	1820-0348	. INTEGRATED CIRCUIT, type 844 (U1)	1
-37	1820-0376	. INTEGRATED CIRCUIT (U3)	1
-38	1853-0036	. TRANSISTOR, PNP, 2N3906 (Q1, Q4)	2
-39	0160-2055	. CAPACITOR, fxd, 0.01 μF, 100 Vdcw (C1, C2, C3, C4, C5, C6)	6
-40	0180-1704	. CAPACITOR, fxd, 47 μF, 10%, 6 Vdcw (C7)	1
-41	1820-0349	. INTEGRATED CIRCUIT (U4)	1
-42	0180-0210	. CAPACITOR, fxd, 3.3 μF, 20%, 15 Vdcw (C14, C15)	2

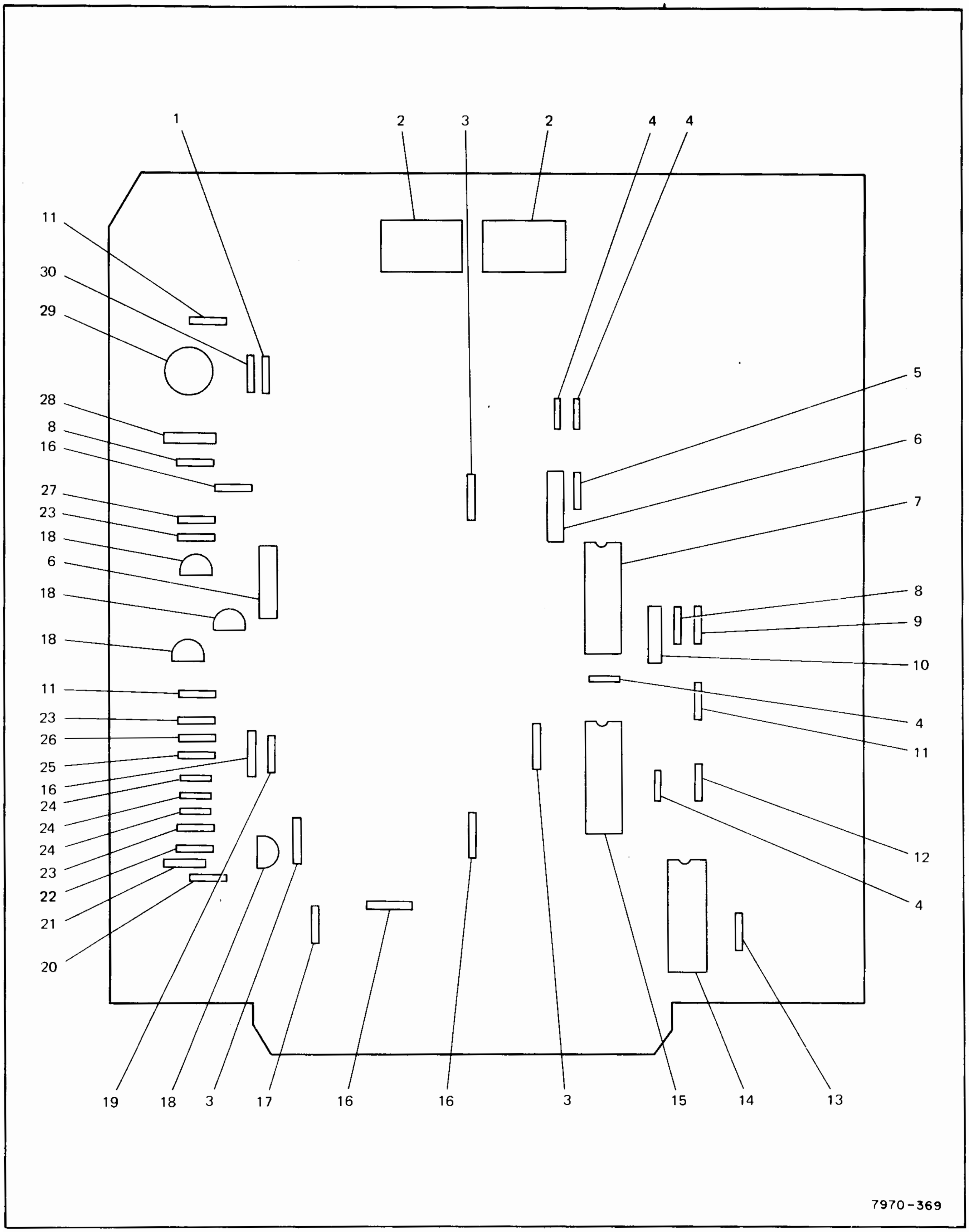


Figure 3-5. Single Channel Read Data PC Assembly (10 - 20.9 IPS)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-5-	07970-62167	READ DATA PC ASSEMBLY A18A2, single-channel (10 - 20.9 ips)	REF
-1	0683-4715	. RESISTOR, fxd, 470 ohms, 1/4W (R14)	1
-2	2100-1923	. RESISTOR, var, 50k (R21, R22)	2
-3	0180-1701	. CAPACITOR, fxd, 6.8 μF, 6V, tant (C1, C8, C9)	3
-4	1901-0040	. DIODE, Si, 30V, 30 mA (CR5, CR6, CR7, CR8)	4
-5	0757-0289	. RESISTOR, fxd, 13.3k, 1%, 1/8W (R20)	1
-6	0160-0160	. CAPACITOR, fxd, 0.0082 μF, My (C3, C7)	2
-7	1820-0515	. INTEGRATED CIRCUIT, MV 9602 (U4)	1
-8	0683-4725	. RESISTOR, fxd, 4.7k, 1/4W (R11, R19)	2
-9	0683-2725	. RESISTOR, fxd, 2.7k, 1/4W (R18)	1
-10	0140-0197	. CAPACITOR, fxd, 180 pF, mica (C6)	1
-11	0683-2225	. RESISTOR, fxd, 2.2k, 1/4W (R4, R16, R17)	3
-12	0683-1025	. RESISTOR, fxd, 1k, 1/4W (R24)	1
-13	0757-0429	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23)	1
-14	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3)	1
-15	1820-0077	. INTEGRATED CIRCUIT, type SN7474 (U1)	1
-16	0180-0210	. CAPACITOR, fxd, 3.3 μF, 15V (C2, C4, C10, C11)	4
-17	0683-1515	. RESISTOR, fxd, 150 ohms, 1/4W (R26)	1
-18	1854-0071	. TRANSISTOR, 2N3391 (Q1, Q2, Q3, Q4)	4
-19	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2)	1
-20	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1)	1
-21	0160-3449	. CAPACITOR, fxd, 2000 pF, 10% (C12)	1
-22	0683-3635	. RESISTOR, fxd, 36k, 1/4W (R3)	1
-23	0683-1035	. RESISTOR, fxd, 10k, 1/4W (R5, R8, R9)	3
-24	1901-0450	. DIODE, Si (CR1, CR2, CR3)	3
-25	0683-2255	. RESISTOR, fxd, 2.2M, 1/4W (R7)	1
-26	0683-1045	. RESISTOR, fxd, 100k, 1/4W (R10)	1
-27	0683-6825	. RESISTOR, fxd, 6.8k, 1/4W (R6)	1
-28	0160-3573	. CAPACITOR, fxd, 680 pF, cer (C5)	1
-29	1826-0065	. INTEGRATED CIRCUIT, comparator, LM 311 (U5)	1
-30	0683-4735	. RESISTOR, fxd, 47k, 1/4W (R15)	1

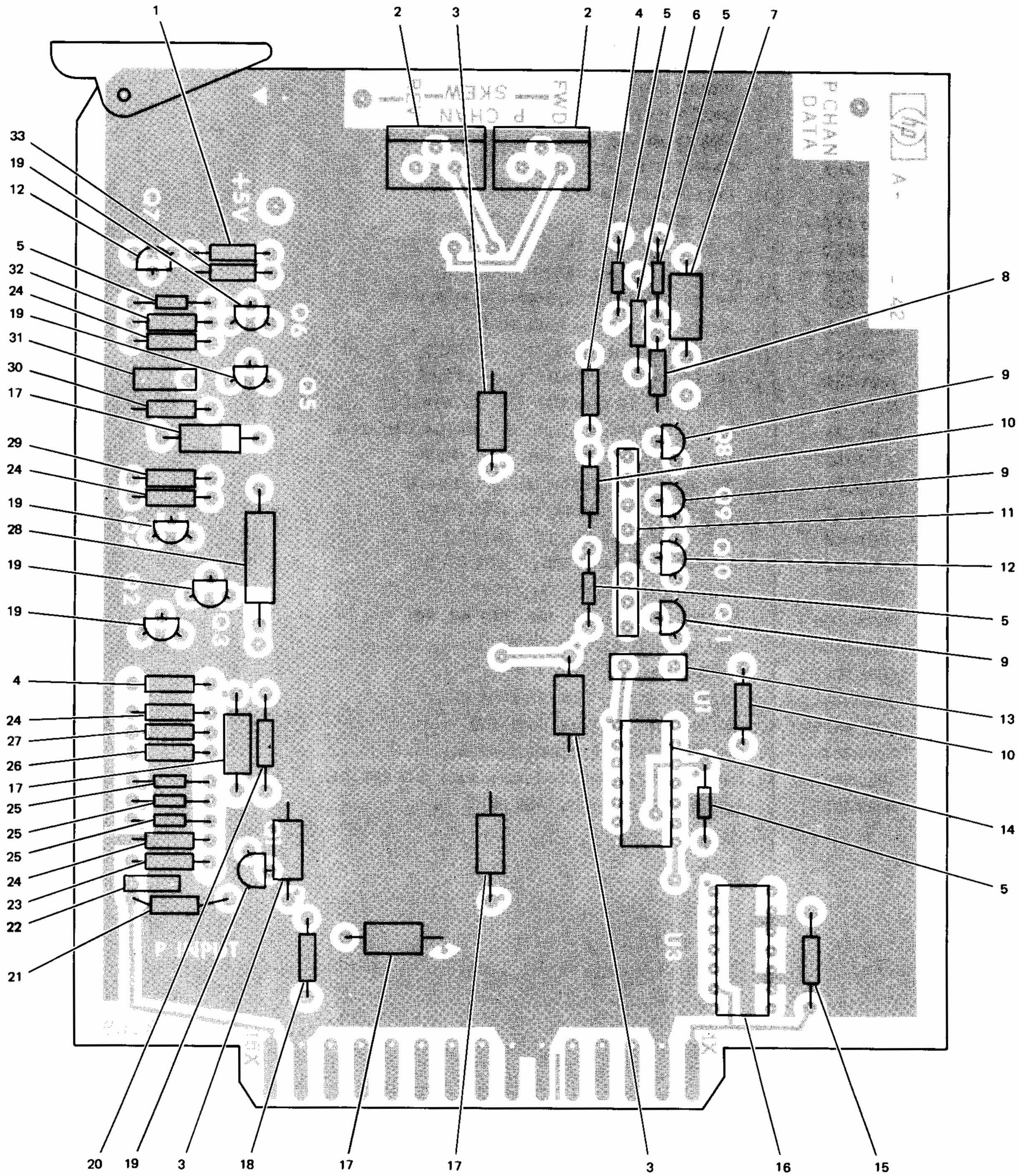


Figure 3-6. Single-Channel Read Data PC Assembly (21 - 45 IPS)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-6-	07970-60570	READ DATA PC ASSEMBLY A18A2, single-channel, 21 - 45 ips	REF
-1	0683-4735	. RESISTOR, fxd, 47k, 5%, 1/4W (R15)	1
-2	2100-1761	. RESISTOR, var, ww, 10k, 5%, 1W (R21, R22)	2
-3	0180-1701	. CAPACITOR, fxd, 6.8 µF, 20%, 6 Vdcw (C1, C8, C9)	3
-4	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R4, R16)	2
-5	1901-0040	. DIODE, Si (CR4, CR5, CR6, CR7, CR8)	5
-6	0757-0279	. RESISTOR, fxd, 3.16k, 1%, 1/8W (R20)	1
-7	0160-0155	. CAPACITOR, fxd, 0.0033 µF, 10% (C7)	1
-8	0683-1015	. RESISTOR, fxd, 100 ohms, 5%, 1/4W (R19)	1
-9	1854-0270	. TRANSISTOR, NPN, Si, 2N4265 (Q8, Q9, Q11)	3
-10	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R17, R24)	2
-11	1810-0044	. RESISTOR NETWORK, (R18)	1
-12	1853-0015	. TRANSISTOR, PNP, Si, 2N3640 (Q7, Q10)	2
-13	0140-0197	. CAPACITOR, fxd, 180 pF, 5%, 300 Vdcw (C6)	1
-14	1820-0077	. INTEGRATED CIRCUIT, type 7474N (U1)	1
-15	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23)	1
-16	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3)	1
-17	0180-0210	. CAPACITOR, fxd, 3.3 µF, 20%, 15 Vdcw (C2, C4, C10, C11)	4
-18	0683-1515	. RESISTOR, fxd, 150 ohms, 5%, 1/4W (R26)	1
-19	1854-0071	. TRANSISTOR, NPN, Si (Q1, Q2, Q3, Q4, Q5, Q6)	6
-20	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2)	1
-21	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1)	1
-22	0160-3449	. CAPACITOR, fxd, 2000 pF, 10%, 250 Vdcw (C12)	1
-23	0683-3635	. RESISTOR, fxd, 36k, 5%, 1/4W (R3)	1
-24	0683-1035	. RESISTOR, fxd, 10k, 5%, 1/4W (R5, R8, R9, R12)	4
-25	1901-0450	. DIODE, Si, (CR1, CR2, CR3)	3
-26	0683-2255	. RESISTOR, fxd, 2.2M, 5%, 1/4W (R7)	1
-27	0683-1045	. RESISTOR, fxd, 100k, 5%, 1/4W (R10)	1
-28	0160-0156	. CAPACITOR, fxd, 0.0039 µF, 10% (C3)	1
-29	0683-6825	. RESISTOR, fxd, 6.8k, 5%, 1/4W (R6)	1
-30	0683-4725	. RESISTOR, fxd, 4.7k, 5%, 1/4W (R11)	1
-31	0160-3572	. CAPACITOR, fxd, 330 pF, 10%, 500 Vdcw (C5)	1
-32	0683-1235	. RESISTOR, fxd, 12k, 5%, 1/4W (R13)	1
-33	0683-4715	. RESISTOR, fxd, 470 ohms, 5%, 1/4W (R14)	1

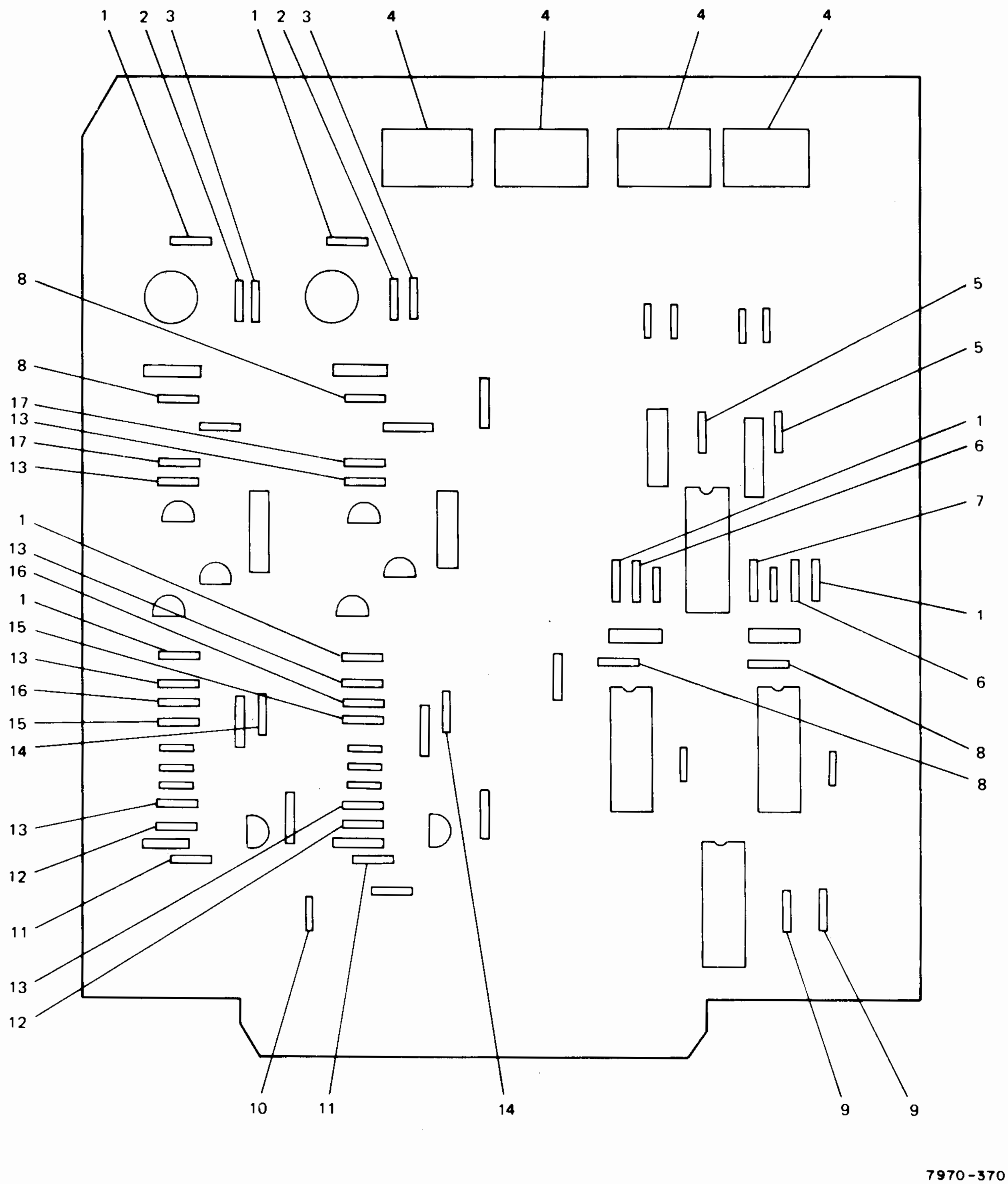


Figure 3-7. Dual Channel Read Data PC Assembly (10 - 20.9 IPS) (Sheet 1 of 2)

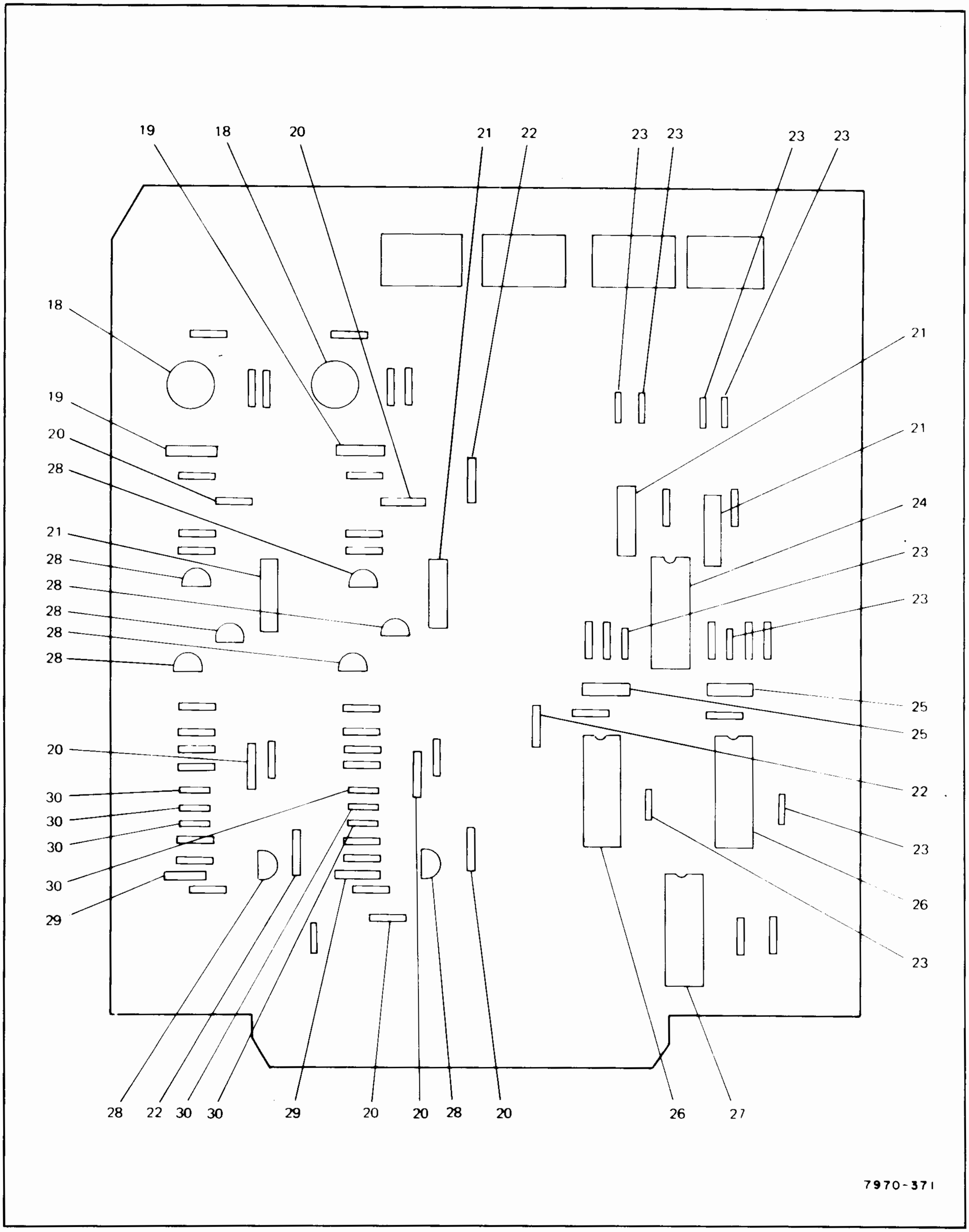


Figure 3-7. Dual Channel Read Data PC Assembly (10 - 20.9 IPS) (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-7-	07970-62166	READ DATA PC ASSEMBLY A18A3, dual-channel (10 - 20.9 ips)	REF
-1	0683-2225	. RESISTOR, fxd, 2.2k, 1/4W (R4, R16, R17, R104, R116, R117)	6
-2	0683-4735	. RESISTOR; fxd, 47k, 1/4W (R15, R115)	2
-3	0683-4715	. RESISTOR, fxd, 470 ohms, 1/4W (R14, R114)	2
-4	2100-1923	. RESISTOR, var, 50k (R21, R22, R121, R122)	4
-5	0757-0289	. RESISTOR, fxd, 13.3k, 1%, 1/8W (R20, R120)	2
-6	0683-2725	. RESISTOR, fxd, 2.7k, 1/4W (R18, R118)	2
-7	0683-1025	. RESISTOR, fxd, 1k, 1/4W (R24)	1
-8	0683-4725	. RESISTOR, fxd, 4.7k, 1/4W (R11, R19, R111, R119)	4
-9	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23, R25)	2
-10	0683-1515	. RESISTOR, fxd, 150 ohms, 1/4W (R26)	1
-11	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1, R101)	2
-12	0683-3635	. RESISTOR, fxd, 36k, 1/4W (R3, R103)	2
-13	0683-1035	. RESISTOR, fxd, 10k, 1/4W (R5, R8, R9, R105, R108, R109)	6
-14	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2, R102)	2
-15	0683-2255	. RESISTOR, fxd, 2.2M, 1/4W (R7, R107)	2
-16	0683-1045	. RESISTOR, fxd, 100k, 1/4W (R10, R110)	2
-17	0683-6825	. RESISTOR, fxd, 6.8k, 1/4W (R6, R106)	2
-18	1826-0065	. INTEGRATED CIRCUIT, comparator, LM 311 (U5, U6)	2
-19	0160-3573	. CAPACITOR, fxd, 680 pF, cer (C5, C105)	2
-20	0180-0210	. CAPACITOR, fxd, 3.3 μF, 15V (C2, C4, C10, C11, C102, C104)	6
-21	0160-0160	. CAPACITOR, fxd, 0.0082 μF, My (C3, C103, C7, C107)	4
-22	0180-1701	. CAPACITOR, fxd, 6.8 μF, 6V, tant (C1, C8, C9)	3
-23	1901-0040	. DIODE, Si, 30V, 30 mA (CR5 thru CR8, CR105 thru CR108)	8
-24	1820-0515	. INTEGRATED CIRCUIT, MV 9602 (U4)	1
-25	0140-0197	. CAPACITOR, fxd, 180 pF, mica (C6, C106)	2
-26	1820-0077	. INTEGRATED CIRCUIT, SN 7474 (U1, U2)	2
-27	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3)	1
-28	1854-0071	. TRANSISTOR, 2N3391 (Q1 thru Q4, Q12 thru Q15)	8
-29	0160-3449	. CAPACITOR, fxd, 2000 pF, 10% (C12, C112)	2
-30	1901-0450	. DIODE, Si (CR1 thru CR3, CR101 thru CR103)	6

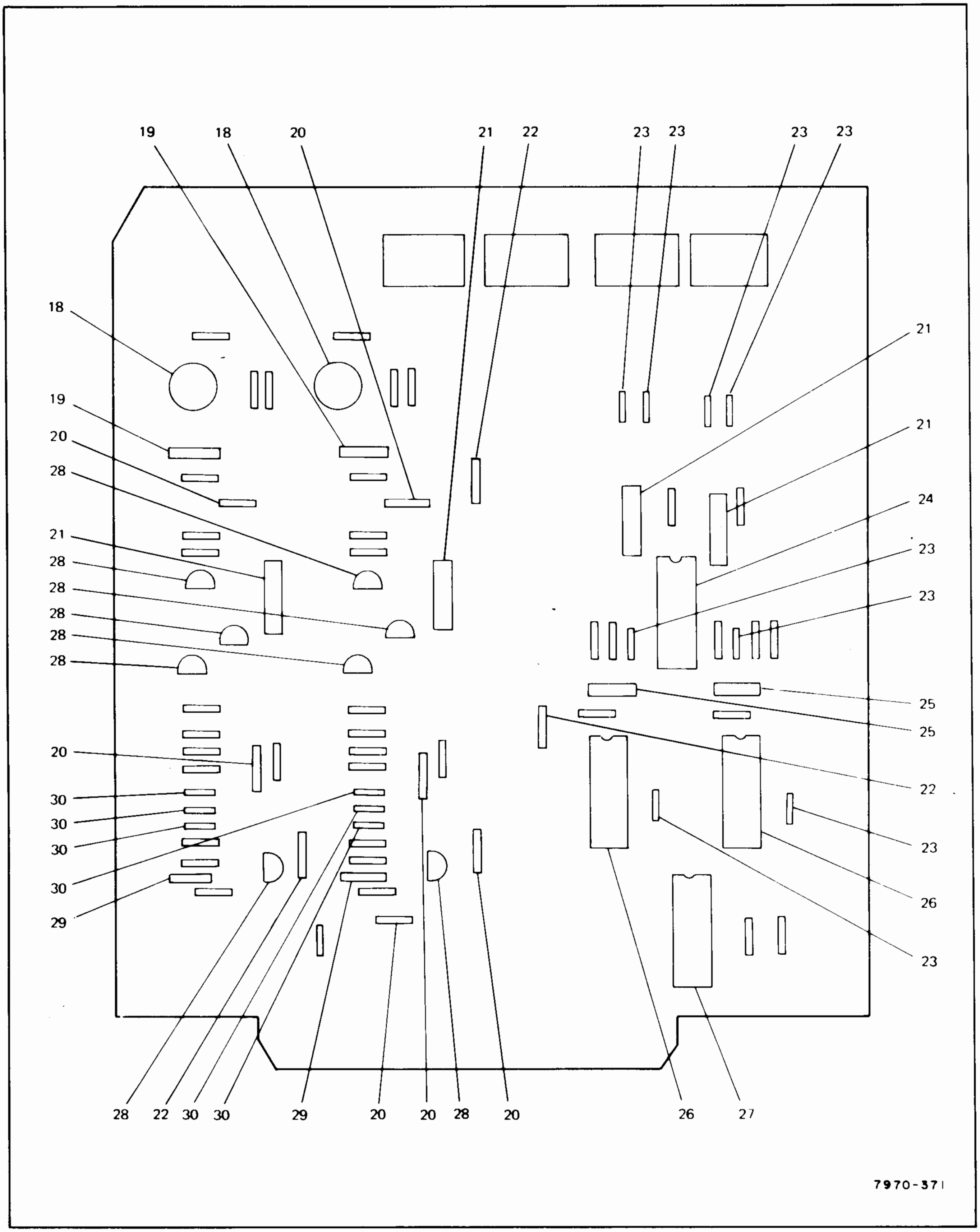


Figure 3-8. Dual-Channel Read Data PC Assembly (21 - 45 ips) (Sheet 1 of 2)

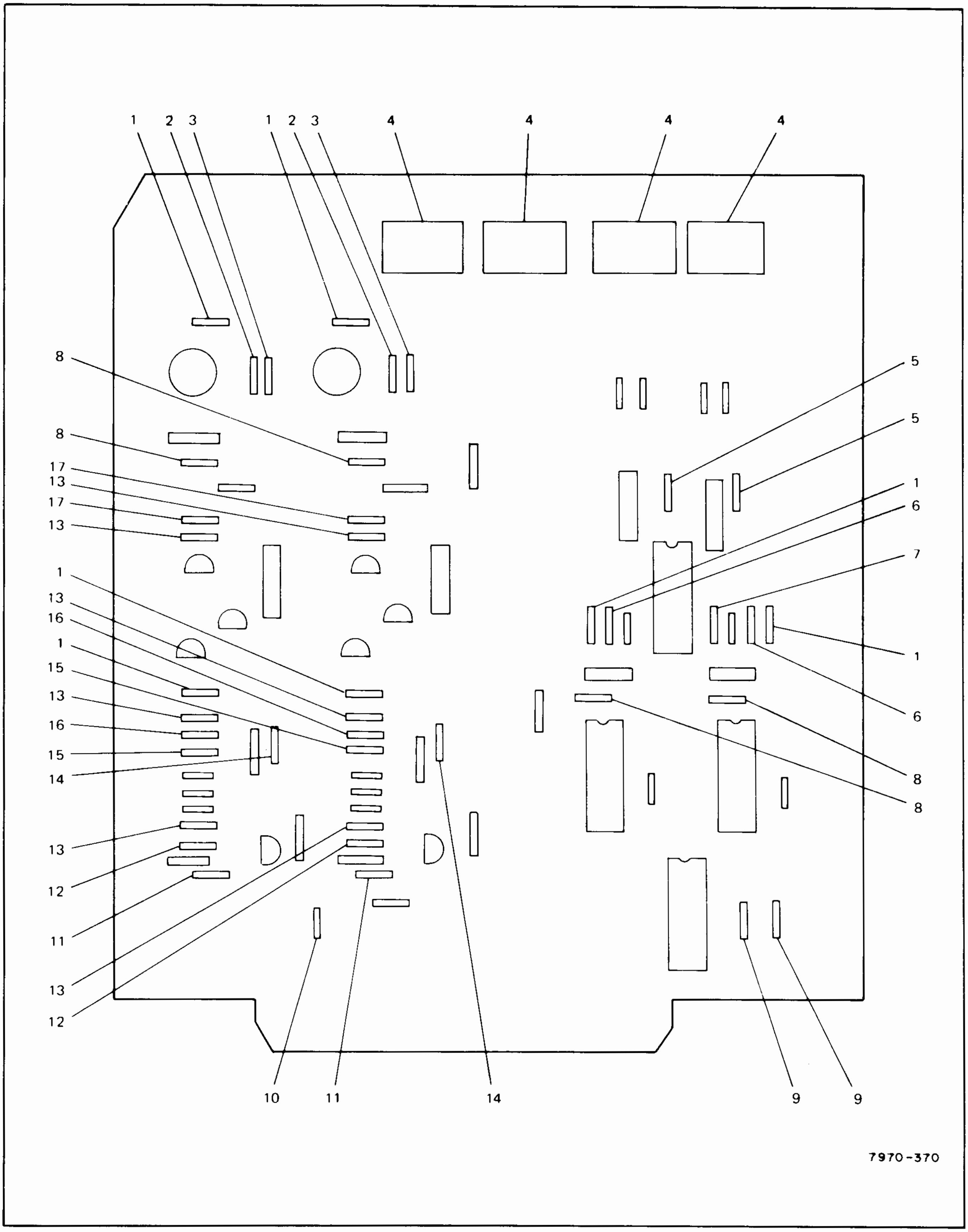


Figure 3-8. Dual-Channel Read Data PC Assembly (21 - 45 ips) (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-8-	07970-62168	READ DATA PC ASSEMBLY A18A3, dual-channel (21 - 45 ips).	REF
-1	0683-2225	. RESISTOR, fxd, 2.2k, 1/4W (R4, R16, R17, R104, R116, R117)	6
-2	0683-4735	. RESISTOR, fxd, 47k, 1/4W (R15, R115)	2
-3	0683-4715	. RESISTOR, fxd, 470 ohms, 1/4W (R14, R114).	2
-4	2100-1923	. RESISTOR, var, 50k, (R21, R22, R121, R122).	4
-5	0757-0289	. RESISTOR, fxd, 13.3k, 1%, 1/8W (R20, R120).	2
-6	0683-2725	. RESISTOR, fxd, 2.7k, 1/4W (R18, R118)	2
-7	0683-1025	. RESISTOR, fxd, 1k, 1/4W (R24)	1
-8	0683-4725	. RESISTOR, fxd, 4.7k, 1/4W (R11, R19, R111, R119).	4
-9	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23, R25)	2
-10	0683-1515	. RESISTOR, fxd, 150 ohms, 1/4W (R26).	1
-11	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1, R101)	2
-12	0683-3635	. RESISTOR, fxd, 36k, 1/4W (R3, R103)	2
-13	0683-1035	. RESISTOR, fxd, 10k, 1/4W (R5, R8, R9, R105, R108, R109)	6
-14	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2, R102)	2
-15	0683-2255	. RESISTOR, fxd, 2.2M, 1/4W (R7, R107)	2
-16	0683-1045	. RESISTOR, fxd, 100k, 1/4W (R10, R110)	2
-17	0683-6825	. RESISTOR, fxd, 6.8k, 1/4W (R6, R106).	2
-18	1826-0065	. INTEGRATED CIRCUIT, comparator, LM 311 (U5, U6)	2
-19	0160-3572	. CAPACITOR, fxd, 330 pF, cer (C5, C105)	2
-20	0180-0210	. CAPACITOR, fxd, 3.3 µF, 15V (C2, C4, C10, C11, C102, C104).	6
-21	0160-0156	. CAPACITOR, fxd, 0.0039 µF, My (C3, C103, C7, C107)	4
-22	0180-1701	. CAPACITOR, fxd, 6.8 µF, 6V, tant (C1, C8, C9)	3
-23	1901-0040	. DIODE, Si, 30V, 30 mA (CR5 thru CR8, CR105 thru CR108)	8
-24	1820-0515	. INTEGRATED CIRCUIT, MV 9602 (U4)	1
-25	0140-0197	. CAPACITOR, fxd, 180 pF, mica (C6, C106).	2
-26	1820-0077	. INTEGRATED CIRCUIT, SN 7474 (U1, U2)	2
-27	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3)	1
-28	1854-0071	. TRANSISTOR, 2N3391 (Q1 thru Q4, Q12 thru Q15)	8
-29	0160-3449	. CAPACITOR, fxd, 2000 pF, 10% (C12, C112)	2
-30	1901-0450	. DIODE, Si (CR1 thru CR3, CR101 thru CR103)	6

Table 3-1. Part Number Cross Reference

HP PART NUMBER	MFR CODE	MFR PART NUMBER
0140-0193	28480	0140-0193
0140-0197	14655	RDM15F181J3C
0140-0208	72136	RDM15F681J3C
0140-0210	28480	0140-0210
0160-0155	56289	192P33292-PTS
0160-0156	56289	192P39292-PTS
0160-0159	56289	192P68282-PTS
0160-0160	56289	192P82292-PTS
0160-0161	56289	192P10392-PTS
0160-0162	56289	192P22392-PTS
0160-2055	56289	C023F101F103ZS22-CDH
0160-2208	28480	0160-2208
0160-2209	72136	RDM15F361J3C
0160-2213	28480	0160-2213
0160-2307	28480	0160-2307
0160-3449	56289	C067B251F202KS25-CDH
0160-3572	56289	C067F501F331KS22-CDH
0160-3573	56289	C067F501F681KS22-CDH
0180-0210	56289	150D335X0015A2-DYS
0180-0228	56289	150D226X9015B2-DYS
0180-0291	56289	150D105X9035A2-DYS
0180-1701	28480	0180-1701
0180-1704	28480	0180-1704
0340-0456	13103	7717-122-N-WHT
0624-0077	00000	OBD
0624-0098	00000	OBD
0683-1015	01121	CB 1015
0683-1025	01121	CB 1025
0683-1035	01121	CB 1035
0683-1045	01121	CB 1045
0683-1235	01121	CB 1235
0683-1515	01121	CB 1515
0683-1525	01121	CB 1525
0683-2225	01121	CB 2225
0683-2235	01121	CB 2235
0683-2255	01121	CB 2255
0683-2725	01121	CB 2725
0683-3325	01121	CB 3325
0683-3335	01121	CB 3335
0683-3635	01121	CB 3635
0683-4715	01121	CB 4715
0683-4325	01121	CB 4325
0683-4725	01121	CB 4725
0683-4735	01121	CB 4735
0683-6815	01121	CB 6815
0683-6825	01121	CB 6825
0683-8235	01121	EB 8235

HP PART NUMBER	MFR CODE	MFR PART NUMBER
0698-0082	28480	0698-0082
0698-3132	28480	0698-3132
0698-3136	28480	0698-3136
0698-3438	28480	0698-3438
0698-4477	28480	0698-4477
0757-0199	28480	0757-0199
0757-0279	28480	0757-0279
0757-0280	28480	0757-0280
0757-0401	28480	0757-0401
0757-0419	28480	0757-0419
0757-0428	28480	0757-0428
0757-0439	28480	0757-0439
0757-0442	28480	0757-0442
0757-0443	28480	0757-0443
0757-0444	28480	0757-0444
0757-0460	28480	0757-0460
0757-1094	28480	0757-1094
1251-0159	71785	251-15-30-261
1400-0292	95987	1/4-6B
1400-0795	05593	SWP-1/4XXT(100')
1810-0044	56289	200C1791-CRR
1820-0069	01295	SN7420N
1820-0077	01295	SN7474N
1820-0088	04713	MC851P
1820-0256	04713	MC858P
1820-0348	04713	MC844P
1820-0349	04713	MC849P
1820-0376	01295	SN74H40N
1853-0015	80131	2N3640
1853-0036	80131	2N3906
1854-0071	28480	1854-0071
1854-0270	80131	2N4265
1901-0040	07263	FDG1088
1901-0450	28480	1901-0450
2100-1758	28480	2100-1758
2100-1761	28480	2100-1761
2140-0209	03508	382
2190-0085	00000	OBD
2190-0416	00000	OBD
2190-0452	95987	D6-140
2360-0195	00000	OBD
2360-0199	00000	OBD
2420-0001	78189	OBD
3030-0143	00000	OBD
3050-0227	80120	AN960AC-6
3050-0228	80120	MS15795-305
8120-1523		

SECTION IV
MAINTENANCE DIAGRAMS

This section contains schematic and parts location diagrams for the read modules of the HP 7970B/7970C Digital Magnetic Tape Units.

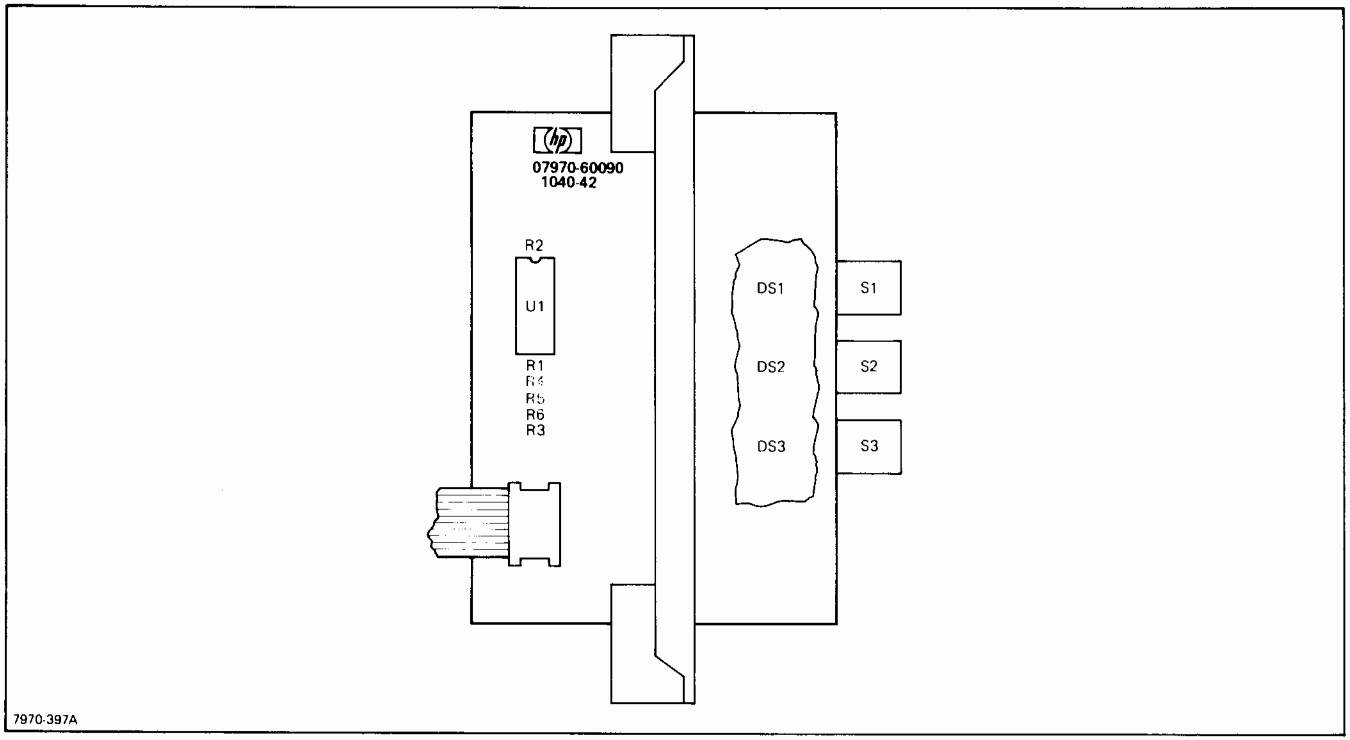


Figure 4-1. Density Select Switch Assembly A12, Parts Location Diagram

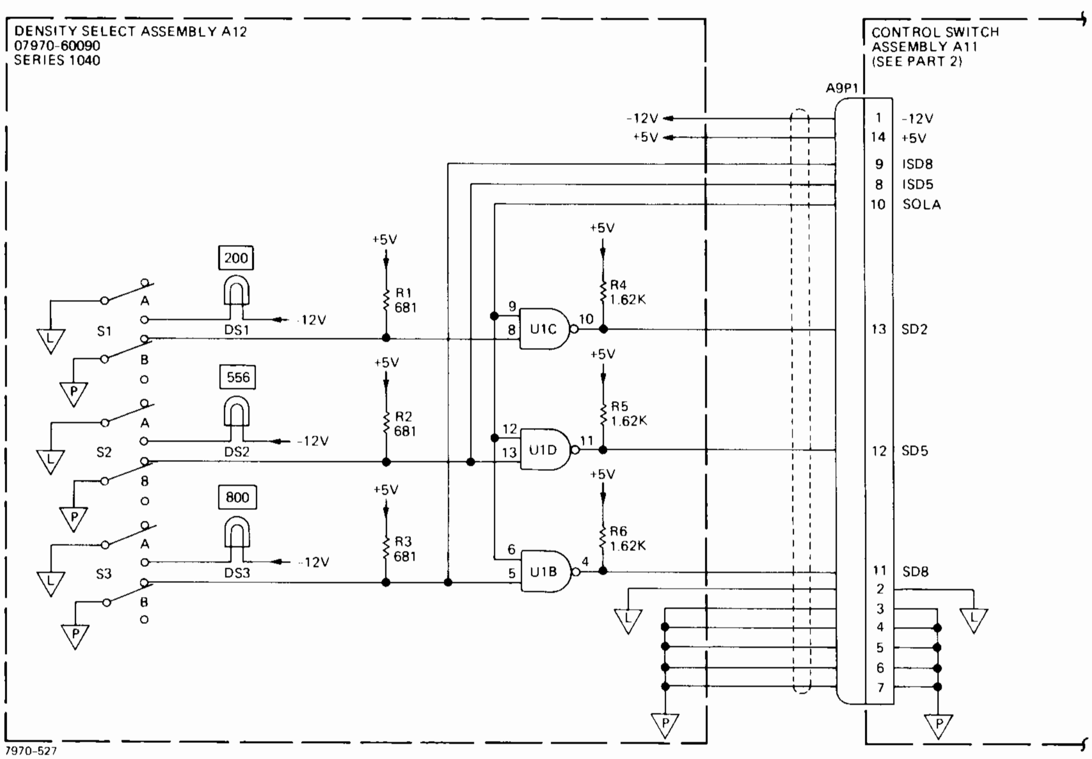
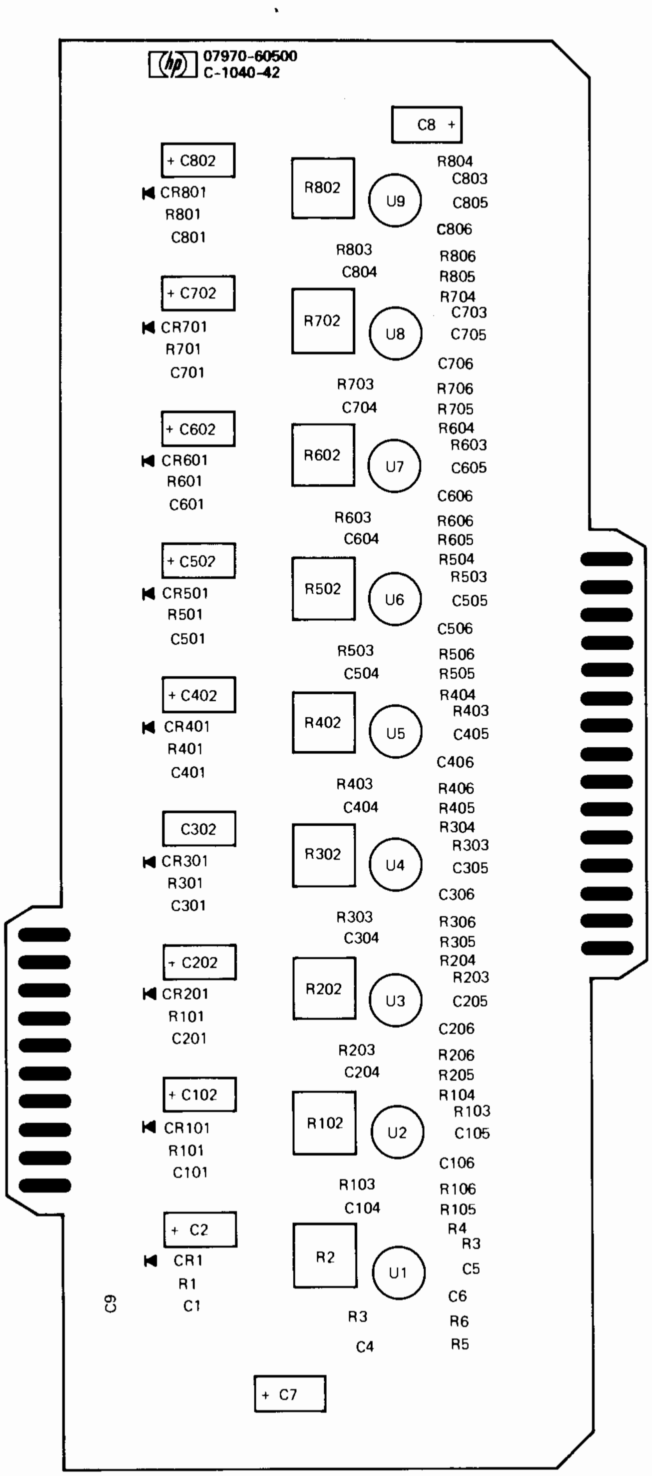


Figure 4-2. Density Select Switch Assembly A12, Schematic Diagram



7970-405

Figure 4-3. Read Preamplifier PC Assembly A15, Parts Location Diagram (Sheet 1 of 2)

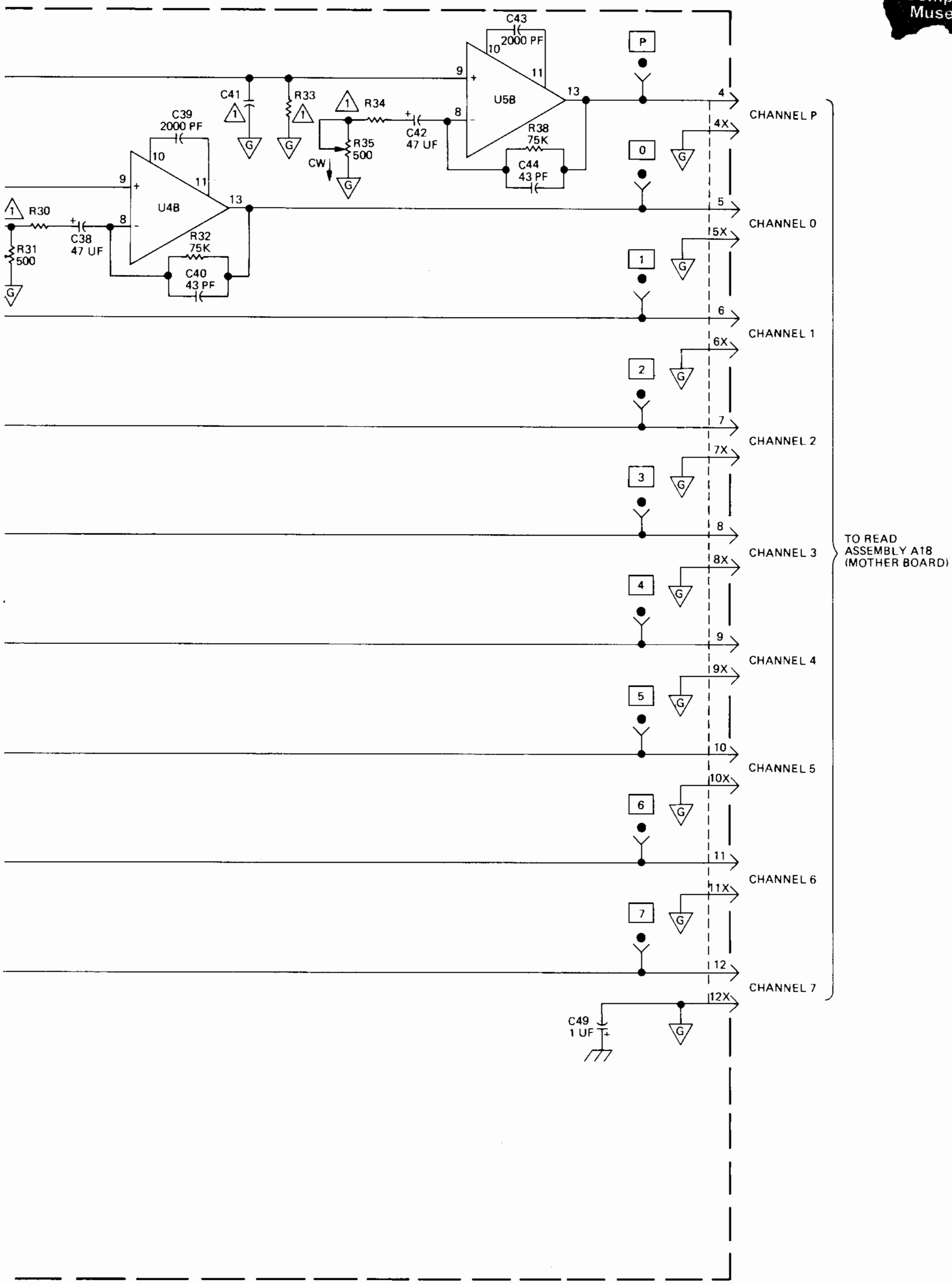
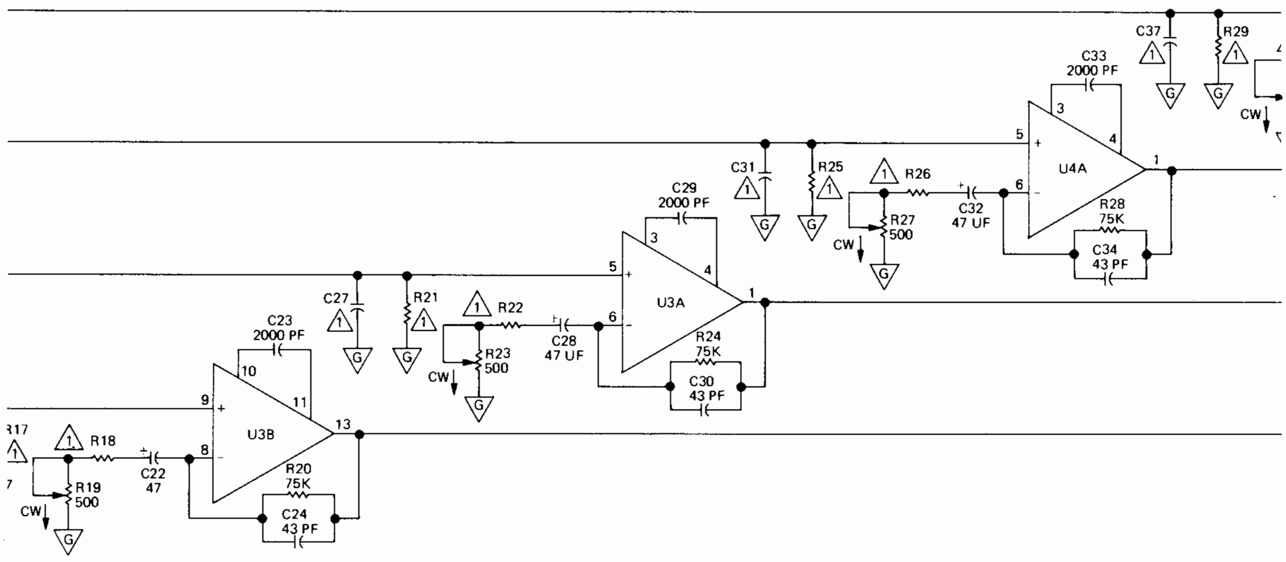
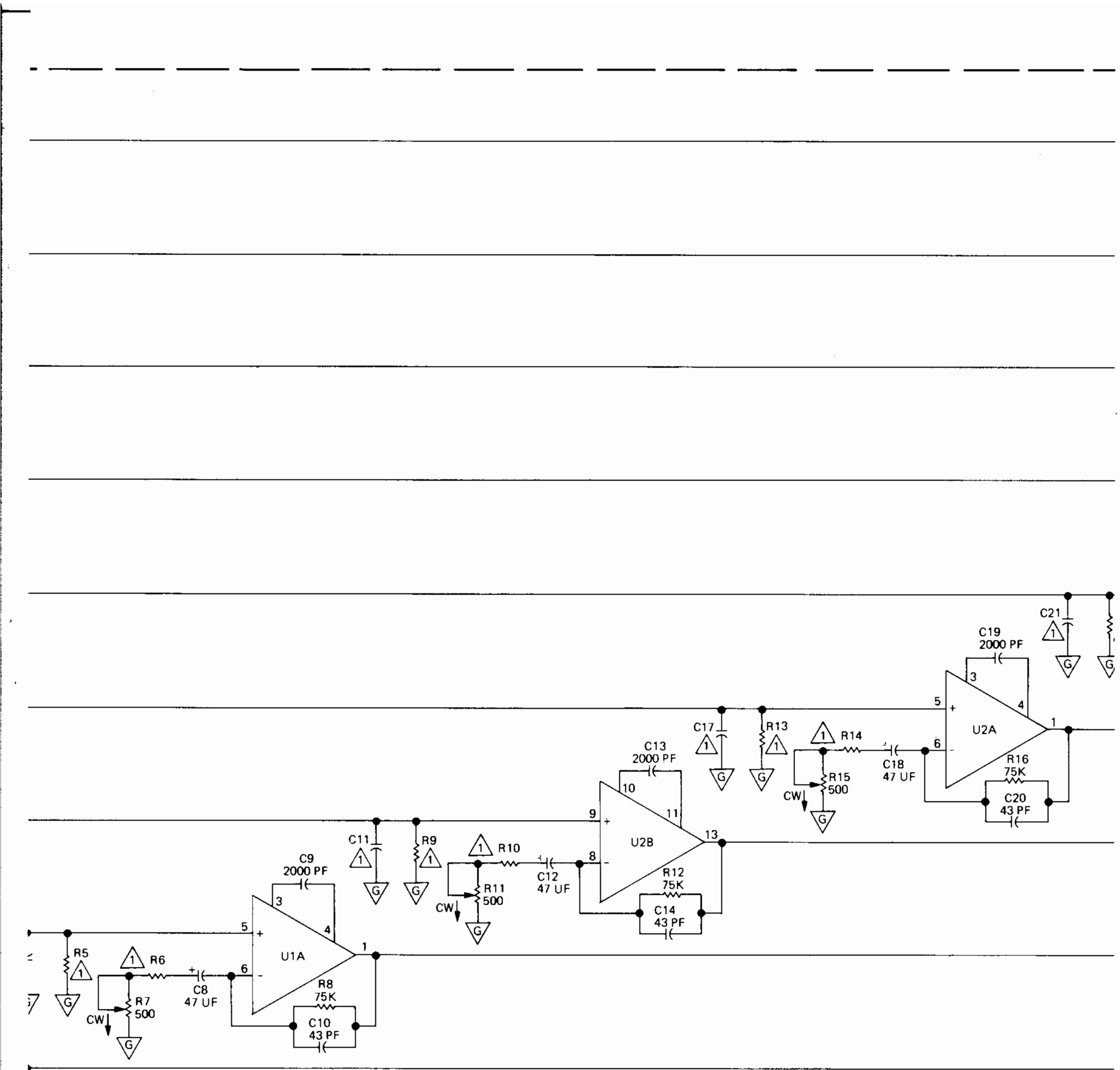


Figure 4-4. Read Preamplifier PC Assembly A15, Schematic Diagram



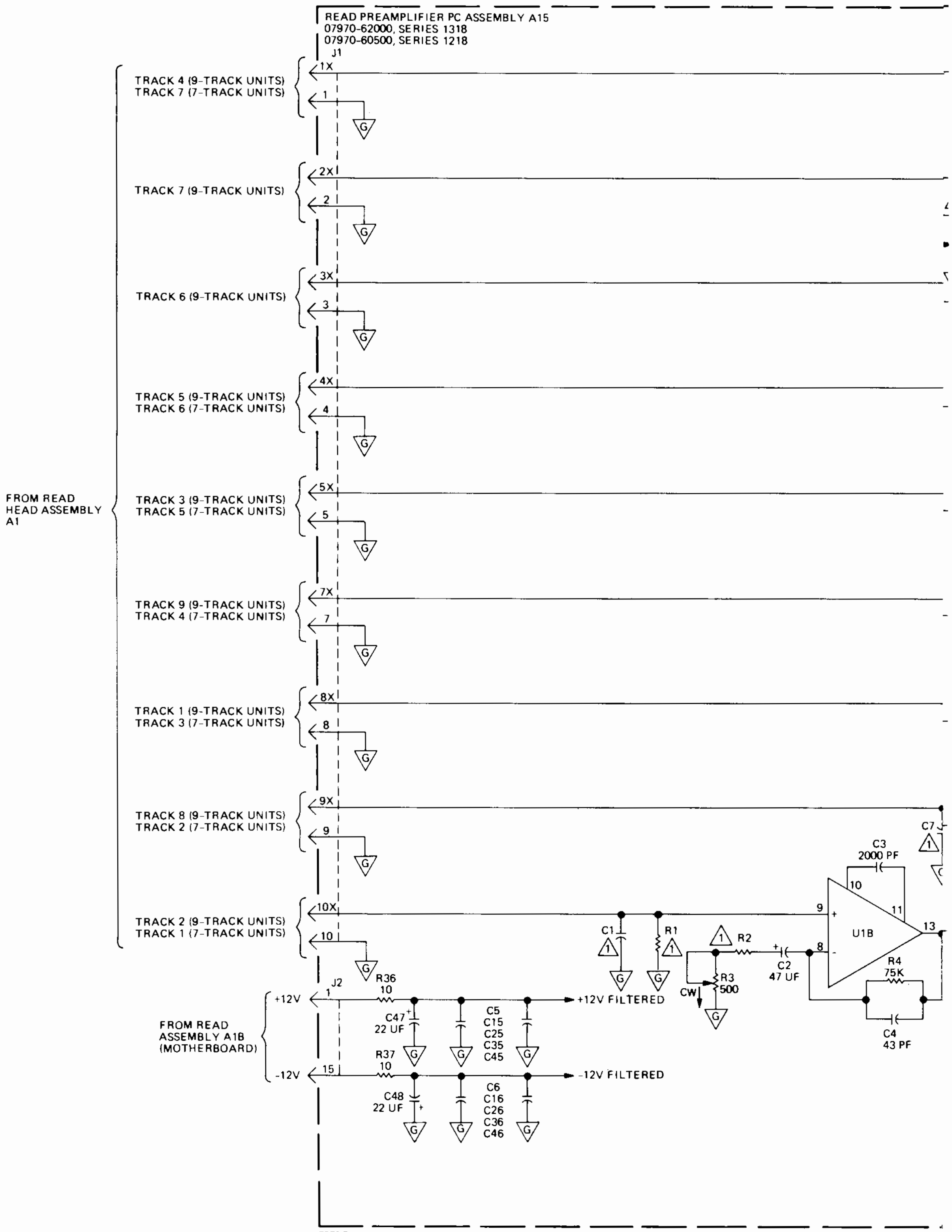
NINE TRACK UNITS		SEVEN TRACK UNITS	
*TAPE TRACK	DATA CHANNEL	*TAPE TRACK	DATA CHANNEL
1	5	1	7
2	7	2	6
3	3	3	5
4	P	4	4
5	2	5	3
6	1	6	2
7	0	7	P
8	6		
9	4		
*STARTING WITH EDGE NEAREST THE OPERATOR			

TRACK VERSUS CHANNEL ASSIGNMENTS



1 SPEED CRITICAL COMPONENTS

SPEED (ips)	C1, C7, C11, C17, C21, C27, C31, C37, C41	R1, R5, R9, R13, R17, R21, R25, R39, R33	R2, R6, R10, R14, R18, R22, R26, R30, R34	ASSEMBLY
10-20.9	4700 PF	4.7K	82.5 OHMS	07970-60500
21-45	270 PF	17.1K	100 OHMS	07970-62000


READ PREAMPLIFIER PC ASSEMBLY A15
07970-62000, SERIES 1318
07970-60500, SERIES 1218
J1
FROM READ HEAD ASSEMBLY A1
TRACK 4 (9-TRACK UNITS)
TRACK 7 (7-TRACK UNITS)
TRACK 7 (9-TRACK UNITS)
TRACK 6 (9-TRACK UNITS)
TRACK 5 (9-TRACK UNITS)
TRACK 6 (7-TRACK UNITS)
TRACK 3 (9-TRACK UNITS)
TRACK 5 (7-TRACK UNITS)
TRACK 9 (9-TRACK UNITS)
TRACK 4 (7-TRACK UNITS)
TRACK 1 (9-TRACK UNITS)
TRACK 3 (7-TRACK UNITS)
TRACK 8 (9-TRACK UNITS)
TRACK 2 (7-TRACK UNITS)
TRACK 2 (9-TRACK UNITS)
TRACK 1 (7-TRACK UNITS)
J2
FROM READ ASSEMBLY A1B (MOTHERBOARD)
+12V
-12V
R36 10
R37 10
C47 22 UF
C48 22 UF
C5 C15 C25 C35 C45
C6 C16 C26 C36 C46
+12V FILTERED
-12V FILTERED
C1
R1
R2
R3 500
CW
C2 47 UF
C3 2000 PF
U1B
R4 75K
C4 43 PF
C7
7970-517B

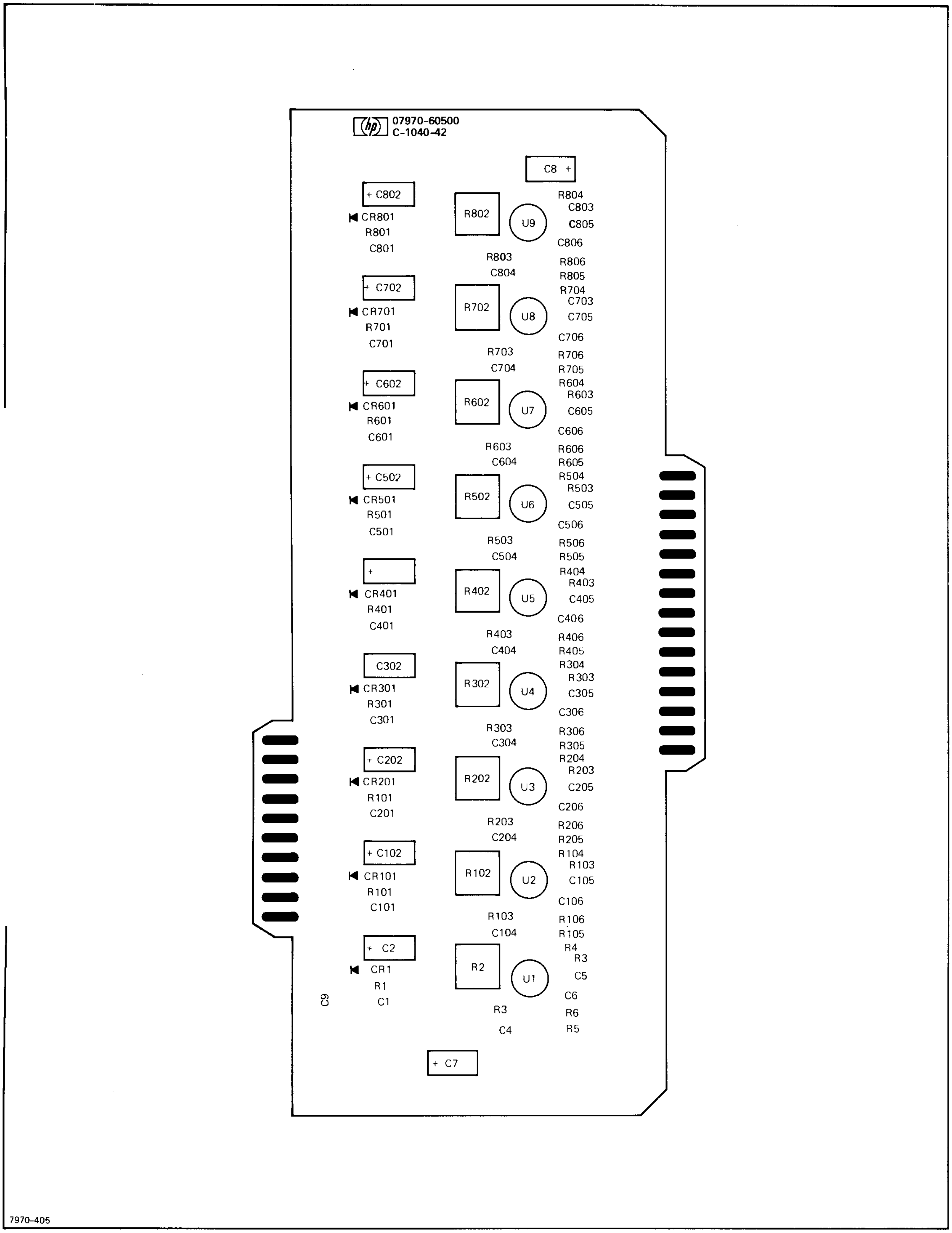


Figure 4-3. Read Preamplifier PC Assembly A15, Parts Location Diagram (Sheet 2 of 2)

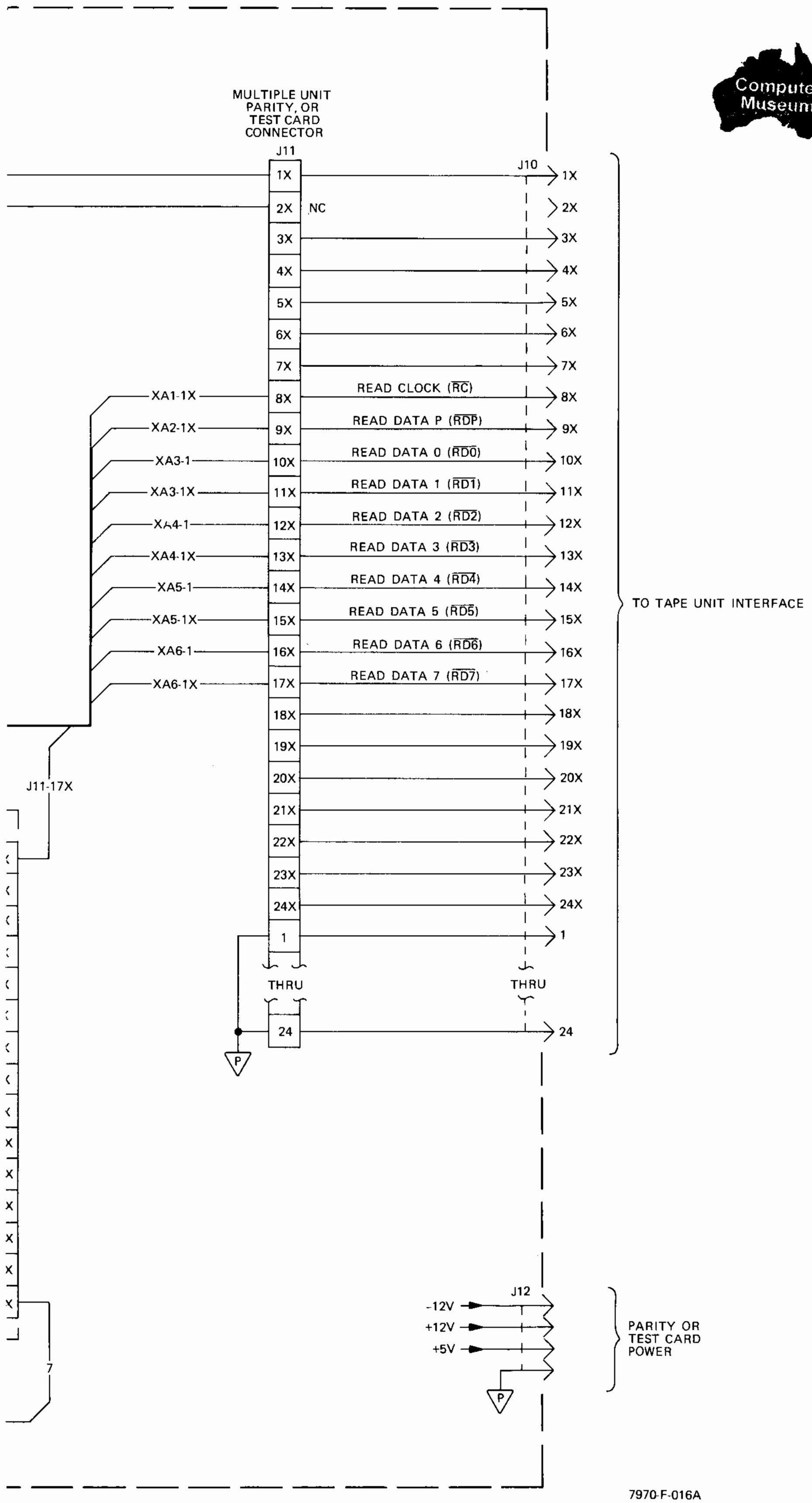
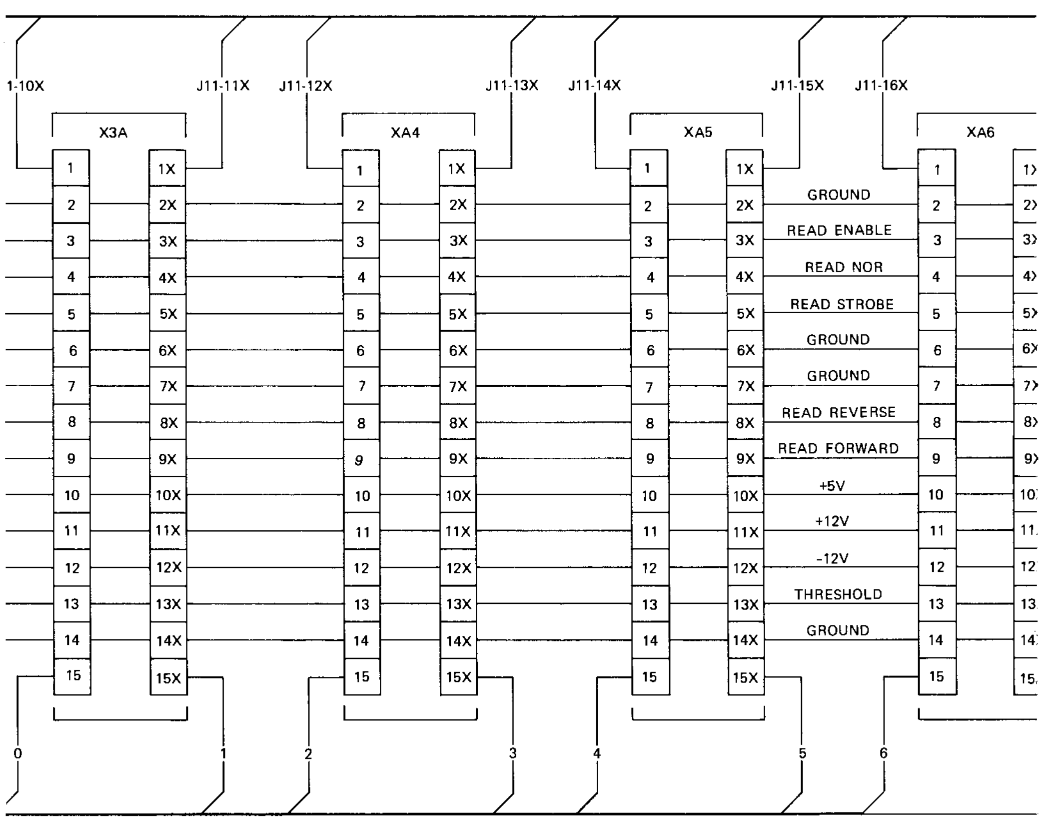
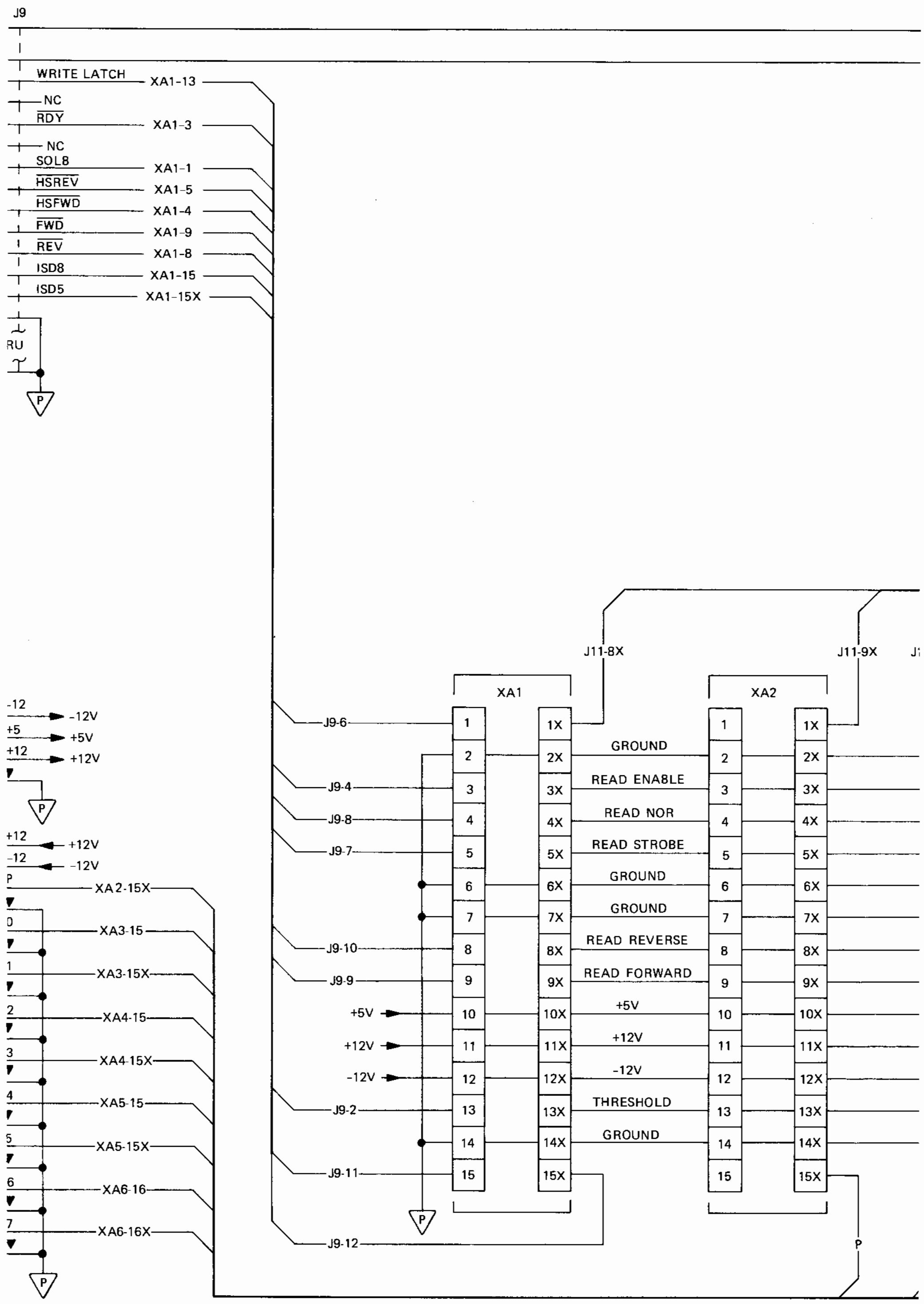
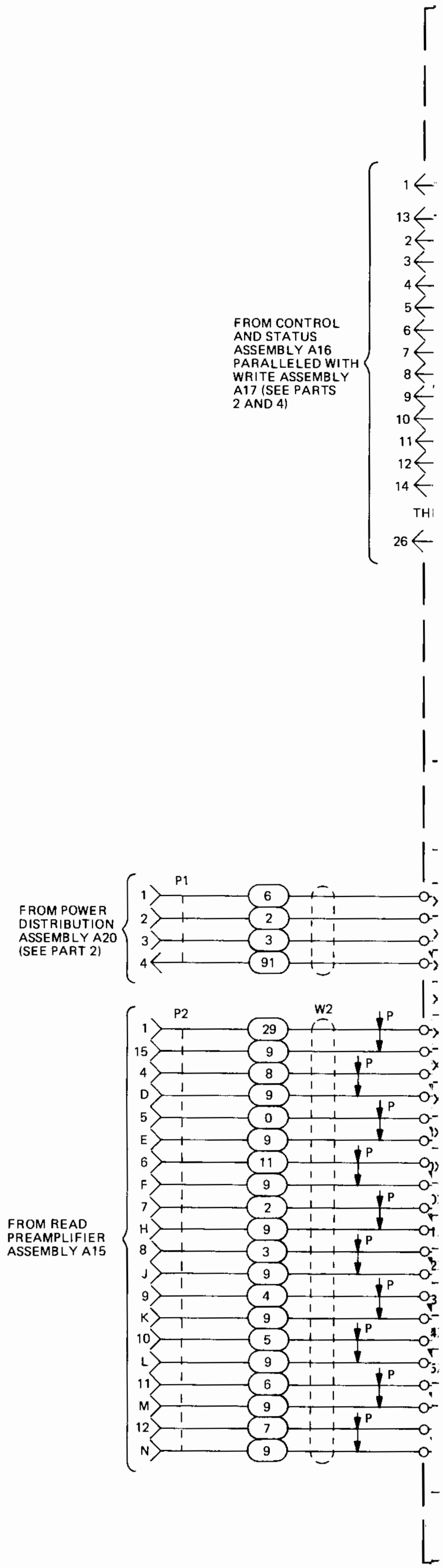


Figure 4-5. Read Assembly A18 (Motherboard), Schematic Diagram


1-10X
J11-11X
J11-12X
J11-13X
J11-14X
J11-15X
J11-16X
X3A
XA4
XA5
XA6
GROUND
READ ENABLE
READ NOR
READ STROBE
GROUND
GROUND
READ REVERSE
READ FORWARD
+5V
+12V
-12V
THRESHOLD
GROUND

READ ASSEMBLY A18
07970-60390
SERIES 1014A




FROM CONTROL AND STATUS ASSEMBLY A16 PARALLELED WITH WRITE ASSEMBLY A17 (SEE PARTS 2 AND 4)
1
13
2
3
4
5
6
7
8
9
10
11
12
14
26
FROM POWER DISTRIBUTION ASSEMBLY A20 (SEE PART 2)
P1
1
2
3
4
6
2
3
91
FROM READ PREAMPLIFIER ASSEMBLY A15
P2
W2
1
15
4
D
5
E
6
F
7
H
8
J
9
K
10
L
11
M
12
N
29
9
8
9
0
9
11
9
2
9
3
9
4
9
5
9
6
9
7
9
P

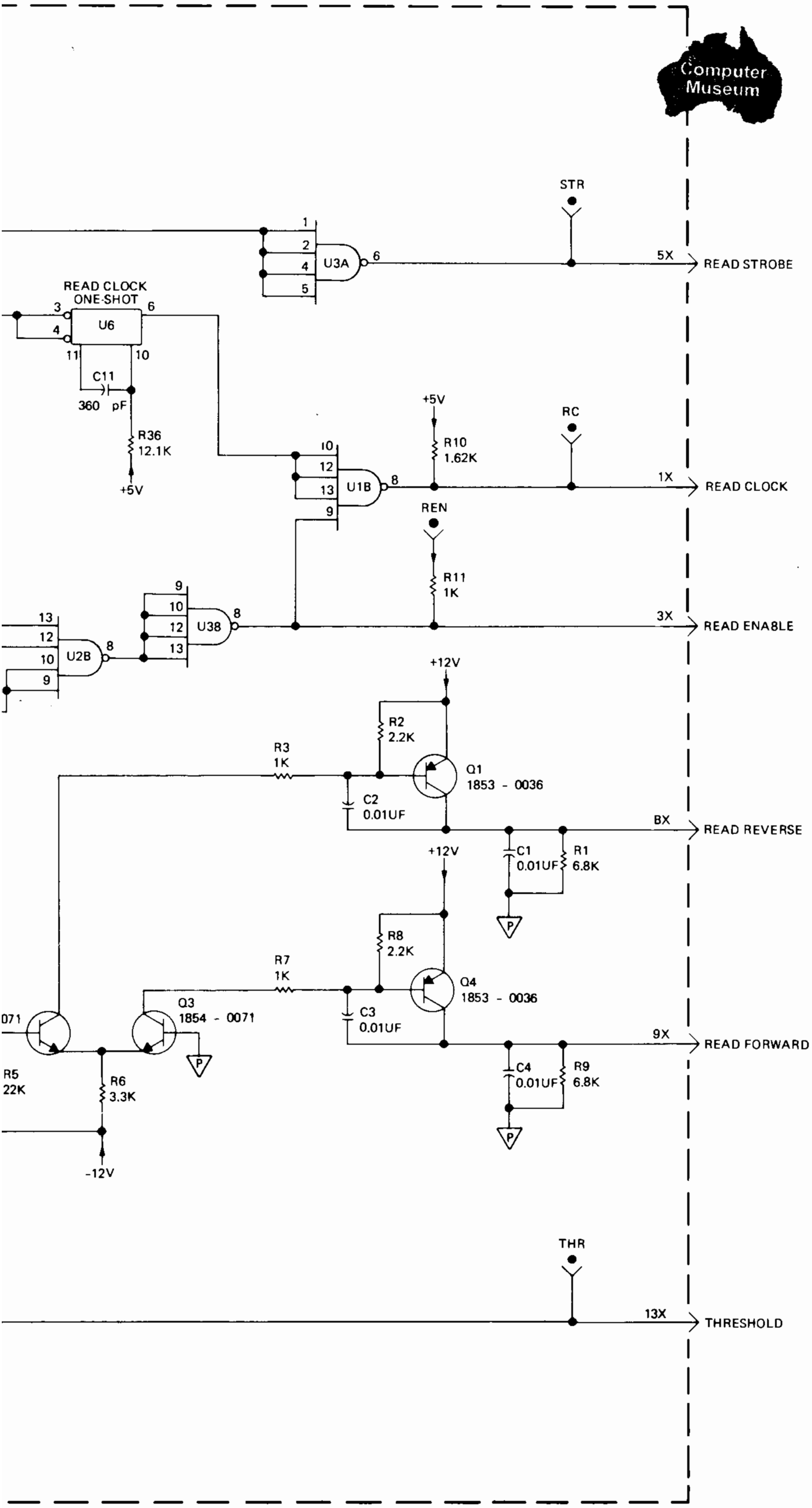
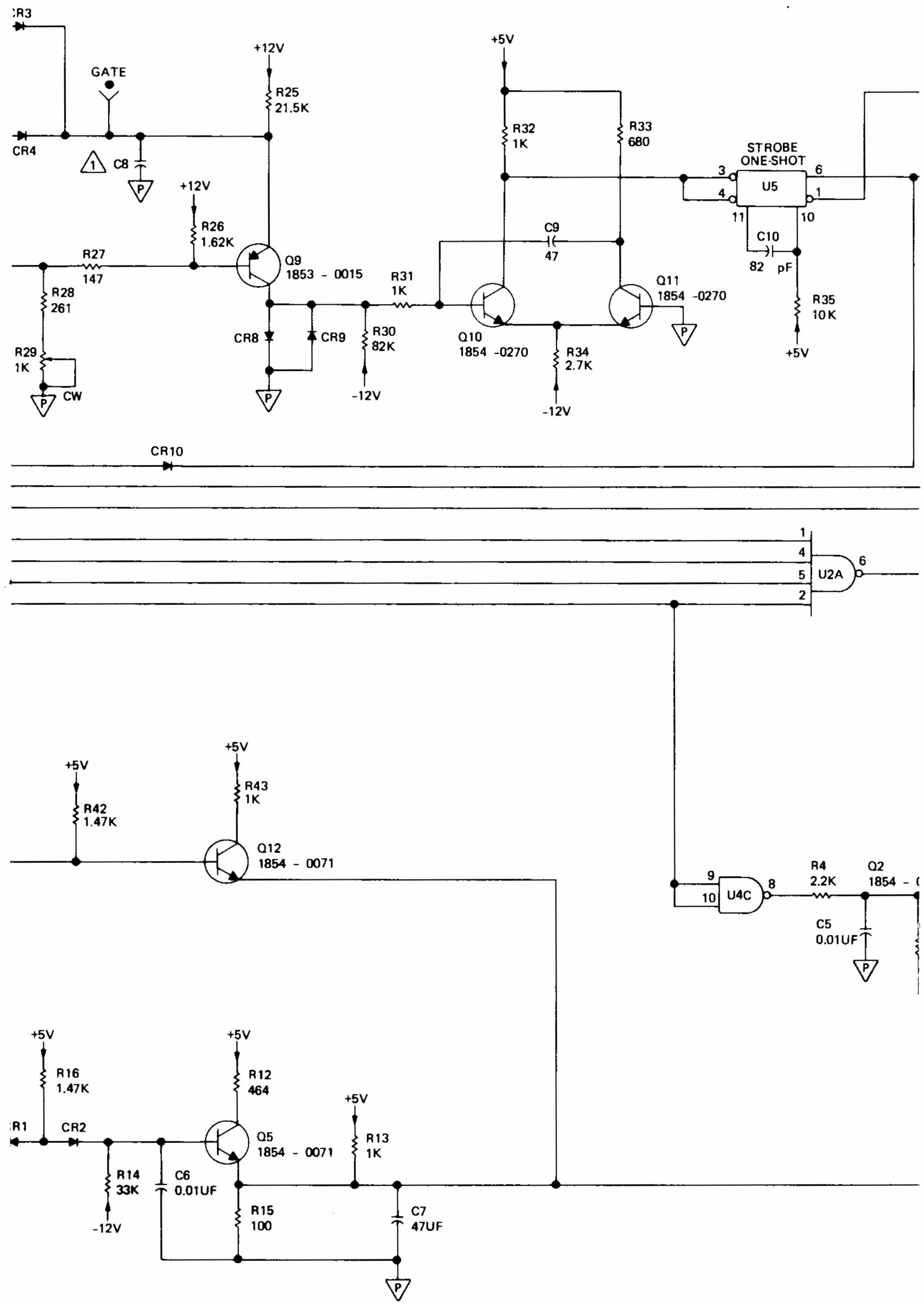
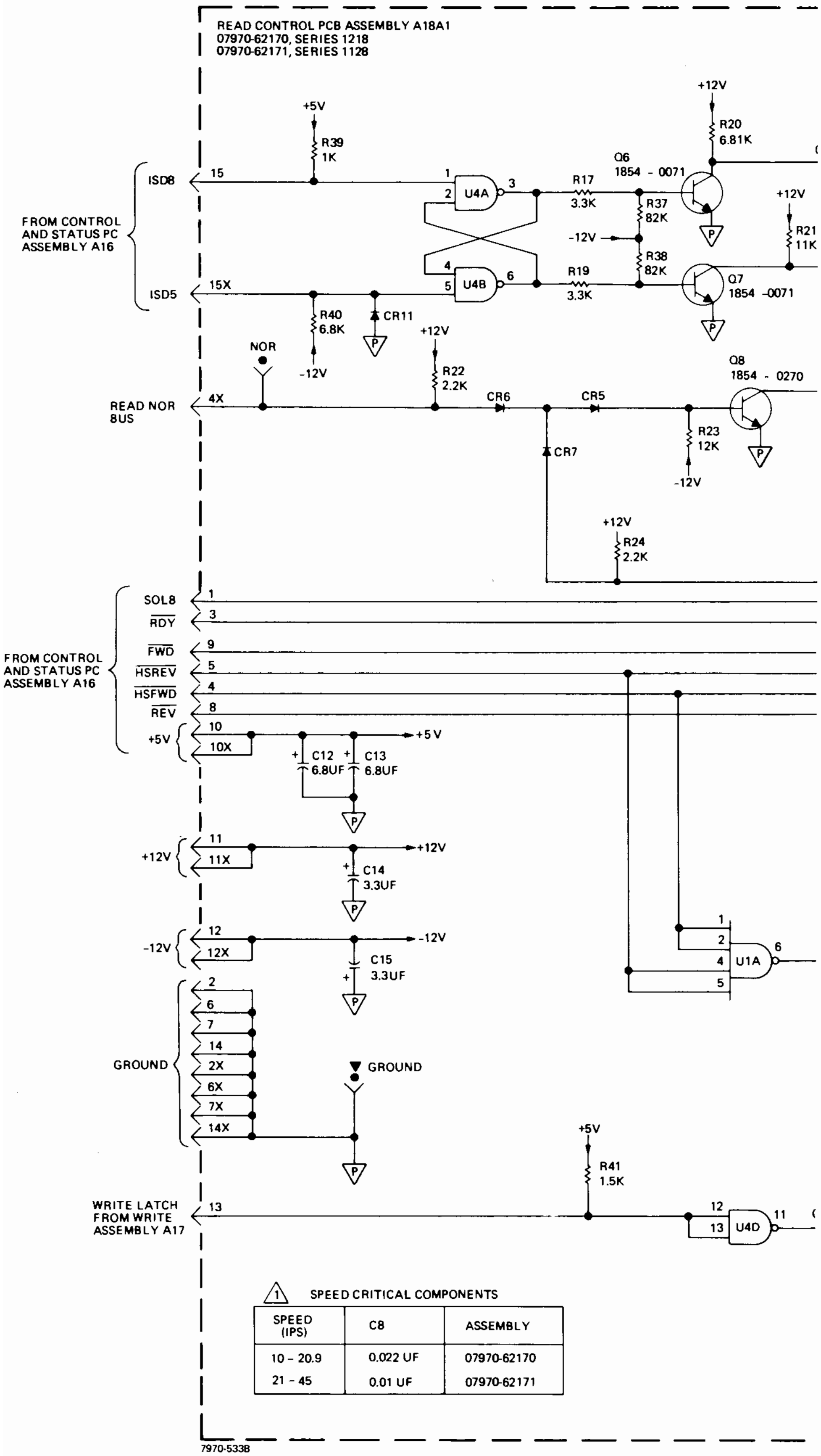


Figure 4-7. Read Control PC Assembly A18A1, Schematic Diagram


CR3
CR4
GATE
C8
+12V
R25
21.5K
+12V
R26
1.62K
R27
147
R28
261
R29
1K
CW
Q9
1853 - 0015
CR8
CR9
R30
82K
-12V
R31
1K
+5V
R32
1K
R33
680
C9
47
Q10
1854 -0270
Q11
1854 -0270
R34
2.7K
-12V
STROBE
ONE-SHOT
U5
3
4
6
1
11
10
C10
82 pF
R35
10K
+5V
CR10
1
4
5
2
U2A
6
+5V
R42
1.47K
+5V
R43
1K
Q12
1854 - 0071
9
10
U4C
8
R4
2.2K
Q2
1854 -
C5
0.01UF
+5V
R16
1.47K
R1
CR2
R14
33K
-12V
C6
0.01UF
+5V
R12
464
Q5
1854 - 0071
+5V
R13
1K
R15
100
C7
47UF



1 SPEED CRITICAL COMPONENTS

SPEED (IPS)	C8	ASSEMBLY
10 – 20.9	0.022 UF	07970-62170
21 – 45	0.01 UF	07970-62171

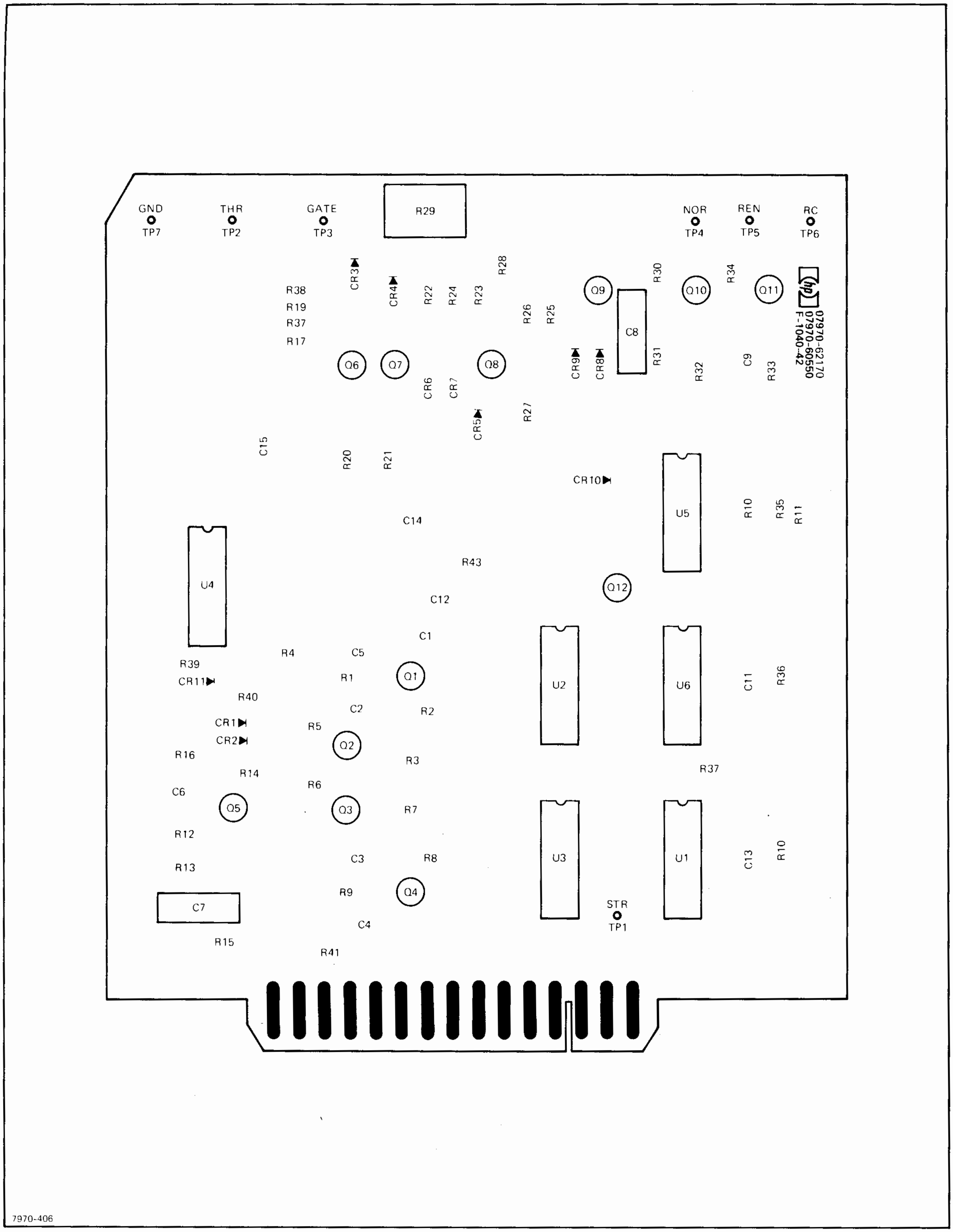


Figure 4-6. Read Control PC Assembly A18A1, Parts Location Diagram

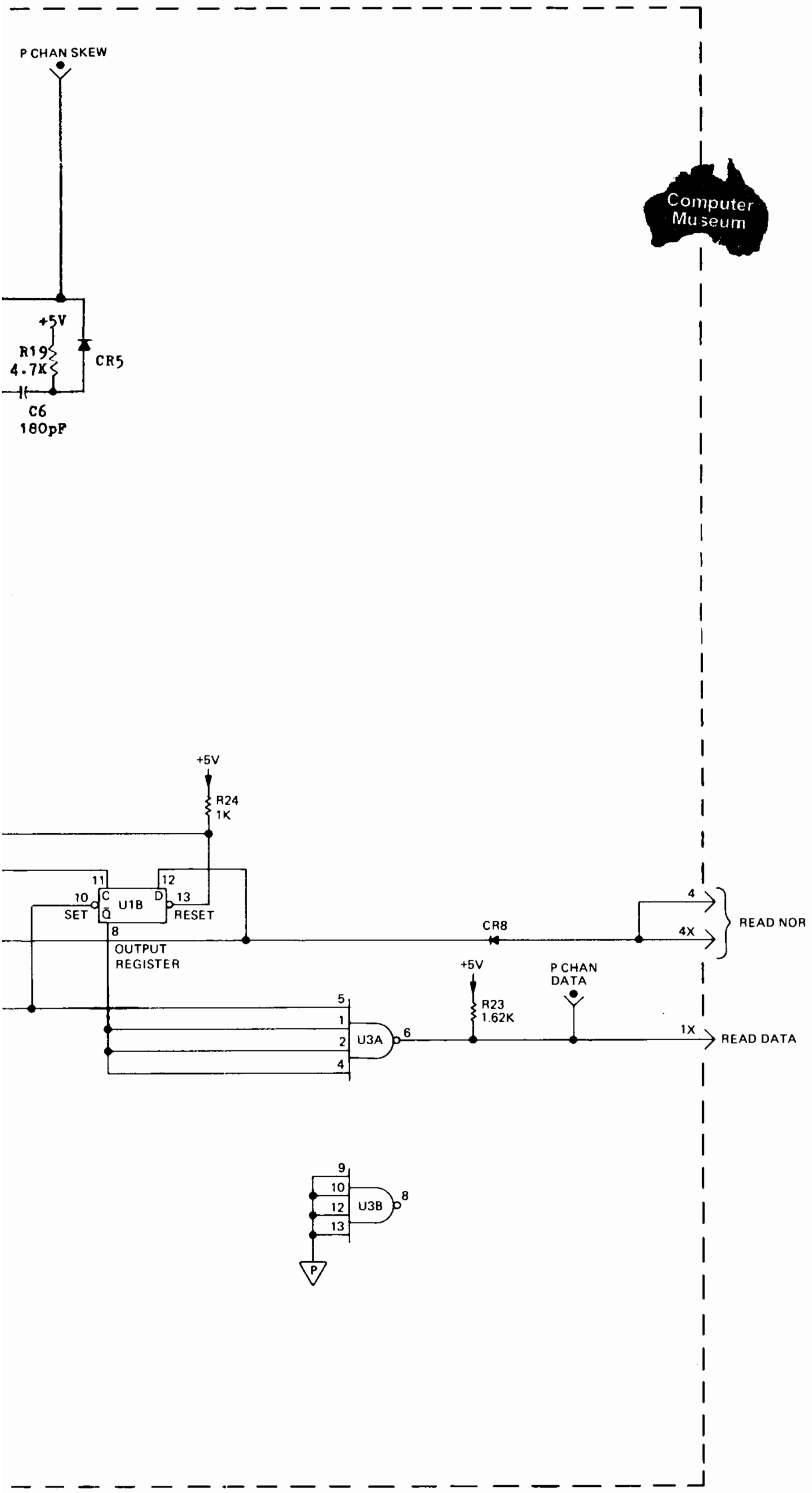
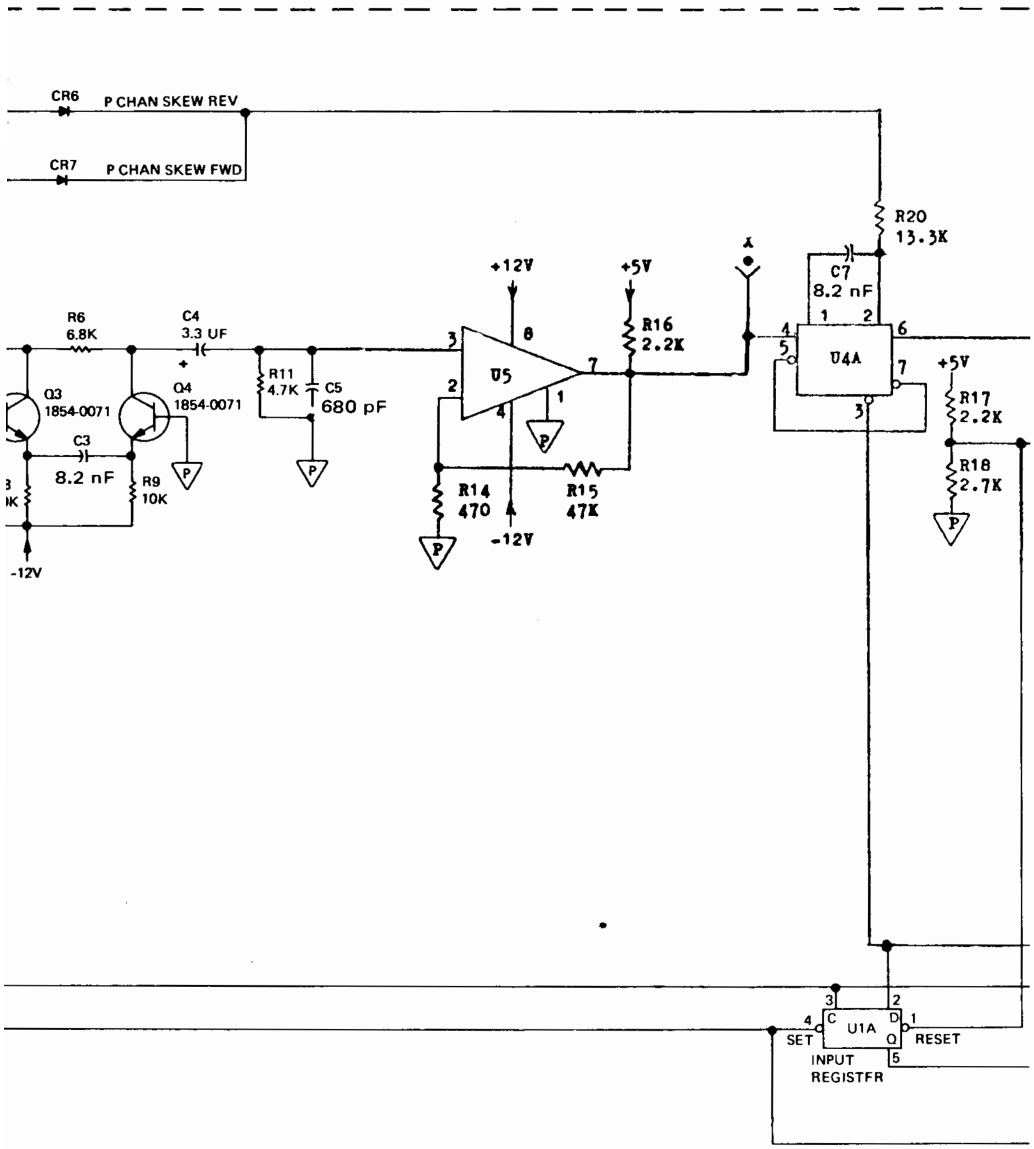
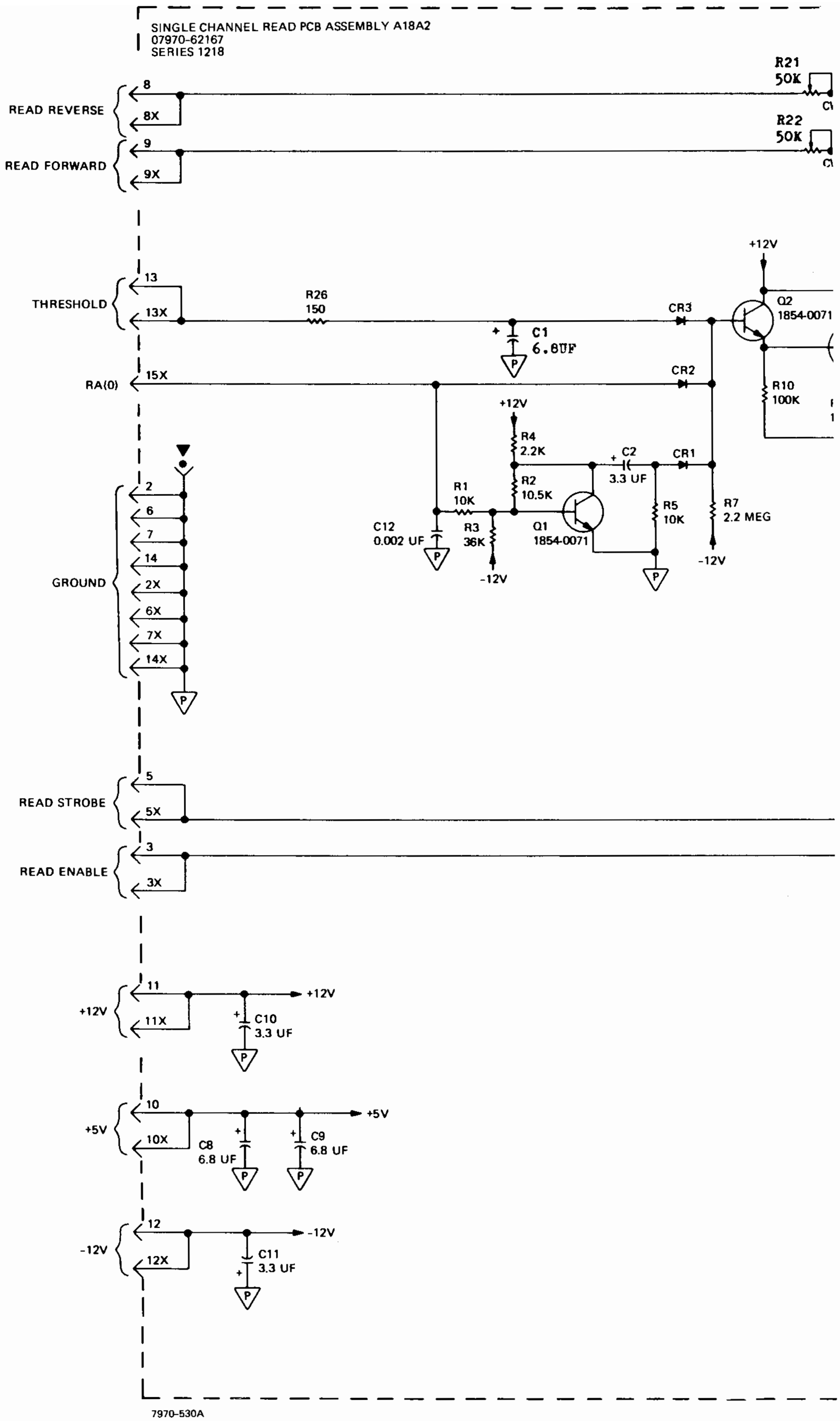


Figure 4-9. Single-Channel Read Data PC Assembly A18A2, (10 - 20.9 IPS), Schematic Diagram


CR6
P CHAN SKEW REV
CR7
P CHAN SKEW FWD
R20
13.3K
C7
8.2 nF
+12V
+5V
R6
6.8K
C4
3.3 UF
R11
4.7K
C5
680 pF
Q3
1854-0071
Q4
1854-0071
C3
8.2 nF
R9
10K
-12V
U5
R16
2.2K
U4A
+5V
R17
2.2K
R18
2.7K
R14
470
R15
47K
-12V
U1A
SET
RESET
INPUT
REGISTER


SINGLE CHANNEL READ PCB ASSEMBLY A18A2
07970-62167
SERIES 1218
READ REVERSE
READ FORWARD
THRESHOLD
RA(0)
GROUND
READ STROBE
READ ENABLE
+12V
+5V
-12V
R21 50K
R22 50K
R26 150
C1 6.8UF
CR3
CR2
CR1
Q2 1854-0071
R10 100K
R4 2.2K
R2 10.5K
R1 10K
R3 36K
C12 0.002 UF
Q1 1854-0071
C2 3.3 UF
R5 10K
R7 2.2 MEG
C10 3.3 UF
C8 6.8 UF
C9 6.8 UF
C11 3.3 UF
7970-530A

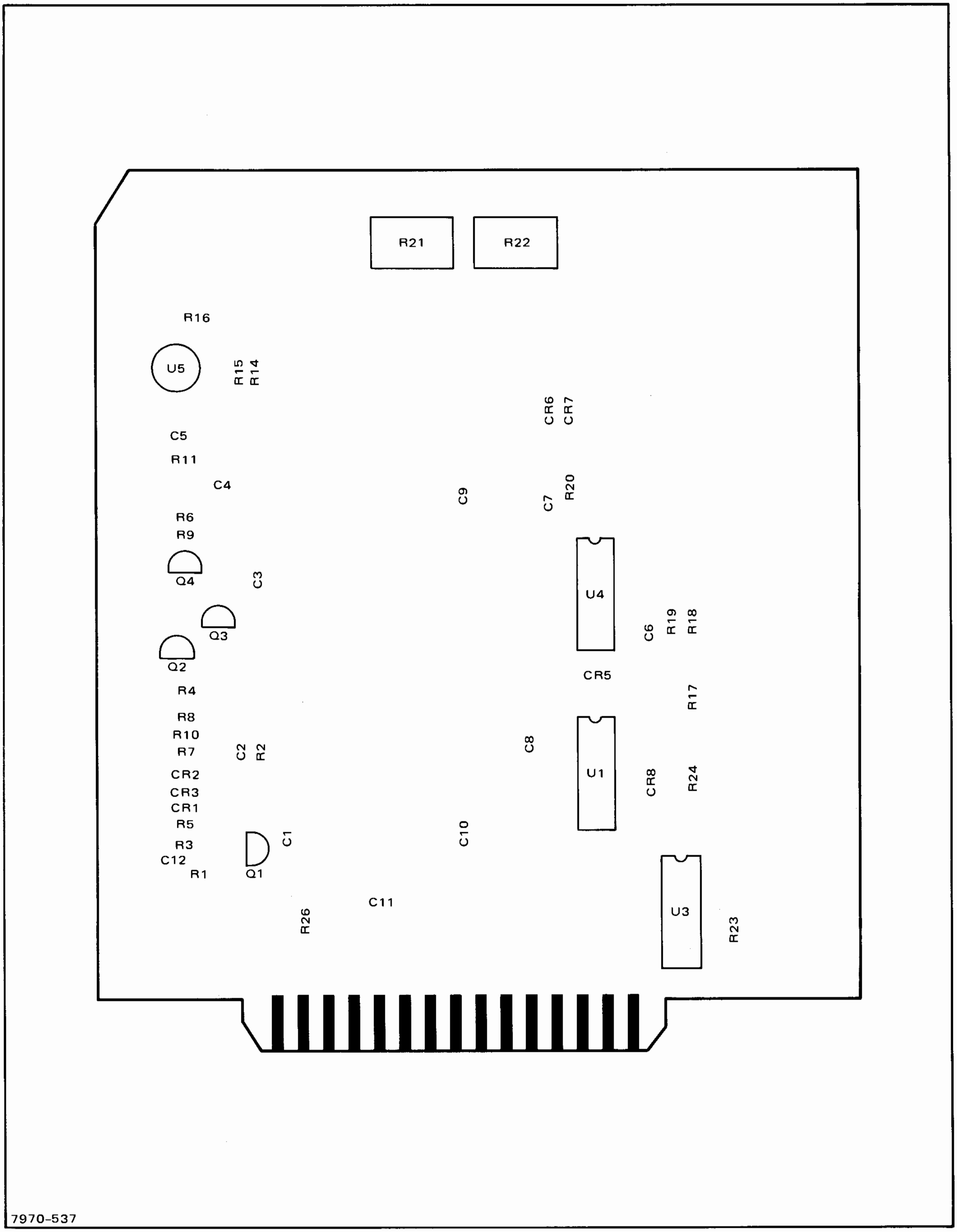


Figure 4-8. Single-Channel Read Data PCA A18A2 (10 - 20.9 IPS) Parts Location Diagram

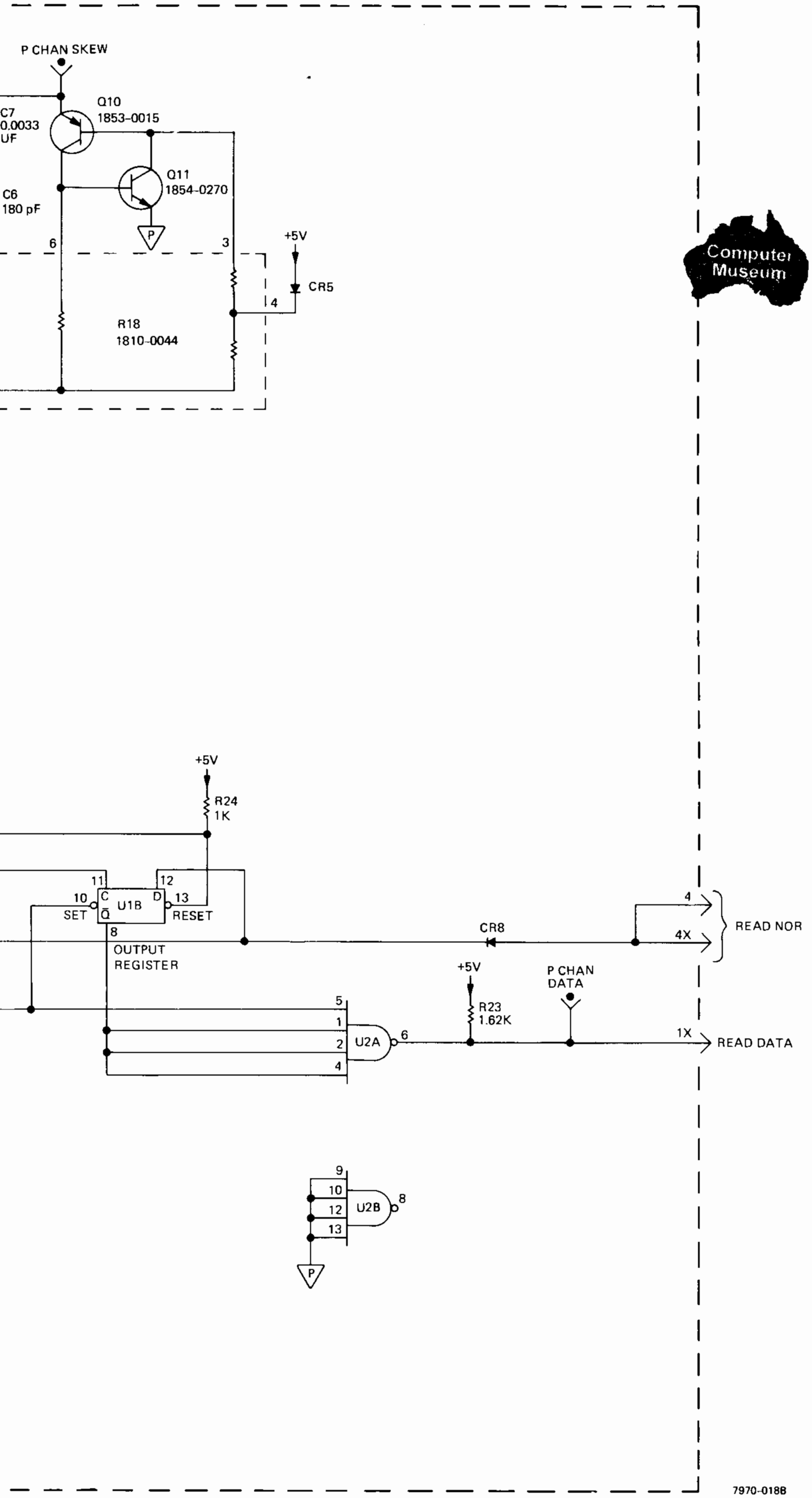
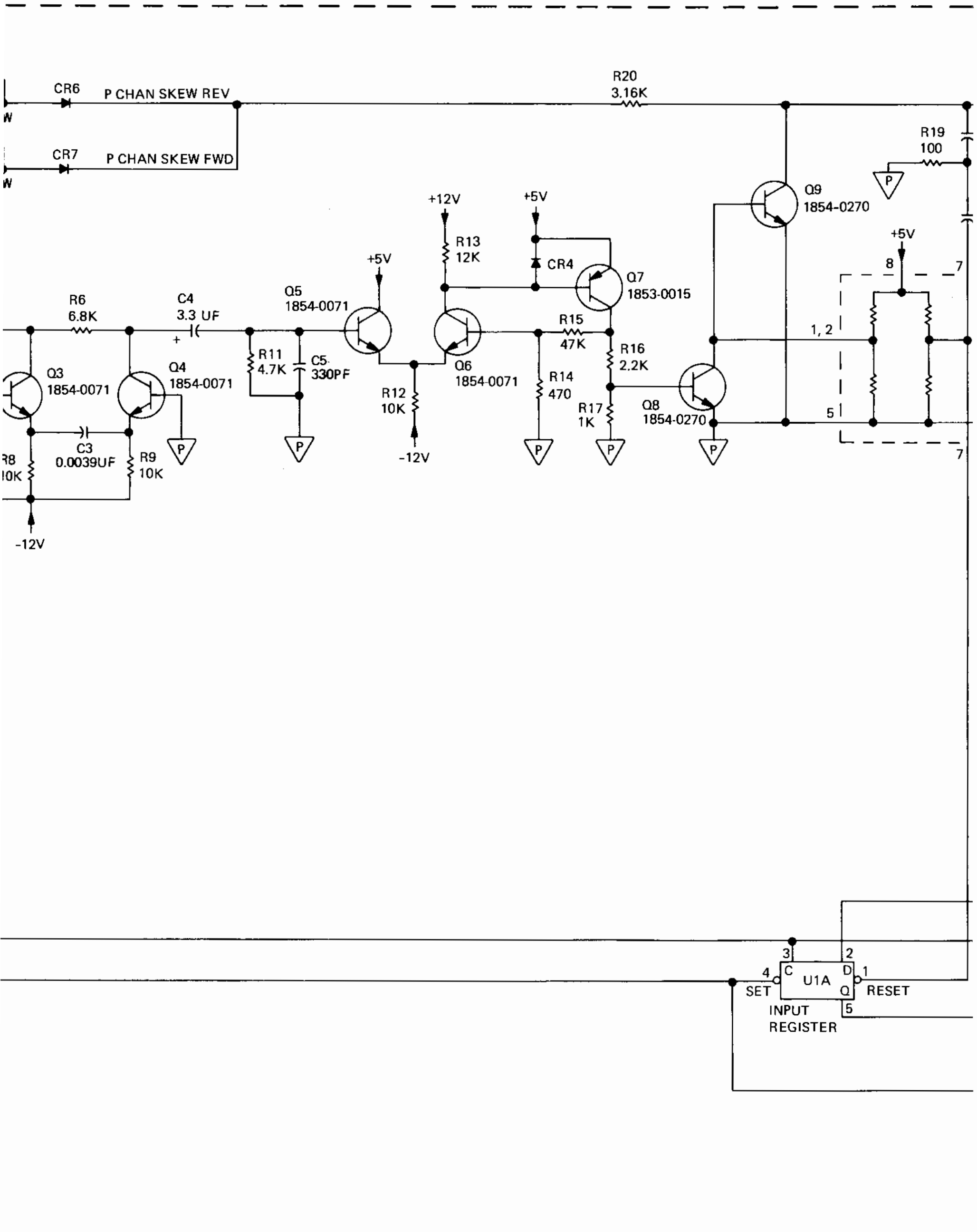
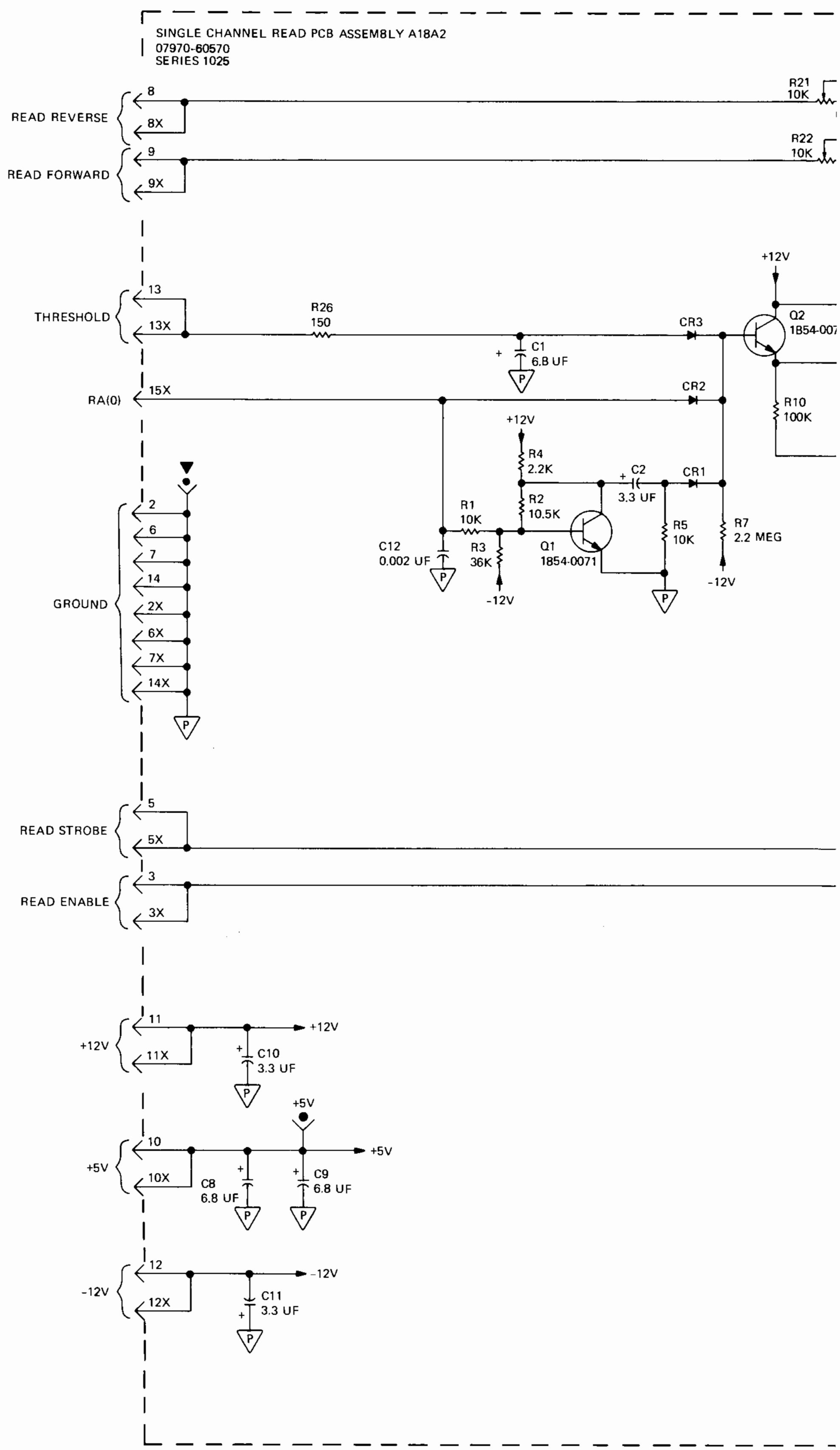


Figure 4-11. Single-Channel Read Data PC Assembly A18A2 (21 - 45 IPS), Schematic Diagram



CR6
P CHAN SKEW REV
CR7
P CHAN SKEW FWD
R20
3.16K
R19
100
Q9
1854-0270
+12V
+5V
R13
12K
CR4
Q7
1853-0015
+5V
R6
6.8K
C4
3.3 UF
Q5
1854-0071
R11
4.7K
C5
330PF
Q6
1854-0071
R15
47K
R16
2.2K
R14
470
R12
10K
-12V
R17
1K
Q8
1854-0270
Q3
1854-0071
Q4
1854-0071
C3
0.0039UF
R9
10K
-12V
1, 2
5
8
7
U1A
SET
RESET
INPUT
REGISTER


SINGLE CHANNEL READ PCB ASSEMBLY A18A2
07970-60570
SERIES 1025
READ REVERSE
READ FORWARD
THRESHOLD
RA(0)
GROUND
READ STROBE
READ ENABLE
+12V
+5V
-12V
R21 10K
R22 10K
R26 150
C1 6.8 UF
CR3
CR2
CR1
Q2 1854-007
R10 100K
R4 2.2K
R2 10.5K
C2 3.3 UF
R1 10K
R3 36K
C12 0.002 UF
Q1 1854-0071
R5 10K
R7 2.2 MEG
C10 3.3 UF
C8 6.8 UF
C9 6.8 UF
C11 3.3 UF

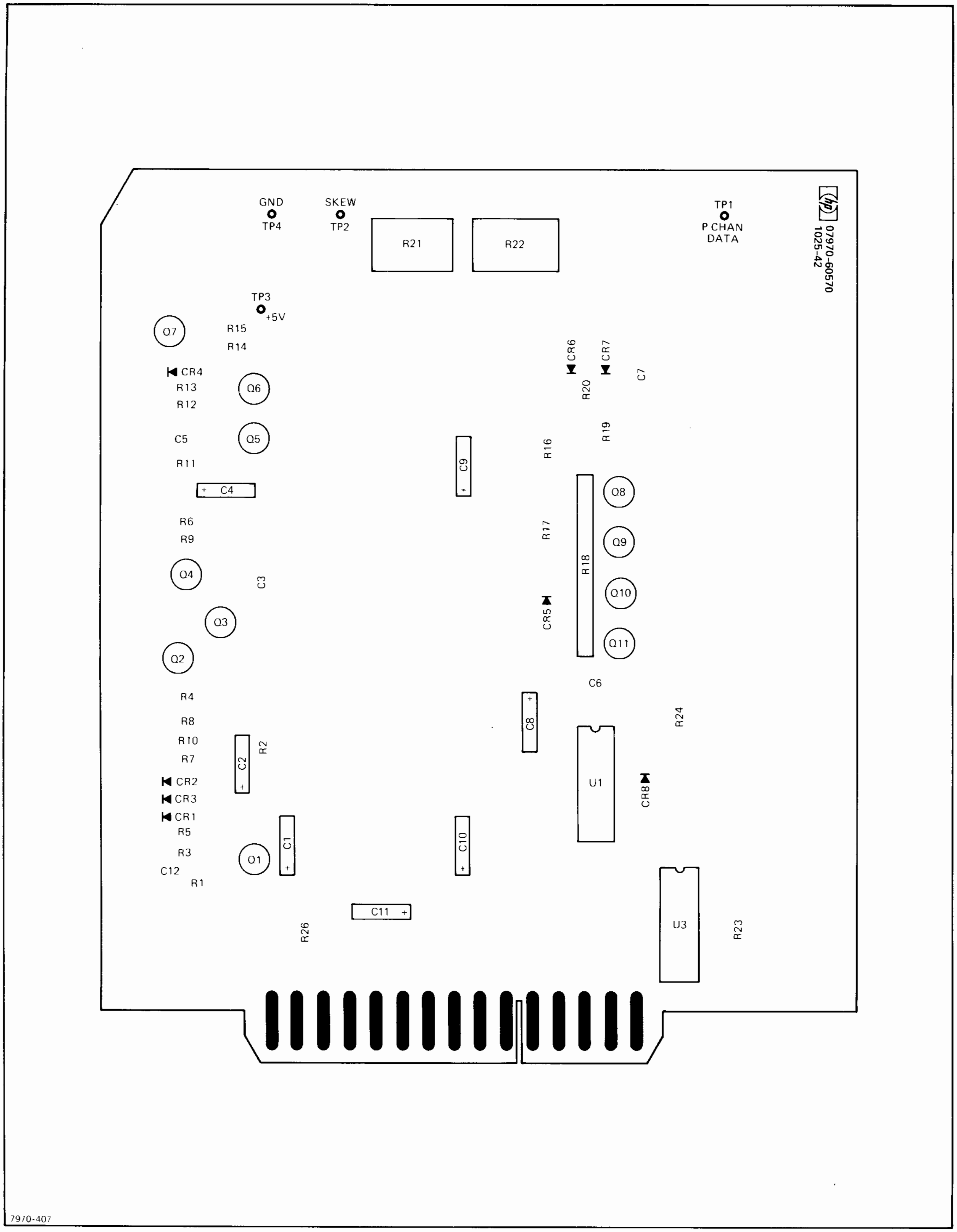


Figure 4-10. Single-Channel Read Data PC Assembly A18A2, (21 - 45 IPS), Parts Location Diagram

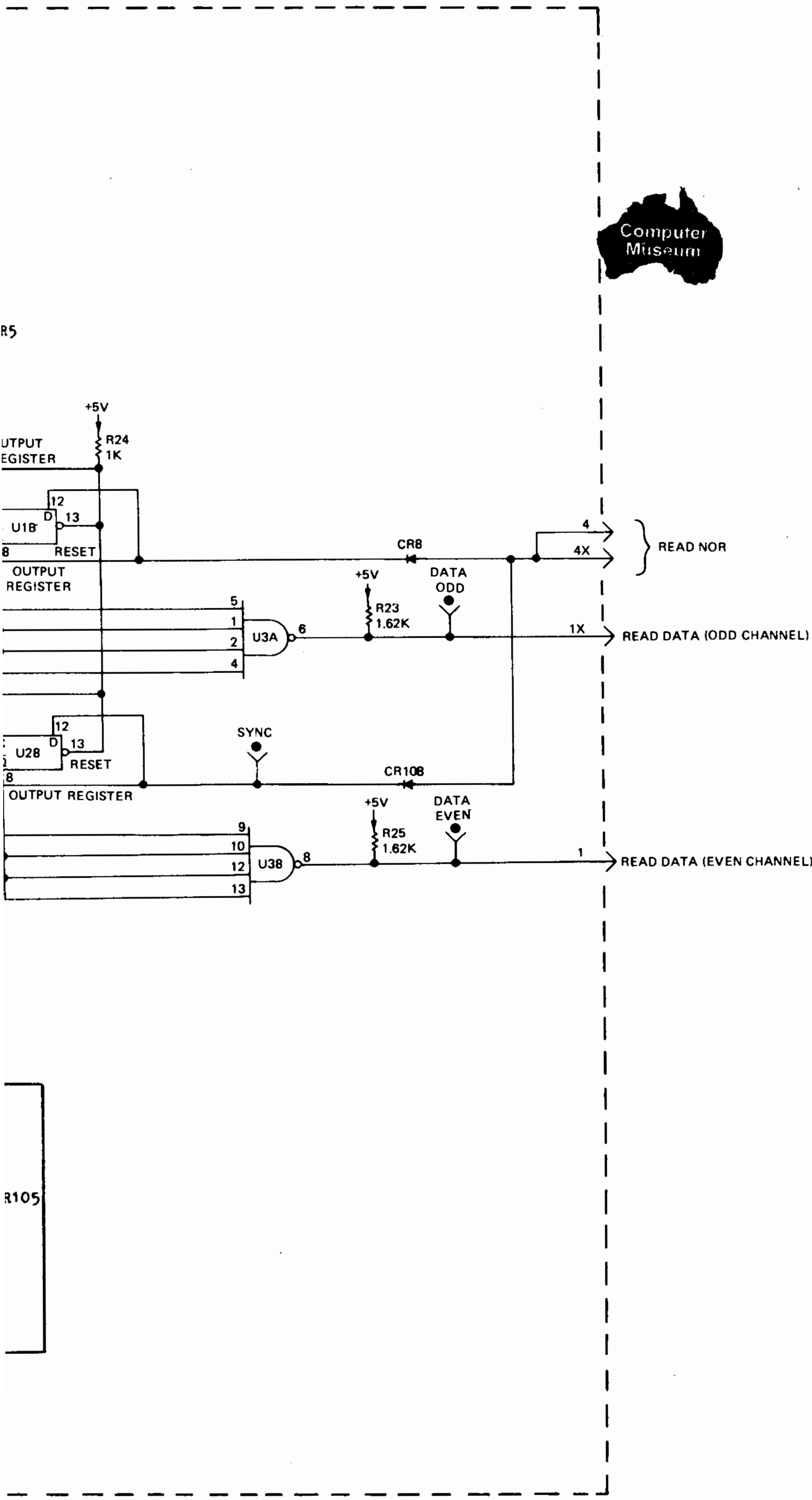
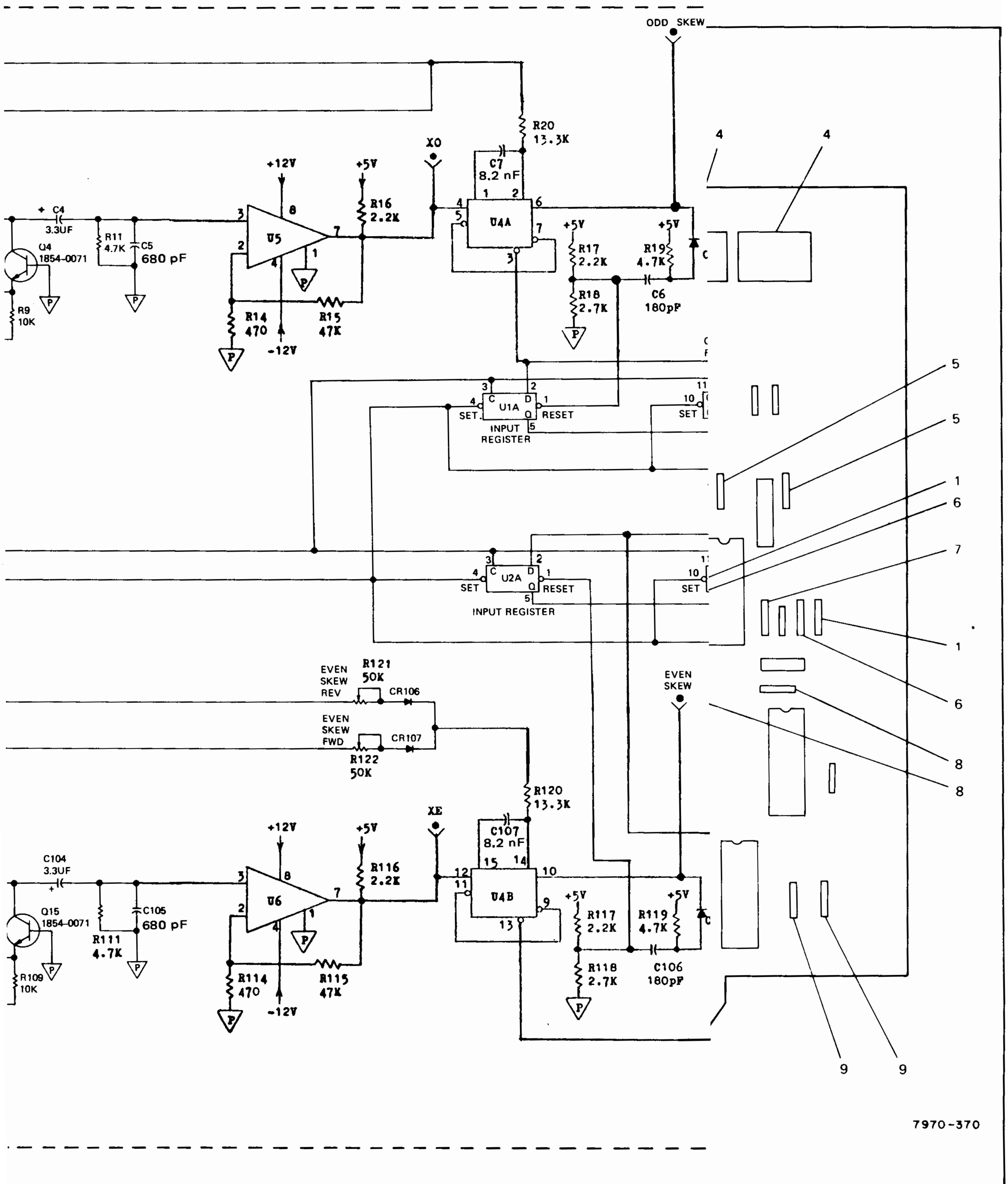
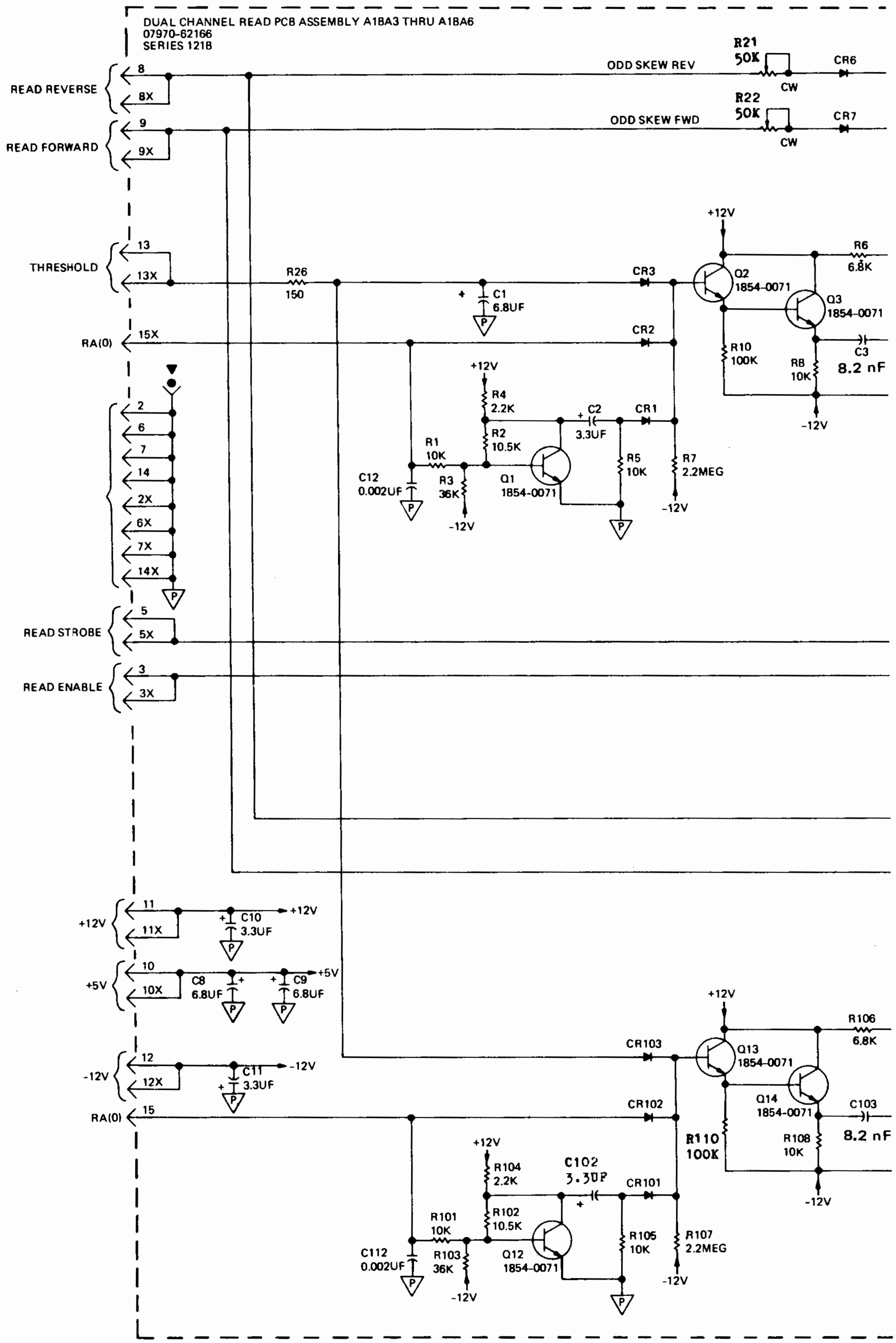


Figure 4-13. Dual-Channel Read Data Assembly
(10 - 20.9 ips), Schematic Diagram



cation Diagram (Sheet 1 of 2)


DUAL CHANNEL READ PCB ASSEMBLY A1BA3 THRU A1BA6
07970-62166
SERIES 121B
READ REVERSE
READ FORWARD
THRESHOLD
RA(0)
READ STROBE
READ ENABLE
+12V
+5V
-12V
ODD SKEW REV
ODD SKEW FWD
R21 50K
R22 50K
CW
CR6
CR7
R26 150
C1 6.8UF
CR3
CR2
CR1
Q2 1854-0071
Q3 1854-0071
R6 6.8K
R10 100K
R8 10K
C3 8.2 nF
R4 2.2K
R2 10.5K
C2 3.3UF
R1 10K
R3 36K
Q1 1854-0071
R5 10K
R7 2.2MEG
C12 0.002UF
C10 3.3UF
C8 6.8UF
C9 6.8UF
C11 3.3UF
CR103
CR102
CR101
Q13 1854-0071
Q14 1854-0071
R106 6.8K
C103 8.2 nF
R110 100K
R108 10K
R104 2.2K
R102 10.5K
C102 3.3UF
R101 10K
R103 36K
Q12 1854-0071
R105 10K
R107 2.2MEG
C112 0.002UF
7970-531A

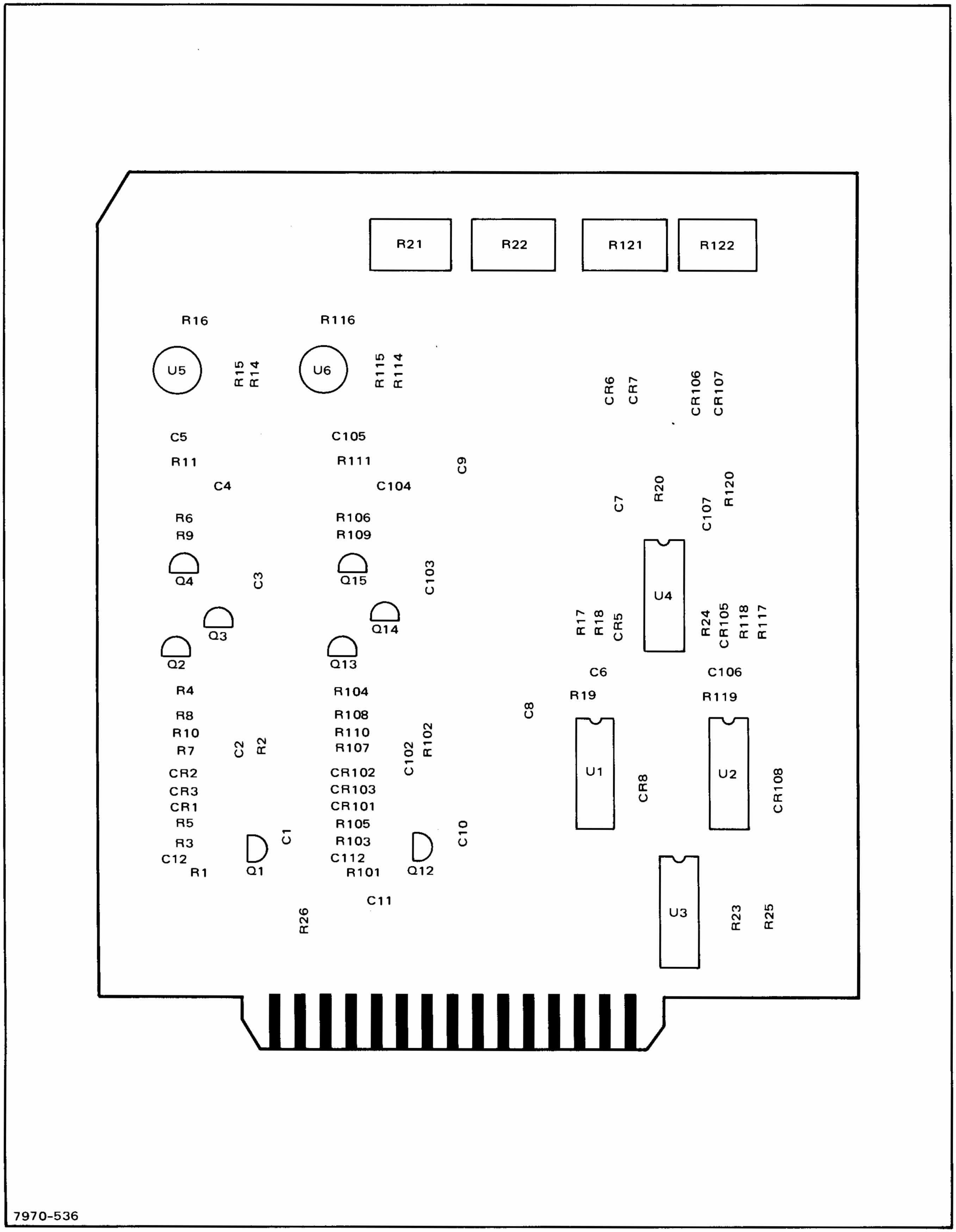


Figure 4-12. Dual-Channel Read Data PC Assembly (10 - 20.9 ips), Parts Location Diagram

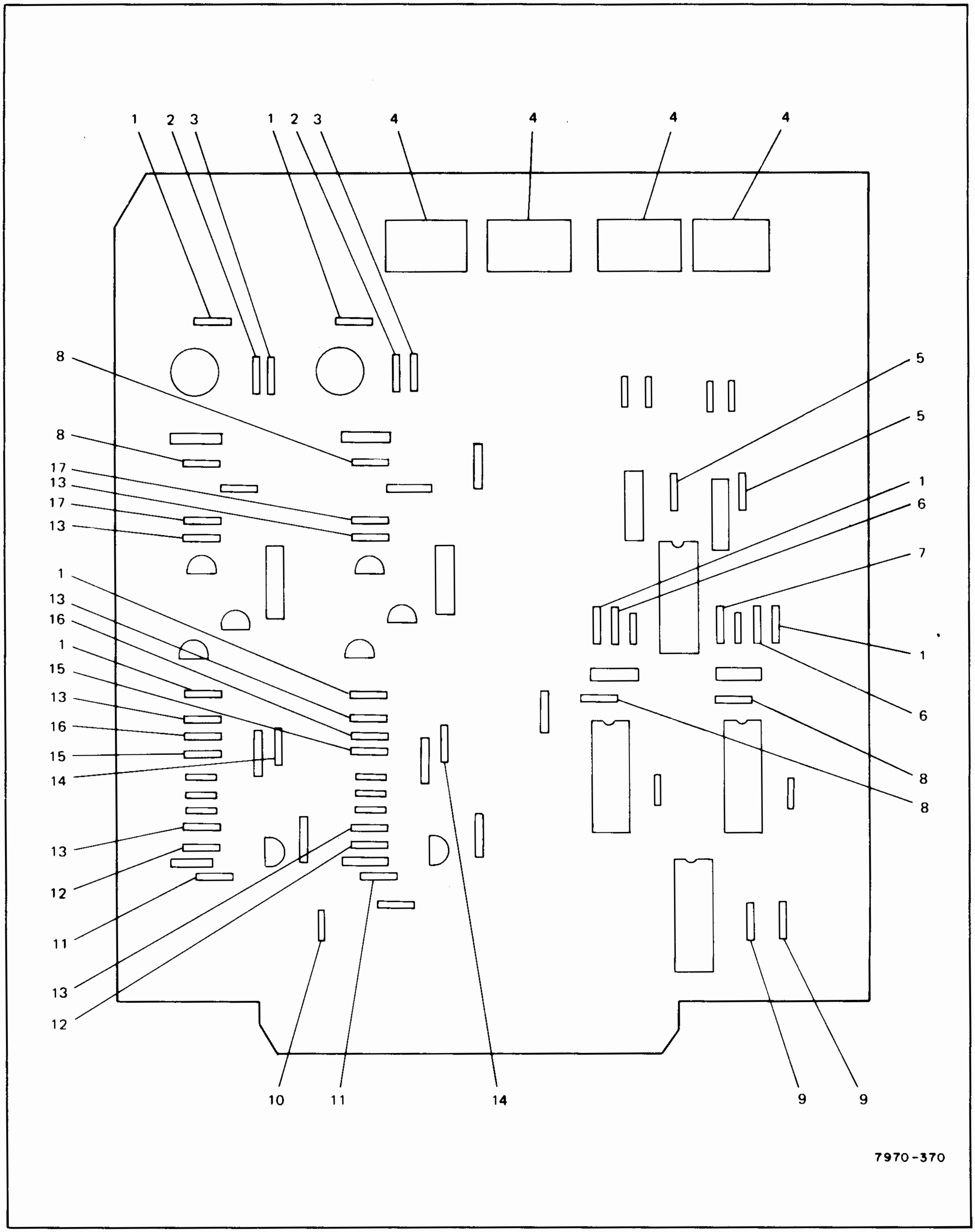


Figure 4-14. Dual-Channel Read Data PC Assembly (21 - 45 ips), Parts Location Diagram (Sheet 1 of 2)

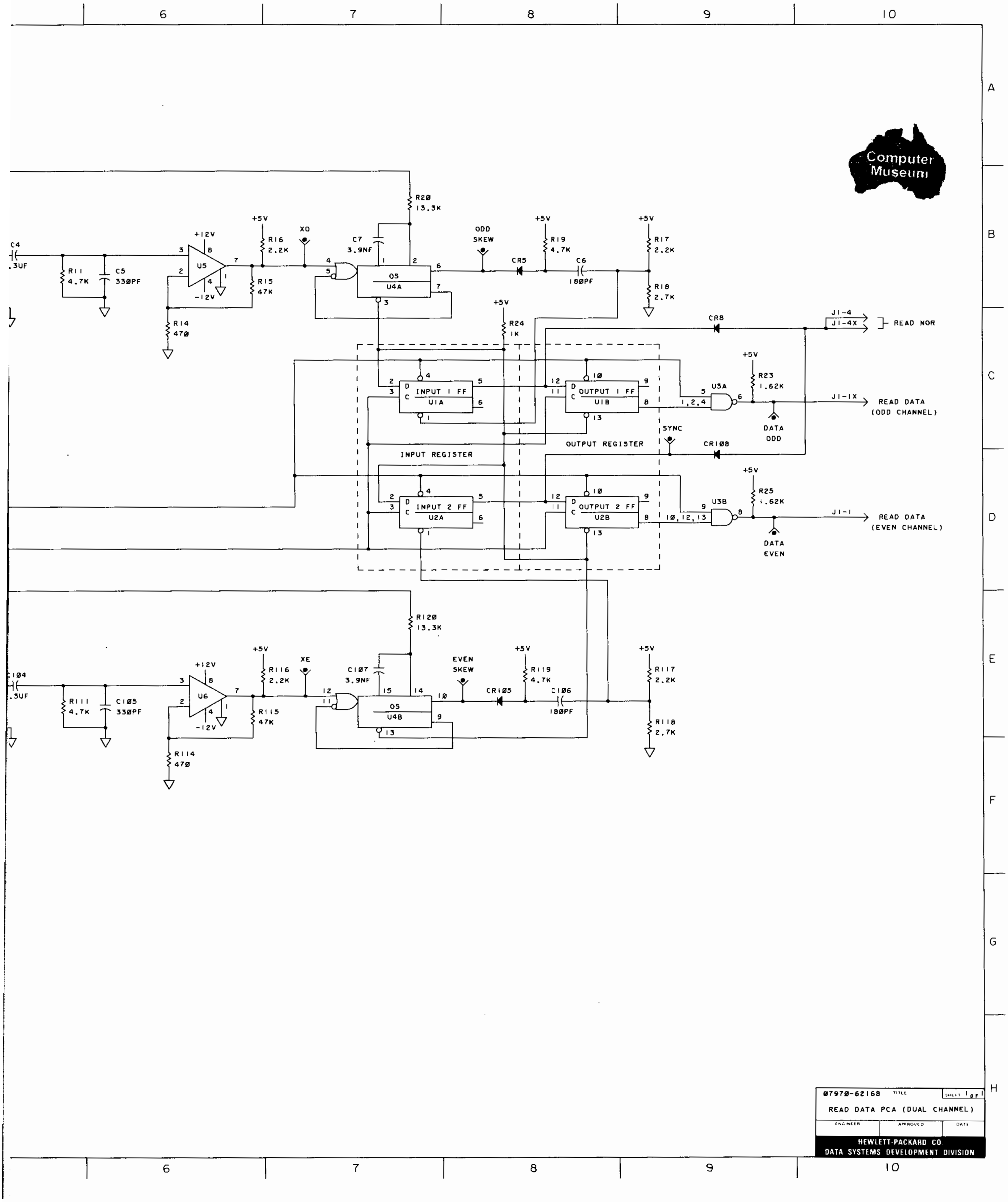
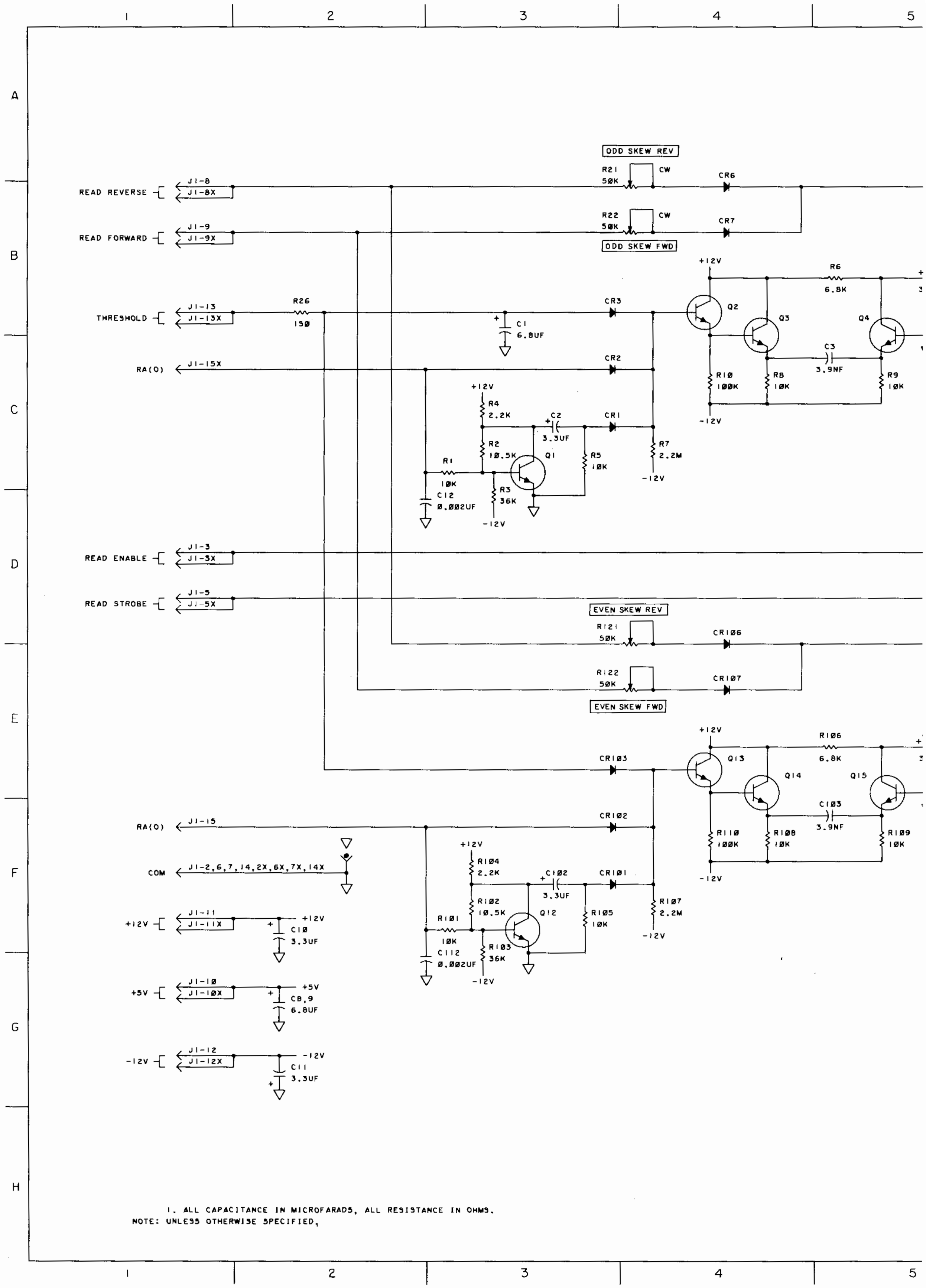


Figure 4-15. Dual-Channel Read Data PC Assembly (21 - 45 ips), Schematic Diagram



1. ALL CAPACITANCE IN MICROFARADS, ALL RESISTANCE IN OHMS.
NOTE: UNLESS OTHERWISE SPECIFIED,

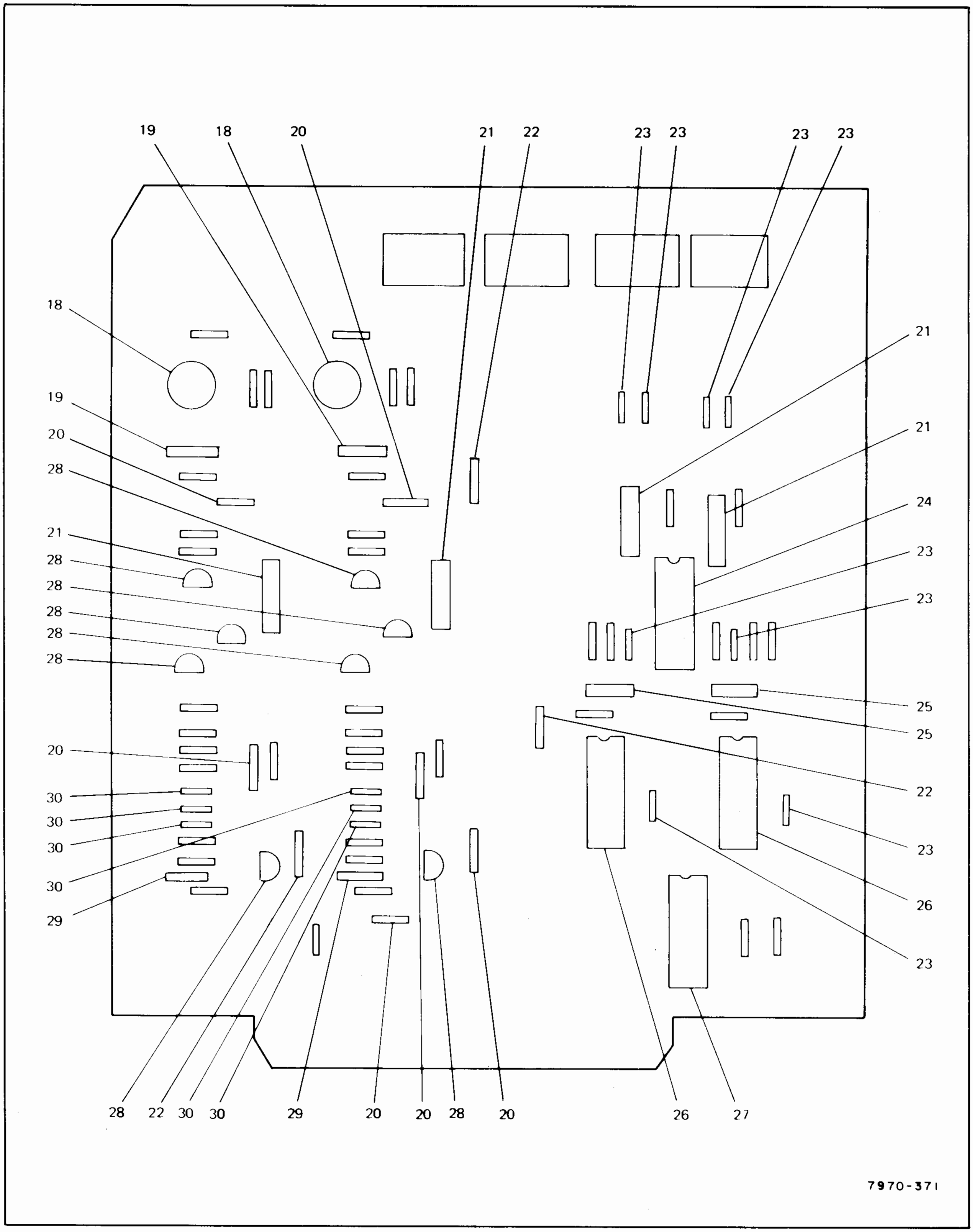


Figure 4-14. Dual-Channel Read Data PC Assembly (21 - 45 ips), Parts Location Diagram (Sheet 2 of 2)

HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

PART 4

7970B/7970C

DIGITAL MAGNETIC TAPE UNIT

WRITE MODULES

Printed-Circuit Assemblies:

07970-60230, Series 1015
07970-60240, Series 1134
07970-60300, Series 1218
07970-60800, Series 1025
07970-60810, Series 1025
07970-60820, Series 1025
07970-60880, Series 1025

07970-90383

PRINTED: AUG 1973

SECTION I
DESCRIPTION

1-1. INTRODUCTION.

1-2. This section describes the write modules of the 7970B/7970C Digital Magnetic Tape Units. A functional description and circuit description is also included to aid in servicing the write modules.

1-3. PHYSICAL DESCRIPTION.

1-4. The write modules consist of a write enable assembly, a write interconnect PC assembly, and a write magnetic head assembly. The write enable assembly senses the presence of a write enable ring on the supply reel and provides write current for the write data circuits. The control switch assembly of write equipped units contains an indicator that displays the write enabled condition.

1-5. The magnetic head assembly is a seven or nine track, read while write, NRZI head with an erase head. Channel scrambling is accomplished in the head assembly wiring. From the reference edge of the tape (edge nearest the operator) the nine-track channel designations are 5, 7, 3, P, 2, 1, 0, 6, and 4. The seven-track channel designations are 7, 6, 5, 4, 3, 2, and P.

1-6. The write assembly is a card cage assembly (motherboard) that contains a write control PC assembly, a single-channel write data PC assembly and three or four dual channel PC assemblies. Seven-track units will have three dual-channel write data PC assemblies and nine-track units will have four dual-channel PC assemblies. Seven-track units do not use channels 0 and 1. The channels are numbered left-to-right starting with P.

1-7. The write interconnect PC assembly contains load resistors for all write drivers and interconnects the head assembly with the write assembly. The write interconnect PC assembly is located near the head assembly.

1-8. FUNCTIONAL DESCRIPTION.

1-9. Information to be written is generated by the on-line interface and processed by the tape unit write data circuits. The information to be written is recorded in NRZI (non-return-to-zero-ones inverted) form. A "one" data bit is represented by a tape flux reversal and a "zero" data bit is represented by the absence of a flux reversal.

1-10. When the tape unit is loaded with a reel of tape equipped with a write enable ring, the write enable assembly provides +12 volts (+12 WE) to the write data circuits. The +12 WE provides write current for the write head drivers and the erase head driver. Tape unit motion status signals and interface commands are processed by the write control circuits to control the write data circuits. The write control circuits also provide a Write Latch status signal which is used to switch the read threshold level.

1-11. When unit write condition is first established, the write control circuits ensure that the write head drivers are in a reset state (inter-record gap flux) and tape is saturated in the same polarity as the erase head. A write "one" data bit from the interface is processed by the write control circuits and the write head drivers change state to generate a flux reversal.

1-12. Each successive "one" data bit causes the write head drivers to alternately conduct. After all characters of a data block have been written, $\overline{WRS}$ from the interface causes an additional flux reversal to be generated if an odd number of bits was written in the channel. All write head drivers are therefore left in a reset state. The LRC character is written on the tape as a result of returning all of the seven or nine write head drivers to the reset state.

1-13. CIRCUIT DESCRIPTION.

1-14. Data bits of the character byte including the CRCC character from the interface are on individual lines to seven or nine individual write data channels. The interface generated Write Clock ($\overline{WC}$) and Write Reset ($\overline{WRS}$) are routed to the write control circuits. The following paragraphs describe the operation of the write control circuits and a typical write data channel. Block diagrams and timing diagrams are included to aid in understanding the operation of the circuits.

1-15. WRITE CONTROL CIRCUITS.

1-16. The write control circuits are on the write control PC assembly located in the write assembly (motherboard). Figure 1-1 is a block diagram of the write control circuits.

1-17. A tape reel equipped with a write enable ring will cause the write enable solenoid to energize. With the solenoid energized, +12 volts (+12 WE) is provided for the write circuits. The driver enable circuit detects the presence of both +5 volts and +12 WE and generates a write bias voltage for the write head drivers and the erase head driver.

1-18. Tape unit status signals are gated to provide a direct clear to the Write Latch flip-flop. If any of the following conditions change, the gate causes a direct clear of the Write Latch flip-flop.

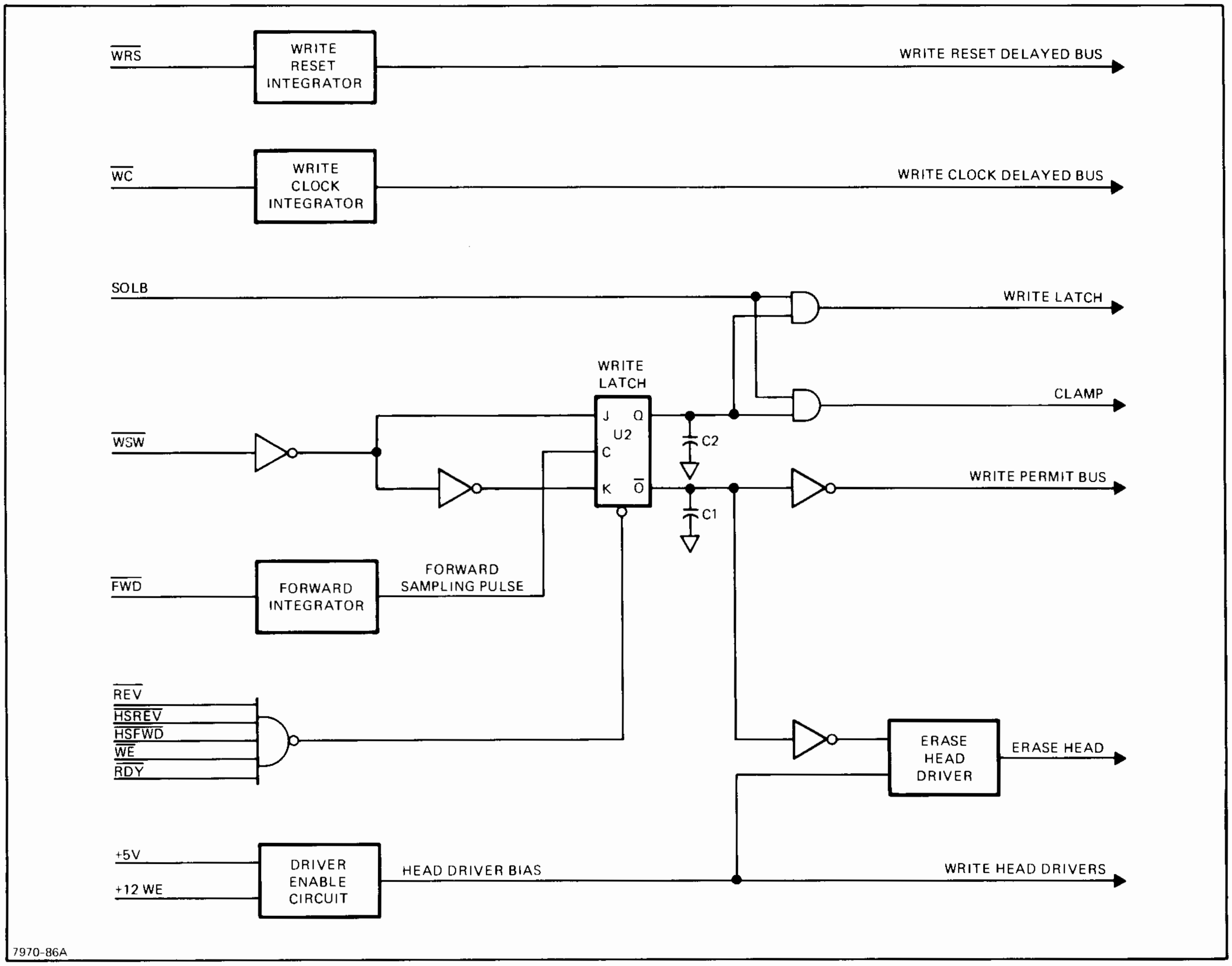


Figure 1-1. Write Control Circuits Block Diagram

a. Tape unit must be ready ($\overline{\text{RDY}}$).

b. Supply reel must be equipped with a write enable ring ($\overline{\text{WE}}$).

c. Tape unit must not be in a reverse mode ($\overline{\text{REV}}$).

d. Tape unit must not be in a high-speed reverse mode ($\overline{\text{HSREV}}$).

e. Tape unit must not be in a high-speed forward mode ($\overline{\text{HSFWD}}$).

1-19. The $\overline{\text{Forward}}$ ($\overline{\text{FWD}}$) status from the control and status circuits is integrated to provide a sampling pulse. The pulse is delayed approximately 10 μs. The leading edge (negative-going) of the $\overline{\text{Forward}}$ ($\overline{\text{FWD}}$) status opens gate U5A (open collector circuit) and capacitor C6 charges towards +12 volts. When the base voltage exceed +5.6 volts, transistor Q1 conducts and the collector of Q1 drops to +5.6 volts. The negative-going transition asserts U4C. The time between the leading edge of $\overline{\text{Forward}}$ ($\overline{\text{FWD}}$) status and the assertion of U4C is the 10 μs delay. The pulse width of the sampling pulse from U4C is determined by the time required for capacitor C5 to recharge toward +5V through R10. When the charge exceeds the threshold level of U4C, the gate changes state and the resulting pulse is applied as a clock input to the Write Latch (U2). Figure 1-2 is a timing diagram showing the generation of the sampling pulse.

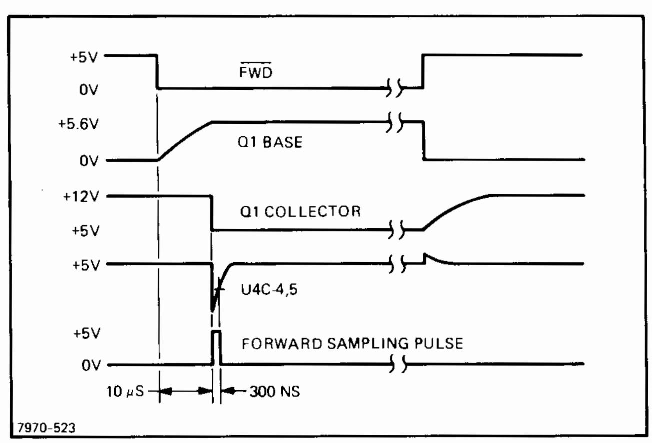


Figure 1-2. Forward Sampling Pulse Generation

1-20. The $\overline{\text{Set Write}}$ ($\overline{\text{WSW}}$) command from the interface (through the control and status PC assembly) is inverted by line receiver U1C and applied to the J input of the Write Latch. The output of the U1C is again inverted and applied to the K input of the Write Latch. The delayed and integrated forward sampling pulse at the clock input therefore samples the $\overline{\text{Set Write}}$ ($\overline{\text{WSW}}$) command. If $\overline{\text{Set Write}}$ ($\overline{\text{WSW}}$) is true (low) when the Write Latch is clocked, the Write Latch is set.

1-21. When the Write Latch is set, capacitor C2 charges toward +5 volts. When the charge on C2 exceeds the threshold of U1A, delayed SOLB (selected and on-line) is gated with the delayed Write Latch Q output to provide clamp. The leading edge of clamp is delayed 100 nanosecond from the start of Write Latch set. The Q output is also gated with SOLB to provide the Write Latch status for the read circuits.

1-22. When the Write Latch is set, the $\overline{Q}$ output goes Low and U3D is negated placing the write permit bus at approximately +5 volts. The leading (positive-going) edge of Write Permit is coincident with the negative going edge of the Write Latch $\overline{Q}$ output. Capacitor C1 has no effect.

1-23. When the write latch changes state, the negative going transition of the $\overline{Q}$ output is not affected by C2 and the trailing (negative-going) edge of clamp is coincident with the transition. The positive going transition of the $\overline{Q}$ output however has to charge C1 and the trailing edge of Write Permit is therefore delayed approximately 100 nanoseconds. Figure 1-3 is a timing diagram showing the generation of write permit and clamp.

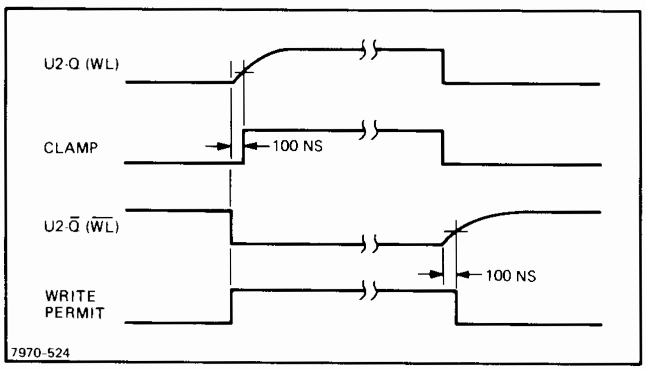


Figure 1-3. Write Permit and Clamp Timing Diagram

1-24. The $\overline{\text{Write Clock}}$ ($\overline{\text{WC}}$) and $\overline{\text{Write Reset}}$ ($\overline{\text{WRS}}$) commands from the interface are delayed and integrated in the same manner as $\overline{\text{Forward}}$ ($\overline{\text{FWD}}$). The commands are delayed 1.1 μs and the pulse width of the integrated pulses is approximately 200 nanoseconds.

1-25. WRITE DATA CIRCUITS.

1-26. The write data circuits are on the single- and dual-channel write data PC assemblies located in the write assembly (motherboard). The single-channel assembly is adjacent to the write control PC assembly and is designated as the P (parity) channel. The dual-channel assemblies are designated as 0, 1, 2, 3, 4, 5, 6, and 7 for nine-track units and 2, 3, 4, 5, 6, and 7 for seven-track units. The dual-channel assembly (0 and 1) adjacent to the single-channel assembly is not used in seven-track units. Figure 1-4 is a block diagram of a typical write data channel.

1-27. Initially the Write Permit and Clamp buses are low. Therefore, the Write Toggle Q and $\overline{Q}$ outputs are both false (high). Inverters U1D and U1E prevent the write drivers from conducting. The Write Permit bus leads the Clamp bus by approximately 100 nanoseconds, therefore when the Write Permit bus goes true (low), the Write Toggle is set. The Write Toggle Q output remains false (high) and the $\overline{Q}$ output is true (low). The inverter is negated, and the set write driver conducts. This allows current to flow through one-half of the center tapped head. Tape is therefore saturated in the same polarity as the erase head.

1-28. A write "one" data bit from the interface is gated with the delayed Write Clock pulse and applied to the skew delay one-shot. The trailing edge of the one-shot output clocks the Write Toggle flip-flop. The Write Toggle flip-flop changes state, the Set Write Driver is turned off and the Reset Write Driver conducts, reversing the direction of tape saturation.

1-29. Each successive "one" bit changes the state of the Write Toggle flip-flop causing the set and reset write drivers to alternately conduct. After all characters have been written, "not" Delayed Write Reset ($\overline{\text{WRSD}}$) from the write control circuits is gated with the Q output of the Write Toggle flip-flop to generate one more flux reversal if an odd number of bits was written in the channel. All Write Toggle flip-flops are therefore left in the clear state.

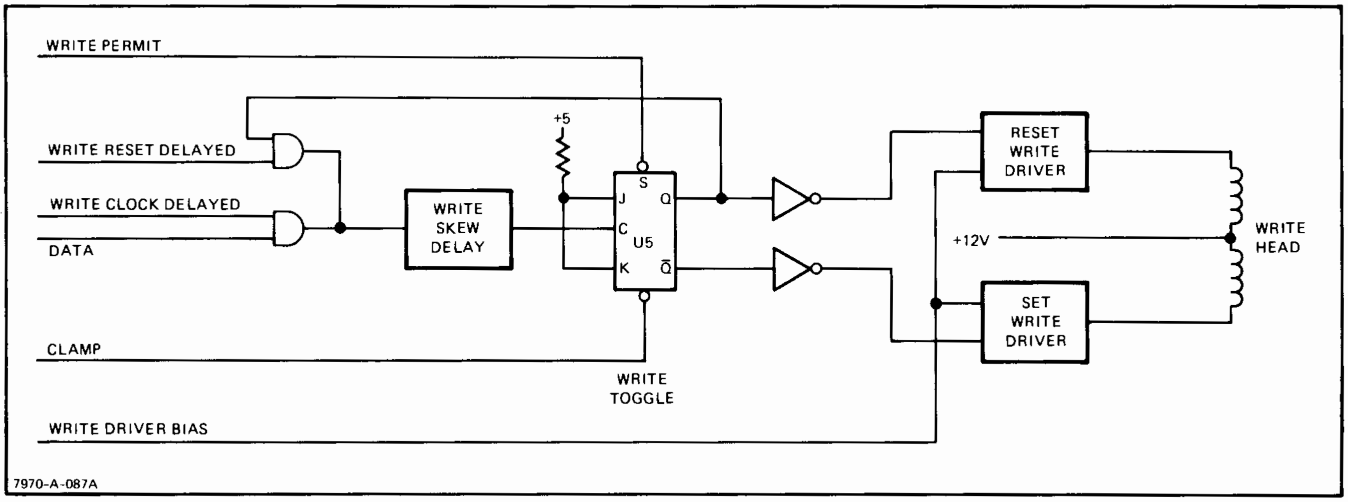


Figure 1-4. Typical Write Data Channel, Block Diagram

SECTION II
MAINTENANCE

2-1. INTRODUCTION.

2-2. This section provides maintenance information for the write modules of the HP 7970B/7970C Digital Magnetic Tape Units. Maintenance information consists of performance test procedures and adjustment procedures. Prior to performing any maintenance to the write modules, ensure that the transport is functioning properly (refer to part 2) and that the read module circuits are operating within specifications. (Refer to part 3.)

2-3. TEST EQUIPMENT REQUIRED.

2-4. In addition to the equipment required for transport maintenance (refer to part 2), the following tapes and test items are required to perform maintenance procedures described in this section.

a. A means of generating a variety of write data patterns specified.

b. A means of reading and detecting parity errors.

c. Write Test Tape, part number 9162-0025.

Note

The HP 13192A Write Test Board is available as an accessory to provide all required write data patterns. When used in conjunction with the HP 13191A Control and Status Test Board and the HP 13193A Read Test Board, maintenance procedures can be performed without the aid of an interfaced computer.

2-5. PERFORMANCE TEST PROCEDURES.

2-6. The following test procedures verify that the write module circuits conform to published specifications. The test procedures described assume the use of an on-line computer or the use of off-line test accessories.

2-7. STATUS AND FUNCTION COMMAND TESTS.

2-8. The status and function command tests verify that the write circuits respond to input commands and that status circuits are operating properly.

2-9. SET WRITE ($\overline{\text{WSW}}$). With the set write function true (from controlling device), a Forward ($\overline{\text{FWD}}$) command will cause the $\overline{\text{WSW}}$ line to be sampled within less than 20 μs following $\overline{\text{FWD}}$. If $\overline{\text{WSW}}$ is true (Low) then the internal write condition will be set true if the tape unit is selected and on-line. Measurement is made as follows:

a. Connect the A probe of an oscilloscope to the write permit test point on the write control printed circuit assembly. When this level goes in the positive direction, write permit is true.

b. Connect the oscilloscope external sweep to the forward drive command from the controlling device $\overline{\text{FWD}}$; and arrange the controlling device to provide bidirectional commands of sufficient length to exceed the start/stop time requirements for the unit. Synchronize sweep with this command.

c. The oscilloscope display should show the Write Permit line going in the positive direction within 5 to 15 microseconds following $\overline{\text{FWD}}$.

d. Observe that the following conditions exist at the write permit line as tape unit is put in the following modes.

(1) Sequential $\overline{\text{FWD}}$ commands: Write Permit remains true (steady level).

(2) Sequential $\overline{\text{REV}}$ commands: Permit remains false (steady level).

(3) $\overline{\text{WSW}}$ command removed and applied during bidirectional: With $\overline{\text{WSW}}$ false, Write Permit remains false and at steady level. With $\overline{\text{WSW}}$ true, Write Permit pulses with $\overline{\text{FWD}}$ command.

2-10. WRITE STATUS ($\overline{\text{SW}}$). Check to be sure status is true when selected tape unit is write enabled and $\overline{\text{WSW}}$ is true.

2-11. WRITE TIME ASYMMETRY TEST.

2-12. Write time asymmetry is the departure (in microinches) of the effective magnetic location of a data bit from that location which would make all sequential data bits equal distances apart. Measurement is made as follows:

a. Place unit in the read after write mode with all ones at 800 cpi.

b. Use channel A of oscilloscope and connect to read skew test point.

c. Sync oscilloscope sweep on negative edge and adjust oscilloscope main sweep rate so that the 10 divisions are equal to two bit-to-bit distances. When this is done, there will be a negative-going trailing edge at the beginning of the sweep and at the end of the sweep. At the center, there may or may not be double trailing edges (this is the time asymmetry). Oscilloscope is now calibrated at 250 microinches per horizontal division, or 25 microinches if the X10 magnifier is used.

d. Observe the separation that may exist between the trailing edges at the center of the oscilloscope. The maximum acceptable condition is a total separation of 75 microinches.

2-13. WRITE/READ SKEW TEST.

2-14. The static skew of the write head is adjusted by electronic skew delays and is set to duplicate the effective bit positions exhibited by the IBM master alignment tape used to check and adjust the read electronic skew delays. Prior to performing the write/read skew test, perform the read skew test described in part 3. Log the results of the read skew test and perform the following procedures:

Note

Skew measurements can become somewhat difficult if significant write time asymmetry exists. When writing tapes for check of write/read skew, it is important that all write pulses start with the same relative flux polarities on tape. This can be assured if there is a sequence of reverse/stop/forward drive commands prior to a skew measurement. The forward command assures complete write reset conditions as the WSW line is made true.

a. Write an all "1's" tape at 800 cpi.

b. Read this tape in the read-after-write mode, and connect the channel A probe of an oscilloscope to the skew test point of the P-track read data printed-circuit assembly. Channel A of the oscilloscope will be used as a reference.

c. Adjust the oscilloscope sweep to synchronize near the zero axis crossover on the positive slope. Set the oscilloscope to operate in the alternate mode.

d. With the delayed sweep operated under a sweep rate of 2 microseconds/cm adjust the delay to display the positive-going step at the start of the channel P skew delay ramp on the center of the scope. This will be the zero time reference for all other measurements. Adjust channel B gain as required to obtain good resolution.

e. Without making any further adjustments to the oscilloscope time base, move the channel B probe to each track skew delay test point in sequence and note its relative position to the center of the oscilloscope. Signals to the left of center are early, and may be noted as "plus" with those to the right noted as "minus" as they are later than the signal from track P.

f. When all measurements have been completed in the forward direction; the same sequence can be repeated for the reverse. It will be necessary to readjust the time delay for positioning track P to center.

g. Review data taken and determine the two tracks that are the earliest (largest plus number) and lates (largest minus number). The time differential between them (sum of the two times) converted to microinches for the tape speed involved is the write skew.

h. Compare the write skew readings taken with read skew test results. Any specific differences represent a measure of the ability of the tape unit write functions to duplicate the master alignment tape. A normally adjusted unit should duplicate the tape within ±1 percent of the bit-to-bit distance at 800 cpi. This corresponds to a time difference equivalent to 25 microinches, or less.

2-15. WRITE/READ PHASING AND WRITE RESET TEST.

2-16. The following checks will verify that the write and read circuitry is correctly phased and that the LRCC character will be written.

a. Arrange for a write data program that will write three characters of all "1's", three characters of all "0's", followed by a Write Reset command. This program should be repetitive and usable for continuous writing.

b. With this program input and the tape unit operated in the read after write mode, observe the preamplifier output test points on each track.

c. Correct phasing and operation of the Write Reset command will result in a series of three recognizable "1" bits, three "0" bits and a single "1" bit. If phasing is correct, the first bit following the "1's" will be caused by the Write Reset and should be a positive-going pulse. It is essential that there be an odd number of all "1's" characters prior to the Write Reset command. The number of characters of all "0's" is not critical and is only to permit positive identification of the first character to follows.

2-17. ERASE/WRITE PHASING TEST.

2-18. This test is made only on the P track, and verifies that the erase head is correctly phased with respect to the write head. Evaluation is accomplished as follows:

a. Starting at loadpoint, write a section of all "0's" data for 30 to 60 seconds, then rewind tape to loadpoint.

b. Remove the P track write data card to preclude any further possibility of the write head changing the tape flux on the P track.

c. Place tape unit in a cyclic forward drive mode ($\overline{\text{FWD}}$ true/FWD false/$\overline{\text{FWD}}$ true, etc). During this period of time (again 30 to 60 seconds) alternate periods of $\overline{\text{WSW}}$ true/WSW false by manual operation of other means. Continue all "0's" program.

d. Operation as instructed in step "c" has resulted in intervals of tape (on track P) which have been magnetized by the write head during step "a" above, and other intervals which possibly have reversed flux polarity as set by the erase head if it is incorrectly phased.

e. After completion of steps "a" through "d", connect oscilloscope channel A to the output of channel P read preamplifier, and read the section of tape in steady forward or reverse drive mode. If the erase head is incorrectly phased, the flux reversal generated will produce full pulse amplitudes of approximately 3 volts zero-to-peak. A correctly phased head will show minor pulse disturbances as the erase current is applied. These levels will generally be below 15 percent of the zero-to-peak signal level or in the vicinity of 0.4 volts zero-to-peak, maximum.

2-19. WRITE CROSSTALK TEST.

2-20. Write crosstalk (or write-feedthru) is a measure of the degree to which write head currents induce read head output voltages due to transformer action between the write and read heads. It is expressed as a percentage of the nominal read-after-write output level. Measurement is as follows:

a. Generate a random data write pattern and place tape unit in the read after write mode.

b. Connect oscilloscope to individual read preamplifier output test points and note the composite peak-to-peak output level (use relatively slow sweep speeds). This will be in the vicinity of 6.4 volts peak-to-peak for typical data.

c. Stop the tape unit but do not drop $\overline{\text{WSW}}$ or give a $\overline{\text{REV}}$ command. This state will allow the write data head currents to continue, provided the write clock and data are still present.

d. Again observe the peak-to-peak composite signal level present at the output of the read preamplifier. This peak-to-peak value must not exceed 5 percent of the value measured for the same track in step "b". Typical crosstalk levels must not exceed 320 millivolts peak-to-peak.

2-21. INTERNAL WRITE CLOCK DELAY AND PULSE WIDTH TEST.

2-22. Measure the internal write clock delay by the following method.

a. The tape unit may be stopped in any mode. Write clock input signals are required.

b. Connect oscilloscope channel A to the Write Clock (WC) test point on the read control card and synchronize main sweep on negative slope.

c. Connect oscilloscope channel B to the delayed Write Clock ($\overline{\text{WCD}}$) test point and using the alternate triggered by A mode, observe the time delay between the negative-going edge of the write clock and the positive-going edge of Write Clock delayed. This should be between 1 and 3 microseconds.

d. Using channel B only, sync on positive slope and observe the pulse width of the delayed Write Clock. This should be between 0.3 and 1.0 microsecond.

2-23. DATA TRANSFER CHARACTERISTICS TEST.

2-24. The following checks cover the general data transfer characteristics of the tape unit and the final sequence of the performance checkout.

2-25. TAPE INTERCHANGEABILITY. Tape interchangeability optional test is evaluated by reading a specially prepared (random length) block tape written by a computer on a tape unit which has been specifically misadjusted to cause the maximum allowable write character skew (150 microinches absolute). The tape unit should read this tape in its entirety without read errors.

2-26. TOTAL DYNAMIC SKEW. Total dynamic skew is the microinch equivalent of the time interval between the arrival of the first and last bit of any read character under worst case data conditions (read or write) using tapes written on the unit under test. Measurement is made as follows:

a. Write a test tape having a maximum variety of random data patterns.

b. Connect channel A of the oscilloscope to the NOR test point on the read control card. The negative-going waveform at this point represents the arrival of the first data bit. All other data bits in the character will also generate negative-going waveforms at this point.

c. Sync the sweep on negative slope and adjust time as required to observe the total time required for all bits to arrive at the NOR test point.

d. This time, converted to equivalent microinches at the tape speed involved, represents the total dynamic skew of any worst case single character.

e. Operate tape unit in read-after-write, read forward, and read reverse modes. Under any of these conditions, the maximum dynamic skew must not exceed 200 microinches.

Note

If total dynamic skew is measured at the read clock (read clock jitter) it will appear as plus or minus dynamic skew and the total jitter band (less read clock pulse width) will correspond to ±200 microinches.

2-27. READ-AFTER-WRITE DATA TRANSFER. Read-after-write data transfer is evaluated by writing a program having odd parity characters. The tape unit must operate error-free in the read-after-write mode throughout a full 10-1/2 inch reel of tape. Errors that can be positively associated with defects in the tape need not negate a test. Such errors will be read in both forward and reverse drive over the same area of the tape.

2-28. READ ONLY DATA TRANSFER. The tape generated during the read-after-write test must also be read error free in both the forward and reverse directions under read only operation.

2-29. ADJUSTMENT PROCEDURES.

2-30. The only adjustment for write data electronics is the write skew delay adjustment. Write skew delay provides additional assurance that tapes written on the unit will not have more than 150 microinches of absolute skew in any data character. This figure applies to any data pattern condition and includes all factors that cause bits to be displaced from theoretical locations. Prior to performing the write skew delay adjustment ensure that power supply adjustment, capstan adjustments, and all read data adjustments have been completed and verified.

2-31. Load the tape transport with a reel of scratch tape equipped with a write enable ring. Set all write skew delay controls fully ccw. Place the unit in synchronous forward write mode and write a data pattern consisting of all "ones" at 800 cpi. Adjust the write skew delays as follows:

a. Using an oscilloscope, compare each read channel skew in a read-while-write condition to determine which channel is lagging the most.

b. Adjust the channel 2 write skew delay until channel 2 is slightly lagging the channel determined in step "a." Channel 2 will be used as a reference channel.

c. Connect the oscilloscope channel A probe to tape unit channel 2 read SKEW test point, and connect the oscilloscope channel B probe to the SKEW test point corresponding to the write data channel being adjusted. Set the oscilloscope controls to algebraically sum channels A and B. Adjust oscilloscope sweep to display at least one full bit time (leading edge of one bit to the leading edge of the next).

d. Adjust the skew delay variable resistor of the channel under adjustment to obtain a maximum amplitude on the oscilloscope display.

e. Repeat step "d" for all remaining channels except the reference channel (channel 2).

Note

Under no circumstances are any of the read skew adjustments to be changed during the write skew compensation process.

SECTION III
REPLACEABLE PARTS

3-1. INTRODUCTION.

3-2. This section provides information for ordering replacement parts for the write modules of the HP 7970B/7970C Digital Magnetic Tape Units.

3-3. This section contains assembly parts lists, supporting illustrations, ordering information, and a part number cross reference.

3-4. ASSEMBLY PARTS LISTS.

3-5. The assembly parts lists represent a breakdown of all replaceable parts of the write data package. The information contained in the lists are under the following headings:

a. FIGURE & INDEX NO.

b. PART NUMBER.

c. DESCRIPTION.

d. UNITS PER ASSY.

3-6. FIGURE AND INDEX NUMBER.

3-7. The figure and index number column will identify the figure that illustrates each listed item and the index number that identifies the item on the illustration.

3-8. PART NUMBER.

3-9. The part number column provides the Hewlett-Packard part number for each item listed in the assembly parts list.

3-10. DESCRIPTION.

3-11. The description column describes the items within the article. An indented column arrangement is used to show the relationship between a part and the next higher assembly. The top assembly of each listing appears in indention 1. Primary subassemblies (of top assembly) and attaching parts appear in indention 2. This method of indention is continued through indention 3, 4, etc., until all replaceable parts are listed. Attaching parts are listed immediately following the part they attach. Attaching parts are identified by the abbreviation (AP) enclosed in parentheses at the end of the description.

3-12. Reference designation and manufacture information (if applicable) is also included in the description column.

3-13. UNITS PER ASSEMBLY.

3-14. The quantity shown in the units per assembly column reflects the total quantity of a part required by the next higher assembly of that part. This quantity is not necessarily the total used for the complete equipment. The abbreviation AR is used to indicate usage as required of a particular item. The abbreviation REF is used to indicate that the quantity of an item used per assembly is listed in the next higher assembly of the group assembly parts list.

3-15. ORDERING INFORMATION.

3-16. To order replacement parts, address the order or inquiry to the local Hewlett-Packard Sales and Service Office (Refer to the list at the end of this manual for addresses.) Specify the following information for each part ordered.

a. Identification of the unit, kit, or assembly containing the part.

b. Hewlett-Packard part number for each part.

c. Description of each part.

d. Circuit reference designation (if applicable).

3-17. PART NUMBER CROSS REFERENCE.

3-18. Table 3-1 at the end of this section provides a cross reference between Hewlett-Packard part numbers and manufacturer's part numbers.

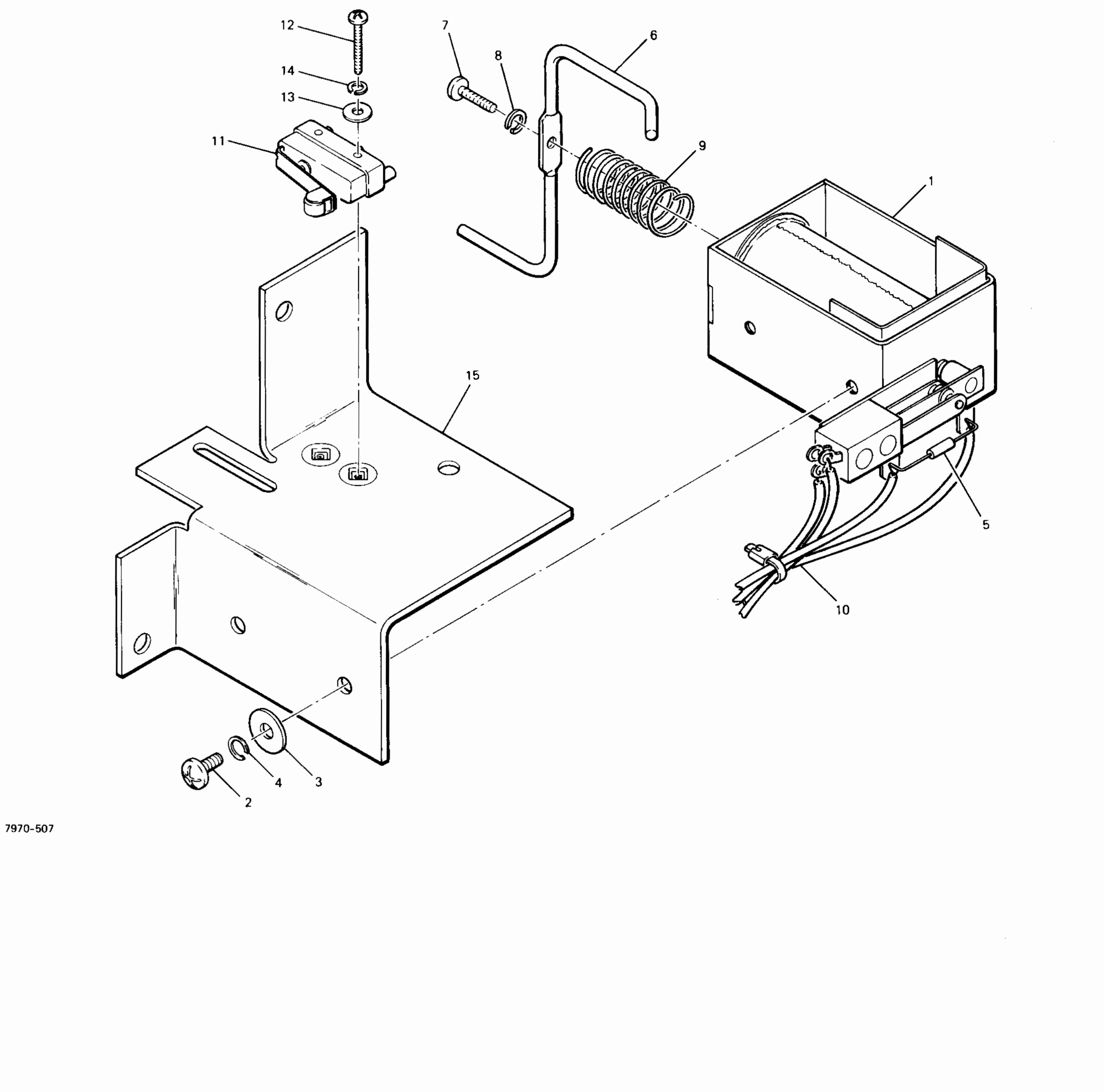


Figure 3-1. Write Enable Assembly A10

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-1-	07970-62122	WRITE ENABLE ASSEMBLY A10	REF
-1	0491-0062	. SOLENOID, 24 Vdcw (L1)	1
-2	2360-0193	. . SCREW, no. 6-32, 0.25-inch, pozi (AP)	2
-3	2190-0227	. . WASHER, flat (AP)	2
-4	2190-0085	. . WASHER, lock, helical (AP)	2
-5	1901-0039	. DIODE, Si (CR1)	1
-6	07970-20833	. ACTUATOR, write enable	1
-7	2200-0145	. . SCREW, no. 4-40, 0.437-inch, pozi (AP)	1
-8	2190-0003	. . WASHER, lock, helical (AP)	1
-9	1460-1288	. SPRING, compression	1
-10	07970-62123	. CABLE ASSEMBLY (W1)	1
-11	3102-0009	. . SWITCH, sensitive (S2)	1
-12	0520-0131	. . SCREW, no. 2-56, 0.437-inch, pozi (AP)	2
-13	2190-0417	. . WASHER, flat (AP)	2
-14	2190-0040	. . WASHER, lock, helical (AP)	2
-15	07970-01187	. BRACKET, write enable	1

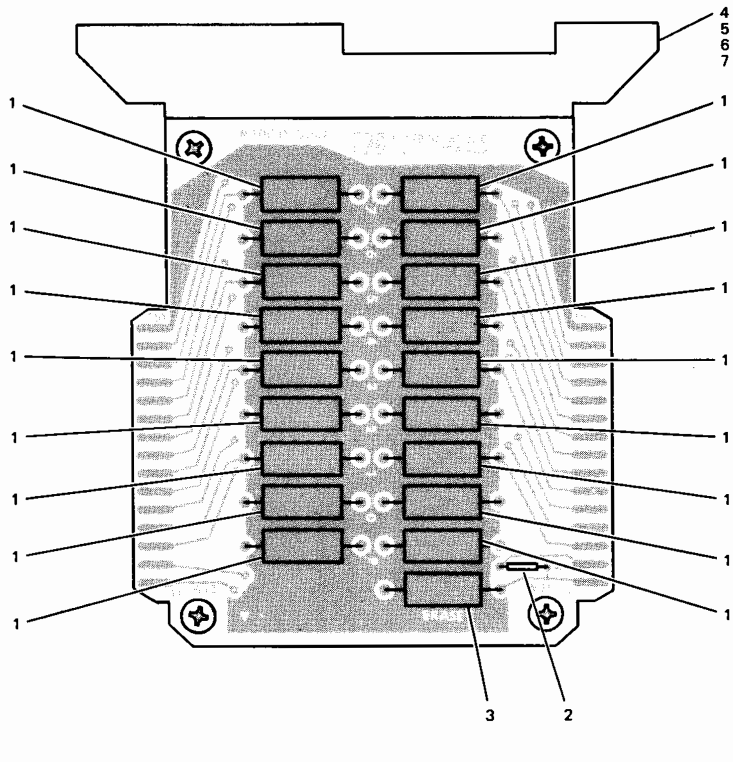


Figure 3-2. Write Interconnect PC Assembly A14

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-2-	07970-60300	WRITE INTERCONNECT PC ASSEMBLY A14	REF
-1	0698-3622	. RESISTOR, fxd, 120 ohms, 5%, 2W (R2 thru R19)	18
-2	1901-0025	. DIODE, Si (CR1)	1
-3	0698-3627	. RESISTOR, fxd, 200 ohms, 5%, 2W (R1)	1
-4	07970-00440	. BRACKET, write interconnect PC assembly	1
-5	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	4
-6	2190-0085	. . WASHER, lock, helical (AP)	4
-7	3050-0228	. . WASHER, flat (AP)	4

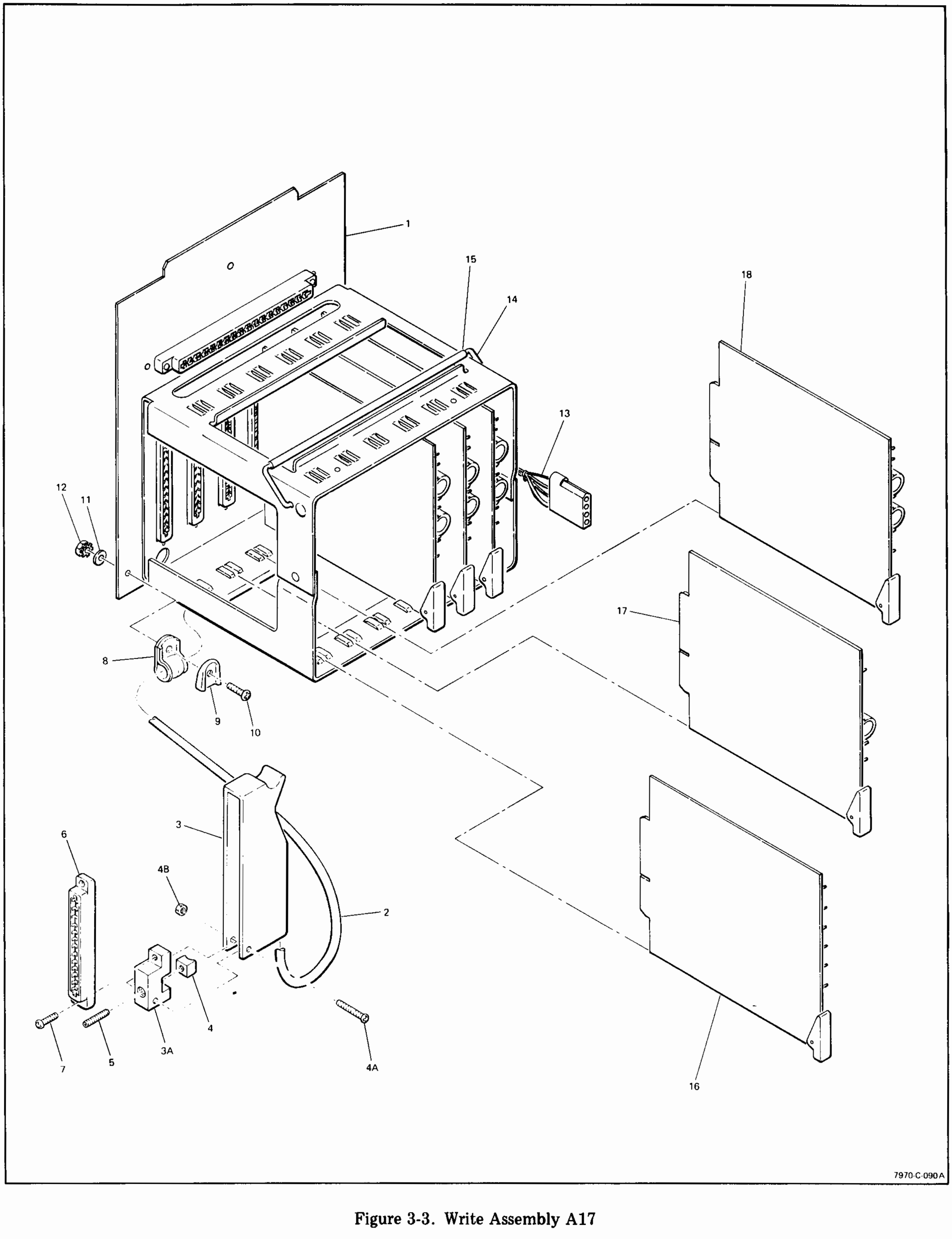


Figure 3-3. Write Assembly A17

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-3-	Reference Only	WRITE ASSEMBLY A17	REF
-1	07970-60230	. WRITE MOTHERBOARD ASSEMBLY	1
-2	8120-1535	. . CABLE, shielded, 29 conductor	3 ft.
-3	07970-40204	. . HOLDER, connector	1
-3A	5040-6072	. . . BLOCK, mounting	1
-4	5040-6003	. . CLAMP, cable, connector holder	1
-4A	2200-0091	. . . SCREW, no. 4-40, 0.562-inch, pozi (AP)	1
-4B	2260-0001	. . . NUT, Hex, no. 4-40 (AP)	1
-5	3030-0143	. . . SCREW, set, no. 6-32, 0.500-inch, socket head (AP)	1
-6	1251-0159	. . CONNECTOR, printed circuit	1
-7	0624-0098	. . . SCREW, tapping, no. 4-40, 0.438-inch, pozi (AP)	2
-8	1400-0440	. . CLAMP, cable, 0.250-inch (AP)	1
-9	2190-0452	. . . WASHER, flat (AP)	1
-10	2360-0199	. . . SCREW, no. 6-32, 0.438-inch, pozi (AP)	1
-11	3050-0227	. . . WASHER (AP)	1
-12	2420-0001	. . . NUT, hex, no. 6-32 (AP)	1
-13	07970-60410	. . CABLE ASSEMBLY, write power (W1)	1
-14	07970-00470	. . RETAINING SPRING, PC board	1
-15	1400-0795	. . TIE, cable, spiral, 0.250-inch	5.8 in.
-16	-----	. WRITE CONTROL PC ASSEMBLY A17A1 (See figure 3-4 for details.)	1
-17	-----	. WRITE DATA PC ASSEMBLY A17A2, single-channel (See figure 3-5 for details.)	1
-18	-----	. WRITE DATA PC ASSEMBLY A17A3 thru A17A6, dual-channel (See figure 3-6 for details.)	3 or 4*

*A17A3 is used only in 9-track applications.

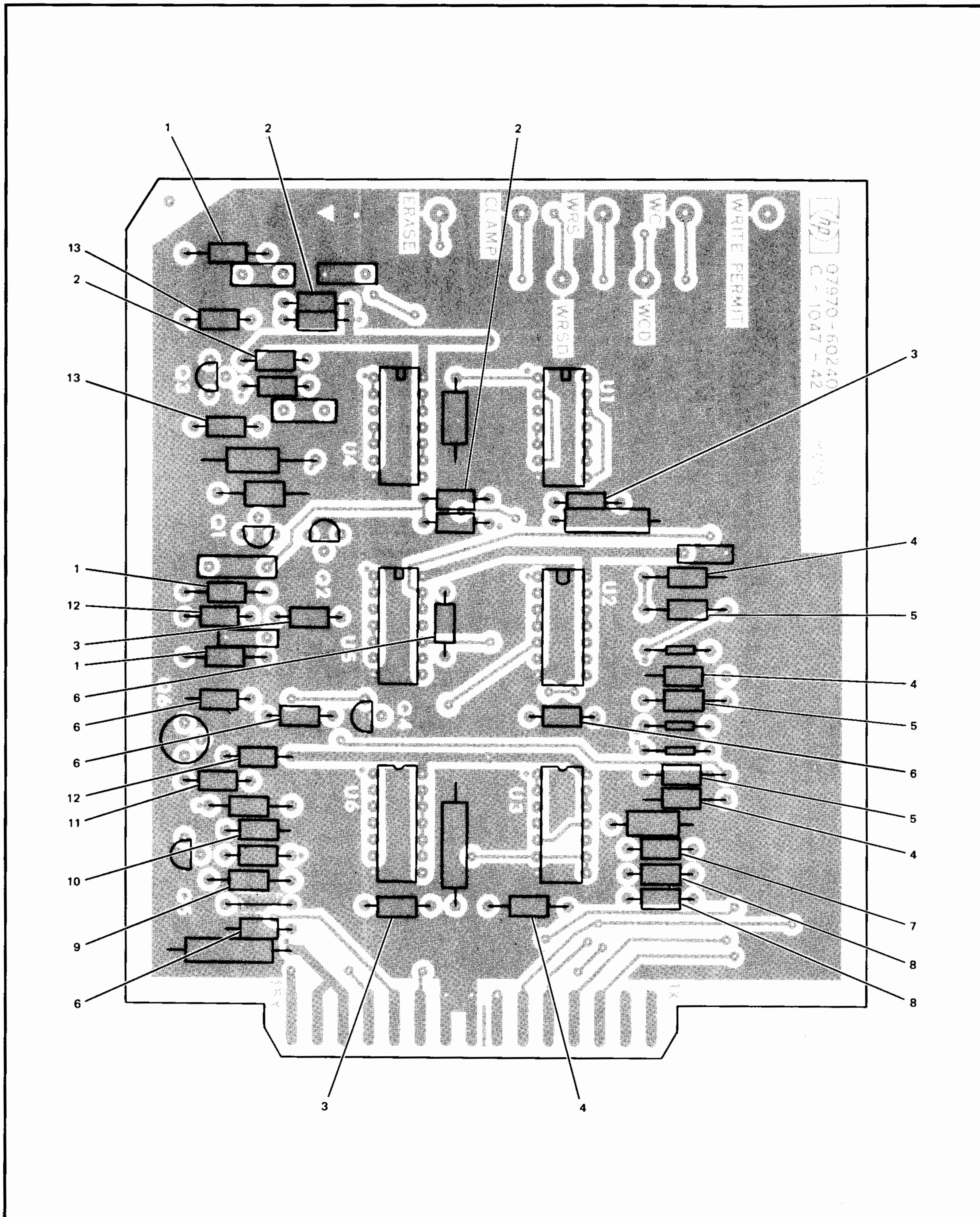


Figure 3-4. Write Control PC Assembly (Sheet 1 of 2)

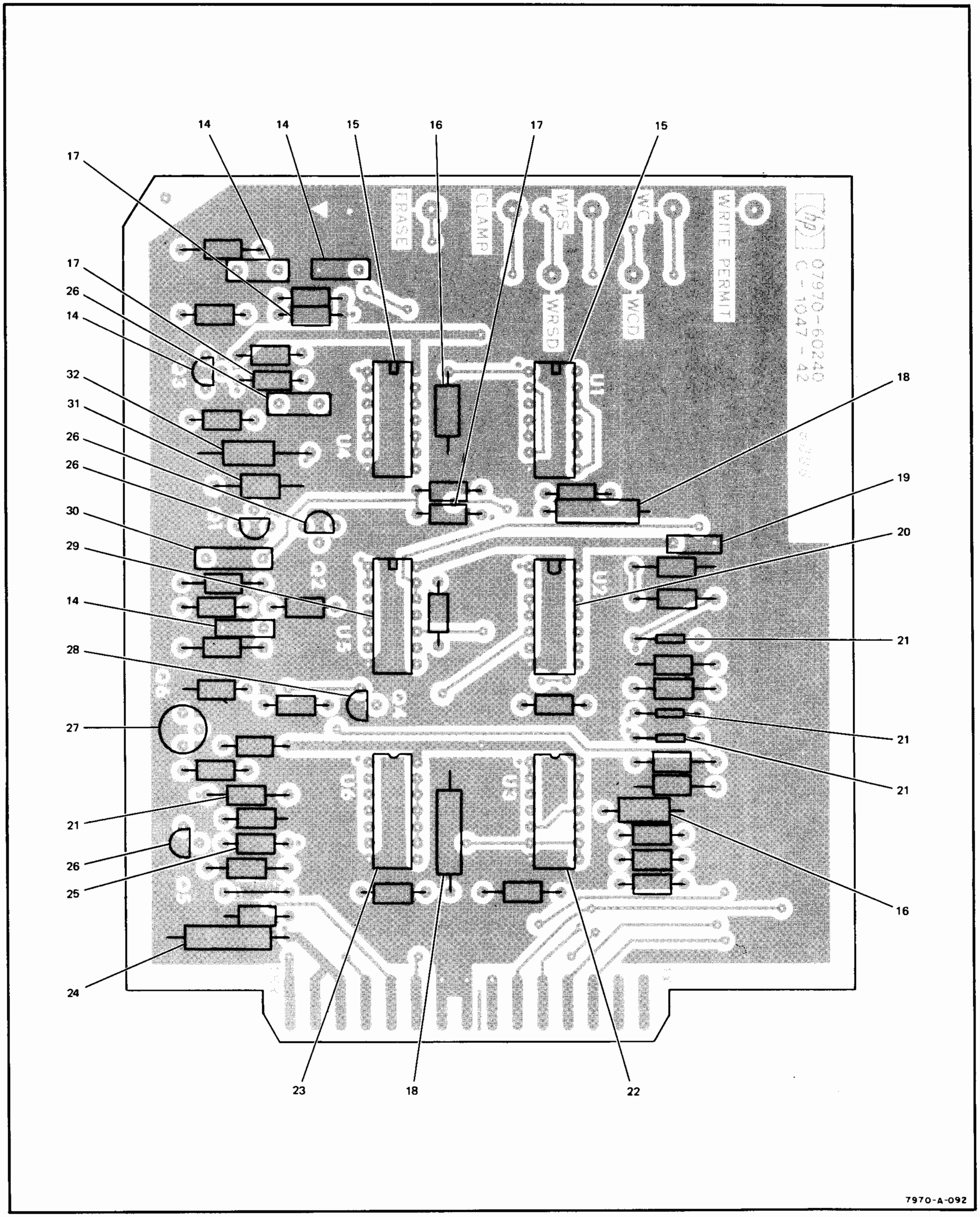


Figure 3-4. Write Control PC Assembly (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-4-	07970-60240	WRITE CONTROL PC ASSEMBLY A17A1	REF
-1	0757-0290	. RESISTOR, fxd, 6.19k, 1%, 1/8W (R8, R12, R25)	3
-2	0683-3925	. RESISTOR, fxd, 3.9k, 5%, 1/4W (R10, R14, R27)	3
-3	0683-8205	. RESISTOR, fxd, 82 ohms, 5%, 1/4W (R15, R28, R30)	3
-4	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R3, R18, R22, R24)	4
-5	0757-0418	. RESISTOR, fxd, 619 ohms, 1%, 1/8W (R17, R21, R23)	3
-6	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R4, R5, R6, R29, R33)	5
-7	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R31)	1
-8	0683-1825	. RESISTOR, fxd, 1.8k, 5%, 1/4W (R, R2)	2
-9	0698-0084	. RESISTOR, fxd, 2.15k, 1%, 1/8W (R20)	1
-10	0698-0085	. RESISTOR, fxd, 2.61k, 1%, 1/8W (R7)	1
-11	0683-3015	. RESISTOR, fxd, 300 ohms, 5%, 1/4W (R11)	1
-12	0683-1035	. RESISTOR, fxd, 10k, 5%, 1/4W (R9, R16)	2
-13	0683-5625	. RESISTOR, fxd, 5.6k, 5%, 1/4W (R13, R26)	2
-14	0160-2207	. CAPACITOR, fxd, 300 pF, 5%, 300 Vdcw (C8, C9, C10, C11)	4
-15	1820-0054	. INTEGRATED CIRCUIT, type 7400N (U1, U4)	2
-16	0160-0153	. CAPACITOR, fxd, 0.001 µF, 10%, 200 Vdcw (C1, C2)	2
-17	1910-0016	. DIODE, Ge (CR1, CR5, CR7)	3
-18	0160-0161	. CAPACITOR, fxd, 0.01 µF, 10% (C25, C26)	2
-19	0160-2055	. CAPACITOR, fxd, 0.01 µF, -20 +80%, 100 Vdcw (C7)	1
-20	1820-0095	. INTEGRATED CIRCUIT, type 848 (U2)	1
-21	1901-0040	. DIODE, Si (CR2, CR4, CR6, CR9)	4
-22	1820-0256	. INTEGRATED CIRCUIT (U3)	1
-23	1820-0441	. INTEGRATED CIRCUIT (U6)	1
-24	0180-1746	. CAPACITOR, fxd, 15 µF, 10%, 20 Vdcw (C4)	1
-25	1902-1261	. DIODE (CR3)	1
-26	1854-0270	. TRANSISTOR, NPN, Si, 2N4265 (Q1, Q2, Q3, Q4)	4
-27	1853-0016	. TRANSISTOR, PNP, Si, (Q6)	1
-28	1854-0246	. TRANSISTOR Q4)	1
-29	1820-0269	. INTEGRATED CIRCUIT (U5)	1
-30	0160-2210	. CAPACITOR, fxd, 470 pF, 5%, 300 Vdcw (C5)	1
-31	0160-0300	. CAPACITOR, fxd, 0.0027 µF, 10%, 20 Vdcw (C6)	1
-32	0180-0106	. CAPACITOR, fxd, 60 µF, 20%, 6 Vdcw (C3)	1

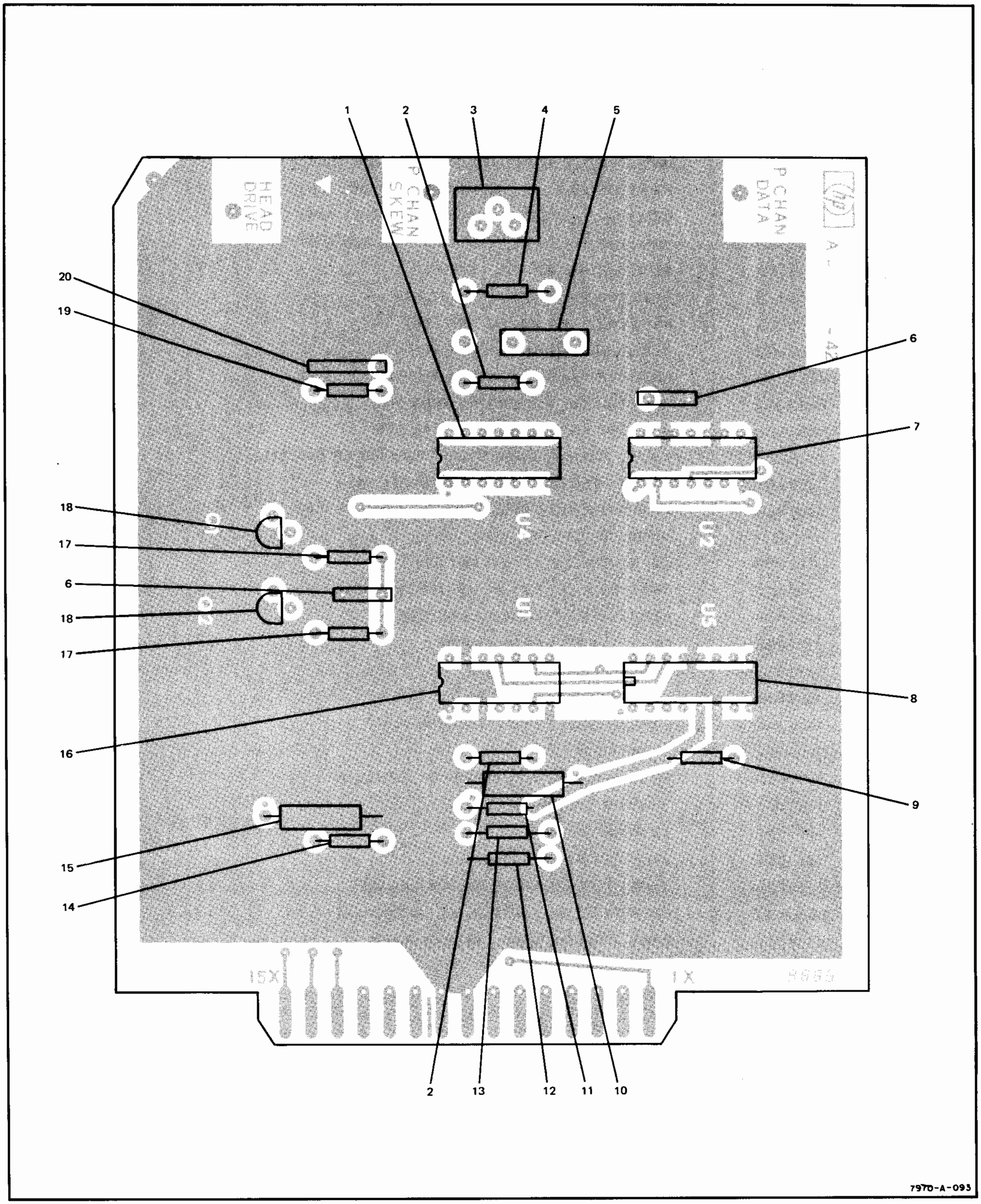


Figure 3-5. Single-Channel Write Data PC Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-5-	07970-60820	WRITE DATA PC ASSEMBLY A17A3, single-channel, 10-20.9 ips	REF
3-5-	07970-60830	WRITE DATA PC ASSEMBLY A17A2, single-channel, 21-45 ips	REF
-1	1820-0088	. INTEGRATED CIRCUIT, type 850 (U4)	1
-2	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R6, R27)	2
-3	2100-1761	. RESISTOR, var, ww, 10k, 5%, 1W (R11)	1
-4	0698-3153	. RESISTOR, fxd, 38.3k, 1%, 1/8W (R12)	1
-5	0160-2373	. CAPACITOR, fxd, 4700 pF, 2%, 300 Vdcw (C4) . . . . (Used on 07970-60820)	1
-5	0160-2227	. CAPACITOR, fxd, 2400 pF, 5%, 300 Vdcw (C4) . . . . (Used on 07970-60830)	1
-6	0160-2055	. CAPACITOR, fxd, 0.01 μF, 100 Vdcw (C6, C9)	2
-7	1820-0094	. INTEGRATED CIRCUIT, type 846 (U2)	1
-8	1820-0076	. INTEGRATED CIRCUIT, type 7476N (U5)	1
-9	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R13)	1
-10	0180-0106	. CAPACITOR, fxd, 60 μF, 20%, 6 Vdcw (C1)	1
-11	1901-0040	. DIODE, Si (CR1)	1
-12	0757-0428	. RESISTOR, fxd, 16.2k, 1%, 1/8W (R2)	1
-13	0757-0418	. RESISTOR, fxd, 619 ohms, 1%, 1/8W (R1)	1
-14	0683-1005	. RESISTOR, fxd, 10 ohms, 5%, 1/4W (R20)	1
-15	0180-1746	. CAPACITOR, fxd, 15 μF, 10%, 20 Vdcw (C7)	1
-16	1820-0479	. INTEGRATED CIRCUIT (U1)	1
-17	0683-8215	. RESISTOR, fxd, 820 ohms, 5%, 1/4W (R16, R17)	2
-18	1854-0246	. TRANSISTOR (Q1, Q2)	2
-19	0683-2205	. RESISTOR, fxd, 20 ohms, 5%, 1/4W (R5)	1
-20	0150-0121	. CAPACITOR, fxd, 0.1 μF, -20 +80%, 50 Vdcw (C2)	1

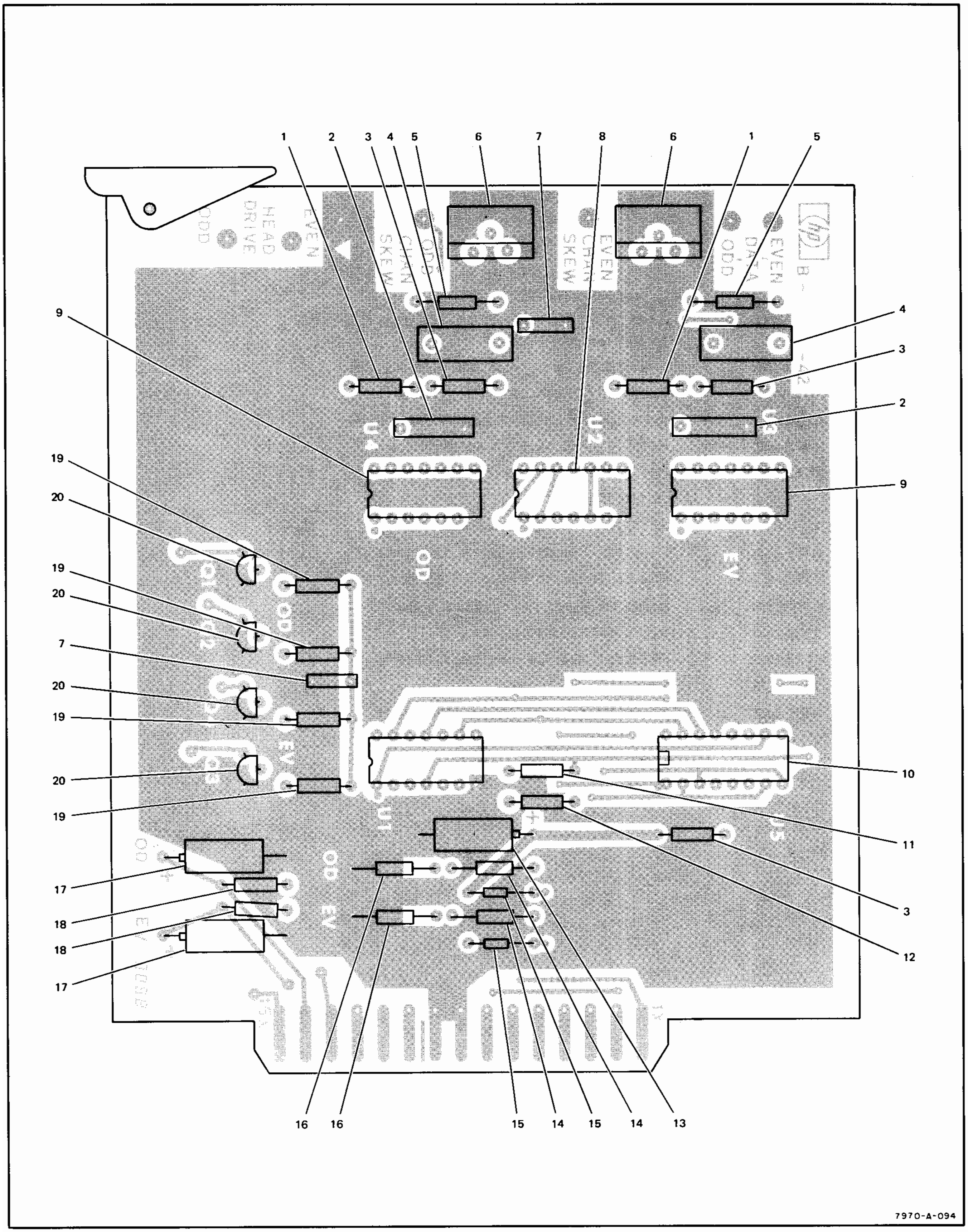


Figure 3-6. Dual-Channel Write Data PC Assembly

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-6-	07970-60800	WRITE DATA PC ASSEMBLY A17A3 thru A17A6, dual-channel, 10-20.9 ips	REF
3-6-	07970-60810	WRITE DATA PC ASSEMBLY A17A3 thru A17A6, dual-channel, 21-45 ips	REF
-1	0683-2205	. RESISTOR, fxd, 22 ohms, 5%, 1/4W (R5, R10)	2
-2	0150-0121	. CAPACITOR, fxd, 0.1 μF, 50 Vdcw (C2, C3)	2
-3	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R6, R9, R27, R28)	4
-4	0160-2373	. CAPACITOR, fxd, 4700 pF, 2%, 300 Vcdw (C4, C5) (Used on 07970-60800)	2
-4	0160-2227	. CAPACITOR, fxd, 2400 pF, 5%, 300 Vdcw (C4, C5) (Used on 07970-60810)	2
-5	0698-3153	. RESISTOR, fxd, 3.83k, 1%, 1/8W (R12, R14)	2
-6	2100-1761	. RESISTOR, var, ww, 10k, 5%, 1W (R11, R15)	2
-7	0160-2055	. CAPACITOR, fxd, 0.01 μF, 100 Vdcw (C6, C9)	2
-8	1820-0094	. INTEGRATED CIRCUIT, type 846 (U2)	1
-9	1820-0088	. INTEGRATED CIRCUIT, type 851 (U3, U4)	2
-10	1820-0479	. INTEGRATED CIRCUIT (U1)	1
-11	1820-0076	. INTEGRATED CIRCUIT, type 7476N (U5)	1
-12	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R13)	1
-13	0180-0106	. CAPACITOR, fxd, 60 μF, 20%, 6 Vdcw (C1)	1
-14	0757-0418	. RESISTOR, fxd, 619 ohms, 1%, 1/8W (R1, R3)	2
-15	1901-0040	. DIODE, Si (CR1, CR2)	2
-16	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R2, R4)	2
-17	0180-1746	. CAPACITOR, fxd, 15 μF, 10%, 20 Vdcw (C7, C8)	2
-18	0683-1005	. RESISTOR, fxd, 10 ohms, 5%, 1/4W (R20, R25)	2
-19	0683-8215	. RESISTOR, fxd, 820 ohms, 5%, 1/4W (R16, R17, R18, R19)	4
-20	1854-0246	. TRANSISTOR (Q1, Q2, Q3, Q4)	4

Table 3-1. Part Number Cross Reference

HP PART NUMBER	MFR CODE	MFR PART NUMBER
0150-0121	56289	5C50BIS-CML
0160-0153	56289	192P10292-PTS
0160-0161	56289	192P10392-PTS
0160-0300	56289	192P27292-PTS
0160-2055	56289	C023F101F103ZS22-CDH
0160-2207	28480	0160-2207
0160-2210	28480	0160-2210
0160-2227	28480	0160-2227
0160-2373	28480	0160-2373
0180-0106	28480	0180-0106
0180-1746	28480	0180-1746
0360-1290	83330	853
0403-0091	77969	9102A
0491-0058	28480	0491-0058
0520-0133	00000	OBD
0610-0001	00000	OBD
0624-0098	00000	OBD
0683-1005	01121	CB 1005
0683-1025	01121	CB 1025
0683-1035	01121	CB 1035
0683-1825	01121	CB 1825
0683-2205	01121	CB 2205
0683-2225	01121	CB 2225
0683-3015	01121	CB 3015
0683-3925	01121	CB 3925
0683-5625	01121	CB 5625
0683-8205	01121	CB 8205
0683-8215	01121	CB 8215
0698-0084	28480	0698-0084
0698-0085	28480	0698-0085
0698-3153	28480	0698-3153
0698-3622	28480	0698-3622
0698-3627	28480	0698-3627
0757-0290	28480	0757-0290
0757-0428	28480	0757-0428
1251-0159	71785	251-15-30-261
1400-0292	95987	1/4-6B
1400-0795	05593	SWP-1/4XXT(100')

HP PART NUMBER	MFR CODE	MFR PART NUMBER
1460-1239	00000	OBD
1820-0054	01295	SN7400N
1820-0076	01295	SN7476N
1820-0088	04713	MC851P
1820-0094	28480	1820-0094
1820-0095	01295	SN15848N
1820-0256	04713	MC858P
1820-0269	01295	SN7403N
1820-0441	04713	MC1801P
1820-0479	04713	MC835P
1853-0016	80131	2N3638
1854-0246	80131	2N3643
1854-0270	80131	2N4265
1901-0025	07263	FD 2387
1901-0026	04713	SR1358-8
1901-0040	07263	FDG1088
1902-1261	28480	1902-1261
1910-0016	93332	D2361
2100-1761	28480	2100-1761
2190-0003	28480	2190-0003
2190-0085	00000	OBD
2190-0117	28480	2190-0117
2190-0128	00000	OBD
2190-0416	00000	OBD
2190-0452	95987	D6-140
2200-0139	00000	OBD
2200-0145	00000	OBD
2200-0147	00000	OBD
2360-0193	00000	OBD
2360-0195	00000	OBD
2360-0199	00000	OBD
2420-0001	78189	OBD
3030-0143	00000	OBD
3050-0066	28480	3050-0066
3050-0227	80120	AN960AC-6
3050-0228	80120	MS15795-305
3102-0009	80207	2LMW-E
8120-1535	28480	8120-1535

SECTION IV
MAINTENANCE DIAGRAMS

This section contains schematic and parts location diagrams for the write modules of the HP 7970B/7970C Digital Magnetic Tape Units.

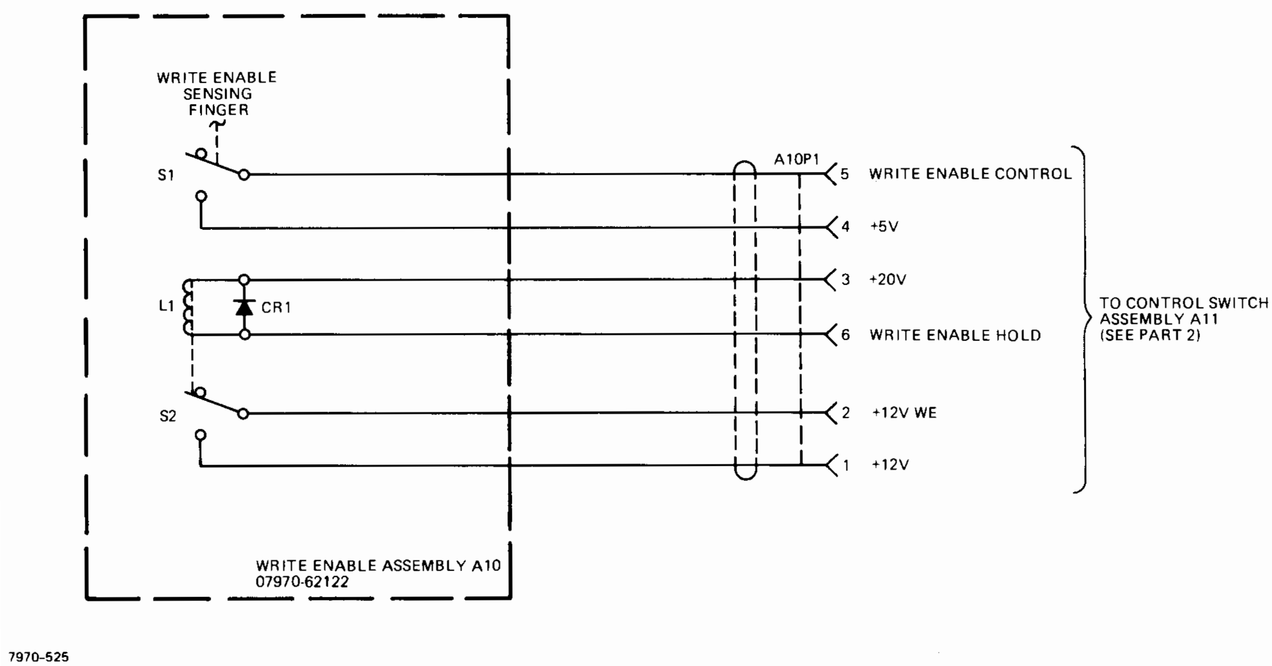
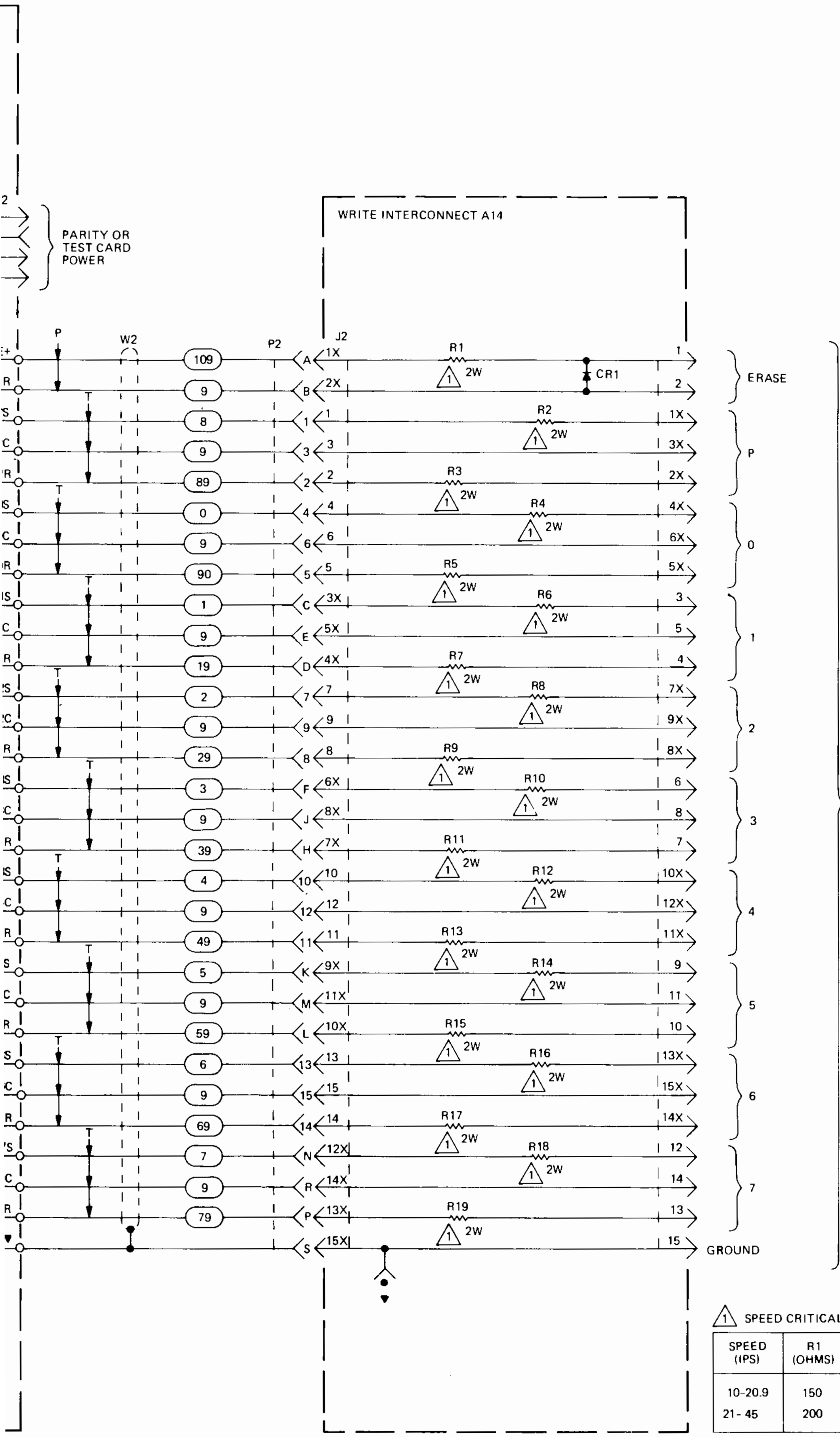
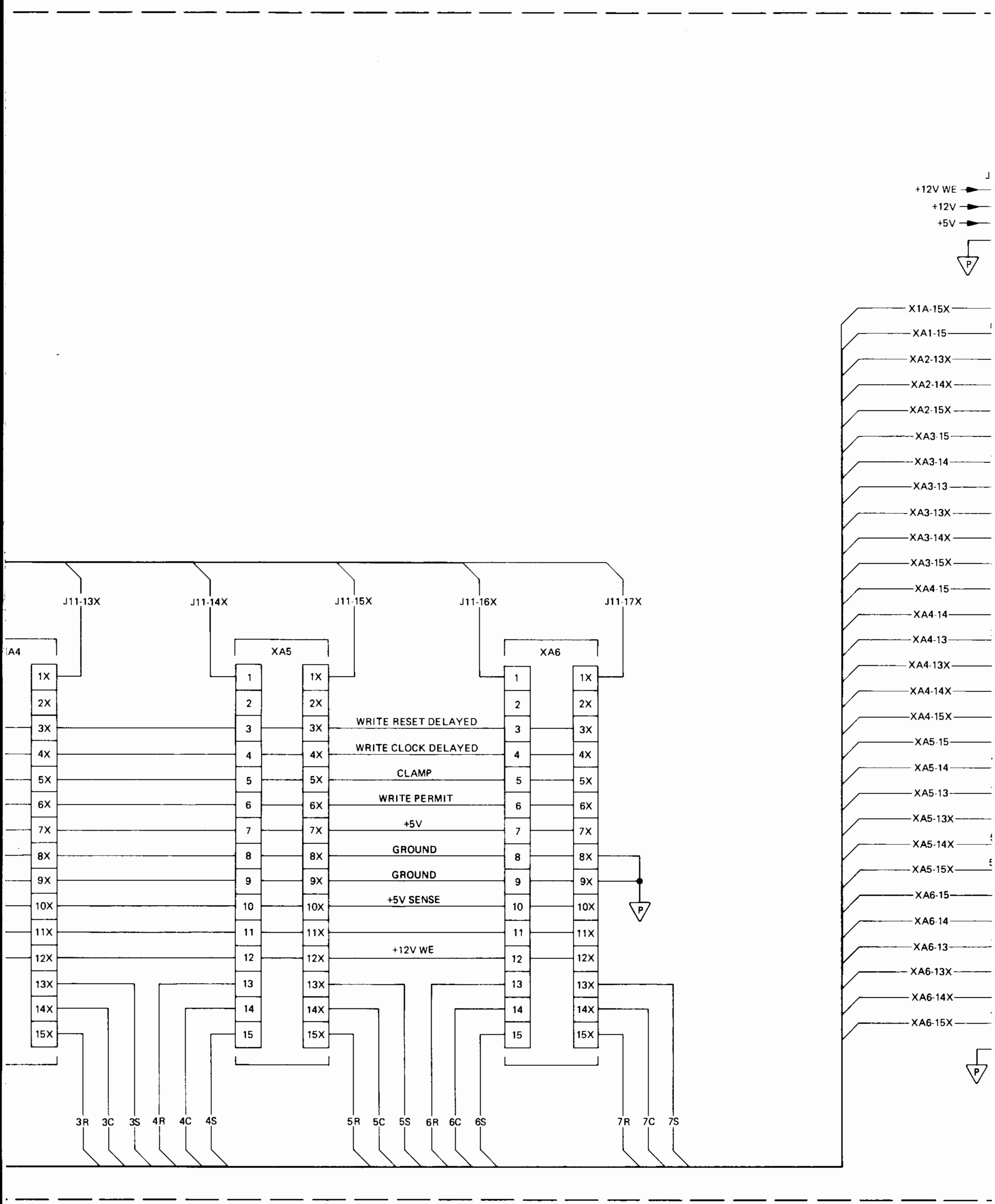


Figure 4-1. Write Enable Assembly A10, Schematic Diagram

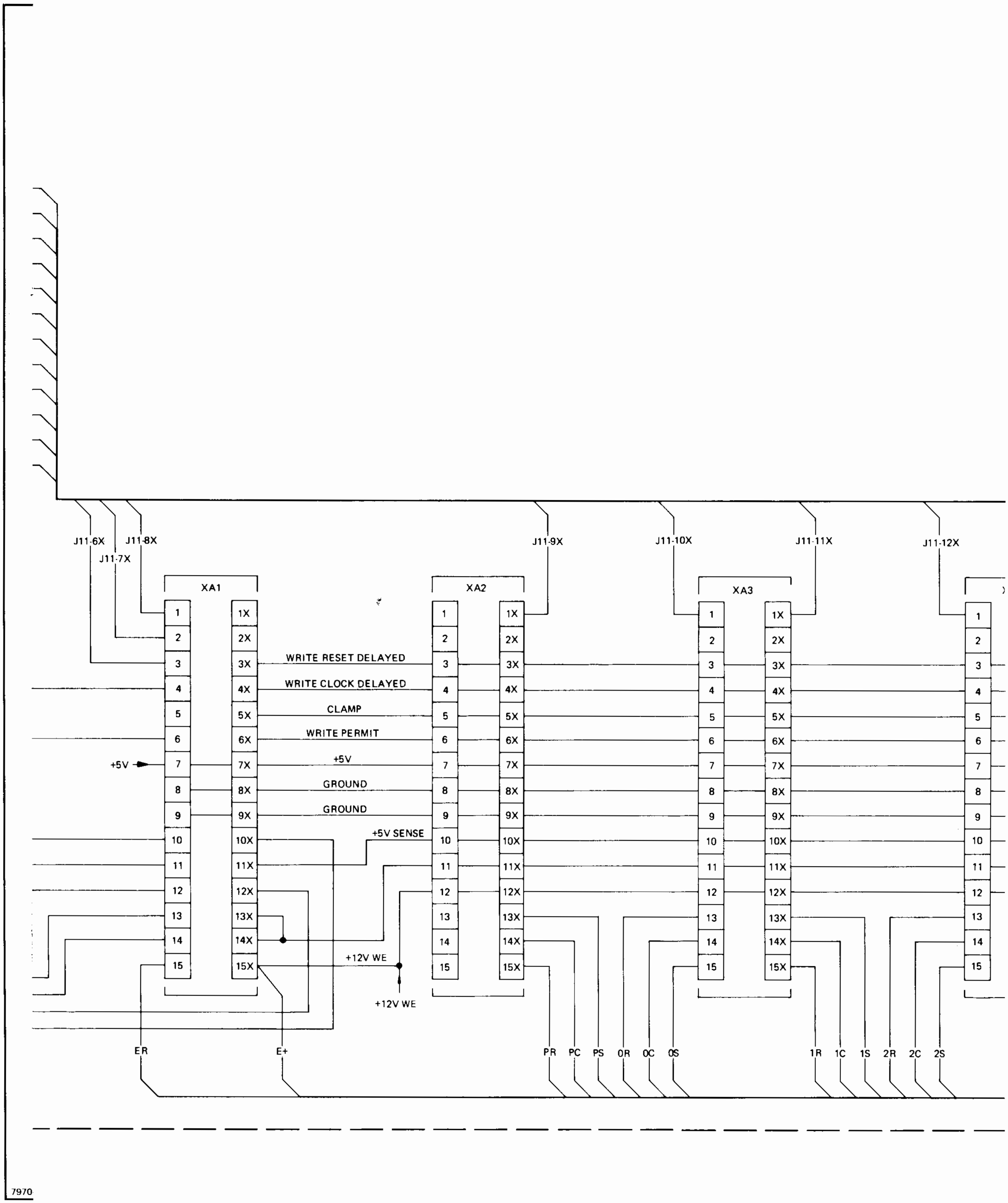


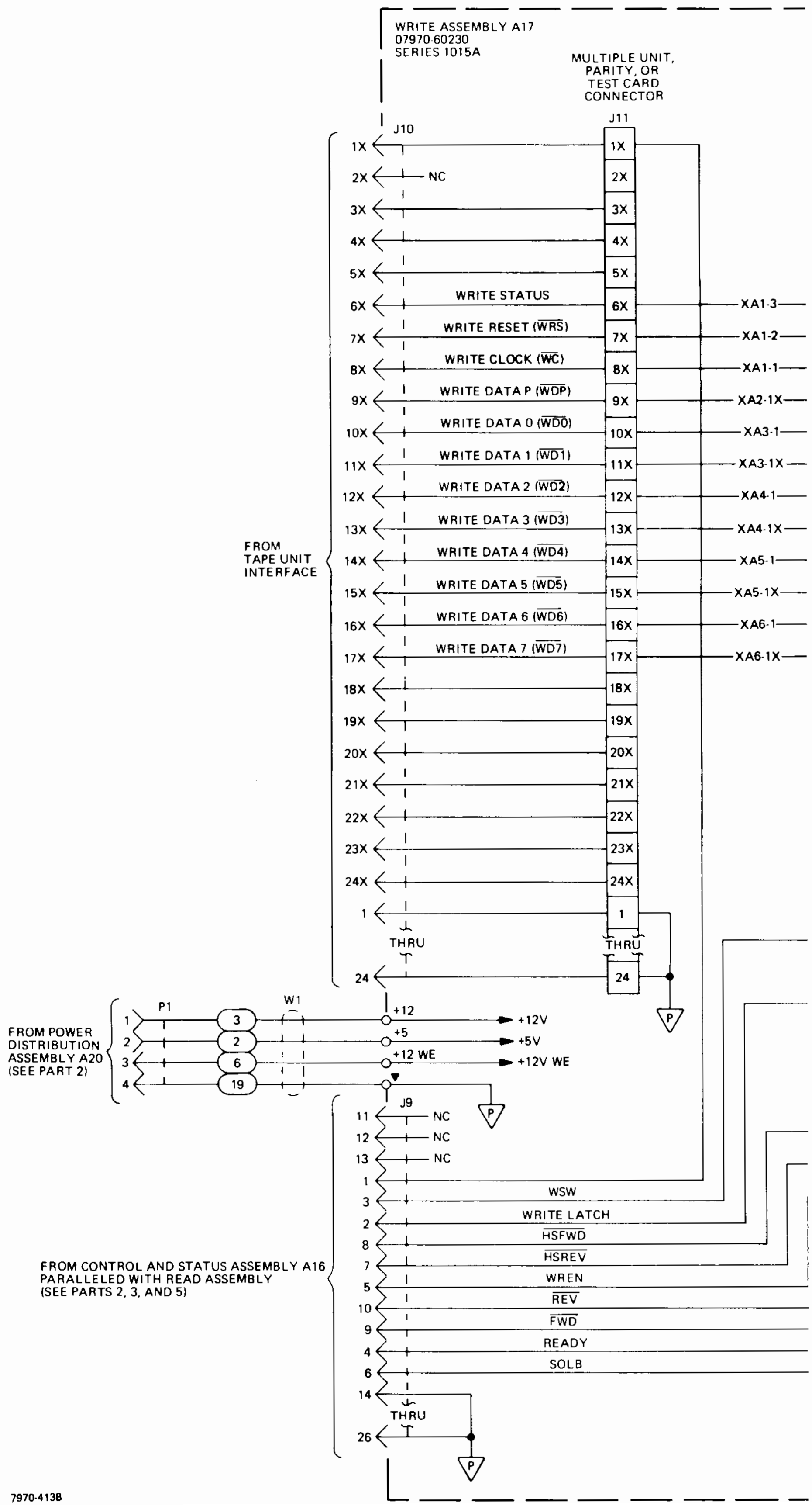
SPEED (IPS)	R1 (OHMS)	R2 THRU R19	ASSEMBLY	SERIES
10-20.9	150	180	07970-62165	1218
21-45	200	120	07970-60300	1035

Figure 4-3. Write Assembly A17 (Motherboard) and Write Interconnect PC Assembly A14, Schematic Diagram



J11-13X
J11-14X
J11-15X
J11-16X
J11-17X
XA4
XA5
XA6
WRITE RESET DELAYED
WRITE CLOCK DELAYED
CLAMP
WRITE PERMIT
+5V
GROUND
GROUND
+5V SENSE
+12V WE
3R 3C 3S 4R 4C 4S
5R 5C 5S 6R 6C 6S
7R 7C 7S
+12V WE
+12V
+5V
X1A-15X
XA1-15
XA2-13X
XA2-14X
XA2-15X
XA3-15
XA3-14
XA3-13
XA3-13X
XA3-14X
XA3-15X
XA4-15
XA4-14
XA4-13
XA4-13X
XA4-14X
XA4-15X
XA5-15
XA5-14
XA5-13
XA5-13X
XA5-14X
XA5-15X
XA6-15
XA6-14
XA6-13
XA6-13X
XA6-14X
XA6-15X


J11-6X
J11-7X
J11-8X
J11-9X
J11-10X
J11-11X
J11-12X
XA1
XA2
XA3
WRITE RESET DELAYED
WRITE CLOCK DELAYED
CLAMP
WRITE PERMIT
+5V
GROUND
GROUND
+5V SENSE
+12V WE
+12V WE
ER
E+
PR
PC
PS
0R
0C
0S
1R
1C
1S
2R
2C
2S
7970


WRITE ASSEMBLY A17
07970-60230
SERIES 1015A
MULTIPLE UNIT, PARITY, OR TEST CARD CONNECTOR
J10
J11
NC
WRITE STATUS
WRITE RESET (WRS)
WRITE CLOCK (WC)
WRITE DATA P (WDP)
WRITE DATA 0 (WD0)
WRITE DATA 1 (WD1)
WRITE DATA 2 (WD2)
WRITE DATA 3 (WD3)
WRITE DATA 4 (WD4)
WRITE DATA 5 (WD5)
WRITE DATA 6 (WD6)
WRITE DATA 7 (WD7)
XA1-3
XA1-2
XA1-1
XA2-1X
XA3-1
XA3-1X
XA4-1
XA4-1X
XA5-1
XA5-1X
XA6-1
XA6-1X
FROM TAPE UNIT INTERFACE
THRU
P1
W1
FROM POWER DISTRIBUTION ASSEMBLY A20 (SEE PART 2)
+12
+5
+12 WE
+12V
+5V
+12V WE
J9
WSW
WRITE LATCH
HSFWD
HSREV
WREN
REV
FWD
READY
SOLB
FROM CONTROL AND STATUS ASSEMBLY A16 PARALLELED WITH READ ASSEMBLY (SEE PARTS 2, 3, AND 5)
7970-413B

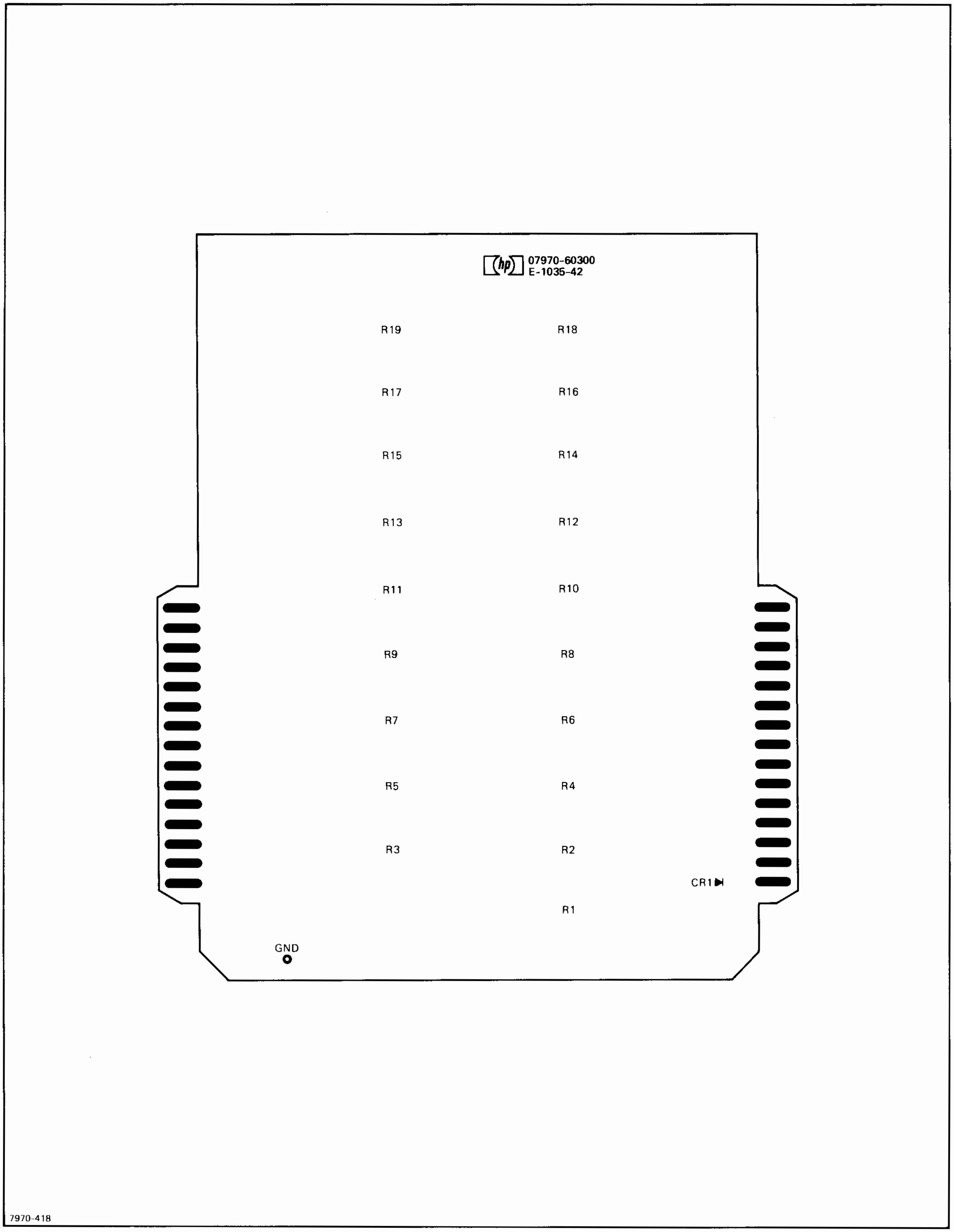


Figure 4-2. Write Interconnect PC Assembly A14, Parts Location Diagram

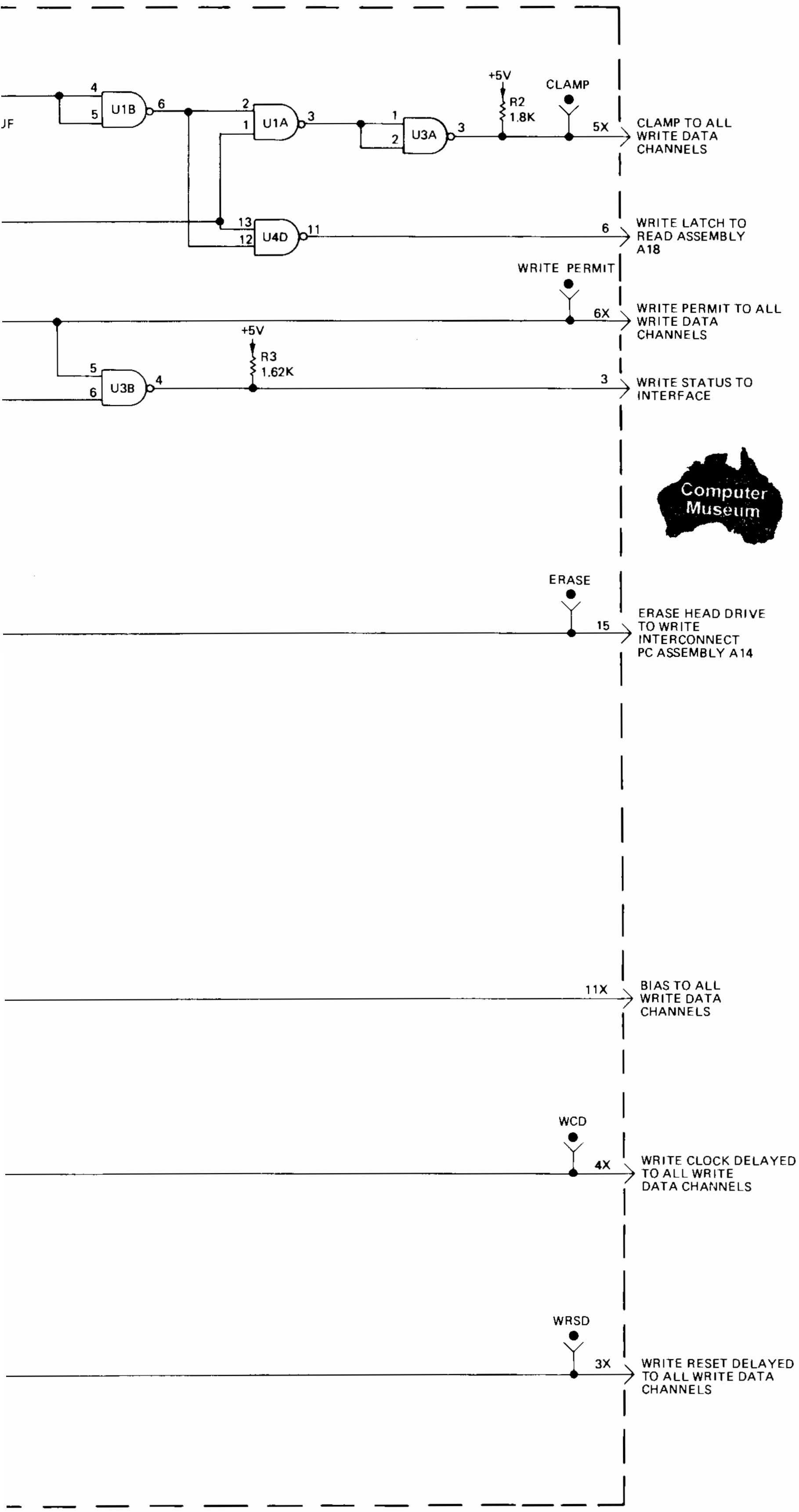
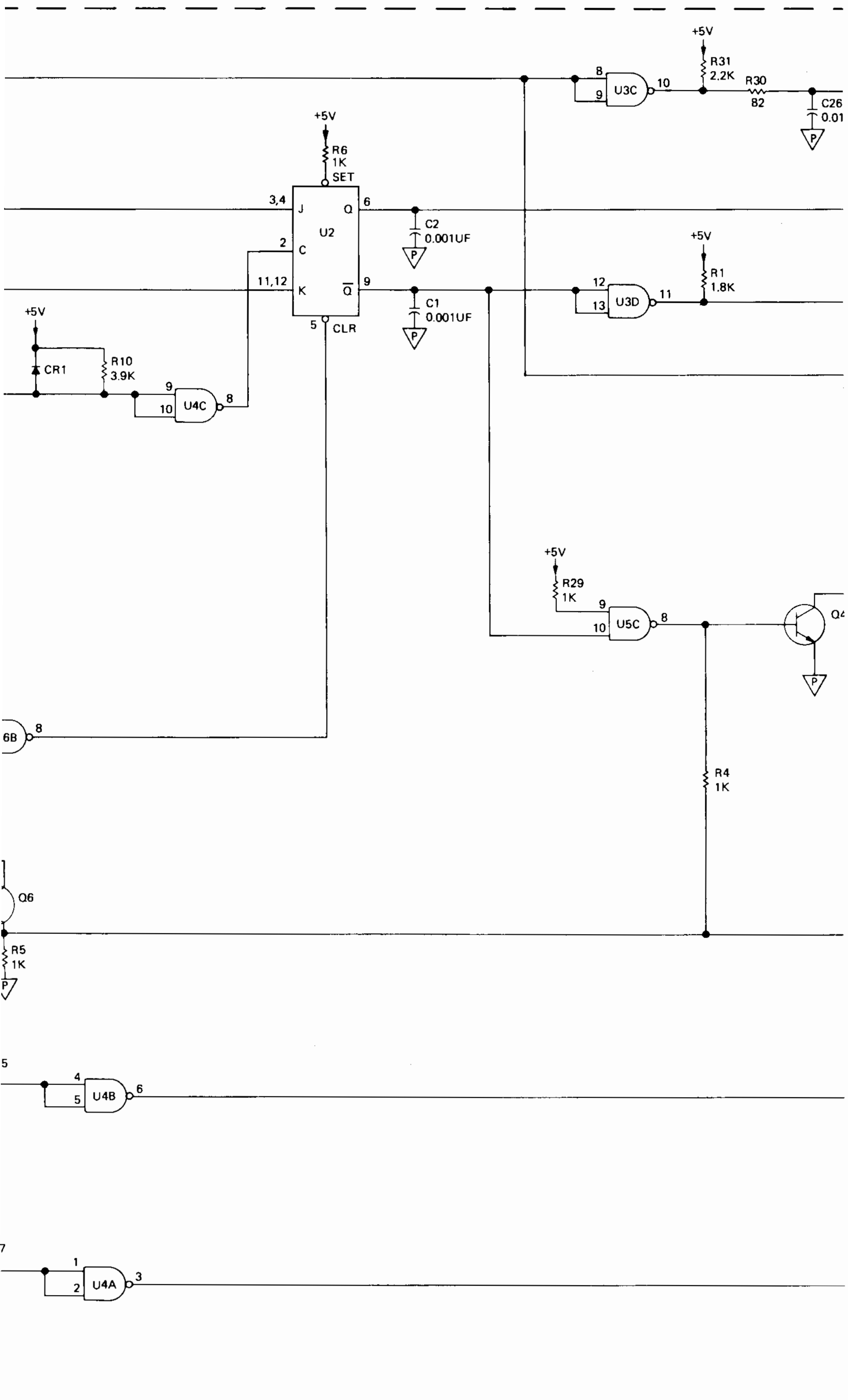
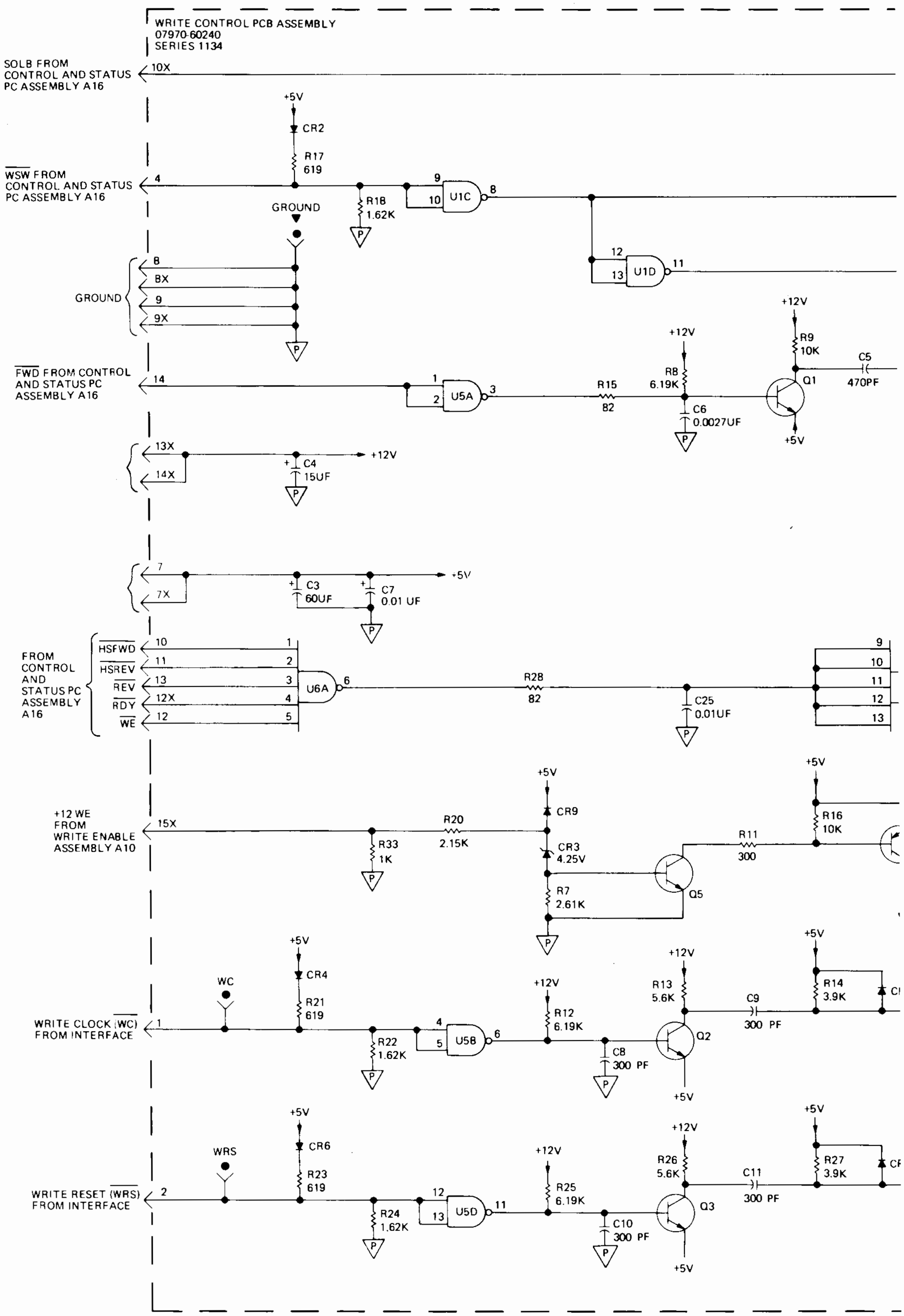


Figure 4-5. Write Control PC Assembly, Schematic Diagram



+5V
R31
2.2K
R30
82
C26
0.01
U3C
+5V
R6
1K
SET
U2
C2
0.001UF
C1
0.001UF
CLR
+5V
R1
1.8K
U3D
+5V
CR1
R10
3.9K
U4C
+5V
R29
1K
U5C
Q4
6B
R4
1K
Q6
R5
1K
U4B
U4A



WRITE CONTROL PCB ASSEMBLY
07970-60240
SERIES 1134
SOLB FROM CONTROL AND STATUS PC ASSEMBLY A16
WSW FROM CONTROL AND STATUS PC ASSEMBLY A16
GROUND
FWD FROM CONTROL AND STATUS PC ASSEMBLY A16
FROM CONTROL AND STATUS PC ASSEMBLY A16
HSFWD
HSREV
REV
RDY
WE
+12 WE FROM WRITE ENABLE ASSEMBLY A10
WRITE CLOCK (WC) FROM INTERFACE
WRITE RESET (WRS) FROM INTERFACE
WC
WRS
CR2
R17 619
R18 1.62K
U1C
U1D
U5A
U6A
U5B
U5D
R15 82
R8 6.19K
C6 0.0027UF
R9 10K
C5 470PF
Q1
C4 15UF
C3 60UF
C7 0.01 UF
R28 82
C25 0.01UF
CR9
R20 2.15K
R33 1K
CR3 4.25V
R7 2.61K
Q5
R11 300
R16 10K
CR4
R21 619
R22 1.62K
R12 6.19K
C8 300 PF
R13 5.6K
C9 300 PF
Q2
R14 3.9K
CR6
R23 619
R24 1.62K
R25 6.19K
C10 300 PF
R26 5.6K
C11 300 PF
Q3
R27 3.9K
+5V
+12V
7970-F-012C

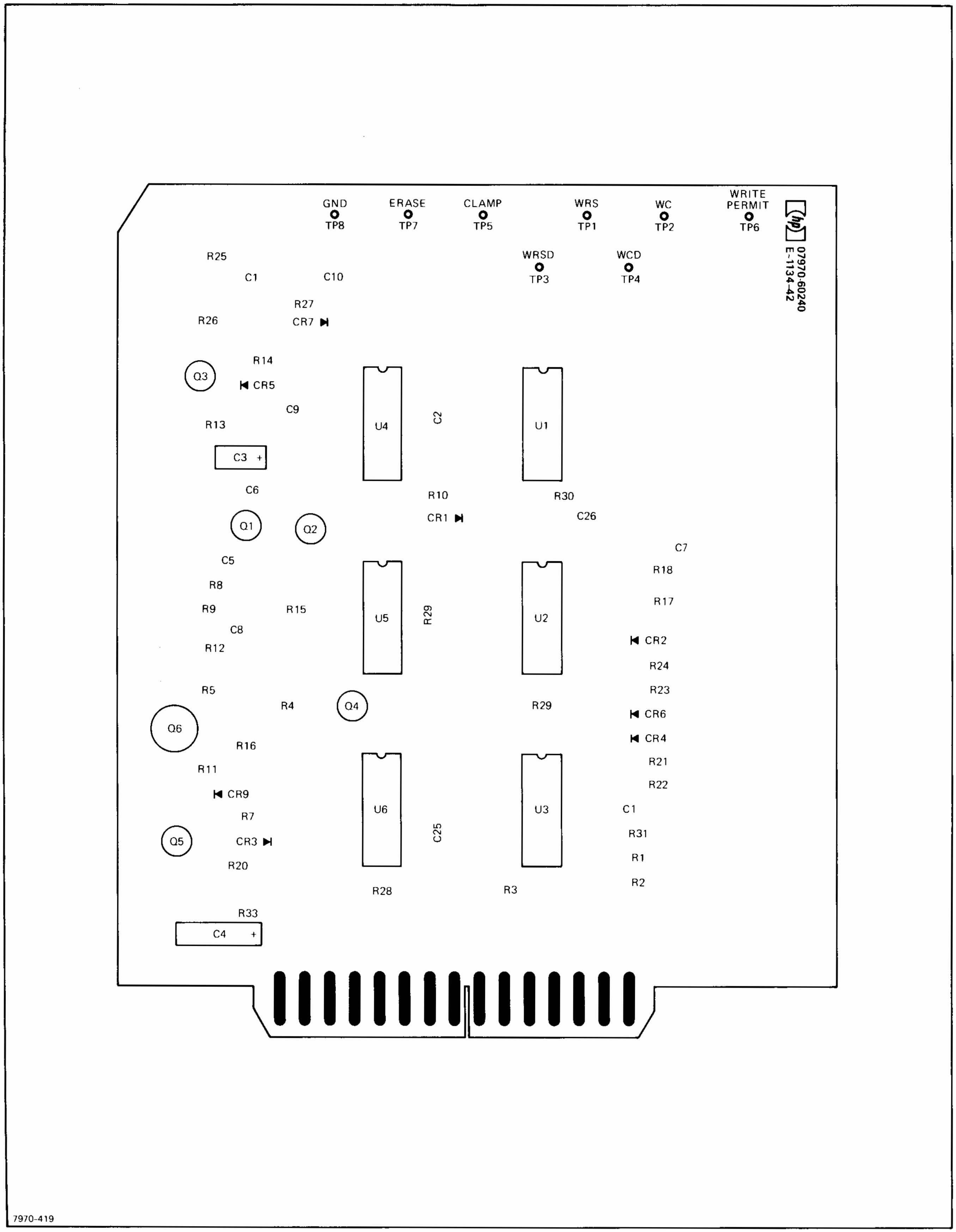


Figure 4-4. Write Control PC Assembly, Parts Location Diagram

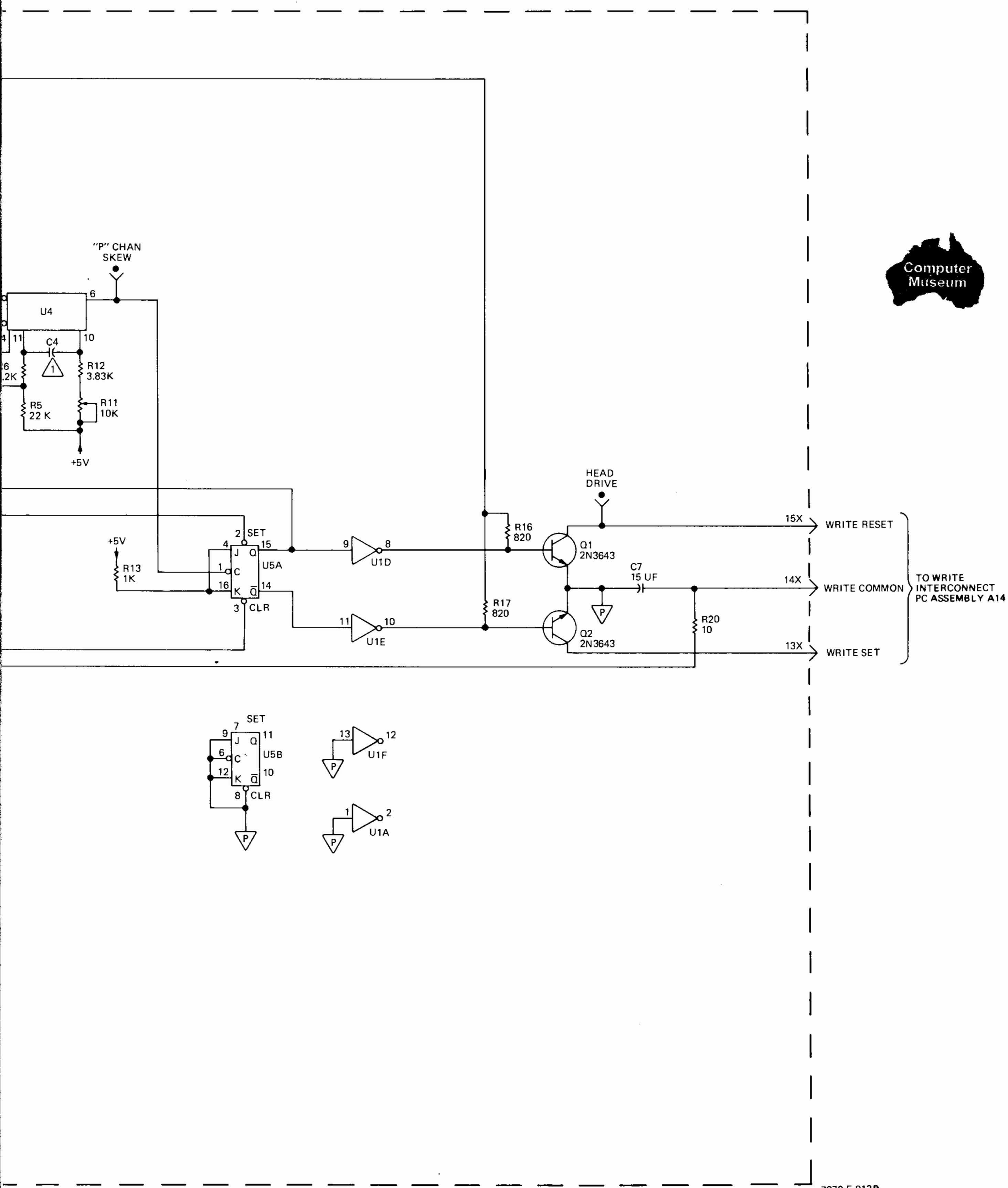
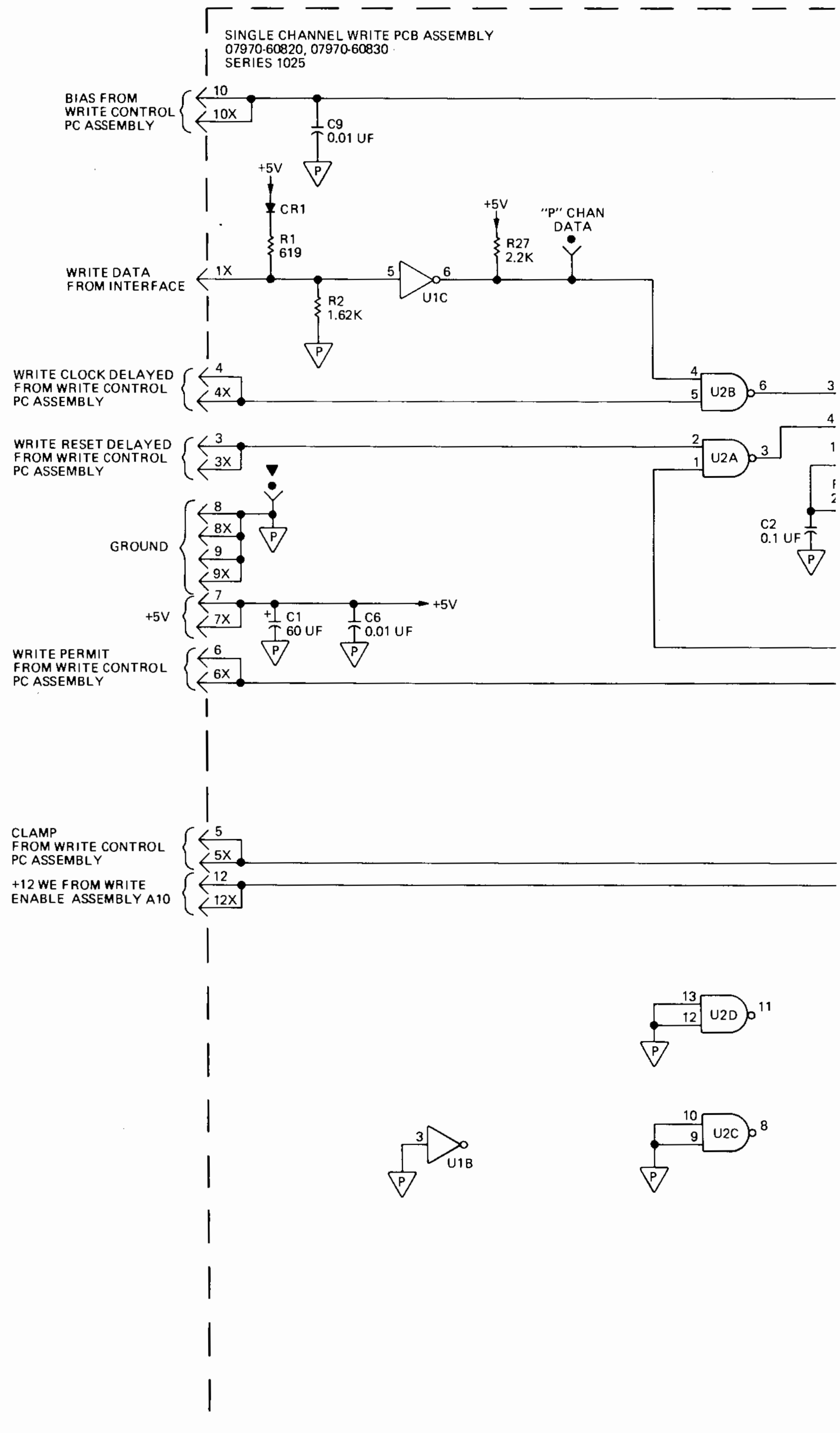


Figure 4-7. Single-Channel Write Data PC Assembly, Schematic Diagram



1 SPEED CRITICAL COMPONENTS

SPEED (ips)	C4	ASSEMBLY
10 – 20.9	4700 pF	07970-60820
21 – 45	2400 pF	07970-60830

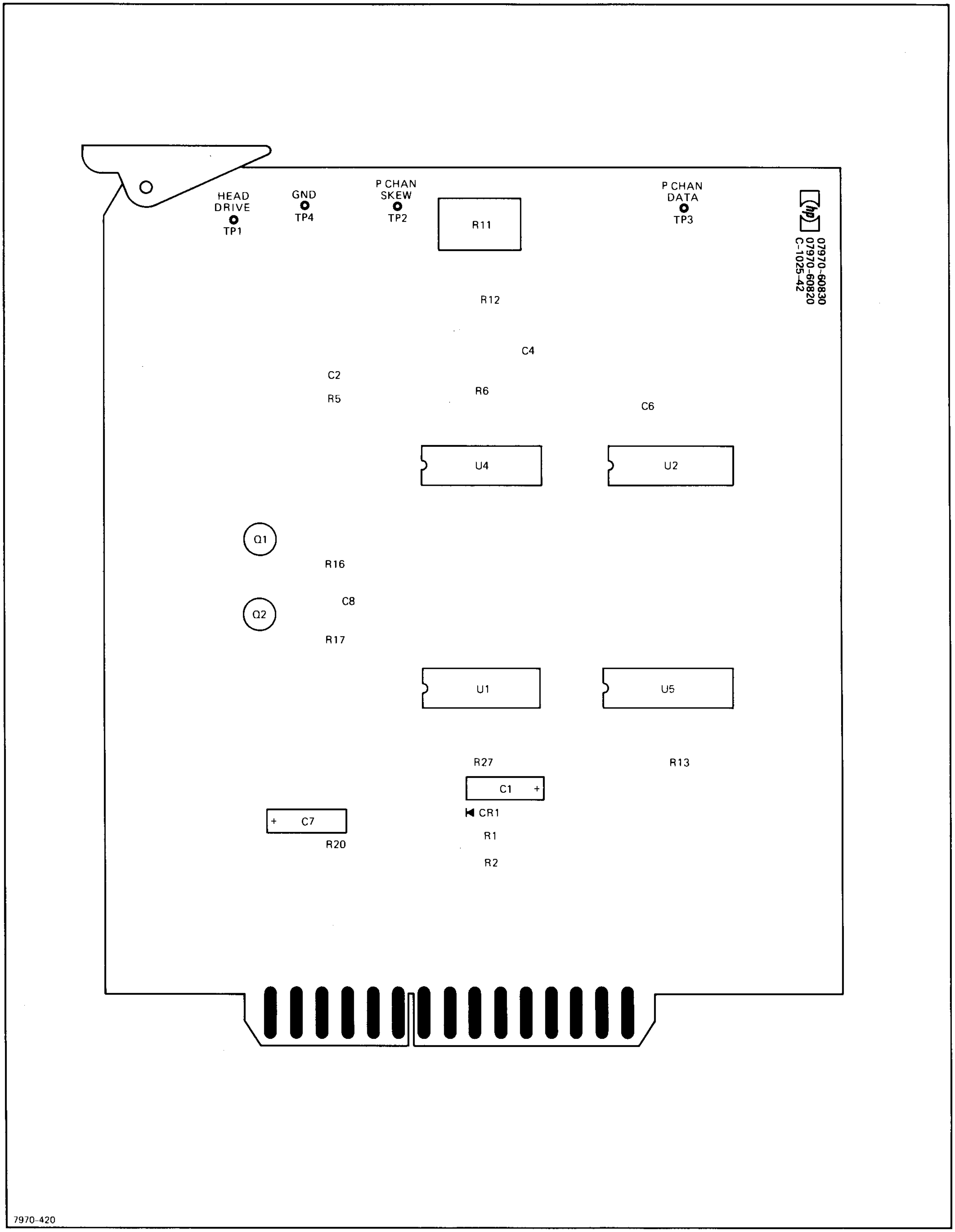


Figure 4-6. Single-Channel Write Data PC Assembly, Parts Location Diagram

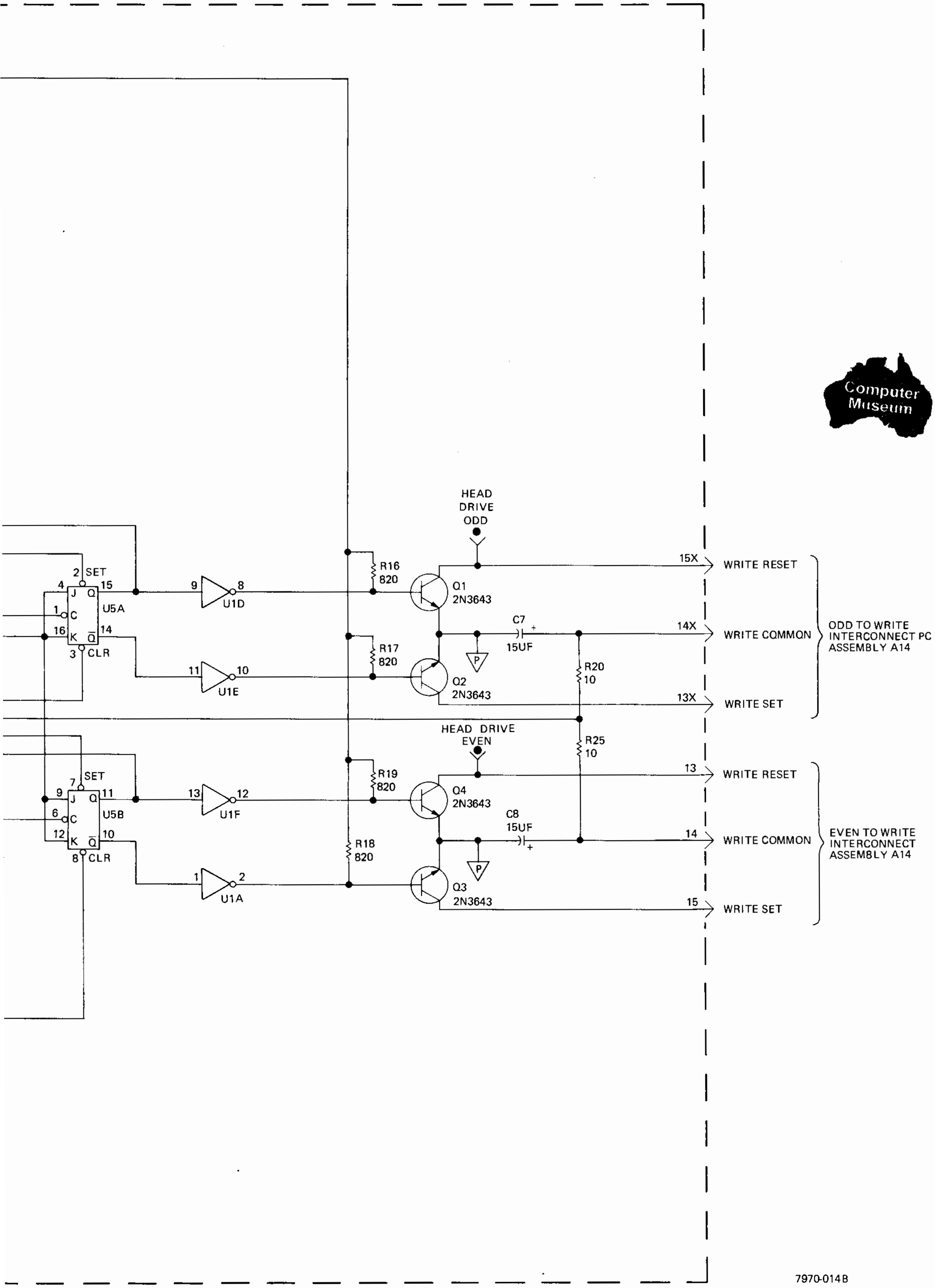
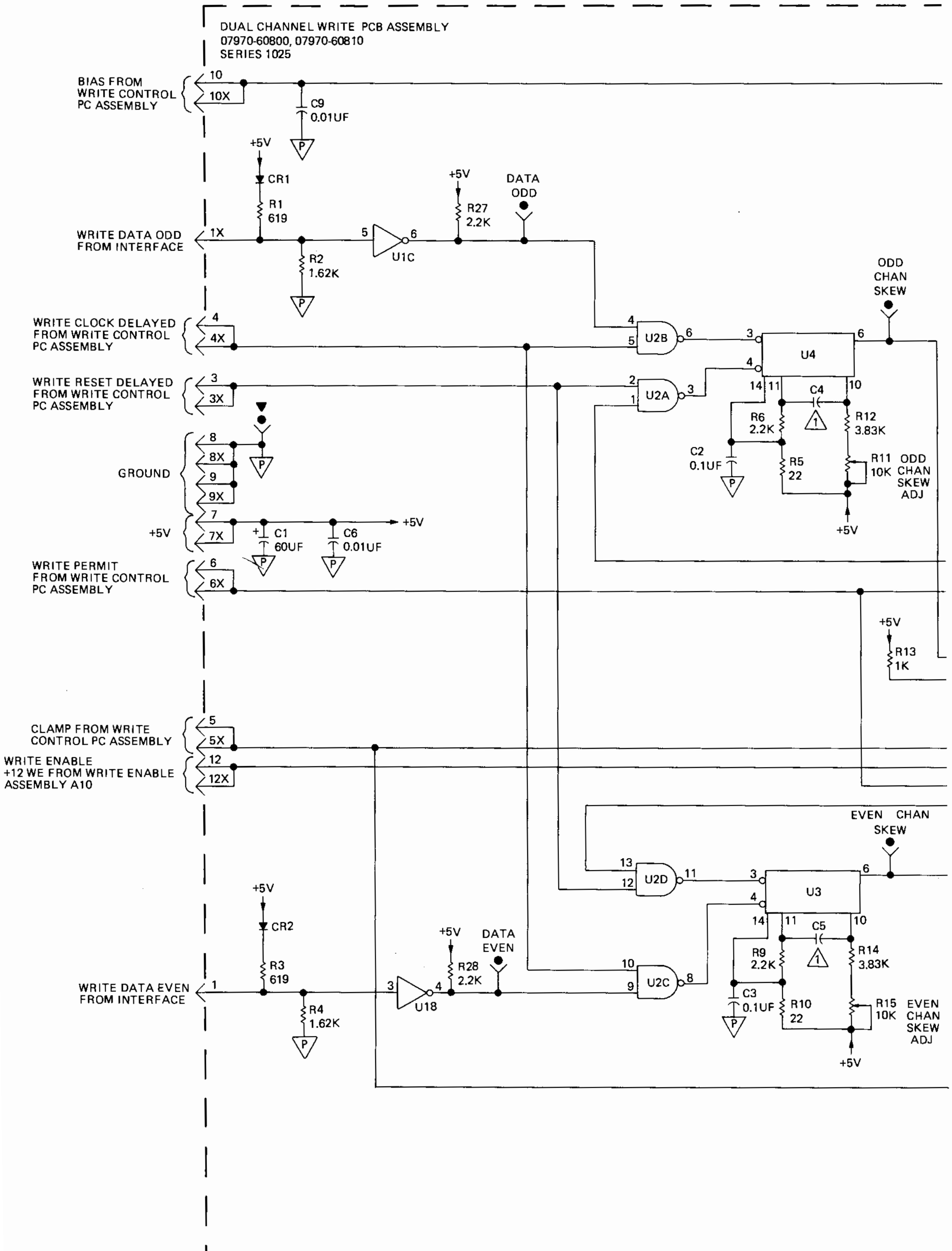


Figure 4-9. Dual-Channel Write Data PC Assembly, Schematic Diagram



SPEED CRITICAL COMPONENTS

SPEED (ips)	C4	C5	ASSEMBLY
10 – 20.9	4700 pF	4700 pF	07970-60800
21 – 45	2400 pF	2400 pF	07970-60810

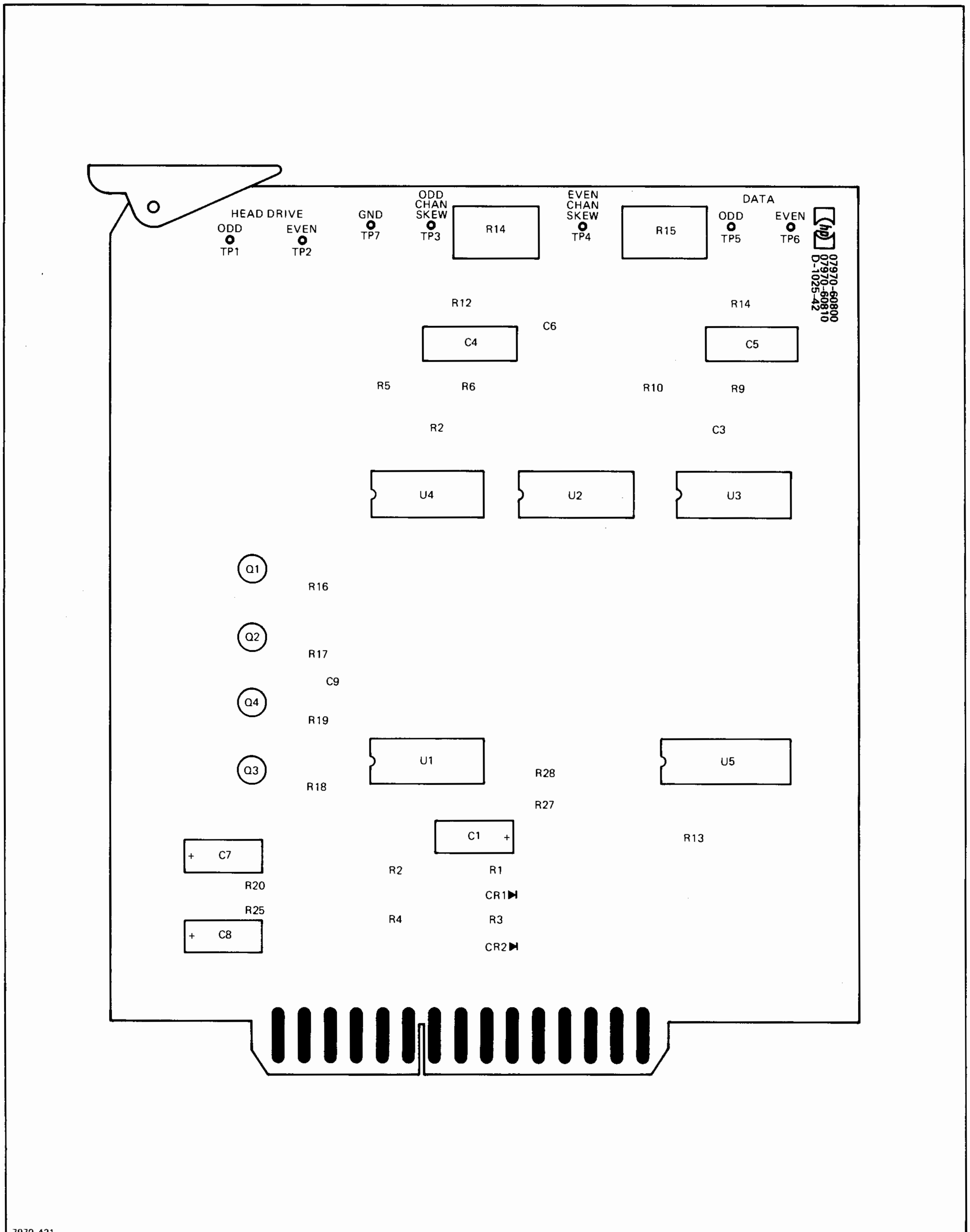


Figure 4-8. Dual-Channel Write Data PC Assembly, Parts Location Diagram

HEWLETT PACKARD

OPERATING AND SERVICE MANUAL

PART 5

7970B/7970C

DIGITAL MAGNETIC TAPE UNIT

READ/READ MODULES

7970B/7970C PART 5

Printed-Circuit Assemblies:

07970-62166, Series 1218
07970-62168, Series 1218
07970-62167, Series 1218
07970-60570, Series 1218
07970-62001, Series 1045
07970-62003, Series 1039
07970-62004, Series 1045
07970-62005, Series 1045
07970-62006, Series 1039
07970-62012, Series 1045

07970-90383

PRINTED: AUG 1973

SECTION I
DESCRIPTION

1-1. INTRODUCTION.

1-2. This section describes the read/read modules of the HP 7970B/7970C Digital Magnetic Tape Units. A functional description and circuit description is also included to aid in servicing the read/read modules.

1-3. PHYSICAL DESCRIPTION.

1-4. The read/read modules consist of the read magnetic head assembly, a read preamplifier printed-circuit assembly, a read assembly and a density select assembly. The magnetic head assembly is a seven- and nine-track, read, NRZI head. Channel scrambling is accomplished in the head assembly wiring. From the reference edge of the tape (edge facing the operator) the nine-track channel designations are 5, 7, 3, P, 2, 1, 0, 6, and 4. The seven-track channel designations are 7, 6, 5, 4, 3, 2, and P.

1-5. The read preamplifier is located near the head assembly. The preamplifier contains nine identical channels. Seven-track operations do not use channels 0 and 1.

1-6. The read assembly consists of a card cage assembly (motherboard) that contains a read/read control printed-circuit assembly, a single-channel read data printed-circuit assembly and three dual-channel read data printed-circuit assemblies.

1-7. The density select switch assembly allows the operator to select read densities of 200, 556, or 800 cpi. The assembly consists of a three-button, interlocked switch assembly with indicators and a printed-circuit assembly that contains line-drivers. A separate switch and indicator on the assembly allows selection of seven- or nine-track operation.

1-8. FUNCTIONAL DESCRIPTION.

1-9. Information to be read from the magnetic tape has been recorded in NRZI (non-return-to-zero-ones inverted) form, in seven or nine tracks. A "one" bit is represented by a flux reversal and a "zero" bit is represented by the absence of a flux reversal. The character bytes are recorded at a density of 200, 556, or 800 character bytes per inch (cpi).

1-10. As the tape moves across the read head, tracks that contain a flux reversal ("one" bit) generate an analog signal from the head. The coding of information on the tape is such that every byte contains a flux reversal in at least one of the tracks. All bits that make up a character byte may not arrive at the head at the same time. The read data circuits detect the flux transitions in each track and produce a parallel digital output with all bits of the character byte presented simultaneously.

1-11. The recovery of the data is accomplished by generating a fixed-time window or character gate. Starting with the first detected flux reversal, all remaining bits must arrive during the character gate. At the end of the character gate time, a read strobe pulse samples the contents of all input registers, transfers the data to the output registers and conditions the input registers for the next data byte.

1-12. CIRCUIT DESCRIPTION.

1-13. The following paragraphs describe the preamplifier circuits, the read control circuits, and a typical channel of the read data circuits.

1-14. READ/READ PREAMPLIFIER.

1-15. The read/read preamplifier PC assembly contains nine identical circuits. Each circuit consists of switching logic, a switching circuit, and an operational amplifier. Figure 1-1 is a block diagram of a typical read/read preamplifier circuit. The nine-track head and the seven-track head outputs are directly coupled to the preamplifier. Switching logic and switching circuits control the input to the operational amplifier. When seven-track operation is selected, the S7T input (from the density select switch assembly) is high (+5V) and switching logic allows the seven-track read head output to be amplified. When nine-track operation is selected, the S7T input is at ground potential and the switching logic allows the nine-track head outputs to be amplified.

1-16. Each of the seven- or nine-track low level analog outputs from the read head are independently amplified by an integrated-circuit preamplifier located on the preamplifier printed-circuit assembly. The gain of each preamplifier is adjustable.

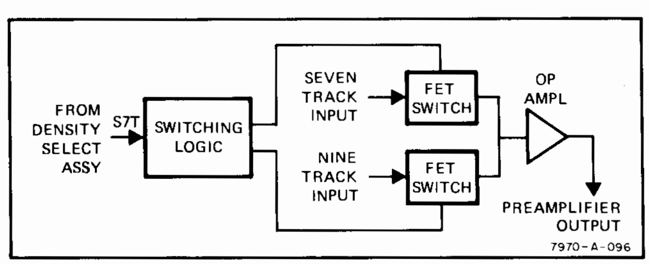


Figure 1-1. Typical Read/Read Preamplifier Circuit, Block Diagram

1-17. READ/READ CONTROL CIRCUITS.

1-18. The read/read control circuits consist of a density select circuit, a read enable circuit, a threshold generator, a skew gate circuit, and a character gate generator. Figure 1-2 is a block diagram of the read/read control circuits. Figure 1-3 is a timing diagram showing the relationship of generated signals and data.

1-19. The read enable circuit is controlled by commands from the tape unit control and status circuits. When the read enable circuit is satisfied, the Read Enable signal conditions the read data input and output registers. The Read Enable signal is also gated with the character gate generator output to provide the "not" Read Clock signal ($\overline{RC}$).

1-20. The threshold generator circuit establishes the bias level for the threshold circuits of the read data circuits. When reading tape the threshold is 22 percent of the nominal peak amplitude.

1-21. The skew gate circuit provides a voltage for the skew delay circuit of the read data circuits. The purpose of skew delay is to compensate for channel-to-channel time differentials introduced in the read system. There are two major sources of interchannel time displacements (static skew). One source is due to non-perfect alignment of individual track gaps in the read head (gap scatter) and the centerlines of the head may be tipped with respect to the tape edge (azimuth misalignment). As a result, certain bits of the byte will be detected before the others. Since the tape speed is constant, the effects of delaying each track so that all outputs occur simultaneously when reading an "all ones" alignment tape, is the same as mechanically aligning the read stack. The second source of static skew is differential phase delays in the individual data channels. The phase response of the head varies from track-to-track because of inductance variance. The overall analog channel bandwidths may be different and reflect differential phase delays at operating frequency.

1-22. During a nine-track operation the skew delay voltage is through Q4 of the read control printed-circuit assembly. During a seven-track operation, Q4 is cut off, and skew delay voltage is through Q1. When changing operations, the voltage sources (Q1 and Q4) do not switch simultaneously; there is a time lag in the switching to prevent the absence of a skew delay voltage.

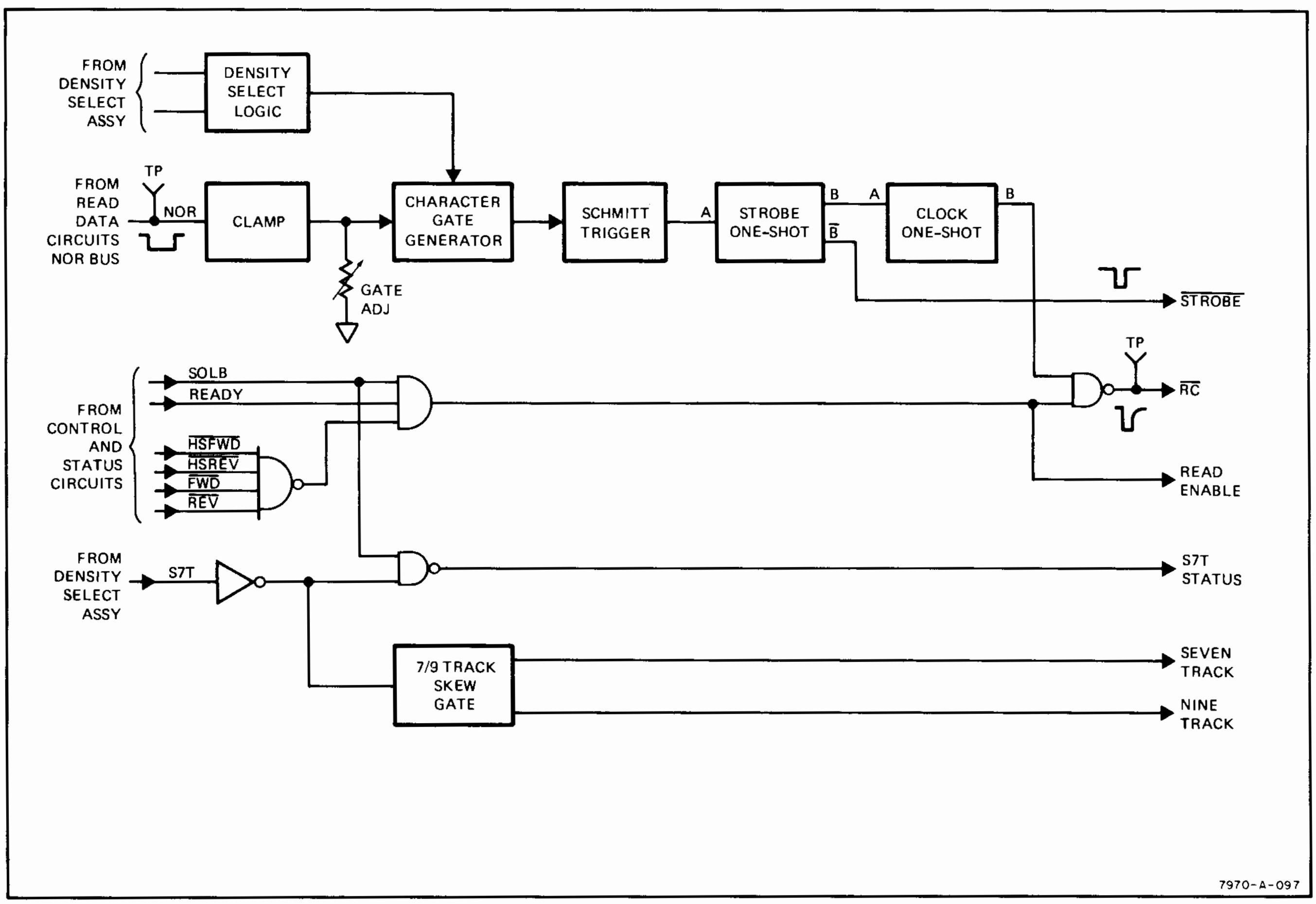


Figure 1-2. Read Control Circuits, Simplified Block Diagram

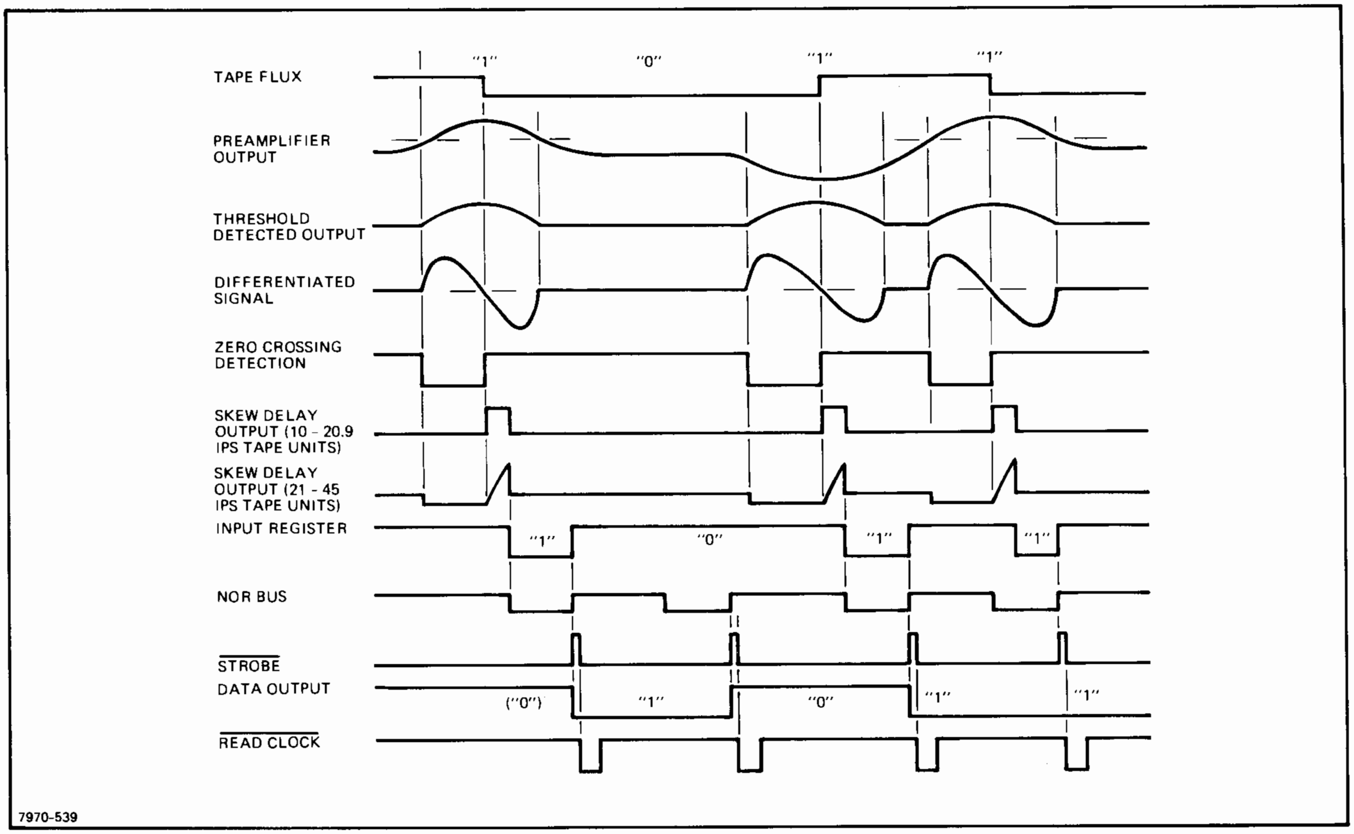


Figure 1-3. Read Data Circuits, Timing Diagram

1-23. The character gate generator provides a "not" Read Strobe ($\overline{\text{STROBE}}$) pulse and a clock pulse that is gated with tape unit status to provide a "not" Read Clock ($\overline{\text{RC}}$) pulse. The first "one" bit detected by the read data circuits conditions the "nor" bus (low) and starts the character gate generator. The width of the character gate is 40 percent of the nominal byte-to-byte spacing and is automatically controlled by the density status input from the tape unit density select switch assembly.

1-24. The output of the character gate generator is coupled to a strobe one-shot through a schmitt-trigger. The trailing edge of the character gate triggers the strobe one-shot, generating the "not" Read Strobe ($\overline{\text{STROBE}}$) pulse. The "not" Read Strobe pulse is an 800 nanosecond pulse used by the read data circuits to sample the output register and set the input register for the next data byte.

1-25. The trailing edge of the "not" Read Strobe pulse triggers the clock one-shot. The output of the clock one-shot is a 3-microsecond pulse that is gated with Read Enable to generate the "not" Read Clock ($\overline{\text{RC}}$) pulse. The read clock pulse indicates that a data byte has been recovered and is on the read data interface lines.

1-26. READ DATA CIRCUITS.

1-27. The analog outputs from the preamplifiers are directly coupled to seven or nine identical data channels located in the read data assembly. Figure 1-4 is a block diagram of the read data circuits. The analog signal from a given channel is phase inverted, fullwave rectified, and threshold clipped so that only the portion of the signal that exceeds the threshold level is processed. This prevents noise or minor tape imperfections from generating erroneous responses.

1-28. The portion of the signal exceeding the threshold level is differentiated and the zero-crossing representing the peak amplitude of data is detected by a high gain amplifier (10 - 20.9 ips tape units) or a Schmitt trigger circuit (21 - 45 ips tape units). The positive-going edge of the trigger output therefore represents the peak of the analog input signal, independent of signal amplitude.

1-29. The positive-going signal triggers the skew delay pulse generator. When the skew delay generator times-out, a short duration negative-going pulse directly clears the input register.

1-30. When the input register is cleared by the detected "one" bit, the input register outputs are set (Q output is low

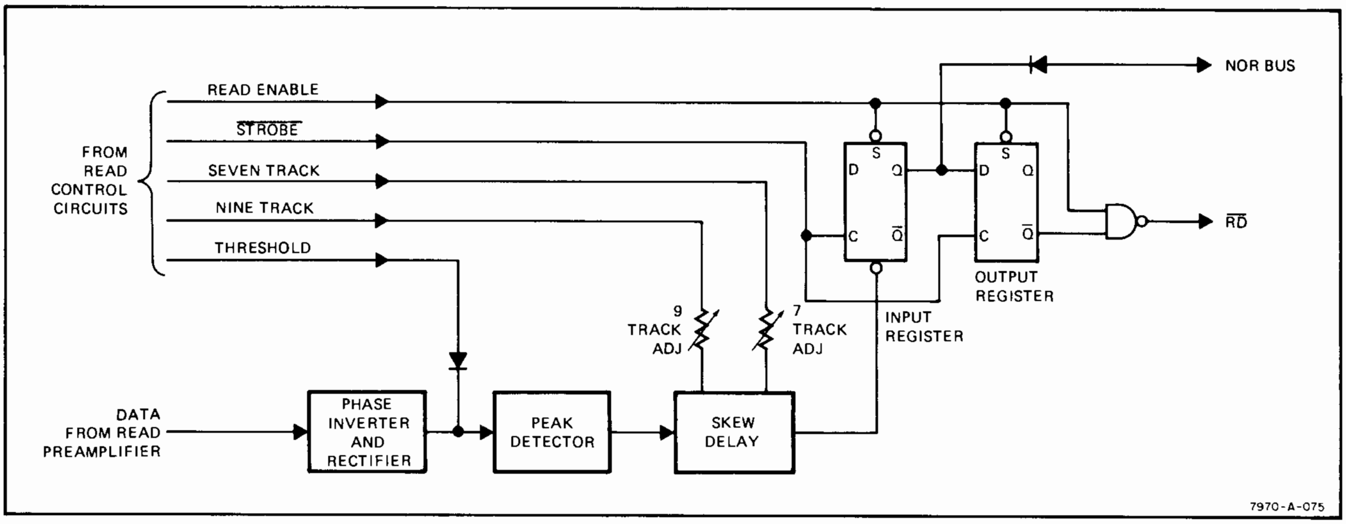


Figure 1-4. Read Data Circuits, Block Diagram

and $\overline{Q}$ output is high). With the input register cleared, the "nor" bus is activated. The "nor" bus is normally at a positive potential; however, when the "nor" bus is activated by the first "one" bit detected, the bus goes low (near 0-volts). When the "nor" bus goes low, the read control character gate is activated. The Q output of the input register (low) is also applied to the output register.

1-31. When the character gate times-out, the leading edge of "not" Read Strobe ($\overline{\text{STROBE}}$) clocks the input register contents to the output register and resets the input register. This transfers the data bit to the output register and prepares the input register for the next data byte. The output of the output register is gated with Read Enable to provide the interface with the read data bit.

SECTION II
MAINTENANCE

2-1. INTRODUCTION.

2-2. This section provides maintenance information for the read/read modules of the HP 7970B/7970C Digital Magnetic Tape Units. Maintenance information consists of performance checkout procedures and adjustment procedures. Prior to performing any maintenance to the read/read modules, ensure that the transport is functioning properly. (Refer to part 2.)

2-3. TEST EQUIPMENT REQUIRED.

2-4. In addition to the equipment required for transport maintenance (refer to part 2), the following tapes and test items are required to perform maintenance procedures described in this section.

a. Master Alignment Tape (All "1's" full width at 800 cpi), part number 9162-0027.

b. Reference Amplitude Test Tape (All "1's", full width at 200 cpi), part number 5080-4547.

Note

The HP 13193A Read Test Board is available as an accessory. When used in conjunction with the HP 13191A Control and Status Test Board, maintenance procedures can be performed without the aid of an interfaced computer.

2-5. PERFORMANCE TEST PROCEDURES.

2-6. The following test procedures verify that the read/read data circuits conform to published specifications. The test procedures described assume the use of an on-line computer or the use of off-line test accessories. Prior to performing the test procedures, ensure that all transport adjustments have been made. (Refer to part 2.)

2-7. READ/READ PREAMPLIFIER GAIN TEST.

2-8. Load the tape unit with the Reference Amplitude Test Tape, HP part number 5080-4547. Note the signal level indicated on the test tape label. Select nine-track operation and measure the peak-to-peak output voltage at the preamplifier test points. The measured voltage should be within ±0.3 volt of the level indicated on the test tape label. (Typically 85 percent of 6.4V p-p.) Select seven-track operation and repeat the preamplifier gain test.

2-9. READ THRESHOLD LEVEL TEST.

2-10. Use oscilloscope and check dc voltage level on the threshold test point on the read control card. Value should be +0.450 ±0.020 volt dc.

2-11. READ HEAD STATIC SKEW TEST.

2-12. Read head static skew is measured optically during head manufacturing and is also verified electrically on special test facilities. When installed on the tape transport, certain electrical and mechanical considerations enter as factors. These may modify the static skew to a minor degree. Measurement may be used as additional information for analysis of field performance. The electronic read de-skewing effectively eliminates this factor in normal operation. Measurement is as follows:

a. Select nine-track operation and use the master alignment tape as the source of data.

b. Connect channel A of the oscilloscope to the P (parity) preamplifier output and adjust the sweep to synchronize near the zero axis crossover on the positive slope.

c. Channel B of the oscilloscope will be connected to the various skew test points on the read cards. Channels will be used in alternate mode.

d. With the delayed sweep operated under a sweep rate of 2 microseconds/cm, adjust the delay to display the positive-going step at the start of the channel skew delay ramp on the center of the oscilloscope. This will be the zero time reference for all other measurements. Adjust channel B gain as required to obtain good resolution.

e. Without making any further adjustments to the oscilloscope time base, move the channel B probe to each skew delay test point in sequence and note its relative position to the center of the oscilloscope. Signals to the left of center are early, and may be noted as "plus" with those to the right noted as "minus" as they are later than the signal from track P.

f. When all measurements have been completed in the nine-track mode; the same sequence can be repeated for the seven-track mode. It will be necessary to readjust the time delay for positioning track P to center.

g. Review data taken and determine the two tracks that are the earliest (largest plus number) and latest (largest minus number). The time differential between them (sum of the two times) converted to microinches for the tape speed involved is the read head static skew. This number should not exceed 225 microinches.

Note

For readings between 200 and 225 microinches, it may be wise to correct for the electronic time delay variation in the peak detection circuitry. This may be measured by repeating steps "a" through "f" except that the oscilloscope channel A probe must be connected to the preamplifier output corresponding to the skew test point on the oscilloscope channel B probe. These figures must be subtracted from the normal readings (taken with channel P as the only sync) to determine the true head skew. Under these conditions, a true head skew in excess of 200 microinches is higher than normal but will not cause any practical problems.

2-13. COMPENSATED STATIC READ SKEW TEST.

2-14. Compensated static read skew is a measure of the degree to which the electronic time delays are effective in eliminating the read head static skew. The termination of each track skew delay is the fall (or negative-going trailing edge) of the positive-going ramp visible at the SKEW testpoints on each read card. With perfect compensation these will all coincide. As a matter of practical consideration this seldom happens except during the period of adjustment with a specific master alignment tape. When comparisons are made using alignment tapes other than the one used for adjustment, or where the same tape is subject to possible damage, it is not uncommon to see a time difference of several microseconds depending on tape speed. Considering only a ±1 percent error in the alignment tapes and complete stability of the skew delay, there could be a difference of 25 microinches between two tapes (allowing a time difference from 2.5 microseconds at 10 ips to 0.5 microsecond at 50 ips). Evaluate compensated skew using the following procedure.

a. Select nine-track operation and use channel A of the oscilloscope for the master reference for all skew measurements. Connect probe to the skew test point for channel P read card.

b. Sync the main sweep to the negative slope of channel A waveform and set sweep speed to display two bit-to-bit distances. This will result in a negative-going trailing edge at the center of the oscilloscope and another at the right side. If there is time asymmetry in the master tape (some tapes have this and some do not), there will be double trailing edges in the center of the screen with the time difference corresponding to the recorded pulse asymmetry on the tape. If this is visible, refer to the note following step "e." Use the variable setting of the main sweep to position pulses as stated. This will assure the visibility of write time asymmetry on the master tape.

c. The delayed sweep will be used to position the next sequential bit in the center of the screen. Use the internal sync, positive slope position on the delayed sweep, and adjust the trigger level for a stable waveform. The delayed sweep should be adjusted (from the ccw position) only as far as required to permit the delayed sweep to internally trigger on the next pulse.

d. Establish final positioning of the P track reference point (negative-going trailing edge) at the center of the screen by use of the sweep positioning controls. Be sure that the delayed sweep remains correctly calibrated since correct time differences in microseconds will be required. Some positioning can also be done with the trigger level.

e. Use channel B of the oscilloscope and the chopped mode to observe the relative position of all other tracks. Note these positions and determine the earliest and latest tracks. The maximum difference should be 30 microinches or less. If readings are between 30 and 50 microinches, check the read skew for the unit. If this skew results in the difference being less than 25 microinches, no adjustment should be made unless there is agreement between two master skew tapes showing that the same relative error exists between the same tracks. If this occurs it can be presumed that the unit adjustments have remained stable (read skew within ±1 percent since last adjustment), but the previous read skew adjustment was made with a bad master alignment tape.

Note

Skew measurements can become somewhat difficult if significant write time asymmetry exists. This asymmetry will be observed on some master alignment tapes. No special steps can be taken when reading the master alignment tape.

f. Select seven-track operation and repeat steps "a" through "e."

2-15. READ CHARACTER GATE, STROBE, AND READ CLOCK TEST.

2-16. The read character gate is initiated by the first "1" bit to complete a read skew delay period. The fall of read skew delay provides a trigger at the "nor" line, causing it to move in a negative direction. This fall triggers the read character gate period which is nominally 40 percent of the bit-to-bit period for each density. Termination of the gate will cause the "nor" line to move in a positive direction, which does two things. It sets the data levels at the read outputs and initiates the leading edge of the read strobe pulse. The read strobe trailing edge then generates the read clock output. The strobe delay time provides an interval for the read data outputs to settle before the read clock output occurs. Measure these characteristics as follows:

a. Load the tape unit with the master alignment tape and select nine-track 800 cpi operation.

b. Sync the scope on the NOR test point with the negative slope. Then adjust the main sweep rate so that the next negative-going edge occurs 10 division later. (Each division now is 10 percent of the bit-to-bit period.)

c. Observe that the positive-going edge (end of gate) occurs between 35 and 45 percent of the bit-to-bit period.

d. Select seven-track operation and repeat steps "b" and "c" for 556 and 200 cpi operation.

2-17. Strobe pulse delay and read clock relationships to data are measured as follows:

a. Select a data pattern that will move a single bit through all data channels in sequence. This will provide a data output pattern and will exercise each read channel in terms of initiating a read strobe.

b. Connect oscilloscope channel A to the data output of any read channel using the negative sync and auto triggering mode.

c. Remove the read data connector to establish standard measurement conditions. (Various lengths of cables and associated capacity will effect measurement.)

d. Set sweep speed to 0.2 microseconds/division and establish a stable pattern for the leading edge of data (for both negative and positive sync).

e. Using the alternate triggered by A mode, connect oscilloscope channel B to the read clock test point on the read control card.

f. Observe the time difference between the leading edge of data and the leading edge of clock. The clock delay must be between 0.5 and 1.5 microseconds.

g. Observe the pulse width of the read clock. This should be between 2 and 3 microseconds.

h. The read clock output should be continuous. (Verifies that read strobe is being initiated by each read channel.)

2-18. ADJUSTMENT PROCEDURES.

2-19. The adjustment procedures for the read/read modules consist of preamplifier gain adjustments, nine-track static skew adjustments, seven-track static skew adjustments, and read character gate adjustments. Prior to performing the read data adjustment, ensure that all transport adjustments have been made and that the adjustments are within tolerance.

2-20. PREAMPLIFIER GAIN ADJUSTMENTS.

2-21. The gain/bandwidth characteristics of the preamplifier will cause small changes in phase that will effect the static skew compensation if the preamplifier gain control is adjusted. Therefore, it must be adjusted prior to the read static skew compensation, and if changed, the read static skew adjustment should be rechecked. Adjustment is made as follows:

a. Load the tape unit with the Reference Amplitude Test Tape, HP part number 5080-4745. Note the signal level indicated on the test tape label and select nine-track operation.

b. Connect an oscilloscope to each preamplifier output test point and adjust the corresponding gain variable resistor to obtain ±0.3 volt of level indicated on the test tape label. (Typically 85 percent of 6.4V p-p.)

c. Select seven-track operation and repeat step "b."

2-22. NINE-TRACK STATIC SKEW COMPENSATION ADJUSTMENTS.

2-23. The techniques for rapid adjustment and for evaluating the need for adjustment differ. Figure 2-1 shows poor skew alignment and proper skew alignment. To adjust the static skew compensation, proceed as follows:

a. Load the Master Alignment Tape, HP part number 9162-0027, and place the unit in synchronous forward mode for the adjustment operation. Select nine-track operation and preset all FWD skew delay controls fully ccw (minimum delay).

b. Using an oscilloscope connected to the SKEW test points compare all data channels to determine which channel is lagging.

c. Adjust FWD skew delay control of channel 2 until it is slightly lagging the channel determined in step "b." Channel 2 will be reference channel for remaining adjustments.

d. Connect the oscilloscope channel A probe to the SKEW test point of the reference channel (channel 2).

e. Connect the oscilloscope channel B probe to each skew test point in succession and algebraically add oscilloscope channel A and B.

f. Adjust the oscilloscope sweep to display at least one full bit time (leading edge of one bit to the leading edge of the next), with the oscilloscope deflection at approximately 2 V/cm.

g. Adjust each channel FWD skew delay potentiometer for a maximum amplitude.

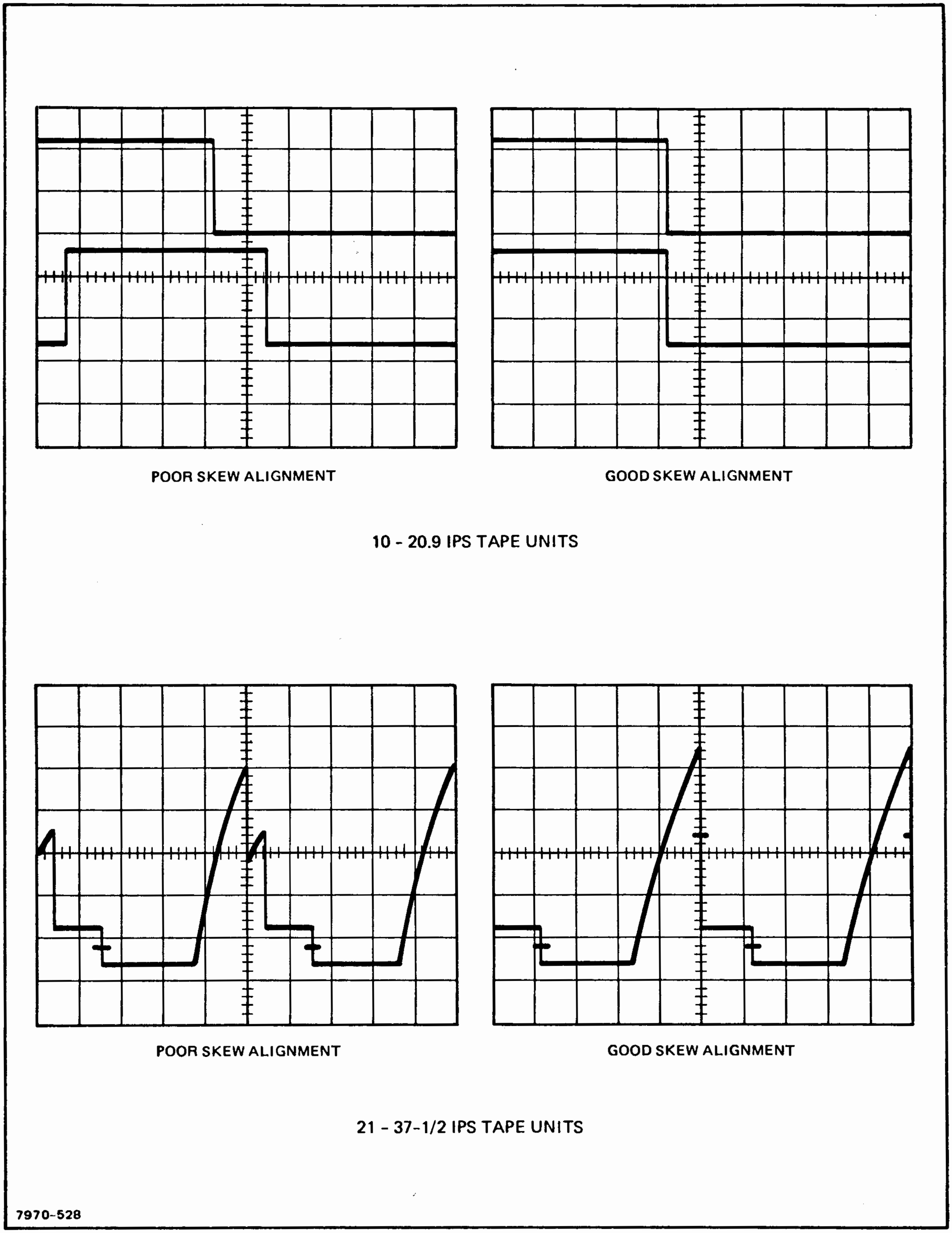


Figure 2-1. Skew Alignment Waveforms

2-24. SEVEN-TRACK STATIC SKEW COMPENSATION ADJUSTMENTS.

2-25. Seven-track static skew compensation is accomplished in exactly the same manner as that used for nine-track skew except for the use of seven-track drive mode and adjustment of REV skew controls. The same SKEW test points are used for both adjustments.

2-26. When considering the need for readjustment, it must be recognized that there are small differences in the master skew tapes. For example, if there is an observed difference of 1 microsecond between channels, this would correspond to 25 microinches at a tape speed of 25 ips. If the previous adjustment had been made with one master tape and checked with another, and if both master tapes were accurate to ±1 percent (±12.5 microinches), this small difference could occur even with complete stability of adjustment on the part of the electrical and mechanical factors involved in the tape unit.

2-27. READ CHARACTER GATE ADJUSTMENTS.

2-28. The read character gate is adjusted to allow a period equal to 40 percent of the bit-to-bit distance for all of the read bits in a character to be placed in the output register. At the end of this period a read strobe occurs which sets all read data lines. One microsecond later, a read clock is generated which lasts 2 to 3 microseconds as an output signal. The read character gate is adjusted as follows:

a. Use the master alignment tape and place the tape unit in the forward read mode. Select 800 cpi density.

b. Synchronize the oscilloscope (negative slope) to the NOR test point on the read control card. (The first data bit of a character will start the gate time when the line goes to ground.)

c. Observe the bit-to-bit time (negative going edge to negative going edge). The low (or ground) portion of this signal represents the character gate time.

d. Using the read control gate potentiometer (R29) adjust "nor" (ground portion) of the signal to 40% of the bit-to-bit time. Ensure that the bit-to-bit time is consistent with the data transfer rate.

SECTION III
REPLACEABLE PARTS

3-1. INTRODUCTION.

3-2. This section provides information for ordering replacement parts for the read/read modules of the HP 7970B/7970C Digital Magnetic Tape Units.

3-3. This section contains assembly parts list, supporting illustrations, ordering information, and a part number cross reference.

3-4. ASSEMBLY PARTS LISTS.

3-5. The assembly parts lists represent a breakdown of all replaceable parts of the read/read modules. The information contained in the lists are under the following headings:

a. FIGURE & INDEX NO.

b. PART NUMBER.

c. DESCRIPTION.

d. UNITS PER ASSY.

3-6. FIGURE AND INDEX NUMBER.

3-7. The figure and index number column identifies the figure that illustrates each listed item and the index number that identifies the item on the illustration.

3-8. PART NUMBER.

3-9. The part number column provides the Hewlett-Packard part number for each item listed in the assembly parts list.

3-10. DESCRIPTION.

3-11. The description column describes the items within the article. An indented column arrangement is used to show the relationship between a part and the next higher assembly. The top assembly of each listing appears in indention 1. Primary subassemblies (of top assembly) and attaching parts appear in indention 2. This method of indention is continued through indention 3, 4, etc, until all replaceable parts are listed. Attaching parts are listed immediately following the part they attach. Attaching parts are identified by the abbreviation (AP) enclosed in parentheses at the end of the description.

3-12. Reference designation and manufacture information (if applicable) is also included in the description column.

3-13. UNITS PER ASSEMBLY.

3-14. The quantity shown in the units per assembly column reflects the total quantity of a part required by the next higher assembly of that part. This quantity is not necessarily the total used for the complete equipment. The abbreviation AR is used to indicate usage as required of a particular item. The abbreviation REF is used to indicate that the quantity of an item used per assembly is listed in the next higher assembly of the group assembly parts list.

3-15. ORDERING INFORMATION.

3-16. To order replacement parts, address the order or inquiry to the local Hewlett-Packard Sales and Service Office. (Refer to the list at the end of this manual for addresses.) Specify the following information for each part ordered.

a. Identification of the unit, kit, or assembly containing the part.

b. Hewlett-Packard part number for each part.

c. Description of each part.

d. Circuit reference designation (if applicable).

3-17. PART NUMBER CROSS REFERENCE.

3-18. Table 3-1 at the end of this section provides a cross reference between Hewlett-Packard part numbers and manufacturer's part numbers.

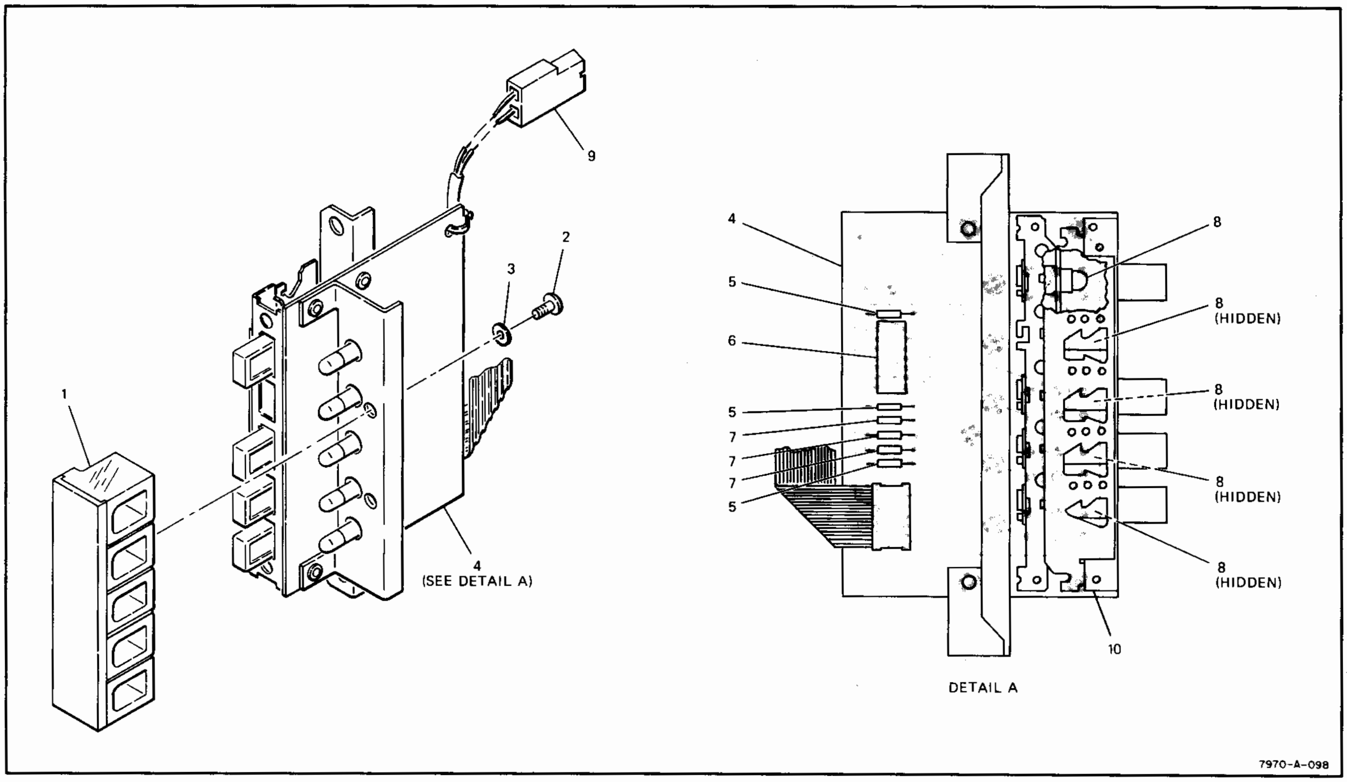


Figure 3-1. Read/Read Density Select Switch Assembly A12

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-1-	07970-62088	DENSITY SELECT SWITCH ASSEMBLY A12, read/read	REF
-1	07970-62008	. LENS BLOCK ASSEMBLY, density select switch, read/read	1
-2	0624-0077	. . SCREW, tapping, no. 4-40, 0.312-inch, pozi (AP)	2
-3	2190-0416	. . WASHER, flat (AP)	2
-4	07970-62006	. DENSITY SELECT PC ASSEMBLY, read/read	1
-5	0757-0419	. . RESISTOR, fxd, 681 ohms, 1%, 1/8W (R1, R2, R3)	3
-6	1820-0256	. . INTEGRATED CIRCUIT (U1).	1
-7	0757-0428	. . RESISTOR, fxd, 1.62k, 1%, 1/8W (R4, R5, R6).	3
-8	2140-0209	. . LAMP, 14V, 0.08A (DS1, DS2, DS3, DS4, DS5).	5
-9	07970-60620	. . CABLE ASSEMBLY, density select switch, read/read	1
-10	3101-1535	. . SWITCH ASSEMBLY (S1 thru S4) (not field replaceable)	1

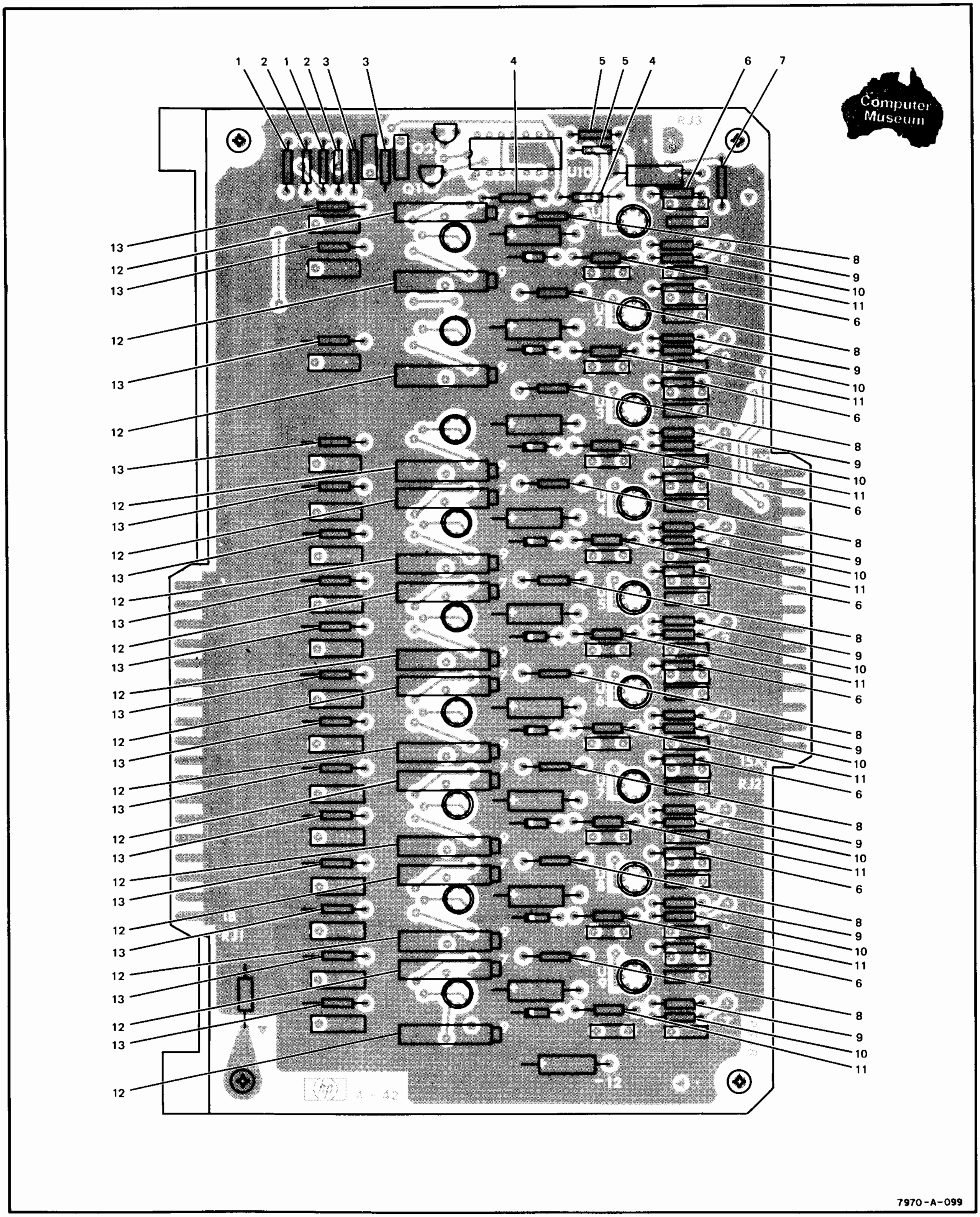


Figure 3-2. Read/Read Preamplifier PC Assembly A15 (Sheet 1 of 2)

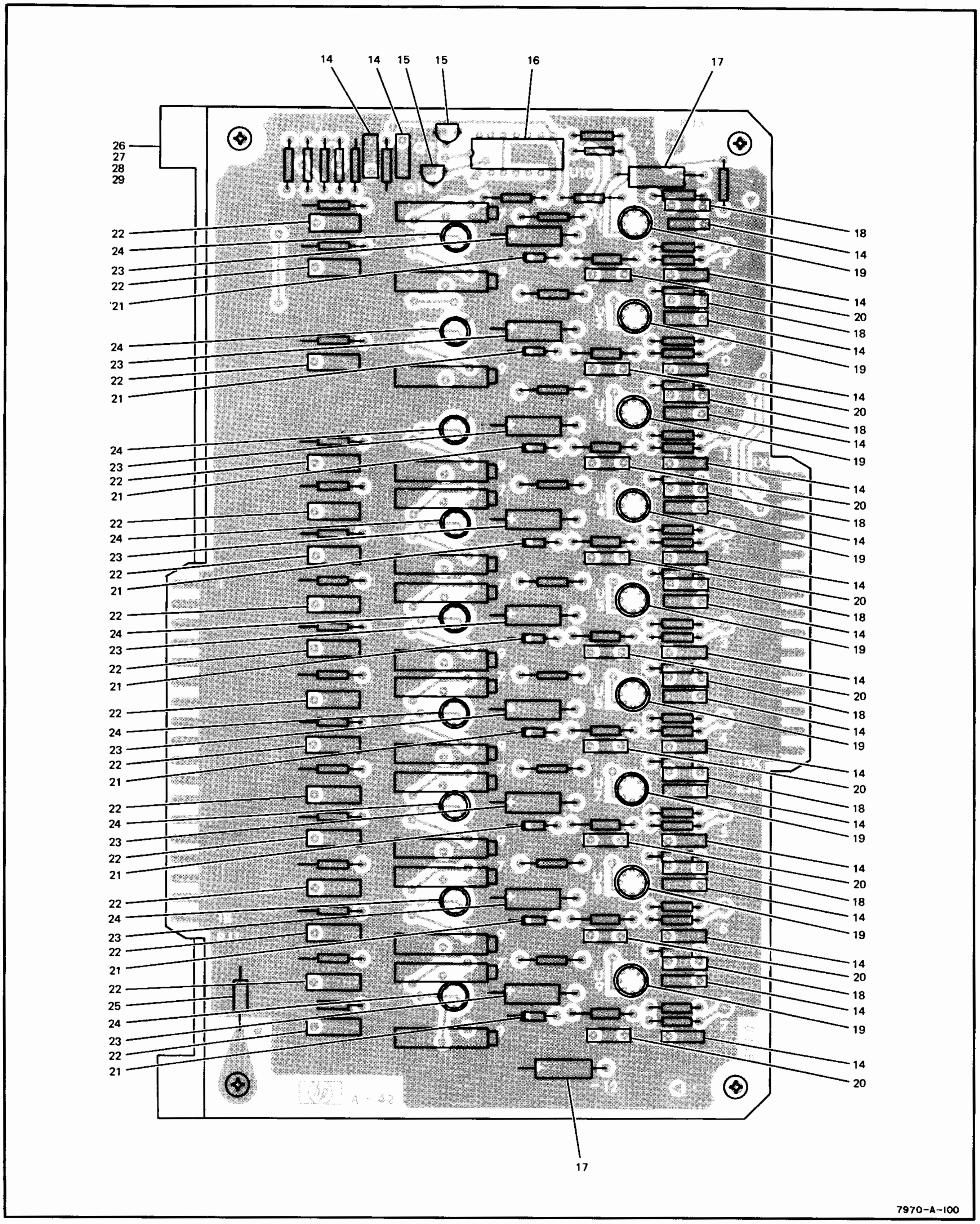


Figure 3-2. Read/Read Preamplifier PC Assembly A15 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-2-	07970-62001	READ/READ PREAMPLIFIER PC ASSEMBLY A15, 10 - 20.9 ips	REF
3-2-	07970-62012	READ/READ PREAMPLIFIER PC ASSEMBLY A15, 21 - 45 ips	REF
-1	0757-0279	. RESISTOR, fxd, 31.6k, 1%, 1/8W (R4, R8)	2
-2	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R9, R5)	2
-3	0683-2235	. RESISTOR, fxd, 22k, 5%, 1/4W (R1, R3)	2
-4	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R6, R10)	2
-5	0683-1035	. RESISTOR, fxd, 10k, 5%, 1/4W (R2, R7)	2
-6	0683-1525	. RESISTOR, fxd, 1.5k, 5%, 1/4W (R107, R207, R307, R407, R507,. R607, R707, R807, R907)	9
-7	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R11).	1
-8	0698-4412	. RESISTOR, fxd, 143 ohms, 1%, 1/8W (R105, R205, R305, R405, ... R505, R605, R705, R805, R905)	9
-9	0683-1015	. RESISTOR, fxd, 100 ohms, 5%, 1/4W (R108, R208, R308, R408, ... R508, R608, R708, R808, R908)	9
-10	0683-4325	. RESISTOR, fxd, 4.3k, 5%, 1/4W (R109, R209, R309, R409, R509,. R609, R709, R809, R909)	9
-11	0757-0460	. RESISTOR, fxd, 61.9k, 1%, 1/8W (R106, R206, R306, R406, R506, ... R606, R706, R806, R906)	9
-12	2100-1972	. RESISTOR, var, ww, 20k, 10%, 1W (R102, R402, R502, R602, R702, ... R802, R902, R104, R204, R304, R404, R504, R604, R704, R804, R904)	16
-13	0683-6825	. RESISTOR, fxd, 6.8k, 5%, 1/4W (R101, R401, R501, R601, R701, R801,. . . R901, R103, R203, R303, R403, R503, R603, R703, R803, R903)	16
-14	0160-2055	. CAPACITOR, fxd, 0.01 μF, -20 +80%, 100 Vdcw (C1, C2, C104, C204, . . . C304, C404, C504, C604, C704, C804, C904, C107, C207, C307, C407, C507, C607, C707, C807, C907)	20
-15	1853-0020	. TRANSISTOR, PNP, Si (Q1, Q2)	2
-16	1820-0349	. INTEGRATED CIRCUIT (U10)	1
-17	0180-0228	. CAPACITOR, fxd, 22 μF, 10%, 15 Vdcw (C4, C5)	2
-18	0140-0198	. CAPACITOR, fxd, 200 pF, 5%, 300 Vdcw (C105, C205, C305, C405, ... C505, C605, C705, C805, C905)	9
-19	07970-80050	. INTEGRATED CIRCUIT, pretested (U1, U2, U3, U4, U5, U6, U7, U8, U9). . .	9
-20	0160-3456	. CAPACITOR, fxd, 1000 pF, 10%, 250 Vdcw (C106, C206, C306, C406, . . . C506, C606, C706, C806, C906)	9
-21	1901-0040	. DIODE, Si (CR101, CR201, CR301, CR401, CR501, CR601, CR701, CR801,. . CR901)	9
-22	0160-2213	. CAPACITOR, fxd, 620 pF, 5%, 300 Vdcw (C101, C401, C501, C601, C701, . . C801, C901, C102, C202, C302, C402, C502, C602, C702, C802, C902)	16
-23	0180-1704	. CAPACITOR, fxd, 47 μF, 10%, 6 Vdcw (C103, C203, C303, C403, C503, . . . C603, C703, C803, C903)	9
-24	1855-0370	. TRANSISTOR, field effect, dual (Q101, Q201, Q301, Q401, Q501, Q601, . . . Q701, Q801, Q901)	9
-25	0180-0291	. CAPACITOR, fxd, 1 μF, +10%, 35 Vdcw (C3)	1
-26	07970-00672	. BRACKET, read/read preamplifier	1
-27	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	4
-28	2190-0007	. . WASHER, lock (AP).	4
-29	3050-0228	. . WASHER, flat (AP)	4

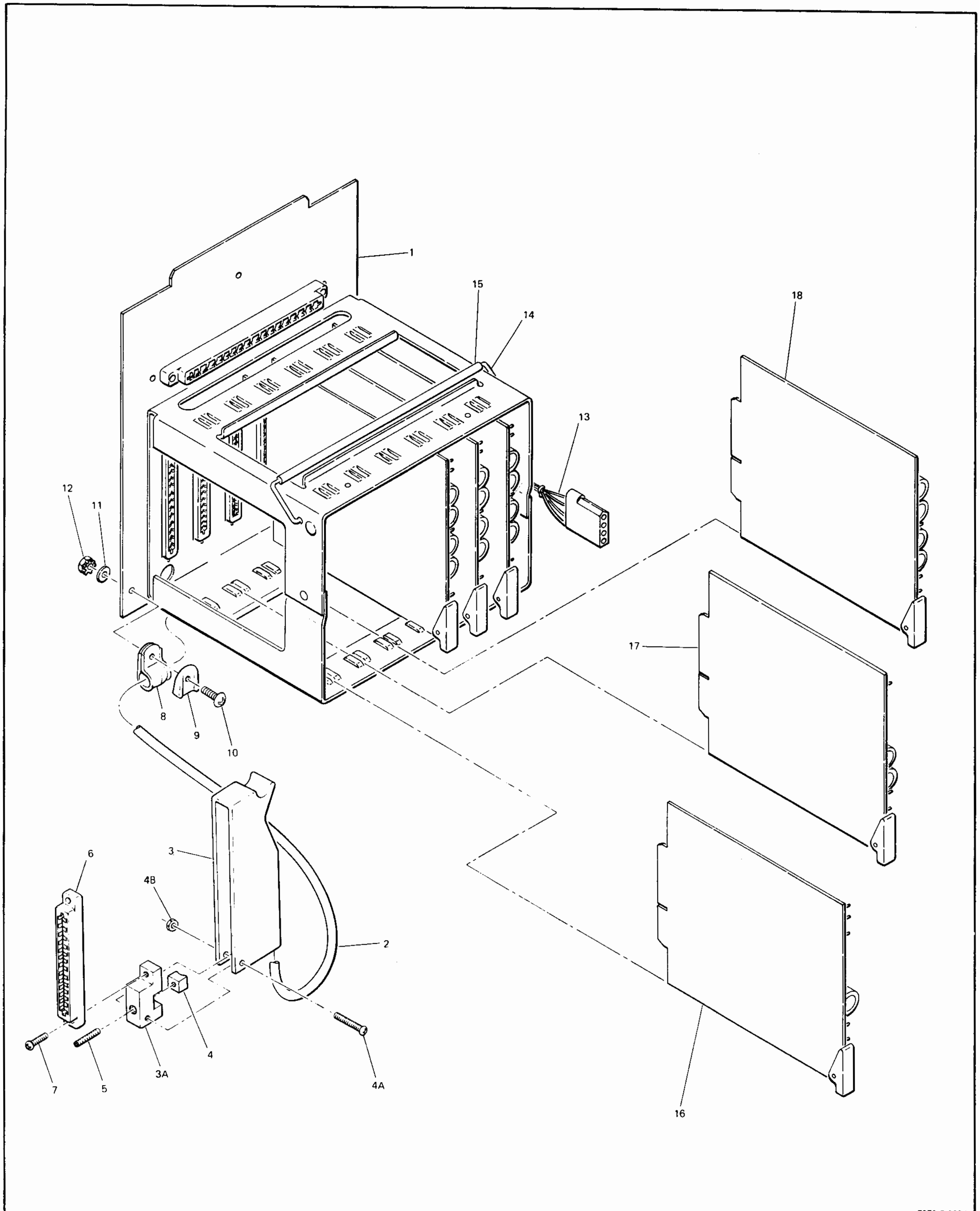


Figure 3-3. Read/Read Assembly A18

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-3-	Reference Only	READ/READ ASSEMBLY A18	REF
-1	07970-62003	. READ/READ MOTHERBOARD ASSEMBLY	1
-2	8120-1523	. . CABLE, unshielded, 24 conductor	3.5 ft.
-3	07970-40204	. . HOLDER, connector	1
-3A	5040-6072	. . . BLOCK, mounting	1
-4	5040-6003	. . CLAMP, cable, connector holder	1
-4A	2200-0091	. . . SCREW, no. 4-40, 0.562-inch, pozi (AP)	1
-4B	2260-0001	. . . NUT, hex, no. 4-40 (AP)	1
-5	3030-0143	. . . SCREW, set, no. 6-32, 0.500-inch, pozi (AP).	1
-6	1251-0159	. . CONNECTOR, printed circuit	1
-7	0624-0098	. . . SCREW, tapping, no. 4-40, 0.438-inch, pozi (AP)	2
-8	1400-0440	. . CLAMP, cable (AP)	1
-9	2190-0452	. . . WASHER, D-type (AP)	1
-10	2360-0199	. . . SCREW, no. 6-32, 0.438-inch, pozi (AP)	1
-11	3050-0227	. . . WASHER, flat (AP)	1
-12	2420-0001	. . . NUT, hex, no. 6-32 (AP)	1
-13	07970-60430	. . CABLE ASSEMBLY, read power	1
-14	07970-00470	. . RETAINING SPRING, PC board	1
-15	1400-0795	. . TIE, cable, spiral, 0.250 OD	6 in.
-16	-----	. READ/READ CONTROL PC ASSEMBLY A18A1 (See figure 3-4 for details.) . .	1
-17	-----	. READ DATA PC ASSEMBLY, single-channel A18A2 . . . . (See figures 3-5, 3-6 for details.)	1
-18	-----	. READ DATA PC ASSEMBLY, dual-channel A18A3 thru A18A6 . . . . . (See figures 3-7, 3-8 for details.)	4

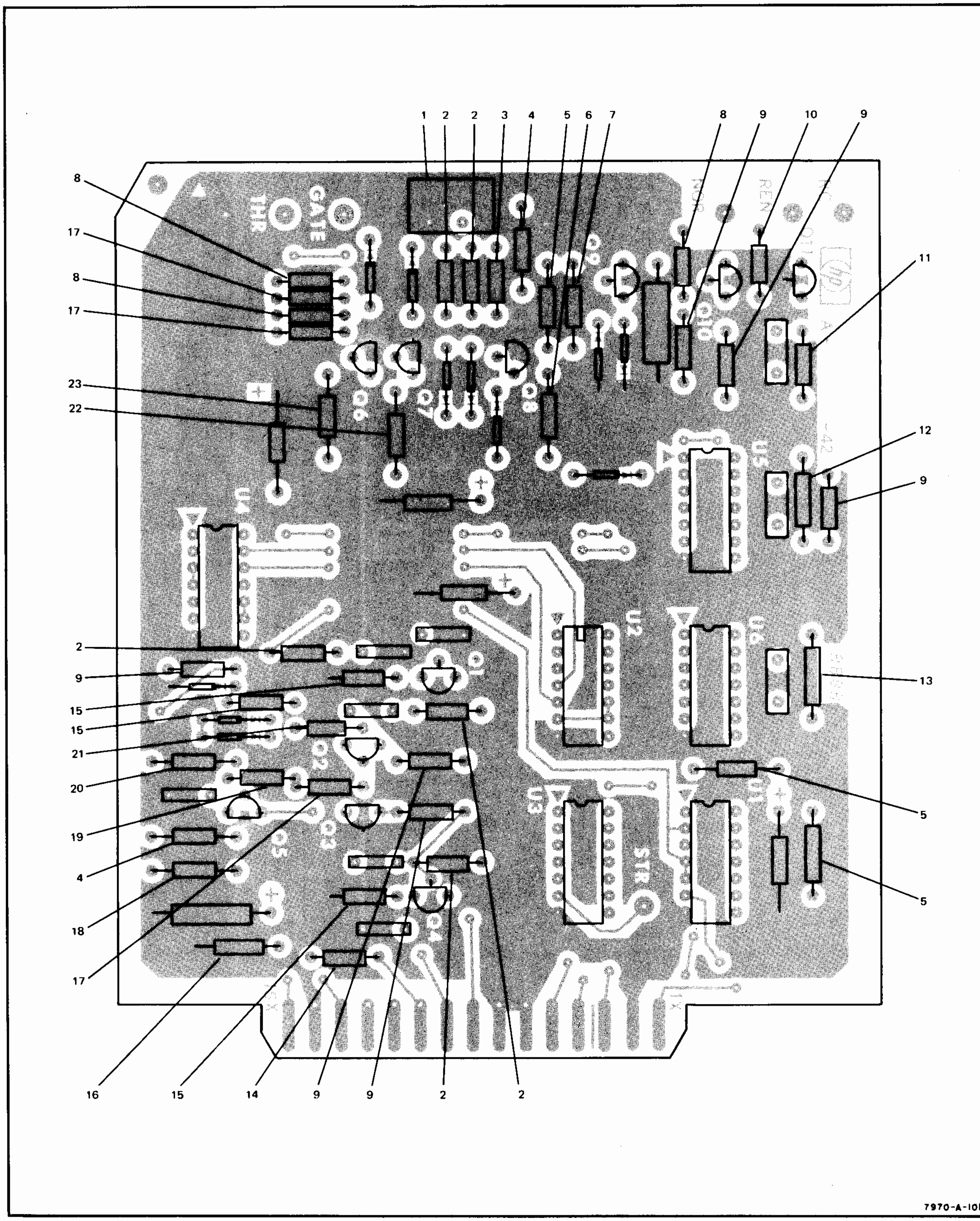


Figure 3-4. Read/Read Control PC Assembly A18A1 (Sheet 1 of 2)

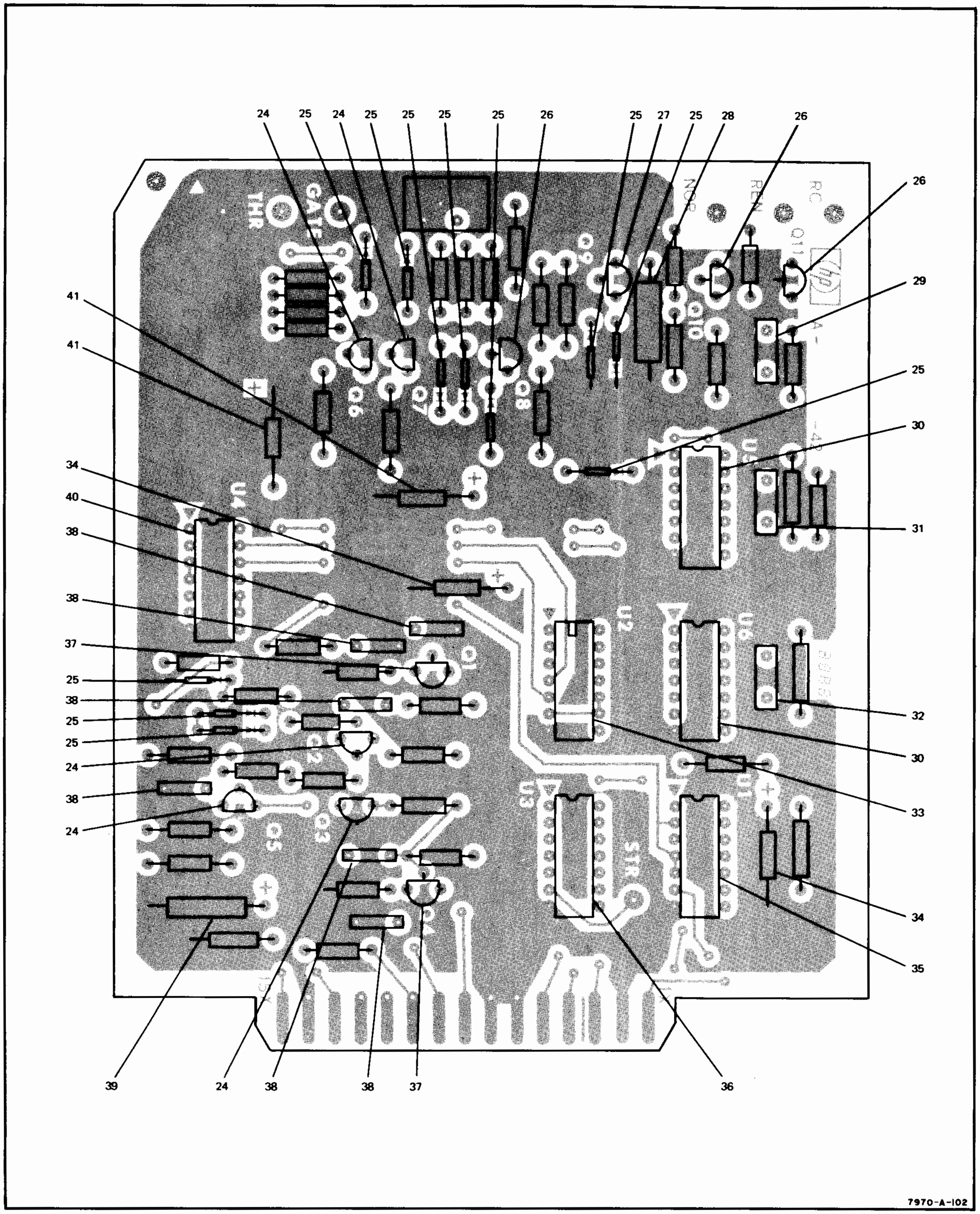


Figure 3-4. Read/Read Control PC Assembly A18A1 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-4-	07970-62004	READ/READ CONTROL PC ASSEMBLY A18A1, 10 - 20.9 ips	REF
3-4-	07970-62005	READ/READ CONTROL PC ASSEMBLY A18A1, 21 - 45 ips	REF
-1	2100-1758	. RESISTOR, var, ww, 1k, 5%, 1W (R29)	1
-2	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R2, R4, R8, R22, R29)	5
-3	0683-1235	. RESISTOR, fxd, 12k, 5%, 1/4W (R23)	1
-4	0698-3132	. RESISTOR, fxd, 261 ohms, 1%, 1/8W (R12, R28)	2
-5	0757-0428	. RESISTOR, fxd, 1620 ohms, 1%, 1/8W (R10, R26, R42)	3
-6	0698-3438	. RESISTOR, fxd, 147 ohms, 1%, 1/8W (R27)	1
-7	0757-0199	. RESISTOR, fxd, 21.5k, 1%, 1/8W (R25)	1
-8	0683-8235	. RESISTOR, fxd, 82k, 5%, 1/4W (R30, R37, R38)	3
-9	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R3, R7, R11, R31, R32, R39)	6
-10	0683-2725	. RESISTOR, fxd, 2.7k, 5%, 1/4W (R34)	1
-11	0683-6815	. RESISTOR, fxd, 680 ohms, 5%, 1/4W (R33)	1
-12	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R35)	1
-13	0757-0444	. RESISTOR, fxd, 12.1k, 1%, 1/8W (R36)	1
-14	0683-1525	. RESISTOR, fxd, 1.5k, 5%, 1/4W (R41)	1
-15	0683-6825	. RESISTOR, fxd, 6.8k, 5%, 1/4W (R1, R9, R40)	3
-16	0757-0401	. RESISTOR, fxd, 100 ohms, 1%, 1/8W (R15)	1
-17	0683-3325	. RESISTOR, fxd, 3.3k, 5%, 1/4W (R6, R17, R19)	3
-18	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R13)	1
-19	0683-3335	. RESISTOR, fxd, 33k, 5%, 1/4W (R14)	1
-20	0757-1094	. RESISTOR, fxd, 1.47k, 1%, 1/8W (R16)	1
-21	0683-2235	. RESISTOR, fxd, 22k, 5%, 1/4W (R5)	1
-22	0757-0443	. RESISTOR, fxd, 11k, 1%, 1/8W (R21)	1
-23	0757-0439	. RESISTOR, fxd, 6.81k, 1%, 1/8W (R20)	1
-24	1854-0071	. TRANSISTOR, NPN, Si (Q2, Q3, Q5, Q6, Q7)	5
-25	1901-0040	. DIODE, Si (CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8, CR9, CR10, CR11)	11
-26	1854-0270	. TRANSISTOR, NPN, Si, 2N4265 (Q8, Q10, Q11)	3
-27	1853-0015	. TRANSISTOR, PNP, Si, 2N3640 (Q9)	1
-28	0160-0162	. CAPACITOR, fxd, 0.022 μF, 10% (C8) (used only on 07970-60540)	1
-28	0160-0161	. CAPACITOR, fxd, 0.01 μF, 10% (C8) (used only on 07970-60550)	1
-29	0160-2307	. CAPACITOR, fxd, 47 pF, 5%, 300 Vdcw (C9)	1
-30	1820-0088	. INTEGRATED CIRCUIT, type 851 (U5, U6)	2
-31	0140-0193	. CAPACITOR, fxd, 82 pF, 5%, 300 Vdcw (C10)	1
-32	0160-2209	. CAPACITOR, fxd, 360 pF, 5%, 300 Vdcw (C11)	1
-33	1820-0069	. INTEGRATED CIRCUIT, type 7420N (U2)	1
-34	0180-1701	. CAPACITOR, fxd, 6.8 μF, 20%, 6 Vdcw (C12, C13)	2
-35	1820-0348	. INTEGRATED CIRCUIT, type 844 (U1)	1
-36	1820-0276	. INTEGRATED CIRCUIT (U3)	1
-37	1853-0036	. TRANSISTOR, PNP, Si, 2N3906 (Q1, Q4)	2
-38	0160-2055	. CAPACITOR, fxd, 0.01 μF, -20 +80%, 100 Vdcw (C1, C2, C3, C4, C5, C6)	6
-39	0180-1704	. CAPACITOR, fxd, 47 μF, 10%, 6 Vdcw (C7)	1
-40	1820-0349	. INTEGRATED CIRCUIT (U4)	1
-41	0180-0210	. CAPACITOR, fxd, 3.3 μF, 20%, 15 Vdcw (C14, C15)	2

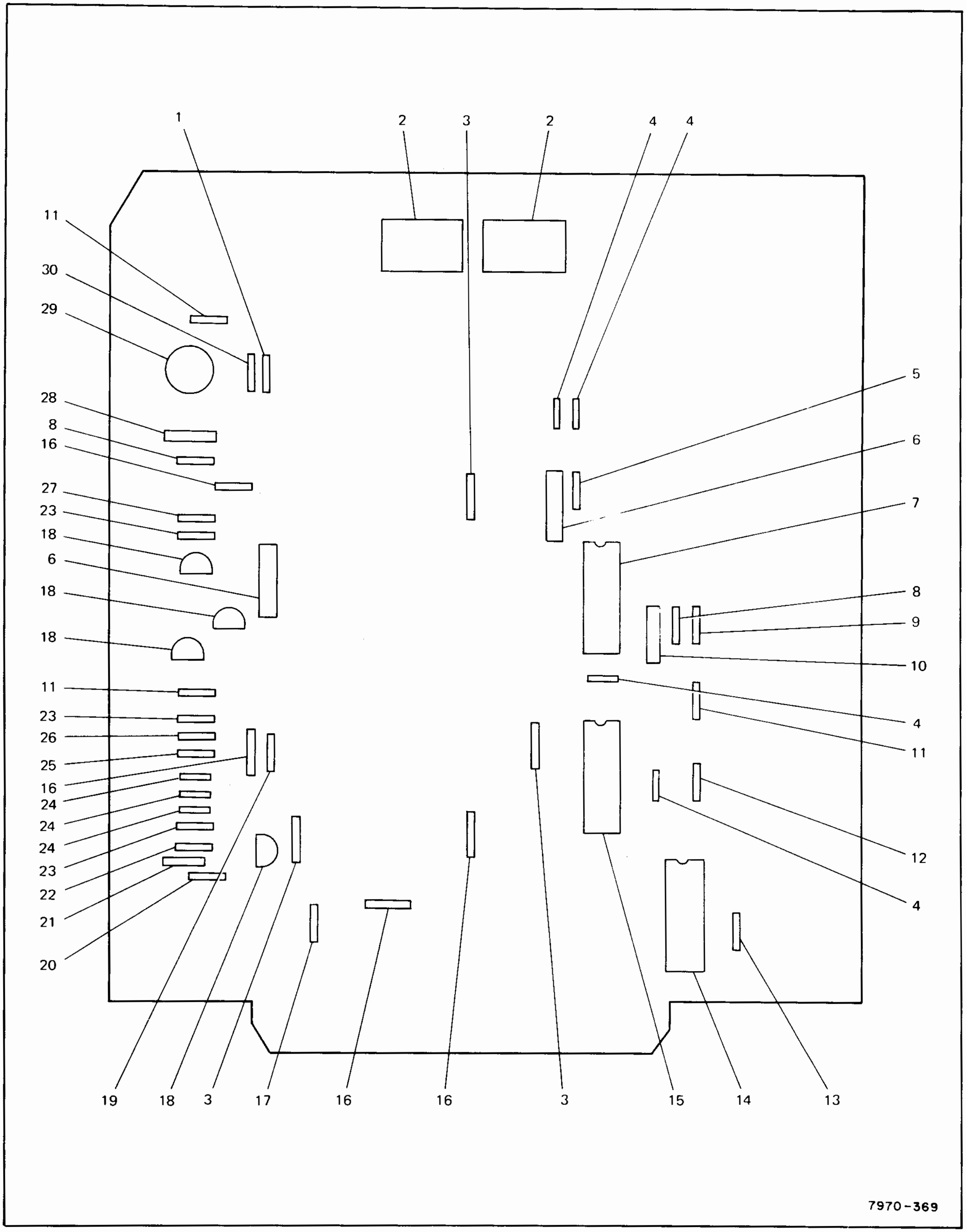


Figure 3-5. Single-Channel Read Data PC Assembly (10 - 20.9 ips)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-5-	07970-62167	READ DATA PC ASSEMBLY A18A2, single-channel (10 - 20.9 ips)	REF
-1	0683-4715	. RESISTOR, fxd, 470 ohms, 1/4W (R14)	1
-2	2100-1923	. RESISTOR, var, 50k (R21, R22)	2
-3	0180-1701	. CAPACITOR, fxd, 6.8 μF, 6V, tant (C1, C8, C9)	3
-4	1901-0040	. DIODE, Si, 30V, 30 mA (CR5, CR6, CR7, CR8)	4
-5	0757-0289	. RESISTOR, fxd, 13.3k, 1%, 1/8W (R20)	1
-6	0160-0160	. CAPACITOR, fxd, 0.0082 μF, Mylar (C3, C7)	2
-7	1820-0515	. INTEGRATED CIRCUIT, MV 9602 (U4)	1
-8	0683-4725	. RESISTOR, fxd, 4.7k, 1/4W (R11, R19)	2
-9	0683-2725	. RESISTOR, fxd, 2.7k, 1/4W (R18)	1
-10	0140-0197	. CAPACITOR, fxd, 180 pF, mica (C6)	1
-11	0683-2225	. RESISTOR, fxd, 2.2k, 1/4W (R4, R16, R17)	3
-12	0683-1025	. RESISTOR, fxd, 1k, 1/4W (R24)	1
-13	0757-0429	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23)	1
-14	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3)	1
-15	1820-0077	. INTEGRATED CIRCUIT, type SN7474 (U1)	1
-16	0180-0210	. CAPACITOR, fxd, 3.3 μF, 15V (C2, C4, C10, C11)	4
-17	0683-1515	. RESISTOR, fxd, 150 ohms, 1/4W (R26)	1
-18	1854-0071	. TRANSISTOR, 2N3391 (Q1, Q2, Q3, Q4)	4
-19	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2)	1
-20	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1)	1
-21	0160-3449	. CAPACITOR, fxd, 2000 pF, 10% (C12)	1
-22	0683-3635	. RESISTOR, fxd, 36k, 1/4W (R3)	1
-23	0683-1035	. RESISTOR, fxd, 10k, 1/4W (R5, R8, R9)	3
-24	1901-0450	. DIODE, Si (CR1, CR2, CR3)	3
-25	0683-2255	. RESISTOR, fxd, 2.2M, 1/4W (R7)	1
-26	0683-1045	. RESISTOR, fxd, 100k, 1/4W (R10)	1
-27	0683-6825	. RESISTOR, fxd, 6.8k, 1/4W (R6)	1
-28	0160-3573	. CAPACITOR, fxd, 680 pF, cer (C5)	1
-29	1826-0065	. INTEGRATED CIRCUIT, comparator, LM 311 (U5)	1
-30	0683-4735	. RESISTOR, fxd, 47k, 1/4W (R15)	1

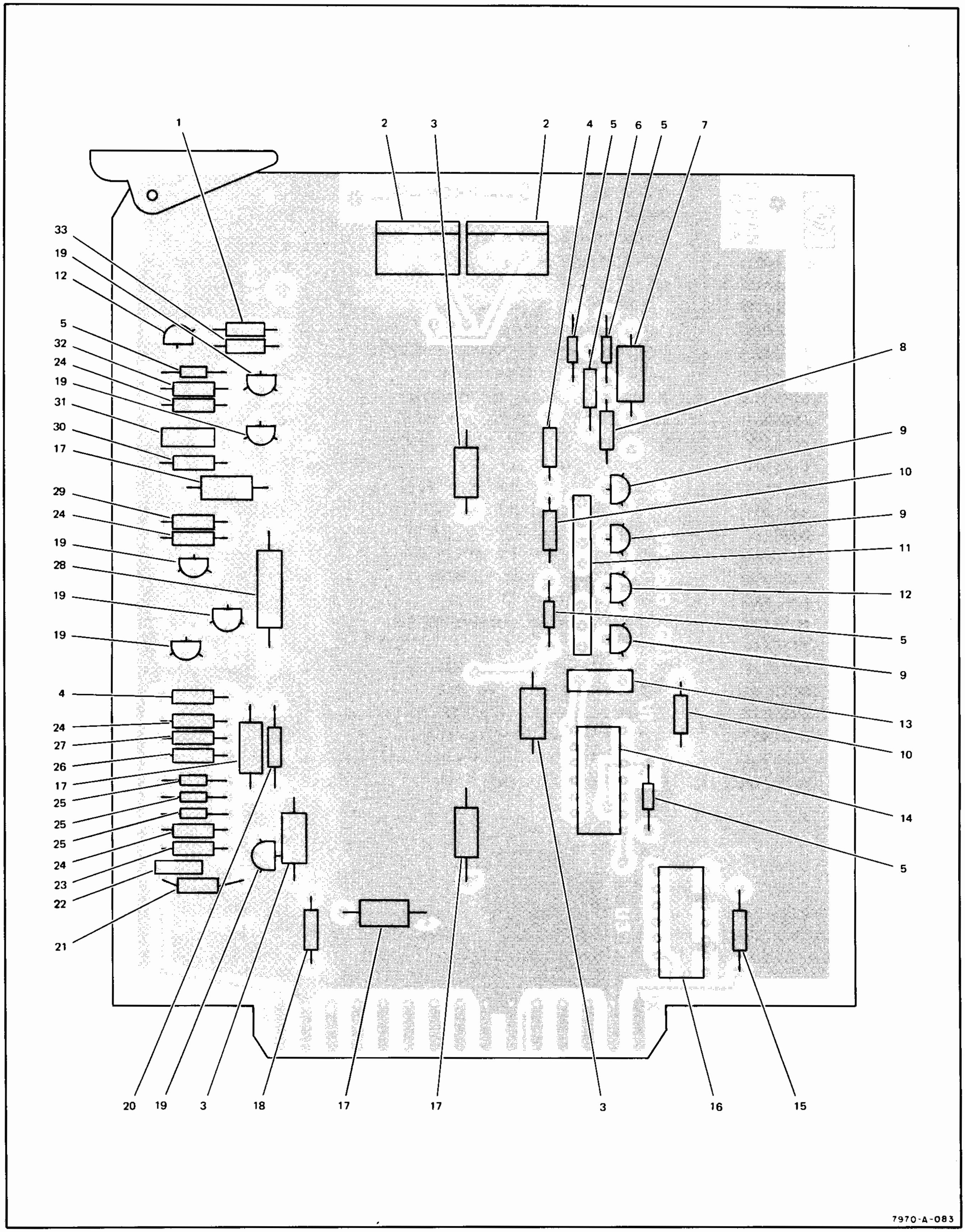


Figure 3-6. Single-Channel Read Data PC Assembly (21 - 45 IPS)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-6-	07970-60570	READ DATA PC ASSEMBLY A18A2, single-channel, 21 - 45 ips	REF
-1	0683-4735	. RESISTOR, fxd, 47k, 5%, 1/4W (R15)	1
-2	2100-1761	. RESISTOR, var, ww, 10k, 5%, 1W (R21, R22)	2
-3	0180-1701	. CAPACITOR, fxd, 6.8 μF, 20%, 6 Vdcw (C1, C8, C9)	3
-4	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R4, R16)	2
-5	1901-0040	. DIODE, Si (CR4, CR5, CR6, CR7, CR8)	5
-6	0757-0279	. RESISTOR, fxd, 3.16k, 1%, 1/8W (R20)	1
-7	0160-0155	. CAPACITOR, fxd, 0.0033 μF, 10% (C7)	1
-8	0683-1015	. RESISTOR, fxd, 100 ohms, 5%, 1/4W (R19).	1
-9	1854-0270	. TRANSISTOR, NPN, Si, 2N4265 (Q8, Q9, Q11)	3
-10	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R17, R24)	2
-11	1810-0044	. RESISTOR NETWORK (R18)	1
-12	1853-0015	. TRANSISTOR, PNP, Si, 2N3640 (Q7, Q10)	2
-13	0140-0197	. CAPACITOR, fxd, 180 pF, 5%, 300 Vdcw (C6)	1
-14	1820-0077	. INTEGRATED CIRCUIT, type 7474N (U1)	1
-15	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23)	1
-16	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3).	1
-17	0180-0210	. CAPACITOR, fxd, 3.3 μF, 20%, 15 Vdcw (C2, C4, C10, C11).	4
-18	0683-1515	. RESISTOR, fxd, 150 ohms, 5%, 1/4W (R26).	1
-19	1854-0071	. TRANSISTOR, NPN, Si (Q1, Q2, Q3, Q4, Q5, Q6)	6
-20	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2)	1
-21	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1)	1
-22	0160-3449	. CAPACITOR, fxd, 2000 pF, 10%, 250 Vdcw (C12).	1
-23	0683-3635	. RESISTOR, fxd, 36k, 5%, 1/4W (R3)	1
-24	0683-1035	. RESISTOR, fxd, 10k, 5%, 1/4W (R5, R8, R9, R12).	4
-25	1901-0450	. DIODE, Si (CR1, CR2, CR3)	3
-26	0683-2255	. RESISTOR, fxd, 2.2M, 5%, 1/4W (R7)	1
-27	0683-1045	. RESISTOR, fxd, 100k, 5%, 1/4W (R10)	1
-28	0160-0156	. CAPACITOR, fxd, 0.0039 μF, 10% (C3)	1
-29	0683-6825	. RESISTOR, fxd, 6.8k, 5%, 1/4W (R6)	1
-30	0683-4725	. RESISTOR, fxd, 4.7k, 5%, 1/4W (R11)	1
-31	0160-3572	. CAPACITOR, fxd, 330 pF, 10%, 500 Vdcw (C5)	1
-32	0683-1235	. RESISTOR, fxd, 12k, 5%, 1/4W (R13)	1
-33	0683-4715	. RESISTOR, fxd, 470 ohms, 5%, 1/4W (R14)	1

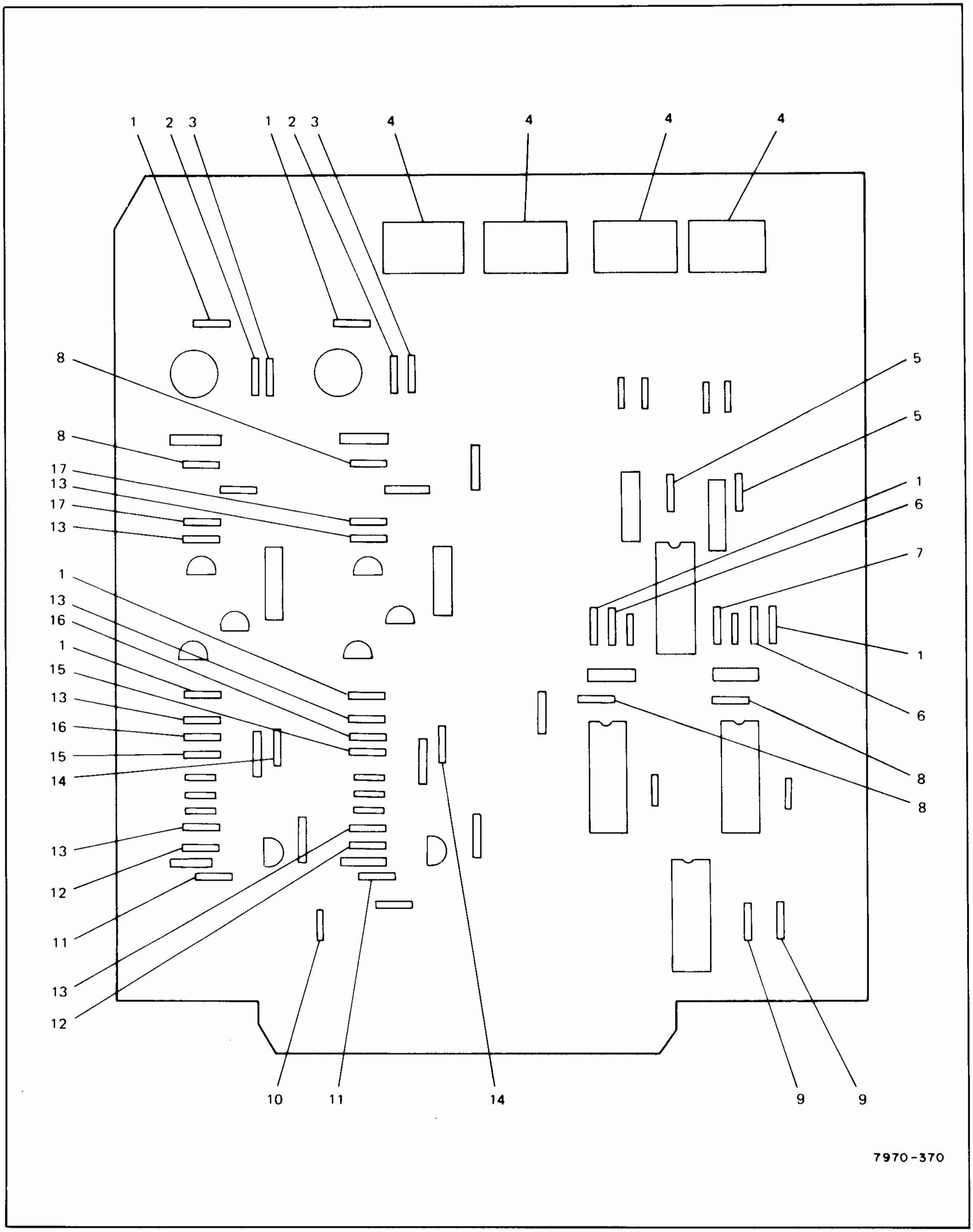


Figure 3-7. Dual-Channel Read Data PC Assembly (10 - 20.9 IPS) (Sheet 1 of 2)

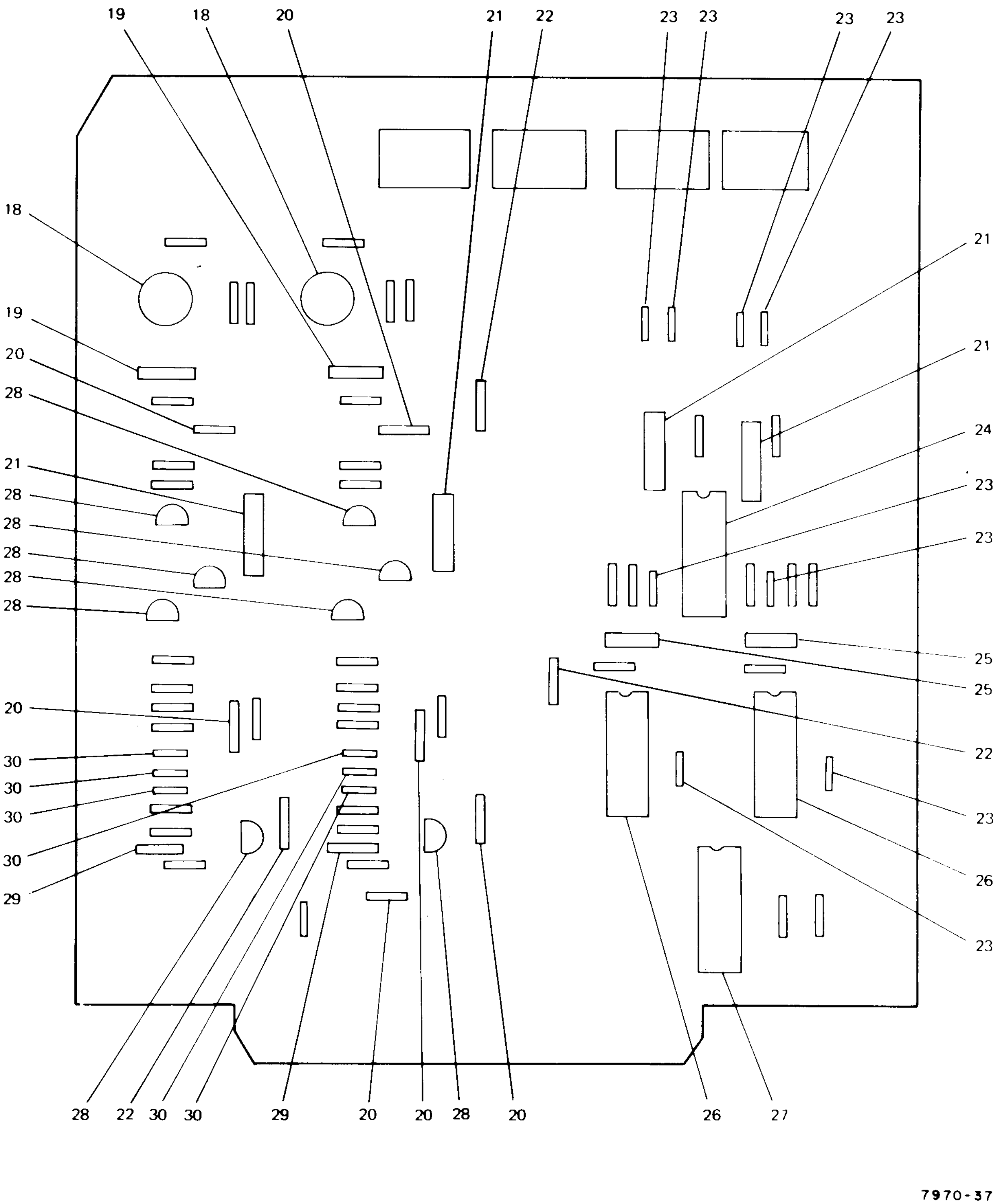


Figure 3-7. Dual-Channel Read Data PC Assembly (10 - 20.9 IPS) (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-7-	07970-62166	READ DATA PC ASSEMBLY A18A3, dual-channel (10 - 20.9 ips)	REF
-1	0683-2225	. RESISTOR, fxd, 2.2k, 1/4W (R4, R16, R17, R104, R116, R117)	6
-2	0683-4735	. RESISTOR, fxd, 47k, 1/4W (R15, R115)	2
-3	0683-4715	. RESISTOR, fxd, 470 ohms, 1/4W (R14, R114)	2
-4	2100-1923	. RESISTOR, var, 50k (R21, R22, R121, R122)	4
-5	0757-0289	. RESISTOR, fxd, 13.3k, 1%, 1/8W (R20, R120)	2
-6	0683-2725	. RESISTOR, fxd, 2.7k, 1/4W (R18, R118)	2
-7	0683-1025	. RESISTOR, fxd, 1k, 1/4W (R24)	1
-8	0683-4725	. RESISTOR, fxd, 4.7k, 1/4W (R11, R19, R111, R119)	4
-9	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23, R25)	2
-10	0683-1515	. RESISTOR, fxd, 150 ohms, 1/4W (R26)	1
-11	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1, R101)	2
-12	0683-3635	. RESISTOR, fxd, 36k, 1/4W (R3, R103)	2
-13	0683-1035	. RESISTOR, fxd, 10k, 1/4W (R5, R8, R9, R105, R108, R109)	6
-14	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2, R102)	2
-15	0683-2255	. RESISTOR, fxd, 2.2M, 1/4W (R7, R107)	2
-16	0683-1045	. RESISTOR, fxd, 100k, 1/4W (R10, R110)	2
-17	0683-6825	. RESISTOR, fxd, 6.8k, 1/4W (R6, R106)	2
-18	1826-0065	. INTEGRATED CIRCUIT, comparator, LM 311 (U5, U6)	2
-19	0160-3573	. CAPACITOR, fxd, 680 pF, cer (C5, C105)	2
-20	0180-0210	. CAPACITOR, fxd, 3.3 μF, 15V (C2, C4, C10, C11, C102, C104)	6
-21	0160-0160	. CAPACITOR, fxd, 0.0082 μF, Mylar (C3, C103, C7, C107)	4
-22	0180-1701	. CAPACITOR, fxd, 6.8 μF, 6V, tant (C1, C8, C9)	3
-23	1901-0040	. DIODE, Si, 30V, 30 mA (CR5 thru CR8, CR105 thru CR108)	8
-24	1820-0515	. INTEGRATED CIRCUIT, MV 9602 (U4)	1
-25	0140-0197	. CAPACITOR, fxd, 180 pF, mica (C6, C106)	2
-26	1820-0077	. INTEGRATED CIRCUIT, SN 7474 (U1, U2)	2
-27	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3)	1
-28	1854-0071	. TRANSISTOR, 2N3391 (Q1 thru Q4, Q12 thru Q15)	8
-29	0160-3449	. CAPACITOR, fxd, 2000 pF, 10% (C12, C112)	2
-30	1901-0450	. DIODE, Si (CR1 thru CR3, CR101 thru CR103)	6

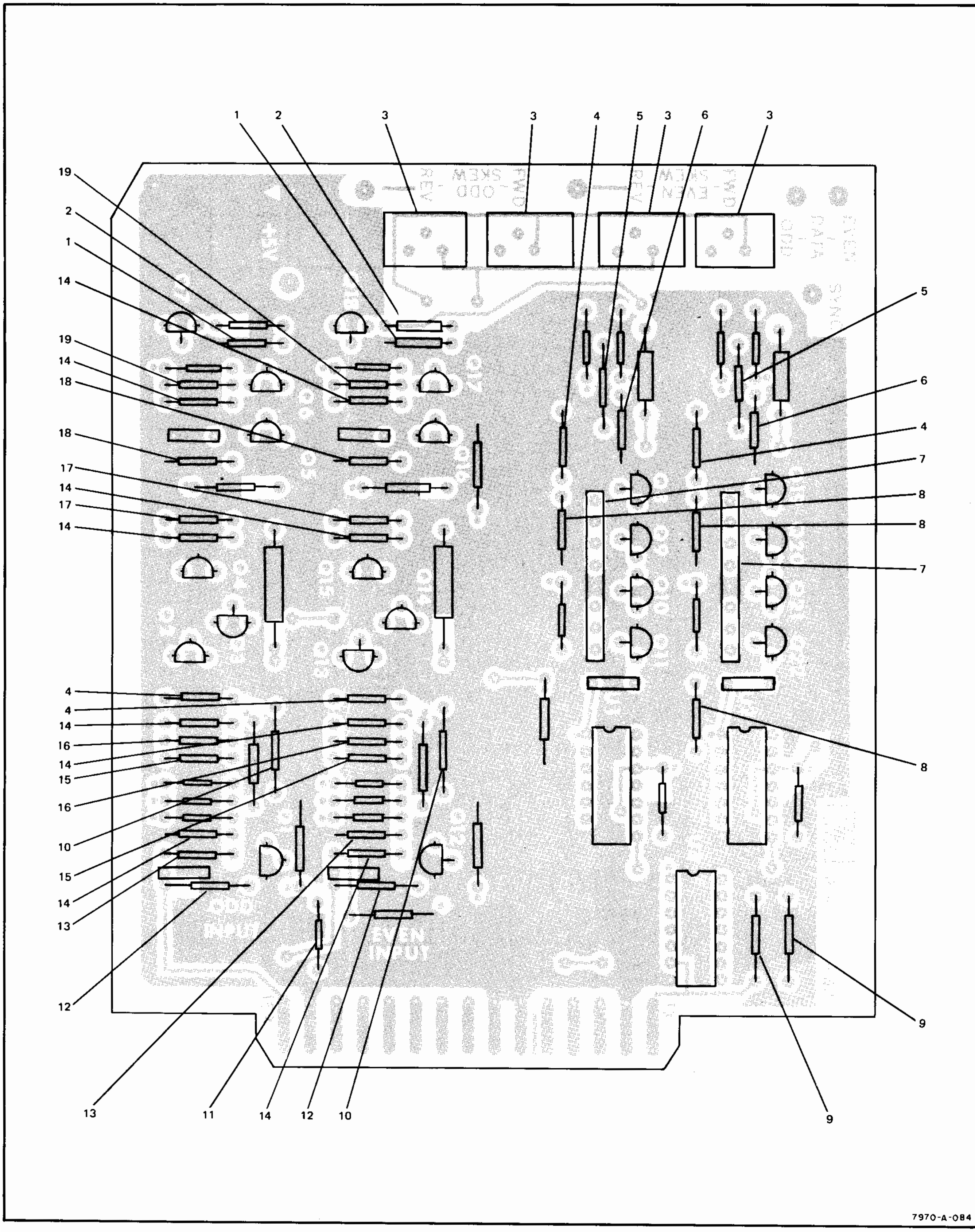


Figure 3-8. Dual-Channel Read Data PC Assembly (21 - 45 IPS) (Sheet 1 of 2)

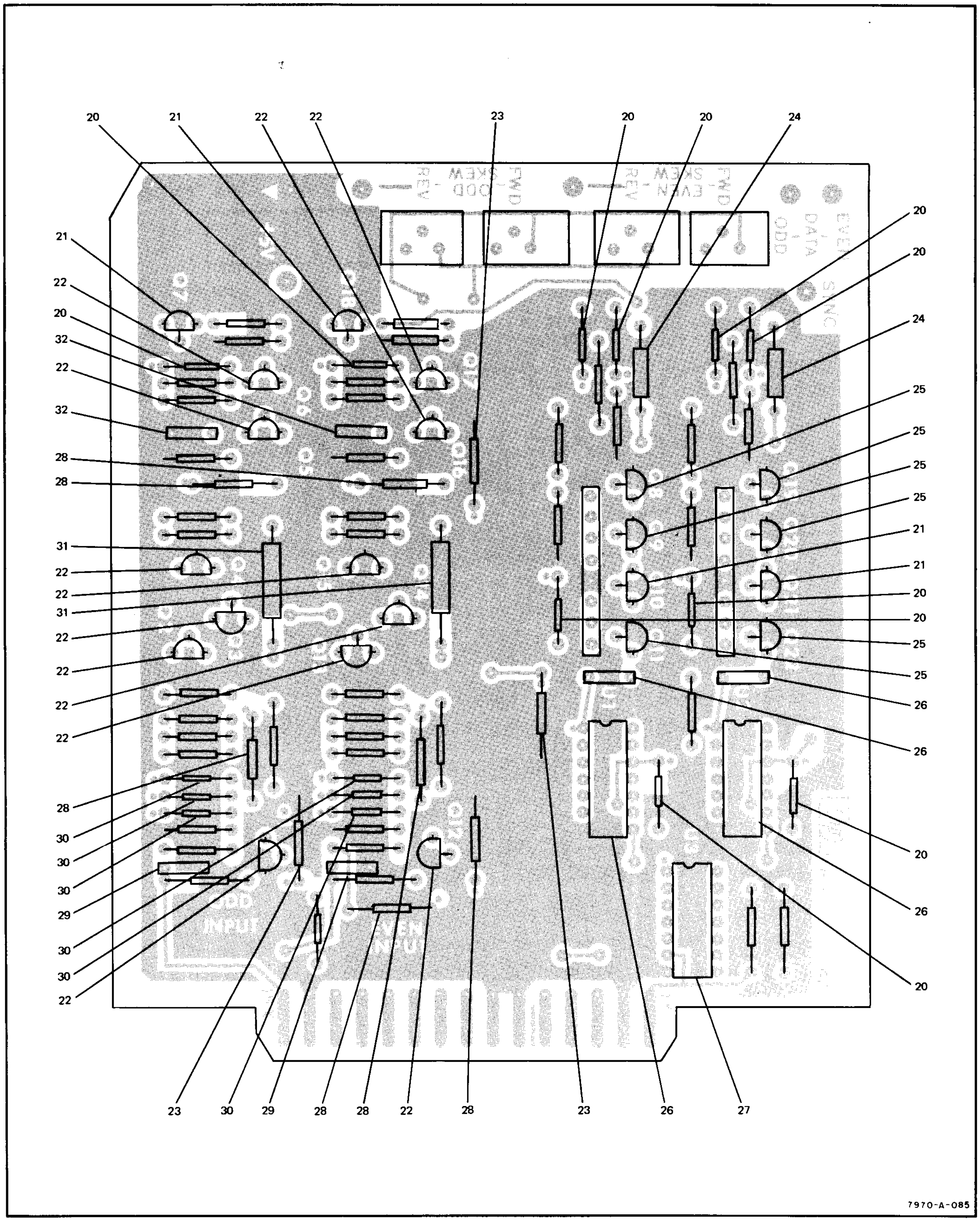


Figure 3-8. Dual-Channel Read Data PC Assembly (21 - 45 IPS) (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-8-	07970-60530	READ DATA PC ASSEMBLY A18A3 thru A18A6, dual-channel, 21 - 45 ips	REF*
-1	0683-4715	. RESISTOR, fxd, 470 ohms, 5%, 1/4W (R14, R114)	2
-2	0683-4735	. RESISTOR, fxd, 47k, 5%, 1/4W (R15, R115)	2
-3	2100-1761	. RESISTOR, var, ww, 10k, 5%, 1W (R21, R22, R121, R122)	4
-4	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R4, R16, R104, R116)	4
-5	0757-0279	. RESISTOR, fxd, 3.16k, 1%, 1/8W (R20, R120)	2
-6	0683-1015	. RESISTOR, fxd, 100 ohms, 5%, 1/4W (R19, R119).	2
-7	1810-0044	. RESISTOR NETWORK (R18, R118)	2
-8	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R17, R24, R117)	3
-9	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23, R25)	2
-10	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2, R102)	2
-11	0683-1515	. RESISTOR, fxd, 150 ohms, 5%, 1/4W (R26)	1
-12	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1, R101)	2
-13	0683-3635	. RESISTOR, fxd, 36k, 5%, 1/4W (R3, R103)	2
-14	0683-1035	. RESISTOR, fxd, 10k, 5%, 1/4W (R5, R8, R9, R12, R105, R108, R109, R112).	8
-15	0683-2255	. RESISTOR, fxd, 2.2M, 5%, 1/4W (R7, R107)	2
-16	0683-1045	. RESISTOR, fxd, 100k, 5%, 1/4W (R10, R110)	2
-17	0683-6825	. RESISTOR, fxd, 6.8k, 5%, 1/4W (R6, R106)	2
-18	0683-4725	. RESISTOR, fxd, 4.7k, 5%, 1/4W (R11, R111)	2
-19	0683-1235	. RESISTOR, fxd, 12k, 5%, 1/4W (R13, R113)	2
-20	1901-0040	. DIODE, Si (CR4 thru CR8, CR105 thru CR108, CR204)	10
-21	1853-0015	. TRANSISTOR, PNP, Si, 2N3640 (Q7, Q10, Q18, Q21).	4
-22	1854-0071	. TRANSISTOR, NPN, Si (Q1 thru Q6, Q12 thru Q17)	12
-23	0180-1701	. CAPACITOR, fxd, 6.8 μF, 20%, 6 Vdcw (C1, C8, C9)	3
-24	0160-0155	. CAPACITOR, fxd, 0.0033 μF, 10% (C7, C107)	2
-25	1854-0270	. TRANSISTOR, NPN, Si, 2N4265 (Q8, Q9, Q11, Q19, Q20, Q22)	6
-26	1820-0077	. INTEGRATED CIRCUIT,type 7474N (U1, U2)	2
-27	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3)	1
-28	0180-0210	. CAPACITOR, fxd, 3.3 μF, 20%, 15 Vdcw (C2, C4, C10, C11, C102, C104)	6
-29	0160-3449	. CAPACITOR, fxd, 2000 pF, 10%, 250 Vdcw (C12, C112).	2
-30	1901-0450	. DIODE, Si (CR1, CR2, CR3, CR101, CR102, CR103)	6
-31	0160-0156	. CAPACITOR, fxd, 0.0039 μF, 10%, (C3, C103)	2
-32	0160-3572	. CAPACITOR, fxd, 330 pF, 10%, 500 Vdcw (C4, C105)	2

*A18A3 used only in 9-track applications.

Table 3-1. Part Number Cross Reference

HP PART NUMBER	MFR CODE	MFR PART NUMBER
0140-0193	28480	0140-0193
0140-0197	14655	RDM15F181J3C
0140-0198	72136	RDM15F201J3C
0160-0155	56289	192P33292-PTS
0160-0156	56289	192P39292-PTS
0160-0159	56289	192P68282-PTS
0160-0160	56289	192P82292-PTS
0160-0161	56289	192P10392-PTS
0160-0162	56289	192P22392-PTS
0160-2055	56289	C023F101F103ZS22-CDH
0160-2209	72136	RDM15F361J3C
0160-2213	28480	0160-2213
0160-2307	28480	0160-2307
0160-3449	56289	C067B251F202KS25-CDH
0160-3456	56289	C067F251F102KE12-CDH
0160-3572	56289	C067F501F331KS22-CDH
0160-3573	56289	C067F501F681KS22-CDH
0180-0210	56289	150D335X0015A2-DYS
0180-0228	56289	150D226X9015B2-DYS
0180-0291	56289	150D105X9035A2-DYS
0180-1701	28480	0180-1701
0180-1704	28480	0180-1704
0624-0077	00000	OBD
0624-0098	00000	OBD
0683-1015	01121	CB 1015
0683-1025	01121	CB 1025
0683-1035	01121	CB 1035
0683-1045	01121	CB 1045
0683-1235	01121	CB 1235
0683-1515	01121	CB 1515
0683-1525	01121	CB 1525
0683-2225	01121	CB 2225
0683-2235	01121	CB 2235
0683-2255	01121	CB 2255
0683-2725	01121	CB 2725
0683-3325	01121	CB 3325
0683-3335	01121	CB 3335
0683-3635	01121	CB 3635
0683-4325	01121	CB 4325
0683-4715	01121	CB 4715
0683-4725	01121	CB 4725
0683-4735	01121	CB 4735
0683-6815	01121	CB 6815
0683-6825	01121	CB 6825
0683-8235	01121	EB 8235
0698-3132	28480	0698-3132
0698-3438	28480	0698-3438
0698-4412	28480	0698-4412
0698-4477	28480	0698-4477
0757-0199	28480	0757-0199
0757-0279	28480	0757-0279
0757-0280	28480	0757-0280
0757-0401	28480	0757-0401
0757-0419	28480	0757-0419
0757-0428	28480	0757-0428
0757-0439	28480	0757-0439
0757-0442	28480	0757-0442
0757-0443	28480	0757-0443
0757-0444	28480	0757-0444
0757-0460	28480	0757-0460
0757-1094	28480	0757-1094
1251-0159	71785	251-15-30-261
1400-0292	95987	1/4-6B
1400-0795	05593	SWP-1/4XXT(100')
1810-0044	56289	200C1791-CRR
1820-0069	01295	SN7420N
1820-0077	01295	SN7474N
1820-0088	04713	MC851P
1820-0256	04713	MC858P
1820-0276	04713	MC 1033P
1820-0348	04713	MC844P
1820-0349	04713	MC849P
1853-0015	80131	2N3640
1853-0020	28480	1853-0020
1853-0036	80131	2N3906
1854-0071	28480	1854-0071
1854-0270	80131	2N4265
1855-0370	28480	1855-0370
1901-0040	07263	FDG1088
1901-0450	28480	1901-0450
2100-1758	28480	2100-1758
2100-1761	28480	2100-1761
2100-1972	28480	2100-1972
2140-0209	03508	382
2190-0007	28480	2190-0007
2190-0416	00000	OBD
2190-0452	95987	D6-140
2360-0195	00000	OBD
2360-0199	00000	OBD
2420-0001	78189	OBD
3030-0143	00000	OBD
3050-0228	80120	MS15795-305

SECTION IV
MAINTENANCE DIAGRAMS

This section contains schematic and parts location diagrams for the read/read modules of the 7970B/7970C Digital Magnetic Tape Units.

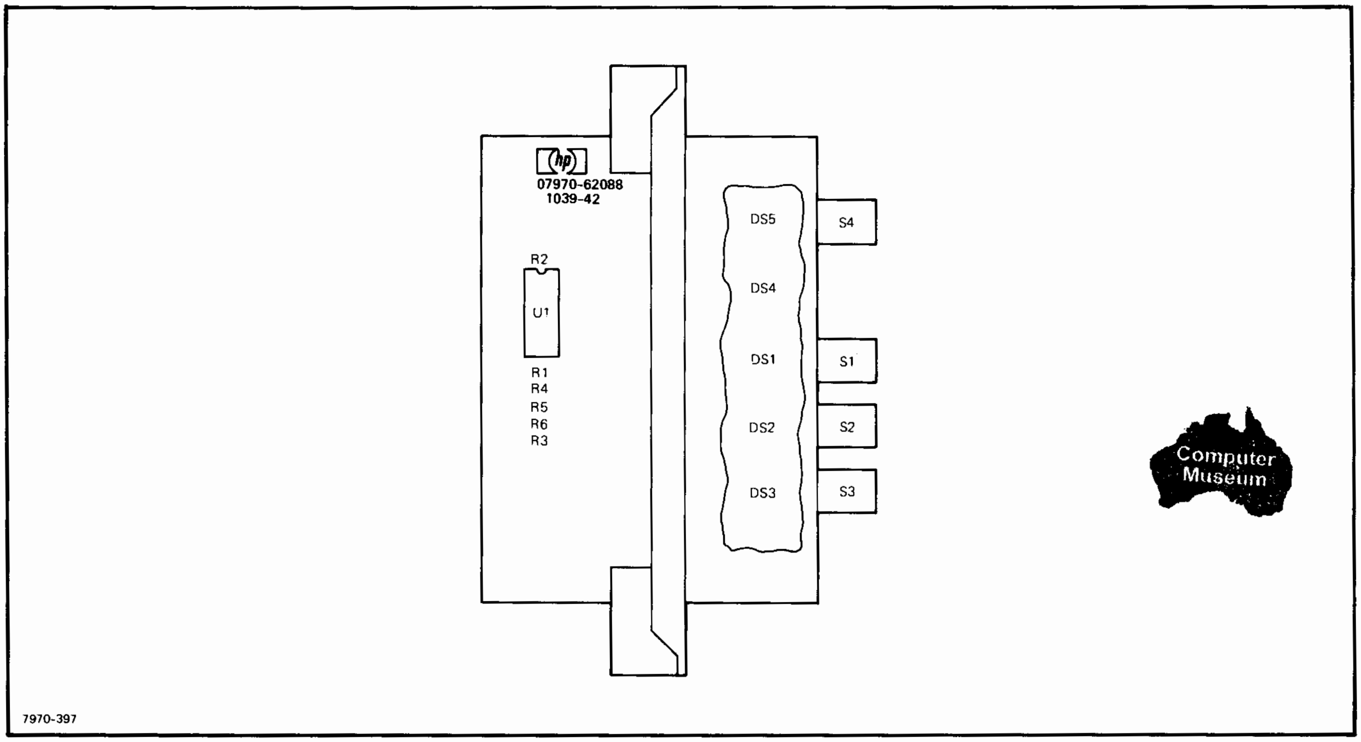


Figure 4-1. Read/Read Density Select Switch Assembly A12, Parts Location Diagram

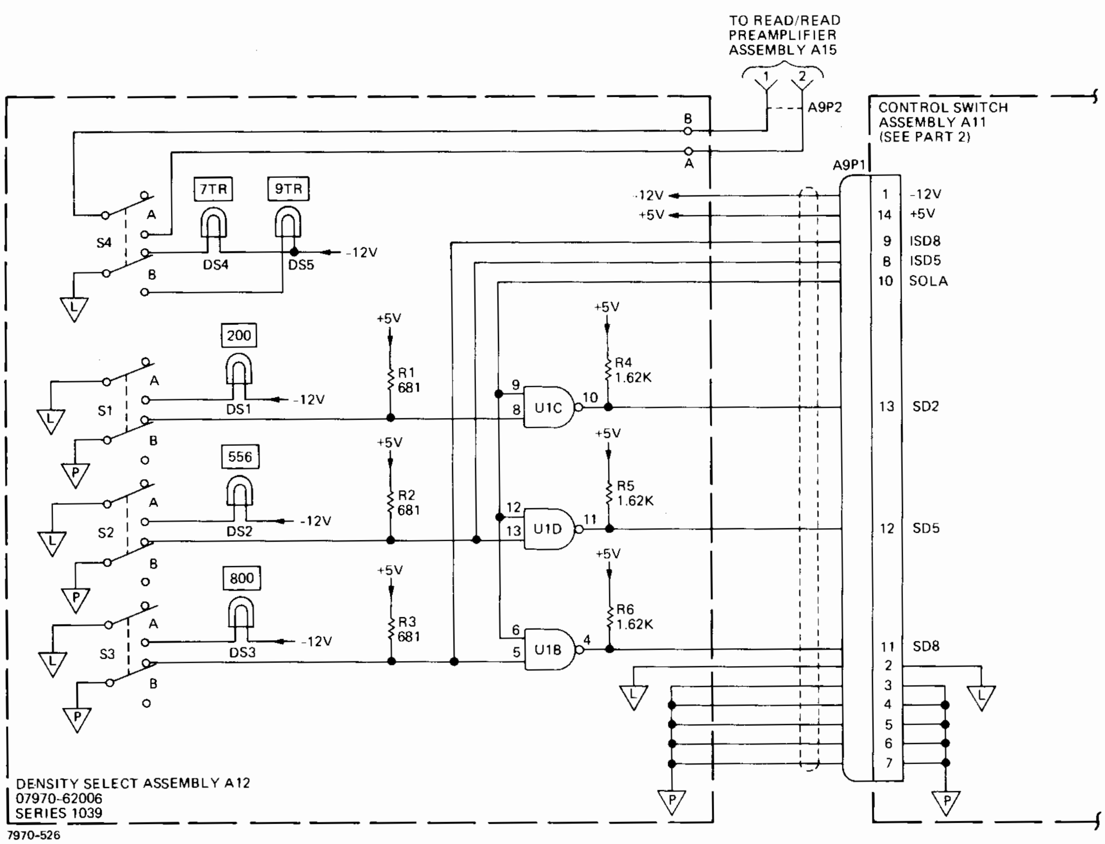
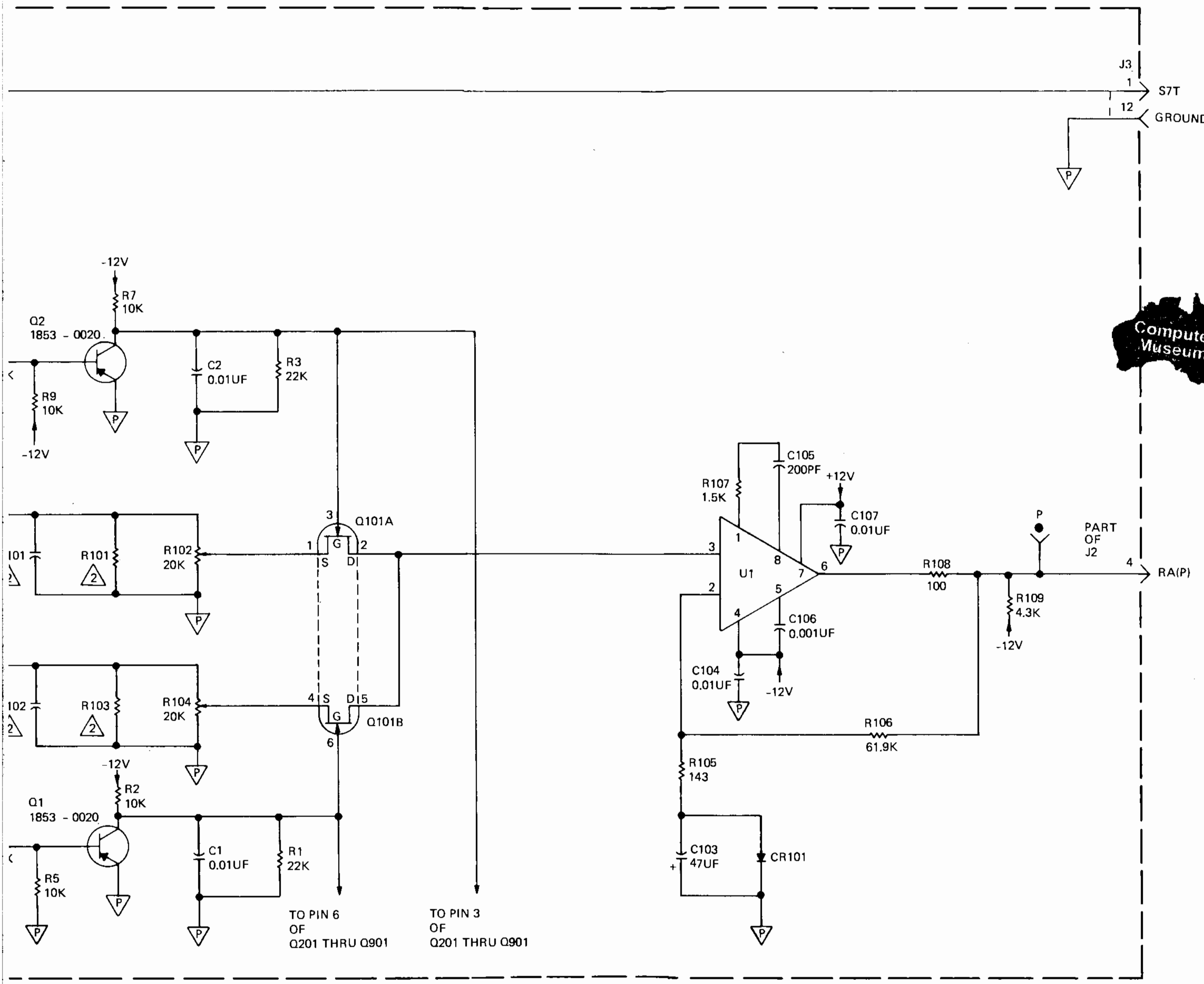


Figure 4-2. Read/Read Density Select Switch Assembly A12, Schematic Diagram



RKS
202 OMITTED
302 OMITTED

1 THIS PCB ASSEMBLY INCLUDES NINE IDENTICAL CIRCUITS. ONE SUCH CIRCUIT AND COMMON GATING, POWER, AND GROUNDING CIRCUITS ARE SHOWN. SHOULD AN INPUT SIGNAL BE NOT APPLICABLE(N/A), THE NORMALLY ASSOCIATED ADJUSTMENT NETWORK IS OMITTED AND THE SOURCE CONNECTION (PIN 1) OF THE ASSOCIATED FET RETURNED TO POWER GROUND. FOR SIGNAL AND REFERENCE DESIGNATIONS OF ALL NINE IDENTICAL CIRCUITS, SEE TABLE I.

2

SPEED	R101 R103	C101 C102	ASSEMBLY
10 – 20.9 21 – 45	6.8K 17.8K	620PF 270PF	07970 – 62001 07970 – 62012

7970-F-020A

Figure 4-4. Read/Read Preamplifier PC Assembly A15, Schematic Diagram

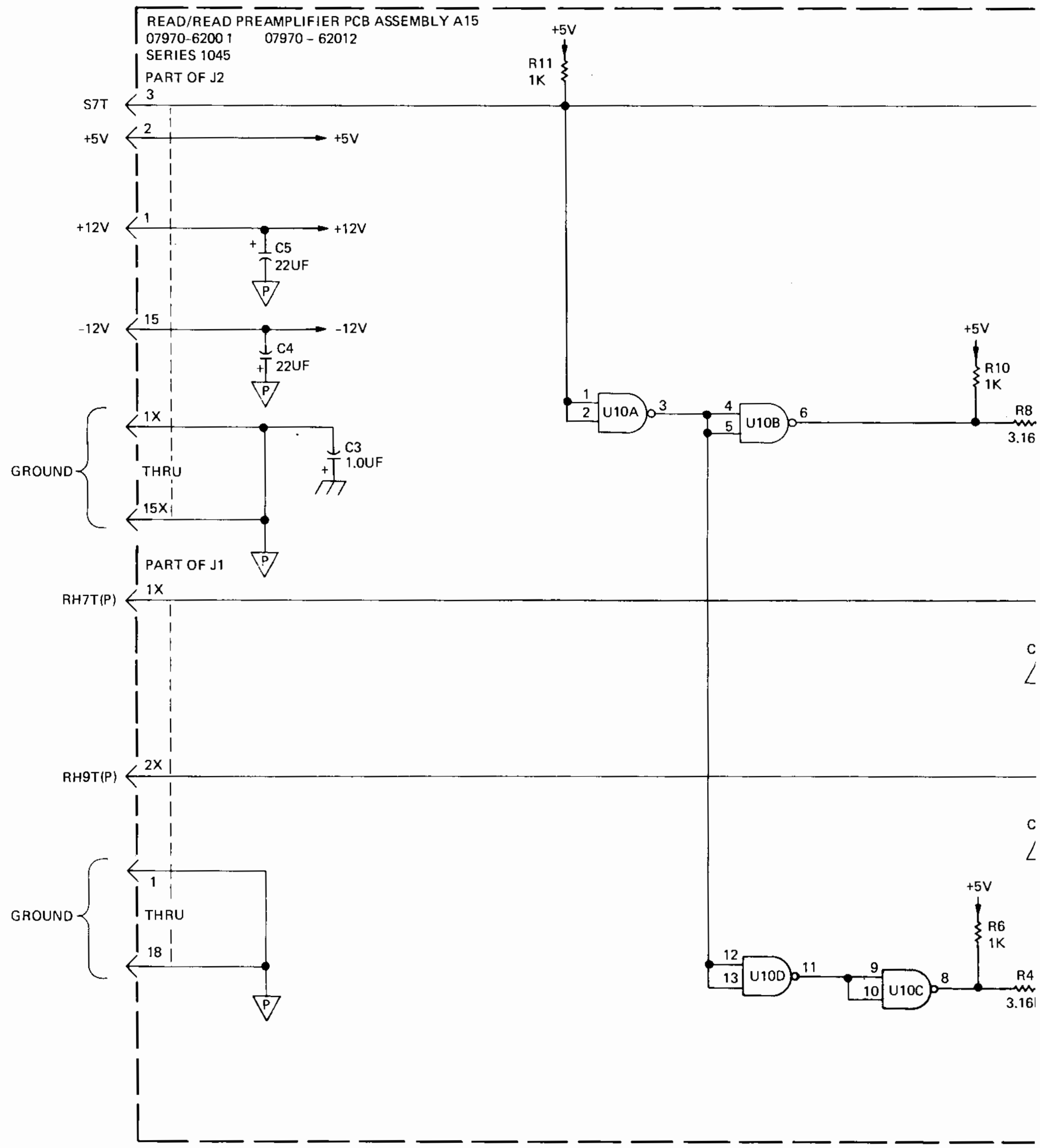


TABLE I

CONNECTOR J1 SIGNAL	CONNECTOR J1 PIN	CONNECTOR J2 SIGNAL	CONNECTOR J2 PIN	TEST POINT IDENT	REF DESIG SERIES (DEVICE AND COMMON CIRCUITS EXCEPTED)	REF DESIG (DEVICE ONLY)	REMA
RH7T(P) RH9T(P)	1X 2X	RA(P)	4	P	100	U1	
RH7T(N/A) RH9T(0)	– 4X	RA(0)	5	0	200	U2	C201, R201, F
RH7T(N/A) RH9T(1)	– 6X	RA(1)	6	1	300	U3	C301, R301, F
RH7T(2) RH9T(2)	7X 8X	RA(2)	7	2	400	U4	
RH7T(3) RH9T(3)	9X 10X	RA(3)	8	3	500	U5	
RH7T(4) RH9T(4)	11X 12X	RA(4)	9	4	600	U6	
RH7T(5) RH9T(5)	13X 14X	RA(5)	10	5	700	U7	
RH7T(6) RH9T(6)	15X 16X	RA(6)	11	6	800	U8	
RH7T(7) RH9T(7)	17X 18X	RA(7)	12	7	900	U9	

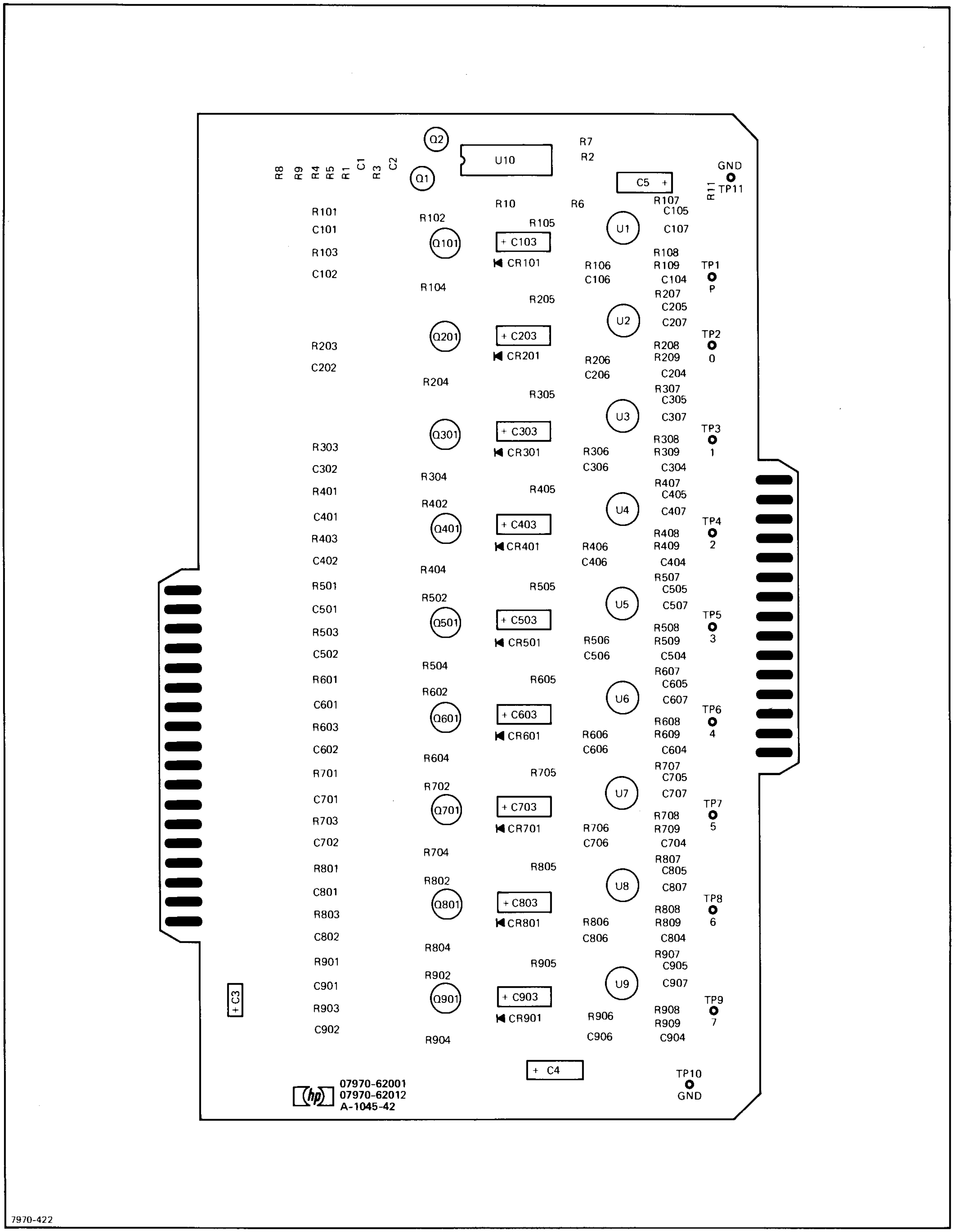


Figure 4-3. Read/Read Preamplifier PC Assembly A15, Parts Location Diagram

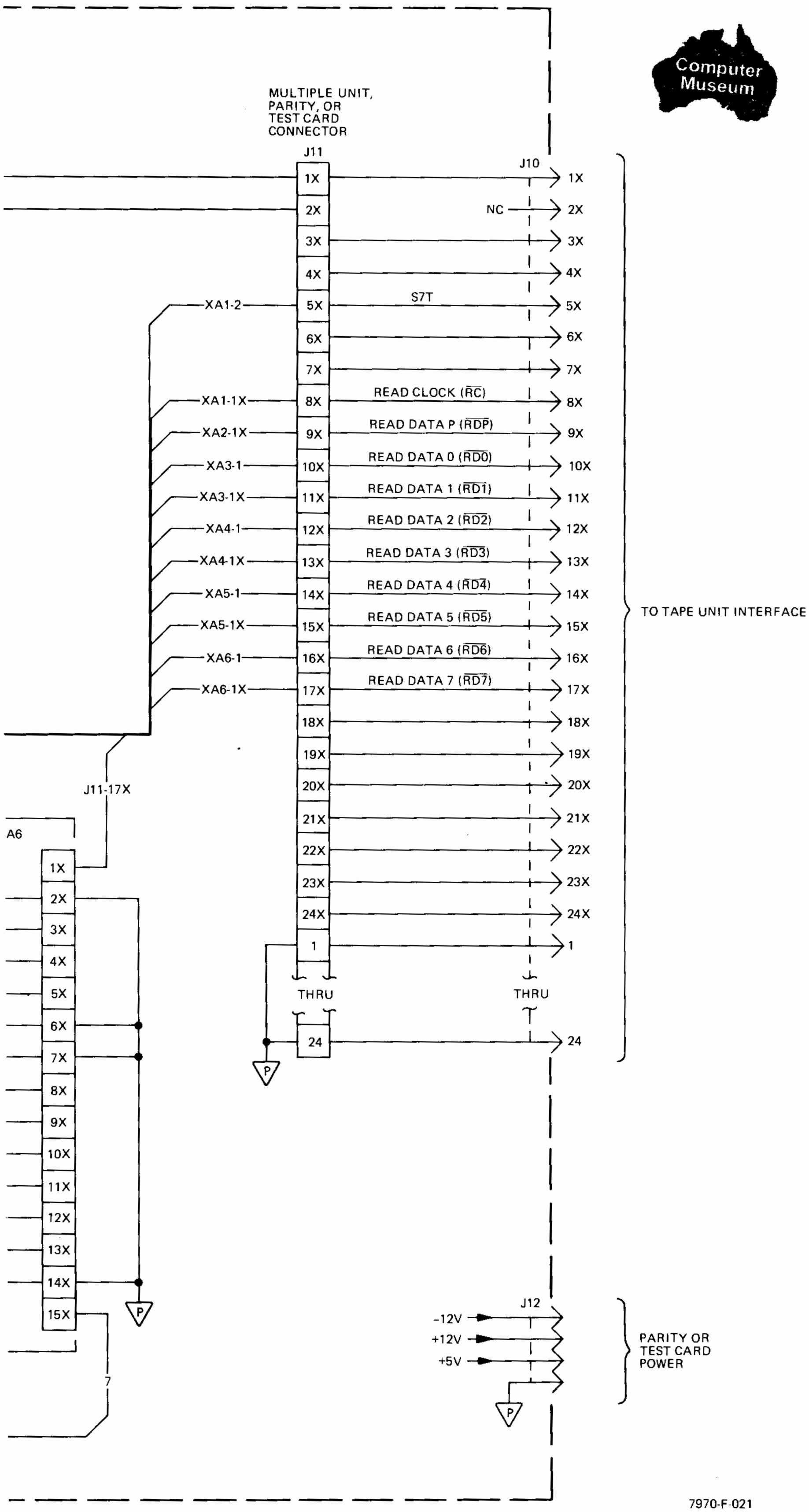
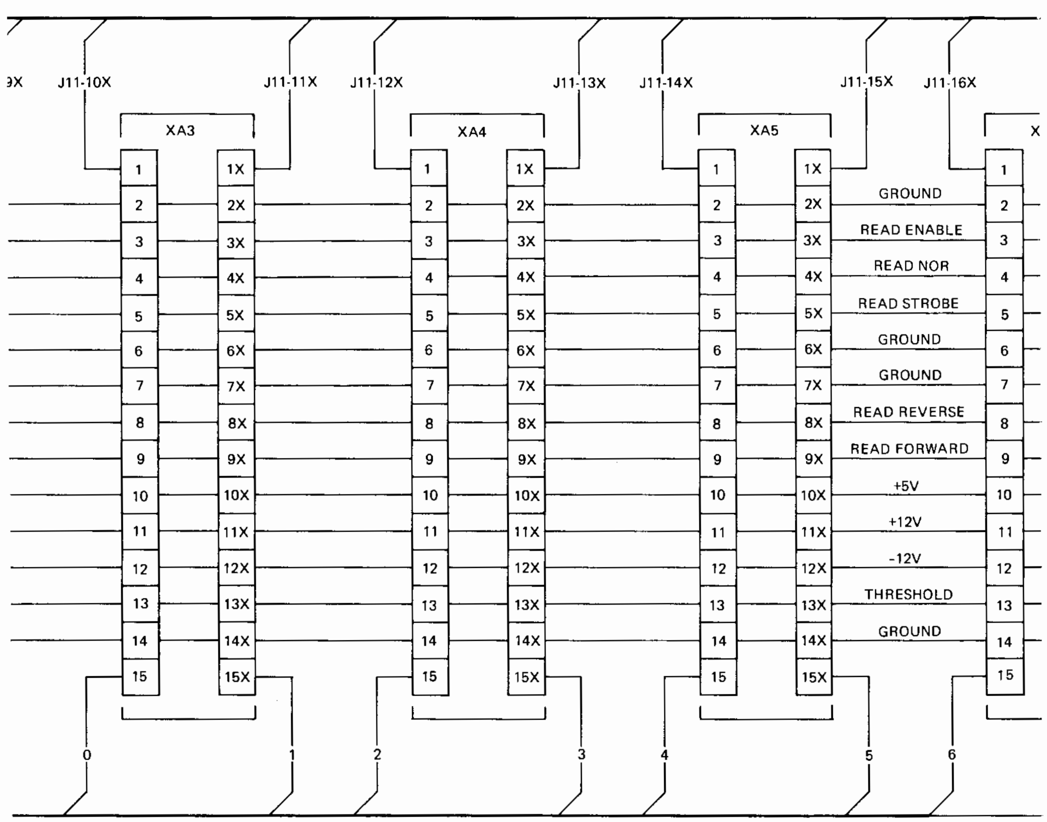
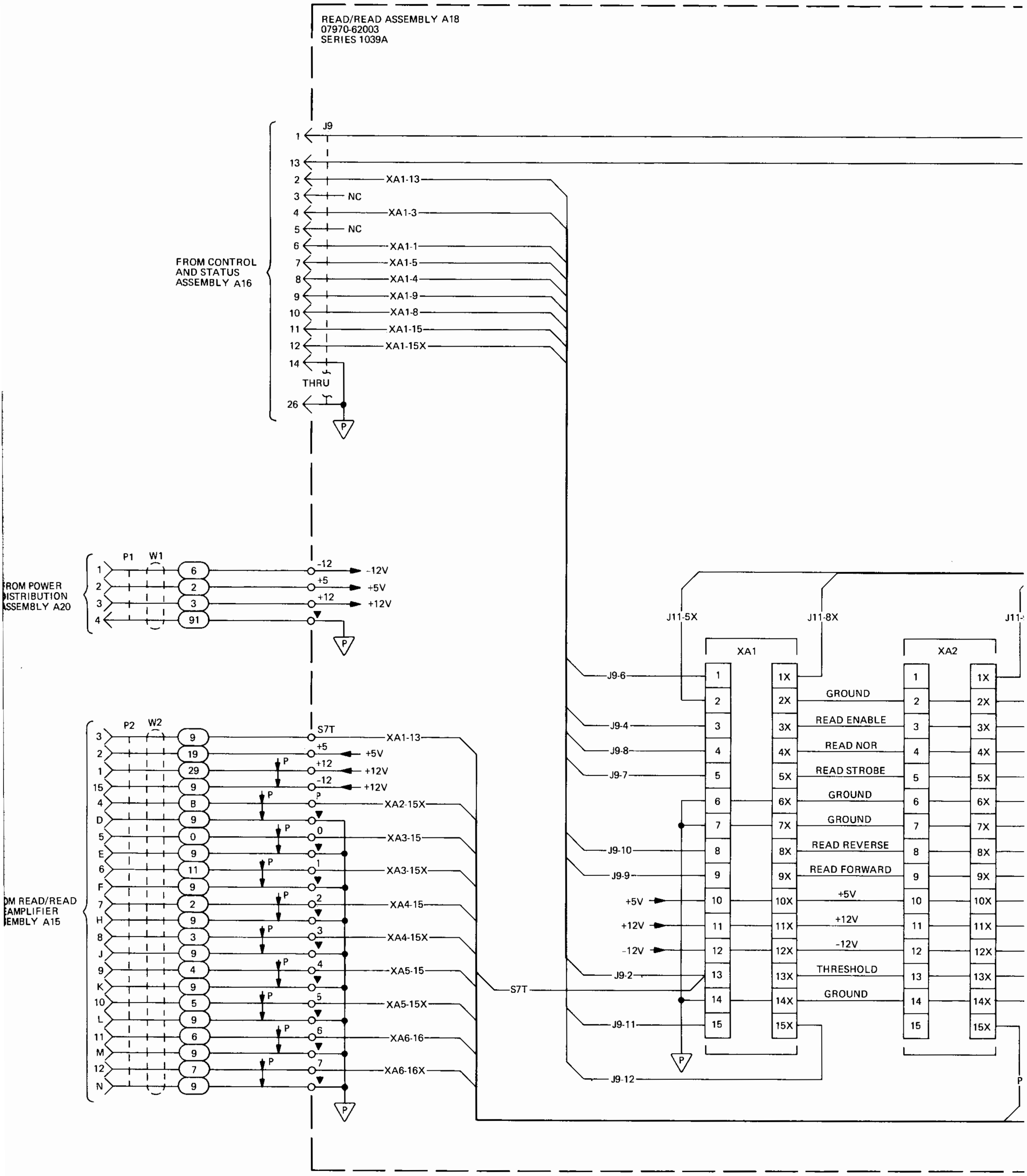


Figure 4-5. Read/Read Assembly A18, Schematic Diagram



J11-10X
J11-11X
J11-12X
J11-13X
J11-14X
J11-15X
J11-16X
XA3
XA4
XA5
GROUND
READ ENABLE
READ NOR
READ STROBE
GROUND
GROUND
READ REVERSE
READ FORWARD
+5V
+12V
-12V
THRESHOLD
GROUND



READ/READ ASSEMBLY A18
07970-62003
SERIES 1039A
FROM CONTROL AND STATUS ASSEMBLY A16
J9
THRU
NC
XA1-13
XA1-3
XA1-1
XA1-5
XA1-4
XA1-9
XA1-8
XA1-15
XA1-15X
FROM POWER DISTRIBUTION ASSEMBLY A20
P1
W1
P2
W2
-12V
+5V
+12V
S7T
XA2-15X
XA3-15
XA3-15X
XA4-15
XA4-15X
XA5-15
XA5-15X
XA6-16
XA6-16X
FROM READ/READ AMPLIFIER ASSEMBLY A15
J11-5X
J11-8X
XA1
XA2
J9-6
J9-4
J9-8
J9-7
J9-10
J9-9
J9-2
J9-11
J9-12
GROUND
READ ENABLE
READ NOR
READ STROBE
READ REVERSE
READ FORWARD
THRESHOLD

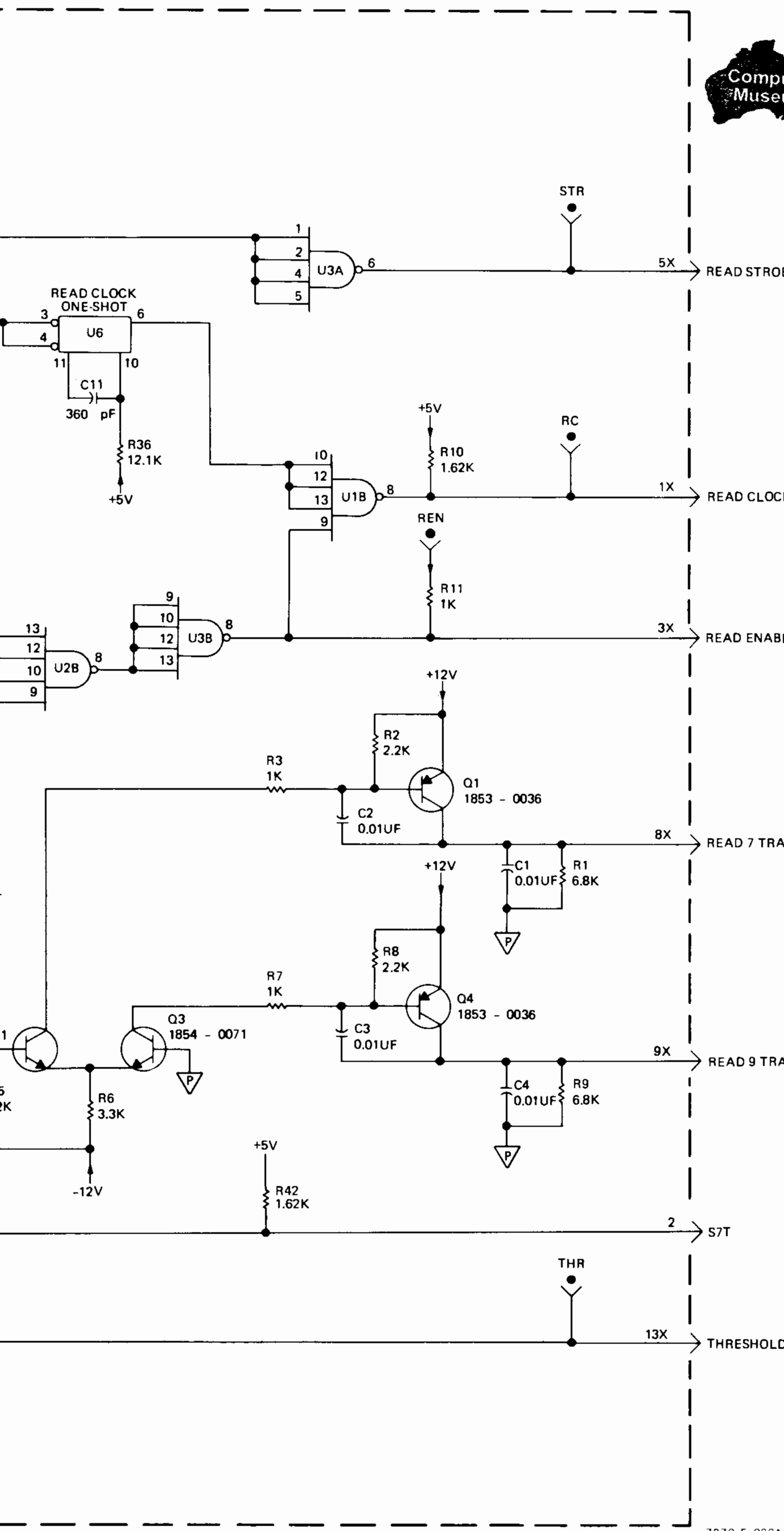
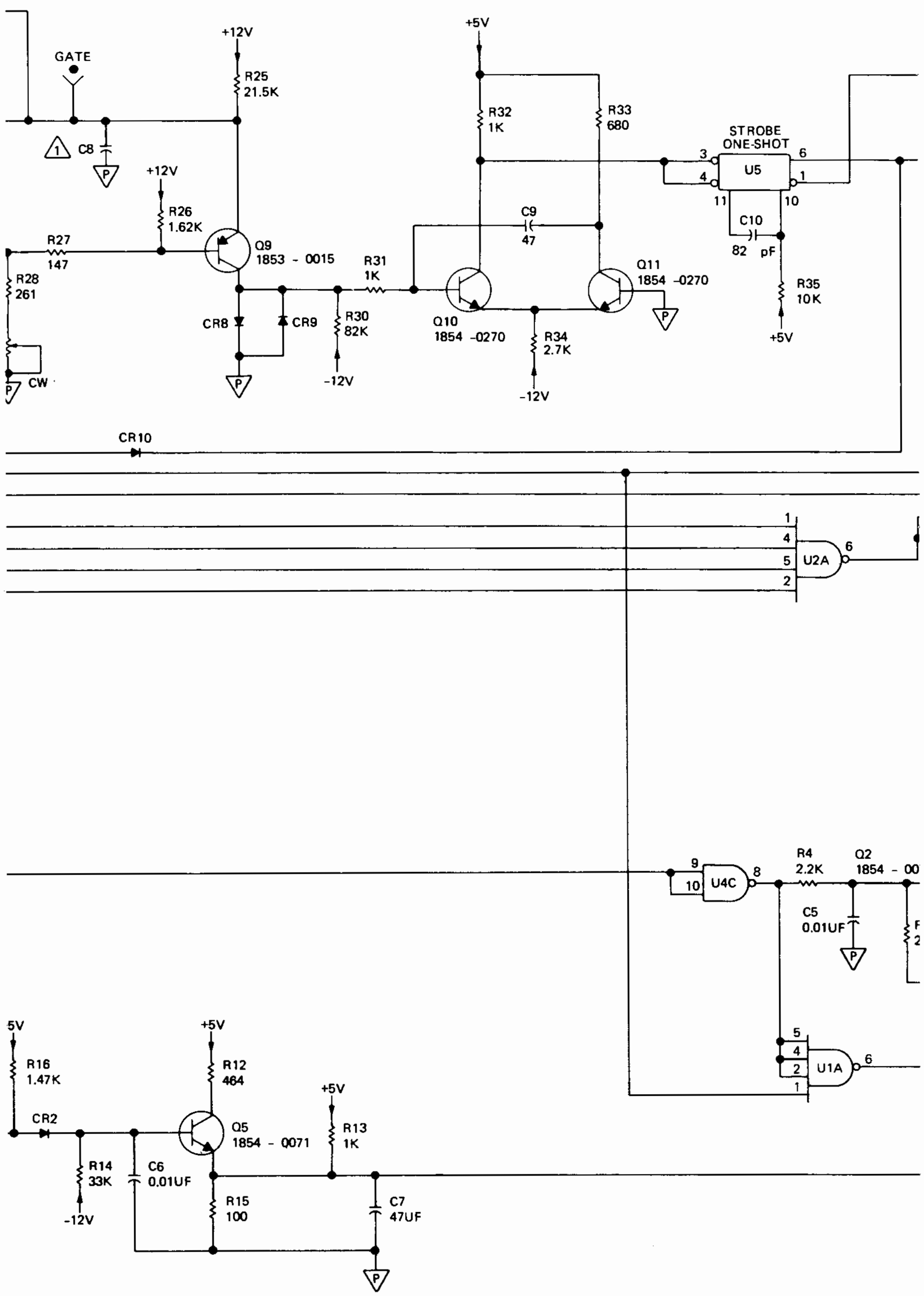
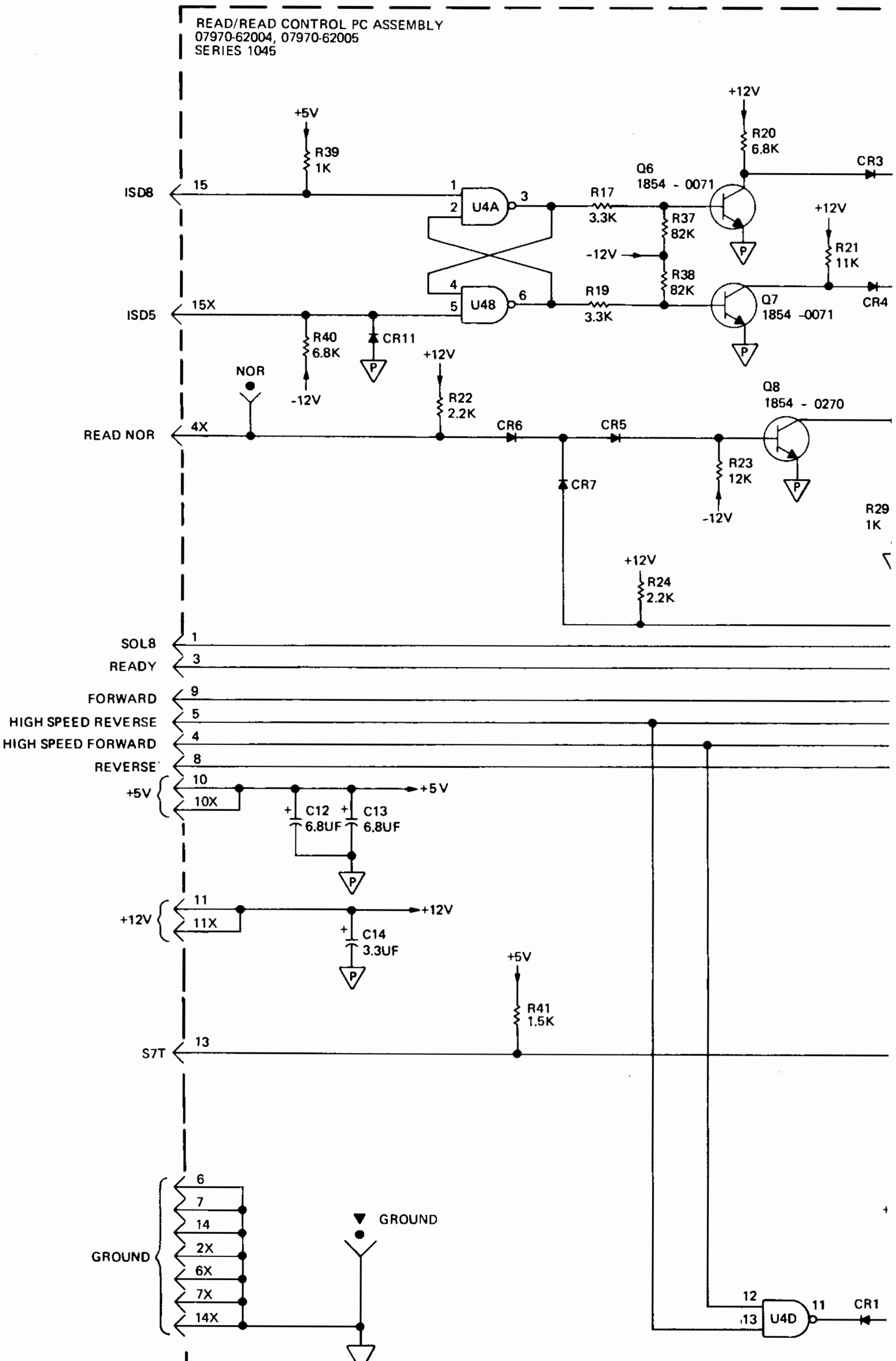


Figure 4-7. Read/Read Control PC Assembly A18A1, Schematic Diagram


GATE
+12V
R25
21.5K
C8
+12V
R26
1.62K
R27
147
R28
261
CW
Q9
1853 - 0015
CR8
CR9
R30
82K
-12V
R31
1K
+5V
R32
1K
R33
680
C9
47
Q10
1854 -0270
Q11
1854 -0270
R34
2.7K
-12V
STROBE
ONE-SHOT
U5
C10
82 pF
R35
10K
+5V
CR10
U2A
U4C
R4
2.2K
Q2
C5
0.01UF
U1A
5V
R16
1.47K
CR2
R14
33K
-12V
C6
0.01UF
+5V
R12
464
Q5
1854 - 0071
+5V
R13
1K
R15
100
C7
47UF



1 SPEED CRITICAL COMPONENTS

SPEED (IPS)		ASSEMBLY
10 - 20	0.02 UF	07970-62004
20 - 37-1/2	0.01 UF	07970-62005

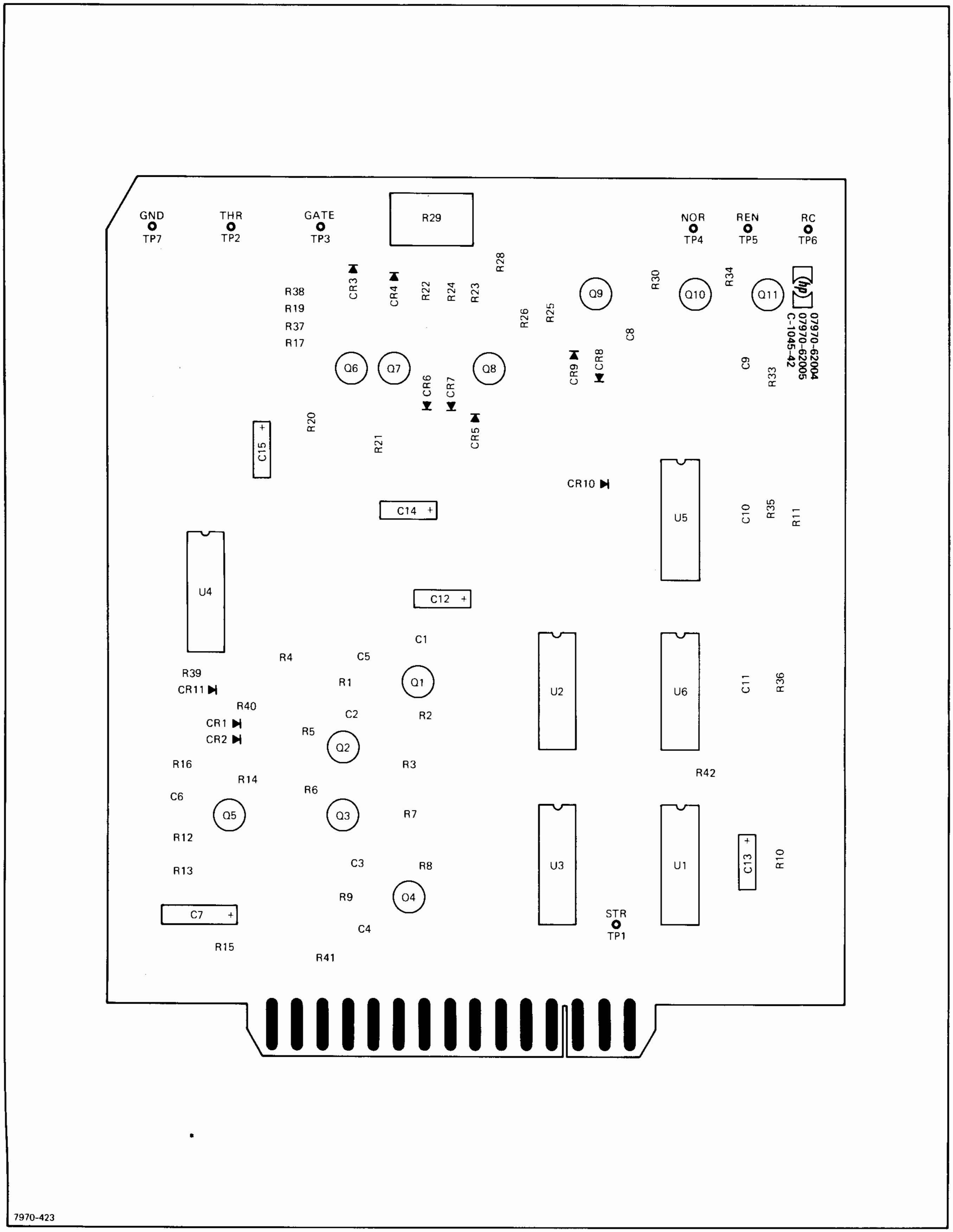


Figure 4-6. Read/Read Control PC Assembly A18A1, Parts Location Diagram

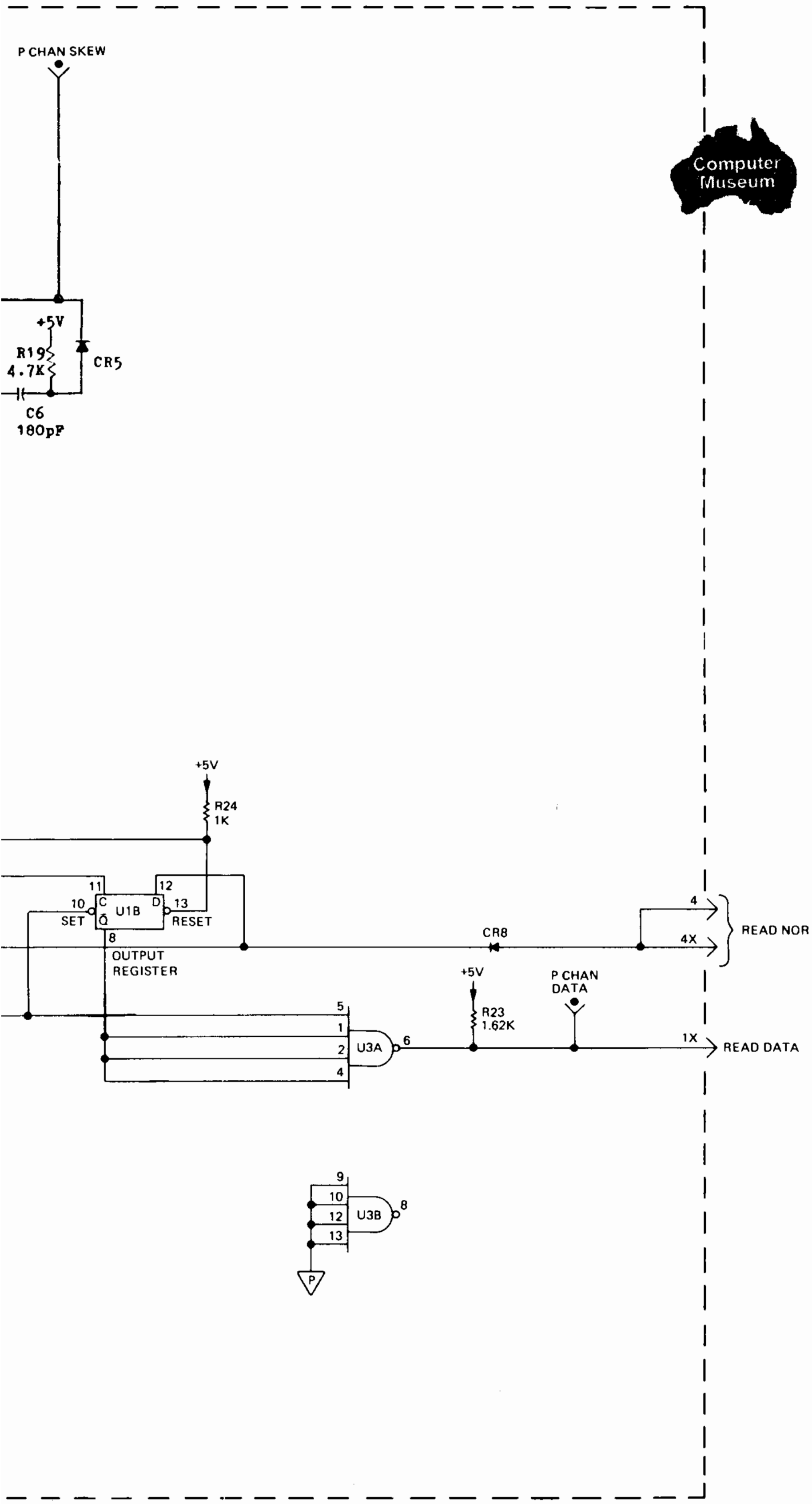
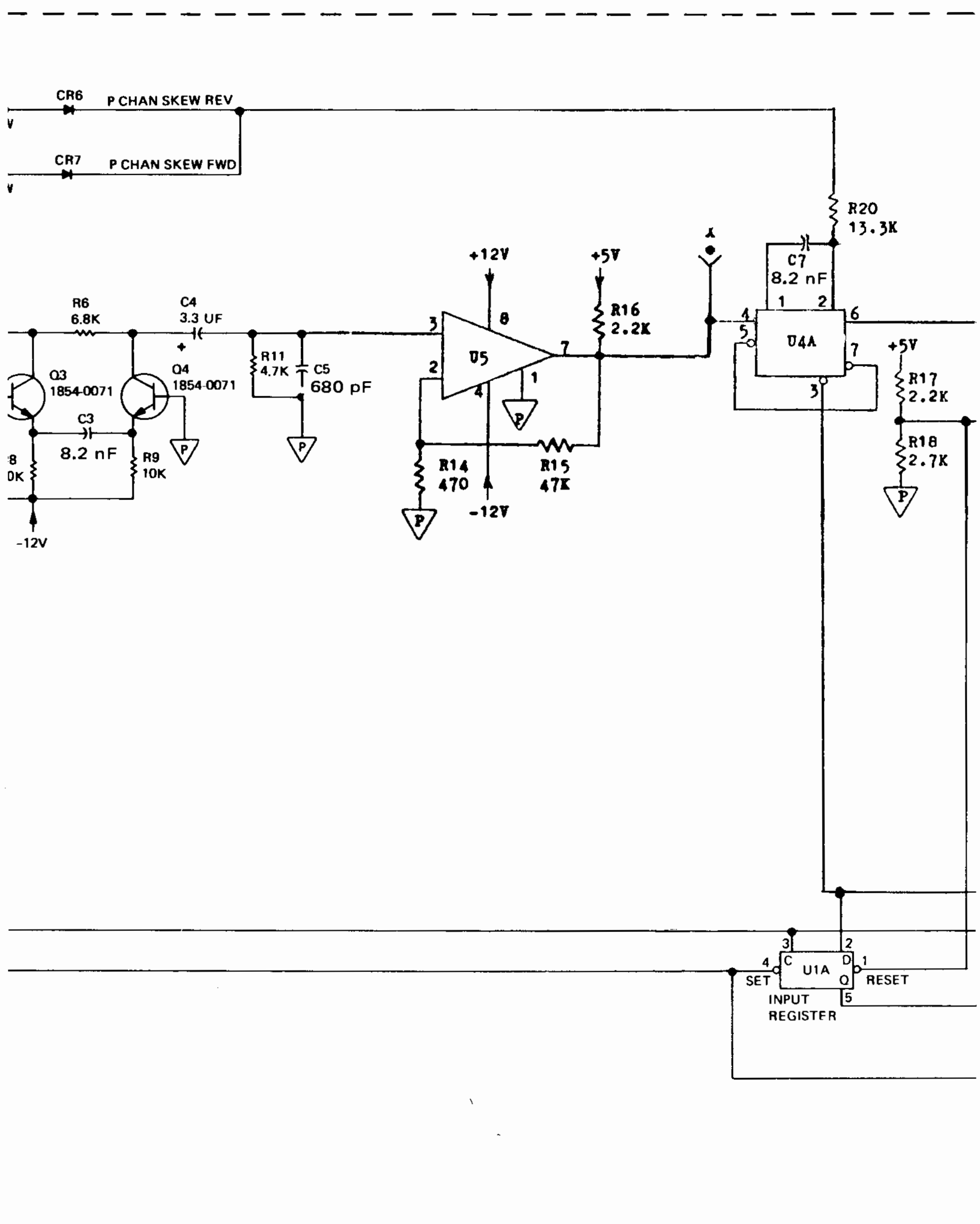
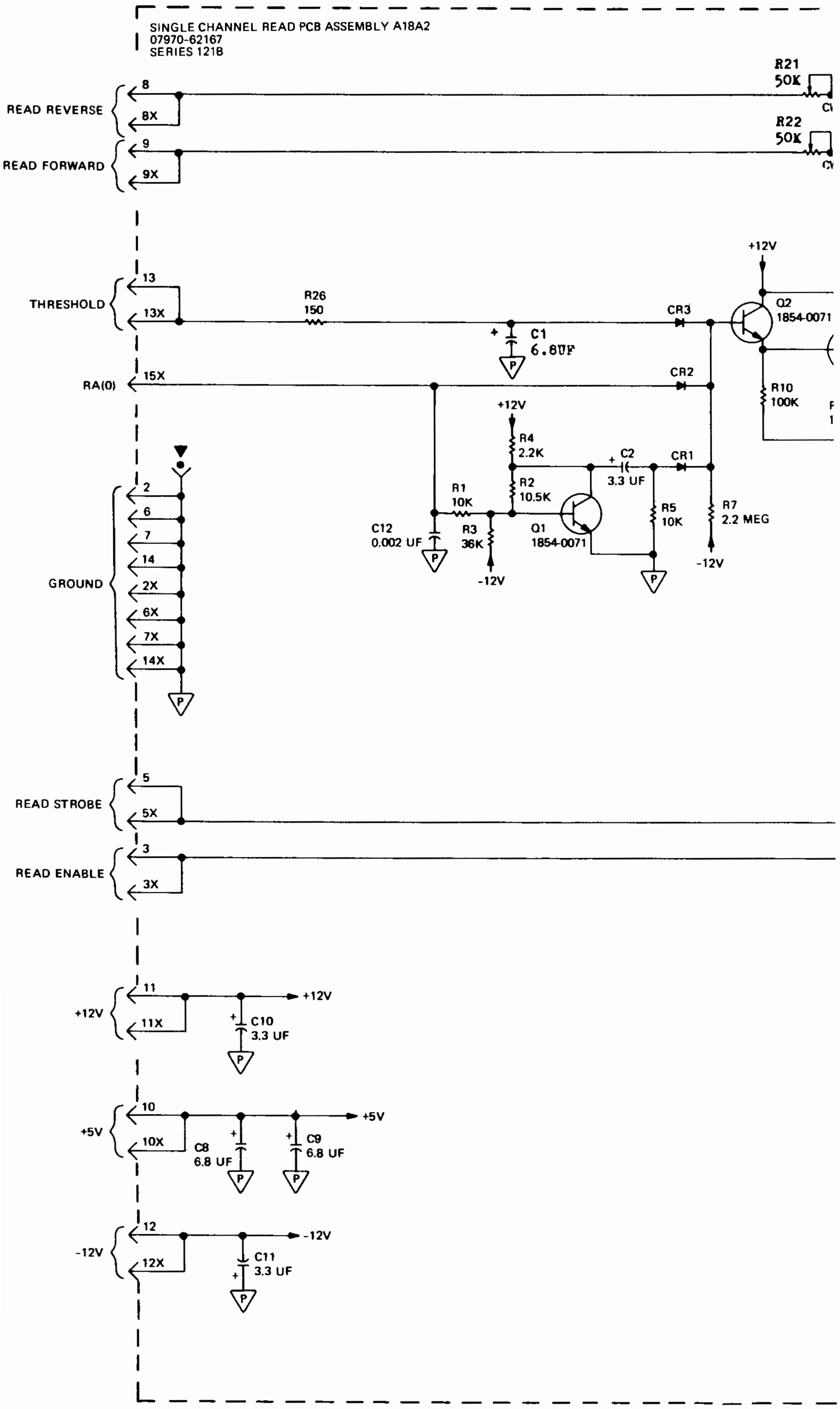


Figure 4-9. Single-Channel Read Data Assembly
(10 - 20.9 IPS), Schematic Diagram


CR6
P CHAN SKEW REV
CR7
P CHAN SKEW FWD
R20
13.3K
C7
8.2 nF
+12V
+5V
R6
6.8K
C4
3.3 UF
R11
4.7K
C5
680 pF
U5
R16
2.2K
U4A
+5V
R17
2.2K
R18
2.7K
Q3
1854-0071
Q4
1854-0071
C3
8.2 nF
R9
10K
R14
470
R15
47K
-12V
-12V
U1A
SET
RESET
INPUT
REGISTER


SINGLE CHANNEL READ PCB ASSEMBLY A18A2
07970-62167
SERIES 121B
READ REVERSE
READ FORWARD
THRESHOLD
RA(0)
GROUND
READ STROBE
READ ENABLE
+12V
+5V
-12V
R21
50K
R22
50K
R26
150
C1
6.8UF
CR3
CR2
CR1
Q2
1854-0071
R10
100K
R4
2.2K
R2
10.5K
R1
10K
R3
36K
C12
0.002 UF
Q1
1854-0071
C2
3.3 UF
R5
10K
R7
2.2 MEG
C10
3.3 UF
C8
6.8 UF
C9
6.8 UF
C11
3.3 UF
7970-530A

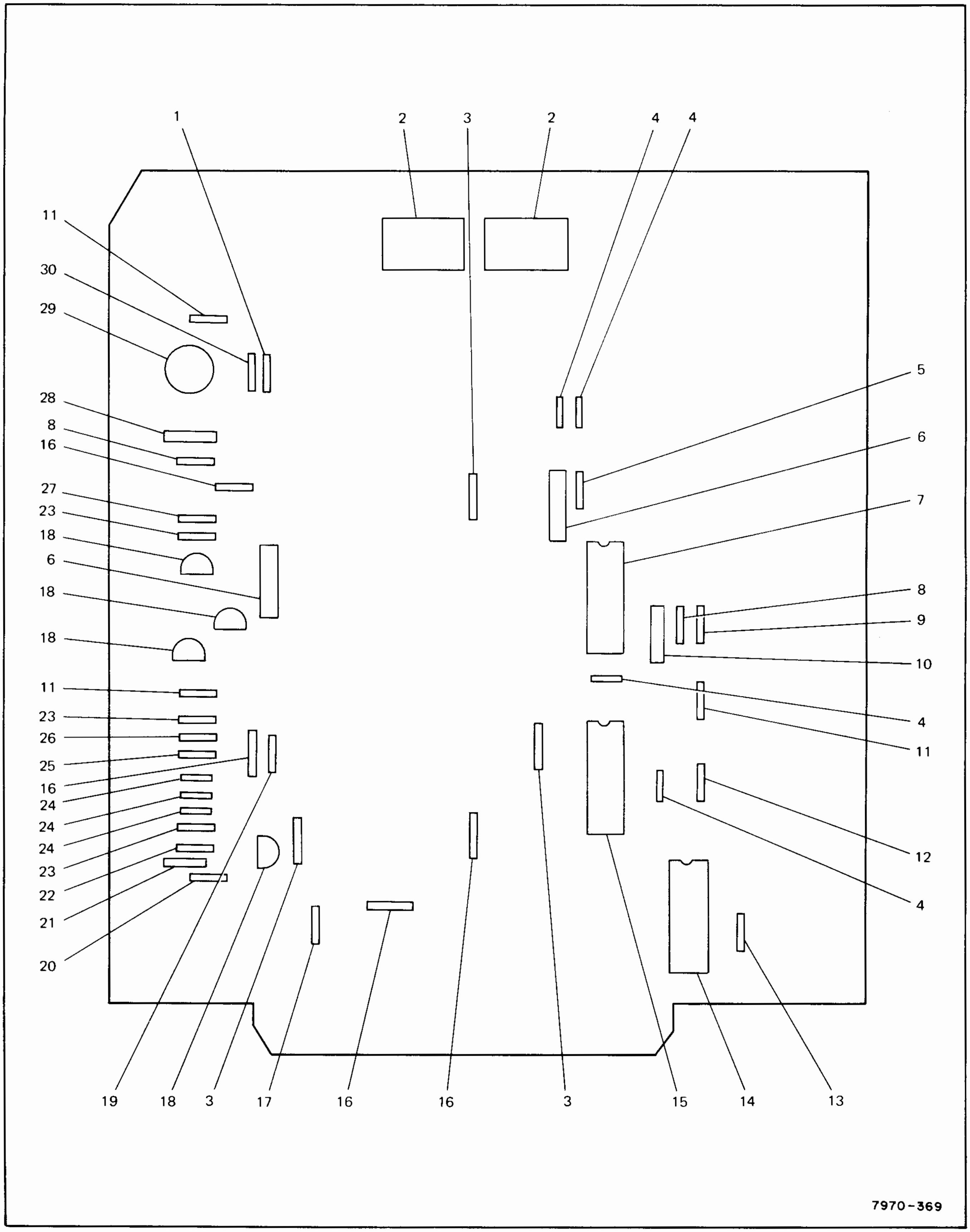


Figure 4-8. Single-Channel Read Data Assembly (10 - 20.9 IPS), Parts Location Diagram

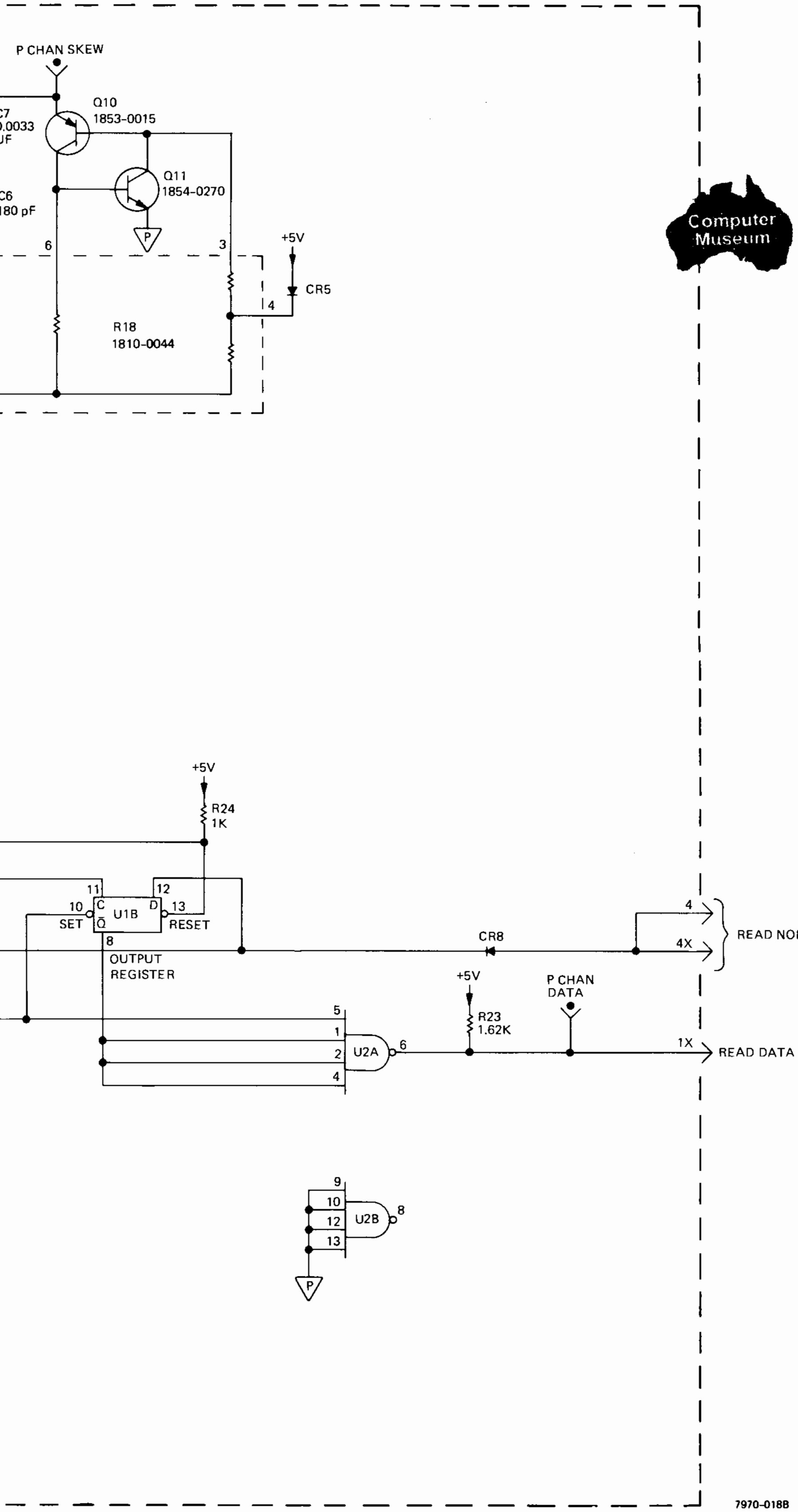
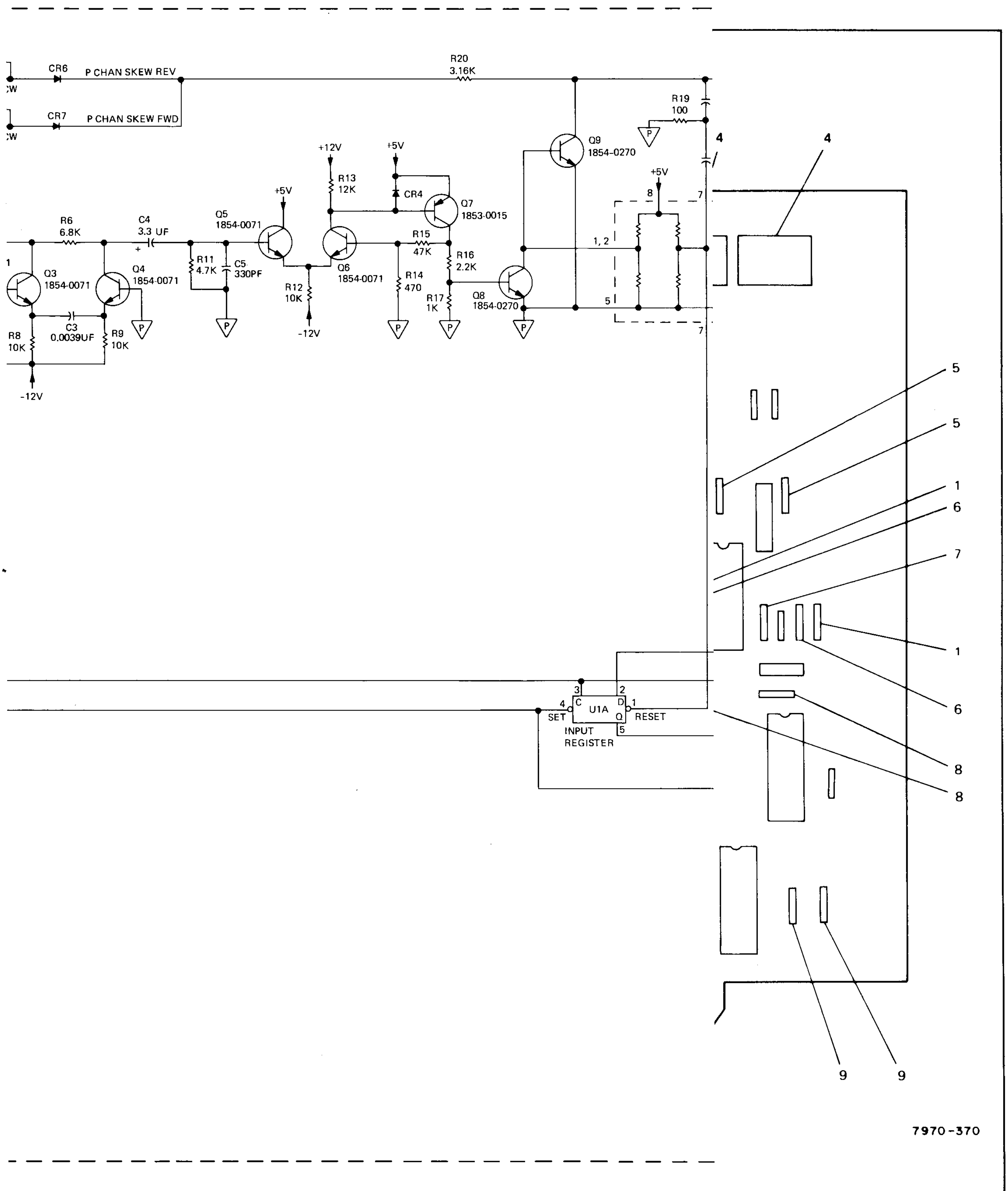
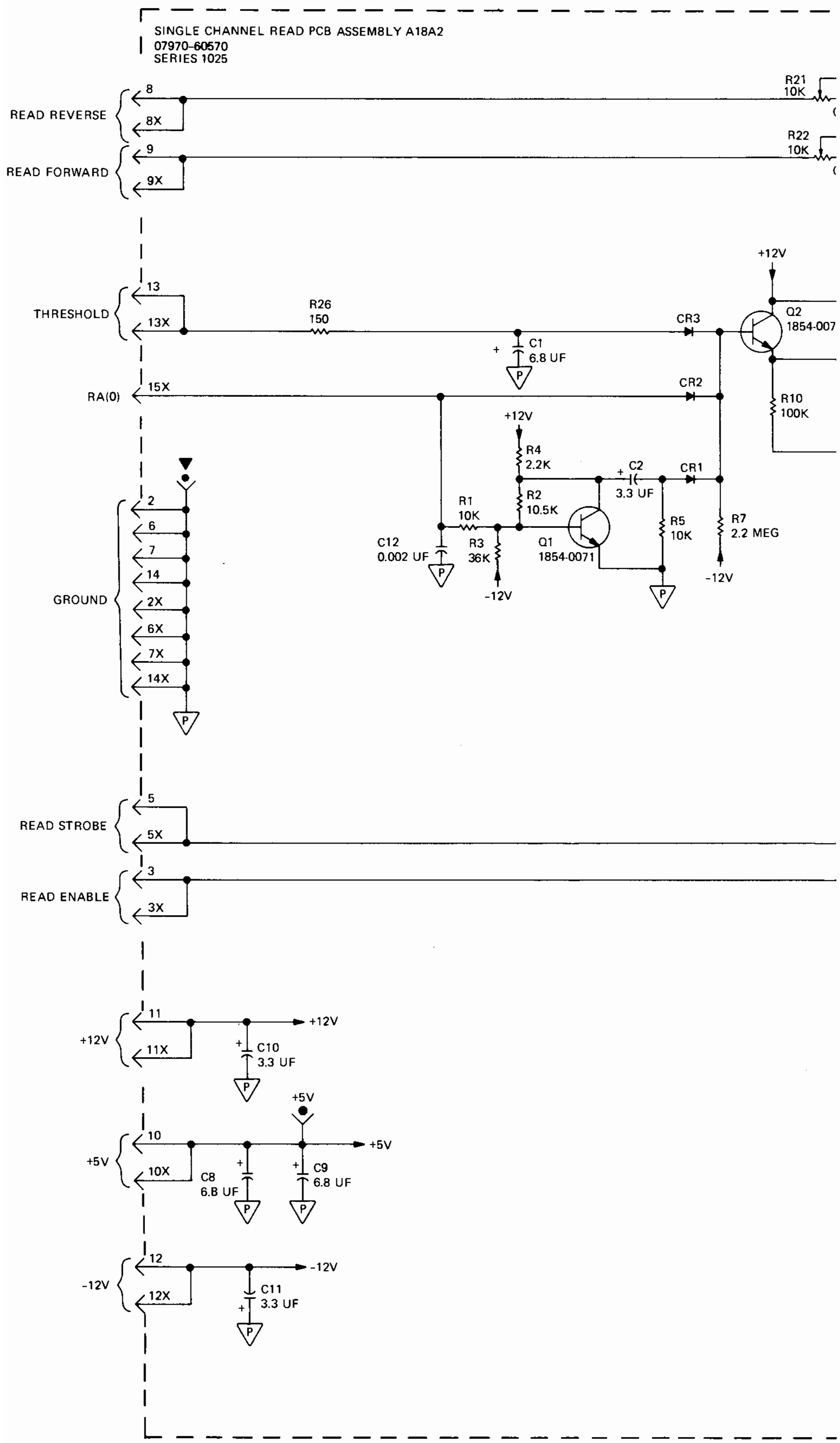


Figure 4-11. Single-Channel Read Data PC Assembly A18A2 (21 - 45 IPS), Schematic Diagram



tion Diagram (Sheet 1 of 2)



SINGLE CHANNEL READ PCB ASSEMBLY A18A2
07970-60570
SERIES 1025
READ REVERSE
READ FORWARD
THRESHOLD
RA(0)
GROUND
READ STROBE
READ ENABLE
+12V
+5V
-12V
R21 10K
R22 10K
R26 150
C1 6.8 UF
CR3
CR2
CR1
Q2 1854-007
R10 100K
R4 2.2K
R2 10.5K
R1 10K
R3 36K
C12 0.002 UF
Q1 1854-0071
C2 3.3 UF
R5 10K
R7 2.2 MEG
C10 3.3 UF
C8 6.8 UF
C9 6.8 UF
C11 3.3 UF

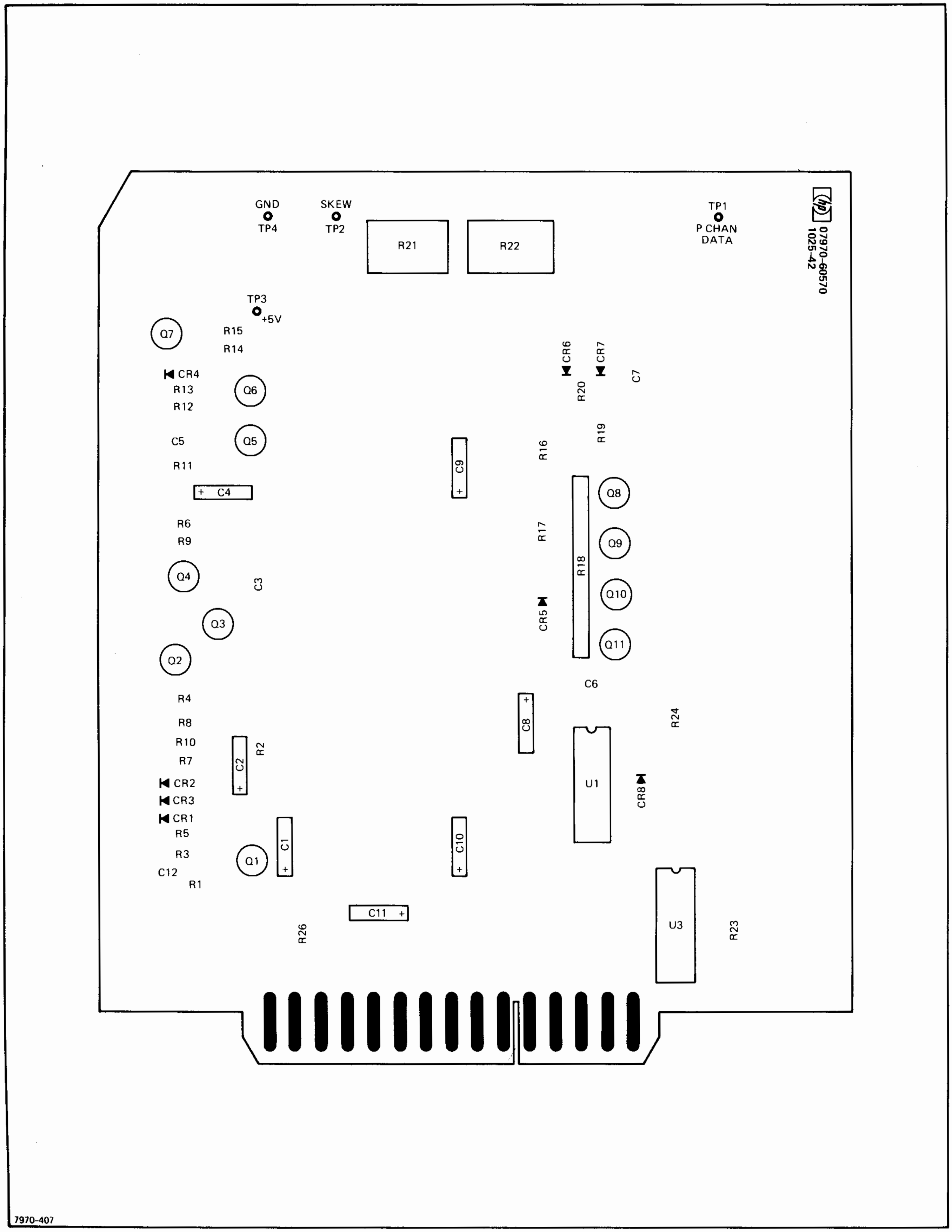


Figure 4-10. Single-Channel Read Data PC Assembly A18A2 (21 - 45 IPS), Parts Location Diagram

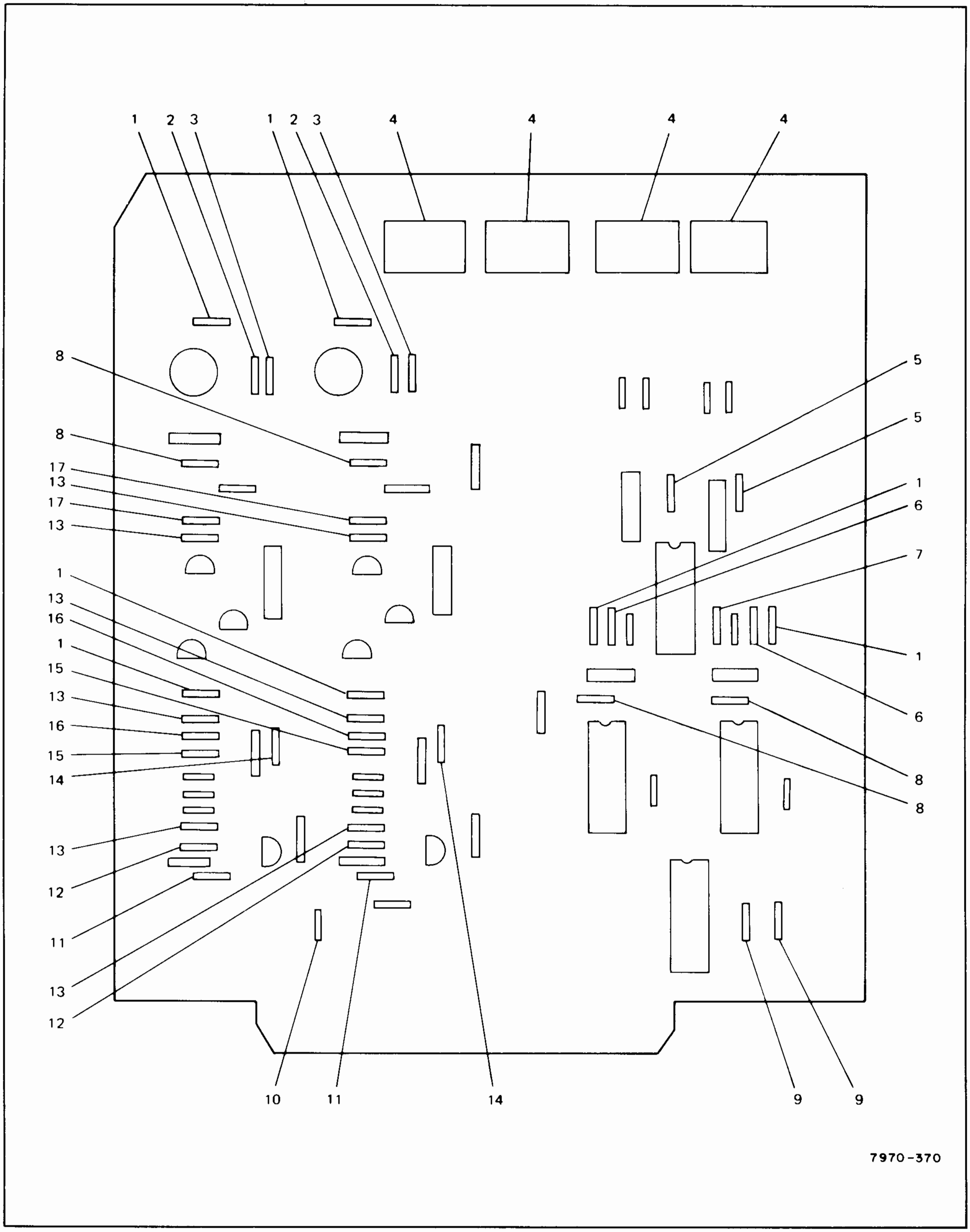


Figure 4-12. Dual-Channel Read Data Assembly (10 - 20.9 ips), Parts Location Diagram (Sheet 1 of 2)

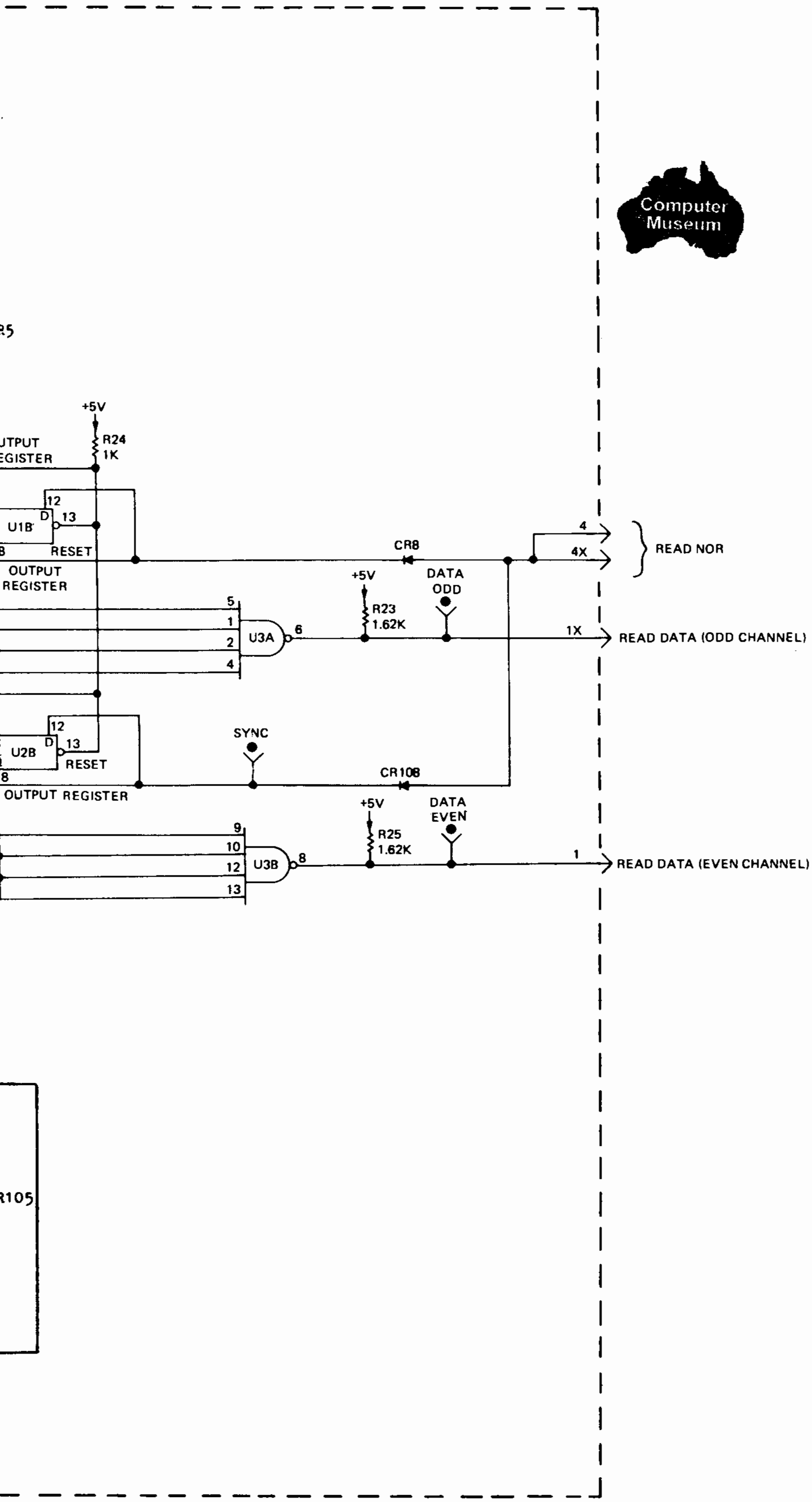
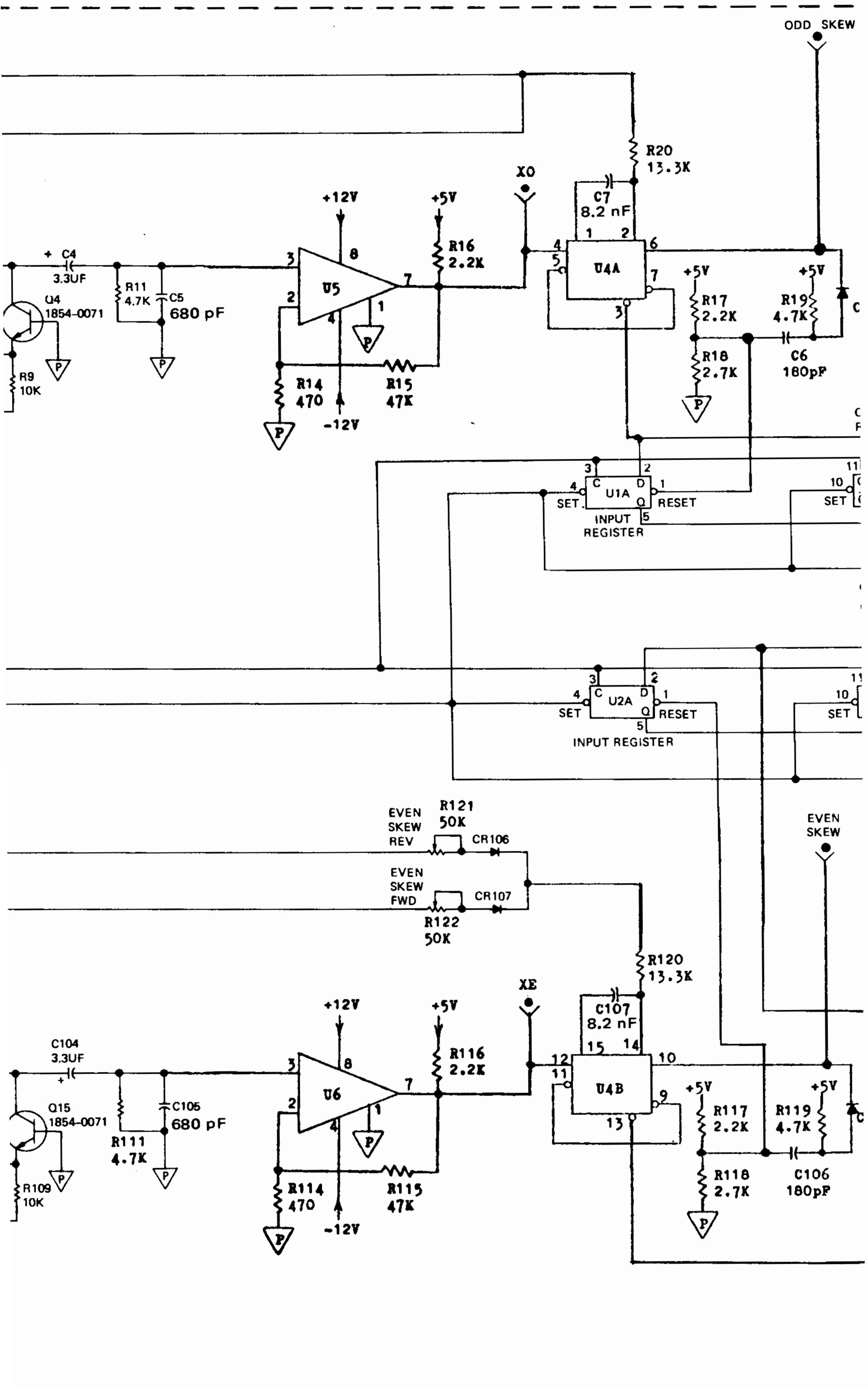
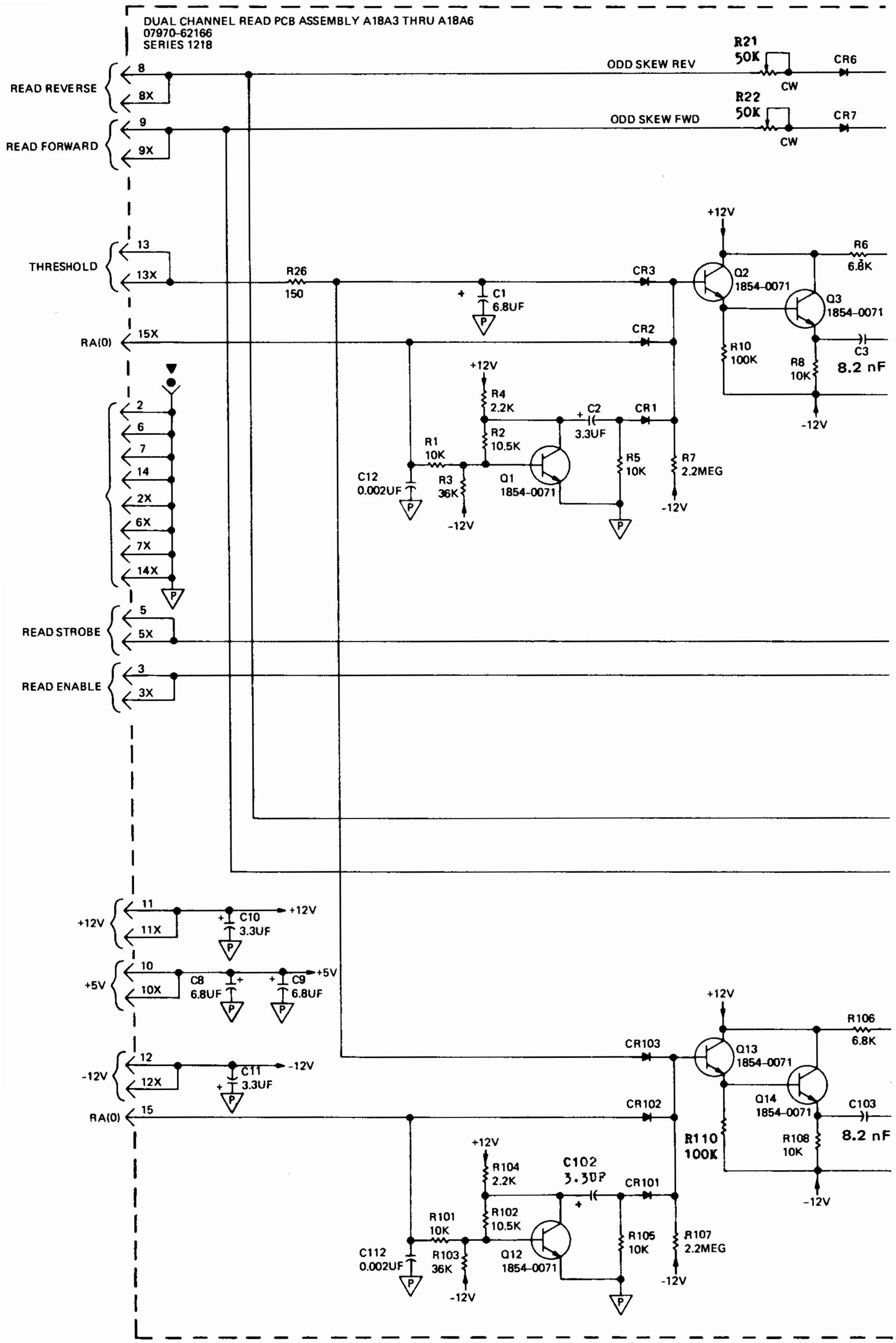


Figure 4-13. Dual-Channel Read Data Assembly (10 - 20.9 IPS), Schematic Diagram



ODD SKEW
R20
13.3K
XO
C7
8.2 nF
+12V
+5V
R16
2.2K
U4A
+5V
R17
2.2K
+5V
R19
4.7K
C4
3.3UF
R11
4.7K
C5
680 pF
U5
Q4
1854-0071
R18
2.7K
C6
180pF
R9
10K
R14
470
R15
47K
-12V
U1A
SET
RESET
INPUT
REGISTER
SET
U2A
SET
RESET
INPUT REGISTER
SET
EVEN
SKEW
REV
R121
50K
CR106
EVEN
SKEW
FWD
CR107
R122
50K
EVEN
SKEW
R120
13.3K
XE
C107
8.2 nF
+12V
+5V
R116
2.2K
U4B
C104
3.3UF
U6
+5V
R117
2.2K
+5V
R119
4.7K
Q15
1854-0071
C105
680 pF
R111
4.7K
R118
2.7K
C106
180pF
R109
10K
R114
470
R115
47K
-12V



DUAL CHANNEL READ PCB ASSEMBLY A18A3 THRU A18A6
07970-62166
SERIES 1218
READ REVERSE
READ FORWARD
THRESHOLD
RA(0)
READ STROBE
READ ENABLE
+12V
+5V
-12V
ODD SKEW REV
ODD SKEW FWD
R21 50K
R22 50K
CW
CR6
CR7
R26 150
C1 6.8UF
CR3
CR2
CR1
Q2 1854-0071
Q3 1854-0071
R6 6.8K
C3 8.2 nF
R10 100K
R8 10K
R4 2.2K
R2 10.5K
C2 3.3UF
R1 10K
R3 36K
Q1 1854-0071
C12 0.002UF
R5 10K
R7 2.2MEG
C10 3.3UF
C8 6.8UF
C9 6.8UF
C11 3.3UF
CR103
CR102
CR101
Q13 1854-0071
Q14 1854-0071
R106 6.8K
C103 8.2 nF
R110 100K
R108 10K
R104 2.2K
R102 10.5K
C102 3.3UF
R101 10K
R103 36K
Q12 1854-0071
C112 0.002UF
R105 10K
R107 2.2MEG

7970-531A

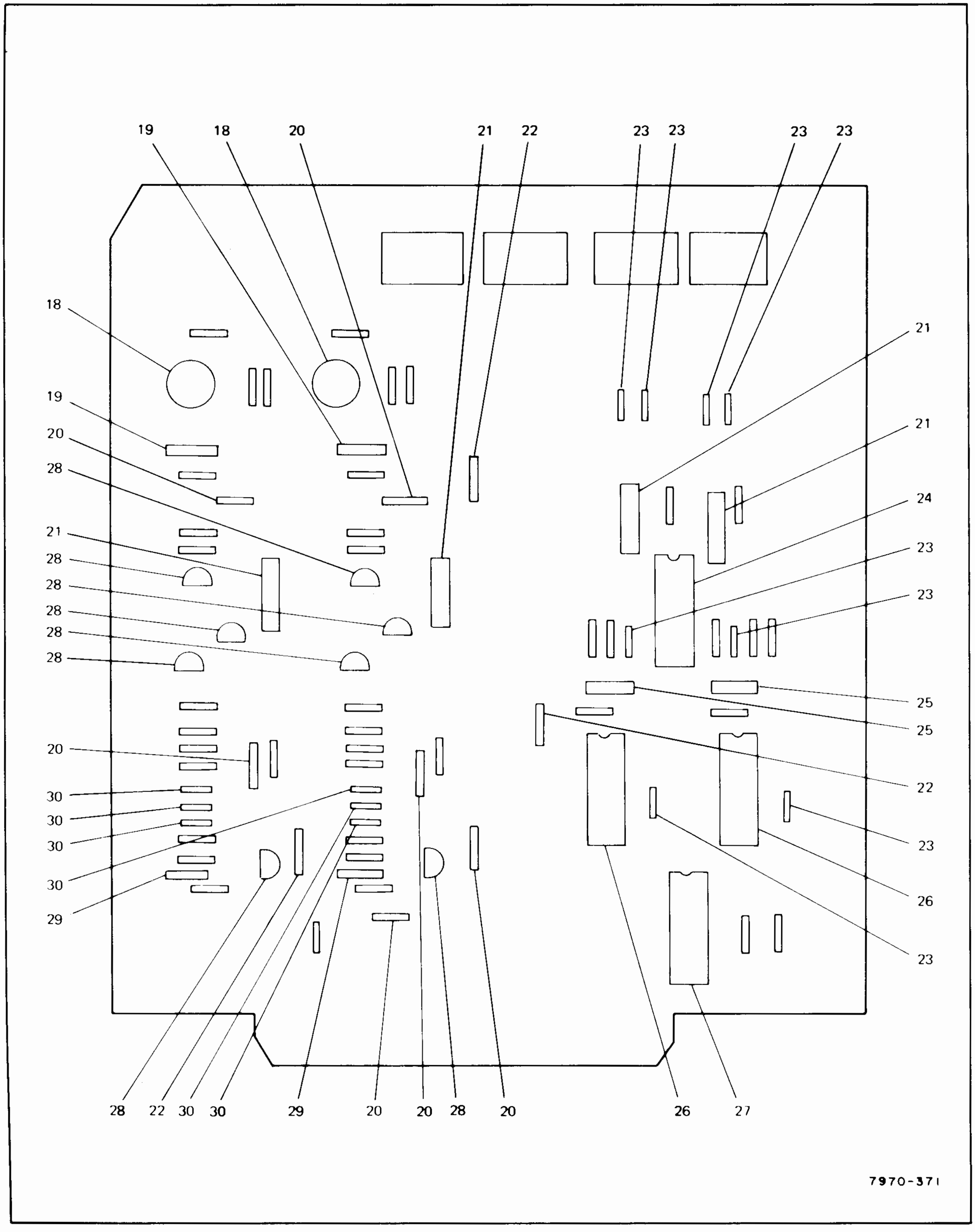


Figure 4-12. Dual-Channel Read Data Assembly (10 - 20.9 ips), Parts Location Diagram (Sheet 2 of 2)

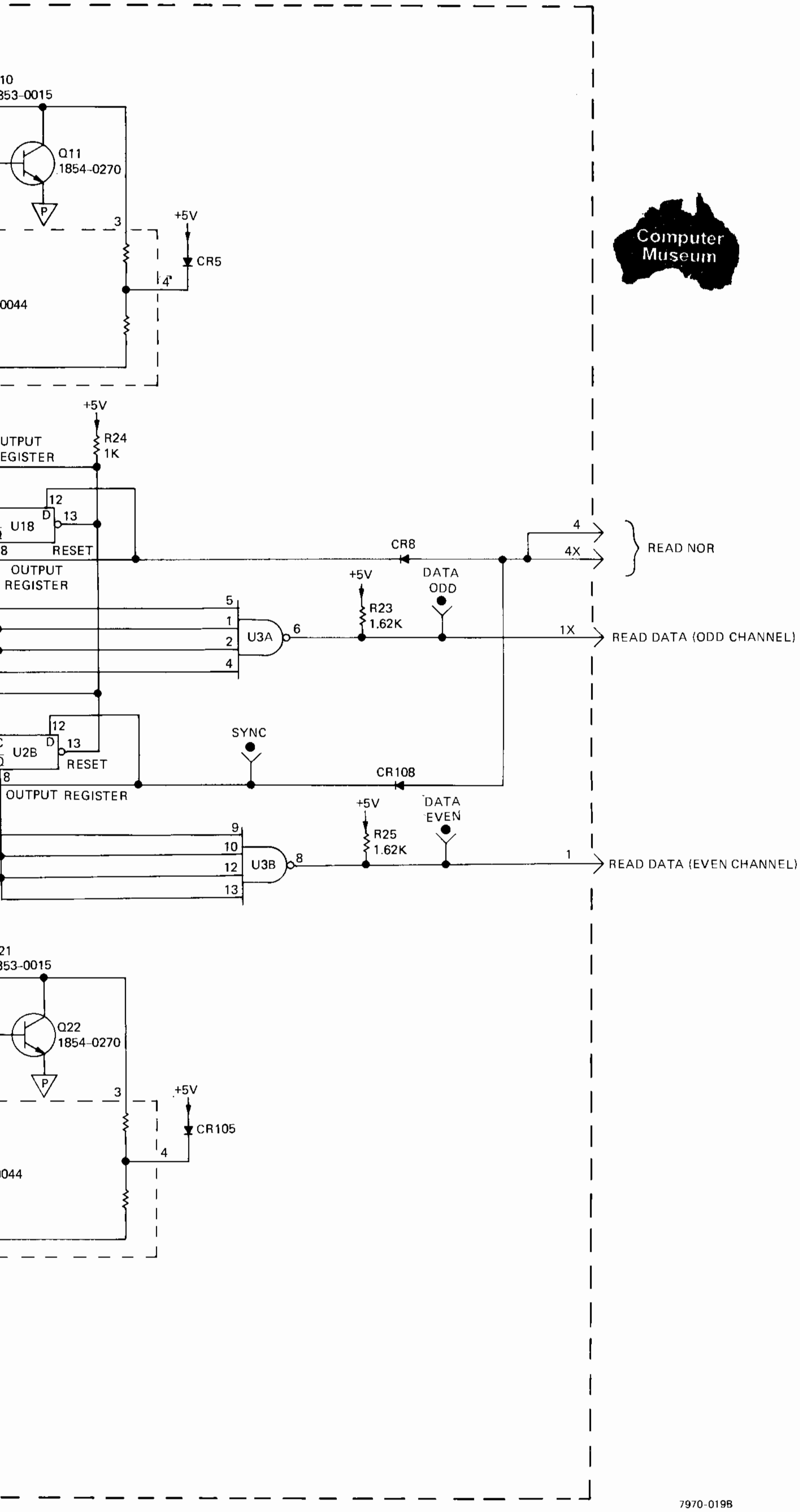
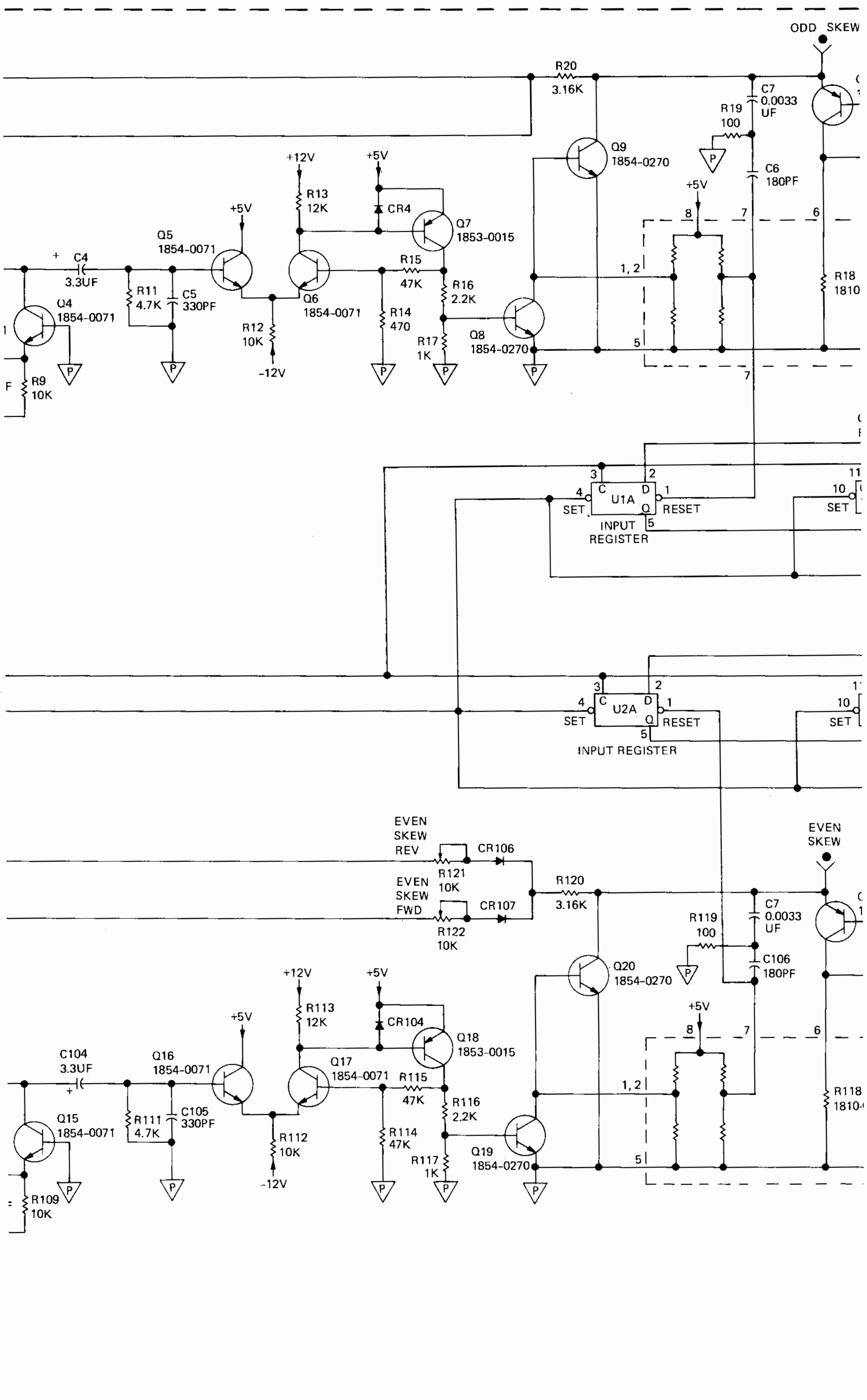
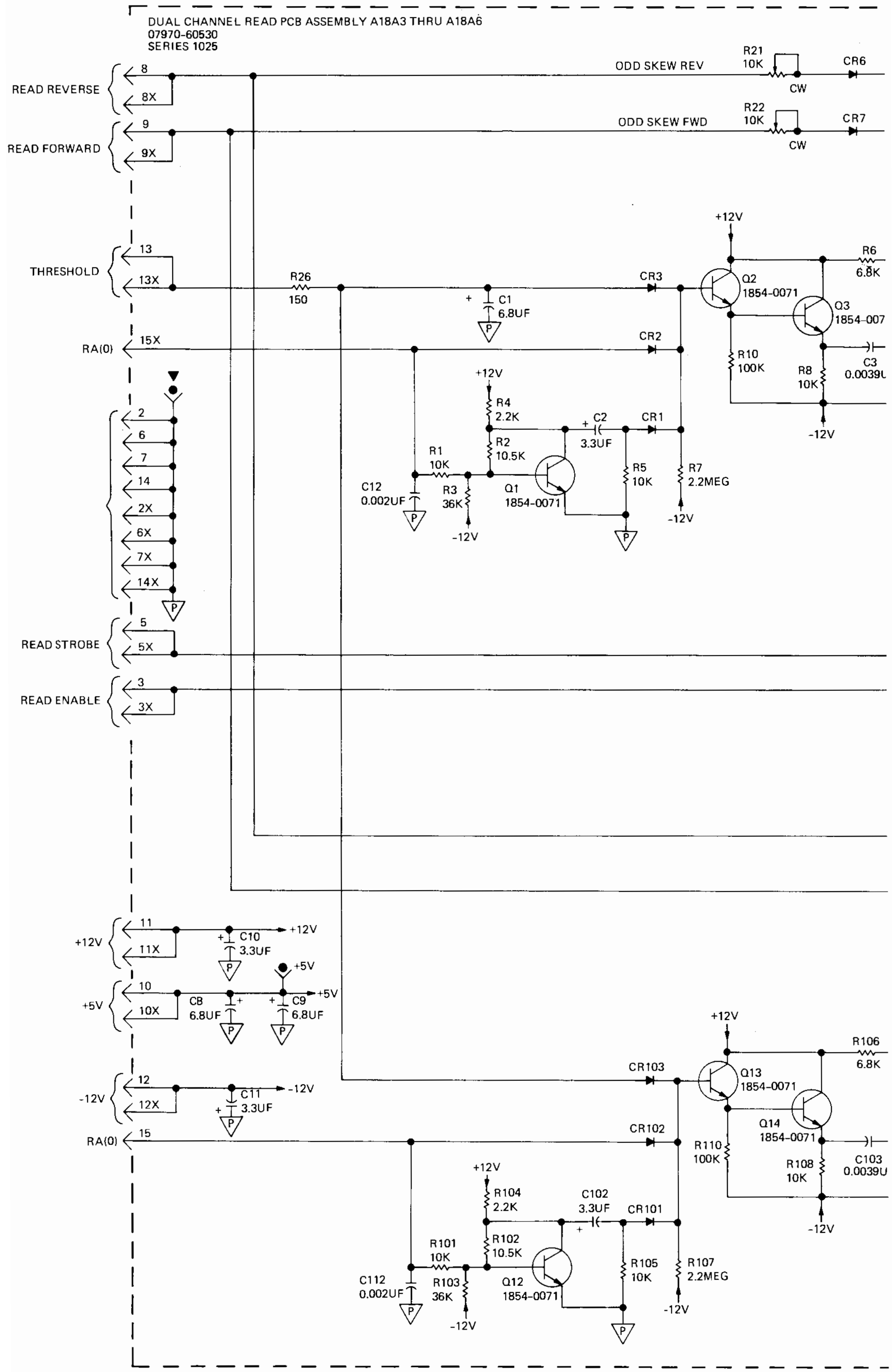


Figure 4-15. Dual-Channel Read Data PC Assembly (21 - 45 ips), Schematic Diagram


ODD SKEW
R20
3.16K
C7
0.0033
UF
R19
100
C6
180PF
Q9
1854-0270
+12V
+5V
R13
12K
CR4
Q7
1853-0015
Q5
1854-0071
C4
3.3UF
R11
4.7K
C5
330PF
Q4
1854-0071
R12
10K
-12V
Q6
1854-0071
R15
47K
R14
470
R16
2.2K
R17
1K
Q8
1854-0270
R9
10K
R18
1810
U1A
SET
RESET
INPUT
REGISTER
U2A
INPUT REGISTER
EVEN
SKEW
REV
R121
10K
CR106
EVEN
SKEW
FWD
R122
10K
CR107
R120
3.16K
EVEN
SKEW
R119
100
C106
180PF
Q20
1854-0270
R113
12K
CR104
Q18
1853-0015
C104
3.3UF
Q16
1854-0071
Q17
1854-0071
R115
47K
R116
2.2K
R111
4.7K
C105
330PF
Q15
1854-0071
R112
10K
R114
47K
R117
1K
Q19
1854-0270
R109
10K
R118


DUAL CHANNEL READ PCB ASSEMBLY A18A3 THRU A18A6
07970-60530
SERIES 1025
READ REVERSE
8
8X
READ FORWARD
9
9X
ODD SKEW REV
ODD SKEW FWD
R21
10K
R22
10K
CW
CR6
CR7
THRESHOLD
13
13X
R26
150
C1
6.8UF
CR3
CR2
CR1
+12V
-12V
Q2
1854-0071
Q3
1854-007
R6
6.8K
R10
100K
R8
10K
C3
0.0039U
RA(0)
15X
R4
2.2K
R2
10.5K
C2
3.3UF
R1
10K
R3
36K
C12
0.002UF
Q1
1854-0071
R5
10K
R7
2.2MEG
2
6
7
14
2X
6X
7X
14X
READ STROBE
5
5X
READ ENABLE
3
3X
+12V
11
11X
C10
3.3UF
+5V
10
10X
C8
6.8UF
C9
6.8UF
-12V
12
12X
C11
3.3UF
RA(0)
15
CR103
CR102
CR101
Q13
1854-0071
Q14
1854-0071
R106
6.8K
R110
100K
R108
10K
C103
0.0039U
R104
2.2K
R102
10.5K
C102
3.3UF
R101
10K
R103
36K
C112
0.002UF
Q12
1854-0071
R105
10K
R107
2.2MEG

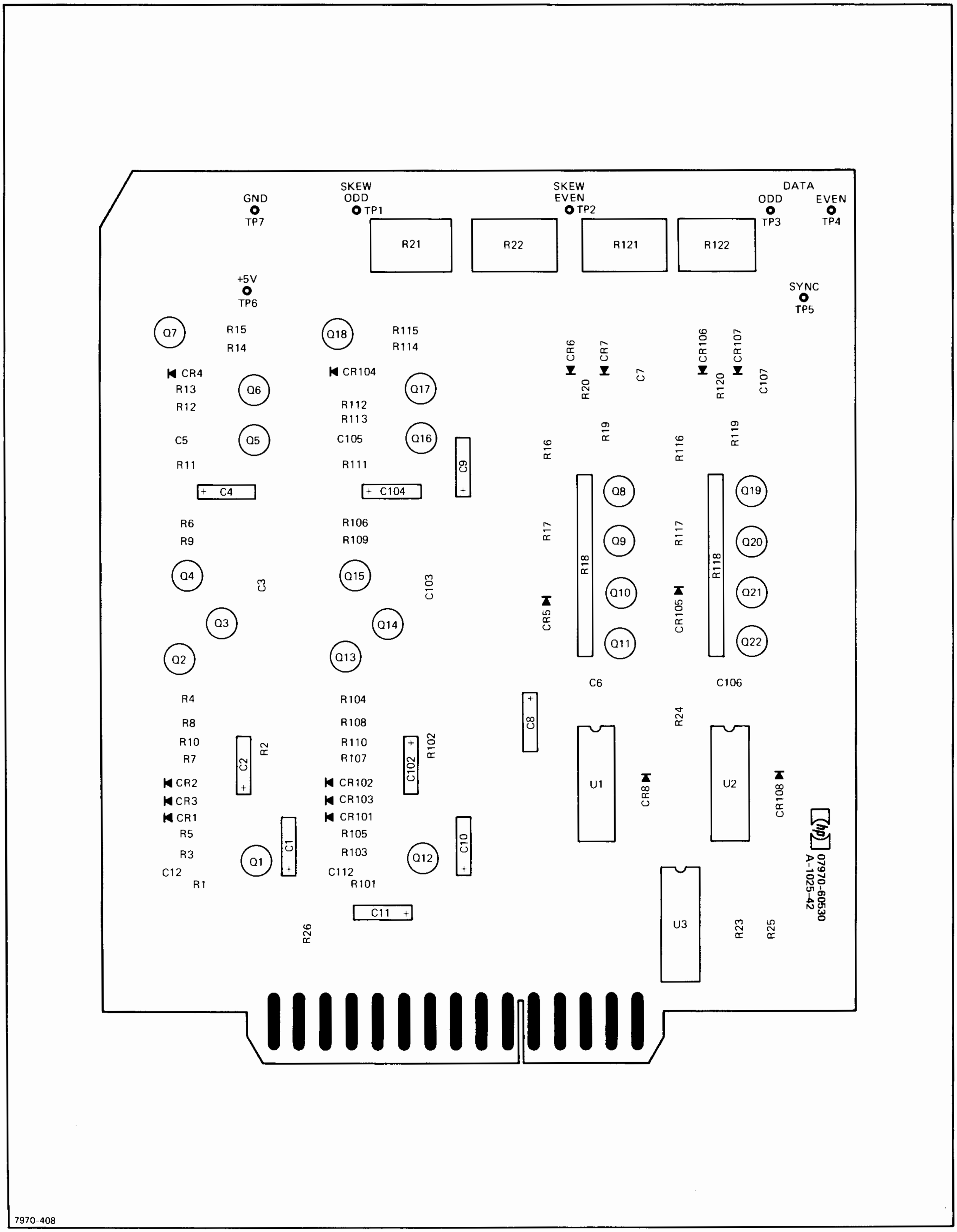


Figure 4-14. Dual-Channel Read Data PC Assembly (21 - 45 ips), Parts Location Diagram

APPENDIX A
BACKDATING INFORMATION

This backdating appendix makes the *7970B/C Digital Magnetic Tape Units Operating and Service Manual*, serial number prefix 1329, applicable to earlier units. Check the serial number prefix of the tape unit on hand and implement the required changes according to the unit changes listed in the table below.

UNIT CHANGES

SERIAL NO. PREFIX	CHANGE NO.	SERIAL NO. PREFIX	CHANGE NO.
1323	1, 2	1201	1 thru 65
1322	1 thru 4	1153	1 thru 69
1321, 1320	1 thru 11	1152	1 thru 75
1318	1 thru 14	1150	1 thru 76
1305, 1303, 1229	1 thru 15	1138	1 thru 77
1218	1 thru 17	1137	1 thru 83
1219	1 thru 51	1134	1 thru 86
1208, 1207	1 thru 57	1124	1 thru 88
1206	1 thru 61	1120	1 thru 89

ASSEMBLY CHANGES

REF DESIG	DESCRIPTION	HP PART NO.	SERIES	CHANGE NO.
A7	Reel Servo PCA	07970-62173	1323	1, 2
A21	Power Regulator PCA	07970-61010	1305	3, 4
A9	Capstan Servo PCA	07970-62172	1207	5 thru 11
A7	Reel Servo PCA	07970-62173	1320	12, 13, 14
A7	Reel Servo PCA	07970-62173	1219	12, 13, 14
A15	Read Preamplifier PCA	07970-60500	1218	15
A20A1	Power Distribution PCA	07970-61020	1137	16, 17
A16	Control and Status PCA	07970-61080	- - - -	23
- - - -	Door Interlock Switch	07970-61030	- - - -	18, 21, 22
A18A1	Read Control PCA	07970-60550	1040	29, 30
A18A1	Read Control PCA	07970-62170	1040	29, 30, 35
A15	Read Preamplifier PCA	07970-60500	1201	27, 33, 34
A18A3 thru A18A6	Read Data PCA	07970-60530	1025	19, 24, 25, 26, 28, 31, 32, 38, 39, 42, 43, 44, 46, 47, 51

ASSEMBLY CHANGES (Continued)

REF DESIG	DESCRIPTION	HP PART NO.	SERIES	CHANGE NO.
A18A2	Read Data PCA	07970-60570	1025	19, 24, 25, 26, 28, 31, 37, 42, 43, 44, 45, 49
A18A2	Read Data PCA	07970-62167	- - - -	19, 24, 25, 26, 28, 31, 36, 42, 43, 44, 45, 48
A18A3 thru A18A6	Read Data PCA	07970-62166	- - - -	19, 24, 25, 26, 28, 31, 42, 43, 44, 45, 50
A14	Write Interconnect PCA	07970-62165 07970-60300	1035	21, 40, 41
A21	Power Regulator PCA	07970-61010	1138	55, 56
A7	Reel Servo PCA	07970-62024	1207	54, 57
- - - -	Interface Connector, 48-pin	1251-0335	- - - -	52, 53
A9	Capstan Servo PCA	07970-62023	1206	60, 61
A7	Reel Servo PCA	07970-62024	1206	58, 59
A21	Power Regulator PCA	07970-61010	1047	78 thru 83
A20	Power Distribution PCA	07970-61020	1120	84 thru 86
A17A1	Write Control PCA	07970-60240	1047	87, 88
A15	Read Preamplifier PCA (21-45 ips)	07970-62000	1025	66 thru 69
A15	Read Preamplifier PCA (10-20.9 ips)	07970-60500	1025	66 thru 69
A11	Control Switch Assembly	07970-62089	1148	62 thru 65
A10	Write Enable Assembly	07970-62122	- - - -	70 thru 75

CHANGE	DESCRIPTION
1	Part 2, page 6-37. Change Q3 and Q7 part nos. from 1853-0323 (2N4900) to 1853-0328 (2N6211). Change Q4 and Q8 part nos. from 1854-0399 (2N4912) to 1854-0282 (2N3583).
2	Part 2, page 7-9, figure 7-7. Change PCA series no. from 1329 to 1320.
3	Part 2, page 7-3, figures 7-1 and 7-2.

a. Delete resistor A21R40 and diode A21CR14.

b. Change A21R8 and A21R19 to 5.1k.

c. Add connection between anode of A21CR7 and base of A21Q5; delete connection between A21Q5 base and cathode of A21CR8.

d. Add connection between cathode of A21CR8 and base of A21Q11; delete connection between A21Q11 base and anode of A21CR8.

e. Change PCA series no. from 1305 to 1138.

CHANGE	DESCRIPTION
4	Part 2, pages 6-40 and 6-41. a. Change item 17 from 2.4k, part no. 0683-2425 to 5.1k, part no. 0683-5125. b. Delete items 60 and 61.
5	Part 2, page 7-11. Replace figures 7-9 and 7-10 with figures 7-9 and 7-10 at the back of this appendix.
6	Part 2, section 6. Replace pages 6-31 through 6-34 with pages 6-31 through 6-34 at the back of this appendix.
7	Part 2, page 6-7. Change part no. of item 87 from 07970-62172 to 07970-62023.
8	Part 2, page 2-6. Replace paragraph 2-49 with the following: 2-49. When power is removed or tape tension is lost, the return from the capstan motor to the current sense resistor is opened by a relay located on the reel servo printed-circuit assembly.
9	Part 2, page 2-5, figure 2-4. Delete switch Q20 circuit.
10	Part 2, page 2-4. Replace figure 2-3 with figure 2-3 at the back of this appendix.
11	Part 2, page 2-3, Replace paragraph 2-25 with the following: 2-25. At initial power-on, the reel servo and capstan servo circuits are disabled and tension limit switch circuits are open. The normally closed contacts of the LOAD switch prevent the relay driver (Q13) located on the reel servo PCA from conducting. (See figure 2-3.) When the LOAD switch is pressed, the +5 volts through R9 and R103 forward bias Q13 and energizes relay K1. This enables the reel and capstan servo circuits. As tension is established, the tension limit switches provide +5 volts through R15 to keep Q13 conducting. The +5 volts from the limit switches also forward bias Q4 to generate the Tension signal. When tape tension is lost, Q4 is reverse biased and all control and status control flip-flops except Rewind (U6B) are cleared. Rewind flip-flop U6B is operated in an inverted mode (the flip-flop is cleared to initiate rewind).
12	Part 2, page 6-8. Change item 93 part no. 07970-62173 to 07970-62024.
13	Part 2, page 7-9. Replace figures 7-7 and 7-8 with figures 7-7 and 7-8 at the back of this appendix.
14	Part 2, pages 6-35, 6-36, and 6-37/6-38. Replace pages 6-35, 6-36, and 6-37/6-38 with pages 6-35, 6-36, 6-37, and 6-38 at the back of this appendix.
15	Part 3, page 3-5. Change item 5 part no. from 0160-0911 to 0160-0157. Part 3, page 4-5, figures 4-3 and 4-4. Change PCA series no. from 1318 to 1201. Part 2, page 7-5. In figure 7-4, delete connection between A11J3 pin 3 and A11J3 pin 6. In figures 7-3 and 7-4, change PCA series no. to 1303.

CHANGE	DESCRIPTION
16	Part 2, page 7-3, figures 7-1 and 7-2. Delete diodes CR8 and CR9 and change PCA series no. from 1229 to 1137.
17	Part 2, pages 6-44 and 6-45. Delete item 22 (CR8, CR9).
18	Part 5, page 4-17. a. In figure 4-14, delete reference to 21-45 ips tape speed and add 07970-60520 to PCA. b. Replace figure 4-15 with figure 4-15 at the back of this appendix.
19	Part 5, page 4-15. Delete figures 4-12 and 4-13.
20	Part 5, page 4-13. a. In figure 4-10, delete reference to 21-45 ips tape speed and add part no. 07970-60560 to PCA. b. Replace figure 4-11 with figure 4-11 at the back of this appendix.
21	Part 5, page 4-11. Delete figures 4-8 and 4-9.
22	Part 5, page 3-23. a. Add to index no. 3-6: 07970-60520, Read Data PC Assembly A18A3 thru A18A6, dual-channel, 10-20.9 ips. b. Add to existing item 24: used only on 07970-60530. c. Add under item 24: 0160-0159, Capacitor, fxd, 0.0068 μF, 10% (C7, C107) (used only on 07970-60520). d. Add to existing item 31: used only on 07970-60530. e. Add to item 31: 0160-0160, Capacitor, fxd, 0.0082 μF, 10% (C3, C103) (used only on 07970-60520).
23	Part 5, pages 3-21 and 3-22. Delete reference to 21-45 ips tape speed.
24	Part 5, section 5. a. Replace page 3-12 with page 3-12 at the back of this appendix. b. Replace page 3-13 with page 3-13 at the back of this appendix. c. Delete pages 3-14, 3-15/3-16, 3-17, 3-18 and 3-19/3-20.
25	Part 5, page 3-7. a. Item 17: Replace reference to figures 3-5 and 3-6 with "figure 3-5." b. Item 18: Replace reference to figures 3-7 and 3-8 with "figure 3-6."
26	Part 5, page 2-4. Replace figure 2-1 with figure 2-1 at the back of this appendix.
27	Part 5, page 1-3. a. Replace figure 1-3 with figure 1-3 at the back of this appendix. b. In paragraph 1-28 delete reference to high gain amplifier and all tape speed qualifications.
28	Part 4, page 4-5, figure 4-3. Change figure 4-3 as shown in figure 4-3 at the back of this appendix.

CHANGE DESCRIPTION

29 Part 4, page 3-5. Replace figure 3-2 with figure 3-2 at the back of this appendix.

30 Part 3, page 4-17.

a. In figure 4-14, delete reference to 21-45 ips tape speed and add part no. 07970-60520 to the PCA.

b. Replace figure 4-15 with figure 4-15 at the back of this appendix.

31 Part 3, page 4-15. Delete figures 4-12 and 4-13.

32 Part 3, page 4-13.

a. In figure 4-10, delete reference to 21-45 ips tape speed and add part no. 07970-60560 to the PCA.

b. Replace figure 4-11 with figure 4-11 at the back of this appendix.

33 Part 3, page 4-11. Delete figures 4-8 and 4-9.

34 Part 3, page 4-9.

a. In figure 4-6, change PCA part no. from 07970-62170 to 07970-60540.

b. Replace figure 4-7 with figure 4-7 at the back of this appendix.

35 Part 3, page 4-5, figure 4-4. Replace figure 4-4 with figure 4-4 at the back of this appendix.

36 Part 3, page 4-5, figure 4-3. Add series no. A-1201-42.

37 Part 3, page 3-23.

a. Add to assembly description: "(07970-60520, 10-20.9 ips)".

b. Add second entry to item 24 as follows: 0160-0159, Capacitor, fxd, 0.0068 μF (C7, C107) (used on 07970-60520 only).

c. Add second entry to item 31 as follows: 0160-0160, Capacitor, fxd, 0.0082 μF (C3, C103) (used on 07970-60530 only).

38 Part 3, section 3.

a. Delete pages 3-13 through 3-15, and 3-17 through 3-19.

b. On pages 3-21 and 3-22 delete: "21-45 ips".

39 Part 3, page 3-11, item 29. Change tape speed references as follows:

"10-20.9 ips" to "used only on 07970-60540";

"21-45 ips" to "used only on 07970-60550".

40 Part 3, page 3-11.

a. Change assembly part no. 07970-62170 to 07970-60540.

b. Change item 4 to read: 0698-3132, Resistor, fxd, 261 ohms, 1%, 1/8W (R28, R43).

41 Part 3, page 3-7.

a. Change item 17 reference to read: figure 3-5.

b. Change item 18 reference to read: figure 3-6.

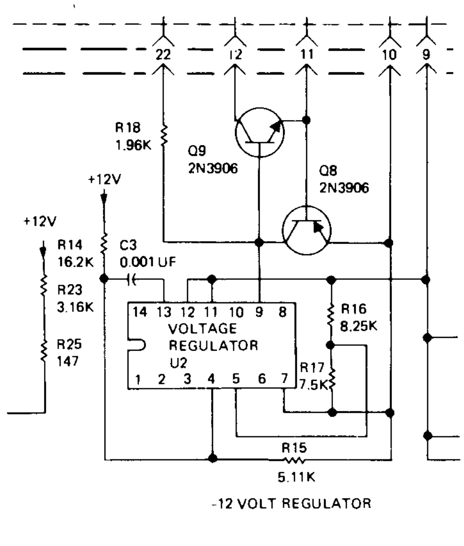
42 Part 3, page 3-5. Replace page 3-5 with page 3-5 at the back of this appendix.

CHANGE	DESCRIPTION
43	Part 3, page 2-4. Replace figure 2-1 with figure 2-1 at the back of this appendix.
44	Part 3, page 1-4, paragraph 1-6. Delete reference to high gain amplifier and the tape speed intervals.
45	Part 3, page 1-2, figure 1-1. Replace figure 1-1 with figure 1-1 at the back of this appendix.
46	Part 2, page 7-7, figure 7-6. a. Add line between J5 pin 9 and J3 pin 1; label the line "PSL". b. Add, in the upper left corner of the PC assembly, part no. 07970-62062, series 1109.
47	Part 2, page 6-8. Delete items 129 through 134.
48	Part 2, page 6-7, item 74. Change item 74 to read: WRITE INTERCONNECT ASSEMBLY A14, part no. 07970-60300.
49	Part 2, page 6-3, figure 6-1. Delete items 129 through 134.
50	Part 1, page 2-12, figure 2-6. Replace figure 2-6 with figure 2-6 at the back of this appendix.
51	Part 1, page 1-1, table 1-2. Delete option 016.
52	Part 2, page 7-9, figure 7-8. a. Change resistors A7R49 and A7R52 to 10k. b. Change resistor A7R50 to 21.5k. c. Change series no. of Reel Servo PC Assembly to 1102.
53	Part 2, page 7-3. a. Change resistor A21R37 to 21.5k. b. Change resistor A21R38 to 19.6k. c. Change series no. of Power Regulator PC Assembly to 1138.
54	Part 2, page 6-41. a. Change item 48 to 0757-0199, 21.5k. b. Change item 49 to 0698-3157, 19.6k.
55	Part 2, page 6-37. a. Change item 10 to 0757-0442, 10k. b. Change item 18 to 0757-0199, 21.5k.
56	Part 1, page 2-9. Delete item 7 from the cable connector diagram.
57	Part 1, page 2-9, figure 2-2. Change the cable-and-connector-parts table as follows: a. Change part number of 48-pin connector to 1251-0335. b. Change part number of setscrew to 3030-0143. c. Delete item 7, polarizing key entry.
58	Part 2, page 7-9, figures 7-7 and 7-8. Change series no. of Reel Servo PC Assembly to 1206.

CHANGE	DESCRIPTION
59	Part 2, page 6-37. Delete items 47 and 48.
60	Part 2, page 7-11, figures 7-9 and 7-10. Change series no. of Capstan Servo PC assembly to 1206.
61	Part 2, page 6-34. Delete items 70 and 71.
62	Part 2, title page, change series number of printed-circuit assembly 07970-62089 to 1148.
63	Part 2, page 6-18, figure 6-7, sheet 2. Delete sheet 2 of figure 6-7 and replace with figure 6-7, sheet 2 attached to this appendix.
64	Part 2, page 6-19. Delete page 6-19 and replace with 6-19 attached to this appendix.
65	Part 2, page 7-5/7-6, figures 7-3 and 7-4. Delete Q6, R13, R12, and C1 from schematic and parts location diagram of control switch assembly A11. Change series number of assembly to 1148.
66	Part 3, title page. Change series numbers of printed-circuit assemblies 07970-60500 and 07970-62000 to 1025.
67	Part 3, page 3-4, figure 3-2. Delete figure 3-2 and replace with figure 3-2 (sheet 1 of 2) and figure 3-2 (sheet 2 of 2), pages 3-4 and 3-4A attached to this appendix.
68	Part 3, page 3-5. Delete page 3-5 and replace with page 3-5 attached to this appendix.
69	Part 3, page 4-5/4-6, figures 4-3 and 4-4. Delete page 4-5/4-6 and replace with page 4-5/4-6 attached to this appendix.
70	Part 2, page 5-2, paragraph 4-16. Change step "c" as follows: Tighten switch S1 mounting screws and loosen switch S2 mounting screws. Manually retrack the sensing finger approximately 1/8-inch from the face of the turntable. With power removed, adjust the position of S2 until an audible click indicates that the switch has closed.
71	Part 2, page 5-3, figure 5-2. Delete figure 5-2 and replace with figure 5-2 attached to this appendix.
72	Part 2, page 6-6. Change part number of item -36 to 07970-62022.
73	Part 4, page 3-2, figure 3-1. Delete figure 3-1 and replace with figure 3-1 attached to this appendix.
74	Part 4, page 3-3/3-4. Delete page 3-3/3-4 and replace with page 3-3/3-4 attached to this appendix.
75	Part 4, page 4-3/4-4. Change part number of write enable assembly A10 to 07970-62022.
76	Part 2, page 6-6. Delete items 46 through 53 and replace with the following:

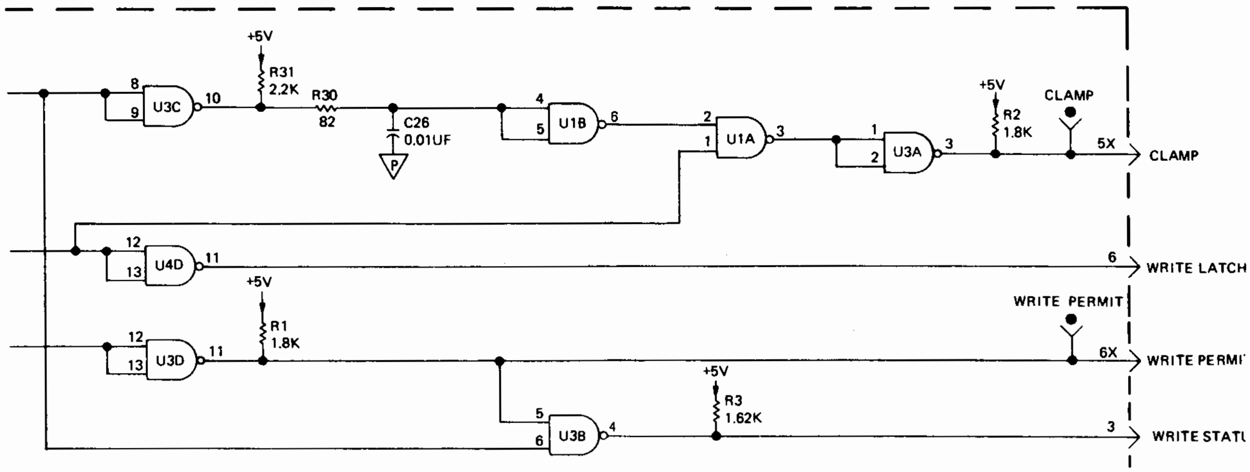
-46	07970-00120	. BRACKET, limit switch, upper	1
-47	0380-0016	. SPACER (AP)	1
-48	3050-0002	. WASHER, flat (AP)	1
-49	2190-0034	. WASHER, lock, helical (AP)	2
-50	2680-0099	. SCREW, no. 10-32, 0.375-inch, pozi (AP) . .	1
-51	2680-0103	. SCREW, no. 6-32, 0.5-inch, pozi (AP) . . .	1
-52	0403-0163	. BUMPER, stop (AP)	1
-53	Deleted		

CHANGE	DESCRIPTION
77	Cover door assembly, part number 07970-60160, on serial number prefix 1138 and earlier are fabricated. Cover door assembly on serial number prefix 1150 and later are cast. Assemblies are interchangeable.
78	Part 2, title page. Change series of printed-circuit assembly 07970-61010 to 1047.
79	Part 2, page 6-39, figure 6-14. Delete figure 6-14 and replace with figure 6-14 attached to this appendix.
80	Part 2, page 6-40. Delete page 6-40 and replace with page 6-40 attached to this appendix.
81	Part 2, page 6-41. Delete page 6-41 and replace with page 6-41 attached to this supplement.
82	Part 2, page 7-3/7-4, figure 7-1, power regulator parts location diagram. Delete CR15, CR16, and CR17. Add R17 between R15 and U2.
83	Part 2, page 7-3/7-4, figure 7-2, power regulator PC assembly schematic diagram. Change series number of assembly to 1047. Change -12 volt regulator circuit as follows:



84	Part 2, title page. Change series number of printed-circuit assembly 07970-61020 to 1120.
85	Part 2, page 6-45. Change part number of item 11 to 0188-1665. Change value of item 11 to 0.82Ω.
86	Part 2, page 7-3/7-4, figure 7-2, power distribution PC assembly schematic diagram. Change value of R9 to 0.82Ω.
87	Part 4, title page. Change series number of printed-circuit assembly 07970-60240 to 1047.

CHANGE	DESCRIPTION
88	Part 4, page 4-7/4-8, figure 4-5. Change series number of assembly to 1047. Change write latch circuit as shown below.



89	Part 2, page 6-8. Change part number of item -97 to 1390-0174.

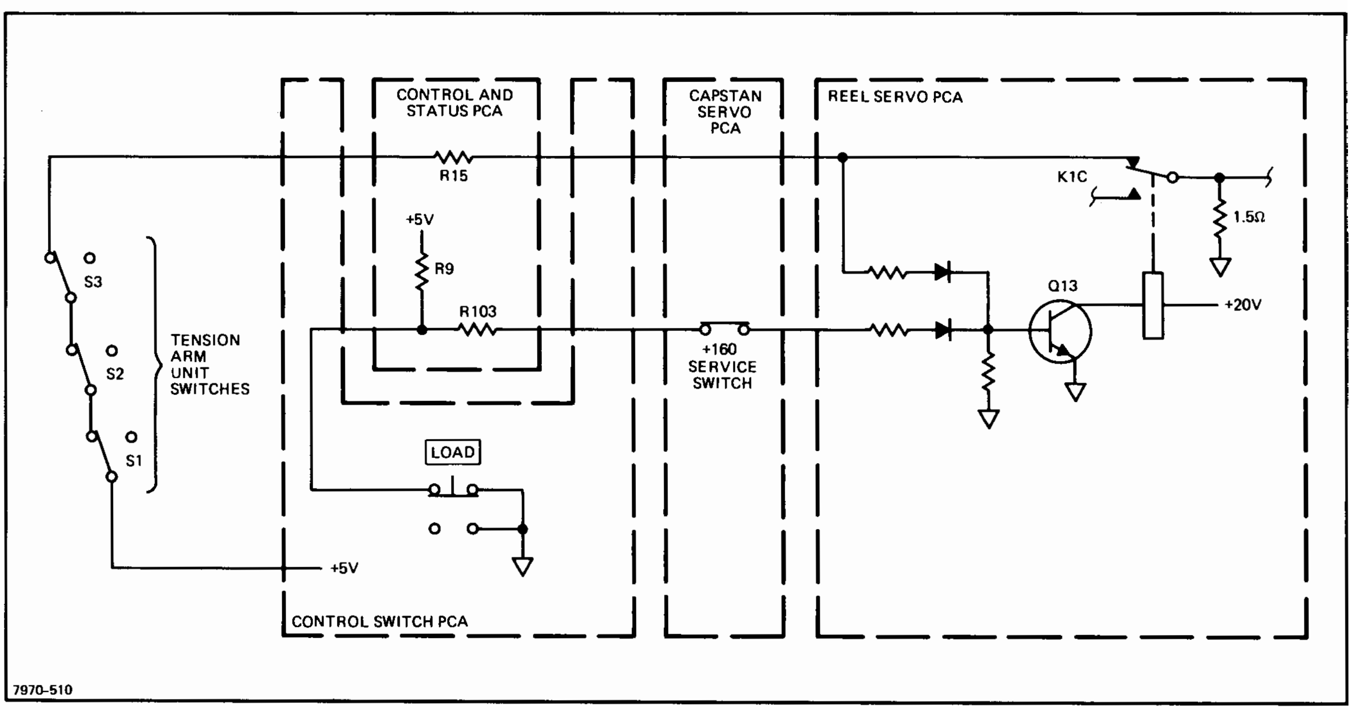


Figure 2-3. Tension Circuit, Simplified Diagram

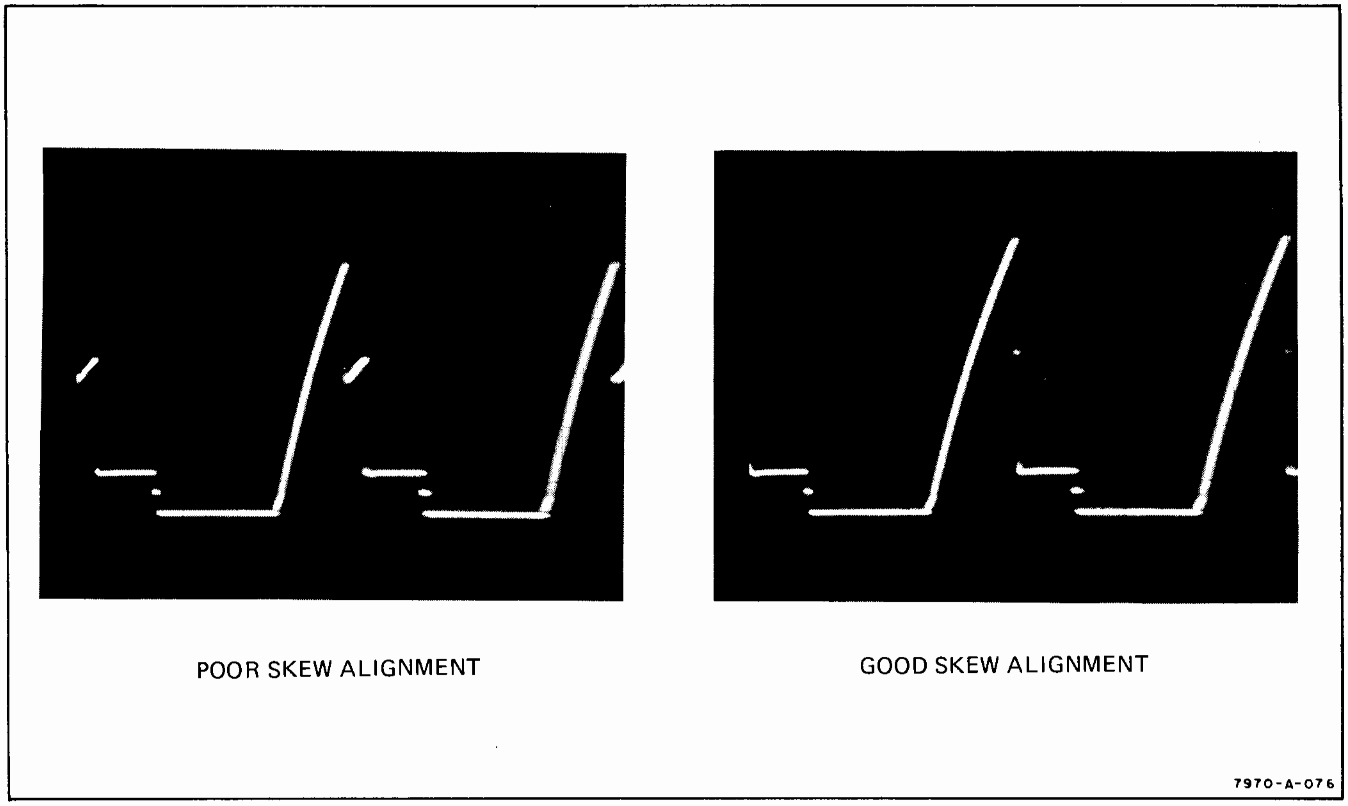


Figure 2-1. Skew Alignment Waveforms

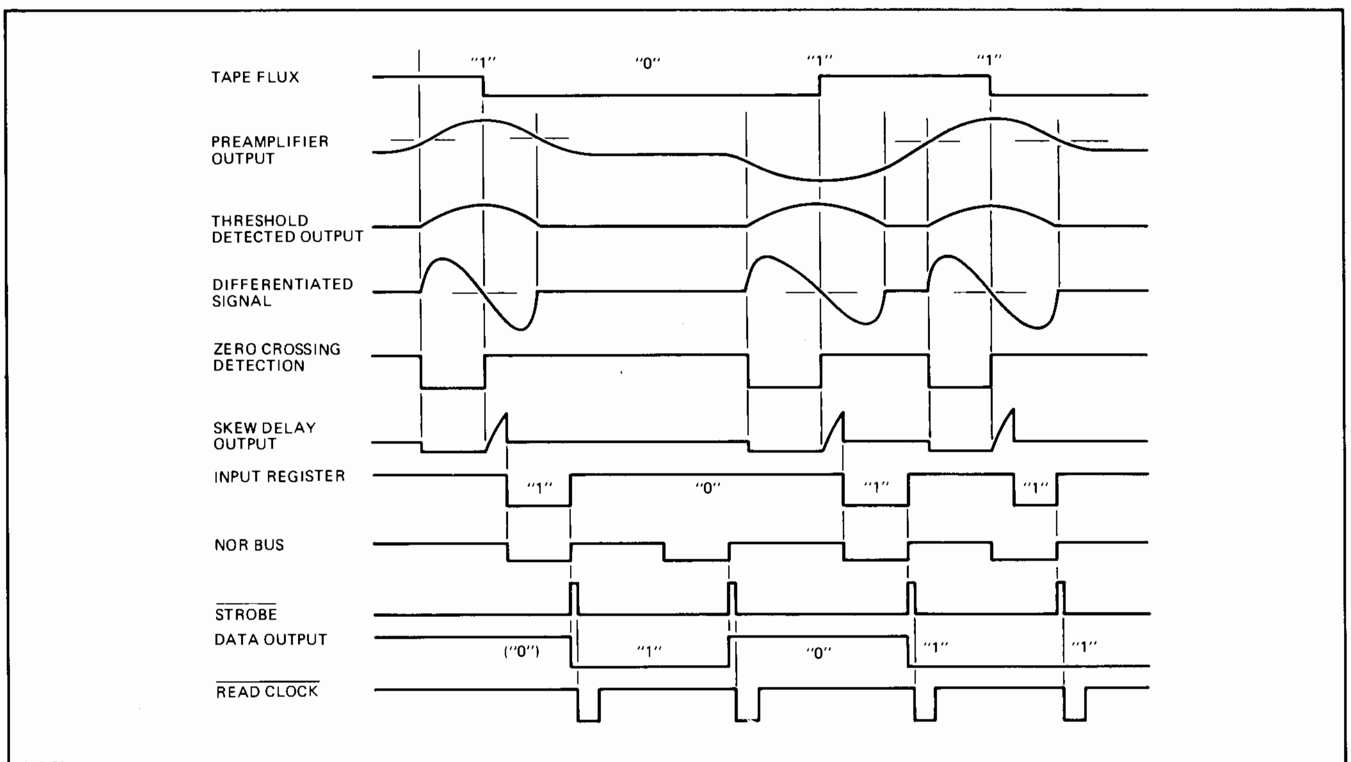


Figure 1-3. Read Data Circuits, Timing Diagram

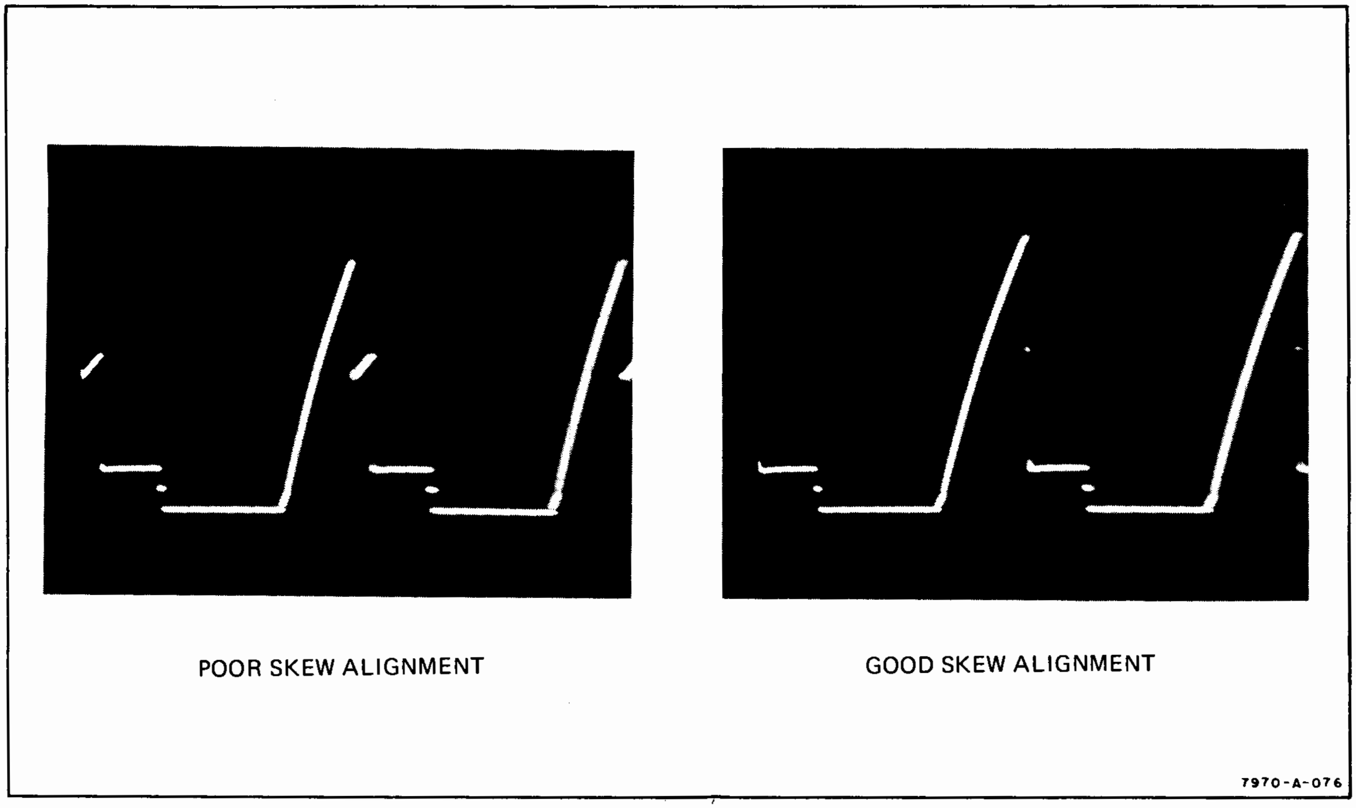


Figure 2-1. Skew Alignment Waveforms

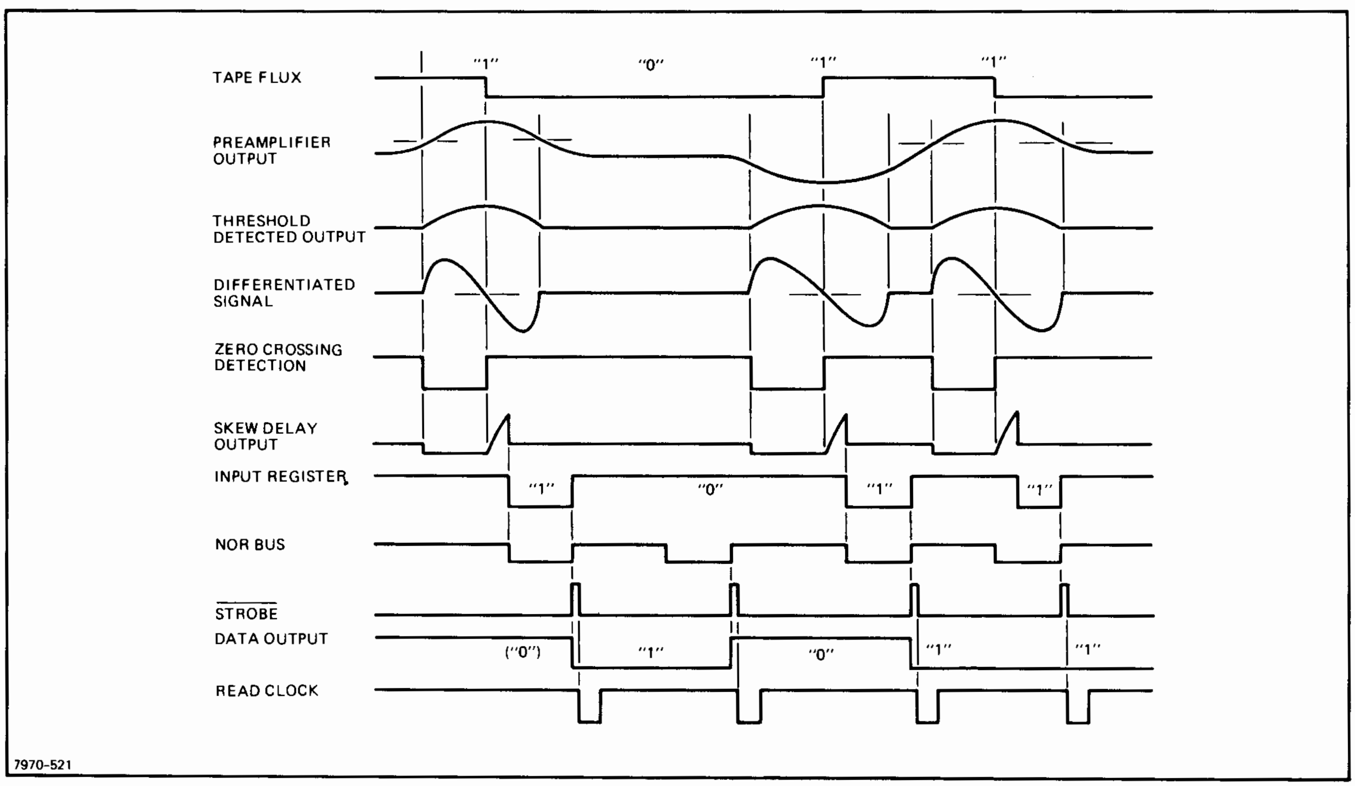


Figure 1-1. Read Data Circuits Timing Diagram

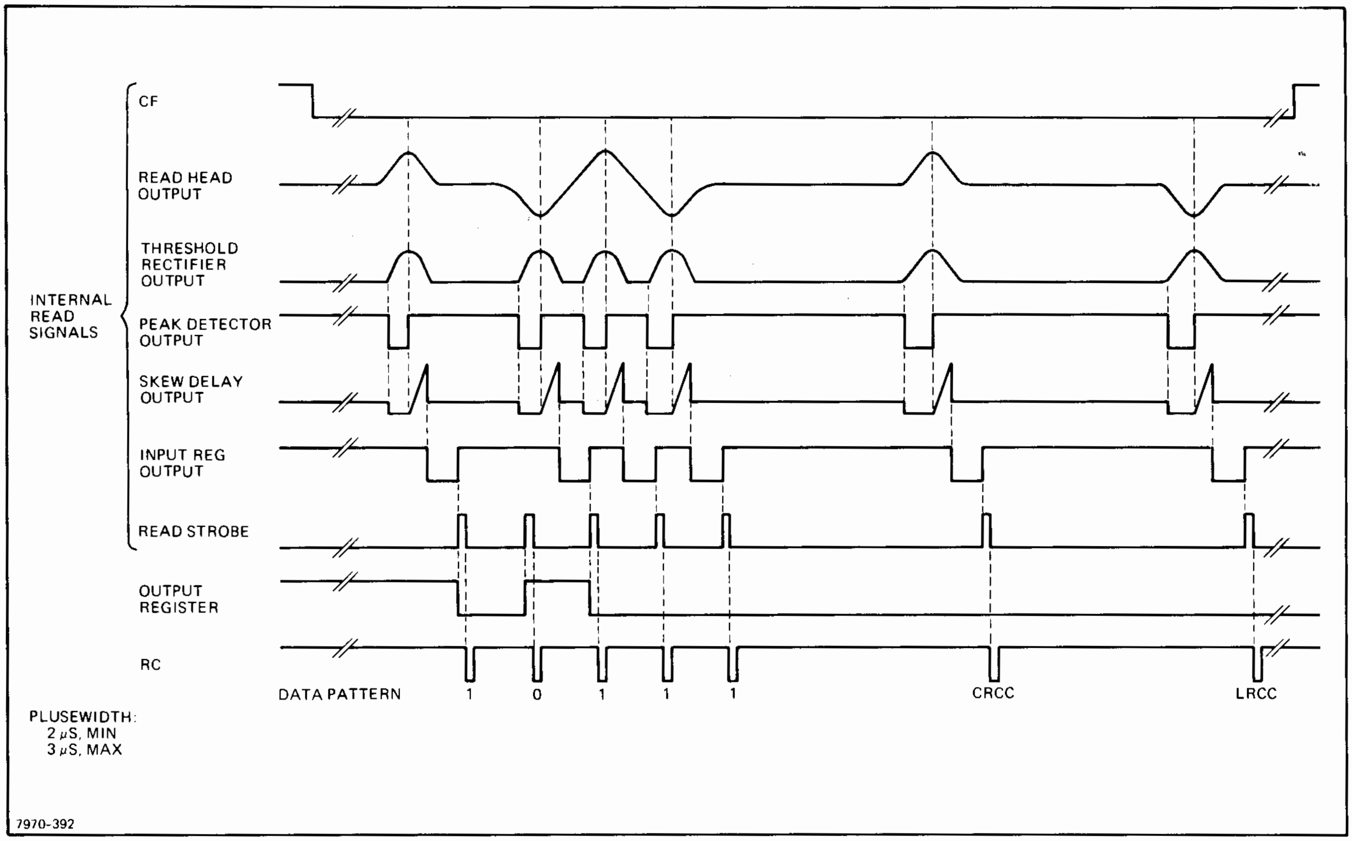


Figure 2-6. Read Waveforms

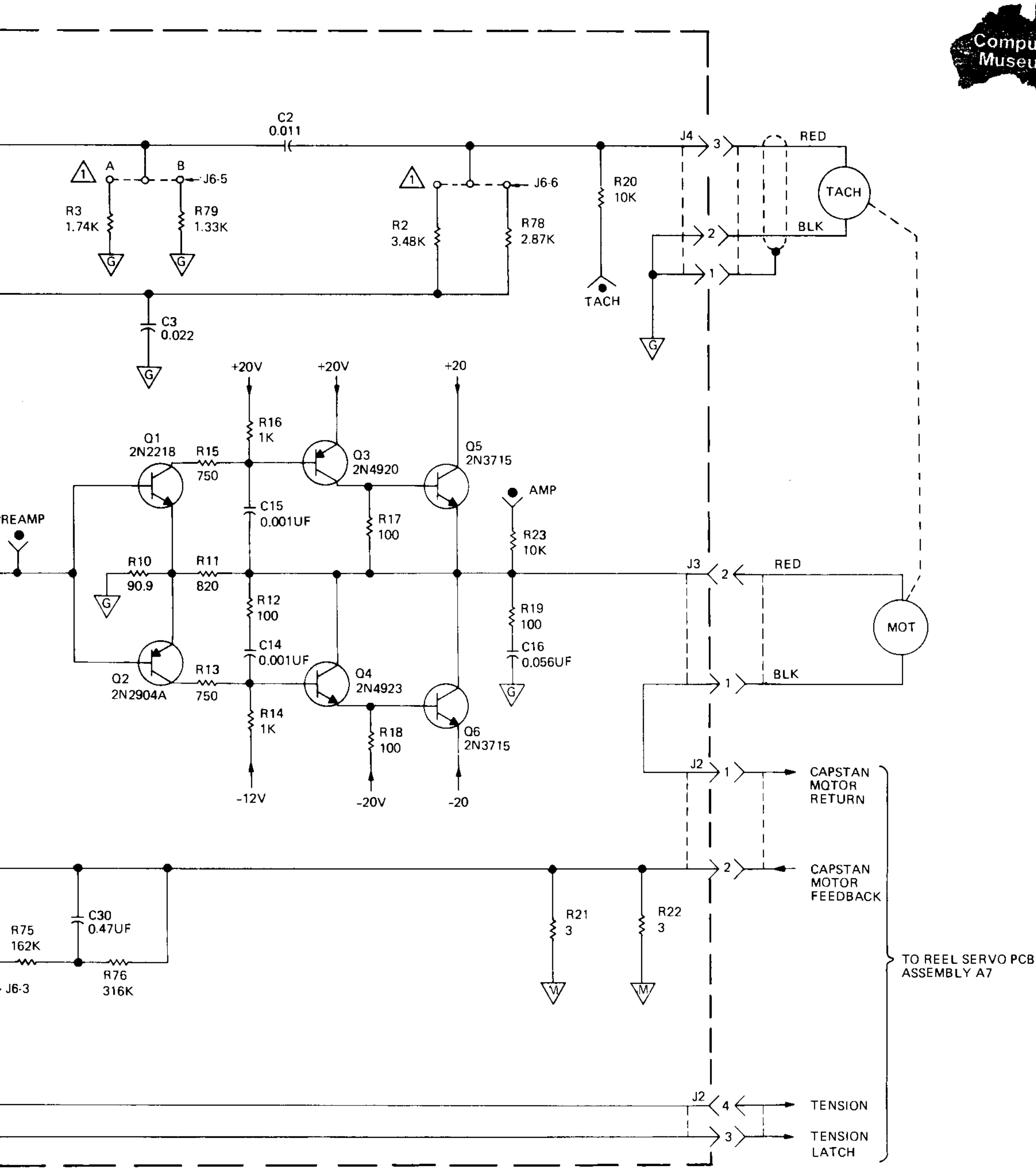
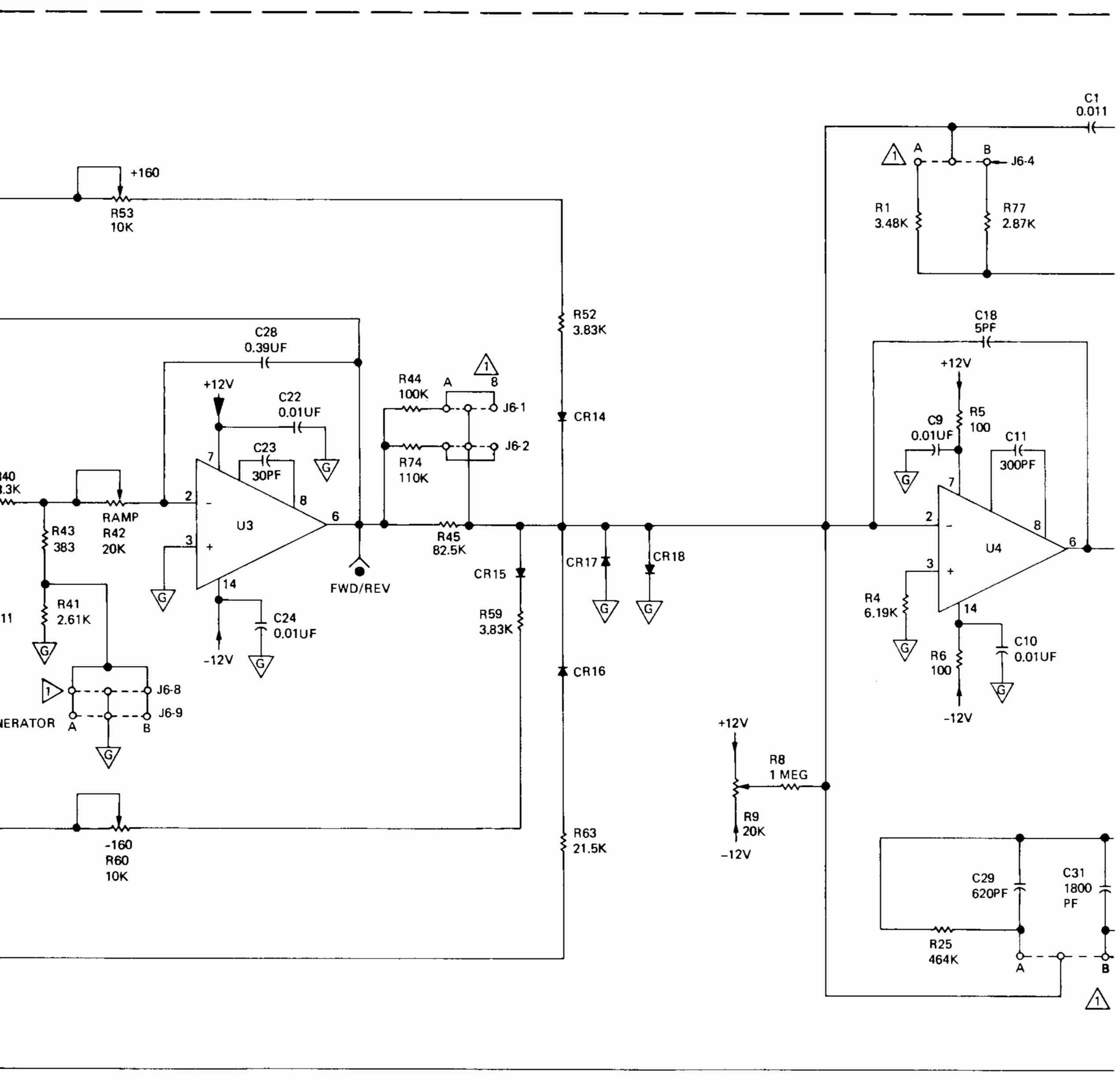
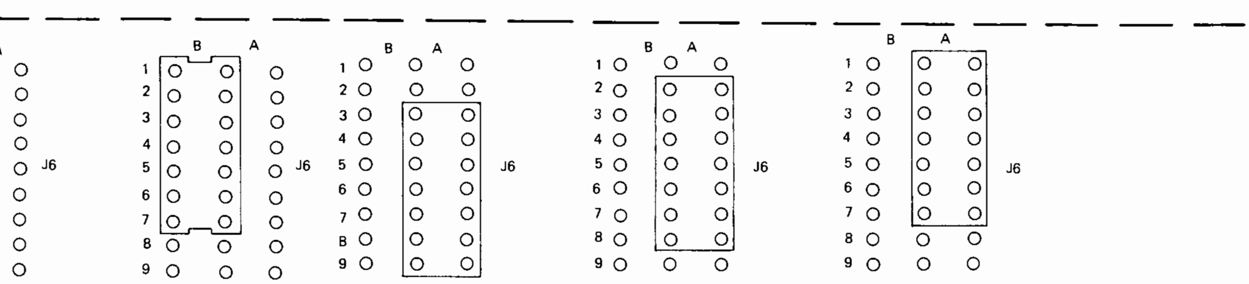


Figure 7-10. Capstan Servo PC Assembly A6, Schematic Diagram





POSITION
60141
SEMBLY

25 TO 45 IPS POSITION
WITH 07970-60141
CAPSTAN ASSEMBLY

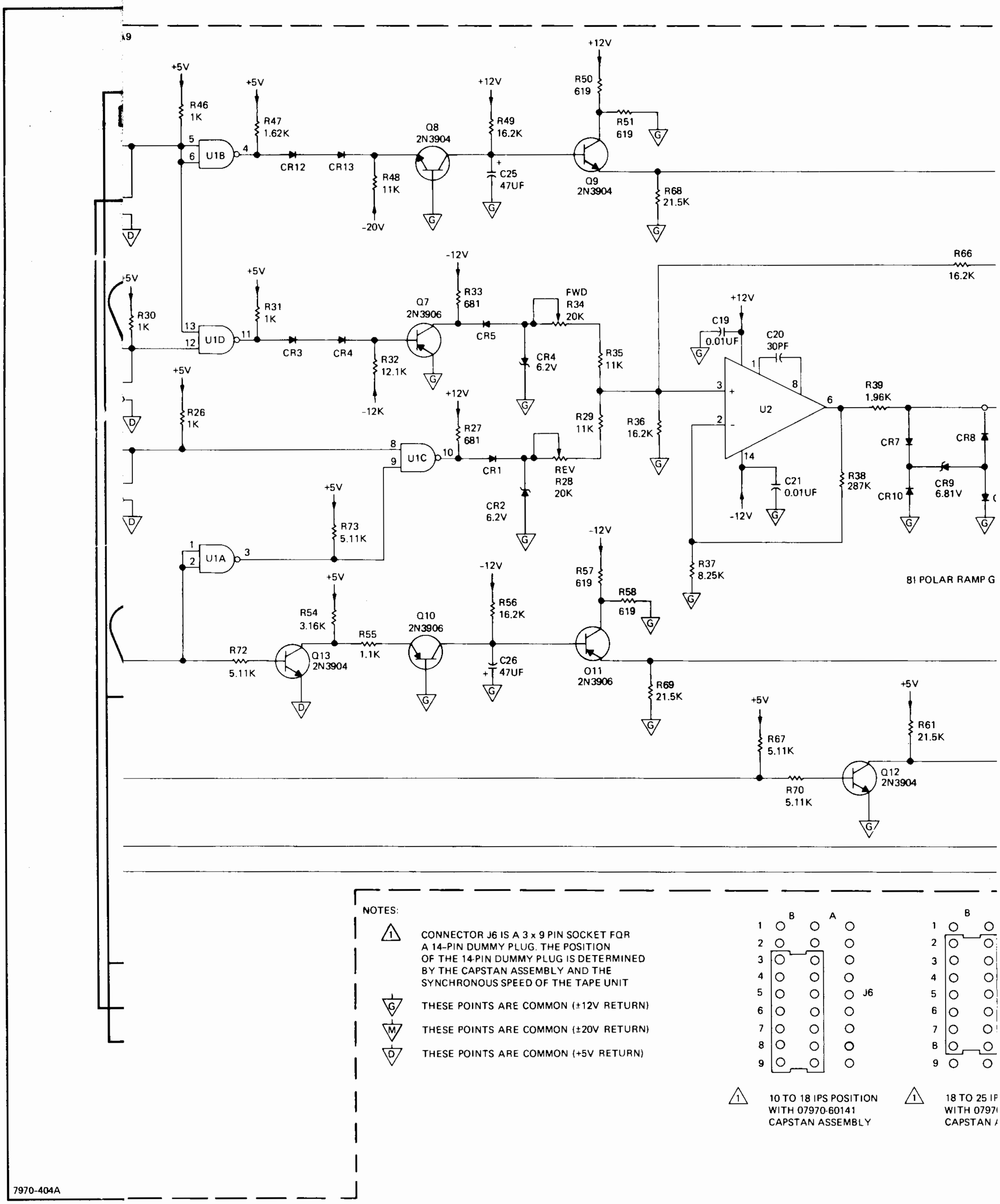
10 TO 18 IPS POSITION
WITH 07970-60140
CAPSTAN ASSEMBLY

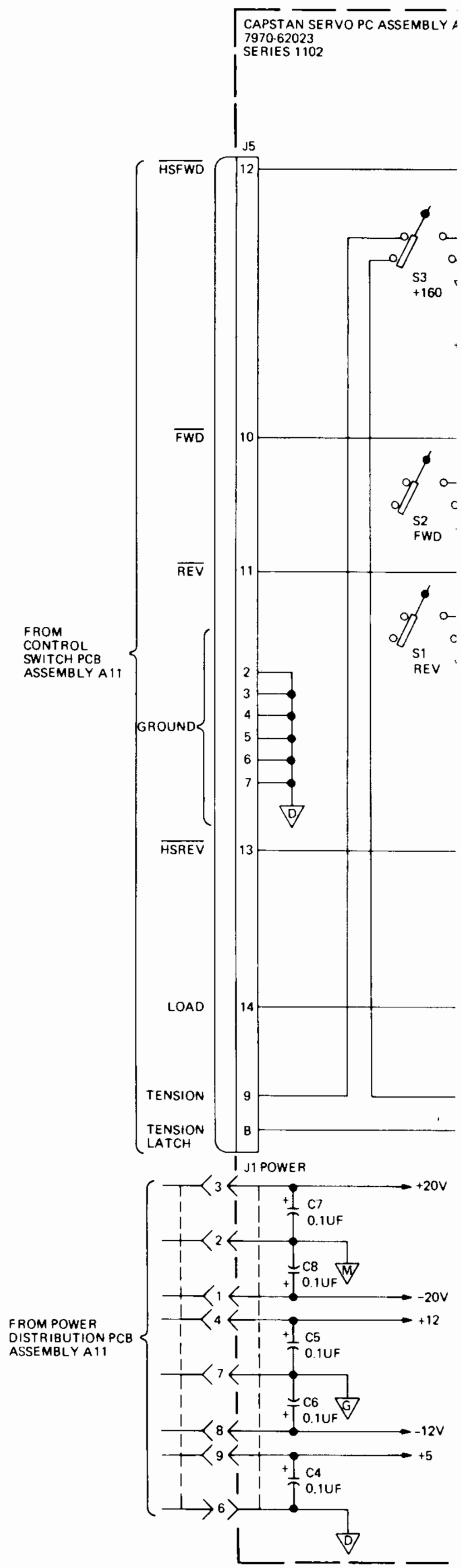
18 TO 25 IPS POSITION
WITH 07970-60140
CAPSTAN ASSEMBLY

25 TO 37.5 IPS POSITION
WITH 07970-60140
CAPSTAN ASSEMBLY

– CAUTION –

ENSURE THAT DIP DUMMY PLUG IS INSTALLED IN THE PROPER POSITION PRIOR TO APPLYING POWER TO THE UNIT. ATTEMPTING TO OPERATE THE UNIT WITHOUT THE PLUG INSTALLED OR WITH THE PLUG IN THE WRONG POSITION MAY RESULT IN DAMAGE TO THE UNIT.


A9
+5V
R46
1K
U1B
+5V
R47
1.62K
CR12
CR13
R48
11K
-20V
Q8
2N3904
+12V
R49
16.2K
C25
47UF
+12V
R50
619
R51
619
Q9
2N3904
R68
21.5K
-12V
R33
681
Q7
2N3906
CR5
FWD
R34
20K
CR4
6.2V
R35
11K
R66
16.2K
+12V
C19
0.01UF
C20
30PF
U2
R39
1.96K
CR7
CR8
CR9
6.81V
CR10
R36
16.2K
R38
287K
C21
0.01UF
-12V
R37
8.25K
BI POLAR RAMP G
+5V
R30
1K
U1D
+5V
R31
1K
CR3
CR4
R32
12.1K
-12K
+5V
R26
1K
U1C
+12V
R27
681
CR1
REV
R28
20K
R29
11K
CR2
6.2V
+5V
R73
5.11K
U1A
-12V
R57
619
R58
619
+5V
R54
3.16K
R55
1.1K
Q10
2N3906
-12V
R56
16.2K
C26
47UF
Q11
2N3906
R69
21.5K
R72
5.11K
Q13
2N3904
+5V
R67
5.11K
R70
5.11K
+5V
R61
21.5K
Q12
2N3904
NOTES:
CONNECTOR J6 IS A 3 x 9 PIN SOCKET FOR A 14-PIN DUMMY PLUG. THE POSITION OF THE 14-PIN DUMMY PLUG IS DETERMINED BY THE CAPSTAN ASSEMBLY AND THE SYNCHRONOUS SPEED OF THE TAPE UNIT
THESE POINTS ARE COMMON (±12V RETURN)
THESE POINTS ARE COMMON (±20V RETURN)
THESE POINTS ARE COMMON (+5V RETURN)
J6
10 TO 18 IPS POSITION WITH 07970-60141 CAPSTAN ASSEMBLY
18 TO 25 IP
WITH 0797
CAPSTAN
7970-404A



CAPSTAN SERVO PC ASSEMBLY A
7970-62023
SERIES 1102
J5
HSFWD
12
S3
+160
FWD
10
S2
FWD
REV
11
S1
REV
FROM
CONTROL
SWITCH PCB
ASSEMBLY A11
GROUND
2
3
4
5
6
7
D
HSREV
13
LOAD
14
TENSION
9
TENSION
LATCH
B
J1 POWER
3
+20V
C7
0.1UF
2
M
C8
0.1UF
1
-20V
4
+12
FROM POWER
DISTRIBUTION PCB
ASSEMBLY A11
C5
0.1UF
7
G
C6
0.1UF
8
-12V
9
+5
C4
0.1UF
6
D

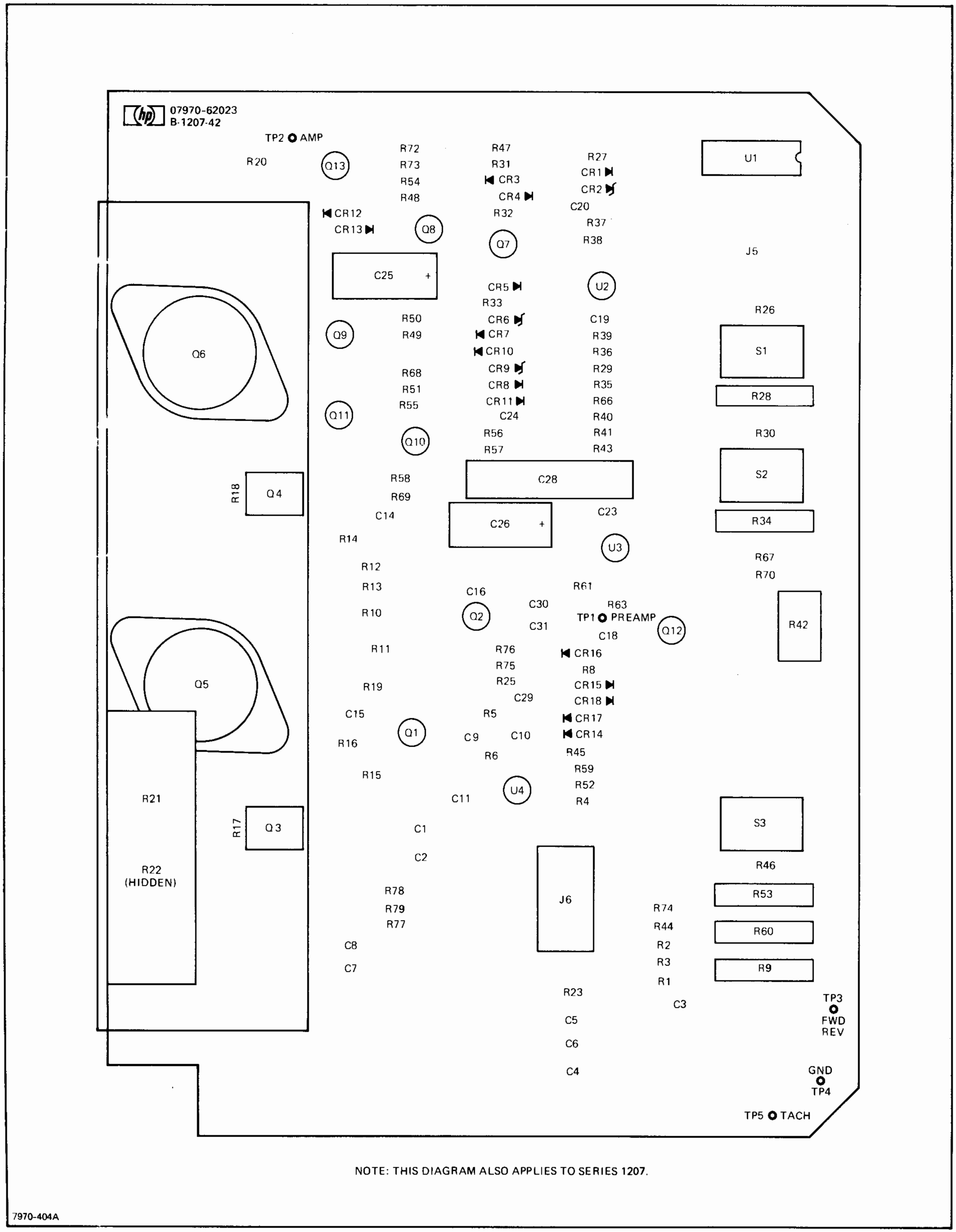


Figure 7-9. Capstan Servo PC Assembly A6, Parts Location Diagram

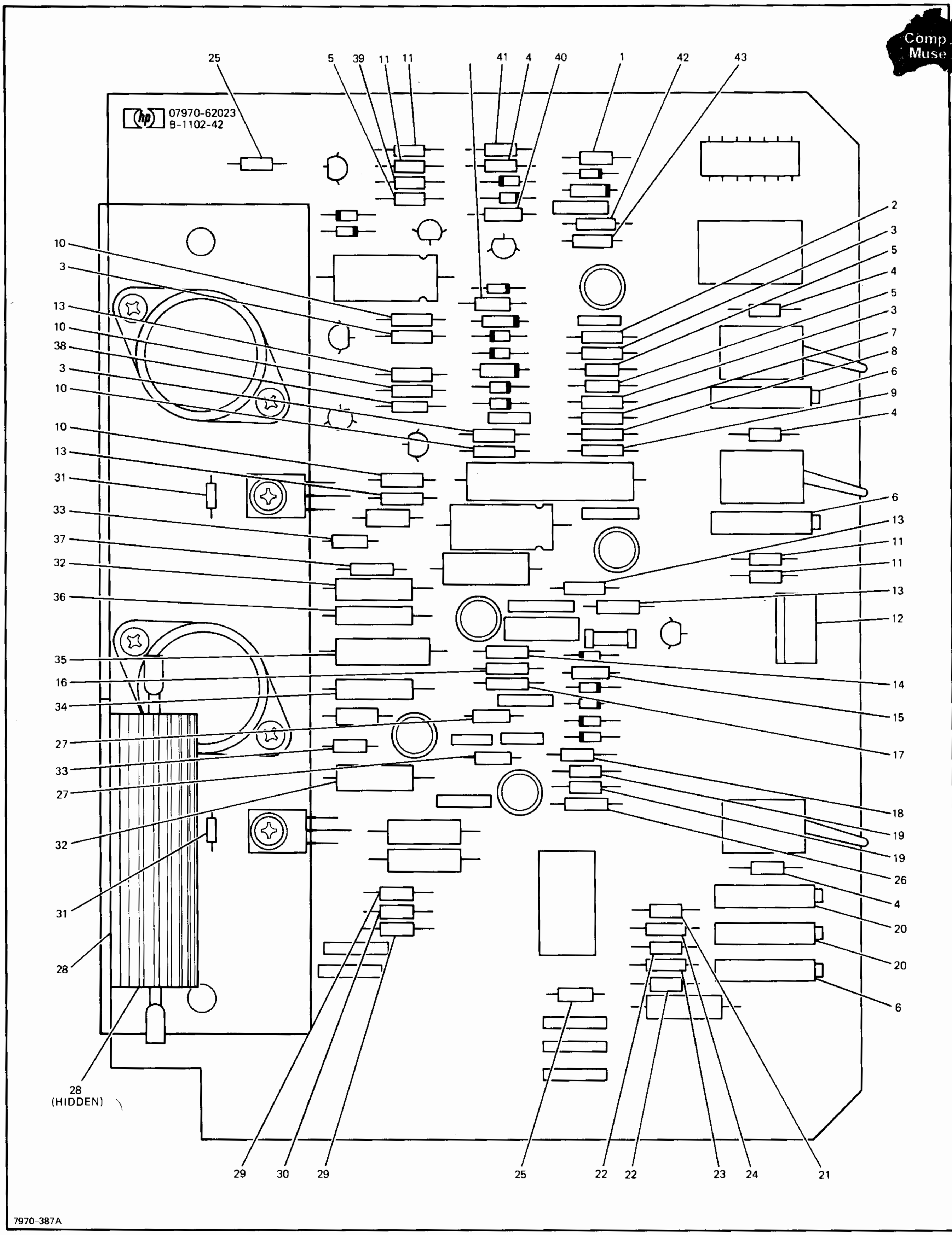


Figure 6-12. Capstan Servo PC Assembly A9 (Sheet 1 of 2)

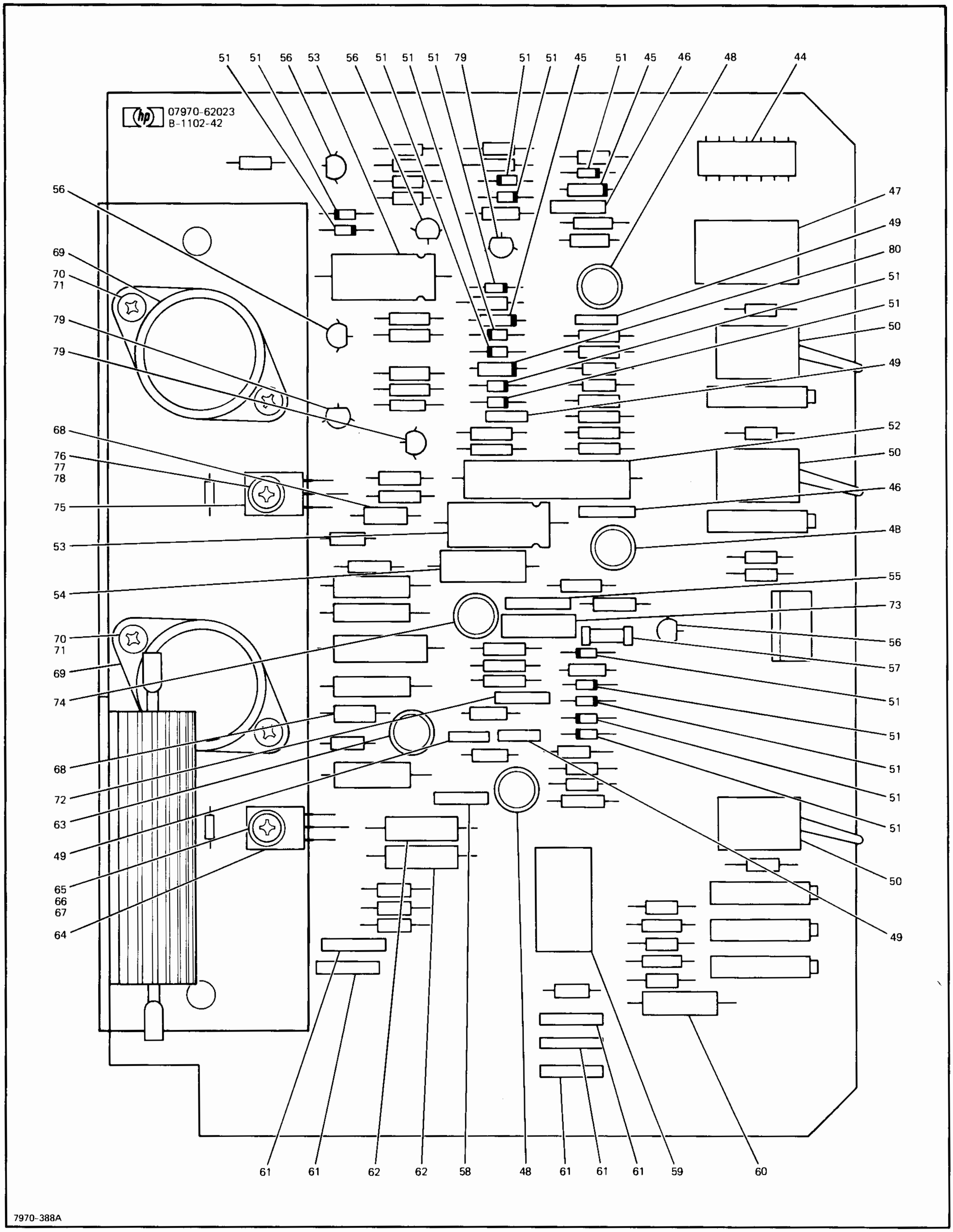


Figure 6-12. Capstan Servo PC Assembly A9 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-12-	07970-62023	CAPSTAN SERVO PC ASSEMBLY A9	REF
-1	0757-0419	. RESISTOR, fxd, 681 ohms, 1%, 1/8W (R27, R33)	2
-2	0698-0083	. RESISTOR, fxd, 1.96k, 1%, 1/8W (R39)	1
-3	0757-0447	. RESISTOR, fxd, 16.2k, 1%, 1/8W (R36, R49, R56, R66)	4
-4	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R26, R30, R31, R46)	4
-5	0757-0443	. RESISTOR, fxd, 11k, 1%, 1/8W (R29, R35, R48)	3
-6	2100-1972	. RESISTOR, var, 20k, 10% (R9, R28, R34)	3
-7	0757-0289	. RESISTOR, fxd, 13.3k, 1%, 1/8W (R40)	1
-8	0698-0085	. RESISTOR, fxd, 2.61k, 1%, 1/8W (R41)	1
-9	0698-3446	. RESISTOR, fxd, 383 ohms, 1%, 1/8W (R43)	1
-10	0757-0418	. RESISTOR, fxd, 619 ohms, 1%, 1/8W (R50, R51, R57, R58)	4
-11	0757-0438	. RESISTOR, fxd, 5.11k, 1%, 1/8W (R67, R70, R72, R73)	4
-12	2100-1762	. RESISTOR, var, 20k, 5% (R42)	1
-13	0757-0199	. RESISTOR, fxd, 21.5k, 1%, 1/8W (R61, R63, R68, R69)	4
-14	0698-3457	. RESISTOR, fxd, 316k, 1%, 1/8W (R76)	1
-15	0683-1055	. RESISTOR, fxd, 1M, 1/4W (R8)	1
-16	0757-0470	. RESISTOR, fxd, 162k, 1%, 1/8W (R75)	1
-17	0698-3260	. RESISTOR, fxd, 464k, 1%, 1/8W (R25)	1
-18	0757-0463	. RESISTOR, fxd, 82.5k, 1%, 1/8W (R45)	1
-19	0698-3153	. RESISTOR, fxd, 3.83k, 1%, 1/8W (R52, R59)	2
-20	2100-2850	. RESISTOR, var, 10k (R53, R60)	2
-21	0757-0466	. RESISTOR, fxd, 110k, 1%, 1/8W (R74)	1
-22	0698-3152	. RESISTOR, fxd, 3.48k, 1%, 1/8W (R1, R2)	2
-23	0698-3202	. RESISTOR, fxd, 1.74k, 1%, 1/8W (R3)	1
-24	0757-0465	. RESISTOR, fxd, 100k, 1%, 1/8W (R44)	1
-25	0683-1035	. RESISTOR, fxd, 10k, 1/4W (R20, R23)	2
-26	0757-0290	. RESISTOR, fxd, 6.19k, 1%, 1/8W (R4)	1
-27	0683-1015	. RESISTOR, fxd, 100 ohms, 1/4W (R5, R6)	2
-28	0811-2966	. RESISTOR, fxd, 3 ohms, 1%, ww (R21, R22)	2
-29	0698-3151	. RESISTOR, fxd, 2.87k, 1%, 1/8W (R77, R78)	2
-30	0757-0317	. RESISTOR, fxd, 1.33k, 1%, 1/8W (R79)	1
-31	0698-3113	. RESISTOR, fxd, 100 ohms, 1/8W (R17, R18)	2
-32	0761-0058	. RESISTOR, fxd, 750 ohms, 5%, 1W (R13, R15)	2
-33	0683-1025	. RESISTOR, fxd, 1k, 1/4W (R14, R16)	2
-34	0757-0198	. RESISTOR, fxd, 100 ohms, 1/2W (R19)	1
-35	0698-3637	. RESISTOR, fxd, 820 ohms, 2W (R11)	1
-36	0757-0797	. RESISTOR, fxd, 90.9 ohms, 1/2W (R10)	1
-37	0757-0401	. RESISTOR, fxd, 100 ohms, 1/8W (R12)	1
-38	0757-0424	. RESISTOR, fxd, 1.10k, 1%, 1/8W (R55)	1
-39	0757-0279	. RESISTOR, fxd, 3.16k, 1%, 1/8W (R54)	1
-40	0757-0444	. RESISTOR, fxd, 12.1k, 1%, 1/8W (R32)	1
-41	0757-0428	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R47)	1

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-12-42	0698-3456	. RESISTOR, fxd, 287k, 1%, 1/8W (R38)	1
-43	0757-0441	. RESISTOR, fxd, 8.25k, 1%, 1/8W (R37)	1
-44	1820-0256	. INTEGRATED CIRCUIT, MC858P (U1)	1
-45	1902-0033	. DIODE, reference, 6.2V, 1N823 (CR2, CR6)	2
-46	0160-2199	. CAPACITOR, fxd, 30 pF, mica (C20, C23)	2
-47	1200-0426	. SOCKET, integrated circuit (J5)	1
-48	1820-0223	. INTEGRATED CIRCUIT, operational amplifier (U2, U3, U4)	3
-49	0160-2055	. CAPACITOR, fxd, 0.01 μF, cer (C9, C10, C19, C24)	4
-50	3101-1213	. SWITCH, toggle (S1, S2, S3)	3
-51	1901-0040	. DIODE, Si, 30V, 3 mA (CR1, Cr3, CR4, CR5, CR7, CR8, CR10, CR11, CR12, CR13, CR14, CR15, CR16, CR17, CR18)	15
-52	0160-3387	. CAPACITOR, fxd, 0.39 μF, 80V (C28)	1
-53	0180-0097	. CAPACITOR, fxd, 47 μF, 35V (C25, C26)	2
-54	0160-0165	. CAPACITOR, fxd, 0.056 μF, My (C16)	1
-55	0160-0174	. CAPACITOR, fxd, 0.47 μF, cer (C30)	1
-56	1854-0215	. TRANSISTOR, 2N3904 (Q8, Q9, Q12, Q13)	4
-57	0160-2250	. CAPACITOR, fxd, cer, 5 pF (C18)	1
-58	0160-2207	. CAPACITOR, fxd, mica, 300 pF (C11)	1
-59	07970-62025	. DUMMY PLUG ASSEMBLY (J6)	1
-60	0160-2414	. CAPACITOR, fxd, My, 0.022 μF (C3)	1
-61	0150-0121	. CAPACITOR, fxd, cer, 0.1 μF (C4, C5, C6, C7, C8)	5
-62	0160-2151	. CAPACITOR, fxd, My, 0.011 μF (C1, C2)	2
-63	1854-0053	. TRANSISTOR, 2N2218 (Q1)	1
-64	1853-0204	. TRANSISTOR, 2N4920 (Q3)	1
-65	2200-0147	. . SCREW, no. 4-40, 0.50-inch, pozi (AP)	1
-66	3050-0105	. . WASHER, flat (AP)	1
-67	2260-0009	. . NUT, hex, no. 4-40 (AP)	1
-68	0160-0153	. CAPACITOR, fxd, My, 0.001 μF (C14, C15)	2
-69	1854-0264	. TRANSISTOR, NPN, Si, 2N3715 (Q5, Q6)	2
-70	2200-0145	. . SCREW, no. 4-40, 0.438-inch, pozi (AP)	2
-71	2260-0009	. . NUT, hex, no. 4-40 (AP)	2
-72	0160-3536	. CAPACITOR, fxd, 620 pF, 5% (C29)	1
-73	0160-2224	. CAPACITOR, fxd, mica, 1800 pF (C31)	1
-74	1853-0012	. TRANSISTOR, PNP, Si, 2N2904A (Q2)	1
-75	1854-0347	. TRANSISTOR, NPN, Si, 2N4923 (Q4)	1
-76	2200-0147	. . SCREW, no. 4-40, 0.50-inch, pozi (AP)	1
-77	3050-0105	. . WASHER, flat (AP)	1
-78	2260-0009	. . NUT, hex, no. 4-40 (AP)	1
-79	1853-0036	. TRANSISTOR, PNP, Si, 2N3906 (Q7, Q10, Q11)	3
-80	1902-0048	. DIODE, reference, 6.81V (CR9)	1

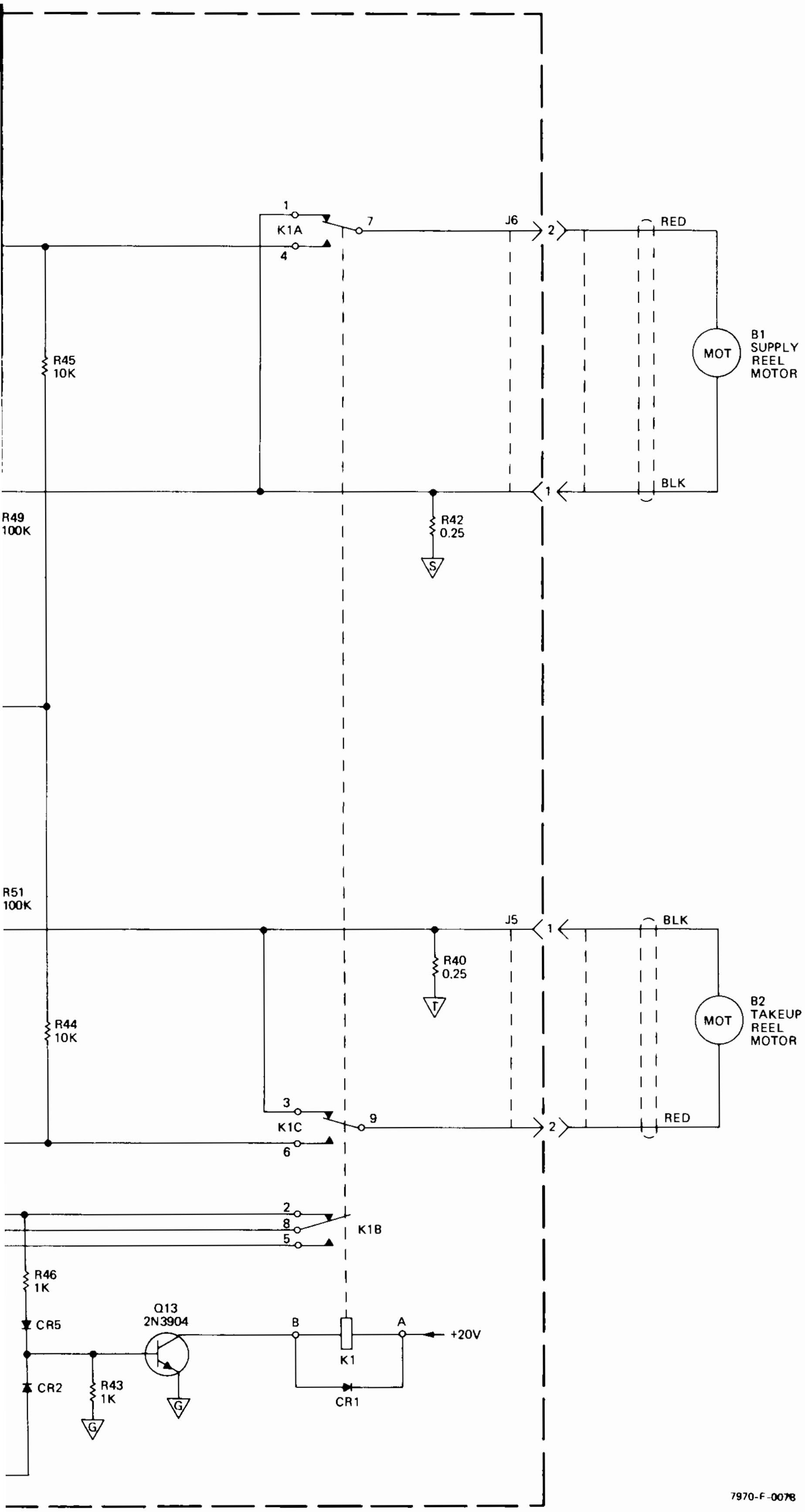
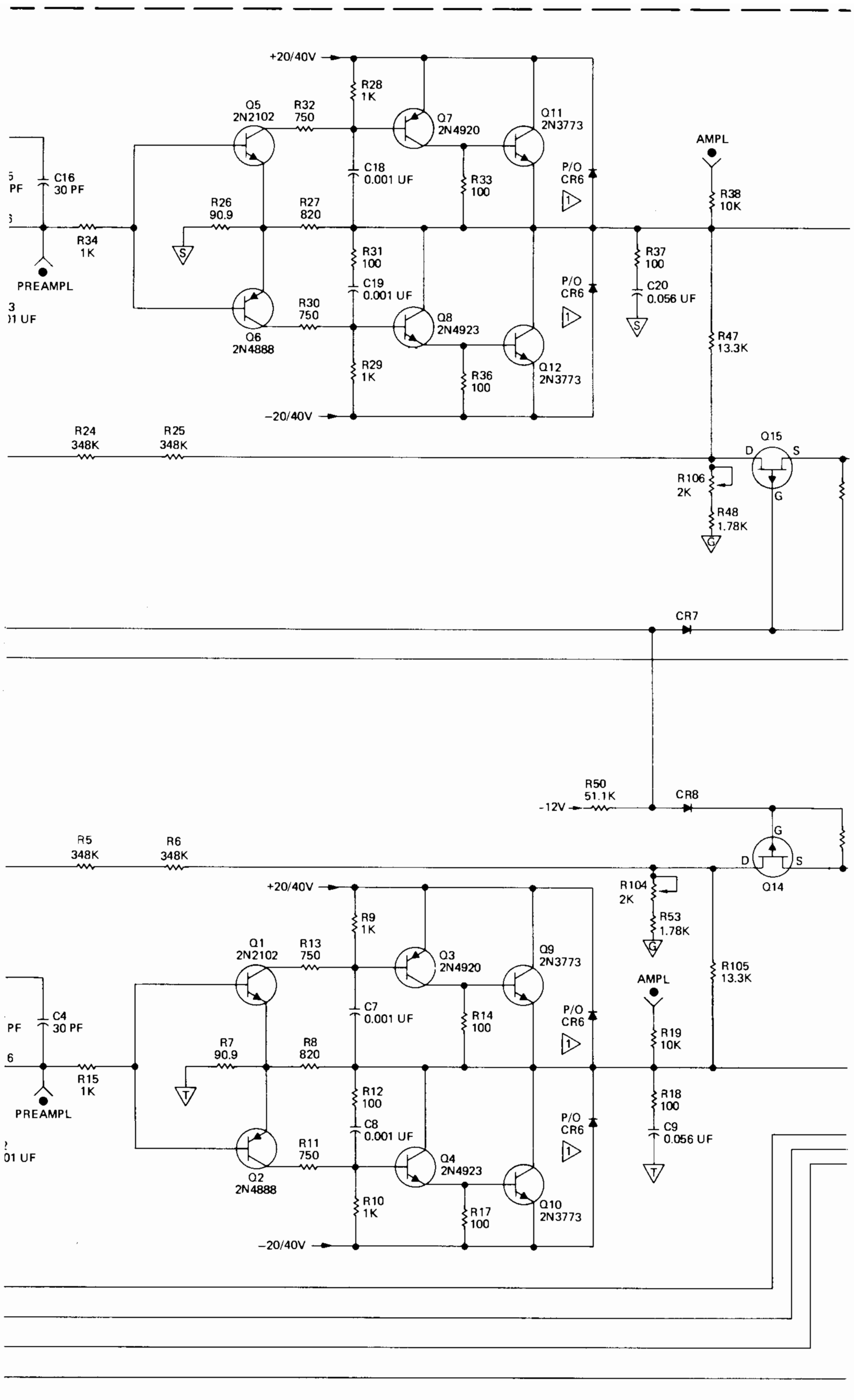
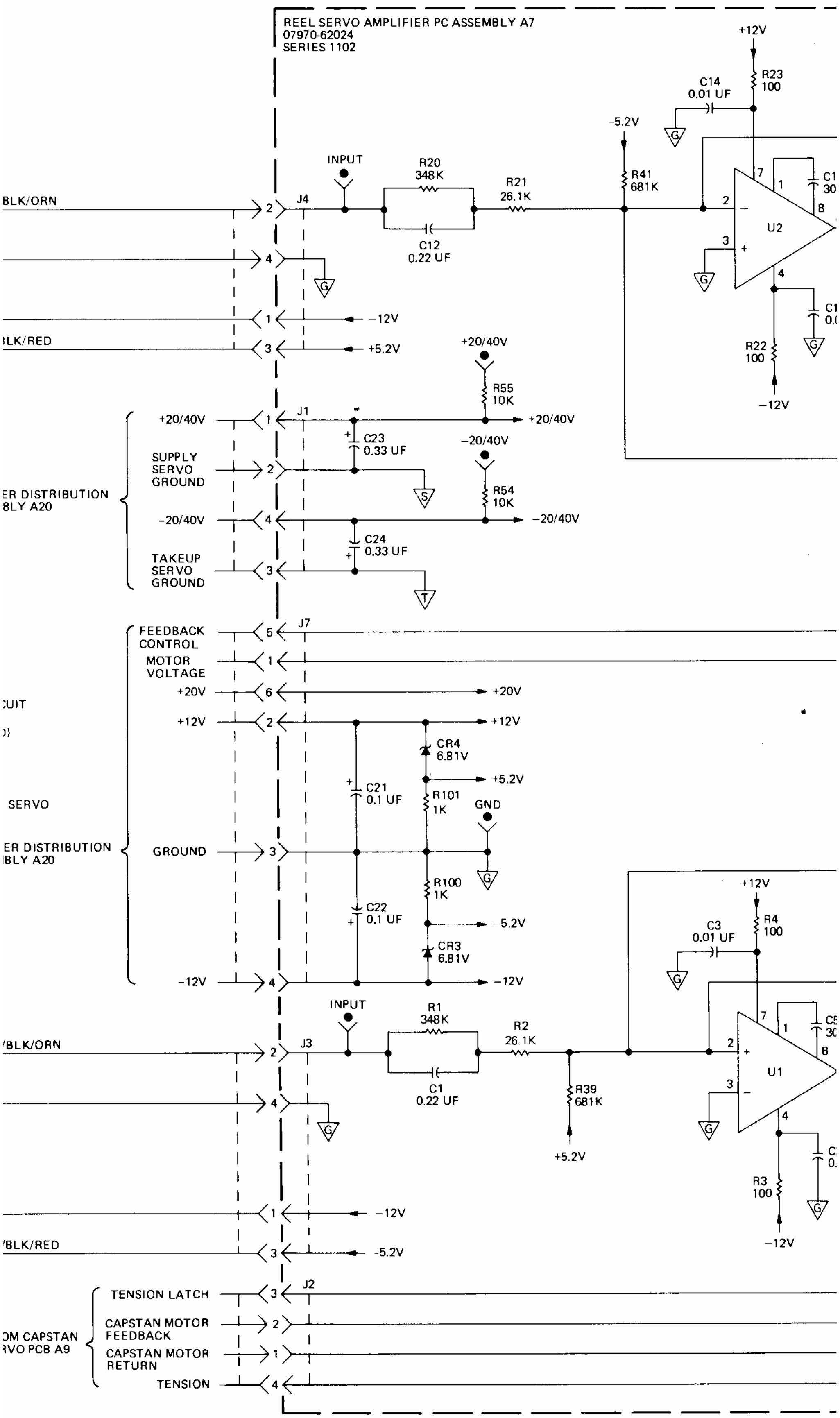


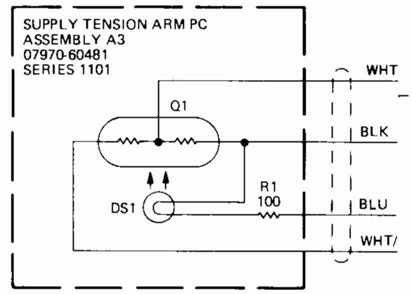
Figure 7-8. Reel Servo Assemblies A3/A4 and A7, Schematic Diagram

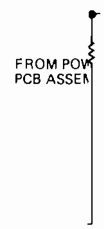


+20/40V
R28
1K
Q5
2N2102
R32
750
Q7
2N4920
Q11
2N3773
AMPL
C16
30 PF
C18
0.001 UF
R33
100
P/O
CR6
R38
10K
R26
90.9
R27
820
R34
1K
PREAMPL
R31
100
R37
100
C19
0.001 UF
P/O
CR6
C20
0.056 UF
R30
750
Q8
2N4923
R47
13.3K
Q6
2N4888
Q12
2N3773
R29
1K
R36
100
-20/40V
R24
348K
R25
348K
Q15
D
S
G
R106
2K
R48
1.78K
CR7
R50
51.1K
-12V
CR8
R5
348K
R6
348K
G
D
S
Q14
+20/40V
R104
2K
R9
1K
R53
1.78K
Q1
2N2102
R13
750
Q3
2N4920
Q9
2N3773
R105
13.3K
AMPL
C4
30 PF
C7
0.001 UF
R14
100
P/O
CR6
R19
10K
R7
90.9
R8
820
R15
1K
PREAMPL
R12
100
R18
100
C8
0.001 UF
P/O
CR6
C9
0.056 UF
R11
750
Q4
2N4923
Q2
2N4888
R10
1K
R17
100
Q10
2N3773
-20/40V



REEL SERVO AMPLIFIER PC ASSEMBLY A7
07970-62024
SERIES 1102
BLK/ORN
ILK/RED
INPUT
R20 348K
C12 0.22 UF
R21 26.1K
R41 681K
-5.2V
+12V
R23 100
C14 0.01 UF
U2
R22 100
-12V
+5.2V
+20/40V
R55 10K
R54 10K
-20/40V
C23 0.33 UF
C24 0.33 UF
SUPPLY SERVO GROUND
TAKEUP SERVO GROUND
ER DISTRIBUTION
BLY A20
J1
J3
J4
J7
FEEDBACK CONTROL
MOTOR VOLTAGE
+20V
CUIT
SERVO
GROUND
GND
CR4 6.81V
CR3 6.81V
R101 1K
R100 1K
C21 0.1 UF
C22 0.1 UF
R1 348K
C1 0.22 UF
R2 26.1K
R39 681K
C3 0.01 UF
R4 100
U1
R3 100
BLK/ORN
BLK/RED
J2
TENSION LATCH
CAPSTAN MOTOR FEEDBACK
CAPSTAN MOTOR RETURN
TENSION
OM CAPSTAN
RVO PCB A9





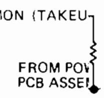
NOTES:

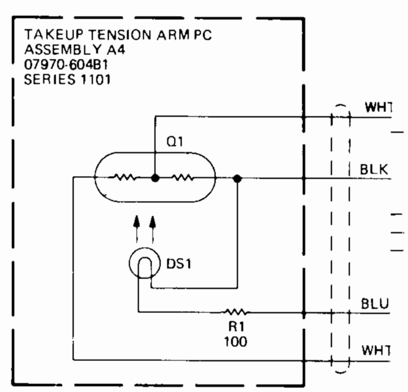
1. CR6 IS AN ENCAPSULATED BRIDGE CIR

G. THESE POINTS ARE COMMON (GROUN

S. THESE POINTS ARE COMMON (SUPPLY SERVO RETURN)

T. THESE POINTS ARE COMMON (TAKEU RETURN)





FF
SE

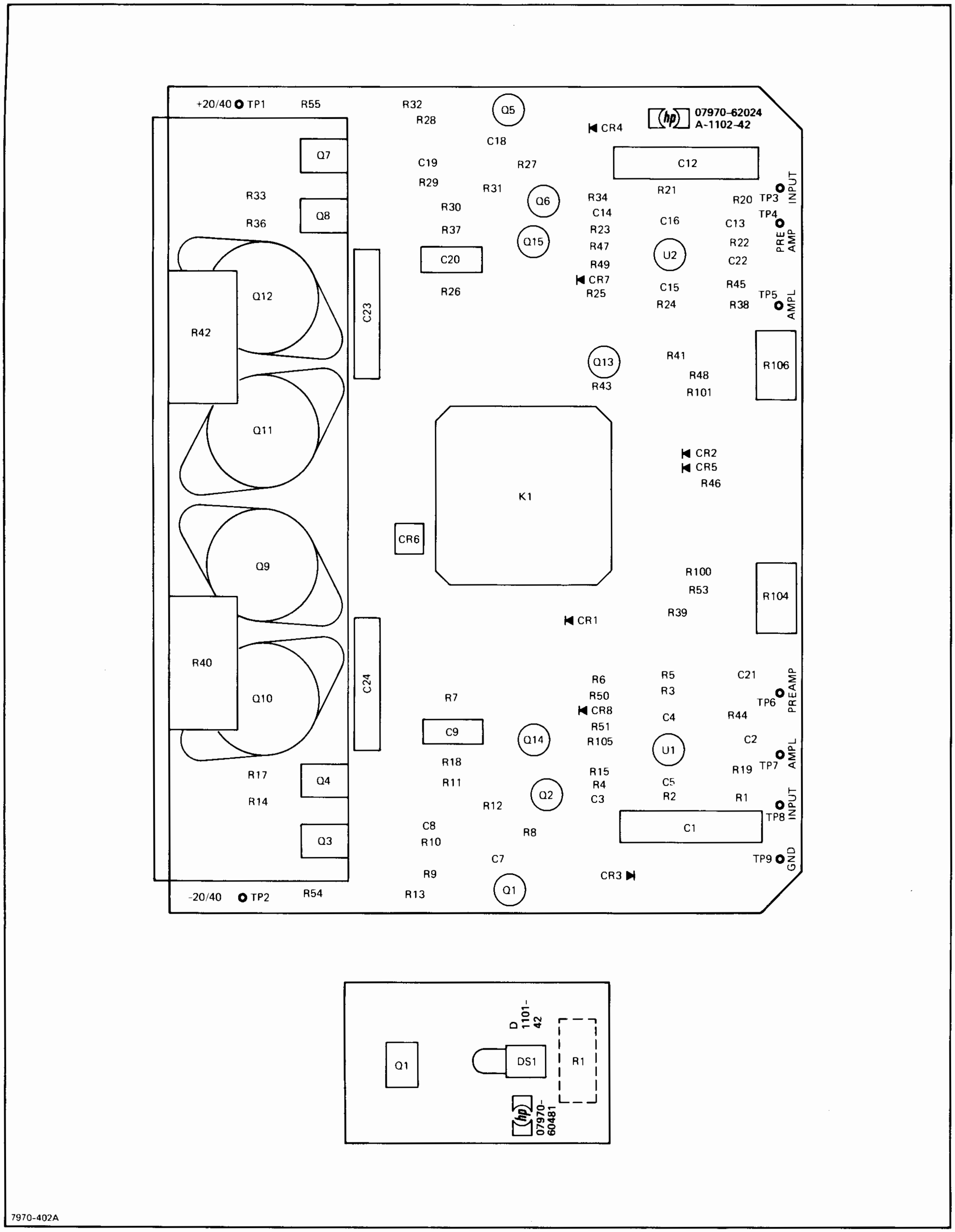


Figure 7-7. Reel Servo Assemblies A3/A4 and A7, Parts Location Diagram

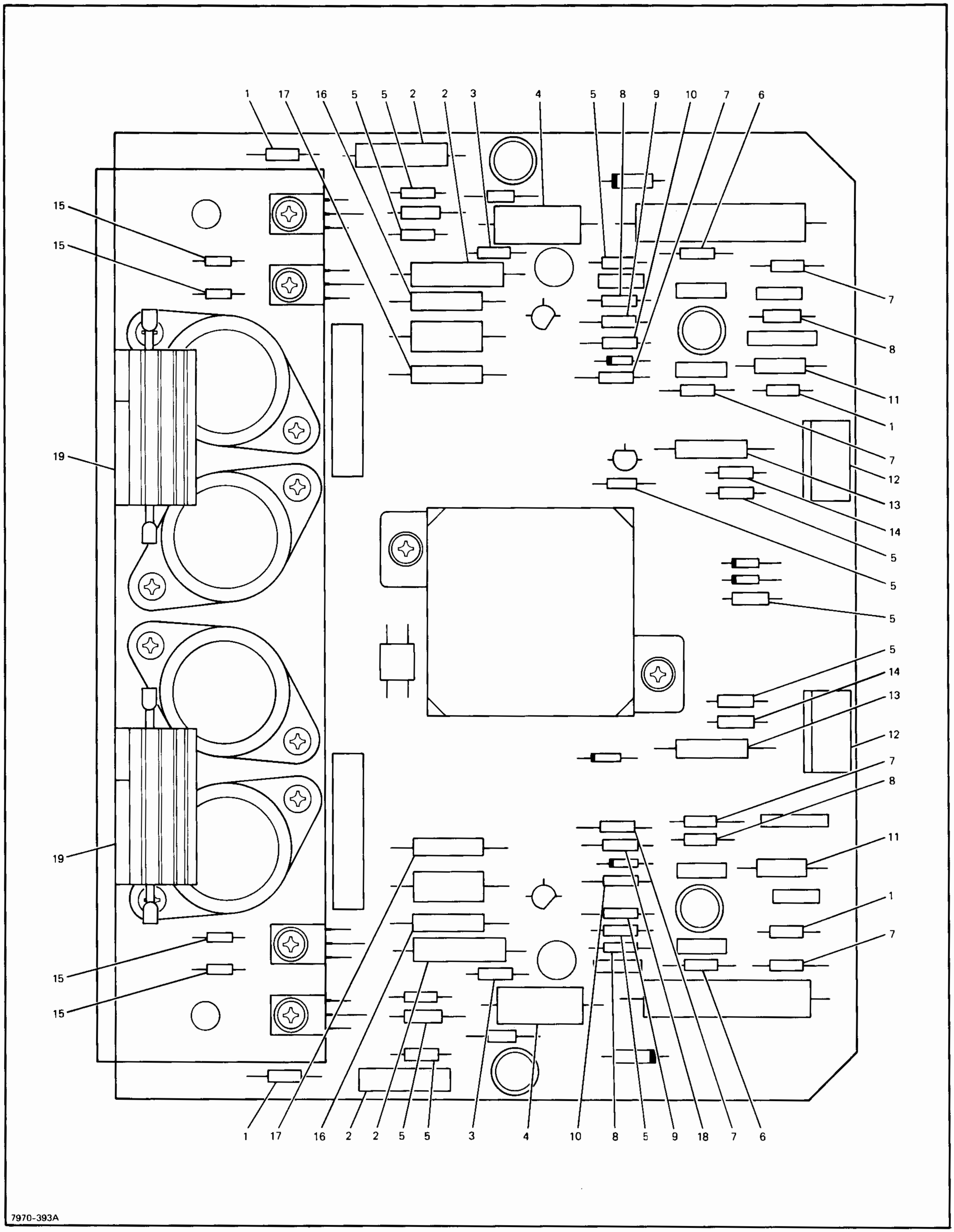


Figure 6-13. Reel Servo PC Assembly A7 (Sheet 1 of 2)

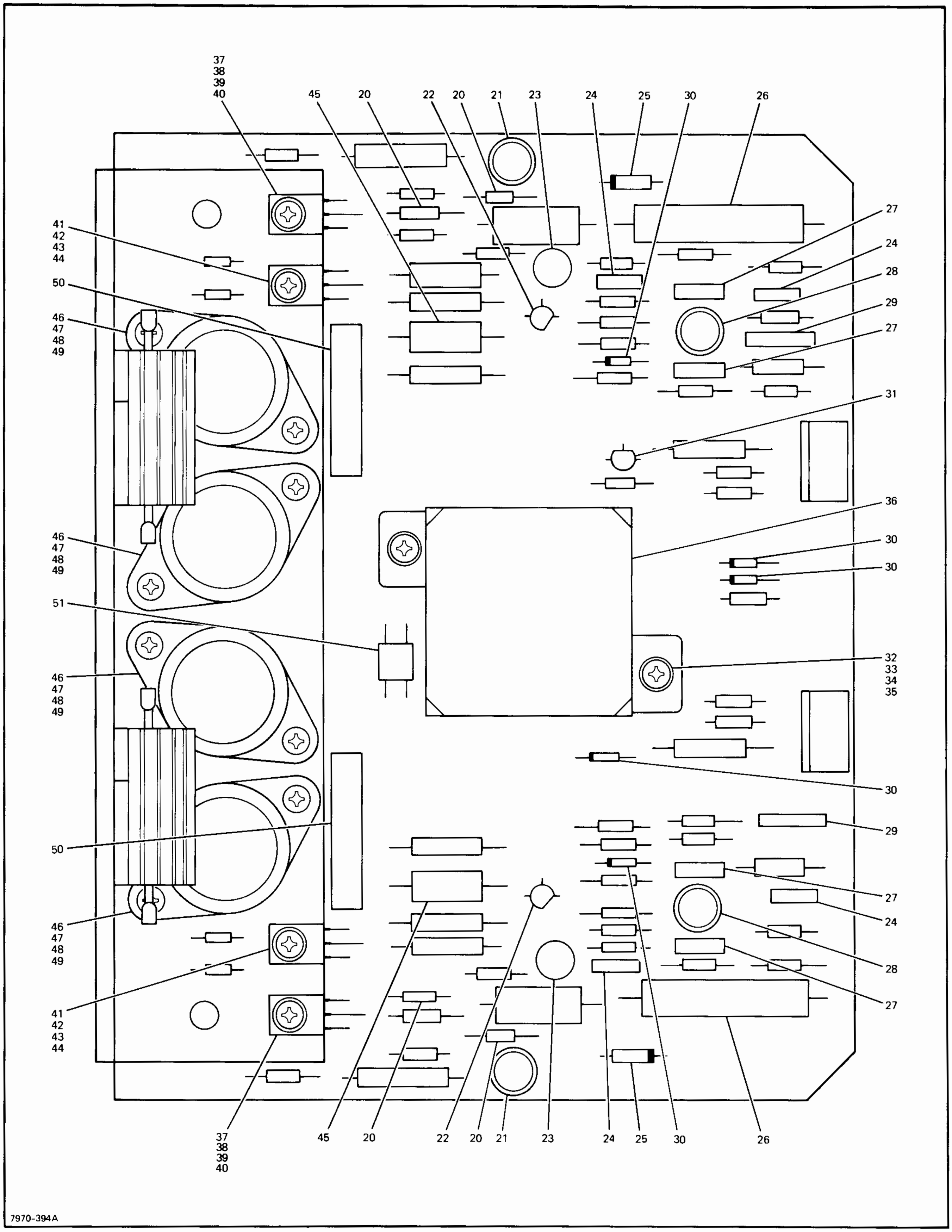
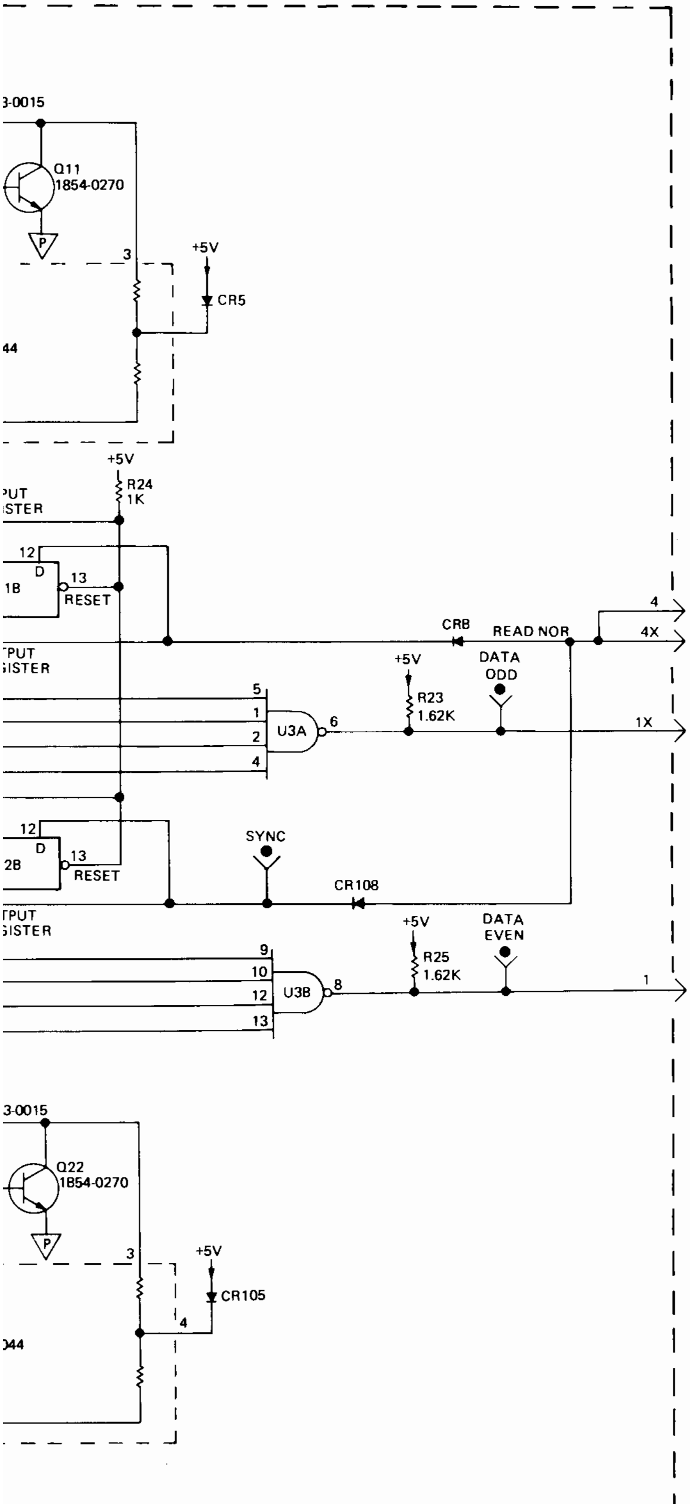


Figure 6-13. Reel Servo PC Assembly A7 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-13-	07970-62024	REEL SERVO PC ASSEMBLY A7	REF
-1	0683-1035	. RESISTOR, fxd, 10k, 5%, 1/4W (R19, R38, R54, R55)	4
-2	0761-0058	. RESISTOR, fxd, 750 ohms, 5%, 1W (R11, R13, R30, R32)	4
-3	0757-0401	. RESISTOR, fxd, 100 ohms, 1/8W (R12, R31)	2
-4	0698-3637	. RESISTOR, fxd, 820 ohms, 2W (R8, R27)	2
-5	0683-1025	. RESISTOR, fxd, 1k, 1/4W (R9, R10, R15, R28, R29, R34, R43, R46, R100, R101)	10
-6	0698-3159	. RESISTOR, fxd, 26.1k, 1%, 1/8W (R2, R21)	2
-7	0698-3458	. RESISTOR, fxd, 348k, 1%, 1/8W (R1, R5, R6, R20, R24, R25)	6
-8	0683-1015	. RESISTOR, fxd, 100 ohms, 1/4W (R3, R4, R22, R23)	4
-9	0757-0289	. RESISTOR, fxd, 13.3k, 1%, 1/8W (R47, R105)	2
-10	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R49, R51)	2
-11	0686-1035	. RESISTOR, fxd, 10k, 1/2W (R44, R45)	2
-12	2100-1759	. RESISTOR, var, 2k, 5% (R104, R106)	2
-13	0757-0869	. RESISTOR, fxd, 681k (R39, R41)	2
-14	0757-0278	. RESISTOR, fxd, 1.78k, 1%, 1/8W (R48, R53)	2
-15	0698-3113	. RESISTOR, fxd, 100 ohms, 1/8W (R14, R17, R33, R36)	4
-16	0757-0198	. RESISTOR, fxd, 100 ohms, 1/2W (R18, R37)	2
-17	0757-0797	. RESISTOR, fxd, 90.9 ohms, 1/2W (R7, R26)	2
-18	0775-0199	. RESISTOR, fxd, 21.5k, 1%, 1/8W (R50)	1
-19	0811-2048	. RESISTOR, fxd, 0.25 ohm, 25W (R40, R42)	2
-20	0160-0153	. CAPACITOR, fxd, 0.001 μF, My (C7, C8, C18, C19)	4
-21	1854-0022	. TRANSISTOR, NPN, Si, 2N2102 (Q1, Q5)	2
-22	1855-0052	. TRANSISTOR, field effect, 2N4360 (Q14, Q15)	2
-23	1853-0080	. TRANSISTOR, 2N4888 (Q2, Q6)	2
-24	0160-2055	. CAPACITOR, fxd, 0.01 μF, cer (C2, C3, C13, C14)	4
-25	1902-0048	. DIODE, breakdown, 6.81V (CR3, CR4)	2
-26	0160-0380	. CAPACITOR, fxd, 0.22 μF, My (C1, C12)	2
-27	0160-2199	. CAPACITOR, fxd, 30 pF, mica (C4, C5, C15, C16)	4
-28	1820-0223	. INTEGRATED CIRCUIT, operational amplifier (U1, U2)	2
-29	0150-0121	. CAPACITOR, fxd, 0.1 μF, cer (C21, C22)	2
-30	1901-0040	. DIODE, Si, 30V, 30 mA (CR1, CR2, CR5, CR7, CR8)	5
-31	1854-0215	. TRANSISTOR, NPN, Si, 2N3904 (Q13)	1
-32	0490-0890	. SOCKET, relay (XK1)	1
-33	2200-0147	. . SCREW, no. 4-40, 0.5-inch, pozi (AP)	2
-34	3050-0105	. . WASHER, flat (AP)	2
-35	2260-0009	. . NUT, hex, no. 4-40 (AP)	2
-36	0490-0891	. RELAY, 10A (K1)	1
-37	1853-0204	. TRANSISTOR, PNP, Si, 2N4920 (Q3, Q7)	2
-38	2200-0147	. . SCREW, no. 4-40, 0.5-inch, pozi (AP)	1
-39	3050-0105	. . WASHER, flat (AP)	1
-40	2260-0009	. . NUT, hex, no. 4-40 (AP)	1

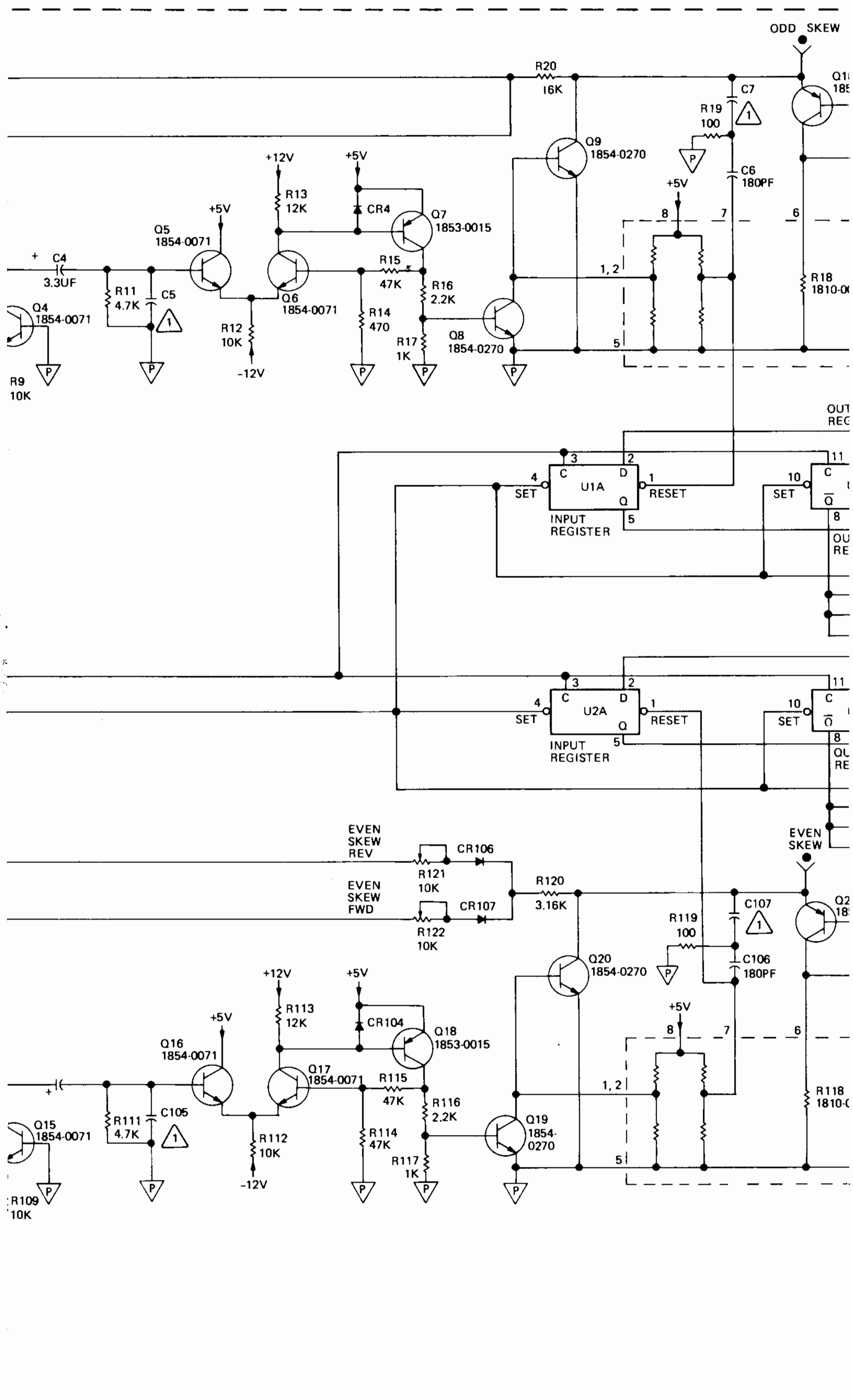
FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-13-41	1854-0347	. TRANSISTOR, NPN, Si, 2N4923 (Q4, Q8)	2
-42	2200-0147	. . SCREW, no. 4-40, 0.5-inch, pozi (AP)	1
-43	3050-0105	. . WASHER, flat (AP)	1
-44	2260-0009	. . NUT, hex, no. 4-40 (AP)	1
-45	0160-0165	. CAPACITOR, fxd, 0.056 μF, My (C9, C20)	2
-46	1854-0490	. TRANSISTOR, NPN, Si, 2N3773 (Q9, Q10, Q11, Q12)	4
-47	2200-0145	. . SCREW, no. 4-40, 0.438-inch, pozi (AP)	2
-48	3050-0105	. . WASHER, flat (AP)	2
-49	2260-0009	. . NUT, no. 4-40 (AP)	2
-50	0160-2128	. CAPACITOR, fxd, 0.33 μF (C23, C24)	2
-51	1901-0364	. DIODE ASSEMBLY, Si (CR6)	1



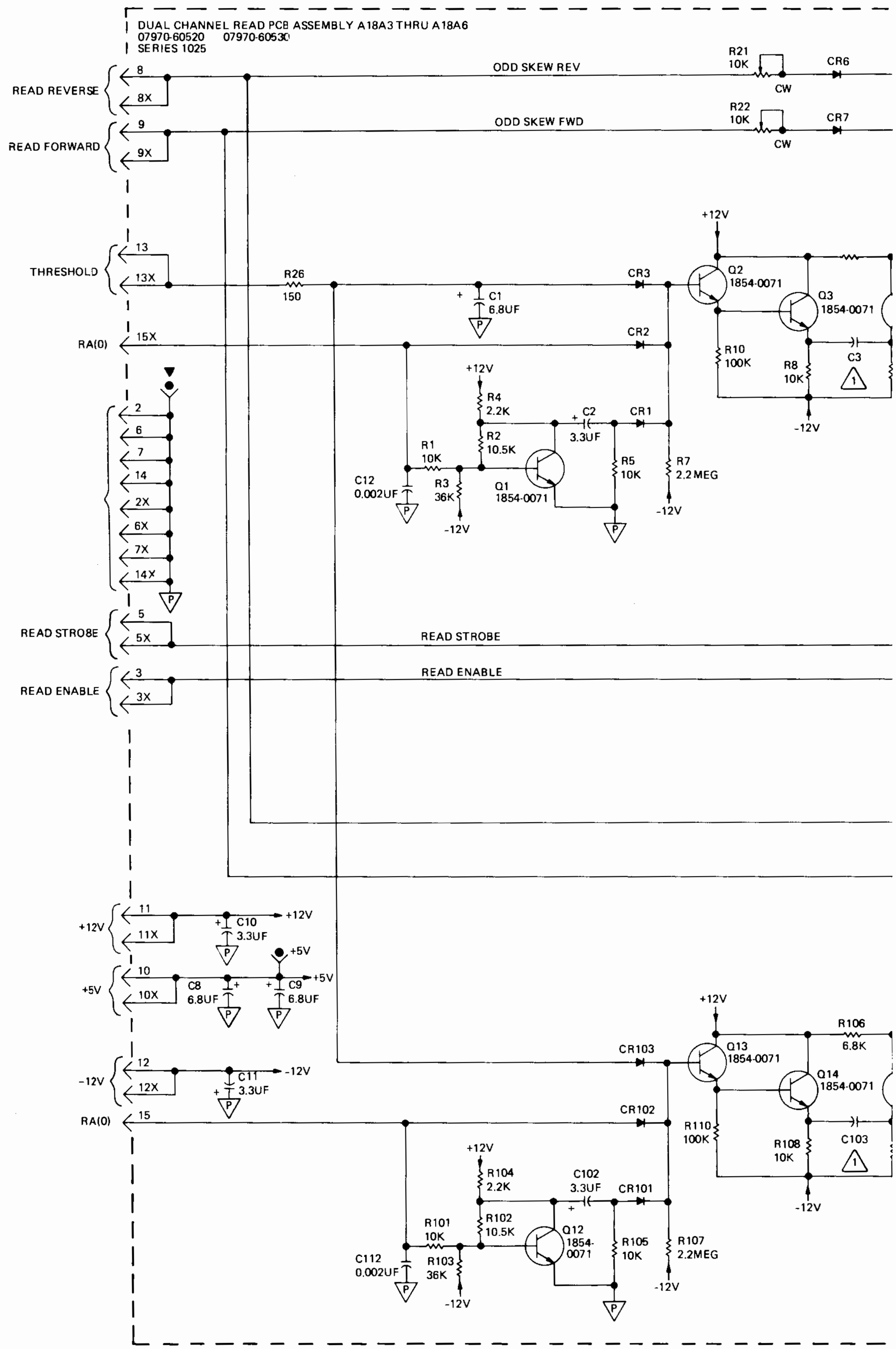
1 SPEED CRITICAL COMPONENTS

SPEED (ips)	C3 C103	C5 C105	C7 C107	ASSEMBLY
10 - 10 – 20.9 21 – 45	0.0082 UF 0.0039 UF	680 pF 330 pF	0.0068 UF 0.0033 UF	07970 – 60520 07970 – 60530

Figure 4-15. Dual-Channel Read Data PC Assembly A18A3 thru A18A6, Schematic Diagram



ODD SKEW
R20 16K
Q9 1854-0270
R19 100
C7
C6 180PF
+12V
+5V
R13 12K
CR4
Q7 1853-0015
Q5 1854-0071
Q6 1854-0071
C4 3.3UF
R11 4.7K
C5
R12 10K
-12V
R15 47K
R16 2.2K
R14 470
R17 1K
Q8 1854-0270
R18
Q4 1854-0071
R9 10K
U1A
INPUT REGISTER
SET
RESET
U2A
INPUT REGISTER
EVEN SKEW REV
EVEN SKEW FWD
R121 10K
R122 10K
CR106
CR107
R120 3.16K
EVEN SKEW
R119 100
C107
C106 180PF
Q20 1854-0270
R113 12K
CR104
Q18 1853-0015
Q16 1854-0071
Q17 1854-0071
R115 47K
R116 2.2K
R111 4.7K
C105
R112 10K
R114 47K
R117 1K
Q19 1854-0270
R118
Q15 1854-0071
R109 10K



DUAL CHANNEL READ PCB ASSEMBLY A18A3 THRU A18A6
07970-60520 07970-60530
SERIES 1025
READ REVERSE
READ FORWARD
ODD SKEW REV
ODD SKEW FWD
THRESHOLD
RA(0)
READ STROBE
READ ENABLE
+12V
+5V
-12V
R21 10K
R22 10K
CW
CR6
CR7
R26 150
C1 6.8UF
CR3
CR2
CR1
Q2 1854-0071
Q3 1854-0071
R10 100K
R8 10K
C3
R4 2.2K
R2 10.5K
C2 3.3UF
R1 10K
R3 36K
C12 0.002UF
Q1 1854-0071
R5 10K
R7 2.2 MEG
C10 3.3UF
C8 6.8UF
C9 6.8UF
C11 3.3UF
CR103
CR102
CR101
Q13 1854-0071
Q14 1854-0071
R106 6.8K
R110 100K
R108 10K
C103
R104 2.2K
R102 10.5K
C102 3.3UF
R101 10K
R103 36K
C112 0.002UF
Q12 1854-0071
R105 10K
R107 2.2MEG

7970-F-019A

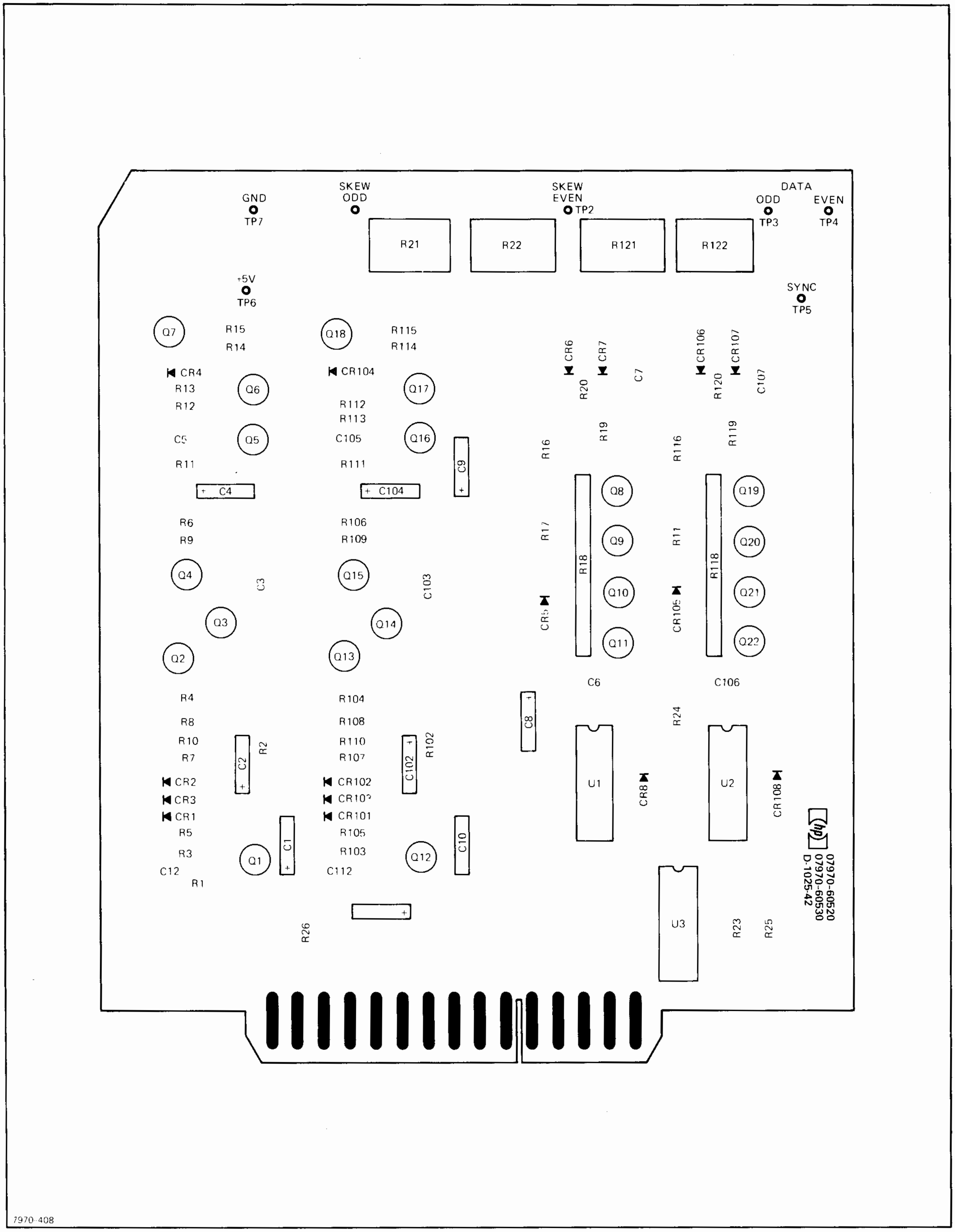
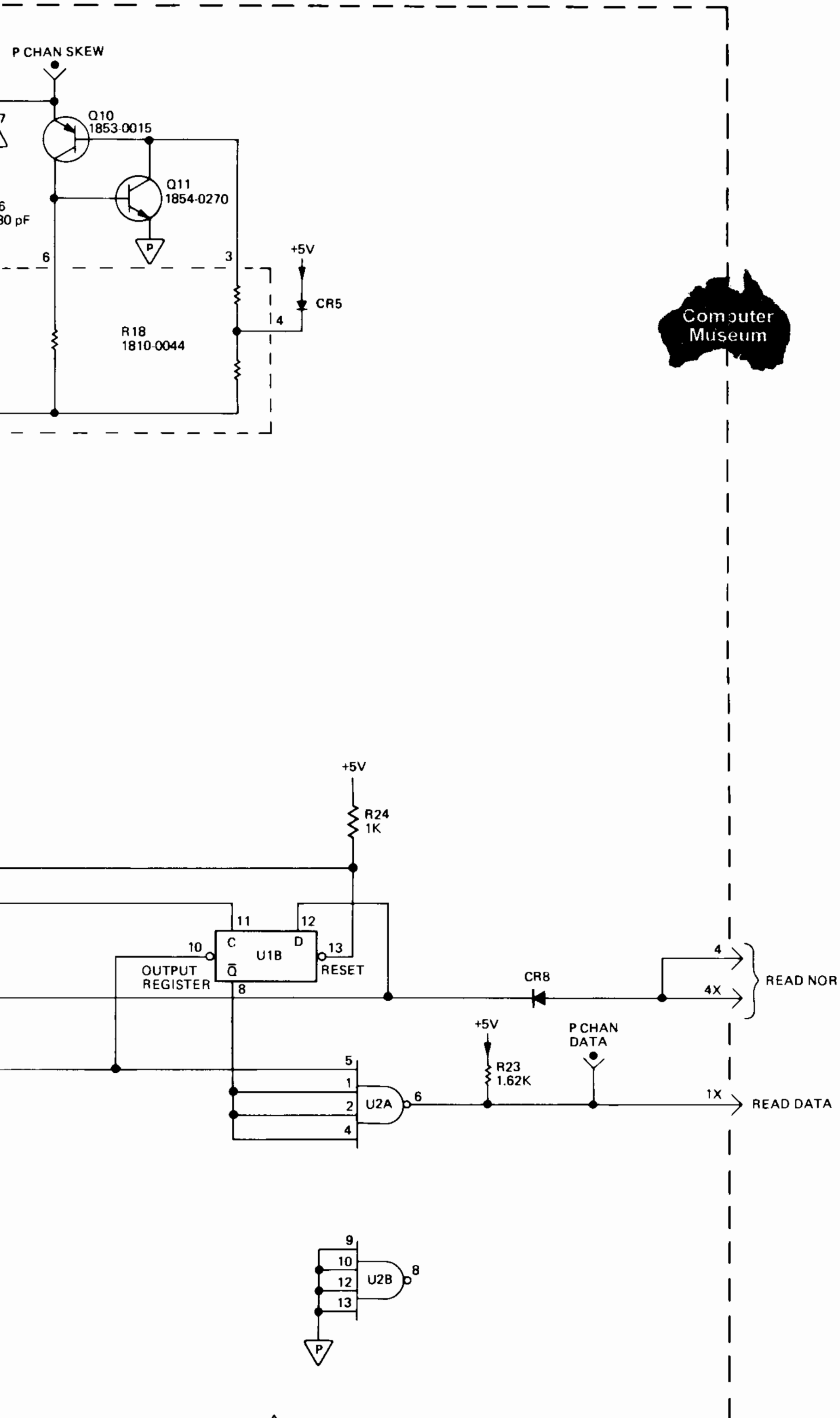


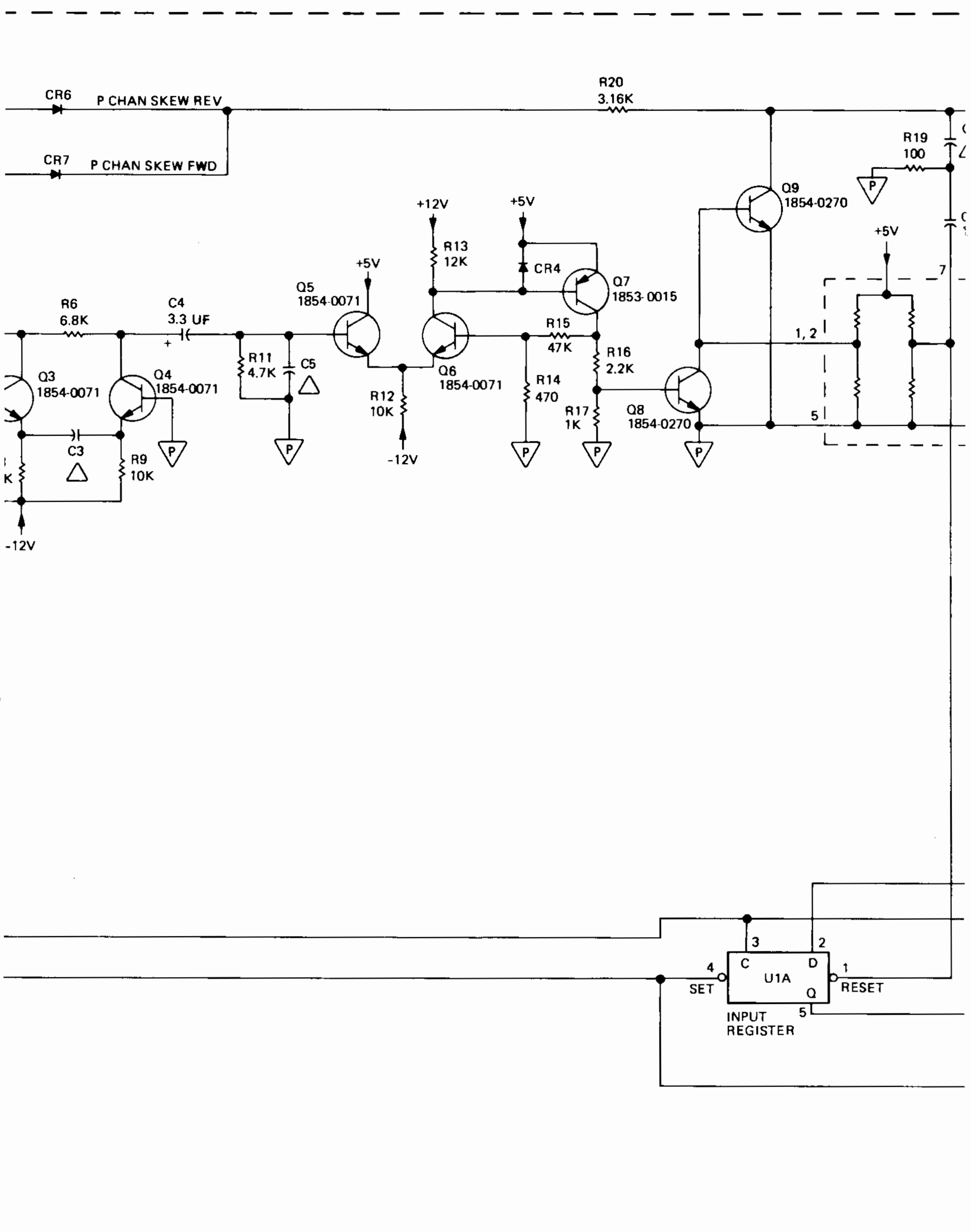
Figure 4-14. Dual-Channel Read Data PC Assembly A18A3 thru A18A6, Parts Location Diagram



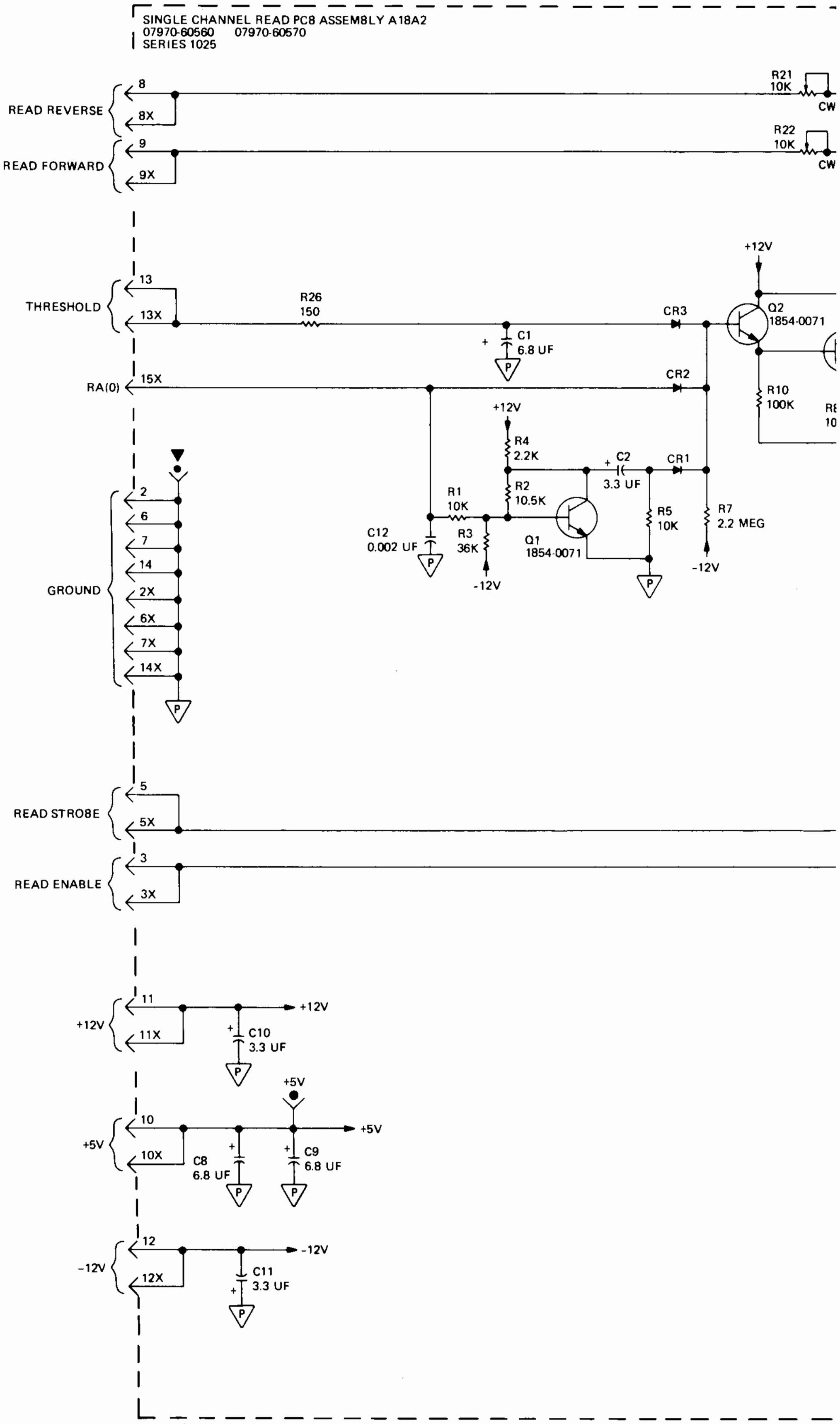
SPEED CRITICAL COMPONENTS

SPEED (ips)	C3	C5	C7	ASSEMBLY
10 - 20.9	0.0082 UF	680 pF	0.0068 UF	07970-60560
21 - 45	0.0039 UF	330 pF	0.0033 UF	07970-60570

Figure 4-11. Single-Channel Read Data PC Assembly A18A2, Schematic Diagram



CR6
P CHAN SKEW REV
CR7
P CHAN SKEW FWD
R20
3.16K
R19
100
Q9
1854-0270
+12V
+5V
R13
12K
CR4
Q7
1853-0015
+5V
Q5
1854-0071
R6
6.8K
C4
3.3 UF
R15
47K
R16
2.2K
1, 2
7
5
Q3
1854-0071
Q4
1854-0071
R11
4.7K
C5
R12
10K
Q6
1854-0071
R14
470
R17
1K
Q8
1854-0270
-12V
C3
R9
10K
-12V
3
2
C
D
4
SET
U1A
1
RESET
Q
5
INPUT
REGISTER


SINGLE CHANNEL READ PCB ASSEMBLY A18A2
07970-60560 07970-60570
SERIES 1025
READ REVERSE
8
8X
READ FORWARD
9
9X
R21
10K
CW
R22
10K
CW
THRESHOLD
13
13X
R26
150
C1
6.8 UF
CR3
CR2
RA(0)
15X
+12V
Q2
1854-0071
R10
100K
R4
2.2K
R2
10.5K
C2
3.3 UF
CR1
R1
10K
R3
36K
C12
0.002 UF
Q1
1854-0071
R5
10K
R7
2.2 MEG
-12V
GROUND
2
6
7
14
2X
6X
7X
14X
READ STROBE
5
5X
READ ENABLE
3
3X
+12V
11
11X
C10
3.3 UF
+5V
10
10X
C8
6.8 UF
C9
6.8 UF
-12V
12
12X
C11
3.3 UF
7970-018A

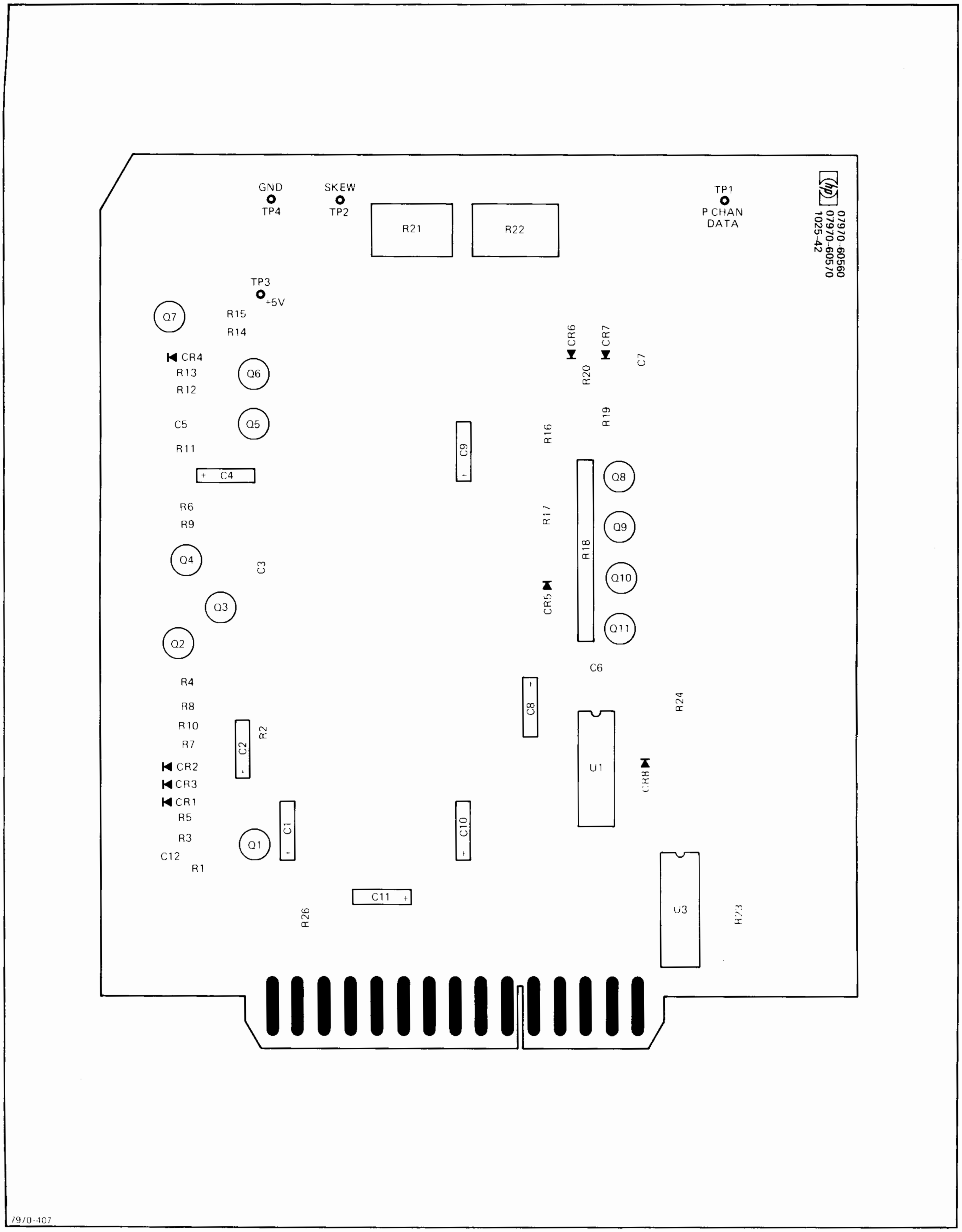


Figure 4-10. Single-Channel Read Data PC Assembly A18A2, Parts Location Diagram

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-4-	07970-62004	READ/READ CONTROL PC ASSEMBLY A18A1, 10 - 20.9 ips	REF
3-4-	07970-62005	READ/READ CONTROL PC ASSEMBLY A18A1, 21 - 45 ips	REF
-1	2100-1758	. RESISTOR, var, ww, 1k, 5%, 1W (R29)	1
-2	0683-2225	. RESISTOR, fxd, 2.2k, 5%, 1/4W (R2, R4, R8, R22, R29)	5
-3	0683-1235	. RESISTOR, fxd, 12k, 5%, 1/4W (R23)	1
-4	0698-3132	. RESISTOR, fxd, 261 ohms, 1%, 1/8W (R12, R28)	2
-5	0757-0428	. RESISTOR, fxd, 1620 ohms, 1%, 1/8W (R10, R26, R42)	3
-6	0698-3438	. RESISTOR, fxd, 147 ohms, 1%, 1/8W (R27)	1
-7	0757-0199	. RESISTOR, fxd, 21.5k, 1%, 1/8W (R25)	1
-8	0683-8235	. RESISTOR, fxd, 82k, 5%, 1/4W (R30, R37, R38)	3
-9	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R3, R7, R11, R31, R32, R39)	6
-10	0683-2725	. RESISTOR, fxd, 2.7k, 5%, 1/4W (R34)	1
-11	0683-6815	. RESISTOR, fxd, 680 ohms, 5%, 1/4W (R33).	1
-12	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R35)	1
-13	0757-0444	. RESISTOR, fxd, 12.1k, 1%, 1/8W (R36)	1
-14	0683-1525	. RESISTOR, fxd, 1.5k, 5%, 1/4W (R41)	1
-15	0683-6825	. RESISTOR, fxd, 6.8k, 5%, 1/4W (R1, R9, R40).	3
-16	0757-0401	. RESISTOR, fxd, 100 ohms, 1%, 1/8W (R15).	1
-17	0683-3325	. RESISTOR, fxd, 3.3k, 5%, 1/4W (R6, R17, R19)	3
-18	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R13)	1
-19	0683-3335	. RESISTOR, fxd, 33k, 5%, 1/4W (R14)	1
-20	0757-1094	. RESISTOR, fxd, 1.47k, 1%, 1/8W (R16)	1
-21	0683-2235	. RESISTOR, fxd, 22k, 5%, 1/4W (R5)	1
-22	0757-0443	. RESISTOR, fxd, 11k, 1%, 1/8W (R21)	1
-23	0757-0439	. RESISTOR, fxd, 6.81k, 1%, 1/8W (R20)	1
-24	1854-0071	. TRANSISTOR, NPN, Si (Q2, Q3, Q5, Q6, Q7)	5
-25	1901-0040	. DIODE, Si (CR1, CR2, CR3, CR4, CR5, CR6, CR7, CR8, CR9, CR10, CR11)	11
-26	1854-0270	. TRANSISTOR, NPN, Si, 2N4265 (Q8, Q10, Q11)	3
-27	1853-0015	. TRANSISTOR, PNP, Si, 2N3640 (Q9)	1
-28	0160-0162	. CAPACITOR, fxd, 0.022 μF, 10% (C8) (used only on 07970-60540).	1
-28	0160-0161	. CAPACITOR, fxd, 0.01 μF, 10% (C8) (used only on 07970-60550)	1
-29	0160-2307	. CAPACITOR, fxd, 47 pF, 5%, 300 Vdcw (C9)	1
-30	1820-0088	. INTEGRATED CIRCUIT, type 851 (U5, U6)	2
-31	0140-0193	. CAPACITOR, fxd, 82 pF, 5%, 300 Vdcw (C10)	1
-32	0160-2209	. CAPACITOR, fxd, 360 pF, 5%, 300 Vdcw (C11)	1
-33	1820-0069	. INTEGRATED CIRCUIT, type 7420N (U2)	1
-34	0180-1701	. CAPACITOR, fxd, 6.8 μF, 20%, 6 Vdcw (C12, C13)	2
-35	1820-0348	. INTEGRATED CIRCUIT, type 844 (U1)	1
-36	1820-0276	. INTEGRATED CIRCUIT (U3)	1
-37	1853-0036	. TRANSISTOR, PNP, Si, 2N3906 (Q1, Q4)	2
-38	0160-2055	. CAPACITOR, fxd, 0.01 μF, -20 +80%, 100 Vdcw (C1, C2, C3, C4, C5, C6).	6
-39	0180-1704	. CAPACITOR, fxd, 47 μF, 10%, 6 Vdcw (C7)	1
-40	1820-0349	. INTEGRATED CIRCUIT (U4)	1
-41	0180-0210	. CAPACITOR, fxd, 3.3 μF, 20%, 15 Vdcw (C14, C15)	2

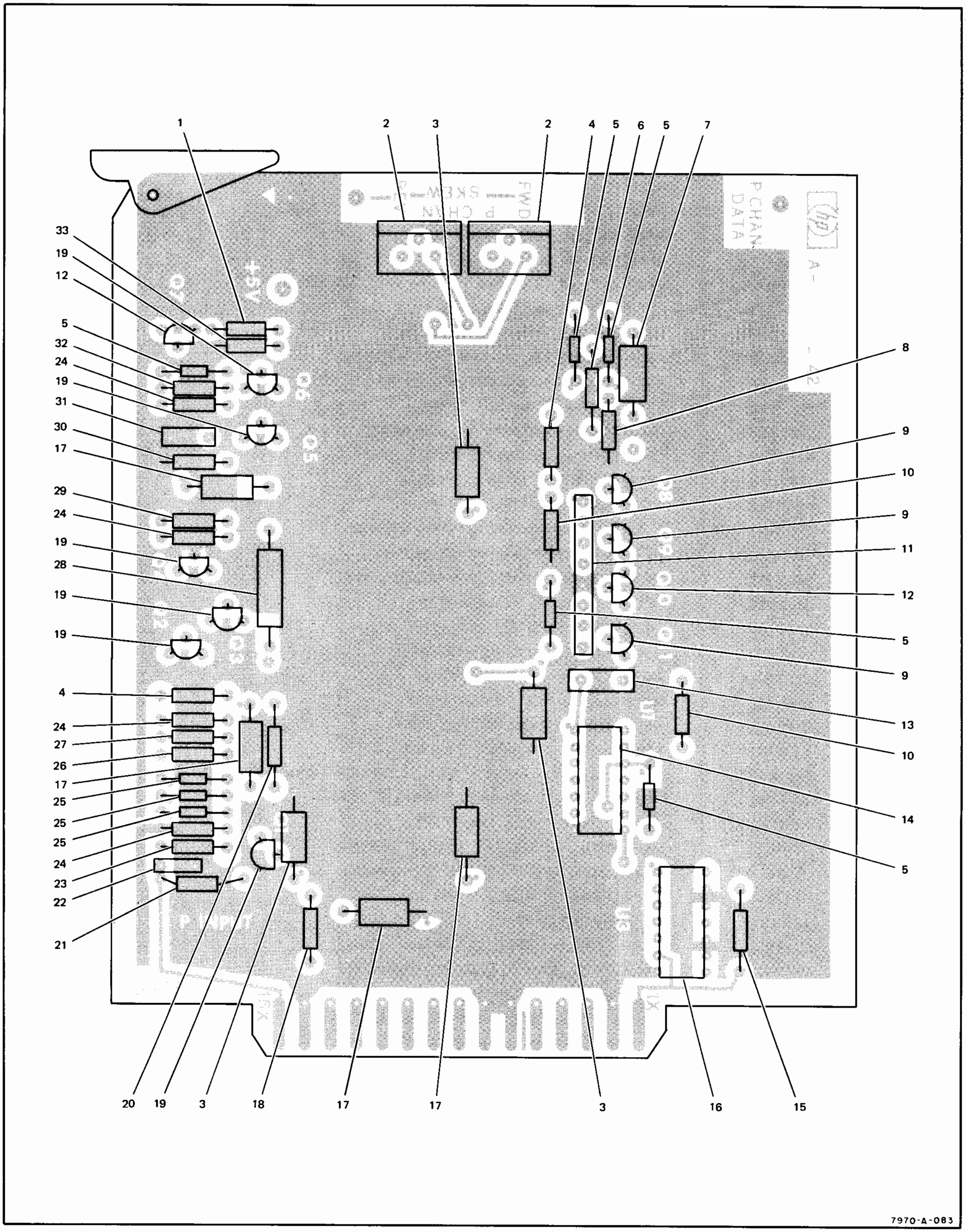


Figure 3-5. Single-Channel Read Data PC Assembly A18A2

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-5-	07970-62167	READ DATA PC ASSEMBLY A18A2, single-channel (10 - 20.9 ips)	REF
-1	0683-4715	. RESISTOR, fxd, 470 ohms, 1/4W (R14)	1
-2	2100-1923	. RESISTOR, var, 50k (R21, R22)	2
-3	0180-1701	. CAPACITOR, fxd, 6.8 μF, 6V, tant (C1, C8, C9)	3
-4	1901-0040	. DIODE, Si, 30V, 30 mA (CR5, CR6, CR7, CR8)	4
-5	0757-0289	. RESISTOR, fxd, 13.3k, 1%, 1/8W (R20)	1
-6	0160-0160	. CAPACITOR, fxd, 0.0082 μF, Mylar (C3, C7)	2
-7	1820-0515	. INTEGRATED CIRCUIT, MV 9602 (U4)	1
-8	0683-4725	. RESISTOR, fxd, 4.7k, 1/4W (R11, R19)	2
-9	0683-2725	. RESISTOR, fxd, 2.7k, 1/4W (R18)	1
-10	0140-0197	. CAPACITOR, fxd, 180 pF, mica (C6)	1
-11	0683-2225	. RESISTOR, fxd, 2.2k, 1/4W (R4, R16, R17)	3
-12	0683-1025	. RESISTOR, fxd, 1k, 1/4W (R24)	1
-13	0757-0429	. RESISTOR, fxd, 1.62k, 1%, 1/8W (R23)	1
-14	1820-0348	. INTEGRATED CIRCUIT, type 844 (U3)	1
-15	1820-0077	. INTEGRATED CIRCUIT, type SN7474 (U1)	1
-16	0180-0210	. CAPACITOR, fxd, 3.3 μF, 15V (C2, C4, C10, C11)	4
-17	0683-1515	. RESISTOR, fxd, 150 ohms, 1/4W (R26)	1
-18	1854-0071	. TRANSISTOR, 2N3391 (Q1, Q2, Q3, Q4)	4
-19	0698-4477	. RESISTOR, fxd, 10.5k, 1%, 1/8W (R2)	1
-20	0757-0442	. RESISTOR, fxd, 10k, 1%, 1/8W (R1)	1
-21	0160-3449	. CAPACITOR, fxd, 2000 pF, 10% (C12)	1
-22	0683-3635	. RESISTOR, fxd, 36k, 1/4W (R3)	1
-23	0683-1035	. RESISTOR, fxd, 10k, 1/4W (R5, R8, R9)	3
-24	1901-0450	. DIODE, Si (CR1, CR2, CR3)	3
-25	0683-2255	. RESISTOR, fxd, 2.2M, 1/4W (R7)	1
-26	0683-1045	. RESISTOR, fxd, 100k, 1/4W (R10)	1
-27	0683-6825	. RESISTOR, fxd, 6.8k, 1/4W (R6)	1
-28	0160-3573	. CAPACITOR, fxd, 680 pF, cer (C5)	1
-29	1826-0065	. INTEGRATED CIRCUIT, comparator, LM 311 (U5)	1
-30	0683-4735	. RESISTOR, fxd, 47k, 1/4W (R15)	1

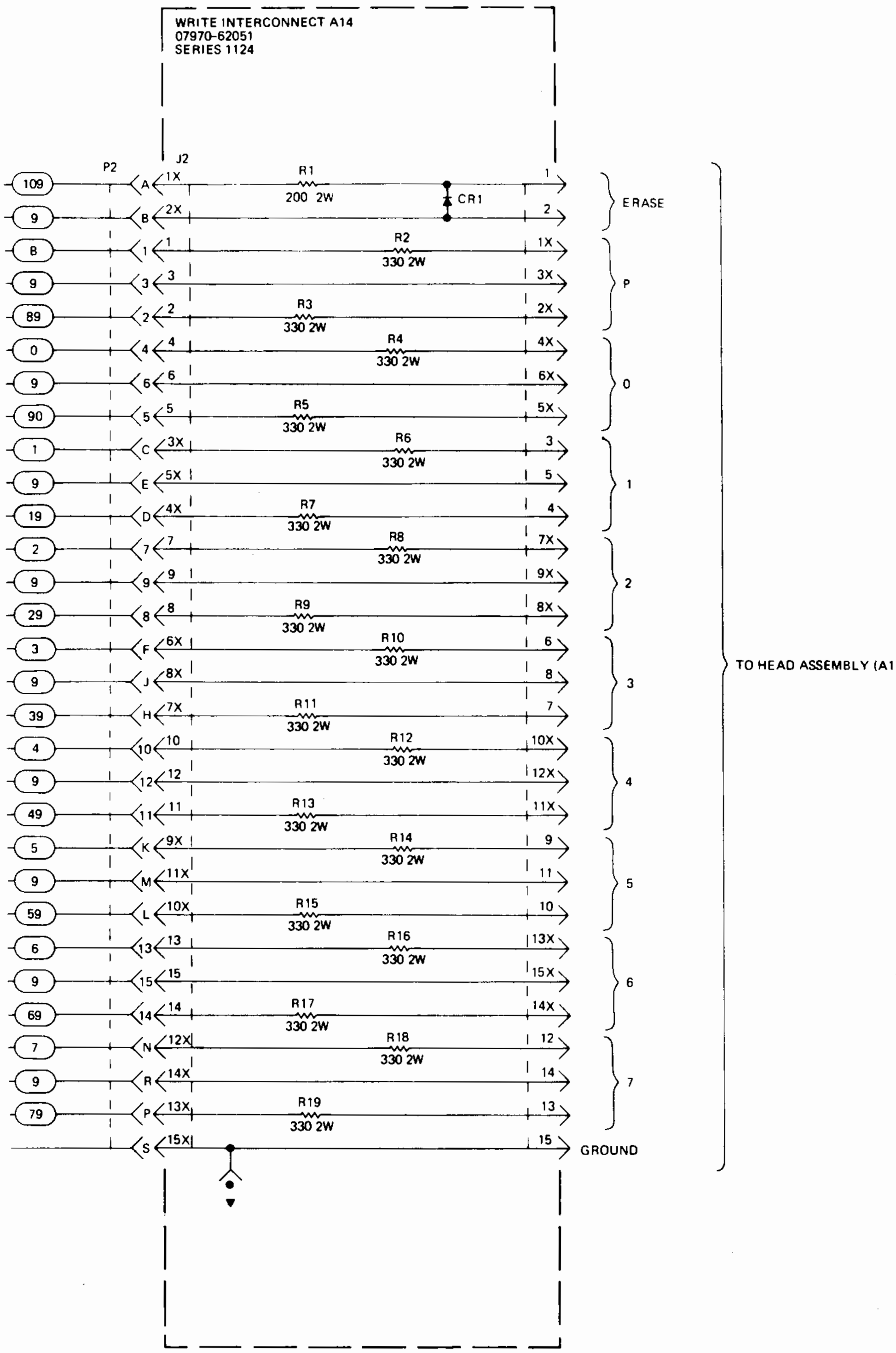


Figure 4-3. Write Assembly A17 (Motherboard) and Write Interconnect Assembly A14, Schematic Diagram

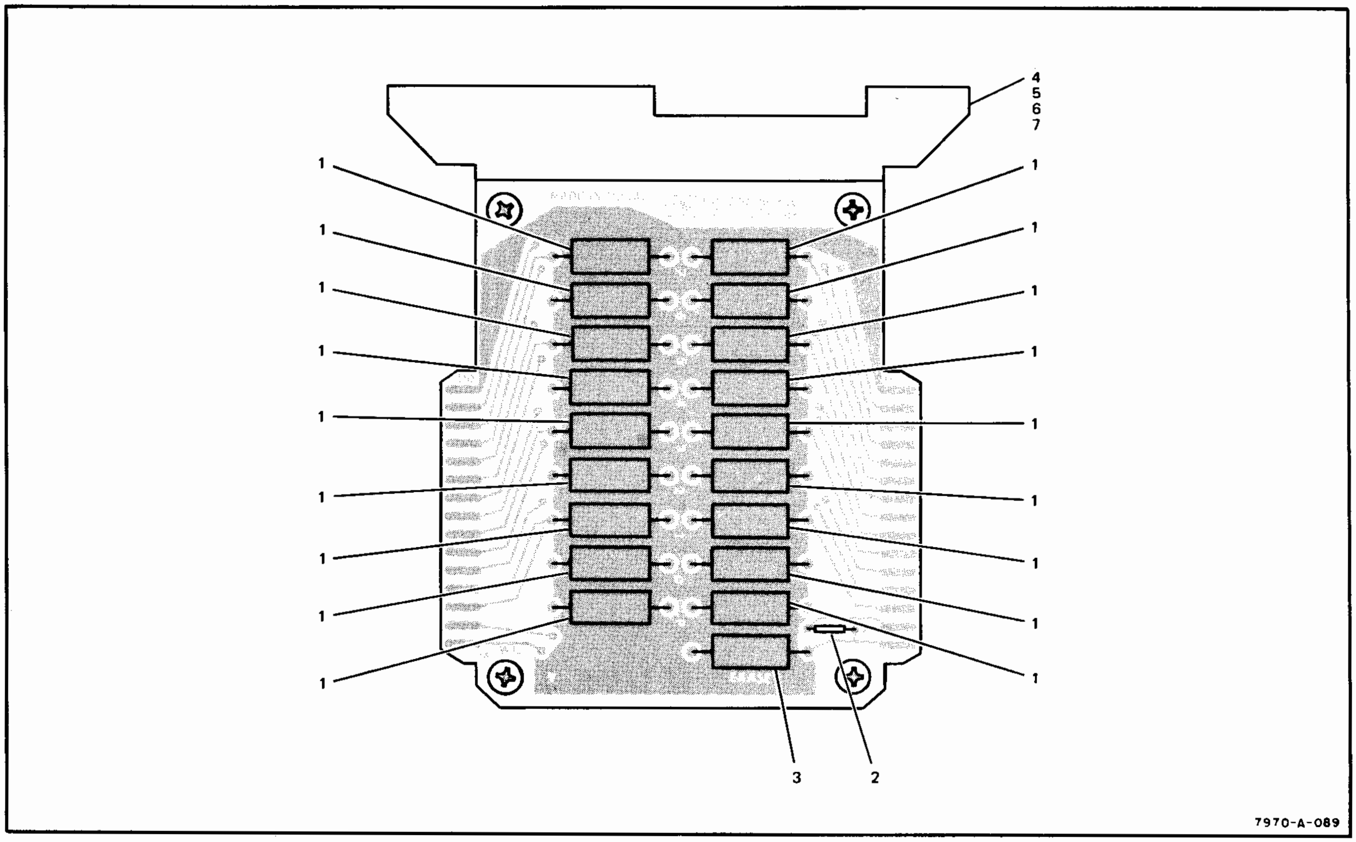


Figure 3-2. Write Interconnect PC Assembly A14

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-2-	07970-62165	WRITE INTERCONNECT PC ASSEMBLY A14 (10 to 20.9 ips)	REF
3-2-	07970-60300	WRITE INTERCONNECT PC ASSEMBLY A14 (21 to 45 ips)	REF
-1	0698-3626	. RESISTOR, fxd, 180 ohms, 5%, 2W (R2 thru R19) (10 to 20.9 ips)	18
-1	0698-3622	. RESISTOR, fxd, 120 ohms, 5%, 2W (R2 thru R19) (21 to 45 ips)	18
-2	1901-0025	. DIODE, Si (CR1)	1
-3	0698-3624	. RESISTOR, fxd, 150 ohms, 5%, 2W (R1) (10 to 20.9 ips)	1
-3	0698-3627	. RESISTOR, fxd, 200 ohms, 5%, 2W (R1) (21 to 45 ips)	1
-4	07970-00440	. BRACKET, write interconnect PC assembly	1
-5	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	4
-6	2190-0085	. . WASHER, lock, helical (AP)	4
-7	3050-0228	. . WASHER, flat (AP)	4

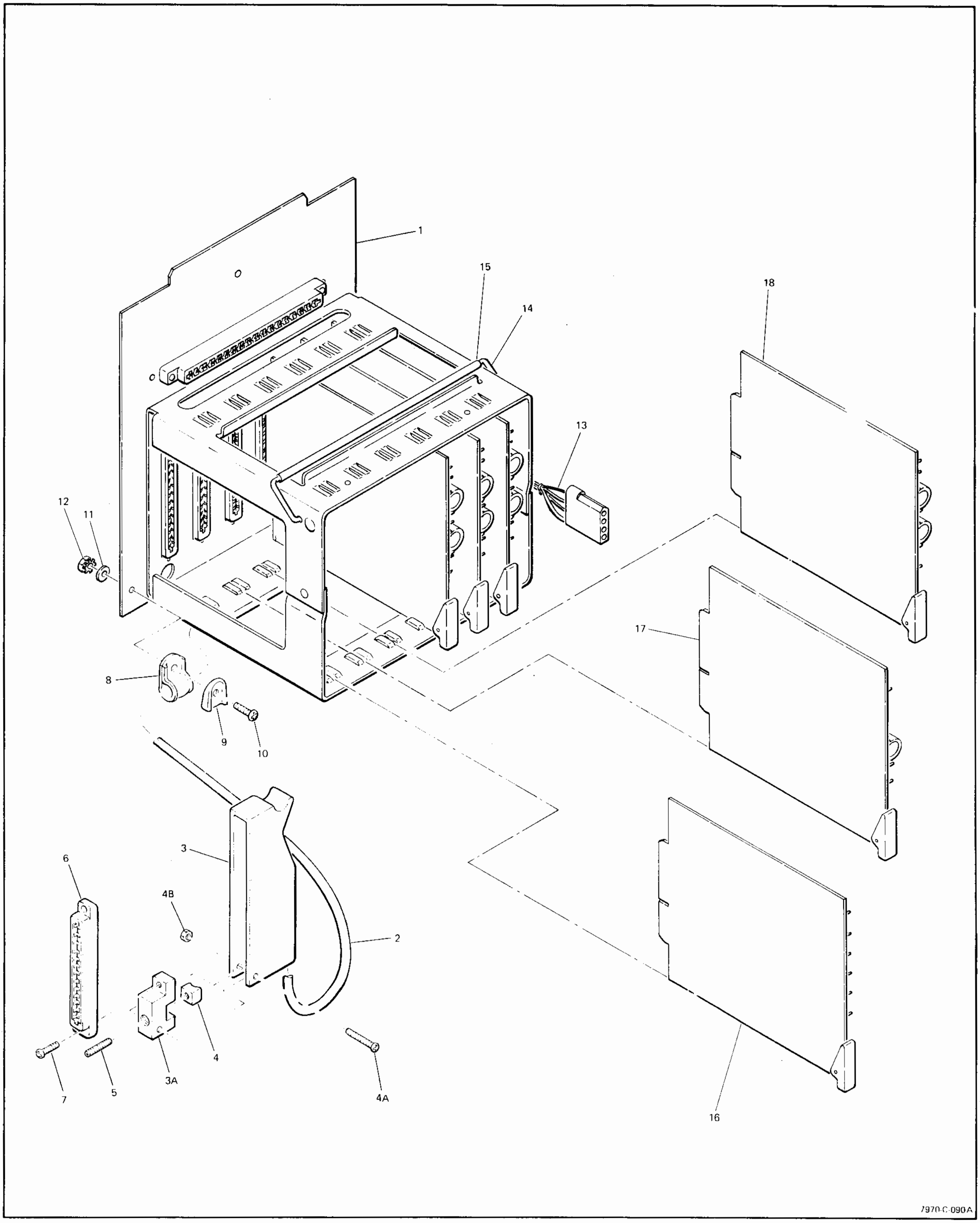
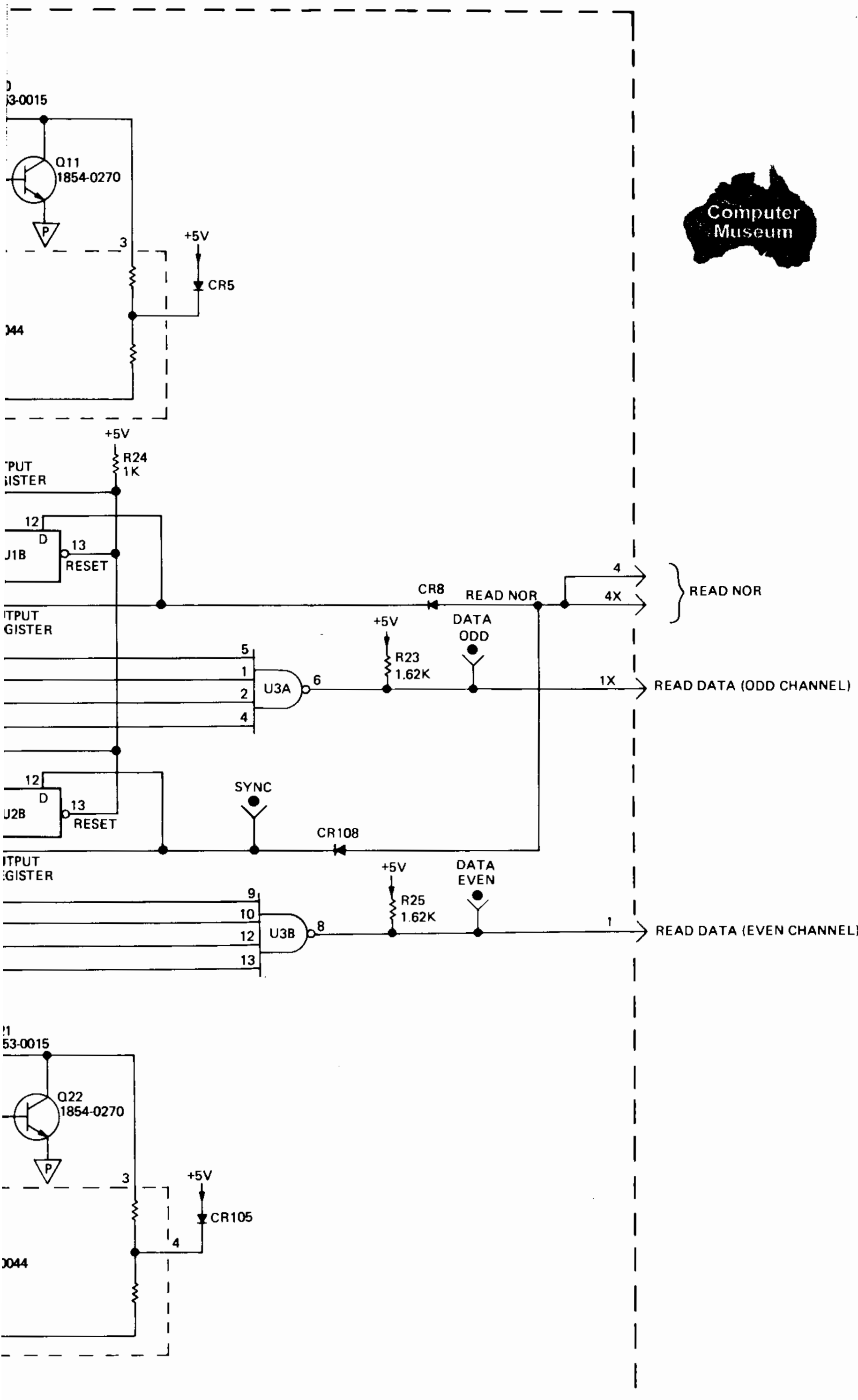


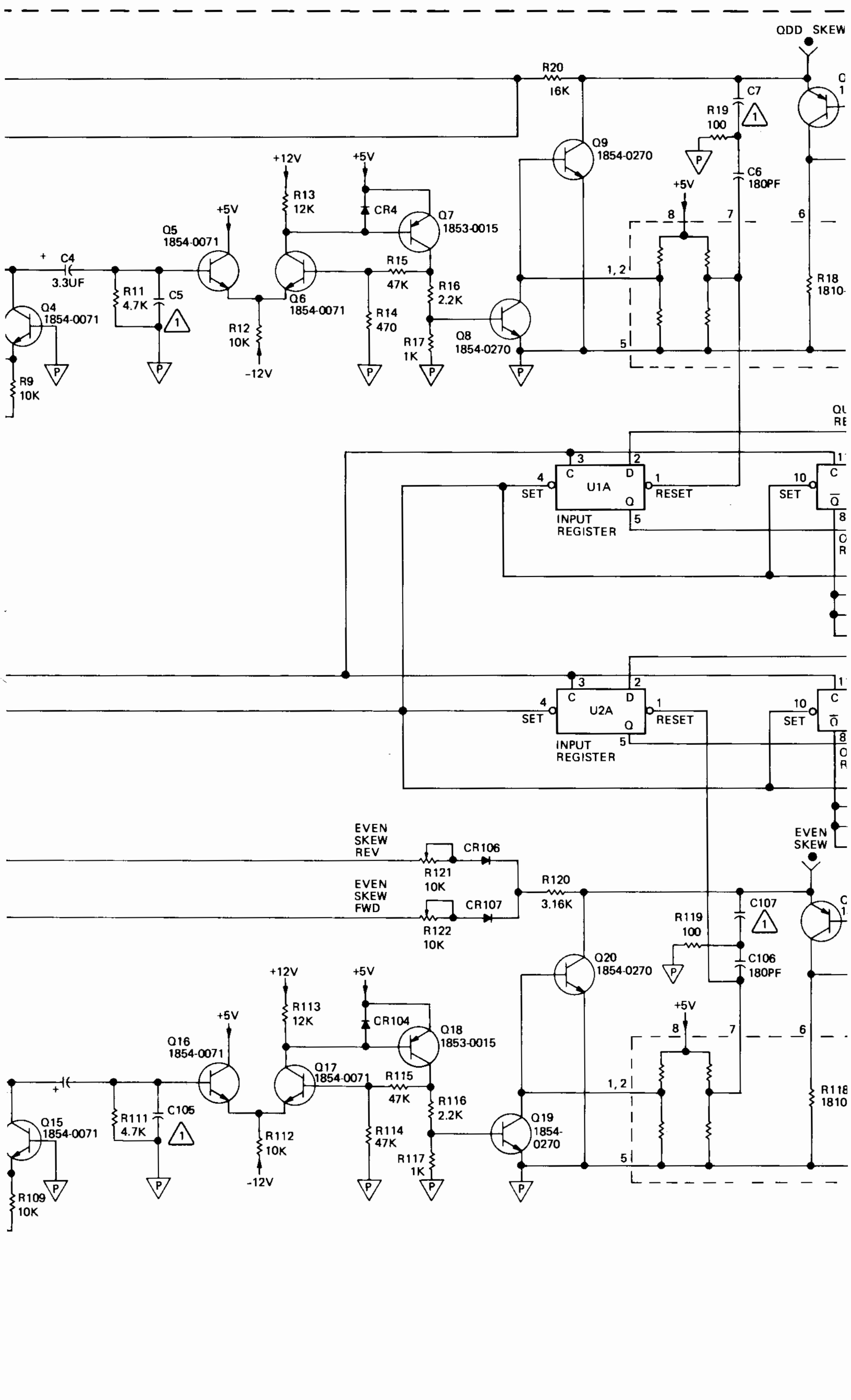
Figure 3-3. Write Assembly A17

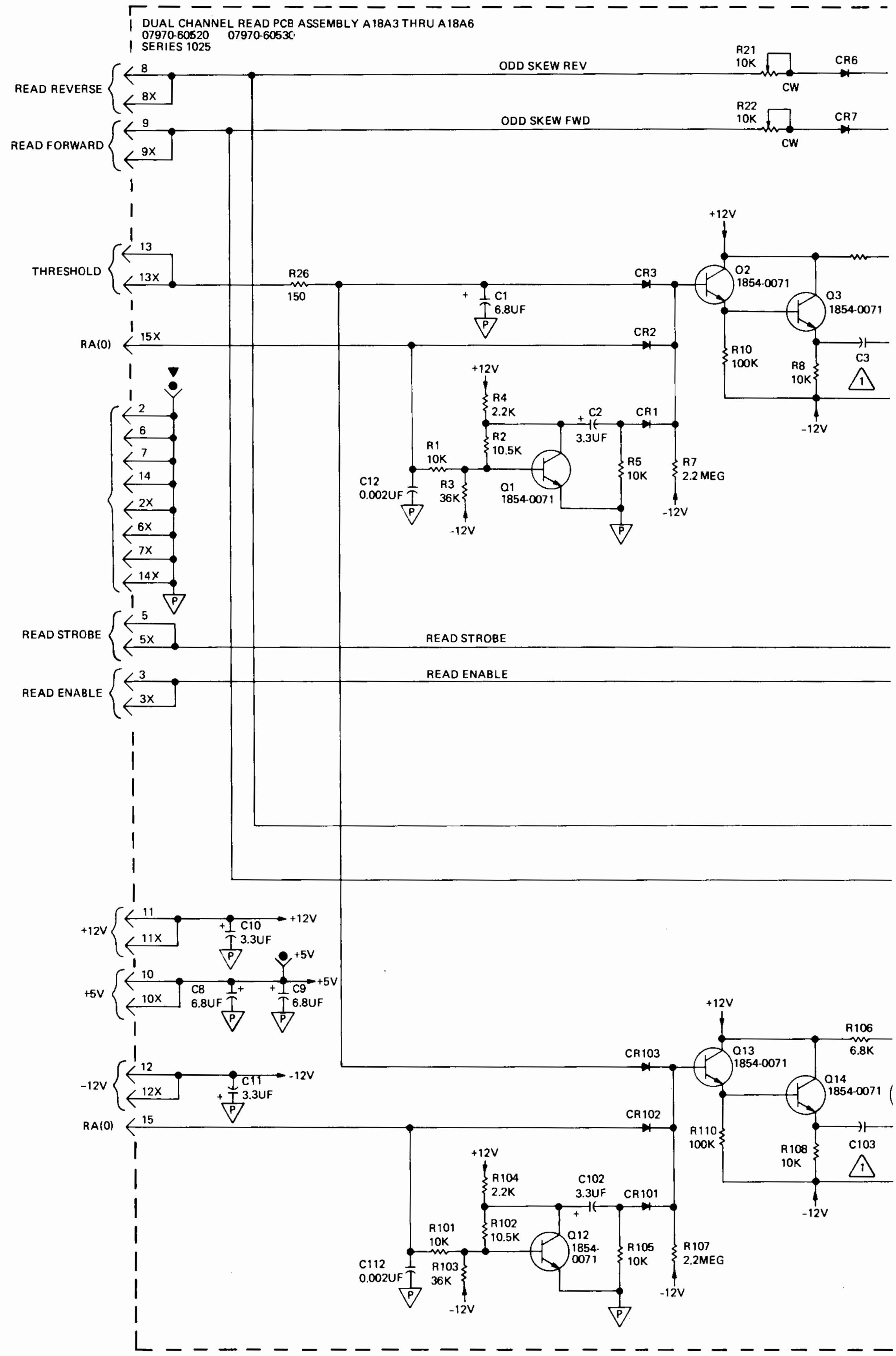


SPEED CRITICAL COMPONENTS

SPEED (ips)	C3 C103	C5 C105	C7 C107	ASSEMBLY
10 · 10 – 20.9 21 – 45	0.0082 UF 0.0039 UF	680 pF 330 pF	0.0068 UF 0.0033 UF	07970 – 60520 07970 – 60530

Figure 4-15. Dual-Channel Read Data PC Assembly A18A3 thru A18A6, Schematic Diagram


ODD SKEW
R20
16K
C7
R19
100
C6
180PF
Q9
1854-0270
+12V
+5V
R13
12K
CR4
Q7
1853-0015
Q5
1854-0071
C4
3.3UF
R11
4.7K
C5
Q6
1854-0071
R15
47K
R16
2.2K
R14
470
R12
10K
-12V
R17
1K
Q8
1854-0270
Q4
1854-0071
R9
10K
R18
U1A
SET
RESET
INPUT
REGISTER
U2A
EVEN
SKEW
REV
CR106
R121
10K
R120
3.16K
EVEN
SKEW
FWD
CR107
R122
10K
R119
100
C107
C106
180PF
Q20
1854-0270
R113
12K
CR104
Q18
1853-0015
Q16
1854-0071
Q17
1854-0071
R115
47K
R116
2.2K
R111
4.7K
C105
Q15
1854-0071
R112
10K
R114
47K
R117
1K
Q19
1854-
0270
R109
10K
EVEN
SKEW
R118


DUAL CHANNEL READ PCB ASSEMBLY A18A3 THRU A18A6
07970-60520 07970-60530
SERIES 1025
READ REVERSE
READ FORWARD
THRESHOLD
RA(0)
READ STROBE
READ ENABLE
+12V
+5V
-12V
ODD SKEW REV
ODD SKEW FWD
R21 10K
R22 10K
CW
CR6
CR7
R26 150
C1 6.8UF
CR3
CR2
CR1
Q2 1854-0071
Q3 1854-0071
R10 100K
R8 10K
C3
R4 2.2K
R2 10.5K
C2 3.3UF
R1 10K
R3 36K
C12 0.002UF
Q1 1854-0071
R5 10K
R7 2.2 MEG
C10 3.3UF
C8 6.8UF
C9 6.8UF
C11 3.3UF
CR103
CR102
CR101
Q13 1854-0071
Q14 1854-0071
R106 6.8K
R110 100K
R108 10K
C103
R104 2.2K
R102 10.5K
C102 3.3UF
R101 10K
R103 36K
C112 0.002UF
Q12 1854-0071
R105 10K
R107 2.2MEG
7970-F-019A

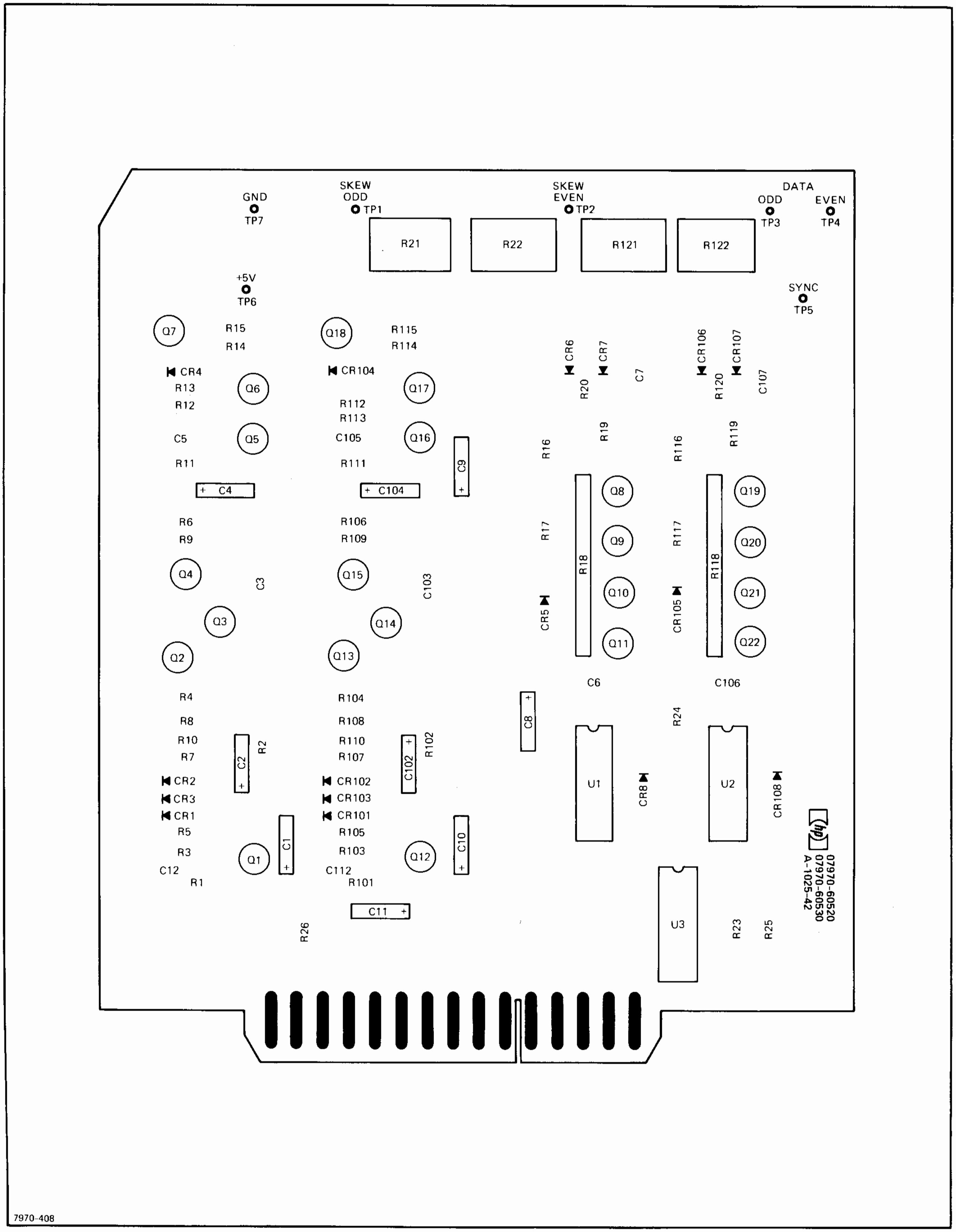
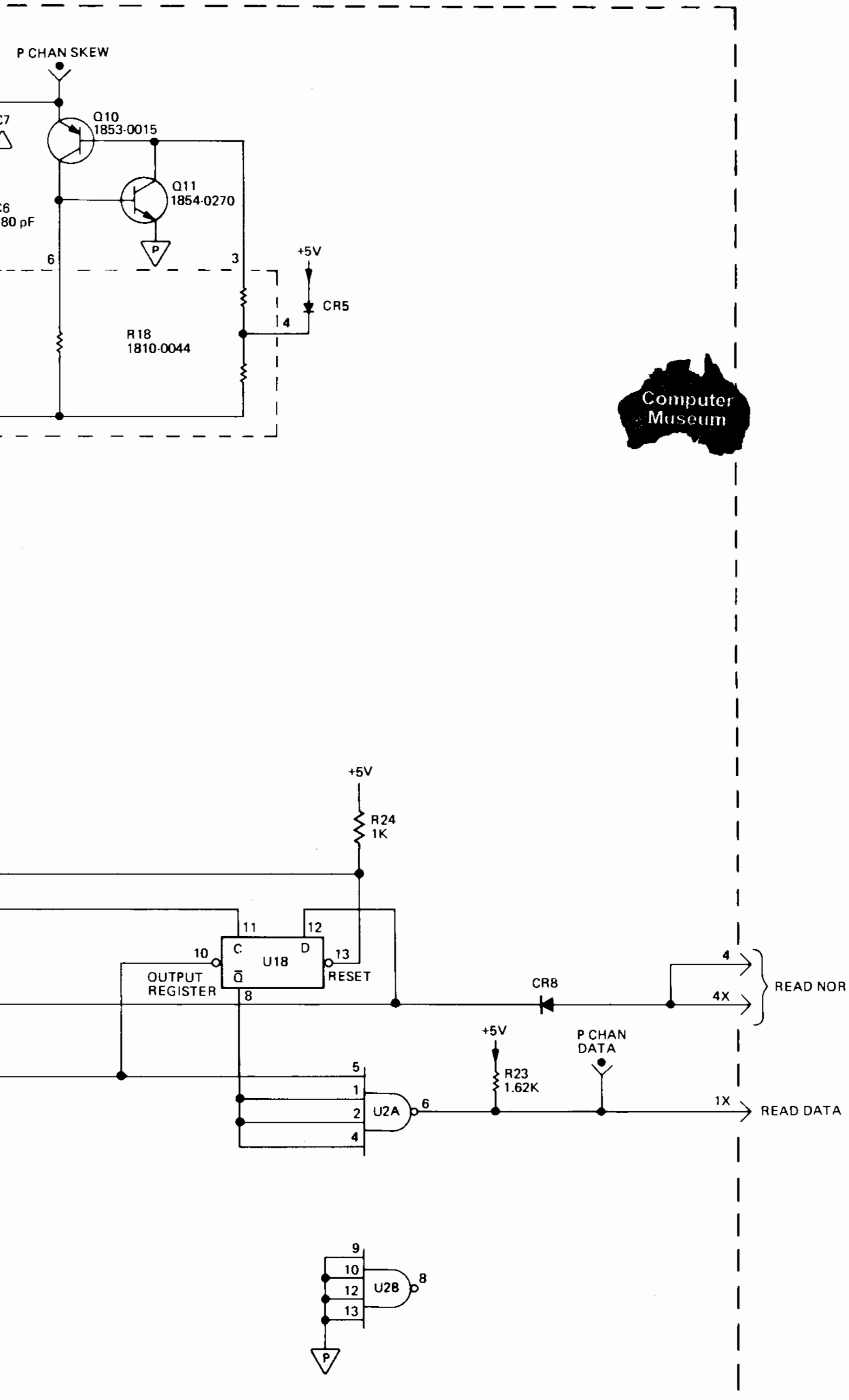


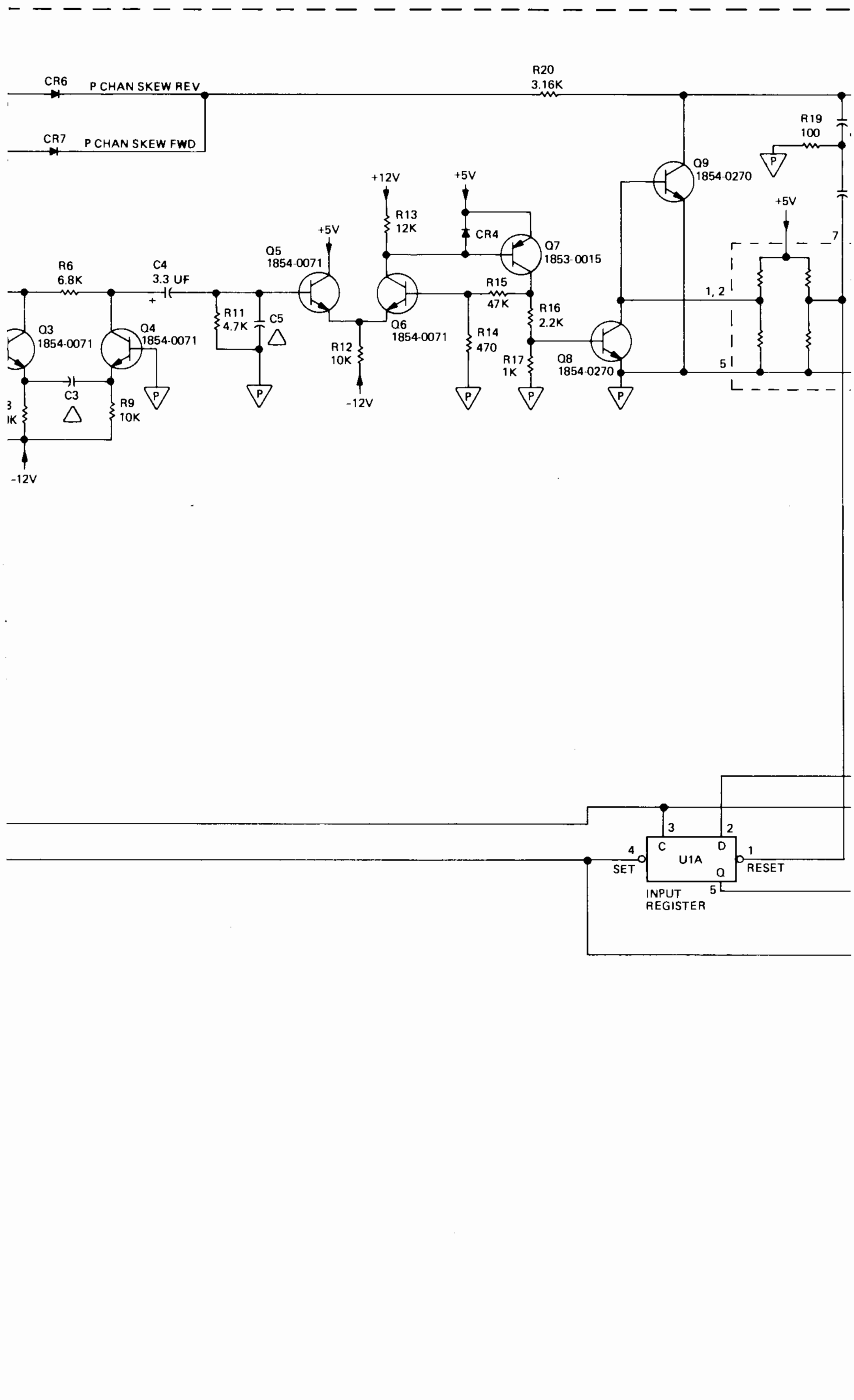
Figure 4-14. Dual-Channel Read Data PC Assembly A18A3 thru A18A6, Parts Location Diagram



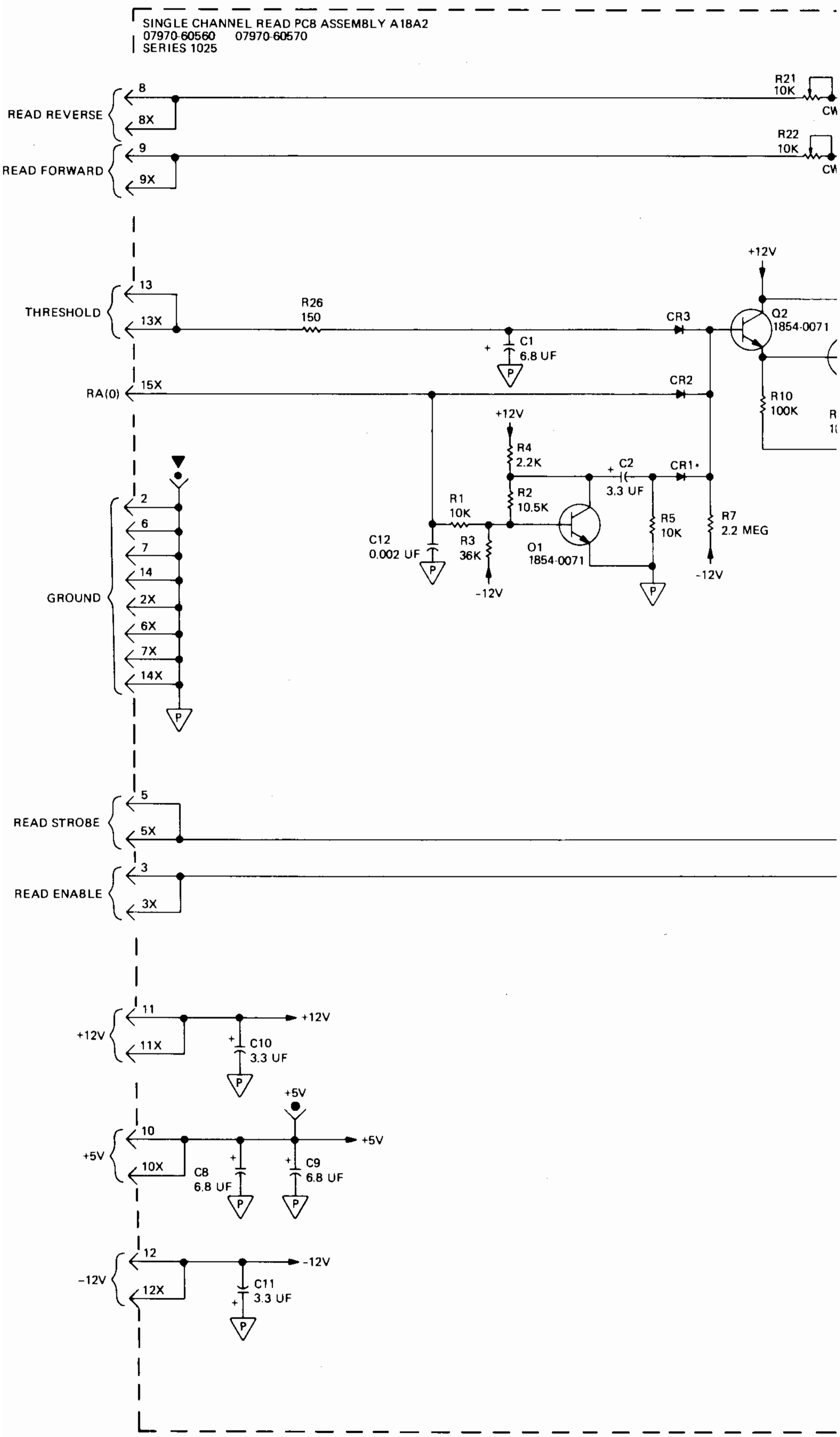
1 SPEED CRITICAL COMPONENTS

SPEED (ips)	C3	C5	C7	ASSEMBLY
10 - 20.9	0.0082 UF	680 pF	0.0068 UF	07970-60560
21 - 45	0.0039 UF	330 pF	0.0033 UF	07970-60570

Figure 4-11. Single-Channel Read Data PC Assembly A18A2, Schematic Diagram



CR6
P CHAN SKEW REV
CR7
P CHAN SKEW FWD
R20
3.16K
R19
100
Q9
1854-0270
+12V
+5V
R13
12K
CR4
Q7
1853-0015
+5V
Q5
1854-0071
R6
6.8K
C4
3.3 UF
R11
4.7K
C5
Q6
1854-0071
R15
47K
R16
2.2K
R14
470
R12
10K
-12V
R17
1K
Q8
1854-0270
Q3
1854-0071
Q4
1854-0071
C3
R9
10K
-12V
+5V
7
1, 2
5
3
2
4
SET
C
U1A
D
1
RESET
Q
5
INPUT
REGISTER



SINGLE CHANNEL READ PCB ASSEMBLY A18A2
07970-60560 07970-60570
SERIES 1025
READ REVERSE
8
8X
R21
10K
CW
READ FORWARD
9
9X
R22
10K
CW
THRESHOLD
13
13X
R26
150
C1
6.8 UF
CR3
+12V
Q2
1854-0071
RA(0)
15X
CR2
R10
100K
+12V
R4
2.2K
C2
3.3 UF
CR1
R2
10.5K
R1
10K
R3
36K
C12
0.002 UF
-12V
Q1
1854-0071
R5
10K
R7
2.2 MEG
-12V
GROUND
2
6
7
14
2X
6X
7X
14X
READ STROBE
5
5X
READ ENABLE
3
3X
+12V
11
11X
+12V
C10
3.3 UF
+5V
+5V
10
10X
C8
6.8 UF
C9
6.8 UF
+5V
-12V
12
12X
C11
3.3 UF
-12V

7970-018A

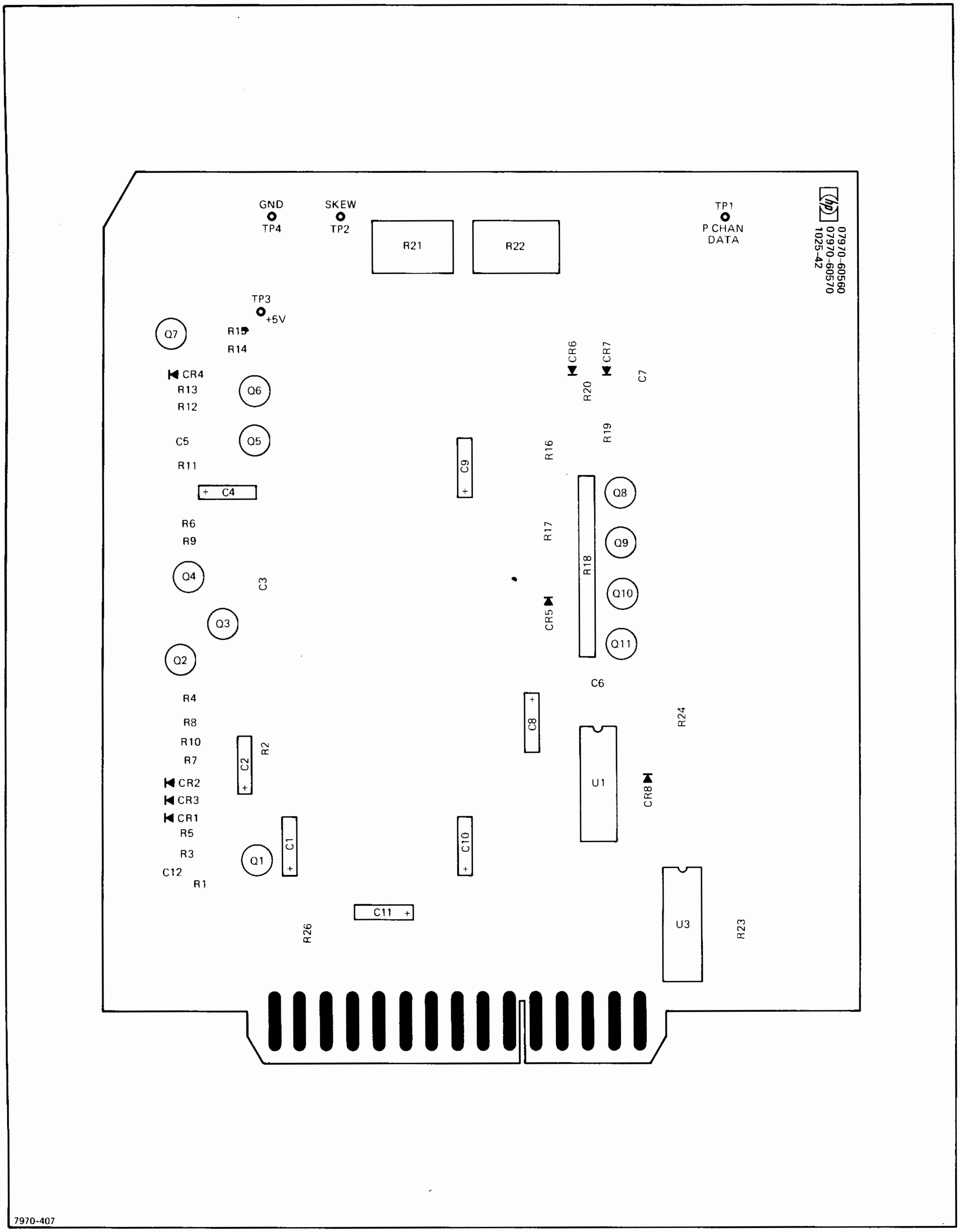


Figure 4-10. Single-Channel Read Data PC Assembly A18A2, Parts Location Diagram

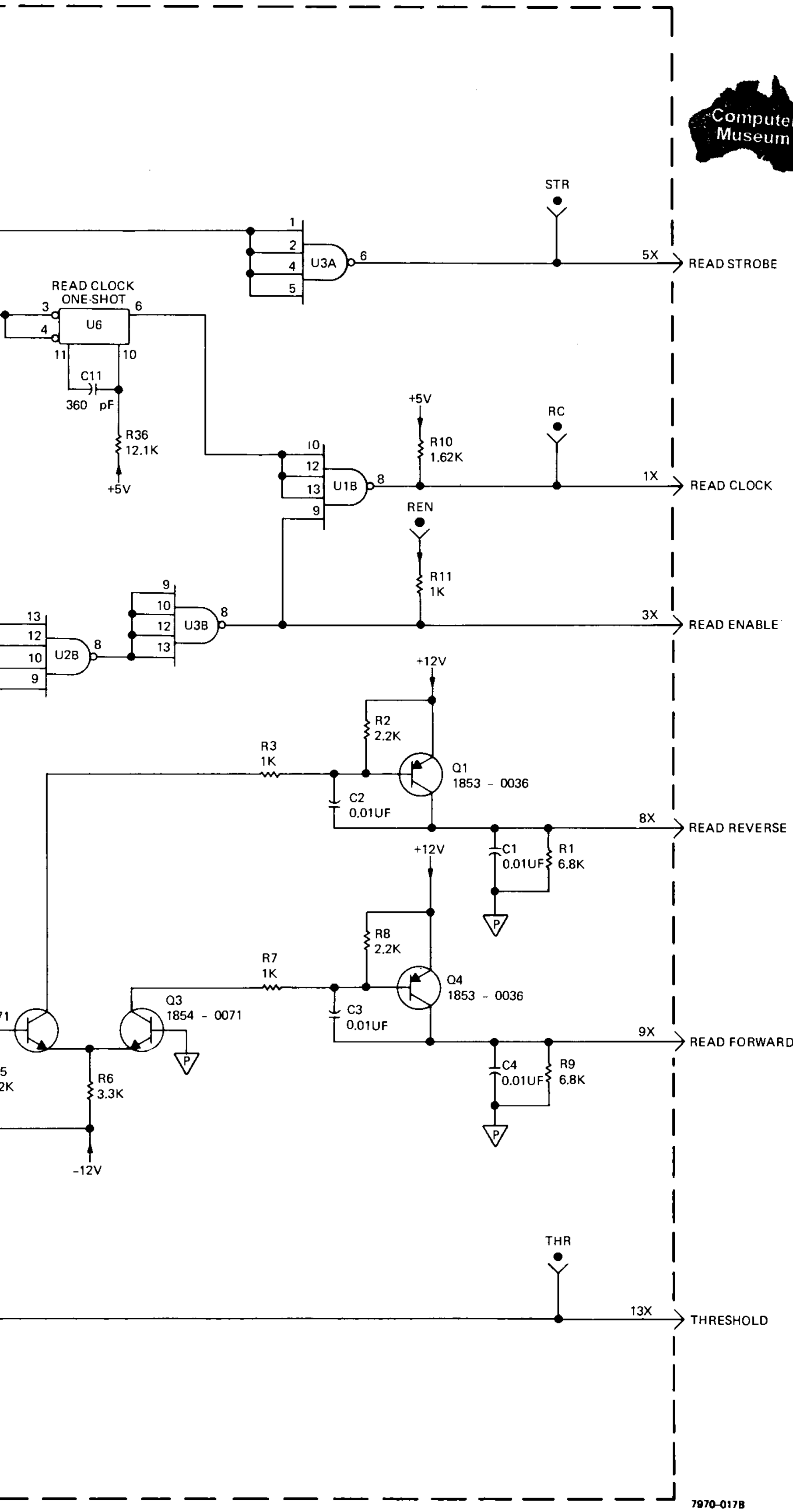
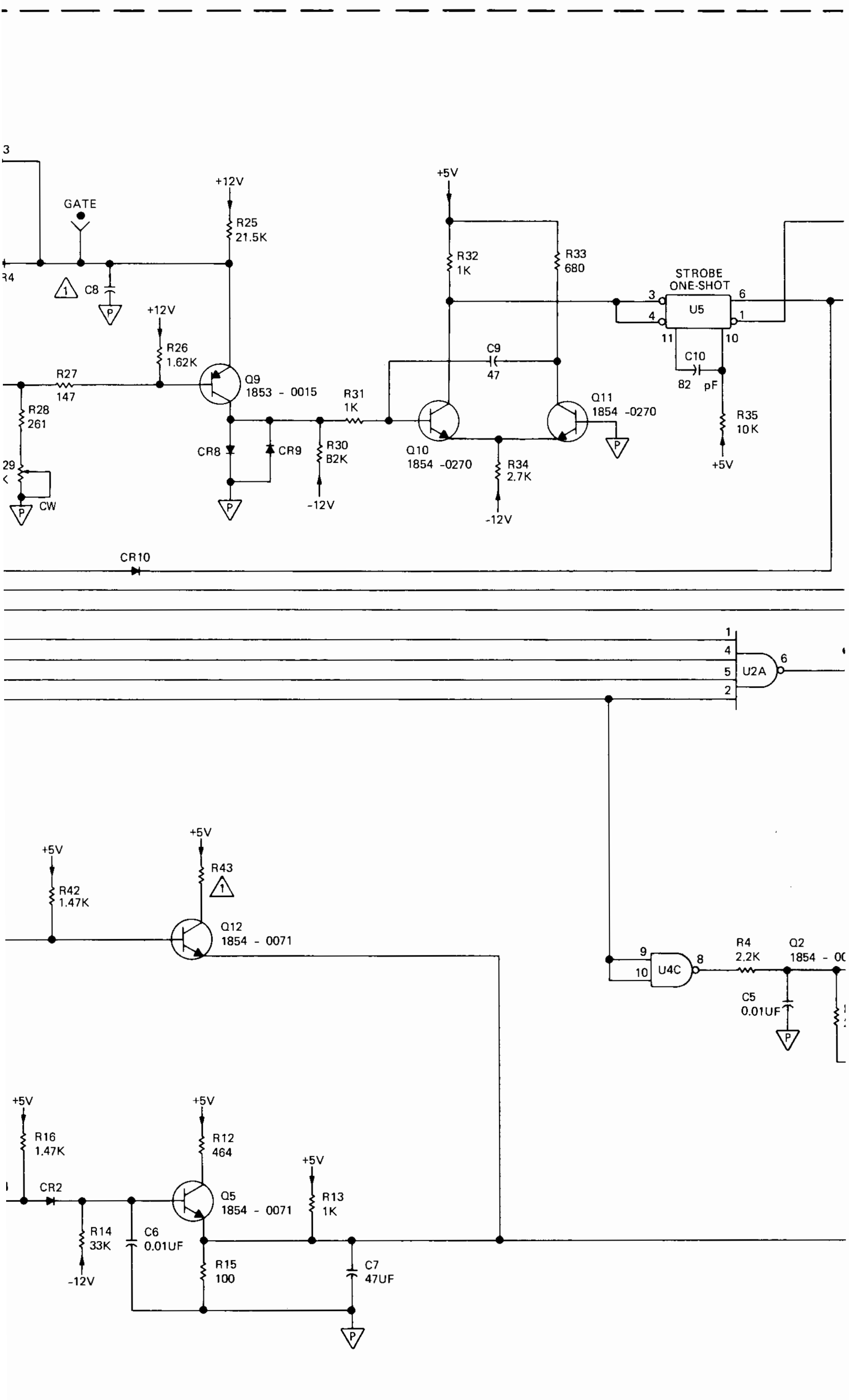
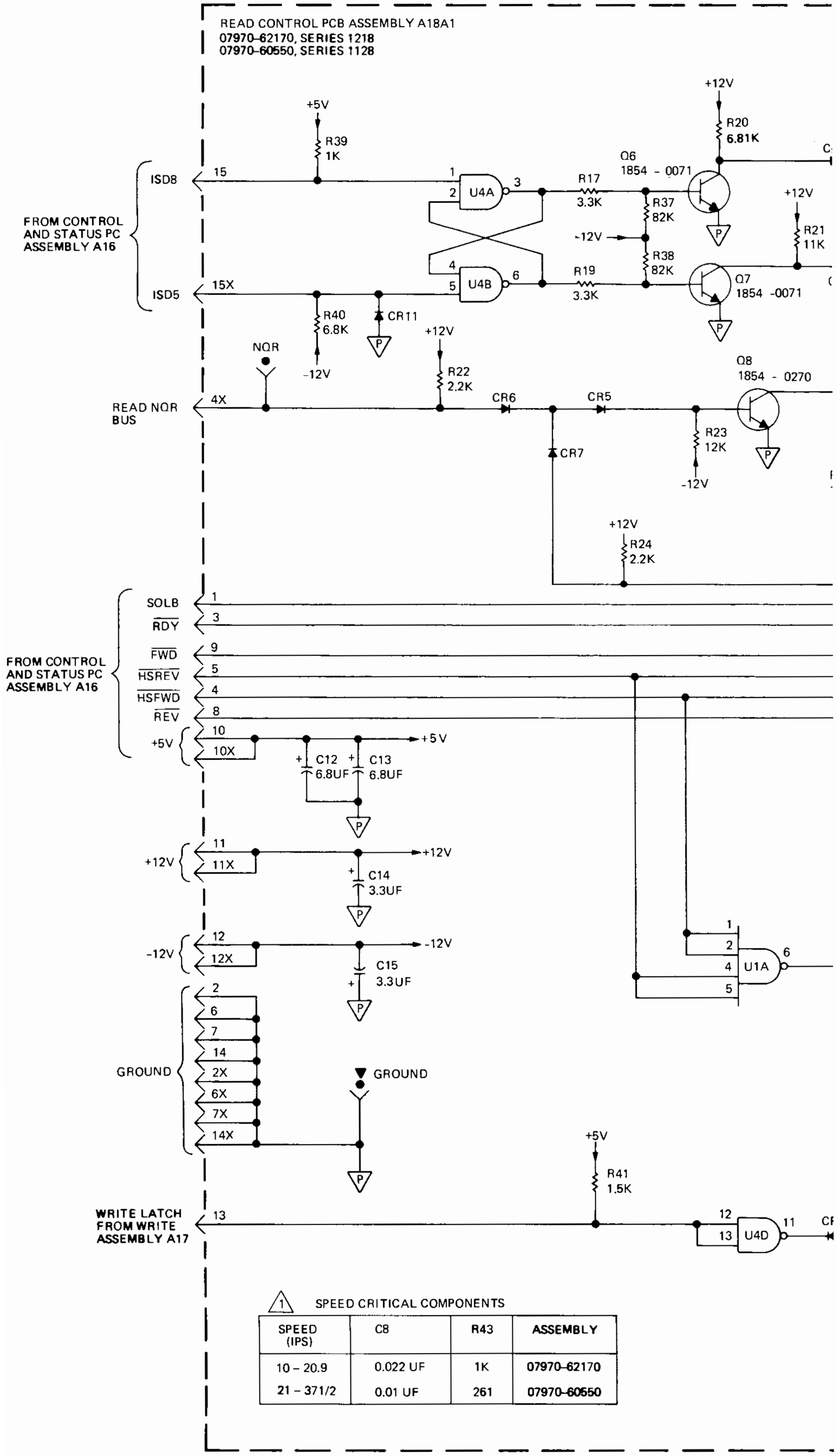


Figure 4-7. Read Control PC Assembly A18A1, Schematic Diagrams



GATE
+12V
R25
21.5K
C8
R26
1.62K
R27
147
R28
261
Q9
1853 - 0015
CR8
CR9
R30
82K
-12V
R31
1K
CW
+5V
R32
1K
R33
680
C9
47
Q10
1854 -0270
Q11
1854 -0270
R34
2.7K
STROBE
ONE-SHOT
U5
C10
82 pF
R35
10K
CR10
U2A
U4C
R4
2.2K
Q2
C5
0.01UF
R42
1.47K
R43
Q12
1854 - 0071
R16
1.47K
CR2
R14
33K
C6
0.01UF
R12
464
Q5
1854 - 0071
R13
1K
R15
100
C7
47UF



SPEED (IPS)	C8	R43	ASSEMBLY
10 – 20.9	0.022 UF	1K	07970-62170
21 – 371/2	0.01 UF	261	07970-60550

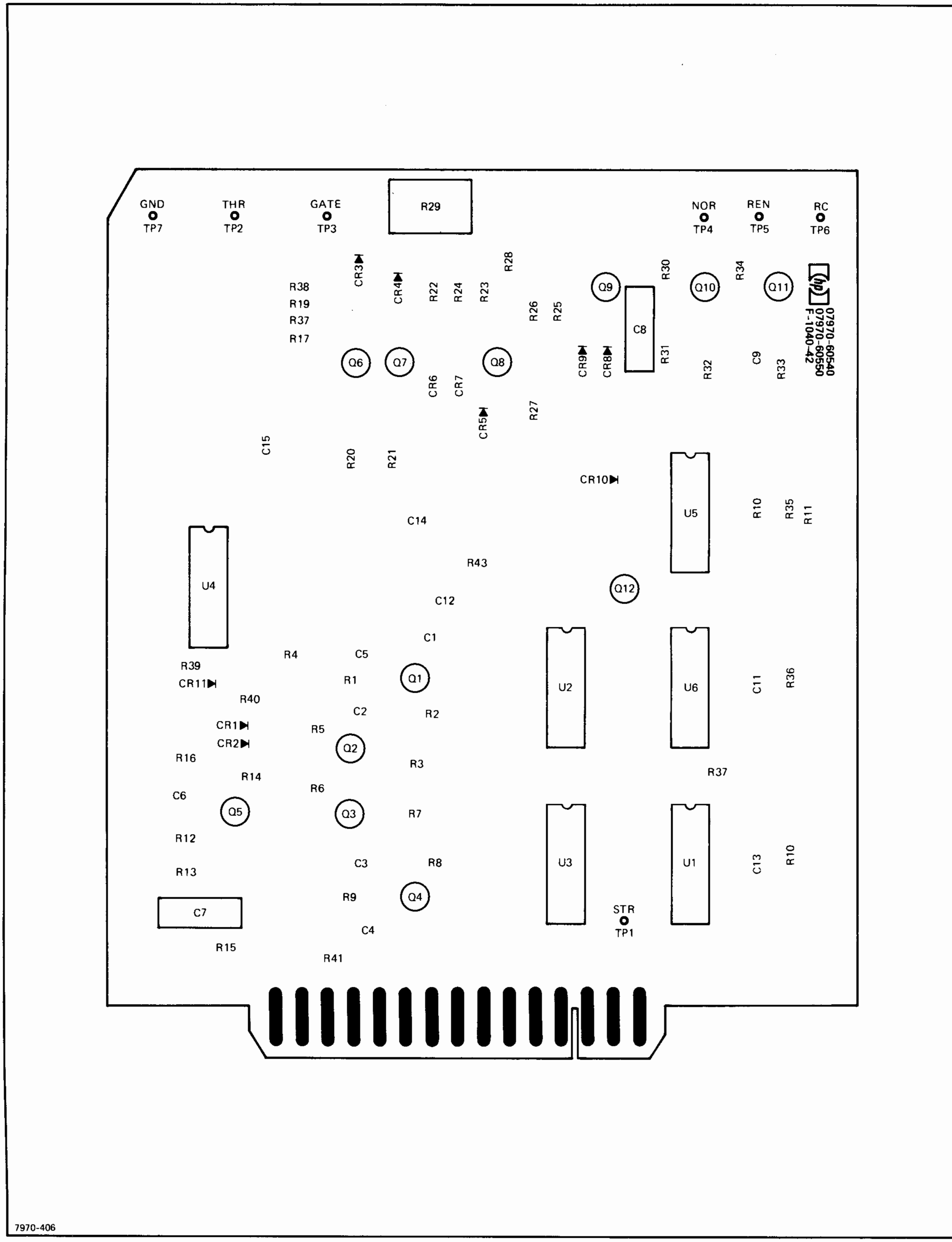


Figure 4-6. Read Control PC Assembly A18A1, Parts Location Diagram

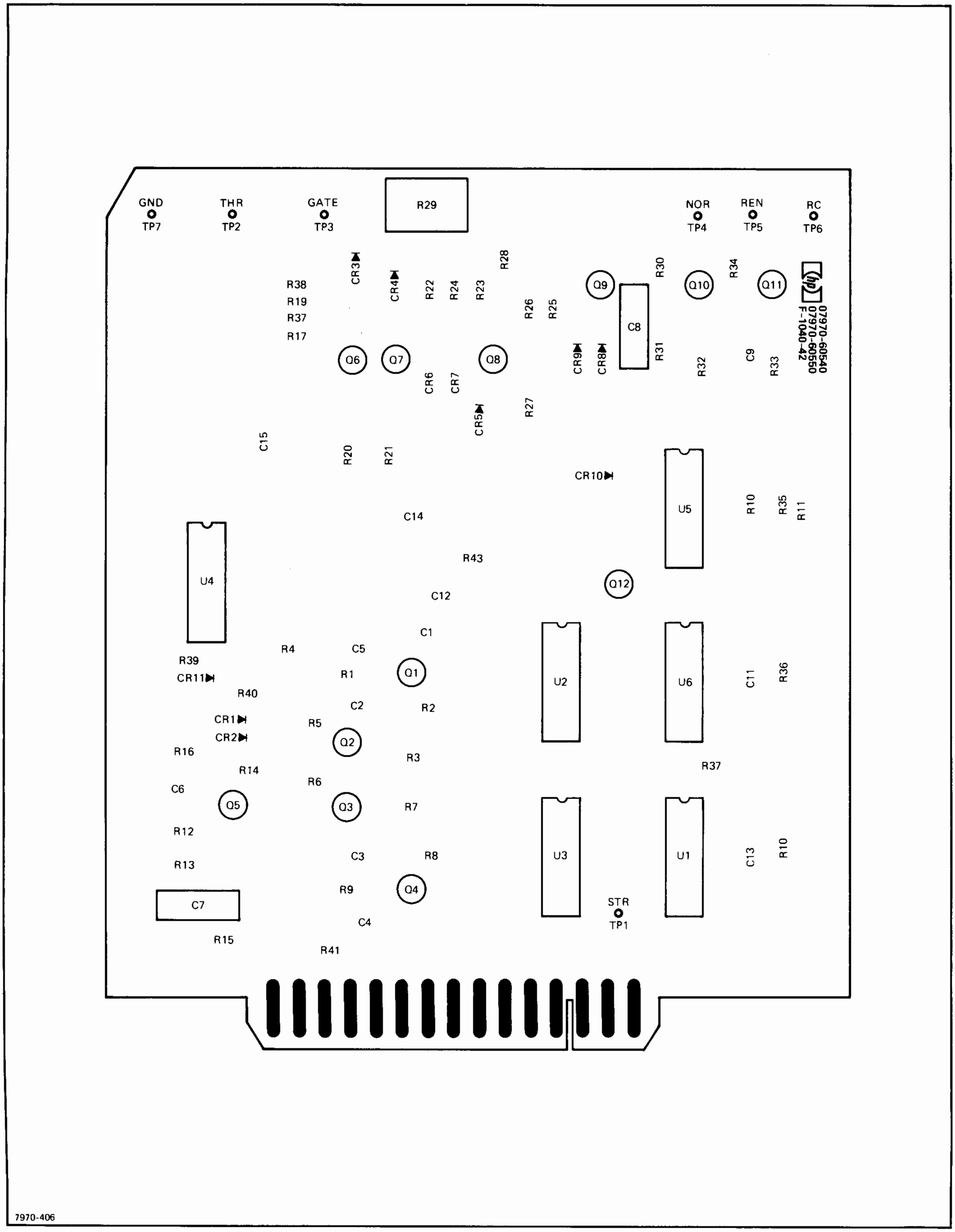


Figure 4-6. Read Control PC Assembly A18A1, Parts Location Diagram

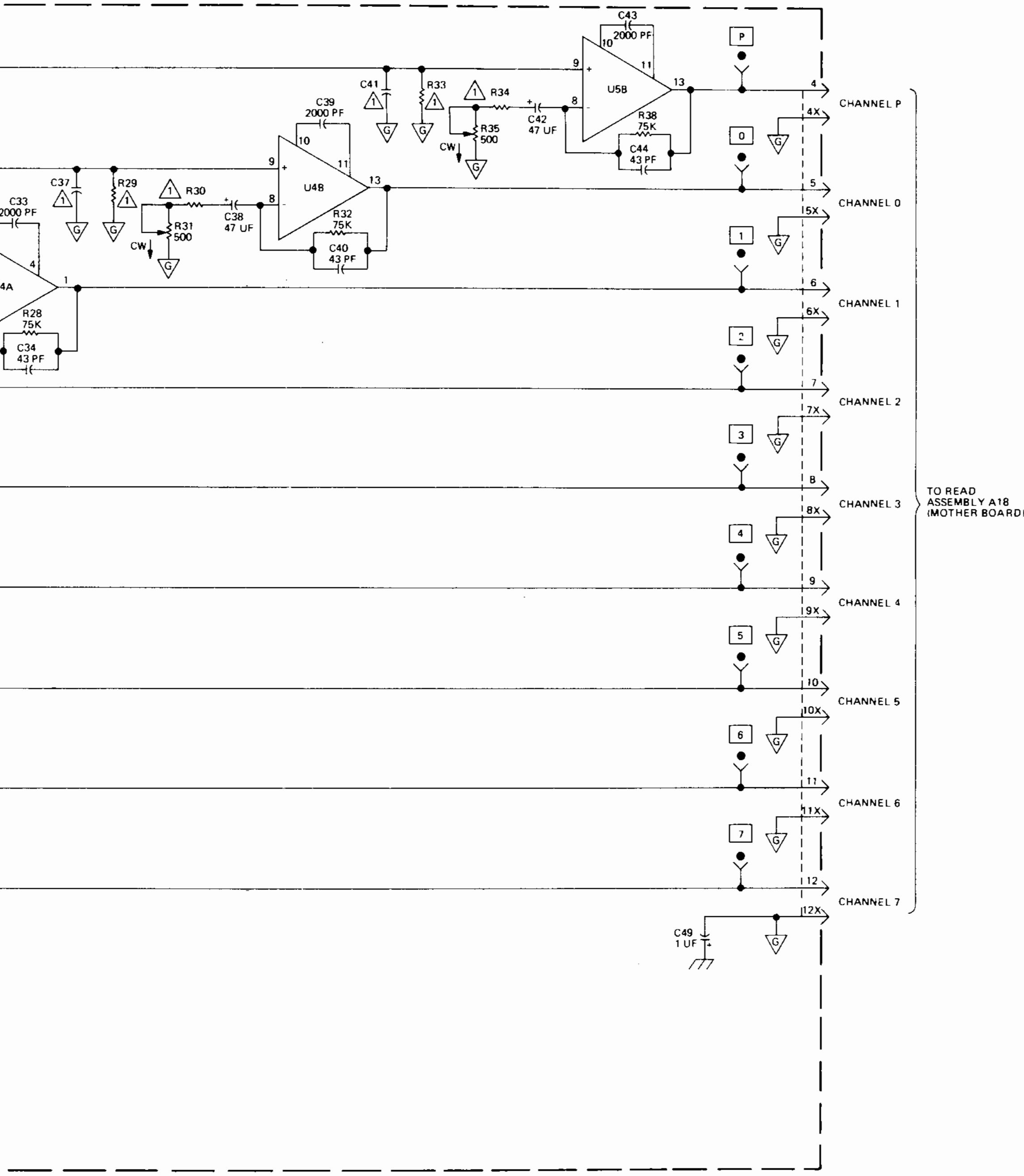
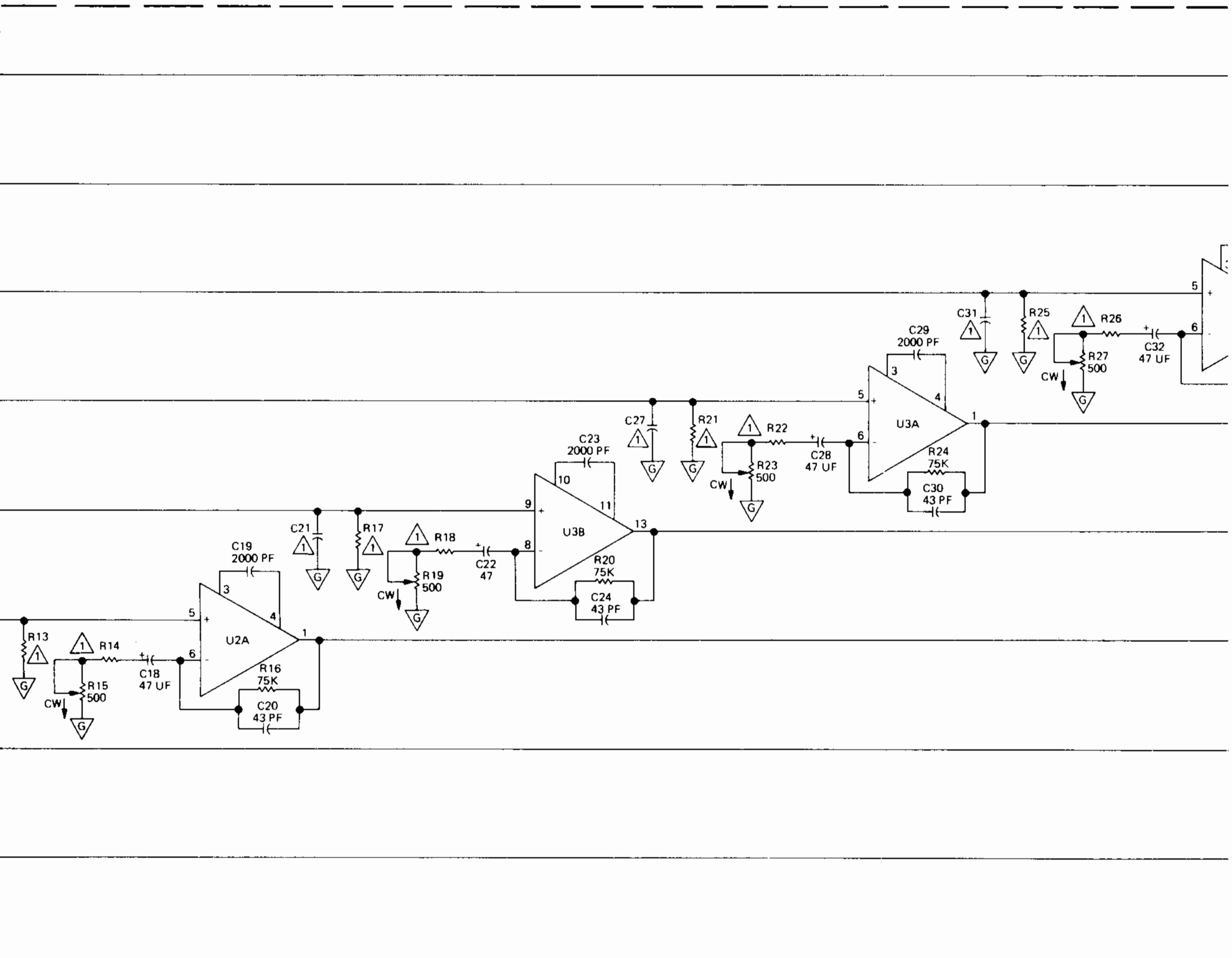


Figure 4-4. Read Preamplifier PC Assembly A15, Schematic Diagram

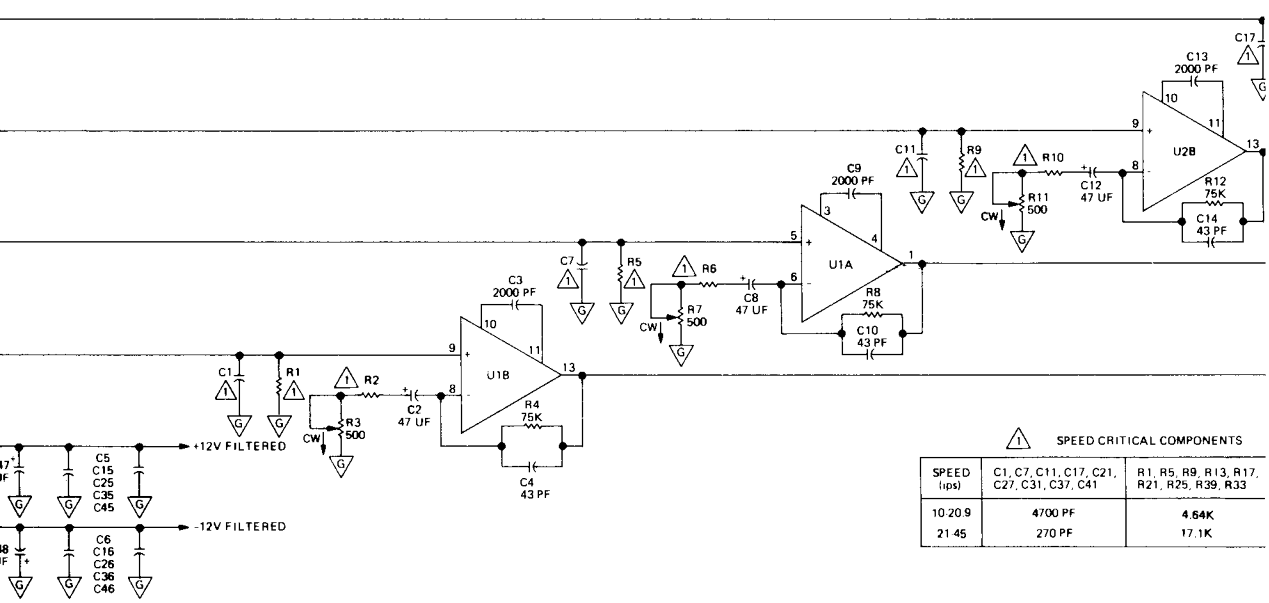


R2, R6, R10, R14, R18, R22, R26, R30, R34	ASSEMBLY
82.5 OHMS	07970-60500
100 OHMS	07970-62000

NINE TRACK UNITS		SEVEN TRACK UNITS	
*TAPE TRACK	DATA CHANNEL	*TAPE TRACK	DATA CHANNEL
1	5	1	7
2	7	2	6
3	3	3	5
4	P	4	4
5	2	5	3
6	1	6	2
7	0	7	P
8	6		
9	4		
*STARTING WITH EDGE NEAREST THE OPERATOR			

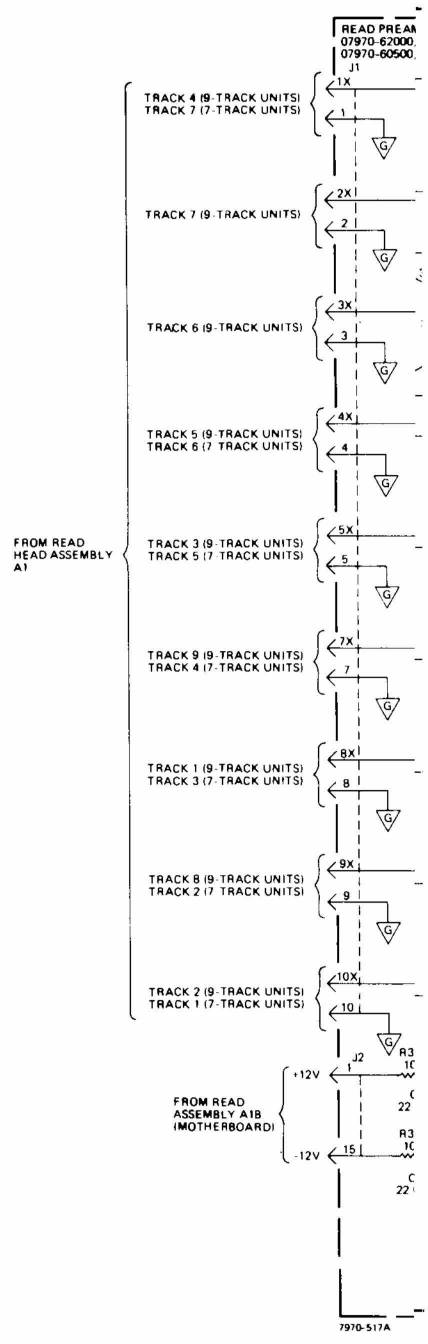
TRACK VERSUS CHANNEL ASSIGNMENTS

PLIFIER PC ASSEMBLY A15
SERIES 1201
SERIES 1218



SPEED CRITICAL COMPONENTS

SPEED (ips)	C1, C7, C11, C17, C21, C27, C31, C37, C41	R1, R5, R9, R13, R17, R21, R25, R39, R33
10-20.9	4700 PF	4.64K
21-45	270 PF	17.1K


READ PREAM
07970-62000,
07970-60500,
J1
TRACK 4 (9-TRACK UNITS)
TRACK 7 (7-TRACK UNITS)
TRACK 7 (9-TRACK UNITS)
TRACK 6 (9-TRACK UNITS)
TRACK 5 (9-TRACK UNITS)
TRACK 6 (7-TRACK UNITS)
TRACK 3 (9-TRACK UNITS)
TRACK 5 (7-TRACK UNITS)
TRACK 9 (9-TRACK UNITS)
TRACK 4 (7-TRACK UNITS)
TRACK 1 (9-TRACK UNITS)
TRACK 3 (7-TRACK UNITS)
TRACK 8 (9-TRACK UNITS)
TRACK 2 (7-TRACK UNITS)
TRACK 2 (9-TRACK UNITS)
TRACK 1 (7-TRACK UNITS)
FROM READ
HEAD ASSEMBLY
A1
1X
1
2X
2
3X
3
4X
4
5X
5
7X
7
8X
8
9X
9
10X
10
G
J2
+12V
-12V
15
FROM READ
ASSEMBLY A1B
(MOTHERBOARD)
R3
7970-517A

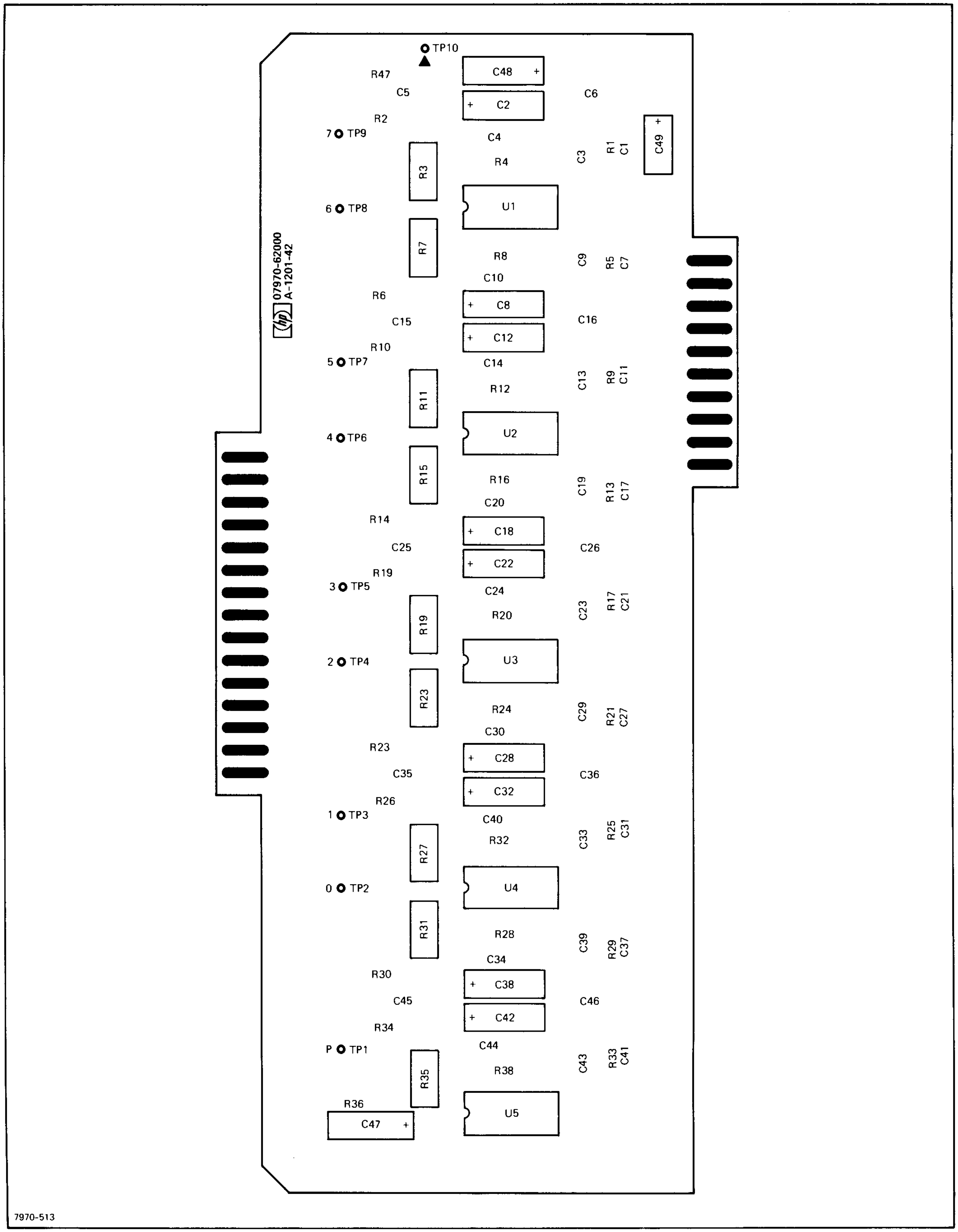


Figure 4-3. Read Preamplifier PC Assembly A15, Parts Location Diagram

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-1-	07970-60500	READ PREAMPLIFIER PC ASSEMBLY A15, 10 - 20 ips	
3-1-	07970-62000	READ PREAMPLIFIER PC ASSEMBLY A15, 21 - 45 ips	
-1	0180-0228	. CAPACITOR, fxd, 22 μF (C47, C48)	2
-2	0180-1704	. CAPACITOR, fxd, 47 μF (C2, C8, C12, C18, C22, C28, C32, C38, C42) . . .	9
-3	0160-2055	. CAPACITOR, fxd, 0.01 μF (C5, C6, C15, C16, C25, C26, C35, ... C36, C45, C46)	10
-4	0180-0291	. CAPACITOR, fxd, 1.0 μF (C49)	1
-5	0140-0210	. CAPACITOR, fxd, 270 pF (C1, C7, C11, C17, C21, C27, C31, C37, C41) . . .	9
-6	0698-3136	. RESISTOR, fxd, 17.8k, 1%, 1/8W (R1, R5, R9, R13, R17, R21, ... R25, R29, R33)	9
-7	0160-2225	. CAPACITOR, fxd, 2000 pF (C3, C9, C13, C19, C23, C29, C33, C39, C43) . . .	9
-8	0160-2200	. CAPACITOR, fxd, 43 pF (C4, C10, C14, C20, C24, C30, C34, C40, C44) . . .	9
-9	0757-0346	. RESISTOR, fxd, 10.0 ohms, 1/8W (R36, R37)	2
-10	0757-0401	. RESISTOR, fxd, 100 ohms, 1/8W (R2, R6, R10, R14, R18, R22, R26, ... R30, R34)	9
-11	0757-0462	. RESISTOR, fxd, 75k, 1%, 1/8W (R4, R8, R12, R16, R20, R24, R28, ... R32, R38)	9
-12	1826-0044	. INTEGRATED CIRCUIT, operational amplifier (U1 thru U5)	5
-13	2100-3251	. RESISTOR, var, 500 ohms, 1/2W (R3, R7, R11, R15, R19, R23 . . . . . . R27, R31, R35)	9

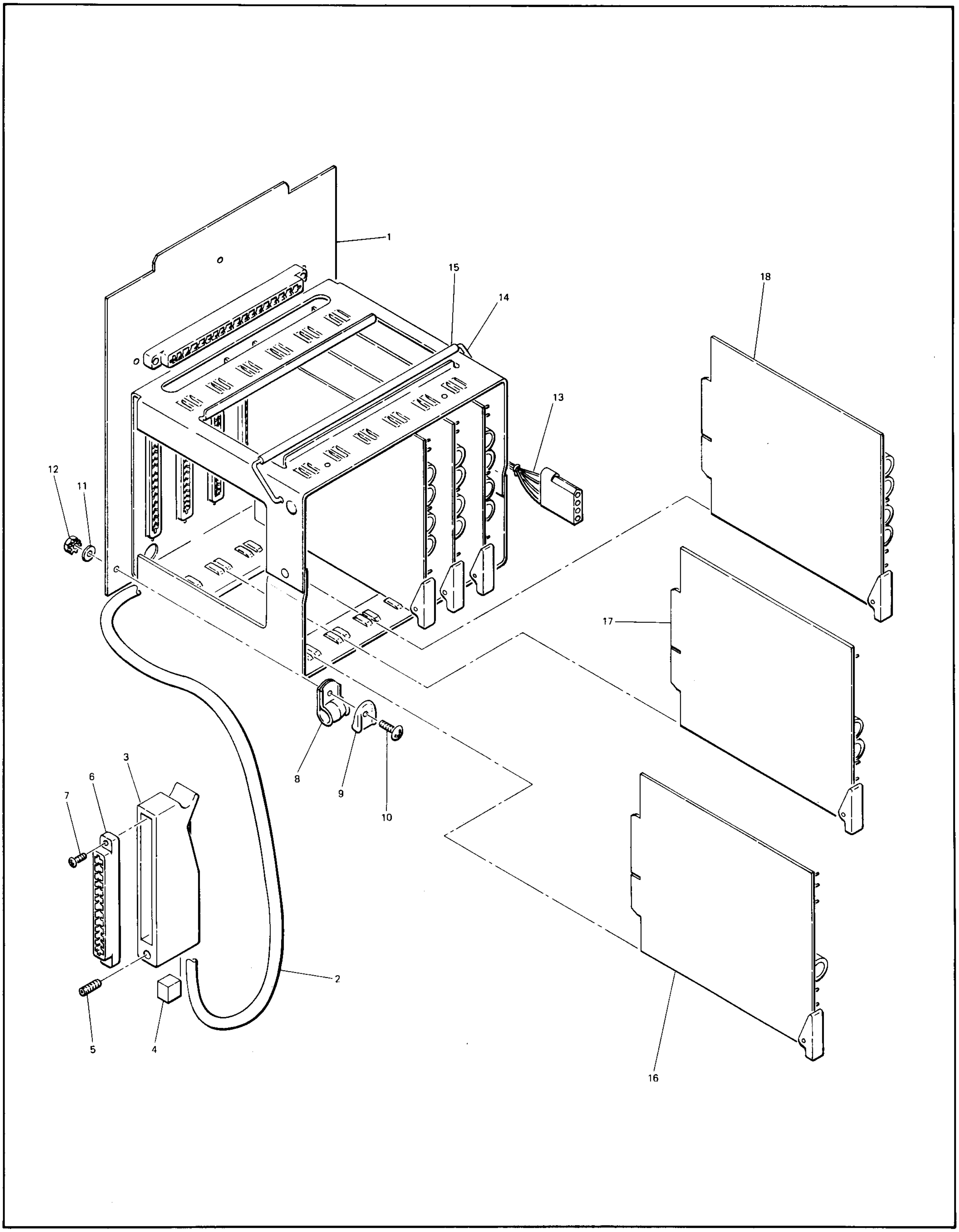


Figure 3-3. Read Assembly A18

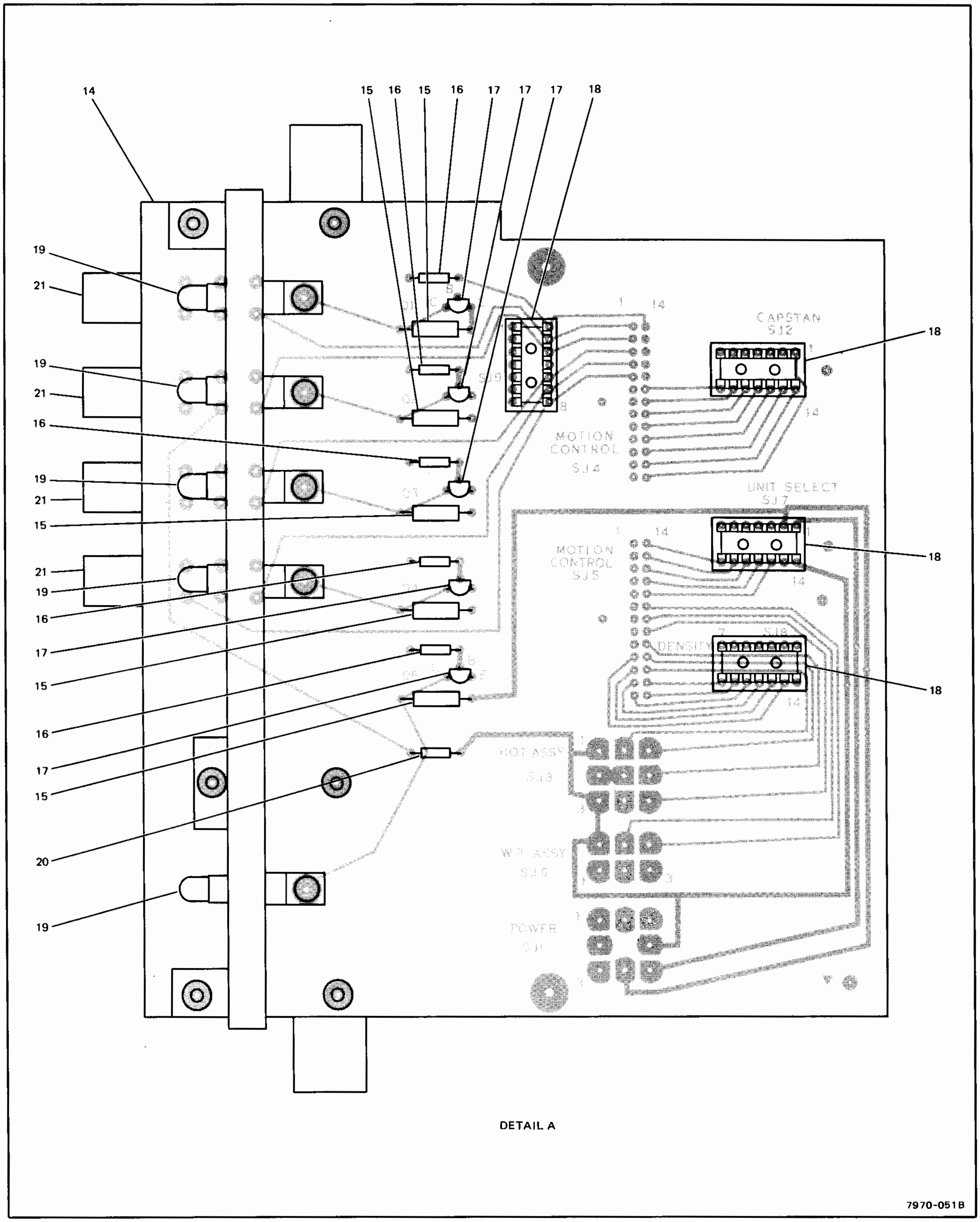


Figure 6-7. Control Switch Assembly A11 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-7-	07970-62089	CONTROL SWITCH ASSEMBLY A11	REF
-1	07970-6-340	. LENS BLOCK ASSEMBLY, control switch	1
-2	0624-0077	. . SCREW, tapping, no. 4-40, 0.312-inch, pozi (AP)	2
-3	2190-0416	. . WASHER, flat (AP)	2
-4	07970-60960	. LENS BLOCK ASSEMBLY, write enable	1*
-5	0624-0077	. . SCREW, tapping, no. 4-40, 0.312-inch, pozi (AP)	1*
-6	2190-0416	. . WASHER, flat (AP)	1*
-7	07970-60610	. CABLE, capstan	1
-8	07970-00620	. . CLAMP, connector (AP)	1
-9	2360-0193	. . SCREW, no. 6-32, 0.250-inch, pozi (AP)	1
-10	2190-0085	. . WASHER, lock, helical (AP)	1
-11	07970-00310	. BRACKET, angle	2
-12	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	1
-13	2420-0001	. . NUT, hex, no. 6-32 (AP)	1
-14	07970-60080	. CONTROL SWITCH PC ASSEMBLY	1
-15	0686-2215	. . RESISTOR, fxd, 220 ohms, 5%, 1/2W (R6, R7, R8, R9, R10)	5
-16	0683-3315	. . RESISTOR, fxd, 330 ohms, 5%, 1/2W (R1, R2, R3, R4, R5)	5
-17	1854-0215	. . TRANSISTOR, NPN, Si, 2N3904 (Q1, Q2, Q3, Q4, Q5)	5
-18	1200-0426	. . SOCKET, integrated circuit, 14 pin	4
-19	2140-0209	. . LAMP, 14V, 0.08A (DS1, DS2, DS3, DS4, DS5)	5
-20	0683-6815	. . RESISTOR, fxd, 680 ohms, 5%, 1/4W (R11)	1
-21	3101-0846	. . SWITCH ASSEMBLY (S1 thru S4) (not field replaceable)	1

*Used only in write configuration.

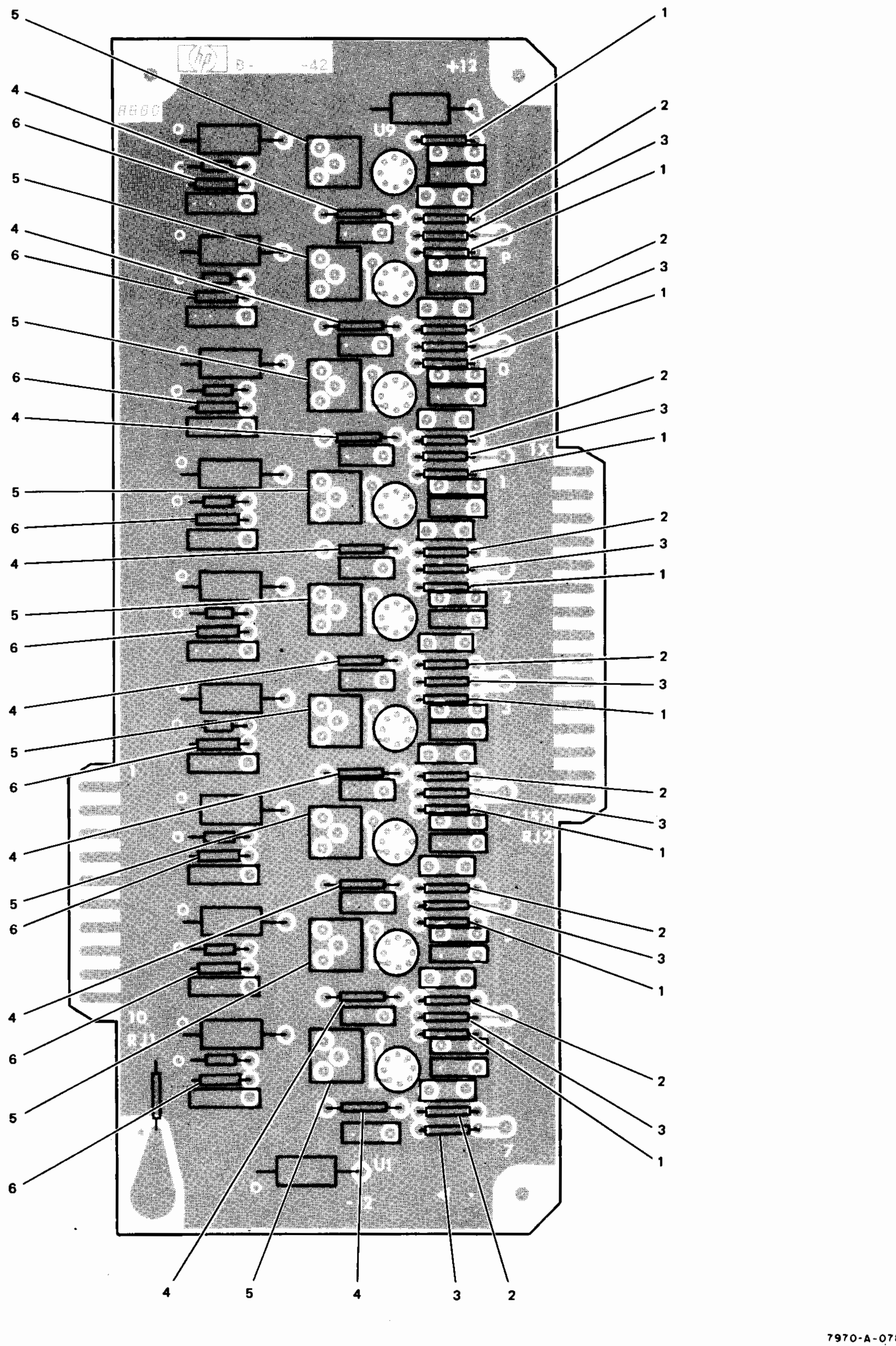


Figure 3-2. Read Preamplifier PC Assembly A15 (Sheet 1 of 2)

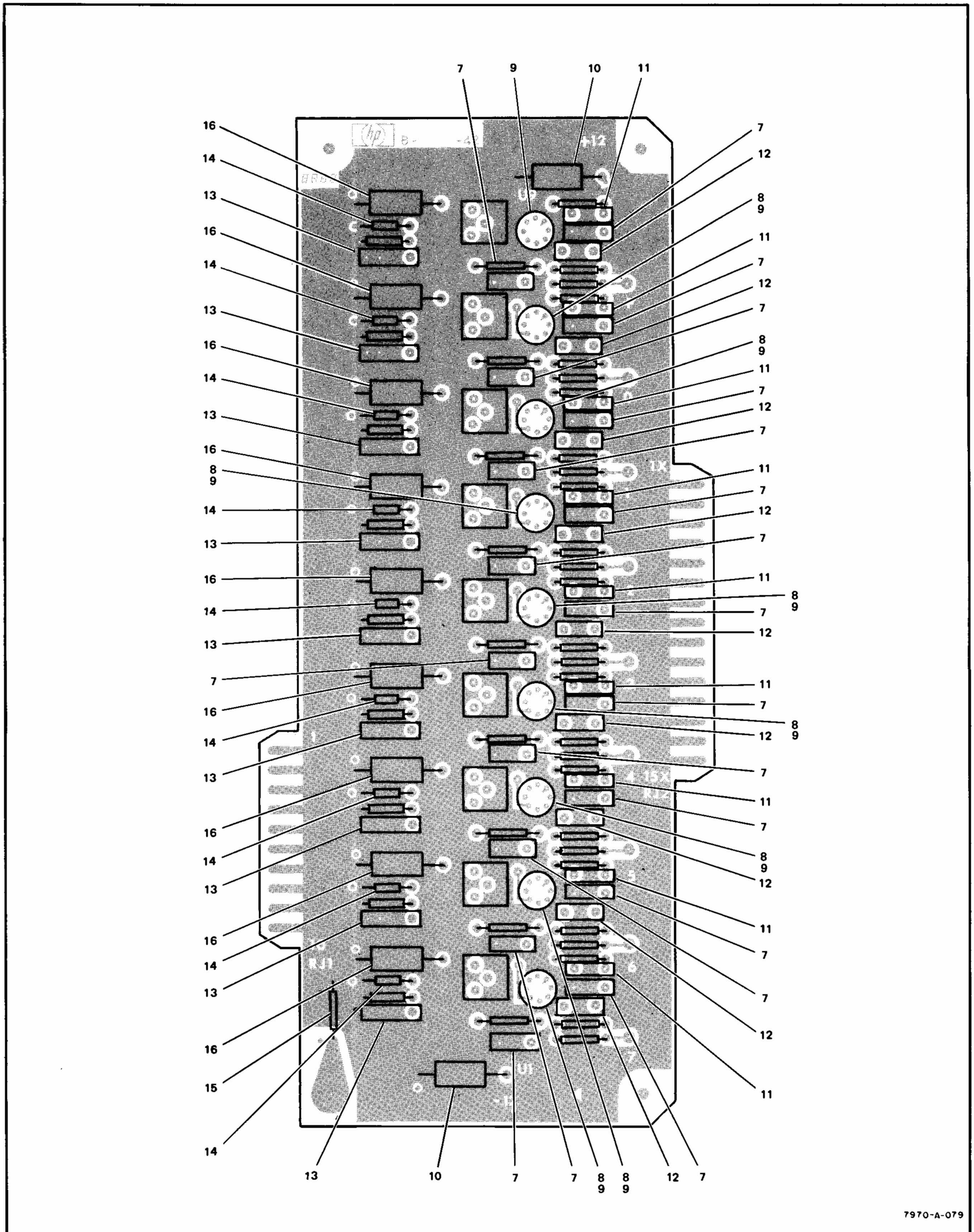
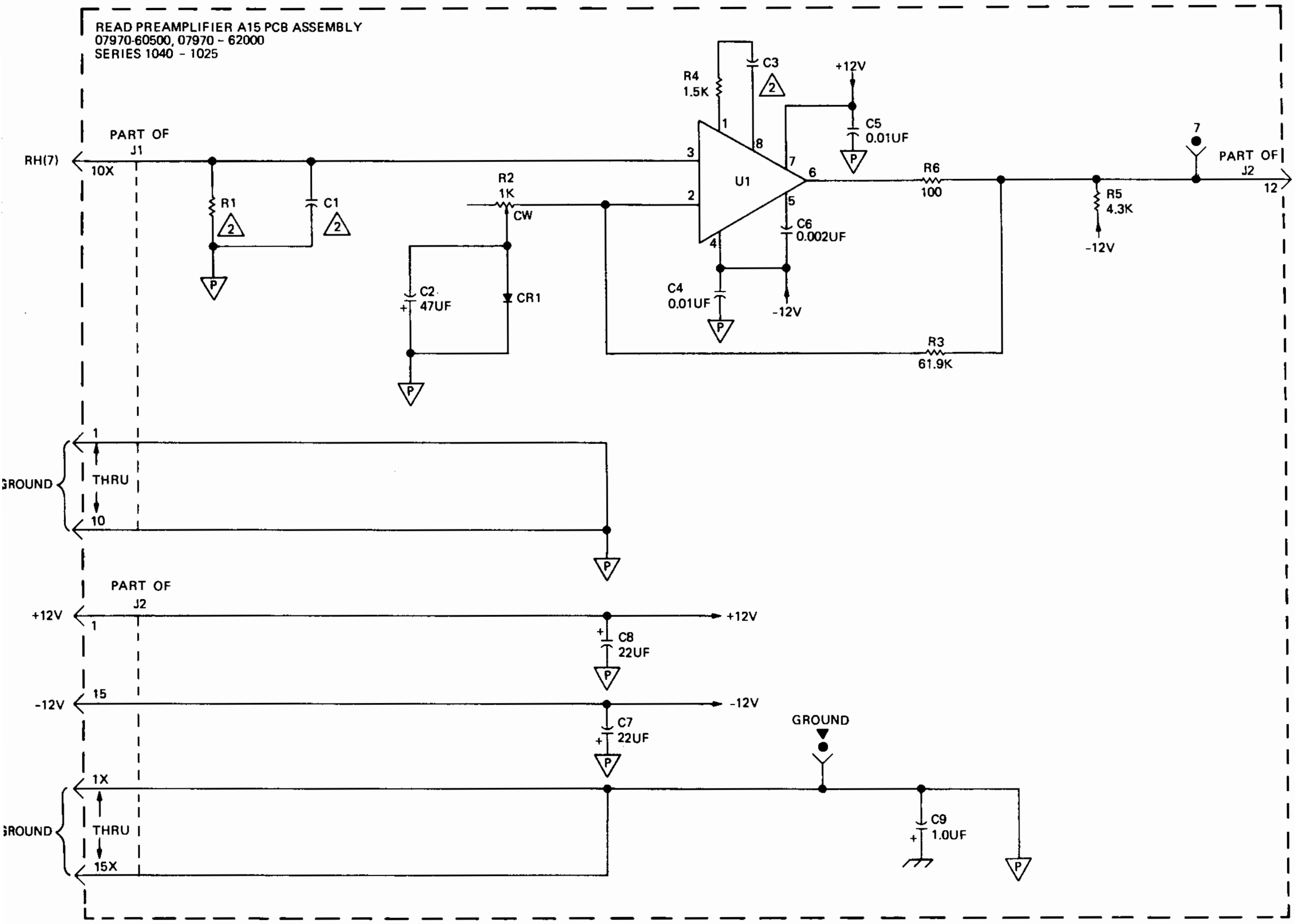


Figure 3-2. Read Preamplifier PC Assembly A15 (Sheet 2 of 2)

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
3-1-	07970-60500	READ PREAMPLIFIER ASSEMBLY A15, 10 - 20 ips	REF
3-1-	07970-62000	READ PREAMPLIFIER PC ASSEMBLY A15, 21 - 45 ips	REF
-1	0683-1525	. RESISTOR, fxd, 1.5k, 5%, 1/4W (R4, R104, R204, R304, R404, R504, R604, R704, R804)	9
-2	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R6, R106, R206, R306, R406, R506, R606, R706, R806)	9
-3	0683-4325	. RESISTOR, fxd, 43.k, 5%, 1/4W (R5, R105, R205, R305, R405, R505, R605, R705, R805)	9
-4	0757-0460	. RESISTOR, fxd, 61.9k, 1%, 1/8W (R3, R103, R203, R303, R403, R503, R603, R703, R803)	9
-5	2100-1758	. RESISTOR, var, ww, 1k, 5%, 1W (R2, R102, R202, R302, R402, R502, R602, R702, R802)	9
-6	0683-6825	. RESISTOR, fxd, 6.8k, 5%, 1/4W (R1, R101, R201, R301, R401, R501, R601, R701, R801) (used on 07970-60500)	9
-6	0698-3136	. RESISTOR, fxd, 17.8k, 1%, 1/8W (R1, R101, R201, R301, R401, R501, R601, R701, R801) (used on 07970-62000)	9
-7	0160-2055	. CAPACITOR, fxd, 10 μF, 10%, 30 Vdcw (C4, C5, C104, C105, C204, C205, C304, C305, C404, C405, C504, C505, C604, C605, C704, C705, C804, C805)	18
-8	07970-80050	. INTEGRATED CIRCUIT, pretested (U1, U2, U3, U4, U5, U6, U7, U8, U9)	9
-9	0340-0456	. . INSULATOR, integrated circuit pad	1
-10	0180-0228	. CAPACITOR, fxd, 22 μF, 10%, 15 Vdcw (C7, C8)	2
-11	0140-0208	. CAPACITOR, fxd, 680 pF, 5%, 300 Vdcw (C3, C103, C203, C303, C403, C503, C603, C703, C803) (used on 07970-60500)	9
-11	0160-2208	. CAPACITOR, fxd, 330 pF, 5%, 300 Vdcw (C3, C103, C203, C303, C403, C503, C603, C703, C803) (used on 07970-60510)	9
-12	0160-3449	. CAPACITOR, fxd, 2000 pF, 10%, 250 Vdcw (C6, C106, C206, C306, C406, C506, C606, C706, C806)	9
-13	0160-2213	. CAPACITOR, fxd, 620 pF, 5%, 300 Vdcw (C1, C101, C201, C301, C401, C501, C601, C701, C801) (used on 07970-60500 and 07970-60510)	9
-13	0140-0210	. CAPACITOR, fxd, 270 pF, 5%, 300 Vdcw (C1, C101, C201, C301, C401, C501, C601, C701, C801) (used on 07970-62000)	9
-14	1901-0040	. DIODE, Si (CR1, CR101, CR201, CR301, CR401, CR501, CR601, CR701, CR801)	9
-15	0180-0291	. CAPACITOR, fxd, 1 μF, +10%, 35 Vdcw (C9)	1
-16	0180-1704	. CAPACITOR, fxd, 47 μF, 10%, 6 Vdcw (C2, C102, C202, C302, C402, C502, C602, C702, C802)	9
-17	07970-00430	. BRACKET, read preamplifier	1
-18	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi (AP)	4
-19	2190-0085	. . WASHER, lock, helical, no. 6 (AP)	4
-20	3050-0228	. . WASHER, no. 6 (AP)	4



NINE IDENTICAL PREAMPLIFIER CIRCUITS COMPRISE THIS PCB ASSEMBLY. ONE SUCH CIRCUIT AND COMMON POWER AND GROUNDING CIRCUITS ARE SHOWN. FOR SIGNAL AND REFERENCE DESIGNATIONS OF ALL NINE PREAMPLIFIER CIRCUITS, SEE TABLE I.

CONNECTOR J1 SIGNAL	CONNECTOR J1 PIN	CONNECTOR J2 SIGNAL	CONNECTOR J2 PIN	TEST POINT IDENT	REF DESIG MODIFIER (DEVICE EXCEPTED)	REF DESIG (DEVICE ONLY)
RH(7)	10X	RA(7)	12	7	000	U1
RH(6)	9X	RA(6)	11	6	100	U2
RH(5)	8X	RA(5)	10	5	200	U3
RH(4)	7X	RA(4)	9	4	300	U4
RH(3)	5X	RA(3)	8	3	400	U5
RH(2)	4X	RA(2)	7	2	500	U6
RH(1)	3X	RA(1)	6	1	600	U7
RH(0)	2X	RA(0)	5	0	700	U8
RH(P)	1X	RA(P)	4	P	800	U9

SPEED CRITICAL COMPONENT

SPEED (ips)	R1 R101- -	C1 C101- -	C3 C103 - -	ASSEMBLY
10 – 20.9	6.8K	620 pF	680 pF	07970-60500
21 – 45	6.8K	620 pF	330 pF	07970-62000

7970-F-015A

Figure 4-4. Read Preamplifier PC Assembly A15, Schematic Diagram

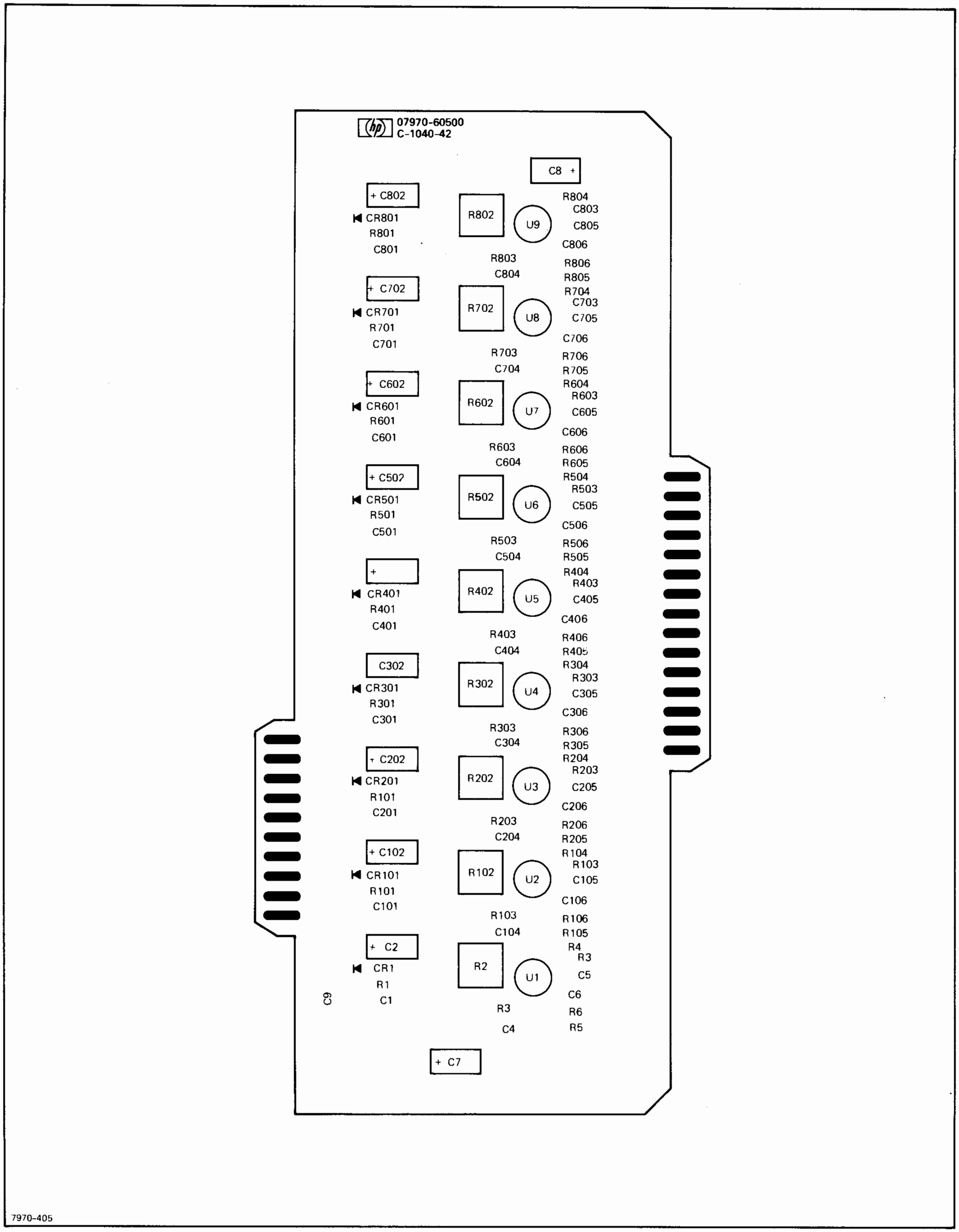


Figure 4-3. Read Preamplifier PC Assembly A15, Parts Location Diagram

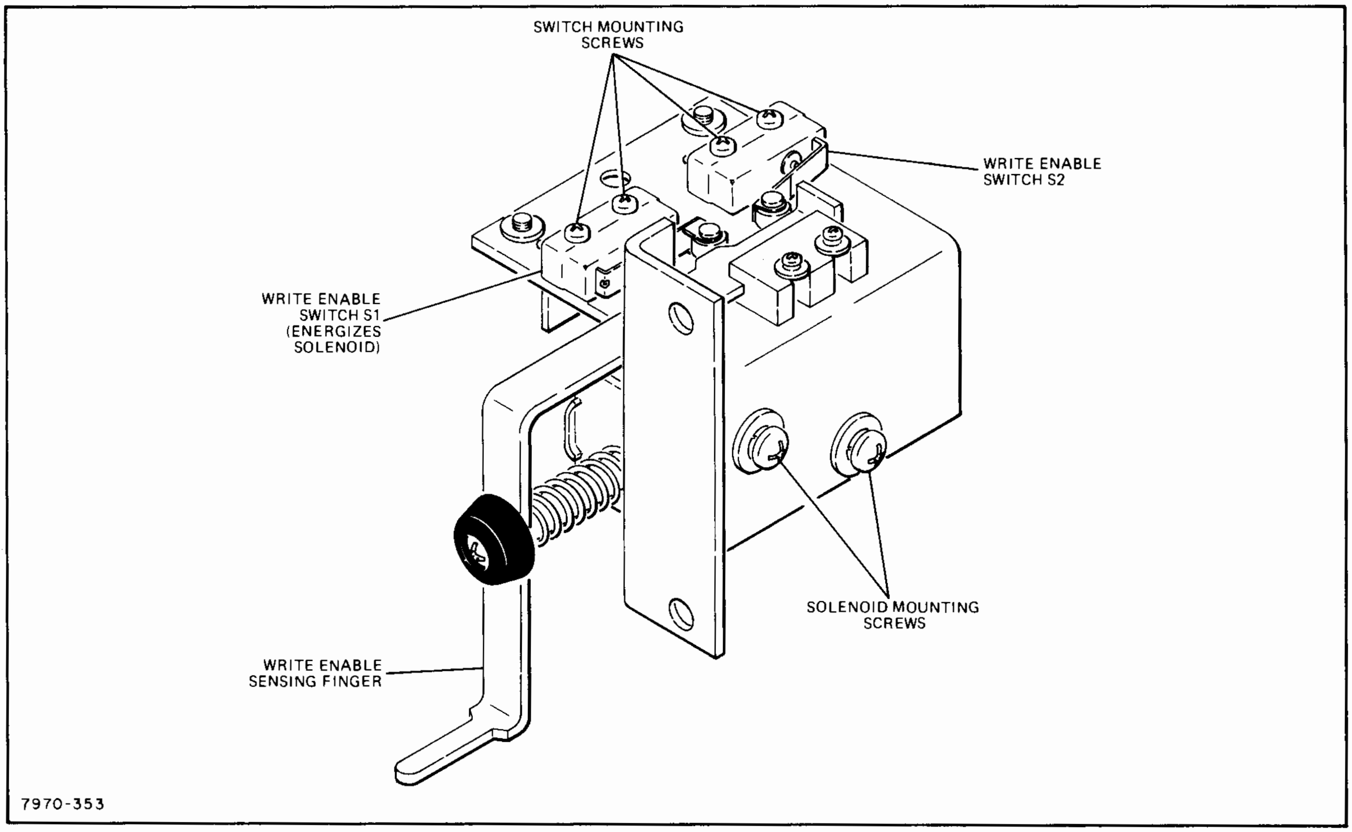


Figure 5-2. Write Enable Assembly

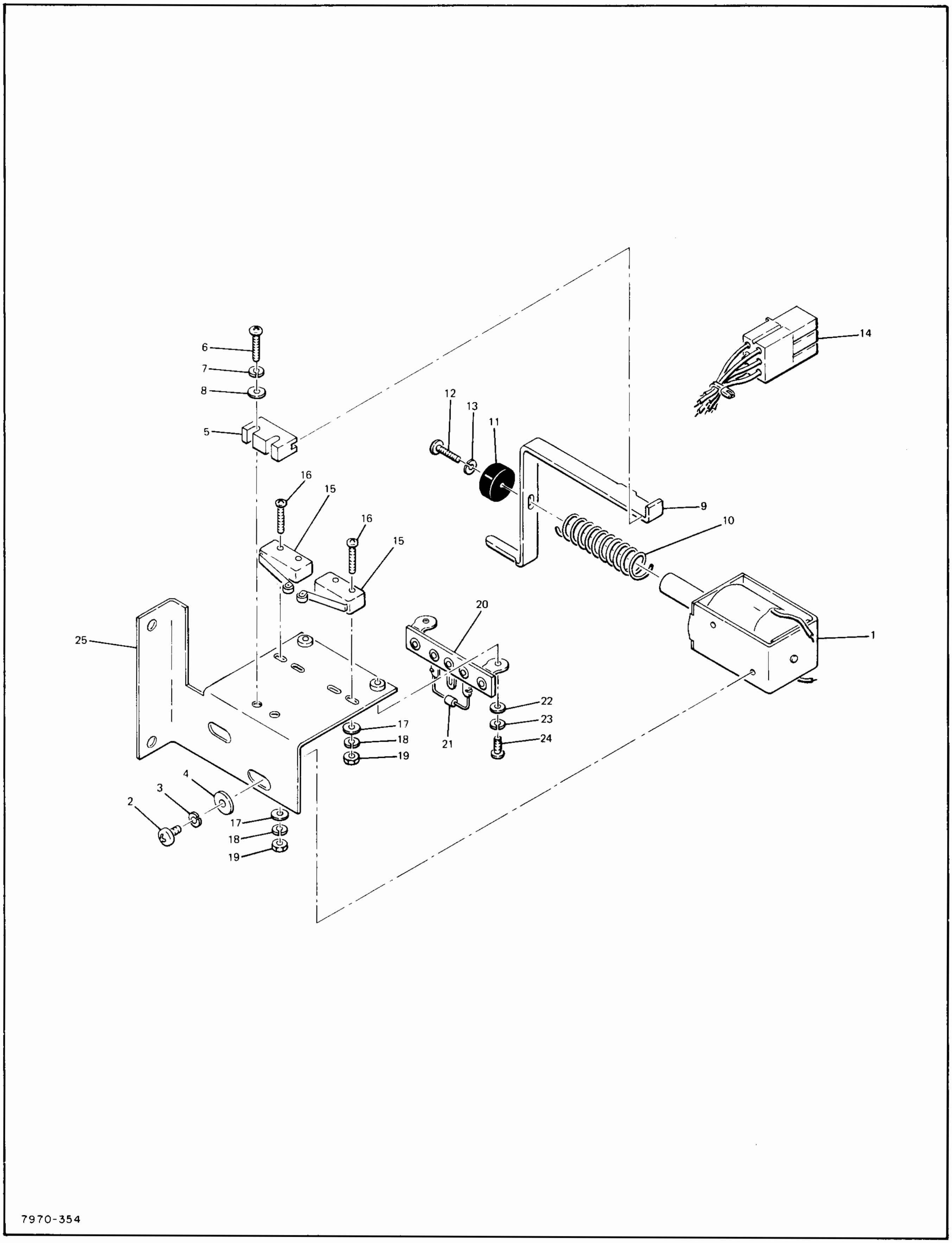


Figure 3-1. Write Enable Assembly A10

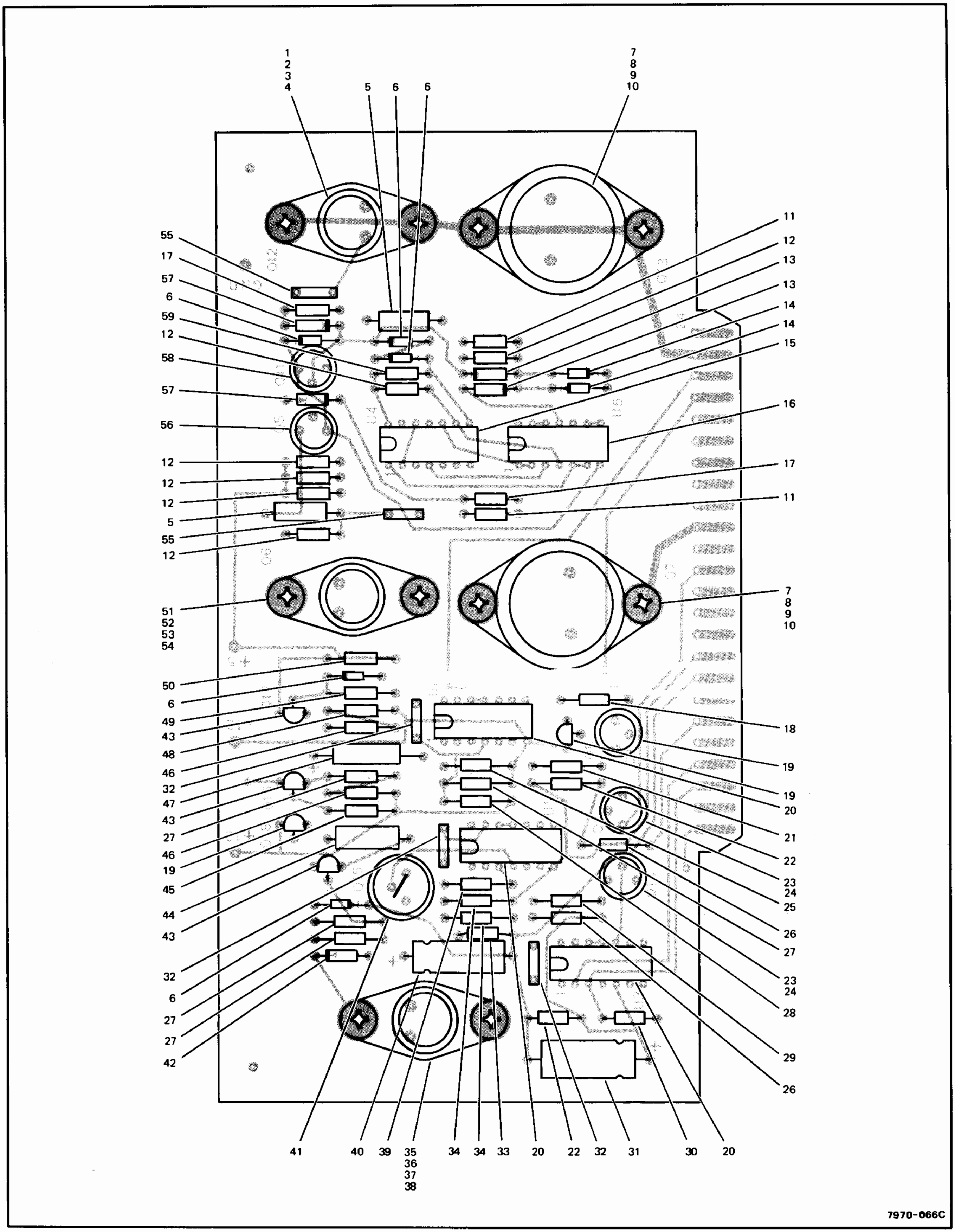


Figure 6-14. Power Regulator PC Assembly A21

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-14-	07970-61010	POWER REGULATOR PC ASSEMBLY A21	REF
-1	1854-0072	. TRANSISTOR, NPN, Si, 2N3054 (Q12)	1
-2	0340-0180	. . INSULATOR, transistor, mica	1
-3	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi	2
-4	2420-0001	. . NUT, hex, no. 6-32	2
-5	0683-3325	. RESISTOR, fxd, 3.3k, 5%, 1/4W (R10, R20)	2
-6	1901-0040	. DIODE, Si (CR9, CR10, CR11, CR12, CR13)	5
-7	1854-0063	. TRANSISTOR, NPN, Si (Q7, Q13)	2
-8	1200-0077	. . INSULATOR, transistor.	1
-9	2360-0197	. . SCREW, no. 6-32, 0.375-inch, pozi	2
-10	2420-0001	. . NUT, hex, no. 6-32	2
-11	0683-1015	. RESISTOR, fxd, 100 ohms, 5%, 1/4W (R12, R22)	2
-12	0683-1025	. RESISTOR, fxd, 1k, 5%, 1/4W (R7, R9, R11, R21, R28, R29)	6
-13	1902-3171	. DIODE, zener, Si (CR4, CR6)	2
-14	1901-0025	. DIODE, Si (CR3, CR5)	2
-15	1820-0348	. INTEGRATED CIRCUIT, type 844 (U4).	1
-16	1820-0256	. INTEGRATED CIRCUIT (U5).	1
-17	0683-5125	. RESISTOR, fxd, 5.1k, 5%, 1/4W (R8, R19)	2
-18	0686-0083	. RESISTOR, fxd, 1.96k, 5%, 1/2W (R18)	1
-19	1853-0036	. TRANSISTOR, PNP, Si, 2N3906 (Q8, Q9, Q18)	3
-20	1820-0439	. INTEGRATED CIRCUIT, voltage regulator (U1, U2, U3)	3
-21	0757-0441	. RESISTOR, fxd, 8.25k, 1%, 1/8W (R16)	1
-22	0698-3150	. RESISTOR, fxd, 2.37k, 1%, 1/8W (R2, R26)	2
-23	1854-0039	. TRANSISTOR, NPN, Si, EIA, 2N3053 (Q1, Q14)	2
-24	0340-0164	. . INSULATOR, transistor	1
-25	0757-0440	. RESISTOR, fxd, 7.5k, 1%, 1/8W (R17)	1
-26	0698-3438	. RESISTOR, fxd, 147 ohms, 1%, 1/8W (R1, R25)	2
-27	0757-0438	. RESISTOR, fxd, 5.11k, 1%, 1/8W (R15, R30, R31, R35)	4
-28	0757-0290	. RESISTOR, fxd, 6.19k, 1%, 1/8W (R14)	1
-29	0757-1094	. RESISTOR, fxd, 1.47k, 1%, 1/8W (R6)	1
-30	0757-0317	. RESISTOR, fxd, 1.33k, 1%, 1/8W (R27)	1
-31	0180-0059	. CAPACITOR, fxd, 10 μF, 25 Vdcw (C7)	1
-32	0160-3456	. CAPACITOR, fxd, 0.001 μF, 10%, 250 Vdcw (C1, C3, C6)	3
-33	0683-6815	. RESISTOR, fxd, 680 ohms, 5%, 1/4W (R24)	1
-34	0757-0279	. RESISTOR, fxd, 3.16k, 1%, 1/8W (R5, R23)	2
-35	1884-0088	. THYRISTOR, 2N3228 (CR1)	1
-36	0340-0180	. . INSULATOR, transistor, mica	1
-37	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi	2
-38	2420-0001	. . NUT, hex, no. 6-32, 0.312-inch	2
-39	0698-0084	. RESISTOR, fxd, 2.15k, 1%, 1/8W (R3)	1
-40	0810-0172	. CAPACITOR, fxd, 5 μF, 15 Vdcw (C5)	1
-41	2100-1773	. RESISTOR, var, ww, 1k, 5%, 1W (R4)	1

FIGURE & INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5	UNITS PER ASSY
6-14-42	1902-0048	. DIODE, zener, 6.8V, 1N3210 (CR2)	1
-43	1854-0215	. TRANSISTOR, NPN, Si, 2N3904 (Q15, Q16, Q17)	3
-44	0757-0198	. RESISTOR, fxd, 100 ohms, 1%, 1/2W (R32)	1
-45	0757-0465	. RESISTOR, fxd, 100k, 1%, 1/8W (R33)	1
-46	0757-0280	. RESISTOR, fxd, 1k, 1%, 1/8W (R34, R36)	2
-47	0180-0228	. CAPACITOR, fxd, 22 μF, 10%, 15 Vdcw (C8)	1
-48	0757-0199	. RESISTOR, fxd, 21.5k, 1%, 1/8W (R37)	1
-49	0698-3157	. RESISTOR, fxd, 19.6k, 1%, 1/8W (R38)	1
-50	0757-0419	. RESISTOR, fxd, 681 ohms, 1%, 1/8W (R39)	1
-51	1853-0052	. TRANSISTOR, PNP, Si, 2N3740 (Q6)	1
-52	0340-0180	. . INSULATOR, transistor, mica	1
-53	2360-0195	. . SCREW, no. 6-32, 0.312-inch, pozi	2
-54	2420-0001	. . NUT, hex, no. 6-32, 0.312-inch	2
-55	0160-2055	. CAPACITOR, fxd, 0.01 μF, 100 Vdcw (C2, C4)	2
-56	1854-0022	. TRANSISTOR, NPN, Si (Q5)	1
-57	0340-0114	. . INSULATOR, transistor	1
-58	1902-3311	. DIODE, zener, 38.5V (CR7, CR8)	2
-59	1853-0080	. TRANSISTOR, PNP, Si, 2N4888 (Q11)	1
-60	0683-4715	. RESISTOR, fxd, 470 ohms, 5%, 1/4W (R13)	1