FINAL REPORT

for

PERCENT RECHARGE UNIT

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SUMMARY

This report discusses in detail the operation of the Percent Recharge Unit developed under contract number NAS5-10379. This unit works with the formation cycler system, which cycles rechargeable battery systems for qualification and acceptance tests. This unit permits the operator to charge each cell of a battery to a percentage (ranging from 100 to 199 per cent) of the discharge capacity of the cell.

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SECTION 1

CHARACTERISTICS

1.1 INTRODUCTION

The Percent Recharge Unit works in conjunction with the automatic formation cycler, current integrator, Hewlett Packard 562A Digital Recorder, Hewlett Packard Digital Voltmeter, and power supply (see Figure 1). The above system automatically monitors and controls a rechargeable battery during its charge-discharge cycling tests. Without the Percent Recharge Unit in the system, the formation cycler would monitor the voltage of each cell of the battery. When the voltage of a cell reached an upper preset voltage limit during charge, or a lower preset voltage limit during discharge, the formation cycler would automatically remove the cell from the battery. When a cell is removed, the cell number, ampere hour capacity, and cell voltage is printed out.

Since the voltage slope of a rechargeable battery is very small near the upper preset voltage limit, voltage sensing is not the ideal parameter to be used for removing a cell when the battery is being charged. The Percent Recharge Unit provides a new parameter which permits each cell of a rechargeable battery to be charged to a preset percentage value of the discharge ampere hour capacity of the cell. This preset percentage value is set on the front panel and has a range of 100 per cent to 199 per cent in one per cent increments.

The process begins by connecting a fully charged battery containing up to twenty (20) cells to the formation cycler and discharge the batteries into its internal load with the current time integrator

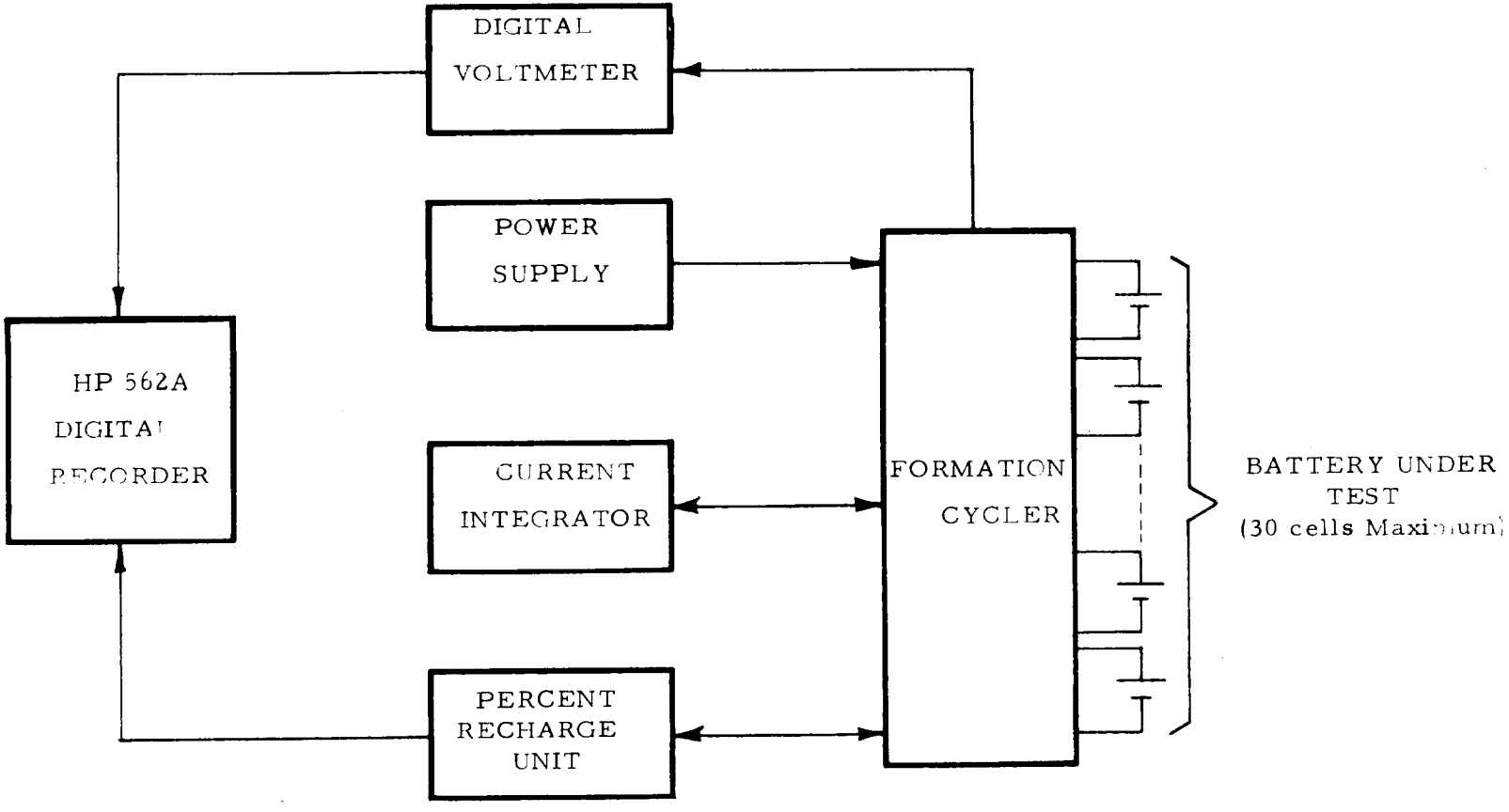

FIGURE 1 SYSTEM BLOCK DIAGRAM

monitoring the ampere hour discharge capacity. During this discharge mode pulses which are generated by the current integrator are counted by twenty (20) discharge counters located within the Percent Recharge Unit. Each cell of the battery has its own discharge counter. When a cell is removed from the battery by the formation cycler, the cell control relay located in the formation cycler will apply an inhibit level to the cell counter gate preventing the integration pulses from being applied to the discharge counter representing that cell. Therefore, at the end of the battery discharge cycle the digital information stored in each of the twenty discharge counters represents the discharge ampere hour capacity of each of the corresponding battery cells.

During the battery charge mode pulses from the current integrator are applied to a single charge counter within the Percent Recharge Unit. Therefore, the digital information in this charge counter represents the ampere hour charge applied to the battery. It is the function of the Percent Recharge Unit to sequentially multiply the ampere hour discharge capacity of each cell, by the percentage value set on the front panel and compare this product to the ampere hour value stored in the charge counter. If this product is equal to or less than the value in the charge counter, a signal will be sent to the formation cycler which will cause it to bypass that cell.

1.2 SPECIFICATIONS

GENERAL

Power Input:	115V, 50 to 60 cps
Panel Size:	8-3/4 inches high by 19 inches wide
Operating Temperature:	0° C to +50° C

Cell Capacity:	20 cells maximum
Cell Counter Capacity Storage:	0 to 99,999
Charge Counter Capacity Storage:	0 to 199,999
Multiply Time:	1 millisecond
Multiply Accuracy:	± least significant bit
Percentage Multiplier:	100% to 199% in 1% increments

OUTPUT (to 562A Digital Recorder)

Cell Number Indicator:	1224 BCD code (2 digits)
Cell Capacity Indicator:	1248 BCD code (5 digits)

SECTION 2

OPERATING INSTRUCTIONS

2.1 OPERATING CONTROLS

Following is a description of each control located on the front panel.

POWER Switch -- Applies AC power to the unit.

OPERATE MODE Switch -- This switch selects the mode of unit operation.

CHECK Mode -- In this position the cell and charge counters can be checked.

REMOTE Mode -- In this position the charge or discharge operating mode can be selected externally.

DISCHARGE Mode -- The switch should be placed in this position when the battery is being discharged. In this mode each cell counter will count the ampere hour pulses generated by the current integrator until that cell is removed by the formation cycler. When the cell is removed, the number stored in the cell counter represents the ampere hour capacity of the cell.

CHARGE Mode -- The OPERATE MODE Switch should be placed in this position when the battery is being charged after undergoing a discharge cycle. In this mode the unit multiplies the ampere hour discharge capacity of each cell by the percentage value set on the front panel and compares this product with the ampere hour capacity applied to the battery during the charge cycle. When the product becomes equal to or less than the charge applied, a pulse is sent to the formation cycler which removes the cell.

MULTIPLIER (N+100%) Switches -- These two switches select the percentage multiplier when the OPERATE MODE is in the CHARGE position. The switches can be set to any value between 100% and 199% in 1% increments.

READOUT Switch -- This switch selects the Nexie tube readout source. When the switch is in the CHARGE COUNTER position, the count in the charge counter can be observed. It is noted that the charge counter counts in both the charge and discharge modes and indicates the ampere hours applied to or supplied by the battery. When the READOUT switch is in the CELL COUNTER position, the ampere capacity of each cell can be observed as the formation cycler steps through the cell positions.

CELL COUNTER RESET Switch -- This switch resets the cell counter manually. The switch resets the counter only when the orange light illuminating the switch is "on". When the light is "off", the switch will not reset the cell counter.

CHARGE COUNTER RESET Switch -- This switch resets the charge counter manually. The switch resets the counter only when the orange light illuminating the switch is "on". When the light is "off", activating the switch will not reset the charge counter.

CHECK COUNTER Switch -- When the OPERATE MODE switch is in the CHECK position the switch applies an internally generated frequency to the cell and charge counters. This switch is used to check that all counters are counting properly.

MULTIPLY CHECK Switch -- This switch inhibits counts from being applied to the cell counters when the CHECK COUNTER switch is pressed.

RETAIN CELL Indicator--This indicator lights when a retain cell decision is made by the multiplier circuitry. The indicator operates only during the CHARGE mode.

REMOVE CELL Indicator -- This indicator lights when a remove cell decision is made by the multiplier circuitry. In the CHARGE mode either a RETAIN CELL or REMOVE CELL decision must be made after each initiated multiply operation.

2.2 OPERATING PROCEDURES

A. The test should begin with a fully charged battery connected to the formation cycler. The OPERATE MODE switch should be placed in the DISCHARGE position.

B. Set all controls on the formation cycler to the discharge position.

C. Reset the cell and charge counters to zero with the CELL COUNTER RESET and CHARGE COUNTER RESET switches. The orange switch illuminating lights will go "off" when the counters are reset.

D. The cell and charge counters will count the pulses generated by the current integrator. When a cell reaches the lower preset limit set by the formation cycler, the formation cycler will remove that cell from the battery series. At the time a cell is removed an inhibit signal is sent to the Percent Recharge Unit which inhibits the succeeding current integrator pulses from being applied to the cell counter representing the removed cell. When all cells are removed by the formation cycler, the numbers stored in the cell registers represent the ampere hour capacity of each battery cell. At the time each cell is removed, the 562A printer prints the cell number and ampere hour

capacity of the cell which is provided to it by the Percent Recharge Unit. The printer also records the cell voltage which is supplied to it by a digital voltmeter.

E. When the discharge cycle is complete, place the OPERATE MODE switch in the CHARGE position.

F. Set the MULTIPLIER (N+100%) to the desired recharge value.

G. Reset the charge counter to zero with the CHARGE COUNTER RESET switch. The orange switch illuminating light should go "off" when the counter is reset.

H. Set all controls of the formation cycler to the CHARGE mode of operation.

I. As the formation cycler steps through the cell sampling sequence, the Percent Recharge Unit will multiply the numbers stored in the cell counters by the MULTIPLIER SET on the front panel. For example, when the formation cycler is sampling the first cell the number stored in the cell counter representing the first cell is multiplied by the preset percentage value. This product is compared with the number in the charge counter. The charge counter starts counting from zero at the beginning of the charge cycle by pulses generated by the current integrator which measures the ampere hours applied to the battery. When a multiplication is made, the RETAIN CELL indicator will light if the multiplied product is greater than the number in the charge counter. If the product is equal to or less than the number in the charge counter, the REMOVE CELL indicator will light and a signal will be sent by the Percent Recharge Unit to the formation cycler which will cause it to bypass the cell. This process continues until all cells are removed.

SECTION 3

THEORY OF OPERATION

3.1 INTRODUCTION

Shown in Figure 2 is a block diagram of the Percent Recharge Unit. During the discharge cycle the current integrator pulses are applied to the twenty cell counters. When a cell is removed by the formation cycler, a cell counter inhibit level is applied to the gate input of the cell counter representing the removed cell. Current integrator pulses are also applied to the charge counter so that the HP printer can print the ampere hour capacity of the cell which was removed. The Nexie driver and indicator permit the operator to monitor the cell counter and charge counter.

At the beginning of the charge cycle, the charge counter is reset to zero; however, the cell counters will retain the ampere hour capacity information of their respective cells. During the charge cycle, as the formation cycler steps through the cell positions, the cell counter outputs will be gated into the multiplier circuitry. During the charge cycle, integrator pulses will be counting into the charge counter. When the gated cell number multiplied by the front panel percentage value is equal to or less than the number in the charge counter, a remove cell indicator will be sent to the formation cycler.

3.2 MULTIPLYING THEORY

Consider the following multiplication.

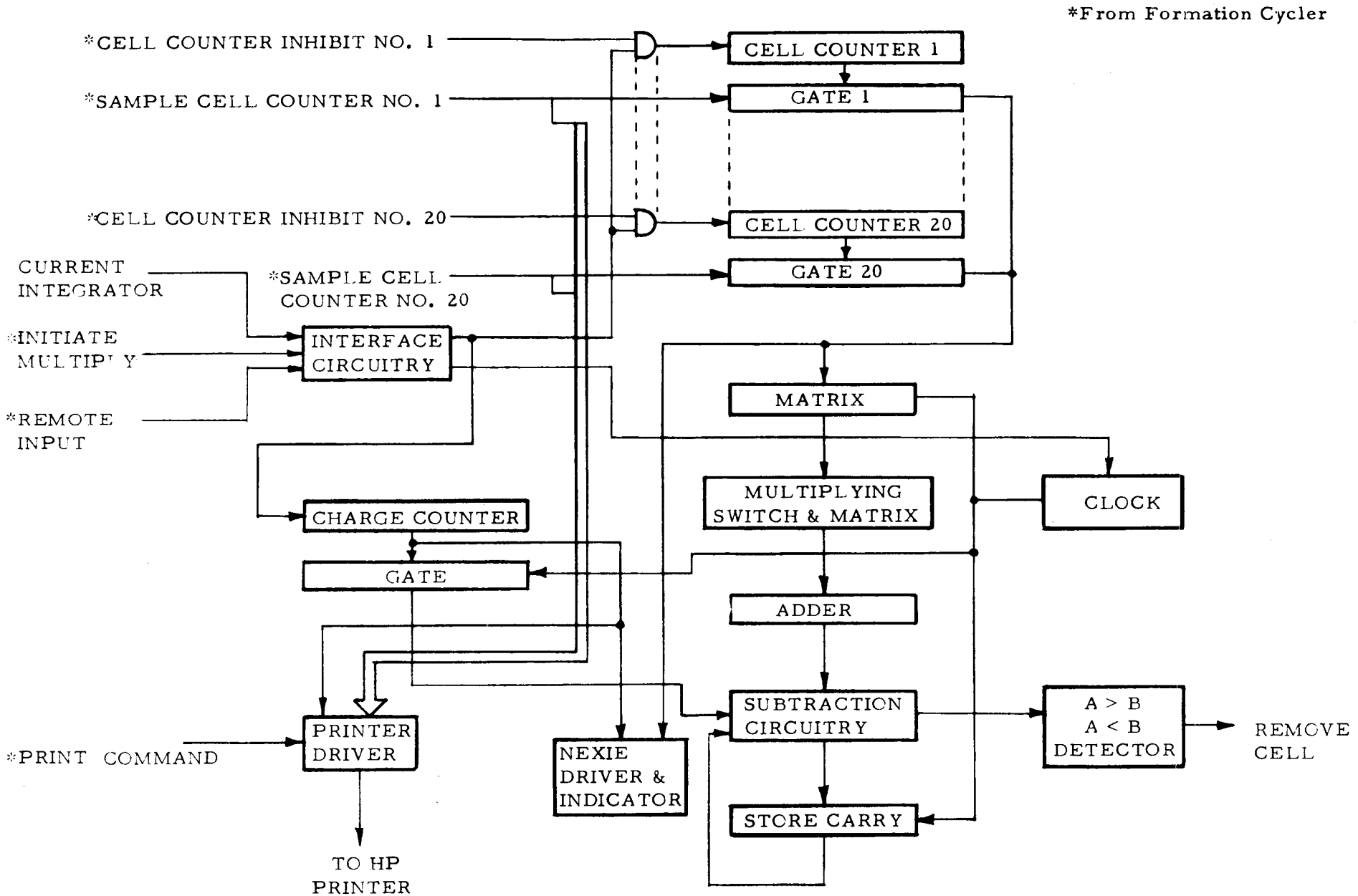

FIGURE 2 BLOCK DIAGRAM - PERCENT RECHARGE UNIT

		A	B	C	D	E
			X	I	Y	Z
		ZA	ZB	ZC	ZD	ZE
	YA	YB	YC	YD	YE	
A	B	C	D	E		
A	B+YA	C+YB+ZA	D+YC+ZB	E+YD+ZC	YE+ZD	ZE

The ABCDE number is the five place decimal gated cell counter number. The Z and Y are the numbers set in the MULTIPLIER (N+100%) switches in the units and tens positions. The multiplication function requires a seven channel timing sequence. The YA, ZA, YB, etc., multiplication is performed in a diode matrix connected to the MULTIPLIER (N+100%) switches. Column addition is performed in the adder card. For example, during the first timing channel, A is the output. During the second timing channel, the sum of B and YA is the output. During the third timing sequence, the sum of C, YB, and ZA is the output. It is noted that the multiplying sequence starts with the most significant digit and ends with the least significant digit. The output of the adder is a 1, 2, 4, 8, 10, 20, 40, 80, 160 BCD code.

3.3 COMPARATOR

The output of the adder is compared with the output of the charge counter to determine if the adder output is greater, equal to, or less than the charge counter number. Assume a number in the charge counter of A' B' C' D' E' F' where A' is a one or zero only. Following is the timing program of the multiplying sequence. A zero is added to a letter to indicate multiplying a number by 10 or giving it a ten's significance.

	Charge Counter Output	A'0+B'	=(1)
	Adder Output	A	=(2)
CHANNEL 1	Subtraction Circuit Output	(1)-(2)	=(3)
	If (3) is Negative	RETAIN CELL	
	If (3) is Greater than 20	REMOVE CELL	
	If (3) is 0 or Positive	STORE(3)	
	Charge Counter Output	C'	=(4)
	Adder Output	B+YA	=(5)
CHANNEL 2	Store Carry Output x 10	(3)0	=(6)
	Subtraction Circuit Output	(4)+(6)-(5)	=(7)
	If (7) is Negative	RETAIN CELL	
	If (7) is Greater than 20	REMOVE CELL	
	If (7) is 0 or Positive	STORE(7)	
	Charge Counter Output	D'	=(8)
	Adder Output	C+YB+ZA	=(9)
CHANNEL 3	Store Carry Output x 10	(7)0	=(10)
	Subtraction Circuit Output	(8)+(10)-(9)	=(11)
	If (11) is Negative	RETAIN CELL	
	If (11) is Greater than 20	REMOVE CELL	
	If (11) is 0 or Positive	STORE(11)	
	Charge Counter Output	E'	=(12)
	Adder Output	D+YC+ZB	=(13)
CHANNEL 4	Store Carry Output x 10	(11)0	=(14)
	Subtraction Circuit Output	(12)+(14)-(13)	=(15)
	If (15) is Negative	RETAIN CELL	
	If (15) is Greater than 20	REMOVE CELL	
	If (15) is 0 or Positive	STORE(15)	
	Charge Counter Output	F'	=(16)
	Adder Output	E+YD+ZC	=(17)
CHANNEL 5	Store Carry Output x 10	(15)0	=(18)
	Subtraction Circuit Output	(16)+(18)-(17)	=(19)
	If (19) is Negative	RETAIN CELL	
	If (19) is Greater than 20	REMOVE CELL	
	If (19) is 0 or Positive	STORE(19)	
	Adder Output	YE+ZD	=(20
	Store Carry Output x 10	(19)0	=(21)
CHANNEL 6	Subtraction Circuit Output	(21)-(20)	=(22)
	If (22) is Negative	RETAIN CELL	
	If (22) is Greater than 20	REMOVE CELL	
	If (22) is 0 or Positive	STORE(22)	

	Adder Output	ZE	=(23)
	Store Carry Output x 10	(22)0	=(24)
CHANNEL 7	Subtraction Circuit Output	(24)-(23)	=(25)
	If (25) is Negative	RETAIN CELL	
	If (25) is 0 or Positive	REMOVE CELL	

For an example, let's assume a gated cell counter number of 29976, a charge counter number of 47661, and a percentage multiplier set on the front panel to 159. The multiplication would be accomplished as follows.

				2	9	9	7	6
						x 1	5	9
		18	81	81		63		54
	10	45	45	35		30		
2	9	9	7	6				
2	19	72	133	122		93		54

The levels observed at the test points of the Adder Card Board 16 (see Figure 14) would be as follows.

CHANNEL →	1	2	3	4	5	6	7
Wht(1)	0	1	0	1	0	1	0
Grn(2)	1	0	1	1	1	1	0
Blu(4)	0	0	0	0	0	0	1
Gry(8)	0	1	0	0	0	0	0
Yel(10)	0	1	1	1	0	1	1
Brn(20)	0	0	1	0	0	0	0
Blk(40)	0	0	1	1	1	0	1
Blu(80)	0	0	0	1	1	1	0
Orn(160)	0	0	0	0	0	0	0
↑ Binary Weight							

The outputs from the Adder Card are; therefore, two for Channel 1, 19 for Channel 2, 72 for Channel 3, 133 for Channel 4, 122 for Channel 5, 93 for Channel 6, and 54 for Channel 7.

The cell counter input applied to the Subtractor Circuit Card Board 17 (reference Figure 16) can be seen at the following test points.

CHANNEL	1	2	3	4	5	6	7
Yel(1)	0	1	0	0	1	0	0
Orn(2)	0	1	1	1	0	0	0
Gry(4)	1	1	1	1	0	0	0
Blu(8)	0	0	0	0	0	0	0

The cell counter input is; therefore, four for Channel 1, seven for Channel 2, six for Channel 3, six for Channel 4, one for Channel 5, and zero for Channel 6 and 7. In accordance with the program the following sequence occurs.

CHANNEL	FUNCTION		ARITHMETIC SOLUTION
1	A'0+B'	=(1)	0+4=4
	A	=(2)	2
	(1)-(2)	=(3)	4-2=2 (Stored)
2	C'	=(4)	7
	B+YA	=(5)	9+10=19
	(3)0	=(6)	20
	(4)+(6)-(5)	=(7)	7+20-19=8
3	D'	=(8)	6
	C+YB+ZA	=(9)	9+45+18=72
	(7)0	=(10)	80
	(8)+(10)-(9)	=(11)	6+80-72=14 (Stored)
4	E'	=(12)	6
	D+YC+ZB	=(13)	7+45+81=133
	(11)0	=(14)	140
	(12)+(14)-(13)	=(15)	6+140-133=13 (Stored)

CHANNEL	FUNCTION		ARITHMETIC SOLUTION
5	F'	=(16)	1
	E+YD+ZC	=(17)	6+35+81=122
	(15)0	=(18)	130
	(16)+(18)-(17)	=(19)	1+130-122=9 (Stored)
6	YE+ZD	=(20)	30+63=93
	(19)0	=(21)	90
	(21)-(20)	=(22)	90-93= -3 Number Negative (RETAIN CELL)

On the sixth channel period, a pulse would be sent to pin 13 of Board 19 (reference Figure 20) which would indicate a retain cell decision.

3.4 BOARD FUNCTIONAL DESCRIPTION

CELL COUNTERS -- BOARDS 1 THRU 10, FIGURE 4

These ten boards contain the twenty (20) cell counters. The current integrator pulses are applied to pin 13 of each card. The counters will count until the formation cycler applies a low to pin 12 or 15 which will inhibit successive pulses from counting into the respective counters. Counter reset is accomplished through pin 25. During the charge cycle the cell counters are sequentially gated into a common bus. The sample cell counter signal developed by the formation cycler is applied to pins 2 and 31. When a high level is applied to one of these inputs, a high level will be applied to gates 6 through 10 or 16 through 20 respectively.

MATRIX CARD -- BOARDS 11 AND 12, FIGURE 6

The matrix card commutates the gated cell counter output. During Channel 1 it gates A directly into the Adder. During Channel 2 it

gates B into the Adder and A into multiplying switch circuitry to be multiplied by Y. Druing Channel 3 the matrix gates C into the Adder, B into the Y multiply switch, and A into the Z multiply switch. This process continues through the multiplying sequence.

BCD TO DECIMAL CONVERTER -- BOARD 13, FIGURE 8

The 1224 BCD number gated into the Y multiply switch and Z multiply switch must be converted to a decimal code. This is accomplished in this card by the SN7441N BCD to Decimal micro-circuits. Output buffers are placed at the output to properly drive the multiplying switch diode matrix.

DIODE MULTIPLYING MATRIX -- BOARDS 21 AND 22, FIGURE 24

The output of Card 13 is applied to the per cent multiplying switches located on the front panel. The switches are ten pole ten position switches. The switches are bussed so as to apply the input signal to the proper product output bus. For example, a BCD 0111 code applied to Card 13 would produce a decimal 17 output. This high, would be applied to the seventh pole of the multiplying switch. If the switch was in the "1" position, the high would be applied to the 7 bus. If the switch was in the "2" position, the high would be applied to the 14 bus. The switch busses are connected to Boards 21 and 22. The input number, which is near the input pin number, indicates the switch bus to which they are attached. For example, the 8 input is connected to the first pole, eighth position, second pole, fourth position, fourth pole, second position, and eighth pole, first position. The diode matrix converts the input number to a 1, 2, 4, 8, 10, 20, 40, 80 BCD output.

CLOCK -- BOARD 14, FIGURE 10

The card performs the timing sequence for the multiplying operation. The timing source is a multivibrator. The Channel 1 pulse is at output pin 11, Channel 2 at pin 2, Channel 3 at pin 4, Channel 4 at lin 17, Channel 5 at pin 16, Channel 6 at pin 15, and Channel 7 at pin 10.

CHARGE COUNTER -- BOARD 15, FIGURE 12

This counter counts the current integrator pulses during both the charge and discharge cycle. During the charge cycle the counter outputs are gated into the subtractor card by the channel pulses developed in the clock card. The sequentially gated output appears at pins 8, 17, 20, and 26. During Channel 1 the output of BCD counter 14 is gated to the output. During channel 2 the output of BCD counter 13 is gated to the output, etc.

ADDER -- BOARD 16, FIGURE 14

The BCD output of the two diode multiplying matrix cards and the matrix card output are added in this card. For example, during Channel 3, C would be applied directly from the matrix card. YB and ZA are applied to the card from the diode multiplying card.

SUBTRACTION CIRCUIT AND STORE CARRY -- BOARD 17, FIGURE 16

This card takes the number from the gated to it from the charge counter and subtracts the adder output applied to it. This board also makes the retain cell or remove cell indication.

INTERFACE CARD A -- BOARD 18, FIGURE 18

This card contains the remote operating interface circuitry and reset circuitry. For remote operation a ground signal is applied to pin 2 or 4. Output pin 26 resets the charge counter and output pin 23 resets the cell counter. Preceeding circuitry locks the reset button out once the counters have been reset.

INTERFACE CARD B -- BOARD 19, FIGURE 20

This board contains the current integrator pulse interface circuitry, remove-retain decisions circuitry, and charge counter input circuitry. The two relay contacts of the current integrator are applied to pins 5 and 7. The flip-flop interface eliminates extraneous pulses due to contact bounce of the relay. The flip-flop output is strapped to pin 29 where the integrator pulses are applied through a buffer to the cell counter input gates. The circuit consisting of gates 5 and 8 and binary 9 prevents the charge counter from counting during a multiply operation or printout by the HP printer. The circuit containing gates 1 and 7 make the remove cell decisions.

DECIMAL TO BCD CONVERTER -- BOARD 20, FIGURE 22

This card provides the cell number to the HP printer in a 1224 BCD code.

NEXIE DRIVER AND PRINTER BUFFER -- BOARDS 23-25, FIGURE 26, 27

These cards have a 1248 BCD to decimal converter for each Nexie tube position. The SN7441N outputs are clamped to 55 volts. The card also provides a printer interface which produces the proper amplitude levels to the printer. This interface is used by the 5 decimal characters which indicate cell capacity when a cell is removed.

TABLE 1

PIN FUNCTIONS

CONNECTOR J1 TO FORMATION CYCLER

CONNECTOR CANNON DPX-57-34P

PIN NO.	FUNCTION
1	CELL COUNTER INHIBIT NO. 1
2	CELL COUNTER INHIBIT NO. 2
3	CELL COUNTER INHIBIT NO. 3
4	CELL COUNTER INHIBIT NO. 4
5	CELL COUNTER INHIBIT NO. 5
6	CELL COUNTER INHIBIT NO. 6
7	CELL COUNTER INHIBIT NO. 7
8	CELL COUNTER INHIBIT NO. 8
9	CELL COUNTER INHIBIT NO. 9
10	CELL COUNTER INHIBIT NO. 10
11	CELL COUNTER INHIBIT NO. 11
12	CELL COUNTER INHIBIT NO. 12
13	CELL COUNTER INHIBIT NO. 13
14	CELL COUNTER INHIBIT NO. 14
15	CELL COUNTER INHIBIT NO. 15
16	CELL COUNTER INHIBIT NO. 16
17	CELL COUNTER INHIBIT NO. 17
18	CELL COUNTER INHIBIT NO. 18
19	CELL COUNTER INHIBIT NO. 19
20	CELL COUNTER INHIBIT NO. 20
21	+5V To CELL REMOVE RELAY
22	Com To CELL REMOVE RELAY
23	GROUND
24	INITIATES MULTIPLY
25	HIGH CELL REMOVE

TABLE 1 (cont'd.)

PIN FUNCTIONS

CONNECTOR J1 TO FORMATION CYCLER

CONNECTOR CANNON DPX-57-34P

PIN NO.	FUNCTION
26	N/C
27	+22 VOLTS
28	N/C
29	REMOTE CHARGE
30	REMOTE DISCHARGE
31	SAMPLE CELL COUNTER NO. 1
32	SAMPLE CELL COUNTER NO. 2
33	SAMPLE CELL COUNTER NO. 3
34	SAMPLE CELL COUNTER NO. 4
35	SAMPLE CELL COUNTER NO. 5
36	SAMPLE CELL COUNTER NO. 6
37	SAMPLE CELL COUNTER NO. 7
38	SAMPLE CELL COUNTER NO. 8
39	SAMPLE CELL COUNTER NO. 9
40	SAMPLE CELL COUNTER NO. 10
41	SAMPLE CELL COUNTER NO. 11
42	SAMPLE CELL COUNTER NO. 12
43	SAMPLE CELL COUNTER NO. 13
44	SAMPLE CELL COUNTER NO. 14
45	SAMPLE CELL COUNTER NO. 15
46	SAMPLE CELL COUNTER NO. 16
47	SAMPLE CELL COUNTER NO. 17
48	SAMPLE CELL COUNTER NO. 18
49	SAMPLE CELL COUNTER NO. 19
50	SAMPLE CELL COUNTER NO. 20

TABLE 1 (cont'd.)

PIN FUNCTIONS

CONNECTOR J1 TO FORMATION CYCLER

CONNECTOR CANNON DPX-57-34P

PIN NO.	FUNCTION
51	N/C
52	PRINT COMMAND
53	N/C
54	CURRENT INTEGRATOR PIN NO. M
55	CURRENT INTEGRATOR PIN NO. B
56	N/C
57	N/C

TABLE 2

PIN FUNCTIONS

CONNECTOR J2 TO HEWLETT PACKARD 562A PRINTER

CONNECTOR 57-40500-50 PIN AMPHENOL

PIN NO.	FUNCTION
1	NUMBER 1, BIT A
2	NUMBER 1, BIT B
3	NUMBER 2, BIT A
4	NUMBER 2, BIT B
5	NUMBER 3, BIT A
6	NUMBER 3, BIT B
7	NUMBER 4, BIT A
8	NUMBER 4, BIT B
9	NUMBER 5, BIT A
10	NUMBER 5, BIT B
11	NUMBER 6, BIT A
12	NUMBER 6, BIT B
13	NUMBER 7, BIT A
14	NUMBER 7, BIT B
15	N/C
16	N/C
17	N/C
18	N/C
19	N/C
20	N/C
21	N/C
22	N/C
23	(+) PRINT COMMAND
24	(-) REFERENCE
25	(+) REFERENCE

TABLE 2 (cont'd.)

PIN FUNCTIONS

CONNECTOR J2 TO HEWLETT PACKARD 562A PRINTER

CONNECTOR 57-40500-50 PIN AMPHENOL

PIN NO.	FUNCTION
26	NUMBER 1, BIT C
27	NUMBER 1, BIT D
28	NUMBER 2, BIT C
29	NUMBER 2, BIT D
30	NUMBER 3, BIT C
31	NUMBER 3, BIT D
32	NUMBER 4, BIT C
33	NUMBER 4, BIT D
34	NUMBER 5, BIT C
35	NUMBER 5, BIT D
36	NUMBER 6, BIT C
37	NUMBER 6, BIT D
38	NUMBER 7, BIT C
39	NUMBER 7, BIT D
40	N/C
41	N/C
42	N/C
43	N/C
44	N/C
45	N/C
46	N/C
47	(-) INHIBIT
48	N/C
49	N/C
50	GROUND

TABLE 3

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TC	
BOARD	PIN		BOARD	PIN
1 thru 20	33	Bus		
1 thru 20	28	Bus		
1 thru 10	3	Bus		
1 thru 10	4	Bus		
1 thru 10	5	Bus		
1 thru 10	6	Bus		
1 thru 10	7	Bus		
1 thru 10	8	Bus		
1 thru 10	9	Bus		
1 thru 10	10	Bus		
1 thru 10	11	Bus		
1 thru 10	13	Bus		
1 thru 10	14	Bus		
1 thru 10	16	Bus		
1 thru 10	17	Bus		
1 thru 10	18	Bus		
1 thru 10	19	Bus		
1 thru 10	20	Bus		
1 thru 10	21	Bus		
1 thru 10	23	Bus		
1 thru 10	24	Bus		
1 thru 10	25	Bus		
1 thru 10	26	Bus		
1 thru 10	27	Bus		
1 thru 10	29	Bus		
1 thru 10	30	Bus		

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
1	2	Green	J1	31
1	2	Green	20	18
1	12	Orange	J1	1
1	15	Orange	J1	2
1	31	Green	J1	34
1	31	Green	20	16
2	2	Green	J1	33
2	2	Green	20	14
2	12	Orange	J1	3
2	15	Orange	J1	4
2	31	Green	J1	34
2	31	Green	20	12
3	2	Green	J1	35
3	2	Green	20	10
3	12	Orange	J1	5
3	15	Orange	J1	6
3	31	Green	J1	36
3	31	Green	20	8
4	2	Green	J1	37
4	2	Green	20	6
4	12	Orange	J1	7
4	15	Orange	J1	8
4	31	Green	J1	38

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
4	31	Green	20	4
5	2	Green	J1	39
5	2	Green	20	2
5	12	Orange	J1	9
5	15	Orange	J1	10
5	31	Green	J1	40
5	31	Green	20	20
6	2	Green	J1	41
6	2	Green	20	19
6	12	Orange	J1	11
6	15	Orange	J1	12
6	31	Green	J1	42
6	31	Green	20	17
7	2	Green	J1	43
7	2	Green	20	15
7	12	Orange	J1	13
7	15	Orange	J1	14
7	31	Green	J1	44
7	31	Green	20	13
8	2	Green	J1	45
8	2	Green	20	11

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
8	12	Orange	J1	15
8	15	Orange	J1	16
8	31	Green	J1	46
8	31	Green	20	9
9	2	Green	J1	47
9	2	Green	20	7
9	12	Orange	J1	17
9	15	Orange	J1	18
9	31	Green	J1	48
9	31	Green	20	5
10	2	Green	J1	49
10	2	Green	20	3
10	3	White	14	7
10	4	White	19	8
10	5	White	19	9
10	6	White	14	6
10	7	Black	10	28
10	8	White	12	31
10	9	White	11	32
10	10	White	11	31
10	11	White	12	32
10	12	Orange	J1	19
10	13	White	19	30
10	14	Violet	S4	6-P

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
10	15	Orange	J1	20
10	16	White	12	29
10	17	White	11	30
10	18	White	11	29
10	19	White	12	30
10	20	White	12	26
10	21	White	11	27
10	23	White	11	26
10	24	White	12	27
10	25	White	18	23
10	26	White	12	25
10	27	White	11	24
10	29	White	12	25
10	30	White	12	24
10	31	Green	J1	50
10	31	Green	20	21
11	1	Yellow	S1	7
11	2	Yellow	S1	11
11	3	Yellow	S1	15
11	4	Yellow	S1	19
11	5	Yellow	S1	8
11	6	Yellow	S1	12
11	7	Yellow	S1	20
11	8	Yellow	S1	16
11	9	Bus	12	9

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
11	10	Bus	12	10
11	11	Yellow	S1	3
11	11	Yellow	19	11
11	12	White	13	1
11	13	White	13	29
11	14	Bus	12	14
11	15	White	13	31
11	16	White	16	7
11	17	Bus	12	17
11	18	Bus	12	18
11	19	Bus	12	19
11	20	Yellow	S1	4
11	20	Yellow	19	10
11	21	White	16	6
11	22	White	13	3
11	23	Bus	12	23
(11)	(24)	(White)	(10)	(27)
(11)	(25)	(White)	(10)	(29)
(11)	(26)	(White)	(10)	(23)
(11)	(27)	(White)	(10)	(21)
(11)	(29)	(White)	(10)	(18)
(11)	(30)	(White)	(10)	(17)
(11)	(31)	(White)	(10)	(10)
(11)	(32)	(White)	(10)	(9)

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
12	1	Yellow	S1	5
12	2	Yellow	S1	9
12	3	Yellow	S1	13
12	4	Yellow	S1	17
12	5	Yellow	S1	6
12	6	Yellow	S1	10
12	7	Yellow	S1	18
12	8	Yellow	S1	14
12	9	White	14	15
(12)	(9)	(Bus)	(11)	(9)
12	10	White	14	10
(12)	(10)	(Bus)	(11)	(10)
12	11	Yellow	S1	1
12	11	Yellow	14	9
12	12	White	13	4
12	13	White	13	32
12	14	White	14	16
(12)	(14)	(Bus)	(11)	(14)
12	15	White	13	30
12	16	White	16	5
12	17	White	14	17
(12)	(17)	(Bus)	(11)	(17)
12	18	White	14	2
(12)	(18)	(Bus)	(11)	(18)
12	19	White	14	11

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
(12)	(19)	(Bus)	(11)	(19)
12	20	Yellow	S1	2
12	20	Yellow	14	8
12	21	White	16	8
12	22	White	13	2
12	23	White	14	4
(12)	(23)	(Bus)	(11)	(23)
(12)	(24)	(White)	(10)	(30)
(12)	(25)	(White)	(10)	(26)
(12)	(26)	(White)	(10)	(20)
(12)	(27)	(White)	(10)	(24)
(12)	(29)	(White)	(10)	(16)
(12)	(30)	(White)	(10)	(19)
(12)	(31)	(White)	(10)	(8)
(12)	(32)	(White)	(10)	(11)
(13)	(1)	(White)	(11)	(12)
(13)	(2)	(White)	(12)	(22)
(13)	(3)	(White)	(11)	(22)
(13)	(4)	(White)	(12)	(12)
13	5	Red	S2	9
13	6	Red	S2	8
13	7	Red	S2	2
13	8	Red	S2	1
13	9	Red	S2	5

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
13	10	Red	S2	4
13	11	Red	S2	6
13	12	Red	S2	7
13	17	Red	S2	3
13	18	Brown	S3	1
13	19	Brown	S3	5
13	20	Brown	S3	4
13	21	Brown	S3	6
13	22	Brown	S3	7
13	23	Brown	S3	3
13	24	Brown	S3	8
13	25	Brown	S3	9
13	27	Brown	S3	2
(13)	(29)	(White)	(11)	(13)
(13)	(30)	(White)	(12)	(15)
(13)	(31)	(White)	(11)	(15)
(13)	(32)	(White)	(12)	(13)
14	1		N/C	
14	2	White	15	24
(14)	(2)	(White)	(12)	(18)
14	4	White	15	18
(14)	(4)	(White)	(12)	(23)
(14)	(6)	(White)	(10)	(6)

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
(14)	(7)	(White)	(10)	(3)
(14)	(8)	(Yellow)	(12)	(20)
(14)	(9)	(Yellow)	(12)	(11)
(14)	(10)	(White)	(12)	(10)
14	11	White	15	31
(14)	(11)	(White)	(12)	(19)
(14)	(15)	(White)	(15)	(9)
14	16	White	15	6
(14)	(16)	(White)	(12)	(14)
14	17	White	15	12
(14)	(17)	(White)	(12)	(17)
14	19	White	19	32
14	20	White	19	18
14	21	White	17	26
14	22	White	17	15
14	23	White	19	14
14	30	White	S7	
15	1	White	18	26
15	2	White	19	24
15	3	Green	S1	1
15	3	White	23	10
15	4	Green	S1	4
15	4	White	23	12
15	5	Green	S1	2

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
15	5	White	23	9
(15)	(6)	(White)	(14)	(16)
15	7	Green	S1	3
15	7	White	23	11
15	8	White	17	5
15	9	Green	S1	5
15	9	White	23	14
15	10	Green	S1	8
15	10	White	25	13
15	11	Green	S1	6
15	11	White	23	13
(15)	(12)	(White)	(14)	(17)
15	13	Green	S1	7
15	13	White	23	15
15	14	White	17	8
15	15	Green	S1	9
15	15	White	24	10
15	16	Green	S1	12
15	16	White	24	12
15	17	Green	S1	10
15	17	White	24	9
(15)	(18)	(White)	(14)	(4)
15	19	Green	S1	11
15	19	White	24	11
15	20	White	17	7

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
15	21	Green	S1	13
15	21	White	24	14
15	22	Green	S1	16
15	22	White	25	12
15	23	Green	S1	14
15	23	White	24	13
(15)	(24)	(White)	(14)	(2)
15	25	Green	S1	15
15	25	White	24	15
15	26	White	17	6
15	27	Green	S1	17
15	27	White	25	8
15	29	Green	S1	20
15	29	White	25	11
15	29	White	18	30
15	30	Green	S1	18
15	30	White	25	9
15	31	White	17	10
(15)	(31)	(White)	(14)	(11)
15	32	Green	S1	19
15	32	White	25	10
16	1	Bus	17	1
16	2	Bus	17	2

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
16	3	Bus	17	3
16	4	Bus	17	4
(16)	(5)	(White)	(12)	(16)
(16)	(6)	(White)	(11)	(21)
(16)	(7)	(White)	(11)	(16)
(16)	(8)	(White)	(12)	(21)
16	9	White	22	44
16	10	White	21	44
16	11	White	21	45
16	12	White	22	45
16	13	White	22	46
16	14	White	22	43
16	15	White	21	43
16	16	White	21	46
16	19	Bus	17	19
16	20	White	21	1
16	21	White	21	39
16	22	White	22	1
16	23	White	22	32
16	24	White	22	42
16	25	White	22	39
16	26	White	21	32
16	27	White	21	42
16	29	Bus	17	29

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
16	30	Bus	17	30
16	31	Bus	17	31
16	32	Bus	17	32
(17)	(1)	(Bus)	(16)	(1)
(17)	(2)	(Bus)	(16)	(2)
(17)	(3)	(Bus)	(16)	(3)
(17)	(4)	(Bus)	(16)	(4)
(17)	(5)	(White)	(15)	(8)
(17)	(6)	(White)	(15)	(26)
(17)	(7)	(White)	(15)	(20)
(17)	(8)	(White)	(15)	(14)
17	9	Green	S1	21
17	9	White	18	29
(17)	(10)	(White)	(15)	(31)
17	14	White		
(17)	(15)	(White)	(14)	(22)
17	18	White	19	13
(17)	(19)	(Bus)	(16)	(19)
(17)	(26)	(White)	(14)	(21)
17	27	White	19	12
(17)	(29)	(Bus)	(16)	(29)
(17)	(30)	(Bus)	(16)	(30)
(17)	(31)	(Bus)	(16)	(31)
(17)	(32)	(Bus)	(16)	(32)

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
18	2	White	J1	29
18	3	White	19	4
18	4		J1	30
18	5		S4	2-3
18	6		S4	1-3
18	8		S4	3-3
18	12		S4	1-P
18	14		S5	NO A
18	16		S6	NO A
18	17		S4	3-P
18	18		S4	2-P
18	19		S6	L A
18	20		S5	L A
(18)	(23)	(White)	(10)	(25)
18	25		S4	4-3
(18)	(26)	(White)	(15)	(1)
(18)	(29)	(White)	(17)	(9)
(18)	(30)	(White)	(15)	(29)
18	31		S4	5-P
18	32		S4	4-P
19	1		J1	54
19	2	White	19	29
19	3		S4	6-3

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
19	4		S4	7-3
(19)	(4)	(White)	(18)	(3)
(19)	(8)	(White)	(10)	(4)
(19)	(9)	(White)	(10)	(5)
(19)	(10)	(Yellow)	(11)	(20)
(19)	(11)	(Yellow)	(11)	(11)
(19)	(12)	(White)	(17)	(27)
(19)	(14)	(White)	(14)	(23)
19	15	Brown	J1	25
19	16	Red	J1	27
19	16	Red	23	1
19	17		J2	47
(19)	(18)	(White)	(14)	(20)
19	20		L1	A
19	21		L2	A
19	22		S4	7-P
19	23	Yellow	J1	24
(19)	(24)	(White)	(15)	(2)
(19)	(29)	(White)	(19)	(2)
(19)	(30)	(White)	(10)	(13)
19	31	White	S4	8-P
(19)	(32)	(White)	(14)	(19)
(20)	(2)	(Green)	(5)	(2)
(20)	(3)	(Green)	(10)	(2)

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
(20)	(4)	(Green)	(4)	(31)
(20)	(5)	(Green)	(9)	(31)
(20)	(6)	(Green)	(4)	(2)
(20)	(7)	(Green)	(9)	(2)
(20)	(8)	(Green)	(3)	(31)
(20)	(9)	(Green)	(8)	(31)
(20)	(10)	(Green)	(3)	(2)
(20)	(11)	(Green)	(8)	(2)
(20)	(12)	(Green)	(2)	(31)
(20)	(13)	(Green)	(7)	(31)
(20)	(14)	(Green)	(2)	(2)
(20)	(15)	(Green)	(7)	(2)
(20)	(16)	(Green)	(1)	(31)
(20)	(17)	(Green)	(6)	(31)
(20)	(18)	(Green)	(1)	(2)
(20)	(19)	(Green)	(6)	(2)
(20)	(20)	(Green)	(5)	(31)
(20)	(21)	(Green)	(10)	(31)
20	23	Violet	J2	11
20	24	Violet	J2	12
20	25	Violet	J2	36
20	26	Violet	J2	37
20	28	Violet	J2	13
20	29	Violet	J2	14
20	31	Violet	J2	38
20	32	Violet	J2	39

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
(21)	(1)	(White)	(16)	(20)
21	2	Yellow	S3	1
21	3	Yellow	S3	2
21	4	Yellow	S3	3
21	5	Yellow	S3	4
21	6	Yellow	S3	5
21	7	Yellow	S3	6
21	8	Yellow	S3	7
21	9	Yellow	S3	8
21	10	Yellow	S3	9
21	11	Yellow	S3	10
21	12	Yellow	S3	12
21	13	Yellow	S3	14
21	14	Yellow	S3	15
21	15	Yellow	S3	16
21	16	Yellow	S3	18
21	17	Yellow	S3	20
21	18	Yellow	S3	21
21	19	Yellow	S3	24
21	20	Yellow	S3	25
21	21	Yellow	S3	27
21	22	Yellow	S3	28
21	23	Yellow	S3	30
21	24	Yellow	S3	32
21	25	Yellow	S3	35
21	26	Yellow	S3	36

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
21	27	Yellow	S3	40
21	28	Yellow	S3	42
21	29	Yellow	S3	45
21	30	Yellow	S3	48
21	31	Yellow	S3	49
(21)	(32)	(White)	(16)	(26)
21	33	Yellow	S3	54
21	34	Yellow	S3	56
21	35	Yellow	S3	63
21	36	Yellow	S3	64
21	37	Yellow	S3	72
21	38	Yellow	S3	81
(21)	(39)	(White)	(16)	(21)
(21)	(42)	(White)	(16)	(27)
(21)	(43)	(White)	(16)	(15)
(21)	(44)	(White)	(16)	(10)
(21)	(45)	(White)	(16)	(11)
(21)	(46)	(White)	(16)	(16)
21	47	Bus	28	47
21	47	Black	Power Supply	-Out
(22)	(1)	(White)	(16)	(22)
22	2	Blue	S2	1
22	3	Blue	S2	2

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
22	4	Blue	S2	3
22	5	Blue	S2	4
22	6	Blue	S2	5
22	7	Blue	S2	6
22	8	Blue	S2	7
22	9	Blue	S2	8
22	10	Blue	S2	9
22	11	Blue	S2	10
22	12	Blue	S2	12
22	13	Blue	S2	14
22	14	Blue	S2	15
22	15	Blue	S2	16
22	16	Blue	S2	18
22	17	Blue	S2	20
22	18	Blue	S2	21
22	19	Blue	S2	24
22	20	Blue	S2	25
22	21	Blue	S2	27
22	22	Blue	S2	28
22	23	Blue	S2	30
22	24	Blue	S2	32
22	25	Blue	S2	35
22	26	Blue	S2	36
22	27	Blue	S2	40
22	28	Blue	S2	42
22	29	Blue	S2	45

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
22	30	Blue	S2	48
22	31	Blue	S2	49
(22)	(32)	(White)	(16)	(23)
22	33	Blue	S2	54
22	34	Blue	S2	56
22	35	Blue	S2	63
22	36	Blue	S2	64
22	37	Blue	S2	72
22	38	Blue	S2	81
(22)	(39)	(White)	(16)	(25)
(22)	(42)	(White)	(16)	(24)
(22)	(43)	(White)	(16)	(14)
(22)	(44)	(White)	(16)	(9)
(22)	(45)	(White)	(16)	(12)
(22)	(46)	(White)	(16)	(13)
(22)	(47)	(Bus)	(21)	(47)
22	47	Bus	23	47
(23)	(1) (22V)	(Red)	(19)	(16)
23	1	Bus	24	1
23	2	Violet	J2	28
23	3	Violet	J2	4
23	4	Violet	J2	3
23	5	Violet	J2	27
23	6	Violet	J2	26

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
23	7	Violet	J2	2
23	8	Violet	J2	1
(23)	(9)	(White)	(15)	(5)
(23)	(10)	(White)	(15)	(3)
(23)	(11)	(White)	(15)	(7)
(23)	(12)	(White)	(15)	(4)
(23)	(13)	(White)	(15)	(11)
(23)	(14)	(White)	(15)	(9)
(23)	(15)	(White)	(15)	(13)
23	16	Violet	V1	12
23	17	Red	S1	3
23	18	Red	S1	2
23	19	Red	S1	4
23	20	Red	S1	1
23	21	Violet	V1	4
23	22	Violet	V1	5
23	23	Violet	V1	3
23	24	Violet	V1	13
23	25	Violet	V1	9
23	26	Violet	V1	10
23	27	Violet	V1	7
23	28	Violet	V1	6
23	29	Violet	V1	11
23	30 (55V)	Bus	24	30
23	31	Black	V2	12

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
23	32	Red	S1	7
23	33	Red	S1	6
23	34	Red	S1	8
23	35	Red	S1	5
23	36	Black	V2	4
23	37	Black	V2	5
23	38 (5V)	Red	Power Supply	+ Out
23	38	Bus	24	38
23	40	Black	V2	3
23	41	Black	V2	13
23	42	Black	V2	9
23	43	Black	V2	10
23	44	Black	V2	7
23	45	Black	V2	6
23	46	Black	V2	11
(23)	(47) (Com)	(Bus)	(22)	(47)
23	47	Bus	24	47
(24)	(1) (22V)	(Bus)	(23)	(1)
24	1	Bus	25	1
24	2	Violet	J2	32
24	3	Violet	J2	8
24	4	Violet	J2	7
24	5	Violet	J2	31
24	6	Violet	J2	30
24	7	Violet	J2	6

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
24	8	Violet	J2	5
(24)	(9)	(White)	(15)	(17)
(24)	(10)	(White)	(15)	(15)
(24)	(11)	(White)	(15)	(19)
(24)	(12)	(White)	(15)	(16)
(24)	(13)	(White)	(15)	(23)
(24)	(14)	(White)	(15)	(21)
(24)	(15)	(White)	(15)	(25)
(24)	(16)	(Orange)	(V3)	(12)
24	17	Red	S1	11
24	18	Red	S1	10
24	19	Red	S1	12
24	20	Red	S1	9
24	21	Orange	V3	4
24	22	Orange	V3	5
24	23	Orange	V3	3
24	24	Orange	V3	13
24	25	Orange	V3	9
24	26	Orange	V3	10
24	27	Orange	V3	7
24	28	Orange	V3	6
24	29	Orange	V3	11
(24)	(30) (55V)	(Bus)	(23)	(30)
24	30	Bus	25	29
24	31	Green	V4	12
24	32	Red	S1	15

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
24	33	Red	S1	14
24	34	Red	S1	16
24	35	Red	S1	13
24	36	Green	V4	4
24	37	Green	V4	5
(24)	(38) (5V)	(Bus)	(23)	(38)
24	38	Bus	25	38
24	40	Green	V4	3
24	41	Green	V4	13
24	42	Green	V4	9
24	43	Green	V4	10
24	44	Green	V4	7
24	45	Green	V4	6
24	46	Green	V4	11
(24)	(47) (Com)	(Bus)	(23)	(47)
24	47	Bus	25	47
(25)	(1) (22V)	(Bus)	(24)	(1)
25	2	Violet	J2	33
25	3	Violet	J2	29
25	4	Violet	J2	35
25	5	Violet	J2	34
25	6	Violet	J2	9
25	7	Violet	J2	10

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
(25)	(8)	(White)	(15)	(27)
(25)	(9)	(White)	(15)	(30)
(25)	(10)	(White)	(15)	(32)
(25)	(11)	(White)	(15)	(29)
(25)	(12)	(White)	(15)	(22)
(25)	(13)	(White)	(15)	(10)
25	14	Red	S1	21
25	15	White	V5	12
25	16	Red	S1	19
25	17	Red	S1	18
25	18	Red	S1	20
25	19	Red	S1	17
25	20	White	V5	4
25	21	White	V5	5
25	22	White	V5	3
25	23	White	V5	13
25	24	White	V5	9
25	25	White	V5	10
25	26	White	V5	7
25	27	White	V5	6
25	28	White	V5	11
(25)	(29) (55V)	(Bus)	(24)	(30)
25	33	Blue	V6	12
25	34	Blue	V6	11

Items In Parentheses Previously Noted

TABLE 3 (cont'd.)

WIRE LIST

PERCENT RECHARGE UNIT

FROM		COLOR	TO	
BOARD	PIN		BOARD	PIN
(25)	(38) (5V)	(Bus)	(24)	(38)
25	39	Bus	V6	10
25	40	Bus	V6	9
25	41	Bus	V6	7
25	42	Bus	V6	6
25	43	Bus	V6	5
25	44	Bus	V6	4
25	45	Bus	V6	3
25	46	Blue	V6	13
(25)	(47) (Com)	(Bus)	(24)	(47)

SCHEMATICS SECTION 5

PARTS LIST

BOARDS 1 THRU 10

PART	DESCRIPTION
1	SN7490N Microcircuit
2	SN7490N Microcircuit
3	SN7490N Microcircuit
4	SN7490N Microcircuit
5	SN7490N Microcircuit
6	SN7400N Microcircuit
7	SN7400N Microcircuit
8	SN7400N Microcircuit
9	SN7400N Microcircuit
10	SN7400N Microcircuit
11	SN7490 Microcircuit
12	SN7490 Microcircuit
13	SN7490 Microcircuit
14	SN7490 Microcircuit
15	SN7490 Microcircuit
16	SN7400 Microcircuit
17	SN7400 Microcircuit
18	SN7400 Microcircuit
19	SN7400 Microcircuit
20	SN7400 Microcircuit
Q1	Transistor 2N4420
Q2	Transistor 2N4420
CR1-CR2	Diode 1N4454
R1	Resistor 3.6k, $\frac{1}{4}$w, 5%
R2	Resistor 6.2k, $\frac{1}{4}$w, 5%
R3	Resistor 24k, $\frac{1}{4}$w, 5%

PARTS LIST

BOARDS 1 THRU 10 (cont'd.)

PART	DESCRIPTION
R4	Resistor 24k, $\frac{1}{4}$w, 5%
R5	Resistor 3.6k, $\frac{1}{4}$w, 5%
R6	Resistor 6.2k, $\frac{1}{4}$ w, 5%
R7	Resistor 24k, $\frac{1}{4}$w, 5%
R8	Resistor 24k, $\frac{1}{4}$w, 5%
C1	Capacitor 6mf, 35V

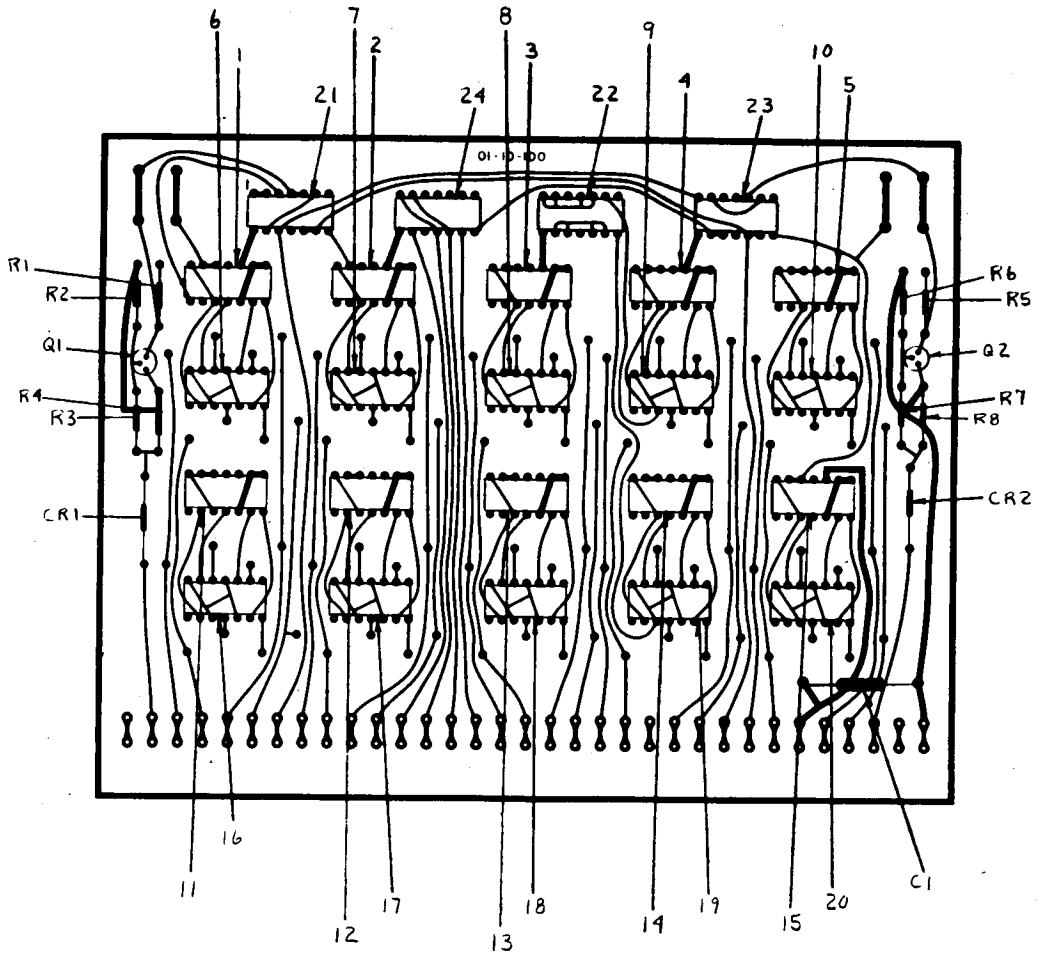

FIGURE 3 ASSEMBLY
BOARDS 1 THRU 10

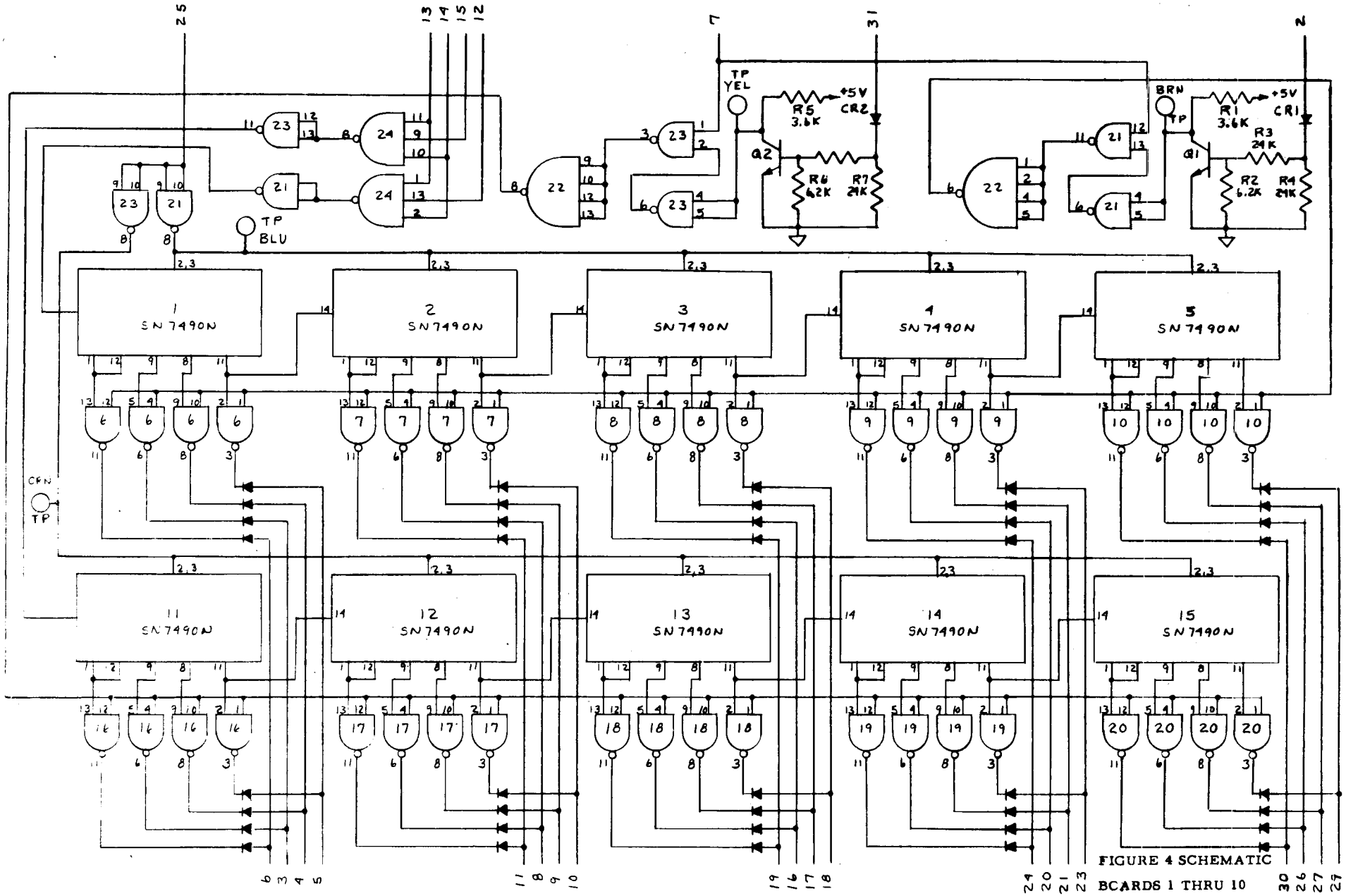

FIGURE 4 SCHEMATIC
BCARDS 1 THRU 10

PARTS LIST

BOARDS 11 AND 12

PART	DESCRIPTION
1	SN5832N Microcircuit
2	SN5832N Microcircuit
3	SN5832N Microcircuit
4	SN5832N Microcircuit
5	SN7454N Microcircuit
6	SN7454N Microcircuit
7	SN7454N Microcircuit
8	SN7454N Microcircuit
9	SN7454N Microcircuit
10	SN7400N Microcircuit
11	SN7400N Microcircuit
12	SN7400N Microcircuit
13	SN7400N Microcircuit
C1	Capacitor, 6mf, 35V

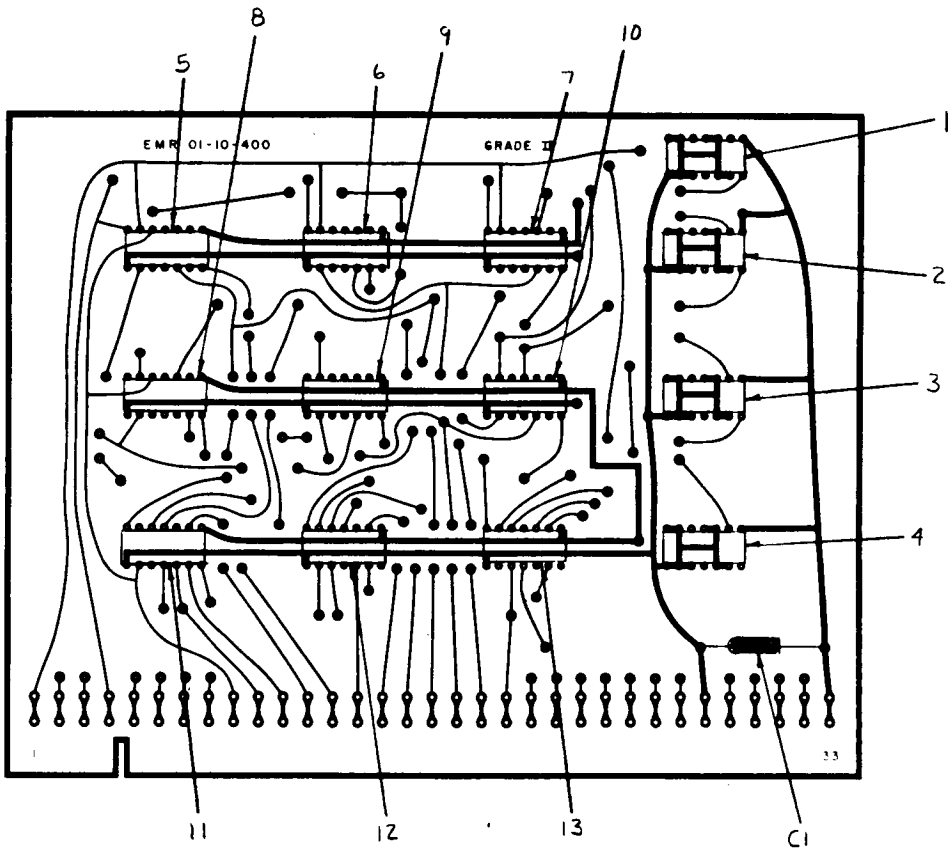

FIGURE 5 ASSEMBLY
BOARDS 11 AND 12

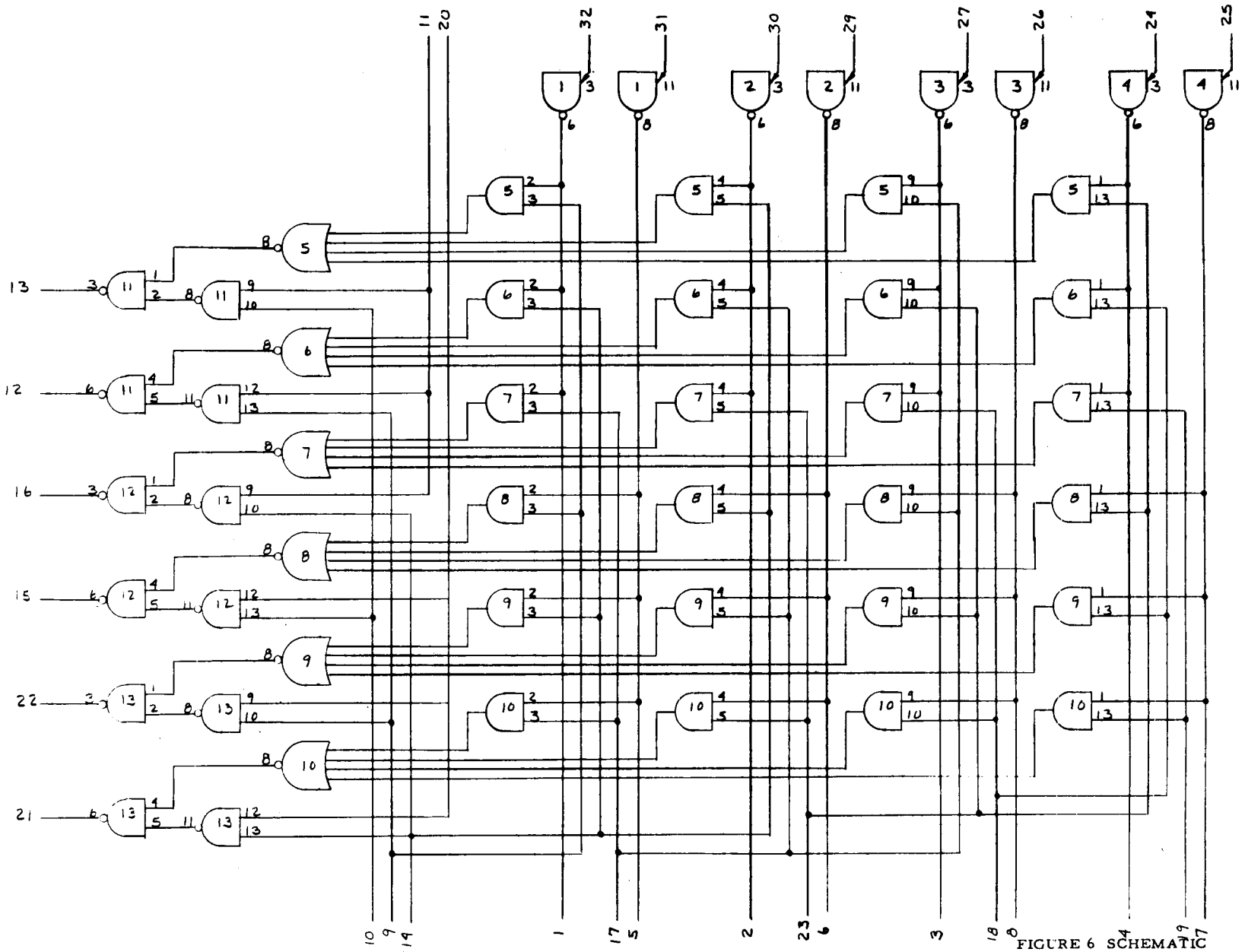

FIGURE 6 SCHEMATIC
BOARDS 11 AND 12

PARTS LIST

BOARD 13

PART	DESCRIPTION
1	SN7441N Microcircuit
2	SN7441N Microcircuit
Q1-Q18	Transistor 2N4423
R1-R18	Resistor 3.6k, $\frac{1}{4}$w, 5%
R19-R36	Resistor 3.6k, $\frac{1}{4}$w, 5%
C1	Capacitor, 6uf, 35V

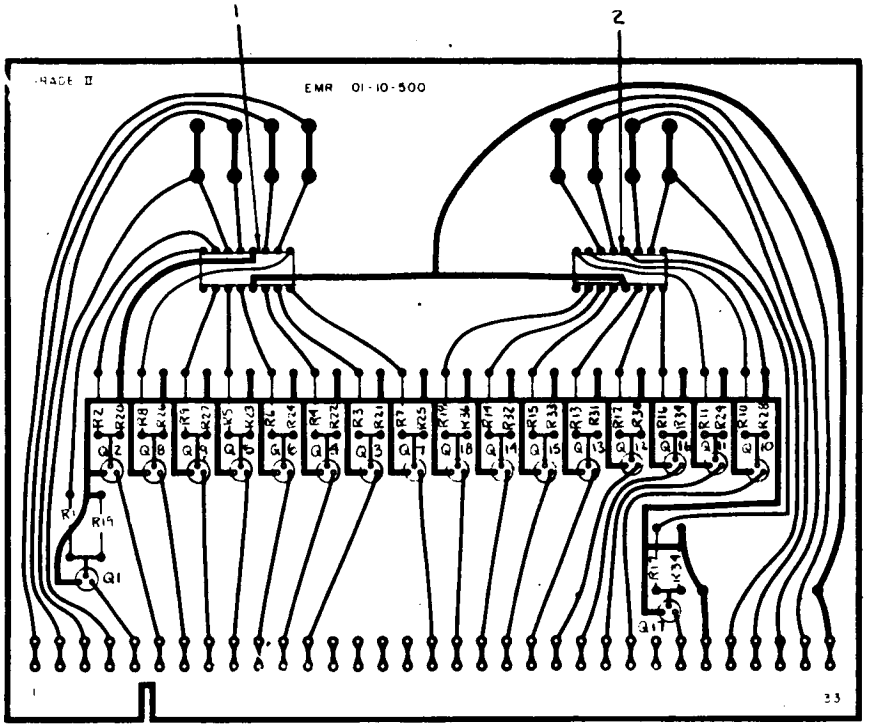

FIGURE 7 ASSEMBLY
BOARD 13

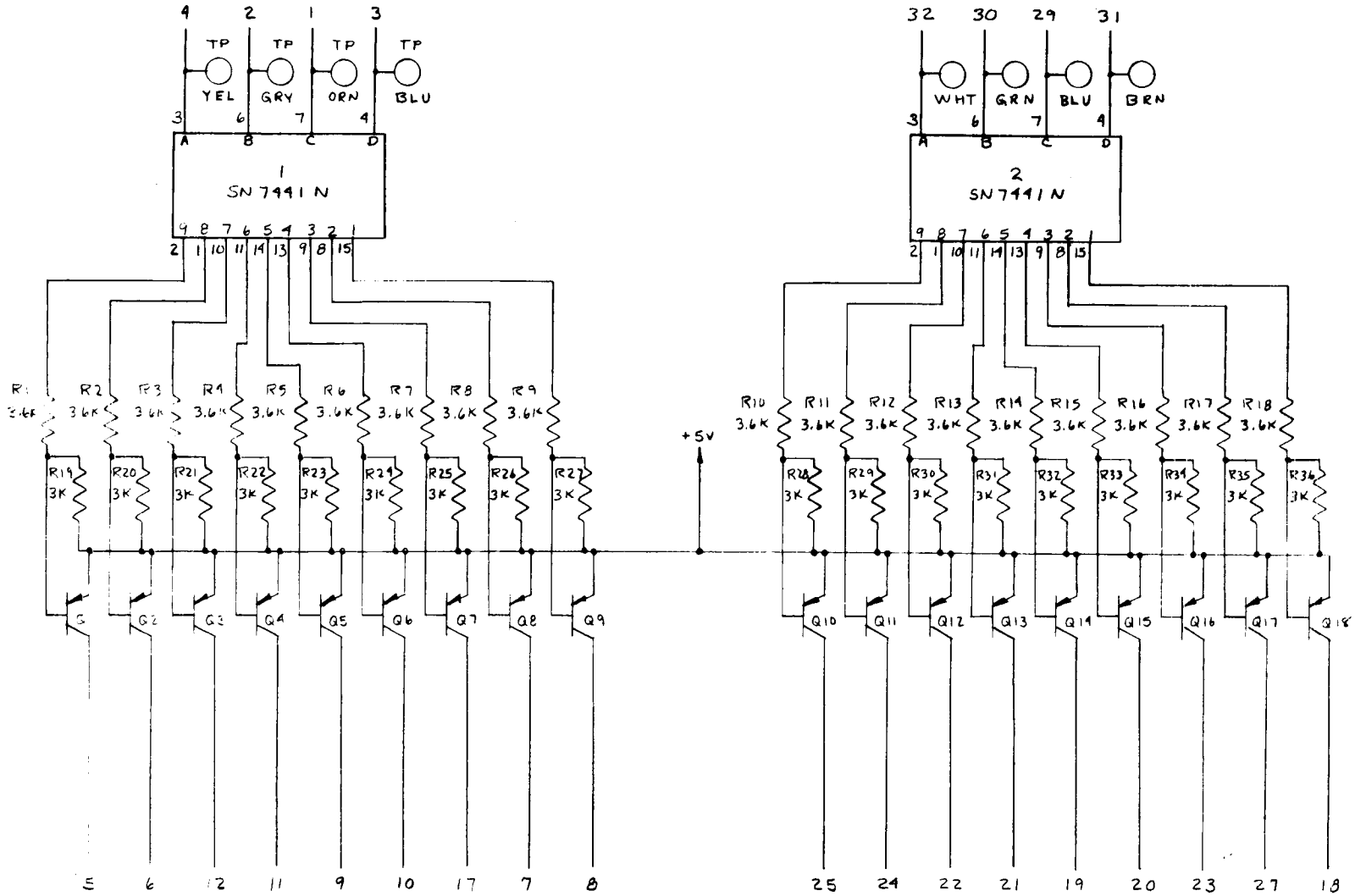

FIGURE 8 SCHEMATIC
BOARD 13

PARTS LIST

BOARD 14

PART	DESCRIPTION
1	SN7473N Microcircuit
2	SN7473N Microcircuit
3	SN7410N Microcircuit
4	SN7410N Microcircuit
5	SN7420N Microcircuit
6	SN7440N Microcircuit
7	SN7440N Microcircuit
8	SN7400N Microcircuit
9	SN7440N Microcircuit
10	SN7440N Microcircuit
11	SN7400N Microcircuit
12	SN5832N Microcircuit
Q1, Q2	2N4423
Q3, Q4	2N4420
R1, R2	Resistor, TBD
R3, R4	Resistor, 200Ω, $\frac{1}{4}$w, 5%
R5, R6	Resistor, TBD
C1, C2	Capacitor, TBD
C3, C4	Capacitor, TBD

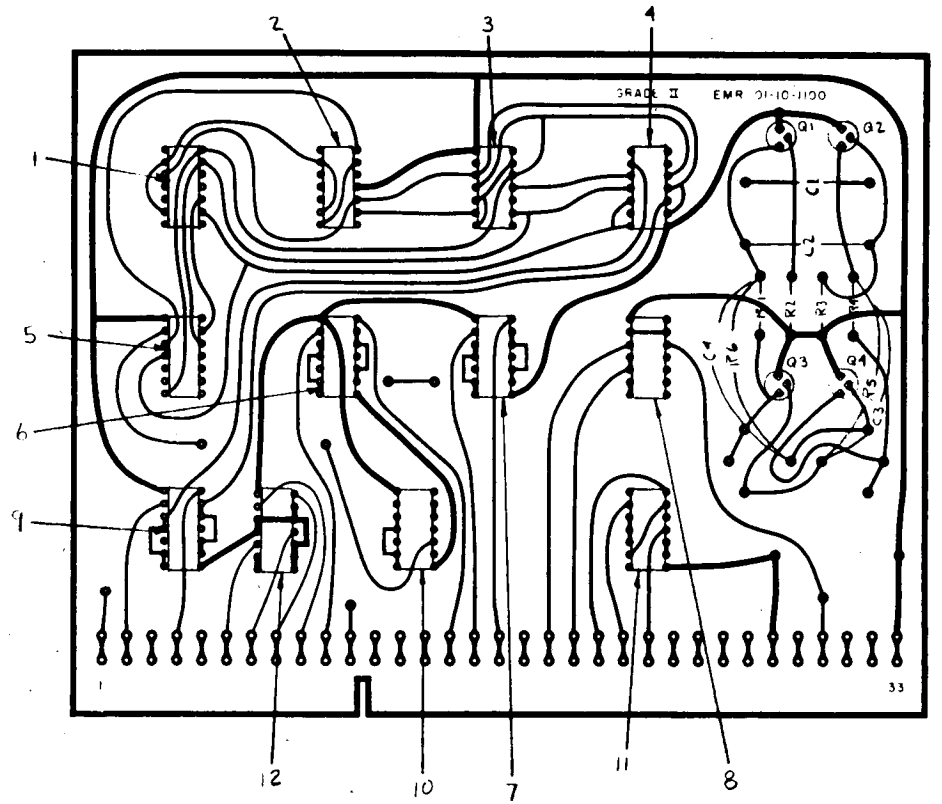

FIGURE 9 ASSEMBLY
BOARD 14

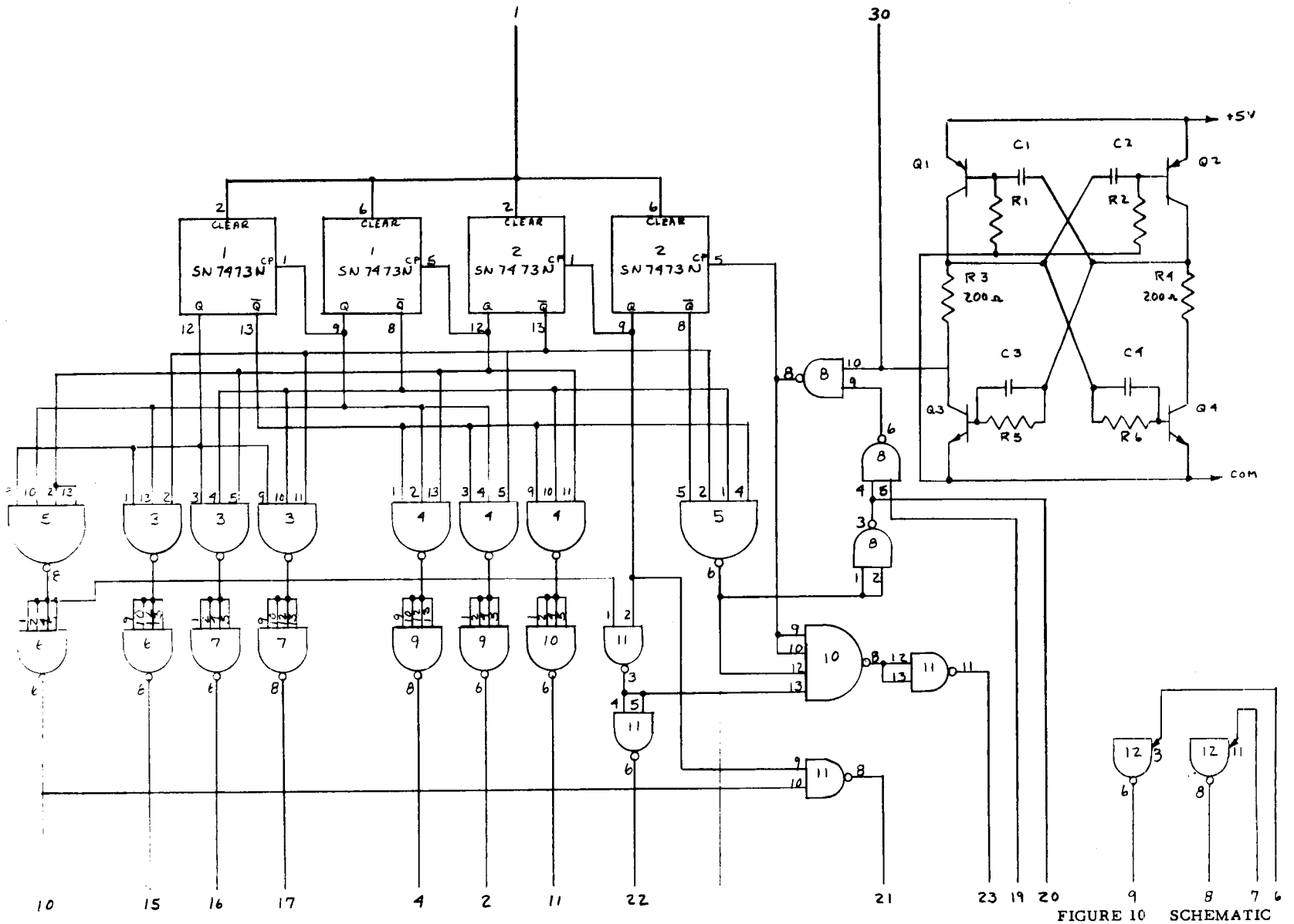

FIGURE 10 SCHEMATIC
BOARD 14

PARTS LIST

BOARD 15

PART	DESCRIPTION
1	SN7430N Microcircuit
2	SN7430N Microcircuit
3	SN7430N Microcircuit
4	SN7430N Microcircuit
5	SN7400N Microcircuit
6	SN7400N Microcircuit
7	SN7400N Microcircuit
8	SN7400N Microcircuit
9	SN7400N Microcircuit
10	SN7490N Microcircuit
11	SN7490N Microcircuit
12	SN7490N Microcircuit
13	SN7490N Microcircuit
14	SN7490N Microcircuit
C1	Capacitor, 6uf, 35V

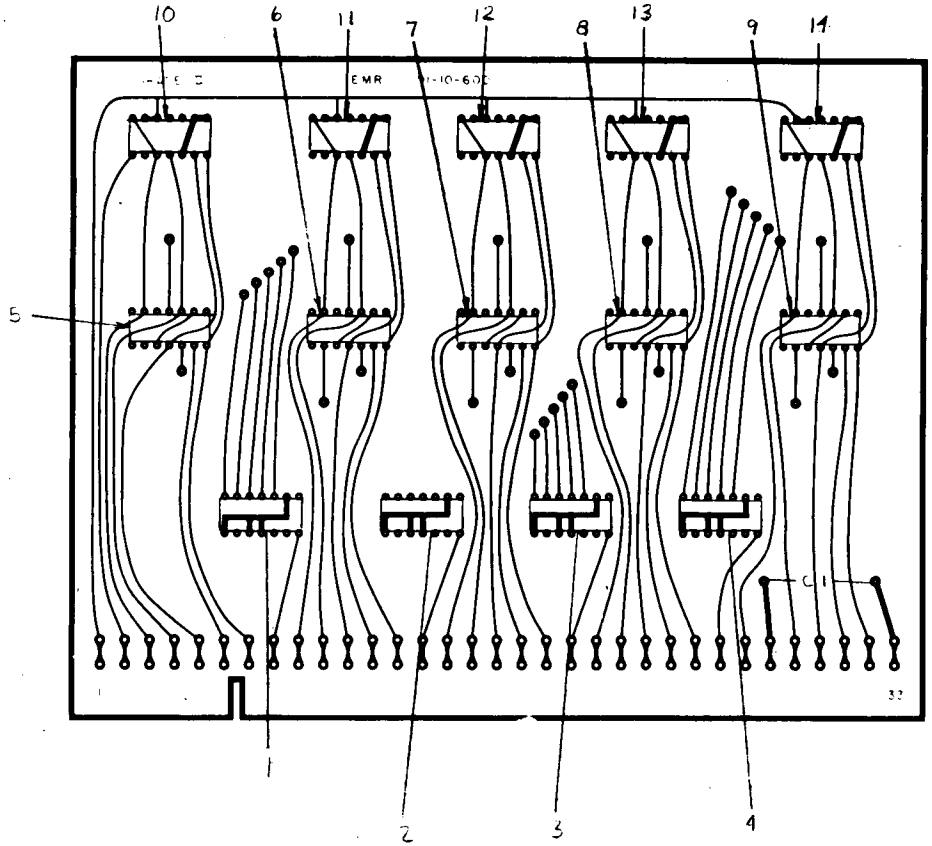

FIGURE 11 ASSEMBLY

CARD 15

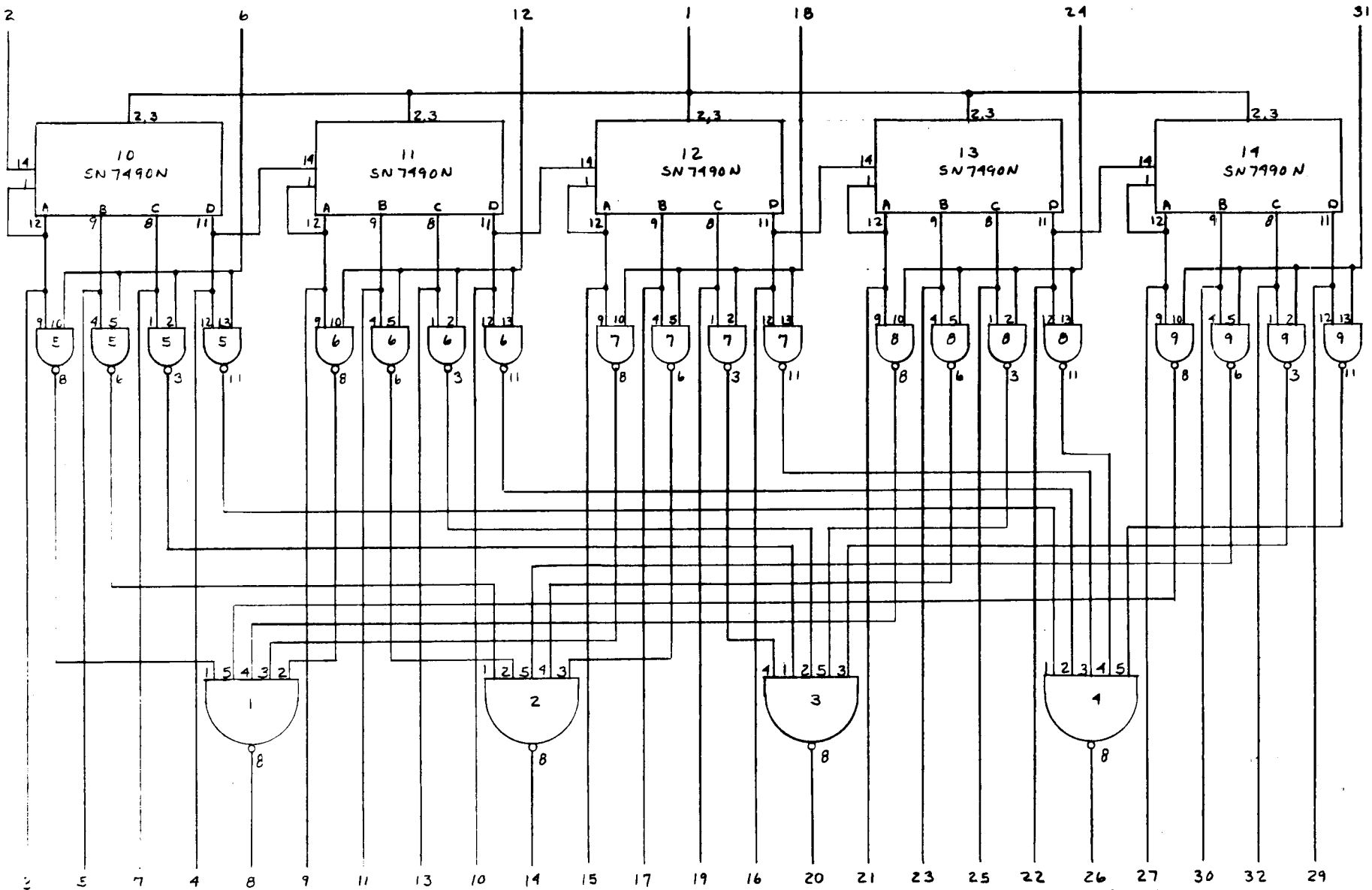

FIGURE 12 SCHEMATIC

BOARD 15

PARTS LIST

BOARD 16

PART	DESCRIPTION
1	SN7483N Microcircuit
2	SN7483N Microcircuit
3	SN7483N Microcircuit
4	SN7400N Microcircuit
5	SN7400N Microcircuit
6	SN7400N Microcircuit
7	SN7483N Microcircuit
8	SN7483N Microcircuit
9	SN7483N Microcircuit
C1	Capacitor

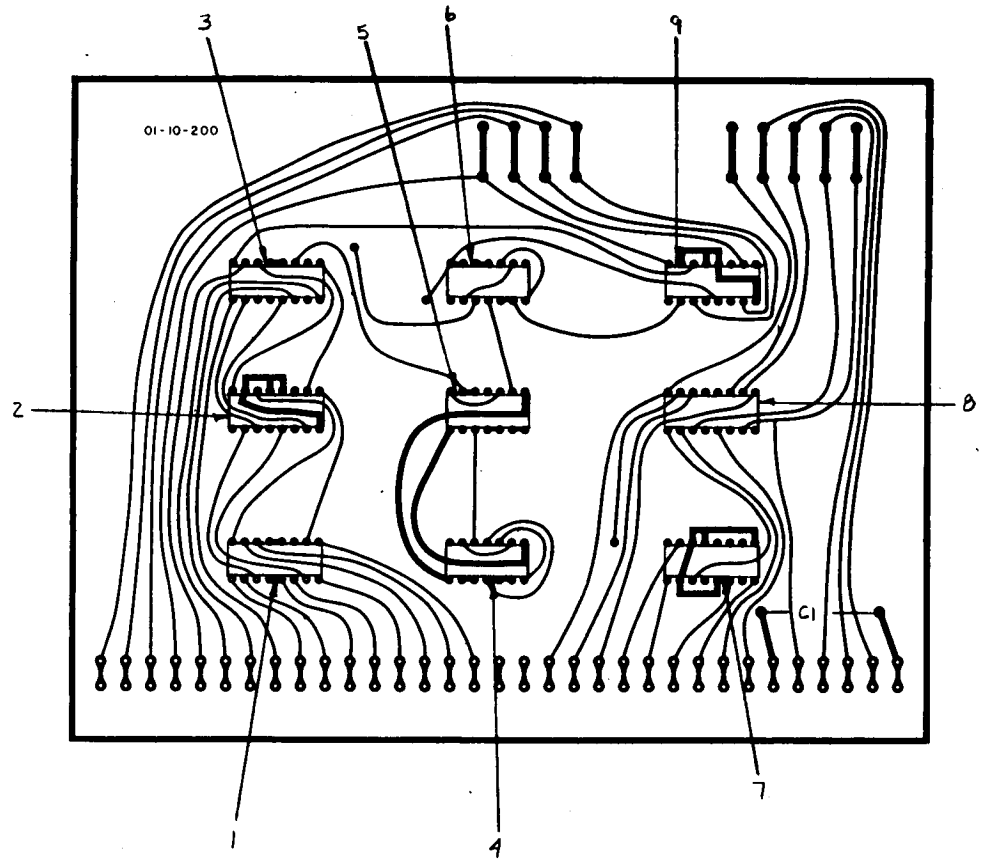

FIGURE 13 ASSEMBLY
BOARD 16

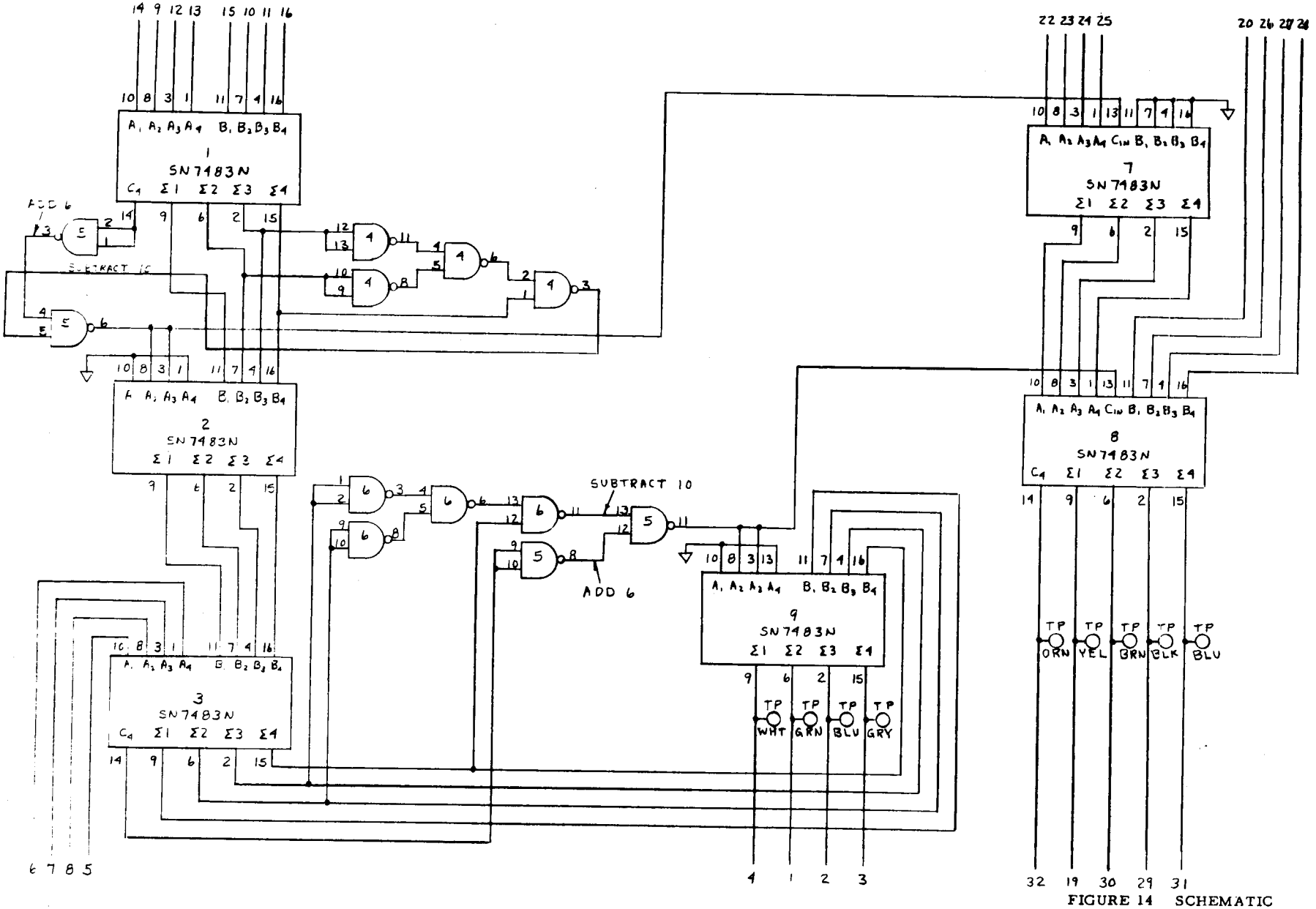

FIGURE 14 SCHEMATIC

BOARD 16

PARTS LIST

BOARD 17

PART	DESCRIPTION
1	SN7400N Microcircuit
2	SN7483N Microcircuit
3	SN7400N Microcircuit
4	SN7400N Microcircuit
5	SN7400N Microcircuit
6	SN7420N Microcircuit
7	SN7483N Microcircuit
8	SN7483N Microcircuit
9	SN7480N Microcircuit
10	SN7473N Microcircuit
11	SN7473N Microcircuit
12	SN7473N Microcircuit
13	SN7400N Microcircuit
14	SN7400N Microcircuit
15	SN7400N Microcircuit
16	SN7400N Microcircuit
17	SN7483N Microcircuit
18	SN7400N Microcircuit
19	SN7430N Microcircuit
20	SN7400N Microcircuit
21	SN7430N Microcircuit
C1	Capacitor

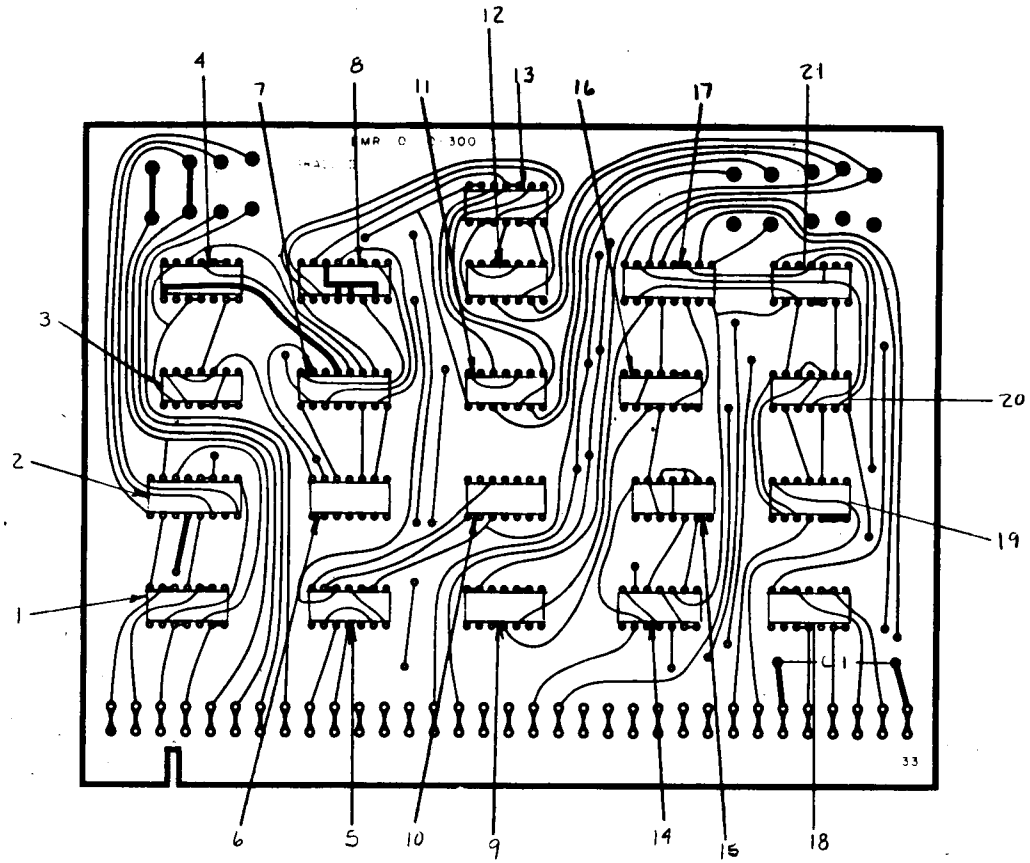

FIGURE 15 ASSEMBLY
BOARD 17

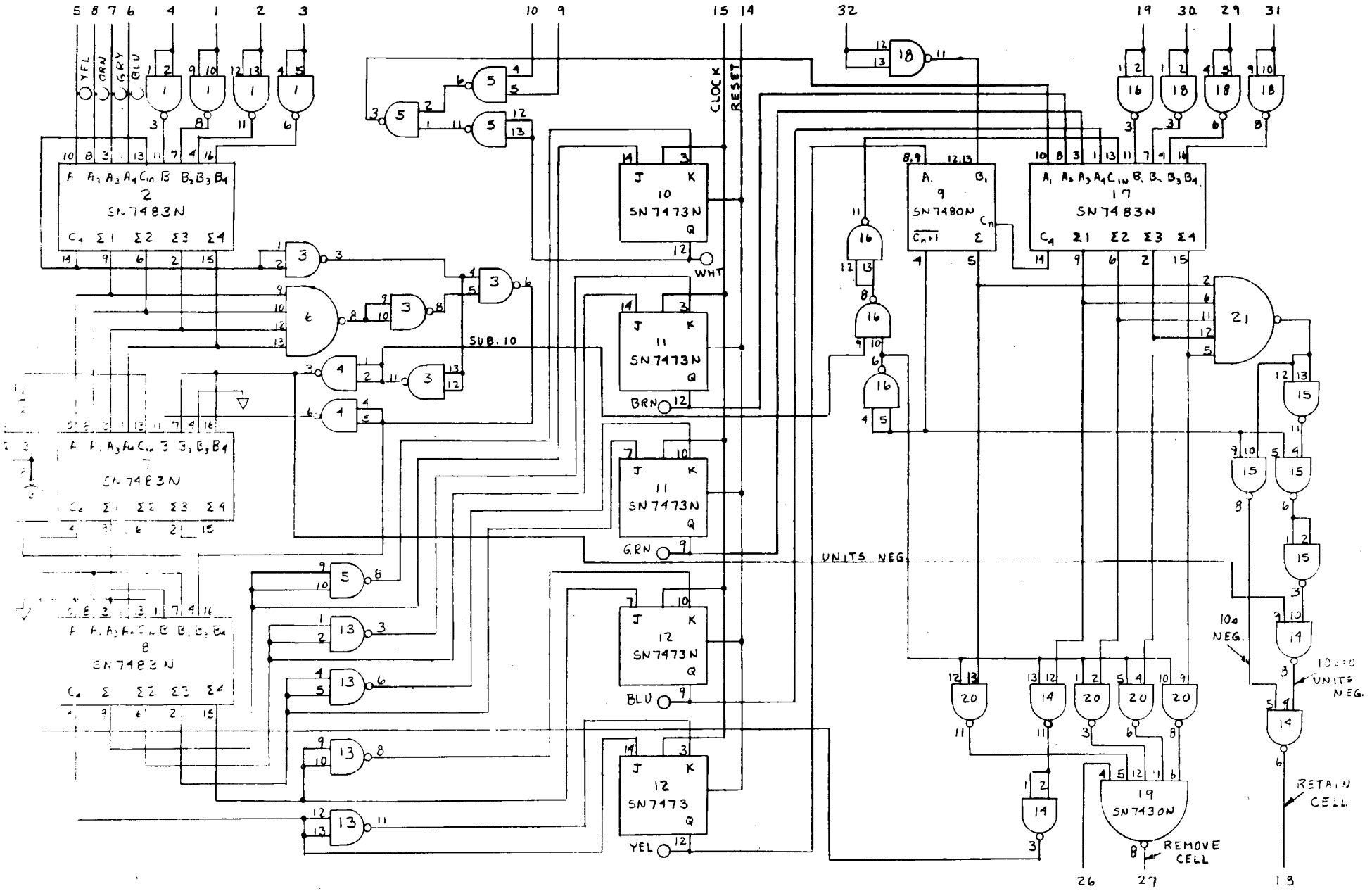

FIGURE 16 SCHEMATIC

BOARD 17

PARTS LIST

BOARD 18

PART	DESCRIPTION
1	SN7400N Microcircuit
2	SN7400N Microcircuit
3	SN7440N Microcircuit
4	SN7410N Microcircuit
5	SN7490N Microcircuit
Q1-Q7	Transistor 2N4420
R1	Resistor, 2.7k, $\frac{1}{4}$w, 5%
R2	Resistor, 2.7k, $\frac{1}{4}$w, 5%
R3	Resistor, 3k, $\frac{1}{4}$w, 5%
R4	Resistor, 51Ω, $\frac{1}{4}$w, 5%
R5	Resistor, 3k, $\frac{1}{4}$w, 5%
R6	Resistor, 3k, $\frac{1}{4}$w, 5%
R7	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R8	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R9	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R10	Resistor, 3k, $\frac{1}{4}$w, 5%
R11	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R12	Resistor, 51Ω, $\frac{1}{4}$w, 5%
R13	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R14	Resistor, 51Ω, $\frac{1}{4}$w, 5%
R15	Resistor, 3k, $\frac{1}{4}$w, 5%
R16	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R17	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R18	Resistor, 3k, $\frac{1}{4}$w, 5%
R19	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R20	Resistor, 51Ω, $\frac{1}{4}$w, 5%

PARTS LIST

BOARD 18 (cont'd.)

PART	DESCRIPTION
R21	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R22	Resistor, 2k, $\frac{1}{4}$w, 5%
R23	Resistor, 2k, $\frac{1}{4}$w, 5%
R24	Resistor, 1k, $\frac{1}{4}$w, 5%
R26	Resistor, 3.6k, $\frac{1}{4}$w, 5%

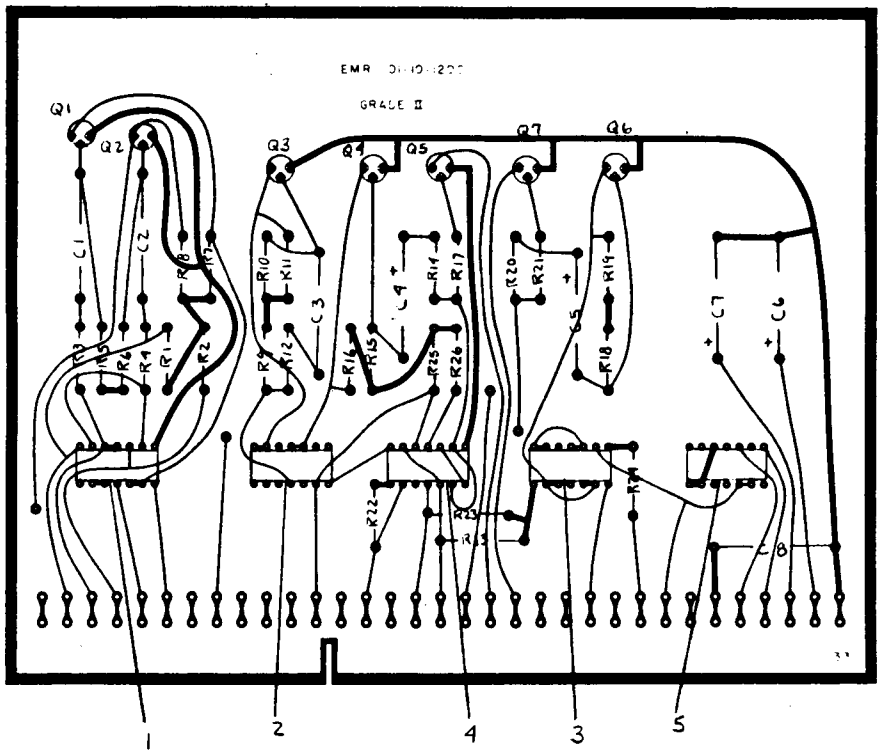

FIGURE 17 ASSEMBLY
BOARD 18

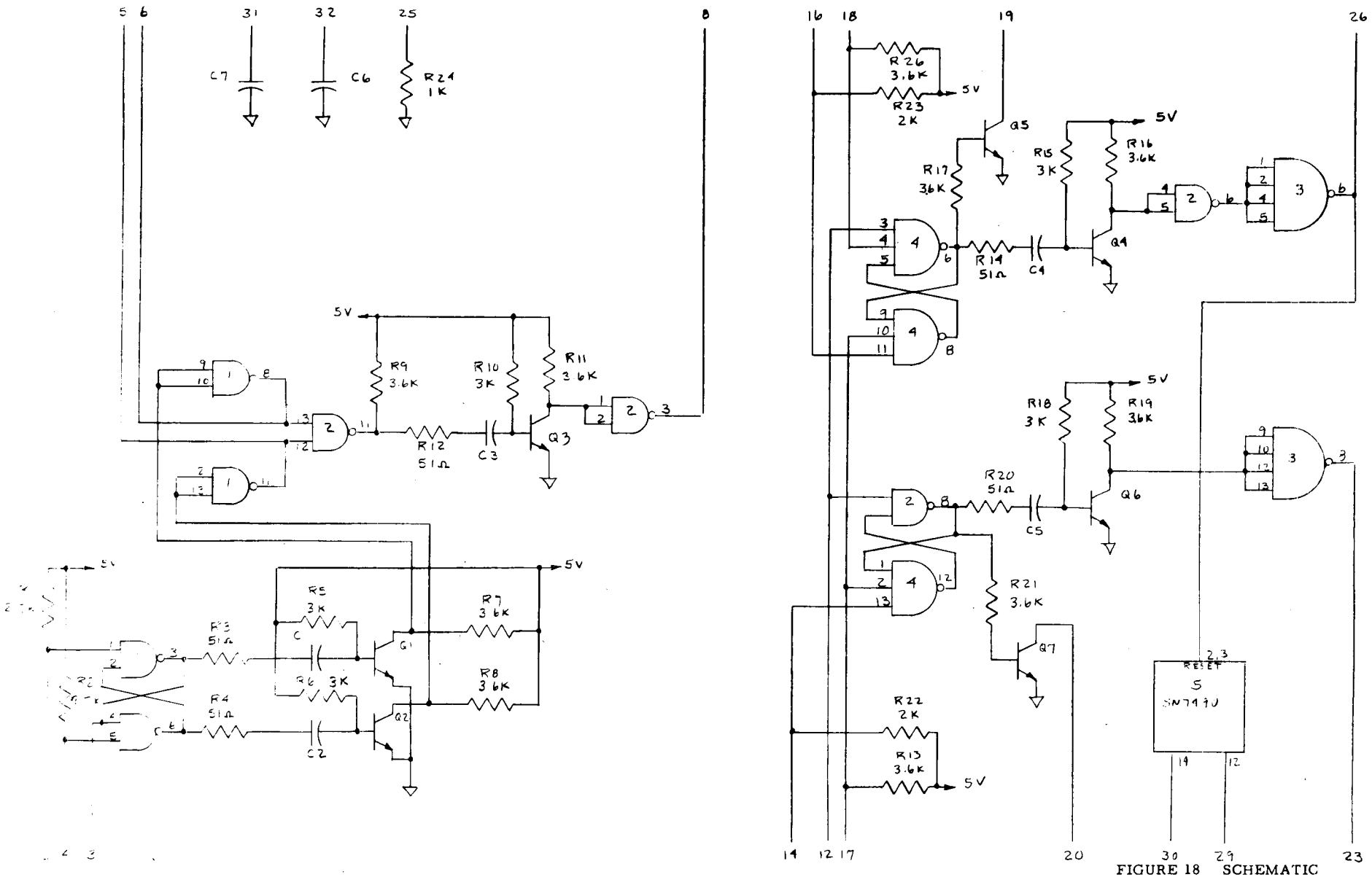

FIGURE 18 SCHEMATIC BOARD 18

PARTS LIST

BOARD 19

PART	DESCRIPTION
1-5	SN7400N Microcircuit
6	SN7451N Microcircuit
7, 8	SN7410N Microcircuit
9	SN7470N Microcircuit
10	SN15832N Microcircuit
C1	Capacitor
C2	Capacitor
C3	Capacitor
C4	Capacitor
C5	Capacitor, 3.3mfb, 15vdc
CR1, CR2	Diode 1N4454
R1	Resistor, 2.7k, $\frac{1}{4}$w, 5%
R2	Resistor, 1k, $\frac{1}{4}$w, 5%
R3	Resistor, 4.3k, $\frac{1}{4}$w, 5%
R4	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R5	Resistor, 2.7k, $\frac{1}{4}$w, 5%
R6	Resistor, 51Ω, $\frac{1}{4}$w, 5%
R7	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R8	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R9	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R10	Resistor
R11	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R12	Resistor
R13	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R14	Resistor, 51Ω, $\frac{1}{4}$w, 5%
R15	Resistor, 6.2k, $\frac{1}{4}$w, 5%

PARTS LIST

BOARD 19 (cont'd.)

PART	DESCRIPTION
R16	Resistor, 470Ω, $\frac{1}{4}$w, 5%
R17	Resistor, 5.6k, $\frac{1}{4}$w, 5%
R18	Resistor, 38Ω, $\frac{1}{4}$w, 5%
R19	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R20	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R21	Resistor, 4.7k, $\frac{1}{4}$w, 5%
R22	Resistor, 3.6k, $\frac{1}{4}$w, 5%
R23	Resistor, 4.7k, $\frac{1}{4}$w, 5%
R24	Resistor
R25	Resistor

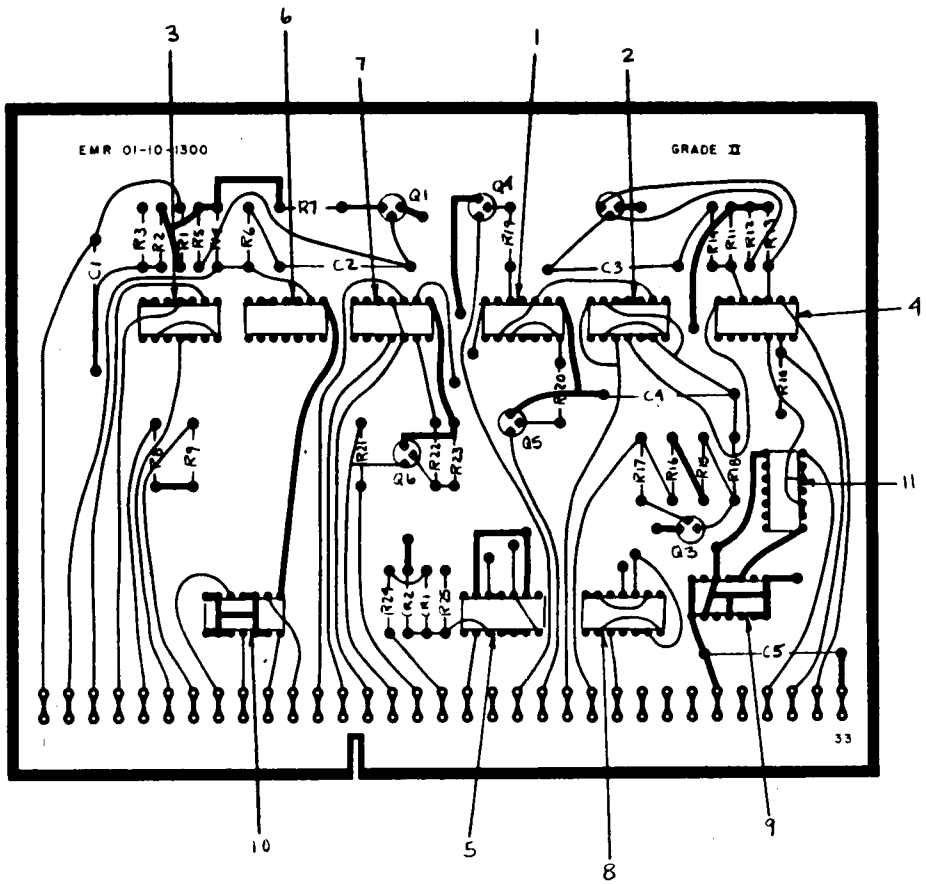

FIGURE 19 ASSEMBLY
BCARD 19

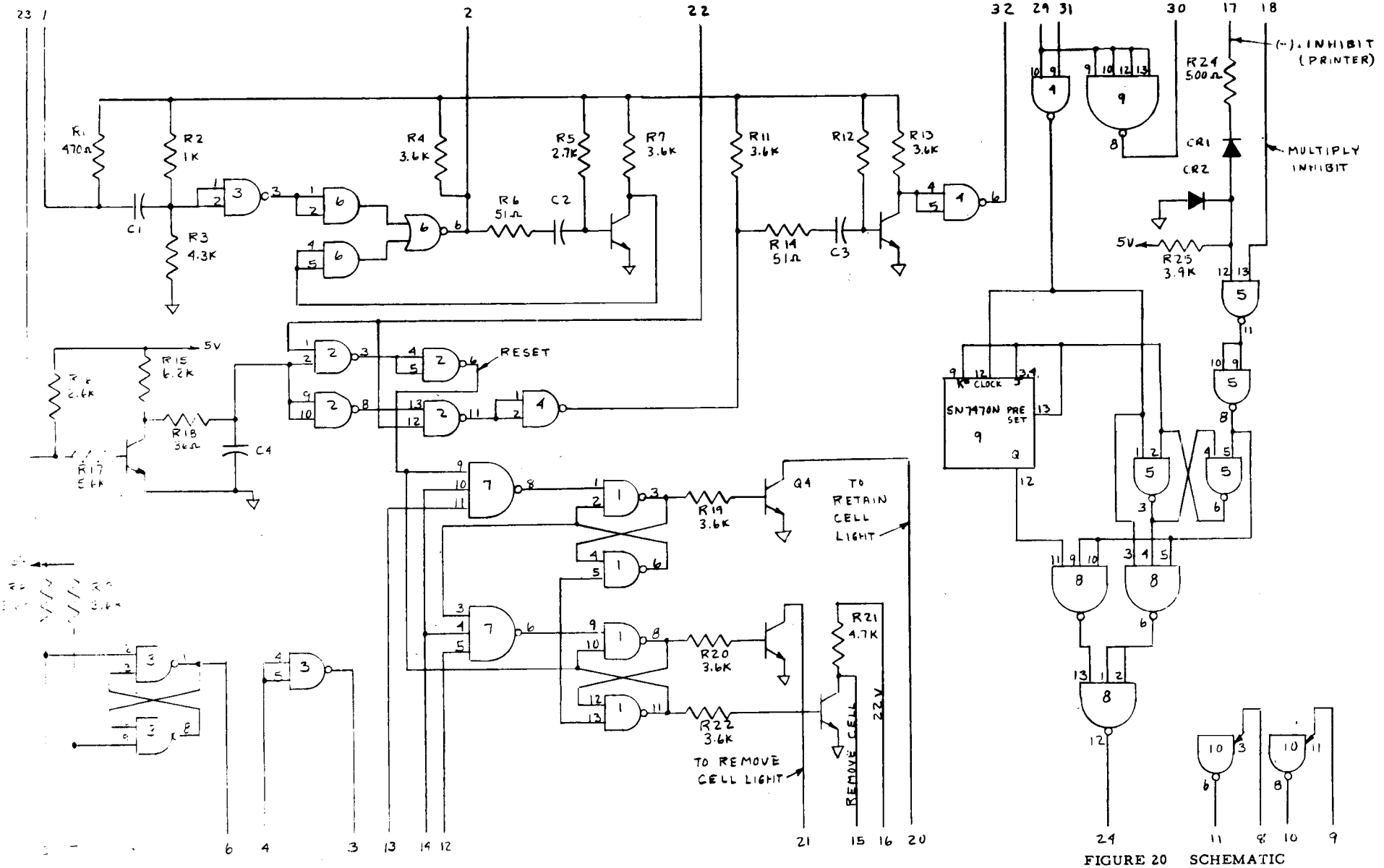

FIGURE 20 SCHEMATIC
BOARD 19

PARTS LIST

BOARD 20

PART	DESCRIPTION
R1-R6	Resistor, 10k, $\frac{1}{4}$w, 5%
CR1-CR52	Diode 1N4454

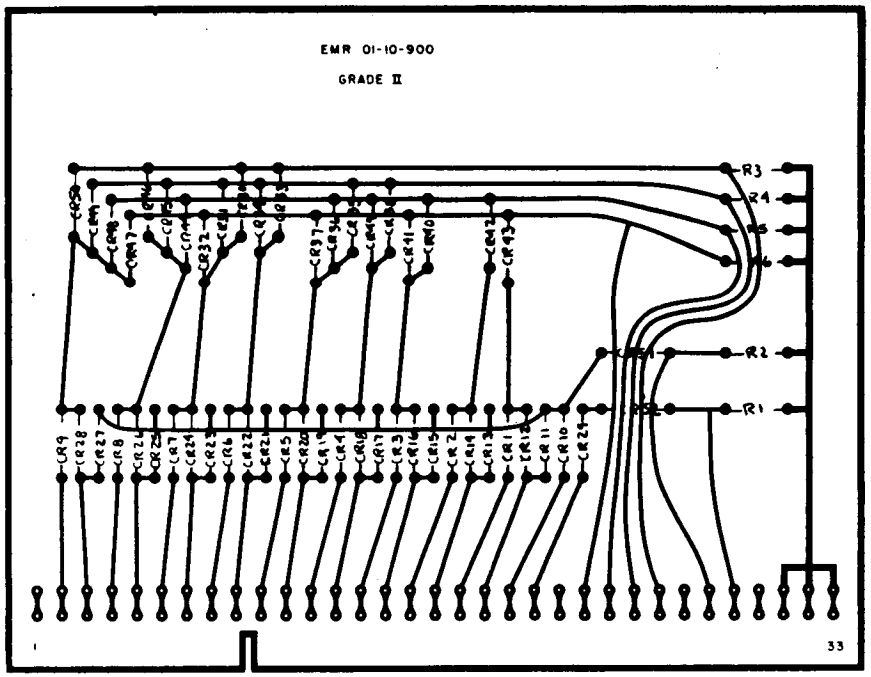

FIGURE 21 ASSEMBLY
BOARD 20

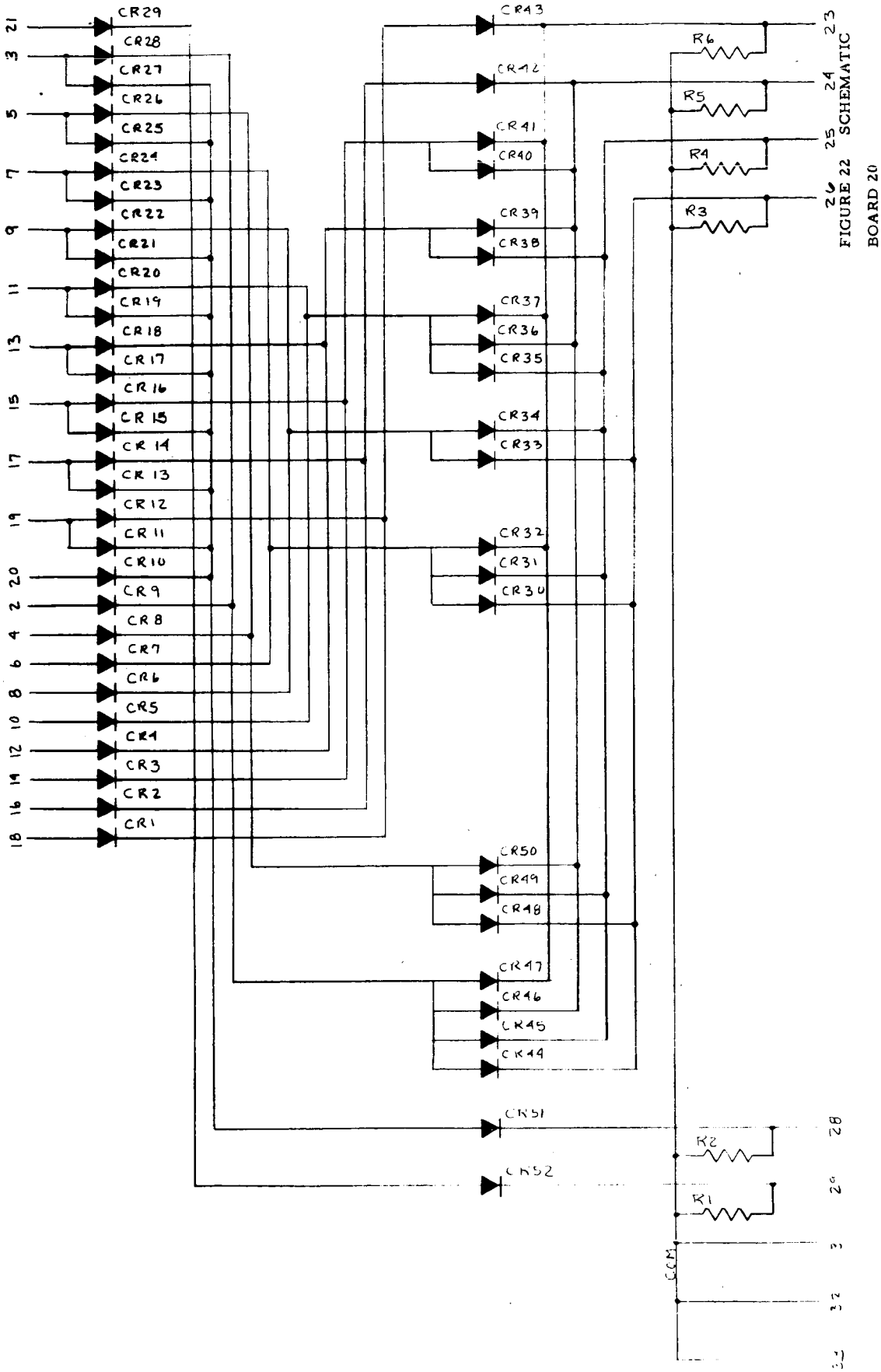

FIGURE 22 SCHEMATIC BOARD 20

PARTS LIST

BOARDS 21 AND 22

PART	DESCRIPTION
R1-R8	Resistor, 390Ω, $\frac{1}{4}$w, 5%
CR1-CR73	Diode 1N4454

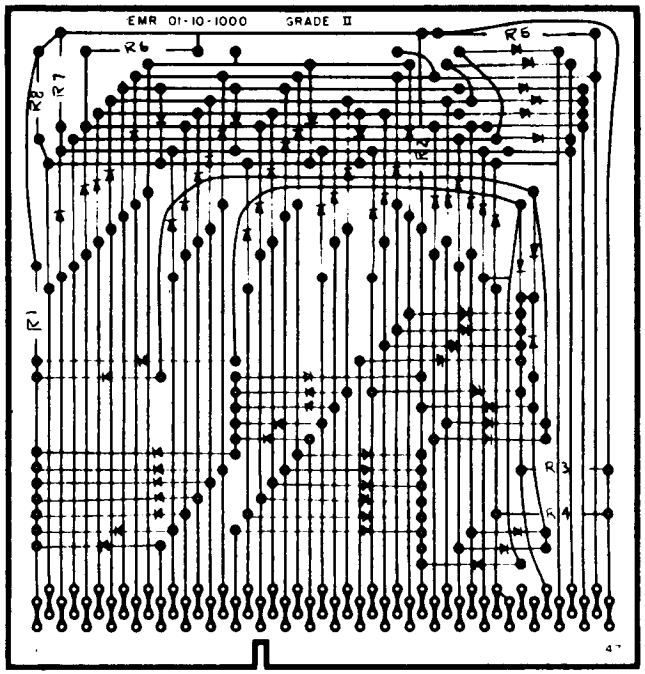

FIGURE 23 ASSEMBLY
BOARDS 21 AND 22

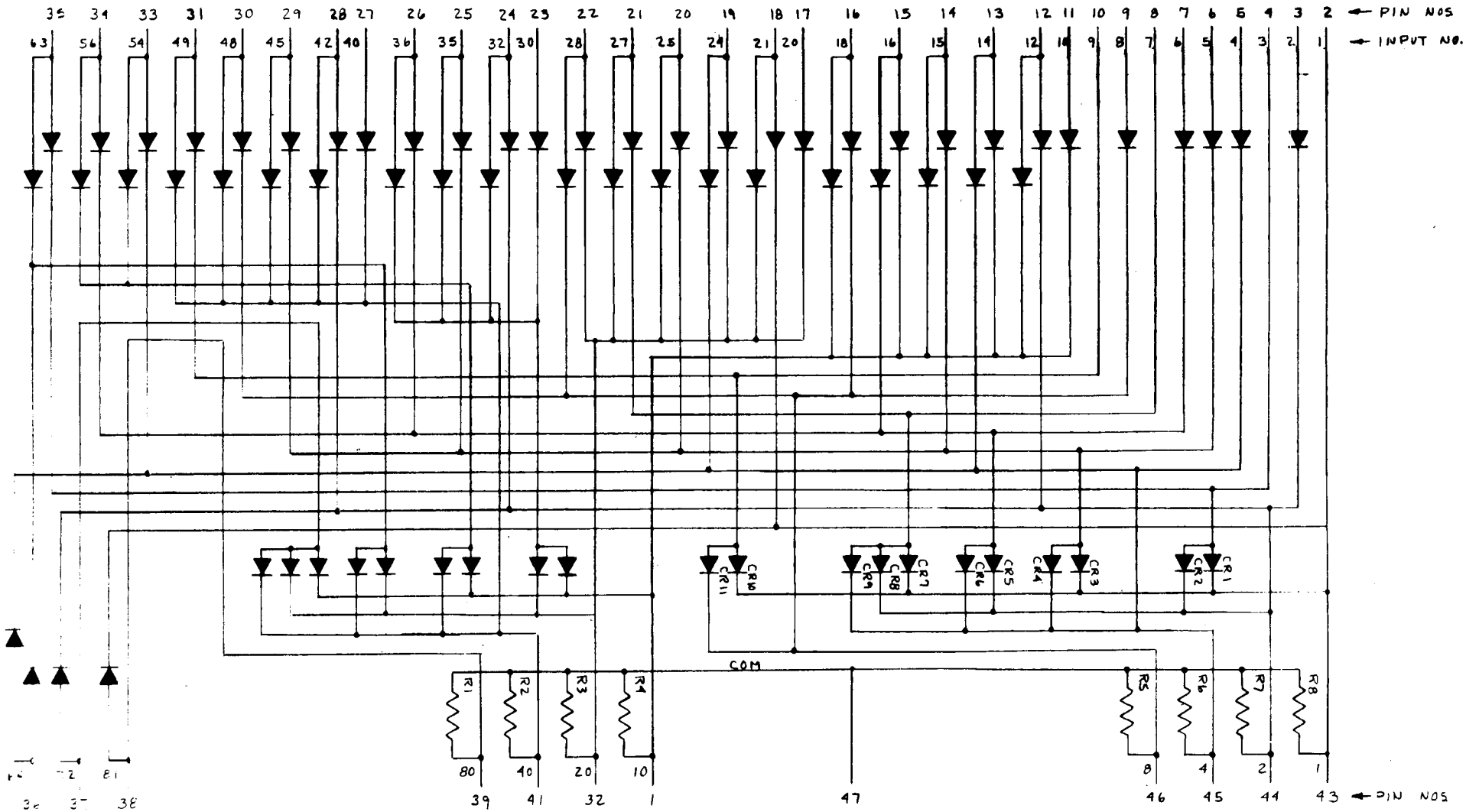

FIGURE 24 SCHEMATIC
BOARDS 21 AND 22

PARTS LIST

BOARDS 23 AND 24

PART	DESCRIPTION
1&2	SN7441N Microcircuit
3&4	SN7400N Microcircuit
C1	Capacitor, 3.3mfd, 15vdc
CR1-CR20	Diode 1N4454
R1, R3, R5, R7, R9, R11&R13	Resistor, 3.3k, $\frac{1}{4}$w, 5%
R2, R4, R6, R8, R10, R12&R14	Resistor, 10k, $\frac{1}{4}$w, 5%
Q1-Q7	Transistor 2N4420

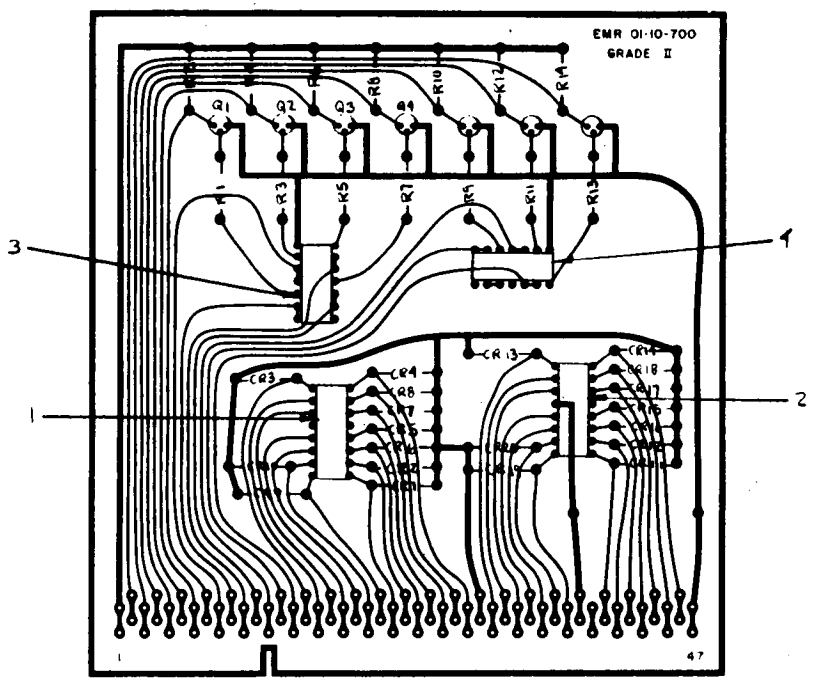

FIGURE 25 ASSEMBLY
BOARDS 23 AND 24

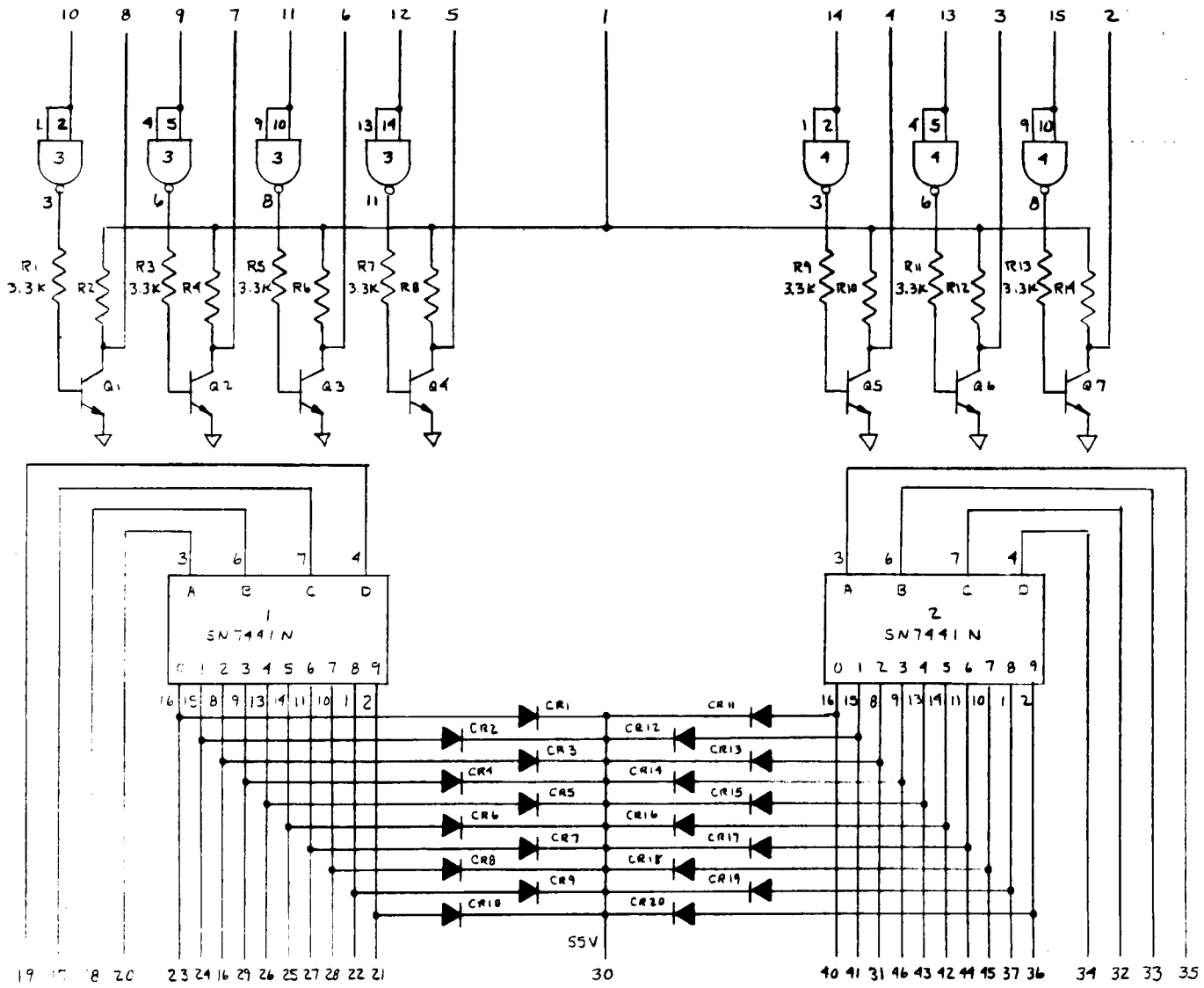

FIGURE 26 SCHEMATIC
BOARDS 23 AND 24

PARTS LIST

BOARD 25

PART	DESCRIPTION
1	SN7441N Microcircuit
2&3	SN7400N Microcircuit
R1-R6	Resistor, 10k, $\frac{1}{4}$w, 5%
R7-R14	Resistor, 3.3k, $\frac{1}{4}$w, 5%
Q1-Q6	Transistor 2N4420
Q7-Q8	Transistor 2N1990
CR1-CR20	Diode 1N4454
C1	Capacitor, 3.3mfd, 15vdc

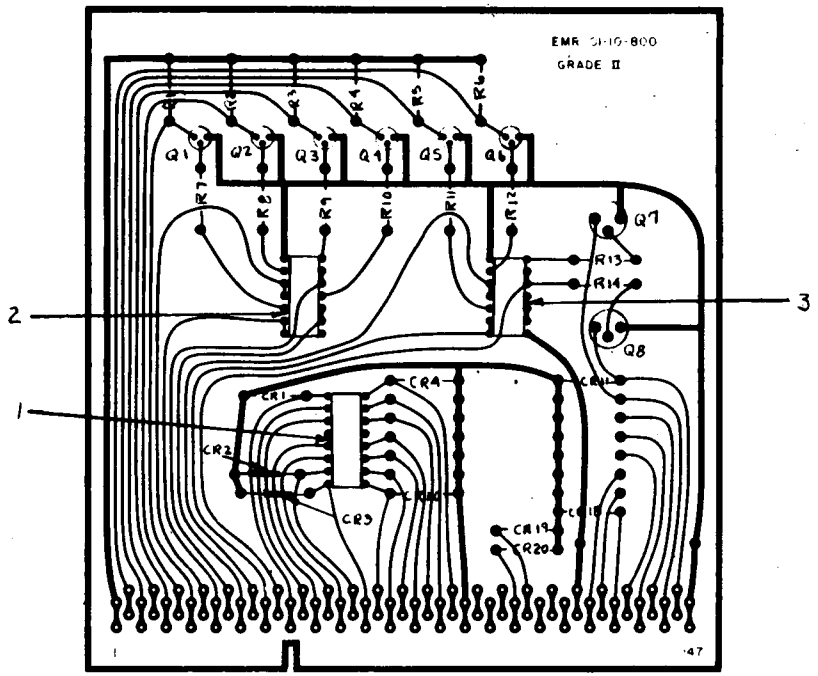

FIGURE 27 ASSEMBLY
BOARD 25

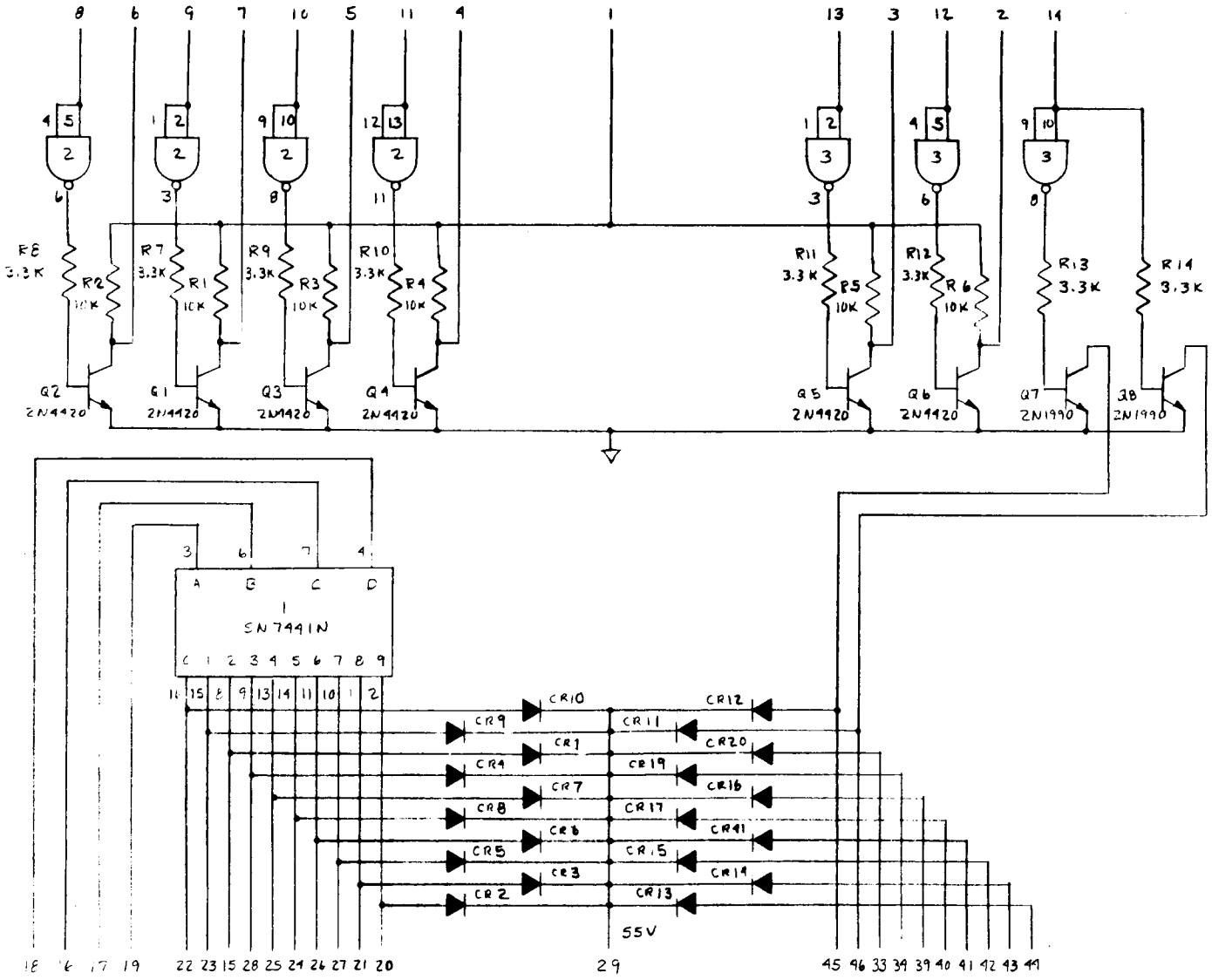

FIGURE 28 SCHEMATIC
BOARD 25