HEATHKIT®
MANUAL

for the

PARALLEL INTERFACE MODULE

Model H11-2

595-2015

HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information ..... (616) 982-3411
Credit ..... (616) 982-3561
Replacement Parts ..... (616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

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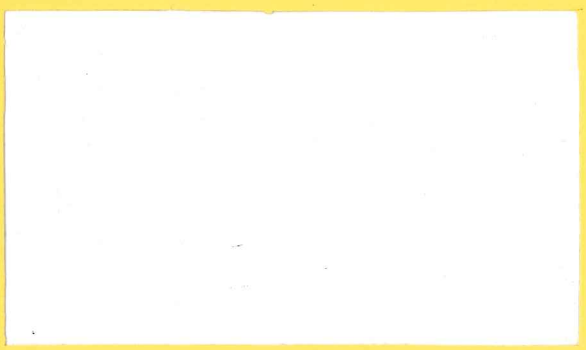
Test Equipment, Weather Instruments and Home Clocks ..... (616) 982-3315
Television ..... (616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products ..... (616) 982-3496
Computers ..... (616) 982-3309



YOUR HEATHKIT 90-DAY FULL WARRANTY

If you are not satisfied with our service - warranty or otherwise - or with our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan 49022. He will make certain your problems receive immediate, personal attention.

Our attorney, who happens to be quite a kitbuilder himself, insists that we describe our warranty using all the necessary legal phrases in order to comply with the new warranty regulations. Fine. Here they are:

For a period of ninety (90) days after purchase, Heath Company will replace or repair free of charge any parts that are defective either in materials or workmanship. You can obtain parts directly from Heath Company by writing us at the address below or by telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that during the first ninety (90) days after purchase, our products, when correctly assembled, calibrated, adjusted and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period through no fault of yours, we will service it free upon proof of purchase and delivery at your expense to the Heath factory, any Heathkit Electronic Center (units of Schlumberger Products Corporation), or any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty does not cover and we are not responsible for damage caused by the use of corrosive solder, defective tools, incorrect assembly, misuse, fire, or by unauthorized modifications to or uses of our products for purposes other than as advertised. Our warranty does not include reimbursement for customer assembly or set-up time.

This warranty covers only Heathkit products and is not extended to allied equipment or components used in conjunction with our products. **We are not responsible for incidental or consequential damages.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

HEATH COMPANY
BENTON HARBOR, MI. 49022

Prices and specifications subject to change without notice.

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for the

PARALLEL INTERFACE MODULE

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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

TABLE OF CONTENTS

INTRODUCTION

This Parallel Interface Module (PIM) is a universal logic card which interfaces an external parallel-word format system with the H11 Computer bus. The Module is organized as a full 16-bit input port and 16-bit output port with each port incorporating its own handshake lines.

On-card jumpers permit full address selection of any four successive locations in the Computer's memory between 28k and 32k.

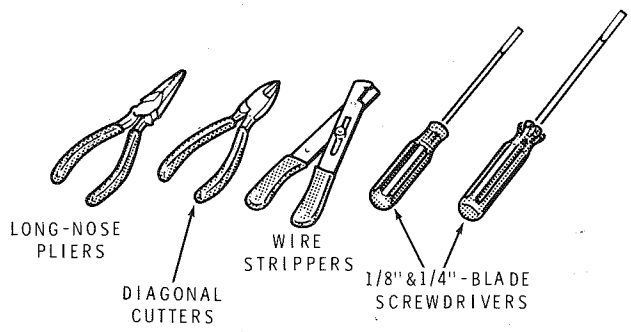
Priority vector interrupt logic with jumper-selected vector addressing permits full use of the H11 interrupt system.

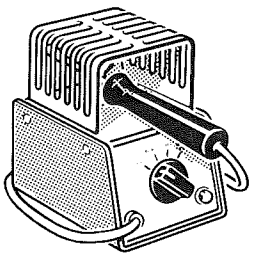
With both word and byte processing, byte-oriented peripherals are handled just as efficiently as are 16-bit systems.

ASSEMBLY NOTES

TOOLS

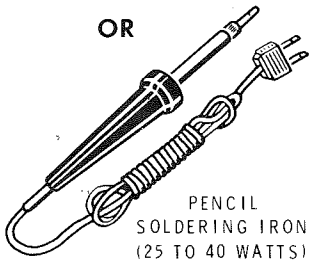
You will need these tools to assemble your kit.





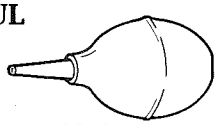
HEATHKIT SOLDERING IRON

OR



PENCIL SOLDERING IRON (25 TO 40 WATTS)

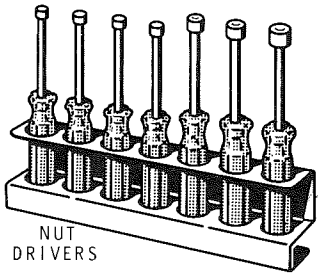
OTHER HELPFUL TOOLS



DESOLDERING BULB*

NUT STARTER (MAY BE SUPPLIED WITH KIT)

DESOLDERING BRAID*



NUT DRIVERS

*TO REMOVE SOLDER FROM CIRCUIT CONNECTIONS.

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

   — In the Parts List,

   — At the beginning of each step where a component is installed,

   — In some illustrations,

   — In the Schematic,

   — In the section at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

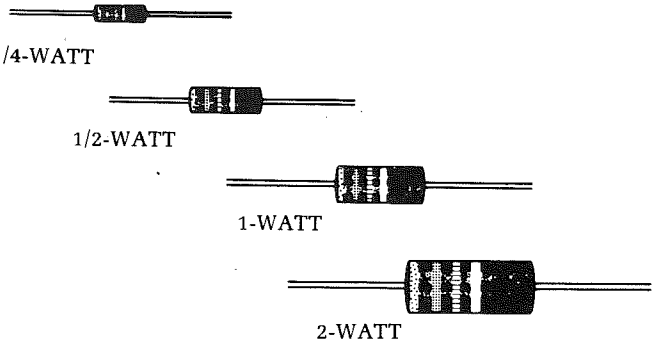
It is easy to make a good solder connection if you follow a few simple rules:

1. Use the right type of soldering iron. A 25 to 40-watt pencil soldering iron with a 1/8″ or 3/16″ chisel or pyramid tip works best.

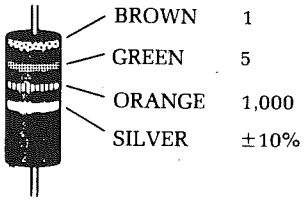
2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

PARTS

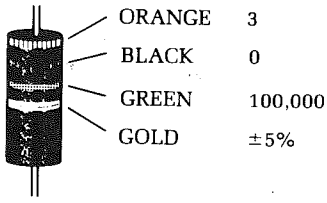
Resistors will be called out by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). Certain types of resistors will have the value printed on the body, while others will be identified by a color code. The colors of the bands and the value will be given in the steps, therefore the following color code is given for information only.



EXAMPLES:

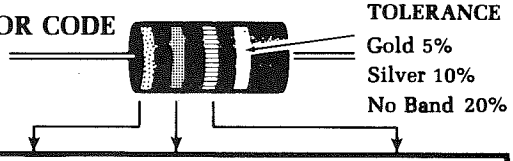


15 × 1,000 = 15,000 Ω (15,000 OHMS), or "15 kΩ"



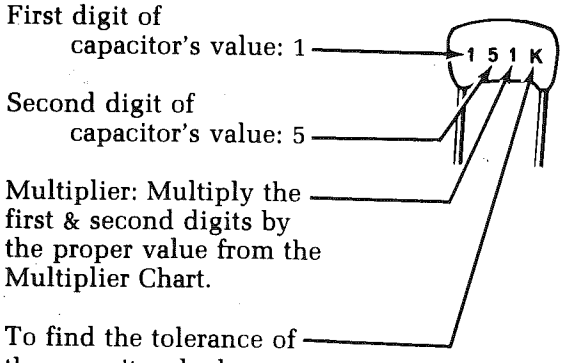
30 × 100,000 = 3,000,000 Ω (or 3 MΩ)
3 MΩ = 3 MEGOHMS

RESISTOR COLOR CODE



COLOR	1st DIGIT	2nd DIGIT	MULTIPLY BY
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000
GOLD			.1
SILVER			.01

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:



EXAMPLES:

151K = 15 × 10 = 150 pF
759 = 75 × 0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point; as in: 2R2 = 2.2 (pF or μF).

MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10pF OR LESS	LETTER	OVER 10pF
0	1	±0.1pF	B	
1	10	±0.25pF	C	
2	100	±0.5pF	D	
3	1000	±1.0pF	F	±1%
4	10,000	±2.0pF	G	±2%
5	100,000		H	±3%
			J	±5%
8	0.01		K	±10%
9	0.1		M	±20%

*DuPont Registered Trademark

PARTS LIST

( ) Unpack the kit and check each part against the following list. The key numbers correspond to the numbers on the "Parts Pictorial" (Illustration Booklet, Page 1). Return any part that is packed in an individual envelope, with the part number on it, back in the envelope after you identify it until that part is called for in a step.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, see "Replacement Parts" inside the rear cover of your Digital Computer Manual. For prices, refer to the separate "Heath Parts Price List."

RESISTORS-CAPACITORS

NOTE: The following resistors are 1/4-watt and have a tolerance of 5% (gold fourth band).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-103-12	4	150 Ω (brown-green-brown) resistor	R1-R4
A1	1-80-12	17	10 kΩ (brown-black-orange) resistor	R5-R9, R11-R19, R21-R23
A2	21-150	1	820 pF ceramic capacitor	C1
A2	21-25	2	1300 pF (.0013 μF) ceramic capacitor	C2, C3
A3	25-221	11	2.2 μF tantalum capacitor	C4-C9, C11-C15

HARDWARE

B1	250-52	2	4-40 × 1/4" screw
B2	252-2	2	4-40 nut
B3	254-9	2	#4 lockwasher

CONNECTORS-SOCKETS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	432-866	52	Spring connector (2 extra)	
C2	432-854	50	Male connector pin (2 extra)	
C3	432-855	50	Female connector pin (2 extra)	
C4	432-702	2	24-pin socket (with ears)	
C5	432-704	2	24-pin plug	
C6	432-948	2	25-connector housing	
C7	432-965	2	25-pin circuit board connector	J1, J2
C8	434-298	18	14-pin IC socket	
C9	434-299	4	16-pin IC socket	
C10	434-311	9	20-pin IC socket	
C11	434-307	1	24-pin IC socket	

INTEGRATED CIRCUITS (IC's)

NOTE: Integrated circuits are marked for identification in one of the following four ways:

1. Part number.
2. Type number. (This refers only to the numbers, the letters may vary.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
D1	443-46	1	7402	IC23
D1	443-77	1	7438	IC7
D3	443-803	4	74273	IC27, IC28, IC31, IC32
D4	443-796	1	8130	IC8
D1	443-728	3	74LS00 (or 9LS00)	IC12, IC13, IC22
D1	443-780	4	74LS08 (or 9LS08)	IC11, IC15, IC21, IC26
D1	443-797	1	74LS10 (or 9LS10)	IC20
D1	443-798	1	74LS20 (or 9LS20)	IC14
D1	443-800	1	74LS27 (or 9LS27)	IC25
D1	443-730	6	74LS74 (or 9LS74)	IC16-IC19, IC24, IC30

Integrated Circuits (IC's) (cont'd.)

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
D2	443-781	1	74LS75 (or 9LS75)	IC29
D2	443-799	1	74LS157 (or 9LS157)	IC9
D3	443-754	3	74LS240 (or 9LS240)	IC1, IC2, IC6
D2	443-802	2	74LS257 (or 9LS257)	IC3, IC10
D3	443-753	2	74S240 (or 9S240)	IC4, IC5

MISCELLANEOUS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
	85-2000-2	1	Parallel I/O circuit board	
E1	56-56	18	1N4149 diode	D1-D18
E2	266-949	1	Circuit board puller	
E3	390-1398	1	Parallel I/O label	
E4	391-34	1	Blue and white label	
	490-185	1	Soder Wick* (desoldering braid)	
E5	490-189	1	IC puller	
	344-90	18"	Black wire	
	347-66	42"	25-wire flat cable	
	597-260	1	Parts Order Form	
		1	Assembly Manual (See Page 1 for part number.)	
			Solder	

*Registered Trademark, Solder Removal Company

STEP-BY-STEP ASSEMBLY

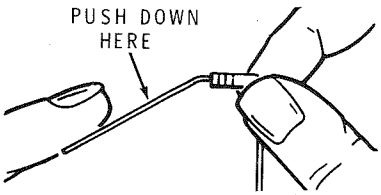
CIRCUIT BOARD

START

In the following steps, you will be given detailed instructions on how to install and solder the first part on the circuit board. Read and perform each step carefully. Then use the same procedure whenever you install parts on a circuit board.

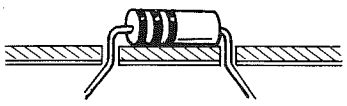
( ) Position the circuit board as shown with the component side (not the foil side) up.

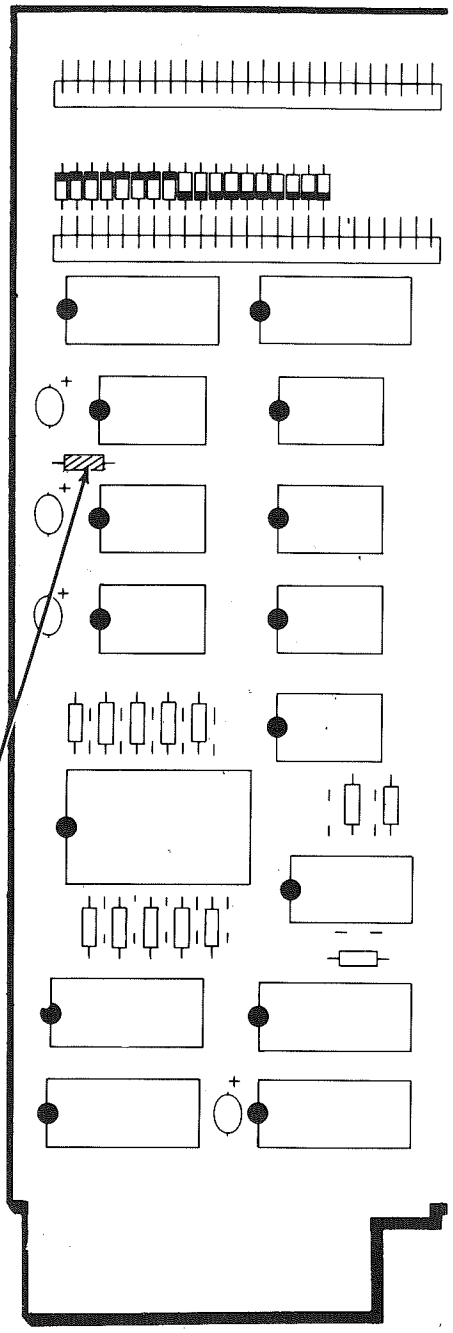
( ) R22: Hold a 10 kΩ (brown-black-orange) resistor as shown and bend the leads straight down.



( ) Push the leads through the holes at the indicated location on the circuit board. The end with color bands may be positioned either way.

( ) Press the resistor against the circuit board. Then bend the leads outward slightly to hold the resistor in place.



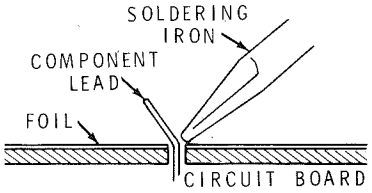


PICTORIAL 1-1

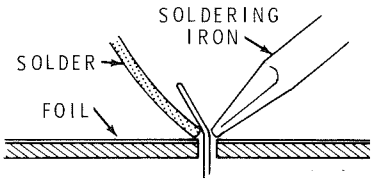
CONTINUE

( ) Solder the resistor leads to the circuit board as follows:

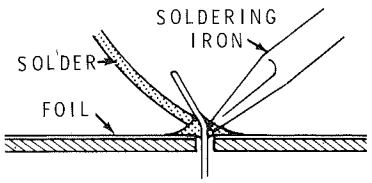
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



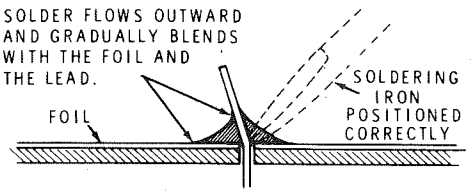
3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.



( ) Cut off the excess lead lengths close to the connection. WARNING: Clip the leads so the ends will not fly toward your eyes.

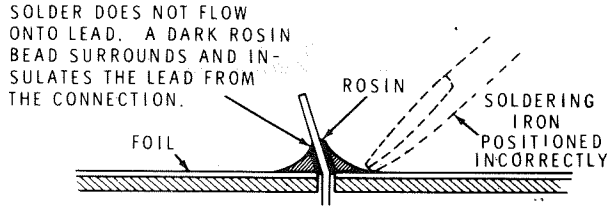
( ) Check the connection. Compare it to the illustrations on Page 9. After you have checked the solder connections, proceed with the assembly on Page 10. Use the same soldering procedure for each connection.

A GOOD SOLDER CONNECTION

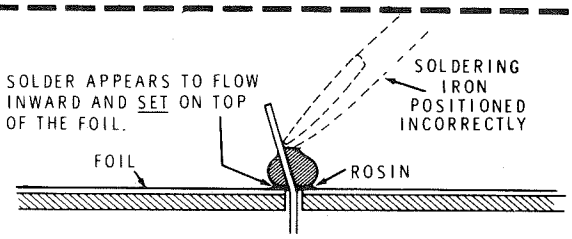


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS



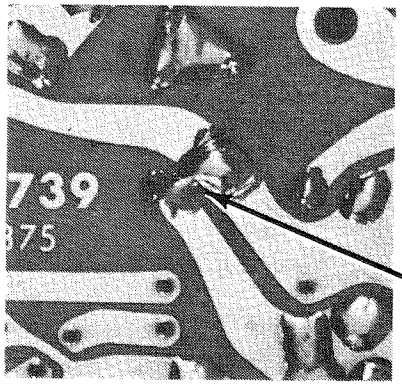
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

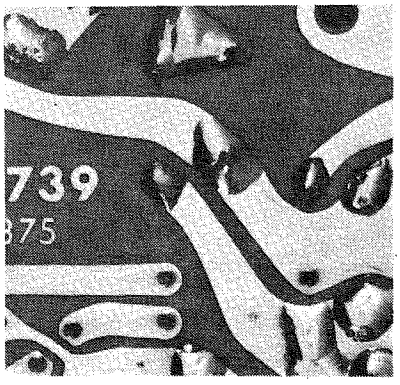
A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.



A

SOLDER BRIDGE

B

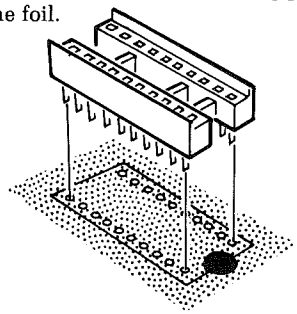


Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.

START

NOTE: Make sure you have installed the resistor in Pictorial 1-1.

NOTE: The IC sockets that you will install in the following steps can be installed either way in the circuit board. Be sure the pins are straight. To install an IC socket, carefully insert the pins into the circuit board holes, push the socket down tight against the circuit board, and then solder one pin at each end of the socket to the foil. Recheck to make sure the socket is against the circuit board and that all the pins are through the circuit board holes. Then solder the remaining pins to the foil.



( ) 20-pin IC socket at IC27.

Install three 14-pin IC sockets at:

( ) IC23. .....

( ) IC19. .....

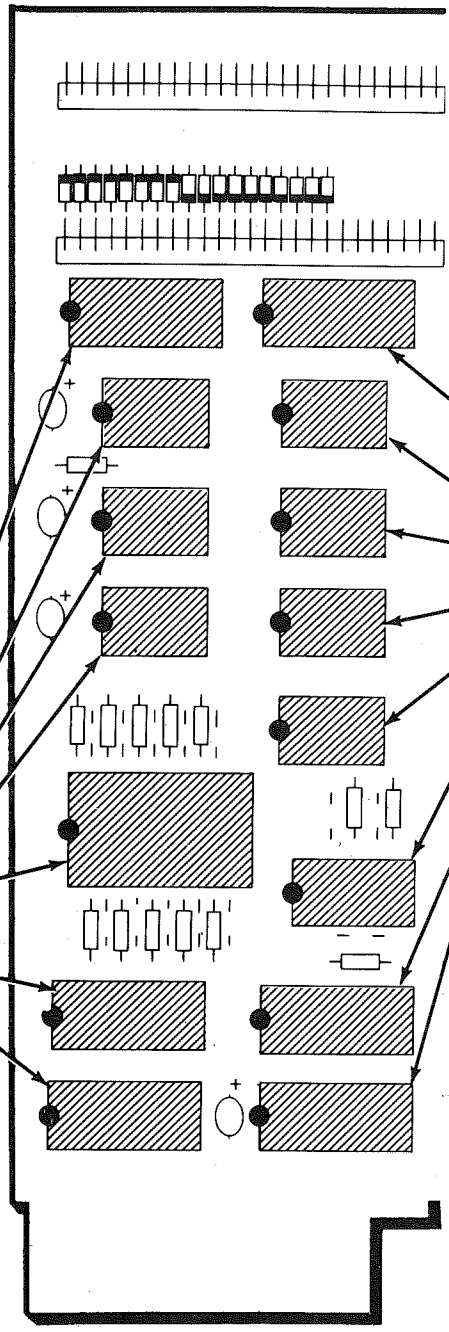
( ) IC15. .....

( ) 24-pin IC socket at IC8.

Install two 20-pin IC sockets at:

( ) IC4. .....

( ) IC1. .....



CONTINUE

( ) 20-pin IC socket at IC28.

Install four 14-pin IC sockets at:

( ) IC24.

( ) IC20.

( ) IC16.

( ) IC12.

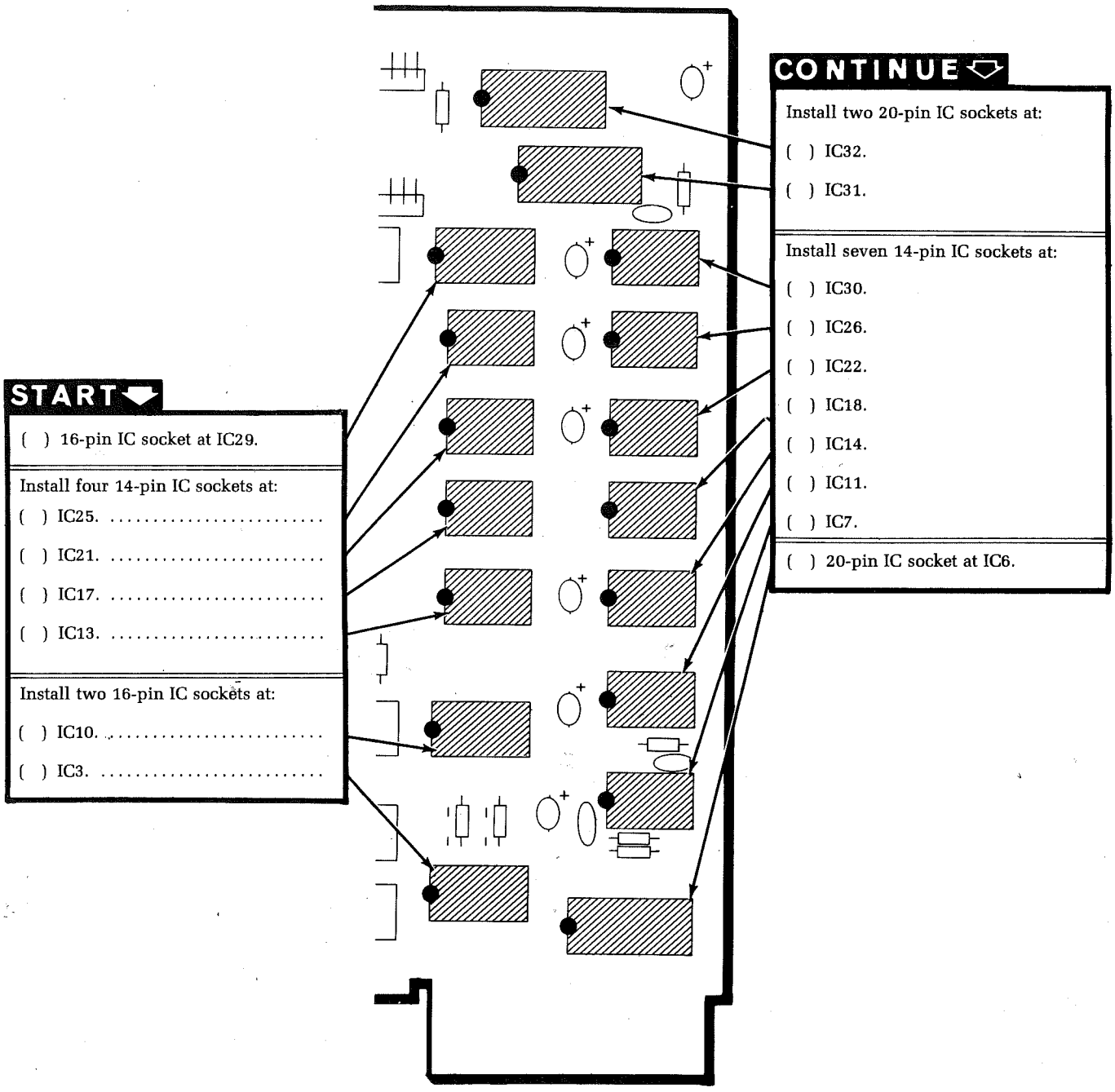
( ) 16-pin IC socket at IC9.

Install two 20-pin IC sockets at:

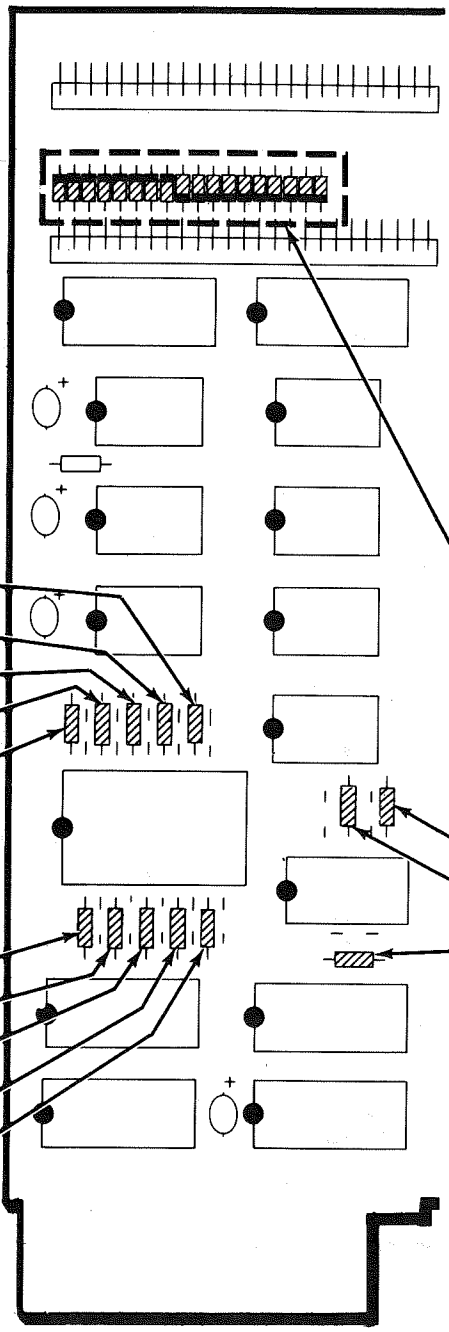
( ) IC5.

( ) IC2.

PICTORIAL 1-2



PICTORIAL 1-3



START

Install five 10 kΩ (brown-black-orange) resistors at:

( ) R5. .....

( ) R6. .....

( ) R7. .....

( ) R14. .....

( ) R15. .....

( ) Solder the leads to the foil and cut off the excess lead lengths.

Install five 10 kΩ (brown-black-orange) resistors at:

( ) R21. .....

( ) R19. .....

( ) R18. .....

( ) R17. .....

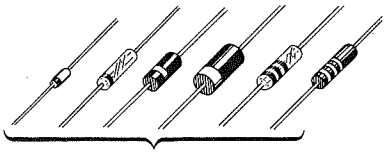
( ) R16. .....

( ) Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE

NOTE: When you install a diode, position its banded end as shown in the Pictorial. A circuit will not operate properly if the diode is installed backward.

IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.



BANDED END

( ) D1-D18: Install eighteen 1N4149 diodes (#56-56) at D1 through D18. Note that ten of the diodes face the opposite direction from the other eight.

( ) Solder the leads to the foil and cut off the excess lead lengths.

Install three 10 kΩ (brown-black-orange) resistors at:

( ) R9.

( ) R11.

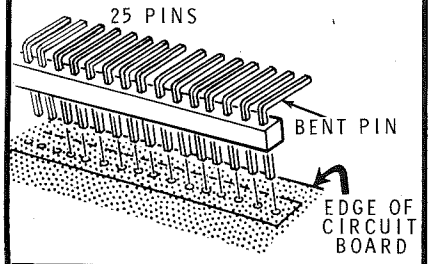
( ) R8.

( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-4

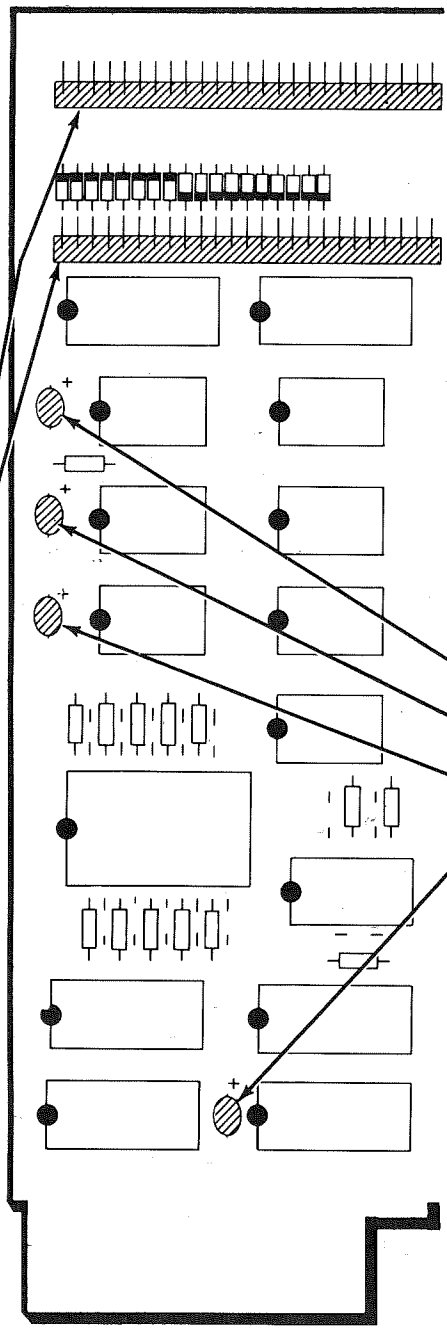
START

NOTE: When you install the following 25-pin circuit board connectors, insert the straight pins into the circuit board holes with the bent pins pointing toward the edge of the circuit board. Push the connector tight against the circuit board. Then solder the pins to the foil.



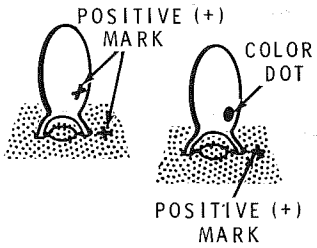
( ) J1: 25-pin circuit board connector.

( ) J2: 25-pin circuit board connector.



CONTINUE

NOTE: When you install a tantalum capacitor, always position the positive (+) or dot marked lead of the capacitor in the positive (+) marked hole.



Install four 2.2 μF tantalum capacitors at:

( ) C13.

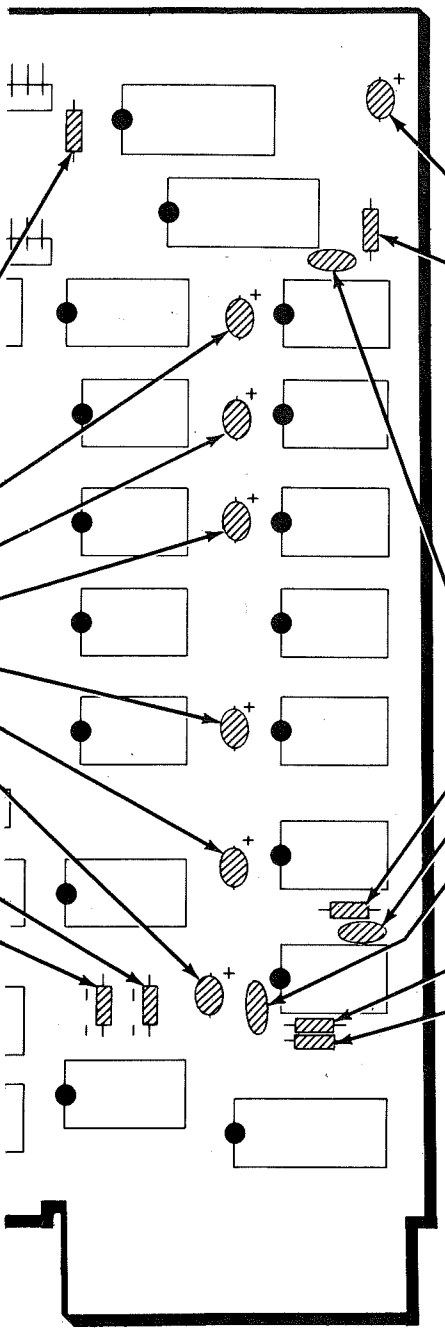
( ) C11.

( ) C9.

( ) C5.

( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-5



START

( ) R23: 10 kΩ (brown-black-orange).

Install six 2.2 μF tantalum capacitors at the following locations. Be sure to position the positive (+) or dot marked lead as shown on the circuit board.

( ) C15. .....

( ) C14. .....

( ) C12. .....

( ) C8. .....

( ) C7. .....

( ) C6. .....

Install two 10 kΩ (brown-black-orange) resistors at:

( ) R13. .....

( ) R12. .....

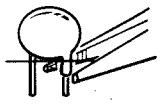
( ) Solder the leads to the foil and cut off the excess lead lengths.

CONTINUE

( ) C4: 2.2 μF tantalum. Position the capacitor as shown on the circuit board.

( ) R1: 150 Ω (brown-green-brown).

NOTE: When you install ceramic capacitors, remove any excess coating from the leads. Use long-nose pliers to remove this coating. Then mount the capacitor as close to the circuit board as possible.



REMOVE COATING EVEN WITH BOTTOM OF CAPACITOR BODY

( ) C1: 820 pF ceramic.

( ) R2: 150 Ω (brown-green-brown).

( ) C2: 1300 pF (.0013 μF) ceramic.

( ) C3: 1300 pF (.0013 μF) ceramic.

Install two 150 Ω (brown-green-brown) resistors at:

( ) R3.

( ) R4.

( ) Solder the leads to the foil and cut off the excess lead lengths.

PICTORIAL 1-6

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of the circuit board for the following most commonly made errors:

( ) Unsoldered connections.

( ) Poor solder connections.

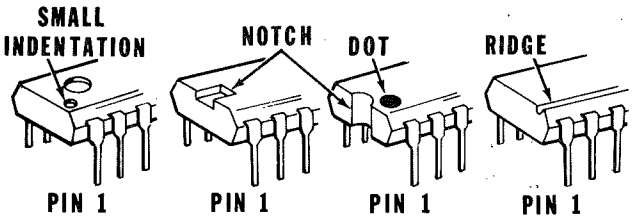
( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

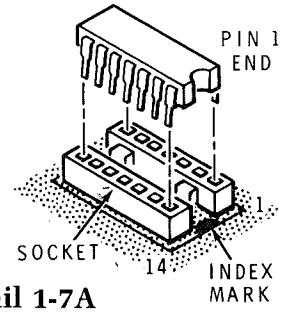
( ) Diodes installed backwards.

( ) Tantalum capacitors installed backwards.

PART A



PART B



Detail 1-7A

Refer to Pictorial 1-7 (Illustration Booklet, Page 1) for the following steps.

NOTES:

1. Refer to Detail 1-7A and, as you install each IC in the following steps, position the pin 1 end of each IC (as shown in Part A of the Detail) toward the index mark on the circuit board (see Part B). Then insert the leads into the socket and push the IC down into place.

2. If it ever becomes necessary to remove an IC from its socket, use the IC puller. Refer to the inset drawing on the Pictorial and insert the hooks of the puller beneath the IC; then gently rock the tool back and forth to lift the IC.

Install IC's as follows:

( ) IC32: 74273 IC (#443-803).

( ) IC31: 74273 IC (#443-803).

( ) IC30: 74LS74 (or 9LS74) IC (#443-730).

( ) IC26: 74LS08 (or 9LS08) IC (#443-780).

( ) IC22: 74LS00 (or 9LS00) IC (#443-728).

( ) IC18: 74LS74 (or 9LS74) IC (#443-730).

( ) IC14: 74LS20 (or 9LS20) IC (#443-798).

( ) IC11: 74LS08 (or 9LS08) IC (#443-780).

( ) IC7: 7438 IC (#443-77).

( ) IC6: 74LS240 (or 9LS240) IC (#443-754).

( ) IC29: 74LS75 (or 9LS75) IC (#443-781).

( ) IC25: 74LS27 (or 9LS27) IC (#443-800).

( ) IC21: 74LS08 (or 9LS08) IC (#443-780).

( ) IC17: 74LS74 (or 9LS74) IC (#443-730).

( ) IC13: 74LS00 (or 9LS00) IC (#443-728).

( ) IC10: 74LS257 (or 9LS257) IC (#443-802).

( ) IC3: 74LS257 (or 9LS257) IC (#443-802).

( ) IC28: 74273 IC (#443-803).

( ) IC24: 74LS74 (or 9LS74) IC (#443-730).

( ) IC20: 74LS10 (or 9LS10) IC (#443-797).

( ) IC16: 74LS74 (or 9LS74) IC (#443-730).

( ) IC12: 74LS00 (or 9LS00) IC (#443-728).

( ) IC9: 74LS157 (or 9LS157) IC (#443-799).

( ) IC5: 74S240 (or 9S240) IC (#443-753).

( ) IC2: 74LS240 (or 9LS240) IC (#443-754).

( ) IC27: 74273 IC (#443-803).

( ) IC23: 7402 IC (#443-46).

( ) IC19: 74LS74 (or 9LS74) IC (#443-730).

( ) IC15: 74LS08 (or 9LS08) IC (#443-780).

( ) IC8: 8130 IC (#443-796).

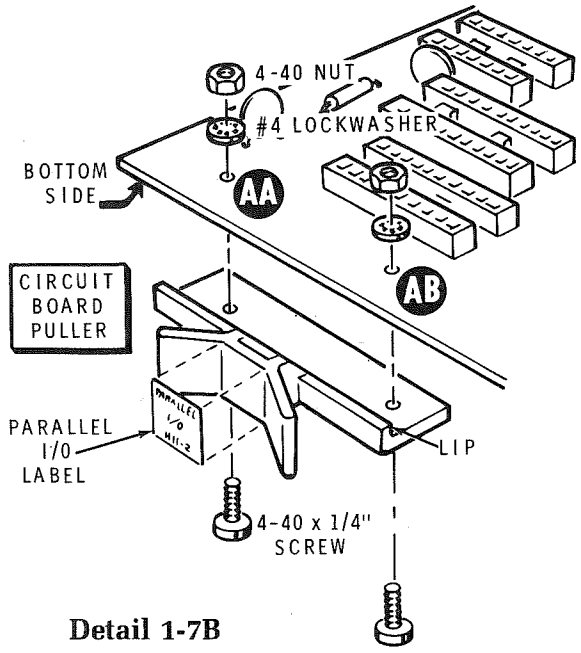
( ) IC4: 74S240 (or 9S240) IC (#443-753).

( ) IC1: 74LS240 (or 9LS240) IC (#443-754).

( ) Check all of the IC's in the circuit board for the proper type and installation. Pay particular attention to IC1, IC2, IC4, IC5, and IC6. The 74S240 (or 9S240) IC's should be at IC4 and IC5. The 74LS240 (or 9LS240) IC's should be at IC1, IC2, and IC6.

( ) Refer to Detail 1-7B and mount a circuit board puller on the bottom of the circuit board at AA and AB. Use a 4-40 × 1/4" screw, a #4 lockwasher, and a 4-40 nut at each mounting hole. Be sure to position the puller so the lip is around the edge of the circuit board as shown.

( ) Carefully peel the backing paper from the parallel I/O label. Then refer again to Detail 1-7B and press the label onto the center portion of the circuit board puller as shown.



Detail 1-7B

CIRCUIT BOARD CHECKOUT

Refer to the foil pattern in the Illustration Booklet, Page 6. Compare your circuit board foil with the foil pattern. Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) Poor solder connections.

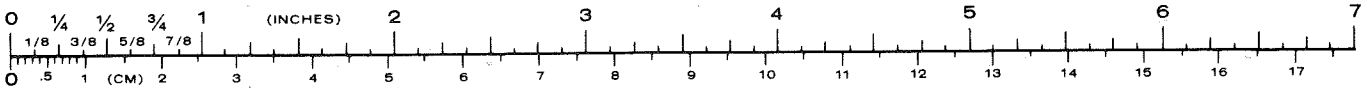
( ) Solder bridges between foils.

( ) Protruding leads which could touch together.

( ) Electrolytic capacitors for the correct position of the positive (+) end.

( ) Diodes for the correct position of the banded end.

Temporarily lay the power supply circuit board aside until it is called for later.



NOTE: The blue and white label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company about your kit. This assures you that you will receive the most complete and up-to-date information in return.

( ) Carefully peel the backing paper from the blue and white label. Then press the label onto the lower right corner of the rear panel on your H11 Computer. Do not cover up any other labels that may already be present.

CABLE PREPARATION

Refer to Pictorial 1-8 (Illustration Booklet, Page 2) for the following steps.

( ) Cut two 21″ lengths of 25-wire flat cable.

NOTE: You will now make two identical 25-wire cables. Use one set of checkoff marks for the first cable and the other set of checkoff marks for the second cable.

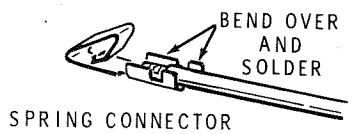
( ) ( ) If necessary, trim both ends of a 25-wire cable so the wire ends are square (all wires of equal length).

( ) ( ) At one end of the cable, use diagonal cutters or a sharp tool to carefully start a small cut between each pair of wires. Then carefully separate the wire ends for a length of 1-1/2″.

NOTE: To prepare stranded wires, as in the next step, remove 1/4″ of insulation from the end of each wire. Then tightly twist each bare wire end and add a small amount of solder to hold the fine strands together.

( ) ( ) At the separated end of the cable, prepare each of the 25 wire ends as described above.

( ) ( ) Position the cable on your work area as shown. Then locate the yellow wire on the right side of the cable.



Detail 1-8A

( ) ( ) Refer to Detail 1-8A and install a spring connector (#432-866) onto the end of the prepared yellow wire.

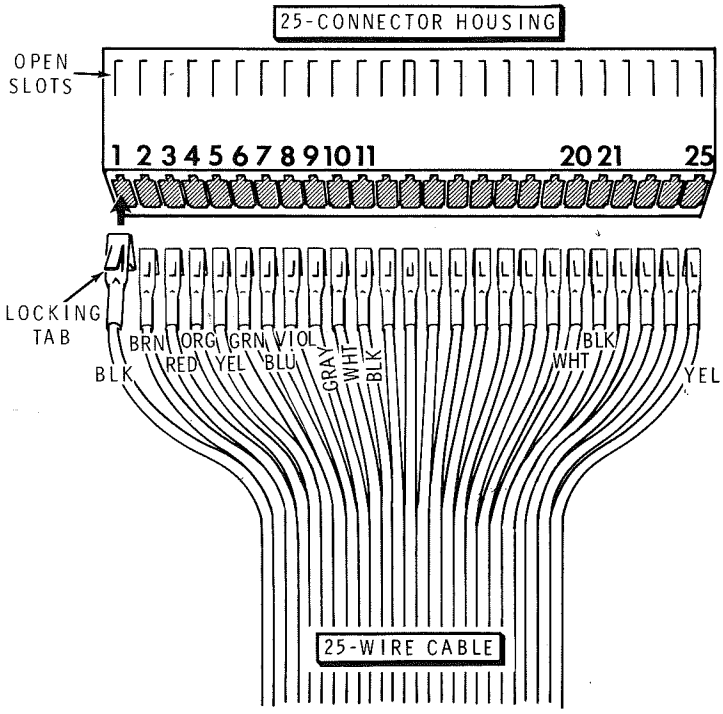
( ) ( ) Similarly, install spring connectors on each of the 24 remaining cable wires.

( ) ( ) Refer to Detail 1-8B. Position the 25-wire cable on your work area so the outer black wire is on the left side of the cable, the yellow outer wire is on the right, and the spring connectors are away from you as shown.

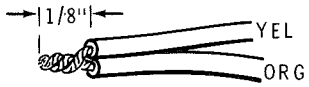
( ) ( ) Position a 25-connector housing just in front of the spring connectors on the wire ends so its open slots face upward as shown.

( ) ( ) Push the spring connector on the outer black wire into slot 1 of the housing as shown until it locks in place. Be sure the small locking tab is positioned upward.

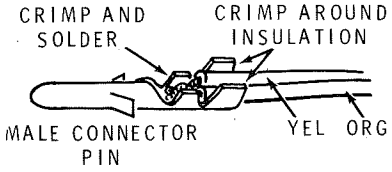
( ) ( ) Similarly, and proceeding from left to right, push the remaining spring connectors into the housing slots in order as shown.



Detail 1-8B



Detail 1-8C



Detail 1-8D

( ) ( ) Prepare the other end of the 25-wire cable as follows:

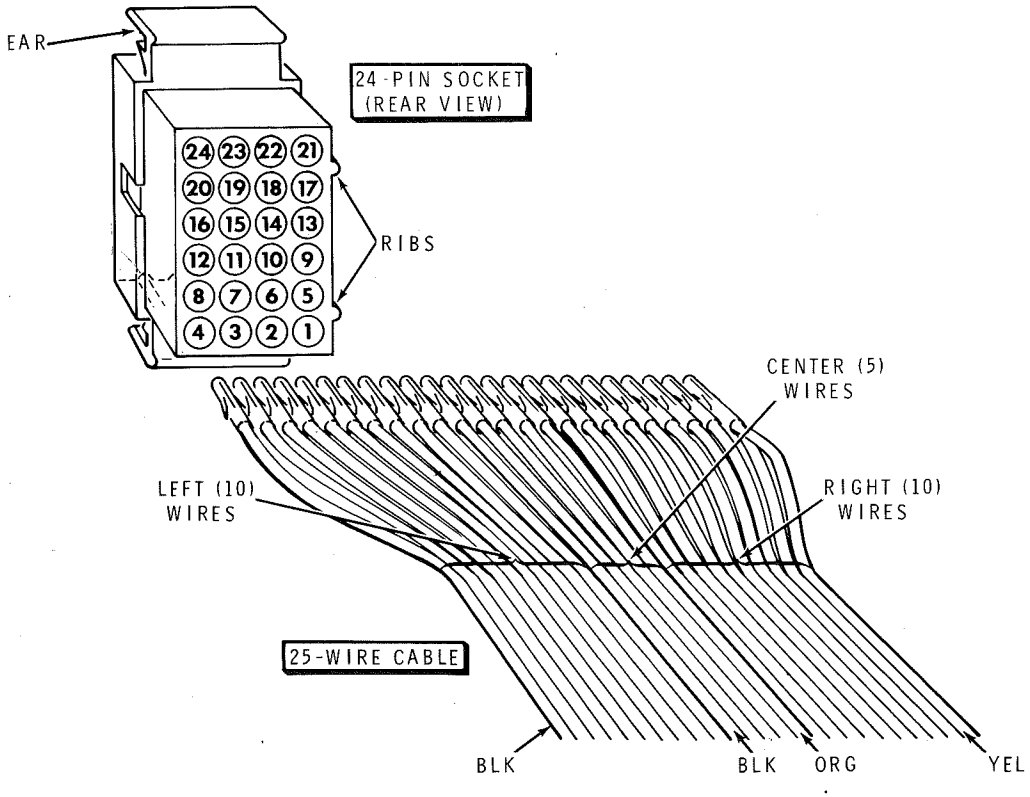
1. Separate the wires for a length of 1-1/2" as you did earlier with the other end.
2. Remove 1/8" of insulation from each wire end.
3. Refer to Detail 1-8C and tightly twist the outer yellow and orange wire ends together as shown. Add a small amount of solder.
4. Tightly twist the ends of the remaining 23 wires and add a small amount of solder to hold the fine strands together.

( ) ( ) Locate the strip of male connector pins. Separate the pins from the bands by bending the bands back and forth until the pins drop free.

( ) ( ) Refer to Detail 1-8D and crimp and solder a male connector pin onto the end of the yellow and orange wires which were twisted and soldered together during the preparation of the cable.

( ) ( ) Cut the excess tabs from 23 male connector pins as shown in the inset drawing on the Pictorial.

( ) ( ) Crimp and solder a prepared male connector pin onto the bare end of each of the remaining 23 cable wires.



Detail 1-8E

( ) ( ) Refer to Detail 1-8E and position a 24-pin socket (with ears) as shown. Note that the ribs are on the side of the socket and the open side faces away from you. Also, carefully note the numbers of the pin holes, from right to left and from bottom to top.

NOTES:

1. When you install the male connector pins in the 24-pin socket, in the following steps, always be sure to keep the socket positioned as shown.

2. Make sure the 25-wire cable is kept in the same relative position with the black outer wire on the left and the yellow outer wire on the right as shown.

3. Locate and identify the five "center" wires, as called out in the following steps. Their colors are (from left to right) black, brown, red, orange, and yellow. All other wires will be identified as either "right" or "left" wires as indicated in Note #2 above.

Refer to Detail 1-8F (Illustration Booklet, Page 2), Part A and push the **center** wires into 24-pin socket holes 1-4 as follows. Push each wire into the socket hole until it locks in place.

( ) ( ) Black wire to hole 1.

( ) ( ) Brown wire to hole 2.

( ) ( ) Red wire to hole 3.

( ) ( ) Orange wire to hole 4.

Refer to Part B of the Detail and push wires into 24-pin socket holes 5-8 as follows:

( ) ( ) **Center** yellow wire to hole 5.

( ) ( ) **Right** green wire to hole 6.

( ) ( ) **Right** blue wire to hole 7.

( ) ( ) **Right** violet wire to hole 8.

Refer to Part C of the Detail and push wires into 24-pin socket holes 9-12 as follows:

( ) ( ) **Right** white wire to hole 9. (NOTE: The gray wire is skipped at this time.)

( ) ( ) **Right** black wire to hole 10.

( ) ( ) **Left** black wire to hole 11.

( ) ( ) **Left** brown wire to hole 12.

Refer to Part D of the Detail and push wires into 24-pin socket holes 13-16 as follows:

( ) ( ) **Left** red wire to hole 13.

( ) ( ) **Left** orange wire to hole 14.

( ) ( ) **Left** yellow wire to hole 15.

( ) ( ) **Left** green wire to hole 16.

Refer to Part E of the Detail and push wires into 24-pin socket holes 17-20 as follows:

( ) ( ) **Left** blue wire to hole 17.

( ) ( ) **Left** violet wire to hole 18.

( ) ( ) **Right** gray wire to hole 19.

( ) ( ) **Left** gray wire to hole 20.

Refer to Part F of the Detail and push wires into 24-pin socket holes 21-24 as follows:

( ) ( ) **Left** white wire to hole 21.

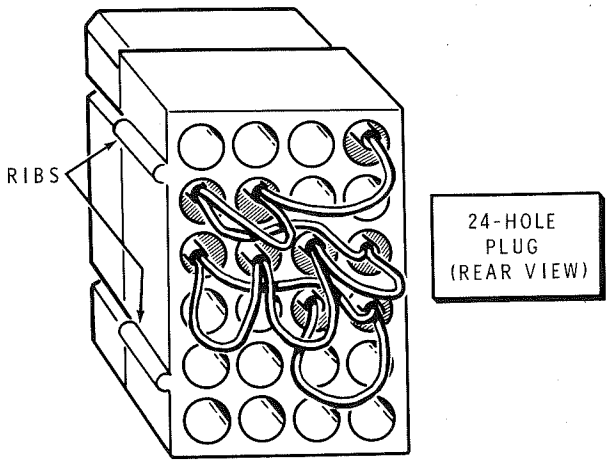
( ) ( ) **Right** brown wire to hole 22.

( ) ( ) **Right** red wire to hole 23.

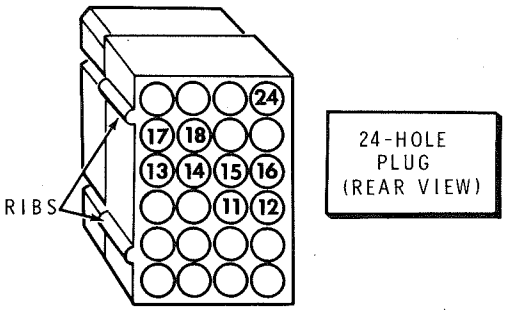
( ) ( ) **Right** yellow/orange wire combination to hole 24.

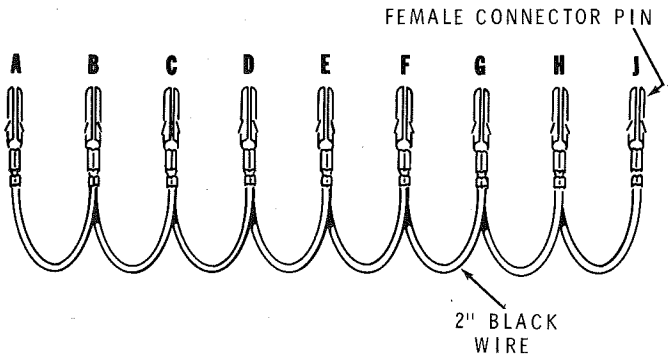
( ) ( ) Set the 25 wire cable assembly aside.

This completes the assembly of the Parallel Interface Module. Proceed to "Shorting Plug Assembly."



PICTORIAL 1-9





Detail 1-9A

SHORTING PLUG ASSEMBLY

Refer to Pictorial 1-9 for the following steps.

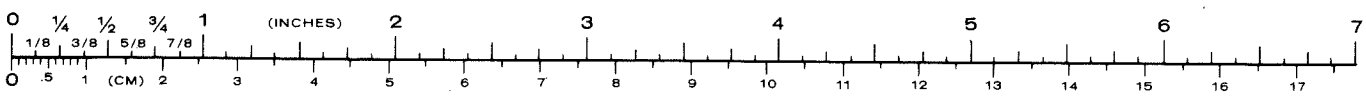
( ) Prepare eight 2" black wires.

( ) Refer to Detail 1-9A and connect the eight 2" black wires to the nine female connector pins as shown. Crimp and solder the wires to the pins in the same manner as with the male pins.

Refer to Detail 1-9A and position the 24-pin socket as shown. Begin at connector pin A and install the female connector pins into the 24-hole plug holes as follows:

( ) A to hole 11.
( ) B to hole 12.
( ) C to hole 13.
( ) D to hole 14.
( ) E to hole 15.
( ) F to hole 16.
( ) G to hole 17.
( ) H to hole 18.
( ) J to hole 19.

NOTE: If you intend to use the H10 Paper Tape Punch and Reader with this Module, install the shorting plug on the rear panel of the H11 Computer at connector AK. If you do not intend to use the H10, set the shorting plug aside. This completes the "Shorting Plug Assembly." Proceed to "Configuring the Parallel Interface Module."



CONFIGURING THE PARALLEL INTERFACE MODULE (PIM)

GENERAL

This section contains the information necessary to properly determine the location of the jumpers required to interface this Module with your Computer.

If you do not intend to operate an H10 Punch/Reader, proceed to "Module Address" below. If you intend to operate one H10, proceed to "Interfacing the PIM with the H10 Punch/Reader" on Page 23. However, if you intend to operate more than one H10 in your System, configure the primary H10 as directed on Page 23 and any other H10's as directed below.

Module Address

Jumpers A3 through A12 determine the address of the Parallel Interface Module. Only address bits 03 through 12 are programmed by the jumpers, producing the 16-bit Module address.

Jumpers not installed produce logic 1.

Jumpers installed produce logic 0.

Only install one PIM at any one address. It is important that no two PIM's respond to the same address.

Install the jumpers as follows:

1. Select the desired octal address of the PIM. This address must be between 160000_8 and 177770_8.

2. Write this octal address in the "Octal Address" boxes provided in Pictorial 1-11 (Illustration Booklet, Page 2).

3. Convert the octal address to a binary address and write this number in the "Binary Address" boxes in Pictorial 1-11 (Illustration Booklet, Page 2).

4. Install jumpers on the Module at all locations where a logic "0" is called for.

Vector Address

Jumpers V3 through V7 determine the vector address of the PIM. Only vector bits 03 through 07 are programmed by jumpers, producing the 16-bit vector address. Refer to Pictorial 1-12 (Illustration Booklet, Page 2) and program it the same as you programmed the Module address.

Jumpers not installed produce logic 1.

Jumpers installed produce logic 0.

Pinouts

The following table describes the cable connections on the rear of your Computer. NOTE: The output control lines from the PIM appear at both J1 and J2. Therefore, the high byte and low byte control lines are the same. High byte data lines are in parentheses.

PIN	FUNCTION
1	Data Out 0 (8)
2	Data Out 1 (9)
3	Data Out 2 (10)
4	Data Out 3 (11)
5	Data Out 4 (12)
6	Data Out 5 (13)
7	Data Out 6 (14)
8	Data Out 7 (15)
9	Take Data L
10	Data Taken L
11	Data In 0 (8)
12	Data In 1 (9)
13	Data In 2 (10)
14	Data In 3 (11)
15	Data In 4 (12)
16	Data In 5 (13)
17	Data In 6 (14)
18	Data In 7 (15)
19	N. C.
20	Data Sent L
21	Send Data L
22	RC 1 H
23	N. C.
24	GND

Word Formats

This Module contains four registers. The least significant octal digit of the device address selects which of these registers is addressed (selected). Below is a listing of these registers.

	Least Significant Octal Digit
RCSR	0
RBUF	2
XCSR	4
XBUF	6

Figure 1-1 (Illustration Booklet, Page 3) Format B describes the input address word format. Formats A, D, and E together with Table A describe the word formats of the above four registers. Format C shows the interrupt vector address word format.

INTERFACING THE PIM WITH THE H10 PUNCH/READER

The following sections show you how to use the PIM to connect the H11 computer to the H10 Punch/Reader. NOTE: The required interconnect cable is supplied with the H10.

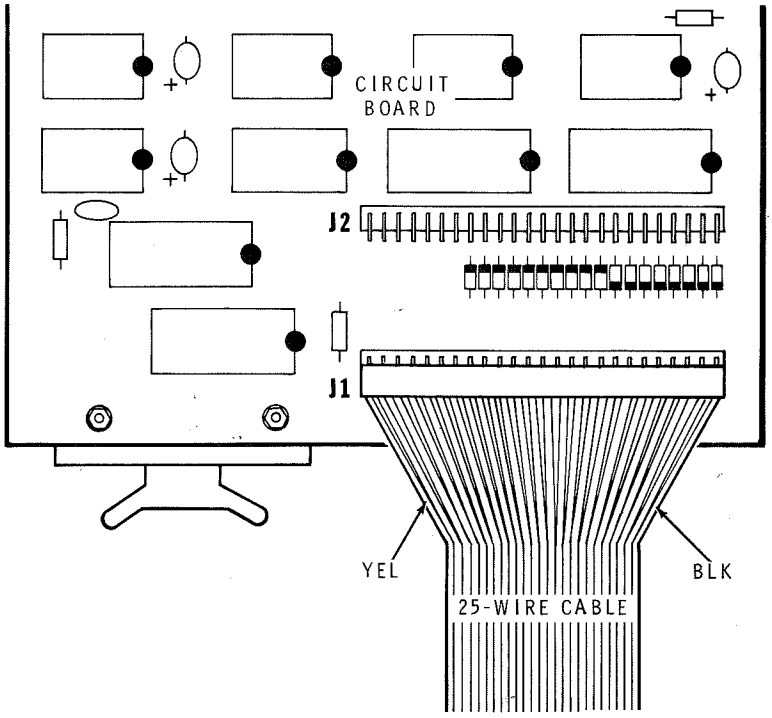
Addressing

Refer to Pictorial 1-10 (Illustration Booklet, Page 2) for the following steps.

In the following chart, use cutoff resistor leads as jumper wires to configure your PIM. Solder them to the foil and cut off the excess wire lengths as you install them. Leave the jumpers arched above the board so they do not short out circuit board foils.

	NAME	INSTALL JUMPERS AT:	COMMENTS
( )	MODULE ADDRESS	A4 and A7.	Sets device address at 177550_8.
( )	VECTOR ADDRESS	V6 and V7.	Sets vector address at 70_8 and 74_8.

INSTALLATION



Detail 1-13A

Refer to Pictorial 1-13 (Illustration Booklet, Page 4) for the following steps.

( ) Refer to Detail 1-13A and position the circuit board as shown. Then plug a 25-wire cable onto the circuit board at J1 as shown. Make sure the outside yellow wire is on your left and the outside black wire is on your right. This is the "Low Byte" cable.

( ) As before, install the remaining 25-wire cable onto the remaining circuit board plug at J2. This is the "High Byte" cable. Use the same cable orientation as you did with J1.

( ) Refer to Detail 1-13B and carefully install the module in slot number 5. Make sure that the circuit board fits into the card guides. NOTE: If you intend to use more than one Serial Module in your Computer, refer to your H11 Operation Manual for installation instructions.

SPECIFICATIONS

Data Transfer Rate	50 kilowords-per-second.
Input/Output	Input: 16-bit word, 1 TTL load, diode clamped to +5V. Output: 16-bit word, 10 TTL loads. Inputs and outputs fully latched.
Interface	Mechanically and electrically compatible with H11 and PDP11/03 buses.
Control Lines	Receiver: Send data. Data sent. RC 1. Transmitter: Take data. Data taken.
Power Requirement	5 volts DC at 1 ampere maximum. 700 milliamperes typical.
Circuit Board Size	8-3/4″ long × 5-1/4″ wide × 1/2″ high. (22.6 × 13.2 × 1.3 cm).
Net Weight	6 oz. (180 grams).

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

APPLICATIONS

This section describes the various handshake lines which are used to communicate with a user defined peripheral. These lines inform the Parallel Interface Module (PIM) of the status of the peripheral and are used by the peripheral to determine when a specific operation is to be performed.

The send data L (SD L) is asserted low by the user's program in order to request data from the peripheral. This negates the DA H (bit 7 of RCSR) line.

The data sent L (DS L) is asserted low by the peripheral to indicate that valid data is available. This data is latched by the input latches (IC's 27 and 31), and DA H (IC18A) is asserted a maximum of 500 nanoseconds after this edge. Consequently, the data must be valid for a minimum of 500 nanoseconds after DS L is asserted low.

The DS L line is also used by the PIM to reset the SD L line high. This is a forcing function such that as long as DS L is negated (high), SD L can not be asserted.

Under program control, whenever bit 1 of the RCSR (IC30A) is asserted, the receiver control 1 H (RC 1 H) line is set high. This forces the SD L line low independent of bit Ø in the RCSR (IC30B). The SD L line now remains asserted as long as bit 1 is set and the DS L line is low. If the SD L line is inverted, and then returned to the DS L input, a continuous string of DS L pulses will result. This causes the data input latches to be updated approximately every 500 nanoseconds and results in a quasi-transparent data input. NOTE: In this mode, do not set the interrupt enable bit (bit 6 of RCSR). This will cause a continuous processor interrupt.

The take data L (TD L) line is asserted low by the user's software to inform the peripheral that valid output data is available from the processor. This edge occurs approximately 150 nanoseconds after the data is actually available at the output connectors. This deskewing of 150 nanoseconds is inherent in the PIM.

The data taken L (DT L) line is asserted low by the peripheral to inform the processor that the peripheral is ready for the next operation.

Since no new operation can be initiated by the processor until the SD L and/or TD L lines are negated, it is important that their respective flip-flops (IC30B and IC17B) be cleared by negating the DS L and/or DT L lines. This can be accomplished by designing the perpheral such that when it receives a command (SD L and/or TD L asserted), it negates the DS L and/or DT L line until the operation is complete. Operation completion then is detected by the processor when DS L and/or DT L is asserted low.

CIRCUIT DESCRIPTION

Refer to the Block Diagram (Illustration Booklet, Page 5) and the Schematic (fold-in) while you read this "Circuit Description." A "Glossary of Signal Terms" follows this Description.

GENERAL

This Parallel Interface Module (PIM) interfaces an I/O device to the H11 Computer bus. It contains the necessary logic to control the I/O device and interrupt the processor.

ADDRESSING

Each PIM has a unique address which the processor treats as a memory location.

Jumpers A3 through A12 program the address decoding circuitry, IC8, to select the desired address of the PIM. The address decoder circuitry performs an exclusive OR operation between these jumpers and the address on the bus and asserts AD H when they are equal. BBS 7 L (bank select 7) is asserted by the processor when it addresses any location between 28k and 32k. AD H is logically ANDed (IC12B) with BS 7 H and is latched by the assertion of SYNC H, to produce ME H.

Address selection jumpers A3 through A12 represent 10 bits of the 16-bit address word (Figure 1-1, Format B). BBS7 L is decoded by the processor from BDAL 13 through BDAL 15. The remaining three bits (BDAL 0 through BDAL 2) are decoded by the function decoding and control circuitry.

FUNCTION DECODING AND CONTROL

Input signals WTBT H, DIN H, DOUT H, and RDAB Ø H through RDAB 2 H are decoded by this circuitry to select the function desired. Table B shows the relationship between the signal inputs and the selected output function.

BRPLY L is generated by this circuitry in response to DIN X ME L or VEC 1 L.

DATA SELECTION

The data selection circuitry gates the appropriate signals to the bus drivers in response to the function decoding and control output signals.

Data inputs to the data selectors are:

1. RCSR status signals (receiver control status register).
2. XCSR status signals (transmitter control status register).
3. Vector address.
4. Low byte received data.

RCSR status signals are applied to the low-byte bus drivers by the data selector when DAL 2 H is low, DAL 1 L is high and VEC 1 L is high (not asserted). The low-byte bus drivers are then enabled by the assertion of DIN X ME L.

The data selector applies the XCSR signals to the low-byte bus drivers if DAL 2 H is high (asserted), DAL 1 L is high and VEC 1 L is high. The low-byte bus drivers are then enabled by the assertion of DIN X ME L. If VEC 1 L is asserted low by the interrupt logic, the data selector applies the vector address to the low-byte bus drivers. The bus drivers are also enabled by the assertion of VEC 1 L. The vector address is determined by jumpers V3 through V7 and VEC 2 H.

If DAL 1 L is asserted low, low-byte data RDØ 7 H is applied to the low-byte bus drivers. These drivers are then enabled by the assertion of DIN X ME L. The assertion of RD DT L by the function decoding and control circuitry enables the high-byte bus drivers, which applies high-byte data RD8-15 H to the bus.

I/O INTERFACE LOGIC

This circuitry is responsible for controlling and monitoring the I/O device connected to the PIM.

The reader is enabled by setting bit Ø in the RCSR. RDAB Ø H is applied to the D input of the reader flip-flop (IC30B) and is clocked by SEL Ø OUT H. When the reader is enabled, DS L is negated and clears the reader enable flip-flop (IC30B). This causes SD L to be negated. DS L is asserted when the reader is ready to output data. 400 nanoseconds after the assertion of DS L, the clear is removed from the reader enable flip-flop (IC30B) and the data status flip-flop (IC18A) is toggled to produce DA H, which is cleared by SD L.

If bit 1 is set in the RCSR, the reader is enabled and runs continuously. The RC flip-flop (IC30A) is set by RDAB 1 H and SEL ø OUT H. The $\overline{Q}$ output of the RC flip-flop (IC30A) presets the reader flip-flop (IC30B), asserting SD L and also clearing the data status flip-flop (IC18A), this holds DA H false. DA H will remain false until the RC flip-flop (IC30A) is reset or cleared. A low-to-high transition on the DS L will cause SD L to go high. A high-to-low transition on DS L will cause reader enable L to go low after a 400 nanosecond time delay (determined by R1 and C1). These transitions do not affect DA H, which remains low.

If bit ø in the XCSR is set, continuous ø's will be transmitted. IC17A is set by RDAB ø H and SEL 4 OUT H, which sets TCSR ø L low. This presets IC17B and clears the output latches.

TD L is asserted 150 nanoseconds after IC17B is preset. TD L remains asserted until IC17A is reset or cleared. TBMT H remains low.

If bit 1 is set in the XCSR, the peripheral is inhibited. IC18A is set by RDAB 1 H and SE 4 OUT H. This forces TD L to a high level until IC18A is reset or cleared.

If SEL 6 OUT H is asserted high (output data), IC17B is set. 150 nanoseconds later, TD L is asserted low. When IC17B is set, TBMT H goes low. When DT L goes high, IC17B is cleared and forces TD L to a high level. When DT L goes low, TBMT H goes high and indicates the peripheral is ready for another character.

INPUT/OUTPUT LATCHES

The input and output latches are TTL, positive edge-triggered D-type flip-flops. Input data is clamped to +5.6 volts maximum by the diode clamps before it is applied to the input latches. The input data is latched by latch RD H 400 nanoseconds after DS L is asserted by the I/O device.

SEL 6 OUT (W + LB) H and SEL 6 OUT (W + HB) H are generated by the function decoding and control circuitry in response to the input signals listed in Table B (Page 27). Assertion of SEL 6 OUT (W + LB) H latches the data (present at the low-byte bus receivers outputs) into the low-byte output latch. Assertion of SEL 6 OUT (W + HB) H latches the data present at the output of the high-byte bus receivers into the high-byte output latch.

TABLE B

FUNCTION, DECODING, AND CONTROL INPUT SIGNALS

RDAB ø H	RDAB 1 H	RDAB 2 H	WTBT H	DIN H	DOUT H	OUTPUT	FUNCTION	ADDRESS
X	0	0	X	1	0	$\overline{\text{DAL 2 H}}$ $\overline{\text{DAL 1 L}}$	READ RCSR	0 OR 1
X	0	0	X	0	1	SEL ø OUT H	WRITE RCSR	0 OR 1
X	1	0	X	1	0	DAL 1 L READ DATA L	READ RBUF WORD	2 OR 3
X	0	1	X	1	0	DAL 2 H	READ XCSR	4 OR 5
X	0	1	X	0	1	SEL 4 OUT H	WRITE XCSR	4 OR 5
0	1	1	1	0	1	SEL 6 OUT WTBT H	WRITE XBUF LOW BYTE	6
1	1	1	1	0	1	SEL 6 OUT WTBT H	WRITE XBUF HIGH BYTE	7
X	1	1	0	0	1	SEL 6 OUT WTBT L	WRITE XBUF WORD	6 OR 7

X = DON'T CARE

INTERRUPT LOGIC

The interrupt logic circuitry allows the PIM to interrupt the processor. Interrupts may be either receiver or transmitter generated. The receiver generated interrupt, however, has the higher priority.

A receiver-generated interrupt occurs if bit 6 in the RCSR is set (interrupts enabled) and DA H is asserted. Bit 6 is set under program control and is latched by IC24A. This asserts RD INT EN H. When the I/O interface logic receives data from the I/O device, DA H is asserted. The combination of DA H and RD INT EN H causes the interrupt logic to assert BIRQ L. The processor then responds (if program status word, bit 7, is not set) by asserting BDIN L. Approximately 150 nanoseconds later, BIAKO L is asserted. BIAKO L is received by the parallel card as BIAKI L from the bus. BIAKI L causes the interrupt logic to clear IC16A, which negates BIRQ L if the transmitter is not also requesting an interrupt. BIAKI L also causes the interrupt logic to assert VEC 1 L which enables the data selector to gate the vector jumper address to the low byte bus drivers. The PIM asserts BRPLY L approximately 150 nanoseconds after the assertion of the VEC 1 L. When the processor receives BRPLY L and the vector address, it negates BDIN L and BIAKO L. The PIM responds by negating VEC 1 L and BRPLY L.

A transmitter-generated interrupt operates similar to a receiver-generated interrupt. A transmitter-generated interrupt occurs if bit 6 in the XCSR is set, TBMT H is asserted, and a receiver interrupt is not present. Bit 6 is set under program control and is latched by IC16B. This asserts TD INT EN H. When the I/O interface logic is ready to accept another character for transmission to the parallel I/O device, TBMT H is asserted. When a transmitter interrupt is initiated, the same sequence of signals occurs as in a receiver-generated interrupt, except that VEC 2 H is also asserted by the interrupt logic when the processor asserts BDIN L. VEC 2 H is gated through the data selector to the bus drivers when VEC 1 L is asserted. This causes the least significant octal digit of the vector address to change from 0_8 to 4_8.

The interrupt logic will pass the BIAKO L signal out to the system bus if the PIM is not requesting an interrupt. If the PIM is requesting an interrupt, it will not pass the BIAKO L. The module electrically nearest the processor will be serviced first if more than one module is requesting an interrupt. This feature allows the user to select interrupt priority by physical placement of the modules in the backplane.

GLOSSARY OF SIGNAL TERMS

SIGNAL NOMENCLATURE	FUNCTION	SIGNAL TRUE CONDITION OCCURS WHEN LINE IS:
AD H	Address detect	high
BBS7 L	Bus band select 7	low
BDAL 0-15 L	Bus data/address lines	low
BDAL2 L	Bus data/address line 2	low
BDIN L	Bus data in	low
BHALT L	Bus halt	low
BIAKI L	Bus interrupt acknowledge in	low
BIAKO L	Bus interrupt acknowledge out	low
BIRO L	Bus interrupt request	low
BRPLY L	Bus reply	low
BS7 H	Bank select 7	high
CLK L	Clock	low
DA H	Data available	high
DAL 0-15 H	Data address line	high
DAL1 L	Data/address line 1	low
DAL2 H	Data/address line 2	high
DIN H	Data in	high
DINOUT H	Data out	high
DS	Data sent	low
DT	Data taken	low
DINXM E	Data in and module enable	low
FE H	Framing error	high
ME H	Module enable	high
ME L	Module enable	low
RD 0-7 H	Receive data from UART	high
RDAB 0-7 H	Receive data/address from bus	high
RDABϕ H	Receive data/address from bus ϕ	high
RDAB1 H	Receive data/address from bus 1	high
RDAB2 H	Receive data/address from bus 2	high
RDINTEN H	Receive interrupt enable	high
RDDT L	Receive data driver enable	low
RD8-15 H	Receive data 8-15	high
SD L	Send data	low
SO H	Serial output	high
SELϕOUT H	Select ϕ out	high
SEL4OUT H	Select 4 out	high
SEL6OUT H	Select 6 out	high
SYNC H	Sync	high
SYNC L	Sync	low
TD L	Take data	low
TCSRϕ L	Transmit control status register ϕ	low
TBMT H	Transmit buffer empty	high
TDINTEN H	Transmit interrupt enable	high
TTLSDIN H	TTL serial data in	high
VEC1 L	Vector 1	low
VEC2 H	Vector 2	high
WTBT H	Write/byte	high

NOTE: Any signal nomenclature which begins with "B" is a "bus signal."

CIRCUIT BOARD X-RAY VIEW

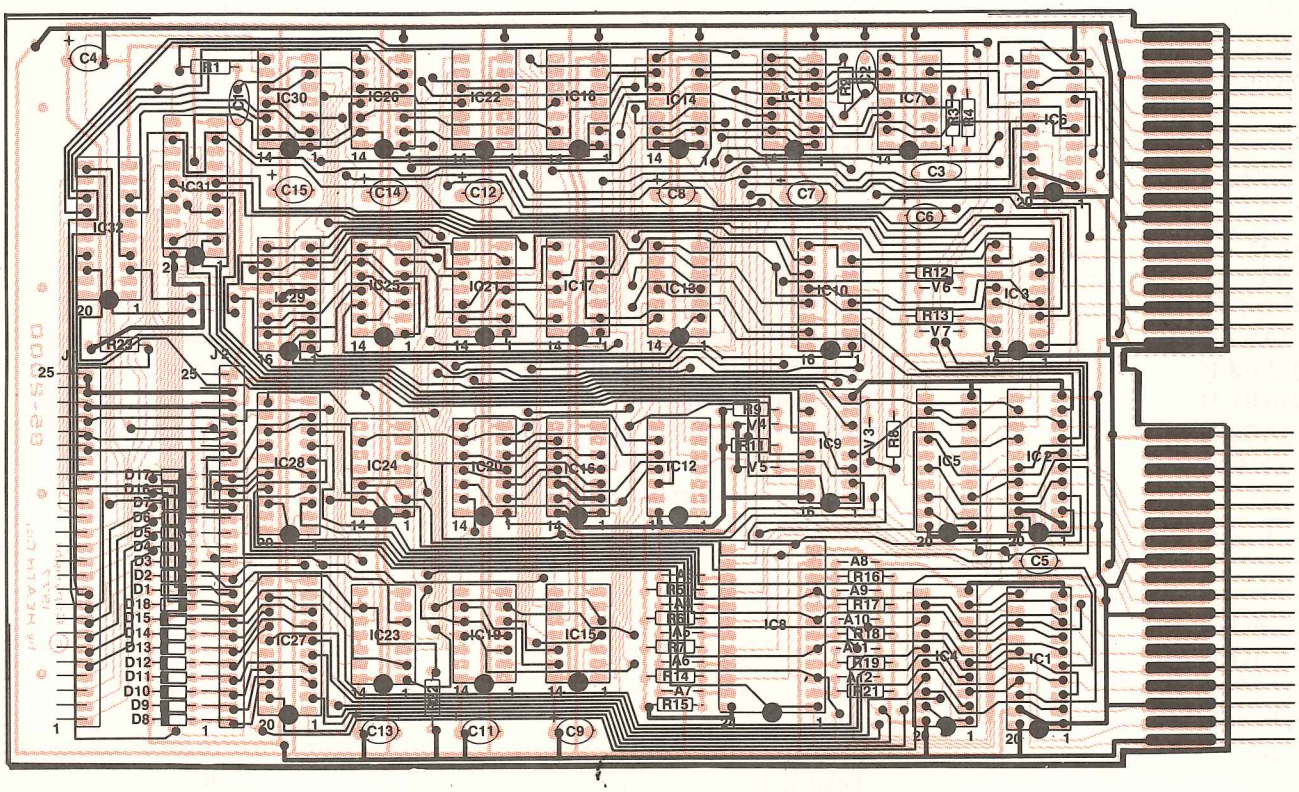
NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R101, C115, etc.) on the X-Ray View.

B. Locate this same number in the "Circuit Component Number" column of the "Parts List."

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

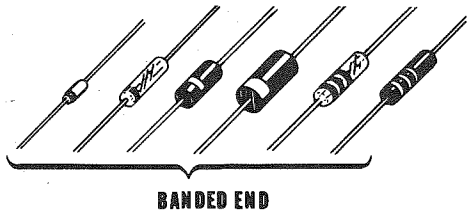
PARALLEL I/O CIRCUIT BOARD



(Shown from component side. Foil on component side is shown in red.)

SEMICONDUCTOR IDENTIFICATION CHARTS

DIODES

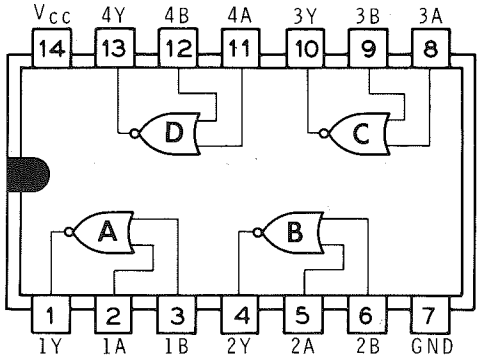
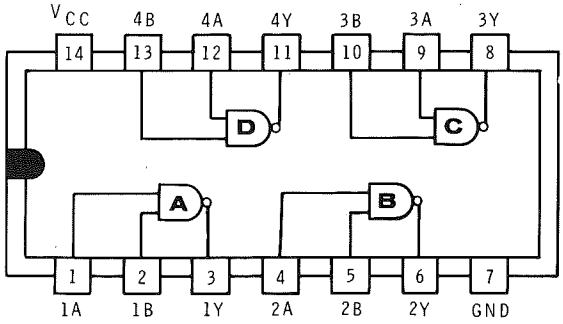
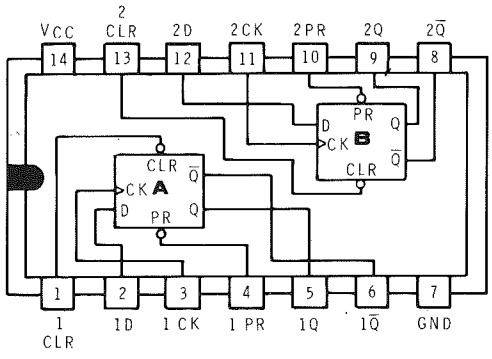
CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D1-D18	56-56	1N4149	NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES  BANDED END

INTEGRATED CIRCUITS

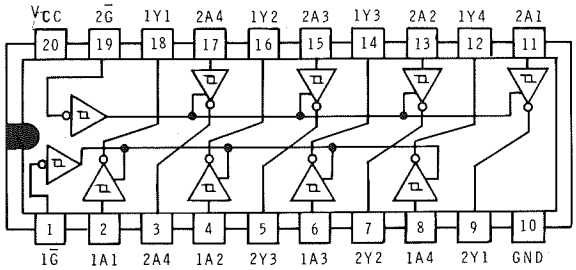
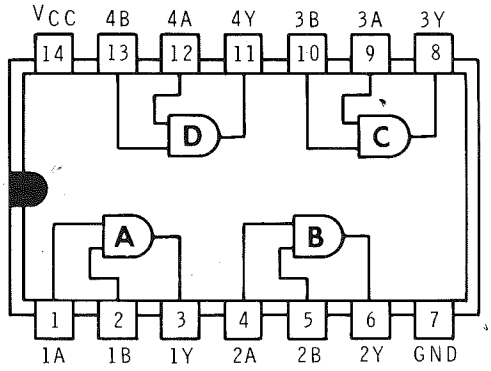
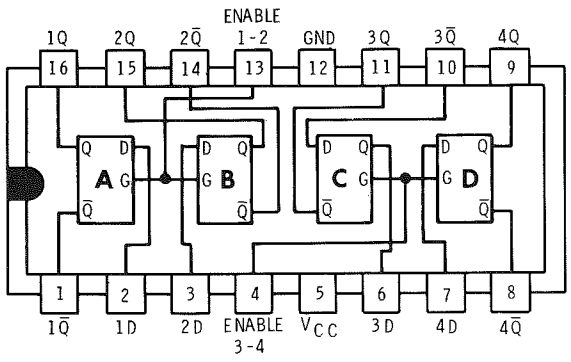
CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
IC1, IC2	443-754
IC3	443-802
IC4, IC5	443-753
IC6	443-754
IC7	443-77
IC8	443-796
IC9	443-799
IC10	443-802
IC11	443-780
IC12, IC13	443-728
IC14	443-798
IC15	443-780

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER
IC16-IC19	443-730
IC20	443-797
IC21	443-780
IC22	443-728
IC23	443-46
IC24	443-730
IC25	443-800
IC26	443-780
IC27, IC28	443-803
IC29	443-781
IC30	443-730
IC31, IC32	443-803

Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-46	7402	IC23	QUAD 2-INPUT POSITIVE NOR GATES	
443-77	7438	IC7	QUAD 2-INPUT POSITIVE NAND BUFFERS	
443-728	74LS00 OR 9LS00	IC12, IC13, IC22	QUAD 2-INPUT POSITIVE NAND GATES	
443-730	74LS74 OR 9LS74	IC16-IC19, IC24, IC30	DUAL D-TYPE POSITIVE EDGE-TRIGGERED FLIP-FLOPS	

Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-753	74S240 OR 9S240	IC4, IC5	OCTAL BUFFERS 3-STATE OUTPUTS	
443-754	74LS240 OR 9LS240	IC1, IC2, IC6	OCTAL BUFFERS 3-STATE OUTPUTS	
443-780	74LS08 OR 9LS08	IC11, IC15, IC21, IC26	QUAD 2-INPUT AND GATES	
443-781	74LS75 OR 9LS75	IC29	4-BIT BISTABLE LATCHES	

Integrated Circuits (cont'd.)

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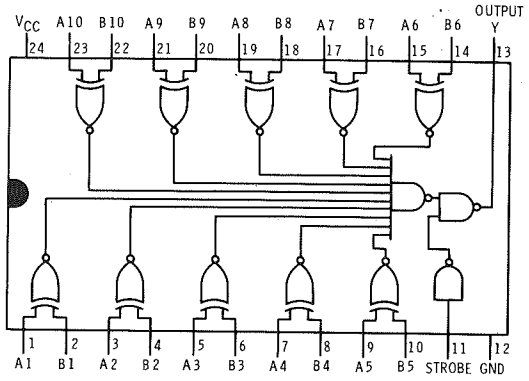
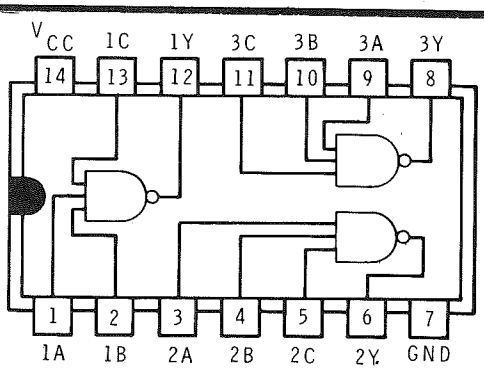
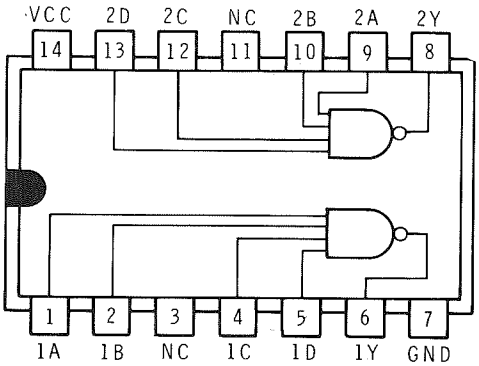
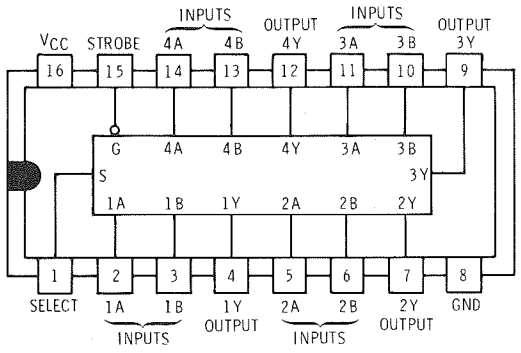
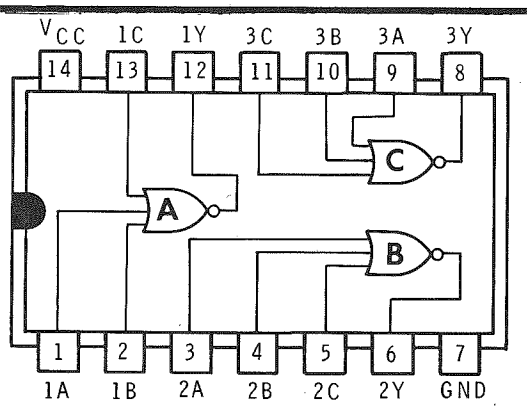
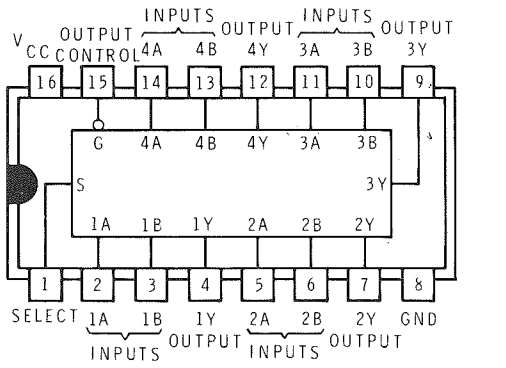
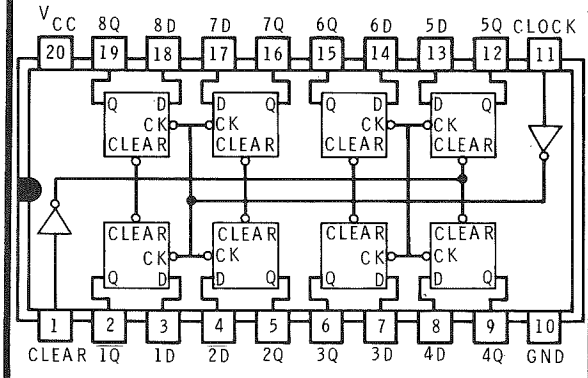
443-796	8130	IC8	MAGNITUDE COMPARATOR	
443-797	74LS10 OR 9LS10	IC20	TRIPLE 3-INPUT POSITIVE NAND GATES	
443-798	74LS20 OR 9LS20	IC14	DUAL 4-INPUT POSITIVE NAND GATES	

Integrated Circuits (cont'd.)

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	DESCRIPTION	LEAD CONFIGURATION (TOP VIEW)
443-799	74LS157 OR 9LS157	IC9	QUAD 2-LINE TO 1-LINE DATA SELECTORS/MULTIPLEXERS	
443-800	74LS27 OR 9LS27	IC25	TRIPLE 3-INPUT POSITIVE NOR GATES	
443-802	74LS257 OR 9LS257	IC3, IC10	QUAD 2-LINE TO 1-LINE DATA SELECTORS/ MULTIPLEXERS WITH 3-STATE OUTPUTS	
443-803	74273	IC27, IC28, IC31, IC32	OCTAL D-TYPE FLIP-FLOPS	

HEATH
Schlumberger

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

February 24, 1978

IMPORTANT NOTICE

Please make the following changes in your Manual before you start to assemble the kit.

Page 6 — Under "Resistors — Capacitors," add:

A1	1-35-12	470 Ω (yellow-violet-brown)	R24
A1	6-102-12	1 kΩ (brown-black-red)	R25

Page 15 — Cut out the new Part A of Detail 1-7A and tape it over the corresponding area on Page 15.

Page 16 — Add the following Note to the top of the right column just before "Circuit Board Checkout."

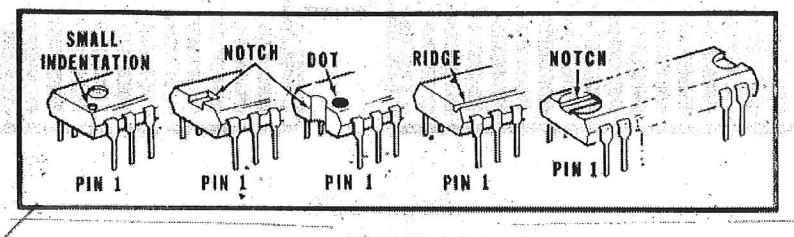
NOTE: Proceed first to the step on Page 16A on the back of the Important Notice and perform the steps as indicated. Then return to this place in the Manual.

Page 16A — Turn this Notice over and place it between Pages 16 and 17 in your Manual.

Thank you,

HEATH COMPANY

Part A

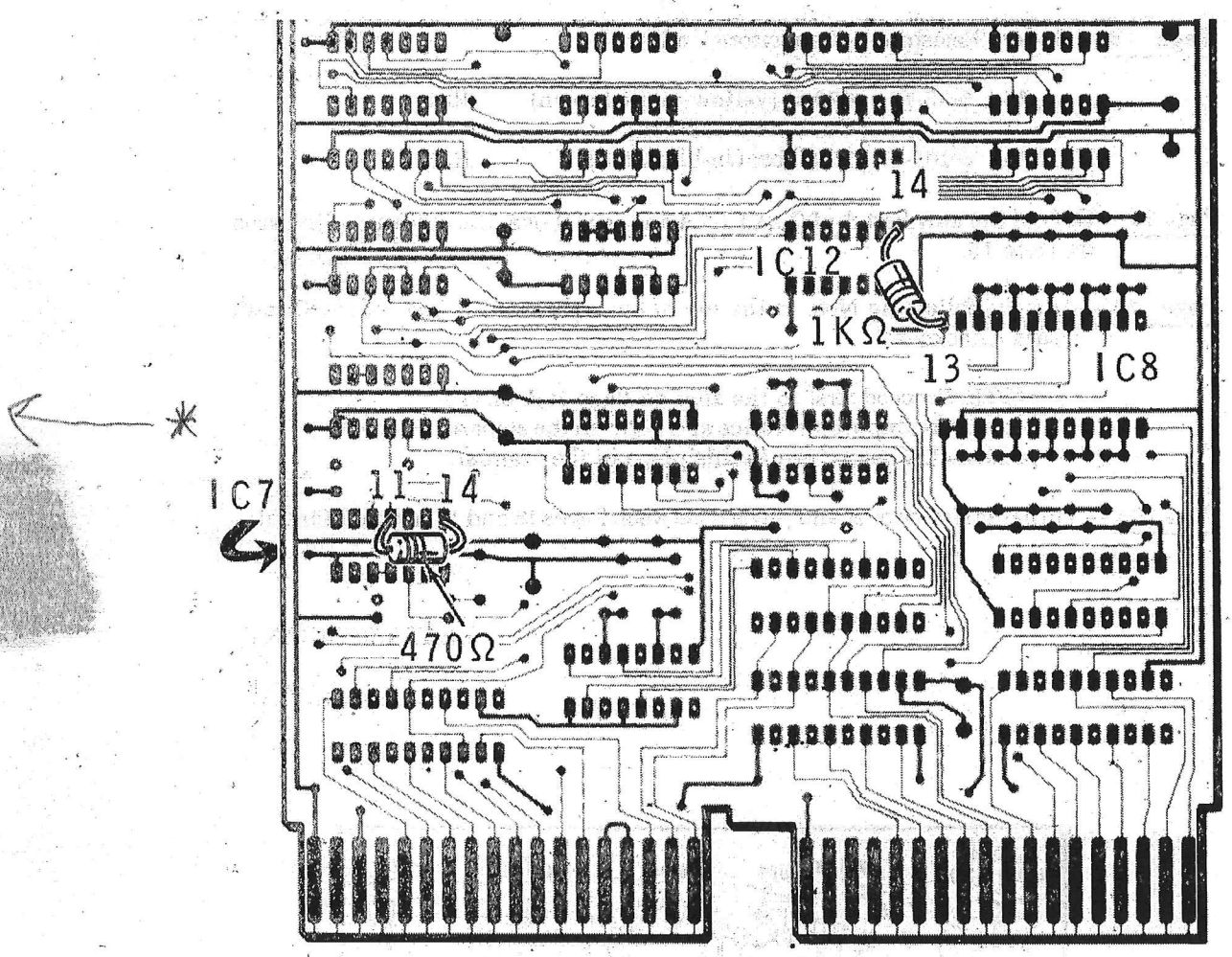


Detail 1-7A

P 15

( ) R24: Refer to Detail 1-7C and install a 470 Ω (yellow-violet-brown) resistor between pins 11 and 14 of IC7 ON THE FOIL SIDE of the circuit board. Keep the leads short and solder them directly to the foil.

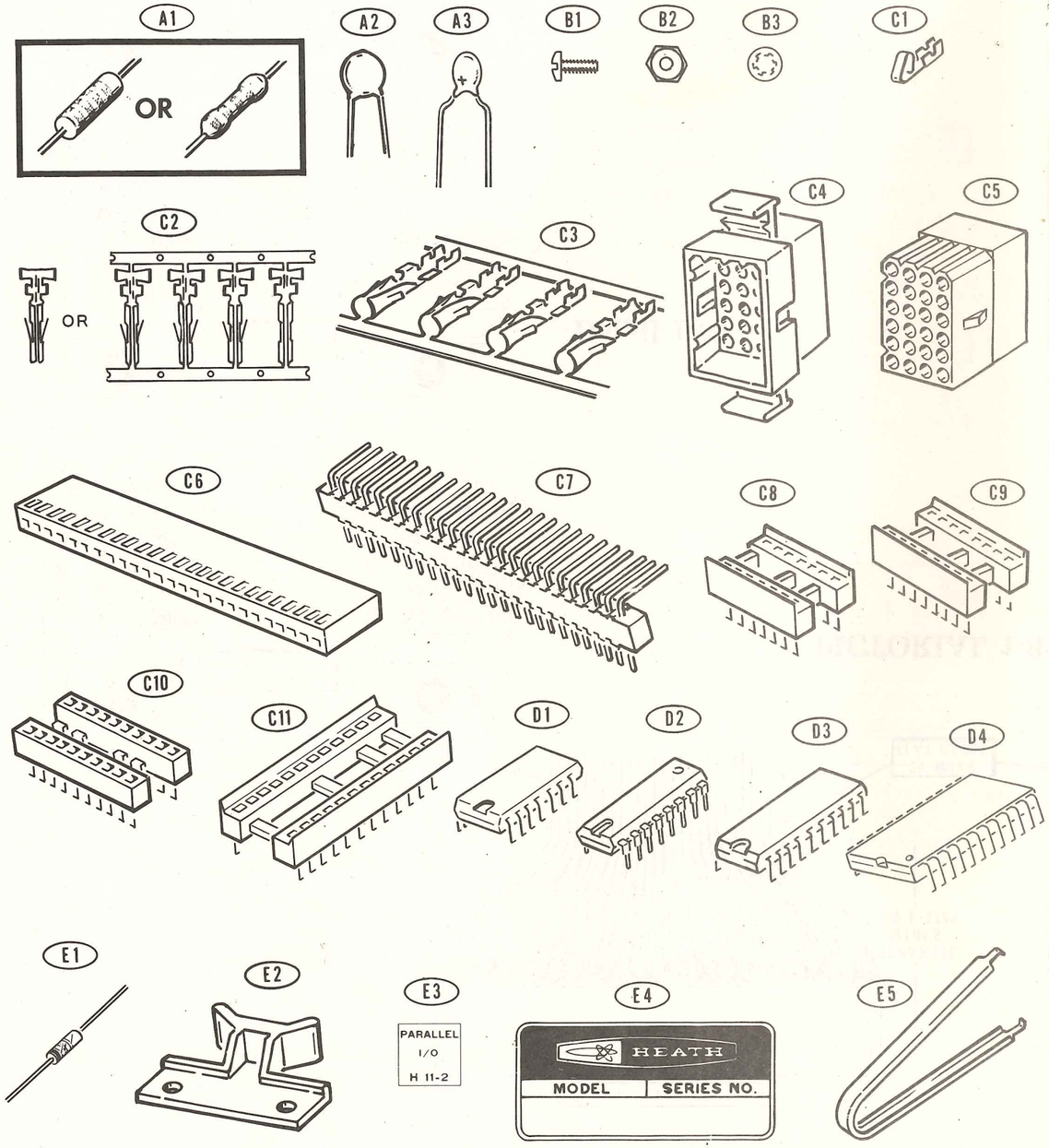
( ) R25: Refer to Detail 1-7C and install a 1 kΩ (brown-black-red) resistor between pin 13 of IC8 and pin 14 of IC12 ON THE FOIL SIDE of the circuit board. Keep the leads short and solder them directly to the foil.

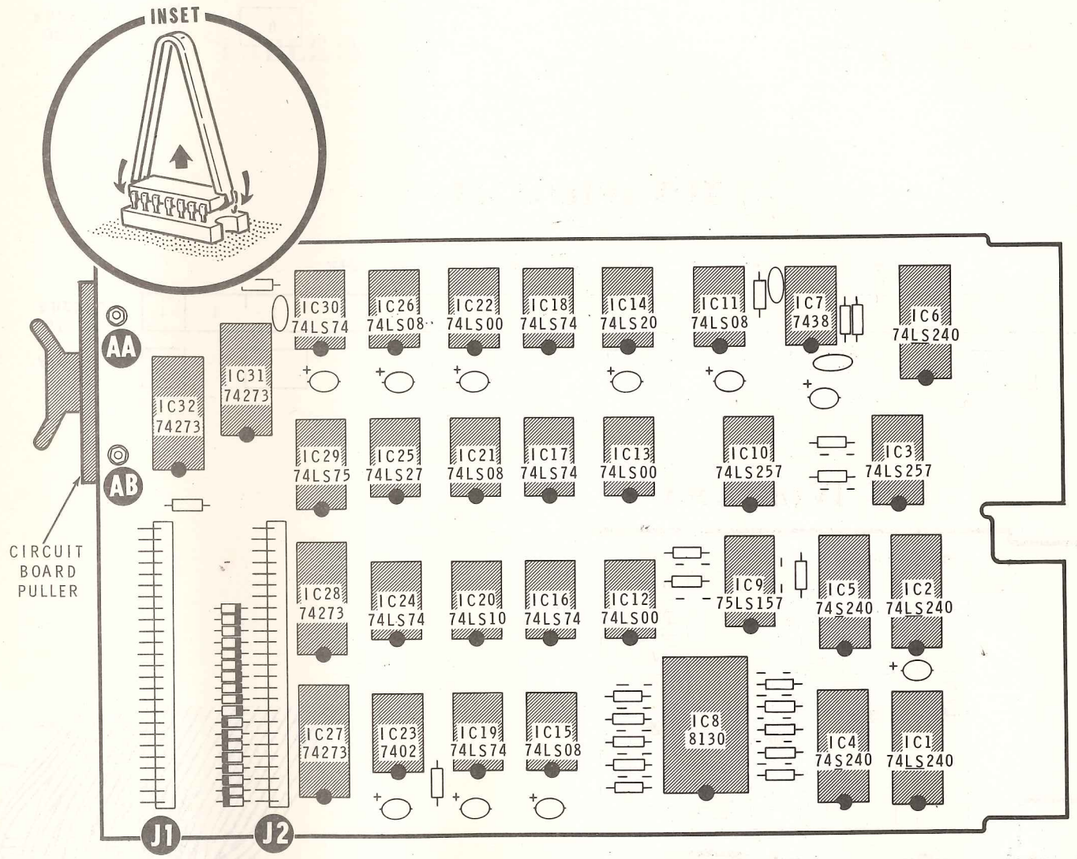


Detail 1-7C

ILLUSTRATION BOOKLET

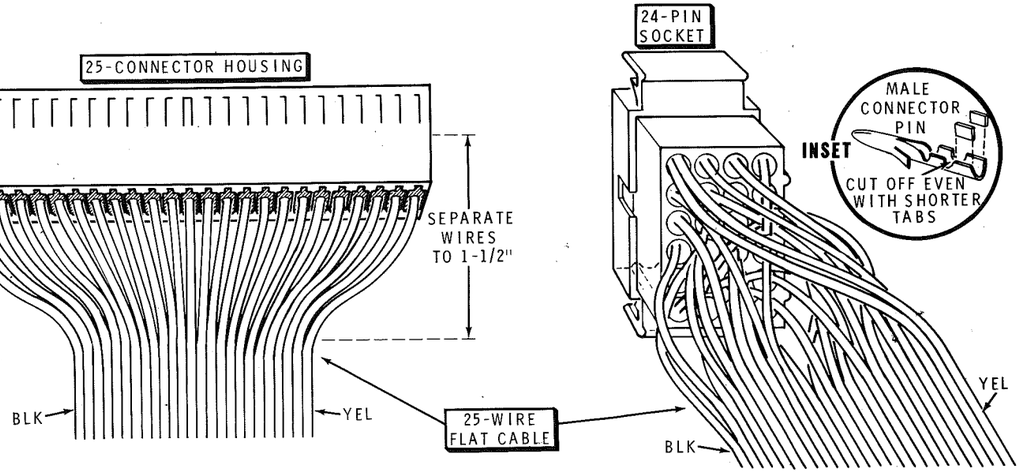
Part of 595-2015



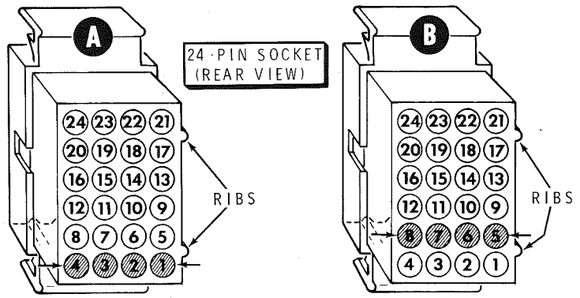


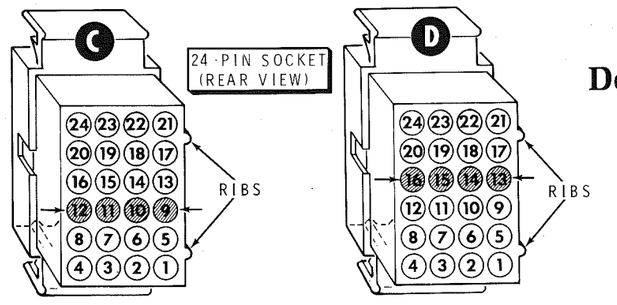
PICTORIAL 1-7

Model H11-2

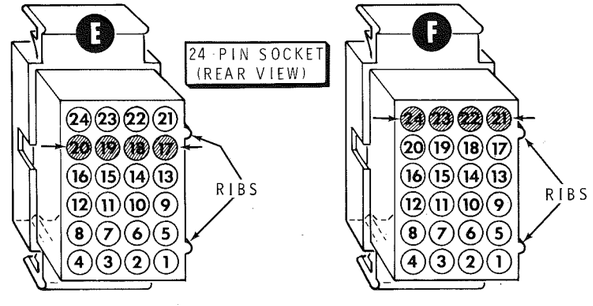


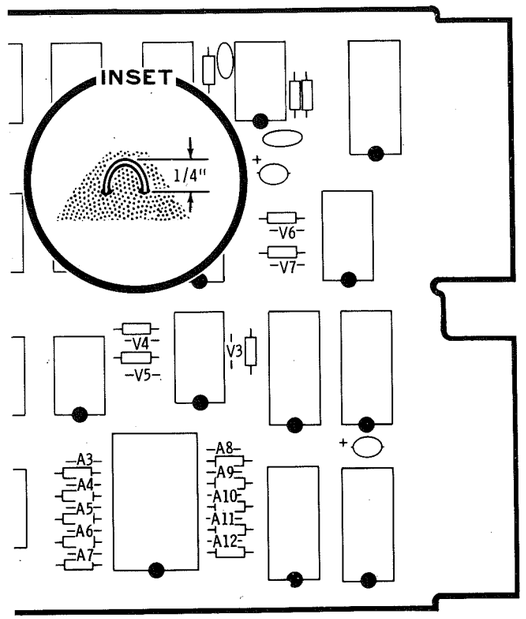
PICTORIAL 1-8



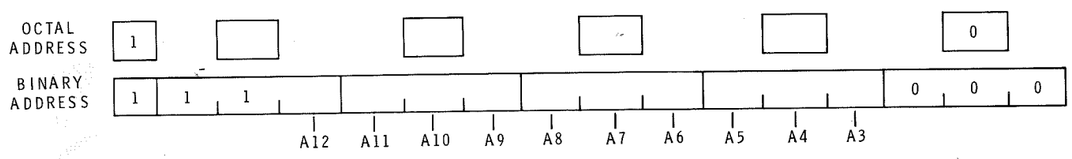


Detail 1-8F

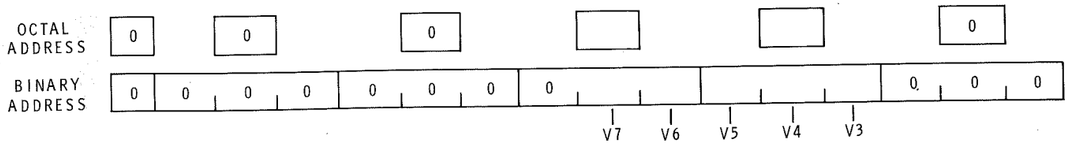




PICTORIAL 1-10



PICTORIAL 1-11



PICTORIAL 1-12

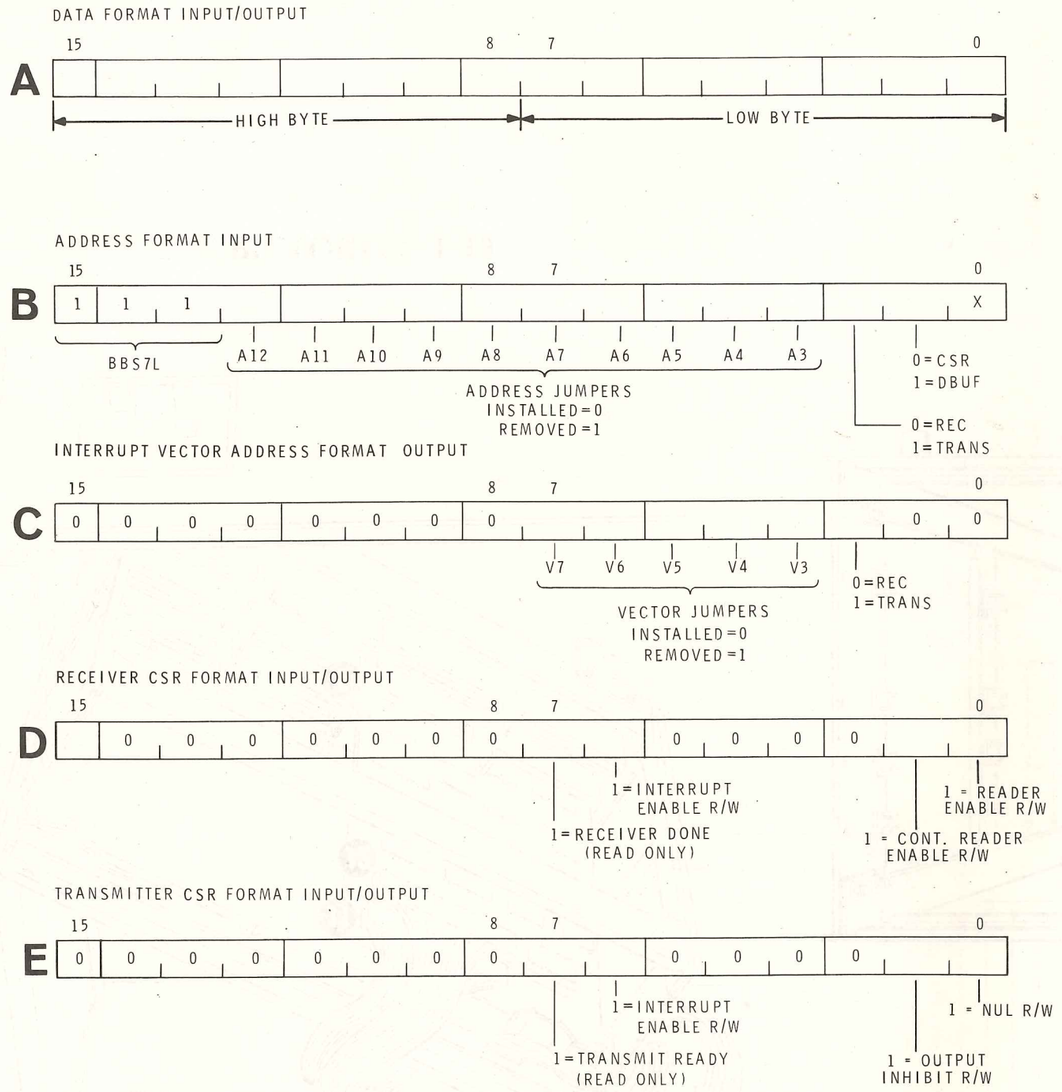
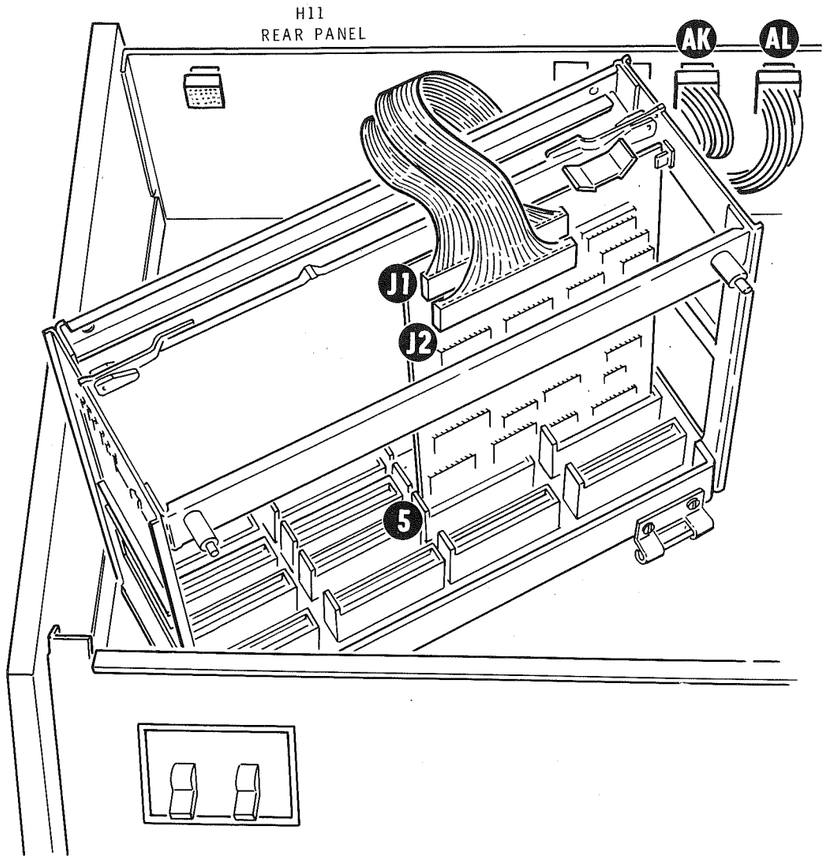


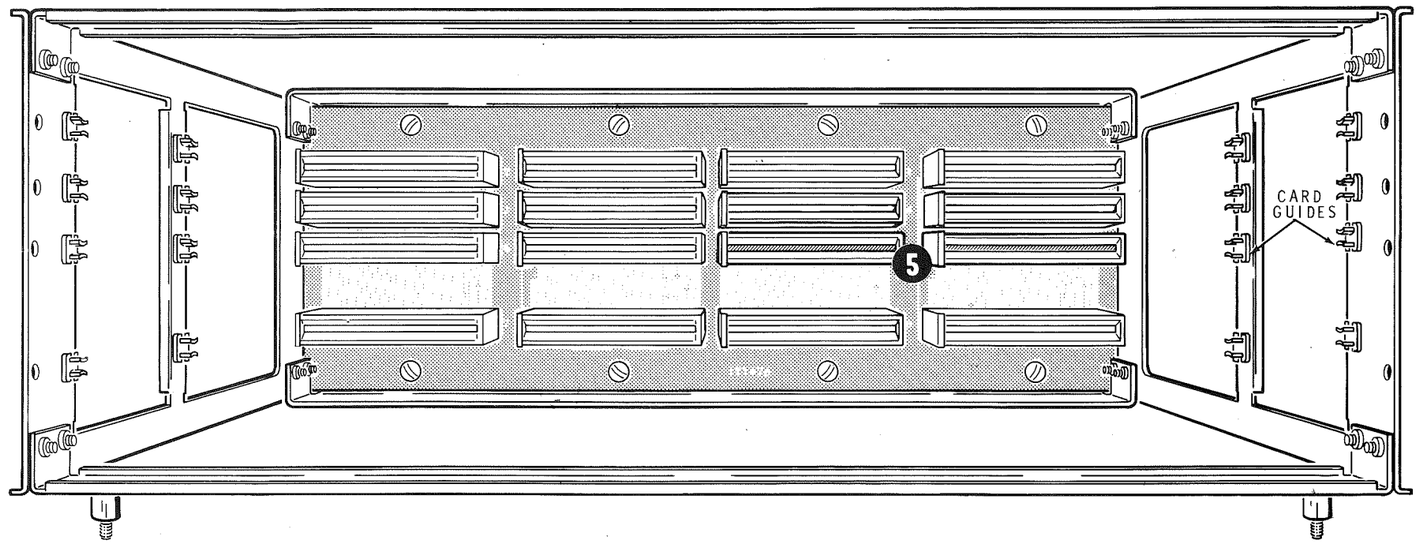
Figure 1-1

TABLE A

WORD	BIT(S)	FUNCTION
RCSR	15-08	Not used. Read as 0.
	07	Receiver Done. Set when an entire character has been received and is ready for input to the processor. This bit is automatically cleared when RBUF, is addressed, when bit ϕ of the RCSR is set, or when BINIT L goes low. A receiver interrupt is enabled by the H11-2 when this bit is set and receiver interrupt is enabled (bit 6 is also set). Read-only bit.
	06	Interrupt Enable. Set under program control when it is desired to generate a receiver interrupt request when a character is ready for input to the processor (bit 7 is set). Cleared under program control or by the BINIT signal. Read/Write bit.
	05-02	Not used. Read as 0.
	01	Run Reader Continuous Read/Write bit. (If the send data L signal is inverted and returned to the data sent L terminal, a transparent input port results when this bit is set.) NOTE: Do not operate in this mode if interrupt enable (bit 6) is set.
	00	Send Data. Set by program control to request a data word from a peripheral device. Automatically cleared by the new character's start bit. Write-only bit.
RBUF	15-08	Contains eight data bits (high byte).
	07-00	Contains eight data bits (low byte).
XCSR	15-08	Not used. Read as 0.
	07	Transmit Ready. Set when XBUF is empty and can accept another character for transmission. It is also set by the BINIT L signal. Automatically cleared when XBUF is loaded. When transmitter interrupt is enabled (bit 6 also set), an interrupt request is asserted by the H11-2 when this bit is set. Read-only bit.
	06	Interrupt Enable. Set under program control when it is desired to generate a transmitter interrupt request when the H11-2 is ready to accept a character for transmission. Reset under program control or by the BINIT signal. Read/Write bit.
	05-02	Not used. Read as 0.
	01	Output Inhibit/Read/Write bit.
	00	NUL. Set or reset under program control. When set a continuous space level is transmitted. BINIT resets this bit. Read/Write bit.
XBUF	15-08	Contains eight data bits. Loaded under program control for parallel transmission to a device. Write only (high byte).
	07-00	Contains eight data bits. Loaded under program control for parallel transmission to a device. Write only (low byte).

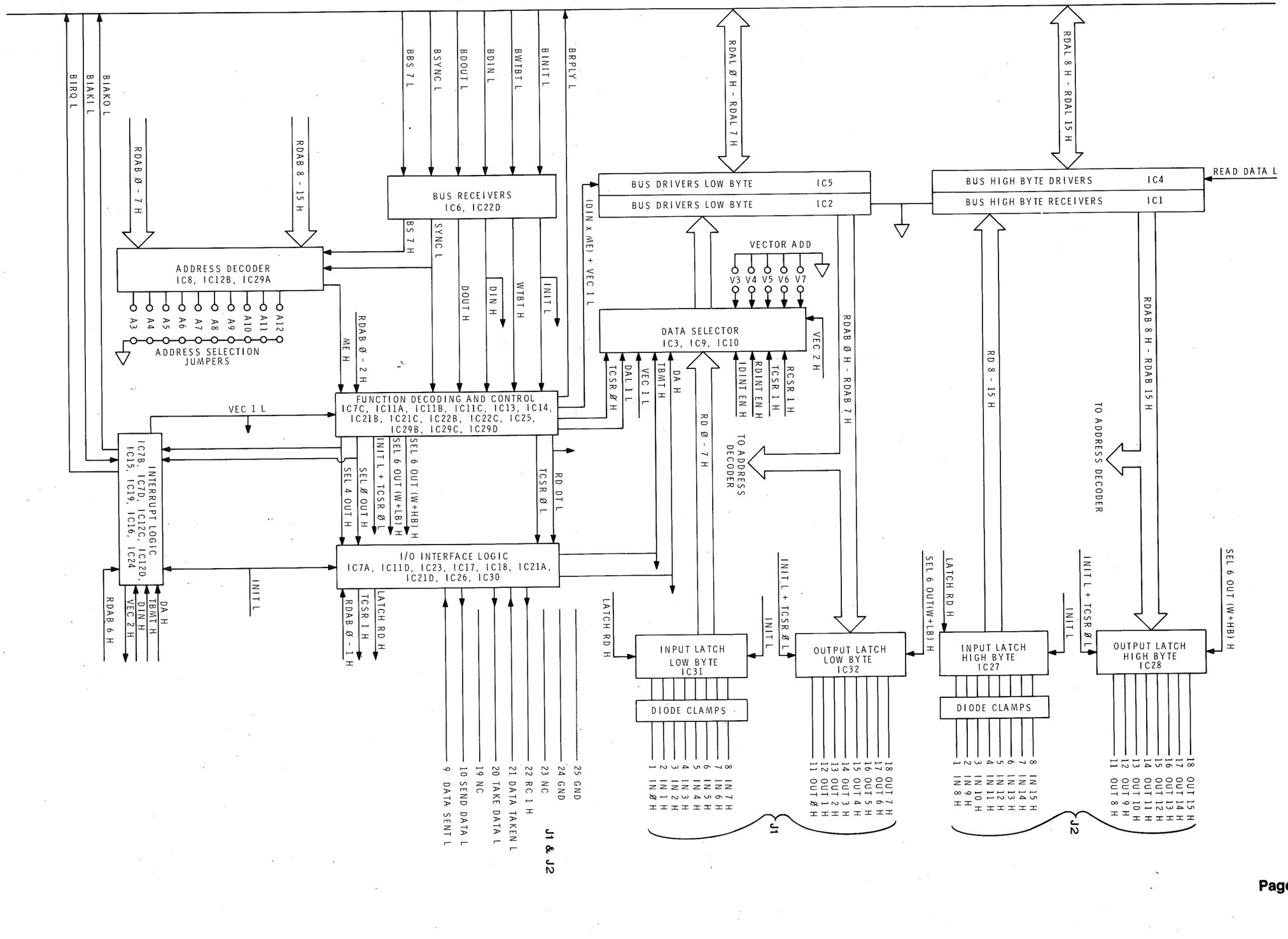


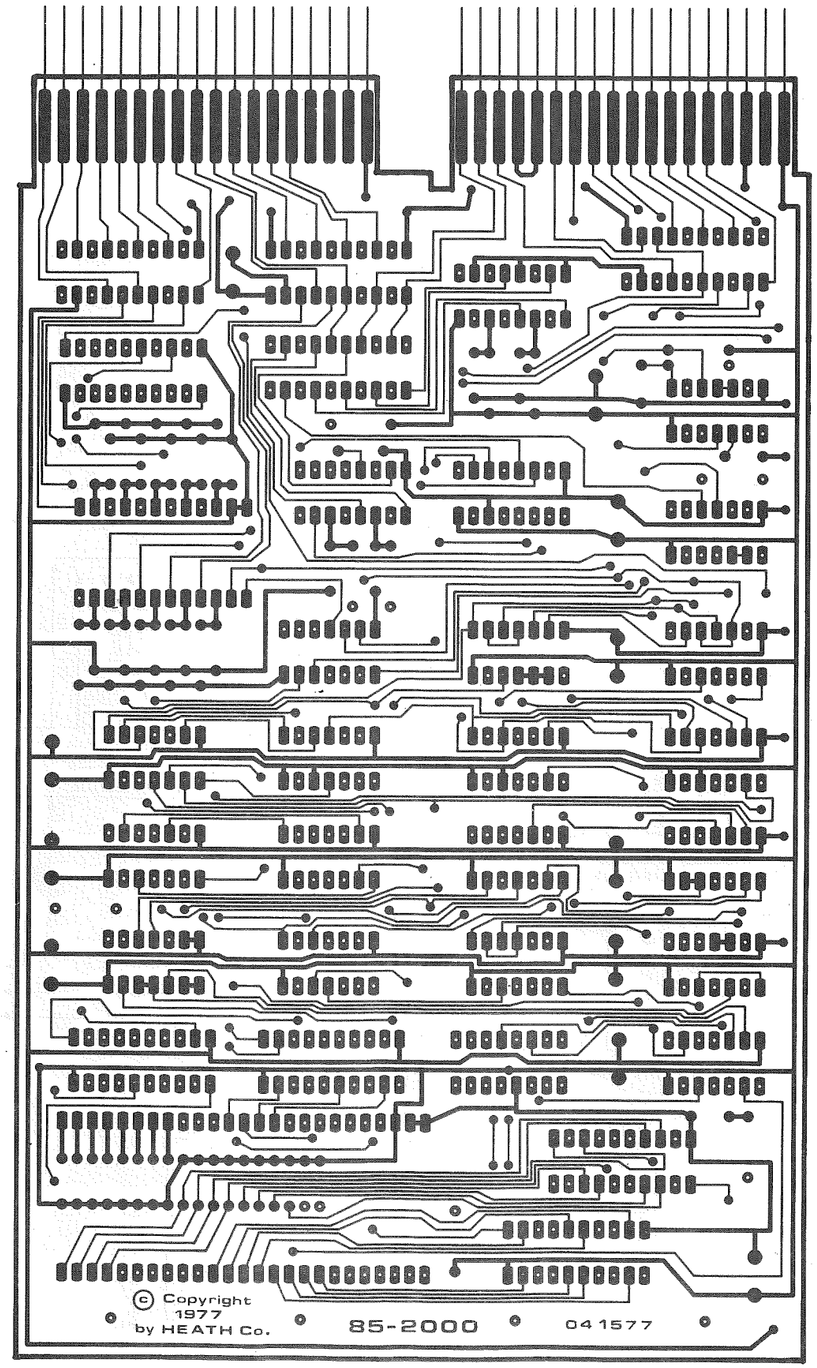
PICTORIAL 1-13



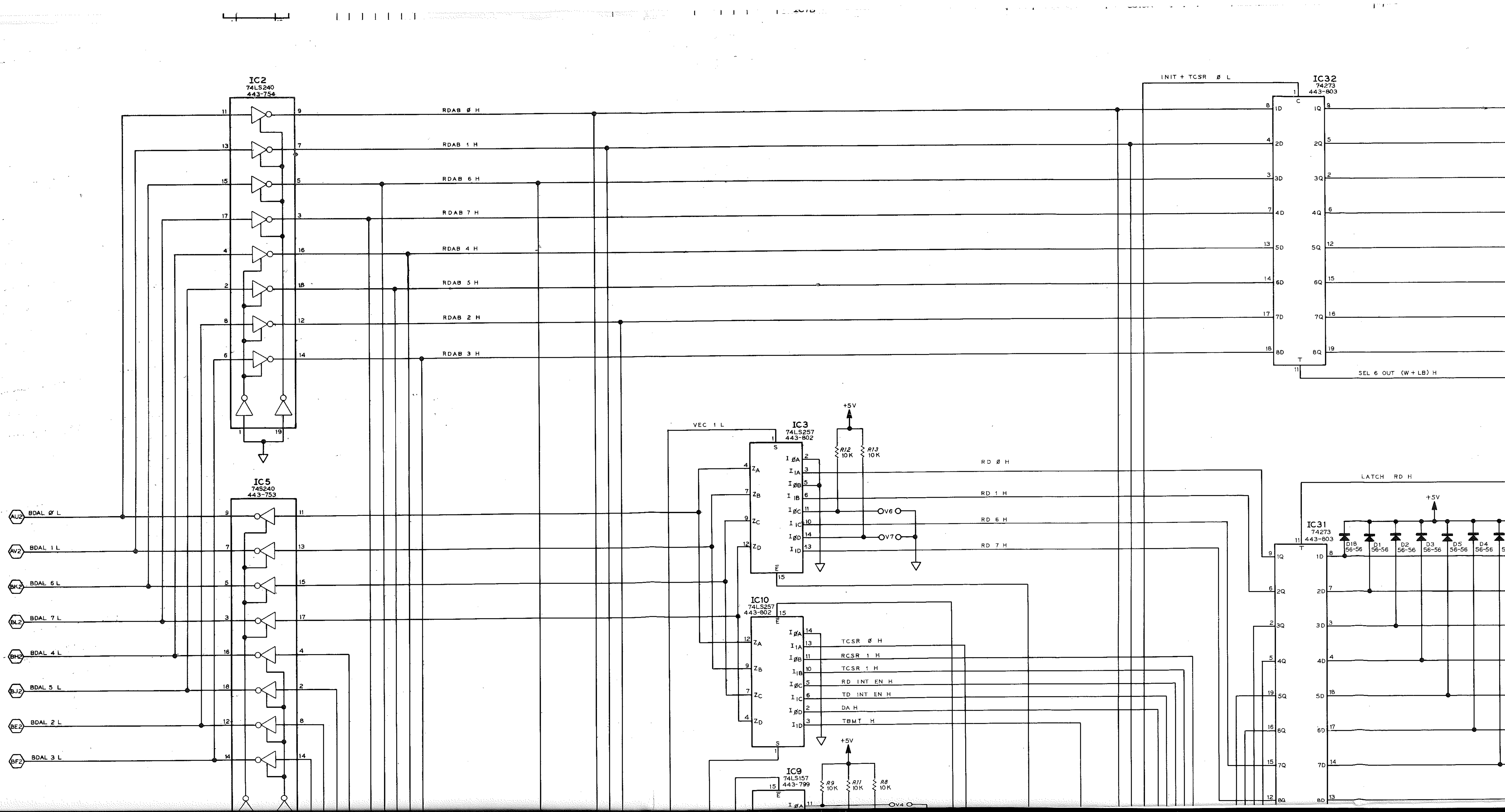
Detail 1-13B

BLOCK DIAGRAM

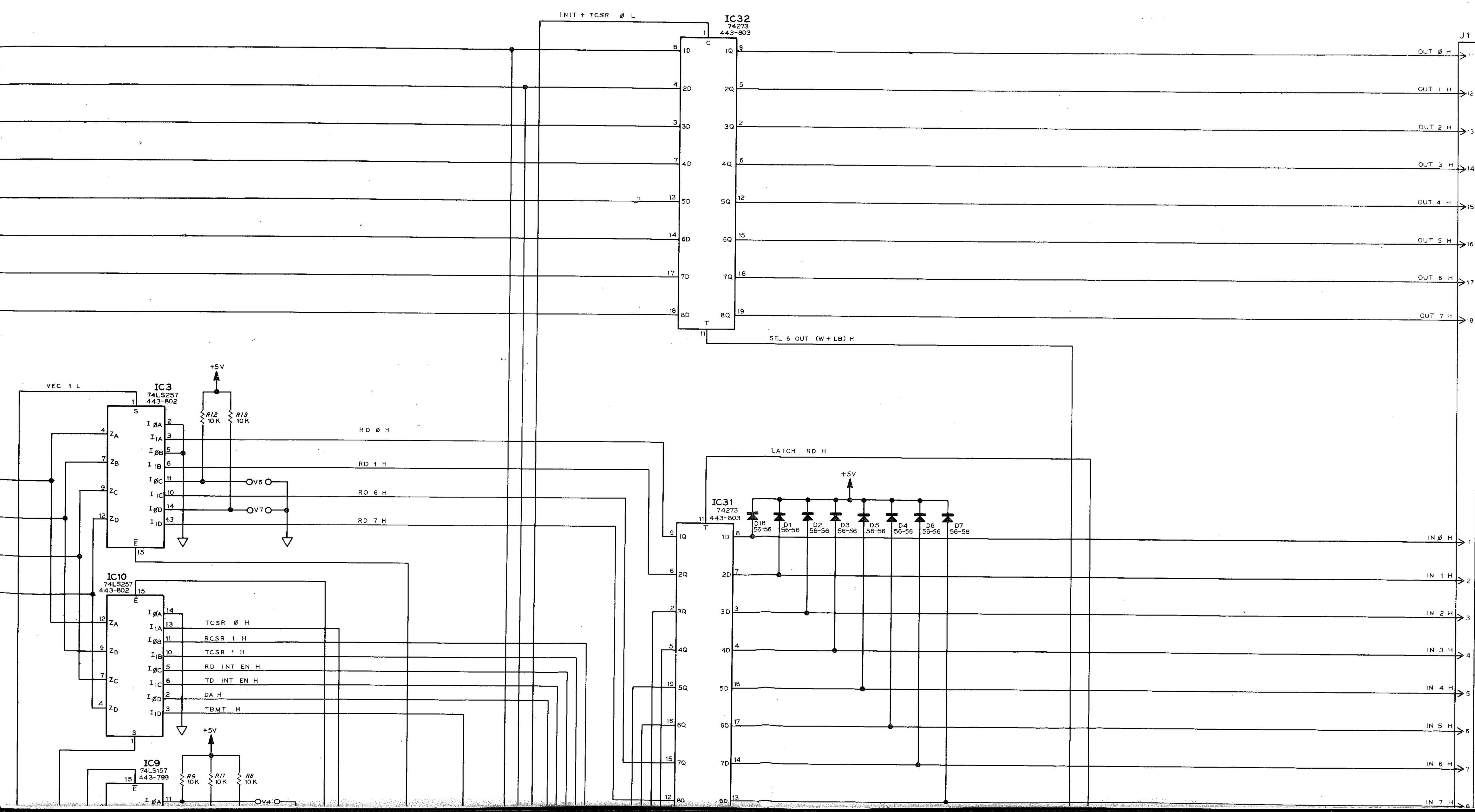




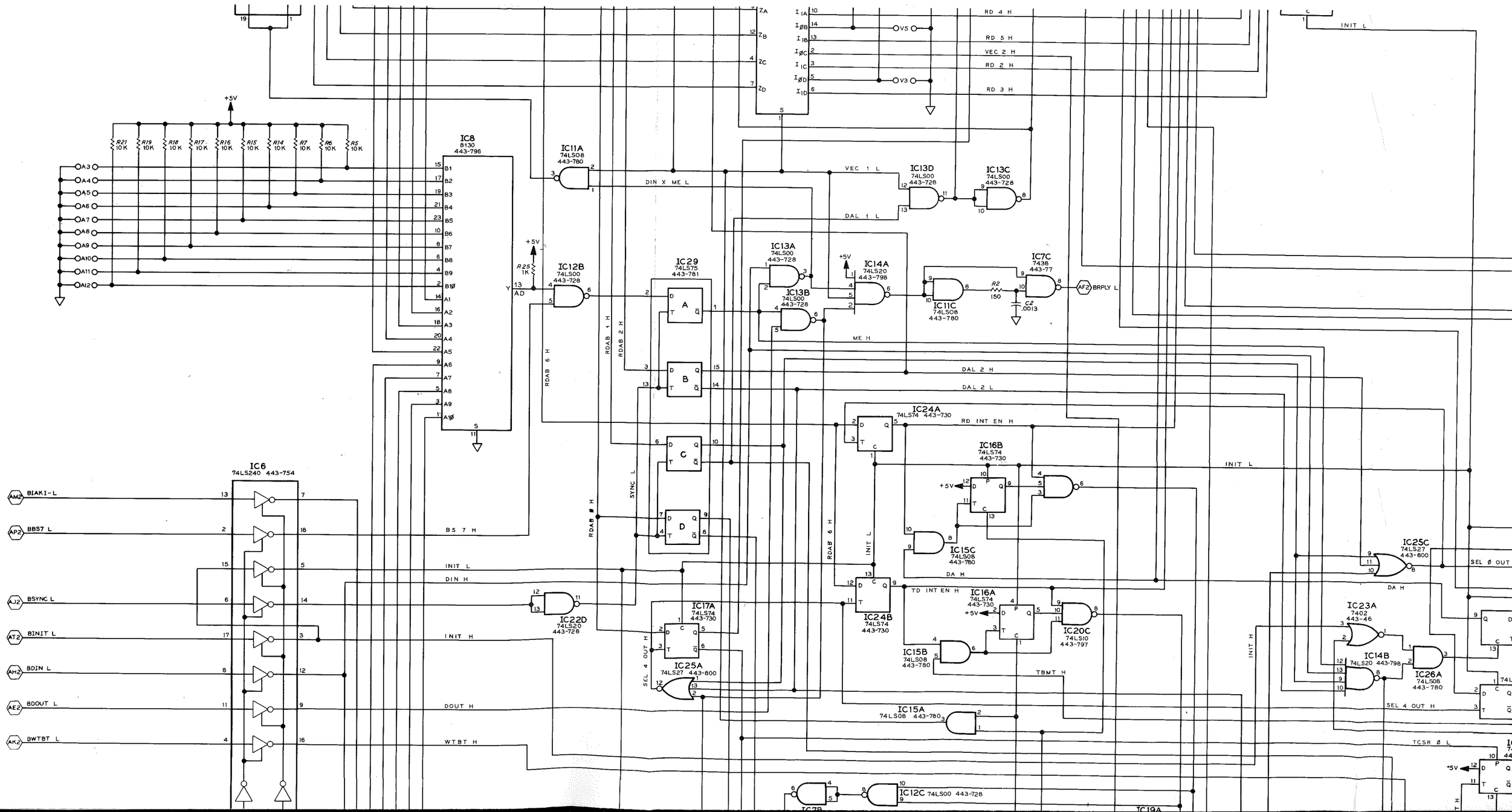
(Shown from foil side.)



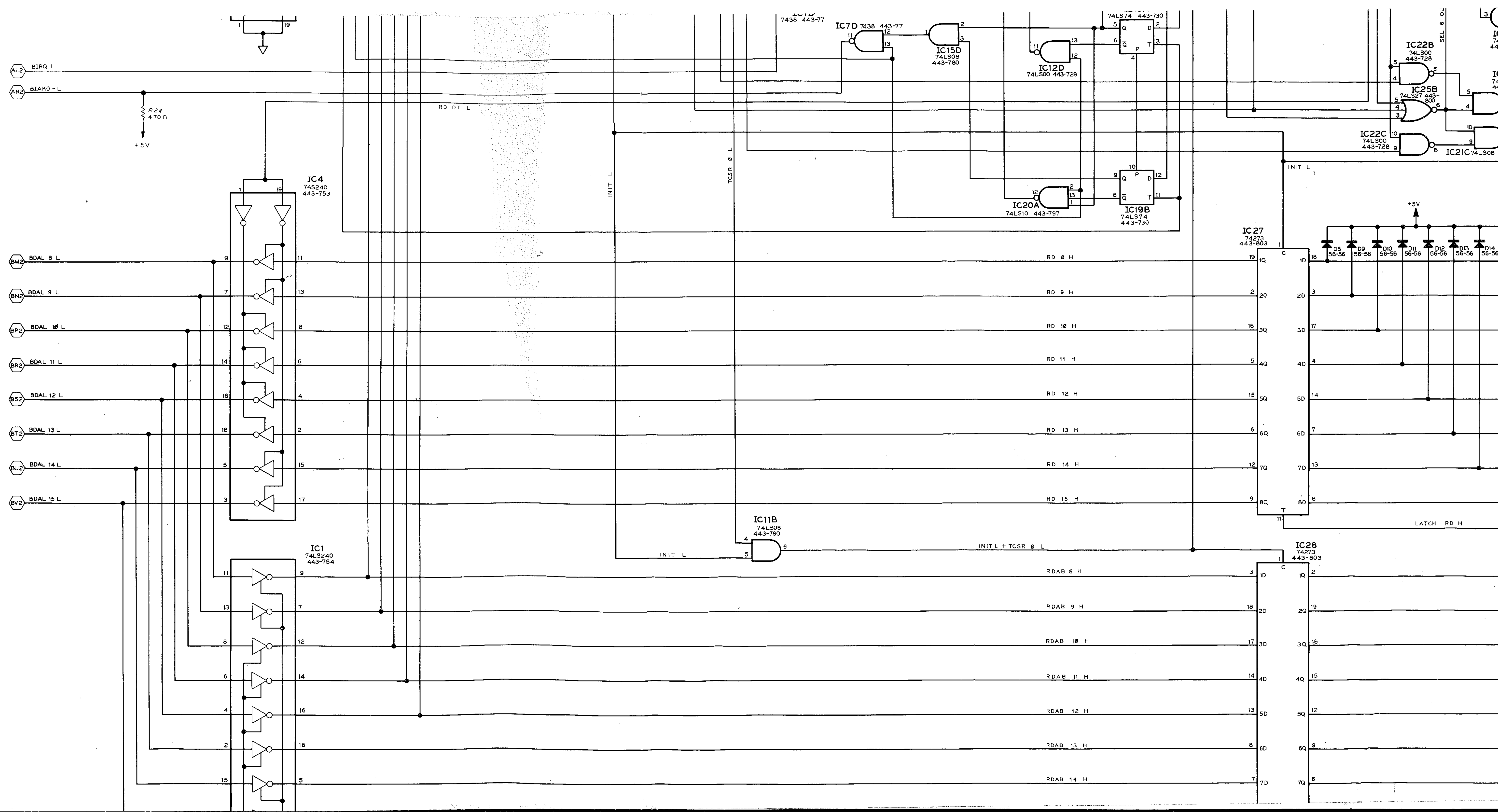
IC2
74LS240
443-754
IC5
74S240
443-753
IC3
74LS257
443-802
IC10
74LS257
443-802
IC9
74LS157
443-799
IC32
74273
443-803
IC31
74273
443-803
RDAB Ø H
RDAB 1 H
RDAB 6 H
RDAB 7 H
RDAB 4 H
RDAB 5 H
RDAB 2 H
RDAB 3 H
INIT + TCSR Ø L
SEL 6 OUT (W + LB) H
VEC 1 L
RD Ø H
RD 1 H
RD 6 H
RD 7 H
LATCH RD H
TCSR Ø H
RCSR 1 H
TCSR 1 H
RD INT EN H
TD INT EN H
DA H
TBMT H
BDAL Ø L
BDAL 1 L
BDAL 6 L
BDAL 7 L
BDAL 4 L
BDAL 5 L
BDAL 2 L
BDAL 3 L
AU2
AV2
BK2
BL2
BH2
BJ2
BE2
BF2
+5V
R12 10K
R13 10K
R9 10K
R11 10K
R8 10K
V6
V7
V4
D18 56-56
D1 56-56
D2 56-56
D3 56-56
D5 56-56
D4 56-56

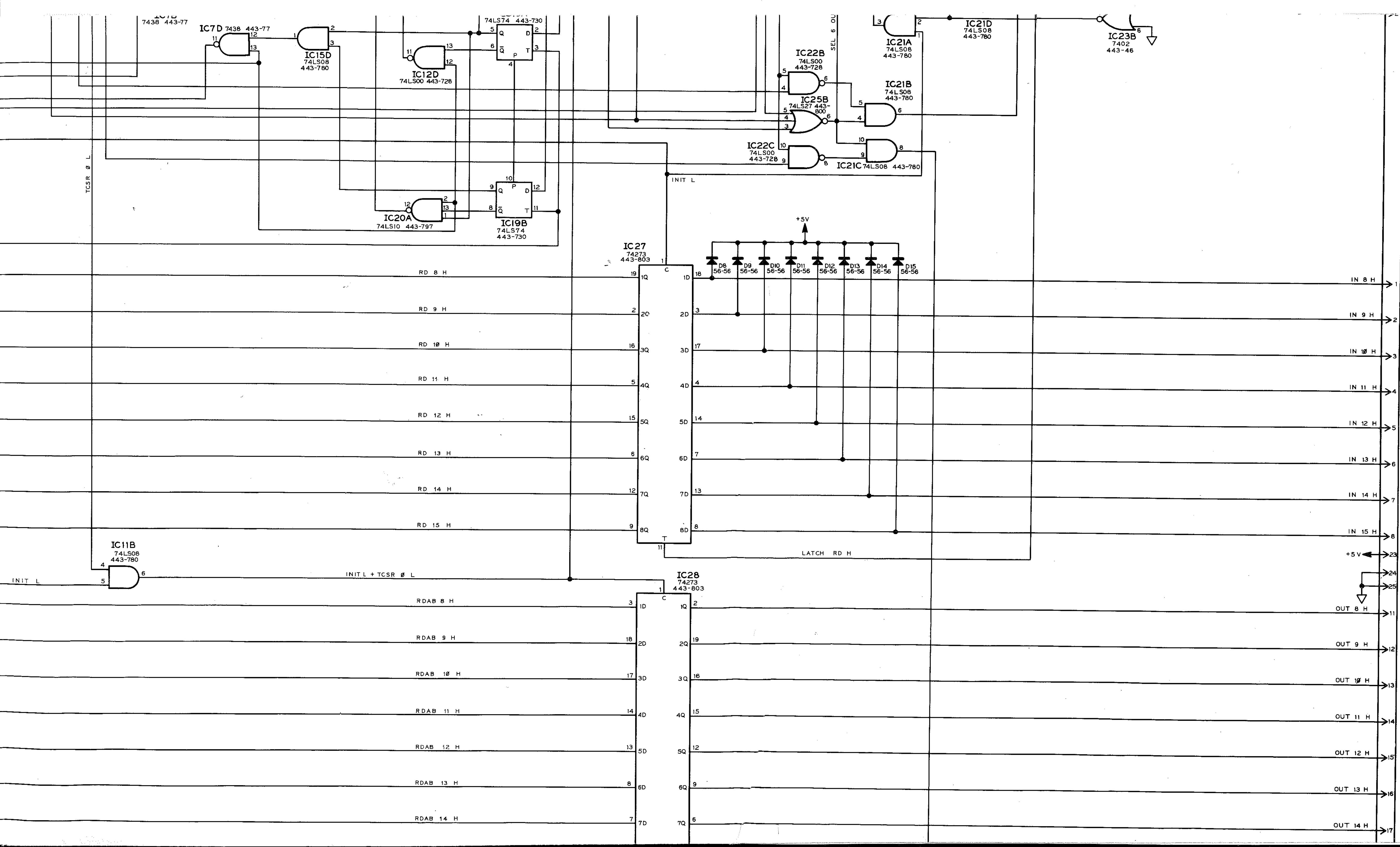


INIT + TCSR Ø L
IC32
74273
443-803
J1
OUT Ø H
OUT 1 H
OUT 2 H
OUT 3 H
OUT 4 H
OUT 5 H
OUT 6 H
OUT 7 H
SEL 6 OUT (W + LB) H
VEC 1 L
IC3
74LS257
443-802
+5V
R12 10K
R13 10K
RD Ø H
RD 1 H
RD 6 H
RD 7 H
V6
V7
LATCH RD H
IC31
74273
443-803
D18 56-56
D1 56-56
D2 56-56
D3 56-56
D5 56-56
D4 56-56
D6 56-56
D7 56-56
IN Ø H
IN 1 H
IN 2 H
IN 3 H
IN 4 H
IN 5 H
IN 6 H
IN 7 H
IC10
74LS257
443-802
TCSR Ø H
RCSR 1 H
TCSR 1 H
RD INT EN H
TD INT EN H
DA H
TBMT H
IC9
74LS157
443-799
R9 10K
R11 10K
R8 10K
V4

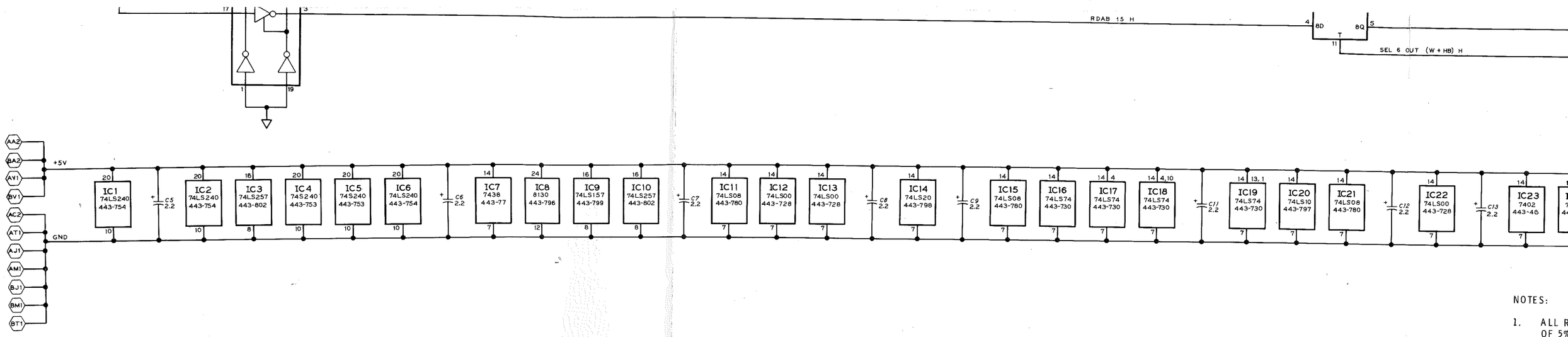

+5V
R21 10K
R19 10K
R18 10K
R17 10K
R16 10K
R15 10K
R14 10K
R7 10K
R6 10K
R5 10K
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
IC8
8130
443-796
B1
B2
B3
B4
B5
B6
B7
B8
B9
B10
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
IC11A
74LS08
443-780
DIN X ME L
VEC 1 L
DAL 1 L
IC13D
74LS00
443-728
IC13C
74LS00
443-728
RD 4 H
RD 5 H
VEC 2 H
RD 2 H
RD 3 H
INIT L
V5
V3
ZA
ZB
ZC
ZD
IA
IB
IC
ID
S
R25 1K
IC12B
74LS00
443-728
IC29
74LS75
443-781
IC13A
74LS00
443-728
IC13B
74LS00
443-728
IC14A
74LS20
443-798
IC11C
74LS08
443-780
IC7C
7438
443-77
R2 150
C2 .0013
AF2
BRPLY L
ME H
DAL 2 H
DAL 2 L
RDAB 1 H
RDAB 2 H
RDAB 6 H
RDAB 8 H
SYNC L
IC24A
74LS74 443-730
RD INT EN H
IC16B
74LS74
443-730
IC15C
74LS08
443-780
DA H
TD INT EN H
IC16A
74LS74
443-730
IC24B
74LS74
443-730
IC20C
74LS10
443-797
IC15B
74LS08
443-780
TBMT H
IC15A
74LS08 443-780
IC25C
74LS27
443-800
SEL Ø OUT
IC23A
7402
443-46
IC14B
74LS20 443-798
IC26A
74LS08
443-780
SEL 4 OUT H
IC6
74LS240 443-754
AM2 BIAKI-L
AP2 BBS7 L
AJ2 BSYNC L
AT2 BINIT L
AH2 BDIN L
AE2 BDOUT L
AK2 BWTBT L
BS 7 H
INIT L
DIN H
INIT H
DOUT H
WTBT H
IC22D
74LS20
443-728
IC17A
74LS74
443-730
IC25A
74LS27 443-800
SEL 4 OUT H
IC12C 74LS00 443-728
IC7B
TCSR Ø L

RD 4 H
RD 5 H
VEC 2 H
RD 2 H
RD 3 H
INIT L
V5
V3
VEC 1 L
DAL 1 L
IC13D 74LS00 443-728
IC13C 74LS00 443-728
IC13A 74LS00 443-728
IC13B 74LS00 443-728
IC14A 74LS20 443-798
IC11C 74LS08 443-780
IC7C 7438 443-77
R2 150
C2 .0013
AF2 BRPLY L
IC29 74LS75 443-781
ME H
DAL 2 H
DAL 2 L
IC24A 74LS74 443-730
RD INT EN H
IC16B 74LS74 443-730
IC15C 74LS08 443-780
RDAB 6 H
INIT L
DA H
TD INT EN H
IC16A 74LS74 443-730
IC24B 74LS74 443-730
IC20C 74LS10 443-797
IC15B 74LS08 443-780
TBMT H
IC17A 74LS74 443-730
IC25A 74LS27 443-800
IC15A 74LS08 443-780
IC12C 74LS00 443-728
IC19A
IC25C 74LS27 443-800
SEL Ø OUT H
DA H
IC30A 74LS74 443-730
RDAB 1 H
IC23A 7402 443-46
IC14B 74LS20 443-798
IC26A 74LS08 443-780
IC18B 74LS74 443-730
IC18A 74LS74 443-730
SEL 4 OUT H
TCSR Ø L
IC17B 74LS74 443-730
D16 56-56
D17 56-56
R22 10K
R23 10K
DATA SENT L
DATA TAKEN L
RC 1 H
SEND DATA L
TAKE DATA L
IC30B 74LS74 443-730
RC 1 L
RDAB Ø H
SD H
SD L
IC23D 7402 443-46
IC26D 74LS08 443-780
IC23C 7402 443-46
IC26C 74LS08 443-780
C1 820
R1 150
IC26B 74LS08 443-780
DS L
R4 150
R3 150
IC11D 74LS08 443-780
C3 .0013
IC7A 7438 443-77
TD L
DT L
J2


BIRQ L
BIAKO - L
R24
470 Ω
+5V
RD DT L
INIT L
TCSR Ø L
IC7D 7438 443-77
IC15D 74LS08 443-780
IC12D 74LS00 443-728
74LS74 443-730
IC22B 74LS00 443-728
IC25B 74LS27 443-800
IC22C 74LS00 443-728
IC21C 74LS08
SEL 6 OU
IC20A 74LS10 443-797
IC19B 74LS74 443-730
IC4 74S240 443-753
IC27 74273 443-803
D8 56-56
D9 56-56
D10 56-56
D11 56-56
D12 56-56
D13 56-56
D14 56-56
BDAL 8 L
BDAL 9 L
BDAL 10 L
BDAL 11 L
BDAL 12 L
BDAL 13 L
BDAL 14 L
BDAL 15 L
RD 8 H
RD 9 H
RD 10 H
RD 11 H
RD 12 H
RD 13 H
RD 14 H
RD 15 H
LATCH RD H
IC11B 74LS08 443-780
INIT L + TCSR Ø L
IC1 74LS240 443-754
IC28 74273 443-803
RDAB 8 H
RDAB 9 H
RDAB 10 H
RDAB 11 H
RDAB 12 H
RDAB 13 H
RDAB 14 H



IC7D 7438 443-77
IC15D 74LS08 443-780
IC12D 74LS00 443-728
74LS74 443-730
IC22B 74LS00 443-728
IC25B 74LS27 443-800
IC22C 74LS00 443-728
IC21A 74LS08 443-780
IC21B 74LS08 443-780
IC21C 74LS08 443-780
IC21D 74LS08 443-780
IC23B 7402 443-46
IC20A 74LS10 443-797
IC19B 74LS74 443-730
TCSR Ø L
INIT L
+5V
IC27 74273 443-803
RD 8 H
RD 9 H
RD 10 H
RD 11 H
RD 12 H
RD 13 H
RD 14 H
RD 15 H
IN 8 H
IN 9 H
IN 10 H
IN 11 H
IN 12 H
IN 13 H
IN 14 H
IN 15 H
LATCH RD H
IC11B 74LS08 443-780
INIT L + TCSR Ø L
IC28 74273 443-803
RDAB 8 H
RDAB 9 H
RDAB 10 H
RDAB 11 H
RDAB 12 H
RDAB 13 H
RDAB 14 H
OUT 8 H
OUT 9 H
OUT 10 H
OUT 11 H
OUT 12 H
OUT 13 H
OUT 14 H

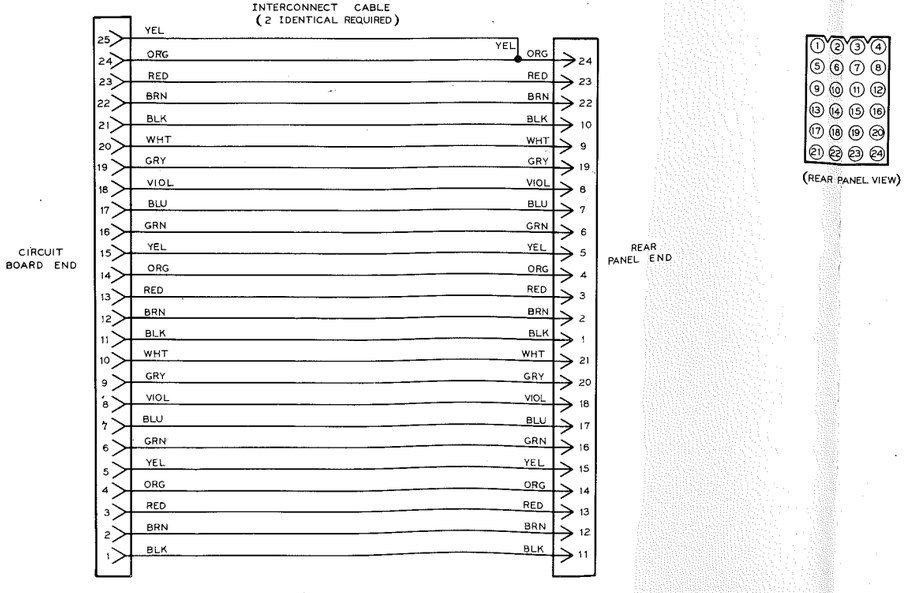


NOTES:

1. ALL R
OF 5%

2. CAPA
CAPA

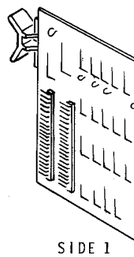
3. SYMB



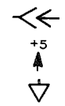
(REAR PANEL VIEW)

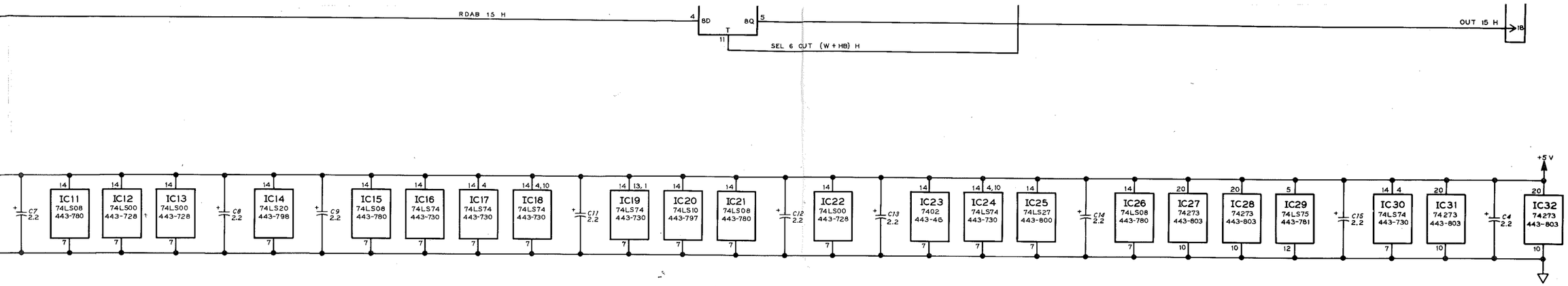
SCHEMATIC OF THE HEATHKIT® MODEL H11-2 PARALLEL INTERFACE MODULE

Part of 595-2015-01



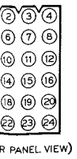
SIDE 1
COMPONENT SI





SCHEMATIC OF THE HEATHKIT® MODEL H11-2 PARALLEL INTERFACE MODULE

Part of 595-2015-01



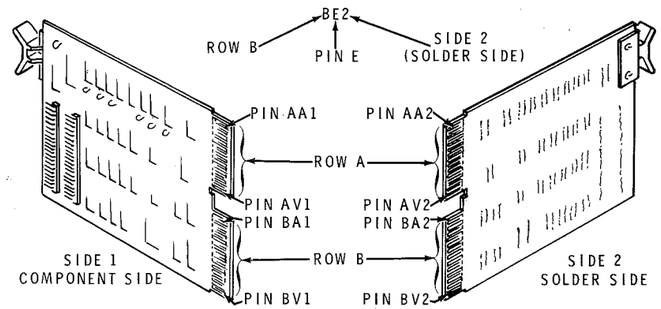
R PANEL VIEW)

NOTES:

1. ALL RESISTORS ARE 1/4-WATT AND HAVE A TOLERANCE OF 5%. VALUES SHOWN ARE IN OHMS (k=1000).
2. CAPACITOR VALUES LESS THAN 1 ARE IN MICROFARADS. CAPACITOR VALUES GREATER THAN 1 ARE IN PICOFARADS.
3. SYMBOLS:

THIS SYMBOL INDICATES A MAIN BUS CONNECTION. THESE CONNECTIONS ARE IDENTIFIED AS FOLLOWS:

THE FIRST LETTER INDICATES THE ROW OF PINS (EITHER A OR B), THE FIRST LETTER INDICATES THE PIN OF THAT ROW (THE PINS ARE LABELED A THROUGH V, EXCLUDING G, I, O, AND Q), AND THE NUMBER INDICATES THE SIDE OF THE CIRCUIT BOARD (1=COMPONENT SIDE; 2=SOLDER SIDE). AS AN EXAMPLE:



PLUG CONNECTION

+5 B+

CIRCUIT BOARD GROUND

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

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