

CUTS, COMPUTER USERS TAPE SYSTEM
ASSEMBLY and TEST INSTRUCTIONS



Processor Technology Corporation
6200 Hollis Street
Emeryville CA 94608

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SECTION I

INTRODUCTION and

GENERAL INFORMATION

CUTS, COMPUTER USERS TAPE SYSTEM

 **Processor
Technology**
Processor Technology Corporation
6200 Hollis Street
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1.1 INTRODUCTION

This manual supplies the information needed to assemble, test and use the CUTS, Computer Users Tape System. We suggest that you first scan the entire manual before starting assembly. Then, make sure you have all the parts and components listed in the "Parts List" (Table 2-1) in Section II. When assembling the module, follow the instructions in the order given.

Should you encounter any problem during assembly, call on us for help if necessary. If your completed module does not work properly, recheck your assembly step by step. Most problems stem from poor soldering, backward installed components, and/or installing the wrong component. Once you are satisfied that the module is correctly assembled, feel free to ask for our help.

1.2 GENERAL INFORMATION

1.2.1 CUTS Description

CUTS, The Computer Users Tape System is a high speed, simple to use audio cassette interface that operates at 300 and 1200 bps data rates under program control. The recording technique used is asynchronously Manchester coded at 1200 or 2400 Hz and is CUTS/Byte/Kansas City Standard compatible.

Two separate tape transport control outputs and two common audio inputs and outputs are provided to drive one or two recorders. In addition, CUTS has provision for selecting 1) a low level audio output signal for driving the microphone input to an audio recorder, 2) a high level audio output signal for driving the auxiliary input to an audio recorder, and 3) a 5-volt peak-to-peak square wave output for driving a digital recorder. A fully automatic gain control operates in the read mode. Unlike other cassette interfaces, CUTS has absolutely no critical adjustments that must be preset or adjusted during operation.

NOTE

All Processor Technology software is available on CUTS cassettes at lower cost than equivalent paper tapes.

1.2.2 Receiving Inspection

When your kit arrives, examine shipping container for signs of possible damage to the contents during transit. Then inspect the contents for damage. (We suggest you save the shipping materials for use in returning the module to Processor Technology should it become necessary to do so.) If your CUTS kit is damaged, please write us at once describing the condition so that we can take appropriate action.

1.2.3 Warranty Information

In brief, parts that fail because of defects in materials or workmanship are replaced at no charge for 3 months for kits, and one year for assembled products, following the date of purchase. Also, products assembled by the buyer are warranted for a period of 3 months after the date of purchase; factory assembled units carry a one year warranty. Refer to Appendix I for the complete "Statement of Warranty".

1.2.4 Replacement Parts

Order replacement parts by component nomenclature (DM8131 IC or 1N2222 diode, for example) and/or a complete description (680 ohm, ¼ watt, 5% carbon resistor, for example).

1.2.5 Factory Service

In addition to in-warranty service, Processor Technology also provides factory repair service on out-of-warranty products. Before returning the unit to Processor Technology, first obtain our authorization to do so by writing us a letter describing the problem. After you receive our authorization to return the unit, proceed as follows:

1. Write a description of the problem.
2. Pack the unit with the description in a container suitable to the method of shipment.
3. Ship prepaid to Processor Technology Corporation, 6200 Hollis Street, Emeryville, CA 94608.

Your unit will be repaired as soon as possible after receipt and return shipped to you prepaid. (Factory service charges will not exceed \$20.00 without prior notification and your approval.)

SECTION II

ASSEMBLY

and

TEST

CUTS, COMPUTER USERS TAPE SYSTEM



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2.1 PARTS AND COMPONENTS

Check all parts and components against the "Parts List" (Table 2-1 on Page II-2). If you have difficulty in identifying any parts by sight, refer to Figure 2-1 on Page II-3.

2.2 ASSEMBLY TIPS

1. Scan Section II in its entirety before you start to assemble your CUTS kit.
2. In assembling your CUTS, you will be following a step-by-step assembly procedure. FOLLOW THE INSTRUCTIONS IN THE ORDER GIVEN.
3. Assembly steps and component installations are preceded by a set of parentheses. Check off each installation and step as you complete them. This will minimize the chances of omitting a step or component.
4. When installing components, make use of the assembly aids that are incorporated on the CUTS PC board and the assembly drawing. (These aids are designed to assist you in correctly installing the components.)
 - a. The circuit reference (R3, C10 and U7, for example) for each component is silk screened on the PC board near the location of its installation.
 - b. Both the circuit reference and value or nomenclature (1.5K and 74LS08, for example) for each component are included on the assembly drawing near the location of its installation.
5. To simplify reading resistor values after installation, install resistors so that their color codes read from left-to-right and top-to-bottom as appropriate (board oriented as defined in Paragraph 2.5 on Page II- .)
6. Unless specified otherwise in the instructions, install components--especially disc capacitors--as close to the board as possible.
7. Should you encounter any problem during assembly, call on us for help if needed.

Table 2-1. CUTS Parts List

<u>INTEGRATED CIRCUITS</u>	
1 1458 or 5558 (U6)	1 6011 (U18)
2 4013 (U3 & U4)	1 74LS04 (U24)
1 4019 (U9)	2 74LS08 (U25 & U26)
1 4023 (U1)	1 74LS109 (U20)
1 4024 (U10)	1 74LS132 (U21)
1 4027 (U2)	2 74LS136 (U14 & U15)
1 4030 (U19)	1 74LS155 (U23)
1 4046 (U11)	1 74LS163 (U12)
1 4049 (U22)	1 74LS175 (U13)
1 4520 (U8)	2 74367 (U16 & U17)
<u>REGULATORS</u>	<u>TRANSISTORS</u>
1 7805UC or LM340T-5.0 (U7)	3 2N2222 (Q1, Q3 & Q4)
1 78L12 (U5)	1 2N2907 (Q5)
	1 2N4360 (Q2)
<u>DIODES</u>	<u>RELAYS</u>
3 1N4148 (D1, D2 & D4)	2 DIP Reed, SIGMA 191TE1A1-55 (K1 & K2)
1 1N5242 (D3)	

Table 2-1. CUTS Parts List (Continued).

<u>RESISTORS</u>	<u>CAPACITORS</u>
1 39 ohm, 2 watt, 5%	1 470 pfd, disc
1 100 ohm, 1/4 watt, 5%	4 .001 ufd, disc
2 470 ohm, 1/4 watt, 5%	1 .001 ufd, Mylar tubular
3 1.5K ohm, 1/4 watt, 5%	1 .01 ufd, Mylar tubular
9 10 K ohm, 1/4 watt, 5%	19 .1 ufd, disc
4 100 K ohm, 1/4 watt, 5%	2 1 ufd, tantalum dipped
2 150 K ohm, 1/4 watt, 5%	3 15 ufd, tantalum dipped
2 1 M ohm, 1/4 watt, 5%	
1 2.2M ohm, 1/4 watt, 5%	
1 50 K ohm Potentiometer	
2 2.2K ohm Resistor Network	
<u>MISCELLANEOUS</u>	
1 CUTS PC Board	10 Molex Crimp Pins for Female Mating Connector
1 Heat Sink	4 Augat Pin
11 14-pin DIP Socket	1 Length #24 Bare Wire
11 16-pin DIP Socket	1 Length Solder
1 40-pin DIP Socket	3 6-32 x 1/2 Screw
1 8-position DIP Switch	3 #6 Lockwasher
2 Right Angle Molex Connector, Male (J1 & J2)	3 6-32 Hex Nut
2 Mating Connector for Above, Female (P1 & P2)	1 Manual

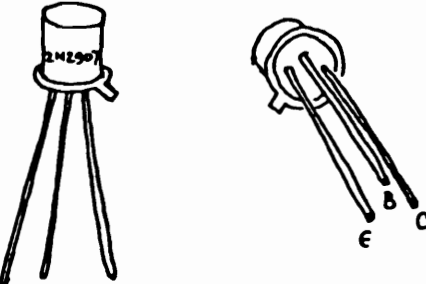
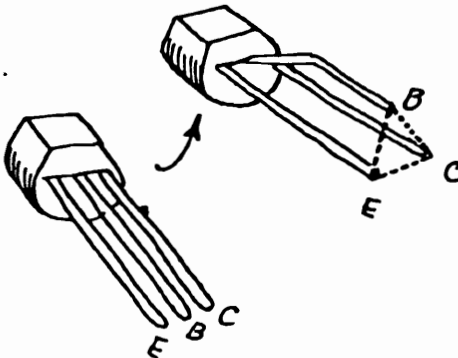
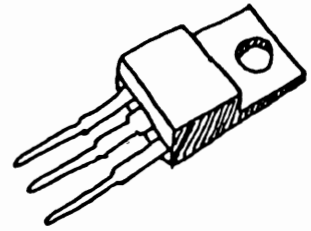


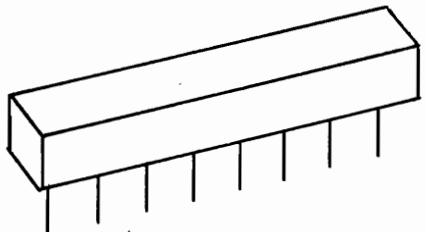
<p>TRANSISTOR TO-18 Package (Metal Can)</p> 	<p>TRANSISTOR TO-92 Package (Plastic)</p> 
<p>TRANSISTOR, POWER or REGULATOR IC TO-220 Package</p> 	<p>CARBON RESISTOR</p>  <p>5% (gold), 10% (silver) See Appendix III for Color Code</p>
<p>METAL FILM PRECISION RESISTOR (1% Tolerance)</p> 	<p>RESISTOR NETWORK</p> 

Figure 2-1. Identification of components.

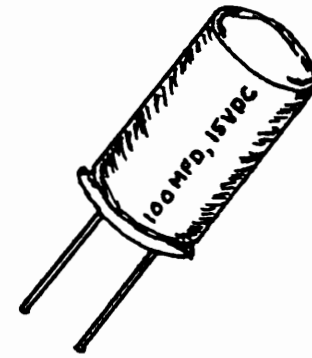
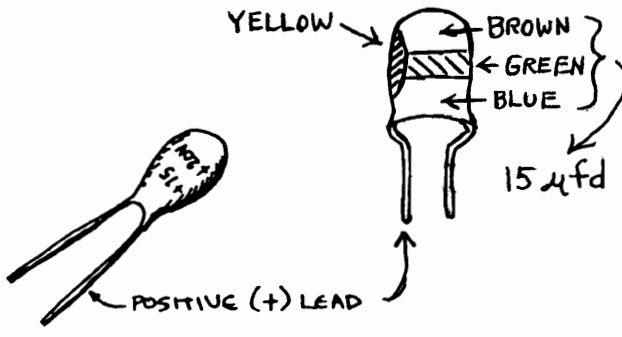
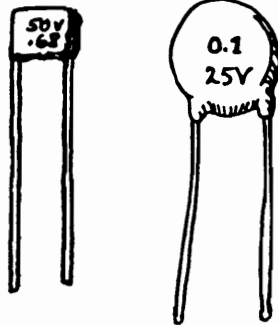

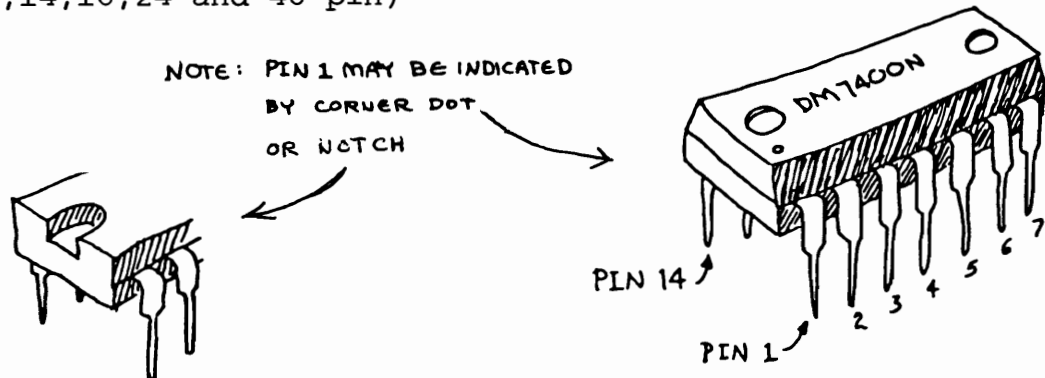
<p>ELECTROLYTIC CAPACITOR (Vertical Mount)</p> 	<p>DIPPED TANTALUM ELECTROLYTIC CAPACITOR</p>  <p>See Appendix III for Color Code</p>
<p>DISC CAPACITOR</p>  <p>Monolythic (left) and Ceramic</p>	<p>MYLAR TUBULAR CAPACITOR</p> 
<p>INTEGRATED CIRCUIT, Dual Inline Package (DIP) (6,8,14,16,24 and 40 pin)</p> <p>NOTE: PIN 1 MAY BE INDICATED BY CORNER DOT OR NOTCH</p> 	

Figure 2-1. Identification of components.

2.3 ASSEMBLY PRECAUTIONS

2.3.1 Handling MOS Integrated Circuits

Many of the IC's used in the CUTS are MOS devices. They can be damaged by static electricity discharge. Always handle MOS IC's so that no discharge will flow through the IC. Also, avoid unnecessary handling and wear cotton--rather than synthetic--clothing when handling these IC's.

2.3.2 Soldering ****IMPORTANT****

1. Use a fine tip, low-wattage iron, 25 watts maximum.
2. DO NOT use excessive amounts of solder. DO solder neatly and as quickly as possible.
3. Use only 60-40 rosin-core solder. NEVER use acid-core solder or externally applied fluxes.
4. To prevent solder bridges, position iron tip so that it does not touch adjacent pins and/or traces simultaneously.
5. DO NOT press tip of iron on pad or trace. To do so can cause the pad or trace to "lift" off the board and permanently damage it.
6. The CUTS circuit board has plated-through holes. Solder flow through to the component (front) side of the board can produce solder bridges. Check for such bridges after you install each component.
7. The CUTS circuit board has an integral solder mask (a lacquer coating) that shields selected areas on the board. This mask minimizes the chances of creating solder bridges during assembly. DO, however, check all solder joints for possible bridges.
8. Additional pointers on soldering are provided in Appendix III of this manual.

2.3.3 Installing and Removing CUTS Module

NEVER install the CUTS in, or remove it from the computer with the power on. To do so can damage the module.

2.3.4 Installing and Removing Integrated Circuits.

NEVER install or remove integrated circuits while power is applied to the CUTS. To do so can damage the IC.

2.3.5 Use of Clip Leads

NEVER attach clip leads to the top edge of the CUTS PC board. To do so can short the +8, +16 and -12 V dc buses to one another.

2.4 REQUIRED TOOLS, EQUIPMENT AND MATERIALS

The following tools, equipment and materials are recommended for assembling and testing the CUTS Module:

1. Needle nose pliers
2. Diagonal cutters
3. Scredriver
4. Sharp knife
5. Controlled heat fine tip soldering iron, 25 watts
6. 60-40 rosin-core solder (supplied)
7. #24 bare wire (supplied)
8. Volt-ohm meter

2.5 ORIENTATION

The heat sink area (large foil area) will be located in the upper right-hand corner of the board when the edge connector is at the bottom. In this position, the component (front) side of the board is facing up and the solder (back) side is facing down. In addition the IC legends (U1 through U4, U8 through U15, etc.) will read from left to right. Subsequent position references in the instructions related to the CUTS PC board assume this orientation.

2.6 ASSEMBLY-TEST

Refer to the assembly drawing in Section VI.

CAUTION

THE CUTS MODULE USES MANY MOS AND CMOS INTEGRATED CIRCUITS. THEY CAN BE DAMAGED BY STATIC ELECTRICITY DISCHARGE. HANDLE THESE IC'S SO THAT NO DISCHARGE FLOWS THROUGH THE IC. AVOID UNNECESSARY HANDLING AND WEAR COTTON--RATHER THAN SYNTHETIC--CLOTHING WHEN YOU DO HANDLE THESE IC'S. (STATIC CHARGE PROBLEMS ARE MUCH WORSE IN LOW HUMIDITY CONDITIONS.)

2.6.1 Circuit Board Check

- (↓) Visually check CUTS PC board for solder bridges (shorts) between traces, broken traces and similar defects.
- (↓) Check board to insure that the +8-volt line, +16-volt line, +5-volt bus, +12-volt bus and -12-volt bus are not shorted to one another or to ground. Using an ohmmeter, make the following measurements (refer to CUTS assembly drawing in Section VI.):
- () +8-volt Line Test. Measure between edge connector pin 1 or 51 (left end of connector) and pin 50 or 100 (right end of connector). There should be no continuity.
 - () +16-volt Line Test. Measure between edge connector pin 2 or 52 and pin 50 or 100. There should be no continuity.
 - () 8/16 Volt Line Test. Measure between edge connector pin 1 or 51 and pin 2 or 52. There should be no continuity.
 - () +5-volt Bus Test. Measure between the upper mounting pad for D2 (to the left of location K2) and pin 50 or 100 of the edge connector. There should be no continuity.
 - () +12-volt Bus Test. Measure between upper mounting pad for C9 (in upper right corner below C8) and pin 50 or 100 of edge connector. There should be no continuity.
 - () -12-volt Bus Test. Measure between upper mounting pad for C18 (between U16 and U17) and pin 50 or 100 of edge connector. There should be no continuity.
 - () 5/12/(-12) Volt Bus Test. Measure between upper mounting pad for C21 (lower left corner) and upper pad for C9, between upper pad for C21 and upper mounting pad for C18, and between upper pad for C9 and upper pad for C18. You should measure no continuity in any of the three measurements.

If visual inspection reveals any defects, or you measure continuity in any of the preceding tests, return the board to Processor Technology for replacement.

If the board is not defective, go on to next paragraph.

2.6.2 Assembly-Test Procedure

- (↓) Step 1. Install heat sink. Position the large, black heat sink (flat side to board) over the square foil area in the upper right corner. Orient the sink so that the two triangles of mounting holes in the board are under the two triangular cutouts in the sink. Using two 6-32 screws, lockwashers and nuts, attach heat sink to board. Insert the screws from back (solder) side of board. (See Figure 2-2.)
- (↓) Step 2. Install U7 (7805UC or LM340T-5.0). Position U7 over left-hand cutout in heat sink and observe how the leads must be bent to fit the mounting holes. Note that the center lead (3) must be bent downwards at a point approximately 0.2 inches further from the body than the other two leads. Bend the leads so that no contact is made with the heat sink when U7 is flat against the sink and its mounting hole is aligned with the hole in the sink. Fasten U7 to sink using a 6-32 screw, lockwasher and nut. Insert screw from back (solder) side of board. Solder and trim leads. (Refer to Figure 2-2.)

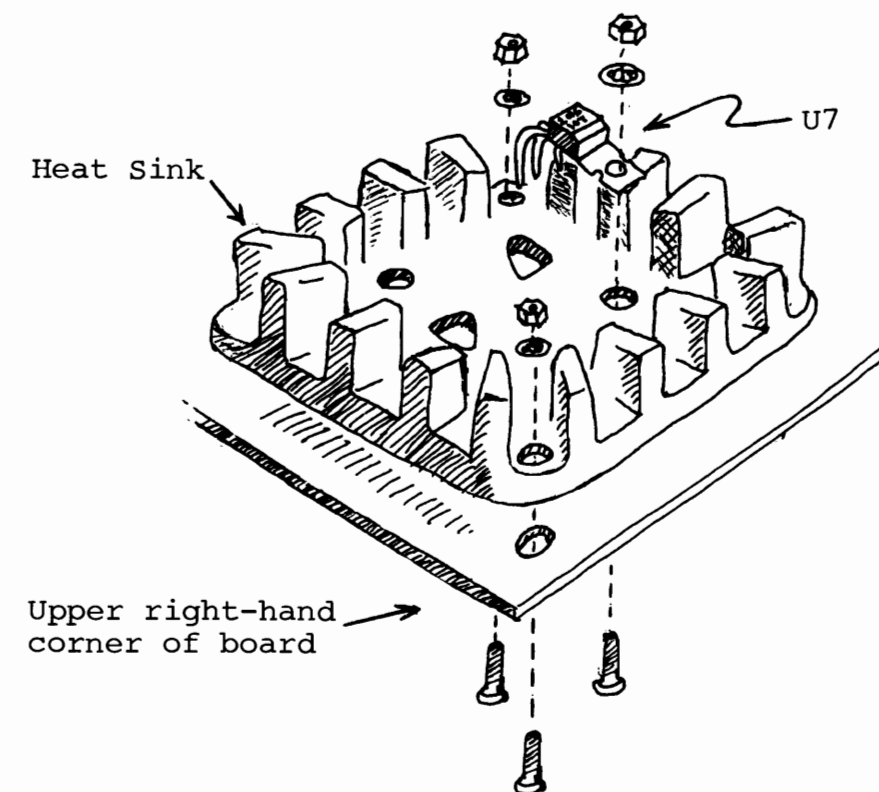


Figure 2-2. Heat sink and U7 installation.

- (✓) Step 3. Install male Molex right angle connectors in locations J1 and J2. Position connector with longer pins facing the top of the board, insert leads in mounting holes and solder.
- (✓) Step 4. Install diodes D1, D2 and D4 (1N4148) in their respective locations. Position D1 and D2 with their dark band mark (cathode) at the top and position D4 with its band at the right. Solder and trim leads.
- (✓) Step 5. Install diode D3 (1N5242) in its location. Position D3 with its dark band mark (cathode) at the right.
- (✓) Step 6. Install transistors Q1, Q3 and Q4 (2N2222) in their respective locations. Position Q1 with its emitter lead (closest to tab on can) at the top and its base lead at the left. Position both Q3 and Q4 with their emitter leads at the right and their base leads at the top. Insert leads and push straight down on transistor until it is 3/16" above the surface of the board. Solder and trim leads.
- (✓) Step 7. Install transistor Q2 (2N4360) in its location. Position Q2 with its flat side at the bottom, insert leads and push straight down on transistor until it is 3/16" above the surface of the board. Solder and trim leads.
- (✓) Step 8. Install transistor Q5 (2N2907) in its location. Position Q5 with its emitter lead (closest to tab on can) at the right and its base lead at the top. Insert leads and push straight down on transistor until it is 3/16" above the surface of the board. Solder and trim leads.
- (✓) Step 9. Install all resistors in numerical order in the indicated locations. Bend leads to fit distance between mounting holes, insert leads, pull down snug to board, bend leads outward on solder (back) side of board, solder and trim.

LOCATION	VALUE (ohms)	COLOR CODE
(✓) R1	100 K	brown-black-yellow
(✓) R2	10 K	brown-black-orange
(✓) R3	1.5K	brown-green-red
(✓) R4	10 K	brown-black-orange
(✓) R5	1.5K	brown-green-red
(✓) R6	1.5K	" " "
(✓) R7	10 K	brown-black-orange
(✓) R8	150 K	brown-green-yellow
(✓) R9	10 K	brown-black-orange
(✓) R10	1 M	brown-black-green
(✓) R11	10 K	brown-black-orange

Continued on Page II-11.

Step 9 continued.

LOCATION	VALUE (ohms)	COLOR CODE
(✓) R12	2.2M	red-red-green
(✓) R13	10 K	brown-black-orange
(✓) R14	150 K	brown-green-yellow
(✓) R15	10 K	brown-black-orange
(✓) R16	470	yellow-violet-brown
(✓) R17	100	brown-black-brown
(✓) R18	100 K	brown-black-yellow
(✓) R19	10 K	brown-black-orange
(✓) R20	10 K	" " "
(✓) R21	470	yellow-violet-brown
(✓) R22	39,2 watt	orange-white-black
(✓) R23	100 K	brown-black-yellow
(✓) R24	100 K	" " "
(✓) R25	1 M	brown-black-green
(✓) VR1	50 K	Potentiometer

- (✓) Step 10. Install resistor networks RX1 and RX2 (2.2K ohms) in their respective locations. Position RX1 so that the dot on its package is at the right end. Position RX2 with its dot at the left end.

CAUTION

THESE RESISTOR NETWORKS ARE DELICATE.
HANDLE WITH CARE.

- (✓) Step 11. Install the five tantalum capacitors in the following locations. Take care to observe proper values and the correct orientation.

LOCATION	VALUE (ufd)	ORIENTATION
(✓) C7	15	"+" lead left
(✓) C8	15	"+" lead top left
(✓) C21	1	"+" lead top
(✓) C24	15	"+" lead right
(✓) C29	1	"+" lead top

- (✓) Step 12. Install the following capacitors in the indicated locations. Take care to observe the proper value and type for each installation. Bend leads outward on solder (back) side of board, solder and trim.

Continued on Page II-12.

Step 12 continued.

NOTE

Disc capacitor leads are usually coated with wax during the manufacturing process. After inserting leads through mounting holes, remove capacitor and clear the holes of any wax. Re-insert and install.

<u>LOCATION</u>	<u>VALUE (ufd)</u>	<u>TYPE</u>
(✓) C1	.1	Disc
(✓) C2	.1	"
(✓) C3	.1	"
(✓) C4	.01	Mylar tubular
(✓) C5	.1	Disc
(✓) C6	.1	"
(✓) C9	.1	"
(✓) C10	.1	"
(✓) C11	.001	"
(✓) C12	.1	"
(✓) C13	.1	"
(✓) C14	.001	"
(✓) C15	.1	"
(✓) C16	.1	"
(✓) C17	.1	"
(✓) C18	.1	"
(✓) C19	.1	"
(✓) C20	.001	"
(✓) C22	.001	"
(✓) C23	.1	"
(✓) C25	.001	Mylar tubular
(✓) C26	.1	Disc
(✓) C27	.1	"
(✓) C28	.1	"
(✓) C30	.1	"
(✓) C31	470 pfd	"

- (✓) Step 13. Install Augat pins in mounting holes A, B and C. (These three holes are located to the left of U16, just below the lower mounting hole for R17.)

NOTE

You will find it helpful to hold the board between two objects so that it stands on edge.

Continued on Page II-13.

Step 13 continued.

To install an Augat pin, insert it into the mounting hole from the component (front) side of board and solder the pin from the solder (back) side of the board so the solder "wicks up" to the front side. (This will hold the pin firmly in place.)

Then insert a component lead into the pin and reheat the solder. Using the component lead, adjust pin until it is perpendicular to board. Allow solder to cool while holding the pin as steady as possible.

NOTE

If the cooled solder is mottled or crystallized, a "cold joint" is indicated, and the solder should be reheated.

- (✓) Step 14. Install DIP switch in location S1. Position switch so Switch No. 1 is at the left. (With this orientation, the ON position of each switch is up.) Note that only the first seven switches are active.
- () Step 15. Install DIP reed relays in locations K1 and K2. Be sure to position each relay with its end notch at the top (pin 1 in upper left corner). These relays are soldered to the board. (Refer to "Loading DIP Devices" in Appendix IV.)
- () Step 16. Install U6 (1458 or 5558) in its location. Position U6 with its end notch at the top (pin 1 in upper left corner) and solder to board. (Refer to "Loading DIP Devices" in Appendix IV.)
- () Step 17. Install U5 (78L12) in its location just above U6. Position U5 with its flat side at the bottom, insert leads and push straight down until it is 3/16" above the surface of the board. Solder and trim leads.
- () Step 18. Install DIP sockets. Install each socket in the indicated location with its end notch oriented as shown on the circuit board and assembly drawing. Take care not to create solder bridges between the pins and/or traces.

INSTALLATION TIP

Insert socket pins into mounting pads of appropriate location. On back (solder) side of board, bend pins at opposite corners of socket (e.g. pins 1 and 9 on a

Continued on Page II-14.

Step 18 continued.

16-pin socket) outward until they are at a 45° angle to the board surface. This secures the socket until it is soldered. Repeat this procedure with each socket until all are secured to the board. Solder the unbent pins on all sockets. Then straighten the bent pins to their original position and solder.

<u>LOCATION</u>	<u>TYPE SOCKET</u>
U1	14 pin
U2	16 pin
U3	14 pin
U4	14 pin
U8	16 pin
U9	16 pin
U10	14 pin
U11	16 pin
U12	16 pin
U13	16 pin
U14	14 pin
U15	14 pin
U16	16 pin
U17	16 pin
U18	40 pin
U19	14 pin
U20	16 pin
U21	14 pin
U22	16 pin
U23	16 pin
U24	14 pin
U25	14 pin
U26	14 pin

(-) Step 19. Using #24 bare wire, install jumpers according to your selection of the options described in Section III.

(-) Step 20. Set DIP switches (S1) to select port address as described in Section III.

NOTE

All Processor Technology software is written with a CUTS port of FA (hex). To set the DIP switches for port FA, place Switch No. 2 in OFF position and the remaining switches in the ON position.

(-) Step 21. Check operation of the regulators. This check is made to prevent potential damage to the IC's from incorrect voltages.

() Using an ohmmeter, make the following measurements:

<u>SUPPLY</u>	<u>MEASUREMENT POINTS</u>
+ 5 V dc	Ground to right-hand lead of U7 Ground to left-hand lead of U7
+12 V dc	Ground to positive (+) lead of C8 Ground to Pin 8 of U6 socket
-12 V dc	Across C21

You should measure some resistance in all three measurements. Zero resistance indicates a short. If required, find and correct the problem before proceeding.

(-) Install CUTS in computer. (The use of a Processor Technology EXB Extender Board is recommended.)

CAUTION

NEVER INSTALL OR REMOVE CIRCUIT BOARD WITH POWER ON.

() Turn power on and make the following voltage measurements:

<u>MEASUREMENT POINTS</u>	<u>VOLTAGE (±5%)</u>
Ground to Pin 1 of U18 Socket	+ 5 V dc
Ground to Pin 8 of U6 Socket	+12 V dc
Ground to Pin 2 of U18 Socket	-12 V dc

If any voltage is incorrect, determine and correct the cause before proceeding.

If voltages are correct, turn power off, remove CUTS from computer and go on to Step 22.

() Step 22. Install the following IC's in the indicated locations. Pay careful attention to the proper orientation.

Continued on Page II-16.

Step 22 Continued.

NOTE

Pin 1 is positioned at the upper left corner of each IC location, and is indicated by a dot on the PC board and assembly drawing.

<u>IC NO.</u>	<u>TYPE</u>
(✓) U1*	4023*
(✓) U2*	4027*
(✓) U3*	4013*
(✓) U4*	4013*
(✓) U8*	4520*
(✓) U9*	4019*
(✓) U10*	4024*
(✓) U11*	4046*
(✓) U12	74LS163
(✓) U13	74LS175
(✓) U14	74LS136
(✓) U15	74LS136
(✓) U16	74LS367
(✓) U17	74LS367
(✓) U18*	6011*
(✓) U19*	4030*
(✓) U20	74LS109
(✓) U21	74LS132
(✓) U22*	4049*
(✓) U23	74LS155
(✓) U24	74LS04
(✓) U25	74LS08
(✓) U26	74LS08

*MOS device. Refer to CAUTION on Page II-7.

() Step 23. Adjust VR1.

NOTE

If you do not have a voltmeter, set arrow on VR1 to the "10 o'clock" position (as viewed from front side of board when VR1 is at the top) and go on to Step 24. (In nearly all cases CUTS operates with VR1 at 10 o'clock.)

Continued on Page II-17

Step 23 continued.

- () If you selected either the digital or microphone audio output options in Step 19, remove the jumper and install a jumper between Augat pins A and B.
- () If you selected the auxiliary option in Step 19, leave the jumper between Augat pins A and B installed.
- () Connect pin 2 of J1 (IN) to pin 4 of J1 (OUT).
- () Install CUTS in computer and turn power on.
- () Set VR1 fully clockwise (CW).
- (✓) Measure the DC voltage at pin 9 of U~~1~~¹¹ and write the measured voltage down. (Call this Voltage A.)
- () Set VR1 fully counterclockwise (CCW).
- () Measure the DC voltage at pin 9 of U~~1~~¹¹ and write the measured voltage down. (Call this Voltage B.)
- () Add Voltages A and B and divide the sum by 2. (Call the result Voltage C.) An example follows:

Voltage A (VR1 fully CW): 3.45 V dc

Voltage B (VR1 fully CCW): 1.80 V dc

A + B = 5.25 V dc

Voltage C = 5.25 V dc/2 = 2.63 V dc

- (✓) Adjust VR 1 so that the voltage at pin 3 of U2 equals Voltage C. (In the preceding example this would be 2.63 V dc.)

(✓) Step 24. Disconnect pin 2 of J1 from pin 4 of J1.

() Step 25. If required by your option selection, remove the A-to-B jumper and re-install the A-to-D or A-to-C jumper as appropriate. Otherwise, leave the A-to-B jumper in and go on to Step 26.

() Step 26. Using the two female mating connectors supplied for J1 and J2, fabricate one or two, as required by your needs, CUTS-to-Recorder interconnect cables as shown in Figure 2-3 on Page II-18.

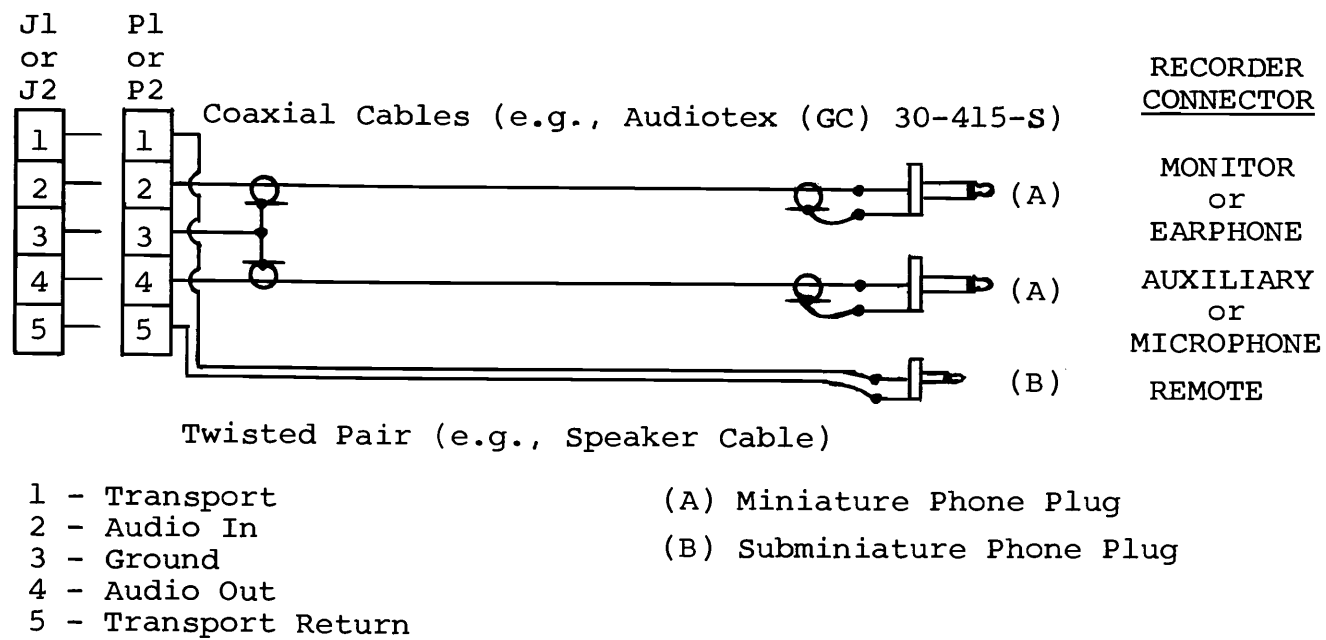


Figure 2-3. CUTS-transport interconnect cabling.

SECTION III

OPTION SELECTION

CUTS, COMPUTER USERS TAPE SYSTEM

3.1 OPTION SELECTION

Jumper options that control two operating parameters, data rate and audio output, are provided on the CUTS Module. The port address for the module is selectable with seven switches. Use the following selection instructions along with the assembly drawing in Section VI.

3.2 PORT ADDRESS SELECTION (DIP Switch, S1)

One of 130 possible port addresses, from 0 through FA (hex), 254 (decimal), for the CUTS is selectable with the first seven DIP switch positions in location S1.

All Processor Technology software is written for a CUTS port assignment of FA (hex). To configure your CUTS for this port, set Switch No. 2 (S1-2) to OFF and Switch No's. 1 (S1-1) and 3 through 7 (S1-3 through S1-7) to ON.

To select another port, set S1-1 through S1-7 as required for the desired address. With these switches the address increases from 0 (all seven switches open) in a binary fashion to 254, decimal, (all seven switches closed). When setting these switches, keep in mind that 1) S1-7 and S1-1 are the most and least significant bits respectively and 2) a closed switch is equivalent to a binary 1.

3.3 AUDIO OUTPUT SELECTION

The A, B, C, D jumper arrangement (to the left of U16) determines the audio output signal supplied to J1 and J2. Three choices are available: 1) a 5 V peak-to-peak signal for driving digital recorders, 2) a 250 mV signal for driving the auxiliary input to an audio cassette recorder, and 3) a 50 mV signal for driving the microphone input to an audio cassette recorder.

NOTE

For audio cassette recorders, the auxiliary input is preferred and recommended over the microphone input.

To select the digital recorder output, install a jumper (#24 bare wire is recommended) between Augat pin A and the mounting pad labeled D.

To select the auxiliary output to drive the auxiliary input (the recommended input) to an audio cassette recorder, install a jumper (#24 bare wire is recommended) between Augat pins A and B.

To select the microphone output to drive the microphone input to an audio cassette recorder, install a jumper (#24 bare wire is recommended) between Augat pins A and C.

3.4 DATA RATE SELECTION

Your CUTS is presently wired for both 1200 and 300 Baud operation, with the selection being program controlled. CUTS is designed, however, for operating at data rates up to 9600 Baud. The pad labeled AA, K, L, Q, R, S, T, U, V, W, X, Y and Z are provided for increasing the data rate. How the board is configured for higher rates will be the subject of a future addendum to this manual.

At this point in time Processor Technology does not recommend operation higher than 1200 Baud.

SECTION IV

OPERATING PROCEDURES

CUTS, COMPUTER USERS TAPE SYSTEM

 **Processor
Technology**
Processor Technology Corporation
6200 Hollis Street
Emeryville CA 94608

4.1 TAPE RECORDER

Any standard cassette tape recorder can be used with CUTS providing it has the following features:

- ALC (automatic level control) in record mode
- "Remote" on-off control input jack
- "Monitor" or "earphone" output jack

Though not required, the following recorder features will be useful:

- Tone control
- Tape counter
- "Cue", "Pause" or "Instant Stop" control

NOTE

Processor Technology currently uses the Panasonic Model RQ-413S with consistently good results.

4.2 CUTS-RECORDER INTERCONNECT (Single Recorder)

Using the interconnect cabling you fabricated in Step 26 of the "Assembly-Test Procedure" (Section II), make the following connections: (Refer to Figure 4-1 on Page IV-3. You may use either output connector J1 or J2 on the CUTS.)

1. Plug transport cable (Pins 1 and 5 of J1 or J2) to remote jack on recorder.
2. Connect "audio out" cable (Pin 4 of J1 or J2) to microphone or auxiliary jack on recorder, with the choice depending on the audio output selection you made. (Refer to Paragraph 3.3 in Section III.) The auxiliary input is preferred and recommended over the microphone input.
3. Connect "audio in" cable (Pin 2 of J1 or J2) to monitor or earphone jack on recorder.

4.3 CUTS-RECORDER INTERCONNECT (Two Recorders)

Two recorders, under program control, can be driven by CUTS. In this case you will need two sets of the interconnect cabling described in Step 26 of the "Assembly-Test Procedure" (Section II).

Using these interconnect cables, connect the CUTS and recorders as shown in Figure 4-1.

When using two recorders you may read or write to both under program control as well as read one tape while writing on the other.

If you intend to read one tape while writing on the other, however, you may have to disconnect the "monitor" plug from the write unit, with the need for disconnect being determined by the recorder design. The monitor disconnect must be made if the recorder provides a "monitor" output in the record mode. (Panasonic RQ-413S and RQ-309DS do, for example.)

NOTE 1

Recorders on which the "monitor" jack is labeled MONITOR usually provide a monitor output in the record mode. If the jack is labeled EAR or EARPHONE, the recorder usually does not provide a monitor output in the record mode.

NOTE 2

To determine if your recorder provides a monitor output in the record mode, install a blank tape, plug earphone into "monitor" jack and microphone into microphone jack, set recorder controls to record, and speak into microphone while listening with the earphone. If you hear yourself through the earphone, your recorder does provide a monitor output in the record mode.

4.4 RECORDER ADJUSTMENTS

4.4.1 Volume Control

Since CUTS incorporates AGC (automatic gain control) circuitry in the read mode and the recorder has ALC in the record mode, the Volume Control setting should not be critical for either read or write operations. Simply set the control at midrange and forget it.

4.4.2 Tone Control

If your recorder has a Tone Control, set it at the top (high end) of its range. Tone controls usually have little effect, but it is safer to obtain a fairly high frequency response by setting the control as just described.

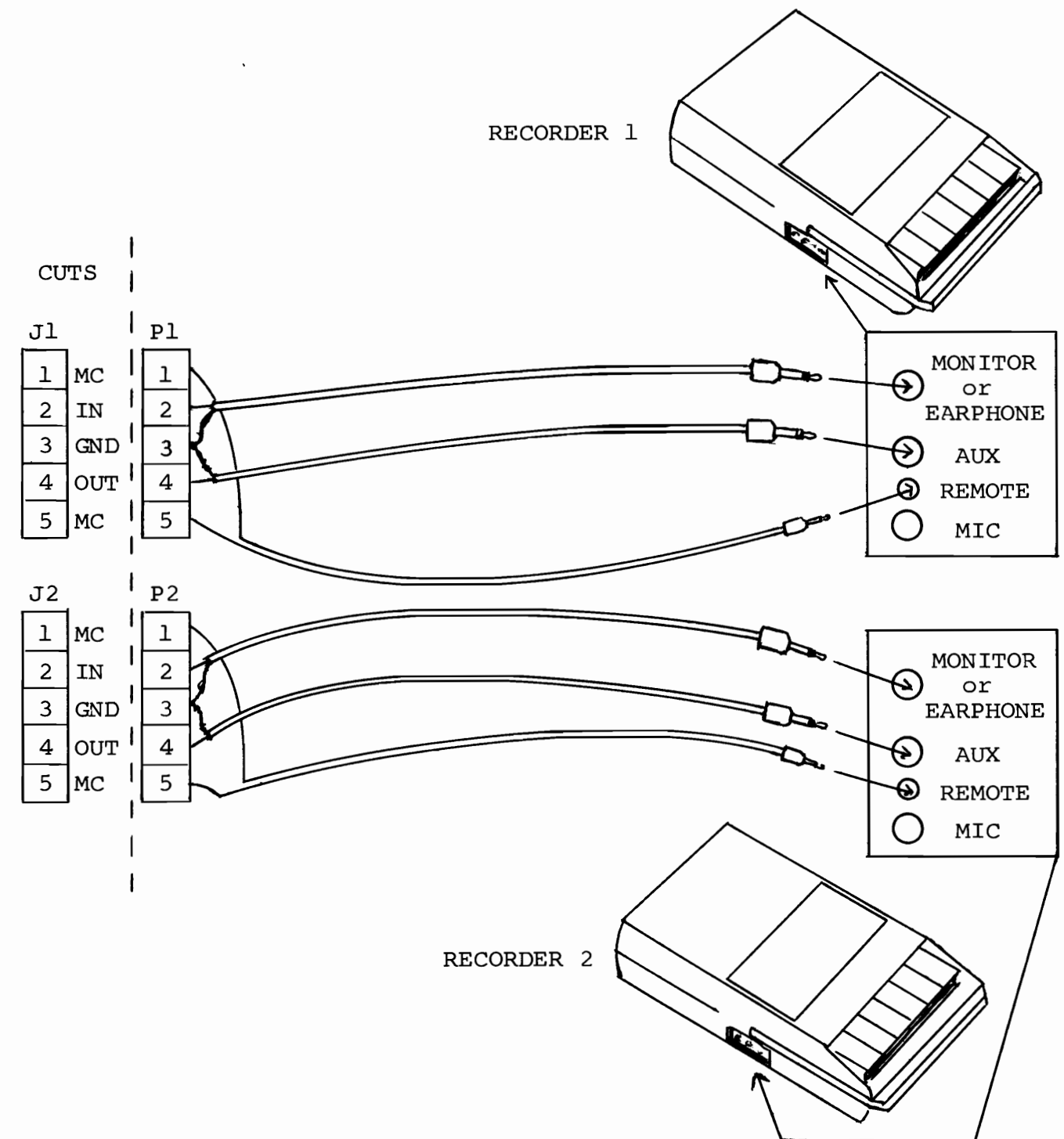


Figure 4-1. CUTS-recorder interconnect (two recorders).

4.5 WRITE OPERATIONS

Other than placing the recorder in the record mode, loading the tape and making sure that the head is on tape (not leader), no manual operations are needed to write on tape.

4.6 READ OPERATIONS

When reading tapes, you must start the tape at least two seconds ahead of the data block you want to read. (CUTS tapes have a standardized header before each data block.) This two second delay is needed to allow the recorder playback electronics and the CUTS circuitry to stabilize after power is turned on.

Use the following procedure for loading tapes:

1. Disconnect monitor and remote plugs from recorder. (On most recorders this must be done in order to listen to the tape.)
2. Load prerecorded cassette and play tape until you hear data. (Data sounds like noise in CUTS format.)

NOTE

Absence of data is indicated by a pure 1200 Hz or 2400 Hz tone if recorded at 1200 bps or 300 bps respectively in the Byte/Kansas City Standard format.

3. Rewind tape far enough so it will take two seconds to reach the data block you want to read after the recorder is placed in the playback mode. STOP RECORDER AT THIS POINT.
4. Set Volume Control as specified in Paragraph 4.4.1 if necessary.
5. Reconnect monitor and remote plugs to recorder.
6. Place "play" control on recorder in play position.
7. Type in appropriate command on your keyboard. After you strike the RETURN key (in most programs), the recorder will automatically start and data will be read into memory at the locations specified by the CUTS data header or, in the case of BASIC-5 or Processor Technology 8K BASIC, into the proper File or READ statement.

SECTION V

THEORY OF OPERATION

CUTS, COMPUTER USERS TAPE SYSTEM



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5.1 INTRODUCTION

The CUTS module functions to transfer data bidirectionally between a computer and one or two audio cassette recorders. To perform its function, the module contains circuitry related to:

1. port address recognition,
2. computer-CUTS buffering,
3. computer input/output command decoding,
4. timing,
5. status reporting,
6. recorder on/off control,
7. parallel-to-serial and digital-to-audio conversions in the write mode,
8. audio-to-digital and serial-to-parallel conversions in
9. and conversion of read data to NRZ (non-return to zero) format.

5.2 BLOCK DIAGRAM ANALYSIS

A simplified block diagram of the CUTS module is provided in Figure 5-1.

An address selector defines the port address for the CUTS module. It works with the address decoder to determine if the address on A1-7 matches the port address for the module. If it does, the decoder produces the indicated CARD SELECT output to enable the status in/out and strobe decoders.

Once an input or output request from the processor is recognized, the status in/out decoder enables a PRDY line driver in the wait state generator. This generator inserts one wait state into every input or output request from the processor.

The strobe decoder decodes the indicated inputs from the processor to produce the STATUS WRITE, READ STATUS, DATA READ and DATA WRITE strobe signals.

On an input cycle when A \emptyset is low, A \emptyset enables status outputs from the UART, and the strobe decoder outputs a READ STATUS signal. READ STATUS produces a delayed DRIVER ENABLE which gates the UART status to the DI bus. Should A \emptyset be high, however, the strobe decoder outputs a DATA READ to indicate to the UART that its data has

been accepted. It also resets the driver enable generator to immediately enable the DI bus drivers.

If the cycle is an output cycle and $A\emptyset$ is high, the strobe decoder outputs a DATA WRITE which transfers D0 bus data into the UART and initiates serial transmission by the UART. Should $A\emptyset$ be low, the strobe decoder outputs a STATUS WRITE. STATUS WRITE strobes the data on D04-7 into the status latch.

The four status bits in this latch are concerned with recorder motor control and data rate. One output turns one recorder motor on and off, another turns a second recorder motor on and off, a third selects a low data rate, and the fourth selects a high data rate.

Timing for the CUTS module is supplied by the clock circuits and read clock. Clock circuitry manipulates $\emptyset 2$ to supply WRITE CLOCK as well as various other timing signals required to obtain two data rates. Read clock uses NRZ data transitions and one of two clock signals to generate READ CLOCK for use in the read mode.

When CUTS is in the write mode, parallel data on D0 \emptyset -7 is serialized in the UART and applied to a synchronizer in the NRZ format. The synchronizer in turn establishes the time at which the bit cell from the UART starts. The digital-to-audio converter converts the data bit levels into corresponding audio signals. These signals are then fed through a driver to the audio output jacks.

In the read mode, inputs from the recorders are mixed and amplified, with an AGC circuit operating on the second stage. Following amplification the audio signals are converted into digital signals, the transitions of which are detected and converted into the NRZ format. NRZ data is applied to the UART which performs the required serial-to-parallel conversion and supplies the parallel data to the DI bus drivers.

5.3 THEORY OF OPERATION

Refer to CUTS schematic in Section VI.

5.3.1 Timing

All timing for the CUTS module is derived from, or related to, the 2 MHz $\emptyset 2$ clock from the computer. As can be seen on the schematic, $\emptyset 2$ is received on pin 24 of the S-100 bus by a hysteresis receiver, U21. The inverted $\emptyset 2$ directly clocks both sections of U20 as well as U12. One half of U20 (clock pin 12) serves as the wait state generator; the other half generates the DRIVER ENABLE signal.

U12, preset to count 3, divides $\emptyset 2$ by 13 to produce a 153.85 KHz signal on pin 11. The output of U12 is in turn counted down in

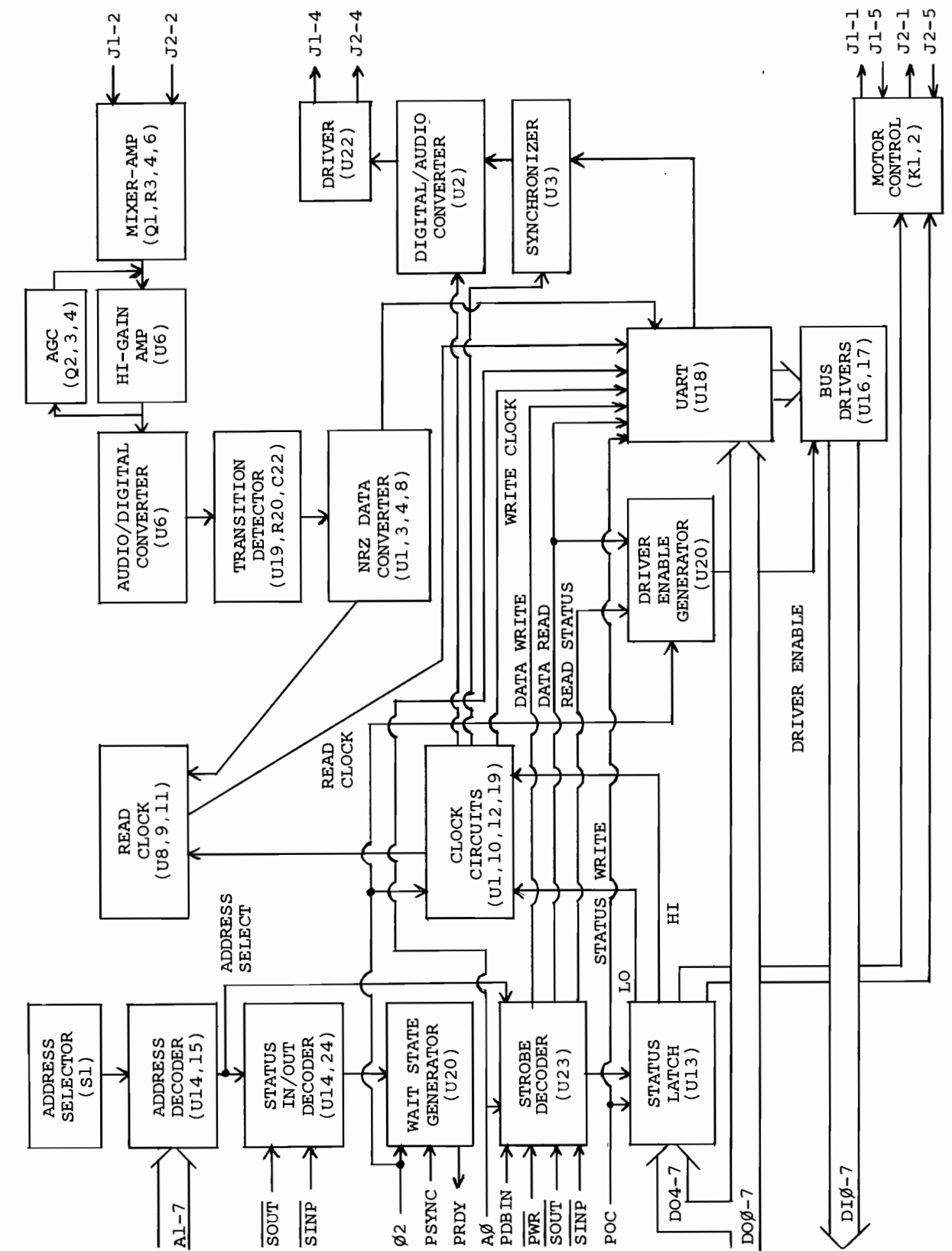


Figure 5-1. CUTS, simplified block diagram.

U10, a seven-stage binary counter, to provide 38.4 KHz on Q2, 19.2 KHz on Q3, 4800 Hz on Q5, 2400 Hz on Q6 and 1200 Hz on Q7. The clocks on Q6 and Q7 are used in the write data synchronizer (U3) and the digital-to-audio converter (U2).

The remaining outputs from U10 are fed to two sections of U9, a quad multiplexer or select gate. All four sections of U9 are used to select clocks for low speed or high speed operation according to the select inputs, pins 9 (A) and 14 (B). The states of these two select inputs must be complementary to each other in order to select the high or low speed clocks. Specifically, A must be high and B low to select high speed clocks; the converse condition selects low speed clocks. The select inputs are supplied by the complementary outputs of one section in U13, the status latch.

The output of the second section of U9 is WRITE CLOCK, 4800 Hz on low speed and 19.2 KHz on high speed. The third section outputs a 19.2 KHz (high speed) or 38.4 KHz (low speed) timing signal to U8 in the NRZ data conversion circuit.

READ CLOCK is produced by U11 (a phase locked loop), U8 (a binary counter) and the remaining two sections in U9. The signal input (pin 14) to U11 is supplied from pin 1 of U3 in the NRZ data conversion circuit. It is a constant frequency, regardless of whether one or two transitions are detected in the read data during the count out time (12 counts) of the counter (U8) in the NRZ conversion circuit. A phase comparator in U11 compares the signal input to the output of a voltage controlled oscillator (VCO) in U11 (pin 4). By feeding the VCO output through a counter (the other half of U8) before feeding the counter output back to the compare input (pin 3) of U11, the circuit acts as a frequency multiplier. The output of this circuit remains locked, therefore, to a multiple of the signal input on pin 14 of U11.

The output of U11 is nominally 19.2 KHz. Remember that the actual output is determined by the signal input which in turn is a function of tape speed. In other words, the phase lock loop circuit tracks input frequency variations. And it will track such variations within its locking range which is determined by the setting of VR1 (connected to pin 12 of U11).

On high speed, the divide by four output of U8 (pin 12) is selected as RECEIVE CLOCK. The VCO output of U11 is selected for the low speed RECEIVE CLOCK.

5.3.2 Control

Basically the wait state generator ($\frac{1}{2}$ of U20), address selector and decoder (S1, U14 and U15), strobe decoder (U23), driver enable generator ($\frac{1}{2}$ of U20), the status latch (U13), the status in/out decoder (U14 and 24), motor control (K1 and 2), and power on clear (U21) comprise the CUTS control circuitry.

The address selector and decoder consists of seven open collector exclusive-OR gates, the inputs of which are connected to A1-7, RX1 and S1. RX1 and S1 function as the selector which is configured to reflect the complement of the module address. That is, a response to a high on an address line is generated by the applicable gate by grounding the other input by closing the appropriate DIP switch position. When the decoder senses an address match, all the gates respond true and RX2-4 pulls the outputs up to a high level CARD SELECT signal.

CARD SELECT enables the output gate (U21) in the status in/out decoder. This gate is satisfied if, and only if, SOUT or SINP is active to indicate either an input or output operation is under way. The output (pin 6) of U21 enables the PRDY line driver.

The input to this driver is provided on pin 10 of U20, the wait state generator which is clocked by $\phi 2$ and reset by PSYNC. Thus, pin 10 of U20 goes high on the falling edge of $\phi 2$ after PSYNC. This is the time during which the processor tests for wait requests. The purpose of this half of U20, therefore, is to insert one wait state into every input or output request by the processor. This is required to lengthen the data strobes to durations required by the UART.

U23, the strobe decoder, decodes SINP, PDBIN, SOUT, \overline{PWR} and $A\emptyset$ to produce $\overline{\text{STATUS WRITE}}$, $\overline{\text{READ STATUS}}$, $\overline{\text{DATA READ STROBE}}$, and $\overline{\text{DATA WRITE STROBE}}$. The truth table for U23 is provided in Table 5-1 on Page V-6. All outputs from U23 are low active.

$\overline{\text{READ STATUS}}$ is applied to the J and \overline{K} inputs to the other half of U20 which is clocked by $\phi 2$. Thus, an active $\overline{\text{READ STATUS}}$ signal produces a $\overline{\text{DRIVER ENABLE}}$ which is delayed from the strobe by one-half a $\phi 2$ cycle. This signal enables the tri-state buffers (U16 and 17) to place data on the DI bus. Note that a $\overline{\text{DATA READ STROBE}}$ resets U20 to immediately enable the DI bus buffers.

The status latch, U13, latches data present on DO4-7. (Note that the data on DO4 is not used.) Data is loaded into U13 when the strobe decoder outputs a $\overline{\text{STATUS WRITE STROBE}}$. Four output bits from this latch select data rate and control the tape recorders. A low on pin 14 energizes K2 to turn recorder #1 on; a high on this pin de-energizes K2 to turn recorder #1 off. The output on pin 11 of U13 does the same thing for K1 which controls recorder #2. (D1 and D2, which shunt K2 and K1 respectively, prevent damage to the logic circuitry due to inductive kickback.) The remaining two outputs from U13, the complementary outputs associated with DO5, select either low or high speed operation by selecting the appropriate clocks out of U9. Low speed is selected when pins 3 and 2 of U13 are high and low respectively. When the converse relationship exists, high speed is selected.

Table 5-1. Strobe Decoder (U23) Truth Table.

INPUTS						ACTIVE OUTPUT (Low)
A \emptyset *	CARD SELECT	PDBIN*	SINP*	$\overline{\text{PWR}}$ *	SOUT*	
L	H	H	H	-	-	$\overline{\text{READ STATUS}}$
H	H	H	H	-	-	$\overline{\text{DATA READ STROBE}}$
L	H	-	-	L	H	$\overline{\text{STATUS WRITE STROBE}}$
H	H	-	-	L	H	$\overline{\text{DATA WRITE STROBE}}$

*Inputs to CUTS module.

The remaining control circuit, POC (power on clear), initializes the CUTS whenever power is applied. When power is applied, POC on S-100 bus pin 99 goes low. POC is inverted in one section of U21 to clear the logic in the UART (U18). In addition, the inverted POC is again inverted in one section of U24 to clear the status register, U13. This clear sets both motor control outputs as well as the high speed select bit high.

5.3.3 Write Mode

When the CUTS is in the write mode, data is input to the UART (U18) under control of the $\overline{\text{DATA WRITE STROBE}}$ signal from U23. Upon completion of this strobe, the transmit sequence is initiated within the UART, with the transmission rate being governed by WRITE CLOCK.

The transmission sequence begins with a start bit, a low (data zero) on the UART's T0 output. It is followed by eight data bits and two stop bits, with the number of bits being fixed by the connections to pins 34 through 39 of U18. This data stream is called NRZ data (non-return to zero) because the data never returns to zero until the next bit cell.

NRZ data from U18 is applied to the D input of U3, a D-type flip-flop which is clocked at 1200 Hz. Consequently, the output on pin 13 of U3 follows the input data on pin 9 after the rising edge of the 1200 Hz clock. This output is connected to the reset (pin 12) of U2, so when the data out of the UART is high, the first section in U2 is forced to a reset condition. In this condition the J and K inputs to the second stage of U2 are held high which allows the flip-flop to change state on the rising edge of the clock.

The clock for U2 is 2400 Hz in the high speed mode or 4800 Hz in the low speed mode. This clock is derived from the 2400 Hz output of U10 in conjunction with the low speed select signal NAND gate U1 and exclusive-OR gate U19.

In the high speed mode, pins 4 and 5 of U1 are held low, thus holding pin 6 of U1 high. As a result the 2400 Hz signal is inverted in U19 to become the clock for U2.

Pins 4 and 5 of U1 are held high, however, in the low speed mode to enable U1. In this case R19 and C20 provide a delay in the U1 gate. When the 2400 Hz signal on pin 9 of U19 changes state, so does pin 10 of U19. Also, C20 charges through R19 for several hundred nanoseconds, at which point pin 6 of U1 is brought to the opposite polarity. The output from U19 then goes high. A series of positive pulses, with a pulse width approximately equal to the R19, C20 time constant and occurring at every transition of the 2400 Hz signal, appears on pin 10 of U19. This circuit thus operates as a frequency doubler in the low speed mode to provide a 4800 Hz clock for U2.

The 2400 Hz signal from which the U2 clocks are derived also produces the 1200 Hz clock signal for U3 by toggling the flip-flop in U10. As a result the 1200 Hz signal changes state following a propagation delay after the 2400 Hz signal falls.

As previously stated, the second stage of U2 is allowed to change state on the positive going transitions of the U2 clock as long as the data out of the synchronizer is a "1". The end result is an output on pin 2 of U2 that is one-half the clock frequency (1200 Hz and 2400 Hz in the high and low speed modes respectively).

Assume the data stream out of the UART goes low ("0"). On the next rising edge of the 1200 Hz signal, U3 will reset with Q low and \overline{Q} high. A low reset on pin 12 of U2 enables the first U2 stage to toggle on the next rising edge of the U2 clock which occurs 1/2400 second after the synchronizer output falls. Remember that the U2 clock moves from a low to a high shortly before the 1200 Hz signal did. The reset on pin 12 of U2 is thus removed slightly after the U2 clock occurred. With the J and K inputs to the first U2 stage high, its output will change state on each succeeding low to high transition of U2 clock. The second U2 stage in turn can only toggle on the positive going transition of U2 clock when its J and K inputs are high. Since the inputs are high at one-half the clock rate, by virtue of the first U2 stage, the second U2 stage toggles at one-fourth the clock rate.

The two sections of U2, therefore, operate as a frequency divider, dividing the clock by two when the write data is a "1" and by four when the data is a "0". Thus, in the low speed mode, four cycles of the 1200 Hz represent a "0" and eight cycles of 2400 Hz represent a "1". In the high speed mode, one cycle of

1200 Hz represents a "1" and one-half cycle of 600 Hz represents a "0".

The output on pin 2 of U2 is applied to one section in U22 which provides sufficient current drive for the R15,16 and 17 divider network. This divider and a jumper arrangement allow selecting one of three outputs to be fed to the audio output jack *J1-4 and J2-4). The A-to-D jumper selects a 4-volt peak-to-peak square wave output for a digital recorder; the A-to-B jumper selects a 270 mv signal for the auxiliary input to an audio recorder; the A-to-C jumper selects a 50 mv signal for the microphone input to an audio recorder.

5.3.4 Read Mode

When CUTS is in the read mode, data from the recorders enters on J1-2 and J2-2. These two inputs are mixed through a resistive mixer (R3,4 and 6) and fed to Q1, an emitter follower, the output of which is applied to the negative input (pin 2) of operational amplifier U6.

The first section of U6 is a high gain amplifier, with its gain being determined by R9 and R10. The output from this amplifier is coupled to the input (pin 6) of the following U6 stage and the base of a Darlington pair (Q3 and 4) which provides high current gain.

Current into the base of Q3 causes C29 to discharge. (C29 charges through R25 to 5 V dc.) The voltage on C29 in turn controls the gate of FET (field effect transistor) Q2. Q2 functions as a variable resistor which can be changed by its gate voltage. Since Q2 is connected between ground and the input network to the first U6 stage, it serves as a variable shunt. A low gate voltage on Q2 decreases the shunt resistance and the input to U6. In a like manner, a high voltage on C29 results in an increased input to U6. Q2, 3 and 4 with their associated circuitry, therefore, serve as an AGC circuit which limits the input to the second U6 stage to approximately a 2 volt peak signal.

The second stage of U6 performs the needed audio to digital conversion. Feedback resistor R12, in conjunction with R13, establishes the level on the positive input (pin 5) of U6. This level, be it positive or negative, is the threshold which the negative input (pin 6) must exceed in order for the output of U6 to switch levels, positive to negative and the converse. Since the feedback loop is regenerative, U6 switches at its maximum rate, and U6 switches on each transition of the audio signal input. It is in this manner that U6 performs the audio to digital conversion.

The digital output of U6 is inverted in one section of U22 and applied to pin 2 of U19, an exclusive-OR gate which is connected as a buffer without inversion. If the output of U22 is low, the

output on pin 3 of U19 is also low and the output on pin 11 of U19 is high. The voltage across C22 under this condition is minimal. When the output of U22 goes high, C22 starts to charge through R20 until pin 2 of U19 crosses the threshold of that gate. At this point pin 3 of U19 goes high, and since the two inputs to the second exclusive-OR gate are both high, pin 11 of U19 goes low. C22 now discharges because pins 2 and 3 of U19 are at the same level so that the circuit can repeat the operation on the next high to low transition at pin 4 of U22. R20, C22 and U19 consequently serve as a transition detector that produces a pulse less than one microsecond long for each transition of the output on pin 4 of U22, regardless of the polarity of the transition.

Transition pulses from U19 clock $\frac{1}{2}$ of U3 and $\frac{1}{2}$ of U4, both of which are D-type flip-flops. A transition pulse clocks U3 to set Q high and \bar{Q} low to enable a binary counter, U8. The Q output of U3 is applied to pin 5 of U4 and the circuit remains in this state until one of two things occurs: 1) a second transition pulse arrives before U8 reaches count 12 or 2) U8 reaches count 12.

If a second transition pulse arrives before count 12, the first U4 stage is set and presents a "1" to pin 9 of U4. This is clocked by the reset of U3 as a low to pin 12 of U4.

If a transition pulse does not arrive before count 12, the first U4 stage presents a "0" to pin 9 of U4. On count 12, the C and D outputs of U8 go high to reset U3 through U1. As a result the U4 second stage clock goes high, as does pin 12 of U4. The output on pin 12 of U4, in the NRZ format, is inverted by U22 and applied to the receive input of the UART.

The Q output of U3, which occurs at the actual bit rate of the incoming data, is also used by the receive clock circuitry to reconstruct the receive clock from the data signal.

Received data undergoes serial-to-parallel conversion in the UART and placed on the R01-8 data outputs of the UART WHEN ROD (pin 4 of the UART) is low. The received data is then gated through U16 and 17 to the DI bus.

Four status outputs from the UART can also be enabled when SFD (pin 16) is low. These four bits are FE (framing error), OE (overrun error), DR (data ready) and TBRE (transmitter buffer register empty). They are also gated through U16 and 17 to DI3,4,6 and 7 respectively by a delayed READ STATUS signal.

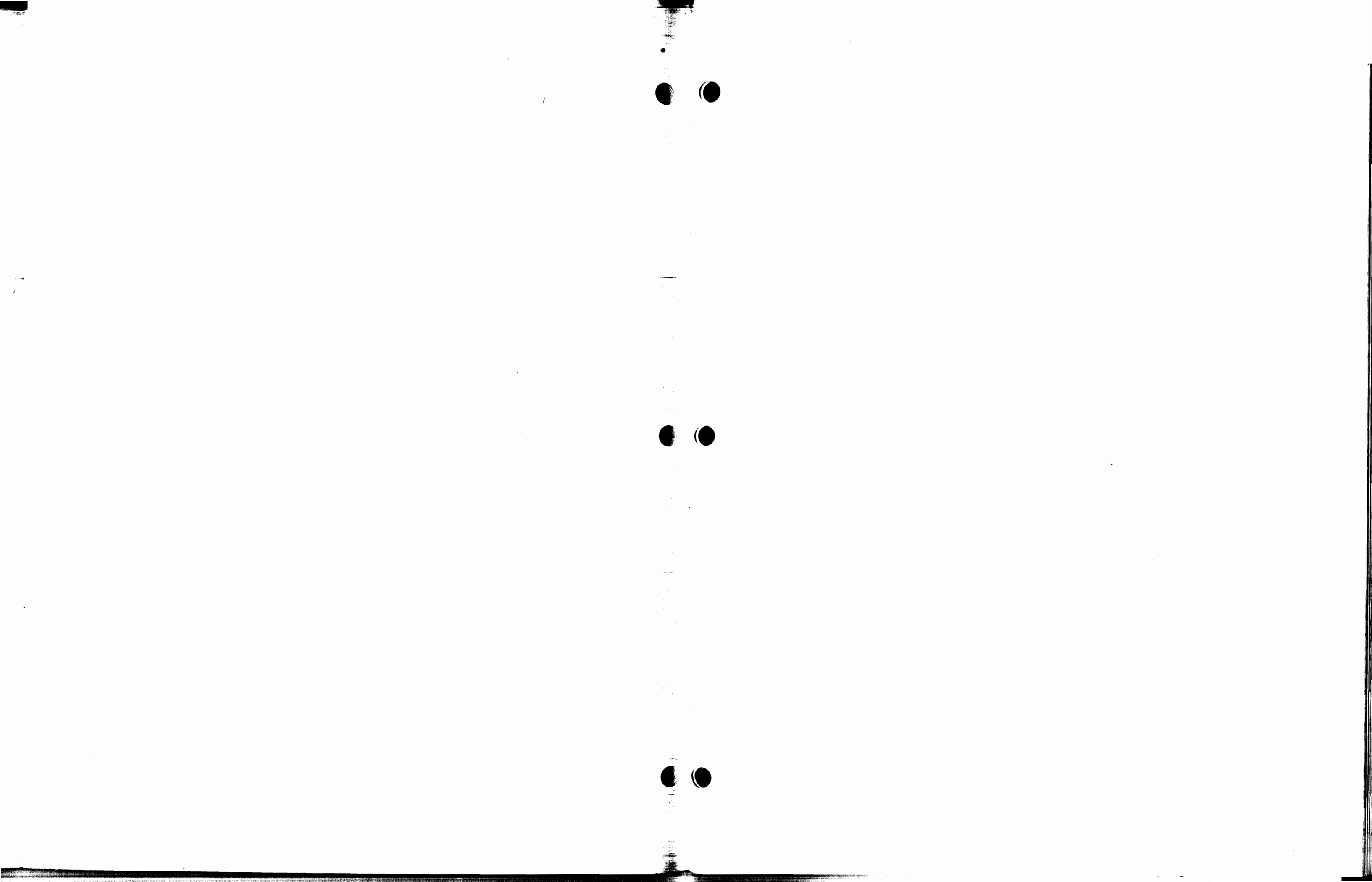
SECTION VI

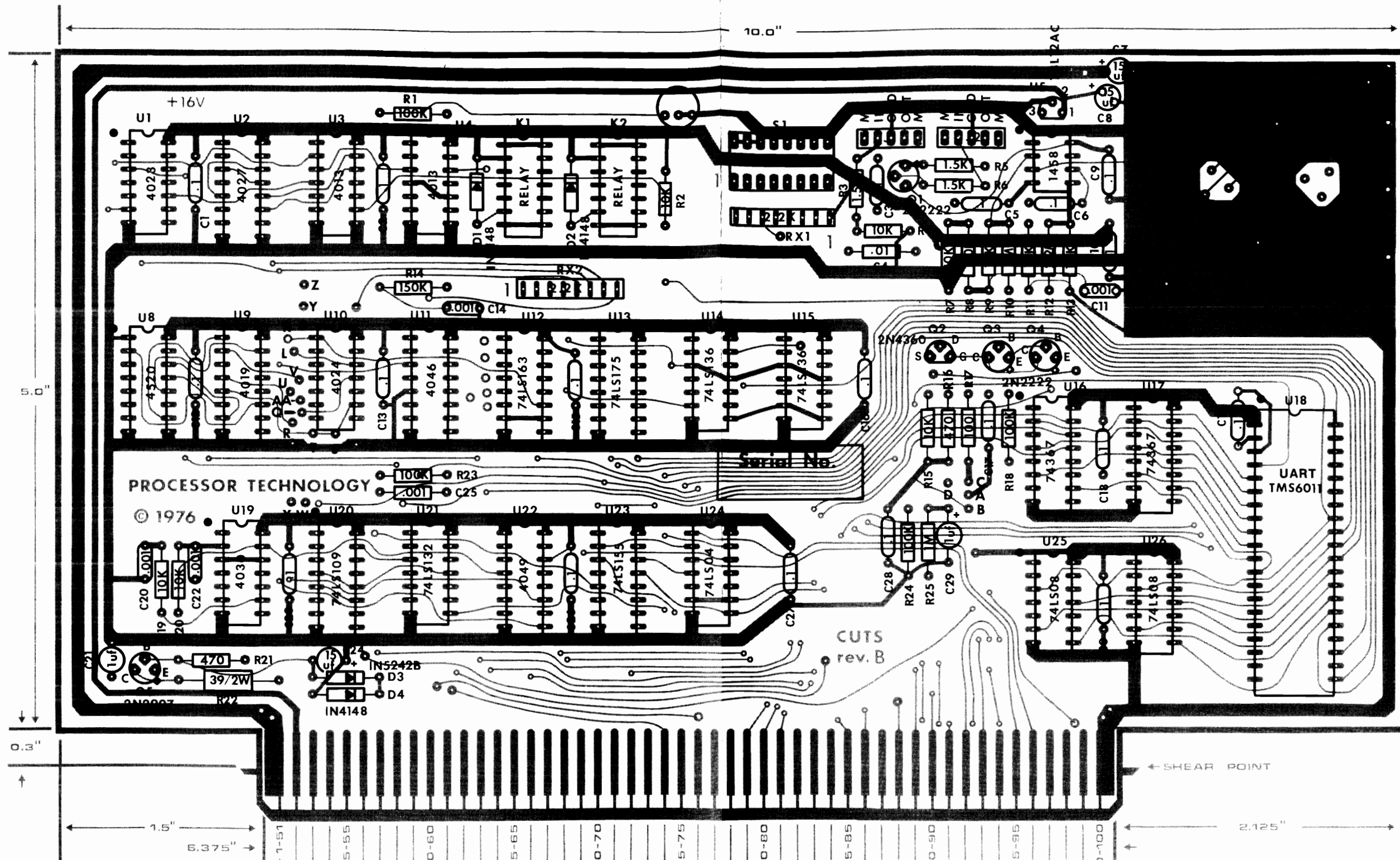
DRAWINGS

CUTS, COMPUTER USERS TAPE SYSTEM



Processor Technology Corporation
6200 Hollis Street
Emeryville CA 94608





DESIGNED BY: RMM
 DATE: 9 21 76
 LAYOUT BY: JD
 DATE: 10 7 76
 REVISION: B RM
 DATE: 11 15 76

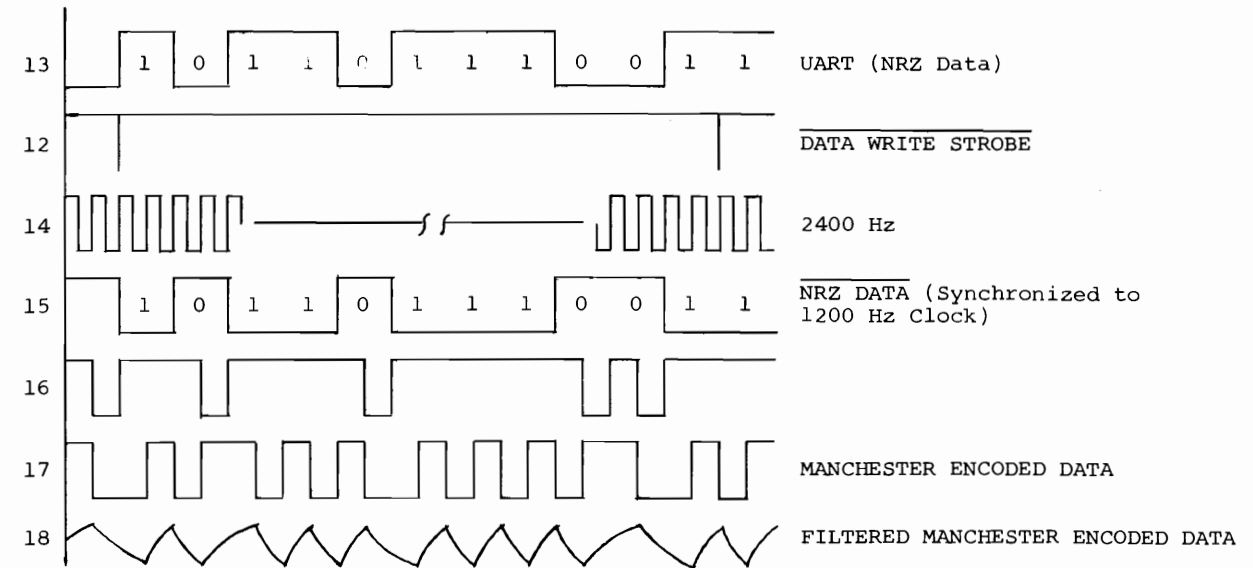
COMPONENT	WIRING
+8	1-51
+16	-16
XRDY	SSW DSB
V10	EXT CLR
V11	RTC 5-55
V12	STSTE
V13	DIG1
V14	PRDY
V15	
V16	10-60
V17	
XRDY2	
	15-65
	PHANTOM
STA DSB	MVRT
C/C DSB	PS
UNPROC	PROC 20-70
SS	RUN
ADD DSB	PRDY
DO DSB	PINT
Ø2 CLK	PHOLD
Ø1 CLK	PRESET 25-75
PHLOA	PSYNC
PWAIT	SWR
PINTE	POBIN
A5	A0
A4	A1
A3	A2
A15	A6
A12	A7
A9	A8
DO 1	A13
DO 0	A14
A10	A11
DO 4	DO 2
DO 5	DO 3
DO 6	DO 7
DO 8	DO 9
DI 2	DI 4
DI 3	DI 5
DI 7	DI 6
SMI	DI 1
SOUT	DI 0
SINP	SINTA
SMER	SWO
SHLTA	SSTACK
CLOCK	POC
GND	GND 50-100

Processor Technology Corporation
 6200 Hollis Street (415) 652-8080
 Emeryville, Ca 94608

STANDARD CARD OUTLINE
 Copyright 1976

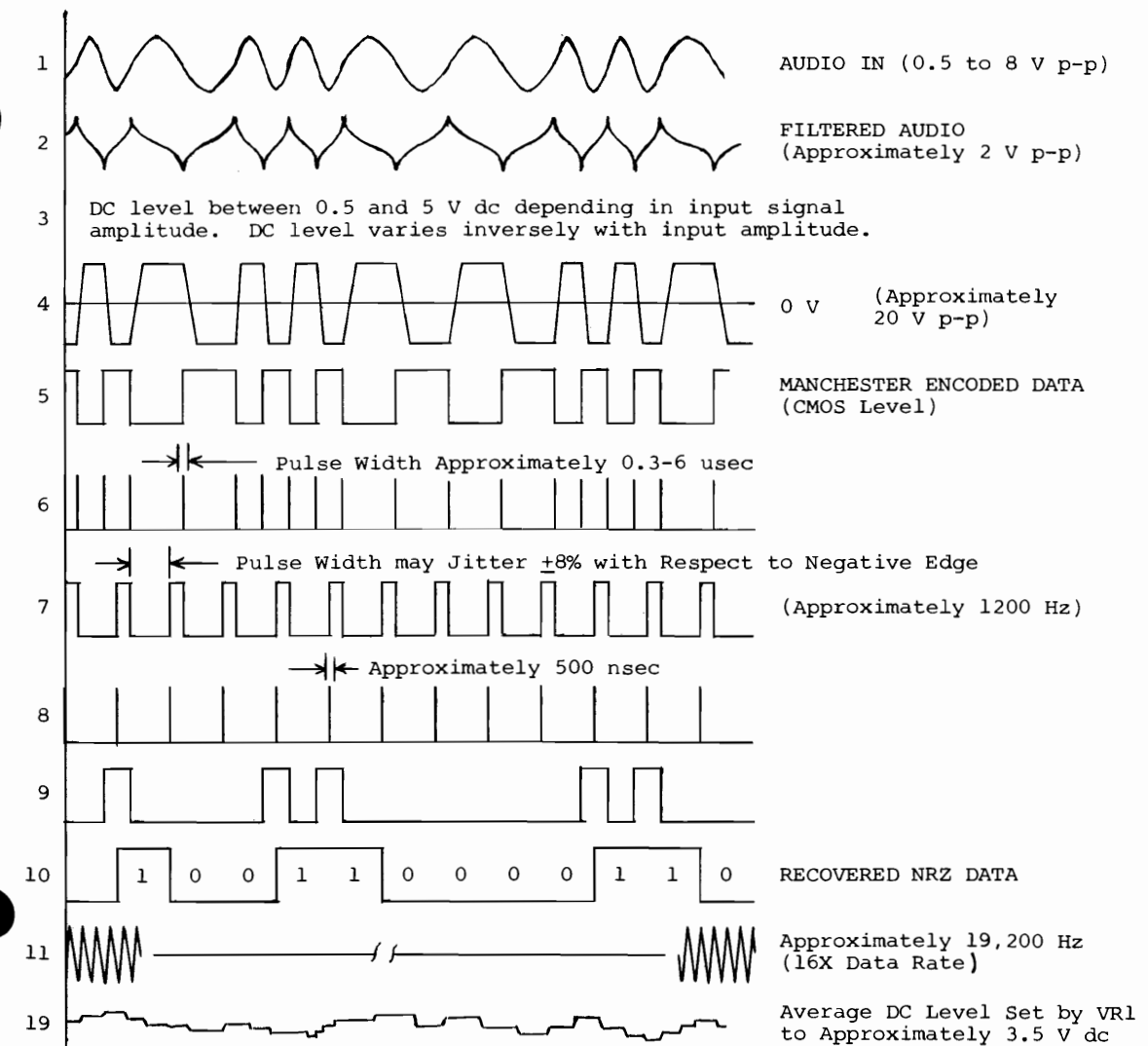
Title: CUTS Rev: B
 Side: BOTH Component
 Assembly

CUTS TIMING, WRITE MODE (1200 Baud Operation)



NOTE: 1200 Baud NRZ data (13) is not necessarily synchronized with 1200 Hz clock. Signal at 15 and its complement on pin 12 of U3 are.

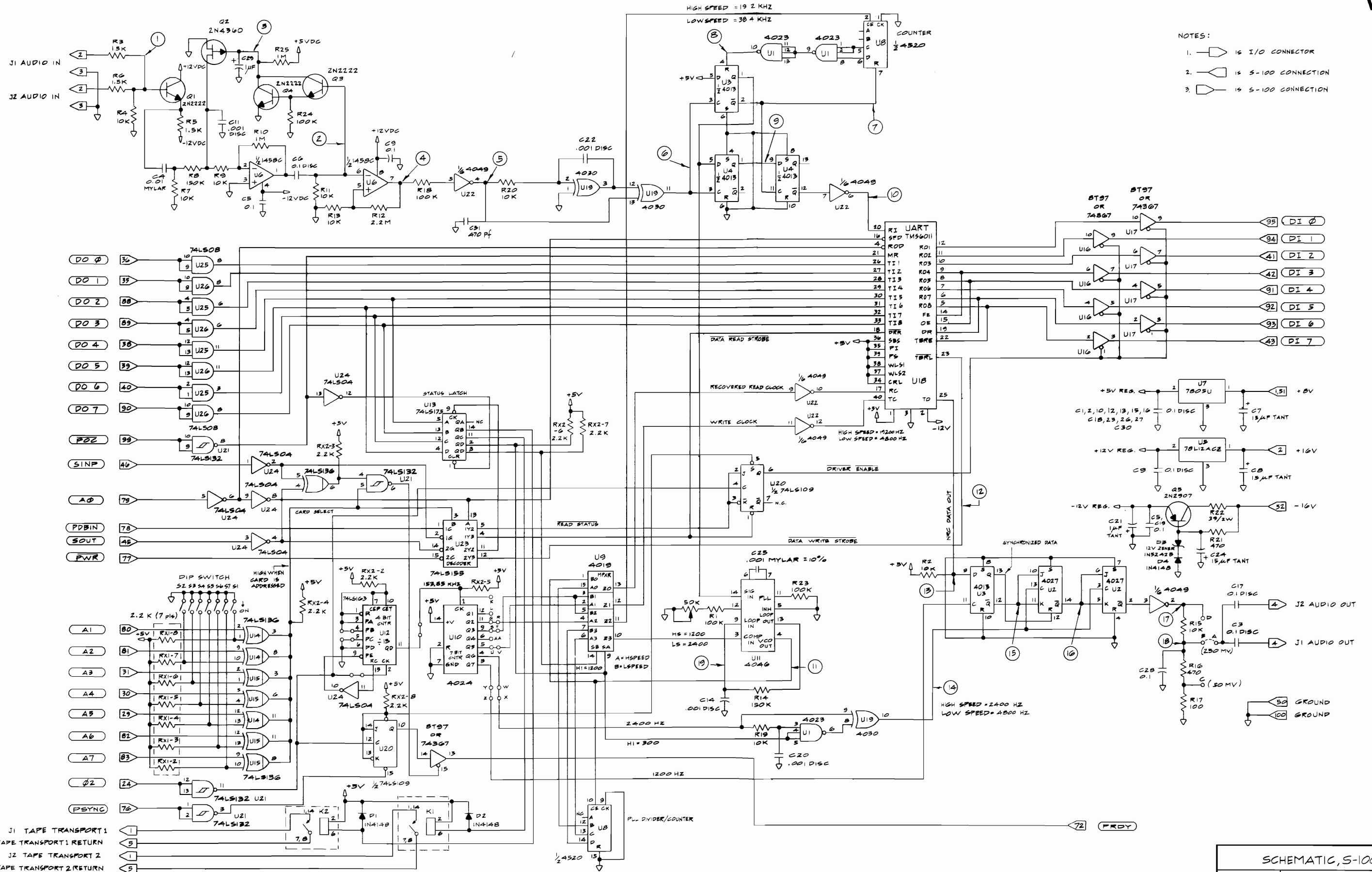
CUTS TIMING, READ MODE (1200 Baud Operation)



J1 AUDIO IN

J2 AUDIO IN

J1 TAPE TRANSPORT 1
 J1 TAPE TRANSPORT 1
 J2 TAPE TRANSPORT 2
 J2 TAPE TRANSPORT 2



- NOTES:
- 1. 16 I/O CONNECTOR
 - 2. 5-100 CONNECTION
 - 3. 5-100 CONNECTION

J1 TAPE TRANSPORT 1
 J1 TAPE TRANSPORT 1 RETURN
 J2 TAPE TRANSPORT 2
 J2 TAPE TRANSPORT 2 RETURN

SCHEMATIC, S-100 CUTS		
SCALE: _____	APPROVED BY: R. MARSH	DRAWN BY LITO
DATE: 9-21-76	REVISION: 02-3-77	
PROCESSOR TECHNOLOGY		
Rev. B	DRAWING NUMBER	

APPENDICES

- I Statement of Warranty
- II 8080 Operating Codes
- III Standard Color Code
- IV Loading DIP Devices,
Soldering Tips and
Installing Augat Pins
- V IC Pin Configurations



Processor Technology Corporation
6200 Hollis Street
Emeryville CA 94608

Warranty

PROCESSOR TECHNOLOGY CORPORATION, in recognition of its responsibility to provide quality components and adequate instruction for their proper assembly, warrants its products as follows:

All components sold by **Processor Technology Corporation** are purchased through normal factory distribution and any part which fails because of defects in workmanship or material will be replaced at no charge for a period of 3 months for kits, and one year for assembled modules, following the date of purchase. The defective part must be returned postpaid to **Processor Technology Corporation** within the warranty period.

Any malfunctioning module, purchased as a kit directly from **Processor Technology** and returned to the factory within the three-month warranty period, which in the judgement of **PTC** has been assembled with care and not subjected to electrical or mechanical abuse, will be restored to proper operating condition and returned, regardless of cause of malfunction, without charge. Kits purchased from authorized **PTC** dealers should be returned to the selling dealer for the same warranty service.

Any modules purchased as a kit and returned to **PTC**, which in the judgement of **PTC** are not covered by the above conditions, will be repaired and returned at a cost commensurate with the work required. In any case, this charge will not exceed \$20.00 without prior notification and approval of the owner.

Any modules, purchased as assembled units are guaranteed to meet specifications in effect at the time of manufacture for a period of at least one year following purchase. These modules are additionally guaranteed against defects in materials or workmanship for the same one year period. All warranted factory assembled units returned to **PTCO** postpaid will be repaired and returned without charge.

This warranty is made in lieu of all other warranties expressed or implied and is limited in any case to the repair or replacement of the module involved.

HEX-ASCII TABLE		HEX-ASCII TABLE	
Printing	Characters	Printing	Characters
30	0	40	@
31	1	41	A
32	2	42	B
33	3	43	C
34	4	44	D
35	5	45	E
36	6	46	F
37	7	47	G
38	8	48	H
39	9	49	I
40		4A	J
41	A	4B	K
42	B	4C	L
43	C	4D	M
44	D	4E	N
45	E	4F	O
46	F	50	P
47	G	51	Q
48	H	52	R
49	I	53	S
4A	J	54	T
4B	K	55	U
4C	L	56	V
4D	M	57	W
4E	N	58	X
4F	O	59	Y
50	P	5A	Z
51	Q		
52	R		
53	S		
54	T		
55	U		
56	V		
57	W		
58	X		
59	Y		
5A	Z		

HEX-ASCII TABLE		HEX-ASCII TABLE	
Non-Printing	Non-Printing	Non-Printing	Non-Printing
00	NULL	00	NULL
01		01	
02		02	
03		03	
04		04	
05		05	
06		06	
07	BELL	07	BELL
08		08	
09	TAB	09	TAB
0A		0A	
0B	VT	0B	VT
0C	FORM	0C	FORM
0D	CR	0D	CR
0E		0E	
0F		0F	
10		10	
11	X-ON	11	X-ON
12	TAPE	12	TAPE
13	X-OFF	13	X-OFF
14		14	
15		15	
16	ESC	16	ESC
17		17	
18		18	
19		19	
1A		1A	
1B		1B	
1C		1C	
1D		1D	
1E		1E	
1F		1F	

D8 = constant, or logical/arithmetic expression that evaluates to an 8 bit data quantity

D16 = constant, or logical/arithmetic expression that evaluates to a 16 bit data quantity

Adr = 16 bit address



CONSTANT DEFINITION		ACCUMULATOR*		MOVE (cont)		ROTATE†		RESTART		RETURN		CALL		JUMP	
0BDH	Hex	B	XRA	58	MOV E,B	07	RLC	C7	RST 0	C9	RET	CD	CALL	C3	JMP
1AH	Hex	C	XRA	59	MOV E,C	0F	RRC	CF	RST 1	C0	RNZ	C4	CNZ	C2	JNZ
105D	Decimal	D	XRA	5A	MOV E,D	17	RAL	D7	RST 2	C8	RZ	C5	CZ	CA	JZ
105	Decimal	E	XRA	5B	MOV E,E	1F	RAR	DF	RST 3	D0	RNC	C6	CNC	D2	JNC
720	Octal	H	XRA	5C	MOV E,H	CONTROL		E7	RST 4	D8	RC	D4	CNC	DA	JC
720	Octal	L	XRA	5D	MOV E,L	00	NOP	EF	RST 5	E0	RPO	D0	CC	D2	JNC
		M	XRA	5E	MOV E,M	76	HLT	F7	RST 6	E8	RPE	E4	CPO	E2	JPO
		A	XRA	5F	MOV E,A	F3	DI	FF	RST 7	F0	RP	E8	CPE	EA	JPE
		B	ORA	60	MOV H,B	FB	EI			F8	RM	F4	CP	F2	JP
		C	ORA	61	MOV H,C							FC	CM	FA	JM
		D	ORA	62	MOV H,D									E9	PCHL
		E	ORA	63	MOV H,E										
		H	ORA	64	MOV H,H										
		L	ORA	65	MOV H,L										
		M	ORA	66	MOV H,M										
		A	ORA	67	MOV H,A										
		B	CMP	68	MOV L,B										
		C	CMP	69	MOV L,C										
		D	CMP	6A	MOV L,D										
		E	CMP	6B	MOV L,E										
		H	CMP	6C	MOV L,H										
		L	CMP	6D	MOV L,L										
		M	CMP	6E	MOV L,M										
		A	CMP	6F	MOV L,A										
		B	SBB	70	MOV M,B										
		C	SBB	71	MOV M,C										
		D	SBB	72	MOV M,D										
		E	SBB	73	MOV M,E										
		H	SBB	74	MOV M,H										
		L	SBB	75	MOV M,L										
		M	SBB	76	MOV M,M										
		A	SBB	77	MOV M,A										
		B	ANA	78	MOV A,B										
		C	ANA	79	MOV A,C										
		D	ANA	7A	MOV A,D										
		E	ANA	7B	MOV A,E										
		H	ANA	7C	MOV A,H										
		L	ANA	7D	MOV A,L										
		M	ANA	7E	MOV A,M										
		A	ANA	7F	MOV A,A										

APPENDIX II

Adr = 16 bit address
 ** = all Flags except CARRY affected;
 (exception: INX & DCX affect no Flags)

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PROCESSOR TECHNOLOGY CORPORATION

CUTS, COMPUTER USERS TAPE SYSTEM

APPENDIX III

The electrical value of many types of resistors and capacitors is printed on the component. Other types, however, are identified by color coding which gives all the information needed to correctly identify the component. In most cases color coding conforms with the EIA (Electronic Industries Association) Standard Color Code. In other cases a manufacturer will adapt the standard to fit his particular requirement. Both the Standard Color Code and a code used to identify tantalum dipped capacitors are provided below.

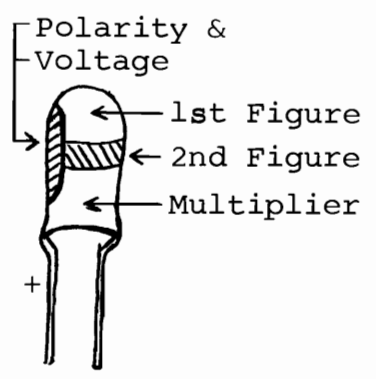
STANDARD COLOR CODE FOR RESISTORS AND CAPACITORS

COLOR	SIGNIFICANT FIGURE	DECIMAL MULTIPLIER	TOLERANCE (%)	VOLTAGE RATING*
Black	0	1		--
Brown	1	10		100
Red	2	100		200
Orange	3	1,000		300
Yellow	4	10,000		400
Green	5	100,000		500
Blue	6	1,000,000		600
Violet	7	10,000,000		700
Gray	8	100,000,000		800
White	9	1,000,000,000		900
Gold	-	0.1	5	1000
Silver	-	0.01	10	2000
None	-	---	20	500

*Applies to capacitors only.

COLOR CODE FOR TANTALUM DIPPED CAPACITORS

Rated Voltage VDC 25°C	Color	CODE FOR CAPACITANCE IN PICO FARADS		
		1st Figure	2nd Figure	Multiplier uuF
3-4	Black	0	0	1
3-6	Brown	1	1	10
3-10	Red	2	2	100
3-15	Orange	3	3	1,000
3-20	Yellow	4	4	10,000
3-25	Green	5	5	100,000
3-35	Blue	6	6	1,000,000
3-50	Violet	7	7	10,000,000
	Gray	8	8	
	White	9	9	



LOADING DIP (DUAL IN-LINE PACKAGE) DEVICES

Most DIP devices have their leads spread so that they can not be dropped straight into the board. They must be "walked in" using the following procedure:

- (1) Orient the device properly. Pin 1 is indicated by a small embossed dot on the top surface of the device at one corner. Pins are numbered counterclockwise from pin 1.
- (2) Insert the pins on one side of the device into their holes on the printed circuit card. Do not press the pins all the way in, but stop when they are just starting to emerge from the opposite side of the card.
- (3) Exert a sideways pressure on the pins at the other side of the device by pressing against them where they are still wide below the bend. Bring this row of pins into alignment with its holes in the printed circuit card and insert them an equal distance, until they begin to emerge.
- (4) Press the device straight down until it seats on the points where the pins widen.
- (5) Turn the card over and select two pins at opposite corners of the device. Using a fingernail or a pair of long-nose pliers, push these pins outwards until they are bent at a 45° angle to the surface of the card. This will secure the device until it is soldered.

SOLDERING TIPS

- (1) Use a low-wattage iron--25 watts is good. Larger irons run the risk of burning the printed-circuit board. Don't try to use a soldering gun, they are too hot.
- (2) Use a small pointed tip and keep it clean. Keep a damp piece of sponge by the iron and wipe the tip on it after each use.
- (3) Use 60-40 rosin-core solder ONLY. DO NOT use acid-core solder or externally applied fluxes. Use the smallest diameter solder you can get.

NOTE: DO NOT press the top of the iron on the pad or trace. This will cause the trace to "lift" off of the board which will result in permanent damage.

- (4) In soldering, wipe the tip, apply a light coating of new solder to it, and apply the tip to both parts of the joint, that is, both the component lead and the printed-circuit pad. Apply the solder against the lead and pad being heated, but not directly to the tip of the iron. Thus, when the solder

melts the rest of the joint will be hot enough for the solder to "take", (i.e., form a capillary film).

- (5) Apply solder for a second or two, then remove the solder and keep the iron tip on the joint. The rosin will bubble out. Allow about three or four bubbles, but don't keep the tip applied for more than ten seconds.
- (6) Solder should follow the contours of the original joint. A blob or lump may well be a solder bridge, where enough solder has been built upon one conductor to overflow and "take" on the adjacent conductor. Due to capillary action, these solder bridges look very neat, but they are a constant source of trouble when boards of a high trace density are being soldered. Inspect each integrated circuit and component after soldering for bridges.
- (7) To remove solder bridges, it is best to use a vacuum "solder puller" if one is available. If not, the bridge can be reheated with the iron and the excess solder "pulled" with the tip along the printed circuit traces until the lump of solder becomes thin enough to break the bridge. Braid-type solder remover, which causes the solder to "wick up" away from the joint when applied to melted solder, may also be used.

INSTALLING AUGAT PINS

Augat pins are normally supplied on carriers (e.g., 8-pin and 16-pin carriers). In many cases the PC board layout permits Augat pins to be installed while still attached to the carrier or a portion of the carrier. In other cases the pins must be installed singly.

To install two or more pins that are still attached to the carrier, proceed as follows:

NOTE

It is perfectly alright to appropriately cut a carrier to accommodate the installation. For example, an 8-pin carrier can be cut in half (4 pins each) across the short dimension to fit a 4-pin, 4-corner layout. It may also be cut in half along the long dimension to fit a 4-pin, inline layout.

- (1) Insert pins in the mounting holes from the front (component) side of board. (The carrier will hold the pins perpendicular to the board.)
- (2) Solder all pins from back (solder) side of board so the solder "wicks up" to the front side.

(3) Check for solder bridges.

(4) Remove carrier.

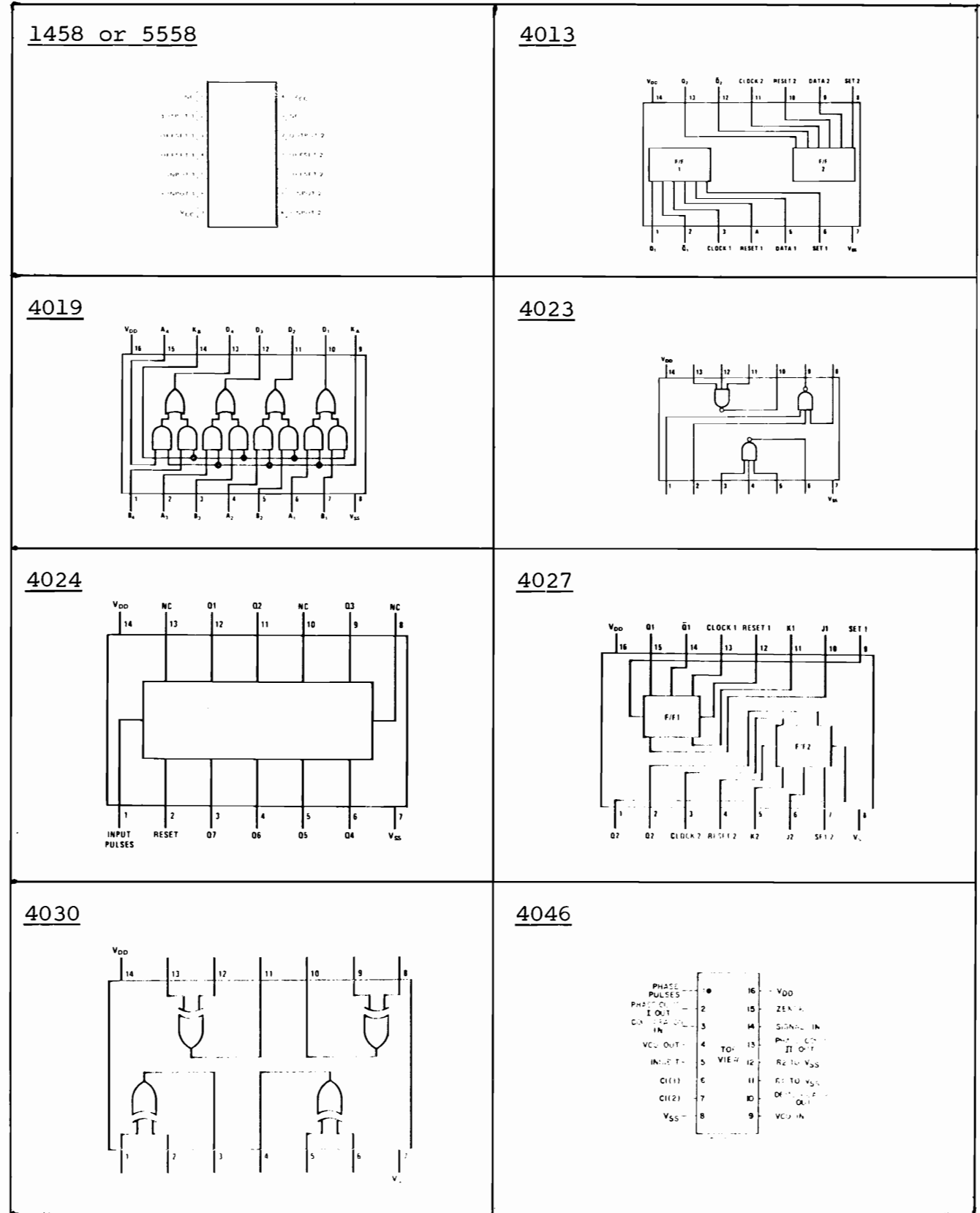
To install single pins, proceed as follows:

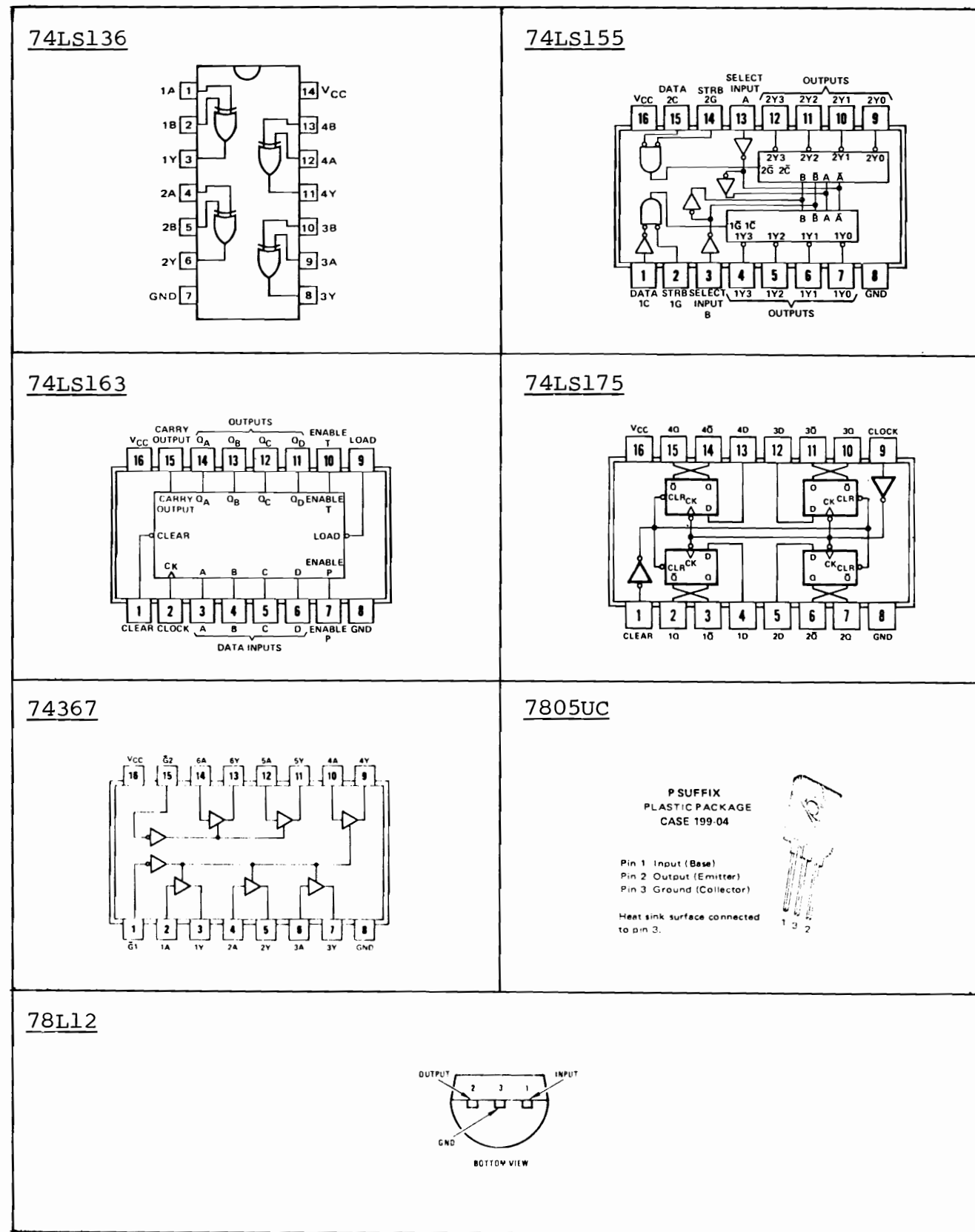
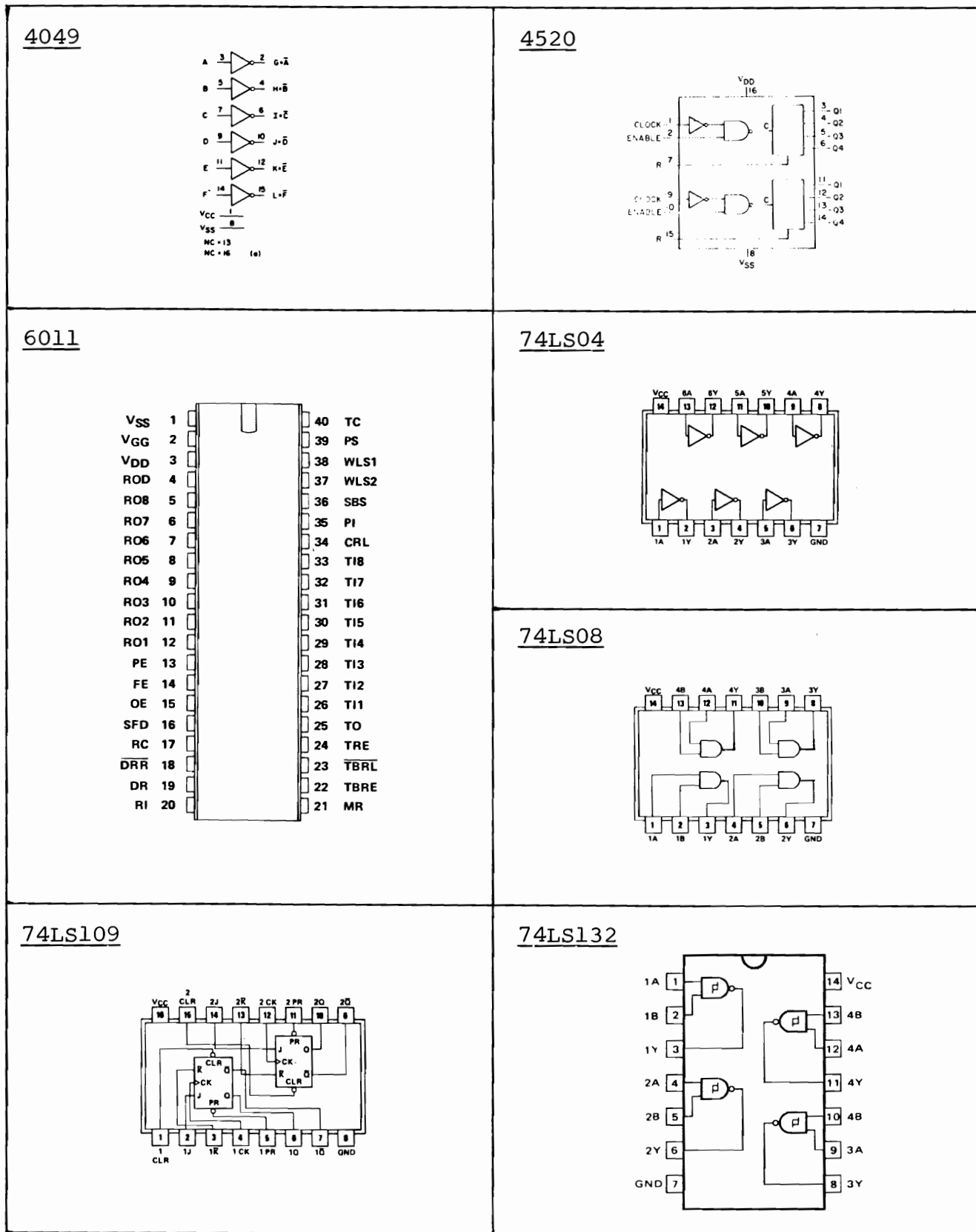
- (1) Hold board between two objects so that it stands on edge.
- (2) Insert pins in the mounting holes from front (component) side of board.
- (3) Solder pins from back (solder) side of board so the solder "wicks up" to the front side. (This will hold the pins firmly in place.)
- (4) Insert a component lead into one pin and reheat the solder. Using the component lead, adjust pin until it is perpendicular to board. Allow solder to cool while holding the pin as steady as possible. Remove component lead. Repeat this procedure with other pins.

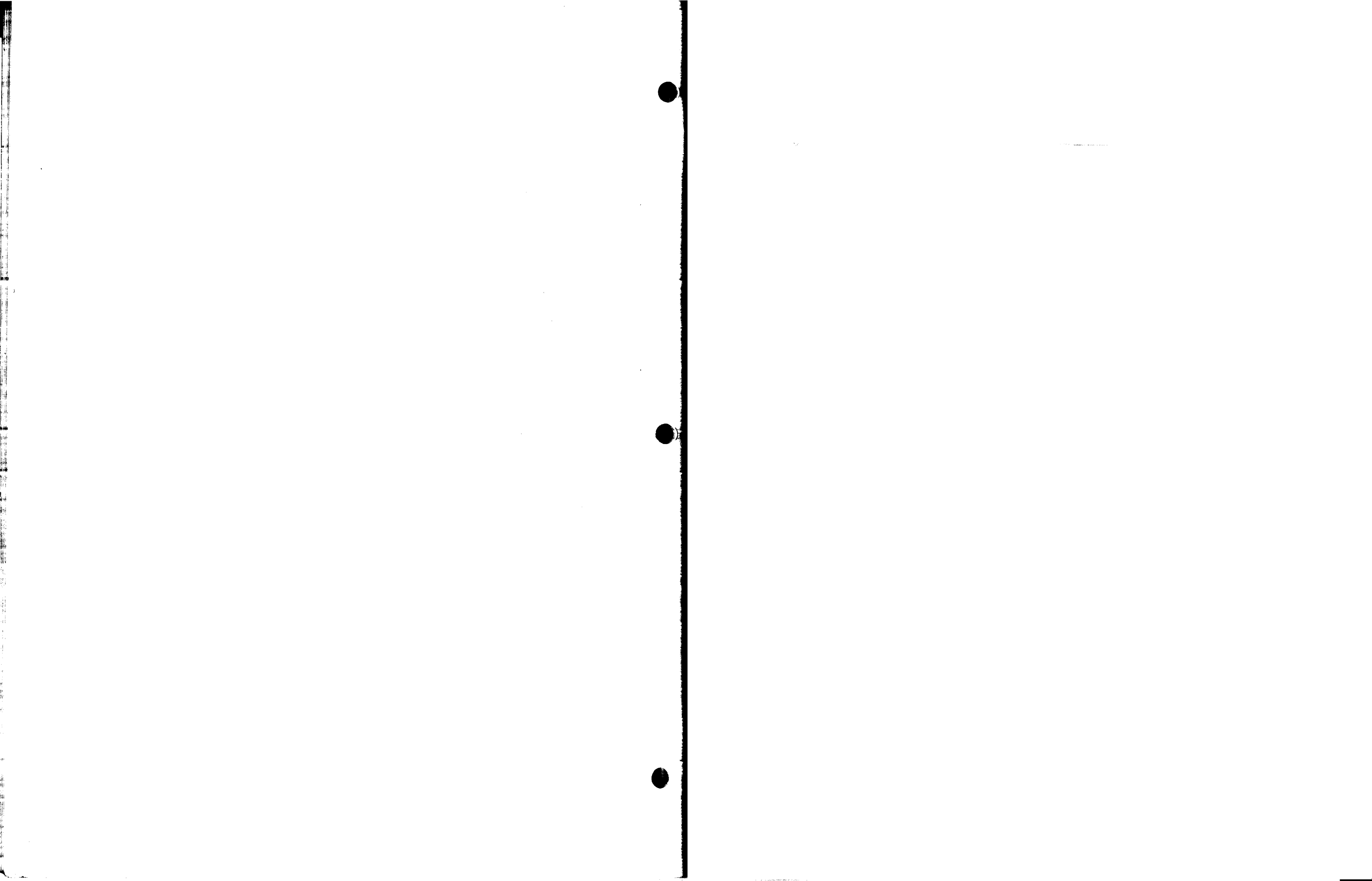
NOTE

If cooled solder is mottled or crystallized, a "cold joint" is indicated, and the solder should be reheated.

- (5) Check each installation for cold joints and solder bridges.







ERRATA SHEET #1

Reference Step 23 on Page II-17

The sixth paragraph should read as follows:

(↓) Measure the DC voltage at pin 9 of U11 and write the measured voltage down. (Call this Voltage A.)

The eighth paragraph should read as follows:

(↓) Measure the DC voltage at pin 9 of U11 and write the measured voltage down. (Call this Voltage B.)

MAKE THESE CORRECTIONS IN YOUR MANUAL BEFORE YOU START TO ASSEMBLE YOUR CUTS MODULE.

ES1-3/77

CUTS (Applies only to Rev B and below circuit boards)

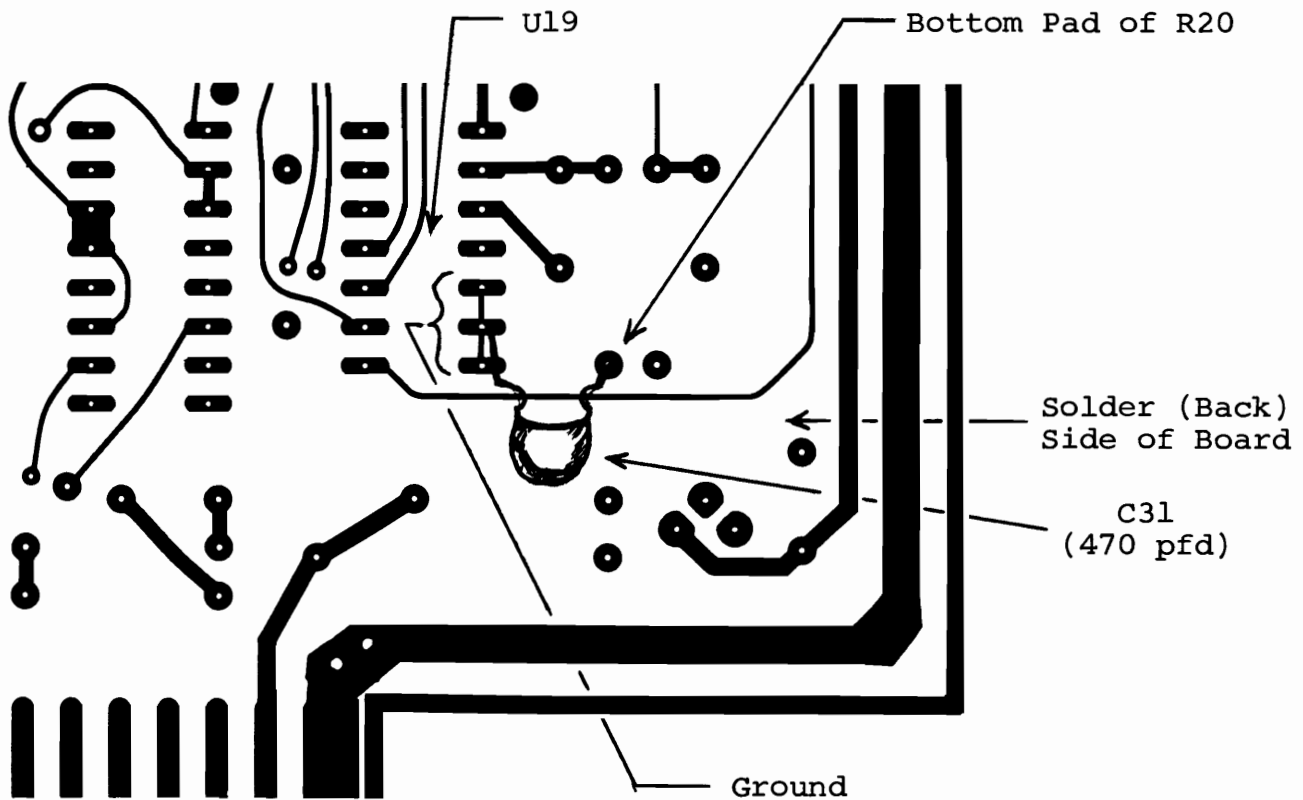


ASSEMBLY PROCEDURE CHANGE NOTICE #1

Reference Section II, Step 12, Page II-

Capacitor C31 is a new addition to the CUTS circuitry made after the manufacture of Rev B circuit boards.

On Rev B and below boards, install C31 on the solder (back) side of the board as shown below.



CUTS (Applies only to Rev B and below circuit boards)



ASSEMBLY PROCEDURE CHANGE NOTICE #2

Rev B and below CUTS circuit boards have an error that was introduced during their manufacture: A trace was connected to pin 8 of U11 which shorts the voltage controlled oscillator (VCO) output on pin 4 of U11 to ground. CORRECT THIS ERROR AS SHOWN BELOW BEFORE YOU CHECK THE BOARD AND START ASSEMBLY.

