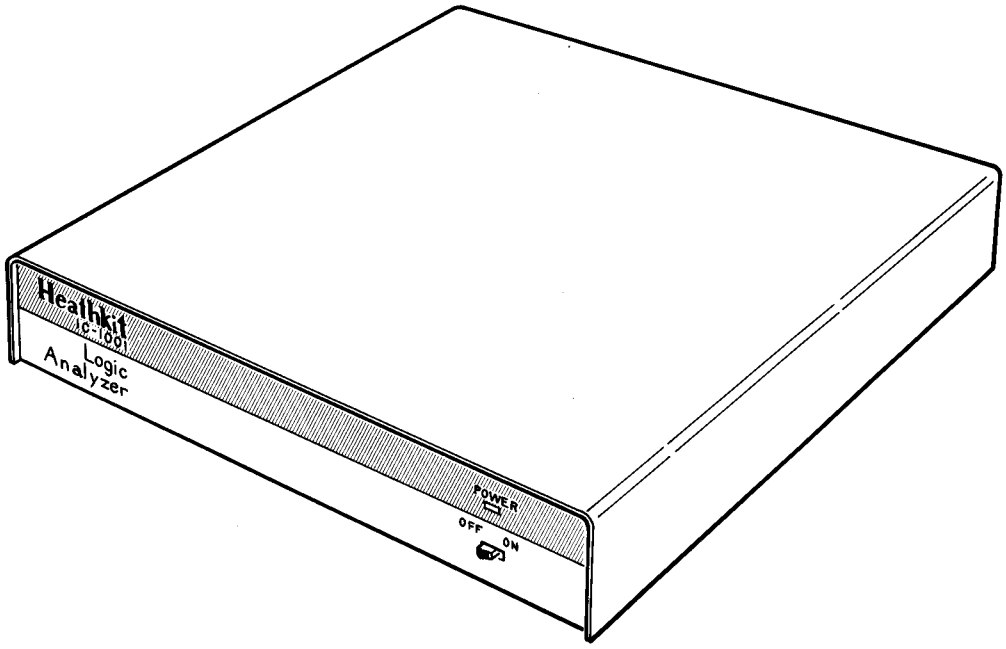
LOGIC ANALYZER

Model IC-1001

595-3849-01



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model IC-1001 Logic Analyzer is an instrument that can simultaneously display digital activity on up to 16 inputs. It was designed to interface with any terminal that is capable of ANSI protocol and can display 24 lines, plus a 25th status line. This includes all of the Heath/Zenith terminals and most modern terminals that are available from other sources. You may use it with a standard terminal or PC-compatible computer (software is included).

Special software is provided for use with PC-compatible computers. This software automatically reconfigures the Analyzer and offers enhanced functions, such as the capability to display much more data at a time, and to compare data from multiple acquisitions.

The terminal (or computer) keys allow you to configure and control the instrument, while its screen displays the captured data, configuration information, error conditions, etc. This allows the Analyzer itself to be lightweight and compact.

Some of the features built into your Logic Analyzer include:

- Automatic baud rate selection.
- Menu-driven operation, with on-screen help.
- 2K x 16-bit acquisition memory.
- Timing and state displays that include hex/octal and ASCII equivalents.
- Non-delay and delay modes. (Delay up to 50,000 clocks.)
- Oscilloscope trigger outputs.
- Versatile display positioning commands.
- High impedance inputs, with convenient spring-loaded clips.
- A checksum function that allows easy data comparison.

SPECIFICATIONS

Data Width	16 bits.
Data Depth	2046 words.
Clock Input	Rising or falling edge.
Clock Qualifiers	Two, each selectable to logic high or logic low.
Input Selections	Logic 0, logic 1, or X (don't care).
Logic Compatibility	TTL or CMOS operating at 5 volts.
Input Impedance	Greater than 1 megohm paralleled by 10 pF (all inputs).
Display Size	
With Terminal	24 words at a time plus a status line.
With PC-compatible computer	Variable to full depth (timing mode).
Display Base Format	Hex or octal.
Displays	Address relative to trigger word, state, timing, hex/octal equivalent, and ASCII equivalent. (Additional information is displayed in the PC mode.)
Logic Sense	Positive or negative.
Trigger Modes	Single trigger or repeating* (selectable time delay).
Operating Modes	Delay and non-delay.
Delay Range	2 to 50,000 qualified clocks (in delay mode).

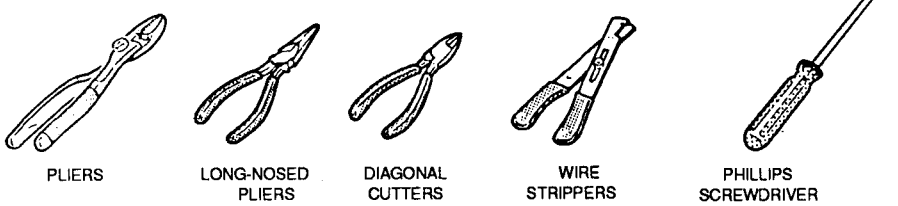
*When the Analyzer is used with a terminal.

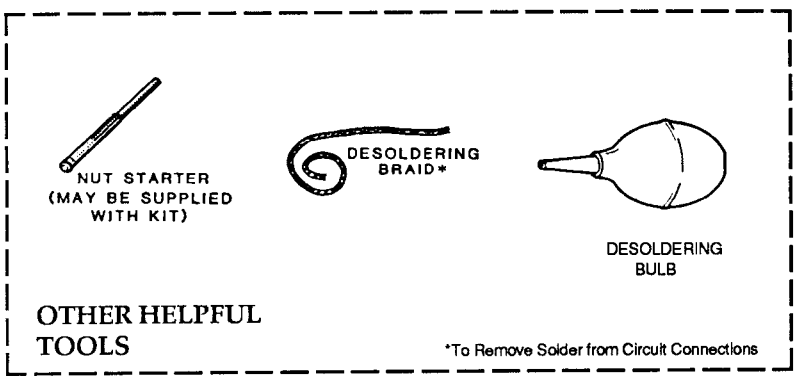
Trigger Word Positions	Selectable within acquired data (in non-delay mode).
Data Positioning	Go to first, go to last, set address, word forward, word back, page forward, page back, and pattern search. (Additional positioning functions are available in the PC mode.)
Clock Period	100 nanoseconds minimum.
Clock Pulse Width (coincident with qualifiers)	40 nanoseconds minimum either level.
Data Set-up Time	Less than 5 nanoseconds typical.
Data Hold Time	Less than 5 nanoseconds typical.
Channel-to-Channel Skew	Less than 5 nanoseconds typical.
Baud Rates	300, 600, 1200, 2400, 4800, 9600, and 19,200 (jumper selectable or automatically determined). Fixed at 9600 or 19,200 when the Analyzer is used with a PC.
Serial Protocol	RS-232, XON/XOFF handshaking (input only). ANSI escape sequences. 32-character type-ahead buffer.
Oscilloscope Triggers	Two. One occurs at the detection of the trigger word, the other at the trigger word plus the selected delay. Both have jumper-selectable polarity.
Power Source	Wall cube (supplied).
Additional Features	On-screen help, prompting, status, and error reporting. Checksum capability, with bit selection for easy comparisons of acquired data. When the Analyzer is used with a terminal, Control-D initiates a binary dump of all acquired data (after a selectable delay). When the Analyzer is used with a PC, Control-D provides disk functions.
Dimensions (overall)	1-3/4" H x 9-1/4" W x 8-1/2" D (4.4 x 23.5 x 20.3 cm).
Weight	2.9 lbs. (1.31 kg).

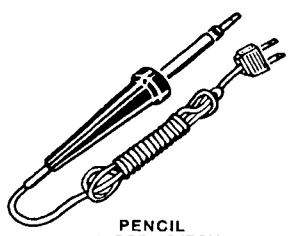
ASSEMBLY NOTES

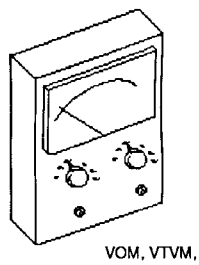
TOOLS

You will need these tools to assemble your kit.









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 to use 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 instructions are generally given only at the end of a series of similar steps. You may solder more often if you desire.

6. Each circuit part in an electronic kit has its own component number (R2, C2, 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 excessive 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:

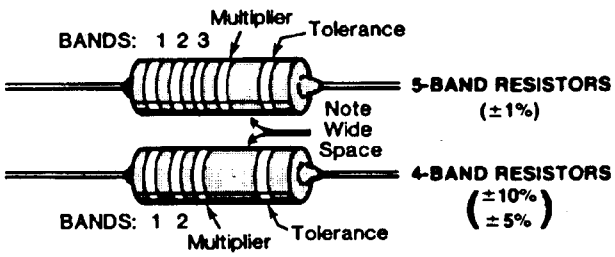
1. Use the proper type of soldering iron. A 22- to 25-watt pencil soldering iron with a 1/8" or 3/16" chisel or pryamid top works best.

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 the solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste flux has been used.

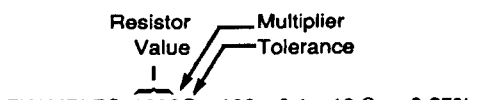
RESISTORS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). They are usually identified by a color code of four or five color bands, where each color represents a number. See the "Resistor Color Code" chart. These colors are given in the steps in their proper order (except the last band, which indicates a resistor's "tolerance"; see the "Resistor Tolerance Chart"). You do not need to memorize the color codes.



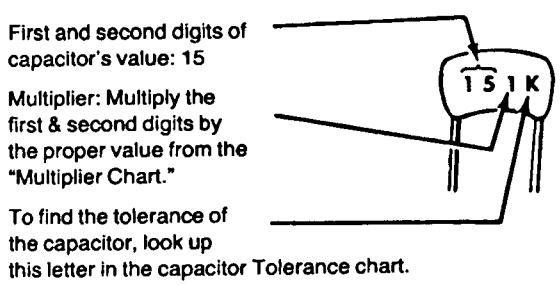
Occasionally, a "precision" or "power" resistor may have the value stanped on it. The letter R, K, or M may also be used at times to signify a decimal point, as in: 2R2 = 2.2 Ω
2K2 = 2.2 kΩ, or 2200 Ω
2M2 = 2.2 MΩ

Precision resistors may also be marked as shown in the following examples. The values of the multipliers are shown in the "Multiplier Chart," and the tolerance values are shown in the "Resistor Tolerance" chart.



CAPACITORS

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:



RESISTOR COLOR CODE

	Band 1	Band 2 (if used)	Band 3	Multiplier
Color	1st Digit	2nd Digit	3rd Digit	
Black	0	0	0	1
Brown	1	1	1	10
Red	2	2	2	100
Orange	3	3	3	1,000
Yellow	4	4	4	10,000
Green	5	5	5	100,000
Blue	6	6	6	1,000,000
Violet	7	7	7	10,000,000
Gray	8	8	8	100,000,000
White	9	9	9	—
Silver	—	—	—	.01
Gold	—	—	—	.1

RESISTOR TOLERANCE

	COLOR OR LETTER	
±10%	SILVER	
±5%	GOLD	J
±2%	RED	G
±1%	BROWN	F
±0.5%	GREEN	D
±0.25%	BLUE	C
±0.1%	VIOLET	B
±0.05%	GRAY	

MULTIPLIER CHART

FOR THE NUMBER:	MULTIPLY BY:	FOR THE NUMBER:	MULTIPLY BY:
0	1	4	10,000
1	10	5	100,000
2	100	8	0.01
3	1000	9	0.1

CAPACITOR TOLERANCE

LETTER	10 pF OR LESS	OVER 10 pF
B	±0.1 pF	
C	±0.25 pF	
D	±0.5 pF	
F	±1.0 pF	±1%
G	±2.0 pF	±2%
H		±3%
J		±5%
K		±10%
M		±20%

EXAMPLES: 151 K = 15 X 10 = 150 pF
759 = 75 X 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).

POD ASSEMBLIES

PARTS LIST

Refer to the Pack Index Sheet and locate Pack #1. Then remove the parts from this pack and check each part against the following list. The key numbers correspond to the numbers on the "Pod Assemblies Parts Pictorial." If a part is packed in an individual envelope, with the part number on it, identify the part; then return it to the envelope until a step calls for it. Do not throw away any packing material until you locate all of the parts.

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, refer to "Replacement Parts" inside the rear cover of this Manual.

A replacement part may look slightly different than the original part, or may have different printing on it. In any case, the performance of the replacement part will meet or exceed the requirements of the original part. For example: A 15-volt capacitor (10 µF, 15 V) may be replaced with a 25-volt capacitor (10 µF, 25 V).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

BINDER PARTS

	597-4460	1	Binder cover
	701-233	1	3-ring assembly
A1	250-357	2	6-32 x 3/8" nylon screw
A2	252-3	2	6-32 nut
A3	253-14	2	#6 flat washer

WIRE — SLEEVING

344-125	30"	Black wire
344-126	24"	Brown wire
344-127	24"	Red wire
344-128	18"	Orange wire
344-129	18"	Yellow wire
344-130	18"	Green wire
344-131	18"	Blue wire

WIRE — SLEEVING (Cont'd)

344-132	18"	Violet wire
344-134	24"	White wire
340-9	7"	Bare wire
346-1	1"	Small sleeving
346-67	3"	Large (heat-shrinkable) sleeving
348-1	24"	Magnet wire

PRINTED MATERIAL

B1	390-3007	3	Pod label*
B2		1	Blue and white label*
	597-260	1	Parts Order Form*
		1	Assembly Manual (See Page 1 for the part number.)

* These items may be packed inside the Manual.

MISCELLANEOUS

NOTE: The three pods contain identical circuit boards. Each board will have a resistor pack at RP201 and a capacitor at C201. Only two of the pods, however, will have a resistor pack at RP202.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C1	9-125	5	Resistor pack (47 Ω)	RP201, RP202
C2	21-786	3	.1 µF (104) axial-lead ceramic capacitor	C201
	85-3307-1	3	Pod circuit board	
C3	134-1858	1	10-wire ribbon cable	
C4	134-1859	2	20-wire ribbon cable	

MISCELLANEOUS (Cont'd)

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
C5	214-264	6	Pod housing	
C6	250-382	6	4-40 x 3/4" nylon screw	
C7	252-2	6	4-40 nut	
C8	260-724	1	Package of 22 micro clips	
C9	434-311	3	20-pin IC socket	
C10	443-1428	3	74HCT245 integrated circuit	U201
C11	490-111	1	IC lifter	
C12	490-185	1	Package of desoldering braid	
			Solder	

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 1-1 while you read the following steps.

NOTES:

1. 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 to install other parts on the circuit board.

2. Check off each step as you perform it. You may also wish to place a check mark near each component on the Pictorial as you install it.

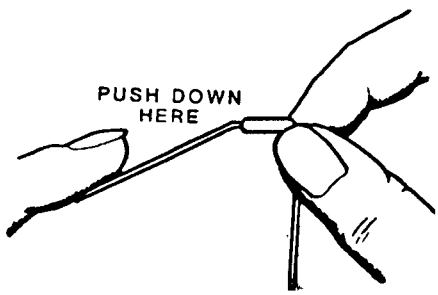
( ) Locate one of the pod circuit boards.

Note that the circuit board has foil patterns on one side and the other side has outlines of components (parts) shown on it. The "foil" side of the circuit board will be referred to as such, and the side with the outlines will be called the "component" side of the board.

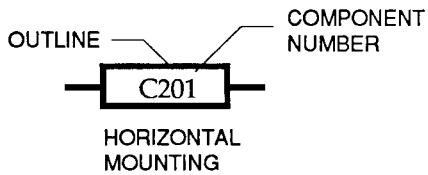
CLOCK POD CIRCUIT BOARD

( ) Position a pod circuit board as shown in the Pictorial with the component side facing up. Always install components on the component side of the circuit board, and solder the leads to the foil on the other side unless a step specifically directs you otherwise.

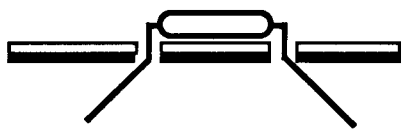
( ) Hold a .1 µF (104) axial-lead ceramic capacitor as shown and bend the leads straight down.



( ) C201: Start the leads into the circuit board holes at location C201 on the circuit board. This type of capacitor may be installed either way in the board.

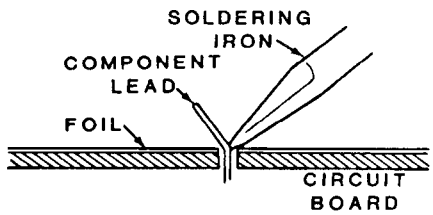


( ) Press the capacitor against the circuit board. Then bend the leads out slightly to hold it in place.

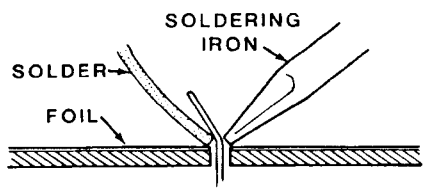


( ) Solder the capacitor leads to the foil as follows:

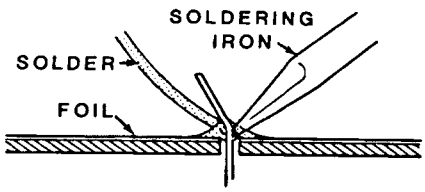
1. Push the soldering iron tip against both the lead and the circuit board foil. Heat both for two or three seconds.



2. 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.

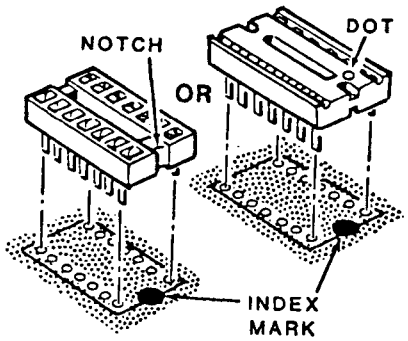


( ) Cut off the excess lead lengths close to the connection. **WARNING:** Clip the leads so the ends will not fly toward your eyes.

NOTE: Save one of the cutoff capacitor leads for use in a later step.

( ) Check the connection. Compare it to Detail 1-1A. After you have checked the connection, proceed with the assembly below. Use the same soldering procedure for each connection.

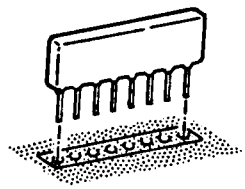
NOTE: In the next step, you will install an IC socket. Before you install the socket, make sure all of the pins are straight. If there is any kind of identification mark (notch, dot, arrowhead, etc.) at or near one end of the socket, position this marked end toward the index mark on the circuit board (this index mark should still be visible after you install the socket). Then start the pins into the circuit board holes and solder them to the foil. Make sure the socket is tight against the circuit board before you solder all of the pins to the foil.



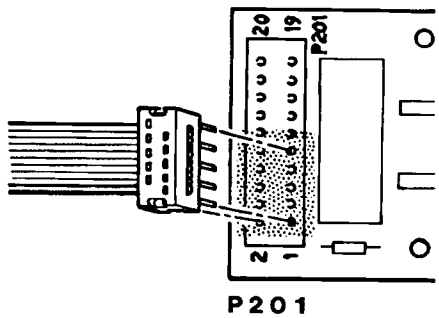
( ) 20-pin IC socket at U201.

NOTE: No part will be installed in this circuit board at RP202.

( ) RP201: Start the leads of a resistor pack into the circuit board holes at RP201. The resistor pack may be installed either way in the circuit board. Then push the pack down against the board and solder the leads to the foil. Cut off any excess lead lengths.



( ) Start the pins on the plug end of the 10-wire ribbon cable into circuit board holes 1 through 10 at P201 as shown below. Then push the plug down against the board and solder the pins to the foil.



P201

NOTE: When you are instructed to prepare a wire, as in the following step, cut it to the indicated length and remove 1/4" of insulation from each end. If the wire is stranded, twist the fine wire strands tightly together and apply a small amount of solder to hold the fine strands together.

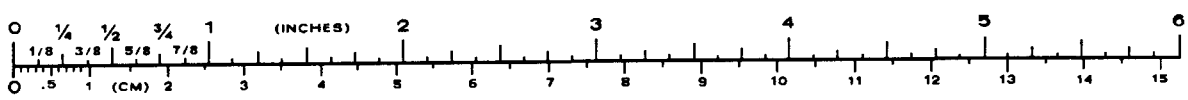
( ) Prepare the following stranded wires:

6" red
6" brown
6" black
6" white

Connect one end of the prepared wires to the circuit board as follows. Solder the end of each wire to the foil as you connect it and cut off any excess wire end. The other wire end will be connected later.

( ) Red wire to hole D7.

( ) Brown wire to hole D6.



( ) Black wire to hole D5.

( ) White wire to hole GND.

( ) Cut a 1" length of large (heat-shrinkable) sleeving. Slide the sleeving as far as possible over the free end of the four wires coming from the circuit board. Then use the heat from a match, lighter, or candle to carefully shrink the sleeving into place. Be careful not to melt the insulation on the wires.

( ) Refer to Detail 1-1B and use the following procedure to install a micro clip on the free end of the red wire coming from the circuit board:

1. Pull the cap off of a micro clip.
2. Route the end of the red wire through the hole in the cap.
3. Solder the end of the wire to the lug of the micro clip. Be careful not to melt the plastic. Be sure to keep the solder connection as small as possible. If the solder connection becomes too large, the cap may not fit over the lug when you install it in the next step. Cut off any excess wire end.
4. Carefully push the cap onto the clip. Be sure the wire exits from the same side of the clip as the tip of the clip points.

( ) Similarly, install micro clips on the free ends of the three remaining wires coming from the circuit board.

Refer to Pictorial 1-2 while you perform the following steps.

( ) Reposition the circuit board foil-side-up as shown in the Pictorial.

( ) Locate the cutoff capacitor lead that you saved from an earlier step. Then solder the wire across socket U201 pins 6, 7, 8, 9, and 10. Cut off any excess length.

Refer back to Pictorial 1-1 for the following steps.

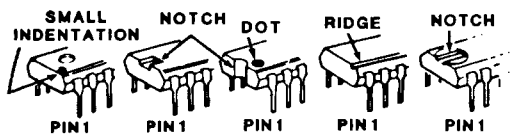
NOTE: Some of the ICs used in this kit are CMOS (complementary metal-oxide semiconductor) devices. These are rugged and reliable components when they are installed, but they can be damaged by static electricity during installation. Other ICs are of a type that is not susceptible to static electricity. Nevertheless, you should treat all ICs as if they were CMOS types, since this will avoid all possible confusion between ICs and provide protection in all cases. Use the procedure described in the following numbered steps to install an IC in its socket.

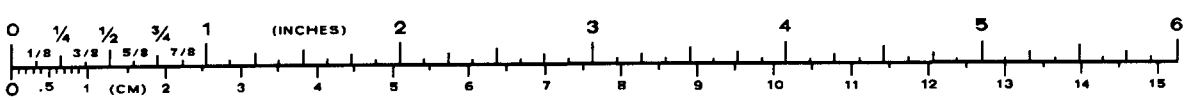
Once you remove a protected IC from its protective foam packing, DO NOT lay the IC down or let go of it until it is installed. When you bend the leads of a protected IC, hold the IC in one hand and place your other hand on your work surface before you touch the IC to your work surface. This will equalize the static electricity between the work surface and the IC.

1. The pins on the IC may be bent out at an angle, so they do not line up with the holes in the socket. DO NOT try to install an IC without first bending the pins as described below. To do so may damage the IC pins.

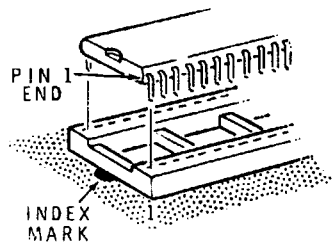
2. Before you install an IC, lay it down on its side as shown below and very carefully bend the lower pins into line. Then turn the pins on the other side in the same manner.

3. Compare the IC to the drawing shown below. Then determine which end of the IC is the pin 1 end.

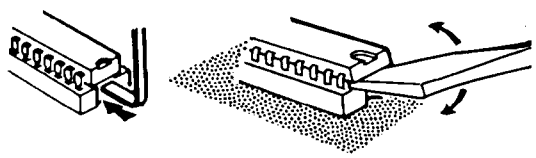




4. Position the pin 1 end of the IC over the index mark on the circuit board. Then touch the circuit board with your free hand and start the IC pins into the socket holes. Make sure all of the pins are in their corresponding socket holes. Then push the IC firmly into the socket. NOTE: It is very easy for a pin to be bent under the IC and appear as though it is in the socket hole.



5. If it ever becomes necessary to remove an IC from its socket, use an IC lifter (if one was supplied with your kit) or a small-blade screwdriver as shown. Push the end of the IC lifter or screwdriver blade between the IC and the socket and carefully lift the IC free. If any IC pins become bent, straighten them carefully.



( ) U201: 74HCT245 integrated circuit (#443-1428).

Set the clock pod circuit board aside temporarily.

HIGH- & LOW-BYTE DATA PODS

NOTE: You will now use the remaining pod circuit boards to assemble two identical pods. Complete the assembly of one pod before you begin to assemble the second pod. Two checkoff boxes are provided in each step. Solder each part to the foil as you install it and cut off any excess lead lengths.

Refer to Pictorial 1-3 while you perform the following steps.

( )( ) C201: .1 µF (104) axial-lead ceramic capacitor.

( )( ) 20-pin IC socket.

( )( ) RP202: Resistor pack.

( )( ) RP201: Resistor pack.

( )( ) P201: 20-wire ribbon cable. Be sure to install this cable so it extends away from the circuit board as shown.

( )( ) Prepare the following stranded wires:

6" white	6" yellow
6" black	6" green
6" brown	6" blue
6" red	6" violet
6" orange	

Connect one end of the prepared wires to the circuit board as follows. Solder the end of each wire to the foil as you connect it and cut off any excess wire end. The other wire end will be connected later.

( )( ) White wire to hole GND.

( )( ) Black wire to hole D0.

( )( ) Brown wire to hole D1.

( )( ) Red wire to hole D2.

( )( ) Orange wire to hole D3.

( )( ) Yellow wire to hole D4.

( )( ) Green wire to hole D5.

( )( ) Blue wire to hole D6.

( )( ) Violet wire to hole D7.

( )( ) Cut a 1" length of large (heat-shrinkable) sleeving. Slide the sleeving as far as possible over the free end of the nine wires coming from the circuit board. Then use the heat from a match, lighter, or candle to shrink the sleeving into place.

( )( ) Install a micro clip on the free end of each wire coming from the circuit board.

( )( ) U201: 74HCT245 integrated circuit (#443-1428). Be sure to match the index mark on the IC with the outline of the index mark on the circuit board.

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of all three pod circuit boards for the following most-commonly-made errors:

( ) Unsoldered connections. NOTE: The clock pod does not have a part installed at RP202.

( ) Poor solder connections.

( ) Solder bridges between foil patterns. NOTE: The clock pod has socket U201 pins 6, 7, 8, 9, and 10 soldered together with a bare wire.

( ) Protruding leads which could touch together.

( ) Check integrated circuit U201 for the proper installation.

ASSEMBLY CONTINUED

Refer to Pictorial 1-4 while you perform the following steps.

( ) Position one of the pod circuit boards between two pod housing halves as shown. Make sure the sleeving on the micro clip wires is in its corresponding housing hole. Also make sure the ribbon cable is in its corresponding slot. Then use two 4-40 x 3/4" nylon screws and two 4-40 nuts to secure the assembly. DO NOT overtighten the hardware.

( ) Similarly use two 4-40 x 3/4" nylon screws and two 4-40 nuts to mount the remaining two pod circuit boards between two pod housing halves.

( ) Carefully peel away the backing paper from a pod label. Then press the label onto the side of a pod so it covers the nuts as shown.

( ) Similarly, press pod labels onto the side of the remaining two pods.

This completes the assembly of the pods. Set them aside until they are called for during the "Initial Tests."

MAIN CIRCUIT BOARD AND CHASSIS

PARTS LIST

Unpack the remainder of the kit. Then check each part against the following list. The key numbers correspond to the numbers on the "Main Circuit Board and Chassis Parts Pictorial." If a part is packed in an individual envelope, with the part number on it, identify the part; then return it to the envelope until a step calls for it. Do not throw away any packing material until you locate all of the parts.

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, refer to "Replacement Parts" inside the rear cover of this Manual.

A replacement part may look slightly different than the original part, or may have different printing on it. In any case, the performance of the replacement part will meet or exceed the requirements of the original part. For example: A 15-volt capacitor (10 µF, 15 V) may be replaced with a 25-volt capacitor (10 µF, 25 V).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
CAPACITORS				
A1	20-100	2	30 pF mica	C151, C152
A2	21-17	1	270 pF ceramic	C153
A3	25-922-1	1	.68 µF electrolytic	C146
A3	25-917-1	3	10 µF electrolytic	C148, C149, C150
A4	25-877	1	2200 µF electrolytic	C147
DIODES				
B1	57-42	4	1N5401	D101, D102, D103, D104

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
INTEGRATED CIRCUITS (ICs)				
C1	442-54	1	**7805**	U101
C2	442-720	1	ICL **7660**	U114
C2	443-791	3	**74LS244**	U104, U105, U118

NOTE: Integrated circuits may be marked in any one of the following four ways:

1. Part number.
2. Type number (This refers only to the letters and numbers in **bold** print. Disregard any other letters or numbers shown on the IC.)
3. Part number and type number.
4. Part number with a type number other than the one shown.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
INTEGRATED CIRCUITS (Cont'd)				
C2	443-877	1	**74LS138**	U115
C2	443-1047	1	**74ALS10**	U135
C2	443-1051	1	**74ALS74**	U139
C2	443-1052	1	**74F86**	U102
C2	443-1065	1	**74F244**	U103
C2	443-1094	7	**74LS191**	U133, U134, U136, U137, U140, U142, U143
C2	443-1096	4	**74ALS244**	U127, U128, U129, U130
C2	443-1110	4	**74LS377**	U106, U109, U110, U113
C2	443-1121	1	**74F00**	U141
C2	443-1175	1	**74HC32**	U138
C2	443-1231	1	**74ALS30**	U132
C2	443-1429	4	**74F175**	U107, U108, U111, U112
C2	443-1372	8	**74F64**	U119, U120, U121, U122, U123, U124, U125, U126
C2	443-1431	1	**74F11**	U131
C2	443-1432	2	MCM **2018**N45	U144, U145
C2	443-1436	1	MC **145406** P	U116
C2	444-560	1	**8052**	U117
PLUGS — SOCKETS				
D1	432-758	2	BNC connector	J2, J3
D2	432-1028	1	25-pin plug shell	
D3	432-1031	9	Female terminal pin	
D4	432-1200	3	2-pin plug	J103, J104, J105
D5	432-1265	2	3-pin plug	J101, J102
D6	432-1336	5	2-pin jumper block	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
PLUGS — SOCKETS (Cont'd.)				
D7	432-1513	1	9-pin plug	S104
D8	432-1664	1	10-pin socket	S101
D9	432-1665	2	20-pin socket	S102, S103
D10	432-1684	1	25-pin plug housing	
D11	434-230	1	8-pin IC socket	
D11	434-298	15	14-pin IC socket	
D11	434-299	13	16-pin IC socket	
D11	434-311	12	20-pin IC socket	
D11	434-368	2	24-pin IC socket	
D11	434-253	1	40-pin IC socket	
D12	436-60	1	Power socket	S105
HARDWARE				
E1	250-1411	14	4-40 x 1/4" screw	
E2	250-1412	1	4-40 x 3/8" screw	
E3	252-2	3	4-40 nut	
E4	254-9	3	#4 lockwasher	
E5	255-757	2	4-40 hex stud	
E6	259-27	2	Control solder lug	
MISCELLANEOUS				
F1	9-128	1	Resistor pack (may be marked **103**)	RP101
F2	60-78	1	Slide switch	SW1
F3	73-4	1	Rubber grommet	
	85-3306-1	1	Main circuit board	
F4	150-267	1	Power cube	
F5	200-1544-1	1	Chassis	
F6	203-2316-1	1	Top cover	
F7	203-2329-1	1	Rear panel	
F8	204-3058	1	Switch bracket	
F9	261-29	4	Foot	
F10	352-13	1	Silicone grease	
F11	404-657	1	7.3728 MHz crystal	Y101
F12	412-646	1	LED (light-emitting diode)	D1
F13	475-12	4	Ferrite bead	
	891-1017	1	Utilities diskette	

TAPED COMPONENTS

The following parts are supplied on taped strips. It is not necessary to check them against the following list.

RESISTORS

NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise noted. A 5% tolrance is indicated by a gold fourth color band.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-101-12	1	100 Ω (brn-blk-brn)	R101
6-681	1	680 Ω, 1/2-watt (blu-gry- brn)	R111
6-102-12	1	1000 Ω (brn-blk-red)	R107
6-332-12	4	3300 Ω (org-org-red)	R103, R104, R105, R108
6-822-12	1	8200 Ω (gry-red-red)	R102
6-103-12	2	10 kΩ (brn-blk-org)	R106, R109

CAPACITORS

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
21-786	43	.1 µF (104) axial-lead ceramic	C101--C113, C115, C116, C118--C145
21-811	1	.33 µF (334) axial-lead ceramic	C117

DIODES

56-608	1	9.1-volt zener	D105
56-655	1	1N6263	D106

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 2-1 while you read the following notes and steps.

NOTES:

1. Many circuit board drawings, such as the one shown in Pictorial 2-1, are divided into two or more sections. You will work in each of these sections for a specific series of steps.

2. In each series of steps, you will install parts in a top-to-bottom, left-to-right sequence. Occasionally, you may be directed to install a part out of sequence.

3. Check off each step as you perform it. You may also wish to place a check mark near each component on the Pictorial as you install it.

4. In general, solder instructions are given only at the end of a series of similar steps. You may solder more often if you wish.

Note that the circuit board has foil patterns on both sides, but only one side has the outlines of the components (parts) shown on it. This side is referred to as the "component side"; and it is on this side that you will install components, unless a step directs you otherwise.

( ) Cut the "Taped Component Chart" from the last page of the Illustration Booklet. Make sure you read the instructions at the top of the chart before you use it. Note that it is divided into numbered sections which correspond to the numbered sections on the circuit board pictorial.

Section 1

( ) Position the circuit board as shown in the Pictorial with the component side up. Always install components on the component side of the circuit board, and solder the leads to the foil on the other side unless a step specifically directs you otherwise.

Install a .1 µF (104) axial-lead ceramic capacitor at each of the following eleven locations:

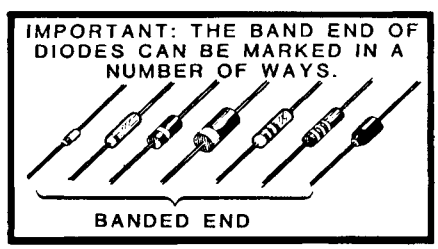
( ) C102.
( ) C103.
( ) C106.
( ) C107.
( ) C108.
( ) C119.
( ) C120.
( ) C121.
( ) C131.
( ) C132.
( ) C138.

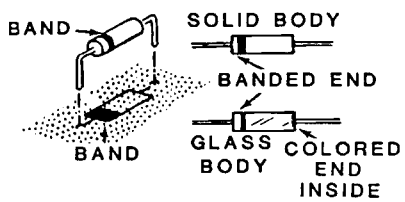
( ) R103: 3300 Ω (org-org-red) resistor.

( ) R104: 3300 Ω (org-org-red) resistor.

( ) R105: 3300 Ω (org-org-red) resistor.

NOTE: In some of the following steps you will install diodes. Whenever you install a diode, always match the banded end with the outline of the band on the circuit board. The circuit will not work properly if the diode is installed backwards.





CAUTION: ALWAYS POSITION THE BANDED END OF A DIODE AS SHOWN ON THE CIRCUIT BOARD.

( ) D106: 1N6263 diode (#56-655).

( ) R106: 10 kΩ (brn-blk-org) resistor.

( ) R107: 1000 Ω (brn-blk-red) resistor.

( ) R108: 3300 Ω (org-org-red) resistor.

( ) R109: 10 kΩ (brn-blk-org) resistor.

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

Section 2

Install a .1 µF (104) axial-lead ceramic capacitor at each of the following nine locations:

( ) C104.
( ) C109.
( ) C110.
( ) C122.
( ) C123.
( ) C133.
( ) C134.
( ) C139.
( ) C140.
( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 3

( ) C105: .1 µF (104) axial-lead ceramic capacitor.

( ) R101: 100 Ω (brn-blk-brn) resistor.

Install a .1 µF (104) axial-lead ceramic capacitor at each of the following twelve locations:

( ) C111.
( ) C112.
( ) C113.
( ) C124.
( ) C125.
( ) C126.
( ) C135.
( ) C136.
( ) C137.
( ) C141.
( ) C142.
( ) C143.

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

Section 4

( ) C101: .1 µF (104) axial-lead ceramic capacitor.

( ) D105: 9.1-volt zener diode (#56-608). Be sure to match the band on this diode with the band mark on the circuit board.

Install a .1 µF (104) axial-lead ceramic capacitor at each of the following four locations:

( ) C115.
( ) C118.
( ) C127.
( ) C144.

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

Section 5

( ) C116: .1 µF (104) axial-lead ceramic capacitor.

( ) C117: .33 µF (334) axial-lead ceramic capacitor.

( ) R102: 8200 Ω (gry-red-red) resistor.

Install a .1 µF (104) axial-lead ceramic capacitor at each of the following four locations:

( ) C128.
( ) C129.
( ) C130.
( ) C145.

( ) R111: 680 Ω, 1/2-watt (blu-gry-brn) resistor.

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

Refer to Pictorial 2-2 while you perform the following steps.

NOTE: When you install the IC sockets in this Pictorial, make sure you match the index mark on each socket with its corresponding circuit board index mark. Solder the pins of each socket to the foil as you install it.

Section 1

( ) 14-pin IC socket at U102.

( ) 20-pin IC socket at U103.

( ) 20-pin IC socket at U104.

( ) 20-pin IC socket at U105.

Section 2

( ) 20-pin IC socket at U106.

( ) 16-pin IC socket at U107.

( ) 16-pin IC socket at U108.

( ) 20-pin IC socket at U109.

( ) 20-pin IC socket at U110.

( ) 16-pin IC socket at U111.

( ) 16-pin IC socket at U112.

( ) 20-pin IC socket at U113.

Section 3

Install a 14-pin IC socket at each of the following eight locations:

( ) U119.
( ) U120.
( ) U121.
( ) U122.
( ) U123.
( ) U124.
( ) U125.
( ) U126.

Section 4

( ) 14-pin IC socket at U131.

( ) 14-pin IC socket at U132.

( ) 16-pin IC socket at U133.

( ) 16-pin IC socket at U134.

( ) 14-pin IC socket at U135.

( ) 16-pin IC socket at U136.

( ) 16-pin IC socket at U137.

Section 5

( ) 14-pin IC socket at U138.

( ) 14-pin IC socket at U139.

( ) 16-pin IC socket at U140.

( ) 14-pin IC socket at U141.

( ) 16-pin IC socket at U142.

( ) 16-pin IC socket at U143.

Section 6

( ) 8-pin IC socket at U114.

( ) 16-pin IC socket at U115.

( ) 16-pin IC socket at U116.

( ) 20-pin IC socket at U118.

( ) 40-pin IC socket at U117.

( ) 20-pin IC socket at U127.

( ) 20-pin IC socket at U128.

( ) 20-pin IC socket at U129.

( ) 20-pin IC socket at U130.

( ) 24-pin IC socket at U144.

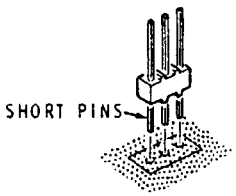
( ) 24-pin IC socket at U145.

Refer to Pictorial 2-3 while you perform the following steps.

Section 1

NOTE: When a step directs you to install the 2 and 3-pin plugs in this Pictorial, start the shorter pins into

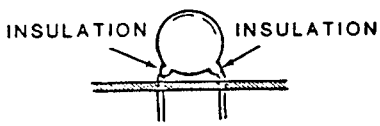
the circuit board holes and push the plug down tight against the board. Then solder the pins to the foil.



( ) J101: 3-pin plug.

( ) J102: 3-pin plug.

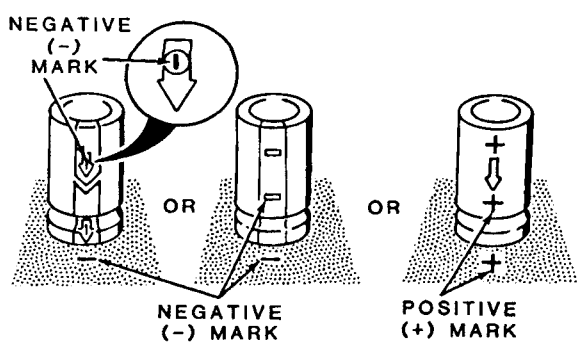
NOTE: When you install the capacitor in the next step, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



( ) C153: 270 pF ceramic capacitor. Solder the leads to the foil and cut off the excess lead lengths.

Section 2

NOTE: Before you install an electrolytic capacitor, look at it and identify the leads. One lead will have either a negative (-) mark or a positive (+) mark near it on the side of the capacitor. (The marking for a negative lead may look like an oblong bar sometimes with a circle around it, inside an arrow.) Be sure to install the negative lead in the negative-marked hole, and the positive lead in the positive-marked hole.



( ) C146: .68 µF electrolytic capacitor.

( ) C148: 10 µF electrolytic capacitor.

( ) C149: 10 µF electrolytic capacitor.

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

Section 3

Install a 1N5401 (#57-42) diode at each of the following four locations. NOTE: Be sure to match the banded end of each diode with the outline of the band on the circuit board.

( ) D101.
( ) D102.
( ) D103.
( ) D104.

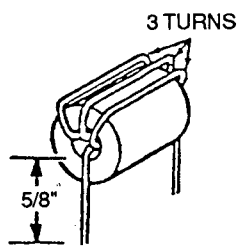
( ) Cut four 4-1/2" lengths of magnet wire. Discard the leftover magnet wire.

( ) Use the following procedure to prepare a ferrite choke:

1. Push one end of a length of magnet wire through a ferrite bead until the end protrudes 5/8".

2. Wrap three turns of wire through the ferrite bead as shown. Then cut the wire ends until they are even.

3. Use sandpaper (not supplied) or a knife to remove 1/2" of the lacquer coating from the wire ends. Make sure the wire ends are free of the coating; otherwise, you will not be able to solder them properly.

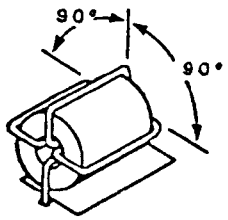


( ) Similarly prepare three more ferrite chokes.

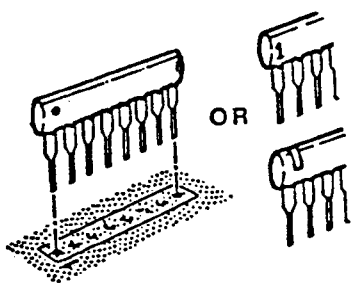
Install a prepared ferrite choke at each of the following four locations:

() FB101.
() FB102.
() FB103.
() FB104.

() Spread the turns on each of the four ferrite chokes 90° apart as shown.



() RP101: Resistor pack. NOTE: When you install this resistor pack, position the index mark (dot, line, or number) near one end of its body toward the number "1" on the circuit board. Solder the resistor pack leads to the foil and cut off any excess lead lengths.



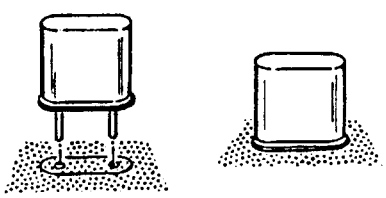
() C150: 10 µF electrolytic capacitor. Make sure you observe the correct polarity when you install this capacitor.

() J103: 2-pin plug. Solder the pins to the foil.

() J104: 2-pin plug. Solder the pins to the foil.

() J105: 2-pin plug. Solder the pins to the foil.

() Y101: 7.3728 MHz crystal (#404-657). This crystal can be installed either way in the circuit board.

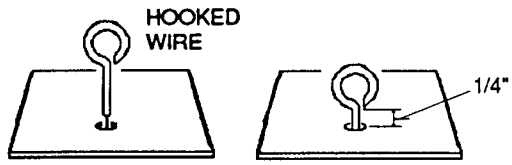


() C151: 30 pF mica capacitor.

() C152: 30 pF mica capacitor.

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

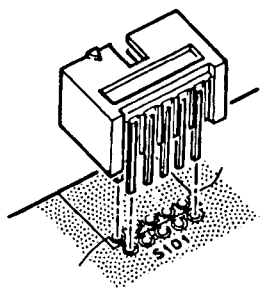
() Cut a 3/4" length of bare wire and form a small hook in one end. Push the straight end of the wire into circuit board hole CLK until the hooked end is 1/4" above the board. Then solder the wire to the foil and cut off the excess wire end.



() Similarly install and solder a bare wire hook at GND.

Refer to Pictorial 2-4 while you perform the following steps.

NOTE: When you install a socket as in the following step, start the pins into the circuit board holes and push it down tight against the board. Solder one pin at each end of the socket to the foil. Then check to make sure the socket is still down tight against the board. Reheat the connections and reposition the socket as necessary. Then solder the remaining pins to the foil.



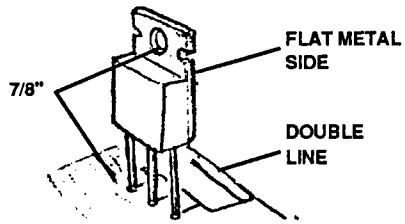
() S101: 10-pin socket.

() S102: 20-pin socket.

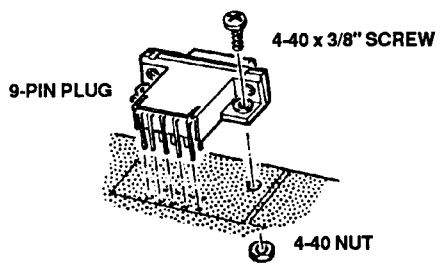
() S103: 20-pin socket.

() U101: 7805 integrated circuit (#442-54). Match the flat metal side of the IC with the double

line on the circuit board outline and start the leads into their corresponding holes. Position the IC so its mounting hole is 7/8" above the board. Also make sure the IC is perpendicular to the circuit board. Then solder the leads to the foil and cut off the excess lead lengths.



( ) S104: 9-pin plug. Use a 4-40 x 3/8" screw and a 4-40 nut to temporarily secure the plug to the circuit board. This will help make sure the plug is down against the board when you solder the pins to the foil. After you solder the pins, remove the hardware and save it for use later.



( ) S105: Power socket. Cut off the excess tab lengths.

( ) C147: 2200 µF electrolytic capacitor. Be sure to observe the correct polarity. Solder the leads to the foil and cut off the excess lead lengths.

Refer to Pictorial 2-5 while you perform the following steps.

( ) Prepare the following stranded wires:

Two 1-1/4" white
Two 1-1/4" green
Two 1-1/2" black

Connect one end of each of the prepared wires to the circuit board as follows. Solder each wire to the foil as you connect it. NOTE: The other ends of these wires will be connected later.

( ) 1-1/4" white wire to hole G (closest to the nearby edge of the board).

( ) 1-1/4" green wire to hole E.

( ) 1-1/4" green wire to hole F.

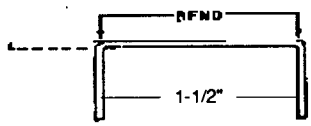
( ) 1-1/4" white wire to remaining hole G.

( ) 1-1/2" black wire to hole C.

( ) 1-1/2" black wire to hole D.

( ) Cut two 2-7/8" lengths of bare wire. Use these wires in the next two steps.

( ) Form a 2-7/8" bare wire as shown. Then refer to Detail 2-5A and install it over the top of socket S102 at LO as shown. Keep the top of the wire 1/2" above the circuit board. Then solder the wire to the foil and cut off any excess wire ends.



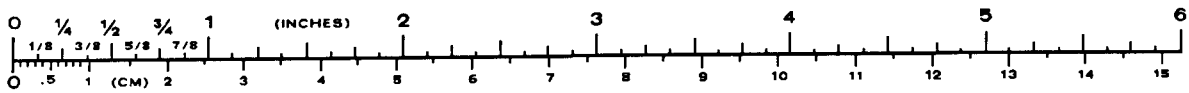
( ) Similarly install a 2-7/8" bare wire over the top of socket S102 at HI. Solder the wire to the foil and cut off any excess wire ends.

( ) Refer to Detail 2-5B and install a rubber grommet in switch bracket hole AA.

( ) SW1: Refer again to Detail 2-5B and use two 4-40 x 1/4" screws to mount a slide switch to the switch bracket at SW1. The switch may be mounted either way in the bracket.

( ) Prepare two 1-1/4" black stranded wires. Remove an additional 1/4" (total 1/2") of insulation from one end of each wire. Use these wires in the next two steps.

( ) Refer again to Detail 2-5B and connect the 1/2" end of a prepared 1-1/4" black wire to switch SW1 lugs 1 and 2. Solder the wire to both switch lugs. NOTE: The other end of this wire will be connected later.



( ) Similarly, connect the 1/2" end of the remaining prepare black wire to switch SW1 lugs 3 and 4. Solder the wire to both switch lugs. NOTE: The other end of this wire will be connected later.

( ) Refer to Detail 2-5C and use two 4-40 x 1/4" screws, two #4 lockwashers, and two 4-40 nuts to mount the switch bracket to the main circuit board as shown.

( ) Connect the free end of the black wire coming from switch SW1 lugs 3 and 4 to circuit board hole A. Solder the wire to the foil and cut off any excess wire end.

( ) Connect the free end of the black wire coming from switch SW1 lugs 1 and 2 to circuit board hole B. Solder the wire to the foil and cut off any excess wire end.

( ) Cut two 1/2" lengths of small sleeving. Then slide a length of sleeving on the end of the black wires coming from circuit board holes C and D.

( ) D1: Refer to Detail 2-5D and push an LED (light-emitting diode) into the rubber grommet on the switch bracket. Make sure the longer lead is toward the left as shown.

( ) Form a small hook in the end of the shorter LED lead. Then crimp and solder the free end of the black wire coming from circuit board hole C to the hook in this LED lead.

( ) Similarly form a small hook in the end of the longer LED lead. Then crimp and solder the free end of the black wire coming from circuit board hole D to the hook in this LED lead.

( ) After the connections cool, slide the sleeving on the black wires coming from circuit board holes C and D up the leads so they cover the solder connections and LED leads.

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.

Refer to the illustrations where parts were installed while you make the following visual checks:

( ) Electrolytic capacitors for the correct position of the positive (+) or negative (-) lead.

( ) Diodes for the proper type and installation.

Set the main circuit board assembly aside temporarily.

ASSEMBLY CONTINUED

Refer to Pictorial 2-6 while you perform the following steps.

( ) Position the chassis upside-down as shown in the Pictorial.

( ) Carefully peel away the backing paper from a foot. Then press the foot onto the bottom of the chassis near one corner as shown.

( ) Similarly press feet onto the bottom of the chassis near the remaining corners as shown.

( ) Carefully peel away the backing paper from the blue and white label. Then press the label onto the bottom of the chassis in the area shown. Be sure to refer to the numbers on this label in any communications you may have with the Heath Company about your kit.

Refer to Pictorial 2-7 while you perform the following steps.

( ) Reposition the chassis as shown in the Pictorial.

( ) Refer to Detail 2-7A and set the main circuit board in the chassis so the slide switch and the LED enter their corresponding chassis holes. Then use 4-40 x 1/4" screws to mount the circuit board to the chassis at CA, CB, and CC. Use a 4-40 x 3/8" screw to mount the circuit board to the chassis at CD.

( ) Adjust LED D1 so the end of its lens is flush with the outside surface of the chassis.

( ) Refer to the inset drawing on Detail 2-7B and bend two control solder lugs as shown. Use these prepared lugs in the next two steps.

( ) J2: Refer to Details 2-7B and 2-7C and match the flat on a BNC connector with the flat in rear panel hole J2. Then use the hardware supplied with the connector and a prepared control solder lug to mount the connector to the panel. Be sure to position the solder lug as shown in the Pictorial before you tighten the hardware.

( ) J3: Similarly use the hardware supplied with the connector and a prepared control solder lug to mount a BNC connector to the rear panel at J3. Be sure to position the solder lug as shown before you tighten the hardware.

( ) Refer to Detail 2-7C and use the following procedure to mount the rear panel onto the chassis:

1. Refer to the inset drawing on the Detail and cut open the silicone grease container. Then apply a thin layer of grease onto the flat metal side of integrated circuit U101. Discard the leftover grease.

2. Use two 4-40 x 1/4" screws to loosely mount the rear panel onto the chassis at CE and CF.

3. Use two 4-40 hex studs to secure socket S105 to the rear panel at CG and CH. Do not overtighten these spacers. Now tighten the screws at CE and CF.

4. Bend the leads of integrated circuit U101 so the hole in the IC lines up with hole CJ in the rear panel. Then use a 4-40 x 1/4" screw, #4 lockwasher, and a 4-40 nut to mount the IC to the rear panel.

NOTE: Solder each wire to the lug as you connect it in the following steps.

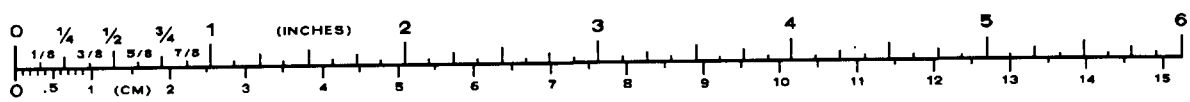
( ) Connect the free end of the white wire coming from circuit board hole G, near plug J101, to the solder lug on BNC connector J2.

( ) Connect the free end of the green wire coming from circuit board hole E to BNC connector J2 lug 1.

( ) Connect the free end of the green wire coming from circuit board hole F to BNC connector J3 lug 1.

( ) Connect the free end of the white wire coming from remaining circuit board hole G to the solder lug on BNC connector J3.

NOTE: You will install the integrated circuits and mount the top cover during the "Initial Tests," which follow.



CONFIGURATION & INTERCONNECTION

Before you use your Analyzer, and before you can perform some of the "Initial Tests", you must configure the Analyzer to match your terminal or computer. The positions of the trigger output polarity jumpers is not important during the "Initial Tests", but you may also wish to set these jumpers at this time.

You will need a cable to connect the Analyzer to your terminal or computer. This section contains information that should enable you to obtain or make your own cable.

NOTE: If you intend to use your Analyzer with a PC-compatible computer, we recommend that you read the READ.ME file on the disk (also printed in Appendix D) that was supplied with the Analyzer before you continue. In addition, we strongly advise you to make a working disk copy of the software as described in Appendix E at the rear of this Manual.

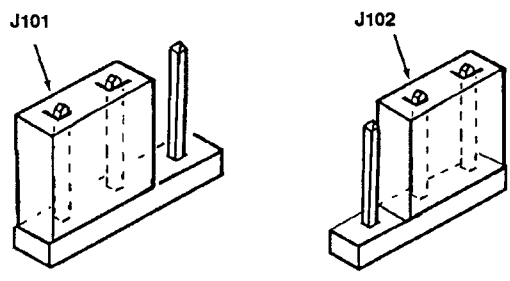
SETTING THE INTERNAL JUMPERS

Refer to Figure A for the locations of the jumpers called out in the following paragraphs.

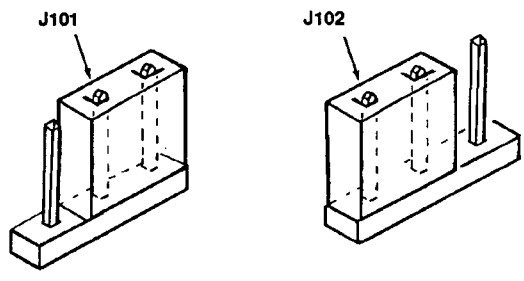
Trigger Output Polarity

You can use either trigger output to trigger an oscilloscope or some other instrument. The TRIG. WD (trigger word) output makes a transition when the Analyzer recognizes a trigger word that you select. The DELAY output makes a transition when the number of qualified clocks after the trigger equals the delay count that you select.

Jumpers J101 and J102 allow you to select the polarity of the transition at each trigger output (J101 for TRIG. WD, and J102 for DELAY). If you desire to have a high-to-low transition at the trigger output when the condition described above occurs, push the jumper block onto J101 so it connects the center pin to the left-hand pin (as viewed from the front of the Analyzer), or onto J102 so it connects the center pin to the right-hand pin. For a low-to-high transition, push the jumper block onto J101 so it connects the center pin to the right-hand pin, or onto J102 so it connects the center pin to the left-hand pin.



HIGH TO LOW



LOW TO HIGH

Baud Rate

J103, J104, and J105 allow you to fix the baud rate at a particular value. They can also be set so that, when you use the Analyzer with a terminal, it determines the correct baud rate each time you apply power. To have the Analyzer determine the baud rate (autobaud), you will have to press the space bar several times upon power up. Refer to the following table to set the baud rate jumpers. So that unused jumper blocks do not get lost, store them on only the left pin of each plug.

NOTES:

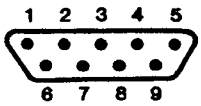
1. The letter "J" indicates that a jumper block should be installed on the corresponding plug.
2. You **must** set the baud rate to 9600 or 19200 if you use the Analyzer with a PC. Refer to Appendix D.

	BAUD RATE							
	300	600	1200	2400	4800	9600	19200	Autobaud
J103	J	J	J	--	--	--	--	J
J104	J	--	--	J	J	--	--	J
J105	--	J	--	J	--	J	--	J

Figure A

INTERFACE CABLE PREPARATION

You will need a suitable cable to connect the Analyzer to your terminal or computer. The following paragraphs describe cables for specific computers, but the information presented should help you make a cable that will work with other units. Figure B shows you the pins of the Analyzer RS-232 socket that must be connected for the Analyzer to work properly.

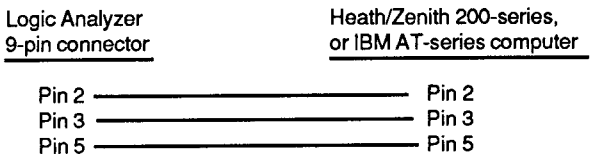


VIEWED FROM
THE PIN SIDE

1 NC	6 NC
2 Output	7 NC
3 Input	8 NC
4 NC	9 NC
5 Ground	

Figure B

The Heath Model HCA-85 is a ready-made cable you can purchase that allows you to connect the Analyzer to a Heath/Zenith 200-series PC-compatible computer, or to the IBM AT series. These computers use a 9-pin "D" connector for the serial I/O. If you wish to make your own cable, Figure C shows the proper connections. NOTE: Be sure to use shielded cable and housings.



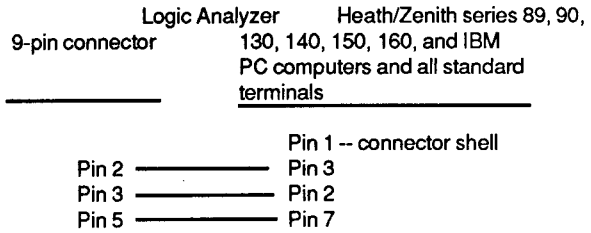
NOTE: Connect the shield wire to both connector shells.

Figure C

The Model HCA-85 cable can also be used with the Heath/Zenith 130-, 140-, 150-, or 160-series computers, or with any video terminal that meets the requirements described in the "Specifications" section of this Manual. One end of the cable, however, must be modified as follows:

( ) Cut off the 9-pin "D" connector on one end of the cable and prepare the end of each wire.

( ) Refer to Pictorial 3-1 and Figure D to install the 25-pin "D" connector (supplied) on the prepared end of the cable as shown. NOTE: You will need to use an ohmmeter or a continuity tester to identify the wires.



NOTE: Connect the shield wire and all unused wires to the connector shell.

Figure D

If the terminal or computer port that you will be using with your Analyzer requires handshaking inputs, you may have to connect jumper wires between several pins on the 25-pin "D" connector to satisfy the requirements. Refer to your appropriate manual for more information. Extra connector pins have been supplied for this purpose.

INITIAL TESTS

This section of the Manual will show you how to check the operation of your Logic Analyzer. You will first check the power supply circuitry to make sure it is operating properly while most of the integrated circuits are removed from the circuit board. After you make the power supply checks, you will install the remainder of the integrated circuits and make some operational tests.

VOLTAGE CHECKS

You will need a VOM (volt-ohmmeter), a VTVM (vacuum tube voltmeter), or a DMM (digital multimeter) to perform the voltage tests in this kit. If you do not have one of these meters, try to obtain one from a friend. It is important that you perform these tests. If you do not get the proper voltage readings, check for unsoldered connections or solder bridges. Make sure the voltages are correct before you proceed.

Refer to Pictorial 4-1 while you perform the following steps.

NOTE: Do not connect the Logic Analyzer to the power cube until a step directs you to do so.

( ) U114: Refer to Detail 4-1A and install an ICL 7660 integrated circuit (#442-720) in the socket at U114.

( ) Make sure the front panel slide switch is OFF.

( ) Connect the power cube to the 8.5 VAC socket on the rear panel and a proper AC outlet.

( ) Connect the common or negative voltmeter lead to the negative (-) lead of capacitor C147. Leave this lead connected to the capacitor lead until a step directs you to disconnect it.

( ) Set the voltmeter so it can measure +16 volts DC.

( ) Push the slide switch to ON. The front panel POWER LED should light.

( ) Touch the positive voltmeter probe to either slide switch lug that has a wire connected to it. The voltmeter should indicate between +12 and +16 volts.

( ) Touch the positive voltmeter probe to the HI buss wire that is above socket S102. The voltmeter should indicate between +4.75 and +5.25 volts.

( ) Set the voltmeter so it can measure -12 volts DC (or interchange the voltmeter leads).

NOTE: When you measure the voltage at the integrated circuit pin, in the next step, do not allow the voltmeter lead to slip and short to one of the adjacent IC pins. To do so could damage the power supply circuitry.

( ) Touch the voltmeter probe to integrated circuit U114 pin 5. The voltmeter should indicate between -8 and -10 volts. NOTE: If this is the only voltage source that is missing or incorrect, make sure zener diode D105 is properly installed.

( ) Push the slide switch to OFF and disconnect the power cube from the Logic Analyzer.

( ) Disconnect the voltmeter leads from the Analyzer and set the voltmeter aside.

Refer to Pictorial 4-2 while you perform the following steps.

Use the same procedure that you used when you installed IC U114 to install the remaining ICs as follows:

NOTES:

1. Be careful; some of the type numbers are similar (74 F 244, 74 LS 244, and 74 ALS 244).

2. Some of the ICs are susceptible to static electricity. Use the same care when you install these ICs as you did when you installed the ICs on the pod circuit boards.

( ) U102: **74F86** (#443-1052).

( ) U103: **74 F 244** (#443-1065).

( ) U104: **74 LS 244** (#443-791).

( ) U105: **74 LS 244** (#443-791).

( ) U106: **74LS377** (#443-1110).

( ) U107: **74F175** (#443-1429).

( ) U108: **74F175** (#443-1429).

( ) U109: **74LS377** (#443-1110).

( ) U110: **74LS377** (#443-1110).

( ) U111: **74F175** (#443-1429).

( ) U112: **74F175** (#443-1429).

( ) U113: **74LS377** (#443-1110).

( ) U119: **74F64** (#443-1372).

( ) U120: **74F64** (#443-1372).

( ) U121: **74F64** (#443-1372).

( ) U122: **74F64** (#443-1372).

( ) U123: **74F64** (#443-1372).

( ) U124: **74F64** (#443-1372).

( ) U125: **74F64** (#443-1372).

( ) U126: **74F64** (#443-1372).

( ) U131: **74F11** (#443-1431).

( ) U132: **74ALS30** (#443-1231).

( ) U133: **74LS191** (#443-1094).

( ) U134: **74LS191** (#443-1094).

( ) U135: **74ALS10** (#443-1047).

( ) U136: **74LS191** (#443-1094).

( ) U137: **74LS191** (#443-1094).

( ) U138: **74HC32** (#443-1175).

( ) U139: **74ALS74** (#443-1051).

( ) U140: **74LS191** (#443-1094).

( ) U141: **74F00** (#443-1121).

( ) U142: **74LS191** (#443-1094).

( ) U143: **74LS191** (#443-1094).

( ) U115: **74LS138** (#443-877).

( ) U116: **MC 145406** P (#443-1436).

( ) U118: **74 LS 244** (#443-791).

( ) U117: **8052** (#444-560).

( ) U127: **74 ALS 244** (#443-1096).

( ) U128: **74 ALS 244** (#443-1096).

( ) U129: **74 ALS 244** (#443-1096).

( ) U130: **74 ALS 244** (#443-1096).

( ) U144: MCM **2018N45** (#443-1432).

( ) U145: MCM **2018N45** (#443-1432).

( ) Recheck each integrated circuit for the proper type and installation. Pay particular attention to integrated circuits that have similar type numbers (such as 74 F 244, 74 LS 244, and 74 ALS 244). NOTE: The pin 1 end of each IC should be toward the rear of the chassis.

OPERATIONAL CHECKS

Before you attempt to perform the following checks, make sure you installed jumpers and either obtained or made a cable as directed in the "Configuration and Interconnection" section of this Manual.

( ) Use a suitable cable to connect the Analyzer to a terminal or PC-compatible computer.

( ) Turn on the terminal or boot the computer.

( ) Turn the Analyzer off (if it is not already off) and back on to set up the default configuration. If you are using a PC-compatible computer, type one of the following commands depending upon how you configured your Analyzer and where you connected the interface cable:

LA COM1 9600
LA COM1 19200
LA COM2 9600
LA COM2 19200

( ) Press the ESCape key to display the Status line.

Refer to Pictorial 4-3 while you perform the following steps.

( ) Attach the three pods to the HIGH BYTE, LOW BYTE, and CLOCK sockets on the rear of the chassis. Note that each plug is keyed to fit only one way.

NOTES

1. To help you distinguish between the high and low-byte pods, you may wish to use tape, or something similar, to mark one or both of them.

2. You can conveniently route the ribbon cables under the cabinet so that you can set the Analyzer on a shelf above your work area.

Connect the clips on the clock pod as follows:

( ) Clock input (red wire) to the CLK pin near integrated circuit U117.

( ) Qualifier 0 (black wire) to the GND pin.

( ) Qualifier 1 (brown wire) to the GND pin.

( ) Ground (white wire) to the GND pin.

( ) Connect the clips on the ends of the high- and low-byte probes to the bare wires at LO and HI as shown in line 1 of the table shown on Page 33 (in this case, connect them all to the LO wire).

( ) Connect the white wires from the two probes to the bare wire at LO. Do not disconnect the white wires from this bare wire while you make the following checks. CAUTION: Make sure these clips do not touch the bare wire at HI.

( ) 1. If necessary, press the ESC key to obtain the acquire menu.

( ) 2. Press the RETURN key to acquire data.

( ) 3. Press the ESC key to return to the configuration menu. Then perform the following numbered steps.

( ) 4. Press the C key to perform the checksum function.

( ) 5. When the bottom line of the display prompts for a start address, press the RETURN key.

( ) 6. When the bottom line of the display prompts for an end address, press the RETURN key.

( ) 7. When the bottom line of the display prompts for a mask, enter the bit pattern that is shown in the table. Press the BACKSPACE key if you need to make a correction to an entry. Then press the RETURN key.

( ) 8. Compare the Mask and Checksum values you obtain with those indicated in the following table for step 1. If your Analyzer is operating properly, they should agree.

( ) Repeat steps 1 through 8 for lines 2 through 8 in the table.

	High-byte Pod								Low-byte Pod									
	DF	DE	DD	DC	DB	DA	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	Mask	Check sum
	VIO	BLU	GRN	YEL	ORG	RED	BRN	BLK	VIO	BLU	GRN	YEL	ORG	RED	BRN	BLK		
1.	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	1111 1111 0000 0000	0000
2.	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	LO	0000 0000 1111 1111	0000
3.	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	1111 1111 0000 0000	0100
4.	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	HI	0000 0000 1111 1111	F701
5.	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	1111 1111 0000 0000	AB00
6.	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	0000 0000 1111 1111	A7AB
7.	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	1111 1111 0000 0000	5600
8.	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	HI	LO	0000 0000 1111 1111	4F56

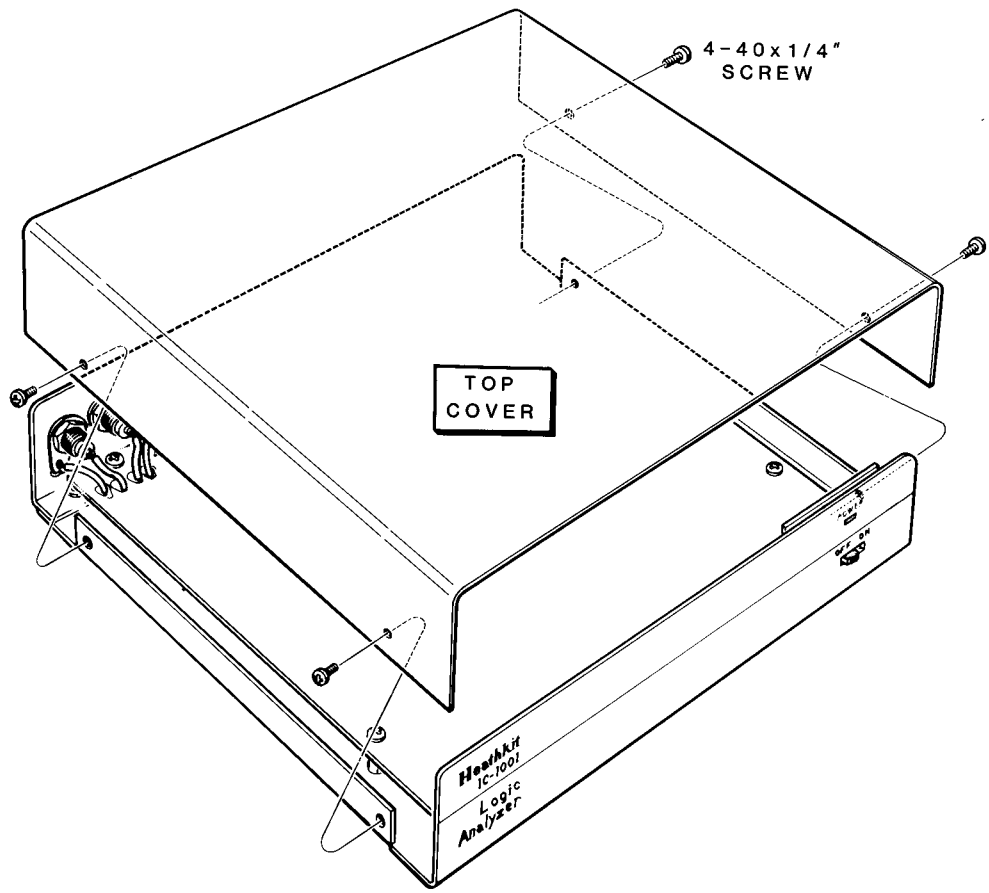
NOTE: Refer to "In Case of Difficulty" if the Analyzer does not trigger, or if any checksum value you obtain does not agree with the value in the table.

This completes the "Initial Tests." Turn the Analyzer off and disconnect the pod leads.

FINAL ASSEMBLY

Refer to Pictorial 5-1 while you perform the following step.

( ) Set the top cover onto the Analyzer chassis (it will fit either way). Then use four 4-40 x 1/4" screws to secure the cover to the chassis.



PICTORIAL 5-1

OPERATION AND APPLICATIONS

OPERATION

CONNECTION TO THE TARGET SYSTEM

Three pods, which contain high-impedance buffers, provide the interface between the Analyzer and the target system or circuit. The high-byte and low-byte pods each provide eight data lines and a ground connection. The clock pod provides a clock input, two qualifier inputs, and a ground connection. (Since the circuitry for all three inputs is identical, the Analyzer assumes that the levels of the two qualifiers are stable prior to the active edge of the clock input.) If a particular application does not require both qualifiers, the unused input clip(s) may be connected to ground or Vcc of the circuit under test. The active level(s) must be appropriately specified as described later.

CAUTION: The high-impedance buffer ICs inside the pods are CMOS devices that can be damaged by static electricity. To help protect these ICs, discharge any static potential that you may have accumulated before you connect the clips.

NOTE: The 74 **HCT** 245 buffer ICs in the pods do not provide any hysteresis. If you intend to use the Analyzer in a circuit where noise is a problem, you may wish to replace these buffers with 74 LS 245 ICs* (which do have hysteresis) to help reject noisy signals. This will, however, increase the circuit loading.

The pod wires are color coded for easy identification. The eight inputs to the low-byte pod follow the standard color code (black is bit 0 and violet is bit 7). The high-byte pod repeats the color sequence from bit 8 through bit 15. Since the high- and low-byte pods are identical, we recommend that you mark one of the pods so you can tell them apart.

The clock pod wires are color coded as follows. NOTE: If you forget these color codes, they appear in the first page of the Help text (Help is explained later).

Black = Qualifier 0
Brown = Qualifier 1
Red = Clock

A white wire coming from each pod is the ground wire and should be connected to the ground bus in the circuit under test. This will minimize noise and waveform distortion that could produce incorrect data.

It is a good idea to remove power from the circuit under test while you connect the pod clips, particularly when you attach them to IC pins to avoid shorting the clips to adjacent pins. To help reduce the chance of the clips becoming bent, however, we recommend that you do not attach the clips directly to IC pins. Clothespin-type test clips are available from several sources and allow easier and safer connection to IC pins. Make sure you do not connect the inputs to negative voltages or voltages greater than +5 volts. To do so could damage the input buffers. Also be sure to turn the Analyzer on before you apply power to the circuit under test.

*Heath part number 443-885.

NOTE: Refer to the "Configuration and Interconnection" section of this Manual for information about connecting the Analyzer to your terminal or computer.

USING THE ANALYZER WITH A TERMINAL

Internal jumper plugs allow you to set any of the seven valid baud rates, or the Analyzer can determine the baud rate and configure itself. To use this feature, turn the Analyzer on, connect it to an ANSI-compatible terminal, and press the SPACE bar several times (the terminal must be set to one of the baud rates listed in the "Specifications" section of this Manual). When the Analyzer determines the baud rate, it will prompt you for configuration information and present the following configuration menu on the 25th line of the screen:

tWord Edge Qual Logic Delay Time Posn Frmt Base Mode Chsm Grfx Help <ESC>

USING THE ANALYZER WITH A COMPUTER

NOTE: The Analyzer requires DOS version 2.0 or later.

The Analyzer normally configures itself for use with a terminal as was described above. For use with a PC-compatible computer, you **must** set the jumpers for either 9600 or 19,200 baud. Computers that operate at 8 MHz should operate properly at 19,200 baud. Computers that operate at 4.77 MHz, however, may occasionally lose a byte of data at 19,200 baud, which will cause a "BAD DATA!" error message to appear. If this happens, you will have to configure the Analyzer and software for 9600 baud as described next.

To run the PC utility program, type LA[<port>][<baud rate>]. The optional port parameter may be either COM1 or COM2 and the optional baud rate parameter may be either 9600 or 19,200. These parameters may be in either order, but each must be preceded by a space. If you omit either parameter, it will default to the last value that was specified. (The utility disk, as supplied, is configured for 9600 baud for use with port COM1.)

The computer sends a ^P to the Analyzer, which causes it to reconfigure itself for the PC mode. If the computer does not receive a response from the Analyzer, an error message will appear.

In the PC mode, the configuration menu is slightly different as shown below:

tWord Edge Qual Logic Delay Frmt Base Mode Cksm Srch Togl eXit Help <ESC>

You can select the function you desire by simply pressing the capitalized letter (it can be entered in upper- or lowercase).

NOTE: Many of the following function descriptions apply to both a terminal and a PC-compatible computer. If a small difference exists, it will be noted in the description. Functions that are considerably different are explained separately. We suggest that you perform each function as you read the description.

SELECTING THE TRIGGER WORD

Press the W key to change the trigger word. If you have not changed the trigger word since the Analyzer was turned on, the following line will appear on the screen:

trigger Word? XXXX XXXX XXXX XXXX

Note that the trigger word is initially all "don't cares." Also notice that it is divided into a hexadecimal format to make it easier to read. (If you use the Base selection to change the base to octal, the line will appear divided appropriately for that base.) The cursor is positioned at the most-significant bit so that you may enter a new trigger word. As you enter new bits (0s, 1s, and/or Xs), the cursor will jump over the dividing spaces as they are encountered. You can also use the SPACE bar and BACKSPACE keys to move the cursor forward or backward over bits you do not wish to change. When the desired trigger word is displayed, press the RETURN key. The configuration menu will again appear.

SELECTING THE CLOCK EDGE

When you press the E key for Edge, you will obtain the following display:

active clock Edge: / or \? /

This defaults to the rising edge at power-up. Press the / or R key to select the rising edge, or press the \ or F key to select the falling edge.

SELECTING THE CLOCK QUALIFIERS

When you press the Q key for Qual, you can select the levels that are required on the two clock qualifier inputs, Q1 and Q0. The screen will display:

clock Qualifier active levels: Q1,Q0? L,L

Both qualifiers default to Low at power-up. Enter LL, LH, HL, or HH to set the levels you desire (as you enter the letters, the comma is automatically skipped over).

SELECTING THE LOGIC POLARITY

When you press the L key for Logic polarity, the screen will display:

Logic polarity: + or -? +

This defaults to positive logic at power-up, where 1 represents a logic high and Ø represents a logic low. Press the "+" (or P) key for positive logic, or press the "-" (or N) key for negative logic. If you change the logic polarity while data is being displayed, the data will be inverted and redisplayed.

OPERATING MODES

The Logic Analyzer can operate in either the Delay or the Non- delay mode. To select the operating mode, press the M key. The screen will display:

Mode: Delay or Non-delay? D

Press the D key for the Delay mode, or press the N key for the Non-delay mode.

The Non-delay mode allows the Analyzer to display data that occurred both before and after the trigger word that you selected. You can select the point where the trigger word will occur by choosing the number of words that will be acquired AFTER the trigger word. (If that number of qualified clocks does not occur, you can press the ESCape key to display the data that was acquired.)

In the Delay mode, you select the number of qualified clocks that must occur following the trigger word before data storage begins. Data storage will then continue until the Analyzer's RAM is filled, or until you press the ESCape key.

Since the Analyzer powers-up in the Delay mode, the next menu selection is "Delay". If the Analyzer is in the Non-delay mode, the selection appears as "After".

SETTING THE DELAY VALUE

When you press the D key in the Delay mode, the screen will display:

Delay: (2-50000)? < 2> _

You can enter a value within the range of 2 to 50000, or you can press the RETURN key to accept the default value that is displayed. You can use the DELETE key to correct errors before you press the RETURN key. Values outside the valid range are not accepted.

SELECTING THE AFTER VALUE

When you press the A key in the Non-delay mode, the screen will display:

number of words After trigger (25-2045)? < 25> _

Use the same procedure that is described above under "Setting the Delay Value" to enter the After value. NOTE: The actual number of words acquired after the trigger word may differ from the value you selected by one.

SETTING THE DISPLAY TIME

In the Terminal Mode, you use TIME* to set the display duration. When you press the T key, the screen will display:

display Time in seconds: (0-99, -1=single trigger)? <-1> _

This is the time that the data will remain on the screen before another acquisition begins. If Time = 0, data is acquired and displayed as rapidly as possible. A value of -1 represents infinity (single trigger); the data will remain until you press the RETURN key, while the STATUS line is displayed, to request another acquisition.

If you press the RETURN key while the STATUS line is being displayed, the Analyzer will request the acquisition of another set of data, regardless of the Time setting.

SELECTING THE DISPLAY FORMAT

Frmt allows you to select between two types of data display. Press the F key to display:

Format: State or Timing? _

Press the S key to select a State display, or press the T key to select a Timing display. If you change the format while data is being displayed, it will be redisplayed in the new format.

SELECTING THE BASE

When you press the B key for Base, the screen will display:

Base: Hex or Octal? _

Press the H key to select Hex base, or press the O key to select Octal base.

* When you use the Analyzer with a PC, it is always in the single-trigger mode so this function is not available. Due to the type-ahead buffer that is incorporated in the program, however, pressing the RETURN key several times in a row causes the Analyzer to immediately rearm itself after each display of data. Enter CTRL-C at any time to clear the type-ahead buffer.

SELECTING GRAPHICS CHARACTERS FOR THE TIMING DISPLAY

When you use the Analyzer with a terminal, you can press the G key for Grfx (Graphics)* to select the graphics characters that are used in the timing display. The default graphics characters that are used by the Analyzer to display the logic levels match those used in Heath/Zenith terminals (left vertical bar = hex 7C; right vertical bar = hex 7D). (See Appendix B.) Use this function if you are using the Analyzer with a terminal that requires different values to produce these characters in the graphics mode. The 25th line will display:

Graphics character for logic LOW=

Enter the appropriate character to produce a left-hand vertical bar. The graphic equivalent of the character you enter will be displayed for confirmation. When it is correct, press the RETURN key. The screen will now display:

Graphics character for logic HIGH=

Enter the appropriate character to produce a right-hand vertical bar, followed by the RETURN key.

The new graphics characters will be used in subsequent timing displays. NOTE: They will be replaced with the default characters upon power-up.

THE STATUS DISPLAY

After you make all of the configuration changes you desire, press the ESCape key. This will cause the STATUS line to be displayed. While the STATUS line is displayed, you may press the RETURN key to acquire data, ^D to dump data*, or ESCape to return to the configuration menu.

Typical status lines are shown below:

TW= XXXX XXXX 1010 0110 / L,H + Delay= 41234 12S.
<RTN> <^D> <ESC>

TW= X XXX 101 011 011 111 \ L,L - After= 1234 SNGL <RTN>
<^D> <ESC>

These lines show the current trigger word, clock edge, qualifiers, logic sense, delay (or after) value, and display time. (The format of the trigger word and whether Delay or After is displayed imply the base and mode.)

* This function is not active when you use the Analyzer with a PC.

ACQUIRING DATA

When you press the RETURN key to initiate an acquisition, the word "Armed..." will appear on the 25th line of the screen. When the Analyzer encounters the trigger word, the word "Triggered" will appear. If you press the ESCape key before data acquisition completes, the word "Aborted" will appear. If no data was acquired, the terminal bell will sound and "No data" will appear.

POSITIONING THE DATA (TERMINAL MODE)

Posn (Position) allows you to set the location of the displayed data. This selection is allowed only when there is data displayed on the screen. It allows you to position the display, and offers several ways that you can use to select the section of the data that is being displayed.

When the Analyzer acquires data in the Non-delay mode, it is initially displayed with the trigger word at the top of the display. In the Delay mode, the first acquired word is displayed first.

The data is displayed in the following four fields:

1. Address relative to the trigger word.
2. A State display (1s and 0s) or a Timing display, depending upon the format you have selected. These are spaced appropriately for the base you have selected.
3. The Hex (Hex mode) or Octal (Octal mode) equivalents of the two bytes.
4. The ASCII equivalents of the two bytes. (Non-printing bytes display as a period when the Analyzer is used with a terminal, or as a single pixel when it is used with a PC.)

In the Hex mode, part of a state display might be:

```
-1234= 1010 1110 0100 1001  AE49  .I

-1233= 0110 1001 0010 1011  692B  I+
```

In the Octal mode, the same data would display as:

```
-1234= 1 010 111 001 001 001  127111  .I

-1233= 0 110 100 100 101 011  064453  I+
```

NOTE: Since negative addresses are displayed, this must be the Non-delay mode because data is displayed that occurred prior to the trigger word.

The same information is displayed in the Timing mode, but the state field is replaced with a timing field. Time is displayed vertically, while the bit levels are displayed horizontally, with the most-significant bit on the left and a logic high to the right of a logic low. This is similar to a conventional timing diagram that is turned clockwise 90° to take advantage of the terminal's scrolling capabilities.

After you select the display mode, press the P key. The following new menu is displayed:

```
Top First Last Page Backspace Search <SPC>forWord
<BS>backWord <ESC>
```

The T key allows you to select the address, relative to the trigger word, of the word to be displayed on the top line. It will prompt you with the following:

```
Top address? < nnnnn>_
```

Where nnnnn is the address currently at the top of the screen.

If the address you enter is beyond the range of valid data, the bell will beep and you will be reprompted. The entry procedure is the same as described earlier for the After value.

Press the F key to position the data with the first valid word that was acquired at the top of the screen. The L key positions the data with the last valid word at the bottom.

The P key advances the display by 24 words (one screenful), and the B key backs up a page.

Search allows you to locate a specific bit pattern within the acquired data. This is actually another way of positioning the display. The Analyzer will prompt you with:

```
Search for? XXXX XXXX XXXX XXXX
```

(The actual bit pattern displayed will be the same as the last one that was used in a search.)

Enter the pattern you want to search for in the same manner that you use to set the trigger word. The routine begins at the second word in the display, and if the Analyzer finds the pattern you request, it will

place it at the top of the screen with 23 subsequent words. You can simply press the S key, followed by the RETURN key, to search for the next occurrence of the pattern. (When the Analyzer reaches the end of the valid data, the routine wraps around to the first word and continues.) If the Analyzer cannot match the pattern, it sounds the bell and displays "Not found."

Press the SPACE bar to scroll the display up and add the next word at the bottom of the screen. BS moves the display down and adds the previous word at the top.

Press the ESCape key to return to the configuration menu.

When you use any of the above commands to reposition the data, each subsequent acquisition will automatically begin displaying at the address you have selected. This allows you to watch for changes in certain sections of the data without going back to the Position menu each time. If you change any parameter that could change the acquired data (trigger word, mode, clock edge, etc.), this autopositioning feature is turned off. You can also enter CTRL-C at any time to turn it off*. (CTRL-C also clears the type-ahead buffer.)

POSITIONING DATA (PC MODE)

The following keys are active in the PC mode to determine how data is displayed:

1. The Up arrow key shrinks the window (decreases the number of words that are displayed) in the Time Format, and increments the top address in the State Format.

2. The Down arrow key expands the window (increases the number of words that are displayed) in the Time Format, and decrements the top address in the State Format.

3. The Left and Right arrow keys move the cursor over the displayed area, one word at a time. When you use these keys with the CTRL key, the cursor remains stationary on the screen, while the data moves under it. (If you precede these keys with some number n, the cursor or data advances n words.) These keys are functional only in the Time Format.

4. The PgUp and PgDn keys move the data under the cursor one page (one screen width) at a time. (If you precede these keys with some number n, the data moves n pages.)

5. The Home key positions the cursor over the first word on the display. (If you precede the Home key with some number n, the cursor will go to word n.)

6. The End key positions the cursor over the last word on the display.

As was true in the Terminal mode, after you position the window as you desire, subsequent acquisitions will appear with the display window unchanged whenever possible. This allows you to easily observe changes.

Also appearing in the timing display are the offset between the cursor and the trigger (C-T), the displacement between the start of data (the first word that is acquired) and the trigger (S-T), the Hex or Octal equivalent of the word at the cursor position, and the ASCII equivalents of the high and low bytes at the cursor. Along the left side of the timing display are the Hex numbers that identify the input bits, and along the right side are the 0s and 1s that represent the bits in the word at the cursor position. (Whether a 0 corresponds to a low or a high level in the state and timing displays depends upon the Logic sense setting. You can change the sense to swap the 0s and 1s.)

There is also a bar across the bottom of the screen that indicates the position and size of the window on the total data. The solid portion of the bar represents the section of data that is currently being displayed, and the shaded section(s) represents the data that is outside the window. A vertical line indicates the position of the trigger word. (This line is not displayed in the Delay mode because the trigger word is not acquired.) When the timing format is selected, there are two additional pieces of information about the window that are displayed just above the right end of the window bar -- the current magnification and the width of the screen in clocks.

A Search function is also available in the configuration menu. It operates in a manner similar to the specified function in the Terminal mode. If the Analyzer locates the search pattern, it will be positioned at the top of the screen in the State format, or under the cursor in the Timing format.

* If in a subsequent acquisition no data is acquired at the address currently at the top of the display, no data will be displayed. You will have to reposition the data to view it.

Press the RETURN key to locate the next occurrence of the pattern. When the Analyzer finds the last occurrence, the RETURN key causes the Analyzer to wrap around to the first occurrence. If the Analyzer does not find the pattern, the screen will display "Not found". Press the ESCape key to exit the search function and return to the configuration menu.

CALCULATING A CHECKSUM

When you press the C key for Cksm (Checksum), the screen will display:

Start address? < nnnnn> _

where nnnnn is the lowest address of valid data.

Enter the address of the first word that is to be included in the checksum. The next prompt is:

End address? < nnnnn> _

where nnnnn is the highest address of valid data.

Enter the address of the last word that is to be included in the checksum. The last prompt is:

Mask? 1111 1111 1111 1111

Enter a bit pattern that is to be logically ANDed with each word in the range of interest, followed by the RETURN key. The Analyzer will AND the mask you entered with the data at each address within the specified range, and add them all together. The result is displayed as:

Checksum= nnnn

This allows you to save a checksum obtained from a working system and compare it later with itself or another suspect system. It also allows you to easily compare the data in a number of acquisitions to narrow down a problem.

NOTE: Since the Analyzer uses a positive logic polarity when it determines the checksum, the checksum is not affected by the setting of the Logic polarity.

DUMPING DATA (Terminal Mode)

Enter a CTRL-D while the status line is being displayed to start a binary dump of ALL of the collected data. (When you use the Analyzer with the PC, CTRL-D allows Disk operations.) The 25th line will display:

Time delay in seconds (0-99)? < 10> _

Enter the number of seconds you need to switch cables, load a computer program to accept the data, etc., and press the RETURN key. The screen will display:

Prepare for dump!

After the time delay has expired, all data will be sent to the serial port. The low byte is sent first, followed by the high byte. The data is sent as represented in the Hex/Octal equivalent field. It will be inverted if you change the Logic polarity.

If no valid data is available, the 25th line will indicate this immediately after you enter CTRL-D. After the data dump, reconnect the terminal and press the ESCape key to cause the Status line to return.

A dump takes a maximum of 2-1/4 minutes at 300 baud, or just over 2 seconds at 19,200 baud.

OPERATIONS (PC Mode)

Enter a CTRL-D while the status line is being displayed when you want to save and load files to and from disk. This will produce the following display:

Save Load <ESC>.

Press the S key or the L key to select the disk operation you desire, or press the ESCape key to abort. The operation you select will become highlighted and the Analyzer will request a filename. In the case of a Save, a default filename (the name of the currently displayed data) will also appear as <filename>. Simply press the RETURN key to save the file under that name. Path names are also allowed. When you load a file, it will overwrite the currently-displayed data.

Press the T key to Toggle between two sets of data for comparison of two disk files, or a disk file and a current set of data. Data is given the default filename of "IC1001.nnn", where nnn is initially set to 001. Each time data is acquired, this extension number increments to help you keep track of the data you are viewing. You may, of course, change the filename before saving the data on the disk. The name of the current file is displayed in the upper right corner of the screen.

EXIT TO SYSTEM (PC MODE)

Press the X key for eXit to return to the operating system.

NOTE: For convenience, CTRL-X instead of just X will return you to the operating system while the LA.EXE program remains as a resident program. This allows you to run another utility and then type "Exit" to return to the point where you left off. To remind you that LA.EXE is resident, the operating system prompt will be preceded by [LA].

HELP

The last selection in the configuration menu is Help, which provides three pages of summarized information. To advance from one page to the next, press the SPACE bar as indicated on the 25th line. The screen will clear following the display of the third page and, if there was data displayed before you selected the Help function, it will be redisplayed.

Appendix A at the rear of this Manual shows the actual Help text.

APPLICATIONS

The Analyzer is a versatile instrument that may be used to troubleshoot or verify proper operation of a wide variety of circuits that contain sequential and/or combinatorial logic. Each particular application determines how you should connect the Analyzer to the target circuit.

More sophisticated (and much more expensive) logic analyzers offer multilevel triggering. In other words, they can be configured to only acquire data when a complex sequence of conditions has been met. Even though the Heathkit Model IC-1001 Logic Analyzer has only a single level of triggering, an understanding of the target system will often allow you to use the Analyzer to find problems that could never be located with an oscilloscope or logic probe. The following example may help you understand this.

Assume you wish to trace program flow in a piece of equipment that contains a Z80 microprocessor. You must have a listing of the program for comparison so that you can determine where the program deviates from the expected path. You want to acquire a list of all addresses, therefore, from which opcode fetches are made.

You could connect the pods as follows:

Data pods: Connect to the equipments data bus.

Clock pods: Connect the clock input to the RD line.
Connect the Q0 qualifier to the M1 line.
Connect the Q1 qualifier to the MREQ line.

$\overline{M1}$ is low only during opcode fetches, while MREQ and RD go low after the address becomes stable. Therefore, you need to configure the Analyzer to trigger on the falling edge of the clock, with both qualifiers set to logic low. Set the trigger word to the first address you wish to acquire, and select the Non-delay mode with an appropriate After value. (Some pretrigger addresses may help you determine how the trigger address was reached.)

If you wish to make asynchronous timing measurements in a circuit, you can use the TTL-compatible output of an external square wave generator to clock the Analyzer. Since the resolution is no better than the clock period, you should normally use a 10 MHz clock in this situation. Due to skew (a timing difference between data input channels) and other considerations, the data that is to be acquired should not have any pulse widths less than about ten times the clock period. This will ensure that the data is properly displayed.

You may also use the Analyzer to compare a malfunctioning circuit to an identical circuit that you know functions properly. Connect the clock pod to an available system clock, and the data pods to various points in the circuit that change as a result of that clock. Be sure to tie all unused pod inputs to ground. You can then use the checksum function to provide a "signature" (a value that represents proper operation for a particular combination of inputs and setup conditions of the instrument. Select a trigger word that provides a consistent result in the functioning circuit so you can compare the faulty circuit with it. When you find a difference between the good and faulty circuits, you can restrict the range of the checksum function. You could also change the bit mask to narrow in on the problem.

IN CASE OF DIFFICULTY

This section of the Manual is divided into four parts. Use the first part, "General Troubleshooting Information," to search for any trouble that may occur right after you assemble the kit.

The second part, "Troubleshooting Precautions," describes some care you should use when you troubleshoot and repair the Analyzer. These suggestions are provided to help prevent you from damaging components during servicing.

The third part contains a "Troubleshooting Chart" that lists some specific problems and checks that you can make.

The fourth part, "Disassembly" shows you how to remove the main circuit board from the chassis for troubleshooting.

NOTE: It is important that you read the "General Troubleshooting Information" and "Troubleshooting Precautions" sections before you attempt to troubleshoot your Analyzer.

GENERAL TROUBLESHOOTING INFORMATION

1. Recheck the circuit board assembly and wiring. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something that you have consistently overlooked.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. You can, therefore, eliminate many troubles by reheating all of your connections to make sure they are soldered as described on Page 12 of this Manual.

3. Closely examine each circuit board foil to make sure that no solder bridges exist between foils. If you think you have a solder bridge but are not sure, you can check the foil pattern against the one shown in the "Circuit Board X-Ray Views" on Page 55. To remove a solder bridge, hold a clean soldering iron tip between the two points that are bridged until the excess solder flows **down** onto the hot tip of the soldering iron. Also examine the component side of the circuit board for solder that may have built up on the top side.

4. Check integrated circuit U101 to make sure it has been correctly installed and properly soldered to the foil.

5. Check the plug-in integrated circuits (ICs) for the proper installation. Make sure the pin 1 end of each IC is toward the index mark on the circuit board (the pin 1 end of each IC should be toward the rear of the chassis). Make sure each pin is in its socket and not bent out or under the IC. If you are not sure about the installation of an IC, remove it so you can check for bent pins.

6. Check each capacitor value. Make sure the correct value capacitor is installed at each capacitor location. Also check electrolytic capacitors to make sure the positive (+) or negative (-) marked lead is in its corresponding circuit board hole.

7. Check each resistor value carefully to be sure that you wired the correct part into the circuit, as shown in the Pictorial. A resistor that is discolored, cracked, or shows any signs of bulging indicates that it is damaged and should be replaced. Since damaged resistors are often the result of some other difficulty (such as incorrect wiring), you should try to determine the cause as well as the effect of the difficulty.

8. Make sure the banded end of each diode is positioned correctly.

9. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

10. Be sure all component leads are cut off close to the foil on the circuit board so the leads do not touch together, other foils, or the chassis.

Refer to the "Circuit Board X-Ray Views" and the Schematic to locate the various components or circuit areas listed in the "Possible Cause" column of the "Troubleshooting Chart."

Refer to "Semiconductor Identification" beginning of Page 51 for identification of diode and IC basings. A cross-reference of Heath part numbers to manufacturer's type numbers is also included.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of this Manual. Your Warranty is located inside the front cover.

COMPONENT REPLACEMENT

To remove faulty resistors, capacitors, or diodes, first clip them from their leads on the component side of the circuit board. Then heat the solder in the foil side and allow each lead to fall out of its hole. Preshape the leads of the replacement part and insert them into the circuit board holes. Solder the leads to the foil and cut off any excess lead lengths.

FOIL REPAIR

To repair a break in a circuit board foil, first clear the solder resist coating to expose clean foil. Then bridge solder across the break. Use a length of bare wire to bridge large gaps in the foil. Lay the wire across the gap and solder each end to the foil. Carefully trim off any excess bare wire.

TROUBLESHOOTING PRECAUTIONS

CAUTION: Be especially careful when you remove or install any CMOS integrated circuits. To avoid any confusion, treat all ICs as if they were of this type. Refer to Detail 4-1A (Illustration Booklet, Page 13) for special handling procedures.

1. When you make repairs to the Analyzer, be sure you eliminate the cause as well as the effect of the trouble. If, for example, you should find a damaged resistor, be sure you find out what damaged the resistor. If the cause is not eliminated, the replacement resistor may also become damaged when you put the Analyzer back into operation.

2. In several areas of the circuit board, the foil patterns are quite narrow. When you unsolder a part to check or replace it, avoid excessive heat while you remove the part. A suction-type desoldering tool makes part removal easier. You can also use the desoldering braid that is supplied with the kit.

3. When you make ohmmeter tests, use only the R x 10, R x 100, or R x 1000 ranges. Higher or lower ranges may impose excessive current or voltage on the Analyzer circuitry.

NOTE: In any area where circuit operation appears to be improper, but is not clearly so, you may find it helpful to review the "Circuit Description."

TROUBLESHOOTING CHART

The following chart lists the "Condition" of a number of malfunctions and some "Checks" you can perform to locate the problem. If a particular part or area is mentioned (U101, SW1, etc.) as a possible cause, check that part to see if it is correctly installed. Also check the parts connected to it for faulty connections. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	CHECKS
Analyzer triggers, but the checksums do not match the values in the table in the "Initial Tests" section.	1. Check for solder bridges, unsoldered foils, or IC pins bent out or under an IC. Note that the odd-numbered steps check the high byte and the even-numbered steps check the low byte. If you suspect RAM ICs U144 and U145, interchange them and their respective buffers with the corresponding ICs in the other byte to see if the problem moves to the other byte. You may similarly exchange high- and low-byte data pods to check for bad connections or ICs.
Analyzer will not communicate with the terminal or computer.	1. Check the wiring of the interface cable. NOTE: The Analyzer does not provide or require any hardware handshake lines. If your terminal or computer requires them, you must hardwire them to the appropriate levels. 2. Integrated circuits U114, U116, or diode D105.
Analyzer will not trigger. Clock and qualifiers are valid and trigger word is all Xs.	1. Check for clock pulses at U141 pins 2 and 3. With a trigger word of XXXXXXXXXXXXXXXX, all inputs to U132 should remain high after you press the Return key to acquire data. This will produce a low on U139 pin 2 and cause the Analyzer to trigger on the first qualified clock input. If any of the eight inputs to U132 is low, interchange the associated gate IC (U119--U126) with one of the others of the same type to see if the low input also moves. If it does, replace the IC. If it does not move, either there is an open or shorted foil, or the associated 74LS377 quad latch is defective.
One or more data bits is "stuck" high or low.	1. Exchange the high- and low-byte probes. If the stuck bit(s) change bytes, inspect the pod wiring. Otherwise, interchange the associated quad latch (U107, U108, U111, or U112) with one of the others to see if there is a change. If there is a change, interchange U104 with U105 to locate the bad IC.

CONDITION	CHECKS
In the Non-delay mode, the Analyzer occasionally does not appear to have acquired sufficient data or "No data!" is displayed, even though the Analyzer is triggered. NOTE: This occurs only when the clock duration is less than approximately 1.6 µs.	1. The pulse stretcher appears to be at fault. To check this, connect the CLOCK input to a 10 MHz square wave, and the QUALIFIER and DATA O inputs to the LO test wire. Configure the Analyzer for low qualifiers, Non-delay mode, and a trigger word of XXXXXXXXXXXXXX1. Press the RETURN key so the Analyzer begins to clock its address counter (the Analyzer will not trigger). Check U117 pin 12; it should have low-going pulses. If these pulses are less than 2 µs wide, check the pulse-stretching components (D106, C153, R106, R107, and R109) and, if necessary, replace U138.
The BAD DATA message occasionally appears when acquiring data (PC mode).	If you have any memory-resident programs that intercept or periodically disable intercept interrupts, you may have to remove them and/or reduce the baud rate to 9600.

DISASSEMBLY

If it becomes necessary to remove the main circuit board from the chassis for troubleshooting, use the following procedure:

1. Remove the hex spacer from the right side of the 9-pin RS-232 plug on the rear of the chassis. (You must remove this spacer to gain access to the 4-40 x 3/8" screw. If you remove both spacers, the regulator IC may get bent.)

2. Remove the two 4-40 x 1/4" screws on the bottom of the chassis.

3. Remove the three 4-40 x 1/4" screws and one 4-40 x 3/8" screw that secure the main circuit board to the chassis.

NOTE: Reverse the above procedure to reinstall the circuit board in the chassis.

CIRCUIT DESCRIPTION

Refer to the Schematic, Simplified Diagram, and Timing Diagram while you read the following description.

CONTROLLER

Integrated circuit U117 is an 8052 single-chip microprocessor that contains 8096 bytes of ROM and 256 bytes of RAM (random-access memory). The ROM contains the control program which interfaces the remainder of the hardware, to be described later, with the terminal or computer you use for control and display.

Capacitor C150 and resistor R102 provide the power-up reset. This time constant is long enough to ensure that pin 9 of the microprocessor is held at a logic high until after the crystal-controlled clock starts. This delay ensures that the internal registers are properly initialized.

Port 0 is used as a data bus. This port is open drain and, therefore, requires an external pull-up resistor pack RP101 Ports 1 and 2, and some bits of port 3, provide general-purpose I/O functions. The remaining bits of port 3 are assigned to special functions, such as full-duplex serial I/O and two external interrupts.

CLOCK & QUALIFIER

All three inputs to the clock pod are identical. Each of these is buffered and enters one input of an exclusive-OR gate of U102 that determines the level required at that input. The microprocessor controls the other input to each gate. Each of the three inputs of a gate must be opposite in logic level to that set by the microprocessor before the output of U131 will go high. This positive-going edge clocks the level on each of the 16 data lines into quad (4-bit) latches U107, U108, U111, and U112. Each latch has complementary outputs. The noninverting output provides data to the RAM (U144 and U145), while both outputs are used to detect the occurrence of the desired trigger word via U132.

DETECTION OF THE TRIGGER WORD

Integrated circuits U106, U109, U110, and U113 are octal (8-bit) latches which are loaded by the microprocessor when you specify the trigger word. Since there are three conditions available for each input bit to be matched to (low, high, and don't care), two bits are necessary to specify which condition. The output of U132 must go low when a match occurs. All eight of its inputs, therefore, must be high. Each input comes from an AND-OR-INVERT gate (U119--U126). Each of these ICs contains a NOR gate that is fed by four AND gates. To register a match, therefore, the outputs of all 32 AND gates must be low. This requires that at least one input to each AND gate be low.

For a given input, the complementary outputs of its corresponding latch are applied to two separate AND gates within U119--U126. The other input to each AND gate is determined by what the microprocessor has loaded into the two corresponding latch bits as follows:

1. If both bits are low, the outputs of both AND gates are low regardless of the level at the other input. This is the "don't care" situation.

2. If both bits are high, the outputs of both AND gates are high regardless of the other input; a match is not possible. Even though this is useless from a user's standpoint, the microprocessor uses this condition to prevent a match from occurring until the system is prepared to look for it.

3. If one bit is high and the other is low (two cases), a match will occur when both AND gates have a low at one input and a high at the other. This corresponds to a low data input in one case, and a high data input in the other.

DELAY COUNTER

Four 4-bit binary up/down counters, U133, U134, U136, and U137, are connected as down counters to form a delay counter. Gate IC U135 eliminates ripple delays and reduces clock pulse width requirements. This counter is loaded by the microprocessor and disables itself when it has counted down to 0. At this time, the $\overline{RC}$ (ripple clock) output of U136 goes low and disables U131A.

When the Analyzer is armed, but has not yet triggered, the microprocessor has placed U139A in a SET condition. Its $\overline{Q}$ output is applied to U131A pin 1 to keep the delay counter disabled. Shortly after the selected trigger word is detected, the output of U132 goes low. This applies a low to the D input of U139A so that the next active clock edge will clear U139A and enable the delay counter. The low on its Q output holds U139A in this cleared state. When the delay counter reaches 0, it disables itself as was described above. At this time, U139B receives a positive-going edge from inverter U141B. Depending upon the mode (Delay or Nondelay), U139B either enables or disables (respectively) the address counter, as described later.

The low-going transition of the Q output of U139A, when it is triggered, generates an interrupt to the microprocessor and causes it to display the "Triggered ..." message.

ADDRESS COUNTER

4-bit binary up/down counters U140, U142, U143, and their associated gates form the address counter. In this circuit, the counter is connected to count up.

In the Delay mode, the microprocessor loads this counter with the number 2048 and disables it by setting U139B, which holds U138 pin 8 high. (Although this is a 12-bit counter, only 11 bits are used to address the RAM, so that 2048 is the same as 0 to the RAM. But since the counter does not terminate until the $\overline{RC}$ output of U143 goes low at a count of 4095, the microprocessor must initialize the counter with 2048 instead of 0.) After the Analyzer is triggered, the delay counter counts down the specified number of qualified clocks (the delay), and then enables the address counter as data storage begins.

The address counter sequences the RAM address lines as data words (supplied by latches U107, U108, U111, and U112) are written to the RAM via buffers U127 and U130. After the latches write 2047 words to RAM (or until you abort it), the address counter stops because U138D inhibits further counts through U131C, and the microprocessor disables U127 and U130. U128 and U129 are then separately enabled to read the strobed data.

Operation is similar in the Non-delay mode, except U139B is initially cleared, and enables the address counter, so that it continually acquires data. The delay counter is loaded with the selected After count, which is the number of words to be acquired after the trigger word. When the trigger word occurs, the delay counter begins counting as it does in the Delay mode. When it reaches 0, it clocks U139B (in this case, it sets it, since the microprocessor has placed a high on the D input). Instead of starting the address counter as in the Delay mode, it stops it.

In either mode, if too few qualified clocks occur to cause the acquisition to stop automatically, you can press the ESC key to abort the process and the Analyzer will display any valid data that was acquired up to that point.

DETERMINING THE RAM LOCATIONS OF THE FIRST- AND LAST-VALID WORDS

In the Delay mode, the first word acquired is always at RAM address 0 since the address counter has been initialized to 2048. Since the address counter will stop itself at 4095 (RAM address 2047), the first word acquired cannot be overwritten, and is therefore the first-valid. The last-valid word is just prior to the point where the address counter stops. (How this address is determined is described later.)

In the Non-delay mode, this may or may not be the case, since the address counter begins counting when the Analyzer is armed. If less than 2048 words are acquired before the address counter stops (either because the delay counter has reached 0, or because you have pressed the ESC key to abort), it works the same as in the Delay mode. In this mode, the address counter is not stopped at 4095 (a high at pin 12 of U138D overrides the RC level at pin 13). Thus, if the RAM address wraps around, the first-acquired word is written over.

For this reason, the microprocessor must be able to determine whether the address counter reached 4095 during the acquisition of data. If the $\overline{RC}$ output of U143 pulses low, it generates an interrupt for the microprocessor through a pulse stretcher formed by U138A, U138B and the associated circuitry. This pulse stretcher is necessary since the duration of the $\overline{RC}$ pulse is equal to the corresponding transition of the input clock, which is only 50 nanoseconds at 10 MHz. This duration must be stretched to a minimum of 1 operation cycle of U117 (12 clock periods), or 1.63 microseconds, to ensure that it is recognized as an interrupt. If the interrupt occurs, a flag is set to indicate to the microprocessor that wrap-around has occurred. The first valid word is, therefore, at address 0 if the flag is not set, or at the address where the address counter stopped if the flag is set.

The microprocessor determines where the address counter stopped by pulsing U131C pin 11, which advances the address counter, while it watches the output of the pulse stretcher to determine when the $\overline{RC}$ output of U143 goes low. The address at which the address counter stopped can be determined by counting the number of pulses required.

LOADING THE COUNTERS & LATCHES

To load the required bit patterns into the 8-bit latches to select the trigger word and the required values into the delay and address counters, the microprocessor places the appropriate data on the data bus (port 0), and the bit address that corresponds to the destination on data selector U115's address inputs. It then pulses U115's enable line low to create a strobe of the data to the selected device.

TRIGGER OUTPUTS

When the Analyzer is triggered, flip-flop U139A toggles from the set state to the reset state. The jumper at J101 allows you to select a high-going or a low-going edge that may be used to trigger an oscilloscope or some other instrument at this time.

Another trigger output is provided when the delay counter reaches 0. This is most useful when the Analyzer is in the delay mode. A jumper (J102) is also provided on this output so you can select the edge polarity.

POWER SUPPLY & SERIAL INTERFACE

The power supply consists of a wall cube that provides 8.5 volts AC to a bridge rectifier inside the Analyzer. You may also operate the Analyzer from an external floating 10- to 14-volt DC supply of either polarity. Filter capacitor C147 is always charged to insure that microprocessor U117 is properly reset when you turn the Analyzer on. Regulator U101 provides a regulated 5 volts for the integrated circuits.

U114 is an oscillator and charge pump that is used to create a negative voltage for the RS-232 interface, U116.

PODS

The clock and data pods contain high-impedance octal data transceivers (U201 pins 1, 2, and 3) which are connected as buffers. These buffers reduce the loading of the circuitry under test, while providing sufficient output to drive the ribbon cables. The series resistors on the inputs prevent excessive input current in the event that the logic under test is operated from a supply voltage that is slightly higher than the 5-volt supply in the Analyzer. They also reduce ringing that could cause erroneous results with high-speed logic.

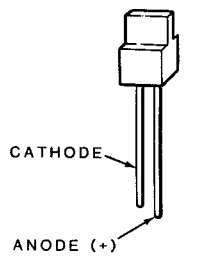
Integrated circuits U103 through U105 act as line receivers. To achieve a minimum hold time specification, the devices in the clock path must have short propagation delays with respect to those in the data path. U103, U102, and U131, therefore, are high-speed Schottky devices, while U104 and U105 are low-power Schottky devices.

SEMICONDUCTOR IDENTIFICATION

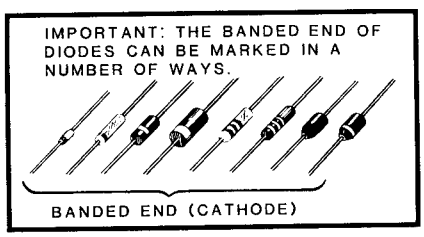
DIODES

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
D1	412-646	Red LED	A1
D101	57-42	1N5401	A2
D102	57-42	1N5401	A2
D103	57-42	1N5401	A2
D104	57-42	1N5401	A2
D105	56-608	9.1-volt zener	A2
D106	56-655	1N6223	A2

A1



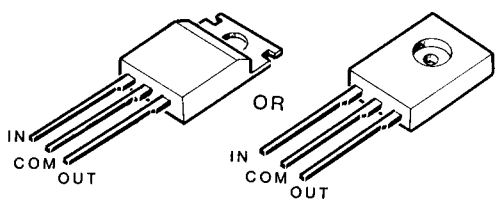
A2



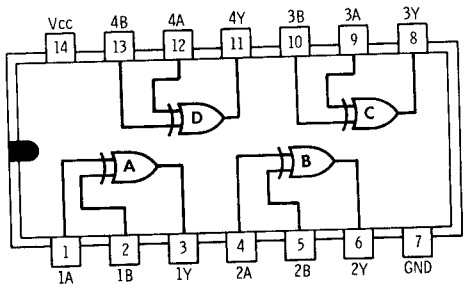
INTEGRATED CIRCUITS

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U101	442-54	7805	B1
U102	443-1052	74F86	B2

B1



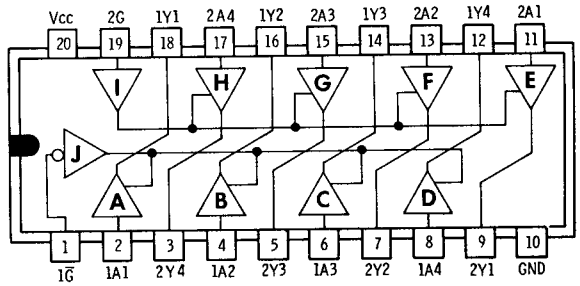
B2



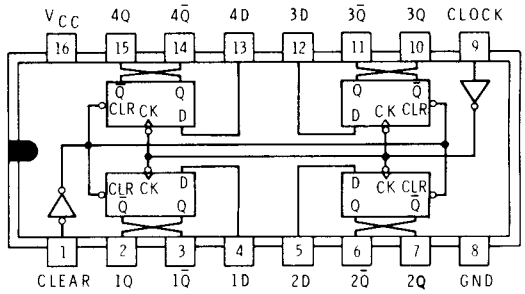
INTEGRATED CIRCUITS (Cont'd)

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U103	443-1065	74F244	B3
U104	443-791	74LS244	B3
U105	443-791	74LS244	B3
U106	443-1110	74LS377	B4
U107	443-1429	74F175	B5
U108	443-1429	74F175	B5
U109	443-1110	74LS377	B4
U110	443-1110	74LS377	B4
U111	443-1429	74F175	B5
U112	443-1429	74F175	B5
U113	443-1110	74LS377	B4
U114	442-800	ICL7662	B6
U115	443-877	74LS138	B7
U116	443-1436	MC145406P	B8
U117	444-560	8052	B9

B3



B5



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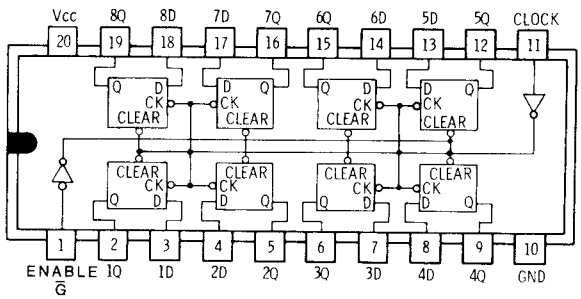

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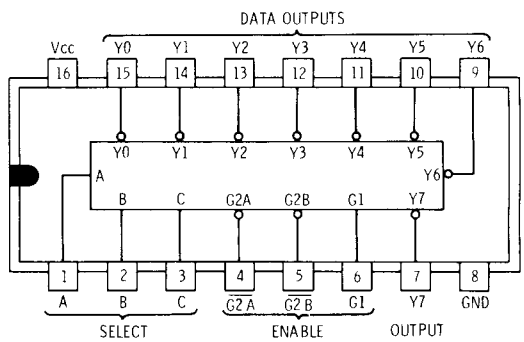
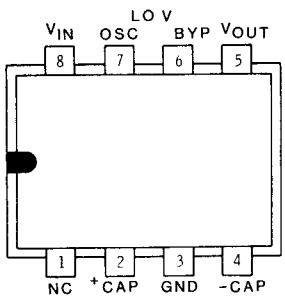


B6



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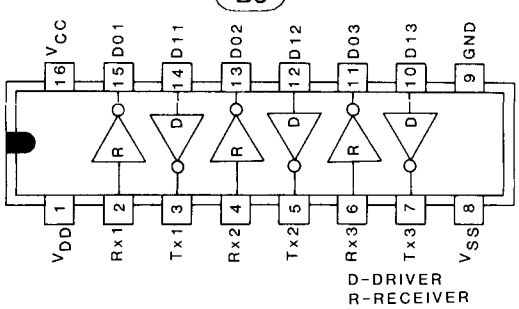
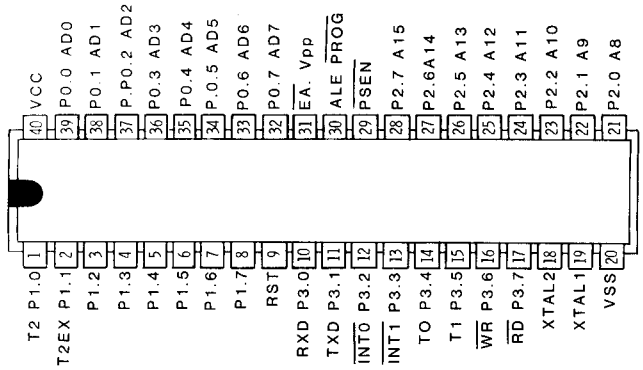


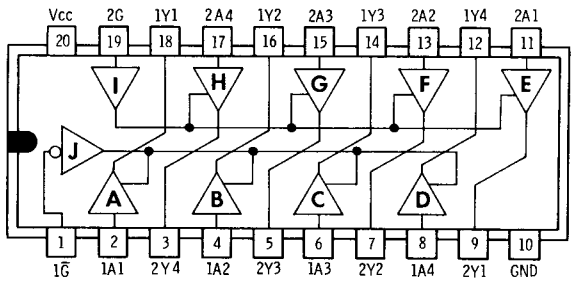
B9



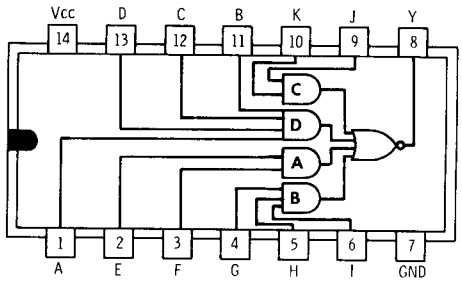
INTEGRATED CIRCUITS (Cont'd)

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE WITH NUMBER	KEY NUMBER
U118	443-791	74LS244	B3
U119	443-1372	74F64	B10
U120	443-1372	74F64	B10
U121	443-1372	74F64	B10
U122	443-1372	74F64	B10
U123	443-1372	74F64	B10
U124	443-1372	74F64	B10
U125	443-1372	74F64	B10
U126	443-1372	74F64	B10
U127	443-1096	74ALS244	B3
U128	443-1096	74ALS244	B3
U129	443-1096	74ALS244	B3
U130	443-1096	74ALS244	B3
U131	443-1431	74F11	B11
U132	443-1231	74ALS30	B12
U133	443-1094	74LS191	B13
U134	443-1094	74LS191	B13
U135	443-1047	74LS10	B14
U136	443-1094	74LS191	B13
U137	443-1094	74LS191	B13

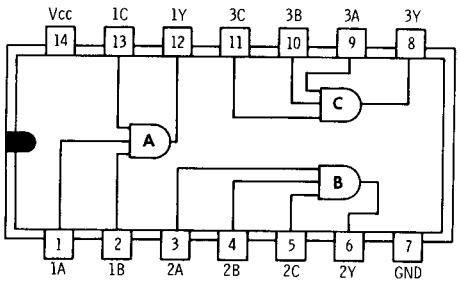
B3



B10



B11



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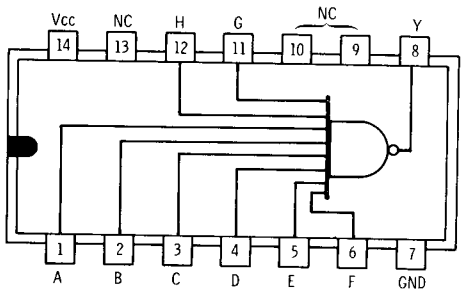

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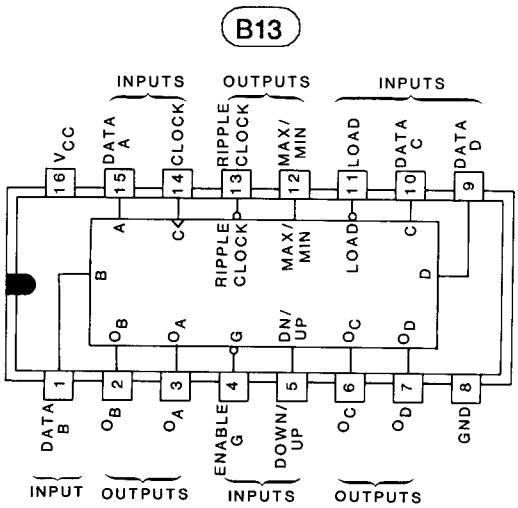
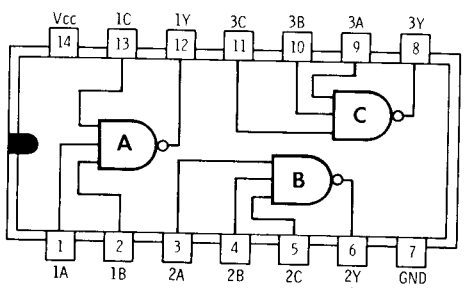


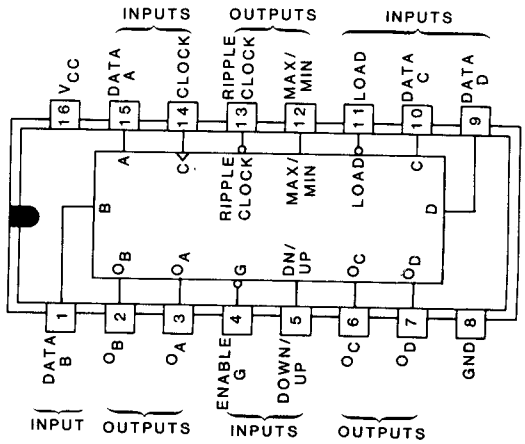
B14



INTEGRATED CIRCUITS (Cont'd)

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U138	443-1175	74HC32	B15
U139	443-1051	74ALS74	B16
U140	443-1094	74LS191	B13
U141	443-1121	74F00	B17
U142	443-1094	74LS191	B13
U143	443-1094	74LS191	B13
U144	443-1432	MCM2018N45	B18
U145	443-1432	MCM2018N45	B18
U201	443-1428	74HCT245	B19

B13



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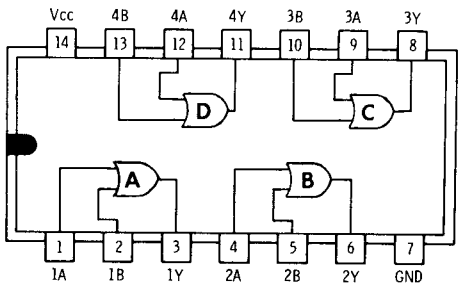

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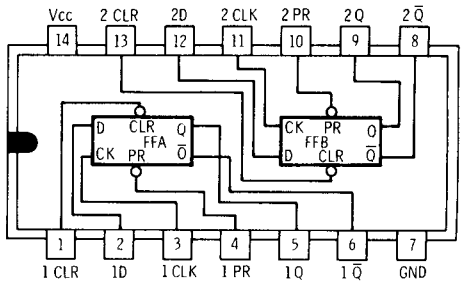

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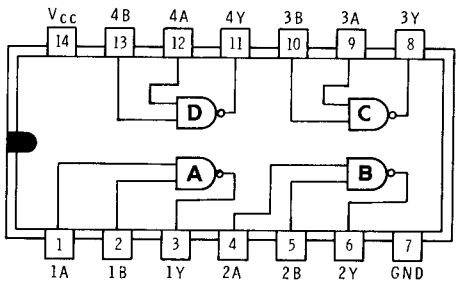

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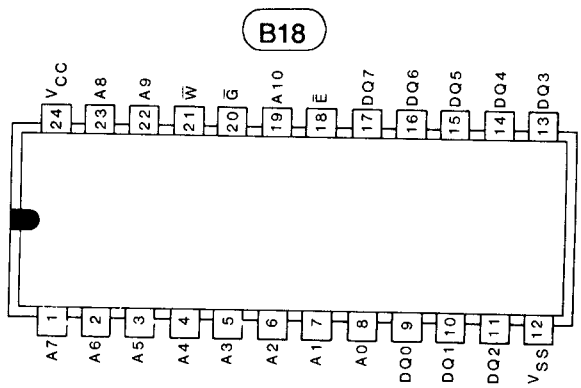

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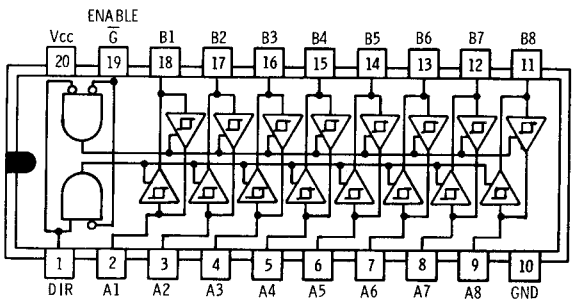


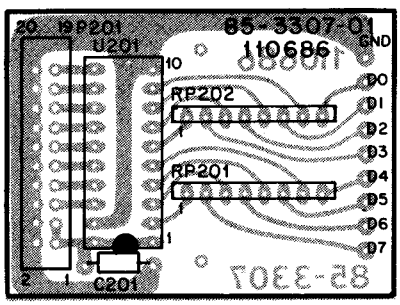
CIRCUIT BOARD X-RAY VIEWS

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

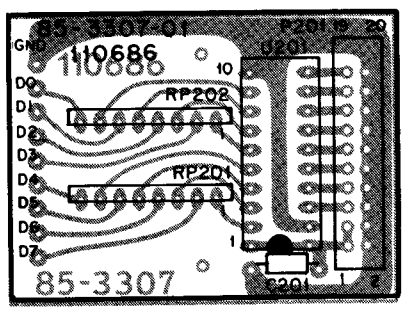
A. Find the circuit component number (R105, C103, etc.) on the corresponding x-ray view.

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

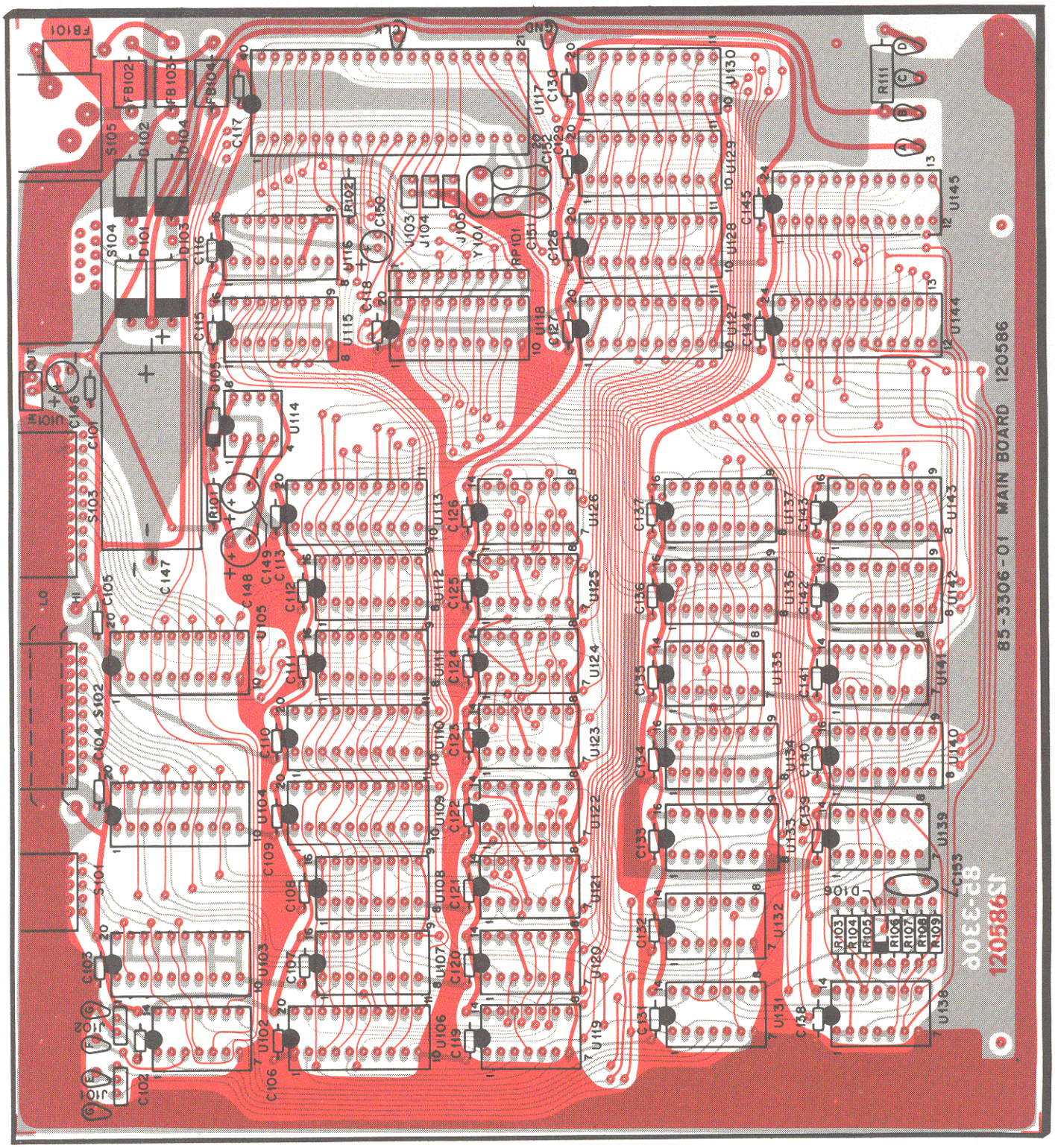
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which you must supply when you order a replacement part.



POD CIRCUIT BOARD
(Shown from the component side.)

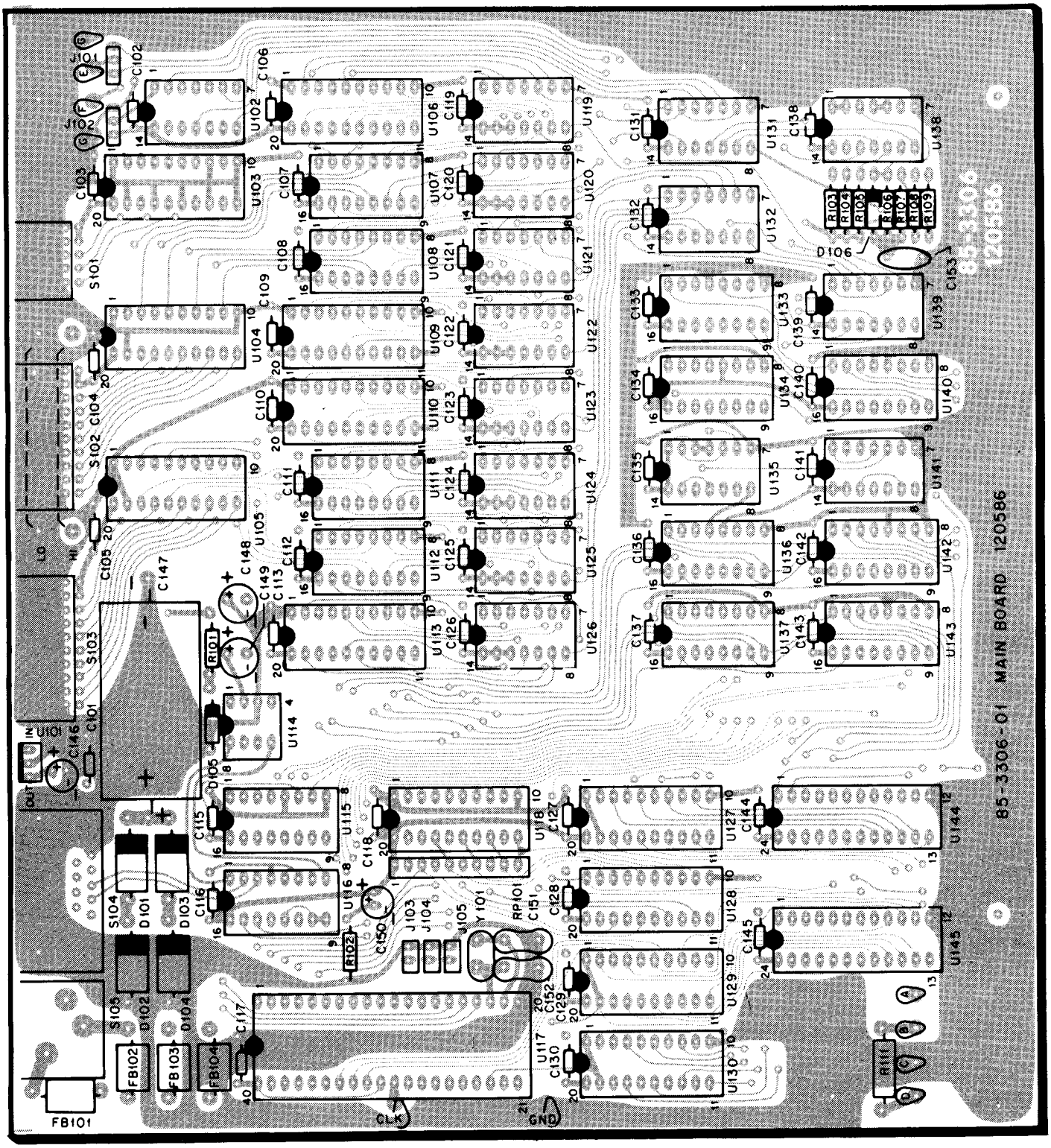


POD CIRCUIT BOARD
(Shown from the foil side.)



MAIN CIRCUIT BOARD

(Shown from the component side. The foil on the component side is shown in red.)



MAIN CIRCUIT BOARD

(Shown from the foil side. The foil on the component side is not shown.)

Appendix A

HELP TEXT

TERMINAL MODE

CONFIGURATION

tWord	—	Bit pattern for trigger word. SPACE bar and BACKSPACE allow changing individual bits.
Edge	—	Active clock (red) edge. (Use / or R for Rising, \ or F for Falling.)
Qual	—	Clock qualifiers Q1 (brown) and Q0 (black).
Logic	—	Logic polarity. (Use + or P for Positive, - or N for Negative.)
Delay	—	(Delay mode) Number of clocks between trigger and first-acquired.
After	—	(Non-delay mode) Number of words to follow trigger word.
Time	—	Time between display of data and automatic re-arming.
Posn	—	Provides commands to position acquired data in display.
Frmt	—	Format of display: State or Timing.
Base	—	Displayed base: Hex or Octal.
Mode	—	Delay mode for delayed acquisition, Non-delay mode to acquire pre-trigger data.
Cksm	—	Sums words between specified addresses after ANDing each with specified bit mask.
Grfx	—	Allows selection of graphics characters used in timing display.
Help	—	Displays this text.
<ESC>	—	Displays configuration status.

OPERATION

After configuring the instrument, press <ESC>. Configuration status is displayed. Press <RETURN> to arm instrument. Press <ESC> to abort. Press ^D to dump data.

If Time= 0-99 seconds, instrument continuously re-arms itself after time delay. Press <ESC> to halt this process.

Data is displayed in four fields:

Address rel. to trigger	State / Timing representation	Hex / Octal equivalents	ASCII equivalents

Several operations may be performed on acquired data. (Press <ESC> to return to configuration menu.) Press:

B to change base.
F to change format.
L to invert polarity. *
P to reposition data.

* Timing display does not change; it represents actual levels.

POSITIONING DATA

Selecting 'Posn' from configuration menu provides eight ways to position data:

setTop ——— Positions word at entered address at the top of display.
First ——— Positions first word acquired at the top of display.
Last ——— Positions last word acquired at the bottom of display.
Page ——— Displays next page of data.
Backpage ——— Displays previous page of data.
<SPC>forWord ——— Scrolls forward one word.
<BS>backWord ——— Scrolls backward one word.
Search ——— Searches for specified bit pattern. Search begins with second word in display, and wraps around from last to first.

<ESC> ——— Returns to configuration menu.

NOTE: If configuration is not changed, data is automatically positioned as selected above in subsequent acquisitions. Press ^C at any time to return to default positioning.

Consult manual for more information.

PC MODE

CONFIGURATION

tWord — Bit pattern for trigger word. SPACE bar and BACKSPACE allow changing individual bits.
Edge — Active clock (red) edge. (Use / or R for Rising, \ or F for Falling.)
Qual — Clock qualifiers Q1 (brown) and Q0 (black).
Logic — Logic polarity. (Use + or P for Positive, - or N for Negative.)
Delay — (Delay mode) Number of clocks between trigger and first-acquired.
After — (Non-delay mode) Number of words to follow trigger word.
Frmt — Format of display: State or Timing.

CONFIGURATION (Cont'd.)

Base	—	Displayed base: Hex or Octal.
Mode	—	Delay mode for delayed acquisition, Non-delay mode to acquire pre-trigger data.
Cksm	—	Sums words between specified addresses after ANDing each with specified bit mask.
Srch	—	Searches for specified bit pattern.
Togl	—	Toggles between data displays.
eXit	—	Exits to operating system.
Help	—	Displays this text.
<ESC>	—	Displays configuration status.

OPERATION

After configuring instrument, press <ESC>. Configuration status is displayed. Press <RETURN> to arm instrument. Press <ESC> to abort. Press ^D for disk functions.

Several operations may be performed on acquired data. (Press <ESC> to return to configuration menu.) Press:

B to change base.
F to change format.
L to invert polarity. *

* Timing display does not change; it represents actual levels.

POSITIONING

CURSOR KEY	FORMAT	FUNCTION
Up/Down	T	Zoom in/out
	S	Incr/decr top addr
Left/Right	T	Move cursor n words (1,2)
Home	T,S	Select word n (2)
PgUp/PgDn	T,S	Move data n pages (2)
End	T,S	Select last word

Notes:

(1) Use with CTRL key to move data.
(2) Precede key with n - defaults otherwise.

Consult manual for more information.

Appendix B

ESCAPE SEQUENCES USED IN TERMINAL MODE

ESC [>1h	Enable 25th line
ESC [25;0H	Cursor to 25th line
ESC [K	Clear 25th line
ESC [24;80H	Cursor to end of 25th line
ESC [>5l	Cursor on
ESC [4l	Insert mode off
ESC [11m	Graphics mode off
ESC [?7l	Line wrap off
ESC [H	Home cursor
ESC [2J	Clear screen
ESC [K	Clear 25th line
ESC [1L	Insert a blank line
ESC [s	Save cursor position
ESC [u	Restore cursor position
ESC [10m	Enter graphics mode
ESC [11m	Exit graphics mode
ESC [C	Move cursor forward one position
ESC [7m	Enter reverse video mode
ESC [m	Exit reverse video mode
ESC [2p	Get character at cursor position

Default graphics characters used (compatible with Heath/Zenith terminals):

{ = logic low (left-hand vertical bar)
} = logic high (right-hand vertical bar)

NOTE: If you are using a Model H-19 Terminal, go off line; then press the ESC key followed by the < key to make the Terminal enter the ANSI mode.

Appendix C

DISK FILE DATA FORMAT

When data is saved to disk, each word is written low byte first. The data is preceeded by eight "housekeeping" bytes. The first two are a file ID code, always ASCII "rb", that the program checks when loading a file to insure that it is a legitimate data file. The next two bytes represent the address, relative to the trigger word, of the first word acquired. This address is also stored low byte first. The next two bytes represent the number of words acquired; again, low byte first. The next two bytes represent the logic polarity under which the data was acquired. They are both 00 for positive logic, 0FFH for negative logic.

Appendix D

READ.ME -- IC-1001 LOGIC ANALYZER PC UTILITY

This LA.EXE program allows you to interface your IC-1001 Logic Analyzer with a PC-compatible computer.

For computers with a 4.77 MHz. system clock, select 9600 baud to avoid occasionally missing a byte of data from the Analyzer. Use 19200 baud for computers with a 6 or 8 MHz. system clock.

Make sure the Analyzer is jumpered for the proper baud rate before you turn it on. Install a jumper plug at J105 to select 9600 baud; remove all of the jumpers for 19200 baud. (Install unused jumper plugs over a single pin to avoid losing them.)

Refer to the Analyzer manual for information on preparing the serial cable, and connect it between the Analyzer and either the COM1 port or COM2 port (if available) on the computer.

If you have an extended graphics card in your system, configure it for the 80-column by 25-line color mode. You may use SETUP in Heath/Zenith 200-series systems — you may have to set DIP switches in other computers.

Turn on the Analyzer and type one of the following commands to run the program:

LA COM1 9600
LA COM1 19200
LA COM2 9600
LA COM2 19200

The program will save the specified port and baud rate, so you may simply type "LA" to rerun the program as long as the port and baud rate are not subsequently changed.

The program will request that you configure the Analyzer, and after a couple of seconds the Configuration menu will be displayed. A sample of data will also be displayed to allow you to familiarize yourself with the operation of the Analyzer without having to connect the clips to anything. The sample is named "DEMO.NDL", which is representative of data you might acquire with the Analyzer in Non-delay mode. Pressing "T" for Toggle will display a second page of sample data named "DEMO.DLY", which is representative of data in Delay mode.

Press "H" for Help as required.

Appendix E

HOW TO MAKE A BACKUP AND/OR A WORKING COPY OF THE SOFTWARE

The following example assumes that your system has two disk drives and you will be using MS-DOS. If you will be using a different operating system, you can use the example as a guide to generate a disk that is configured for your system.

1. Insert an MS-DOS system disk that contains the program FORMAT into drive A (the default drive).

2. Insert a blank disk into drive B.

3. Boot the system. When you obtain the A> prompt, type "FORMAT/S/V" followed by the RETURN key.

4. When the program asks you which drive to format, type "B". Make sure a blank disk is in drive B. Then press the RETURN key.

5. When the program asks for a volume label, type "ANALYZER" followed by the RETURN key.

6. When the program asks if you have more disks to format, type "N".

7. When the A> prompt reappears, remove the system disk from drive A and insert the Analyzer disk (currently in drive B) into drive A.

8. Insert the disk that was supplied with the Analyzer into drive B.

9. Type "COPY B:*.* = A: followed by the RETURN key. This will copy the files from the disk in drive B to the new (working) disk.

10. Store the disk supplied with the Analyzer in a safe place. Use the working disk for the normal operation of your Analyzer.

NOTE: Unlike other software, you do not have to run CONFIGUR to make the working disk work with your system. The software will configure itself as described in the "Initial Tests" section of this Manual.