BUGTRAP
INSTRUMENTATION

LOGIC COMPARATOR

MODEL 1674

BUGTRAP LOGIC COMPARATOR

REFERENCE MANUAL

BUGTRAP INSTRUMENTATION

THEORY OF OPERATION

The BUGTRAP LOGIC COMPARATOR, while itself a refined instrument, works on a basic principle. The integrated circuits that this unit is designed to test all have one thing in common; all of these I.C.s have inputs and related outputs as well as a 5 volt (VCC) supply and a ground (VSS).

This unit has been designed to compare a "known good" or "reference" integrated circuit with a suspect I.C. that is on a powered board so that time consuming removal is not necessary. This process takes place with the 2 I.C.'s inputs effectively "piggy-backed" to one another, and the outputs separated completely. The comparison takes place between these separated outputs. The suspect or "on board" I.C. is allowed to continue it's function without interruption while it's activity is constantly monitored.

The "reference" I.C. is connected into the comparator circuitry via a zero-insertion-force socket mounted on the comparator. By use of the switching circuitry the inputs of the "reference" I.C. are tied to the inputs of the "suspect" I.C., thereby placing the two into parallel operation. The "reference" I.C.'s power supply, as well as the comparator's power supply is sourced, identified and tapped automatically from the I.C. under test. Through parallel, yet isolated comparator lines, the activity of the

"reference" I.C. is then compared directly to that of the "suspect" chip. If the two I.C.s do not compare exactly, an "error" signal is generated immediately and a corresponding LED is lit and latched to expose the faulty line.

Unlike other comparators, the BUGTRAP will "lock-on" the faulty line as opposed to a mere flicker of an LED. This is particularly useful in finding intermittent problems that may span several minutes, or even hours between failures.

OPERATION OF THE BUGTRAP COMPARATOR

1) Identify the I.C. to be tested. Refer to NOTE 4: I.C. identification.

2) Check part number against "I.C. Test Specifications" to verify that I.C. can be used under comparator testing. The BUGTRAP comparator is designed to test TTL or DTL (5VDC max.) I.C.s. However, it will not accurately test open collector, tri-state or bidirectional devices.

3) The "type" of I.C. ("L", "S", "LS", "H", etc.) has been omitted from the I.C. Test Specifications since the test procedure is the same with only one exception; I.C. 7454 and 74LS54, noted.

4) Locate a "reference" I.C. of the part number that you want to test. Most of the time the part number is all that is necessary without regard to the "type", however, it is recommended that the exact number and type is used for a "reference" sample.

5) Insert the "reference" I.C. in the zero-insertion-force socket on the comparator. With 14 pin I.C.s, make sure that the I.C. is placed in the uppermost socket position, leaving the empty socket spaces at the bottom portion of the socket.

6) Be sure that the #1 pin on the I.C. is in the proper position.

The #1 pin location is in the upper left corner of the Z.I.F. socket (handle location). Next, lock the Z.I.F. handle down to hold the chip securely in place. *CHECK AGAIN, IMPROPER LOCATION OF THE "KNOWN GOOD" I.C. OR #1 PIN CAN CAUSE DAMAGE TO YOUR "REFERENCE" I.C. AS WELL AS THE ON BOARD I.C. UNDER TEST.

7) Set "COMP" switches on the comparator according to the "switch settings" prescribed in the I.C. Test Specifications for that particular I.C.. All other switches must be opposite these that are on "COMP".

8) Connect test clip to on board I.C. under test. This connection must be done carefully to insure that the #1 pin location, marked by a red dot on the test clip, is aligned with the marking for the #1 pin location on the test clip. The 14 pin I.C.s will have 2 unconnected clip leads on the bottom end of the test clip. CHECK AGAIN, DO NOT CONNECT TO ANY I.C. THAT IS NOT TTL OR DTL, MAXIMUM 7 VOLTS.

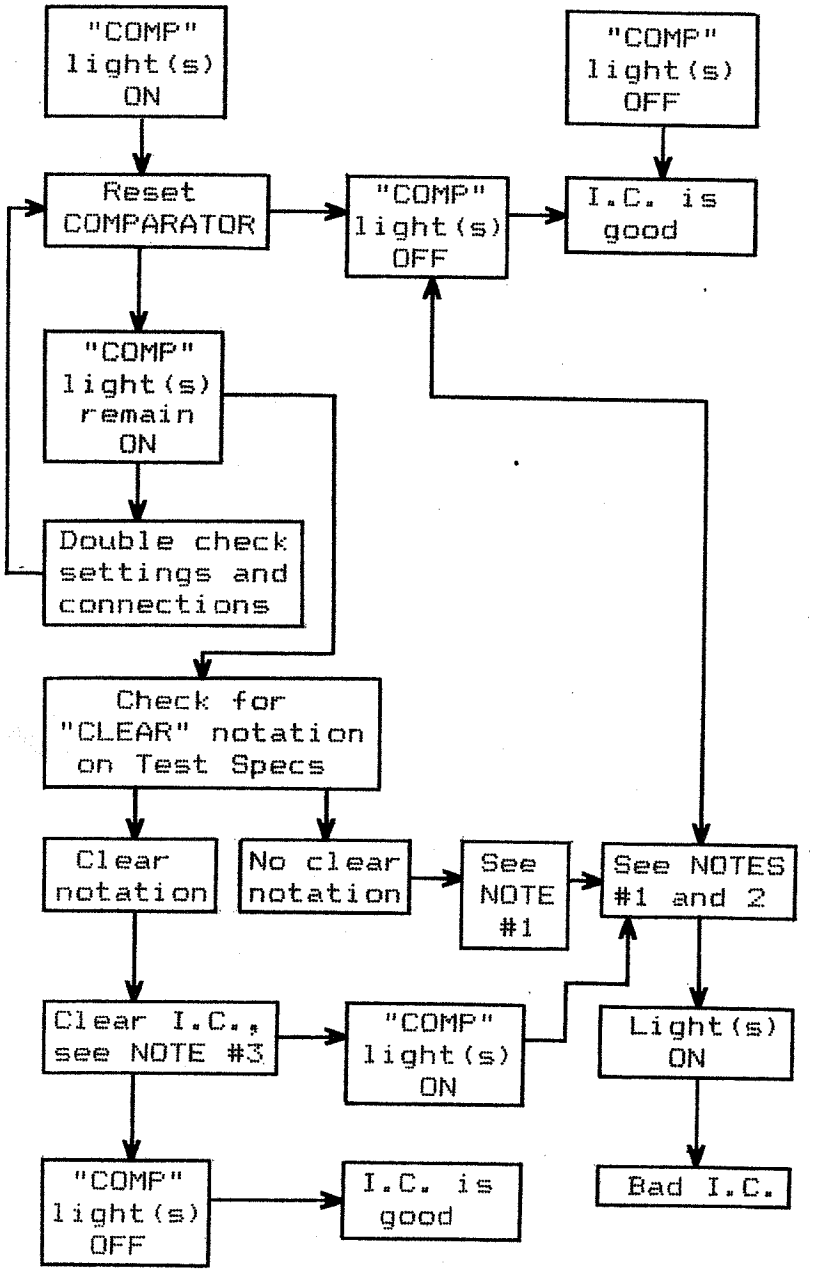
9) Once the "reference" I.C. test clip and switch settings are confirmed, power the board. At this point the power light on the comparator should be lit. If not, double check your connection. If you still don't have a power indication then check that I.C. with a voltmeter for 5VDC.

10) Once you have a power indication, observe the 16 red LEDs on the comparator, particularly the LEDs at switch locations in the "COMP" setting.

11) If any lights other than power come on then press the "RESET" button on the comparator. If lights other than those associated with "COMP" switches should light, they are to be ignored. These input associated lights may be lit due to power spikes exceeding positive or negative limits (0 volts or +6 volts) on the inputs.

12) If light(s) still remain on refer to "FAILURE TABLE".

FAILURE TABLE



NOTE #1

If the output of an I.C. is connected to a resistor/capacitor circuit, a false error indication may occur. This is usually a problem in the primary clock circuits. These generally exist in close proximity to the clock crystal.

NOTE #2

If a failure is indicated in an I.C. with no "clear" instructions, chances are that the I.C. has failed. However, it is also a possibility that the line(s) that show a miscompare are tied to another component that has a shorted input. This may be traced on the board or by schematic. If another component is suspected it can easily be confirmed by lifting it's connected input lead or by severing the trace from the faulty output line on the I.C. under test. If you still have a miscompare then replace the I.C. under test, but if you cleared the miscompare problem by following these procedures, then the input of the following component should be suspect. On rare occasion the I.C. may miscompare while completely in circuit and compare with suspect pins lifted, due to legitimate feedback on the output/input line. See NOTE #1.

NOTE #3

Provided in the Test Specifications is information on how to "clear" or reset an I.C. if necessary. Generally this will not be necessary if the board has

an operating clock and the damage to the board is not extensive. However, it is recommended that an I.C. with a "clear" be cleared, if a miscompare should occur.

Generally, the easiest way to reset an I.C. is to either temporarily interrupt power to the board under test, thereby causing a "power-on" reset, or by resetting the MPU, usually done by a reset button on board.

The I.C.s are cleared by a pulse of a logic 1 (high) or a logic 0 (low) to a designated input pin or pins.

It is strongly recommended that a logic pulser be used for this purpose. The clear instructions are written for simple interpretation. They are a combination of a number (I.C. pin number) and a pulse state. For example, if you need to clear a 7496, you will see the instruction 16-L. This means, simply, pulse pin #16 low or to logic 0. Some of the clear instructions will have two sets of clear instructions (example, 7476). Multiple clear instructions usually indicate a dual pack I.C. that has 2 separate clears, one for each half of a dual function. They may be cleared separately.

If the clear instructions are enclosed by 2 vertical lines (example 7492), then these clear commands must be pulsed at the same time, together.

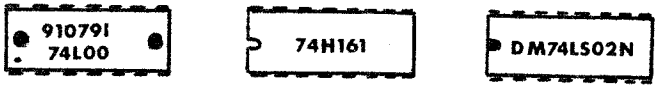
Although it is not recommended, these clear pulses can be executed by a brief contact of a wire jumper from a logic 1 source (VCC) or a logic 0 source (ground). These VCC and ground pin locations are noted in the I.C. Test Specifications.

If you should choose to use this method, please use extreme caution. The jumper wire has a great potential for shorting adjacent pins if not handled very carefully. The length of time that is required to clear the I.C. is very, very short. Momentarily touching or striking the ground or VCC source to the clear pin is all that is required.

If a logic pulser is used, as recommended, it will automatically source and sink a signal required for a "clear".

NOTE #4

I.C. Identification



We are dealing here with the "7400" series of TTL, 14 and 16 pin I.C.s.

The actual part number, depending upon the manufacturer, will often appear to be hiding among a string of other letters and numbers. The first step is to I.D. the part number by itself. Since you are primarily interested in the "74" series for testing, locate the "74" number on the I.C..

Example:

NOTE: "74" may also appear as "54" in some equipment. This is the same I.C. as the "74", built and tested to military specifications.

Any series of numbers or letters preceeding this "74" may be disregarded for simple I.C. identification. Next, we often have some letters immediately following the "74". These letters are important to note, they generally are the following: "H", "S", "L" or "LS". These letters identify the "type" of I.C.:

- "H" - High speed
- "L" - Low power
- "S" - Schottkey
- "LS" - Low power Schottkey

The final portion of the part number is the last set of numbers. In this case, "161":

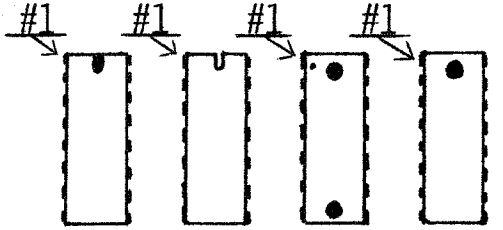
Any letters following this may also be disregarded. So, our complete part number is "74LS161".

Here are some examples of common part number configurations:

I.C.#	N7400	74H191A	SN74LS04N
PART#	7400	74H191	74LS04

It is also very important that the #1 pin on the I.C. is identified. All I.C.s have some marking to identify either the "top end" of the I.C. or pin #1 specifically.

Here are the common markings, they are generally embossed in the I.C. package itself:



16 PIN TO 14 PIN CONVERSION TABLE

COMPARATOR SWITCH #	16 PIN I.C. PIN #	14 PIN I.C. PIN #
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	NOT USED
9	9	NOT USED
10	10	8
11	11	9
12	12	10
13	13	11
14	14	12
15	15	13
16	16	14

NOTE: I.C.s should always be placed in the uppermost part of the zero-insertion-force socket, with pin #1 of the I.C. placed in the top left corner of the Z.I.F., by the locking handle.

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
7400	NAND GATE	3 6 10 13			14
7402	NOR GATE	1 4 12 15			14
7404	HEX INVERTER	2 4 6 10 12 14		SEE NOTE #1	14
7408	AND GATE	3 6 10 13			14
7410	NAND GATE	6 10 14			14
7411	AND GATE	6 10 14			14
7413	SCHMITT TRIGGER	6 10			14
7414	SCHMITT TRIGGER	2 4 6 10 12 14			14
7420	NAND GATE	6 10			14
7421	AND GATE	6 10			14

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
7423	NOR GATE	7 9			16
7425	NOR GATE	6 10			14
7427	NOR GATE	6 10 14			14
7428	NOR BUFFER	1 4 12 15			14
7430	NAND GATE	10			14
7432	OR GATE	3 6 10 13			14
7433	NOR BUFFER	1 4 12 15			14
7437	NAND BUFFER	3 6 10 13			14
7440	NAND BUFFER	6 10			14
7442	DECODER	1 2 3 4 5 6 7 9 10 11			16

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
7443	DECODER	1 2 3 4 5 6 7 9 10 11			16
7444	DECODER	1 2 3 4 5 6 7 9 10 11			16
7448	DECODER	9 10 11 12 13 14 15			16
7450	AOI GATE	6 10			14
7451	AOI GATE	6 10			14
7452	AO GATE	10			14
7453	AOI GATE	10			14
7454	AOI GATE	10			14
74LS54	AOI GATE	6			14
7455	AOI GATE	10			14

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
7462	AO EXPANDER	10			14
7464	AOI GATE	10			14
7470	JK FLIP-FLOP	6 10	2-L	GND-7 VCC-14	14
7471	FLIP-FLOP	6 10	5-L	GND-7 VCC-14	14
7472	FLIP-FLOP	6 10	2-L	GND-7 VCC-14	14
7473	JK FLIP-FLOP	10 11 14 15	2-L 6-L	GND-11 VCC-4	14
7474	FLIP-FLOP	5 6 10 11	1-L 13-L	GND-7 VCC-14	14
7475	LATCH	1 8 9 10 11 14 15 16	4-H 13-H	GND-12 VCC-5	16
7476	JK FLIP-FLOP	10 11 14 15	3-L 8-L	GND-13 VCC-5	16
7477	LATCH	1 8 11 14			16

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
7478	JK FLIP-FLOP	10 11 14 15	5-L	GND-11 VCC-4	14
7480	ADDER	4 5 6			14
7483	ADDER	2 6 9 15			16
7485	COMPARATOR	5 6 7			16
7486	XOR GATE	3 6 10 13			14
7490	COUNTER	10 11 13 14	2-H 3-H	GND-10 VCC-5	14
7492	COUNTER	10 11 13 14	6-H 7-H	GND-10 VCC-5	14
7493	COUNTER	10 11 13 14	2-H 3-H	GND-11 VCC-5	14
7494	REGISTER	9	10-H	GND-12 VCC-5	16
7496	REGISTER	10 11 13 14 15	16-L	GND-12 VCC-5	16

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
74101	JK FLIP-FLOP	6 10	5-L	GND-7 VCC-14	14
74102	JK FLIP-FLOP	6 10	2-L	GND-7 VCC-14	14
74103	JK FLIP-FLOP	10 11 14 15	2-L 6-L	GND-11 VCC-4	14
74106	JK FLIP-FLOP	10 11 14 15	3-L 8-L	GND-13 VCC-5	16
74107	JK FLIP-FLOP	2 3 5 6	10-L 13-L	GND-7 VCC-14	14
74108	JK FLIP-FLOP	2 3 5 6	12-L	GND-7 VCC-14	14
74109	JK FLIP-FLOP	6 7 9 10	1-L 15-L	GND-8 VCC-16	16
74112	JK FLIP-FLOP	5 6 7 9	14-L 15-L	GND-8 VCC-16	16
74113	JK FLIP-FLOP	5 6 10 11	4-L 10-L	GND-7 VCC-14	14
74114	JK FLIP-FLOP	5 6 10 11	1-L	GND-7 VCC-14	14

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
74121	MULTIVIBRATOR	1 6		SEE NOTE #1	14
74122	MULTIVIBRATOR	6 10		SEE NOTE #1	14
74123	MULTIVIBRATOR	4 5 12 13		SEE NOTE #1	16
74128	NOR BUFFER	1 4 12 15			14
74132	SCHMITT TRIGGER	3 6 10 13			14
74133	NAND GATE	9			16
74135	XOR/NOR GATE	3 7 9 13			16
74138	DECODER	7 9 10 11 12 13 14 15			16
74139	DECODER	4 5 6 7 9 10 11 12			16
74147	ENCODER	6 7 9 14			16

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
74148	ENCODER	6 7 9 14 15			16
74151	MULTIPLEXER	5 6			16
74152	MULTIPLEXER	6			14
74153	MULTIPLEXER	7 9			16
74155	MULTIPLEXER	4 5 6 7 9 10 11 12			16
74157	MULTIPLEXER	4 7 9 12			16
74158	MULTIPLEXER	4 7 9 12			16
74160	COUNTER	11 12 13 14 15	1-L	GND-8 VCC-16	16
74161	COUNTER	11 12 13 14 15	1-L	GND-8 VCC-16	16
74162	COUNTER	11 12 13 14 15	1-L	GND-8 VCC-16	16

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
74163	COUNTER	11 12 13 14 15	1-L	GND-8 VCC-16	16
74164	REGISTER	3 4 5 6 12 13 14 15	9-L	GND-7 VCC-14	14
74165	REGISTER	7 9	1-L		16
74166	REGISTER	13	9-L	GND-8 VCC-16	16
74168	COUNTER	11 12 13 14 15	9-L	GND-8 VCC-16	16
74169	COUNTER	11 12 13 14 15	9-L	GND-8 VCC-16	16
74174	HEX D FLIP-FLOP	2 5 7 10 12 15	1-L	GND-8 VCC-16	16
74175	D FLIP-FLOP	2 3 6 7 10 11 14 15	1-L	GND-8 VCC-16	16
74190	COUNTER	2 3 6 7 12 13	11-L	GND-8 VCC-16	16
74191	COUNTER	2 3 6 7 12 13	11-L	GND--8 VCC-16	16

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
74192	COUNTER	2 3 6 7 12 13	14-H	GND-8 VCC-16	16
74193	COUNTER	2 3 6 7 12 13	14-H	GND-8 VCC-16	16
74194	REGISTER	12 13 14 15	1-L	GND-8 VCC-16	16
74195	REGISTER	11 12 13 14 15	1-L	GND-8 VCC-16	16
74196	COUNTER	2 5 11 14	13-L	GND-7 VCC-14	14
74197	COUNTER	2 5 11 14	13-L	GND-7 VCC-14	14
74221	MULTIVIBRATOR	4 5 12 13		SEE NOTE #1	16
74256	LATCH	4 5 6 7 9 10 11 12	14-H 15-L	GND-8 VCC-16	16
74259	LATCH	4 5 6 7 9 10 11 12	14-H 15-L	GND-8 VCC-16	16
74260	NOR GATE	5 6			14

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
74279	SR LATCH	4 7 9 13			16
74283	ADDER	1 4 9 10 13			16
74290	COUNTER	4 5 10 11	12-H 13-H	GND-7 VCC-14	14
74293	COUNTER	4 5 10 11	12-H 13-H	GND-7 VCC-14	14
74298	REGISTER	12 13 14 15			16
74375	LATCH	2 3 5 6 10 11 13 14	4-H 12-H	GND-8 VCC-16	16
74378	D FLIP-FLOP	2 5 7 10 12 15	1-L	GND-8 VCC-16	16
74379	D FLIP-FLOP	2 3 6 7 10 11 14 15	1-L	GND-8 VCC-16	16
74390	COUNTER	3 5 6 7 9 10 11 13	2-H 14-H	GND-8 VCC-16	16
74393	COUNTER	3 4 5 6 10 11 12 13	2-H 12-H	GND-7 VCC-14	14

I.C.	FUNCTION	SWITCH SETTINGS >COMP<	CLEAR	NOTES	PINS
74399	REGISTER	2 7 10 15			16
74490	COUNTER	3 5 6 7 9 10 11 13	2-H 14-H	GND-8 VCC-16	16

LIMITED
WARRANTY

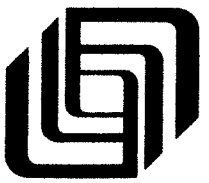
BUGTRAP INSTRUMENTATION warrants to the original purchaser that it's BUGTRAP Logic Comparator, and the component parts thereof, will be free from defects in workmanship and materials for a period of one year from the date of purchase.

In this period, BUGTRAP INSTRUMENTATION will, without charge, repair or replace, at it's option, defective BUGTRAP Logic Comparators or component parts.

Return entire unit, shipping prepaid and insured to:

BUGTRAP INSTRUMENTATION
1209 Alderwood Avenue
Sunnyvale, California 94089

Exclusions: This warranty does not apply in the event of improper use, abuse of the product or as a result of unauthorized alterations or repairs.



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