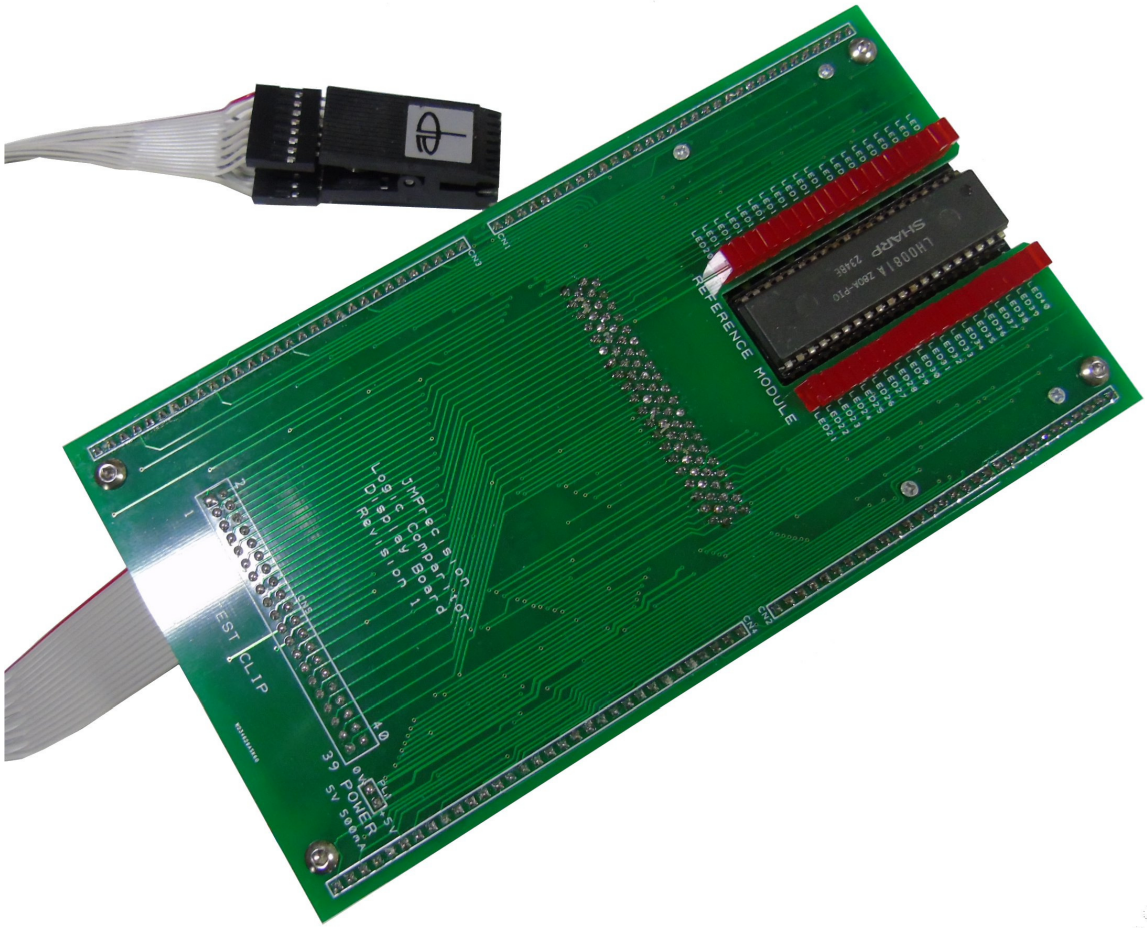
JMLC – 001

Logic Comparator

Assembly Instructions



Revision 1

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Introduction

The JMLC-001 Logic Comparator clips onto powered TTL or DTL ICs and detects functional failures by comparing the in-circuit test IC with a known good reference IC inserted in the Comparator.

Inputs of the particular IC to be tested are selected via solder jumpers on the module board which tell the Comparator which pins of the reference IC are inputs and which are outputs. Any logic state difference between the test IC and reference IC is identified to the specific pin(s) on dual in-line packages on the Comparator's display. A lighted LED corresponds to a logic difference. Intermittent errors as short as 100 nanoseconds are detected, and the error indication on the Comparator's display is stretched for a visual indication. A failure on an input pin, such as an internal short, will appear as a failure on the IC driving the failed IC; thus a failure indication actually pinpoints a malfunctioning node.

The logic comparator can also detect slow or out of tolerance conditions even if the device under test is actually switching. This can be very useful as faulty IC’s can be detected which a static IC tester may show as good.

The JMLC-001 can support IC’s up to 20 pins when a single comparator board is fitted or IC’s with up to 40 pins when two comparator boards are fitted.

Connection to the device under test can be made using what ever method you prefer but the recommended method is to use DIL test clips.

JMLC Specification

Power	+5V (max 300mA)
Maximum frequency	20MHz (see section on pulse detection)
Minimum pulse error detection	10nS (see section on pulse detection)

Parts List

Only bare pcbs are supplied along with the module board guides, mounting screws and module connector. The builder must source and purchase all other required components.
JMPrecision is not able to help with sourcing of parts and so only a generic parts list is provided.

The quantities shown in brackets are quantities when two comparator boards are to be fitted.
Although not shown in the parts list it is recommended that IC sockets are used for the comparator boards.

Display Board

Component	Qty
2 pin 90 degree header 2.54mm pitch	1
** 30 pin SIL 2.54mm pitch (height to suit board spacing)	1 (2)
** 32 pin SIL 2.54mm pitch (height to suit board spacing)	1 (2)
80 pin BBC micro connector	Included
40 pin 90 degree DIL Header 40 pin 2x20	1
LED Red 2x5x7 Pitch 2.54mm	20 (40)

Comparator Board

The following parts list is for a single comparator board.
If you are building two comparator boards then 2 sets of components will be needed.

Ref Name	Description
C11	* See Instructions below
C13	* See Instructions below
C15	* See Instructions below
C17	* See Instructions below
C19	* See Instructions below
C22	* See Instructions below
C24	* See Instructions below
C26	* See Instructions below
C27	* See Instructions below
C30	* See Instructions below
C32	* See Instructions below
C34	* See Instructions below
C35	* See Instructions below
C38	* See Instructions below
C40	* See Instructions below
C42	* See Instructions below
C43	* See Instructions below
C46	* See Instructions below
C48	* See Instructions below
C50	* See Instructions below

C12	1uF 50V 20% 2.54mm pitch ceramic
C14	1uF 50V 20% 2.54mm pitch ceramic
C16	1uF 50V 20% 2.54mm pitch ceramic
C18	1uF 50V 20% 2.54mm pitch ceramic
C20	1uF 50V 20% 2.54mm pitch ceramic
C21	1uF 50V 20% 2.54mm pitch ceramic
C23	1uF 50V 20% 2.54mm pitch ceramic
C25	1uF 50V 20% 2.54mm pitch ceramic
C28	1uF 50V 20% 2.54mm pitch ceramic
C29	1uF 50V 20% 2.54mm pitch ceramic
C31	1uF 50V 20% 2.54mm pitch ceramic
C33	1uF 50V 20% 2.54mm pitch ceramic
C36	1uF 50V 20% 2.54mm pitch ceramic
C37	1uF 50V 20% 2.54mm pitch ceramic
C39	1uF 50V 20% 2.54mm pitch ceramic
C41	1uF 50V 20% 2.54mm pitch ceramic
C44	1uF 50V 20% 2.54mm pitch ceramic
C45	1uF 50V 20% 2.54mm pitch ceramic
C47	1uF 50V 20% 2.54mm pitch ceramic
C49	1uF 50V 20% 2.54mm pitch ceramic
U2	IC 74ls02
U5	IC 74ls02
U8	IC 74ls02
U11	IC 74ls02
U14	IC 74ls02
U3	IC 74ls04
U6	IC 74ls04
U9	IC 74ls04
U12	IC 74ls04
U15	IC 74ls04
U1	IC 74ls86
U4	IC 74ls86
U7	IC 74ls86
U10	IC 74ls86
U13	IC 74ls86
C1	Capacitor 100n 50V -20/+80% 2.54 pitch
C2	Capacitor 100n 50V -20/+80% 2.54 pitch
C3	Capacitor 100n 50V -20/+80% 2.54 pitch
C4	Capacitor 100n 50V -20/+80% 2.54 pitch
C5	Capacitor 100n 50V -20/+80% 2.54 pitch
C6	Capacitor 100n 50V -20/+80% 2.54 pitch
C7	Capacitor 100n 50V -20/+80% 2.54 pitch
C8	Capacitor 100n 50V -20/+80% 2.54 pitch
C9	Capacitor 100n 50V -20/+80% 2.54 pitch
C10	Capacitor 100n 50V -20/+80% 2.54 pitch
R1	Resistor 10k 1/8W
R4	Resistor 10k 1/8W
R7	Resistor 10k 1/8W
R10	Resistor 10k 1/8W
R14	Resistor 10k 1/8W
R16	Resistor 10k 1/8W
R19	Resistor 10k 1/8W

R22	Resistor 10k 1/8W
R26	Resistor 10k 1/8W
R28	Resistor 10k 1/8W
R31	Resistor 10k 1/8W
R34	Resistor 10k 1/8W
R38	Resistor 10k 1/8W
R40	Resistor 10k 1/8W
R43	Resistor 10k 1/8W
R46	Resistor 10k 1/8W
R50	Resistor 10k 1/8W
R52	Resistor 10k 1/8W
R55	Resistor 10k 1/8W
R58	Resistor 10k 1/8W
R2	Resistor 470R 1/8W
R5	Resistor 470R 1/8W
R8	Resistor 470R 1/8W
R11	Resistor 470R 1/8W
R15	Resistor 470R 1/8W
R17	Resistor 470R 1/8W
R20	Resistor 470R 1/8W
R23	Resistor 470R 1/8W
R27	Resistor 470R 1/8W
R29	Resistor 470R 1/8W
R32	Resistor 470R 1/8W
R35	Resistor 470R 1/8W
R39	Resistor 470R 1/8W
R41	Resistor 470R 1/8W
R44	Resistor 470R 1/8W
R47	Resistor 470R 1/8W
R51	Resistor 470R 1/8W
R53	Resistor 470R 1/8W
R56	Resistor 470R 1/8W
R59	Resistor 470R 1/8W
R3	Resistor 68k 1/8W
R6	Resistor 68k 1/8W
R9	Resistor 68k 1/8W
R12	Resistor 68k 1/8W
R13	Resistor 68k 1/8W
R18	Resistor 68k 1/8W
R21	Resistor 68k 1/8W
R24	Resistor 68k 1/8W
R25	Resistor 68k 1/8W
R30	Resistor 68k 1/8W
R33	Resistor 68k 1/8W
R36	Resistor 68k 1/8W
R37	Resistor 68k 1/8W
R42	Resistor 68k 1/8W
R45	Resistor 68k 1/8W
R48	Resistor 68k 1/8W
R49	Resistor 68k 1/8W
R54	Resistor 68k 1/8W
R57	Resistor 68k 1/8W

R60	Resistor 68k 1/8W
ZD1	Zenner Diode 3.3V
ZD2	Zenner Diode 3.3V
ZD3	Zenner Diode 3.3V
ZD4	Zenner Diode 3.3V
ZD5	Zenner Diode 3.3V
ZD6	Zenner Diode 3.3V
ZD7	Zenner Diode 3.3V
ZD8	Zenner Diode 3.3V
ZD9	Zenner Diode 3.3V
ZD10	Zenner Diode 3.3V
ZD11	Zenner Diode 3.3V
ZD12	Zenner Diode 3.3V
ZD13	Zenner Diode 3.3V
ZD14	Zenner Diode 3.3V
ZD15	Zenner Diode 3.3V
ZD16	Zenner Diode 3.3V
ZD17	Zenner Diode 3.3V
ZD18	Zenner Diode 3.3V
ZD19	Zenner Diode 3.3V
ZD20	Zenner Diode 3.3V
CN1	** 32 pin SIL 2.54mm pitch (height to suit board spacing)
CN2	** 30 pin SIL 2.54mm pitch (height to suit board spacing)

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The value used for these components will depend on your requirements for the comparator performance.
The smaller the capacitor value then the higher frequency the comparator will work to but it will be more prone to displaying errors due to slow switching speeds.
Larger values will reduce allow for slower device under test switching speeds without showing errors but will reduce the maximum useable frequency.
If you require the comparator to detect slow device under test switching speeds or high frequency operation then select a lower value capacitor value otherwise select a higher value.
As a general guide:
A value of 470pF will allow use up to 20MHz (test lead dependant) but will show switching speeds of longer than 10nS as errors.
A value of 1nF will reduce the maximum useable frequency to 8MHz but will then allow switching speeds up to 40nS without showing errors.
I recommend a value of 1nF for these capacitors (2.54mm pitch ceramic).

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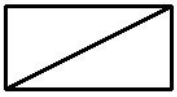
The connectors used here will depend on the board spacing that you require and this will depend if sockets were used for the comparator board IC's.
You should select sockets and headers to give the required spacing and it is up to personal preference which boards have the sockets or pins.

Do not start assembly until all parts have been checked, all replacement parts will only be supplied at cost.

Resistor Identification

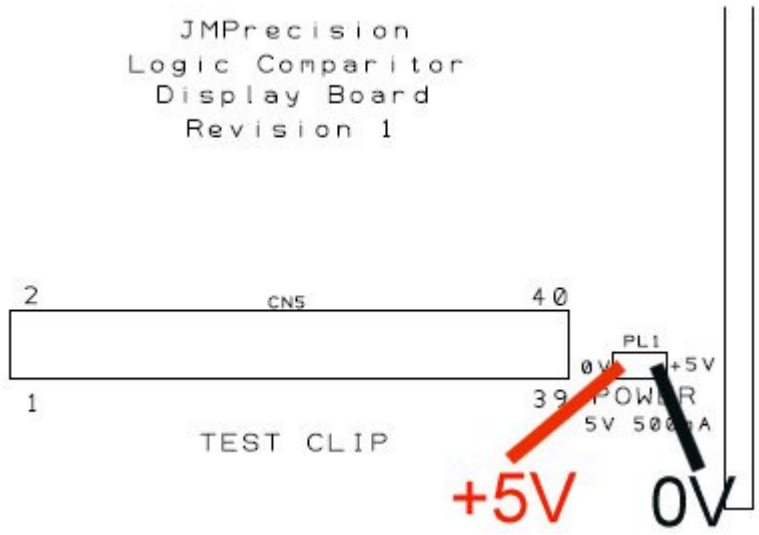
To simplify the build process and hopefully minimise the possibility of errors the resistors are identified on the boards by using unique pcb silk screen identifiers.
The silk screen therefore has different symbols for each resistor value and these are shown in the table below.
When assembling the boards you simply need to insert resistors of the correct value into each location with the matching symbol. There is no need to constantly refer to the board overlay when inserting these parts.

Board Symbol	Colour Code	Value
		68k
		470R
		10k

IMPORTANT
Applies only to Revision 1 boards

ERROR ON SILK SCREEN

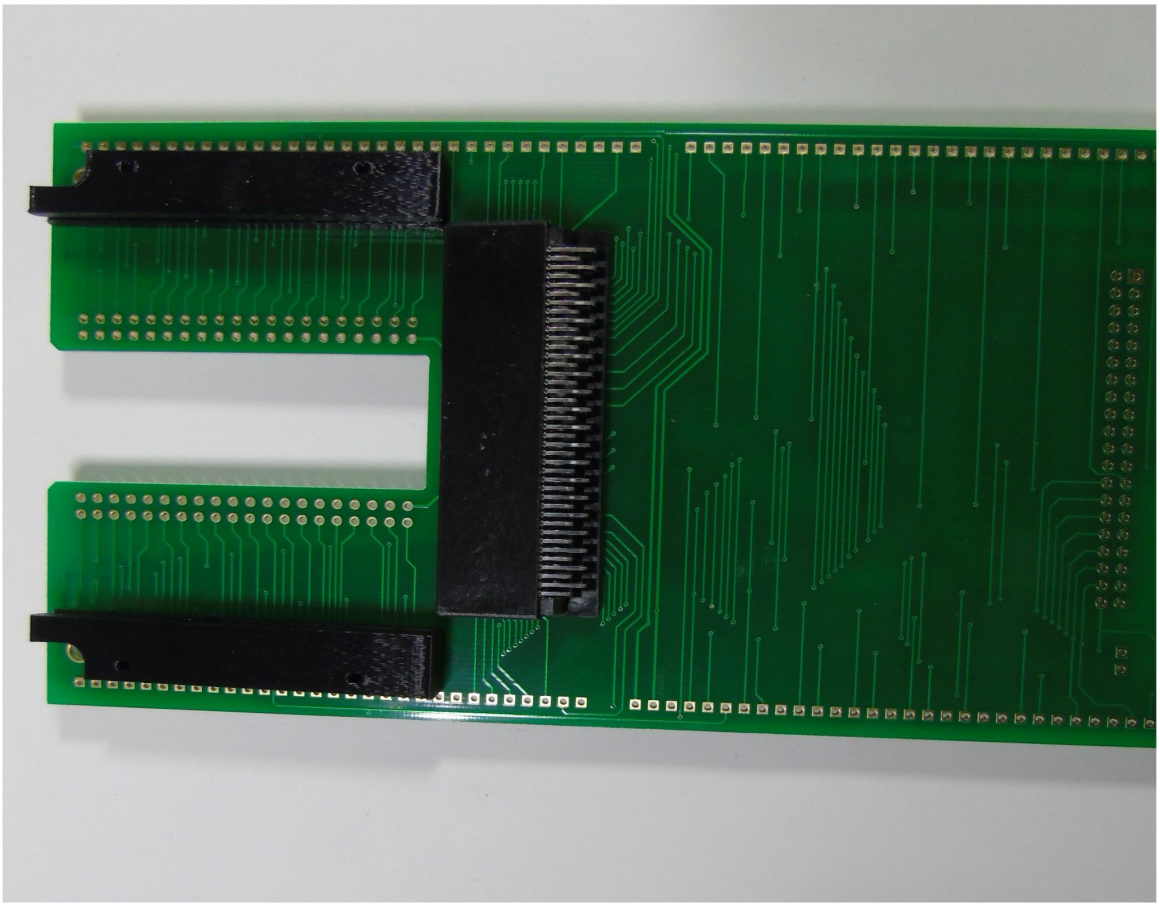
There is an error on the display board silk screen.
The power supply polarity is indicated incorrectly.
Power should be applied as shown in the image below and NOT as shown on the silk screen
Connecting power as shown on the silk screen will result in damage to the boards.



Assembling the Display board

Step 1)
Attach the 2 module board guides to the underside of the display pcb as shown in the image below using the supplied screws.
DO NOT OVER TIGHTEN THE SCREWS.

Note the orientation of the guides.
The two guides are NOT the same and the guide with the step in the slot should be fixed on the right side of the display board cut out when viewed from the top of the display board.



Step 2)
Install the module board connector to the underside of the display board as shown in the image above.
It is advisable to it a bare module board into the guides and into the connector before soldering the connector to the display board to ensure that they all align correctly.
Be sure to push the connector fully against the display board before soldering it into place.

Step 3)
Install the LED's
If a single comparator board is to be used then fit the first 10 LED's on each side at the top of the display board cut out.
The +ve terminal of each LED should be inserted into the hole closest to the display board cut out.

Step 4)
Install the 2 pin power supply connector socket
(NOTE THE SILK SCREEN ERROR ON THE PREVIOUS PAGE).

This connector can be fitted either on top of the display pcb or on the underside depending on preference.

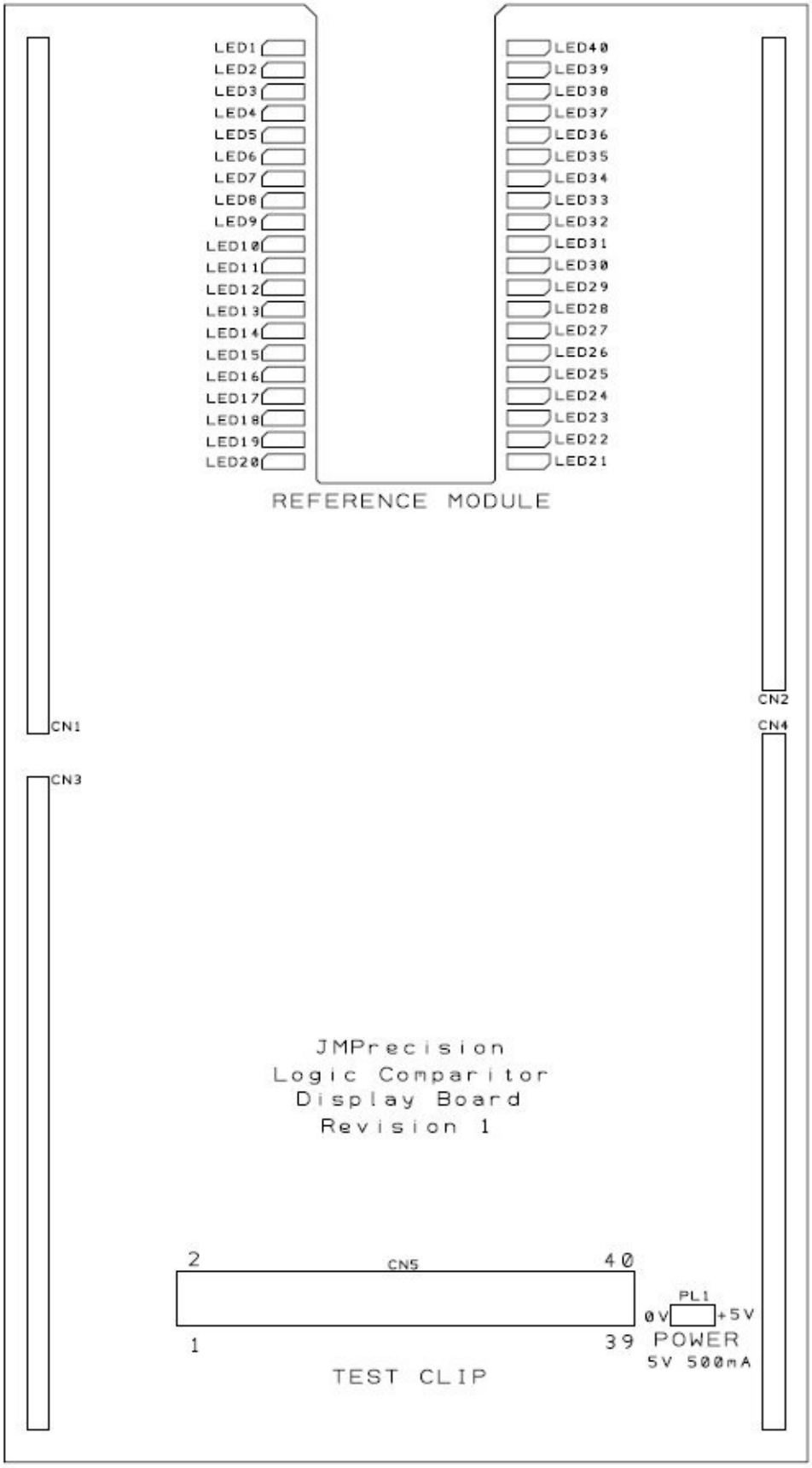
Step 5)
Install the 40 pin test lead connector socket.

This connector can be fitted either on top of the display pcb or on the underside depending on preference.

Step 6)

Install the 30 pin and 32 pin board to board connector on the underside of the display board.
Be sure to select suitable connectors to allow the required board spacing.

Display Board



Assembling the Comparator board

Step 1)
Fit all the resistors to the board ensuring that they are in the correct locations.
It is advisable to prepare and fit all the resistors of each value in turn to avoid any errors. See the resistor identification chart shown earlier.

Step 2)
Fit all the capacitors.
See the diagram below which shows where each capacitor should be fitted.
You should select the required comparator timing capacitor values as described previously.

Step 3)
Fit all the zenner diodes noting their polarity.

Step 4)
Fit all the IC's as indicated in the image below.
It is recommended that IC sockets are used unless you want a lower profile tester.

Step 5)
Install the 30 pin and 32 pin board to board connector on the top side of the comparator board.
Be sure to select suitable connectors to allow the required board spacing.
Note that if you are fitting 2 comparator boards then the height of the connectors will be different for each board.

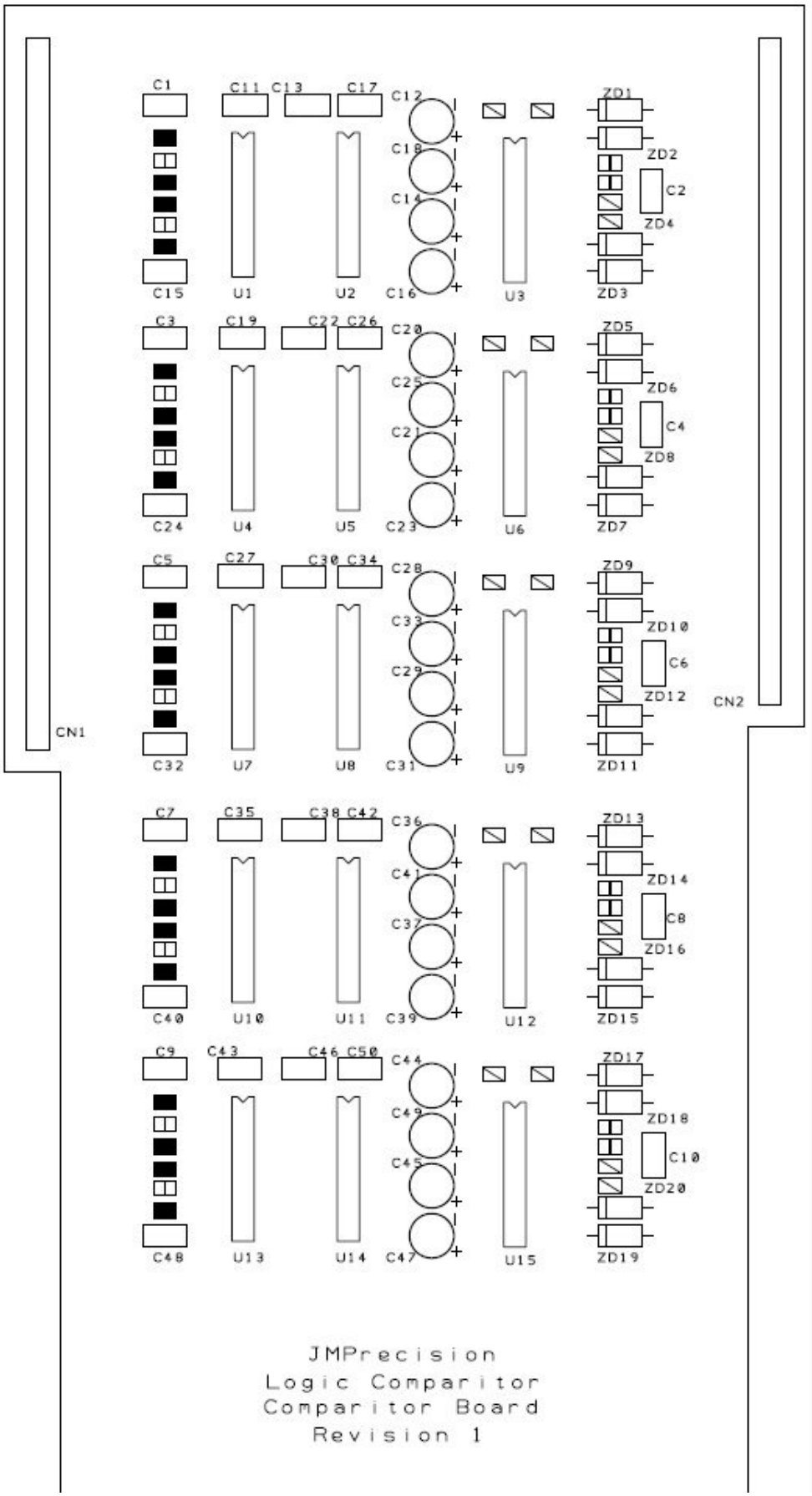
Final assembly.

Plug the first comparator board into the Display board connectors. The first comparator board should be fitted so that it connects to the upper display board connectors.

If used then plug the second comparator board into the Display board connectors. The second comparator board should be fitted so that it connects to the lower display board connectors.

Use suitable M3 screws and spacers to hold all 3 boards together.

Comparator Board



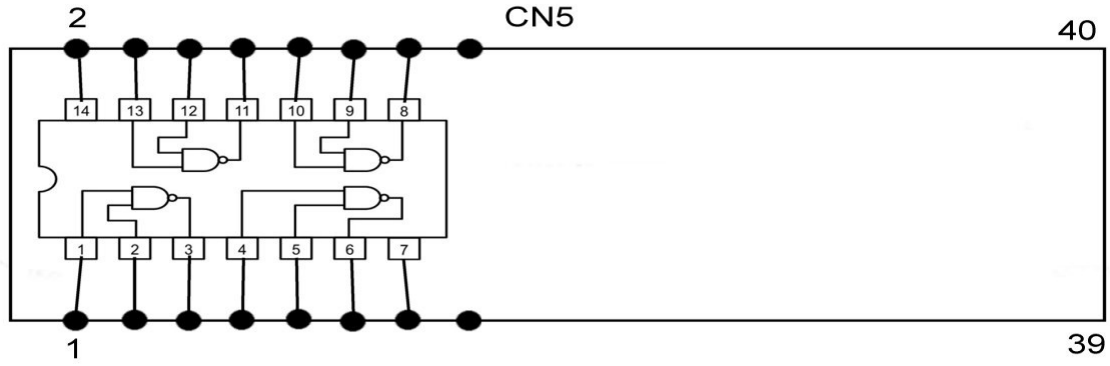
Principle of operation

The 40 LED's are error indicators which are used to indicate the status of a comparison between the input and output conditions of a reference IC and an IC that is under test. Should there be a mismatch between the reference IC and the unit under test IC then the LED(s) associated with the pins which do not match is illuminated indicating a possibly faulty IC.

The logic comparator is dynamic in nature and so can detect errors which static IC testers would miss.
The exact error timing will depend on the values selected for the timing capacitors as described earlier but essentially if an output on the IC under test does not reach the same state as the matching pin on the reference IC within a fixed time limit then the LED associated with that pin will be illuminated.
To allow the detection of short duration errors the outputs of the error comparators are stretched to 70 mS and this gives a clearly visible error indication.
Errors which are of shorter duration than the limit set by the timing capacitor values are deemed to be spurious and are ignored.

Operating Instructions

To use the logic comparator you must first prepare a test module as described in the following section.
The required test module is inserted into the module guides and into connector socket.
Note that the module pcb is not symmetrical so cannot be inserted incorrectly.
A suitable test cable is then connected to the comparator test connector and the other end of this test cable is connected to the device which is to be tested.
It is advised that DIL test clips are used for this purpose.
When making up test leads it should be noted that the pins on the 40 way test cable connector are arranged in the same way as the pins on a DIL IC package.
So pins 1,2,3 etc are connected to pins 1,2,3 etc of the IC to be tested and pins 40,39,38 etc are connected to the pins on the opposite side of the IC package.
The pin numbers will depend on the number of pins on the IC.
See the image below for an example



TEST CLIP

Test Module Configuration

In order to test a particular IC a test module must be configured.
To configure a test module then the solder jumpers for all pins which are inputs should be shorted and also the power pins (0V and VDD).
Leave all jumpers for pins which are outputs open.

Because many logic IC's share common pin out configurations then often a single test module can be used for more than one type of IC without changing the jumper settings so it is best to fit IC sockets to the test modules rather than soldering the test IC directly to the module.

The appropriate IC type can then be fitted to the test module.
The image below shows an example configuration.

This module is configured for testing 74LS00 devices.
Note the shorted jumpers for all the inputs and power pins.
The label shows other devices with the same pin configuration which can also be used with this same module configuration.

It is beyond the scope of this guide to provide detailed fault finding instructions but the comparator can be used for many different types of testing and fault finding.