LOGIC PROBE KIT

MODEL LP-525K

Assembly and Instruction Manual

Elenco™ Electronics, Inc.

 REV-F Revised 2003 753241

PARTS LIST

If you are a student, and any parts are missing or damaged, please see instructor or bookstore.

If you purchased this LP-525K Logic Probe kit from a distributor, catalog, etc., please contact Elenco™ Electronics (address/phone/e-mail is at the back of this manual) for additional assistance, if needed.

RESISTORS

Qty.	Symbol	Description	Color Code	Part #
☐ 3	R21, R23, R24	200Ω 5% 1/4W	red-black-brown-gold	132000
☐ 1	R16	2kΩ 5% 1/4W	red-black-red-gold	142000
☐ 1	R4	4.7kΩ 5% 1/4W	yellow-violet-red-gold	144700
☐ 1	R14	5.1kΩ 5% 1/4W	green-brown-red-gold	145100
☐ 1	R11	15kΩ 5% 1/4W	brown-green-orange-gold	151500
☐ 1	R13	18kΩ 5% 1/4W	brown-gray-orange-gold	151800
☐ 2	R10, R15	20kΩ 5% 1/4W	red-black-orange-gold	152000
☐ 2	R12, R22	30kΩ 5% 1/4W	orange-black-orange-gold	153000
☐ 7	R1, R5 - R8, R19, R20	100kΩ 5% 1/4W	brown-black-yellow-gold	161000
☐ 1	R17	120kΩ 5% 1/4W	brown-red-yellow-gold	161200
☐ 1	R18	150kΩ 5% 1/4W	brown-green-yellow-gold	161500
☐ 3	R2, R3, R9	4.7MΩ 5% 1/4W	yellow-violet-green-gold	174700

CAPACITORS

Qty.	Symbol	Description	Part #	Qty.	Symbol	Description	Part #
☐ 1	C2	100pF (101) Discap	221017	☐ 1	C4	.005μF (502) Discap	235018
☐ 1	C3	200pF (201) Discap	222010	☐ 1	C5	.047μF (473) Discap	244780
☐ 2	C1, C6	.001μF (102) Discap	231036	☐ 1	C7	.1μF (104) Discap	251010

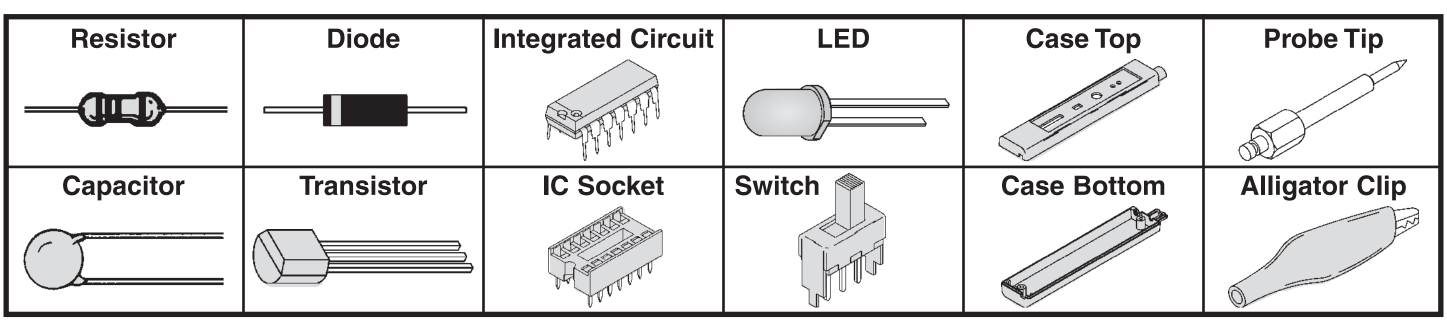
SEMICONDUCTORS

Qty.	Symbol	Description	Part #	Qty.	Symbol	Description	Part #
☐ 1	D6	1N4002 Diode	314002	☐ 3	Q1, 3, 5	2N3906 Transistor	323906
☐ 5	D1 - D5	1N4148 Diode	314148	☐ 1	U1	LM2901 IC	332901
☐ 2	Q2, Q4	2N3904 Transistor	323904	☐ 3	L1 - L3	LED	350001

MISCELLANEOUS

Qty.	Description	Part #	Qty.	Description	Part #
☐ 1	PC Board	517014	☐ 1	Label Front	724002
☐ 2	Switch SPDT	541024	☐ 1	Label Back	724003
☐ 1	Probe Tip	616001	☐ 1	Wire 1.5”	814220
☐ 1	Case	623005	☐ 3’	Wire 2 cond.	870500
☐ 2	Screw #4 x 5/8”	643450	☐ 3”	Tubing #20	890020
☐ 1	IC Socket 14-pin	664014	☐ 1”	Shrink Tubing (red)	890312
☐ 1	Alligator Clip Black	680001	☐ 1	Solder Tube	9ST4
☐ 1	Alligator Clip Red	680002			

PARTS IDENTIFICATION



IDENTIFYING RESISTOR VALUES

Use the following information as a guide in properly identifying the value of resistors.

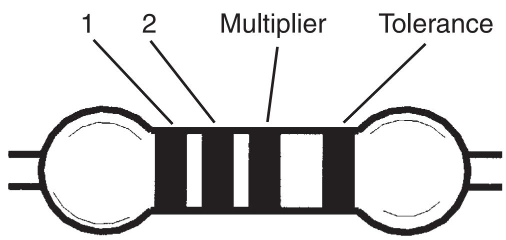
BAND 1 1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

BAND 2 2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Multiplier	
Color	Multiplier
Black	1
Brown	10
Red	100
Orange	1,000
Yellow	10,000
Green	100,000
Blue	1,000,000
Silver	0.01
Gold	0.1

Resistance Tolerance	
Color	Tolerance
Silver	±10%
Gold	±5%
Brown	±1%
Red	±2%
Orange	±3%
Green	±.5%
Blue	±.25%
Violet	±.1%

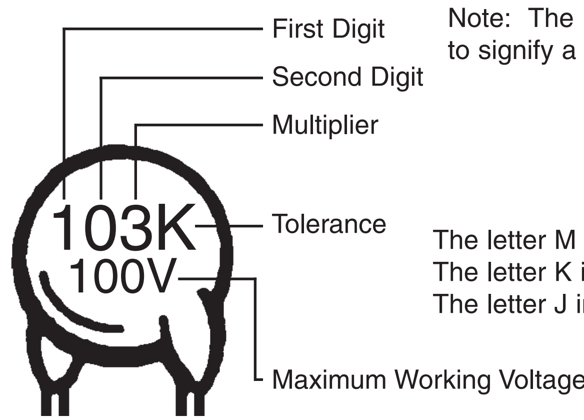
BANDS



IDENTIFYING CAPACITOR VALUES

Capacitors will be identified by their capacitance value in pF (picofarads), nF (nanofarads), or μF (microfarads). Most capacitors will have their actual value printed on them. Some capacitors may have their value printed in the following manner. The maximum operating voltage may also be printed on the capacitor.

Multiplier	For the No.	0	1	2	3	4	5	8	9
	Multiply By	1	10	100	1k	10k	100k	.01	0.1



Note: The letter "R" may be used at times to signify a decimal point; as in 3R3 = 3.3

The letter M indicates a tolerance of ±20%
The letter K indicates a tolerance of ±10%
The letter J indicates a tolerance of ±5%

The value is 10 x 1,000 = 10,000pF or .01μF 100V

METRIC UNITS AND CONVERSIONS

Abbreviation	**Means**	**Multiply Unit By**	**Or**
p	Pico	.000000000001	10^{-12}
n	nano	.000000001	10^{-9}
μ	micro	.000001	10^{-6}
m	milli	.001	10^{-3}
–	unit	1	10^{0}
k	kilo	1,000	10^{3}
M	mega	1,000,000	10^{6}

1. 1,000 pico units = 1 nano unit
2. 1,000 nano units = 1 micro unit
3. 1,000 micro units = 1 milli unit
4. 1,000 milli units = 1 unit
5. 1,000 units = 1 kilo unit
6. 1,000 kilo units = 1 mega unit

CIRCUIT DESCRIPTION

The Elenco™ Model LP-525K Logic Probe kit is a convenient and precise instrument for use in the measurement of logic circuits. It displays logic levels (high or low), and voltage transients down to 25 nanoseconds. The LED readouts provide instant response to the logic state.

To detect the high and low logic levels, the LP-525 uses two comparators of a Quad Comparator LM2901 Integrated Circuit (see schematic diagram). One comparator drives the HI LED and the other drives the LOW LED. The comparator output goes low, lighting the LED, when the (–) input is more positive than the (+) input. To measure TTL circuits, the TTL-CMOS switch is set to TTL and the red and black alligator clips are connected to +5VDC and ground. The (+) input (pin 5) of the HI comparator is then biased to 2.3VDC by resistor network R9 through R15. Thus, the LED lights when the probe tip is more positive than 2.3VDC. To measure CMOS circuits, the HI comparator changes to 3.5VDC or 70% of the supply voltage.

The (–) input of the LOW comparator is biased to .8VDC for TTL operation and 1.5VDC or 30% of the supply voltage for CMOS operation. The LOW LED thus lights when the probe tip is connected to voltages less than .8 or 1.5VDC.

The pulse LED is controlled by a bipolar edge detector circuit which responds to both positive and negative transients. This circuit is made up of capacitors C2 and C3, transistors Q1 through Q4, and the associated resistors. When the circuit is activated by pulses as short as 25 nanoseconds, a negative pulse is applied to the (+) input (pin 11) of the pulse stretcher comparator. The comparator then turns on and is held by the feedback resistor R8. The ground level on the output (pin 13) causes C5 to discharge through R17. In approximately 1.5 milliseconds, the voltage on the (–) input (pin 10) becomes more negative than the (+) input and the comparator turns off. The short pulse on the input is thus stretched to 1.5 milliseconds.

The (–) input (pin 8) of the PULSE LED driver is biased to +2.5VDC by resistors R19 and R20. The (+) input is biased to +3VDC by resistors R6 and R18. The 1.5 milliseconds pulse from the pulse stretcher grounds the (+) input through diode D5 turning the comparator on and lighting the PULSE LED. When the PULSE-MEM switch is in MEM, Q5 is also turned on, causing the (–) input of the comparator to go to +5VDC. This keeps the comparator on even after the (+) input returns to +3VDC. When the PULSE-MEM switch is in PULSE, the feedback path to the (–) input is broken and the LED is lit only for the duration of the 1.5 milliseconds pulse.

Thus, each time the input signal changes state, the PULSE LED is activated for 1.5 milliseconds. When observing low frequency signals, the PULSE LED provides an immediate indication of this pulse activity. By observing the HI and LOW LEDs, the polarity of the pulse train can be determined. Low frequencies cause the PULSE LED to blink once for each transition. High frequencies cause the LED to flash at a rate that makes it appear to be on continuously. When the PULSE-MEM switch is in MEM, a single input pulse will cause the PULSE LED to come on and stay on until the switch is returned to the PULSE position.

The input impedance of the LP-525 is 1MΩ. This eliminates any loading effect on the circuit under test.

CAUTION: Do not connect the alligator clips to any AC power source or to a DC power source greater than 35VDC. Failure to comply with this warning may result in damage to this instrument.

SPECIFICATIONS

Input Impedance	1MΩ	
Input Overload Protection	50V DC continuous	
Thresholds	Logic 1	Logic 0
TTL	2.3 $\pm$ .25V	0.80V $\pm$ .1V
CMOS	70% Vcc	30% Vcc
Response better than	25 nanoseconds	
Pulse Detector	1.5 millisecond pulse stretcher	
Power Requirements	5V Vcc @ 30mA	
	15V Vcc @ 40mA	
Operating Temperature	–40°C to +85°C	

CONSTRUCTION

Introduction

The most important factor in assembling your LP-525K Logic Probe Kit is good soldering techniques. Using the proper soldering iron is of prime importance. A small pencil type soldering iron of 25 - 40 watts is recommended. **The tip of the iron must be kept clean at all times and well tinned.**

Safety Procedures

- Wear eye protection when soldering.
- Locate soldering iron in an area where you do not have to go around it or reach over it.
- **Do not hold solder in your mouth.** Solder contains lead and is a toxic substance. Wash your hands thoroughly after handling solder.
- Be sure that there is adequate ventilation present.

Assemble Components

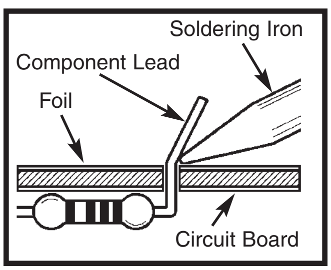
In all of the following assembly steps, the components must be installed on the top side of the PC board unless otherwise indicated. The top legend shows where each component goes. The leads pass through the corresponding holes in the board and are soldered on the foil side.
Use only rosin core solder of 63/37 alloy.

DO NOT USE ACID CORE SOLDER!

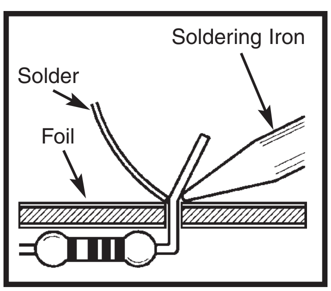
What Good Soldering Looks Like

A good solder connection should be bright, shiny, smooth, and uniformly flowed over all surfaces.

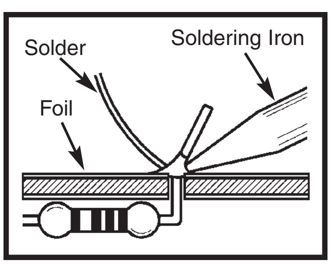
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



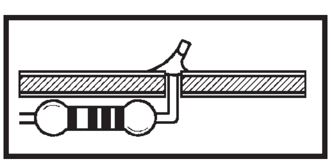
2. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and the circuit foil to melt the solder.



3. Allow the solder to flow around the connection. Then, remove the solder and the iron and let the connection cool. The solder should have flowed smoothly and not lump around the wire lead.

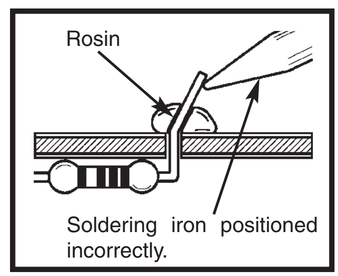


4. Here is what a good solder connection looks like.

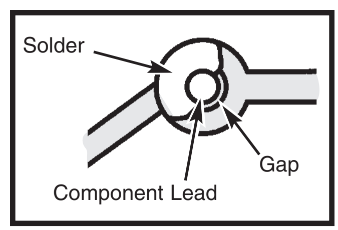


Types of Poor Soldering Connections

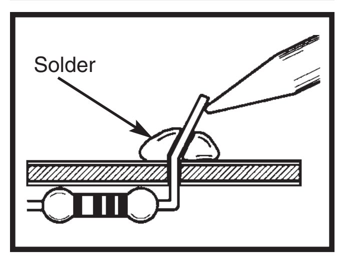
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



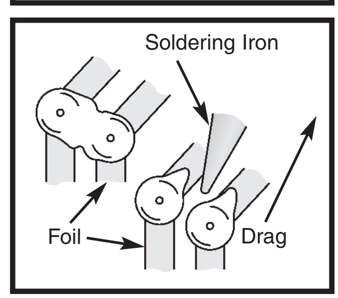
2. **Insufficient solder** - let the solder flow over the connection until it is covered. Use just enough solder to cover the connection.



3. **Excessive solder** - could make connections that you did not intend to between adjacent foil areas or terminals.



4. **Solder bridges** - occur when solder runs between circuit paths and creates a short circuit. This is usually caused by using too much solder. To correct this, simply drag your soldering iron across the solder bridge as shown.



ASSEMBLE COMPONENTS TO THE PC BOARD

Refer to the top legend on the PC board, install and solder the following resistors.

Stand resistor on end when called for.

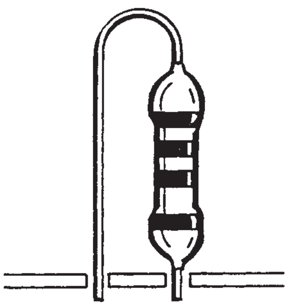
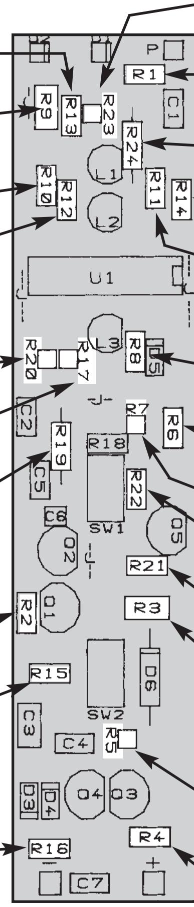


Figure 1

- ☐ R13 - 18kΩ Resistor (brown-gray-orange-gold)
- ☐ R9 - 4.7MΩ Resistor (yellow-violet-green-gold)
- ☐ R10 - 20kΩ Resistor (red-black-orange-gold)
- ☐ R12 - 30kΩ Resistor (orange-black-orange-gold)
- ☐ R20 - 100kΩ Resistor (brown-black-yellow-gold) (see Figure 1)
- ☐ R17 - 120kΩ Resistor (brown-red-yellow-gold) (see Figure 1)
- ☐ R19 - 100kΩ Resistor (brown-black-yellow-gold)
- ☐ R2 - 4.7MΩ Resistor (yellow-violet-green-gold)
- ☐ R15 - 20kΩ Resistor (red-black-orange-gold)
- ☐ R16 - 2kΩ Resistor (red-black-red-gold)



- ☐ R23 - 200Ω Resistor (red-black-brown-gold) (see Figure 1)
- ☐ R1 - 100kΩ Resistor (brown-black-yellow-gold)
- ☐ R24 - 200Ω Resistor (red-black-brown-gold)
- ☐ R14 - 5.1kΩ Resistor (green-brown-red-gold)
- ☐ R11 - 15kΩ Resistor (brown-green-orange-gold)
- ☐ R8 - 100kΩ Resistor (brown-black-yellow-gold)
- ☐ R6 - 100kΩ Resistor (brown-black-yellow-gold)
- ☐ R7 - 100kΩ Resistor (brown-black-yellow-gold) (see Figure 1)
- ☐ R22 - 30kΩ Resistor (orange-black-orange-gold)
- ☐ R21- 200Ω Resistor (red-black-brown-gold)
- ☐ R3 - 4.7MΩ Resistor (yellow-violet-green-gold)
- ☐ R5 - 100kΩ Resistor (brown-black-yellow-gold) (see Figure 1)
- ☐ R4 - 4.7kΩ Resistor (yellow-violet-red-gold)

Save 5 discarded leads for jumper wires.

ASSEMBLE COMPONENTS TO THE PC BOARD

Refer to the top legend on the PC board, install and solder the following diodes, capacitors and jumper wires.

When mounting diodes vertically, mount as indicated by band. (Diodes have polarity).

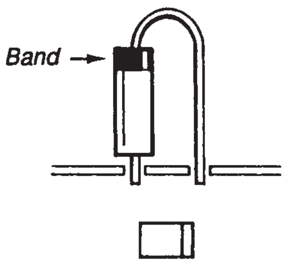


Figure 2

Form jumper wire from discarded resistor lead.

Figure 3

When mounting diodes horizontally, mount as indicated by the band. (Diodes have polarity).

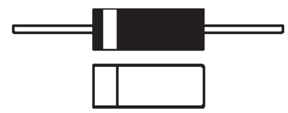
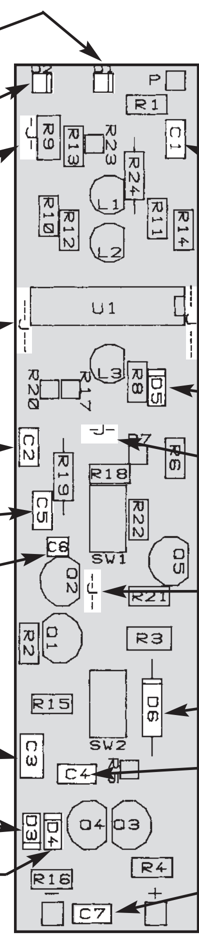


Figure 4

- ☐ D1 - 1N4148 Diode (see Figure 2)
- ☐ D2 - 1N4148 Diode (see Figure 2)
- ☐ J - Jumper Wire (see Figure 3)
- ☐ J - Jumper Wire (see Figure 3)
- ☐ C2 - 100pF Capacitor (May be marked 101)
- ☐ C5 - .047μF Capacitor (May marked 473)
- ☐ C6 - .001μF Capacitor (May be marked 102)
- ☐ C3 - 200pF Capacitor (May be marked 201)
- ☐ D3 - 1N4148 Diode (see Figure 4)
- ☐ D4 - 1N4148 Diode (see Figure 4)



- ☐ C1 - .001μF Capacitor (May be marked 102)
- ☐ J - Jumper Wire (see Figure 3)
- ☐ D5 - 1N4148 Diode (see Figure 4)
- ☐ J - Jumper Wire (see Figure 3)
- ☐ J - Jumper Wire (see Figure 3)
- ☐ D6 - 1N4002 Diode (see Figure 4)
- ☐ C4 - .005μF Capacitor (May be marked 502)
- ☐ C7 - .1μF Capacitor (May be marked 104)

ASSEMBLE COMPONENTS TO THE PC BOARD

Refer to the top legend on the PC board, install and solder the following components.

Insert the IC socket into the PC board with the notch in the direction shown on the top legend. Solder the IC socket into place. Insert the IC into the socket with the notch in the same direction as the notch on the socket.

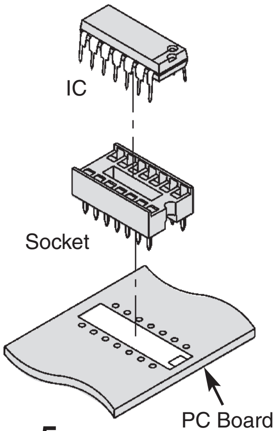


Figure 5

Mount the transistor with the flat side in the direction shown on the top legend. Leave 1/4” between the part and PC board.

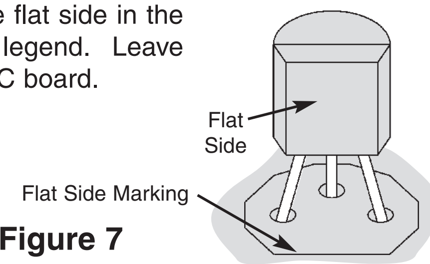


Figure 7

Cut a 3/8” piece of tubing for each LED lead, to be used as stand-offs. Mount the LED with the flat side in the direction shown on the top legend.

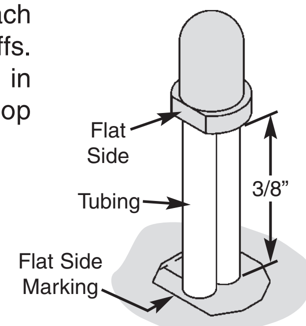


Figure 8

Before installing, snip off the tabs. Mount the switch so that the legs are touching the PC board.

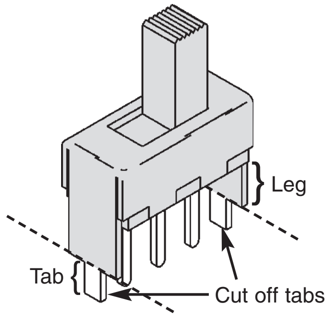
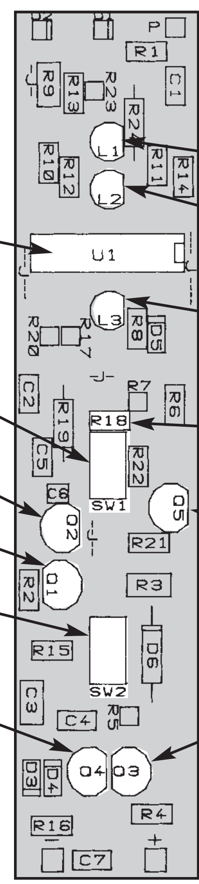


Figure 6

- ☐ U1 - 14-pin IC Socket
- ☐ U1 - LM2901 IC (see Figure 5)
- ☐ SW1 - Switch (see Figure 6)
- ☐ Q2 - 2N3904 Transistor (see Figure 7)
- ☐ Q1 - 2N3906 Transistor (see Figure 7)
- ☐ SW2 - Switch (see Figure 6)
- ☐ Q4 - 2N3904 Transistor (see Figure 7)



- ☐ L1 - LED (see Figure 8)
- ☐ L2 - LED (see Figure 8)
- ☐ L3 - LED (see Figure 8)
- ☐ R18 - 150kΩ Resistor (brown-green-yellow-gold) Install SW1 first.
- ☐ Q5 - 2N3906 Transistor (see Figure 7)
- ☐ Q3 - 2N3906 Transistor (see Figure 7)

☐ Install the power cord as shown in Figure 9. Pull the power cord wires apart about 2 inches on one end. Strip the insulation off of both wires to expose 1/4” of bare wire. Note that one wire is ribbed on the edge. Solder the red alligator clip to the ribbed wire. Solder the black clip to the round wire. On the other side of the power cord, pull the wires apart 1/2”. Strip 1/4” of insulation off of both wires. Make a knot to serve as a strain relief (about 1 inch from the end). Solder the ribbed wire to hole marked “+” and the round wire to the hole marked “–” (see Figure 10).

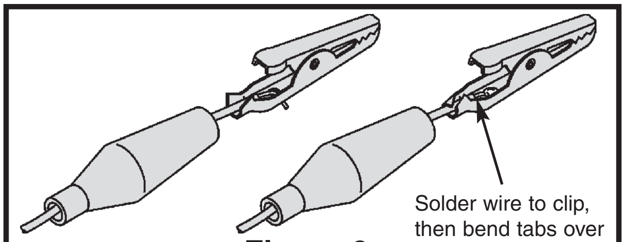


Figure 9

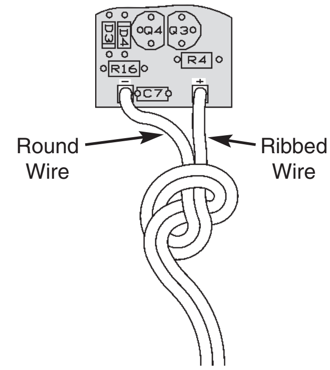


Figure 10

☐ Install the probe tip as shown in Figure 11. Using the 1 1/2” wire, strip 1/4” of insulation off of both ends. Solder one end to point P on the PC board. Solder the other end of the wire to the probe tip groove.

☐ Install the two labels to the case, as shown in Figure 12. Be careful to place the labels on neatly and correctly. Peal the backing off to expose the glue.

☐ Place the PC board assembly into the case as shown in Figure 12. Use two #4 screws to hold the case together. **Do not over-tighten** or the holes may strip out.

☐ Cut a 13/16” piece of red shrink tubing and slide it over the probe tip until it touches the plastic case. Shrink the tubing by heating it with your soldering iron. Be sure the soldering iron does not contact the tubing or plastic case.

This completes the assembly procedure. Your Logic Probe is now ready for testing.

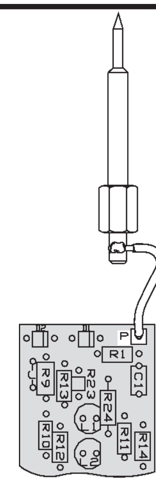


Figure 11

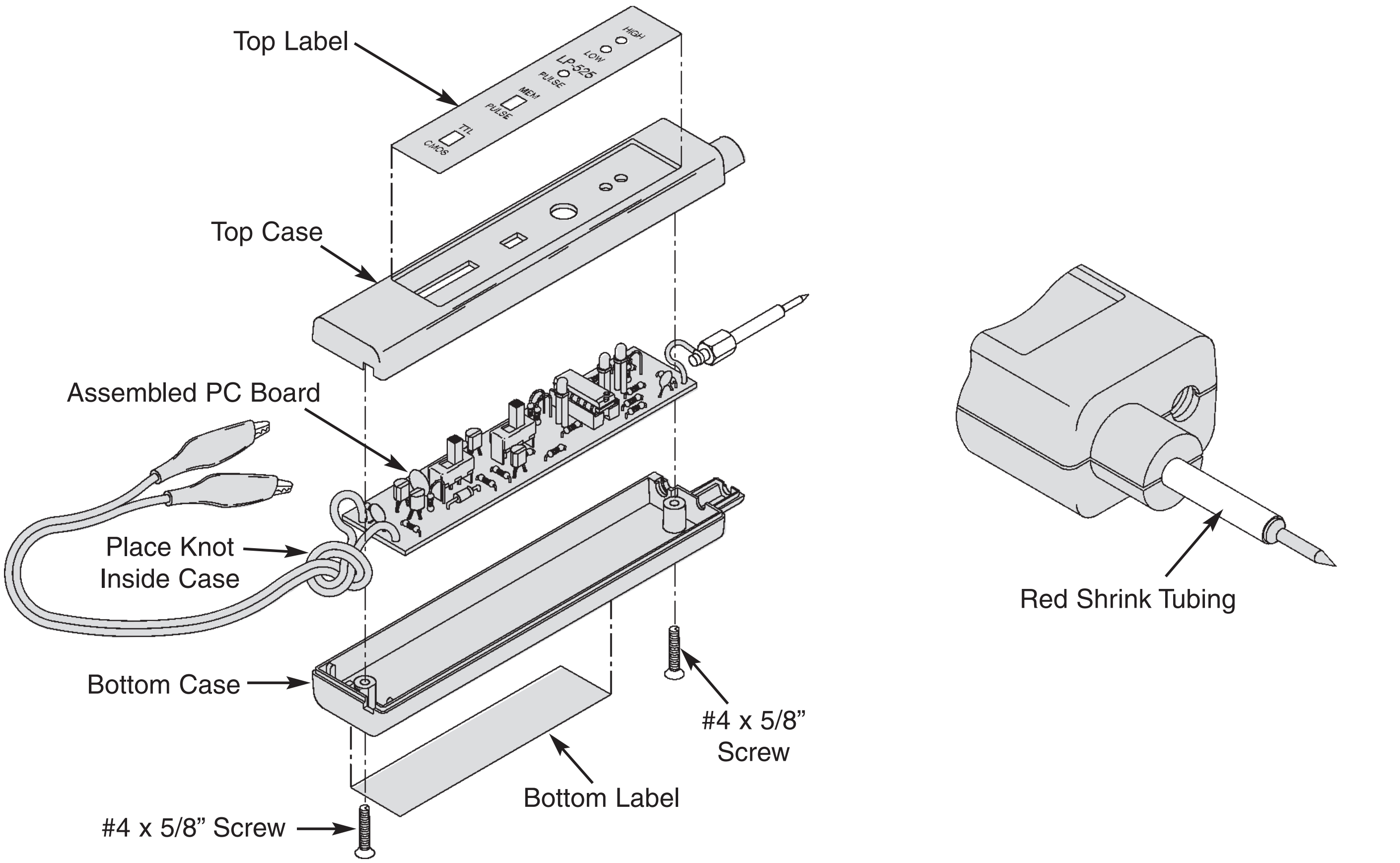


Figure 12

CAUTION: Do not connect the alligator clips to any AC power source or to DC power source greater than 35VDC. Failure to comply to this warning may result in damage to this instrument.

TESTING YOUR DIGITAL PROBE

Checking out your Logic Probe for proper operation is fairly easy. All that is needed is a 9V battery or other DC power source (5-10V). Connect the red alligator clip to the positive terminal of the battery and the black clip to the negative terminal. Set the PULSE-MEM switch to the PULSE position and the TTL-CMOS switch to the TTL position. Touch the probe tip to the positive side of the battery, the PULSE LED should blink once and the HIGH LED should light up. Place the probe tip to the negative terminal and the LOW LED should light up. To check the operation of the memory switch, set the PULSE-MEM switch to the MEM position and set the TTL-CMOS switch to the TTL position. Now touch the probe tip to the positive side of the battery. The PULSE LED should come on and stay on until the switch is flipped back to the pulse position. No LED's should light up when the tip is not touching anything (open circuit).

The logic probe should operate at the following logic levels when the power supply voltage is precisely set to 5VDC.

DTL/TTL Position	Logic 0 - under .8V $\pm$ .1V Logic 1 - above 2.3V $\pm$ .25V
CMOS Position	Logic 0 - under 1.5V $\pm$ .2V Logic 1 - above 3.5V $\pm$ .35V

TROUBLESHOOTING CHART

Condition	Possible Cause
No LED's light up.	Power Cord leads reversed. Check U1, C7, or D6.
HIGH LED or LOW LED never lights.	Check LED by shorting pins. 1, 2, or 14 to negative supply. Check U1.
HIGH or LOW LED always on.	Check U1, R9 to R15.
Pulse LED always on.	Check Q3 - Q5, U1.
PULSE LED never flashes.	Check LED 3, Q1 - Q4, D3, D4.
All LED's flash.	Noise on power line.

OPERATING INSTRUCTIONS

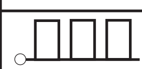
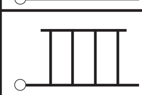
To operate the logic probe, connect the two alligator clips to the circuit DC power supply, red clip to the positive voltage, black to ground. BE SURE THE CIRCUIT SUPPLY IS UNDER 35V OR DAMAGE MAY OCCUR TO THE PROBE. Set the logic family switch to TTL or CMOS. Touch the probe tip to the circuit node to be analyzed. The LED display on the probe body will light to indicate the condition of the node. Refer to the chart below to interpret the LED readings. To prevent power supply spikes, connect the leads as close to the node to be tested as possible.

Interpreting the LEDs

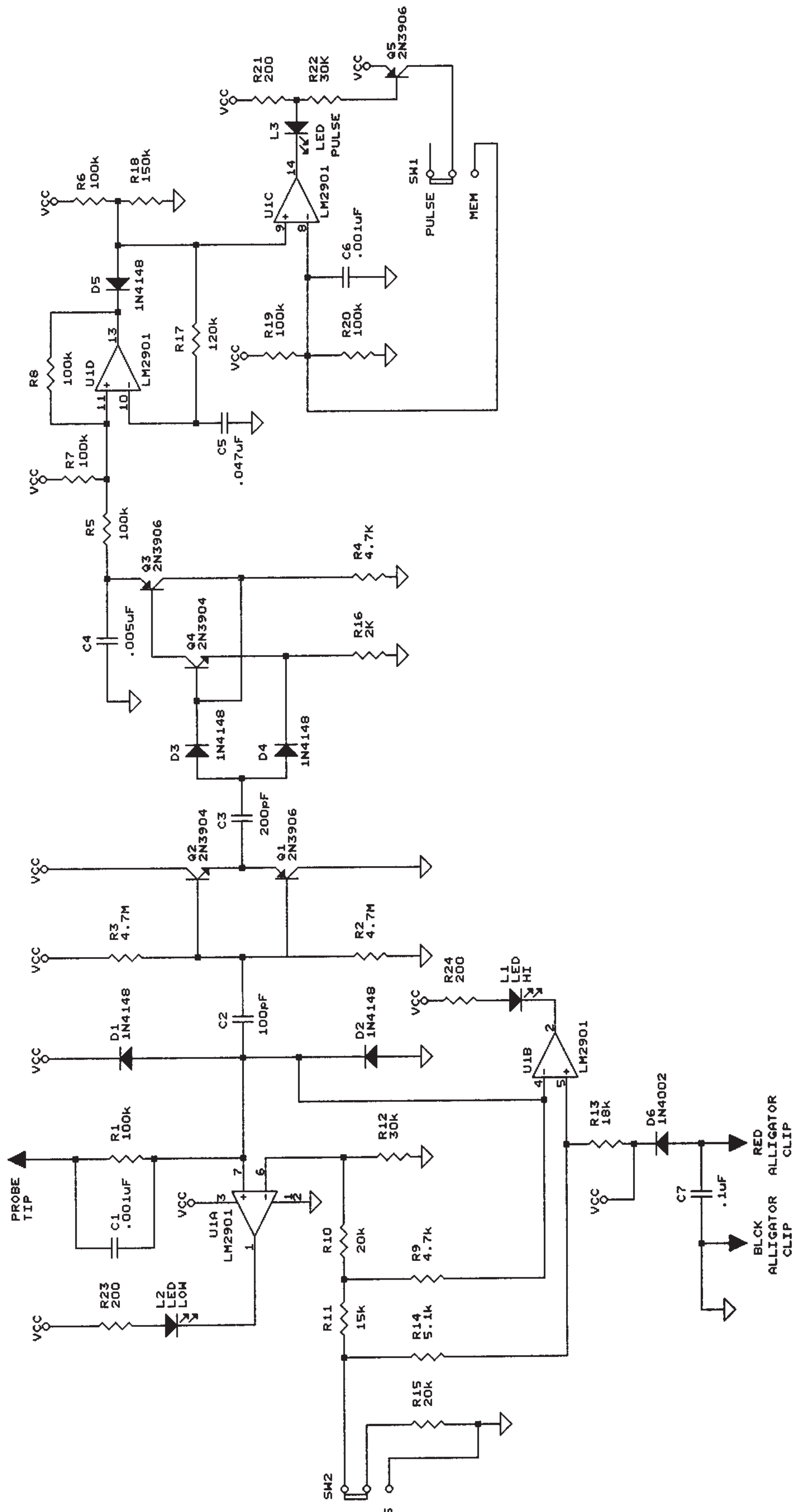
● LED On

○ LED Off

* LED Blinking

LED STATES HIGH	LO	PULSE	INPUT SIGNAL	
○	●	○		Logic "0" no pulse activity.
●	○	○		Logic "1" no pulse activity.
○	○	○		All LEDs off 1. Test point is an open circuit. 2. Out of tolerance signal. 3. Probe not connected to power. 4. Node or circuit not powered.
●	●	*		Equal brightness of the HI and LO LED indicates approx. a 50% duty cycle square wave.
○	○	*		High frequency square wave greater than approximately 3MHz.
○	●	*		Logic "0" with positive pulses present. Low duty cycle since HI LED is not on. If duty cycle were increased, the HI LED would start to turn on.
●	○	*		Logic "1" with negative pulses present. High duty cycle since LO LED is not on. If duty cycle were reduced, the LO LED would start to turn on.

SCHEMATIC DIAGRAM



REV-B

Elenco™ Electronics, Inc.
150 W. Carpenter Avenue
Wheeling, IL 60090
(847) 541-3800
http://www.elenco.com
e-mail: elenco@elenco.com