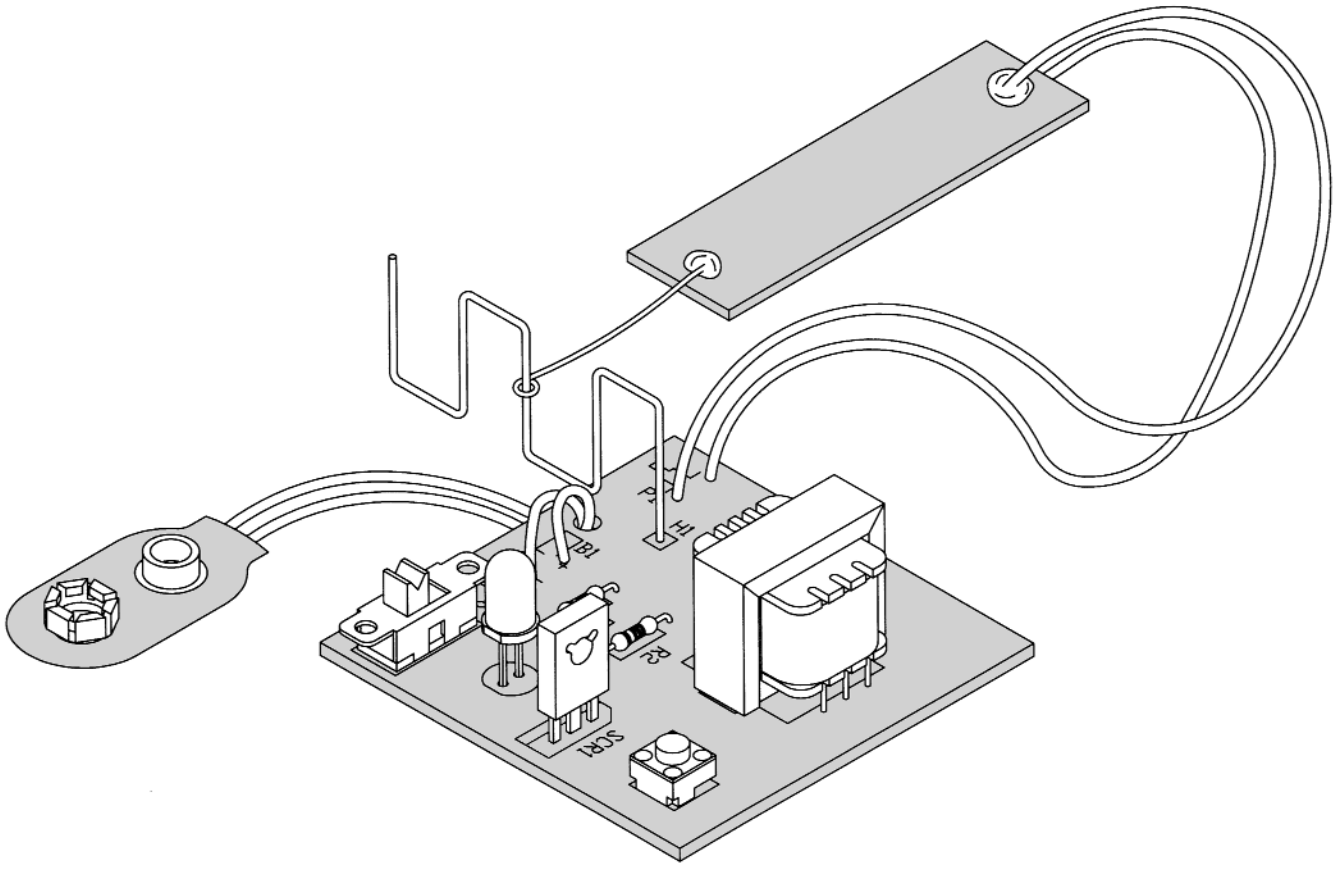
NERVE TESTER KIT

MODEL K-20



Assembly and Instruction Manual

ELENCO®

 Revised 2010 REV-H 753220

PARTS LIST

If you are a student, and any parts are missing or damaged, please see instructor or bookstore.
If you purchased this nerve tester kit from a distributor, catalog, etc., please contact ELENCO® (address/phone/e-mail is at the back of this manual) for additional assistance, if needed.

Parts Verification

Before beginning the assembly process, familiarize yourself with the components and this instruction book. Verify that all of the parts are present. This is best done by checking off each item in the box provided next to the part in the parts list.

RESISTORS

Qty.	Symbol	Description	Color Code	Part #
❒ 1	R1	470Ω 5% 1/4W	yellow-violet-brown-gold	134700
❒ 1	R2	47kΩ 5% 1/4W	yellow-violet-orange-gold	154700

SEMICONDUCTORS

Qty.	Symbol	Description	Part #
❒ 1	SCR1	SCR C106B	319106
❒ 1	D1	Diode LED red	350002

MISCELLANEOUS

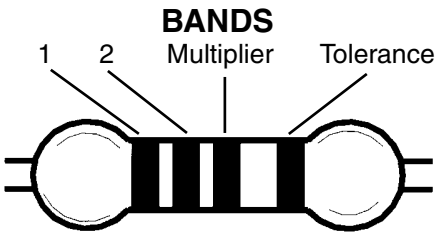
Qty.	Symbol	Description	Part #
❒ 1	T1	Transformer	442100
❒ 1	P1	Double Sided PC Board	510320
❒ 1		PC Board	518020
❒ 1	S1	Switch Push Button	540100
❒ 1	S2	Switch Slide	541102
❒ 1		Solder Roll 24”	551124
❒ 1	B1	Battery Snap	590098
❒ 2		Wire 9”	814920
❒ 1	H1	Wire 9” Bare	845000

Batteries:

- **Do not short circuit the battery terminals.**
- **Never throw batteries in a fire or attempt to open its outer casing.**
- **Use only 9V type, alkaline battery (not included).**
- **Insert battery with correct polarity.**
- **Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.**
- **Non-rechargeable batteries should not be recharged. Rechargeable batteries should only be charged under adult supervision, and should not be recharged while in the product.**
- **Remove the battery when it is used up.**
- **Batteries are harmful if swallowed, so keep away from small children.**

IDENTIFYING RESISTOR VALUES

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



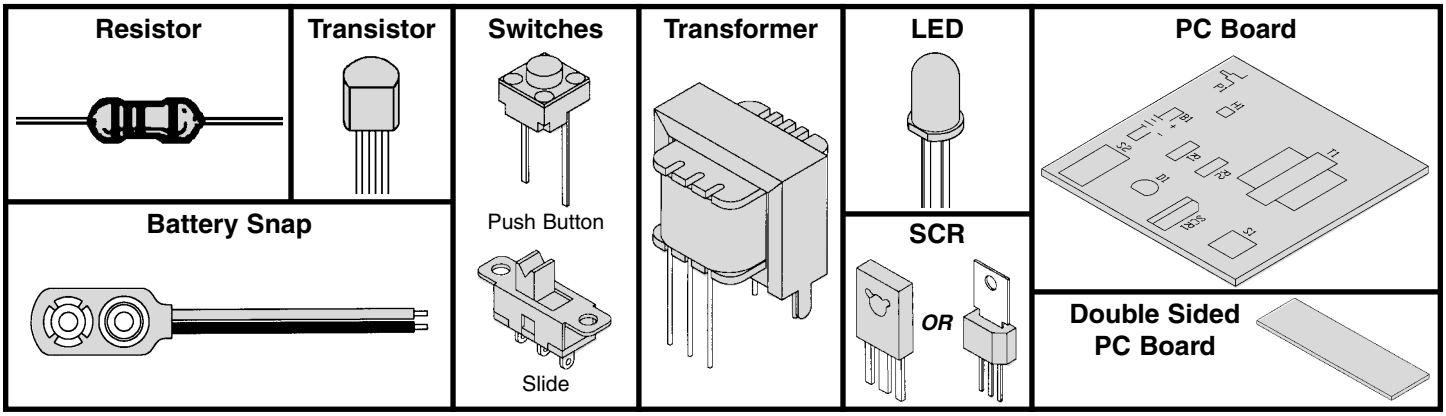
BAND 1 1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

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%

PARTS IDENTIFICATION



INTRODUCTION

Test your nerve with the Nerve Tester Kit. It takes a steady hand, should you touch the twisted wire with the probe, a slight electrical shock will be felt. The shock is very weak and harmless. For the weak of heart or "chickens" a switch removes the electrical shock and substitutes a Light Emitting Diode (LED) which lights up when the probe touches the wire.

THEORY OF OPERATION

The circuit of the Nerve Tester is shown on page 6 of this manual. The circuit consists of two basic circuits. One is the high voltage generator and the other the LED with its latch circuit. We shall study each circuit further.

THE LED CIRCUIT

Figure 1 shows the basic LED circuit. Note that the battery is placed in a series circuit with resistor R1, the LED and the Silicon Controlled Rectifier (SCR). The positive voltage of the battery is placed on the anode of the SCR. The negative voltage is connected to the cathode. Under these conditions if a positive voltage is placed on the gate of the SCR, even for a 1/1000 of a second, the SCR will conduct current and keep conducting when the positive voltage is removed from the gate. This will keep the LED lit until the voltage is removed from the SCR. This is done by closing switch 1, which shorts out the SCR. Resistors R1 and R2 are needed to limit the current in the LED and SCR.

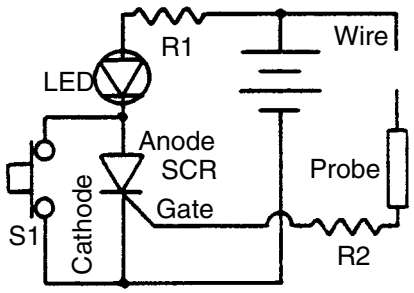


Figure 1

THE SHOCKER GENERATOR

Figure 2 shows the basic circuit used to produce the high voltage of the shocker generator. The heart of this circuit is the transformer. We shall review the operation of a transformer to understand the circuit.

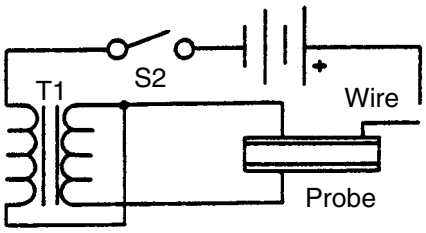


Figure 2

A transformer has two or more windings around an iron core. If a changing current is placed in one of the windings, it will appear in the other winding. The voltage across the second winding will be the ratio of the turns of the transformer. If the first winding has 100 turns and the second has 1,000 turns (10:1 ratio) the secondary voltage will be 10 times the primary voltage. In our transformer, the ratio is 30:1. Therefore, the 9V battery voltage will be stepped up to 270V on the secondary.

The primary wire of the transformer is connected to the negative side of the battery. The positive side of the battery is connected to the twisted wire. The other primary wire is connected to the probe. When the probe touches the twisted wire, a DC current flows through the primary of the transformer. The secondary of the transformer will only have voltage the instant the probe touches the twisted wire and the instant the probe leaves the wire. Again, only when the current changes. Refer to Figure 3 and note that there are two voltage spikes for each time the probe touches the twisted wire. This is because the current changes twice.

Note that the probe is double-sided copper with an insulation in between. One side is negative (ground), the other side connects to the high voltage. Your hand touches both plates and therefore you feel the shock.

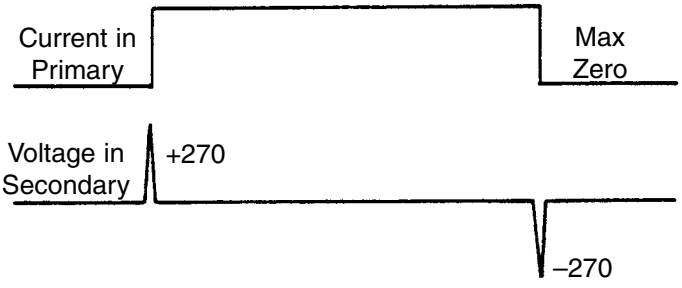


Figure 3

CONSTRUCTION

Introduction

The most important factor in assembling your K-20 Nerve Tester 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.**

Solder

For many years leaded solder was the most common type of solder used by the electronics industry, but it is now being replaced by lead-free solder for health reasons. This kit contains lead-free solder, which contains 99.3% tin, 0.7% copper, and has a rosin-flux core.

Lead-free solder is different from lead solder: It has a higher melting point than lead solder, so you need higher temperature for the solder to flow properly. Recommended tip temperature is approximately 700°F; higher temperatures improve solder flow but accelerate tip decay. An increase in soldering time may be required to achieve good results. Soldering iron tips wear out faster since lead-free solders are more corrosive and the higher soldering temperatures accelerate corrosion, so proper tip care is important. The solder joint finish will look slightly duller with lead-free solders.

Use these procedures to increase the life of your soldering iron tip when using lead-free solder:

- Keep the iron tinned at all times.
- Use the correct tip size for best heat transfer. The conical tip is the most commonly used.
- Turn off iron when not in use or reduce temperature setting when using a soldering station.
- Tips should be cleaned frequently to remove oxidation before it becomes impossible to remove. Use Dry Tip Cleaner (Elenco® #SH-1025) or Tip Cleaner (Elenco® #TTC1). If you use a sponge to clean your tip, then use distilled water (tap water has impurities that accelerate corrosion).

Safety Procedures

- **Always wear safety glasses or safety goggles to protect your eyes when working with tools or soldering iron, and during all phases of testing.**
- Be sure there is **adequate ventilation** when soldering.
- Locate soldering iron in an area where you do not have to go around it or reach over it. Keep it in a safe area away from the reach of children.
- **Do not hold solder in your mouth.** Solder is a toxic substance. Wash hands thoroughly after handling solder.

Assemble Components

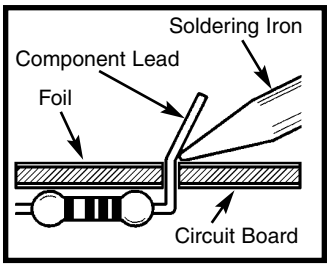
In all of the following assembly steps, the components must be installed on the top side of the PC board unless otherwise indicated. The top legend shows where each component goes. The leads pass through the corresponding holes in the board and are soldered on the foil side.
Use only rosin core solder.

DO NOT USE ACID CORE SOLDER!

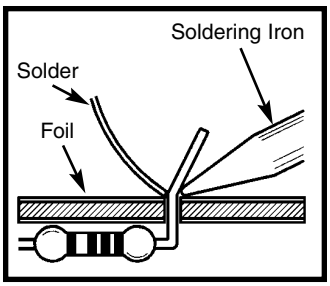
What Good Soldering Looks Like

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

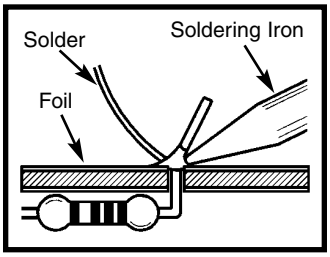
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



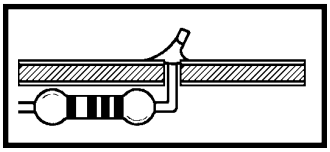
2. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and the circuit foil to melt the solder.



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.

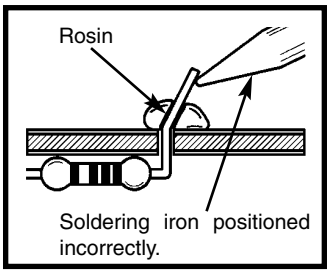


4. Here is what a good solder connection looks like.

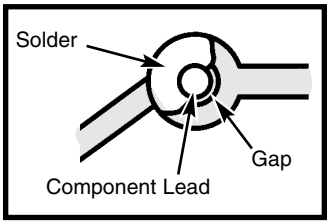


Types of Poor Soldering Connections

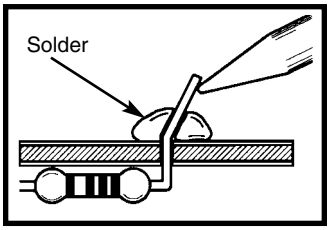
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



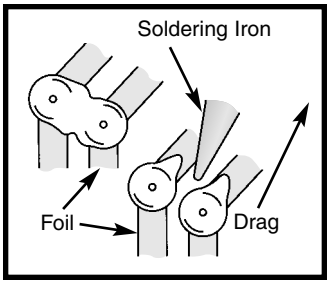
2. **Insufficient solder** - let the solder flow over the connection until it is covered.
Use just enough solder to cover the connection.



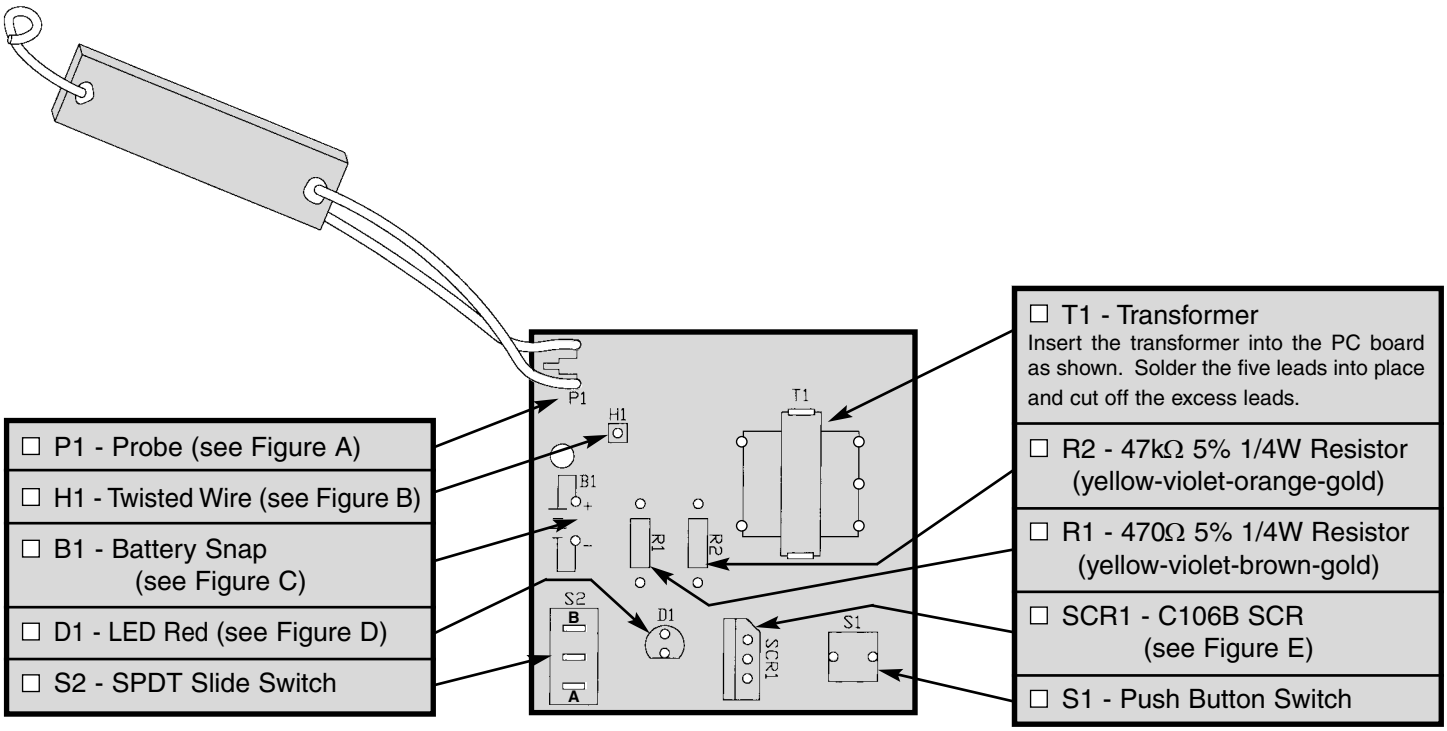
3. **Excessive solder** - could make connections that you did not intend to between adjacent foil areas or terminals.



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



- ☐ P1 - Probe (see Figure A)
- ☐ H1 - Twisted Wire (see Figure B)
- ☐ B1 - Battery Snap (see Figure C)
- ☐ D1 - LED Red (see Figure D)
- ☐ S2 - SPDT Slide Switch
- ☐ T1 - Transformer
  Insert the transformer into the PC board as shown. Solder the five leads into place and cut off the excess leads.
- ☐ R2 - 47kΩ 5% 1/4W Resistor (yellow-violet-orange-gold)
- ☐ R1 - 470Ω 5% 1/4W Resistor (yellow-violet-brown-gold)
- ☐ SCR1 - C106B SCR (see Figure E)
- ☐ S1 - Push Button Switch

Figure A

Assemble the probe (P1). Solder an excess lead from the resistors to a side of the double sided PC board. Leave 1/2 inch extending from the end. Form a loop at the end of the wire.

Cut two 9 inch wires and strip 1/2 inch of insulation off of both ends. Solder a wire to each side of the double sided PC board. Insert the other ends of the wires in the holes marked P1. Solder and cut off the excess leads.

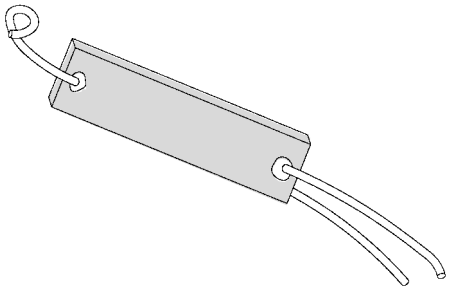


Figure B

Bend the 9" bare wire into the shape as shown below. Insert one end of the wire into the PC board, in the hole marked H1 and solder into place.

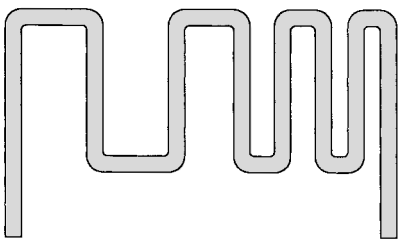


Figure C

Insert the battery snap wire through the PC board as shown. Then, insert the red wire into the positive (+) hole and the black wire into the negative (–) hole. Solder and cut off the excess leads.

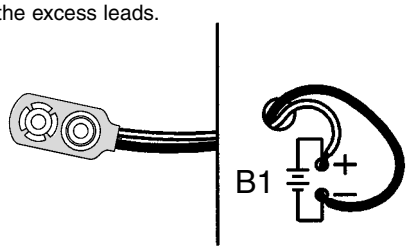


Figure D

Mount the LED with the flat side of its body in the direction as marked on the top legend. Leave 1/4" between the LED and the surface of the PC board. Solder and cut off the excess leads.

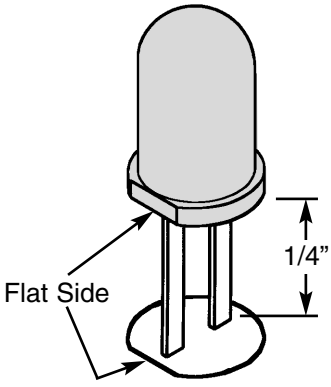
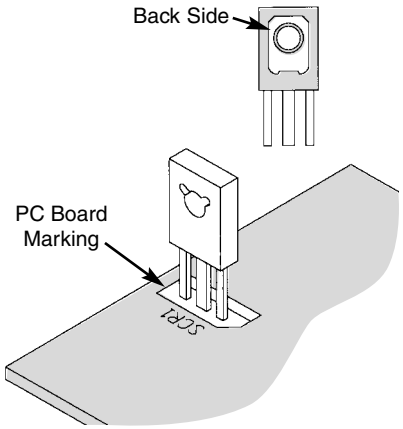
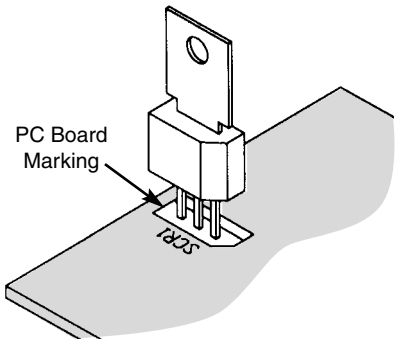


Figure E

Mount the silicon controlled rectifier (SCR) with the back side (metal backing) in the same direction as the marking on the PC board as shown.



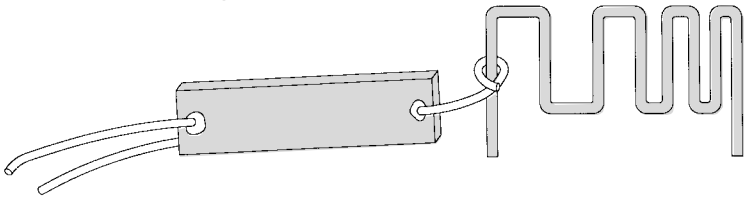


COMPONENT CHECK

1. Be sure that all components have been mounted in their correct places.
2. Has the LED D1 been installed correctly? The flat side of its body should be in the hole as shown on the top legend. If the LED is in backwards, it will not light.
3. Pay close attention to the red and black wires of the battery snap. The red wire should be installed in the positive (+) hole and the black wire in the negative (–) hole. Snap in a fresh 9-volt battery.

OPERATING THE K-20

1. Grasp the probe so that you touch the copper on both sides of the probe.
2. Try to guide the loop along the wire. If the loop touches the wire, you will receive a mild shock or throw the slide switch S2 and the LED will light instead.
3. Push switch S1 to reset the LED.



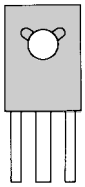
TROUBLESHOOTING

Contact ELENCO® if you have any problems. **DO NOT** contact your place of purchase as they will not be able to help you.

1. One of the most frequently occurring problems is poor solder connections. Tug slightly on all parts to make sure that they are indeed soldered.
2. All solder connections should be shiny. Resolder any that are not.
3. Solder should flow into a smooth puddle rather than a round ball. Resolder any connection that has formed into a ball.
4. Have any solder bridges formed? A solder bridge may occur if you accidentally touch an adjacent foil by using too much solder or by dragging the soldering iron across adjacent foils. Break the bridge with your soldering iron.

LED CIRCUIT REMEDY

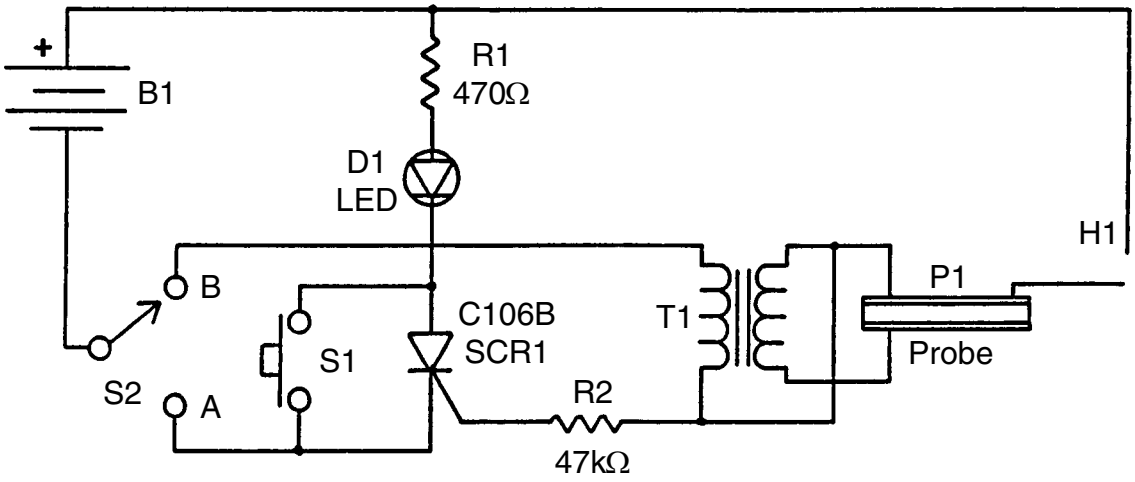
1. **LED** - Move switch S2 into position A (shown on the top legend drawing in the assembly manual). Place a clip-lead from the cathode lead of the LED (the lead on the flat side) to the negative terminal of the 9-volt battery. The LED should light. If the LED does not light, the problem is with the LED or resistor R1. If the LED is installed with the flat side in the correct direction and R1 is the correct value, then most likely the LED is at fault.
2. **SCR** - Move switch S2 into position A. Place a clip-lead from the gate (G) of the SCR to the positive terminal of the battery. The LED should light even when the clip-lead is removed. If not, the problem could be with S1, be sure that S1 is in the open position first. If you get no response, place a clip-lead from the center lug to the position A lug of switch S2. If the circuit works now, the problem was S2. If the circuit still does not work, the problem is the SCR.



SHOCKER GENERATOR REMEDY

1. **TRANSFORMER** - Be sure that the transformer is installed correctly, with the three lead side in the direction as shown in the top legend drawing in this manual.
2. **S2** - Place a clip-lead from the center lug to position B. If the shocker circuit now works, the problem is with S2.

SCHEMATIC DIAGRAM



QUIZ

1. The nerve tester produces a _____ whenever the probe touches the twisted wire.
2. A “chicken” afraid of the shock will switch the nerve tester to the _____ position.
3. The LED will light when a positive voltage touches the _____ of the SCR.
4. Once the LED is lit, removing the probe from the twisted wire will turn off the LED. (true or false)
5. A transformer has _____ or more windings.
6. A _____ current in the primary winding will produce voltage in the _____ winding.
7. The voltage in the secondary winding is equal to the primary voltage times the ratio of the _____ in the transformer.
8. The nerve tester produces about a _____ volt spike for a very short time.
9. There are _____ spikes of voltage every time the probe touches the twisted wire.
10. The probe has _____ sides of copper between an insulator.

Answers: 1. shock; 2. LED; 3. gate; 4. false; 5. two; 6. DC, secondary; 7. turns; 8. 270; 9. two; 10. two

ELENCO®
150 Carpenter Avenue
Wheeling, IL 60090
(847) 541-3800
Website: www.elenco.com
e-mail: elenco@elenco.com