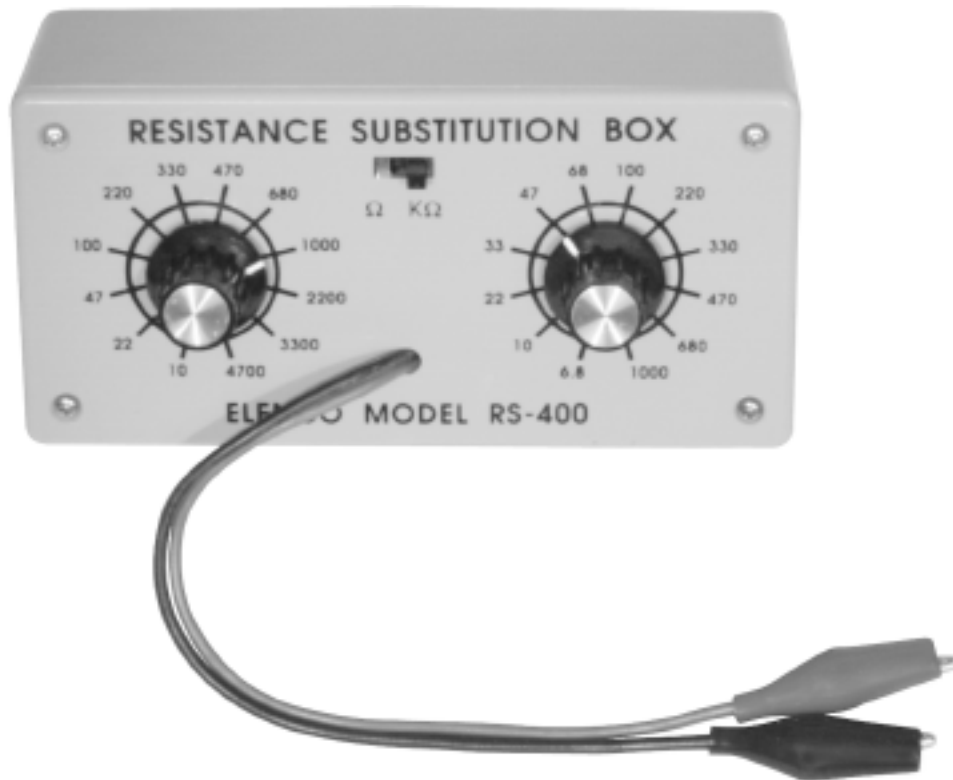


RESISTANCE SUBSTITUTION BOX

MODEL RS-400 / K-37



7 56619 00085 5



Assembly and Instruction Manual

Elenco™ Electronics, Inc.

The Resistance Substitution Box is a convenient instrument in determining the desired resistance values in circuits under design or test. The values selected for your resistance substitution box were determined to be the most commonly used in modern solid-state circuits. The values are from 10Ω to 1,000kΩ (1 meg) in 24 steps. All resistors are 5% tolerance 1/2 watt.

PARTS LIST

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

If you purchased this resistance substitution box 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.

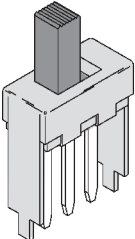
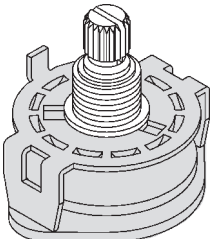


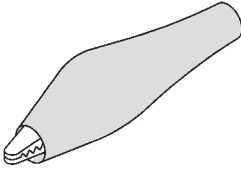

RESISTORS

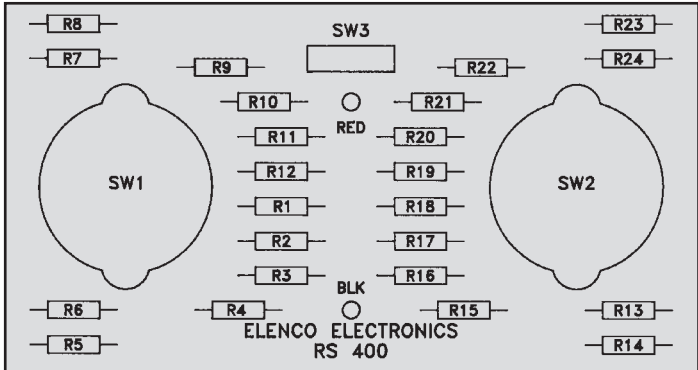
Qty.	Symbol	Description	Color Code	Part #
□1	R1	10Ω 5% 1/2W	brown-black-black-gold	121001
□1	R2	22Ω 5% 1/2W	red-red-black-gold	122201
□1	R3	47Ω 5% 1/2W	yellow-violet-black-gold	124701
□1	R4	100Ω 5% 1/2W	brown-black-brown-gold	131001
□1	R5	220Ω 5% 1/2W	red-red-brown-gold	132201
□1	R6	330Ω 5% 1/2W	orange-orange-brown-gold	133301
□1	R7	470Ω 5% 1/2W	yellow-violet-brown-gold	134701
□1	R8	680Ω 5% 1/2W	blue-gray-brown-gold	136801
□1	R9	1kΩ 5% 1/2W	brown-black-red-gold	141001
□1	R10	2.2kΩ 5% 1/2W	red-red-red-gold	142201
□1	R11	3.3kΩ 5% 1/2W	orange-orange-red-gold	143301
□1	R12	4.7kΩ 5% 1/2W	yellow-violet-red-gold	144701
□1	R13	6.8kΩ 5% 1/2W	blue-gray-red-gold	146801
□1	R14	10kΩ 5% 1/2W	brown-black-orange-gold	151001
□1	R15	22kΩ 5% 1/2W	red-red-orange-gold	152201
□1	R16	33kΩ 5% 1/2W	orange-orange-orange-gold	153301
□1	R17	47kΩ 5% 1/2W	yellow-violet-orange-gold	154701
□1	R18	68kΩ 5% 1/2W	blue-gray-orange-gold	156801
□1	R19	100kΩ 5% 1/2W	brown-black-yellow-gold	161001
□1	R20	220kΩ 5% 1/2W	red-red-yellow-gold	162201
□1	R21	330kΩ 5% 1/2W	orange-orange-yellow-gold	163301
□1	R22	470kΩ 5% 1/2W	yellow-violet-yellow-gold	164701
□1	R23	680kΩ 5% 1/2W	blue-gray-yellow-gold	166801
□1	R24	1MΩ 5% 1/2W	brown-black-green-gold	171001

MISCELLANEOUS

Qty.	Description	Part #
□1	PC Board	517007
□1	Switch SPDT PC Mount	541103
□2	Switch 12 Position	542013
□2	Knob	622009
□1	Case with Cover	62RS400
□4	Screw 4 x 1/2" Phil A	642465
□2	Nut 9mm	644102
□2	Washer 9mm x 15mm	645103
□1	Alligator Clip Black	680001
□1	Alligator Clip Red	680002
□1	Wire Black Stranded 12"	814210
□1	Wire Red Stranded 12"	814215
□1	Solder	9ST4

PARTS IDENTIFICATION

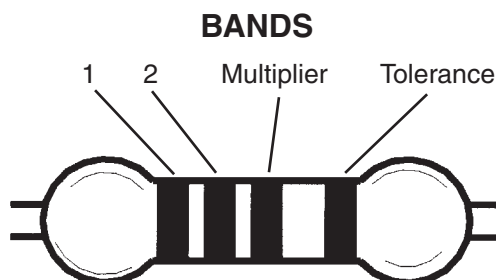
Switch PC Mount 	Switch 12 Position 	9mm Nut 	Washer 	Alligator Clip 
		Resistor 		

PC Board


IDENTIFYING RESISTOR VALUES

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

BAND 1 1st Digit		BAND 2 2nd Digit		Multiplier		Resistance Tolerance	
Color	Digit	Color	Digit	Color	Multiplier	Color	Tolerance
Black	0	Black	0	Black	1	Silver	±10%
Brown	1	Brown	1	Brown	10	Gold	±5%
Red	2	Red	2	Red	100	Brown	±1%
Orange	3	Orange	3	Orange	1,000	Red	±2%
Yellow	4	Yellow	4	Yellow	10,000	Orange	±3%
Green	5	Green	5	Green	100,000	Green	±.5%
Blue	6	Blue	6	Blue	1,000,000	Blue	±.25%
Violet	7	Violet	7	Silver	0.01	Violet	±.1%
Gray	8	Gray	8	Gold	0.1		
White	9	White	9				



CONSTRUCTION

Introduction

The most important factor in assembling your RS-400 Resistance Substitution Box 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.

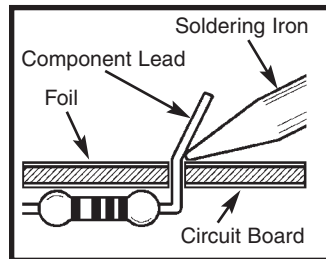
Use only rosin core solder of 63/37 alloy.

DO NOT USE ACID CORE SOLDER!

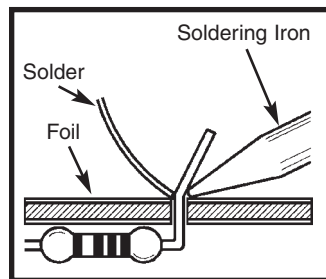
What Good Soldering Looks Like

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

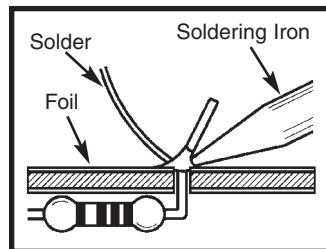
1. Solder all components from the copper foil side only. Push the soldering iron tip against both the lead and the circuit board foil.



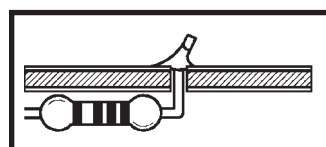
2. Apply a small amount of solder to the iron tip. This allows the heat to leave the iron and onto the foil. Immediately apply solder to the opposite side of the connection, away from the iron. Allow the heated component and the circuit foil to melt the solder.



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.

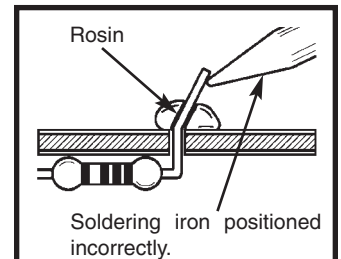


4. Here is what a good solder connection looks like.

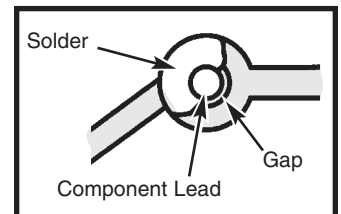


Types of Poor Soldering Connections

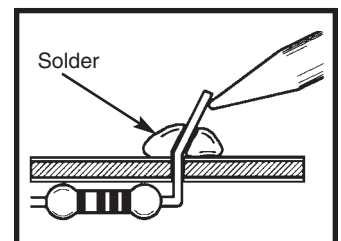
1. **Insufficient heat** - the solder will not flow onto the lead as shown.



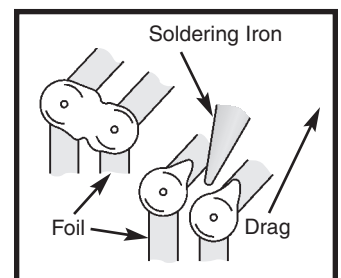
2. **Insufficient solder** - let the solder flow over the connection until it is covered. Use just enough solder to cover the connection.



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



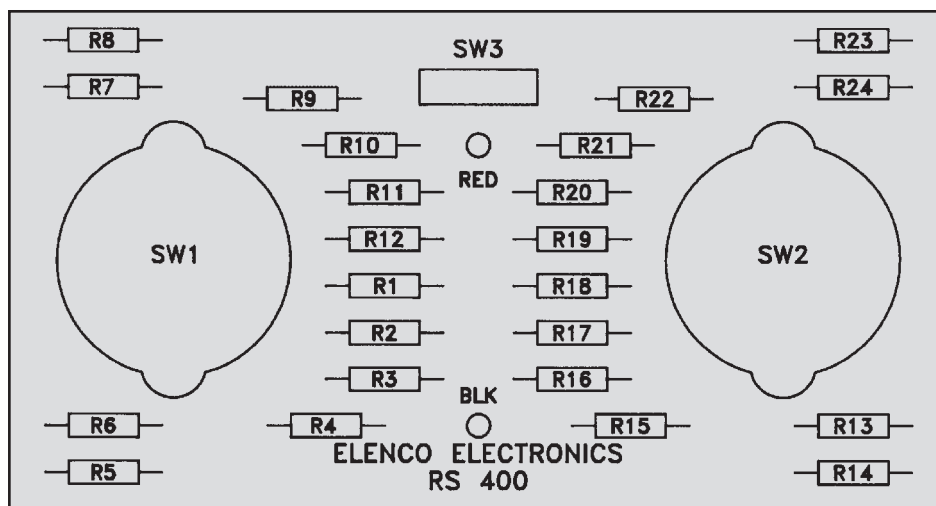
4. **Solder bridges** - occur when solder runs between circuit paths and creates a short circuit. This is usually caused by using too much solder. To correct this, simply drag your soldering iron across the solder bridge as shown.



ASSEMBLY INSTRUCTIONS

Begin the PC board assembly with resistor R12. Be sure to identify the correct value by reading the color code. Place the resistor into the PC board with the leads coming out on the copper foil side. Solder in place and clip off the excess leads, close to the connection.

<input type="checkbox"/> R12 - 4.7k Ω 5% 1/2W Resistor (yellow-violet-red-gold)		<input type="checkbox"/> R19 - 100k Ω 5% 1/2W Resistor (brown-black-yellow-gold)
<input type="checkbox"/> R11 - 3.3k Ω 5% 1/2W Resistor (orange-orange-red-gold)		<input type="checkbox"/> R20 - 220k Ω 5% 1/2W Resistor (red-red-yellow-gold)
<input type="checkbox"/> R10 - 2.2k Ω 5% 1/2W Resistor (red-red-red-gold)		<input type="checkbox"/> R21 - 330k Ω 5% 1/2W Resistor (orange-orange-yellow-gold)
<input type="checkbox"/> R8 - 680 Ω 5% 1/2W Resistor (blue-gray-brown-gold)		<input type="checkbox"/> R23 - 680k Ω 5% 1/2W Resistor (blue-gray-yellow-gold)
<input type="checkbox"/> R7 - 470 Ω 5% 1/2W Resistor (yellow-violet-brown-gold)		<input type="checkbox"/> R24 - 1M Ω 5% 1/2W Resistor (brown-black-green-gold)
<input type="checkbox"/> R9 - 1k Ω 5% 1/2W Resistor (brown-black-red-gold)		<input type="checkbox"/> R22 - 470k Ω 5% 1/2W Resistor (yellow-violet-yellow-gold)
<input type="checkbox"/> R1 - 10 Ω 5% 1/2W Resistor (brown-black-black-gold)		<input type="checkbox"/> R18 - 68k Ω 5% 1/2W Resistor (blue-gray-orange-gold)
<input type="checkbox"/> R2 - 22 Ω 5% 1/2W Resistor (red-red-black-gold)		<input type="checkbox"/> R17 - 47k Ω 5% 1/2W Resistor (yellow-violet-orange-gold)
<input type="checkbox"/> R3 - 47 Ω 5% 1/2W Resistor (yellow-violet-black-gold)		<input type="checkbox"/> R16 - 33k Ω 5% 1/2W Resistor (orange-orange-orange-gold)
<input type="checkbox"/> R5 - 220 Ω 5% 1/2W Resistor (red-red-brown-gold)		<input type="checkbox"/> R14 - 10k Ω 5% 1/2W Resistor (brown-black-orange-gold)
<input type="checkbox"/> R6 - 330 Ω 5% 1/2W Resistor (orange-orange-brown-gold)		<input type="checkbox"/> R13 - 6.8k Ω 5% 1/2W Resistor (blue-gray-red-gold)
<input type="checkbox"/> R4 - 100 Ω 5% 1/2W Resistor (brown-black-brown-gold)		<input type="checkbox"/> R15 - 22k Ω 5% 1/2W Resistor (red-red-orange-gold)



- SW3 - PC Mount Switch

Mount SW3 in the place shown on the PC board.
Solder into place.

- Red Test Lead
- Black Test Lead

Cut off 1 1/2" of wire off of both the red and black wires (SAVE them for later use). Strip 1/4" of insulation off both ends of the 10 1/2" red and black wires and insert them into the holes as marked on the PC board. Solder into place. Tie a knot with both wires 1 1/2" from the surface of the PC board as shown in Figure 1. Pull the wires through the hole in the cover. Slide the alligator boots onto the wires. Solder the wires to the alligator clips. Then, slide the boots onto the clips.

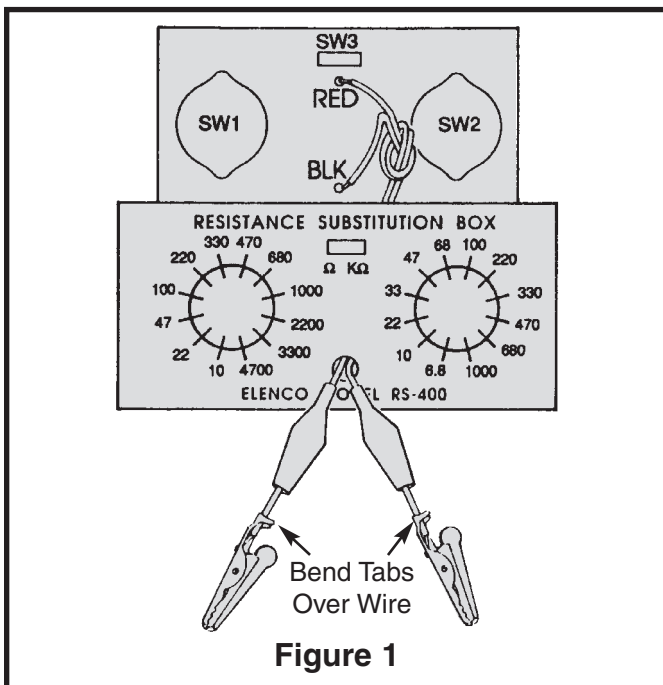


Figure 1

- SW1
- SW2

Bend the tab on the switches down (see Figure 2). Attach the two switches loosely to the front panel with the 9mm nuts and washers. Line up the holes of the PC board with the switch lugs, as shown in Figure 3. Be sure that the board lays flat, then solder the lugs into place. Tighten down the 9mm nuts.

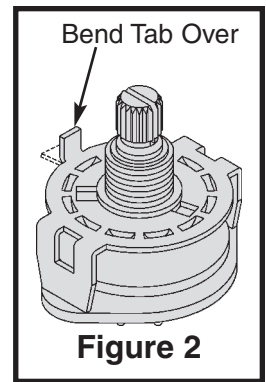


Figure 2

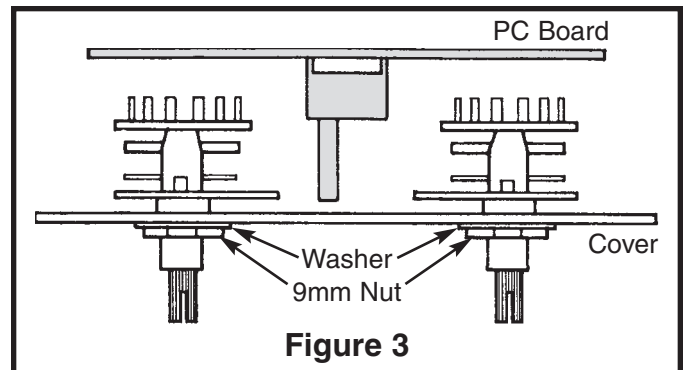


Figure 3

- Jumper wire from SW1
- Jumper wire from SW2

Strip 1/4" of insulation off of both ends of the 1 1/2" red and black wires. Solder one end of the wire to the wiper pin on the 12 position switches and the other to the pad without a hole, as shown in Figure 4.

- Installation of Knobs if an Ohm Meter is Available

Place the knobs loosely on the switch posts. Push the slide switch to the "Ω" position. Connect an ohm meter to the output. Line up the pointer of the knob with the value shown on your meter, then push the knob onto the shaft. Push the slide switch to the "KΩ" position and repeat the same procedure.

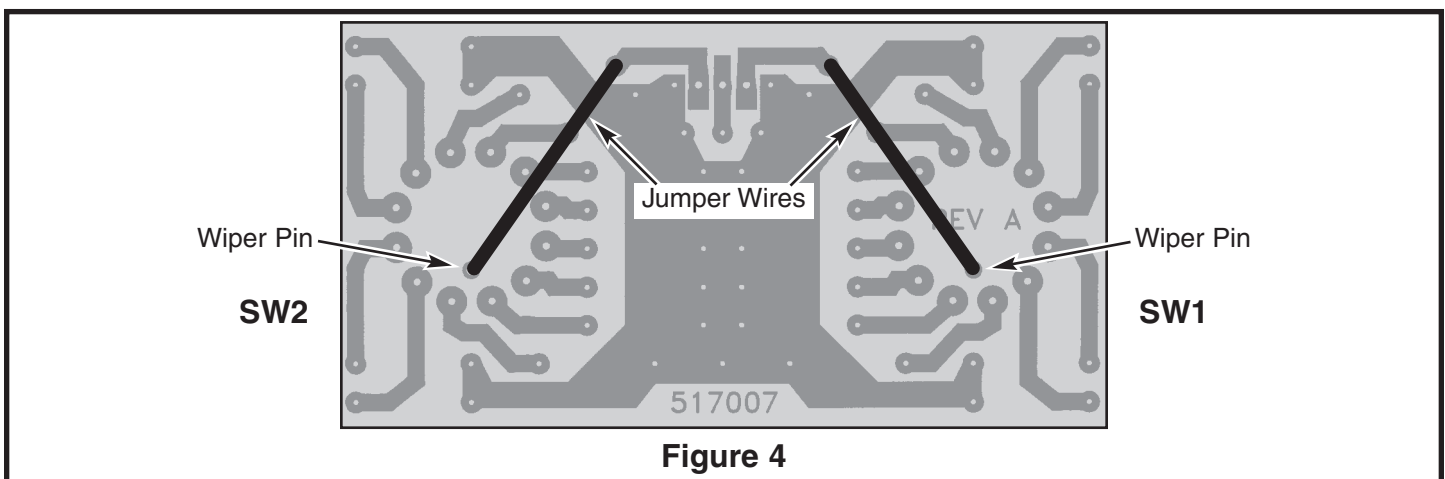


Figure 4

□ Installation of Knobs without an Ohm Meter

If an ohm meter is not available, turn both switches so that the wiper contact is in the position shown in Figure 5. Start with switch SW1, follow the copper run on the PC board from the lug in contact with the wiper to the 470Ω (R7) resistor, to be sure that the switch is set in the proper position. Align the knob on the SW1 (Ω) switch to the 470 position, push the knob onto the shaft. Follow the same procedure for switch SW2 (KΩ), except follow the copper run to the 6.8KΩ (R13) resistor. Align the knob on the SW2 (KΩ) switch to the 6.8 position.

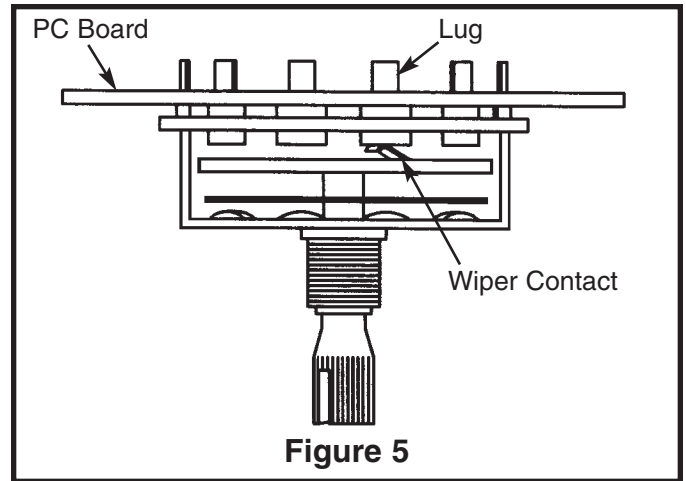


Figure 5

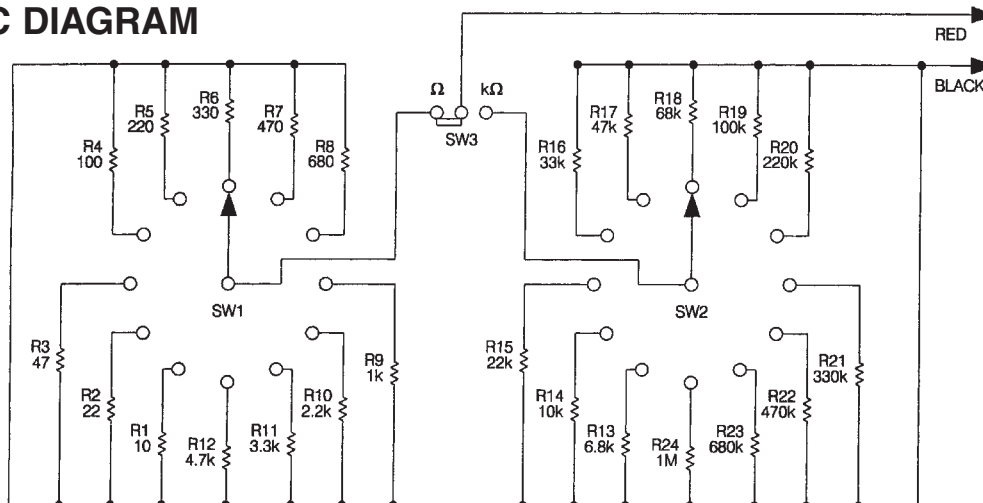
TESTING THE CIRCUIT

The following test is to be made with your meter to determine that the resistors are in their correct circuit positions. The resistors used in your circuit are gold banded with a tolerance of ±5%. That means that a 10kΩ resistor could measure between 9,500Ω and 10,500Ω and be correct. Each of the 24 resistance value positions will be tested and recorded in the chart below.

SW1 Ω POSITION	
Value Position	Meter Reading
10Ω	
22Ω	
47Ω	
100Ω	
220Ω	
330Ω	
470Ω	
680Ω	
1000Ω	
2200Ω	
3300Ω	
4700Ω	

SW2 KΩ POSITION	
Value Position	Meter Reading
6.8KΩ	
10KΩ	
22KΩ	
33KΩ	
47KΩ	
68KΩ	
100KΩ	
220KΩ	
330KΩ	
470KΩ	
680KΩ	
1MΩ	

SCHEMATIC DIAGRAM



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