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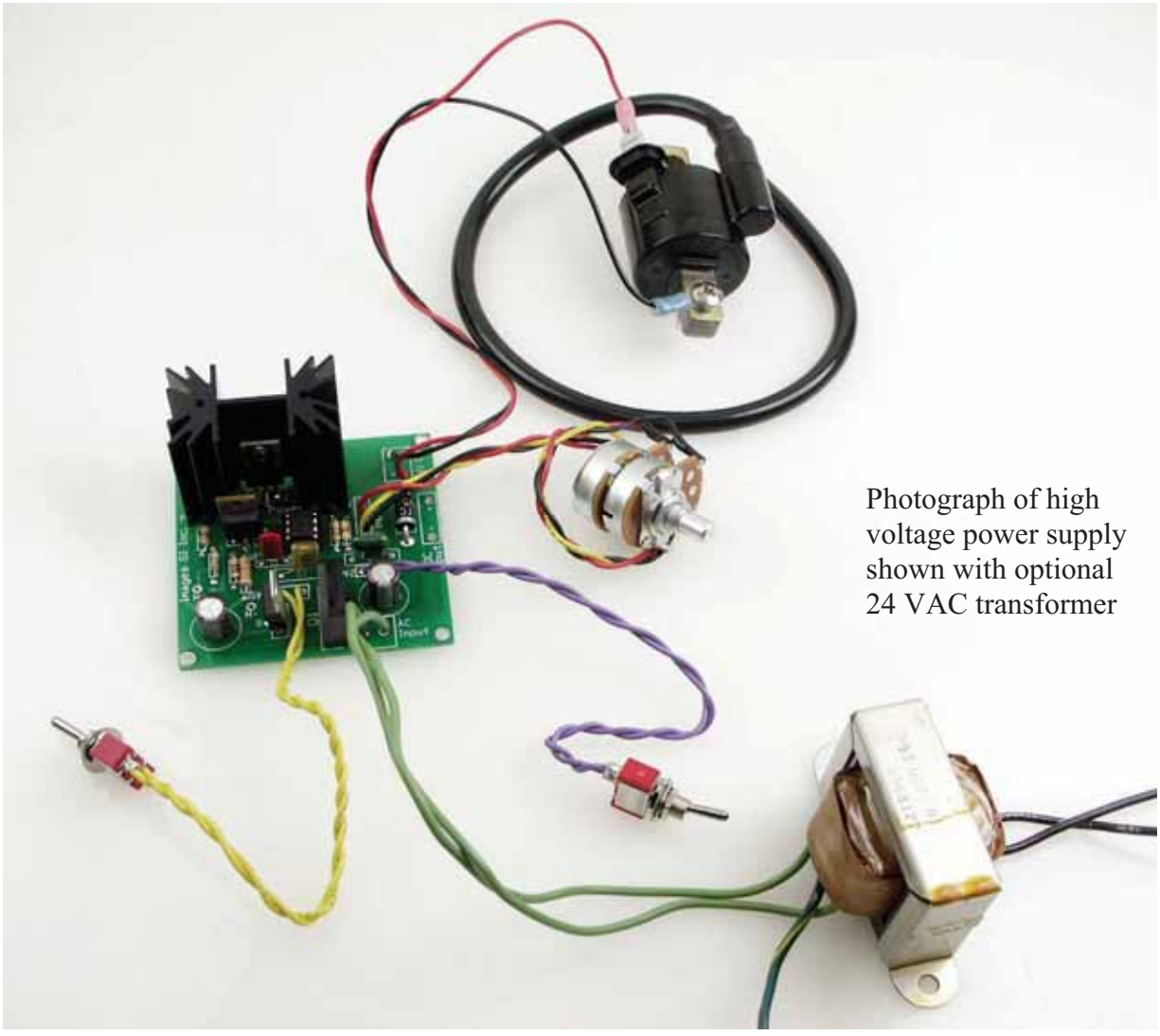
High Voltage Power Supply



Photograph of high voltage power supply shown with optional 24 VAC transformer

Important Safety Warning

This kit is not intended for children! Assembly of this kit requires high-temperature soldering and the use of sharp edged components and cutting tools. Some included components may become hot, leak, or explode if used improperly. Images strongly recommends that you wear safety glasses when building or working with any electronic equipment.

This is a high voltage power supply that is intended for use by adults. Children should not build or operate this kit.

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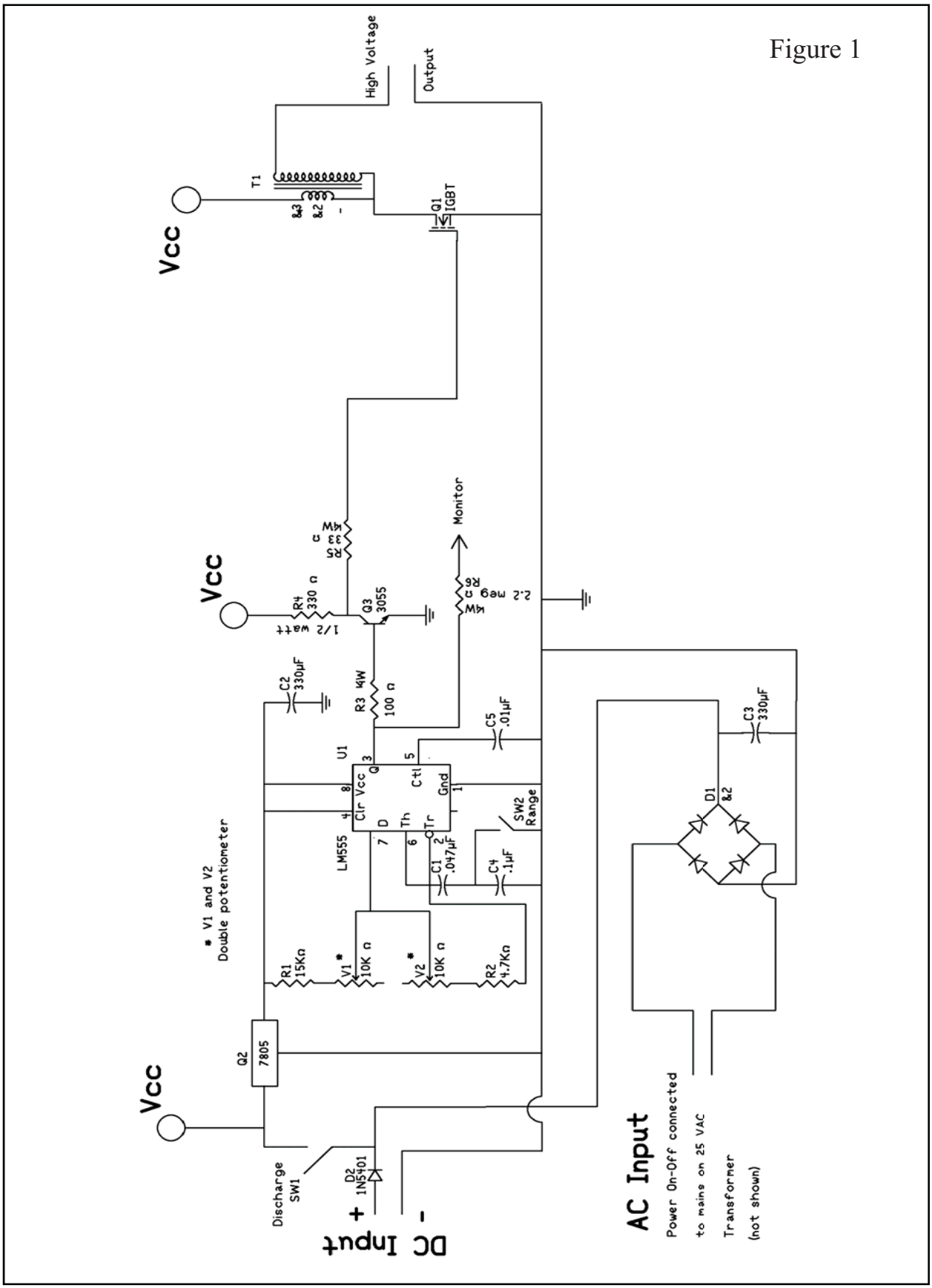
Figure 1


High Voltage
Output
T1
Vcc
Q1
IGBT
Monitor
R6
2.2 meg Ω
R4
330 Ω
1/2 watt
Q3
3055
R5
33 Ω
C2
330µF
R3 4W
100 Ω
C5
.01µF
C3
330µF
U1
LM555
Clr
Vcc
D
Th
Tr
Ctl
Gnd
SW2
Range
D1
C1
.047µF
C4
.1µF
* V1 and V2
Double potentiometer
R1
15KΩ
V1 *
10K Ω
V2 *
10K Ω
R2
4.7KΩ
Q2
7805
Vcc
Discharge
SW1
D2
1N5401
+
DC Input
-
AC Input
Power On-Off connected
to mains on 25 VAC
Transformer
(not shown)

This High Voltage power source may be used in a variety of applications, that include:

* Kirlian photography
* HeNe Laser tube power supply
* X-ray tubes
* Plasma and neon tubes
* Negative ion generators, etc.

The power supply features variable frequency control using a potentiometer. It also has a High-Low frequency range switch. In addition, this circuit can be either battery powered 12 VDC, or powered from a wall transformer, 9-24 V with either an AC or DC output. Powering the unit from batteries provides the advantage of portability for fieldwork.

How the Circuit Works

The circuit schematic for the high voltage power supply is shown in Figure 1. This is a simple device that is based on the 555 timer. The 555 Timer is set up as an astable oscillator. The output signal from the 555 Timer is fed to the base of Q2, a 3055 transistor. The signal from the collector of Q2 is fed to the base of a high voltage transistor that turns the transistor on and off.

The frequency of the 555 timer is controlled by the potentiometer and hi-low switch that adjust the timing capacitor. The potentiometer used in this circuit is a double-ganged potentiometer. Which means that it is two potentiometers that share a common shaft. A close up of the potentiometer is shown in Figure 5. The center terminal of the potentiometer is called the wiper. The two wipers of the potentiometers are soldered together and connected to pin 7 of the 555 Timer.

All the current to energize the HV ignition coil passes through transistor Q1. To prevent Q1 from overheating, a large heat sink is attached.

The transformer T1 is a high voltage autotransformer. The T1 ignition coil transformer is a three terminal device. Figure 2 shows where we connect power from our circuit to the coil. The coil has a plastic protuberance that is the high voltage output of the transformer. A well-insulated (HV) wire is molded to this protuberance. The leads on the PC board labeled M+ and M– are not used.

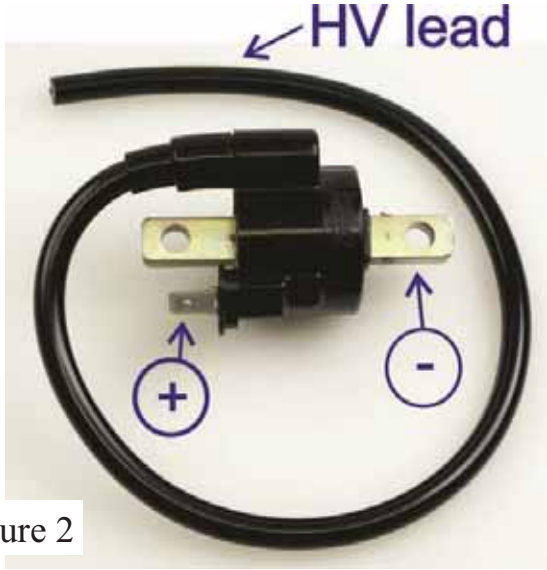


Figure 2

Construction of High Voltage Power Supply

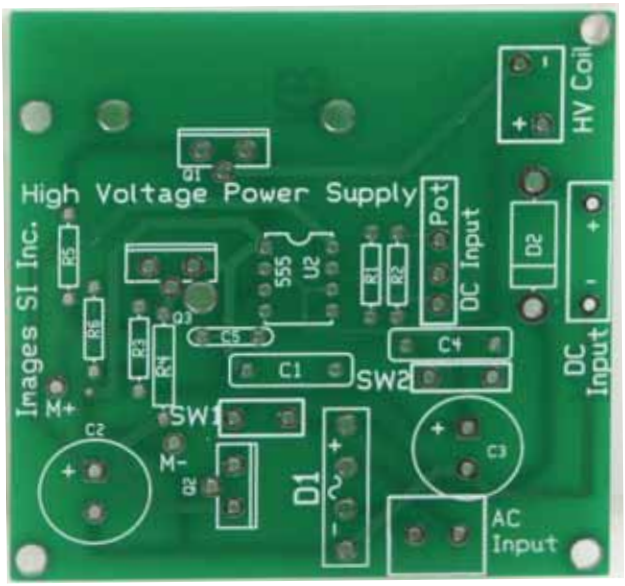


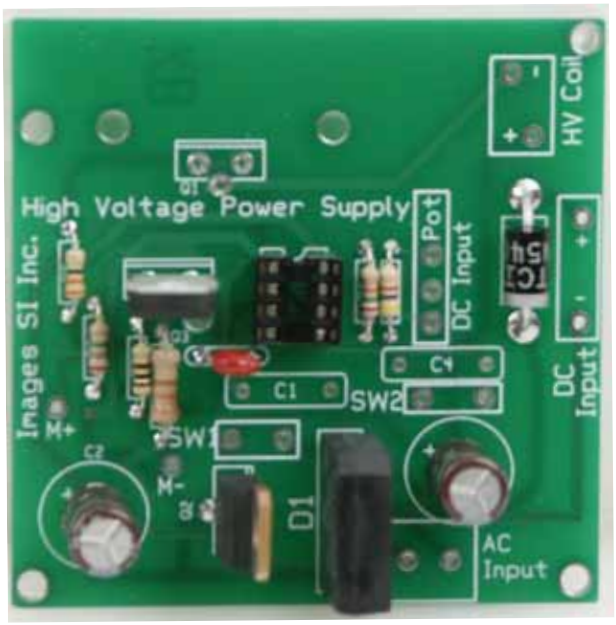
Figure 3

The components are mounted on the top side of the PC board. The top side of the board has white silk screen component drawings. The components are soldered on the opposite side of the pc board. After soldering the component to the board, any excess wire is clipped off.

Begin construction by mounting and soldering the 8-pin socket. Insert the IC socket, making sure to orient the notch on the socket to the drawing on the PCB and solder to the PC board.

Next mount and solder Q2, the 7805 voltage regulator and Q3, the 3055. Mount and solder R1, the 15K (color bands brown, green, orange) resistor and R2, the 4.7K resistor (color bands yellow, violet and red). R3, the 100 ohm resistor (color bands brown, black, brown), R4, the 330 ohm 1/2 watt resistor (color bands orange, orange, brown), and R5, the 33 ohm resistor (color bands orange, orange, black) should now be mounted and soldered. Next mount and solder the bridge rectifier D1, making sure to orientated the + pin of the rectifier to the silk screen. Now, mount and solder capacitors C2 and C3, 330uF capacitors. Next mount and solder D2, the 1N5401 diode and C5, .01 uF capacitor.

Figure 4



Wire the double ganged potentiometer as shown in Figure 5. Next, solder the opposite ends of the wires to the printed circuit board, in the box labeled “POT”. The center wire of the potentiometer is soldered into the center pad on the labeled box. The two end wires are soldered into the pads on either side of the center position.

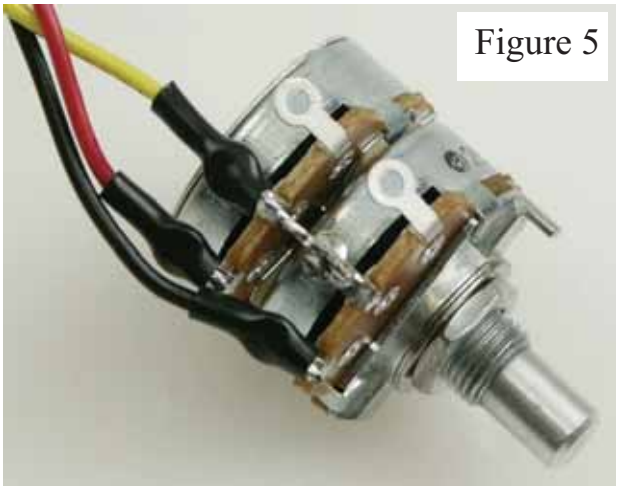


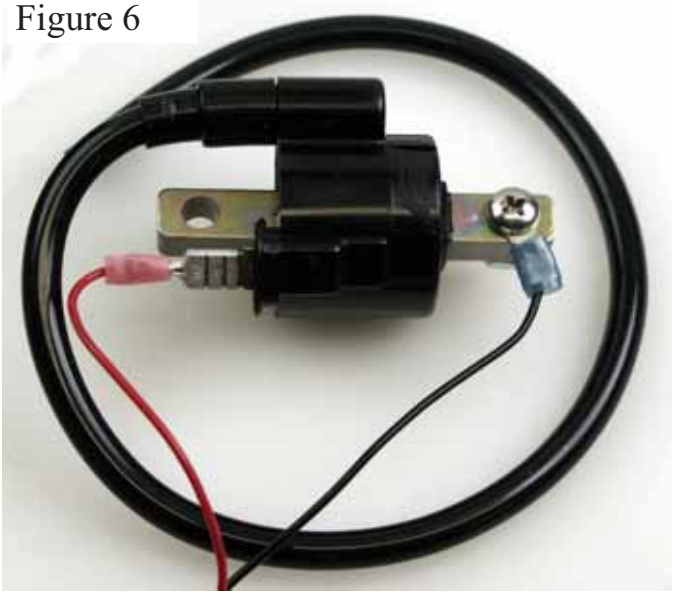
Figure 5

Mount the Q1 transistor to the black aluminum heat sink. Next, mount the heat sink and transistor to the Q1 position on the PC board. The heat sink has two feet that fit into the holes on the PC board. Solder the heat sink feet in the holes to make a mechanically strong bond.

Attach 6 inch wires to both switches SW1 and SW2. Solder opposite ends of the wire into the pads marked SW1 and SW2 on the pc board respectively. Switch SW1 controls power to the circuit. Switch SW2 is the frequency high-low frequency control. Mount and solder capacitors C1 (.047uF), C4 (.1uF) to the PC board. Solder two 10” lengths of wire to the HV coil pads on the PC board. Attach the crimp terminals to the opposite ends on these wires. The quick disconnect terminal attaches to the (+) wire; the ring terminal to the (-). Attach these terminals to the HV coil as shown in Figure 6. Making sure to place the (+) lead to the (+) terminal on the HV coil. See Figure 2.

Attach power leads to either the AC input or DC input pads on the PC board.

Figure 6



Next install the integrated circuit. When installing integrated circuit (IC) chips, begin by first identifying the top of the chip. The top of the chip has a marker, many times it is a half circle cutout. Sometimes it is a small mark identifying pin 1 on the IC. In both cases the marks show us the top of the IC chip. Orientate the top of IC chips with the white silk screen drawings of the components on the top of the pc board (usually a half circle cutout) or on the parts placement drawings and install the IC into their socket. The leads on the PC board labeled M+ and M– are not used.

Testing & Finishing Construction

To test the circuit, take the open end of the HV wire and place it about ¼" away from the (-) terminal on the ignition coil. Apply power to the circuit. An electrical discharge should jump between the HV wire and the negative terminal of the ignition coil. Adjust the potentiometer (frequency control) to obtain the largest spark across the discharge.

If you do not get a continuous HV spark, you have a board error. Go back to your pc board and start checking your components and soldering.

The working circuit should be mounted inside a plastic enclosure. Coat any exposed wires with a plastic spray to provide insulation (No-Arc spray is available at your local Radio-Shack store. Corona dope is another insulating material. In a pinch you can use clear nail polish. Since nail polish is flammable, allow the nail polish to completely dry before using the circuit.)

Frequency & Voltage Output

Using the standard C1 and C4 capacitors the low frequency range is approximately 500-1250 Hz. The high frequency range is approximately 1000-2000 Hz. Using a 24 VDC input voltage to the circuit, the voltage output, measured using a spark gap and spherical electrodes is approximately 30-40 KV.

HVPS-01 Parts List

(1) PCB-36

(1) Heatsink-03

(1) .047 uF, 100V capacitor -C1

(2) 330 uF, 16V capacitors -C2,C3

(1) .1 uF, 100V capacitor- C4

(1) .01 uF, 100V capacitor- C5

(1) HV Transistor-Q1

(1) 7805 Voltage Regulator-Q2

(1) 3055-Q3

(1) LM555 Timer-U2

(1) HV transformer (HVT-09)-T1

(1) 15K 1/4 watt resistor-R1

(1) 4.7 K 1/4 watt resistor-R2

(1) 100 ohm 1/4 watt resistor-R3

(1) 330 ohm 1/2 watt resistor-R4

(1) 33 ohm 1/4 watt resistor-R5

(1) 2.2 Mega ohm 1/4 watt resistor-R6

(1) Bridge rectifier (BR-4A-100)-D1

(1) 1N5401 diode-D2

(1) SPST toggle switches(SW18)-SW1,SW2

(1) double ganged 10K potentiometer-POT

(1) 8 pin socket

(1) Screw 540x3/8 PH Z

(1) Nut 540x5/16 SS

(1) Ring Terminal (blue)-Terminal-34161

(1) 1/4" Quick Disconnect Terminal (red)

(1) Screw 1024x5/8-PH

(1)Nut 1024x3/8Z

(1)Lockwasher-LW-10

How to Solder

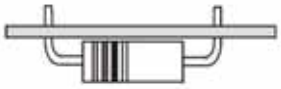
Tools

This page provides the basic steps for soldering electronic components onto a pc board.

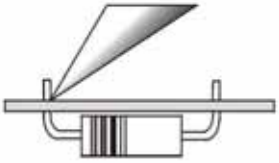
Soldering Iron, small sponge, electronic rosin core solder, side cutters and needle nose pliers.

Step 1:
Turn on soldering iron. Moisten small sponge with water.
When soldering iron is hot, tin the soldering iron tip using a small amount of rosin core solder. Melt the solder onto the tip until the tip is completely covered with solder. Excess solder on the tip may be removed by wiping the tip across the wet sponge. Keep the tip clean by wiping the iron across the wet sponge periodically.

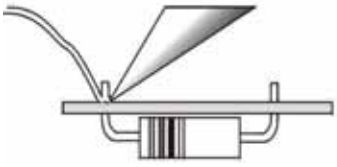
Step 2:
Bend the component leads to fit inside the PC board holes



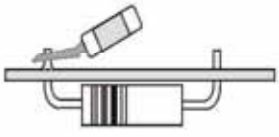
Step 3:
Insert the component into the pc board, taking care to orientate the component as described in the directions. Bend the leads slightly to hold the part into position



Step 4:
Tin soldering iron tip if necessary. Heat the joint by positioning soldering iron tip against the component lead and the pc board lead.

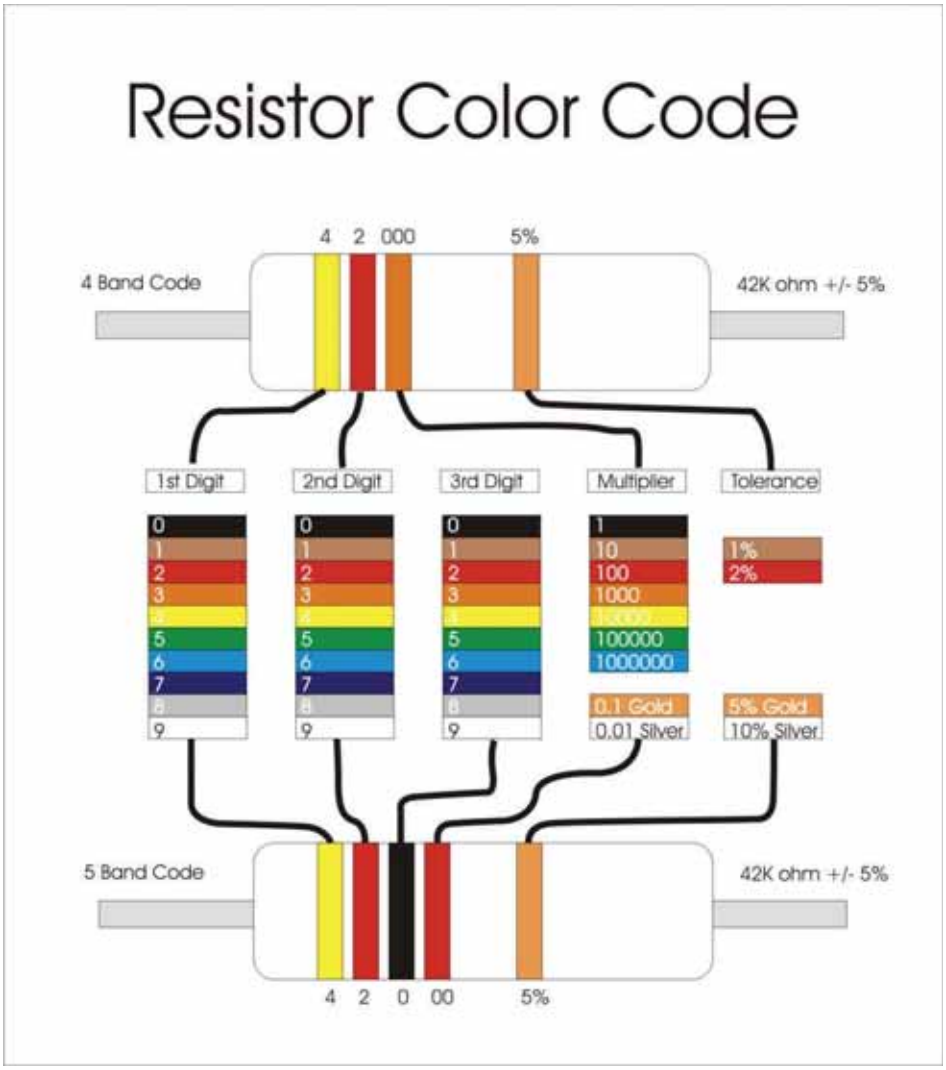


Step 5
After a few moments of heating, apply the solder to the joint. The solder should flow easily around the joint. After the solder flows, remove the solder, while keeping the soldering iron tip in contact. Then remove the soldering iron tip.



Step 6:
Trim the excess component lead from the bottom of the pc board using the side cutters.

Step 7: Inspect the solder connection
A good solder connection joints the component lead and pad together and has a bright finish.
If the connection is a glob of solder that looks like a ball, or bridges other solder connections.. Reflow the connection by remelting the connection using the soldering iron. Do not apply any more solder.



Appendix A
Determining Resistor Values:

Resistor values are read using the color bands on the body of the resistor. The first band is the one nearest the end of the resistor. Start reading from this band. The first band represents the first significant number, the second band, the second significant number and the third band is the multiplier. If the third band is gold or silver this indicates a multiplier value of .1 or .01 respectively.

Color	Value	Multiplier
Black	0	1
Brown	1	10
Red	2	100
Orange	3	1000
Yellow	4	10000
Green	5	100000
Blue	6	1000000
Violet	7	10000000
Gray	8	100000000
White	9	1000000000

Tolerance (%)

Gold 5%
Silver 10%
No Band 20%

Example: A resistor with the following color bands Red, Red, Orange, Silver

1st Number Red = 2
2nd number Red = 2
3rd Number Orange = 3 multiplier (# of zeros) that equals 1000
Silver = 10%

Putting it all together:

Red	Red	Orange	Value	Tolerance
2	2	x 1000	= 22,000 ohms	+/- 10%