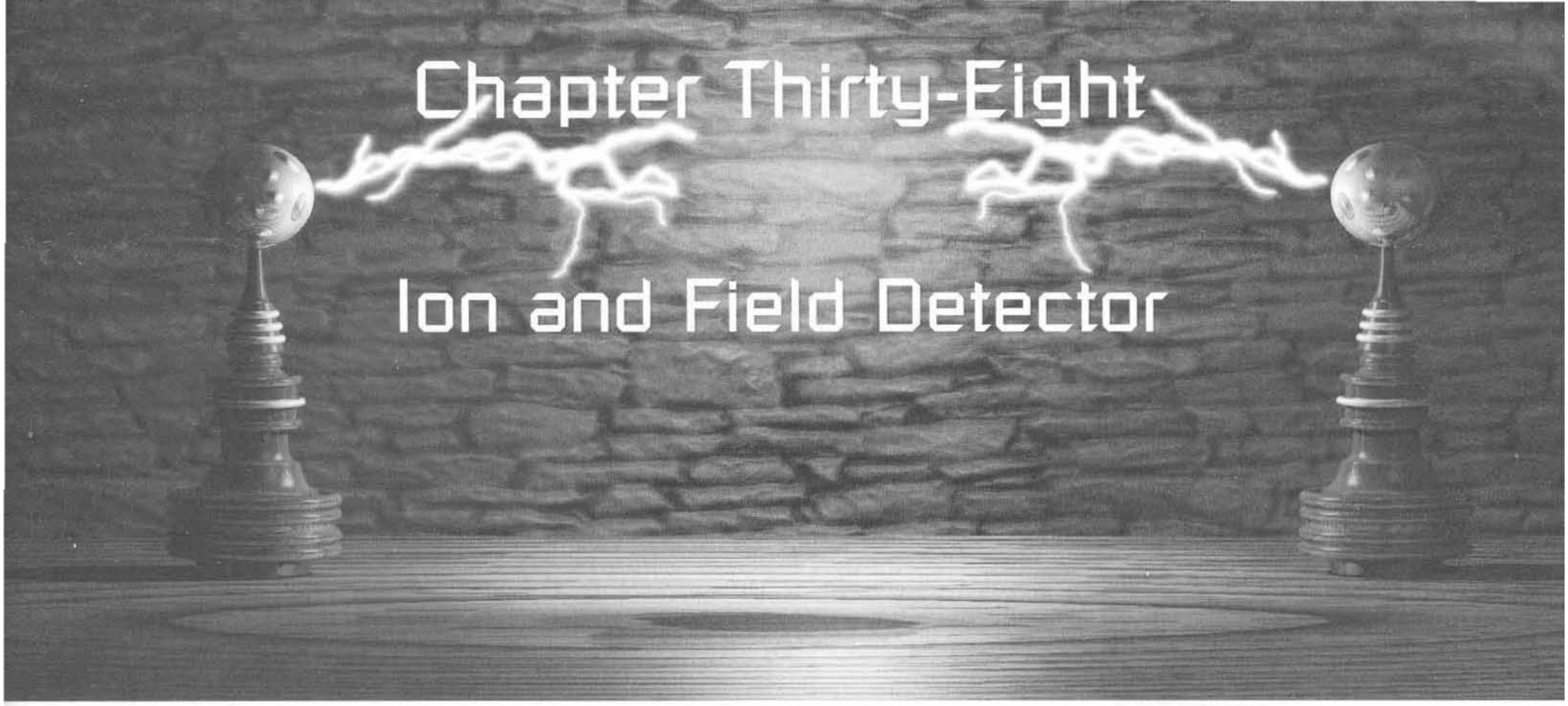


Chapter Thirty-Eight

Ion and Field Detector

This chapter focuses on a device capable of detecting and indicating the relative amount of free ions in the air (see Figure 38-1). It can determine the output of ion generators, high-voltage leakage points, static electrical conditions electric field gradients, and any other application where the presence of ions or a measurement of their relative flux density is required. It can also be used as a very sensitive lightning indicator, showing dangerous electric field levels.

Figure 38-1 *Ion and field detector*

The unit is handheld and enclosed in a plastic enclosure about the size of a king-size pack of cigarettes. A sensitivity control with an on/off switch, a high flux indicator lamp, and a meter are located on the front panel. A telescoping antenna exits a hole in the top of the unit and is used as a moving probe or a stationary pickup point for these charge fields. Grounding the unit is a strip of metallic foil on the outside of the enclosure that contacts the user's hand or may be directly connected to earth ground via a wire. Please note that the performance of this unit can be seriously affected by high humidity conditions.

Circuit Description

As shown in Figure 38-2, ions are accumulated on the collector probe ANT1 and cause a minute, negative base current to flow in transistor Q1 connected as a PNP Darlington pair with transistor Q2. Capacitor Cl and resistor R1 form a time constant to eliminate any rapid fluctuations. The response of the time constant can be changed for various applications and is discussed in Figure 38-2. Diodes D1 and D2 prevent excessive voltage from destroying Q1 by clamping any transients to ground. The collector of Q2 is DC

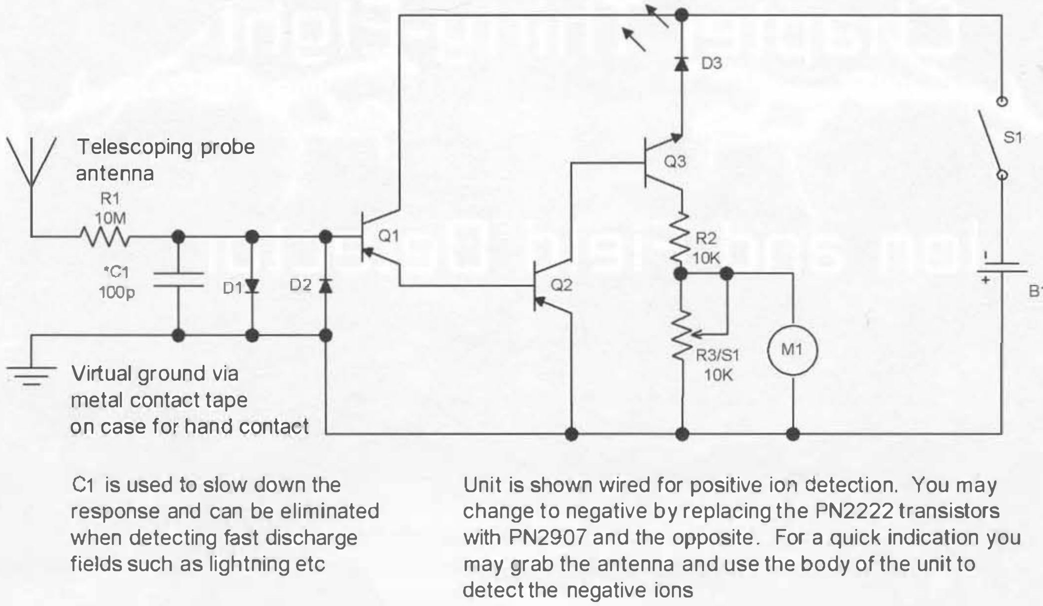


Figure 38-2 *Circuit schematic*

coupled to the base of NPN transistor Q3 in series with current-limiting resistor R2 and meter sensitivity pot R3. Current flowing through Q3 now causes a voltage to develop across R3, driving the indicator meter M1. *Light-emitting diode* (LED) D3 is connected in series with the emitter of Q3 and serves as a visual indicator of strong charge fields. It should be noted that the meter serves only as a relative indicator of ion flux and is not totally that linear.

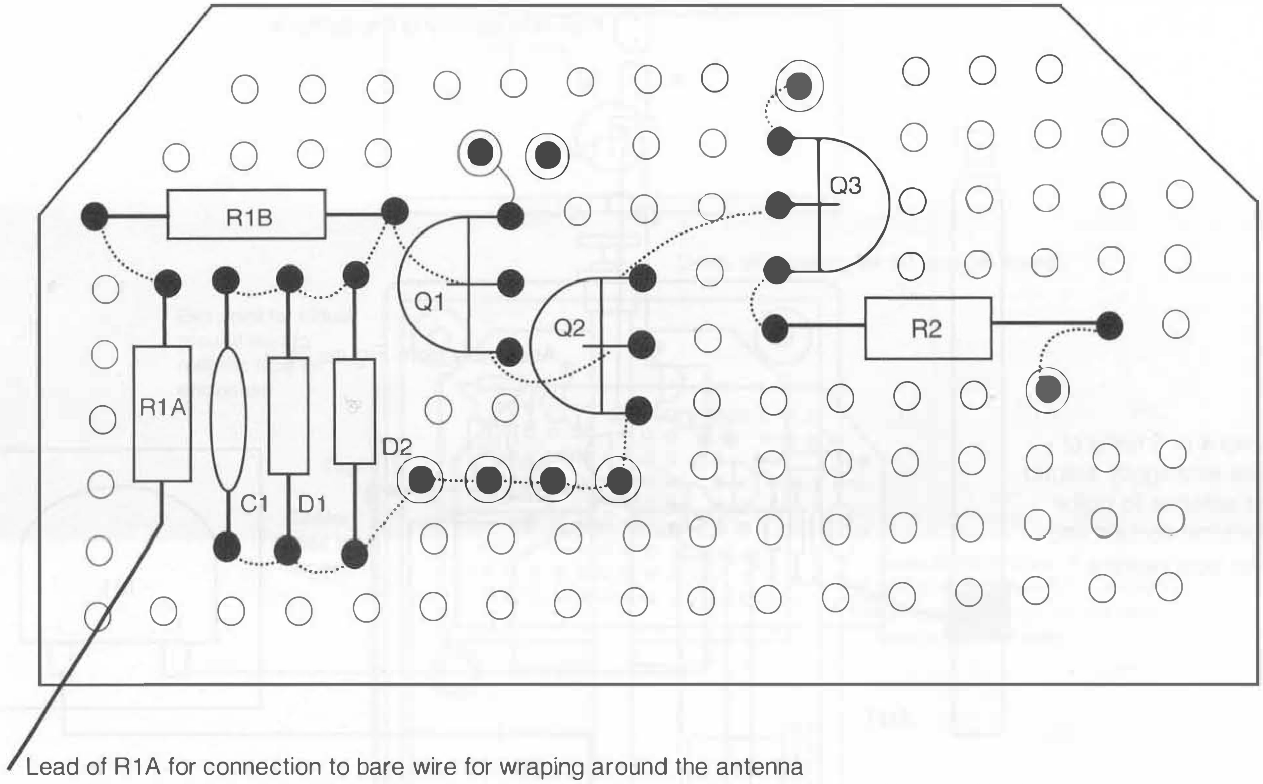
A threshold voltage, as a result of the base emitter, drops off Q1 and Q2 is only noticeable at almost non-detectable levels. It should be noted that in order for the unit to operate properly, some sort of ground is usually required. Metallic tape is used as shown and provides contact to the operator's hand, providing a partial ground. If the unit is placed remotely, it should be earth grounded to a water pipe, for example.

Measuring positive ions simply involves holding the antenna, using the body of the unit as the probe, or reversing the polarity of the transistors. A *double pole, double throw* (DPDT) switch may be optionally installed for polarity reversal, allowing reversal at the flick of a switch. Be aware that a ceramic or quality switch must be used to avoid leakage in high humidity conditions.

Construction Steps

1. Lay out and identify all the parts and pieces. Verify them with the parts list, and separate the resistors as they have a color code to determine their value. Colors are noted in the parts list at the end of the chapter.

2. Cut a piece of .1-inch grid perforated board to 2 × 1 inches. Locate and drill the holes as shown in Figure 38-3. If you are building from a perforated board, it is suggested that you insert the components starting in the lower left-hand corner as shown. Pay attention to the polarity of all the semiconductors. Route



This symbol indicates holes used for leads of components.

This symbol indicates holes used for connection points of external leads.

Dashed line indicates wiring performed on underside of board. Use the leads of the components whenever possible for these wire runs.

Board size is 1.9 x 1 inch and is .1 x .1 centers.

Figure 38-3 *Assembly board wiring*

the leads of the components as shown and solder as you go, cutting away unused wires. Attempt to use certain leads as the wire runs or use pieces of the #24 bus wire. Follow the dashed lines on the assembly drawing as these indicate the connection runs on the underside of the assembly board.

3. Attach the external leads and components as shown in Figure 38-4.

4. Double-check the accuracy of the wiring and the quality of the solder joints. Avoid wire bridges, shorts, and close proximity to other circuit components. If a wire bridge is necessary, sleeve some insulation onto the lead to avoid any potential shorts.

5. Create the plastic case, as shown in Figure 38-5. Note the 1-inch meter hole centered and located approximately 1½ inch from the top as shown. Holes for the switches are centered and located 1 inch below the meter line. Location is not critical, but make sure everything is clear and fits together.

6. Place a strip of foil tape as shown, noting a hole for the connection to the common circuit

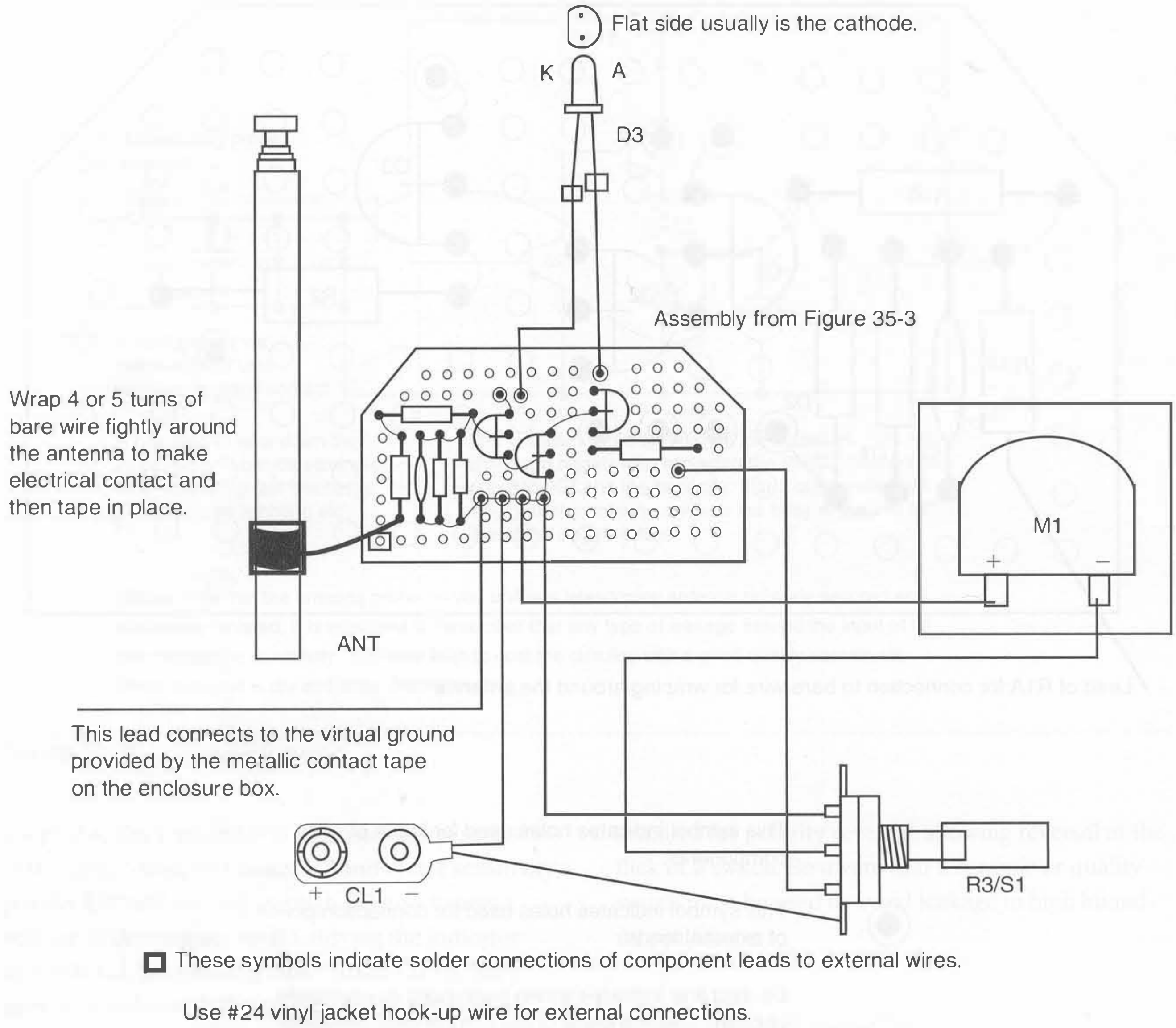


Figure 38-4 *Final wiring and assembly*

point. Secure the assembly board with double-sided tape after circuit operation has been verified.

7. Install battery B1 as shown and turn on the control. Rotate R3 fully clockwise and note the meter showing a slight indication. This is due to transistor and circuit leakage and should not be considered an indication of the ions. If meter sensitivity responds in the opposite way, you may have to reverse the wires across the outer terminals of R3 or the meter leads.

8. Extend the antenna about 6 inches and adjust R3 fully clockwise. Obtain a plastic comb and run it through your hair or rub a plastic object with a dry cloth. Place it near the probe and note the meter indicating a strong charge and the diode lighting. This effect may be reduced if the air is damp or moist.

9. Make the final assembly, as shown in Figure 38-6.

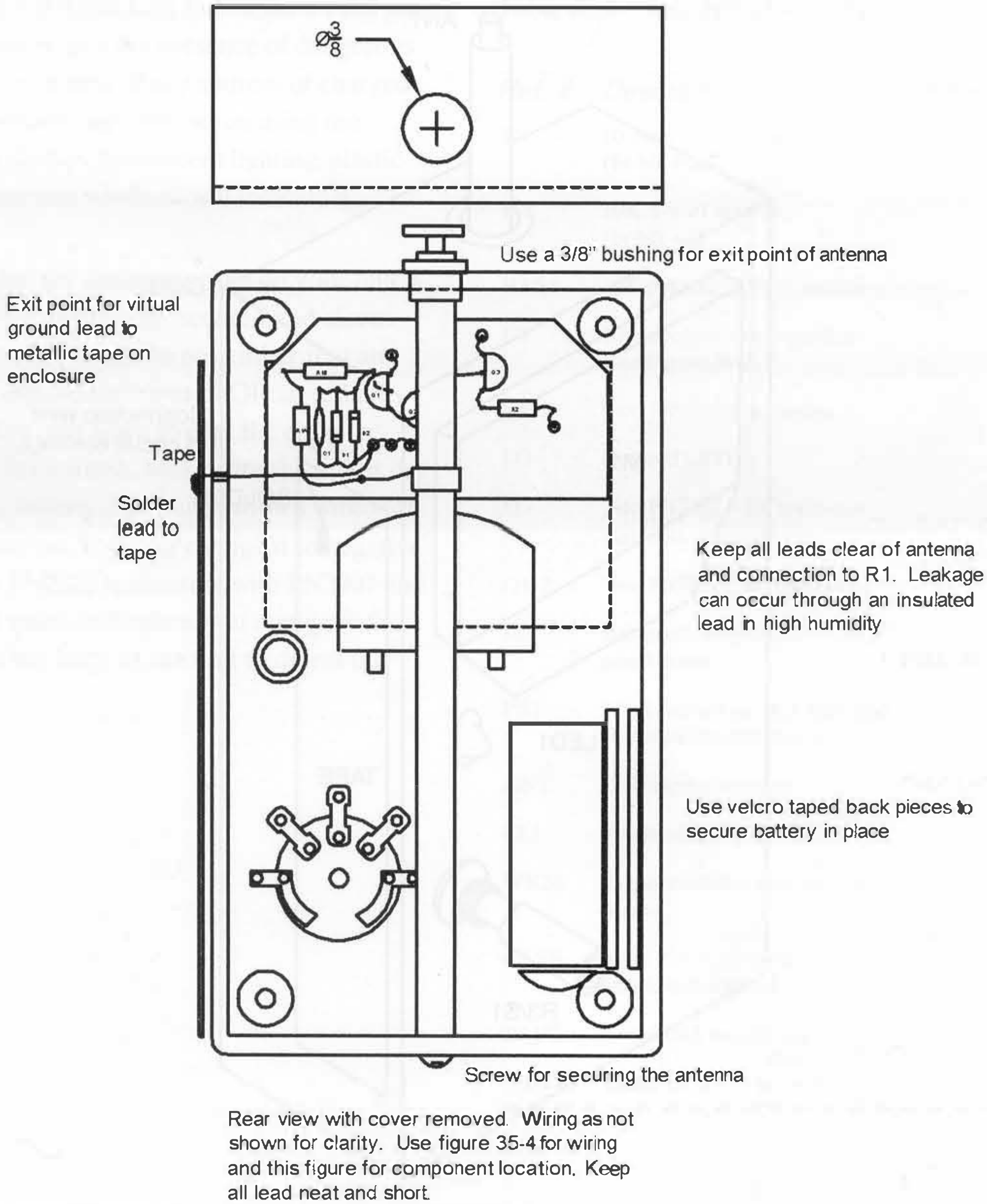


Figure 38-5 *Final assembly*

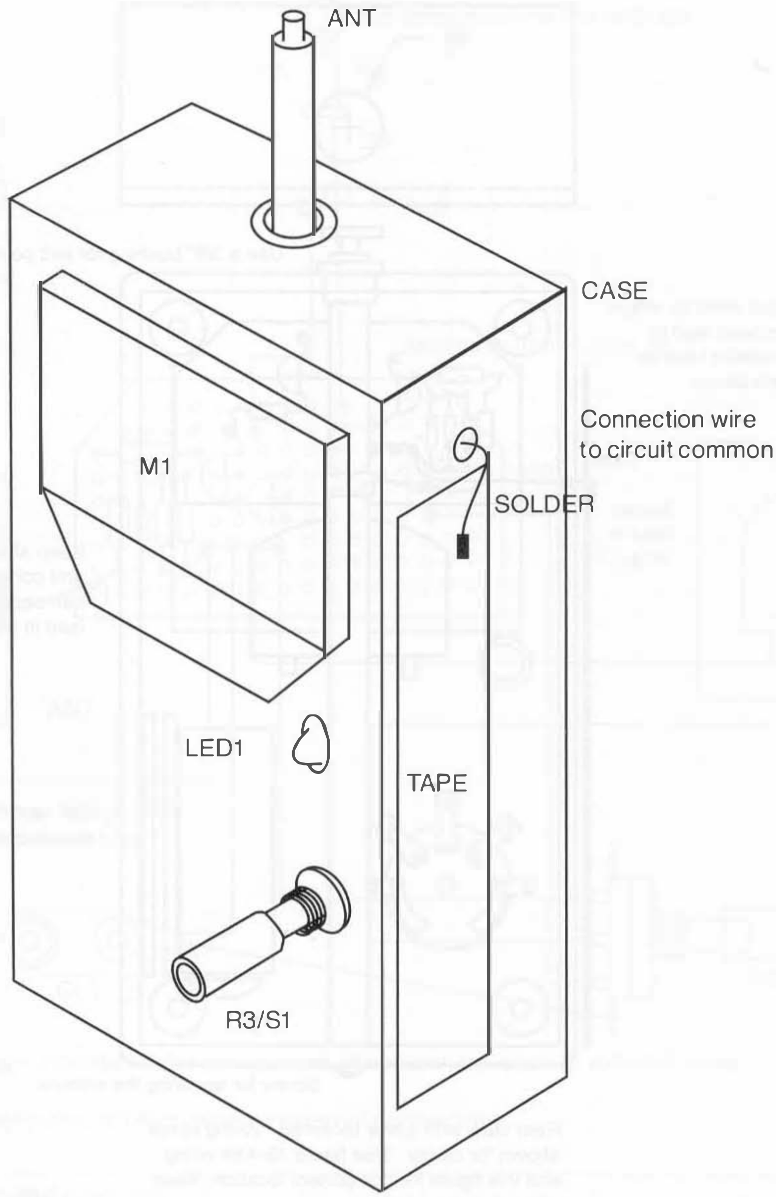


Figure 38-6 *Completed unit*

Applications

Your ion detector is a very, very sensitive ion-measuring device. It can be used for relative measurement but is not designed for absolute measurement.

For quick indications of the presence of a negative ion field, the unit may be handheld and actually used to determine where the source is. The sensitivity of this device can be realized by the simple experiment of running a plastic comb through one's hair and laying it near the probe, as described above.

Those who are familiar with the metallic leaf electroscope will soon realize the advantage of portability and sensitivity. When used for indicating or testing the relative strength of ion sources, the unit should be hard wire grounded for the best results. Adjustments to an ion source to determine the ion output may be made, noting the meter reading and then readjusting R3 to bring the meter reading to scale.

A very interesting phenomenon will be noted when using this device for detecting residual ion fields, the shielding of ions, field direction, static charges, resultant polarity, and the intensity of static charges, as well as a host of others. The unit is an invaluable tool for determining the output of ion generators, any purifiers, and the presence of dangerous static electricity situations. Many sources of charged particles soon become apparent when using the device. People's clothes, fluorescent lighting, plastic containers, and certain winds all will indicate a charge.

Please note that the antenna probe on your unit is a telescoping antenna properly secured and electrically isolated. It is important to remember that any type of leakage around the input of Q1 can reduce the sensitivity. You may want to coat the circuitry with a good-quality varnish. Make sure the unit is dry and clean before sealing. The unit is shown wired for positive ion detection. You may change it to negative by replacing the PN2222 transistors with PN2907 and vice versa. For a quick indication, you may grab the antenna and use the body of the unit to detect the negative ions.

Table 38-1 Ion Detector Parts List

Ref. #	*Description*	*DB Part #*
R1	10 meg, ¼-watt resistor (br-blk-blue)	
R2	10K, 1-watt resistor (br-blk-or)	
R3/S1	10K pot and 12 VDC switch	
C1	100-picofard disk capacitor (see Figure 38-2)	
D1,2	Two 1N914 signal diodes	
D3	Colored LED	
Q3	Two PN2222 NPN transistor (see note on reversing)	
Q1,2	Two PN2907 PNP transistors	
M1	100-micro-amp, small panel meter	DB# METER50S
PB1	1 × 2-inch piece of .1-inch grid perforated circuit board	
ANT	Telescoping antenna	DB#ANT1
CL1	9-volt battery clip	
WR24	24 inches of #24 vinyl hookup wire	
CASE	4⅜ × 2⁷⁄₁₆ × 1¼-inch plastic box with lid	
TAPE	4 × ½-inch metal tape	
WR24B	12 inches of #24 bus wire	