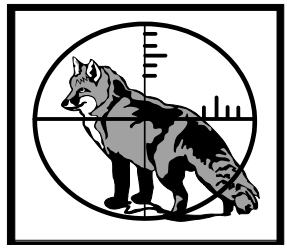
"FOXHOUND" RADIO DIRECTION FINDER KIT



Ramsey Electronics Model No. DF1

Track down those mysterious signals with ease! Join the latest craze, Foxhunting! The DF1 hooks up to ANY radio in seconds with just two connections: antenna and speaker. Be the one with the answers, win those transmitter hunts, track down jammers, you'll do it all with the Foxhound!

- **Works with any radio, any frequency**
- **Whip antennas provided, just add a few feet of PVC pipe or wood on which to mount them and you're off!**
- **Dual LEDs show which direction to the transmitter**
- **Meter and audio tone indication of direction null**
- **Convenient 9 volt battery or 12 volt operation**
- **Automatic transmit detector circuit allows transmitting through the Foxhound - no more switching cables!**
- **Informative manual answers questions on theory, hook-ups and uses - enhances resale value, too!**
- **Clear, concise assembly instruction carefully guide you to a finished kit that works FIRST time!**

PARTIAL LIST OF AVAILABLE KITS

RAMSEY TRANSMITTER KITS

- **FM25B, FM10A FM Stereo Transmitters**
- **AM1, AM25 AM Transmitters**
- **TV6 Television Transmitter**
- **FM100B Professional FM Stereo Transmitter**

RAMSEY RECEIVER KITS

- **FR1 FM Broadcast Receiver**
- **AR1 Aircraft Band Receiver**
- **SR2 Shortwave Receiver**
- **AA7 Active Antenna**
- **SC1 Shortwave Converter**

RAMSEY HOBBY KITS

- **SG7 Personal Speed Radar**
- **SS70A Speech Scrambler**
- **MX5, MX10 Mixers**
- **MD3 Microwave Motion Detector**
- **PH10 Peak hold Meter**
- **STC1 Stereo Transmitter Companion**

RAMSEY AMATEUR RADIO KITS

- **DDF1 Doppler Direction Finder**
- **HR Series HF All Mode Receivers**
- **QRP Series HF CW Transmitters**
- **CW7 CW Keyer**
- **CPO3 Code Practice Oscillator**
- **QRP Power Amplifiers**

RAMSEY MINI-KITS

Many other kits are available for hobby, school, scouts and just plain FUN. New kits are always under development. Write or call for our free Ramsey catalog.

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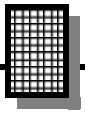

KIT ASSEMBLY
AND INSTRUCTION MANUAL FOR

DF1 DIRECTION FINDER KIT

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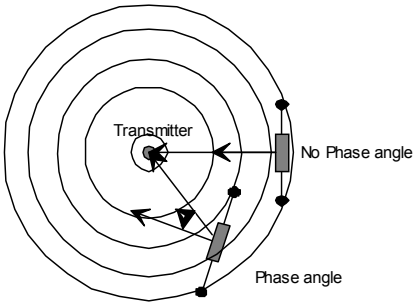
INTRODUCTION TO THE RAMSEY DF1:

The Ramsey DF1 is a switched phase array direction finder. It switches back and forth between two antennas to detect where the transmission is being sent from. Using this method, it is very accurate to determine the direction of transmission, unlike a directional antenna which is subject to mechanical limitations if made big enough to provide sharp directional characteristics. While a directional antenna relies on a strong signal, and a lot of tweaking around to find its peak, the DF1 does not. Once the kit is put together, and tuned up, your kit is ready to go. No adjustments or changes have to be made for different bands, it may be used with virtually any radio as long as you can hook up to its audio output and antenna! Let's see how it works.

DF1 CIRCUIT THEORY:

The operation of the DF1 is based on phase differences. When the two antennas on the array are switched back and forth rapidly and the antennas are not the same distance away from a transmission, a phase modulation is developed in the received frequency. Since phase modulation is very much the same as frequency modulation, it can be demodulated on any FM receiver. This comes through the receiver as a tone with a specific phase in reference to the rate at which the antennas are being switched. If the switched array is rotated so that the antennas are the same distance away from the transmission signal source, there will be no phase difference. When the received signals are in phase the tone disappears and a null is achieved. When the switched array is rotated either to the left or to the right of the null, the phase of the resulting audio shifts in respect to the rate of the switched antennas. This phase shift is then detected resulting in the left to right indications on the DF1.



Take a look at the DF1's schematic diagram as we walk through the actual. circuit.

U3:A and U3:B form a simple oscillator operating at about 100kHz. This is the standard frequency that all other components in this circuit are run by or referenced to. The output of the oscillator is fed into the 74HC390 dual decade divider to be divided down to 1kHz for the rate at which the antennas are switched.

The 1kHz signal passes through a low frequency coupling capacitor network formed by C2 and C3 and then through the RF choke L1 to pin diodes D1 and D2. These diodes do most of the work in the circuit; they switch your receiver from one antenna to the other at the rate of 1kHz.

C4, C6, and R11 act as a high pass circuit to reject the 1kHz from going into your receiver. The RF received by the two antennas passes right through from the switched antennas to J3.

When you key up the radio, or push to talk in radio lingo, the circuit consisting of Q4, Q5, Q1, and surrounding parts act as a TX switch. When activated, the TX line goes high, so that it leaves D1 in the switching circuit on during the duration of transmission. This prevents your transmitted signal from being modulated by the switching of the antennas, and all your friends from hearing an obnoxious 1kHz tone.

The audio from the radio, which now includes the switched antenna tone, is fed back into the DF1 to be processed by U2, a switched capacitor filter. U2 is a very unique component due to the fact that it requires no frequency dependent components, and can reproduce a bandpass filter, a notch filter, a lowpass, a highpass, and even an all-pass filter. In this case we only want the 1kHz tone passed, so a bandpass filter will suit our needs. To make the LTC1059 pass a 1kHz signal, a 100x frequency reference is required. This is the reason why the oscillator runs a 100kHz instead of 1kHz. The 100kHz signal is fed into U2 which allows us to very accurately bandpass the 1kHz tone with a very narrow bandwidth.

Since the amplitude of the 1kHz tone is dependent on the direction of the array in respect to the transmission received, the output of the LTC1059 is fed directly through a DC rectifier, and into the analog meter for level indication.

The LTC1059's bandpass output is also fed into the remaining opamp on the same chip for further amplification. Its purpose in the circuit is to square-up the 1kHz received tone so that phase detection can be completed.

The phase detection portion of the circuit uses an exclusive NOR gate, U3:C to

compare the oscillator's phase to the received phase of the 1kHz tone. The output of this phase comparator is converted to a DC level and is fed to a window comparator. To properly set the reference voltages for the window comparator, a second XNOR gate U3:D is used to maintain the standard in-phase voltage on the voltage divider R24, R26, R28, and R31. When the inputs to the phase detector are from the left of a transmission signal source, the output voltage is low, U4:B's output is low, and U4:A's output is high so the LED lights. When the inputs are from the right, the output of the phase detector is higher, U4:B's output is high, and U4:A's output is low. This output level is what determines what comparator in the window comparator is high, and determines if the transmission is to the right or to the left.

RAMSEY DF1 "FOXHOUND" PARTS LIST:

SEMICONDUCTORS

- ❑ 1 7805 5 volt power regulator (VR1)
- ❑ 1 2N3906 (or 221-334) PNP transistor (Q1)
- ❑ 3 2N3904 NPN transistor (Q2,Q4,Q5)
- ❑ 1 LTC1059 or MF5 switched capacitor filter IC (U2)
- ❑ 1 LM358 dual opamp IC (U4)
- ❑ 1 74HC266 or 74HC7266 quad XNOR IC (U3)
- ❑ 1 74HC390 dual decade counter IC (U1)
- ❑ 2 Jumbo LED (D8,D9)
- ❑ 2 BA482 pin diode (D1,D2) (small glass body marked BA482)
- ❑ 6 1N4148 type diode (D3,4,5,6,7,12) (glass body with black band)
- ❑ 1 1N4000 series diode (any 1N4000 diode may be shipped) style black epoxy diode (D11)

CAPACITORS AND INDUCTORS

- ❑ 4 .01uF disc capacitor (marked .01 or 103 or 10 nF) (C4,5,6,16)
- ❑ 1 27pF disc capacitor (marked 27 or 27K) (C8)
- ❑ 1 100pF disc capacitor (marked 100 or 101)
- ❑ 1 330pF disc capacitor (marked 330 or 331) (C20)
- ❑ 1 100 uF electrolytic capacitor (C11)
- ❑ 4 100 to 220uF electrolytic capacitor (C2,C3,C7,C13)
- ❑ 6 10uF electrolytic capacitor (C1,C10,C12,C17,C18,C19)
- ❑ 1 2.2uH inductor (red-red-gold, green body) (L1)

RESISTORS

- ❑ 2 100 ohm (brown-black-brown) (R25,30)
- ❑ 1 100K ohm (brown-black-yellow) (R14)
- ❑ 7 10K ohm (brown-black-orange) (R1,2,4,5,22,24,31)
- ❑ 1 150 ohm (brown-green-brown) (R12)
- ❑ 14 1K ohm (brown-black-red) (R6,10,11,15,18,23,26,27,28,29, 32-35)
- ❑ 1 2.2K ohm (red-red-red) (R3)
- ❑ 2 4.7K ohm (yellow-violet-red) (R16,20)
- ❑ 2 470 ohm (yellow-violet-brown) (R8,9)
- ❑ 1 220K ohm (red-red-yellow) or 200K ohm (red-black-yellow) (R13)
- ❑ 1 10K to 100K ohm potentiometer with switch (R17)
- ❑ 1 25K ohm potentiometer [thumb wheel style, stand-up](R21)

HARDWARE AND MISCELLANEOUS

- ❑ 1 Battery holder
- ❑ 1 Battery clip
- ❑ 1 Set hardware for potentiometer
- ❑ 1 length (approx 7') of thin coax wire, RG-174 style
- ❑ 4 Whip antennas
- ❑ 4 mounting screws and nuts for antennas
- ❑ 1 Meter
- ❑ 1 RCA jack (J3)
- ❑ 2 2.5 MM earphone style jacks (J1,2)
- ❑ 1 DC power jack (J4)
- ❑ 1 length or pieces (approx 2' total) of hookup wire

"THE RAMSEY LEARN AS YOU BUILD ASSEMBLY STRATEGY"

Take a look at the parts layout diagram; there is quite a lot to the construction of the DF1. In order to simplify things a bit we begin by placing a few of the larger "landmark" components. Once these "landmark" components are placed, other part's positions are referenced to them, and construction goes quite smoothly. This will help in relating from one part to another what specific holes a part may require on the board, and the part's orientation. In addition, we will discuss the purpose of most components or groups of components as we go along. This is the Ramsey Learn As You Build kit assembly philosophy.

Be sure to read through all the steps, and check the boxes as you go so that you didn't miss any important steps. Most of the problems we find here at the factory are due to faulty assembly - no matter how experienced the builder may be - it's especially tough to tell a 30 year experienced ham that he goofed! Before you run the circuit, check all diodes and polarized capacitors for proper orientation.

Tips and Notes:

Use a good soldering technique - let your soldering iron tip gently heat the traces to which you are soldering; heat both wires and pads simultaneously. Apply the solder on the iron and the pad when the pad is hot enough to melt the solder. The finished joint should look like a drop of water on paper, somewhat soaked in.

Parts are mounted on the top side of the board, that is the side that has no traces or pads on it.

IC sockets - A good practice, but not necessary in digital or low frequency circuits such as this. This prevents the horror of desoldering a bad or incorrectly placed IC.

Part orientation - All parts in the kit are mounted at 90 degree angles to each other, meaning that all parts are either parallel or perpendicular to the board.

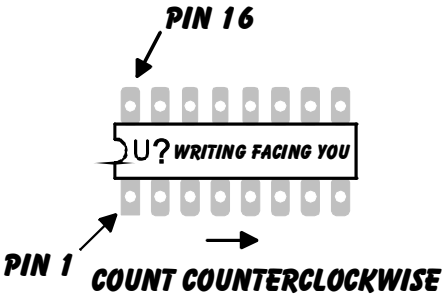
Part installation - when parts are installed, the part is placed flat to the board, and the leads are bent on the backside of the board to prevent the part from falling out before soldering. The part is then soldered securely to the board, and the remaining lead length is then clipped off. Make sure lead lengths are as short as possible when dealing with the RF section of this kit. Some parts may have body paint on their leads, preventing the solder from making a firm bond. In this case, lightly scrap the paint away to allow the solder to make contact with the wire.

CONSTRUCTION OF THE DF1:

The first thing we will do with this kit is check all of our parts and pieces to make sure we have them all. Use the parts list and your parts finder to do this. If there are any differences, make sure the schematic agrees with what you have, and also be aware of the tolerances parts have in a kit. Non-critical parts can vary quite a bit with almost no effect on kit operation. For example you may get 1uF capacitors in place of 10uF capacitors, or a 100K pot in place of a 10K pot. No harm done as these will make no difference in kit operation. Now that your parts are sorted go ahead and break apart the small antenna circuit boards from the main board. You can use the edge of a table or your workbench at the breaking point for a clean break. Once you start soldering the parts in and clipping off the excess leads you'll want to save a few of the longer ones to use as jumpers later in the construction process.

- ❒ 1. Orient the circuit board as shown in the parts layout diagram.
- ❒ 2. Install J1 and J2, the 2.5 MM earphone style jacks.
- ❒ 3. Install J3, RCA jack. Solder all pins securely. This is the connection to the antenna of your radio.
- ❒ 4. Install R21, the 25K ohm stand up style potentiometer. R21 is the adjustment for the 100 kHz clock signal.
- ❒ 5. Install R20, 4.7K ohm resistor (yellow-violet-red).
- ❒ 6. Install C20, 330pF ceramic capacitor (marked 330 or 331).
- ❒ 7. Install U3, 74HC266 Exclusive NOR gate. Study the orientation of the IC on the parts layout diagram. Make sure the dot or notch is in the same direction on the parts layout as on the IC chip. We have just completed the 100kHz oscillator section of your kit. Grab a soda and celebrate!
- ❒ 8. Install R25, 100 ohm resistor (brown-black-brown), this is to limit current to the left indicator LED.
- ❒ 9. Install JMP4 and JMP6. Jumpers act like "bridges" over traces on the underside of the board. Construct a jumper by using a scrap of wire from a previously installed part.
- ❒ 10. Install R31, a 10K ohm resistor (brown-black-orange).
- ❒ 11. Install R30, 100 ohm resistor (brown-black-brown). This resistor limits the current to the right indicator LED.
- ❒ 12. In the same way that you installed U3 in step 7, install U4, LM358 dual op amp. Study the orientation of this device to make sure it is correct before soldering

- ❒ 13. Install C19 and C18, 10uF electrolytic capacitors. Caution! pay special attention to the orientation of these devices because they are polarized and will only work properly if connected correctly. Usually the Negative (-) lead is marked on the capacitor body while the Positive (+) hole is marked on the PC board.
- ❒ 14. Install R28, 1K ohm (brown-black-red).
- ❒ 15. Install R27, 1K ohm resistor (brown-black-red).
- ❒ 16. Install R29, also a 1K ohm resistor (brown-black-red)
- ❒ 17. Install R24, 10K ohm resistor (brown-black-orange).
- ❒ 17a. Install R32-R35, 1K ohm resistors (brown-black-red). Note that all four resistors are mounted on end. Bend one lead back across the resistor so both of the leads fit neatly in their holes.
- ❒ 18. Install R26, another 1K ohm resistor (brown-black-red - you most likely know the colors by now!) to the right of R24. We will hold off on D8 and D9 for now (the two LEDs) these will be installed when you begin installation into the case. So far we've completed the 100kHz oscillator, phase detection section and direction indicators.
- ❒ 19. It is time to install U2, the LTC1059 or MF5 switched capacitor filter. Before installing, bend pin 9 out from the body of the part at a 90 degree angle. You do not want to place pin 9 through the PC board and solder it. The pins on an IC are counted starting below the notch or dot and going counterclockwise around. See the diagram below if you're unsure. First, pay attention to the orientation of U2; that it is properly oriented as shown in the parts layout diagram. Place U2 with pin 9 sticking out into the PC board and solder all the pins except pin 9 into place. Take a small piece of wire, wrap it around and solder it to pin 9, then loop it over pin 10 and solder it to pin 11. Be sure the wire does not connect both pins to pin 10 but that it loops over without touching pin 10.
- ❒ 20. Install R22, 10K ohm resistor (brown-black-orange).
- ❒ 21. Install JMP1 from a piece of scrap wire clipping.



- ❒ 22. Install R1, a 10K ohm resistor (brown-black-orange).
- ❒ 23. Install C11, the small 100 uF electrolytic capacitor. Again pay special attention to the orientation of the capacitor's polarity. This capacitor helps smooth unwanted signals out of the power source.
- ❒ 24. Install R13, 220K ohm resistor (red-red-yellow). May be a 200K (red-black-yellow).
- ❒ 25. Install R15, 1K ohm resistor (brown-black-red).
- ❒ 26. Install R16, 4.7K ohm (yellow-violet-red).
- ❒ 27. Install C10, 10uF electrolytic capacitor. Pay close attention to polarity.
- ❒ 28. Install R18, 1K ohm resistor (brown-black-red).
- ❒ 29. Install D6, 1N4148 style diode (glass body with black band), paying special attention to it's banded end. This end is the cathode and it will only work in one direction, so orient it in the same direction as shown on the parts layout diagram. This diode rectifies the received signal into a DC level for the meter.
- ❒ 30. Install C17, 10uF electrolytic capacitor. Note orientation.
- ❒ 31. Install R23, 1K ohm resistor (brown-black-red).
- ❒ 32. Install D7, 1N4148 style diode (glass body with black band). This diode prevents over voltage on U3. Pay special attention to its orientation.
- ❒ 33. Install C13, 220uF electrolytic capacitor. Pay extra close attention to the polarity, if oriented incorrectly, it may get warm or explode upon power up - a definite attention getter!
- ❒ 34. Install VR1, the 7805 three pin 5 volt regulator. Observe the correct orientation of the metal heat sink tab.
- ❒ 35. Install C7, a 220uF electrolytic capacitor. Be sure and observe the proper orientation.
- ❒ 36. Install jumper JMP3.
- ❒ 37. Install R5 a 10K ohm resistor (brown-black-orange).
- ❒ 38. Install Q2, a 2N3904 NPN transistor. This transistor helps to drive the null meter so that your unit is sensitive to low volumes. Be sure to observe the orientation of the flat side, and that it is the same as the parts layout diagram.
- ❒ 39. Install C1, a 10uF electrolytic capacitor. Pay close attention to the orientation of this device, otherwise your meter may not work as desired.

❒ 40. Install D12, a 1N4148 type diode (glass body with black band), be sure to orient the band on the diode in the same direction that the band on the parts layout diagram is pointing.

❒ 41. Install R6, a 1K ohm resistor (brown-black-red).

Whew! I think we're ready for a break. We have just completed a total of 4 more sections. We've completed the voltage regulated section consisting of C13 and VR1. Also the switched capacitor filter of U2, and a secondary op amp circuit in that IC. We have also completed the meter driver circuit consisting of C1, C17, D6, D12, Q2, R5, R6 and R18.

❒ 42. Install D3, 1N4148 style diode (glass body with black band). Pay close attention to the orientation of this device. This diode prevents the 9 volt TX signal from occurring on the 74HC390, which could destroy it.

❒ 43. Install U1, the 74HC390 dual decade counter. Pay special attention to the orientation of this component and make sure that the dot or notch is in the same position as the notch on the parts layout diagram.

❒ 44. Install C12, 10uF electrolytic capacitor. Pay close attention to the orientation of this component. This capacitor smooths out the unwanted noise in the 5 volt power source.

❒ 45. Install R4, a 10K ohm resistor (brown-black-orange).

❒ 46. Install C3 and C2, 220 uF electrolytic capacitors. These convert the single ended (0 to +5 volt) TTL output of U1 to a bipolar AC output (-2.5 to +2.5 volt), allowing the PIN diodes for the switching antennas to be alternately switched on and off.

❒ 47. Install R2, 10K ohm resistor (brown-black-orange).

❒ 48. Install R3, 2.2K ohm resistor (red-red-red).

❒ 49. Install Q1, marked 221334 PNP transistor (similar to 2N3906) make sure the larger flat side is oriented in the same direction as in the parts layout. This transistor performs the task of switching on one PIN diode continuously when RF is sensed from the radio going into transmit mode.

❒ 50. Install L1, 2.2 uH inductor (green body with red-red-gold bands).

❒ 51. Install C5, a .01uF ceramic capacitor (marked .01 or 103 or 10 nF), since ceramic capacitors are not polarity sensitive, orientation is not critical as it was with electrolytic capacitors.

❒ 52. Install R10, 1K ohm resistor (brown-black-red).

❒ 53. Install D2, BA482 pin diode (small glass body marked BA482). This diode switches one of the antennas on and off.

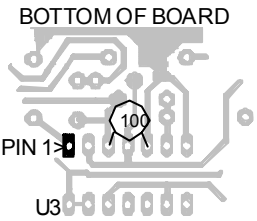
Now we are leaving the low frequency world and moving into the high

frequency RF world. It is very important in an RF environment to keep all leads lengths as short as possible and create solid, clean solder joints.

- ❒ 54. Install C4, .01uF ceramic capacitor (marked .01 or 103 or 10 nF).
- ❒ 55. Install C6, .01uF ceramic capacitor (marked .01 or 103 or 10 nF).
- ❒ 56. Install C8, 27pF ceramic capacitor (marked 27 or 27K or 27J). This capacitor directs a little of the transmitted RF into the TR sensing circuit.
- ❒ 57. Install R11, 1K ohm resistor (brown-black-red).
- ❒ 58. Install R9, 470 ohm resistor (yellow-violet-brown), a current limiting resistor for D2.
- ❒ 59. Install D1, BA482 pin diode (small glass body marked BA482). Observe the correct polarity of the diode, making sure the banded end is facing in the same direction as in the parts layout. This is one of the RF steering diodes that does one of two things depending on the DC bias on the part. It either directs RF into your radio or prevents it from being directed into your radio. When it is forward biased RF can travel easily through the diode. When the diode is reversed biased it prevents RF from traveling through it.
- ❒ 60. Install R12, 150 ohm resistor (brown-green-brown).
- ❒ 61. Install R8, 470 ohm resistor (yellow-violet-brown). This resistor limits the current through D1 while allowing it to be forward biased to allow RF to pass through it.
- ❒ 62. Install D4, 1N4148 style diode (glass body with black band). Pay close attention to it's orientation.
- ❒ 63. Install D5, also a 1N4148 type diode.
- ❒ 64. Install C16, .01uF ceramic capacitor (marked .01 or 103 or 10nF).
- ❒ 65. Install R14, 100K ohm resistor (brown-black-yellow).
- ❒ 66. Install Q4 and Q5, both 2N3904 NPN type transistors. Note the proper orientation of the flat side. These transistors help in the TX switching circuit, they sense the RF along with D4 and D5.
- ❒ 67. Install diode D11 a 1N4002 style epoxy rectifier diode. Observe correct orientation of the cathode band. This diode prevents the battery, if used, from feeding into the external power source.
- ❒ 68. Install J4, external power source jack. Due to the large hole size in relation to mounting lugs, you may wish to bend over the lugs on J4 to allow more mechanical contact to the PC board before soldering.
- ❒ 69. Install the 9 volt battery snap, paying close attention to placing the red and black leads into the proper PC board holes.

❒ 70. Install your battery bracket. To do this you can use a spot of hot glue, or solder pieces of wire lead through the holes provided to the bracket. Make sure and mount this securely since this kit will most likely be handled roughly.

❒ 70a. Install a 100pf capacitor on the bottom side of the board from pin 3 of U3 to pin 5 of U3 as shown. This is a modification that has been added to increase the reliability of your DF1.



Well, we have completed another long stretch of part placing and it's time to take a break. In the past section we installed the divide by 100 chip to get 1kHz, the TR switching, antenna switching, and some minor audio circuitry. All we have left to do is assembly of the case, and wiring some final components to the board.

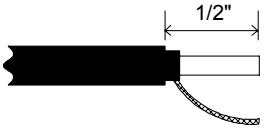
❒ 71. This is a critical step in the production of a working kit. Take your seven feet of coax cable and cut it in half so that both pieces are exactly equal (within an inch or so). If the coax to the antennas are not equal in length, some phase difference will result, and will prevent accurate location of a transmitter.

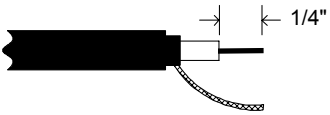
❒ 72. Strip both ends of each piece very carefully about ½ of an inch back from the ends, being careful not to remove any of the outside shield wires. This is a gentle procedure, so take your time. Use a sharp knife or X-acto blade and lightly cut through the coax's black insulation. Slip off the insulation to expose the coax braid. If you mess up, and cut the wire or have some other mishap, just clip off the bad end and remove the same amount from the other coax wire to keep the lengths equal.

❒ 73. Carefully unbraid the braided wires and twist them all together neatly. Ensure that there are no stragglers or frayed ends.

❒ 74. Now strip back the center insulation about ¼ of an inch from the end. Twist these center conductor wires together neatly.

❒ 75. Lightly "tin" the wire ends by gently heating the conductors and then applying solder, using enough to coat the wires. The solder will "soak" up into the wires nicely. Be especially careful when tinning the shield braid wires since the heat from soldering will travel up the shield wires and may melt the insulation. Its a good idea to use a "heat-sink" when soldering. Use a pair of long nose pliers and grip the shield wires





between where you're soldering and the rest of the cable. The heat cannot travel past the point where the pliers are touching the wires - unless there's enough heat to heat up the pliers!

❒ 76. Since you did so good on one of the coax ends, you get to do it 3 more times! Prepare the ends of all coax wires the same.

❒ 77. These coax wires are now soldered to the indicated points on the PC board. Insert the coax center conductor and shield wires into the indicated holes on the board. Carefully solder in place, without melting the wire insulation by overheating.

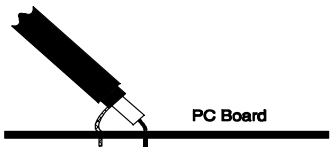
You may wonder what the extra 4 small holes are that surround the large coax shield hole. These holes may be used as ground holes if you want to use Teflon coax wire. Some folks - with both exceptional RF experience and a strong budget! - like to use Teflon coax due to its ability to be soldered without melting insulation.

❒ 78. Repeat the above procedure with the other piece of coax wire.

❒ 79. A QUICK COAX CHECK:

When you are done, check to make sure that the coax center connector is not shorted to the shield. Use an ohmmeter or continuity checker to measure resistance between the center conductor and the shield - it should be greater than 200 ohms (remember there are some resistors on the PC board which are connected to the cable). If it is not, you have a short. Don't be too disappointed, it means you have to repair the short circuit by rechecking the just soldered connections or start over by reinstalling the wires - remember that both coax wire must be the same length (within an inch or so).

❒ 80. From the hookup wire supplied, select or cut 7 pieces about 3½ inches long. Strip the ends back ¼ of an inch of all seven wires. Tin the exposed ends of each wire with a little solder to make later soldering easier. The following steps assume that you have purchased the Ramsey case set, if not use your own case and adjust the instructions accordingly.



ASSEMBLY INSTRUCTIONS FOR CUSTOM CASE

The enclosure is a key element to the overall pride you will have upon completing your Ramsey kit. The enclosure will show how you were able to "build from scratch" a commercial piece of high-tech electronics. For some of us, the enclosure will also hide a number of "not-so-pretty" assembly mistakes. Once the kit is enclosed, your friends will never know that you were new to soldering. Finally, the enclosure case will protect your electronics from many possible causes of damage so that you can receive years worth of enjoyment using, talking about, and remembering the fun you had building your kit. In short, TAKE YOUR TIME when assembling the enclosure. This is the part that you and your friends will look at and admire for years!

◊ Lay the front and rear plastic plates over their corresponding labels to verify which sticker goes with which panel. You'll want to work with one panel at a time to avoid possible mix-ups.

◊ Remove the backing material from one of the stickers and line it up properly on its pre-punched panel. Make sure that they are aligned correctly before allowing them to touch the plastic plates. They stick the first time; line them up right!

◊ Use a sharp hobby knife to cut out the holes in the labels along the pre-punched holes. A short sawing motion works well around the inner circumference of the holes.

◊ Repeat the above steps for the other panel.

❒ 81. Mount the analog meter onto the case top (textured side).

❒ 82. Solder a wire from the positive terminal of the meter to the "+" meter hole on the circuit board. This hole is marked on the parts layout diagram.

❒ 83. Solder a wire from the negative terminal of the meter to the "-" meter hole on the circuit board.

❒ 84. Mount the potentiometer with switch in the case cover. Use the mounting hardware supplied to securely fasten the control to the case.

❒ 85. Solder a wire from the hole marked "A" on the parts layout to the "A" pin on the potentiometer.

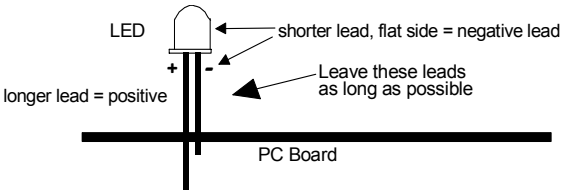
❒ 86. Solder a wire from the hole marked "B" on the parts layout to the "B" pin on the potentiometer.

❒ 87. Solder a wire from the hole marked "C" on the parts layout to the "C" pin on the potentiometer.

❒ 88. Solder a wire from the hole marked "W" on the parts layout to the "W" pin on the potentiometer.

❒ 89. Solder a wire from the hole marked "CC" on the parts layout to the "CC" pin on the potentiometer.

❒ 90. Mount D8 and D9, the two direction LEDs. They must be installed correctly for proper operation. Examine the LED body, notice that one side is flat; this side must face the edge of the board. Since the LED has to protrude through the case cover, you must leave the lead as long as possible. Just pass through the PC board the minimum amount of lead to allow a good solder joint.



Now we're done with our PC board assembly. Time for a well deserved rest and careful examination of our craftsmanship! The next step is to construct the antenna assembly.

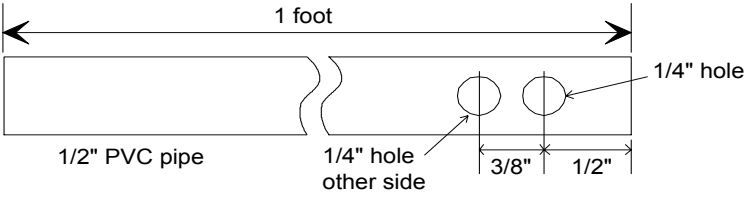
ANTENNA ASSEMBLY INSTRUCTIONS:

The antenna assembly requires the purchase of some common PVC pipe, fittings and cement. These materials are available at hardware, plumbing and home improvement stores. Of course, you may elect to use other materials you may have on hand - just be sure that you follow the same basic instructions.

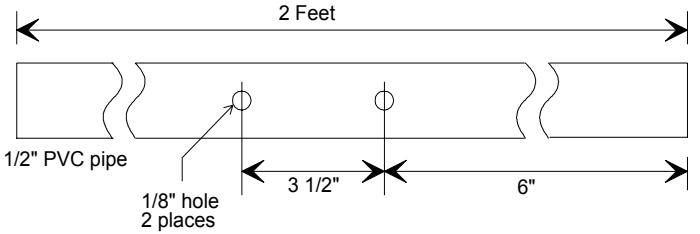
Materials needed:

- 4 feet ½ inch PVC pipe
- 1 ½ inch PVC Female "T"
- 2 ½ inch PVC caps
- PVC cement

❒ 91. Cut the 4 foot piece of ½ inch PVC into two 1 foot long sections and one 2 foot long section.



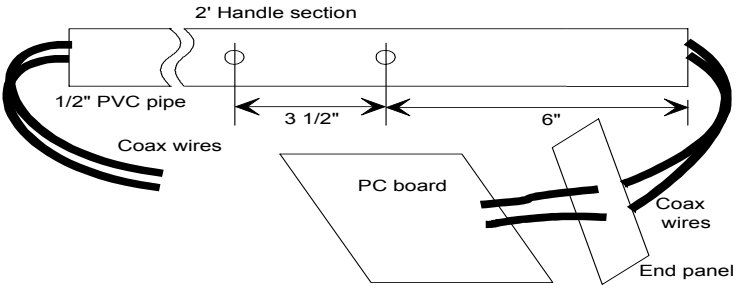
❒ 92. Follow the antenna hole drilling drawing and drill (or melt) the indicated holes in each end of the two 1 foot long pieces.



❒ 93. Follow the handle hole drilling drawing to locate and drill two 1/8" holes in the 2 foot long PVC pipe handle section. These holes are where the case will be attached to the handle.

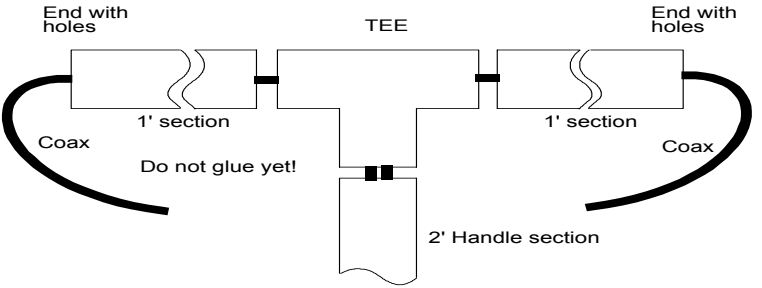
❒ 94. Use two 1 inch long mounting screws and nuts to mount the bottom of the case to the PVC pipe handle section.

❒ 95. Thread the coax wires through the case end panel holes, making sure the silk screened text is facing outward. Then thread the coax through the PVC pipe handle section. Let some coax hang out the open end of the pipe so it doesn't fall back through.

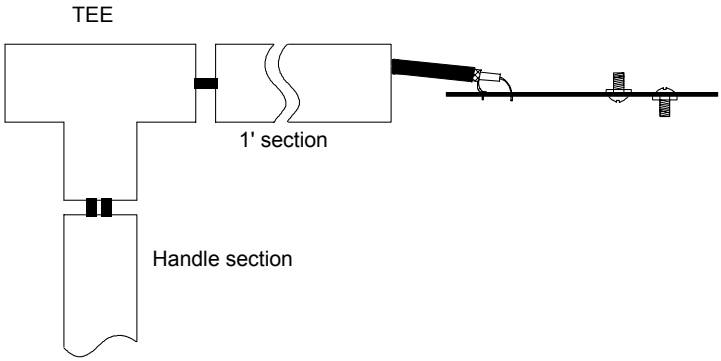


❒ 96. Mount the PC board to the bottom of the case using four 4-40 screws provided in the case set.

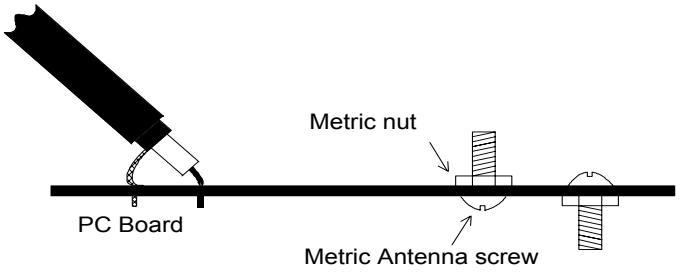
❒ 97. Mount the "TEE" on the end of the pipe with the coax, lead the left (ANT1A1) antenna wire through the left side of the TEE, and the right wire (ANT1A2) through the right side. Do not glue PVC pipe yet.



❒ 98. Thread the coax through the 1 foot PVC pipe sections. Have the ends with the pre-drilled holes facing away from the TEE.



❒ 99. Solder the coax to the narrow antenna mounting PC boards. Pay special attention to the orientation of the boards, Note that the larger antenna mounting holes face outwards, lining up with the pre-drilled holes in the PVC pipe. Use the same soldering technique that was used in previous steps. Use your ohmmeter or continuity checker to check for cable shorts as you did before.



❒ 100. Fasten the antenna mounting hardware to the PC board strips. One screw faces up while the other faces down. Tighten these securely since they are responsible for mechanical stability of the antenna whips.

❒ 101. Slip the PC board strips into the PVC pipe end with the outermost screw facing down, then screw on the antenna whips.

This completes all the circuit assembly of your DF1 kit, let's move on to finishing it all up.

INITIAL TESTING:

To begin our initial tests, we need a few missing pieces to complete the whole direction finding system. These are:

- A radio which you will be using in your direction finding hunts - in most cases a VHF handi-talkie or receiver,
- Suitable connectors for antenna and audio connection to the DF1
- A 9 volt battery.

1. Verify that all parts are mounted and soldered in the correct places, and there are no shorts in your antenna array.

2. Connect the 9V battery to the battery connector. Place the battery into the battery clip on the PC board.

3. Connect a cable from the speaker jack of your radio to the DF1 speaker input. Icom style radios use a 3.5 MM jack for speaker output while Kenwood radios use a 2.5 MM jack. The DF1 uses a 2.5 MM jack. These plugs are very common on small earphones that you probably have kicking around in the junk-box. If your junk-box isn't at full health, a quick trip to Radio Shack for the connectors may be in order.

4. Connect a speaker or headphone to the speaker output jack of the DF1. Unfortunately, when we plug into the handie-talkie speaker jack, it disconnects the handie's internal speaker, so we have to add another.
5. Connect a coax jumper from your radio antenna jack to the DF1 RCA phono jack antenna input.

6. Dial up a known repeater or transmitter on your radio.

7. Turn on the DF1 on and listen to a received signal, you should also hear a tone along with the signal. This tone indicates that the DF1 is properly switching the antennas, and that they are not pointing directly at the transmitter.

8. Adjust R21, the internal potentiometer until the tone is between 1kHz and 3kHz, (somewhat higher pitch than a CW tone) this is not critical because all the frequency dependant stages are tied together.

9. Adjust the sensitivity control on the front until the meter has a reading of almost full scale.

10. Rotate the antenna array to verify that the left/right indicators are working properly, and are indicating proper direction. If they are reversed, simply rotate the top beam of your antenna around 180 degrees so

that it is opposite from what it was. Now you know why we decided not to glue it yet!

11. Key (transmit) your radio and have a friend listen to it. Verify that the transmitted signal does not have any tone on it, this checks for correct operation of the RF sensing PIN diode circuitry. You don't want to have the antennas switching while you are transmitting - only when receiving! If any of these steps did not work as described, go to the trouble shooting section of the manual to determine how to resolve the problem. Screw the cover onto the DF1 and glue your antenna pipes together, we are ready to go!

Note: The DF1 should only be used with low power transmitters (5 watts max). If you wish to use it with higher power radios, no problem - just be sure not to transmit through the DF1 or you may damage the PIN diodes.

TROUBLESHOOTING TIPS:

PROBLEM: No audible tone when radio receives station, no response from the meter, and left right indicators are not operating.
SOLUTION: There are several problems associated with this symptom. The first and most often occurring is a short in the antenna coax cables. Check the resistance between the center lead and the outside lead for a resistance greater than 100 ohms; if it is less, or even zero, you will unfortunately have to rewire the coax to the antennas. If they both test OK and you still have no tone, check pin 3 of the 74HC266 IC to verify that there is a 100 kHz signal present. If not check to make sure you read five volts on pin 14 of the same IC. If not, check your battery and your power supply for solder bridges or cold solder joints (no connection).

If you do have a 100kHz signal, check pin 10 of U1, the 74HC390 IC. Verify that there is a 1kHz signal present. If not check pin 16 for 5VDC. If you read 5 volts and the output level is very low at pin 10, check to make sure there are no solder bridges in the circuit surrounding D1, D2, and L1. Also inspect the orientation of the diodes in the surrounding area.

PROBLEM: The meter pegs in the wrong direction.
SOLUTION: Reverse the wires going to the meter.

PROBLEM: The sensitivity control seems to operate in reverse.
SOLUTION: Switch the connections C and CC.

PROBLEM: The left/right indicators are reversed.
SOLUTION: Spin the top bar of the antenna around 180 degrees.

PROBLEM: The null is not directly pointing at the transmitter. It is always off by a couple of degrees in the same direction.
SOLUTION: Check to make sure that your coax cable lengths are equal.

PROBLEM: The LEDs are dim, and the tone frequency varies.
SOLUTION: Time for a new battery.

PROBLEM: The sensitivity of your radio is reduced, but still receives.
SOLUTION: This is normal since the actual time the antennas are switched on is not 100%. Typically the sensitivity is degraded about 6dB.

PROBLEM: The darn thing just won't work and I can't figure it out!
SOLUTION: See the Ramsey kit warranty information in the manual.

USING YOUR DF1

Since most ham magazine have articles or columns on fox hunting, we'll go over only some of the major details.

A variety of methods can be used in locating a hidden transmitter with the DF1. The first and most popular is the team method of triangulation. Three or more people spread out in different directions around where they suspect a transmitter is hiding. They then locate themselves on a map, and get a fix on the direction that the transmitter is located from each one of them. Lines are then drawn on the map, and where all three intersect is the area where the transmitter is located.

Another method that is popular is "following the null". This is done only if the transmission is continuous, and the signal strength is fairly strong. While you are moving in a vehicle or walking around, you simply swing the antenna array back and forth across the null. Then you walk or drive in the direction that the null is being detected. This method will lead you up to the very spot that the transmitter is located.

The ARRL has an excellent book on Foxhunting: "Transmitter Hunting: Radio Direction Finding Simplified" by Joseph Moell and Thomas Curlee available from: ARRL 225 Main St. Newington, CT 06111. 73 Magazine also has a monthly column, "Homing In" conducted by Joe Moell - 73 Magazine 70 Rt. 202N Peterborough, NH 03458. The site is: http://members.aol.com/homingin/

HINTS AND IDEAS:

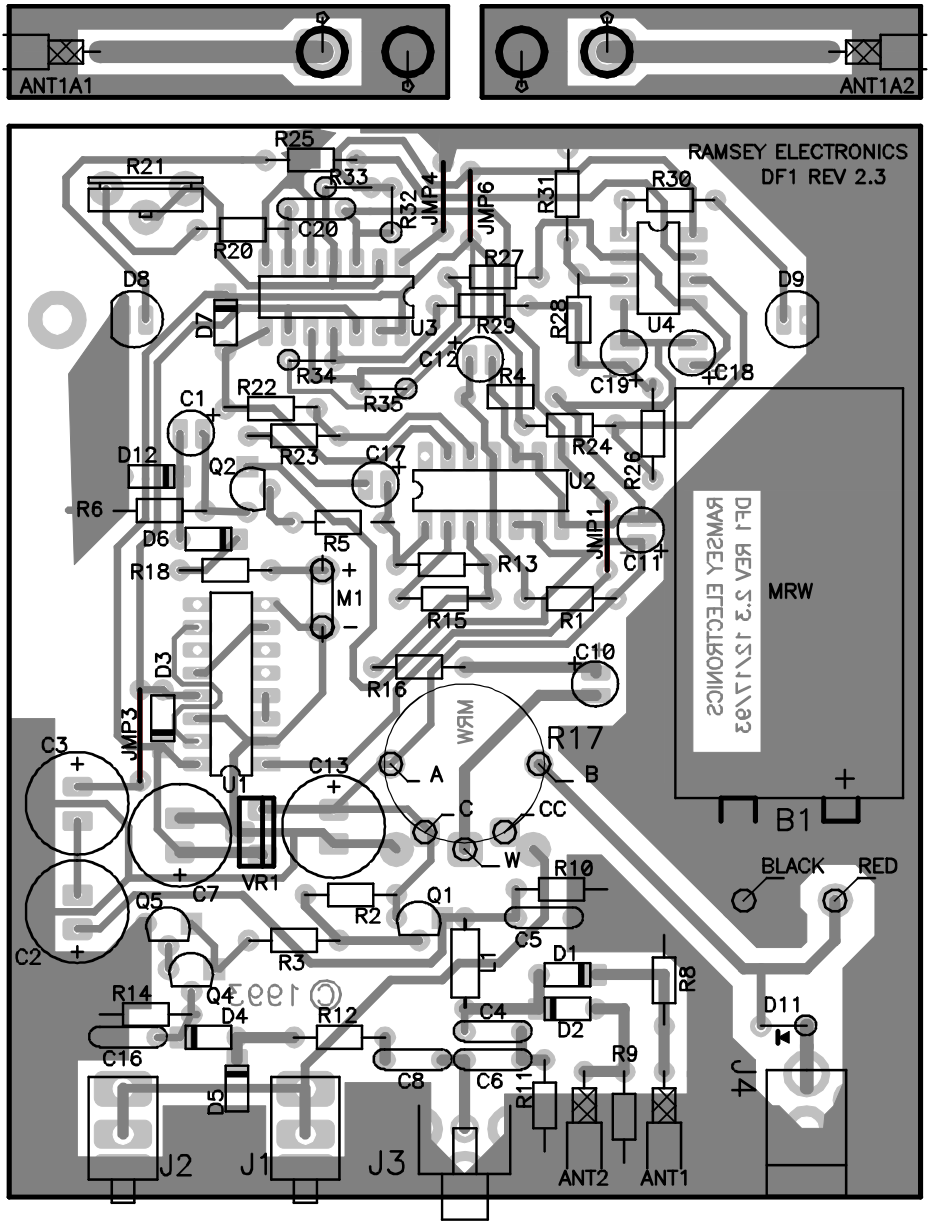
To get a good fix on the direction of the transmitter, a compass is usually used. A compass can be mounted directly onto or even inside of the DF1. Remember that you want to be able to detect the fox quickly and efficiently, so you will win the contest. Make sure you are comfortable with the DF1, you may want to put a cushioned bike handle over the pipe for your grasp, or even counter balance the DF1 with weight attached to the bottom pipe.

Remember that sometimes you may receive a null from a reflection that is stronger that the actual transmission. Don't be fooled! Move around a bit so that you are sure of your direction heading. Being near cars or buildings, or even other people can give erroneous direction readings. For best results, mount the array above your car if a mobile unit is desired, or stay away from large conductive objects.

Use your imagination; with a little ingenuity, you'll be winning those fox hunts in record time!

Call or write to us for details on our other hobby and amateur radio kits. And, ask for our free catalog, chock full of goodies!

DF1 PARTS LAYOUT DIAGRAM



The Ramsey Kit Warranty

Please read carefully BEFORE calling or writing in about your kit. Most problems can be solved without contacting the factory.

Notice that this is not a "fine print" warranty. We want you to understand your rights and ours too! All Ramsey kits will work if assembled properly. The very fact that your kit includes this new manual is your assurance that a team of knowledgeable people have field-tested several "copies" of this kit straight from the Ramsey Inventory. If you need help, please read through your manual carefully, all information required to properly build and test your kit is contained within the pages!

1. DEFECTIVE PARTS: It's always easy to blame a part for a problem in your kit, Before you conclude that a part may be bad, thoroughly check your work. Today's semiconductors and passive components have reached incredibly high reliability levels, and it's sad to say that our human construction skills have not! But on rare occasions a sour component can slip through. All our kit parts carry the Ramsey Electronics Warranty that they are free from defects for a full ninety (90) days from the date of purchase. Defective parts will be replaced promptly at our expense. If you suspect any part to be defec ive, please mail it to our factory for testing and replacement. Please send only he defective part(s), not the entire kit. The part(s) MUST be returned to us in suitable condition for testing. Please be aware that testing can usually determine if the part was truly defective or damaged by assembly or usage. Don't be afraid of telling us that you 'blew-it', we're all human and in most cases, replacement parts are very reasonably priced.

2. MISSING PARTS: Before assuming a part value is incorrect, check the parts listing carefully to see if it is a critical value such as a specific coil or IC, or whether a RANGE of values is suitable (such as "100 to 500 uF"). Often times, common sense will solve a mysterious missing part problem. If you're missing five 10K ohm resistors and received five extra 1K resistors, you can pretty much be assured that the '1K ohm' resistors are actually the 'missing' 10 K parts ("Hum-m-m, I guess the 'red' band really does look orange!") Ramsey Electronics project kits are packed with pride in the USA. If you believe we packed an incorrect part or omitted a part clearly indicated in your assembly manual as supplied with the basic kit by Ramsey, please write or call us with information on the part you need and proof of kit purchase

3. FACTORY REPAIR OF ASSEMBLED KITS:
To qualify for Ramsey Electronics factory repair, kits MUST:
1. NOT be assembled with acid core solder or flux.
2. NOT be modified in any manner.
3. BE returned in fully-assembled form, not partially assembled.
4. BE accompanied by the proper repair fee. No repair will be undertaken until we have received the MINIMUM repair fee (1/2 hour labor) of $25.00, or authorization to charge it to your credit card account.
5. INCLUDE a description of the problem and legible return address. DO NOT send a separate letter; include all correspondence with the unit. Please do not include your own hardware such as non-Ramsey cabinets, knobs, cables, external battery packs and the like. Ramsey Electronics, Inc., reserves the right to refuse repair on ANY item in which we find excessive problems or damage due to construction methods. To assist customers in such situations, Ramsey Electronics, Inc., reserves the right to solve their needs on a case-by-case basis.

The repair is $50.00 per hour, regardless of the cost of the kit. Please understand that our technicians are not volunteers and that set-up, testing, diagnosis, repair and repacking and paperwork can take nearly an hour of paid employee time on even a simple kit. Of course, if we find that a part was defective in manufacture, there will be no charge to repair your kit (But please realize that our technicians know the difference between a defective part and parts burned out or damaged through improper use or assembly).

4. REFUNDS: You are given ten (10) days to examine our products. If you are not satisfied, you may return your unassembled kit with all the parts and instruc ions and proof of purchase to the factory for a full refund. The return package should be packed securely. Insurance is recommended. Please do not cause needless delays, read all information carefully.

DF1 "FOXHOUND" DIRECTION FINDER
Quick Reference Page Guide

REQUIRED TOOLS

- Soldering Iron Ramsey WLC100,
- Thin Rosin Core Solder Ramsey RTS12
- Needle Nose Pliers Ramsey RTS05
- Small Diagonal Cutters Ramsey RTS04
  <OR> Complete Soldering Tool Set RS64-2801

ADDITIONAL SUGGESTED ITEMS

- Optivisor Magnifier Headband Ramsey OPMAG
- Helping Hands Holder for PC Board/Parts Ramsey HH3
- Desoldering Braid Ramsey RTS08

Price: $5.00
Ramsey Publication No. MDF1

Assembly and Instruction manual for:
RAMSEY MODEL NO. DF1 "FOXHOUND"
DIRECTION FINDER KIT

TOTAL SOLDER POINTS
201
ESTIMATED ASSEMBLY TIME
Beginner.....5.8 hrs
Intermediate.....3.3 hrs
Advanced .....2.5 hrs