# T H E  B U T T E R F L Y  H A N D I - F I N D E R

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The first ever Foxhunt in Calcutta will be held in January, 1995. Here is the design of a simple, inexpensive hand-held direction finder that I came across in the May, 1993 issue of QST published by the American Radio Relay League of which I am an Associate Member since 1988. The idea is ingenious, simple, state-of-art and all components are available locally. This handi-finder is great for Foxhunting. Simply connect it to the antenna input of your H-T and you can locate AM or FM sources over the range of 45 - 170 MHz. The real beauty of this contraption is that it is portable and can be used with our home-brewed 2 meter rigs as it doesnot require an S-meter nor an attenuator as you get very close to the signal source. The actual prototype built by the author was constructed on a printed circuit board but in order to reduce the cost of the same, I have built it on a simple verroboard with minor modifications.

**The author and designer of this handi-finder is Bob Leskovec, K8DTS of Cleveland, Ohio. He has been licensed since 1957, holds five patents and is the Director of Electronic Services at Case Western Reserve University, where he designs special electronic instrumentation for research and development.**

The heart of this circuit is based on an astable multivibrator built on a CMOS IC, CD4047 available at the local market in Calcutta at Rs. 35/- only. The 4047 has two astable outputs namely Q and Q compliment. The multivibrator alternatively switches the two diodes D1 and D2 (See Fig. 1) connecting one of the two antennas to the feed line attached to an FM receiver tuned to the desired frequency. Antenna switching is done at an audio rate, in the range of 400 - 1500 Hz usually at 1KHz, well within the receiver's audio pass band.

When one of the two antennas is closer to an interference source, it receives the wave-front a fraction of a second earlier than the other antenna. The result is a phase difference between signals received by the two antennas. The switching action imposes phase modulation on the incoming signal. The receiver detects this phase modulation as a tone equal to the switching frequency. As the physical separation of the two antennas increases the audio amplitude increases without any change in the audio pitch. When the antenna array is rotated such that the plane of the antennas is perpendicular (Broadside) to the incoming signal direction, the two antennas receive the signal simultaneously in phase resulting in a sharp audio null.

The only disadvantage of this direction finder is that their ia a 180 ambiguity which can be easily overcome by taking multiple bearings. The advantages however are overwhelming. The apparatus is very light, small and portable and there is

no need of a field-strength meter or an attenuator. Moreover it works on a nulling rather than a peaking principle. The null is sharp and easy to detect. Again the audio tone is nulled which is much easier to detect than conventional loop antennas where the carrier is nulled.

The CD4047B CMOS IC contains an oscillator and a flip-flop to automatically provide complimentary symmetrical square wave outputs at pins 10 and 11 without special adjustment. The values of C1 and R1 determine the switching frequency and hence the frequency of the audio tone. The inset table in the figure shows the values of C1 and R1 to be used for a particular frequency and corresponding tone. Very little current is used to bias the switching diodes D1 and D2, so the total circuit current drain is 1.7 mA at 9V. No power on LED is used as even an LED uses 10 mA or more. A 9 volt battery is sufficient and no external power supply is required. I mounted the battery on the board using two clamps made of brass soldered on the board. The switch S1 is a DPDT slide switch (on-off-on) having three positions. Centre is off, up is for Dfing and down is for straight receiving or standby. **Donot transmit through the unit as that could blow the diodes, because the switching system doesnot maintain a 50 ohm impedance.**

As the antennas have no path to circuit ground there is no need for dc blockling capacitors. I used two simple copper wire antennas having the appearance of butterfly wings soldered directly to the board. Take two equal lengths of stiff wire about 19 inches long and bend each of them into a neat U shape. The bottom of the U should be 6 inches across. One end of the U is soldered at the junction of D1 and R4 at one end of the board and the other bottom end soldered to the other extremity of the board 6 inches from the previously soldered end of the U. This bottom end of the U antenna is electrically isolated and floating. **Donot ground the bottom of the loop.** If you do so you will create a closed loop that causes a **carrier null** in the direction of the signal. Better choices of antenna material are brass rod or brazing rod. **It is very important that both antennas and their respective circuitry be identical and values of all similar capacitors and resistors be the same.** The active antenna element is the vertical portion of the open loop. The longer the vertical element the more signal it receives and hence more carrier and better quieting. You can experiment by trying out various antenna dimensions and also inserting two VHF pre-amplifiers using BF966 mosfets after the antennas thereby increasing the sensitivity of the Handi-finder. You could also experiment with extravagant antennas such as identical dipoles and yagis soldered to the board with two equal lengths of coax wire.

Fix a handle at the bottom of the board (I used an ordinary plastic scale) and on this handle you could also fix a compass of the kind you get along with key-rings. The Handi-

finder works best when the first 1/4 th wavelength of the feed line is kept vertical and parallel to the centre of the board. Measure the 1/4 th wavelength of feed line from the floating antenna terminal. If the coax moves it can lose the bearing, therefore tape the first 1/4 wavelength to the handle.

It is best to start off with a source whose direction is known. Hold the unit straight and high above your head so that the feedline hangs down and position it for the best null. The null is sharp but it might not be a total null of the audio tone. Calibrate the direction in an open field by walking in a circle around a central signal source. The null should always occur perpendicular to the plane of the antennas. **Donot try DFing indoors as you will never get the true direction.** Wish you very happy DFing and Foxhunting and one last tip, **During a hunt never trust anything said by another hunter.**

| FREQ | R1 | C1 |
|---|---|---|
| 400Hz | 10KΩ | ·056MF |
| 1KHz | 10KΩ | ·02MF |
| 1.2KHz | 47KΩ | ·01MF |

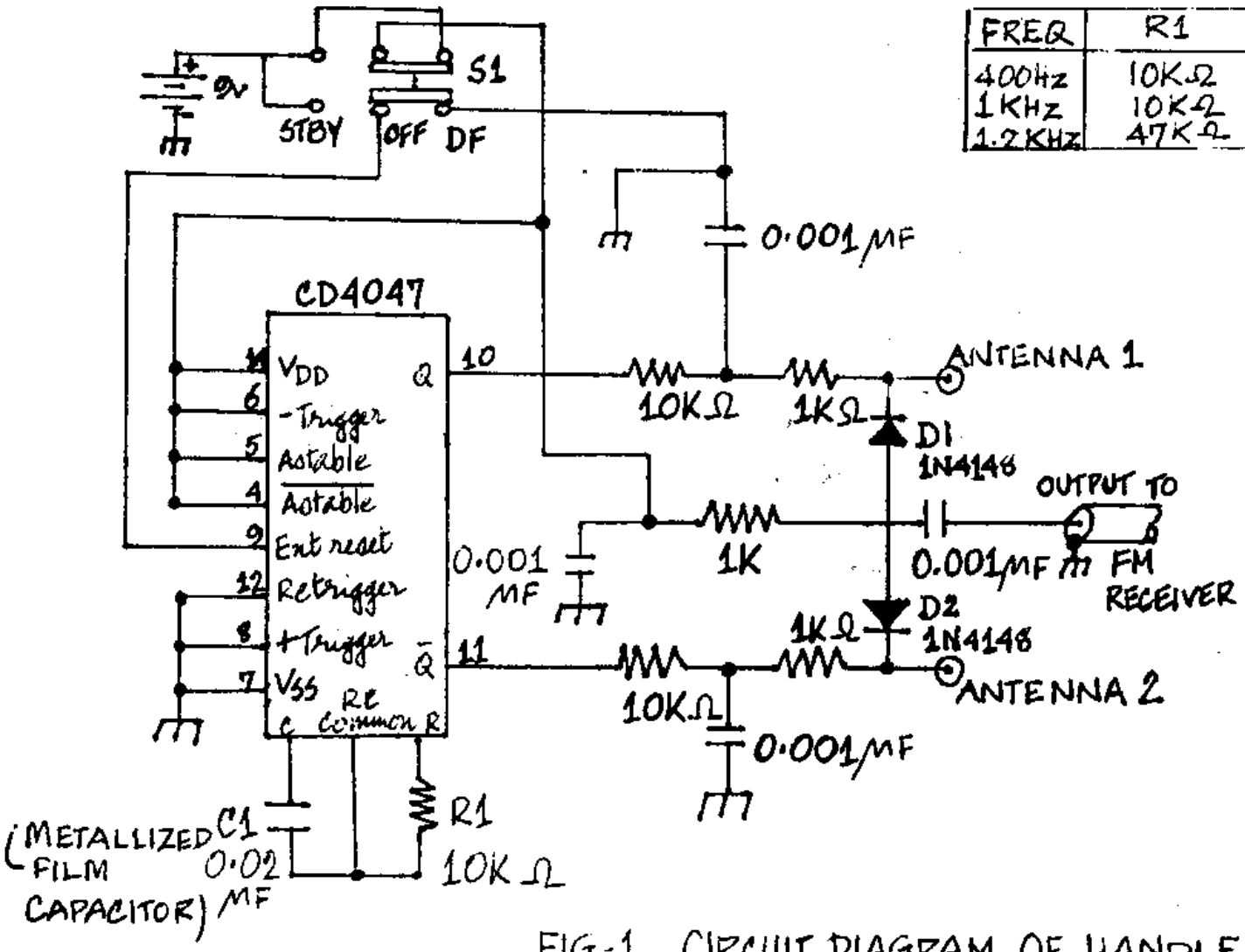


FIG-1 CIRCUIT DIAGRAM OF HANDI FINDER

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