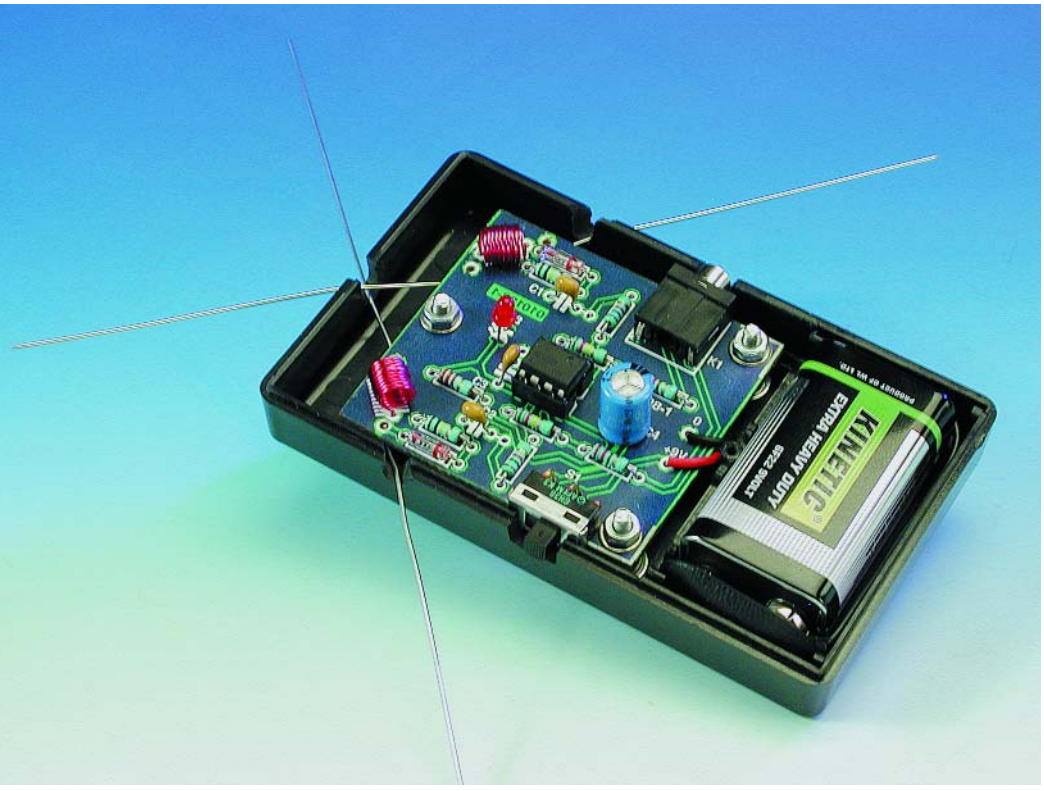
Mobile Phone Sniffer

track down mobile phones using this handy directional finder

Design by B. Kainka

In some situations and locations, the use of a mobile phone is forbidden. You may be discussing sensitive information in a closed meeting or holding important exams. How can you be sure that a concealed phone is not being used to pass information outside? Maybe you're just curious and would like to know if someone nearby is using a phone. This neat unit will not only detect the presence of mobile phone activity (voice or text), it can home in on the culprit!



If you are not familiar with the characteristic RF pulses sent out by a mobile cell phone just go over to an FM radio and switch the mobile on or off while holding it close to the radio aerial. These radio frequency (RF) pulses are an annoyance to amateur radio enthusiasts because they always seem to be picked up by sensitive input stages and you sometimes hear them on Outside Broadcast television programmes where people close to the presenter are using a mobile.

Detecting these pulses is not difficult; all you need is a small aerial, a diode detector and amplifier. Better still, why not double-up on the entire circuit, use directional aerials offset by 90° and feed the signals into a stereo headset to produce a directional detector for pin-pointing cell-phones!

Apart from mobile phones this unit can also pick-up the signals sent out by modern digital cordless (DECT) phones. These operate around the same frequency as cell phones. As with cell phones you will not be able to eavesdrop on conversations because the speech is digitally encoded but you will be able to hear the telltale RF pulses.

Microwave ovens operate in the SHF band at about 2,400 MHz and you can use this unit to check for RF leaks around the door seal. Adding a few turns to the two coils and increasing the antennae length will allow you to experiment at lower frequencies in the short wave radio spectrum (not in stereo however).

Elementary, my dear Watson

This circuit for the Sniffer unit (**Figure 1**) is quite simple. Looking at just one half of the circuit, the dipole antenna arms A1 and A2 form a resonant circuit with L1. Diode D1

Mini Project series

This new series is designed with the novice or younger reader in mind. The projects described will have an emphasis on low build cost and simplicity. The aim is to motivate and encourage self-build and experimentation rather than providing a heavy technical content. Along the way you will undoubtedly pick up useful technical knowledge and insights along with the fun.
All the components used in the projects should be widely available from the majority of the usual component suppliers.

The Elektor Electronics Mini Project series is also freely available on our website at www.elektor-electronics.co.uk. We hope this will prove not only a useful introduction to electronics but also stimulate new circuit design ideas from our readers. We want to provide the best possible service so go along to the website and tell us what you think is good and how it can be improved. We look forward to your comments and suggestions, especially if you have any circuit ideas yourself that would be suitable as a Mini Project feature. Do not hesitate to contact us.
E-Mail: editors@elektorelectronics.co.uk

detects the RF pulses and the signal is amplified by IC1.

A dual operational amplifier type LM358 forms the headphone amplifier. The 'power-on' LED D3 also provides a reference voltage for the virtual earth inputs for IC1. The output signal is direct coupled to the standard Walkman type headphones via R4; this means that the amplifier operates in class 'A' mode giving lower distortion even at high output signal levels.

The elements for each dipole antenna are made up of two lengths of wire from 3 to 7.5 cm long arranged in-line. These two antennae are fitted at 90° to each other at the corners of the PCB. This arrangement works rather like your ears and gives you spatial awareness of the transmitter direction (handy for pin-pointing a cellphone if many phones are sending simultaneously).

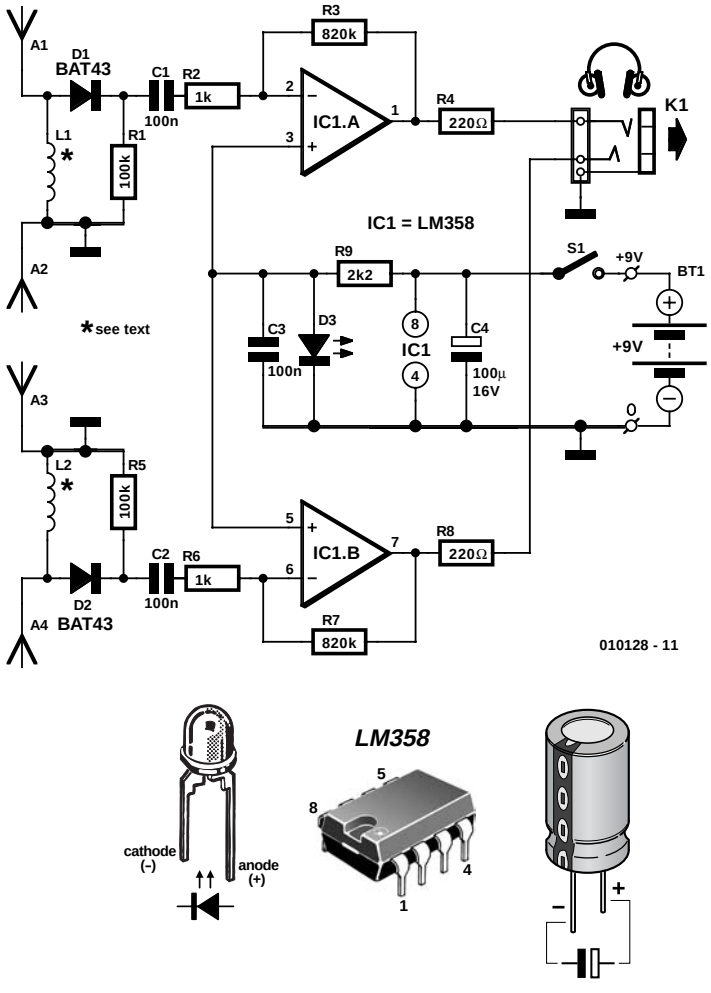


Figure 1. The Sniffer circuit diagram consists of stereo UHF receivers!

Construction

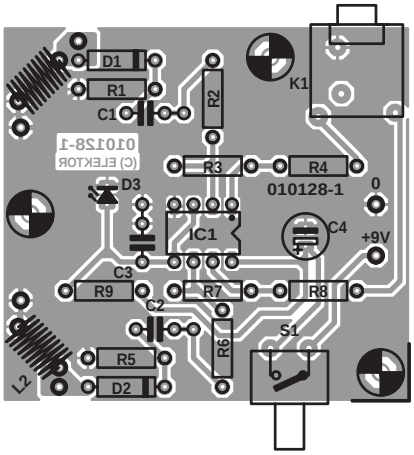
Detector diodes D1 and D2 are shown in the parts list as BAT43 or BAT45 Schottky diodes. Three alternative germanium diodes are also listed, and during tests these actually improved the Sniffer units sensitivity! The popular BAT85 Schottky diode is unsuitable in this application because it has poor high frequency characteristics. The construction of L1 and L2 is not critical. In the prototype, we wound the ten turns around a 5mm diameter LED before removing the LED and fitting the coils to the PCB. The on/off switch (S1) for the unit is connected to two pads on the PCB (**Figure 2**). If the switch is fitted with changeover contacts, the unused connections can simply be clipped off. A press-to-make push-button can be used for S1; this would ensure that you never accidentally leave the unit switched on.

Make certain that the battery connector is correctly connected to the PCB. The red cable will carry +9 V from the battery but if you are in any doubt check with a voltmeter. Fit all the components to the PCB but do not plug IC1 into its socket yet. Before connecting power to the Sniffer unit, double-check that all the polarised components are correctly fitted. If the LED lights when the battery is fitted, S1 is switched on and you are confident that all is in order, turn off the unit and fit IC1 carefully into its socket.

Fit the Sniffer unit into any suitable case that will accept the PCB and battery.

The phone Sniffer's sensitivity is dependent on three factors: The type of diodes used, the length of the antennae and the voltage gain of amplifiers IC1A and IC1B.

The antenna length is matched to the radio frequency of interest. GSM phones transmit at around 950 MHz so each arm of the dipole should be half the wavelength or 7.5 cm (3 cm for phones operating in the new 1800 MHz band). Try experimenting with aerial length. The wire type is not critical but its best to choose a fairly thick wire gauge that will not bend too easily. It's important to make strong soldered joints for the aerials so it is best to fit solder posts to the PCB aerial pads and solder the aerials to the posts.



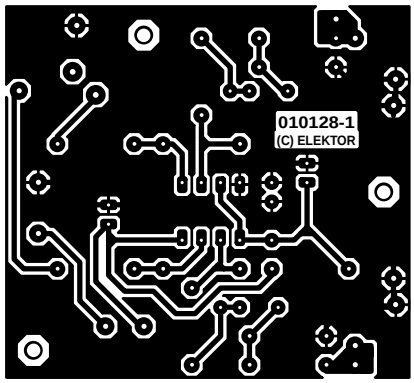


Figure 2. PCB layout and component placement.

Trying it out

Test the unit with a mobile phone. Turn the ringer off on the phone and then ring up the mobile from another phone. There is no need to answer the mobile because it emits RF pulses whenever it receives an incoming call request. Start off 1 to 2 metres away from the phone switch on the Sniffer and make sure that the bleeping sounds in the headset are equal volume when the Sniffer is pointing directly at the phone. Point the Sniffer off to the left of the phone and the bleeps in the left headphone should get softer. If the opposite occurs you have mixed up the wiring to the headphone socket. Don't panic, the problem can be fixed without even warming up the soldering iron: If it's not comfortable wearing the headphones round the other way, then just flip the Sniffer unit over and use it upside-down!

The range at which the Sniffer can detect a mobile is dependent on the RF power output of the phone. GSM phones alter their radiated power dynamically. The nearer the phone is to the base station, the less transmit power it will need to reach it. This is partly done to conserve battery life.

The amplifier gain can be increased to improve the Sniffer's detection range. Feedback resistors R3 and R7 set the gain of amplifiers IC1.A and IC1.B. Try increasing both of these up to 1 MΩ or even 10 MΩ. It will not cause any damage and you will soon know when the amplification factor is too high because the headphone noise level increases and eventually the amplifier will start to whistle.

I'm sure I'm not the only one who rings my mobile number to find out where I have left the phone but what if the mobile's ringer is turned off? No problem for the Sniffer, it can simply pin-point the (silently) ringing mobile by homing in on its RF pulses! Sounds like a good idea for a party game…

(010128-1)

COMPONENTS LIST

Resistors:
R1,R5 = 100kΩ
R2,R6 = 1kΩ
R3,R7 = 820kΩ
R4,R8 = 220Ω
R9 = 2kΩ2

Capacitors:
C1,C2,C3 = 100nF
C4 = 100µF 16V radial

Inductors:
L1,L2 = 10 turns of 0.3-0.5mm diameter (30-24 SWG) enamelled copper wire, internal diameter 5mm (see text)

Semiconductors:
D1,D2 = BAT43, BAT45, AA112, AA116, AA119
D3 = LED, low-current
IC1 = LM358 P

Miscellaneous:
K1 = STEREO socket for 3.5mm jack plug, PCB mount (e.g. Conrad Electronics #732893)
S1 = on/off switch or pushbutton, 1 make contact
9-V battery (PP3) with clip-on leads
8-way IC socket
Case with battery compartment, e.g., Pactec type K-RC-24-9VB-BC (Conrad Electronics #522864)
Antennae: 2 wire pieces, length 3 to 7.5cm each (see text).