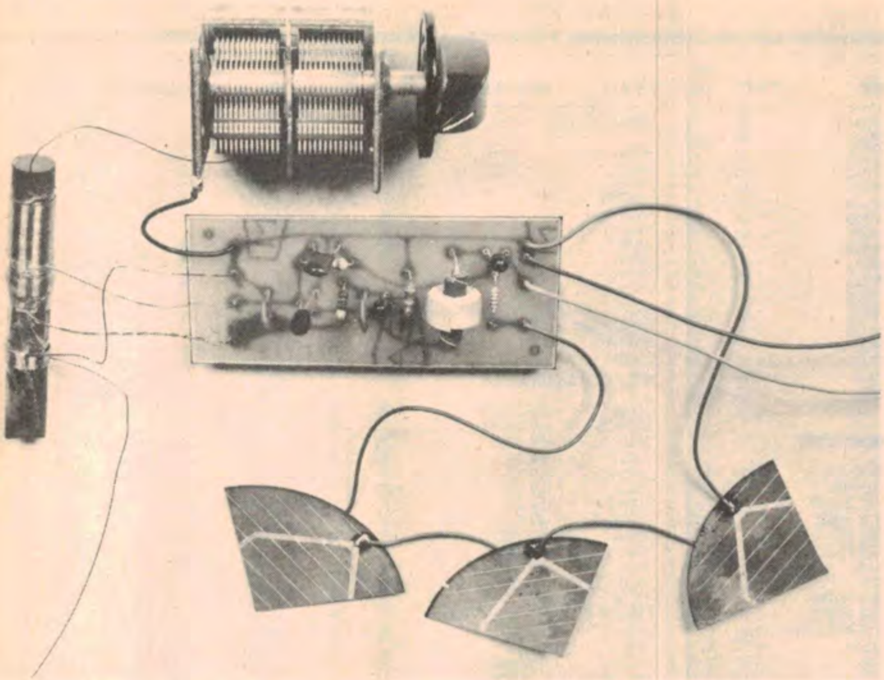


Conversely, a capacitor may be chosen to allow high frequency signals (RF) to pass but block low frequency (audio) signals.

So impedance increases with frequency in an inductor and decreases with frequency in a capacitor. The value of the impedance at any one frequency depends on the value of the inductance, (henrys, millihenrys etc) and the capacitance (nanofarads, microfarads etc). Thus, inductors and capacitors can be used to separate two signals if they are vastly different in frequency.

Now, let's look at our circuit again. The RF signal has been applied to the base of the transistor and appears, amplified, at the collector. The signal is still RF and will not pass through the radio frequency choke because it has a high impedance at these frequencies. It can, however, pass through the 10 nF capacitor, which has a low impedance at RF, to the diode detector. The diode rectifies the signal, leaving half-wave RF pulses which vary in amplitude with the superimposed audio from the station. The RF is then removed by shorting it to ground through a capacitor having a low impedance at RF but a high impedance at audio, leaving only the low frequency audio waveform. This is exactly the same detection process as used in our crystal sets and the process is the same in all but the most complex receivers.

Now the audio signal from the detector is passed through the link winding of the coil to the base of the transistor. The link has no effect on the audio as it has a low impedance. The audio signal is then amplified and appears on the collector but this time, because of the low impedance of the RF choke to audio frequencies, the audio appears across the collector load resistor (R2) and is passed through to the output.

The single transistor does double duty, first amplifying the RF signal, then the audio signal. Pretty nifty, eh?

A solar-powered 'reflex' receiver

Simple, yet cunning, this circuit technique is actually quite old. Good fun to build, too!

FOLLOWING the crystal set era, came the valve radio era. It lasted some thirty years. As times were tough in the 1930s, when the valve era began, hobbyists had to make the best of every hard-won component. As a valve was just about the single most expensive item, one-valve radio receivers enjoyed enormous popularity.

Here's a modern version. Just one transistor and a handful of components. Not much more to it than a crystal set!

How it works

This simple but very sensitive radio uses a 'reflex' circuit, where the radio station signal is passed through the transistor and amplified at radio frequency, detected, then passed through the transistor once more for audio frequency amplification.

This circuit can operate at very low voltages, which makes it ideal for use with solar cells. In fact only three cells in series giving about 1.2 V, will power this radio.

Signals picked up by the antenna are coupled into the coil of the tuned circuit via a 'link' — several turns of wire near one end. The desired station is selected by varying the tuning capacitor — which varies the resonant frequency of the coil/tuning capacitor combination. Another link winding, coupled into the coil of the tuned circuit, picks up the RF energy from the selected station, passing it to the base of transistor for amplification and detection.

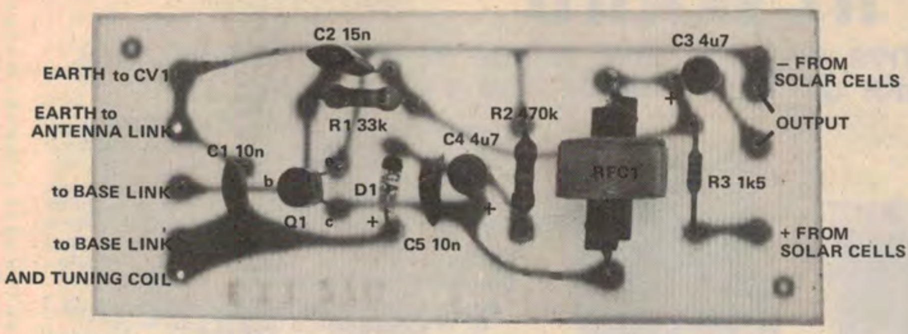
To understand reflex operation of the transistor, let's look at what happens to inductors and capacitors at different frequencies. Two vastly different frequencies pass through this circuit. The radio frequency is between 500 kHz and 1600 kHz while the audio frequencies lie between about 20 Hz and 5 kHz.

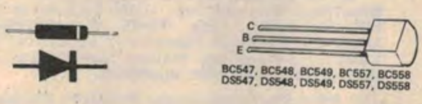
Capacitors and inductors have what's called 'impedance'. This is the term given to the resistance of the inductor or capacitor to the passage of an ac current. Inductors and capacitors behave as opposites. As the frequency *increases* the impedance of an inductor *increases* but the impedance of a capacitor *decreases*. An inductor can be chosen to prevent high frequency signals (RF) from passing through but still allow low frequency (audio) signal to pass.

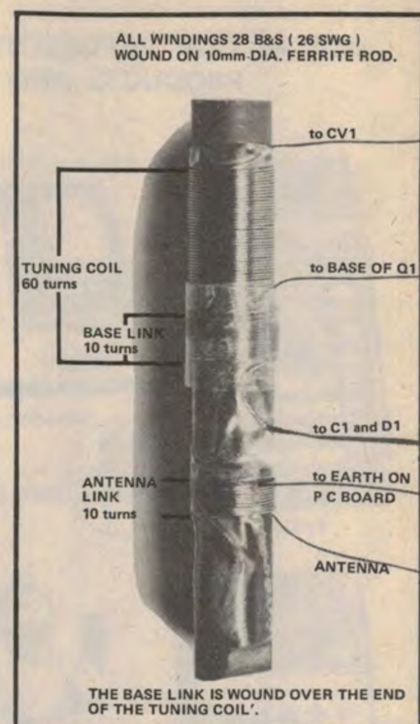
Construction

We decided to build this radio on a printed circuit board to simplify the construction.

The coil requires a little care but is not as mysterious as some people tend to think. In fact even the sloppiest coils can work perfectly. A ferrite rod is used which reduces the size of the coil







Coil winding and connection details (shown actual size).

required. Compare the size of this coil to those used in the crystal sets.

Wind the tuning coil first and hold it in place with a small amount of Araldite or quick-setting glue. The turns must be 'closewound', next to each other. Next, wind the base link over the top of the tuning coil at the one end. Hold this winding in place with Araldite or glue also. The adjacent ends of each coil should be twisted together and joined at the printed circuit board. The antenna link can be wound anywhere on the ferrite rod as its signal is coupled through the ferrite to the tuning coil. Once all windings are finished make sure they are rigidly held in place.

We used a readily available tuning gang, but any gang from an old radio will do equally as well. If you have a dual-gang capacitor, only use one section.

The solar cells are brittle, so take care. The terminal uppermost in the photo is the negative terminal. Solder quickly, but carefully.

We have left the mechanical construction up to you as so many possibilities exist. The only limitation is that if housed in a box it should be plastic or wood if an antenna is not used, and the solar cells should be mounted where they get the most light. And, as solar power is free, a switch is unnecessary.

Using it

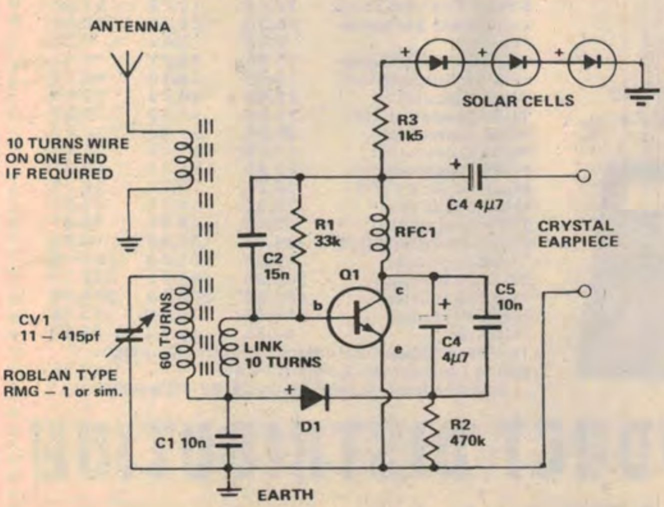
This radio makes very efficient use of its transistor and can give surprisingly good results. In areas close to stations an antenna will not be necessary and only short antennas will have to be used in most areas. In fact, if the antenna is too long the audio may sound distorted as strong signals can overload the transistor.

A good idea may be to have two antennas – one just a few feet long for local stations and the other quite long for distant stations. The best way to find out what you need is to experiment a little. Generally, an earth will not be necessary, but try one anyway. Details are given with the crystal sets.

As the radio is powered by solar cells, some light is essential. We found, using three cells, the radio would burst into life in quite low light levels.

If you want to use it at night, when distant stations can usually be heard, disconnect the solar cells and use a 1.5 V battery.

Although most artificial lighting will operate the radio it will misbehave with fluorescent lighting. If you try it you will hear a buzz because these lights are 'modulated' by the ac mains current giving rise to the raw 50 Hz buzz. A 1000 µF, 6 V electrolytic across the supply connections should fix that. ●



This circuit has been designed for the maximum possible gain. If you find that the circuit begins to oscillate, reduce the number of turns on the base link winding from ten to , say, eight turns.

The pc board pattern is on page 145.

PARTS LIST - ETI 270

Resistors	all ½W, 5%
R1	33k
R2	470k
R3	1k5
Capacitors	
C1	10n greencap
C2	15n greencap
C3, C4	4µ7 10V electrolytic
C5	10n greencap
Semiconductors	
D1	OA90, OA91, OA95, OA202 or similar germanium diode
Q1	BC108, BC548, DS548, 2N3565, 2N3564 or similar
Miscellaneous	
Coil	see text
CV1	tuning gang, 10 - 400p approx, Roblan type RMG1 or similar - see Shoparound, p.83
Solar cell	Sensor Technology C202; Dick Smith Cat. No. Z-4820 or similar - see Shoparound, p.83
RFC1	1 mH - 5 mH RF choke
pcb	ETI 270