Fault Finding

Most circuits do not work first time!

If your circuit does not work straight away, don't worry; just find out *why* it does not work.

1. **BEFORE connecting the power supply to the circuit**

Check that everything is in the right place (then check again and again and again ...etc).

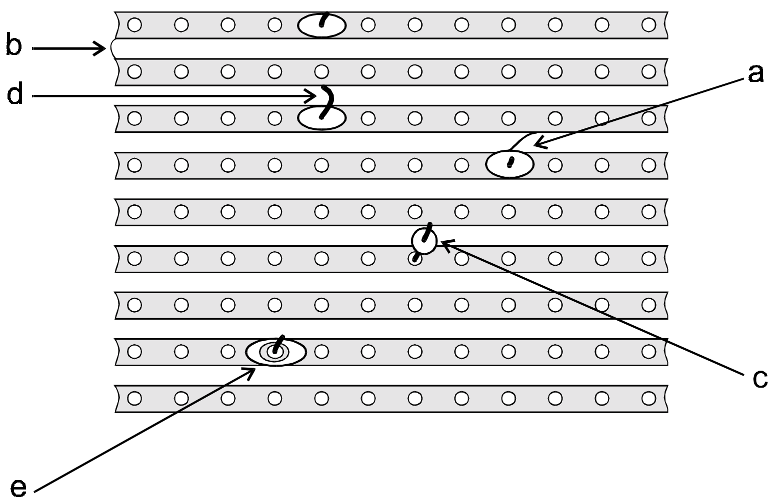
Check that you have made all the necessary cuts to the vero board.

Check that all soldered joints are good; a well soldered component should *not move very much when you give it a little push.*

CHECK THAT THERE ARE NO ACCIDENTAL SHORT CIRCUITS FROM ONE TRACK TO THE NEXT (this is the most common cause of problems); if necessary, use a magnifying glass.

N.B. look also at the ends of the vero board; sometimes even unused board has short circuits at the ends of the tracks.

The diagram below shows some of the possible faults to look for.



a - well soldered joints but “filament” of solder from one track to the next
b - thin piece of copper joining the end of one track to the end of the next track
c - badly soldered joint; the solder is not making good contact with the copper track
d - well soldered joint but wire too long; it might reach the next track
e - badly soldered joint; the solder is not making good contact with the wire.

2. **When connecting the power supply**

As soon as possible after the power supply has been connected to the circuit, see if any of the transistors or chips are overheating.

If they are *switch off immediately* and *do not switch on again* until the reason for the overheating has been found.

N.B.

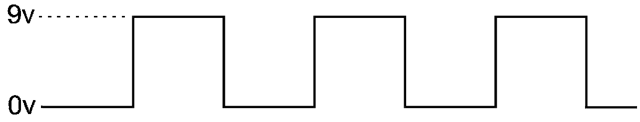
You now have two problems i) you must find the original cause of the overheating and ii) you must find out whether the overheated components have been damaged.

To detect overheating components touch them lightly with the back of your finger but **DO NOT USE THIS METHOD FOR ANY COMPONENTS SUCH AS TRIACS, THYRISTORS ETC WHICH ARE CONNECTED TO THE 220v SUPPLY.**

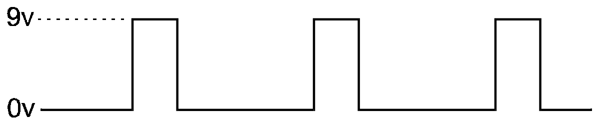
3. **Using a Voltmeter**

- In general, if we refer to the voltage “at a point” in a circuit, we mean the voltage shown by a meter connected to that point and the circuit “ground” line. In most cases, the circuit “ground” line is the negative supply connection.
- First check that the supply voltage is reaching all parts of the circuit board
- Measure the voltage across base and emitter (V_{be}) of any transistors in the circuit; V_{be} must be between **zero** and (about) **0·7v** (for silicon transistors); a voltage significantly outside this range means that the transistor will have to be replaced. N.B. if the voltage is zero, the transistor *might* be faulty.
- In analogue circuits (amplifiers, radios etc) you can also measure V_{ce} (the voltage across the collector and emitter). V_{ce} should usually be *greater than* zero but *less than* the supply voltage.
- In digital circuits (using CMOS chips, that is chips with numbers starting with 40...) all points should be either at zero volts or a voltage very nearly equal to the supply voltage.

  However, if the voltage at a point in a circuit is *oscillating* the voltmeter will either give a regularly varying reading (for low frequency oscillations) or will read a sort of average voltage (for high frequency oscillations). For example, if the voltage at a point is varying as shown below (at high frequency), a voltmeter would read about 4·5v because the voltage spends as much time at zero as it spends at spends at 9v.



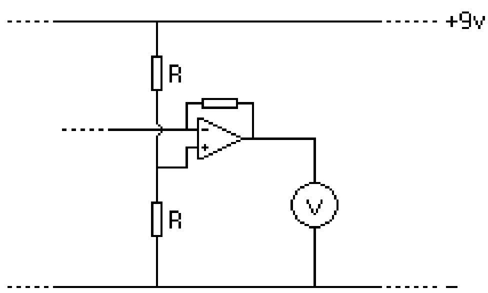
If, on the other hand, the voltage varies as shown in the next diagram, the voltmeter would read less than half the maximum because it spends a longer time at zero than at 9v. In this case we would expect a reading of about 3v.



Voltages in Op. Amp. Circuits

Op. Amp. used as an amplifier

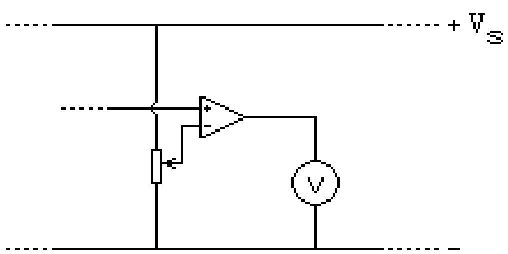
Consider the amplifier circuit shown below.



The potential divider formed by the two resistors, R, is intended to ensure that, when no other input is applied to the amplifier, its output voltage will be equal to *half the supply voltage*. So, in this case, the voltmeter will read 4·5v.

Op. Amp. used as comparator

Consider the comparator circuit shown below.



In comparator circuits, the actual output voltage depends on which op. amp. you use.

The following table shows the output voltages to be expected when using some of the most common op. amps.

	Output voltage when V+ < V-	Output voltage when V+ > V-
741	2v	V_s - 0·6v
081/4	1·5v	V_s - 0·6v
3130	zero	V_s
3140	zero	V_s - 2v