Fault Finding Techniques

This document deals with some techniques for fault-finding within electronic systems. It is worth saying at the outset that teaching fault-finding is difficult. Fault-finding is a skill which is primarily based on experience. People develop a "feel" for where the problems lie and how they can be solved.

However, there are several techniques that **can be learned and used**, that will cope with a wide range of problems within electronics.

You will generally be using two types of measuring instrument:

a multimeter used as:

- an ammeter to measure current flow
- a voltmeter to measure signal strength

an oscilloscope:

- to give a visual impression of what is happening to the signal in different parts of the system.

1. Getting a feel for what to expect

When using the systems approach you will begin to appreciate:

- the types of signals that some electronic building blocks produce
- the types of signals that some electronic building blocks need to make them work
- the way in which some signals are altered by electronic building blocks

If you have experienced designing and developing electronic systems using a kit such as ‘System Alpha’ or appropriate software such as ‘Control Studio’ you will have gained some experience in understanding the basic operation of a number of electronic building blocks.

A knowledge of these basic operations could then be transferred into your realisation of the system design in a printed circuit board. You should be able to describe what electronic signals to expect from different parts of the printed circuit board you have been designing.

2. Use a procedure or checklist

Be systematic when fault-finding in any electronic system or circuit. Do not dive into a system or circuit and say "let's see what this does". The circuit should have been designed and constructed in such a way as to enable you to work through it logically - building block by building block. This is true not only when the system is in kit form but also when it has been made up as a printed circuit. You should always keep a careful record of what you do and develop some kind of tick-list, check-list or chart of tests that you will do.

(a) starter list for working with systems:-

1. Find out what each section of the system is intended to do before any testing or fault finding.
2. Has the power supply been switched on and is the polarity of the power supply correctly connected?

3. Check that each part of the system has power (use a voltmeter to test this)
4. Work through the system stage by stage from the input to the output, making sure that the signals you measure are what you expect.

5. Do not replace individual components in any building block - this can introduce even more
6. faults. If you suspect a faulty building block replace the it with an equivalent that you know works.
7. If the fault has been identified within one building block, remove it from the system and test it on its own with known input signals.
8. Get circuit diagrams of the building blocks to help you if the fault persists.

(b) starter list for working with printed circuit boards:-

Some of the above ideas are also going to be of use here.You also need your circuit diagram to help you. In addition you should:-

1. Inspect the circuit for:

    - broken tracks
    - missing components
    - components placed incorrectly
    - wrong values of components
    - faulty solder joints
    - broken wires
    - fuses blown, etc.

2. Measure the signal strength (potential or voltage) at critical points on the circuit - i.e. where the signal is transferred from one sub-system to another. Depending on the type of signal this should be done with a multimeter or an oscilloscope. Some simple digital circuits can be checked with a home-made tester using an battery and led.

    For example:

        on the base of transistors
        on the collector of transistors
        on power lines to microchips
        on inputs to and outputs from microchips etc.

3. Measure the current strength flowing at critical points on the circuit - i.e. where the signal is transferred from one sub-system to another.

    For example:

        flowing into the base of transistors
        through output devices connected to the collector of transistors
        on power lines to microchips
        through inputs to and outputs from microchips etc.

4. Check that these voltages and current values are what you expect, and work logically and consistently from the input to the output. (You could repeat this by working backwards from output to input as a check).

5. If you have narrowed down the fault to an area, only then start to replace components – carefully, and re-test after each replacement. Only replace one component at a time and keep a list of all the components you test and replace. Make a list of the components in this area and starting with the active components - transistors, ics, etc - record the effects when they are replaced one at a time.

6. Check the artwork you have used to make the circuit board with the circuit diagram.

Add any other tips and techniques that you find useful to these lists and develop your own checklist of fault-finding procedures. The key to fault-finding is - **be systematic!**