An Approach to Electronic Troubleshooting

Levels of Troubleshooting

The basic approaches to troubleshooting are system level, equipment level, module or PC board level, and component level.

If the whole system fails, it is usually one of the other three items that caused it.

In equipment level troubleshooting, if the system fails, replace the entire unit. Example: A PC fails. Replace it.

Board or module troubleshooting has you look for a sub-equipment unit like a PC board or complete module. Example: Replacing the power supply in a PC.

Component level troubleshooting has you narrow the fault down to a specific component failure. Example: Replacing a defective rectifier and filter capacitor in a PC power supply.

Equipment Level

Equipment level troubleshooting is the best if the organization or the individual can afford it. This is the fastest and the most expensive approach, but it can often be justified if the equipment is essential to a specific job that will have high costs or other consequences associated with waiting on a repair.

Many organizations such as the military, government, and critical business units take this approach. It requires that spare equipment be on hand so that the replacement can be made quickly. The defective unit can be taken out of service and repaired later.

Module Level

A module level repair is a good balance between cost and time lost. If troubleshooting narrows down the fault to a specific PC board or module, it is usually fast and easy to replace it providing the unit is available and the cost is reasonable.

Most equipment is modular to some degree. A PC is a good example with its individual parts like a mother board, power supply, memory sticks, power supply, disk drives and other pluggable units. A quick repair can be made only if spare modules or boards are on hand or can be ordered or received quickly.

Component Level Troubleshooting

Component level troubleshooting may seem like the fastest and the least expensive but it is not.

While the cost of the replacement component is the lowest of the three approaches, it takes an enormous amount time to trace the fault to a specific circuit. With technician salaries and hourly work rates ranging from $30 to $150 per hour, it does not take many hours to exceed the price of just replacing the defective board or module.

For example, a PC power supply is available new for less than $40. But a typical troubleshooting time is 3 hours. At a low $30 per hour, you could buy two new power supplies. Most boards and modules are very modestly priced making component level troubleshooting impractical as well as uneconomical in most modern equipment.

Component Level Troubleshooting Difficulties

In addition, component level troubleshooting requires that the technician have the right test equipment. The right test equipment includes only the usual meters and oscilloscopes as well as special testers specific to the equipment. Such equipment can cost tens of thousands of dollars and usually exceeds the budget of most repair organizations.

Today, troubleshooting and repair at the board and module level is the most common. It is the fastest and the lowest cost. Only the most expensive equipment undergoes component level troubleshooting since extra modules may be too expensive. Medical, some manufacturing equipment, and one of a kind systems are examples.

Equipment Downtime

Just as important, if not more important, is the issue of how the down time of the equipment will affect production in a manufacturing application. If the loss of the use of the equipment results in a major stoppage of production output, this will seriously affect the finances of the business.

For this reason, it is almost always preferable to perform the absolute fastest troubleshooting procedure possible. Module or equipment level repair may be more expensive but overall it will result in less equipment down time and a faster return to normal production routines and output.

Troubleshooting Method

Here is a basic procedure that works well in finding the fault in any piece of electronic equipment.

- Validate the problem
- Search for and recognize symptoms
- Verify that power is applied
- Perform a visual inspection
- Isolate the problem to a specific module or circuit
- Repair the problem
- Test the unit after the repair to verify operation

Validate the Problem

Troubleshooting usually begins with a complaint or the recognition of a problem or failure. The individual reporting the problem is not usually the one to perform the troubleshooting.

As a very first step, the person performing the troubleshooting should question the operator of the equipment to capture their observations and comments.

Next, the person performing the troubleshooting must validate the problem. That is, he or she must try to repeat the problem and recognize it themselves. No troubleshooting can begin without this first critical step.

A common problem is when the operator of the equipment senses something is wrong and reports a problem. In many cases, the equipment may actually be working but the operator or user may not know how to use the equipment or has it misadjusted or in an incorrect setting or mode. This is called a cockpit problem.

The solution is to instruct the user about the proper settings and operations.

Observe the Symptoms

The symptoms of the alleged failure will help reveal what the problem is.

Ask, what is the unit *not* doing?

Use any displays such as LED indicator lights, cathode ray tube displays, liquid crystal displays, meters, or other readouts to gather additional information.

Try to use the equipment as the operator would.

You must repeat and demonstrate the problem before you can begin troubleshooting.

Check for AC Power

This step may seem obvious but a common problem is that power is not being received.

This can be caused by the AC plug may have been pulled out. The power strip into which the equipment is plugged may be unplugged or turned off. It can also be caused by a circuit breaker that may have been tripped or a fuse that may have been blown.

Check for DC Power

The battery, if one is used, may not have been recharged or may just be dead and need replacement.

Use a voltmeter to measure the DC voltages out of the power supplies. You will need to refer to the equipment manuals or other documentation to find the places to make these measurements and the required voltage levels.

Incorrect voltages are usually a signal that the power supply is defective. If this is the case, replace or repair the power supply.

Perform a Visual Inspection

A first step in to perform a visual inspection to see that any external connections are properly made. Check for connectors that have come unplugged. A connector may appear to be plugged in but it may be loose or only partially seated.

Look for broken or cut wires or cables.

Look for smoke or burned components or other items. A burned smell is a give away to a problem. Common items that burn are transformers and motors.

Touch various components (be careful!!) and if they are too hot to touch they may be bad.

Check to see that any cooling fans are running and that their filters are not blocked.

Listen for any unusual noises and trace the noise to its source to get a clue to the defect.

Isolate the Problem

All of the steps up to now should have provided some clues to a place to start more detailed troubleshooting procedures.

The most common troubleshooting procedures are component or module substitution, signal injection, and signal tracing.

These techniques will be covered in the next section.

Repair the Defect

Once the defect has been identified, you can repair it.

If you are troubleshooting to the component level, you will usually have to unsolder a bad component and install a new one.

Fixing a connector or cable may require a special crimping tool.

If you are troubleshooting at the module level, you will just replace the module or PC board.

Repair at the equipment level is the simplest: just replace the entire unit.

Test the Unit

Once the repair has been made, you must test the equipment to see that it works as intended. Some equipment will have a test procedure but most can be tested by just turning it on and using it in normal operation.

For some critical equipment, replacing a component, or in some cases a module, will require that you follow a strict test procedure or re-align or re-calibrate certain circuits. Follow the manufacturer's guidelines for best results.

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Troubleshooting Electronic Circuits and Systems
Knowledge Probe 2
An Approach to Electronic Troubleshooting

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