In this lesson you will:
- learn how to use logical methods to troubleshoot circuits
- learn to gather information useful in troubleshooting
- see six troubleshooting methods
ADVANCED TROUBLESHOOTING

Creating and testing circuit designs and projects requires troubleshooting skill

Efficient troubleshooting saves time (and money on the job)

Logical methods promote efficient troubleshooting

Experience builds troubleshooting skills

Systematic techniques more productive

LOGICAL VS “SHOTGUN” TROUBLESHOOTING

Troubleshooting is a trial and error process

“Shotgun” Method – replace parts with little regard to symptoms of circuit/system faults.

Eventually, maybe, the fault disappears

Logical Method – use knowledge of circuit or system operation/theory to identify likely failure points. Gather information on symptoms to help.
### STEPS TO LOGICAL TROUBLESHOOTING

Gather information about problem before testing and substituting components

Questions to ask:

- How is the circuit or system suppose to work?
- Is the problem continuous or intermittent?
- Did the defect occur suddenly or gradually?
- Did the defect occur when the system of circuit was in operation?

Look for additional details like:

- Did you use the test instruments correctly?
- Is the power supply on and set correctly?
- Are there any wiring errors?
- Does time or temperature have an effect?
**STEPS TO LOGICAL TROUBLESHOOTING**

Gather information about problem

Has any other person worked on the circuit or system?

Check for proper component installation
- Diodes
- IC’s
- LED’s
- Polarized Capacitors

**STEPS TO LOGICAL TROUBLESHOOTING**

Collect and use documentation

Do you have any circuit or system documentation?

Always work from a schematic
- Make quick sketches in lab
- Keep revising schematic to reflect work
Technique 1: Symptom-Function Analysis

Analyze Failure Symptoms -> Compare to Function of Each Stage or Component -> Start Testing on Stage

What Stage or Components Could Cause the Symptoms?

Example: Stereo AM/FM radio

Left Speaker: No radio output
Right Speaker: Normal radio output
Receiver/Amp

Use knowledge of system to identify possible faulted stage

Possible Fault: bad left channel amplifier
**Technique 2: Physical Observation**

Use Symptom-Function to guide senses: sight, smell, hearing, touch

Look for catastrophic failures—signs of heat, burned components, broken/loose components or wires/PCB traces.

Check for excessive heating using “Five Second Rule”. Should be able to touch most components for five seconds or more without discomfort.

Try to find fault cause before re-energizing

Use Caution: burn and/or shock hazard

**Technique 3: Signal Injection/Tracing**

Use function generator/voltage source and scope/multimeter to inject and measure signals
**TECHNIQUE 4: VOLTAGE AND RESISTANCE MEASUREMENTS**

Use DVM to measure critical AC and DC voltage values and component resistances

Test power supply values
- Test IC power supplies on the chip pins when working with SEB's

Test AC supplies on both sides of transformer
- Use caution with “wall power”

**Resistance Measurements**

Some electronic components have characteristic resistance values

Diodes and Transistors
- Different meters give different values due to meter internal circuits

**Safety First:** power must be off to make resistance measurements

Remove components from circuit for accurate measurements
**Technique 4: Voltage and Resistance Measurements**

Resistance Measurements – Checking a diode using a DVM or multimeter.

- **Reverse Test**
  - Use Continuity or Diode Check setting
  - Reading: (Hi Ohms, Open Circuit)

- **Forward Test**
  - Reading: 0.7 - 0.5 Volts (low ohms 10's)

**Technique 5: Substitution**

Replace questionable parts with new or known good parts

Easier to implement with socketed devices such as vacuum tubes Ics and daughter boards (board swapping)

Use this technique when fault is isolated or you are stumped (Shot gunning)
TECHNIQUE 6: STATISTICAL METHODS

Use historical record of repairs and maintenance to determine possible faults and problems

Must create and maintain repair record for circuits and systems
Record experiences with circuits and devices
Not applicable to design and prototyping, no historical record of circuit

COMING NEXT: POWER AND POWER MEASUREMENT
End Lesson 19
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