Troubleshooting without a Schematic

Our thanks to Huntron for allowing us to reprint the following article.

A technician may be required to repair boards and systems with a minimum of service information. At first glance a circuit card or system may instill panic but upon closer inspection we find that the total board is simply a collage of familiar components arranged in text book configurations. In this article, we will discuss troubleshooting without the aid of a schematic diagram.

THE LIBRARY

A shop library can be an important asset to a successful repair shop. Knowing what an electronic component does can assist you in making troubleshooting decisions. The pin-out information can help locate a fault and supply information needed for pin-to-pin comparison. The right pieces of information can make the difference between success and failure.

1. There are many data manuals available to the technician for a small fee or free of charge. Manufacturers supply these to encourage people to use their products. These data books normally supply pin out, application, and labeling information. Contact a local distributor or the manufacturer directly to obtain these manuals.

2. Cross Reference manuals are an important addition to a shop library. These manuals allow you to cross one manufacturer's part number to that of another. This is particularly useful if you have a limited number of data manuals. The better manuals give specifications, pin designations, and numerous replacement possibilities. With the right Cross Reference manual, you can locate replacement parts for American, Asian, and European devices. Some suppliers, for example JDR Microdevices, sell data manuals.

3. An IC identification manual, for example the IC Master, will tell the purpose, manufacturer, voltage, number of pins, and comparable replacement devices of most (or all) commercial ICs. While supplying a possible clue, these manuals usually will not have information regarding custom ICs.

4. Electronic circuit manuals can be very useful and are available from a number of technical publishers. They show actual working circuits that can be used as a reference.

5. Be aware of what you may already have. It is not uncommon to find a part used in many different applications. When looking for a Z80 CPU pin out, you may find that you have another system with a schematic diagram that uses a Z80 CPU also.

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With the preceding library at hand, the first step is to take some note paper and draw a block diagram of the board. Some items to note:

1. Take note of logical divisions such as power supply, amplifier stage, memory, I/O circuitry, etc. If there are any questions as to what or where these sections are located, start by looking up the ICs in a data book. Begin with the largest ICs which contain the most circuitry and usually dictate the overall function of the board. This is also a good time to record IC pin out information by making copies of the IC diagrams on a copier for use in troubleshooting.

2. Look for symmetry, multiple circuits, and patterns. The comparison of repetitive circuits against each other can overcome the absence of a second "good board". Identical circuits on the same board often compare closer than the same circuits on a different board mainly because of the minor manufacturing differences in the construction of the components from one board to another. On digital boards, look for groups of Eproms or RAM. Determine the size and configuration using one of the library manuals previously mentioned. Look for address and data bus lines that run in parallel between components on the circuit card.

3. Analog circuits may have multiple drivers, op amps, and I/O lines. As an example, a stereo will have one power supply and two identical channels, right and left. If the right channel is faulty, compare it directly to the identical left channel circuitry. This is an excellent troubleshooting technique especially when a second "good board" is not available.

4. Power is always one of the first areas to check when troubleshooting a board. Note whether the power supply is on or off the board and if protective devices

such as diodes, regulators, and fuses are on the board. Be attentive for different voltages by noting the presence of regulators, zener diodes, and capacitors. The presence of op amps, linear and communication devices would indicate multiple voltages and possible negative voltages.

5. Take note of the edge connectors. The edge connector is where the circuit card meets the rest of the world and has proven to be where a majority of the electrical stress failures can be found. Ask yourself, what does this edge connector interface to?

6. With today's trend towards miniaturization, many ordinary components become visually unrecognizable. When unknown components are encountered, use the red and black probes to analyze the Tracker signature generated by the device. **Remember, there are four basic signatures- resistance, capacitance, inductance, and semiconductance**. All other signatures are composites of these four signatures.

7. Write down the device number and manufacturer of each IC and locate these devices in an IC identification manual such as the IC Master noting their function and operating parameters. Consult any data book that might contribute a device pin out and make copies of these for reference.

8. Use failure symptoms to logically probe the board. For example, if a communications problem is reported, look in the communications area by probing a RS-232 connector first. Check the signatures of the transmitter/receivers and the associated circuitry. This technique will be much more successful and less troublesome than "shot gunning" or groping in the dark hoping to find something.

9. Processor bus circuitry offers numerous possibilities for comparison troubleshooting. As an example, there are sixteen address lines and each should give the same identical signature when probed with a Tracker. If one line is damaged, it will have a different signature when compared to the other address lines. These same sixteen lines travel around the board connecting to various components, so you should directly compare address lines on the input side as well as the output side of these bus components. The same technique would apply to the data bus.

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