MODULE X3

REVERSE ENGINEERING

PREREQUISITES: PERMISSION OF INSTRUCTOR AND COMPLETION OF AT LEAST 10 PRIOR MODULES.

OUTLINE OF MODULE X3:

What you will learn about in this Module:

You will learn to study existing circuits to learn how different devices are designed. You will learn to identify IC chips and other components, and how to "reverse engineer" the circuit, that is, how to re-build the schematic diagram given only the finished circuit board.

What you will build in the lab:

You will start with a circuit board from a commercially available device, or from a piece of custom laboratory equipment, and will first identify each component. You will then develop a circuit diagram for the circuit board from which you could build the functional equivalent of the original device.

INTRODUCTION:

On the surface of it, reverse engineering sounds like outright theft of Ideas. Although sometimes this may be the case, often reverse engineering is an excellent educational exercise, and there are many legitimate instances in which reverse engineering is completely acceptable. For instance, I have sometimes had to reverse engineer circuits that I myself designed many years before, before I fully appreciated the need for redundant backups of technical design documentation. You might find yourself in a situation where you need to modify an old circuit to perform some new function, to repair or duplicate that circuit, or just need to understand the operating principle of a circuit so that you can use it as a building block in an entirely new circuit or device. In any event, there are several useful tools for reverse engineering of electronic circuits, which we will touch upon in this module.

READINGS FROM HOROWITZ AND HILL (H&H): *ART OF ELECTRONICS*

None

ADDITIONAL READINGS & INTERNET RESEARCH:

See if you can find web sites that allow you to do electronic component parts searches. These might include electronic parts distributors such as DigiKey.com and Newark.com, manufacturers such as MAXIM-IC, National Semiconductor, Fairchild, Texas Instruments and Motorola, and there are even general databases for electronics parts such as IC-master. The advantage of the general databases is that they will often give you several options for common components that may have several different manufacturers.

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SELF QUIZ

1: What is a MAX630 chip? (what is its function?). Which manufacturers make this exact chip? Can you find other chips that perform the same basic function?

PLEASE ANSWER THE ABOVE QUESTIONS AND E-MAIL TO THE INSTRUCTOR
"I have neither given nor received aid on this examination, nor have I concealed any violation of the Honor Code"

X_____

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LABORATORY PROJECTS

1- Find an old circuit board or an electronic system that contains one. The best ones to use are from an old piece of home-made lab equipment. Many universities have these lying around. At U-Michigan, you can find them sometimes at "Property Disposition". You can also ask the instructor to help you find one. It should not be *too* complex (not too many components). Some junked-out old computer peripherals are good places to look, like an old mouse for example.

2- Try to determine what this device did when it was used, and if it ever even worked (lots of old home-built circuits never actually worked, so they just got tucked away for decades). If you find a schematic, fold it up and save it for later (*don't cheat!*). Also, try to determine how power is applied (batteries? voltage? …)

3- Now, using the information resources you found earlier in this module, try to identify *every* component on the board. Start with the ICs, then the passive components. As you do this, begin drawing out the circuit using ExpressSCH. The more you know about circuits, the more you will be able to "fill in the blanks" as the circuit diagram begins to take shape. Continue to do this until you get bored, frustrated, or you just think you are not getting any more out of the exercise. Feel free to ask for help in identifying "odd" components. Note any missing or damaged components.

4- In some cases you will need to remove components (to repair/replace them, or just to identify them). First, be sure to note the position and polarity of the component before removing it. You can try desoldering using a device called a "solder sucker" which is just a spring-loaded suction plunger, or "solder wick" which is just fine braided copper wire. Both are used to remove solder from solder joints. In many cases, the best thing to do is *add* some fresh solder to the joint first, heat the solder up well so it is fully liquid, then suck or wick away as much as you can. You may have to repeat the process several times to get most of the solder off. This takes a bit of practice, but after a while is easy enough to do.

5. Using ExpressSCH, go ahead and try to generate a schematic for the circuit (or just that part of the circuit of specific interest to you). You may need to use the DVM to follow traces. Use the pointed probes (not text clips) and set the DVM to a low range, such as the 200 Ω resistance range, not just for "continuity". This is because some components, under some circumstances, will pass a continuity test but usually will be at a higher resistance than just wire or a copper trace. You may also need to remove components to verify trace connections.

If the circuit is simple enough, and if you are brave enough, you might even try building the reverse engineered circuit. Do this only if you feel that the finished circuit will be of some use to you (such as an old laboratory circuit you need to duplicate).

MODULE X3

FEEDBACK

Was this Module useful and informative?

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Is there a topic that should get more or better coverage?

_____

In what way can this Module be improved:

Content: _____

Depth of Coverage: _____

Style: _____

Any additional comments that will help us to improve this course:

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If you prefer, you may e-mail comments directly to Bob Dennis: yoda@umich.edu