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CHAPTER 2
Integrated Circuits and the 7400 Logic Families

Once basic logic design theory is understood, the next step is transferring that knowledge to a practical context that includes real components. This chapter explains what an integrated circuit is and how off-the-shelf components can be used to implement arbitrary logic functions.

Integrated circuits, called *chips* by engineers and laymen alike, are what enable digital systems as we know them. The chapter begins with an introduction to how chips are constructed. Familiarity with basic chip fabrication techniques and terminology enables an engineer to comprehend the distinctions between various products so that their capabilities can be more readily evaluated.

A survey of packaging technology follows to provide familiarity with the common physical characteristics of commercially available chips. Selecting a package that is appropriate for a particular design can be as critical as selecting the functional parameters of the chip itself. It is important to understand the variety of available chip packages and why different types of packages are used for different applications.

The chapter's major topic follows next: the 7400 logic families. These off-the-shelf logic chips have formed the basis of digital systems for decades and continue to do so, although in fewer numbers as a result of the advent of denser components. 7400 family features are presented along with complete examples of how the chips are applied in real designs. The purpose of this discussion is to impart a practical and immediately applicable understanding of how digital system design can be executed with readily available components. Although these devices are not appropriate for every application, many basic problems can be solved with 7400 chips once it is understood how to employ them.

Having seen how real chips can be used to solve actual design problems, a closely related topic is presented at the end of this chapter: the interpretation of data sheets. Manufacturers' data sheets contain critical information that must be understood to ensure a working design. An understanding of how data sheets are organized and the types of information that they contain is a necessary knowledge base for every engineer.

2.1 THE INTEGRATED CIRCUIT

Digital logic and electronic circuits derive their functionality from electronic switches called *transistors*. Roughly speaking, the transistor can be likened to an electronically controlled valve whereby energy applied to one connection of the valve enables energy to flow between two other connections. By combining multiple transistors, digital logic building blocks such as AND gates and flip-flops are formed. Transistors, in turn, are made from *semiconductors*. Consult a periodic table of elements in a college chemistry textbook, and you will locate semiconductors as a group of elements separating the metals and nonmetals. They are called semiconductors because of their ability to behave as both