An Introduction to Digital Logic

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An Introduction to Digital Logic

A. Potton

*Principal Lecturer
School of Electronic and Electrical Engineering
City of Leicester Polytechnic*

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Preface

During the past few years, we have seen an unprecedented expansion in the applications of electronic techniques. It is no accident that a large part of this expansion has involved systems using digital techniques. Undoubtedly, economic factors provide the major reasons for this. Digital systems which, even a few years ago, would occupy weeks of an engineer's time in the design phase can now be bought as low cost, 'off the shelf' integrated circuits. As a result of this the engineer can now contemplate the design of systems which would previously have been considered totally uneconomic and hopelessly complex. A further consequence of the expansion of digital electronic techniques has been that engineers in fields not traditionally associated with electronics have become aware of the potentialities and power of these techniques.

The aim of this book is to introduce the reader to electronic digital systems and assist him to develop the techniques necessary for the understanding and design of such systems. The book is essentially an introductory text, no previous knowledge of digital systems or indeed of general electronics being assumed. From time to time in the text, reference is made to the discrete component circuit form of some digital system elements. Particular examples are the NOT and NOR gates in chapter 1 and the R-S bistable circuit in chapter 5. The brief explanations which accompany these circuits are intended to assist readers who have some background knowledge of electronic circuits and devices. Such a background is not essential to the general understanding of the text however and readers who have no previous knowledge of the subject may accept the description of the characteristics of the circuit without being unduly worried about the actual details of the circuit action.

The book should prove suitable for use as a text for first and second year HND and BSc engineering students at Polytechnics, Universities and Technical Colleges. Much of the material will also be useful to students pursuing the more advanced stages of some technician level courses such as the HNC in electrical engineering.

The common types of logic gates are introduced in chapter 1 of the text as are the ideas of positive and negative logic. The action of gates and logic systems is described in this chapter mainly by the use of truth tables.

Chapter 2 provides a brief introduction to boolean algebra. In a text of this kind, it is neither essential nor desirable to include a detailed treatment of boolean algebra with full mathematical rigour. The object of chapter 2 is to establish the basic concept of two-state variables and accustom the reader to the boolean manner of describing logical relationships. A list of some useful boolean relationships is included at the end of this chapter for completeness. There is no suggestion that these relationships should be committed to memory before proceeding with the remainder of the text.

Chapter 3 is perhaps unusual in that it discusses design techniques before the reader has been introduced to logical map methods. The purpose of this is twofold;

firstly to provide the reader with an incentive to persevere with the study of the techniques which assist the design of logic systems, and secondly, to accustom the reader to the use of boolean terminology.

Logical maps are dealt with in chapter 4 and are used in the remainder of the text when simplification of a logical function is required.

Chapters 5 to 8 cover the more formal aspects of sequential logic systems starting with bistable elements in chapter 5, proceeding to registers and ripple-through counters in chapter 6 and synchronous counters in chapter 7. Chapter 8 deals with a selection of practical design problems which require the use of sequential logic elements for their solution.

In chapter 9 systems are described for performing arithmetic operations. It was felt that a chapter of this type merited inclusion if only because an introductory text on logic design is often used as a preliminary to a more detailed study of computer hardware.

Chapter 10 contains a review of important logic element parameters. Also included in this chapter are details of the important ranges of currently available integrated circuits. As has been said previously, the reader with no formal electronics background may choose to pass over the details of the circuit operation of particular logic families although the importance of the various parameters should be understood.

My grateful thanks are extended to Dorothy, without whose understanding, tolerance and superlative typing this book would never have been finished. In conclusion, the author would welcome any useful comments or criticism on the material presented in this modest text.

Alan Potton