

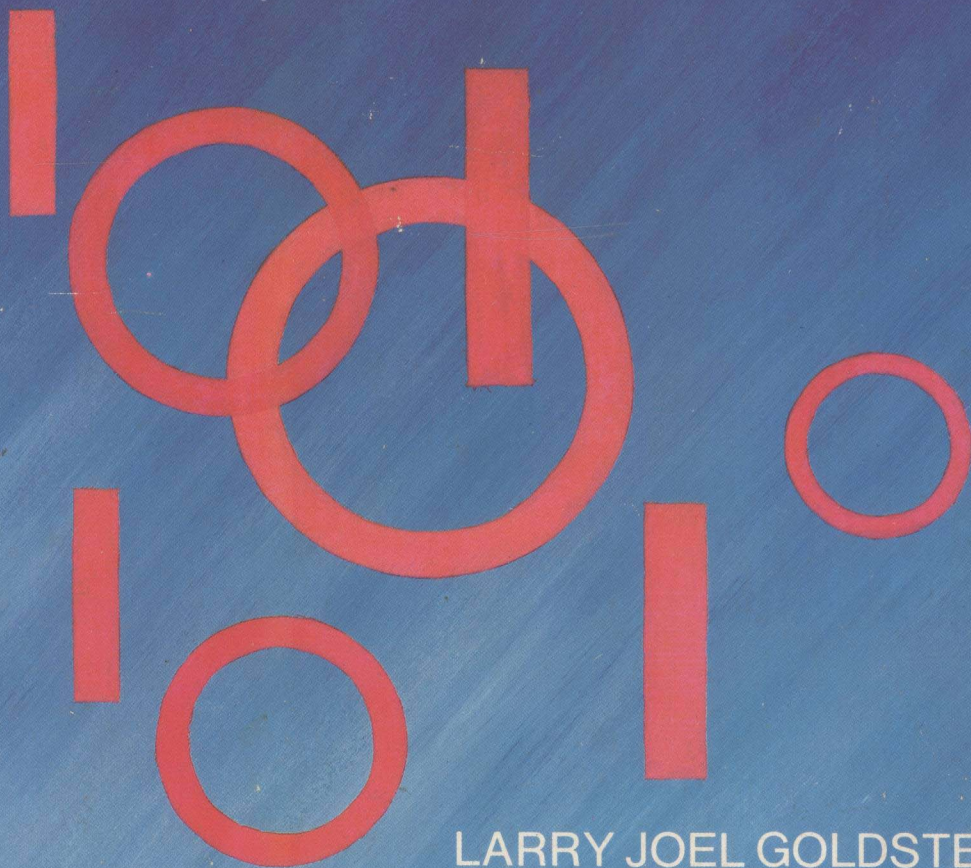
\$14.95

T.M.

TRS 80

MODEL III

PROGRAMMING AND APPLICATIONS



LARRY JOEL GOLDSTEIN

THE TRS-80 MODEL III PROGRAMMING and APPLICATIONS

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**Robert J. Brady Company
A Prentice-Hall Publishing and Communications Company
Bowie, Maryland 20715**

The TRS-80 Model III: Programming and Applications

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Library of Congress Cataloging in Publication Data

Goldstein, Larry Joel.
The TRS-80 model III.

Includes index.

1. TRS-80 (Computer)	I. Title.
QA76.8.T18G64	001.64 81-21588
ISBN 0-89303-050-3	AACR2

Prentice-Hall International, Inc., London
Prentice-Hall of Australia, Pty., Ltd., Sydney
Prentice-Hall of India Private Limited, New Delhi
Prentice-Hall of Japan, Inc., Tokyo
Prentice-Hall of Southeast Asia Pte. Ltd., Singapore
Whitehall Books, Limited, Petone, New Zealand

Printed in the United States of America

TRS-80 MODEL III

Executive Editor: David T. Culverwell
Production Editor: Michael J. Rogers
Art Director: Don Sellers,
Illustrator: Nancy Obloy
Typesetting by: Bi-Comp, Incorporated, York, PA
Typefaces: Zapf (display) and Optima (text)
Printed by: R. R. Donnelley & Sons Company, Harrisonburg, VA
Text designer: Michael J. Rogers
Cover design: Don Sellers

PREFACE

This book is designed to teach the computer novice how to use one of the most popular personal computers, the TRS-80 Model III. The development of the personal computer is one of the most exciting breakthroughs of our time. Indeed, the small, inexpensive, personal computer promises to bring the computer revolution to tens of millions of people and promises to alter the way we think, learn, work, and play. This book is an introduction to this revolution. Accordingly, it has two purposes: first, it instructs the reader in the operation of the Model III; and, second, it illustrates some of the many ways to use the TRS-80.

I have attempted to guide the reader from the moment he or she turns on the TRS-80 for the first time and discuss the rudiments of BASIC programming. Since the book is designed as a tutorial, it includes an exercise set in each section, with answers at the end of the book. Furthermore, this book may be used for self-study. In the text are questions labeled "Test Your Understanding." These questions test concepts as they are introduced and a built-in study guide. The answers to these questions are to be found at the end of the exercises for the section.

Because of my conviction that, in addition to BASIC programming, the beginner should also gain an overview of real-life applications, I have included many applied discussions, e.g., a brief look at word processing. These applications are designed to stimulate the reader's interest and can be used as preludes to further study.

Most enthusiastic personal computer users quickly upgrade their computers to include various optional equipment. Accordingly, I have included an introduction to Disk BASIC, and brief discussions of printers and communications interfaces. The book closes with possible topics for further study.

Any book owes its existence to the dedicated labors and inspirations of many people. In my case, I have been inspired by my wife, Sandy and my children, Melissa and Jonathan, who have enthusiastically joined me in applying our TRS-80 to a variety of tasks. Further inspiration has been supplied by my father, Martin Goldstein, who has come out of retirement to join the computer revolution and to assist me in researching and editing this book. My thanks to Michael Rogers, Production Editor, for the professional manner in which he managed the editing and production of this book. Finally, I would like to thank my friends Harry Gaines, President of the Brady Company, and David Culverwell, Editor-in-Chief of the Brady Company, for their continued support over the years. Their friendship has enhanced my excitement and pleasure in writing this book.

Dr. Larry Joel Goldstein
Silver Spring, Maryland
September 19, 1981

to
my father, Martin Goldstein,
always a father,
recently a collaborator

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1

A First Look At Computers

1.1 INTRODUCTION

The computer age is barely thirty years old but it has already had a profound effect on all our lives. Indeed, computers are now commonplace in the office, the factory, and even the supermarket. In the last three or four years, the computer has even invaded the home, as people have purchased millions of computer games and hundreds of thousands of personal computers. Computers are in such common use today that it is hard to imagine a single day in which a computer will not somehow affect us.

In spite of the explosion of computer use in our society, most people know very little about them. People view a computer as an "electronic brain," and have no idea how a computer works, how it may be used, and the extent to which it may simplify various everyday tasks. This does not reflect a lack of interest. Most people recognize that computers are here to stay and are interested in finding out how to use them. If you are so inclined, then this is the book for you!

I have designed this book as an introduction to personal computing for the novice. You may be a student, teacher, homemaker, business person, or just a curious individual. I assume that you have had little or no previous exposure to computers and are interested in learning the fundamentals. I will guide you as you turn on your computer for the first time. (There is really nothing to it!) From there, I will lead you through the fundamentals of computer programming in the BASIC language. Throughout, we will provide exercises for you to test your understanding of the concepts presented. The approach will stress the various ways in which *you can apply your computer*. The exercises will suggest programs you can write. Many of the programs will be designed to give you insight into the workings of computers in

business and industry. I will suggest a number of applications of the computer within your home. For good measure, we will build a few computer games!

What is Personal Computing?

In the early days of computing (the 1940s and 1950s), the typical computer was a huge mass of electronic components which occupied several entire rooms. In those days, it was often necessary to reinforce the floor of a computer room and install special air conditioning in order for the computer to function properly. Moreover, an early computer was likely to cost several million dollars. Over the years, the cost of computers has decreased dramatically and, thanks to micro-miniaturization, their size has shrunk quicker than their price.

A few years ago, the first "personal" computers were introduced to the marketplace. These computers were reasonably inexpensive and were designed to allow the average person to learn about the computer and to use it to solve everyday problems. These personal computers proved to be incredibly popular and several hundred thousand of them were sold in only three years.

The personal computer is not a toy. It is a genuine computer which has most of the features of its big brothers, the so-called "main-frame" computers, which still cost several million dollars. A personal computer can be equipped with enough capacity to handle the accounting and inventory control tasks of most small businesses. It can perform computations for engineers and scientists. It can even be used to keep track of home finance and personal clerical chores. It would be quite impossible to give anything like a comprehensive list of the applications of personal computers. However, the following list can suggest the range of possibilities:

For the business person:

- Accounting
- Record-keeping
- Clerical chores
- Inventory
- Cash management
- Payroll
- Graph and chart preparation

For the home:

- Record-keeping
- Budget management

- Investment analysis
- Correspondence
- Energy conservation
- Home security

For the professional:

- Billing
- Analysis of data
- Report generation
- Correspondence

For recreation:

- Computer games
- Computer graphics
- Computer art

As you can see, the list is quite comprehensive. However, your interests may not be included in any of the categories on the list. Do not worry about that. There is plenty of room for those of you who are just plain curious about computers and wish to pursue them as a hobby.

The TRS-80 Model III*

This book will introduce you to personal computing on the TRS-80 Model III computer. This is an excellent machine with remarkable capabilities for its very modest price. Radio Shack has been one of the genuine pioneers in the personal computer movement and its Model III is a "second generation" personal computer, enjoying many more advanced features than its earlier sisters, the Model I, Levels I and II. Before we begin to discuss the features of the Model III, however, let us begin by discussing the features which are common to all computers.

1.2 WHAT IS A COMPUTER?

At the heart of every computer is a **central processing unit** (or **CPU**) which executes the commands you specify. This unit carries out arithmetic, makes logical decisions, and so forth. In essence, the CPU is the "brain" of the computer. The **memory** of a computer allows it to "remember" numbers, words, paragraphs, as well as the list of commands you wish the computer to perform. The **input unit** allows you to send information to the computer; the

*TRS-80 is a registered trademark of the Tandy Corporation.

output unit allows the computer to send information to you. The relationship of these four basic components of a computer are shown in Figure 1-1.

In a TRS-80 computer, the CPU is contained in a tiny circuitry chip, called a Z80 microprocessor. As a computer novice, it will not be necessary for you to know anything at all about the electronics of the CPU. For now, view the CPU as a magic device somewhere inside the case of your computer and do not give it another thought!

The input device of the TRS-80 is the computer keyboard. We will discuss the special features of the keyboard in Section Three. For now it suffices to think of the keyboard as a typewriter. By typing symbols on the keyboard, you are inputting them to the computer.

The TRS-80 has a number of output devices available. The most basic is the "TV screen" or **video display**. In addition, you may use a printer to provide output on paper. In computer jargon, such output is called **hard copy**.

There are four types of memory in a TRS-80: ROM, RAM, cassette, and disk. Each of these types of memory has its own advantages and disadvantages, so we attempt to make the memory as versatile as possible by combining the good features of each type.

ROM stands for "read only memory." This type of memory can be read by the computer (that is, the CPU), but you cannot record anything in it. The ROM is reserved for the computer language which the CPU utilizes. More

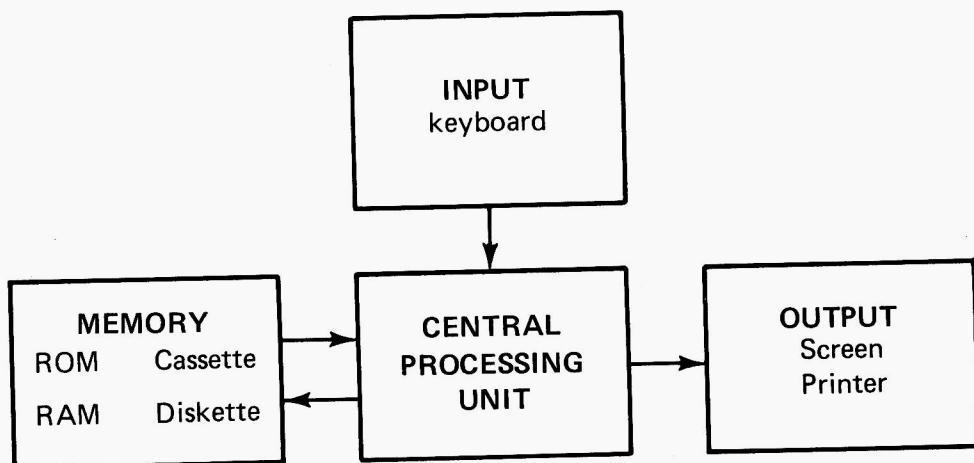


Figure 1-1.

about this language later. For now just remember that the ROM contains the information necessary for the computer to understand your commands. This information is pre-recorded in the factory and is permanently situated in the ROM. You will never need to concern yourself further with the ROM.

RAM stands for "random access memory." This is the memory into which you can write. If you type characters on the keyboard, then they are stored in RAM. Similarly, results of calculations are kept in RAM awaiting output to you. There is an extremely important feature of RAM which you should remember.

Important: If the computer is turned off, then RAM is erased.

Thus, RAM may not be used to store data in permanent form. Nevertheless, it is used as the computer's main working storage because of its great speed. It takes only about a millionth of a second to store or retrieve a piece of data from RAM.

To make permanent copies of programs and data, we may use either the cassette recorder or the disk file. The cassette recorder is just a tape recorder which allows the recording of information in a form intelligible to the computer. The recording medium is the same sort of cassette you use for musical recordings, but of a much higher quality.

A disk file records information on flexible disks which resemble phonograph records. The disks are often called "floppy disks," and can store several hundred thousand characters each! (A double-spaced typed page contains about 3,000 characters.) A disk file can provide access to information in much less time, on the average, than a cassette recorder. On the other hand, disk files are more costly than cassette recorders.

The TRS-80 Model III comes in both disk and non-disk models. Since this book is meant for novices, we will begin by assuming that you have the non-disk version. It will not make much difference which version you own until we discuss file maintenance (in Chapter 4).

1.3 MEET YOUR TRS-80

The best way to quickly master the operation of your computer is to read this book while sitting down in front of it and verifying the various statements as they come up. So why don't you have a seat in front of your TRS-80. If your computer is not conveniently available, you may refer to Figures 1-2 and 1-3.

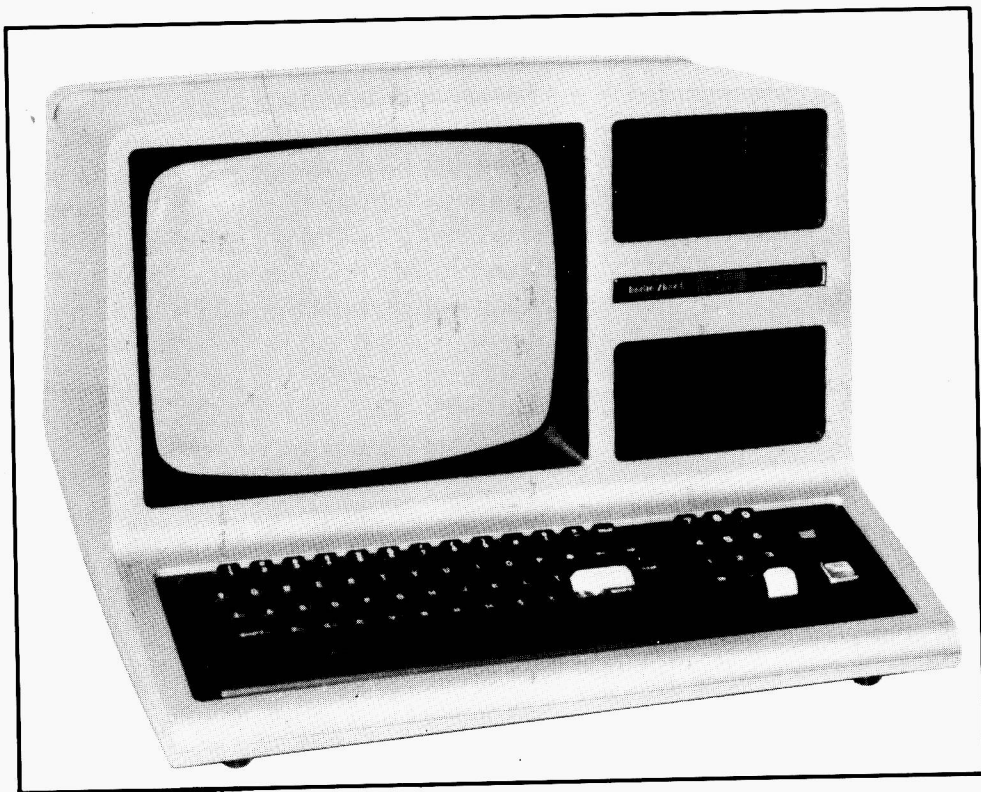


Figure 1-2. The TRS-80 Model III.

Let us begin by examining the keyboard. Note that it is similar to a typewriter keyboard, with a few significant differences. Many typewriters use the same key for the number 1 and a lower case letter l. However, for the computer, spellings must not allow for any ambiguity, so there are distinct keys for these two symbols. Similarly, it is very easy to confuse the capital letter O ('oh') and the number 0 (zero). For this reason, a computer specialist usually writes zero with a slash through it: 0. To prevent possible confusion, you should also adopt this convention.

Note that the keyboard has a number of specialized keys which are not on a standard typewriter keyboard. We will discuss these keys one at a time, but first let's turn the computer on. Look under the keyboard. On the right side you will find the Power-On. Push it. The computer should respond with the question:*

*The following discussion applies to the Model III, Levels I and II. If your computer is the disk version, then the power-on will be followed by the displayed message "Insert Diskette." In



Figure 1-3. The Model III keyboard.

CASS?

Respond by hitting the **ENTER** key. Next, the computer will ask:

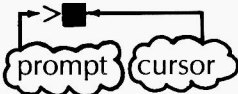
MEMORY SIZE?

Hit the **ENTER** key again. (Later on we will discuss the significance of these questions.) The computer should now respond with the message:

RADIO SHACK MODEL III BASIC

(C) '80 TANDY

READY



Your computer is now awaiting your instructions! Strike a few keys just to get the feel of the keyboard. Note that as you type, the corresponding characters

learning to operate your computer, we recommend that you ignore the disk drives for the time being. To do so, as you turn on your computer, depress the **Break** key. This procedure causes the computer to ignore the presence of the disk files. From here on the computer will function as described above. For start-up dialog to use the disk drives and disk BASIC, see Chapter Four.

will appear on the screen. Note, also, how the small white box travels along the typing line. This box is called the **cursor**. The cursor always sits at the location where the next typed character will appear. Note also that the symbol > always sits out in the left hand margin. This symbol is called a **prompt** and indicates the current line being typed.

As you type, you should notice the similarities between the Model III keyboard and that of a typewriter. However, you should also note the differences. At the end of a typewriter line you return the carriage, either manually or, on an electric typewriter, with a carriage return key. Of course, your screen has no carriage to return. The **ENTER** key serves the same function. If you depress the **ENTER** key, the cursor will then return to the next line and position itself at the extreme left side of the screen. The **ENTER** key has another function. It signals the computer to accept the line just typed. Until you hit the **ENTER** key, the computer does not even know that the current line exists!

Keep typing until you are at the bottom of the screen. If you hit **ENTER**, the entire contents of the screen will move up by one line and the line at the top of the screen will disappear. This property of the screen is called **scrolling**.

By this time, your screen should look pretty cluttered. To clear it, push the **CLEAR** key on the right side of the keyboard. All characters on the screen are erased and only the cursor remains. The cursor is positioned in the upper left corner of the screen. See Figure 1-4.

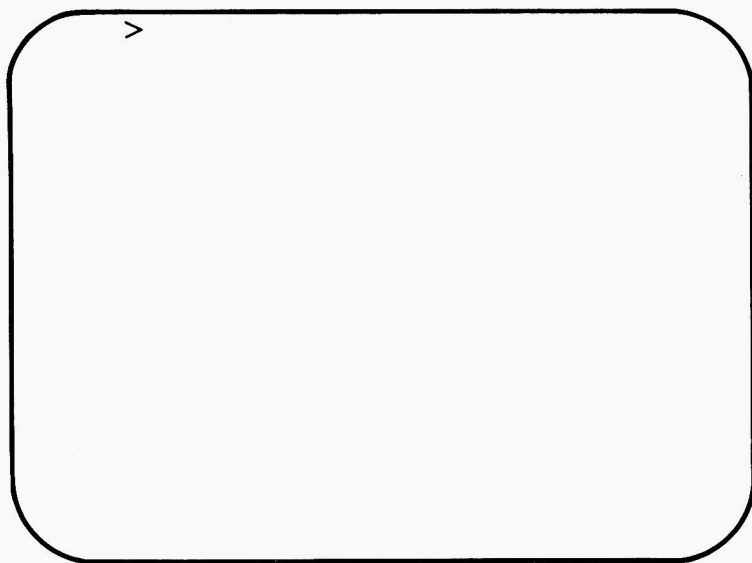


Figure 1-4. Screen after CLEAR.