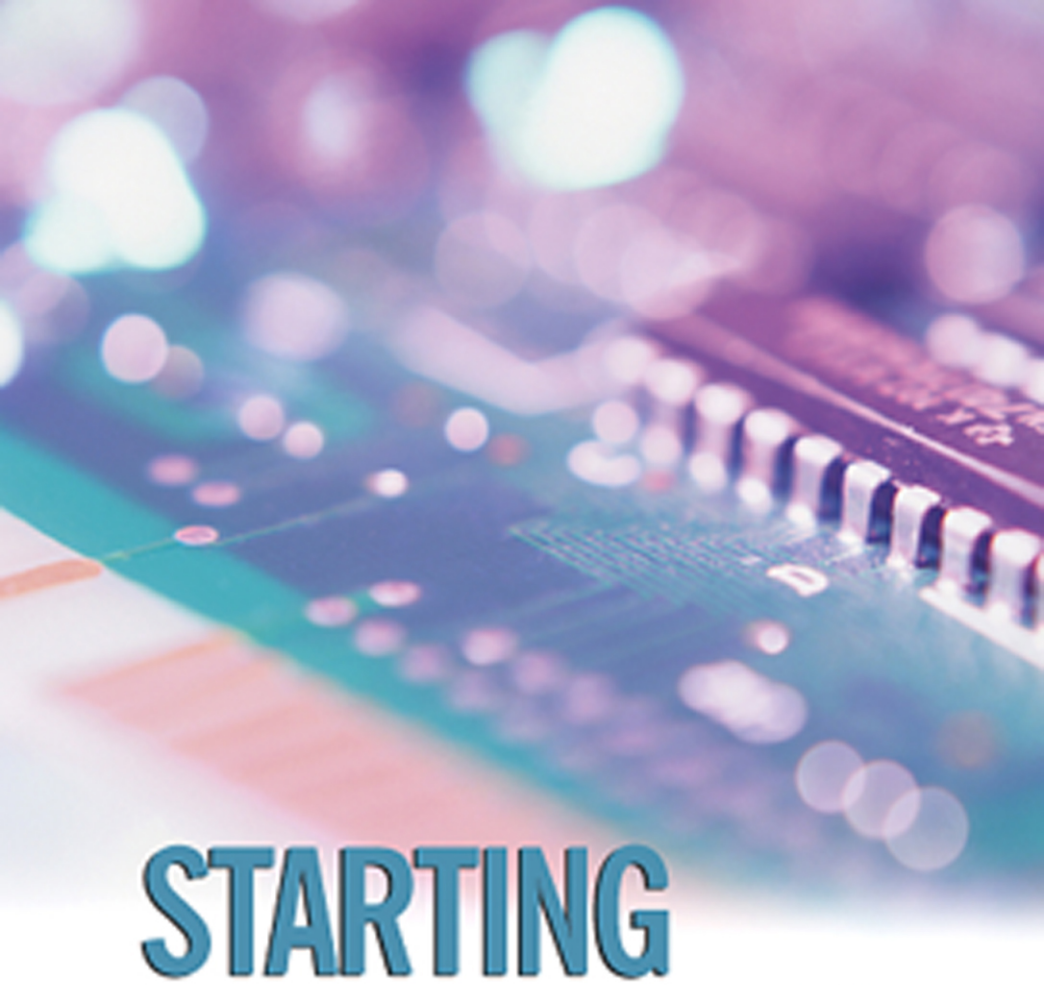

STARTING ELECTRONICS CONSTRUCTION

TECHNIQUES, EQUIPMENT AND PROJECTS

KEITH BRINDLEY

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Starting Electronics Construction

Techniques, Equipment and Projects

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Newnes is an imprint of Elsevier

Newnes
An imprint of Elsevier
Linacre House, Jordan Hill, Oxford OX2 8DP
30 Corporate Drive, Burlington, MA 01803, United States.
First edition 2005

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN 0 7506 67362

Typeset and produced by Co-publications, Loughborough

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Preface

This book is all about how to make electronics devices, from a constructional perspective. It is aimed at relative newcomers to electronics construction — that is, not the knowledgeable and trained electronics engineer, but those of us who want to find out about how to actually make up the circuits and projects that have already been designed.

It matters not whether the circuits you want to construct have been designed by others — perhaps they are presented in a magazine or a book as projects to build — or by yourself. It matters not whether you actually understand how that circuit works, or whether you haven't the foggiest idea of even its first principles — and maybe you don't even care! It matters not whether the intricate workings of a resistor; transistor; transformer; capacitor; or the latest wonder component is like Greek to double Dutch ears. There are other books that you can read which can give you all that understanding — and I'm bound to suggest my own book *Starting Electronics* as the ideal companion reference to this one, if that's the sort of understanding you are also looking for.

What *does* matter, on the other hand, is that *this* book (at least, that's my intention) shows everyone how to take an existing circuit and transform it into a complete and working device. This book starts from only the most limited knowledge of electronics processes, assuming very little — hopefully nothing at all, and introduces you to *all* the required concepts; the tools; the components; and the processes involved in turning a circuit

into a finished electronic device. In fact, my intention in writing it is not only to make the journey from circuit to device as easy as possible to traverse, but to make it fun at the same time. I hope I've succeeded.

Running to keep up…

In electronics, as with most fast-moving technologies, there's always the risk that a book such as this one can become out-of-date very quickly. The way electronics moves these days, it's not unfair to say that a book like this is only up-to-date for as long as the ink is wet. So, at this point, I'd like to introduce readers to a central website:

http://keithbrindley.members.beeb.net

where I will try to keep relevant information about the methods and processes covered here up-to-date. The website also features relevant links to manufacturers, component stockists, and other links as I see fit. Projects (in Chapter 8) all feature printed circuit board copper foil track patterns, and there are links on the website to allow you to download these in electronic formats too. Indeed, I'd go as far as suggesting that if you intend constructing any of the projects here you should look on the website to see if there are any alterations or other suggestions regarding the projects before you start. Any corrections or alterations to the copper foil track patterns (or anything else to do with the projects) will be featured on the website as soon as I can get them there.

As you make it…

Electronics in general is a fascinating area. However, getting 'into it' in the first place is sometimes daunting. It is my aim that *Starting Electronics Construction* gives as many people as possible the means whereby they can do just that. In the meanwhile, if I can offer anyone a suggestion if they intend to try, it is this: make it fun!

That way, you'll learn so much more than you ever could from stuffy textbooks. I hope that by reading this book and getting into practical electronics construction that you do have fun.

Keith Brindley

1

Introduction

This book is a guide to anyone who wants to build an electronic device. It assumes very little prior knowledge, and so introduces you to the various practices that you need to follow — whether you want to build something for pleasure, or for education, or even for profit. Also, this book takes the stance that it matters little what the particular electronic product is you wish to build — the most important fact is that the practices you follow are similar (if not identical) whatever the electronic device happens to be.

Electronics is in part a theoretical entity, and you could go to textbooks or to magazines, schools, colleges or universities, or elsewhere to find and learn that theory. However, it is also in a very large part a practical entity; a fact that — particularly in recent years — seems almost to have been overlooked. The many students of electronics at universities who have little or no prior experience with the handling of components or the building of circuits attest to this.

So, although what you read on the pages of this book is theory, it is theory about the practical aspects of building electronic devices. As such, included in this book are (hopefully most of, possibly all) the practical things you need to know about and be able to do before you can make an electronic device.

What this book is *not*, on the other hand, is a book about how electronics circuits *work* (for that, see this book's sister book: *Starting Electronics*, which is written also by me). What you have in front of you now is a book only about how to *construct* electronic devices. I hope you enjoy it, and gain some knowledge about how to do just that.

What do you need to know about making an electronic device?

This section is intended as a summary of the whole book. It would be easy to miss this out altogether, but my feeling in writing it is that you need to see the *big picture* before you go on to look at things in more detail.

And the big picture in terms of building electronics devices is simply a quick overview of what an electronic device is, and also what parts of it should we understand in order that we can build it.

So, what is an electronic device?

We can summarize an electronic device (an example of which is given in Figure 1.1) as below.

An electronic device invariably has three main features:

NUMBER 1 Electronic components. An electronic device is anything that incorporates electronic components of any description.

NUMBER 2 A printed circuit board. The electronic components which make up an electronic device are mounted upon a *printed circuit board* — (often called just a *PCB*), which is a means of holding all the components securely while at the same time making the necessary electrical connections between them all.

NUMBER 3 A housing. The printed circuit board, together with all the electronic components that it holds, will be housed in a box, or a module, or a case. In this way the electronic components are protected from damage.

So, what's next?

Given that any electronic device you might choose to build has these three main features, it follows that you need to know as much as you can

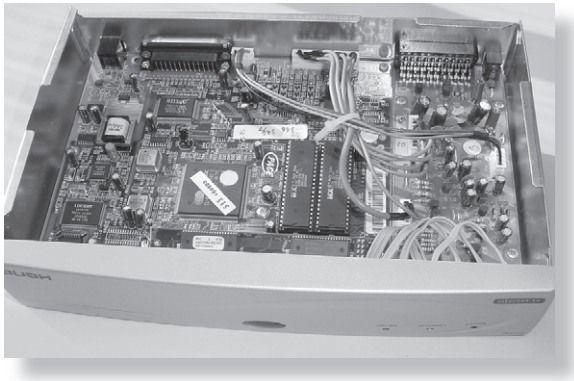

FIGURE 1.1 An example of an electronic device – note the electronic components, the printed circuit board, and the housing

about the features. And we'll look at them now, in brief, before devoting the rest of the book to that purpose.

Electronic components

There are many categories of electronic components, and each category is divided often into several sub-categories, and from there into a multitude of sub-sub-categories. You don't need to know about them *all* by any means, but you do need to know about the most common categories, and their most common sub-categories. You need to know how to handle these components so that you don't damage them, and so you need to know what damage *can* be done to them.

Some components are easily damaged just by holding them a little too roughly; some components are damaged by heat; and certainly many components are damaged if you insert them into a circuit incorrectly (the wrong way round, say, or too forcefully, thereby breaking their connection pins).

You also need to know about which tools you need to handle them and how to use these tools correctly.

Printed circuit boards

Making the printed circuit board onto which the electronic components of a device are mounted is not a trivial job. Indeed, the work involved in designing it, making it, then attaching the components to it represents a major proportion of the overall task. However, making a printed circuit board is not a job which should be rushed, for a poorly made printed circuit board is a recipe for disaster.

The printed circuit board is used for two main purposes: to support the electronics component; and to connect between the electronic components so that the circuit they are to be connected into can be formed. As a result, a printed circuit board that cannot support the components adequately, or makes incorrect connections, will prevent the electronic device from functioning correctly. So, you need to know about all aspects of printed circuit boards: how to design them; how to make them; and how to mount the components. You need to know what tools to use to do these tasks, and how to use the tools correctly.

I simply cannot stress enough how important the printed circuit board is. If the circuit itself is the brain of an electronic device — that monitors, controls and sends the signals that make the device work — then the printed circuit board is the heart that keeps the whole device going in the first place.

Housings

Once the printed circuit board is complete, with all electronic components in place, you have to consider how to house it. Housings are used to protect the components inside, as well as their printed circuit board. Housings also usually give a little extra space to allow batteries to be held, when needed, as well as providing mounting space for some components and controls not mounted on the board. They also protect users from potentially harmful voltages that may be present in the circuit — mains voltages, say. Labelling on a housing's facing panels can indicate what various control adjustments may be made by the user. As such, a housing is the interface — technically, visually, and aesthetically — with the outside world.

In short, if the circuit is the brain, and the printed circuit board is the heart, then the housing is the body, the skeleton, and the skin of an electronic device.

Housings done right can make a product a winner; done wrong the product is a duffer.

What have we learned?

To summarize this chapter we only need to remember one thing — an electronic device comprises three main parts. These main parts — the electronic components, the printed circuit board, and the housing — are highly dependent on each other. Designers and makers of *good* electronic devices understand this dependence, and use the main parts to the best advantage of their devices.