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MASTERING ELECTRONICS

THIRD EDITION

JOHN WATSON

M
MACMILLAN

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This one, at last, is for Olly

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PREFACE TO THE

THIRD EDITION

Mastering electronics in one book is a tall order.

When I began writing the preface to the first edition of *Mastering Electronics*, I set out to describe the electronics industry and the way it is growing and changing. I started to say that changes in the technology have resulted in changes in the way electronics is — and must be — taught. Then I decided to abandon that approach in favour of explaining briefly why I wrote *Mastering Electronics* the way I did.

I want to go back to my original thought in the new preface to this third edition. The electronics industry continues to grow and change, and the newer 'consumer' products illustrate this better than anything.

Compact Disc players for example, make use of lasers, servo systems and extraordinarily complex digital computing techniques to produce sound quality that is approaching perfection; the technology used was unheard of when the Beatles were recording.

'Camcorders', integrated video cameras and recorders (no larger than three copies of this book), work reliably and efficiently and cost relatively little.

Satellite TV receivers — designed to pick up faint signals directly from an artificial satellite almost 23 000 miles out in space — are available in the High Street stores for about the price of a good lawn-mower.

Under our streets and across the sea-beds, safe and relatively inexpensive glass fibre-optic cables (carrying hundreds of times more telephone traffic than the old copper cables) are using light to revolutionise telecommunications.

In learning about electronics, it is no longer enough to study audio amplifiers, radio, and perhaps TV — we need to look at digital electronics, computers, lasers, optoelectronics — all sorts of different but related topics. Although the details of the way many of today's complicated circuits

work are for graduate students and engineers rather than those starting out to learn about electronics, we do need to know about the *systems*.

I wrote this book to explain how electronic systems, devices, and components work. Too many books — even textbooks — still give cursory and unsatisfactory descriptions of interesting things. So I have explained the operation of, for example, LCDs, stepping motors, computers, and compact disc players a little more thoroughly than is usual — simply because to *understand* how a liquid crystal display works, you need first to have it explained to you!

This leads to my apology for what I have had to leave out of *Mastering Electronics*. To prevent the book becoming even bigger than it is (and more expensive) I have had to keep **Part 1 — Electricity** on the brief side. It is more than a revision section, but it is not comprehensive. There is less on computers than I would have liked, but fortunately there are lots of books on computing (see Appendix 4). I have, however, left in a few pages of semiconductor physics. Many exams do not require it, but it does give an insight into the basis for all this technology.

On the principle that if a picture is worth a thousand words a circuit diagram must be worth five thousand, I have been lavish with the illustrations. The concomitant is that the text is, in places, on the dense side and will repay careful reading.

I have included a number of practical circuits in the book which are integrated into the text rather than separated out as 'project work'. Where I recommend a circuit for practical work, I have built and tested the design before committing it to paper.

Mastering Electronics can be used as a self-teaching book or as a textbook; I think that on balance it has gained something in being designed for this dual role.

I hope you enjoy it.

JOHN WATSON

SYMBOLS AND UNITS

Successive attempts to 'metricate', both in the UK and in the USA, have left the electronics industry a little confused about units in some areas. Similarly, different 'standards' have been issued in different countries regarding the symbols to be used in circuit and logic diagrams, and although there are general similarities, there are disagreements about the details.

I have tried to take a middle and sensible course in *Mastering Electronics*. I have used SI metric units for all measurements, except where the original is clearly in Imperial units, imported, paradoxically, from the USA. For example, the plastic DIL pack (dual in-line) for integrated circuits has a standard spacing between connecting pins: it seems silly to assert that the spacing is 2.54 mm, when it is clearly $\frac{1}{16}$ inch!

I have used British Standard symbols in all circuit diagram, except in those very few cases where, for reasons of its own, the electronics industry has obstinately refused to use them. In such cases I have bowed to what seems to be the majority opinion and done what everybody else does. Where symbols are distinctly different, for example the logic symbols in BS 3939:1985/IEC 617-12 and ANSI Y32.14:1973, I have shown both initially then stuck with the BS/IEC version. The 'new' IEC logic symbols are progressively being adopted by European countries, and (with slight differences) by many countries outside Europe. If some of the IEC symbology — for example the counter in figure 21.11 — looks unfamiliar to teachers, lecturers and others who already have some acquaintance with circuit diagrams, then Appendix 4 suggests further sources of information.

For component values, I have generally omitted the units in circuit diagrams; thus a 1.8 k Ω resistor becomes 1.8 k on the diagram. I have avoided the 1k8 convention.