

OPTOELECTRONICS CIRCUITS MANUAL

R.M. MARSTON



A NEWNES
CIRCUITS MANUAL

**Optoelectronics
Circuits Manual**

Newnes Circuits Manual Series

CMOS Circuits Manual R. M. Marston

Optoelectronics Circuits Manual

R. M. Marston



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To Ashley, with love

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Contents

Preface	vii
1 Basic principles	1
2 LED display circuits	18
3 LED graph circuits	45
4 Seven-segment displays	66
5 Light-sensitive devices	90
6 Optocoupler devices	109
7 Brightness-control techniques	126
8 Light-beam alarms	144
9 Remote control systems	155
Index	179

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Preface

Optoelectronics can be defined as the study of any devices that produce an electrically-induced optical (visible or invisible light) output, or an optically-induced electrical output, and of the electronic techniques and circuitry used for controlling such devices. It is one of the fastest-growing branches of modern electronics and encompasses a wide variety of devices, ranging from simple light bulbs and light-emitting diodes (LEDs) to complete infra-red light-beam alarm and remote control systems.

This book is intended to act as a useful single-volume guide to the optoelectronics device user, and is specifically aimed at the practical design engineer, technician, and experimenter, as well as the electronics student and amateur. It deals with the subject in an easy-to-read, down-to-earth, non-mathematical but very comprehensive manner. It starts off by explaining the basic principles and characteristics of the best known types of optoelectronic device, and then goes on to look at the practical applications of many of these devices in depth.

Individual chapters of the book are devoted to LED display circuits, to LED dot- and bar-graph circuits, to applications of seven-segment displays, light-sensitive devices, and optocouplers, and to a variety of brightness-control techniques. The final two chapters deal with infra-red light-beam alarms and with multichannel remote control systems.

Throughout the book, great emphasis is placed on practical user information and circuitry, and the book abounds with useful circuits and graphs; over two hundred and sixty diagrams are included. Most of the ICs and other devices used in the practical circuits are inexpensive and readily available types, with universally recognized type numbers.

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1 Basic principles

Optoelectronics can be regarded as the study of any devices that produce an electrically-induced optical (visible or invisible light) output, or an optically-induced electrical output, and of the electronic techniques and circuitry used for controlling such devices. Optoelectronics is obviously a fairly large subject; in this chapter we present a brief survey of some of the devices, principles and techniques that it entails.

The best known types of light-generating optoelectric device are the ordinary tungsten filament lamp, the LED (light-emitting diode), the multisegment LED array, and the neon or gas-discharge lamp; other types of light-generator include the cathode ray tube and the LASER. An associated device is the LCD (liquid-crystal display), which does not in fact generate light but produces variations in the device's ability to reflect existing ambient light.

Light-sensitive devices include photodiodes and phototransistors (which have optosensitive conductivity), light-sensitive resistors (which have optosensitive resistivity), and so-called solar or photovoltaic cells (which are optosensitive voltage generators). Some specialist devices such as optoisolators and optoreflectors combine both light-generating and light-sensitive units in a single package.

Optoelectronic devices have many practical applications. They can be used to generate a wide variety of stationary or moving visual displays. They can be used to give an automatic switching or alarm action in the presence or absence of a visible or invisible light source, or to give a similar action when a person or object moves within range of a generated light source. They can be used to give remote-control action via an infra-red light generator and a remotely placed detector. In some applications, fibre-optic cables can be used to form a low-loss closed-circuit connecting link between a code-modulated light generator and a matching remotely placed light-sensitive device, thus forming