

Preface

The rapid adoption of automation techniques in industry has increased the requirement for better process control. This has resulted in many new applications for AC variable speed drives (VSDs) to control the speed and torque of driven machinery. Variable speed drives (VSDs) are also used to meet particular starting and stopping requirements.

The variable speed drives book promotes a sound understanding of how VSDs work and how to correctly select, install, commission and maintain them. There is also detailed coverage of many typical applications in process control and materials handling such as those for pumping, ventilation, conveyers and hoists.

This book will benefit anyone associated with the use of VSDs in the industrial or automation environment. This book will also benefit those working in system design as well as site commissioning, maintenance and troubleshooting.

Although a basic understanding of electrical engineering principles is essential, even those with a superficial knowledge of VSDs will substantially benefit from this book.

In particular, if you work in any of the following areas, you will benefit from this book:

- Consulting electrical engineers
- Plant engineers and instrument technicians
- Operations technicians
- Electrical maintenance technicians and supervisors
- Instrumentation and control system engineers
- Process control engineers
- Mechanical engineers

We would hope that you will learn the following from this book:

- The principles of AC variable speed drives for industrial speed control
- The essentials of squirrel cage induction motors
- The latest developments in power electronic converters used for VSDs
- How to select the correct AC variable speed drive for industrial applications
- How to identify faults on VSDs and how to rectify them
- The key issues about flux vector control and how it can be used in drive applications
- The main concepts in interfacing the control circuits of VSDs with PLCs/DCSs using serial data communications

The structure of the book is as follows.

Chapter 1: Introduction. A review of the fundamentals in variable speed drives including motion concepts, torque speed curves, types of variable speed drives, mechanical variable speed drive methods and electrical variable speed drive methods.

Chapter 2: 3-phase AC induction motors. These versatile and robust devices are the prime movers for the vast majority of machines. This chapter covers the basic construction, electrical and mechanical performance, motor acceleration, AC induction generator performance, efficiency of electric motors, rating of AC induction motors, duty cycles, cooling and ventilation, degree of protection of motor enclosures, methods of starting and motor selection.

Chapter 3: Power electronic converters. This chapter deals with the active components (e.g. diodes, thyristors, transistors) and passive components (e.g. resistors, chokes, capacitors) used in power electronic circuits and converters.

Chapter 4: Electromagnetic compatibility (EMC). Interference in circuits refers to the presence of unwanted voltages or currents in electrical equipment, which can damage the equipment or degrade its performance. The impact of variable speed drives can be severe and this chapter examines what causes interference and how to minimize its impact.

Chapter 5: Protection of AC converters and motors. The protection of AC variable speed drives includes the protection of the AC converter and the electric motor. The main methods of protection are examined.

Chapter 6: Control systems for AC variable speed drives. The overall control system can be divided into four main areas of the inverter control system, speed feedback and control system, current feedback and control system and the external interface.

Chapter 7: Selection of AC converters. Although manufacturers' catalogs try to make it as easy as possible, there are many variables associated with the selection and rating of the optimum electric motor and AC converter for a VSD application. This chapter covers many of the principles for the correct selection for AC variable speed drives, which use pwm-type variable voltage variable frequency (VVVF) converters to control the speed of standard AC squirrel cage induction motors.

Chapter 8: Installation and commissioning. The main issues here of general installation and environmental requirements, power supply and earthing requirements, start/stop of AC drives, installing AC converters into metal enclosures, control wiring and commissioning variable speed drives.

Chapter 9: Special topics and new developments. Typical topics of soft-switching and the matrix converter are examined here.