CONTENTS

Contributors xv
About the Editor xvii
Preface xix

Part 1 Introduction

Chapter 1. Introduction   Ronald K. Jurgen  1.3

1.1 The Dawn of a New Era  / 1.3
1.2 The Microcomputer Takes Center Stage  / 1.4
1.3 Looking to the Future  / 1.5
References  / 1.6

Part 2 Sensors and Actuators

Chapter 2. Pressure Sensors   Randy Frank  2.3

2.1 Automotive Pressure Measurements  / 2.3
2.2 Automotive Applications for Pressure Sensors  / 2.5
2.3 Technologies for Sensing Pressure  / 2.15
2.4 Future Pressure-Sensing Developments  / 2.23
   Glossary  / 2.24
   Bibliography  / 2.24

Chapter 3. Linear and Angle Position Sensors   Paul Nickson  3.1

3.1 Introduction  / 3.1
3.2 Classification of Sensors  / 3.1
3.3 Position Sensor Technologies  / 3.2
3.4 Interfacing Sensors to Control Systems  / 3.19
   Glossary  / 3.19
   References  / 3.20

Chapter 4. Flow Sensors   Robert E. Bicking  4.1

4.1 Introduction  / 4.1
4.2 Automotive Applications of Flow Sensors  / 4.1
4.3 Basic Classification of Flow Sensors  / 4.3
4.4 Applicable Flow Measurement Technologies  / 4.4
   Glossary  / 4.8
   Bibliography  / 4.9
### Chapter 10. Actuators  
*Klaus Müller*

10.1 Preface / 10.1  
10.2 Types of Electromechanical Actuators / 10.2  
10.3 Automotive Actuators / 10.19  
10.4 Technology for Future Application / 10.28  
Acknowledgments / 10.31  
Glossary / 10.31  
Bibliography / 10.32

### Part 3 Control Systems

### Chapter 11. Automotive Microcontrollers  
*David S. Boehmer*

11.1 Microcontroller Architecture and Performance Characteristics / 11.3  
11.2 Memory / 11.24  
11.3 Low-Speed Input/Output Ports / 11.31  
11.4 High-Speed Input/Output Ports / 11.36  
11.5 Serial Communications / 11.41  
11.6 Analog-to-Digital Converter / 11.45  
11.7 Failsafe Methodologies / 11.49  
11.8 Future Trends / 11.51  
Glossary / 11.54  
Bibliography / 11.55

### Chapter 12. Engine Control  
*Gary C. Hirschlieb, Gottfried Schiller, and Shari Stottler*

12.1 Objectives of Electronic Engine Control Systems / 12.1  
12.2 Spark Ignition Engines / 12.5  
12.3 Compression Ignition Engines / 12.32

### Chapter 13. Transmission Control  
*Kurt Neuffer and Kurt Engelsdorf*

13.1 Introduction / 13.1  
13.2 System Components / 13.2  
13.3 System Functions / 13.3  
13.4 Communications with Other Electronic Control Units / 13.7  
13.5 Optimization of the Powertrain / 13.8  
13.6 Future Developments / 13.17  
Glossary / 13.18  
References / 13.19

### Chapter 14. Cruise Control  
*Richard Valentine*

14.1 Cruise Control System / 14.1  
14.2 Microcontroller Requirements for Cruise Control / 14.3  
14.3 Cruise Control Software / 14.4  
14.4 Cruise Control Design / 14.6  
14.5 Future Cruise Concepts / 14.7
## Chapter 20. Lighting, Wipers, Air Conditioning/Heating

*Richard Valentine*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.1 Lighting Controls</td>
<td>20.1</td>
</tr>
<tr>
<td>20.2 Windshield Wiper Control</td>
<td>20.9</td>
</tr>
<tr>
<td>20.3 Air Conditioner/Heater Control</td>
<td>20.15</td>
</tr>
<tr>
<td>20.4 Miscellaneous Load Control Reference</td>
<td>20.20</td>
</tr>
<tr>
<td>20.5 Future Load Control Concepts</td>
<td>20.25</td>
</tr>
<tr>
<td>20.6 Summary</td>
<td>20.26</td>
</tr>
<tr>
<td>Glossary</td>
<td>20.27</td>
</tr>
<tr>
<td>Bibliography</td>
<td>20.28</td>
</tr>
</tbody>
</table>

## Part 4 Displays and Information Systems

### Chapter 21. Instrument Panel Display Technologies

*Ronald K. Jurgen*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.1 The Evolution to Electronic Displays</td>
<td>21.3</td>
</tr>
<tr>
<td>21.2 Vacuum Fluorescent Displays</td>
<td>21.3</td>
</tr>
<tr>
<td>21.3 Liquid Crystal Displays</td>
<td>21.4</td>
</tr>
<tr>
<td>21.4 Cathode-Ray Tube Displays</td>
<td>21.6</td>
</tr>
<tr>
<td>21.5 Head-Up Displays</td>
<td>21.6</td>
</tr>
<tr>
<td>21.6 Electronic Analog Displays</td>
<td>21.8</td>
</tr>
<tr>
<td>21.7 Future Displays</td>
<td>21.9</td>
</tr>
<tr>
<td>References</td>
<td>21.10</td>
</tr>
</tbody>
</table>

## Part 5 Safety, Convenience, Entertainment, and Other Systems

### Chapter 23. Passenger Safety and Convenience

*Bernhard K. Mattes*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>23.1 Passenger Safety Systems</td>
<td>23.3</td>
</tr>
<tr>
<td>23.2 Passenger Convenience Systems</td>
<td>23.15</td>
</tr>
<tr>
<td>Glossary</td>
<td>23.19</td>
</tr>
<tr>
<td>Bibliography</td>
<td>23.20</td>
</tr>
</tbody>
</table>

### Chapter 24. Remote Keyless Entry and Antitheft Systems

*Melissa Simpler and Patrick Boyer*

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.1 Introduction</td>
<td>24.1</td>
</tr>
<tr>
<td>24.2 System Features</td>
<td>24.2</td>
</tr>
<tr>
<td>24.3 RKE System Design</td>
<td>24.3</td>
</tr>
</tbody>
</table>
Chapter 25. Entertainment Products  Thomas Chrapkiewicz  25.1

25.1 Fundamentals of Audio Systems / 25.1
25.2 A Brief History of Automotive Entertainment / 25.4
25.3 Contemporary Audio Systems / 25.5
25.4 Future Trends / 25.12
   Glossary / 25.17
   References / 25.18

Chapter 26. Multiplex Wiring Systems  Fred Miesterfeld  26.1

26.1 Vehicle Multiplexing / 26.1
26.2 Encoding Techniques / 26.12
26.3 Vehicle Multiplexing Physical Layer / 26.27
26.4 Protocols / 26.31
26.5 Summary and Conclusions / 26.61
   Glossary / 26.67
   References / 26.75

Part 6   Electromagnetic Interference and Compatibility

Chapter 27. Electromagnetic Standards and Interference  James P. Muccioli  27.3

27.1 SAE Automotive EMC Standards / 27.3
27.2 IEEE Standards Related to EMC / 27.11
27.3 The Electromagnetic Environment of an Automobile Electronic System / 27.13
   Bibliography / 27.18

Chapter 28. Electromagnetic Compatibility  James P. Muccioli  28.1

28.1 Noise Propagation Modes / 28.1
28.2 Cabling / 28.2
28.3 Components / 28.4
28.4 Printed Circuit Board EMC Checklist / 28.9
28.5 Integrated Circuit Decoupling—A Key Automotive EMI Concern / 28.10
28.6 IC Process Size Affects EMC / 28.14
   Bibliography / 28.19

Part 7   Emerging Technologies

Chapter 29. Object Detection, Collision Warning, Collision Avoidance  Ross Bannatyne  29.3

29.1 Introduction / 29.3
29.2 Active and Passive Safety Systems / 29.4
Chapter 30. Adaptive Cruise Control  
*Hermann Winner*

30.1 Introduction / 30.1
30.2 Overview / 30.1
30.3 Functions / 30.2
30.4 Man-Machine Interface / 30.6
30.5 Basic Structure of Signal Processing and Control / 30.9
30.6 ACC Sensor / 30.11
30.7 Control / 30.25
30.8 A Look at Future Development / 30.27
30.9 Conclusion / 30.28
Glossary / 30.29
References / 30.29

Chapter 31. Navigation Aids and Driver Information Systems  
*Robert L. French and Edward J. Krakiwsky*

31.1 Background / 31.1
31.2 Automobile Navigation Technologies / 31.2
31.3 Examples of Navigation Systems / 31.8
31.4 Future Directions / 31.13
References / 31.15

Chapter 32. Intelligent Transportation Systems (ITS)  
*Robert L. French and Kan Chen*

32.1 Introduction / 32.1
32.2 Background / 32.2
32.3 User Services / 32.2
32.4 System Architecture / 32.5
32.5 In-Vehicle ITS Functions / 32.7
32.6 Future Directions / 32.7
References / 32.11

Chapter 33. Electric and Hybrid Vehicles  
*George G. Karady, Tracy Blake, Shahin H. Berisha, Raymond S. Hobbs, and Donald B. Karner*

33.1 Introduction / 33.1
33.2 System Description / 33.4
33.3 Charger and Protection System / 33.5
33.4 Motor Drive System / 33.9
33.5 Battery / 33.18
33.6 Vehicle Control and Auxiliary Systems / 33.21
33.7 Infrastructure / 33.23
33.8 Hybrid Vehicles / 33.25
Glossary / 33.27
References / 33.28