

Contents :

1. Introduction to the HC12 Microcontrollers

- Brief History of Computers
- Computers and Embedded Controllers
- Applications of Embedded Controllers
- Overview of the HC12
 - Software Instruction Set
 - Hardware
- Overview of the S12
 - Software Instruction Set
 - Hardware
- Summary
- Further Reading

2. HC12 and S12 Assembly Language Programming

- Programmer's Model
- Freescale Assembly Language
- Instruction Execution Cycle
- Instruction Set
 - Data Transfer and Manipulation Instructions
 - Arithmetic Operations
 - Logical and Bit Operations
 - Data Test Instructions
 - Optional: Fuzzy Logic Instructions
- Addressing Modes
 - Inherent Addressing Mode
 - Immediate Addressing Mode
 - Direct Addressing Mode
 - Extended Addressing Mode
 - Index Addressing Mode
 - Relative Addressing Mode
- Branch Instructions
- Directives (Pseudo-Op Code) and a Good Programming Approach
 - Directives
 - A Good Programming Approach
- Laboratory Applications
- Summary
- Chapter Problems

3. Advanced Assembly Programming

- Assembly Process
- Loops
- Stack
 - Definition of Stack
 - Use of a Stack

- Access to a Stack
- Subroutines
 - Subroutine Calls and Returns
 - Parameter-Passing Techniques
- HC12 and S12 D-Bug12 Utility Subroutines
- Programming Modules
- Programming Techniques
- Applications: Robot Navigation Using HC12/S12
- Laboratory Applications
- Summary
- Further Reading
- Chapter Problems

4. Fuzzy Logic

- Conventional Controller versus Fuzzy Logic Controller
- Fuzzy Logic Controller for a Balancing Robot
 - Background
 - Optional: Dynamic Model for the Robot
 - Fuzzy Logic Controller
- The HC12 and S12 Fuzzy Logic Operations
 - Membership Function Design Process
 - Fuzzy Rule Implementation
 - HC12 and S12 Fuzzification Process
 - Unweighted Rule Evaluation (REV) and Weighted Rule Evaluation (REW)
 - HC12 and S12 Defuzzification Process
 - Other Fuzzy Logic Controller-Related Instructions
- Application
- Some Comments on Fuzzy Logic Controller Design
- Laboratory Application
- Summary
- Further Reading
- Chapter Problems

5. Hardware Configuration

- The Wall Following Robot
- The 68HC12 Hardware System
- Modes of Operation
 - Normal Operating Modes
- Hardware Pin Assignments
- 68HC12 Subsystems
 - Register Block
 - Port System
 - The Timing System — The Standard Timer Module
 - The Memory System
 - Interrupts
 - Clock Functions
 - Serial Communications — The Multiple Serial Interface
 - The Data Conversion System — The Analog-to-Digital Converter

- Application — Switches, Keypads, Indicators
 - Input Switches
 - Keypads
 - Indicators — Light Emitting Diodes
 - Indicators — Seven-Segment Displays
 - Programming Switches and Indicators
- Application — Wall Following Robot
- Laboratory Application
- Summary
- Chapter Problems

6. Exceptions — Resets and Interrupts

- Overview
- What Is an Interrupt?
- General Interrupt Response
- Reset and Exception Systems aboard the 68HC12
 - Resets
 - Interrupts
 - Exception Vector
 - Exception Priority
- Interrupt System-Associated Registers
- How Does 68HC12 Respond to an Interrupt?
- Writing Interrupt Service Routines for the 68HC812A4EVB
- How to Program an ISR — An Example
- Programming the Real-Time Interrupt (RTI) System
- A Few More Details
- Advanced Interrupt Topics
- Laboratory Application
- Summary
- Further Reading
- Chapter Problems

7. The 68HC12 Clock Module and Standard Timer Module (TIM)

- Overview
- Background Theory
- The 68HC12 Clock Module
- Clock Divider Chain Serving the TIM
- The 68HC12 Timer Module
- Components of the Timer Module
- Free-Running Counter
- Free-Running Counter-Associated Registers
- Input Capture/Output Compare Channels
- The Pulse Accumulator
- The Real-Time Interrupt (RTI)
- Programming Input Capture, Output Compare, and the Pulse Accumulator Features of the TIM
 - Programming the Input Capture System
 - Programming the Input Capture System with an Interrupt

- Programming the Output Compare System
 - Programming the Output Compare System with Interrupts
 - Programming the Pulse Accumulator System
- Applications
- Laboratory Applications
- Summary
- References
- Chapter Problems

8. The 68HC12 Memory System

- Overview
- Background Theory
- Basic Memory Concepts
 - Memory Capacity and Control Signals
 - Memory Buses
 - Memory Technologies: ROM versus RAM
 - Memory Map
- The A4 Memory System
- Linear Memory Expansion
 - Memory Layout Design
 - 68HC12 and Memory Chip Control Signal Connections
 - Timing Analysis of Basic Memory Operations
 - Electrical Compatibility
- Memory Paging
- EEPROM Modification
- Applications
- Further Reading
- Summary
- Chapter Problems

9. Analog-to-Digital (ATD) Converter

- Overview
- Transducer Interface Design
- Analog-to-Digital Conversion Background Theory
 - Sampling Rate
 - Encoding
 - Quantizing and Resolution
 - Data Rate
- Analog-to-Digital Converter Technologies
 - Successive-Approximation Converters
 - Integration-Based Converters
 - Counter-Type Converters
 - Parallel Converters
- The 68HC12 Analog-to-Digital (ATD) Conversion System
 - 68HC12 ATD System
 - 68HC12 ATD System Control Registers
 - Programming the 68HC12 ATD System
 - Programming the ATD System Using Interrupts

- Application
- Laboratory Application
- Summary
- Further Reading
- Chapter Problems

10. 68HC12 Communications System — Multiple Serial Interface

- Need for Communication Features
- Fundamentals of Serial Communication
 - Serial Communication Terminology
 - Serial Communication Signals
- Multiple Serial Interface
- The Serial Communications Interface
 - Hardware Description — The SCI Transmitter
 - Hardware Description — The SCI Receiver
 - SCI Registers
 - SCI Transmitter and Receiver Operation
 - Programming the Serial Communication Interface
- SPI — Serial Peripheral Interface
 - SPI Concepts
 - SPI General Description
 - SPI Registers
 - Programming the SPI
 - SPI Applications
- Laboratory Application
- Summary
- Chapter Problems

Appendices

A. 68HC12 Instruction Set

B. 68HC812A4 Register Set

C. Number Systems and Number Arithmetic

- Number Representations
- Binary Number Arithmetic
- The 2's Complement Number Representation
- Arithmetic
- Changing the Base of Numbers
- Summary and Further Readings

D. Digital Logic Fundamentals

- Overview
- Basic Combinational Logic
- Medium-Scale Integration Combinational Circuits

- Sequential Logic Circuits
- Flip-Flops
- MSI Sequential Circuit Components
- Summary

E. Mobile Robot and Related Products for the 68HC12

- Building Your Own Mobile Robot
- 68HC12-Related Hardware and Software Products
 - Hardware
 - Software