
Table of Contents

Preface	xi
1. An Introduction to Computer Architecture	1
Concepts	2
Memory	16
Input/Output	20
DMA	20
Embedded Computer Architecture	26
2. Assembly Language	30
Registers	32
Machine Code	32
Signed Numbers	34
Addressing Modes	35
Coding in Assembly	37
Disassembly	40
Position-Independent Code	41
Loops	41
Masking	42
Indexed Addressing	43
Stacks	44
Timing of Instructions	45
3. Forth/Open Firmware	48
Introducing Forth	48
String Words	51
Stack Manipulation	52
Creating New Words	54

Comments	56
if ... else	57
Loops	58
Data Structures	61
Interacting with Hardware and Memory	62
Forth Programming Guidelines	64
4. Electronics 101	65
Voltage and Current	65
Analog Signals	67
Power	68
Reading Schematics	68
Resistors	73
Capacitors	80
RC Circuits	83
Inductors	86
Transformers	89
Diodes	90
Crystals	93
Digital Signals	98
Electrical Characteristics	99
Logic Gates	108
The Importance of Reading the Datasheet	109
5. Power Sources	110
The Stuff Out of the Wall	110
Batteries	111
Low Power Design	111
Regulators	112
LM78xx Regulators	114
MAX603/MAX604 Regulators	116
MAX1615 Regulator	117
MAX724 Regulator	118
Electrical Noise and Interference	119
6. Building Hardware	124
Tools	124
Soldering	129
Quick Construction	136

Printed-Circuit Boards	140
Building It	153
JTAG	157
7. Adding Peripherals Using SPI	160
Serial Peripheral Interface	160
8. Adding Peripherals Using I²C	174
Overview of I ² C	174
Adding a Real-Time Clock with I ² C	178
Adding a Small Display with I ² C	179
9. Serial Ports	180
UARTs	180
Error Detection	182
Old Faithful: RS-232C	183
RS-422	190
RS-485	192
10. IrDA	196
Introduction to IrDA	196
11. USB	203
Introduction to USB	204
USB Packets	206
Physical Interface	208
Implementing a USB Interface	211
12. Networks	215
Controller Area Network (CAN)	215
Ethernet	219
13. Analog	226
Amplifiers	226
Analog to Digital Conversion	229
Interfacing an External ADC	233
Temperature Sensor	235
Light Sensor	237
Accelerometer	240
Pressure Sensors	242

Magnetic-Field Sensor	244
Digital to Analog Conversion	245
PWM	248
Motor Control	249
Switching Big Loads	256
14. The PIC Microcontrollers	258
A Tale of Two Processors	258
Starting Simple	260
A Bigger PIC	263
PIC-Based Environmental Datalogger	265
Motor Control with a PIC	271
15. The AVR Microcontrollers	277
The AVR Architecture	278
The ATtiny15 Processor	280
Downloading Code	287
A Bigger AVR	289
AVR-Based Datalogger	290
Bus Interfacing	291
16. 68HC11	316
Architecture of the 68HC11	316
A Simple 68HC11-Based Computer	317
17. MAXQ	327
Architectural Overview	327
Schematics	329
18. 68000-Series Computers	334
The 68000 Architecture	335
A Simple 68000-Based Computer	339
19. DSP-Based Controllers	348
The DSP56800	351
A DSP56805-Based Computer	353
JTAG	361
Index	363