

Contents

Preface9

Chapter 1 • Automotive Bus Systems10

1.1 Overview10

1.2 Vehicle network systems11

1.2.1 LIN bus12

1.2.2 FlexRay13

1.2.3 MOST13

1.2.4 Byteflight.13

1.2.5 Intellibus14

1.2.6 CAN bus14

1.2.7 Others.15

1.3 Comparison of automotive bus systems15

1.4 The basic structure of a CAN bus automotive system19

1.5 CAN bus advantages22

1.6 CAN bus disadvantages22

1.7 CAN bus main properties22

1.8 CANopen23

Chapter 2 • CAN Physical Layer Structure24

2.1 Overview24

2.2 CAN bus termination24

2.3 CAN bus data rate27

2.4 Cable stub length27

2.5 CAN bus node28

2.6 CAN bus signal levels28

2.6.1 CAN_H voltage29

2.6.2 CAN_L voltage29

2.6.3 CAN signal waveform30

2.6.4 Bus arbitration30

2.6.5 Bus transceiver.30

2.7 CAN connectors.31

2.8 CAN repeaters.	34
2.9 CAN PC interface	35
Chapter 3 • CAN Bus Frames	36
3.1 Data Frame.	37
3.1.1 Start of Frame (SOF)	39
3.1.2 Arbitration Field	39
3.1.3 RTR Field	41
3.1.4 Control Field	41
3.1.5 Data Field	42
3.1.6 CRC Field	42
3.1.7 ACK Field.	43
3.1.8 End of Frame Field.	43
3.2 Remote Frame	44
3.3 Error Frame	44
3.4 Overload Frame.	46
3.5 Extended CAN Frames	46
Chapter 4 • Data Exchange on the CAN Bus.	48
4.1 Overview	48
4.2 Data exchange with data frames	48
4.3 Remote frames on the bus	51
Chapter 5 • CAN Bus Interface Modules	53
5.1 Overview	53
5.2 MCP2515 CAN bus interface module	53
5.2.1 The MCP2515 CAN controller chip.	55
5.2.2 The TJA1050 CAN transceiver chip	58
Chapter 6 • Arduino Uno CAN Bus Projects	59
6.1 Overview	59
6.2 Arduino Uno CAN bus interface	59
6.3 Project 1: Simple Arduino to Arduino CAN bus communication	59
6.4 Project 2: Pushbutton and LED	68
6.5 Project 3: Pushbutton and LED with CAN bus interrupts	72

6.6 Project 4: Remote temperature alarm	75
6.7 Project 5: Temperature request.	79
6.8 Project 6: Temperature request with a pushbutton	83
6.9 Project 7: RGB display with buttons.	86
6.10 Project 8: Ambient temperature and humidity display on LCD	91
6.11 Project 9: CAN bus with 3 nodes: External and internal temperature measurement	102
6.12 Using acceptance masks and filters	107
6.13 Project 10: CAN bus with 3 nodes: External and internal temperature measurement with pushbuttons	109
Chapter 7 • Error Conditions on the CAN Bus	117
7.1 Overview	117
7.2 Bit stuffing	117
7.3 CAN Bus error detection	118
7.3.1 Bit error	119
7.3.2 Bit stuffing error	119
7.3.3 CRC error	119
7.3.4 Frame error	119
7.3.5 ACK Error	119
7.4 CAN bus fault confinement	119
7.5 Summary	121
Chapter 8 • CAN Bus Analyzers	122
8.1 Overview	122
8.2 CAN Bus analyzers.	122
8.2.1 Microchip, Inc. CAN bus analyzer	122
8.2.2 CANdo.	123
8.2.3 PCAN Explorer	124
8.2.4 CAN-Bus-Tester 2 (CBT2).	125
8.2.5 BitScope Logic	127
8.2.6 LAP-C logic analyzer	128
8.3 Project 11: CAN bus sniffer.	129
8.4 Summary	133

Chapter 9 • Raspberry Pi CAN Bus Projects.135

9.1 Overview135

9.2 Project 11: Simple Raspberry Pi – Arduino Uno CAN bus communication135

9.3 Project 12: Raspberry Pi displaying messages from CAN bus141

9.4 Project 13: Controlling LEDs connected to Arduino Uno143

9.5 Using Python for CAN bus programs146

9.6 Project 14: Controlling LEDs using buttons147

9.7 Project 15: CAN bus with 3 nodes: Controlling LEDs on Raspberry Pi node
and Arduino Uno node149

Appendix.155

Index156