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*High-Performance 8-Bit Microcontrollers*

## **Z8 Encore! XP<sup>®</sup> 8K and 4K Series**

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## Revision History

Each instance in the following table reflects a change to this document from its previous revision. To see more detail, click the appropriate link in the table below.

| Date          | Revision Level | Description  | Page No  |
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| August 2006   | 16             | Changes for improved readability. Added data to <a href="#">Electrical Characteristics</a> chapter.  | All  |
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| June 2005     | 11             | Inserted missing temperature sensor chapter. Updated Figure 1 to include Transimpedance Amplifier. Added Transimpedance Amplifier to Feature Description. Removed reference to VBO enable. Updated Table 124 format. Changed Temperature Sensor column in ordering information pages.   | 3, 5, 152, 223, 227  |
| May 2005      | 10             | Added clarifying information for using the UART Baud Rate Generator as a simplified timer. Removed 2.2 V <sub>REF</sub> in Table 129. Changed VBO to LVD in Interrupt Controller. Changed PA5 T1OUT to T1OUT and added clarification of Ports A-C for 8-pin and 20/28 pin devices in Tables 21, 26 and 27 in the GPIO. Changed T <sub>POR</sub> and T <sub>SMR</sub> typical values in Table 125, and Endurance minimum value in Table 126 in Electrical Characteristics. Removed 2.2 V reference in Electrical Characteristics and Analog-to-Digital Converter chapters. Added clarifying text when writing to the Flash Control Register in Flash Memory chapter. Added Lead-Free Packaging order information | 99, 129, 39, 50, 51, 56, 58, 59, 61, 43, 46, 203, 204, 206, 121, 123, 126-140, 222-228 |
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# Table of Contents

|   |            |
|---|------------|
| <b>List of Figures</b> .....                      | <b>xii</b> |
| <b>List of Tables</b> .....                       | <b>xv</b>  |
| <b>Overview</b> .....                             | <b>1</b>   |
| Features .....                                    | 1          |
| Part Selection Guide .....                        | 2          |
| Block Diagram .....                               | 4          |
| CPU and Peripheral Overview .....                 | 5          |
| eZ8 CPU Features .....                            | 5          |
| 10-Bit Analog-to-Digital Converter .....          | 5          |
| Low-Power Operational Amplifier .....             | 6          |
| Internal Precision Oscillator .....               | 6          |
| Temperature Sensor .....                          | 6          |
| Analog Comparator .....                           | 6          |
| External Crystal Oscillator .....                 | 6          |
| Low Voltage Detector .....                        | 6          |
| On-Chip Debugger .....                            | 6          |
| Universal Asynchronous Receiver/Transmitter ..... | 7          |
| Timers .....                                      | 7          |
| General Purpose I/O .....                         | 7          |
| Direct LED Drive .....                            | 7          |
| Flash Controller .....                            | 7          |
| Non-Volatile Data Storage .....                   | 7          |
| Interrupt Controller .....                        | 8          |
| Reset Controller .....                            | 8          |
| <b>Pin Description</b> .....                      | <b>9</b>   |
| Available Packages .....                          | 9          |
| Pin Configurations .....                          | 9          |
| Signal Descriptions .....                         | 11         |
| Pin Characteristics .....                         | 13         |
| <b>Address Space</b> .....                        | <b>16</b>  |
| Register File .....                               | 16         |
| Program Memory .....                              | 16         |
| Data Memory .....                                 | 18         |
| Flash Information Area .....                      | 18         |



|  |           |
|--|-----------|
| <b>Register Map</b> .....  | <b>20</b> |
| <b>Reset, Stop Mode Recovery and Low Voltage Detection</b> ..... | <b>24</b> |
| Reset Types .....  | 24        |
| Reset Sources .....  | 26        |
| Power-On Reset .....   | 26        |
| Voltage Brownout Reset .....                                     | 27        |
| Watchdog Timer Reset .....                                       | 28        |
| External Reset Input .....                                       | 28        |
| External Reset Indicator .....                                   | 29        |
| On-Chip Debugger Initiated Reset .....                           | 29        |
| Stop Mode Recovery .....   | 29        |
| Stop Mode Recovery Using Watchdog Timer Time-Out .....           | 30        |
| Stop Mode Recovery Using a GPIO Port Pin Transition .....        | 30        |
| Stop Mode Recovery Using the External RESET Pin .....            | 31        |
| Low Voltage Detection .....                                      | 31        |
| Reset Register Definitions .....                                 | 31        |
| <b>Low-Power Modes</b> .....                                     | <b>34</b> |
| STOP Mode .....  | 34        |
| HALT Mode .....  | 35        |
| Peripheral-Level Power Control .....                             | 35        |
| Power Control Register Definitions .....                         | 35        |
| <b>General-Purpose Input/Output</b> .....                        | <b>37</b> |
| GPIO Port Availability By Device .....                           | 37        |
| Architecture .....   | 38        |
| GPIO Alternate Functions .....                                   | 38        |
| Direct LED Drive .....   | 39        |
| Shared Reset Pin .....   | 39        |
| Shared Debug Pin .....   | 39        |
| Crystal Oscillator Override .....                                | 40        |
| 5 V Tolerance .....  | 40        |
| External Clock Setup .....                                       | 40        |
| GPIO Interrupts .....  | 45        |
| GPIO Control Register Definitions .....                          | 45        |
| Port A–D Address Registers .....                                 | 46        |
| Port A–D Control Registers .....                                 | 47        |
| Port A–D Data Direction Sub-Registers .....                      | 47        |
| Port A–D Alternate Function Sub-Registers .....                  | 48        |



|   |           |
|---|-----------|
| Port A–C Input Data Registers .....             | 52        |
| Port A–D Output Data Register .....             | 52        |
| LED Drive Enable Register .....                 | 53        |
| LED Drive Level High Register .....             | 53        |
| LED Drive Level Low Register .....              | 54        |
| <b>Interrupt Controller .....</b>               | <b>55</b> |
| Interrupt Vector Listing .....                  | 55        |
| Architecture .....                              | 57        |
| Operation .....                                 | 57        |
| Master Interrupt Enable .....                   | 57        |
| Interrupt Vectors and Priority .....            | 58        |
| Interrupt Assertion .....                       | 58        |
| Software Interrupt Assertion .....              | 59        |
| Interrupt Control Register Definitions .....    | 59        |
| Interrupt Request 0 Register .....              | 60        |
| Interrupt Request 1 Register .....              | 60        |
| Interrupt Request 2 Register .....              | 61        |
| IRQ0 Enable High and Low Bit Registers .....    | 62        |
| IRQ1 Enable High and Low Bit Registers .....    | 63        |
| IRQ2 Enable High and Low Bit Registers .....    | 64        |
| Interrupt Edge Select Register .....            | 65        |
| Shared Interrupt Select Register .....          | 66        |
| Interrupt Control Register .....                | 66        |
| <b>Timers .....</b>                             | <b>68</b> |
| Architecture .....                              | 68        |
| Operation .....                                 | 69        |
| Timer Operating Modes .....                     | 69        |
| Reading the Timer Count Values .....            | 81        |
| Timer Pin Signal Operation .....                | 81        |
| Timer Control Register Definitions .....        | 82        |
| Timer 0–1 Control Registers .....               | 82        |
| Timer 0–1 High and Low Byte Registers .....     | 86        |
| Timer Reload High and Low Byte Registers .....  | 86        |
| Timer 0-1 PWM High and Low Byte Registers ..... | 87        |
| <b>Watchdog Timer .....</b>                     | <b>89</b> |
| Operation .....                                 | 89        |
| Watchdog Timer Refresh .....                    | 90        |
| Watchdog Timer Time-Out Response .....          | 90        |
| Watchdog Timer Reload Unlock Sequence .....     | 91        |





|  |            |
|--|------------|
| Watchdog Timer Calibration .....                               | 92         |
| Watchdog Timer Control Register Definitions .....              | 92         |
| Watchdog Timer Control Register .....                          | 92         |
| Watchdog Timer Reload Upper, High and Low Byte Registers ..... | 93         |
| <b>Universal Asynchronous Receiver/Transmitter .....</b>       | <b>95</b>  |
| Architecture .....   | 95         |
| Operation .....  | 96         |
| Data Format .....  | 96         |
| Transmitting Data using the Polled Method .....                | 97         |
| Transmitting Data using the Interrupt-Driven Method .....      | 98         |
| Receiving Data using the Polled Method .....                   | 99         |
| Receiving Data using the Interrupt-Driven Method .....         | 100        |
| Clear To Send (CTS) Operation .....                            | 101        |
| MULTIPROCESSOR (9-bit) Mode .....                              | 101        |
| External Driver Enable .....                                   | 102        |
| UART Interrupts .....  | 103        |
| UART Baud Rate Generator .....                                 | 105        |
| UART Control Register Definitions .....                        | 106        |
| UART Control 0 and Control 1 Registers .....                   | 106        |
| UART Status 0 Register .....                                   | 109        |
| UART Status 1 Register .....                                   | 110        |
| UART Transmit Data Register .....                              | 111        |
| UART Receive Data Register .....                               | 111        |
| UART Address Compare Register .....                            | 111        |
| UART Baud Rate High and Low Byte Registers .....               | 112        |
| <b>Infrared Encoder/Decoder .....</b>                          | <b>115</b> |
| Architecture .....   | 115        |
| Operation .....  | 115        |
| Transmitting IrDA Data .....                                   | 116        |
| Receiving IrDA Data .....                                      | 117        |
| Infrared Encoder/Decoder Control Register Definitions .....    | 118        |
| <b>Analog-to-Digital Converter .....</b>                       | <b>119</b> |
| Architecture .....   | 119        |
| Operation .....  | 120        |
| Data Format .....  | 120        |
| Hardware Overflow .....  | 121        |
| Automatic Powerdown .....                                      | 121        |
| Single-Shot Conversion .....                                   | 121        |
| Continuous Conversion .....                                    | 122        |



|  |            |
|--|------------|
| Interrupts . . . . .   | 123        |
| Calibration and Compensation . . . . .                                 | 124        |
| ADC Compensation Details . . . . .                                     | 125        |
| Input Buffer Stage . . . . .   | 127        |
| ADC Control Register Definitions . . . . .                             | 128        |
| ADC Control Register 0 . . . . .                                       | 128        |
| ADC Control/Status Register 1 . . . . .                                | 130        |
| ADC Data High Byte Register . . . . .                                  | 130        |
| ADC Data Low Byte Register . . . . .                                   | 131        |
| <b>Low Power Operational Amplifier . . . . .</b>                       | <b>132</b> |
| Overview . . . . .   | 132        |
| Operation . . . . .  | 132        |
| <b>Comparator . . . . .</b>  | <b>133</b> |
| Operation . . . . .  | 133        |
| Comparator Control Register Definitions . . . . .                      | 134        |
| <b>Temperature Sensor . . . . .</b>                                    | <b>137</b> |
| Temperature Sensor Operation . . . . .                                 | 137        |
| <b>Flash Memory . . . . .</b>  | <b>139</b> |
| Architecture . . . . .   | 139        |
| Flash Information Area . . . . .                                       | 140        |
| Operation . . . . .  | 141        |
| Flash Operation Timing Using the Flash Frequency Registers . . . . .   | 143        |
| Flash Code Protection Against External Access . . . . .                | 143        |
| Flash Code Protection Against Accidental Program and Erasure . . . . . | 143        |
| Byte Programming . . . . .   | 145        |
| Page Erase . . . . .   | 145        |
| Mass Erase . . . . .   | 145        |
| Flash Controller Bypass . . . . .                                      | 146        |
| Flash Controller Behavior in Debug Mode . . . . .                      | 146        |
| Flash Control Register Definitions . . . . .                           | 147        |
| Flash Control Register . . . . .                                       | 147        |
| Flash Status Register . . . . .  | 148        |
| Flash Page Select Register . . . . .                                   | 148        |
| Flash Sector Protect Register . . . . .                                | 149        |
| Flash Frequency High and Low Byte Registers . . . . .                  | 150        |
| <b>Flash Option Bits . . . . .</b>                                     | <b>152</b> |
| Operation . . . . .  | 152        |
| Option Bit Configuration By Reset . . . . .                            | 152        |



|  |            |
|--|------------|
| Option Bit Types .....                                 | 153        |
| Reading the Flash Information Page .....               | 154        |
| Flash Option Bit Control Register Definitions .....    | 154        |
| Trim Bit Address Register .....                        | 154        |
| Trim Bit Data Register .....                           | 155        |
| Flash Option Bit Address Space .....                   | 155        |
| Flash Program Memory Address 0000H .....               | 155        |
| Flash Program Memory Address 0001H .....               | 156        |
| Trim Bit Address Space .....                           | 157        |
| Trim Bit Address 0000H .....                           | 157        |
| Trim Bit Address 0001H .....                           | 157        |
| Trim Bit Address 0002H .....                           | 158        |
| Trim Bit Address 0003H .....                           | 158        |
| Trim Bit Address 0004H .....                           | 160        |
| ZiLOG Calibration Data .....                           | 160        |
| ADC Calibration Data .....                             | 160        |
| Temperature Sensor Calibration Data .....              | 163        |
| Watchdog Timer Calibration Data .....                  | 163        |
| Serialization Data .....                               | 164        |
| Randomized Lot Identifier .....                        | 165        |
| <b>Non-Volatile Data Storage .....</b>                 | <b>167</b> |
| Operation .....  | 167        |
| NVDS Code Interface .....                              | 167        |
| Byte Write .....                                       | 167        |
| Byte Read .....  | 168        |
| Power Failure Protection .....                         | 169        |
| Optimizing NVDS Memory Usage for Execution Speed ..... | 169        |
| <b>On-Chip Debugger .....</b>                          | <b>171</b> |
| Architecture .....                                     | 171        |
| Operation .....  | 172        |
| OCD Interface .....                                    | 172        |
| DEBUG Mode .....                                       | 173        |
| OCD Data Format .....                                  | 174        |
| OCD Auto-Baud Detector/Generator .....                 | 174        |
| OCD Serial Errors .....                                | 175        |
| OCD Unlock Sequence (8-Pin Devices Only) .....         | 175        |
| Breakpoints .....                                      | 176        |
| Runtime Counter .....                                  | 176        |
| On-Chip Debugger Commands .....                        | 176        |



|   |            |
|---|------------|
| On-Chip Debugger Control Register Definitions . . . . .           | 181        |
| OCD Control Register . . . . .                                    | 181        |
| OCD Status Register . . . . .                                     | 182        |
| <b>Oscillator Control . . . . .</b>                               | <b>184</b> |
| Operation . . . . .   | 184        |
| System Clock Selection . . . . .                                  | 184        |
| Clock Failure Detection and Recovery . . . . .                    | 186        |
| Oscillator Control Register Definitions . . . . .                 | 187        |
| <b>Crystal Oscillator . . . . .</b>                               | <b>189</b> |
| Operating Modes . . . . .   | 189        |
| Crystal Oscillator Operation . . . . .                            | 189        |
| Oscillator Operation with an External RC Network . . . . .        | 191        |
| <b>Internal Precision Oscillator . . . . .</b>                    | <b>194</b> |
| Operation . . . . .   | 194        |
| <b>eZ8 CPU Instruction Set . . . . .</b>                          | <b>195</b> |
| Assembly Language Programming Introduction . . . . .              | 195        |
| Assembly Language Syntax . . . . .                                | 196        |
| eZ8 CPU Instruction Notation . . . . .                            | 196        |
| eZ8 CPU Instruction Classes . . . . .                             | 198        |
| eZ8 CPU Instruction Summary . . . . .                             | 203        |
| <b>Opcode Maps . . . . .</b>                                      | <b>212</b> |
| <b>Electrical Characteristics . . . . .</b>                       | <b>216</b> |
| Absolute Maximum Ratings . . . . .                                | 216        |
| DC Characteristics . . . . .                                      | 217        |
| AC Characteristics . . . . .                                      | 222        |
| On-Chip Peripheral AC and DC Electrical Characteristics . . . . . | 224        |
| General Purpose I/O Port Input Data Sample Timing . . . . .       | 229        |
| General Purpose I/O Port Output Timing . . . . .                  | 231        |
| On-Chip Debugger Timing . . . . .                                 | 232        |
| UART Timing . . . . .   | 233        |
| <b>Packaging . . . . .</b>  | <b>235</b> |
| <b>Ordering Information . . . . .</b>                             | <b>244</b> |
| <b>Customer Support . . . . .</b>                                 | <b>255</b> |
| <b>Index . . . . .</b>  | <b>256</b> |



# List of Figures

|  |     |
|--|-----|
| Figure 1. Z8 Encore! XP <sup>®</sup> 8K and 4K Series Block Diagram                        | 4   |
| Figure 2. Z8F08xA, Z8F04xA, Z8F02xA, and Z8F01xA in 8-Pin SOIC, QFN/MLF-S, or PDIP Package | 10  |
| Figure 3. Z8F08xA, Z8F04xA, Z8F02xA, and Z8F01xA in 20-Pin SOIC, SSOP or PDIP Package      | 10  |
| Figure 4. Z8F08xA, Z8F04xA, Z8F02xA, and Z8F01xA in 28-Pin SOIC, SSOP or PDIP Package      | 10  |
| Figure 5. Power-On Reset Operation   | 27  |
| Figure 6. Voltage Brown-Out Reset Operation  | 28  |
| Figure 7. GPIO Port Pin Block Diagram  | 38  |
| Figure 8. Interrupt Controller Block Diagram   | 57  |
| Figure 9. Timer Block Diagram  | 69  |
| Figure 10. UART Block Diagram  | 96  |
| Figure 11. UART Asynchronous Data Format without Parity                                    | 97  |
| Figure 12. UART Asynchronous Data Format with Parity                                       | 97  |
| Figure 13. UART Asynchronous MULTIPROCESSOR Mode Data Format                               | 101 |
| Figure 14. UART Driver Enable Signal Timing (shown with 1 Stop Bit and Parity)             | 103 |
| Figure 15. UART Receiver Interrupt Service Routine Flow                                    | 105 |
| Figure 16. Infrared Data Communication System Block Diagram                                | 115 |
| Figure 17. Infrared Data Transmission  | 116 |
| Figure 18. IrDA Data Reception   | 117 |
| Figure 19. Analog-to-Digital Converter Block Diagram                                       | 120 |
| Figure 20. Comparator Block Diagram  | 133 |
| Figure 21. Flash Memory Arrangement  | 140 |
| Figure 22. Flash Controller Operation Flow Chart   | 142 |
| Figure 23. On-Chip Debugger Block Diagram  | 171 |
| Figure 24. Interfacing the On-Chip Debugger's DBG Pin with an RS-232 Interface (1)         | 172 |



|  |     |
|--|-----|
| Figure 25. Interfacing the On-Chip Debugger's DBG Pin with an RS-232 Interface (2) .....                           | 173 |
| Figure 26. OCD Data Format .....   | 174 |
| Figure 27. Recommended 20 MHz Crystal Oscillator Configuration .....   | 190 |
| Figure 28. Connecting the On-Chip Oscillator to an External RC Network ...   | 192 |
| Figure 29. Typical RC Oscillator Frequency as a Function of the External Capacitance with a 45 KOhm Resistor ..... | 193 |
| Figure 30. Opcode Map Cell Description .....   | 212 |
| Figure 31. First Opcode Map .....  | 214 |
| Figure 32. Second Opcode Map after 1FH .....   | 215 |
| Figure 33. Typical Active Mode IDD Versus System Clock Frequency .....   | 221 |
| Figure 34. Port Input Sample Timing .....  | 230 |
| Figure 35. GPIO Port Output Timing .....   | 231 |
| Figure 36. On-Chip Debugger Timing .....   | 232 |
| Figure 37. UART Timing With CTS .....  | 233 |
| Figure 38. UART Timing Without CTS .....   | 234 |
| Figure 39. 8-Pin Plastic Dual Inline Package (PDIP) .....  | 235 |
| Figure 40. 8-Pin Small Outline Integrated Circuit Package (SOIC) .....   | 236 |
| Figure 41. 8-Pin Quad Flat No-Lead Package (QFN)/ MLF-S .....  | 237 |
| Figure 42. 20-Pin Plastic Dual Inline Package (PDIP) .....   | 238 |
| Figure 43. 20-Pin Small Outline Integrated Circuit Package (SOIC) .....  | 239 |
| Figure 44. 20-Pin Small Shrink Outline Package (SSOP) .....  | 240 |
| Figure 45. 28-Pin Plastic Dual Inline Package (PDIP) .....   | 241 |
| Figure 46. 28-Pin Small Outline Integrated Circuit Package (SOIC) .....  | 242 |
| Figure 47. 28-Pin Small Shrink Outline Package (SSOP) .....  | 243 |



# List of Tables

|   |    |
|---|----|
| Table 1. Z8 Encore! XP <sup>®</sup> 8K and 4K Series Family Part Selection Guide . . . . .          | 3  |
| Table 2. Signal Descriptions. . . . .   | 11 |
| Table 3. Pin Characteristics (20 and 28-pin Devices) . . . . .                                      | 13 |
| Table 4. Pin Characteristics (8-Pin Devices) . . . . .  | 14 |
| Table 5. Z8 Encore! XP <sup>®</sup> 8K and 4K Series Program Memory Maps . . . . .                  | 17 |
| Table 6. Z8 Encore! XP <sup>®</sup> 8K and 4K Series Flash Memory Information Area<br>Map . . . . . | 19 |
| Table 7. Register File Address Map. . . . .   | 20 |
| Table 8. Reset and Stop Mode Recovery Characteristics and Latency . . . . .                         | 25 |
| Table 9. Reset Sources and Resulting Reset Type . . . . .   | 26 |
| Table 10. Stop Mode Recovery Sources and Resulting Action . . . . .                                 | 30 |
| Table 11. Reset Status Register (RSTSTAT). . . . .  | 32 |
| Table 12. Power Control Register 0 (PWRCTL0). . . . .   | 36 |
| Table 13. Port Availability by Device and Package Type. . . . .                                     | 37 |
| Table 14. Port Alternate Function Mapping (Non 8-Pin Parts). . . . .                                | 41 |
| Table 15. Port Alternate Function Mapping (8-Pin Parts). . . . .                                    | 44 |
| Table 16. GPIO Port Registers and Sub-Registers . . . . .   | 45 |
| Table 17. Port A–D GPIO Address Registers (PxADDR). . . . .   | 46 |
| Table 18. Port A–D Control Registers (PxCTL) . . . . .  | 47 |
| Table 19. Port A–D Data Direction Sub-Registers (PxDD) . . . . .                                    | 47 |
| Table 20. Port A–D Alternate Function Sub-Registers (PxAF). . . . .                                 | 48 |
| Table 21. Port A–D Output Control Sub-Registers (PxOC) . . . . .                                    | 49 |
| Table 22. Port A–D High Drive Enable Sub-Registers (PxHDE) . . . . .                                | 49 |
| Table 23. Port A–D Stop Mode Recovery Source Enable Sub-Registers<br>(PxSMRE) . . . . .             | 50 |
| Table 24. Port A–D Pull-Up Enable Sub-Registers (PxPUE). . . . .                                    | 50 |
| Table 25. Port A–D Alternate Function Set 1 Sub-Registers (PxAFS1). . . . .                         | 51 |
| Table 26. Port A–D Alternate Function Set 2 Sub-Registers (PxAFS2). . . . .                         | 51 |



|   |    |
|---|----|
| Table 27. Port A–C Input Data Registers (PxIN) . . . . .            | 52 |
| Table 28. Port A–D Output Data Register (PxOUT). . . . .            | 52 |
| Table 29. LED Drive Enable (LEDEN) . . . . .                        | 53 |
| Table 30. LED Drive Level High Register (LEDLVLH) . . . . .         | 53 |
| Table 31. LED Drive Level Low Register (LEDLVLL). . . . .           | 54 |
| Table 32. Trap and Interrupt Vectors in Order of Priority . . . . . | 56 |
| Table 33. Interrupt Request 0 Register (IRQ0) . . . . .             | 60 |
| Table 34. Interrupt Request 1 Register (IRQ1) . . . . .             | 61 |
| Table 35. Interrupt Request 2 Register (IRQ2) . . . . .             | 61 |
| Table 36. IRQ0 Enable and Priority Encoding . . . . .               | 62 |
| Table 37. IRQ0 Enable High Bit Register (IRQ0ENH) . . . . .         | 62 |
| Table 38. IRQ0 Enable Low Bit Register (IRQ0ENL). . . . .           | 63 |
| Table 39. IRQ1 Enable and Priority Encoding . . . . .               | 63 |
| Table 40. IRQ1 Enable High Bit Register (IRQ1ENH) . . . . .         | 63 |
| Table 41. IRQ1 Enable Low Bit Register (IRQ1ENL). . . . .           | 64 |
| Table 42. IRQ2 Enable and Priority Encoding . . . . .               | 64 |
| Table 43. IRQ2 Enable Low Bit Register (IRQ2ENL). . . . .           | 65 |
| Table 44. Interrupt Edge Select Register (IRQES). . . . .           | 65 |
| Table 45. IRQ2 Enable High Bit Register (IRQ2ENH) . . . . .         | 65 |
| Table 46. Shared Interrupt Select Register (IRQSS) . . . . .        | 66 |
| Table 47. Interrupt Control Register (IRQCTL) . . . . .             | 67 |
| Table 48. Timer 0–1 Control Register 0 (TxCTL0). . . . .            | 82 |
| Table 49. Timer 0–1 Control Register 1 (TxCTL1). . . . .            | 83 |
| Table 50. Timer 0–1 High Byte Register (TxH) . . . . .              | 86 |
| Table 51. Timer 0–1 Low Byte Register (TxL) . . . . .               | 86 |
| Table 52. Timer 0–1 Reload High Byte Register (TxRH). . . . .       | 87 |
| Table 53. Timer 0–1 Reload Low Byte Register (TxRL). . . . .        | 87 |
| Table 54. Timer 0–1 PWM High Byte Register (TxPWMH) . . . . .       | 87 |
| Table 55. Timer 0–1 PWM Low Byte Register (TxPWML). . . . .         | 88 |
| Table 56. Watchdog Timer Approximate Time-Out Delays . . . . .      | 90 |





|   |     |
|---|-----|
| Table 57. Watchdog Timer Control Register (WDTCTL) . . . . .                          | 92  |
| Table 58. Watchdog Timer Reload Upper Byte Register (WDTU) . . . . .                  | 93  |
| Table 59. Watchdog Timer Reload High Byte Register (WDTH) . . . . .                   | 93  |
| Table 60. Watchdog Timer Reload Low Byte Register (WDTL) . . . . .                    | 94  |
| Table 61. UART Control 0 Register (U0CTL0) . . . . .                                  | 106 |
| Table 62. UART Control 1 Register (U0CTL1) . . . . .                                  | 107 |
| Table 63. UART Status 0 Register (U0STAT0) . . . . .                                  | 109 |
| Table 64. UART Status 1 Register (U0STAT1) . . . . .                                  | 110 |
| Table 65. UART Transmit Data Register (U0TXD) . . . . .                               | 111 |
| Table 66. UART Receive Data Register (U0RXD) . . . . .                                | 111 |
| Table 67. UART Address Compare Register (U0ADDR) . . . . .                            | 112 |
| Table 68. UART Baud Rate High Byte Register (U0BRH) . . . . .                         | 112 |
| Table 69. UART Baud Rate Low Byte Register (U0BRL) . . . . .                          | 112 |
| Table 70. UART Baud Rates . . . . .   | 113 |
| Table 71. ADC Control Register 0 (ADCCTL0) . . . . .                                  | 128 |
| Table 72. ADC Control/Status Register 1 (ADCCTL1) . . . . .                           | 130 |
| Table 73. ADC Data High Byte Register (ADCD_H) . . . . .                              | 131 |
| Table 74. ADC Data Low Byte Register (ADCD_L) . . . . .                               | 131 |
| Table 75. Comparator Control Register (CMP0) . . . . .                                | 134 |
| Table 76. Z8 Encore! XP <sup>®</sup> 8K and 4K Series Flash Memory Configurations . . | 139 |
| Table 77. Flash Code Protection Using the Flash Option Bits . . . . .                 | 144 |
| Table 78. Flash Control Register (FCTL) . . . . .                                     | 147 |
| Table 79. Flash Status Register (FSTAT) . . . . .                                     | 148 |
| Table 80. Flash Page Select Register (FPS) . . . . .                                  | 149 |
| Table 81. Flash Sector Protect Register (FPROT) . . . . .                             | 149 |
| Table 82. Flash Frequency High Byte Register (FFREQH) . . . . .                       | 150 |
| Table 83. Flash Frequency Low Byte Register (FFREQL) . . . . .                        | 150 |
| Table 84. Trim Bit Address Register (TRMADR) . . . . .                                | 154 |
| Table 85. Trim Bit Data Register (TRMDR) . . . . .                                    | 155 |
| Table 86. Flash Option Bits at Program Memory Address 0000H . . . . .                 | 155 |



|  |     |
|--|-----|
| Table 87. Flash Options Bits at Program Memory Address 0001H . . . . .                     | 156 |
| Table 88. Trim Options Bits at Address 0000H . . . . .                                     | 157 |
| Table 89. Trim Option Bits at 0001H . . . . .  | 157 |
| Table 90. Trim Option Bits at 0002H (TIPO) . . . . .                                       | 158 |
| Table 91. Trim Option Bits at Address 0003H (TLVD). . . . .                                | 158 |
| Table 92. Trim Option Bits at 0004H . . . . .  | 160 |
| Table 93. ADC Calibration Bits. . . . .  | 160 |
| Table 94. ADC Calibration Data Location . . . . .  | 160 |
| Table 95. Temperature Sensor Calibration High Byte at 003A (TSCALH). . . . .               | 163 |
| Table 96. Temperature Sensor Calibration Low Byte at 003B (TSCALL) . . . . .               | 163 |
| Table 97. Watchdog Calibration High Byte at 007EH (WDTCALH). . . . .                       | 163 |
| Table 98. Watchdog Calibration Low Byte at 007FH (WDTCALL). . . . .                        | 164 |
| Table 99. Serial Number at 001C - 001F (S_NUM) . . . . .                                   | 164 |
| Table 100. Serialization Data Locations. . . . .   | 165 |
| Table 101. Lot Identification Number (RAND_LOT). . . . .                                   | 165 |
| Table 102. Randomized Lot ID Locations . . . . .   | 165 |
| Table 103. Write Status Byte . . . . .   | 168 |
| Table 104. NVDS Read Time. . . . .   | 170 |
| Table 105. OCD Baud-Rate Limits. . . . .   | 175 |
| Table 106. OCD Control Register (OCDCTL) . . . . .   | 182 |
| Table 107. OCD Status Register (OCDSTAT). . . . .  | 183 |
| Table 108. Oscillator Configuration and Selection . . . . .                                | 185 |
| Table 109. Oscillator Control Register (OSCCTL) . . . . .                                  | 187 |
| Table 110. Recommended Crystal Oscillator Specifications. . . . .                          | 190 |
| Table 111. Transconductance Values for Low, Medium, and High Gain Operating Modes. . . . . | 191 |
| Table 112. Assembly Language Syntax Example 1. . . . .                                     | 196 |
| Table 113. Assembly Language Syntax Example 2. . . . .                                     | 196 |
| Table 114. Notational Shorthand . . . . .  | 197 |
| Table 115. Additional Symbols. . . . .   | 198 |
| Table 116. Arithmetic Instructions . . . . .   | 199 |



|  |     |
|--|-----|
| Table 117. Bit Manipulation Instructions . . . . .   | 200 |
| Table 118. Block Transfer Instructions. . . . .  | 200 |
| Table 119. CPU Control Instructions . . . . .  | 200 |
| Table 120. Load Instructions . . . . .   | 201 |
| Table 121. Logical Instructions. . . . .   | 201 |
| Table 122. Program Control Instructions . . . . .  | 202 |
| Table 123. Rotate and Shift Instructions . . . . .   | 202 |
| Table 124. eZ8 CPU Instruction Summary. . . . .  | 203 |
| Table 125. Opcode Map Abbreviations . . . . .  | 213 |
| Table 126. Absolute Maximum Ratings . . . . .  | 216 |
| Table 127. DC Characteristics . . . . .  | 217 |
| Table 128. Power Consumption. . . . .  | 219 |
| Table 129. AC Characteristics . . . . .  | 222 |
| Table 130. Internal Precision Oscillator Electrical Characteristics . . . . .                  | 223 |
| Table 131. Power-On Reset and Voltage Brown-Out Electrical Characteristics and Timing. . . . . | 224 |
| Table 132. Flash Memory Electrical Characteristics and Timing . . . . .                        | 225 |
| Table 133. Watchdog Timer Electrical Characteristics and Timing . . . . .                      | 225 |
| Table 134. Analog-to-Digital Converter Electrical Characteristics and Timing. . . . .          | 226 |
| Table 135. Non Volatile Data Storage . . . . .   | 226 |
| Table 136. Low Power Operational Amplifier Electrical Characteristics. . . . .                 | 228 |
| Table 137. Comparator Electrical Characteristics . . . . .                                     | 228 |
| Table 138. Temperature Sensor Electrical Characteristics . . . . .                             | 229 |
| Table 139. GPIO Port Input Timing . . . . .  | 230 |
| Table 140. GPIO Port Output Timing . . . . .   | 231 |
| Table 141. On-Chip Debugger Timing . . . . .   | 232 |
| Table 142. UART Timing With CTS . . . . .  | 233 |
| Table 143. UART Timing Without CTS . . . . .   | 234 |



# Overview

The Z8 Encore!<sup>®</sup> MCU family of products are the first in a line of ZiLOG<sup>®</sup> microcontroller products based upon the 8-bit eZ8 CPU. The Z8 Encore! XP<sup>®</sup> 8K and 4K Series products expand upon ZiLOG's extensive line of 8-bit microcontrollers. The Flash in-circuit programming capability allows for faster development time and program changes in the field. The new eZ8 CPU is upward compatible with existing Z8<sup>®</sup> instructions. The rich peripheral set of the Z8 Encore! XP<sup>®</sup> 8K and 4K Series makes it suitable for a variety of applications including motor control, security systems, home appliances, personal electronic devices, and sensors.

## Features

The key features of Z8 Encore! XP<sup>®</sup> 8K and 4K Series products include:

- 20 MHz eZ8 CPU.
- 1 KB, 2 KB, 4 KB or 8 KB Flash memory with in-circuit programming capability.
- 256 B, 512 B or 1 KB register RAM.
- Up to 128 B non-volatile data storage (NVDS).
- Optional 8-channel, 10-bit analog-to-digital converter (ADC).
- Optional on-chip temperature sensor.
- On-chip analog comparator.
- Optional on-chip low-power operational amplifier (LPO).
- Full-duplex UART.
- The UART baud rate generator (BRG) can be configured and used as a basic 16-bit timer.
- Infrared Data Association (IrDA)-compliant infrared encoder/decoders, integrated with UART.
- Two enhanced 16-bit timers with capture, compare, and PWM capability.
- Watchdog timer (WDT) with dedicated internal RC oscillator.
- Up to 20 vectored interrupts.
- 6 to 25 I/O pins depending upon package.
- Up to thirteen 5 V-tolerant input pins.
- Up to 8 ports capable of direct LED drive with now current limit resistor required.



- Internal precision oscillator.
- External crystal oscillator.
- On-Chip Debugger.
- Voltage brownout protection (VBO).
- Programmable low battery detection (LVD) (8-pin devices only).
- Bandgap generated precision voltage references available for the ADC, comparator, VBO, and LVD.
- Power-on reset (POR).
- 2.7 V to 3.6 V operating voltage.
- 8-, 20- and 28-pin packages.
- 0 °C to +70 °C and -40 °C to +105 °C for operating temperature ranges.

## Part Selection Guide

[Table 1](#) identifies the basic features and package styles available for each device within the Z8 Encore! XP<sup>®</sup> 8K and 4K Series product line.



**Table 1. Z8 Encore! XP<sup>®</sup> 8K and 4K Series Family Part Selection Guide**

| Part Number | Flash (KB) | RAM (B) | NVDS <sup>1</sup> (B) | I/O  | Comparator | Advanced Analog <sup>2</sup> | ADC Inputs | Packages            |
|-------------|------------|---------|-----------------------|------|------------|------------------------------|------------|---------------------|
| Z8F082A     | 8          | 1024    | 0                     | 6–23 | Yes        | Yes                          | 4–8        | 8-, 20- and 28-pins |
| Z8F081A     | 8          | 1024    | 0                     | 6–25 | Yes        | No                           | 0          | 8-, 20- and 28-pins |
| Z8F042A     | 4          | 1024    | 128                   | 6–23 | Yes        | Yes                          | 4–8        | 8-, 20- and 28-pins |
| Z8F041A     | 4          | 1024    | 128                   | 6–25 | Yes        | No                           | 0          | 8-, 20- and 28-pins |
| Z8F022A     | 2          | 512     | 64                    | 6–23 | Yes        | Yes                          | 4–8        | 8-, 20- and 28-pins |
| Z8F021A     | 2          | 512     | 64                    | 6–25 | Yes        | No                           | 0          | 8-, 20- and 28-pins |
| Z8F012A     | 1          | 256     | 16                    | 6–23 | Yes        | Yes                          | 4–8        | 8-, 20- and 28-pins |
| Z8F011A     | 1          | 256     | 16                    | 6–25 | Yes        | No                           | 0          | 8-, 20- and 28-pins |

<sup>1</sup> Non-volatile data storage

<sup>2</sup> Advanced Analog includes ADC, temperature sensor, and low-power operational amplifier.

## Block Diagram

Figure 1 illustrates the block diagram of the architecture of the Z8 Encore! XP<sup>®</sup> 8K and 4K Series devices.

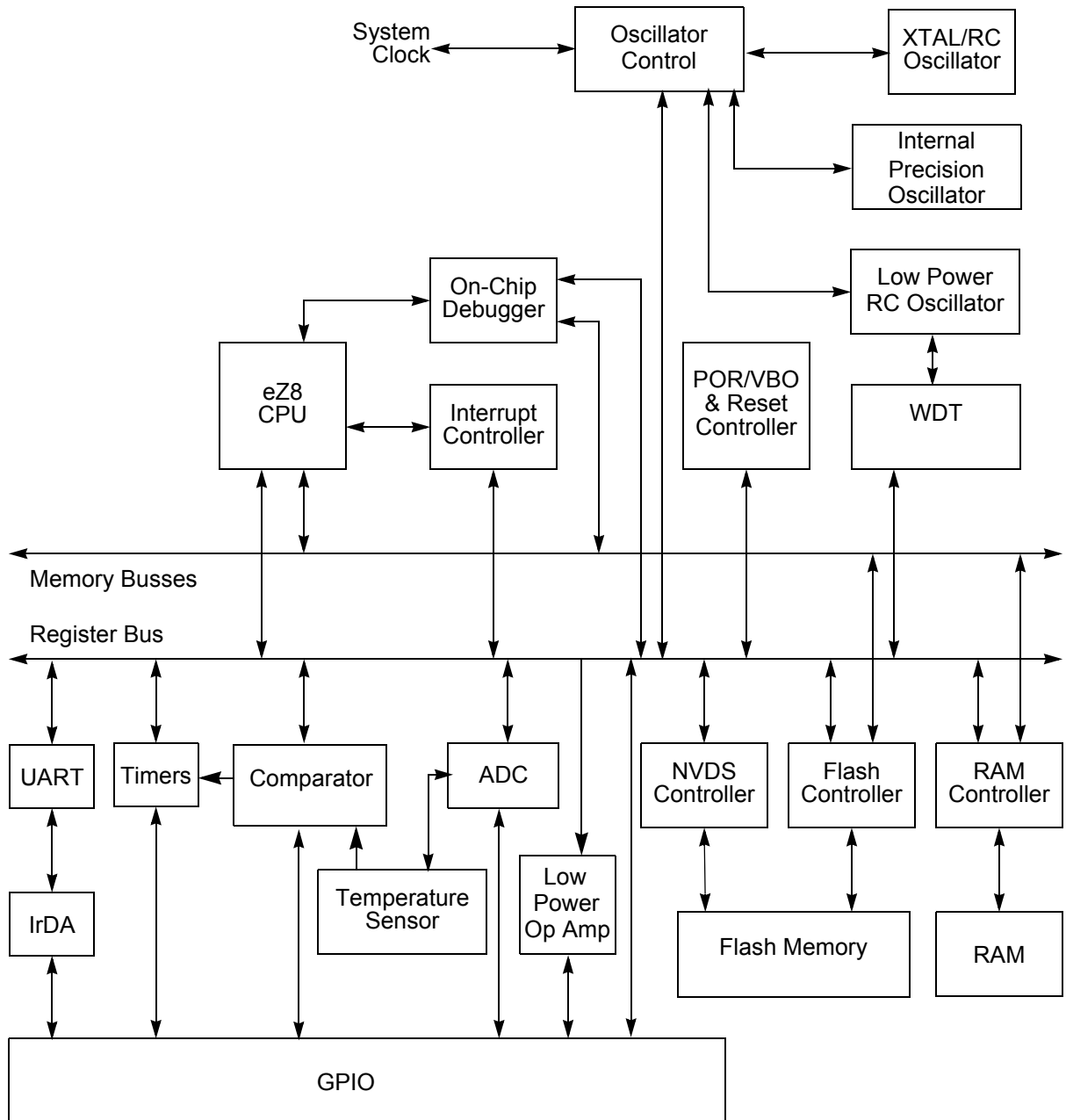


Figure 1. Z8 Encore! XP<sup>®</sup> 8K and 4K Series Block Diagram



## CPU and Peripheral Overview

### eZ8 CPU Features

The eZ8 CPU, ZiLOG's latest 8-bit Central Processing Unit (CPU), meets the continuing demand for faster and more code-efficient microcontrollers. The eZ8 CPU executes a superset of the original Z8<sup>®</sup> instruction set. The eZ8 CPU features include:

- Direct register-to-register architecture allows each register to function as an accumulator, improving execution time and decreasing the required program memory.
- Software stack allows much greater depth in subroutine calls and interrupts than hardware stacks.
- Compatible with existing Z8<sup>®</sup> code.
- Expanded internal Register File allows access of up to 4 KB.
- New instructions improve execution efficiency for code developed using higher-level programming languages, including C.
- Pipelined instruction fetch and execution.
- New instructions for improved performance including BIT, BSWAP, BTJ, CPC, LDC, LDCI, LEA, MULT, and SRL.
- New instructions support 12-bit linear addressing of the Register File.
- Up to 10 MIPS operation.
- C-Compiler friendly.
- 2 to 9 clock cycles per instruction.

For more information regarding the eZ8 CPU, refer to the *eZ8 CPU User Manual* available for download at [www.zilog.com](http://www.zilog.com).

### 10-Bit Analog-to-Digital Converter

The optional analog-to-digital converter (ADC) converts an analog input signal to a 10-bit binary number. The ADC accepts inputs from eight different analog input pins in both single-ended and differential modes. The ADC also features a unity gain buffer when high input impedance is required.



## Low-Power Operational Amplifier

The optional low-power operational amplifier (LPO) is a general-purpose amplifier primarily targeted for current sense applications. The LPO output may be routed internally to the ADC or externally to a pin.

## Internal Precision Oscillator

The internal precision oscillator (IPO) is a trimmable clock source that requires no external components.

## Temperature Sensor

The optional Temperature Sensor produces an analog output proportional to the device temperature. This signal can be sent to either the ADC or the analog comparator.

## Analog Comparator

The analog comparator compares the signal at an input pin with either an internal programmable voltage reference or a second input pin. The comparator output can be used to drive either an output pin or to generate an interrupt.

## External Crystal Oscillator

The crystal oscillator circuit provides highly accurate clock frequencies with the use of an external crystal, ceramic resonator or RC network.

## Low Voltage Detector

The low voltage detector (LVD) is able to generate an interrupt when the supply voltage drops below a user-programmable level. The LVD is available on 8-pin devices only.

## On-Chip Debugger

The Z8 Encore! XP<sup>®</sup> 8K and 4K Series products feature an integrated on-chip debugger (OCD) accessed via a single-pin interface. The OCD provides a rich set of debugging capabilities, such as reading and writing registers, programming Flash memory, setting breakpoints and executing code.

## Universal Asynchronous Receiver/Transmitter

The full-duplex UART is included in all Z8 Encore! XP<sup>®</sup> package types. The UART supports 8- and 9-bit data modes and selectable parity. The UART also supports multi-drop address processing in hardware. The UART baud rate generator (BRG) can be configured and used as a basic 16-bit timer.

## Timers

Two enhanced 16-bit reloadable timers can be used for timing/counting events or for motor control operations. These timers provide a 16-bit programmable reload counter and operate in One-Shot, Continuous, Gated, Capture, Capture Restart, Compare, Capture and Compare, PWM Single Output and PWM Dual Output modes.

## General Purpose I/O

The Z8 Encore! XP<sup>®</sup> 8K and 4K Series features 6 to 25 port pins (Ports A–D) for general purpose I/O (GPIO). The number of GPIO pins available is a function of package, and each pin is individually programmable. 5 V tolerant input pins are available on all IOs on 8 pin devices and most IOs on other package types.

## Direct LED Drive

The 20- and 28-pin devices support controlled current sinking output pins capable of driving LEDs without the need for a current limiting resistor. These LED drivers are independently programmable to four different intensity levels.

## Flash Controller

The Flash Controller programs and erases Flash memory. The Flash Controller supports several protection mechanisms against accidental program and erasure, as well as factory serialization and read protection.

## Non-Volatile Data Storage

The non-volatile data storage (NVDS) uses a hybrid hardware/software scheme to implement a byte programmable data memory and is capable of over 100,000 write cycles.

► **Note:** Devices with 8 KB Flash memory do not include the NVDS feature.