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Details

Product Status	Obsolete
Core Processor	eZ8
Core Size	8-Bit
Speed	5MHz
Connectivity	IrDA, UART/USART
Peripherals	Brown-out Detect/Reset, LED, POR, PWM, WDT
Number of I/O	6
Program Memory Size	2KB (2K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	512 x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 3.6V
Data Converters	-
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	8-VDFN Exposed Pad
Supplier Device Package	8-QFN (5x6)
Purchase URL	https://www.e-xfl.com/product-detail/zilog/z8f0213qb005ec

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Table 3. Signal Descriptions (Continued)

Signal Mnemonic	I/O	Description
Analog		
ANA[7:0]	I	Analog port. These signals are used as inputs to the ADC. The ANA0, ANA1, and ANA2 pins can also access the inputs and output of the integrated transimpedance amplifier.
VREF	I/O	Analog-to-Digital Converter reference voltage input.
Clock Input		
CLKIN	I	Clock Input Signal. This pin can be used to input a TTL-level signal to be used as the system clock.
LED Drivers		
LED	O	Direct LED drive capability. All port C pins have the capability to drive an LED without any other external components. These pins have programmable drive strengths set by the GPIO block.
On-Chip Debugger		
DBG	I/O	Debug. This signal is the control and data input and output to and from the OCD.
<p>! Caution: <i>The DBG pin is open-drain and requires an external pull-up resistor to ensure proper operation.</i></p>		
Reset		
RESET	I/O	RESET. Generates a reset when asserted (driven Low). Also serves as a reset indicator; the Z8 Encore! XP forces this pin Low when in reset. This pin is open-drain and features an enabled internal pull-up resistor.
Power Supply		
V _{DD}	I	Digital Power Supply.
AV _{DD}	I	Analog Power Supply.
V _{SS}	I	Digital Ground.
AV _{SS}	I	Analog Ground.
<p>Note: The AV_{DD} and AV_{SS} signals are available only in 28-pin packages with ADC. They are replaced by PB6 and PB7 on 28-pin packages without ADC.</p>		

Pin Characteristics

Table 4 provides detailed information about the characteristics for each pin available on Z8 Encore! XP F0823 Series 20- and 28-pin devices. Data in Table 4 is sorted alphabetically by the pin symbol mnemonic.

Reset and Stop Mode Recovery

The Reset Controller within the Z8 Encore! XP[®] F0823 Series controls Reset and Stop Mode Recovery operation and provides indication of low supply voltage conditions. In typical operation, the following events cause a Reset:

- Power-On Reset (POR)
- Voltage Brownout (VBO)
- Watchdog Timer time-out (when configured by the WDT_RES Flash Option Bit to initiate a reset)
- External $\overline{\text{RESET}}$ pin assertion (when the alternate RESET function is enabled by the GPIO register)
- On-chip Debugger initiated Reset (OCDCTL[0] set to 1)

When the device is in STOP mode, a Stop Mode Recovery is initiated by either of the following:

- Watchdog Timer time-out
- GPIO port input pin transition on an enabled Stop Mode Recovery source

The VBO circuitry on the device performs the following function:

- Generates the VBO reset when the supply voltage drops below a minimum safe level

Reset Types

Z8 Encore! XP F0823 Series provides several different types of Reset operation. Stop Mode Recovery is considered a form of Reset. Table 9 lists the types of Reset and their operating characteristics. The System Reset is longer if the external crystal oscillator is enabled by the Flash option bits, allowing additional time for oscillator start-up.

Table 10. Reset Sources and Resulting Reset Type

Operating Mode	Reset Source	Special Conditions
NORMAL or HALT modes	Power-On Reset/Voltage Brownout	Reset delay begins after supply voltage exceeds POR level.
	Watchdog Timer time-out when configured for Reset	None.
	RESET pin assertion	All reset pulses less than three system clocks in width are ignored.
	OCD initiated Reset (OCDCTL[0] set to 1)	System Reset, except the OCD is unaffected by the reset.
STOP mode	Power-On Reset/Voltage Brownout	Reset delay begins after supply voltage exceeds POR level.
	RESET pin assertion	All reset pulses less than the specified analog delay are ignored. See Electrical Characteristics on page 193.
	DBG pin driven Low	None.

Power-On Reset

Each device in the Z8 Encore! XP F0823 Series contains an internal POR circuit. The POR circuit monitors the supply voltage and holds the device in the Reset state until the supply voltage reaches a safe operating level. After the supply voltage exceeds the POR voltage threshold (V_{POR}), the device is held in the Reset state until the POR Counter has timed out. If the crystal oscillator is enabled by the option bits, this time-out is longer.

After the Z8 Encore! XP F0823 Series device exits the POR state, the eZ8 CPU fetches the Reset vector. Following the POR, the POR status bit in Watchdog Timer Control (WDTCTL) register is set to 1.

Figure 5 displays POR operation. For the POR threshold voltage (V_{POR}), see Electrical Characteristics on page 193.

Table 19. Port A–C Control Registers (PxCTL)

BITS	7	6	5	4	3	2	1	0
FIELD	PCTL							
RESET	00H							
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADDR	FD1H, FD5H, FD9H							

PCTL[7:0]—Port Control

The Port Control register provides access to all sub-registers that configure the GPIO Port operation.

Port A–C Data Direction Sub-Registers

The Port A–C Data Direction sub-register is accessed through the Port A–C Control register by writing 01H to the Port A–C Address register (Table 20).

Table 20. Port A–C Data Direction Sub-Registers (PxDD)

BITS	7	6	5	4	3	2	1	0
FIELD	DD7	DD6	DD5	DD4	DD3	DD2	DD1	DD0
RESET	1	1	1	1	1	1	1	1
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADDR	If 01H in Port A–C Address Register, accessible through the Port A–C Control Register							

DD[7:0]—Data Direction

These bits control the direction of the associated port pin. Port Alternate Function operation overrides the Data Direction register setting.

0 = Output. Data in the Port A–C Output Data register is driven onto the port pin.

1 = Input. The port pin is sampled and the value written into the Port A–C Input Data Register. The output driver is tristated.

Port A–C Alternate Function Sub-Registers

The Port A–C Alternate Function sub-register (Table 21) is accessed through the Port A–C Control register by writing 02H to the Port A–C Address register. The Port A–C Alternate Function sub-registers enable the alternate function selection on pins. If disabled, pins functions as GPIO. If enabled, select one of four alternate functions using alternate function set subregisters 1 and 2 as described in the Port A–C Alternate Function Set 1 Sub-Registers on page 48 and Port A–C Alternate Function Set 2 Sub-Registers on

Table 30. LED Drive Enable (LEDEN)

BITS	7	6	5	4	3	2	1	0
FIELD	LEDEN[7:0]							
RESET	0	0	0	0	0	0	0	0
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADDR	F82H							

LEDEN[7:0]—LED Drive Enable

These bits determine which Port C pins are connected to an internal current sink.

0 = Tristate the Port C pin.

1= Connect controlled current sink to the Port C pin.

LED Drive Level High Register

The LED Drive Level registers contain two control bits for each Port C pin (Table 31).

These two bits select between four programmable drive levels. Each pin is individually programmable.

Table 31. LED Drive Level High Register (LEDLVLH)

BITS	7	6	5	4	3	2	1	0
FIELD	LEDLVLH[7:0]							
RESET	0	0	0	0	0	0	0	0
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADDR	F83H							

LEDLVLH[7:0]—LED Level High Bit

{LEDLVLH, LEDLVLL} select one of four programmable current drive levels for each Port C pin.

00 = 3 mA

01= 7 mA

10= 13 mA

11= 20 mA

LED Drive Level Low Register

The LED Drive Level registers contain two control bits for each Port C pin (Table 32).

These two bits select between four programmable drive levels. Each pin is individually programmable.

Table 32. LED Drive Level Low Register (LEDLVLL)

BITS	7	6	5	4	3	2	1	0
FIELD	LEDLVLL[7:0]							
RESET	0	0	0	0	0	0	0	0
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADDR	F84H							

LEDLVLH[7:0]—LED Level High Bit
{LEDLVLH, LEDLVLL} select one of four programmable current drive levels for each Port C pin.
00 = 3 mA
01 = 7 mA
10 = 13 mA
11 = 20 mA

- Writing a 1 to the IRQE bit in the Interrupt Control register

Interrupts are globally disabled by any of the following actions:

- Execution of a Disable Interrupt (DI) instruction
- eZ8 CPU acknowledgement of an interrupt service request from the interrupt controller
- Writing a 0 to the IRQE bit in the Interrupt Control register
- Reset
- Execution of a Trap instruction
- Illegal Instruction Trap
- Primary Oscillator Fail Trap
- Watchdog Timer Oscillator Fail Trap

Interrupt Vectors and Priority

The interrupt controller supports three levels of interrupt priority. Level 3 is the highest priority, Level 2 is the second highest priority, and Level 1 is the lowest priority. If all interrupts are enabled with identical interrupt priority (for example, all as Level 2 interrupts), the interrupt priority is assigned from highest to lowest as specified in Table 33 on page 54. Level 3 interrupts are always assigned higher priority than Level 2 interrupts which, in turn, always are assigned higher priority than Level 1 interrupts. Within each interrupt priority level (Level 1, Level 2, or Level 3), priority is assigned as specified in Table 33. Reset, Watchdog Timer interrupt (if enabled), Primary Oscillator Fail Trap, Watchdog Timer Oscillator Fail Trap, and Illegal Instruction Trap always have highest (Level 3) priority.

Interrupt Assertion

Interrupt sources assert their interrupt requests for only a single system clock period (single pulse). When the interrupt request is acknowledged by the eZ8 CPU, the corresponding bit in the Interrupt Request register is cleared until the next interrupt occurs. Writing a 0 to the corresponding bit in the Interrupt Request register likewise clears the interrupt request.

! Caution: *The following coding style that clears bits in the Interrupt Request registers is not recommended. All incoming interrupts received between execution of the first LDX command and the final LDX command are lost.*

Poor coding style that can result in lost interrupt requests:

```
LDX r0, IRQ0
AND r0, MASK
LDX IRQ0, r0
```

Interrupt Control Register Definitions

For all interrupts other than the Watchdog Timer interrupt, the Primary Oscillator Fail Trap, and the Watchdog Timer Oscillator Fail Trap, the interrupt control registers enable individual interrupts, set interrupt priorities, and indicate interrupt requests.

Interrupt Request 0 Register

The Interrupt Request 0 (IRQ0) register (Table 34) stores the interrupt requests for both vectored and polled interrupts. When a request is presented to the interrupt controller, the corresponding bit in the IRQ0 register becomes 1. If interrupts are globally enabled (vectored interrupts), the interrupt controller passes an interrupt request to the eZ8 CPU. If interrupts are globally disabled (polled interrupts), the eZ8 CPU reads the Interrupt Request 0 register to determine if any interrupt requests are pending.

Table 34. Interrupt Request 0 Register (IRQ0)

BITS	7	6	5	4	3	2	1	0
FIELD	Reserved	T1I	T0I	U0RXI	U0TXI	Reserved	Reserved	ADCI
RESET	0	0	0	0	0	0	0	0
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADDR	FC0H							

Reserved—Must be 0

T1I—Timer 1 Interrupt Request

0 = No interrupt request is pending for Timer 1

1 = An interrupt request from Timer 1 is awaiting service

T0I—Timer 0 Interrupt Request

0 = No interrupt request is pending for Timer 0

1 = An interrupt request from Timer 0 is awaiting service

U0RXI—UART 0 Receiver Interrupt Request

0 = No interrupt request is pending for the UART 0 receiver

1 = An interrupt request from the UART 0 receiver is awaiting service

U0TXI—UART 0 Transmitter Interrupt Request

0 = No interrupt request is pending for the UART 0 transmitter

1 = An interrupt request from the UART 0 transmitter is awaiting service

ADCI—ADC Interrupt Request

0 = No interrupt request is pending for the ADC

1 = An interrupt request from the ADC is awaiting service

Timers

Z8 Encore! XP® F0823 Series products contain up to two 16-bit reloadable timers that are used for timing, event counting, or generation of PWM signals. The timers' features include:

- 16-bit reload counter.
- Programmable prescaler with prescale values from 1 to 128.
- PWM output generation.
- Capture and compare capability.
- External input pin for timer input, clock gating, or capture signal. External input pin signal frequency is limited to a maximum of one-fourth the system clock frequency.
- Timer output pin.
- Timer interrupt.

In addition to the timers described in this chapter, the baud rate generator of the UART (if unused) also provides basic timing functionality. For information on using the baud rate generator as an additional timer, see Universal Asynchronous Receiver/Transmitter on page 93.

Architecture

Figure 9 displays the architecture of the timers.

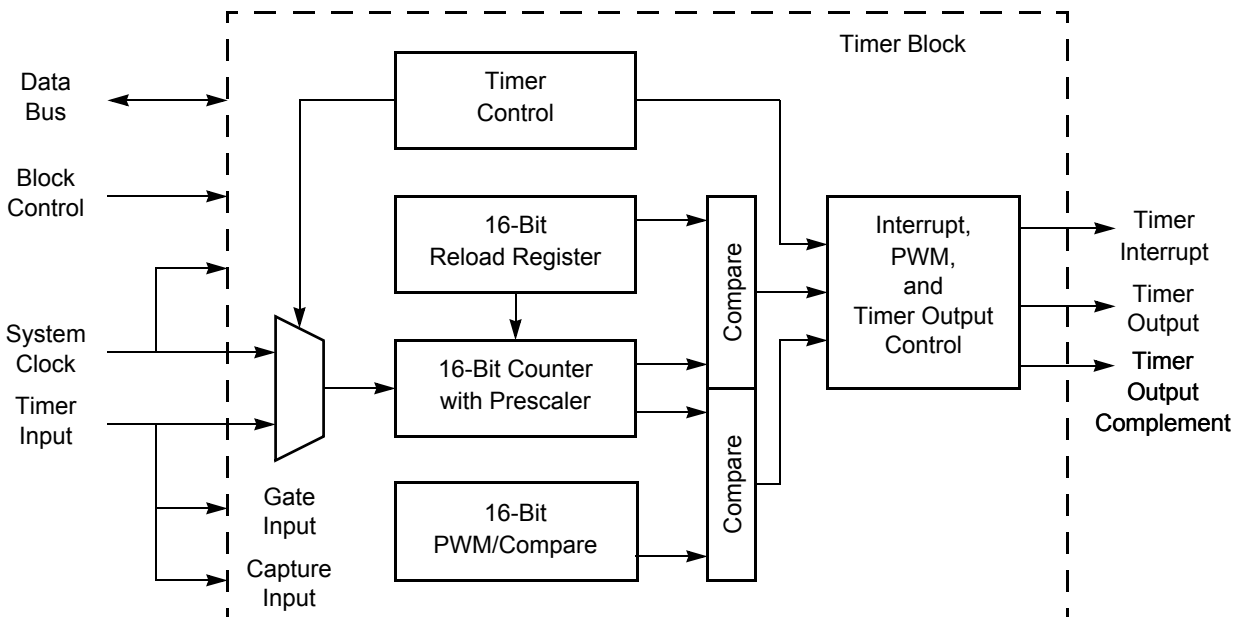


Figure 9. Timer Block Diagram

COUNTER Mode

In COUNTER mode, the timer counts input transitions from a GPIO port pin. The timer input is taken from the GPIO port pin Timer Input alternate function. The TPOL bit in the Timer Control register selects whether the count occurs on the rising edge or the falling edge of the timer input signal. In COUNTER mode, the prescaler is disabled.

! Caution: *The input frequency of the timer input signal must not exceed one-fourth the system clock frequency.*

Upon reaching the Reload value stored in the Timer Reload High and Low Byte registers, the timer generates an interrupt, the count value in the Timer High and Low Byte registers is reset to 0001H and counting resumes. Also, if the Timer Output alternate function is enabled, the Timer Output pin changes state (from Low to High or from High to Low) at timer Reload.

Follow the steps below for configuring a timer for COUNTER mode and initiating the count:

1. Write to the Timer Control register to:
 - Disable the timer.
 - Configure the timer for COUNTER mode.
 - Select either the rising edge or falling edge of the Timer Input signal for the count. This selection also sets the initial logic level (High or Low) for the Timer Output alternate function. However, the Timer Output function is not required to be enabled.
2. Write to the Timer High and Low Byte registers to set the starting count value. This only affects the first pass in COUNTER mode. After the first timer Reload in COUNTER mode, counting always begins at the reset value of 0001H. In COUNTER mode the Timer High and Low Byte registers must be written with the value 0001H.
3. Write to the Timer Reload High and Low Byte registers to set the Reload value.
4. If appropriate, enable the timer interrupt and set the timer interrupt priority by writing to the relevant interrupt registers.
5. Configure the associated GPIO port pin for the Timer Input alternate function.
6. If using the Timer Output function, configure the associated GPIO port pin for the Timer Output alternate function.
7. Write to the Timer Control register to enable the timer.

In COUNTER mode, the number of Timer Input transitions since the timer start is given by the following equation:

$$\text{COUNTER Mode Timer Input Transitions} = \text{Current Count Value} - \text{Start Value}$$

If an initial starting value other than 0001H is loaded into the Timer High and Low Byte registers, use the ONE-SHOT mode equation to determine the first PWM time-out period. If TPOL is set to 0, the ratio of the PWM output High time to the total period is represented by the following equation:

$$\text{PWM Output High Time Ratio (\%)} = \frac{\text{Reload Value} - \text{PWM Value}}{\text{Reload Value}} \times 100$$

If TPOL is set to 1, the ratio of the PWM output High time to the total period is represented by the following equation:

$$\text{PWM Output High Time Ratio (\%)} = \frac{\text{PWM Value}}{\text{Reload Value}} \times 100$$

PWM Dual Output Mode

In PWM DUAL OUTPUT mode, the timer outputs a PWM output signal pair (basic PWM signal and its complement) through two GPIO port pins. The timer input is the system clock. The timer first counts up to the 16-bit PWM match value stored in the Timer PWM High and Low Byte registers. When the timer count value matches the PWM value, the Timer Output toggles. The timer continues counting until it reaches the Reload value stored in the Timer Reload High and Low Byte registers. Upon reaching the Reload value, the timer generates an interrupt, the count value in the Timer High and Low Byte registers is reset to 0001H and counting resumes.

If the TPOL bit in the Timer Control register is set to 1, the Timer Output signal begins as a High (1) and transitions to a Low (0) when the timer value matches the PWM value. The Timer Output signal returns to a High (1) after the timer reaches the Reload value and is reset to 0001H.

If the TPOL bit in the Timer Control register is set to 0, the Timer Output signal begins as a Low (0) and transitions to a High (1) when the timer value matches the PWM value. The Timer Output signal returns to a Low (0) after the timer reaches the Reload value and is reset to 0001H.

The timer also generates a second PWM output signal Timer Output Complement. The Timer Output Complement is the complement of the Timer Output PWM signal. A programmable deadband delay can be configured to time delay (0 to 128 system clock cycles) PWM output transitions on these two pins from a low to a high (inactive to active). This ensures a time gap between the deassertion of one PWM output to the assertion of its complement.

Follow the steps below for configuring a timer for PWM Dual Output mode and initiating the PWM operation:

1. Write to the Timer Control register to:
 - Disable the timer
 - Configure the timer for PWM Dual Output mode. Setting the mode also involves writing to TMODEHI bit in TxCTL1 register
 - Set the prescale value

010 = Divide by 4
011 = Divide by 8
100 = Divide by 16
101 = Divide by 32
110 = Divide by 64
111 = Divide by 128

TMODE—Timer mode

This field along with the TMODEHI bit in TxCTL0 register determines the operating mode of the timer. TMODEHI is the most significant bit of the Timer mode selection value.

0000 = ONE-SHOT mode
0001 = CONTINUOUS mode
0010 = COUNTER mode
0011 = PWM SINGLE OUTPUT mode
0100 = CAPTURE mode
0101 = COMPARE mode
0110 = GATED mode
0111 = CAPTURE/COMPARE mode
1000 = PWM DUAL OUTPUT mode
1001 = CAPTURE RESTART mode
1010 = COMPARATOR COUNTER Mode

The baud rate error relative to the acceptable baud rate is calculated using the following equation:

$$\text{UART Baud Rate Error (\%)} = 100 \times \left(\frac{\text{Actual Data Rate} - \text{Desired Data Rate}}{\text{Desired Data Rate}} \right)$$

For reliable communication, the UART baud rate error must never exceed five percent. Table 71 provides information about data rate errors for 5.5296 MHz System Clock.

Table 71. UART Baud Rates

5.5296 MHz System Clock			
Acceptable Rate (kHz)	BRG Divisor (Decimal)	Actual Rate (kHz)	Error (%)
1250.0	N/A	N/A	N/A
625.0	N/A	N/A	N/A
250.0	1	345.6	38.24
115.2	3	115.2	0.00
57.6	6	57.6	0.00
38.4	9	38.4	0.00
19.2	18	19.2	0.00
9.60	36	9.60	0.00
4.80	72	4.80	0.00
2.40	144	2.40	0.00
1.20	288	1.20	0.00
0.60	576	0.60	0.00
0.30	1152	0.30	0.00

Endec, and passed to the UART. Communication is half-duplex, which means simultaneous data transmission and reception is not allowed.

The baud rate is set by the UART's baud rate generator and supports IrDA standard baud rates from 9600 baud to 115.2 kbaud. Higher baud rates are possible, but do not meet IrDA specifications. The UART must be enabled to use the Infrared Endec. The Infrared Endec data rate is calculated using the following equation:

$$\text{Infrared Data Rate (bits/s)} = \frac{\text{System Clock Frequency (Hz)}}{16 \times \text{UART Baud Rate Divisor Value}}$$

Transmitting IrDA Data

The data to be transmitted using the infrared transceiver is first sent to the UART. The UART's transmit signal (TXD) and baud rate clock are used by the IrDA to generate the modulation signal (IR_TXD) that drives the infrared transceiver. Each UART/Infrared data bit is 16 clocks wide. If the data to be transmitted is 1, the IR_TXD signal remains low for the full 16 clock period. If the data to be transmitted is 0, the transmitter first outputs a 7 clock low period, followed by a 3 clock high pulse. Finally, a 6 clock low pulse is output to complete the full 16 clock data period. Figure 17 displays IrDA data transmission. When the Infrared Endec is enabled, the UART's TXD signal is internal to Z8 Encore! XP[®] F0823 Series products while the IR_TXD signal is output through the TXD pin.

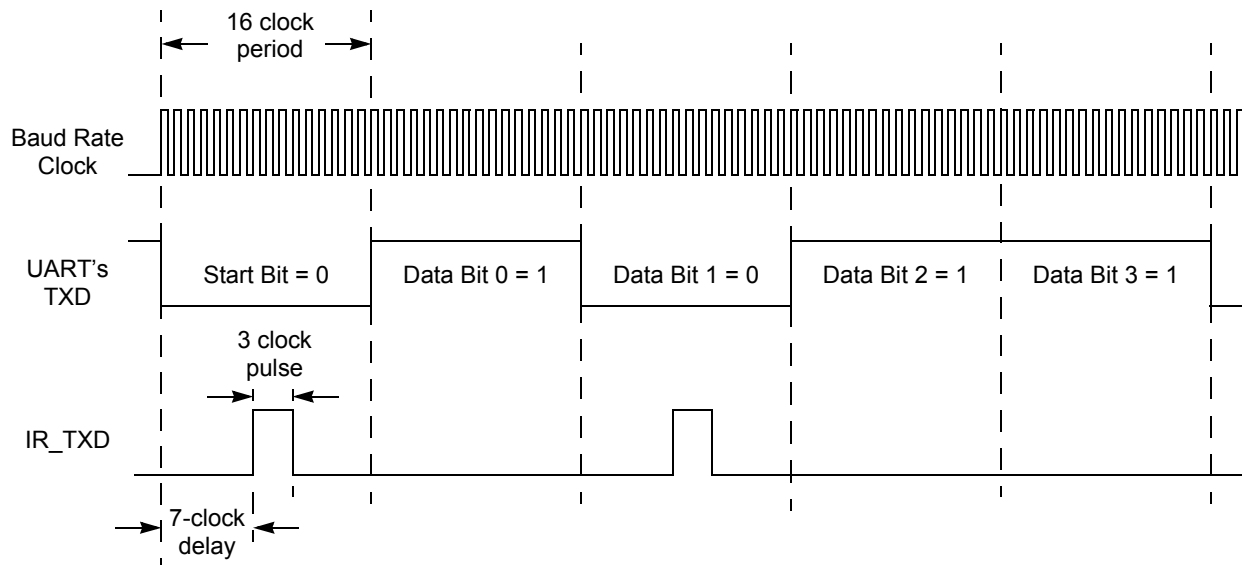


Figure 17. Infrared Data Transmission

Table 76. Comparator Control Register (CMP0)

BITS	7	6	5	4	3	2	1	0
FIELD	INPSEL	INNSEL	REFLVL				Reserved	
RESET	0	0	0	1	0	1	0	0
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADDR	F90H							

INPSEL—Signal Select for Positive Input

0 = GPIO pin used as positive comparator input

1 = temperature sensor used as positive comparator input

INNSEL—Signal Select for Negative Input

0 = internal reference disabled, GPIO pin used as negative comparator input

1 = internal reference enabled as negative comparator input

REFLVL—Internal Reference Voltage Level

► **Note:** *This reference is independent of the ADC voltage reference.*

0000 = 0.0 V

0001 = 0.2 V

0010 = 0.4 V

0011 = 0.6 V

0100 = 0.8 V

0101 = 1.0 V (Default)

0110 = 1.2 V

0111 = 1.4 V

1000 = 1.6 V

1001 = 1.8 V

1010–1111 = Reserved

Reserved—R/W bits must be 0 during writes; 0 when read

Flash Memory

The products in Z8 Encore! XP[®] F0823 Series features either 8 KB (8192), 4 KB (4096), 2 KB (2048) or 1 KB (1024) of non-volatile Flash memory with read/write/erase capability. Flash Memory can be programmed and erased in-circuit by either user code or through the On-Chip Debugger.

The Flash Memory array is arranged in pages with 512 bytes per page. The 512-byte page is the minimum Flash block size that can be erased. Each page is divided into 8 rows of 64 bytes.

For program/data protection, the Flash memory is also divided into sectors. In the Z8 Encore! XP F0823 Series, these sectors are either 1024 bytes (in the 8 KB devices) or 512 bytes in size (all other memory sizes); each sector maps to a page. Page and sector sizes are not generally equal.

The first two bytes of the Flash Program memory are used as Flash Option Bits. For more information on their operation, see Flash Option Bits on page 141.

Table 77 describes the Flash memory configuration for each device in the Z8 Encore! XP F0823 Series. Figure 20 displays the Flash memory arrangement.

Table 77. Z8 Encore! XP F0823 Series Flash Memory Configurations

Part Number	Flash Size KB (Bytes)	Flash Pages	Program Memory Addresses	Flash Sector Size (bytes)
Z8F08x3	8 (8192)	16	0000H–1FFFFH	1024
Z8F04x3	4 (4096)	8	0000H–0FFFFH	512
Z8F02x3	2 (2048)	4	0000H–07FFFH	512
Z8F01x3	1 (1024)	2	0000H–03FFFH	512

Reserved—0 when read

FSTAT—Flash Controller Status

000000 = Flash Controller locked

000001 = First unlock command received (73H written)

000010 = Second unlock command received (8CH written)

000011 = Flash Controller unlocked

000100 = Sector protect register selected

001xxx = Program operation in progress

010xxx = Page erase operation in progress

100xxx = Mass erase operation in progress

Flash Page Select Register

The Flash Page Select (FPS) register shares address space with the Flash Sector Protect Register. Unless the Flash controller is unlocked and written with 5EH, writes to this address target the Flash Page Select Register.

The register is used to select one of the eight available Flash memory pages to be programmed or erased. Each Flash Page contains 512 bytes of Flash memory. During a Page Erase operation, all Flash memory having addresses with the most significant 7-bits given by FPS[6:0] are chosen for program/erase operation.

Table 81. Flash Page Select Register (FPS)

BITS	7	6	5	4	3	2	1	0
FIELD	INFO_EN	PAGE						
RESET	0	0	0	0	0	0	0	0
R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W
ADDR	FF9H							

INFO_EN—Information Area Enable

0 = Information Area us not selected

1 = Information Area is selected. The Information Area is mapped into the Program Memory address space at addresses FE00H through FFFFH.

PAGE—Page Select

This 7-bit field identifies the Flash memory page for Page Erase and page unlocking. Program Memory Address[15:9] = PAGE[6:0]. For the Z8F04x3 devices, the upper 4 bits must always be 0. For the Z8F02x3 devices, the upper 5 bits must always be 0. For the Z8F01x3 devices, the upper 6 bits must always be 0.

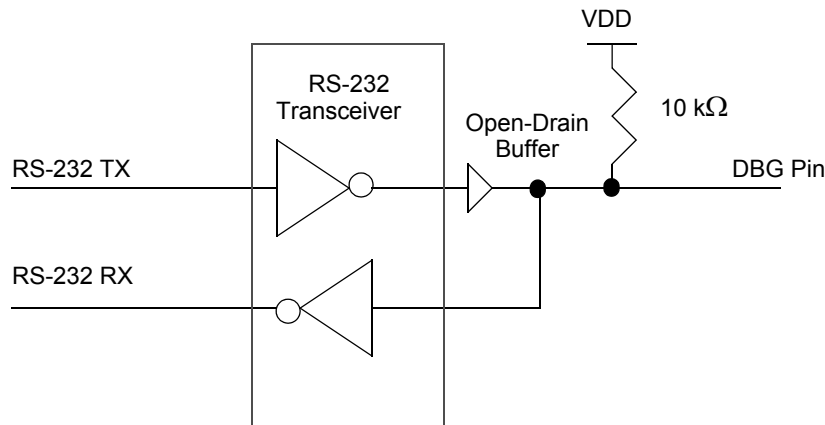


Figure 24. Interfacing the On-Chip Debugger's DBG Pin with an RS-232 Interface (2)

DEBUG Mode

The operating characteristics of the devices in DEBUG mode are:

- The eZ8 CPU fetch unit stops, idling the eZ8 CPU, unless directed by the OCD to execute specific instructions
- The system clock operates unless in STOP mode
- All enabled on-chip peripherals operate unless in STOP mode
- Automatically exits HALT mode
- Constantly refreshes the Watchdog Timer, if enabled.

Entering DEBUG Mode

The device enters DEBUG mode following the operations below:

- The device enters DEBUG mode after the eZ8 CPU executes a BRK (breakpoint) instruction
- If the DBG pin is held Low during the most recent clock cycle of System Reset, the part enters DEBUG mode upon exiting System Reset

► **Note:** Holding the DBG pin Low for an additional 5000 (minimum) clock cycles after reset (making sure to account for any specified frequency error if using an internal oscillator) prevents a false interpretation of an Autobaud sequence (see OCD Auto-Baud Detector/Generator on page 154).

- If the PA2/ $\overline{\text{RESET}}$ pin is held Low while a 32-bit key sequence is issued to the PA0/DBG pin, the DBG feature is unlocked. After releasing PA2/ $\overline{\text{RESET}}$, it is pulled high. At this






		Lower Nibble (Hex)															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Upper Nibble (Hex)	0	1.1 BRK	2.2 SRP IM	2.3 ADD r1,r2	2.4 ADD r1,r2	3.3 ADD R2,R1	3.4 ADD IR2,R1	3.3 ADD R1,IM	3.4 ADD IR1,IM	4.3 ADDX ER2,ER1	4.3 ADDX IM,ER1	2.3 DJNZ r1,X	2.2 JR cc,X	2.2 LD r1,IM	3.2 JP cc,DA	1.2 INC r1	1.2 NOP
	1	2.2 RLC R1	2.3 RLC IR1	2.3 ADC r1,r2	2.4 ADC r1,r2	3.3 ADC R2,R1	3.4 ADC IR2,R1	3.3 ADC R1,IM	3.4 ADC IR1,IM	4.3 ADCX ER2,ER1	4.3 ADCX IM,ER1						See 2nd Opcode Map
	2	2.2 INC R1	2.3 INC IR1	2.3 SUB r1,r2	2.4 SUB r1,r2	3.3 SUB R2,R1	3.4 SUB IR2,R1	3.3 SUB R1,IM	3.4 SUB IR1,IM	4.3 SUBX ER2,ER1	4.3 SUBX IM,ER1						1, 2 ATM
	3	2.2 DEC R1	2.3 DEC IR1	2.3 SBC r1,r2	2.4 SBC r1,r2	3.3 SBC R2,R1	3.4 SBC IR2,R1	3.3 SBC R1,IM	3.4 SBC IR1,IM	4.3 SBCX ER2,ER1	4.3 SBCX IM,ER1						
	4	2.2 DA R1	2.3 DA IR1	2.3 OR r1,r2	2.4 OR r1,r2	3.3 OR R2,R1	3.4 OR IR2,R1	3.3 OR R1,IM	3.4 OR IR1,IM	4.3 ORX ER2,ER1	4.3 ORX IM,ER1						
	5	2.2 POP R1	2.3 POP IR1	2.3 AND r1,r2	2.4 AND r1,r2	3.3 AND R2,R1	3.4 AND IR2,R1	3.3 AND R1,IM	3.4 AND IR1,IM	4.3 ANDX ER2,ER1	4.3 ANDX IM,ER1						1.2 WDT
	6	2.2 COM R1	2.3 COM IR1	2.3 TCM r1,r2	2.4 TCM r1,r2	3.3 TCM R2,R1	3.4 TCM IR2,R1	3.3 TCM R1,IM	3.4 TCM IR1,IM	4.3 TCMX ER2,ER1	4.3 TCMX IM,ER1						1.2 STOP
	7	2.2 PUSH R2	2.3 PUSH IR2	2.3 TM r1,r2	2.4 TM r1,r2	3.3 TM R2,R1	3.4 TM IR2,R1	3.3 TM R1,IM	3.4 TM IR1,IM	4.3 TMX ER2,ER1	4.3 TMX IM,ER1						1.2 HALT
	8	2.5 DECW RR1	2.6 DECW IRR1	2.5 LDE r1,lr2	2.9 LDEI lr1,lr2	3.2 LDX r1,ER2	3.3 LDX lr1,ER2	3.4 LDX IRR2,R1	3.5 LDX IRR2,IR1	3.4 LDX r1,rr2,X	3.4 LDX rr1,r2,X						1.2 DI
	9	2.2 RL R1	2.3 RL IR1	2.5 LDE r2,lr1	2.9 LDEI lr2,lr1	3.2 LDX r2,ER1	3.3 LDX lr2,ER1	3.4 LDX R2,IRR1	3.5 LDX IR2,IRR1	3.3 LEA r1,r2,X	3.5 LEA rr1,rr2,X						1.2 EI
	A	2.5 INCW RR1	2.6 INCW IRR1	2.3 CP r1,r2	2.4 CP r1,r2	3.3 CP R2,R1	3.4 CP IR2,R1	3.3 CP R1,IM	3.4 CP IR1,IM	4.3 CPX ER2,ER1	4.3 CPX IM,ER1						1.4 RET
	B	2.2 CLR R1	2.3 CLR IR1	2.3 XOR r1,r2	2.4 XOR r1,r2	3.3 XOR R2,R1	3.4 XOR IR2,R1	3.3 XOR R1,IM	3.4 XOR IR1,IM	4.3 XORX ER2,ER1	4.3 XORX IM,ER1						1.5 IRET
	C	2.2 RRC R1	2.3 RRC IR1	2.5 LDC r1,lr2	2.9 LDCI lr1,lr2	2.3 JP IRR1	2.9 LDC lr1,lr2		3.4 LD r1,r2,X	3.2 PUSHX ER2							1.2 RCF
	D	2.2 SRA R1	2.3 SRA IR1	2.5 LDC r2,lr1	2.9 LDCI lr2,lr1	2.6 CALL IRR1	2.2 BSWAP R1	3.3 CALL DA	3.4 LD r2,r1,X	3.2 POPX ER1							1.2 SCF
	E	2.2 RR R1	2.3 RR IR1	2.2 BIT p,b,r1	2.3 LD r1,r2	3.2 LD R2,R1	3.3 LD IR2,R1	3.2 LD R1,IM	3.3 LD IR1,IM	4.2 LDX ER2,ER1	4.2 LDX IM,ER1						1.2 CCF
	F	2.2 SWAP R1	2.3 SWAP IR1	2.6 TRAP Vector	2.3 LD lr1,r2	2.8 MULT RR1	3.3 LD R2,IR1	3.3 BTJ p,b,r1,X	3.4 BTJ p,b,lr1,X								

Figure 27. First Opcode Map