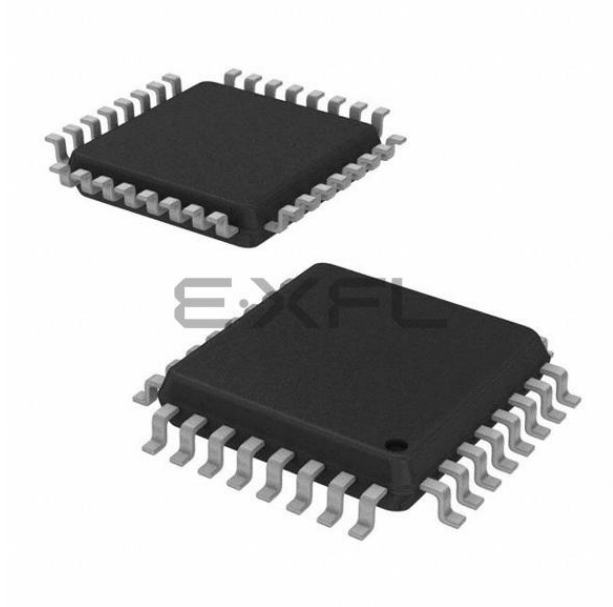

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	8051
Core Size	8-Bit
Speed	48 MIPS
Connectivity	I²C, SPI, UART/USART, USB
Peripherals	Brown-out Detect/Reset, POR, PWM, Temp Sensor, WDT
Number of I/O	25
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	2.25K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.25V
Data Converters	A/D 21x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	32-LQFP
Supplier Device Package	32-LQFP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/silicon-labs/c8051f383-gqr

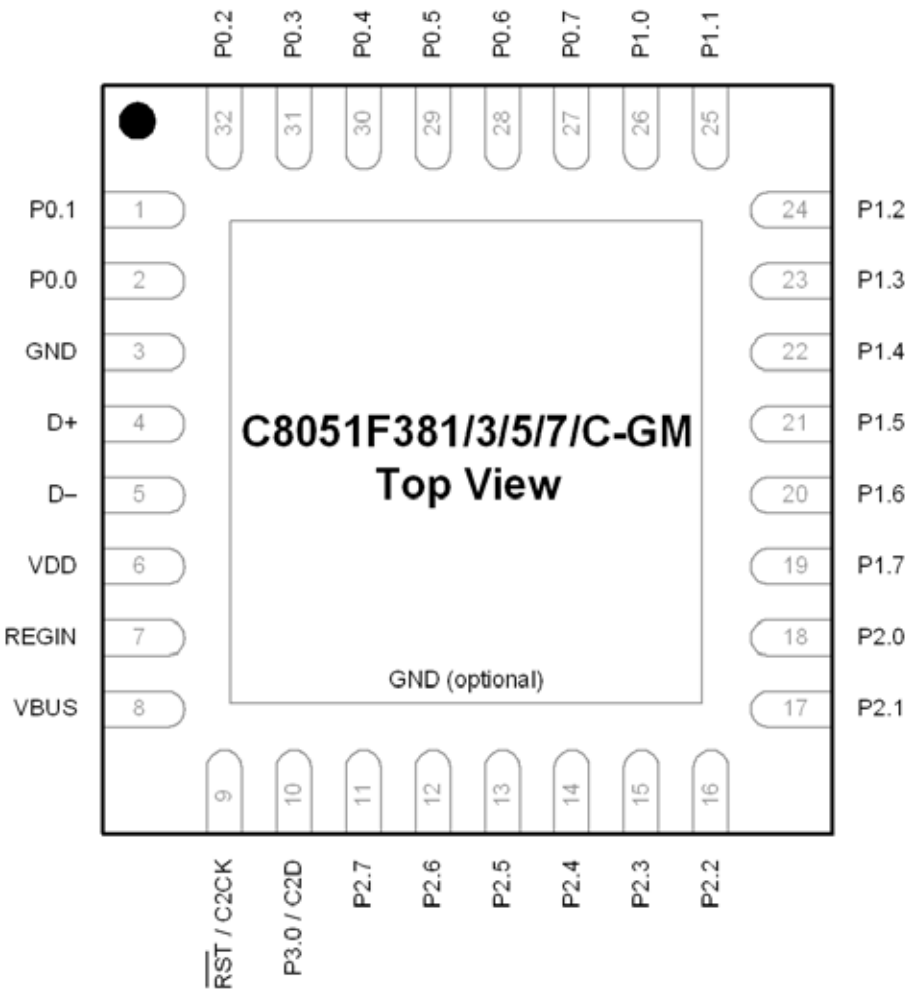

Figure 3.7. QFN-32 Pinout Diagram (Top View)

6.4. Programmable Window Detector

The ADC Programmable Window Detector continuously compares the ADC0 output registers to user-programmed limits, and notifies the system when a desired condition is detected. This is especially effective in an interrupt-driven system, saving code space and CPU bandwidth while delivering faster system response times. The window detector interrupt flag (AD0WINT in register ADC0CN) can also be used in polled mode. The ADC0 Greater-Than (ADC0GTH, ADC0GTL) and Less-Than (ADC0LTH, ADC0LTL) registers hold the comparison values. The window detector flag can be programmed to indicate when measured data is inside or outside of the user-programmed limits, depending on the contents of the ADC0 Less-Than and ADC0 Greater-Than registers.

SFR Definition 6.5. ADC0GTH: ADC0 Greater-Than Data High Byte

Bit	7	6	5	4	3	2	1	0
Name	ADC0GTH[7:0]							
Type	R/W							
Reset	1	1	1	1	1	1	1	1

SFR Address = 0xC4; SFR Page = All Pages

Bit	Name	Function
7:0	ADC0GTH[7:0]	**ADC0 Greater-Than Data Word High-Order Bits.**

SFR Definition 6.6. ADC0GTL: ADC0 Greater-Than Data Low Byte

Bit	7	6	5	4	3	2	1	0
Name	ADC0GTL[7:0]							
Type	R/W							
Reset	1	1	1	1	1	1	1	1

SFR Address = 0xC3; SFR Page = All Pages

Bit	Name	Function
7:0	ADC0GTL[7:0]	**ADC0 Greater-Than Data Word Low-Order Bits.**

SFR Definition 8.5. CPT0MX: Comparator0 MUX Selection

Bit	7	6	5	4	3	2	1	0
Name		CMX0N[2:0]				CMX0P[2:0]		
Type	R	R/W			R	R/W		
Reset	0	0	0	0	0	0	0	0

SFR Address = 0x9F; SFR Page = All Pages

Bit	Name	Function		
7	Unused	Read = 0b; Write = don't care.		
6:4	CMX0N[2:0]	**Comparator0 Negative Input MUX Selection.**		
		Selection	32-pin Package	48-pin Package
		000:	P1.1	P2.1
		001:	P1.5	P2.6
		010:	P2.1	P3.5
		011:	P2.5	P4.4
		100:	P0.1	P0.4
		101-111:	Reserved	Reserved
3	Unused	Read = 0b; Write = don't care.		
2:0	CMX0P[2:0]	**Comparator0 Positive Input MUX Selection.**		
		Selection	32-pin Package	48-pin Package
		000:	P1.0	P2.0
		001:	P1.4	P2.5
		010:	P2.0	P3.4
		011:	P2.4	P4.3
		100:	P0.0	P0.3
		101-111:	Reserved	Reserved

SFR Definition 9.1. REG01CN: Voltage Regulator Control

Bit	7	6	5	4	3	2	1	0
Name	REG0DIS	VBSTAT	Reserved	REG0MD	STOPCF	Reserved	REG1MD	Reserved
Type	R/W	R	R/W	R/W	R/W	R/W	R/W	R/W
Reset	0	0	0	0	0	0	0	0

SFR Address = 0xC9; SFR Page = All Pages

Bit	Name	Function
7	REG0DIS	**Voltage Regulator (REG0) Disable.** This bit enables or disables the REG0 Voltage Regulator. 0: Voltage Regulator Enabled. 1: Voltage Regulator Disabled.
6	VBSTAT	**VBUS Signal Status.** This bit indicates whether the device is connected to a USB network. 0: VBUS signal currently absent (device not attached to USB network). 1: VBUS signal currently present (device attached to USB network).
5	Reserved	Must Write 0b.
4	REG0MD	**Voltage Regulator (REG0) Mode Select.** This bit selects the Voltage Regulator mode for REG0. When REG0MD is set to 1, the REG0 voltage regulator operates in lower power (suspend) mode. 0: REG0 Voltage Regulator in normal mode. 1: REG0 Voltage Regulator in low power mode.
3	STOPCF	**Stop Mode Configuration (REG1).** This bit configures the REG1 regulator's behavior when the device enters STOP mode. 0: REG1 Regulator is still active in STOP mode. Any enabled reset source will reset the device. 1: REG1 Regulator is shut down in STOP mode. Only the $\overline{\text{RST}}$ pin or power cycle can reset the device.
2	Reserved	Must Write 0b.
1	REG1MD	**Voltage Regulator (REG1) Mode.** This bit selects the Voltage Regulator mode for REG1. When REG1MD is set to 1, the REG1 voltage regulator operates in lower power mode. 0: REG1 Voltage Regulator in normal mode. 1: REG1 Voltage Regulator in low power mode. This bit should not be set to '1' if the REG0 Voltage Regulator is disabled.
0	Reserved	Must Write 0b.

14.7.2.2. 8-bit MOVX without Bank Select: EMI0CF[4:2] = 001 or 011

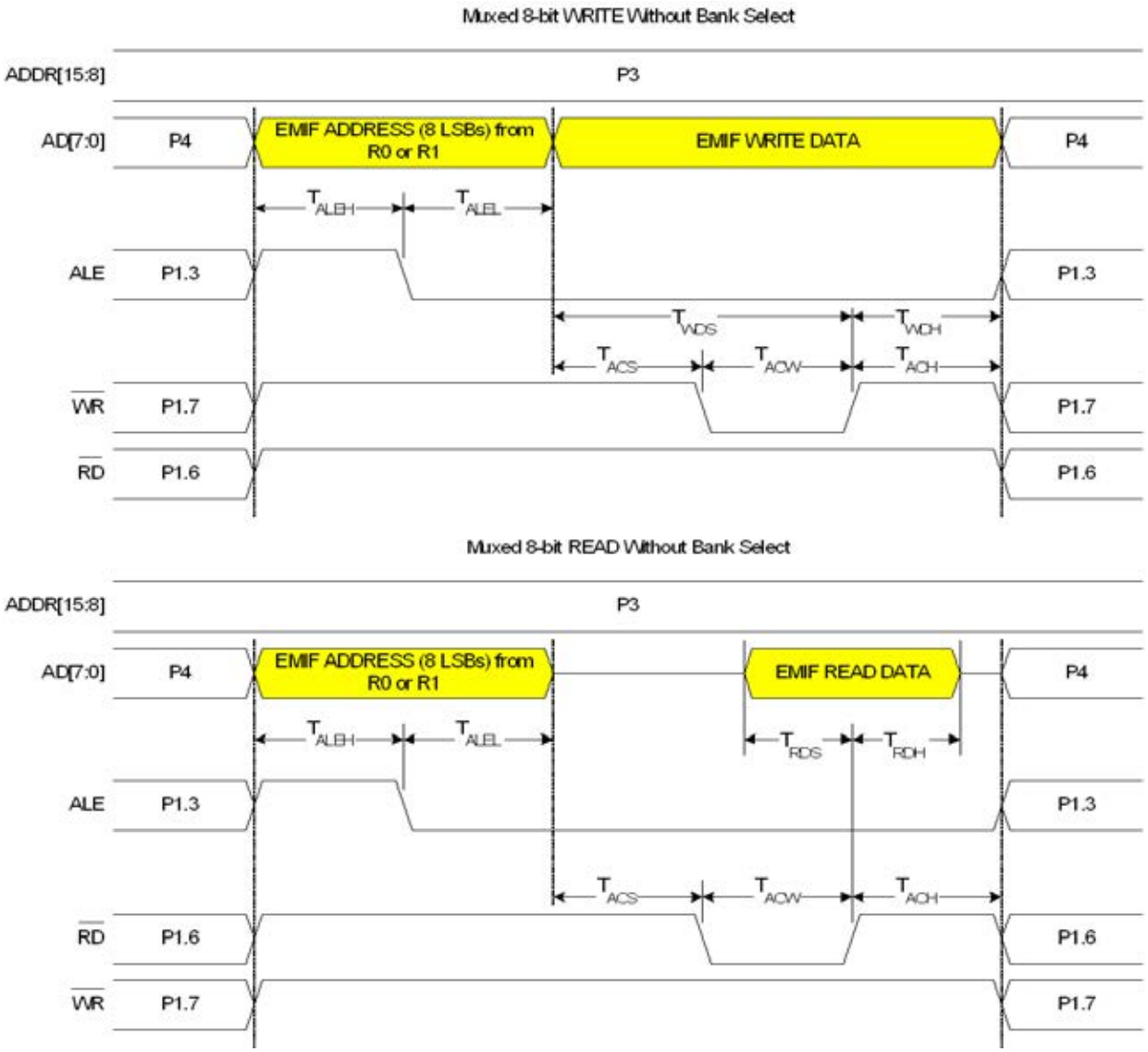

Figure 14.9. Multiplexed 8-bit MOVX without Bank Select Timing

SFR Definition 16.7. IT01CF: $\overline{\text{INT0}}$/$\overline{\text{INT1}}$ Configuration

Bit	7	6	5	4	3	2	1	0
Name	IN1PL	IN1SL[2:0]			IN0PL	IN0SL[2:0]		
Type	R/W	R/W			R/W	R/W		
Reset	0	0	0	0	0	0	0	1

SFR Address = 0xE4; SFR Page = 0

Bit	Name	Function
7	IN1PL	**$\overline{\text{INT1}}$ Polarity.** 0: $\overline{\text{INT1}}$ input is active low. 1: $\overline{\text{INT1}}$ input is active high.
6:4	IN1SL[2:0]	**$\overline{\text{INT1}}$ Port Pin Selection Bits.** These bits select which Port pin is assigned to $\overline{\text{INT1}}$. Note that this pin assignment is independent of the Crossbar; $\overline{\text{INT1}}$ will monitor the assigned Port pin without disturbing the peripheral that has been assigned the Port pin via the Crossbar. The Crossbar will not assign the Port pin to a peripheral if it is configured to skip the selected pin. 000: Select P0.0 001: Select P0.1 010: Select P0.2 011: Select P0.3 100: Select P0.4 101: Select P0.5 110: Select P0.6 111: Select P0.7
3	IN0PL	**$\overline{\text{INT0}}$ Polarity.** 0: $\overline{\text{INT0}}$ input is active low. 1: $\overline{\text{INT0}}$ input is active high.
2:0	IN0SL[2:0]	**$\overline{\text{INT0}}$ Port Pin Selection Bits.** These bits select which Port pin is assigned to $\overline{\text{INT0}}$. Note that this pin assignment is independent of the Crossbar; $\overline{\text{INT0}}$ will monitor the assigned Port pin without disturbing the peripheral that has been assigned the Port pin via the Crossbar. The Crossbar will not assign the Port pin to a peripheral if it is configured to skip the selected pin. 000: Select P0.0 001: Select P0.1 010: Select P0.2 011: Select P0.3 100: Select P0.4 101: Select P0.5 110: Select P0.6 111: Select P0.7

SFR Definition 19.6. OSCXCN: External Oscillator Control

Bit	7	6	5	4	3	2	1	0
Name	XCLKVLD	XOSCMD[2:0]				XFCN[2:0]		
Type	R	R/W			R	R/W		
Reset	0	0	0	0	0	0	0	0

SFR Address = 0xB1; SFR Page = All Pages

Bit	Name	Function
7	XCLKVLD	**External Oscillator Valid Flag.** Provides External Oscillator status and is valid at all times for all modes of operation except External CMOS Clock Mode and External CMOS Clock Mode with divide by 2. In these modes, XCLKVLD always returns 0. 0: External Oscillator is unused or not yet stable. 1: External Oscillator is running and stable.
6:4	XOSCMD[2:0]	**External Oscillator Mode Select.** 00x: External Oscillator circuit off. 010: External CMOS Clock Mode. 011: External CMOS Clock Mode with divide-by-2 stage. 100: RC Oscillator Mode with divide-by-2 stage. 101: Capacitor Oscillator Mode with divide-by-2 stage. 110: Crystal Oscillator Mode. 111: Crystal Oscillator Mode with divide-by-2 stage.
3	Unused	Read = 0; Write = don't care
2:0	XFCN[2:0]	**External Oscillator Frequency Control Bits.** Set according to the desired frequency for RC mode. Set according to the desired K Factor for C mode.

XFCN	Crystal Mode	RC Mode	C Mode
000	f ≤ 20 kHz	f ≤ 25 kHz	K Factor = 0.87
001	20 kHz < f ≤ 58 kHz	25 kHz < f ≤ 50 kHz	K Factor = 2.6
010	58 kHz < f ≤ 155 kHz	50 kHz < f ≤ 100 kHz	K Factor = 7.7
011	155 kHz < f ≤ 415 kHz	100 kHz < f ≤ 200 kHz	K Factor = 22
100	415 kHz < f ≤ 1.1 MHz	200 kHz < f ≤ 400 kHz	K Factor = 65
101	1.1 MHz < f ≤ 3.1 MHz	400 kHz < f ≤ 800 kHz	K Factor = 180
110	3.1 MHz < f ≤ 8.2 MHz	800 kHz < f ≤ 1.6 MHz	K Factor = 664
111	8.2 MHz < f ≤ 25 MHz	1.6 MHz < f ≤ 3.2 MHz	K Factor = 1590

SFR Definition 20.4. P0: Port 0

Bit	7	6	5	4	3	2	1	0
Name	P0[7:0]							
Type	R/W							
Reset	1	1	1	1	1	1	1	1

SFR Address = 0x80; SFR Page = All Pages; Bit Addressable

Bit	Name	Description	Write	Read
7:0	P0[7:0]	**Port 0 Data.** Sets the Port latch logic value or reads the Port pin logic state in Port cells configured for digital I/O.	0: Set output latch to logic LOW. 1: Set output latch to logic HIGH.	0: P0.n Port pin is logic LOW. 1: P0.n Port pin is logic HIGH.

SFR Definition 20.5. P0MDIN: Port 0 Input Mode

Bit	7	6	5	4	3	2	1	0
Name	P0MDIN[7:0]							
Type	R/W							
Reset	1	1	1	1	1	1	1	1

SFR Address = 0xF1; SFR Page = All Pages

Bit	Name	Function
7:0	P0MDIN[7:0]	**Analog Configuration Bits for P0.7–P0.0 (respectively).** Port pins configured for analog mode have their weak pullup, digital driver, and digital receiver disabled. 0: Corresponding P0.n pin is configured for analog mode. 1: Corresponding P0.n pin is not configured for analog mode.

Table 21.1. Endpoint Addressing Scheme

Endpoint	Associated Pipes	USB Protocol Address
Endpoint0	Endpoint0 IN	0x00
	Endpoint0 OUT	0x00
Endpoint1	Endpoint1 IN	0x81
	Endpoint1 OUT	0x01
Endpoint2	Endpoint2 IN	0x82
	Endpoint2 OUT	0x02
Endpoint3	Endpoint3 IN	0x83
	Endpoint3 OUT	0x03

21.2. USB Transceiver

The USB Transceiver is configured via the USB0XCN register shown in SFR Definition 21.1. This configuration includes Transceiver enable/disable, pull-up resistor enable/disable, and device speed selection (Full or Low Speed). When bit SPEED = 1, USB0 operates as a Full Speed USB function, and the on-chip pull-up resistor (if enabled) appears on the D+ pin. When bit SPEED = 0, USB0 operates as a Low Speed USB function, and the on-chip pull-up resistor (if enabled) appears on the D- pin. Bits4-0 of register USB0XCN can be used for Transceiver testing as described in SFR Definition 21.1. The pull-up resistor is enabled only when VBUS is present (see Section “9.1.2. VBUS Detection” on page 74 for details on VBUS detection).

Important Note: The USB clock should be active before the Transceiver is enabled.

Suspend Interrupt Service Routine (ISR) should perform application-specific configuration tasks such as disabling appropriate peripherals and/or configuring clock sources for low power modes. See Section “19.3. Programmable Internal High-Frequency (H-F) Oscillator” on page 145 for more details on internal oscillator configuration, including the Suspend mode feature of the internal oscillator.

USB0 exits Suspend mode when any of the following occur: (1) Resume signaling is detected or generated, (2) Reset signaling is detected, or (3) a device or USB reset occurs. If suspended, the internal oscillator will exit Suspend mode upon any of the above listed events.

Resume Signaling: USB0 will exit Suspend mode if Resume signaling is detected on the bus. A Resume interrupt will be generated upon detection if enabled (RESINTE = 1). Software may force a Remote Wakeup by writing 1 to the RESUME bit (POWER.2). When forcing a Remote Wakeup, software should write RESUME = 0 to end Resume signaling 10-15 ms after the Remote Wakeup is initiated (RESUME = 1).

ISO Update: When software writes 1 to the ISOUP bit (POWER.7), the ISO Update function is enabled. With ISO Update enabled, new packets written to an ISO IN endpoint will not be transmitted until a new Start-Of-Frame (SOF) is received. If the ISO IN endpoint receives an IN token before a SOF, USB0 will transmit a zero-length packet. When ISOUP = 1, ISO Update is enabled for all ISO endpoints.

USB Enable: USB0 is disabled following a Power-On-Reset (POR). USB0 is enabled by clearing the USBINH bit (POWER.4). Once written to 0, the USBINH can only be set to 1 by one of the following: (1) a Power-On-Reset (POR), or (2) an asynchronous USB0 reset generated by writing 1 to the USBRST bit (POWER.3).

Software should perform all USB0 configuration before enabling USB0. The configuration sequence should be performed as follows:

1. Select and enable the USB clock source.
2. Reset USB0 by writing USBRST= 1.
3. Configure and enable the USB Transceiver.
4. Perform any USB0 function configuration (interrupts, Suspend detect).
5. Enable USB0 by writing USBINH = 0.

22.5.3. Write Sequence (Slave)

During a write sequence, an SMBus master writes data to a slave device. The slave in this transfer will be a receiver during the address byte, and a receiver during all data bytes. When slave events are enabled (INH = 0), the interface enters Slave Receiver Mode when a START followed by a slave address and direction bit (WRITE in this case) is received. If hardware ACK generation is disabled, upon entering Slave Receiver Mode, an interrupt is generated and the ACKRQ bit is set. The software must respond to the received slave address with an ACK, or ignore the received slave address with a NACK. If hardware ACK generation is enabled, the hardware will apply the ACK for a slave address which matches the criteria set up by SMB0ADR and SMB0ADM. The interrupt will occur after the ACK cycle.

If the received slave address is ignored (by software or hardware), slave interrupts will be inhibited until the next START is detected. If the received slave address is acknowledged, zero or more data bytes are received.

If hardware ACK generation is disabled, the ACKRQ is set to 1 and an interrupt is generated after each received byte. Software must write the ACK bit at that time to ACK or NACK the received byte.

With hardware ACK generation enabled, the SMBus hardware will automatically generate the ACK/NACK, and then post the interrupt. **It is important to note that the appropriate ACK or NACK value should be set up by the software prior to receiving the byte when hardware ACK generation is enabled.**

The interface exits Slave Receiver Mode after receiving a STOP. The interface will switch to Slave Transmitter Mode if SMB0DAT is written while an active Slave Receiver. Figure 22.7 shows a typical slave write sequence. Two received data bytes are shown, though any number of bytes may be received. Notice that the ‘data byte transferred’ interrupts occur at different places in the sequence, depending on whether hardware ACK generation is enabled. The interrupt occurs **before** the ACK with hardware ACK generation disabled, and **after** the ACK when hardware ACK generation is enabled.

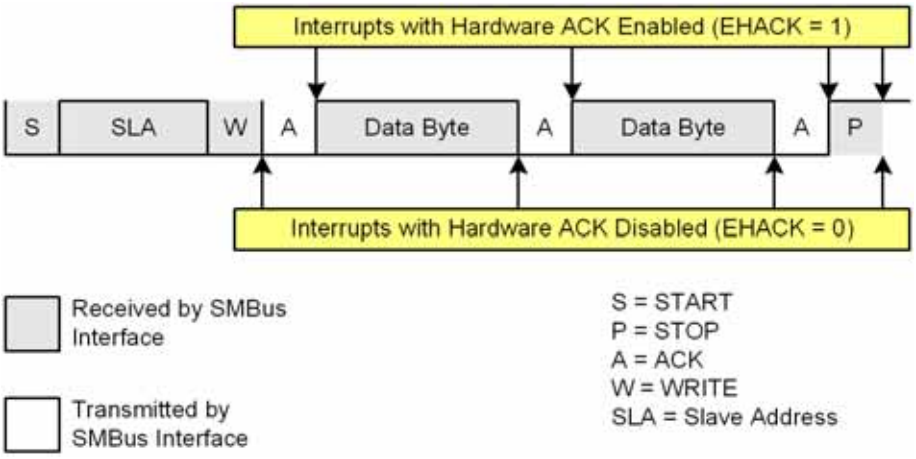

Figure 22.7. Typical Slave Write Sequence

24.1. Baud Rate Generator

The UART1 baud rate is generated by a dedicated 16-bit timer which runs from the controller's core clock (SYSCLK), and has prescaler options of 1, 4, 12, or 48. The timer and prescaler options combined allow for a wide selection of baud rates over many SYSCLK frequencies.

The baud rate generator is configured using three registers: SBCON1, SBRLH1, and SBRLL1. The UART1 Baud Rate Generator Control Register (SBCON1, SFR Definition) enables or disables the baud rate generator, and selects the prescaler value for the timer. The baud rate generator must be enabled for UART1 to function. Registers SBRLH1 and SBRLL1 contain a 16-bit reload value for the dedicated 16-bit timer. The internal timer counts up from the reload value on every clock tick. On timer overflows (0xFFFF to 0x0000), the timer is reloaded. For reliable UART operation, it is recommended that the UART baud rate is not configured for baud rates faster than SYSCLK/16. The baud rate for UART1 is defined in Equation 24.1.

$$\text{Baud Rate} = \frac{\text{SYSCLK}}{(65536 - (\text{SBRLH1:SBRLL1}))} \times \frac{1}{2} \times \frac{1}{\text{Prescaler}}$$

Equation 24.1. UART1 Baud Rate

A quick reference for typical baud rates and system clock frequencies is given in Table 24.1.

Table 24.1. Baud Rate Generator Settings for Standard Baud Rates

	Target Baud Rate (bps)	Actual Baud Rate (bps)	Baud Rate Error	Oscillator Divide Factor	SB1PS[1:0] (Prescaler Bits)	Reload Value in SBRLH1:SBRLL1
SYSCLK = 12 MHz	230400	230769	0.16%	52	11	0xFFE6
	115200	115385	0.16%	104	11	0xFFCC
	57600	57692	0.16%	208	11	0xFF98
	28800	28846	0.16%	416	11	0xFF30
	14400	14388	0.08%	834	11	0xFE5F
	9600	9600	0.0%	1250	11	0xFD8F
	2400	2400	0.0%	5000	11	0xF63C
	1200	1200	0.0%	10000	11	0xEC78
SYSCLK = 24 MHz	230400	230769	0.16%	104	11	0xFFCC
	115200	115385	0.16%	208	11	0xFF98
	57600	57692	0.16%	416	11	0xFF30
	28800	28777	0.08%	834	11	0xFE5F
	14400	14406	0.04%	1666	11	0xFCBF
	9600	9600	0.0%	2500	11	0xFB1E
	2400	2400	0.0%	10000	11	0xEC78
	1200	1200	0.0%	20000	11	0xD8F0
SYSCLK = 48 MHz	230400	230769	0.16%	208	11	0xFF98
	115200	115385	0.16%	416	11	0xFF30
	57600	57554	0.08%	834	11	0xFE5F
	28800	28812	0.04%	1666	11	0xFCBF
	14400	14397	0.02%	3334	11	0xF97D
	9600	9600	0.0%	5000	11	0xF63C
	2400	2400	0.0%	20000	11	0xD8F0
	1200	1200	0.0%	40000	11	0xB1E0

25.4. SPI0 Interrupt Sources

When SPI0 interrupts are enabled, the following four flags will generate an interrupt when they are set to logic 1:

All of the following bits must be cleared by software.

- The SPI Interrupt Flag, SPIF (SPI0CN.7) is set to logic 1 at the end of each byte transfer. This flag can occur in all SPI0 modes.
- The Write Collision Flag, WCOL (SPI0CN.6) is set to logic 1 if a write to SPI0DAT is attempted when the transmit buffer has not been emptied to the SPI shift register. When this occurs, the write to SPI0DAT will be ignored, and the transmit buffer will not be written.This flag can occur in all SPI0 modes.
- The Mode Fault Flag MODF (SPI0CN.5) is set to logic 1 when SPI0 is configured as a master, and for multi-master mode and the NSS pin is pulled low. When a Mode Fault occurs, the MSTEN and SPIEN bits in SPI0CN are set to logic 0 to disable SPI0 and allow another master device to access the bus.
- The Receive Overrun Flag RXOVRN (SPI0CN.4) is set to logic 1 when configured as a slave, and a transfer is completed and the receive buffer still holds an unread byte from a previous transfer. The new byte is not transferred to the receive buffer, allowing the previously received data byte to be read. The data byte which caused the overrun is lost.

25.5. Serial Clock Phase and Polarity

Four combinations of serial clock phase and polarity can be selected using the clock control bits in the SPI0 Configuration Register (SPI0CFG). The CKPHA bit (SPI0CFG.5) selects one of two clock phases (edge used to latch the data). The CKPOL bit (SPI0CFG.4) selects between an active-high or active-low clock. Both master and slave devices must be configured to use the same clock phase and polarity. SPI0 should be disabled (by clearing the SPIEN bit, SPI0CN.0) when changing the clock phase or polarity. The clock and data line relationships for master mode are shown in Figure 25.5. For slave mode, the clock and data relationships are shown in Figure 25.6 and Figure 25.7. Note that CKPHA should be set to 0 on both the master and slave SPI when communicating between two Silicon Labs C8051 devices.

The SPI0 Clock Rate Register (SPI0CKR) as shown in SFR Definition 25.3 controls the master mode serial clock frequency. This register is ignored when operating in slave mode. When the SPI is configured as a master, the maximum data transfer rate (bits/sec) is one-half the system clock frequency or 12.5 MHz, whichever is slower. When the SPI is configured as a slave, the maximum data transfer rate (bits/sec) for full-duplex operation is 1/10 the system clock frequency, provided that the master issues SCK, NSS (in 4-wire slave mode), and the serial input data synchronously with the slave's system clock. If the master issues SCK, NSS, and the serial input data asynchronously, the maximum data transfer rate (bits/sec) must be less than 1/10 the system clock frequency. In the special case where the master only wants to transmit data to the slave and does not need to receive data from the slave (i.e. half-duplex operation), the SPI slave can receive data at a maximum data transfer rate (bits/sec) of 1/4 the system clock frequency. This is provided that the master issues SCK, NSS, and the serial input data synchronously with the slave's system clock.

SFR Definition 26.1. CKCON: Clock Control

Bit	7	6	5	4	3	2	1	0
Name	T3MH	T3ML	T2MH	T2ML	T1M	T0M	SCA[1:0]	
Type	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Reset	0	0	0	0	0	0	0	0

SFR Address = 0x8E; SFR Page = All Pages

Bit	Name	Function
7	T3MH	**Timer 3 High Byte Clock Select.** Selects the clock supplied to the Timer 3 high byte (split 8-bit timer mode only). 0: Timer 3 high byte uses the clock defined by the T3XCLK bit in TMR3CN. 1: Timer 3 high byte uses the system clock.
6	T3ML	**Timer 3 Low Byte Clock Select.** Selects the clock supplied to Timer 3. Selects the clock supplied to the lower 8-bit timer in split 8-bit timer mode. 0: Timer 3 low byte uses the clock defined by the T3XCLK bit in TMR3CN. 1: Timer 3 low byte uses the system clock.
5	T2MH	**Timer 2 High Byte Clock Select.** Selects the clock supplied to the Timer 2 high byte (split 8-bit timer mode only). 0: Timer 2 high byte uses the clock defined by the T2XCLK bit in TMR2CN. 1: Timer 2 high byte uses the system clock.
4	T2ML	**Timer 2 Low Byte Clock Select.** Selects the clock supplied to Timer 2. If Timer 2 is configured in split 8-bit timer mode, this bit selects the clock supplied to the lower 8-bit timer. 0: Timer 2 low byte uses the clock defined by the T2XCLK bit in TMR2CN. 1: Timer 2 low byte uses the system clock.
3	T1	**Timer 1 Clock Select.** Selects the clock source supplied to Timer 1. Ignored when C/T1 is set to 1. 0: Timer 1 uses the clock defined by the prescale bits SCA[1:0]. 1: Timer 1 uses the system clock.
2	T0	**Timer 0 Clock Select.** Selects the clock source supplied to Timer 0. Ignored when C/T0 is set to 1. 0: Counter/Timer 0 uses the clock defined by the prescale bits SCA[1:0]. 1: Counter/Timer 0 uses the system clock.
1:0	SCA[1:0]	**Timer 0/1 Prescale Bits.** These bits control the Timer 0/1 Clock Prescaler: 00: System clock divided by 12 01: System clock divided by 4 10: System clock divided by 48 11: External clock divided by 8 (synchronized with the system clock)

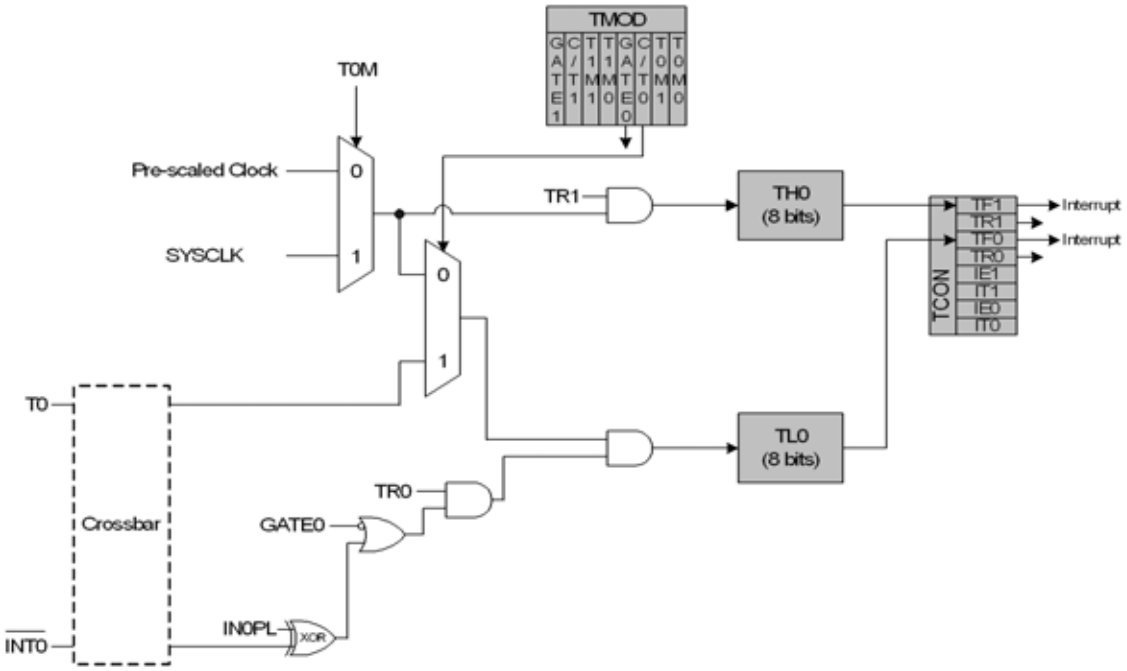

Figure 26.3. T0 Mode 3 Block Diagram

26.3. Timer 3

Timer 3 is a 16-bit timer formed by two 8-bit SFRs: TMR3L (low byte) and TMR3H (high byte). Timer 3 may operate in 16-bit auto-reload mode, (split) 8-bit auto-reload mode, USB Start-of-Frame (SOF) capture mode, or Low-Frequency Oscillator (LFO) Rising Edge capture mode. The Timer 3 operation mode is defined by the T3SPLIT (TMR3CN.3), T3CE (TMR3CN.4) bits, and T3CSS (TMR3CN.1) bits.

Timer 3 may be clocked by the system clock, the system clock divided by 12, or the external oscillator source divided by 8. The external clock mode is ideal for real-time clock (RTC) functionality, where the internal oscillator drives the system clock while Timer 3 (and/or the PCA) is clocked by an external precision oscillator. Note that the external oscillator source divided by 8 is synchronized with the system clock.

26.3.1. 16-bit Timer with Auto-Reload

When T3SPLIT (TMR3CN.3) is zero, Timer 3 operates as a 16-bit timer with auto-reload. Timer 3 can be clocked by SYSCLK, SYSCLK divided by 12, or the external oscillator clock source divided by 8. As the 16-bit timer register increments and overflows from 0xFFFF to 0x0000, the 16-bit value in the Timer 3 reload registers (TMR3RLH and TMR3RLL) is loaded into the Timer 3 register as shown in Figure 26.8, and the Timer 3 High Byte Overflow Flag (TMR3CN.7) is set. If Timer 3 interrupts are enabled (if EIE1.7 is set), an interrupt will be generated on each Timer 3 overflow. Additionally, if Timer 3 interrupts are enabled and the TF3LEN bit is set (TMR3CN.5), an interrupt will be generated each time the lower 8 bits (TMR3L) overflow from 0xFF to 0x00.

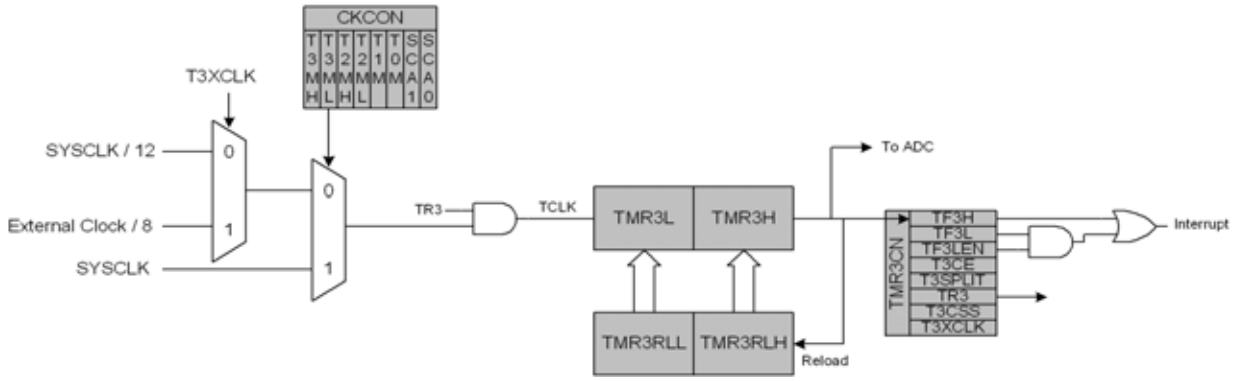

Figure 26.8. Timer 3 16-Bit Mode Block Diagram

SFR Definition 26.15. TMR3RLL: Timer 3 Reload Register Low Byte

Bit	7	6	5	4	3	2	1	0
Name	TMR3RLL[7:0]							
Type	R/W							
Reset	0	0	0	0	0	0	0	0

SFR Address = 0x92; SFR Page = 0

Bit	Name	Function
7:0	TMR3RLL[7:0]	**Timer 3 Reload Register Low Byte.** TMR3RLL holds the low byte of the reload value for Timer 3.

SFR Definition 26.16. TMR3RLH: Timer 3 Reload Register High Byte

Bit	7	6	5	4	3	2	1	0
Name	TMR3RLH[7:0]							
Type	R/W							
Reset	0	0	0	0	0	0	0	0

SFR Address = 0x93; SFR Page = 0

Bit	Name	Function
7:0	TMR3RLH[7:0]	**Timer 3 Reload Register High Byte.** TMR3RLH holds the high byte of the reload value for Timer 3.

SFR Definition 26.17. TMR3L: Timer 3 Low Byte

Bit	7	6	5	4	3	2	1	0
Name	TMR3L[7:0]							
Type	R/W							
Reset	0	0	0	0	0	0	0	0

SFR Address = 0x94; SFR Page = 0

Bit	Name	Function
7:0	TMR3L[7:0]	**Timer 3 Low Byte.** In 16-bit mode, the TMR3L register contains the low byte of the 16-bit Timer 3. In 8-bit mode, TMR3L contains the 8-bit low byte timer value.

27.2. PCA0 Interrupt Sources

Figure 27.3 shows a diagram of the PCA interrupt tree. There are six independent event flags that can be used to generate a PCA0 interrupt. They are: the main PCA counter overflow flag (CF), which is set upon a 16-bit overflow of the PCA0 counter and the individual flags for each PCA channel (CCF0, CCF1, CCF2, CCF3, and CCF4), which are set according to the operation mode of that module. These event flags are always set when the trigger condition occurs. Each of these flags can be individually selected to generate a PCA0 interrupt, using the corresponding interrupt enable flag (ECF for CF, and ECCFn for each CCFn). PCA0 interrupts must be globally enabled before any individual interrupt sources are recognized by the processor. PCA0 interrupts are globally enabled by setting the EA bit and the EPCA0 bit to logic 1.

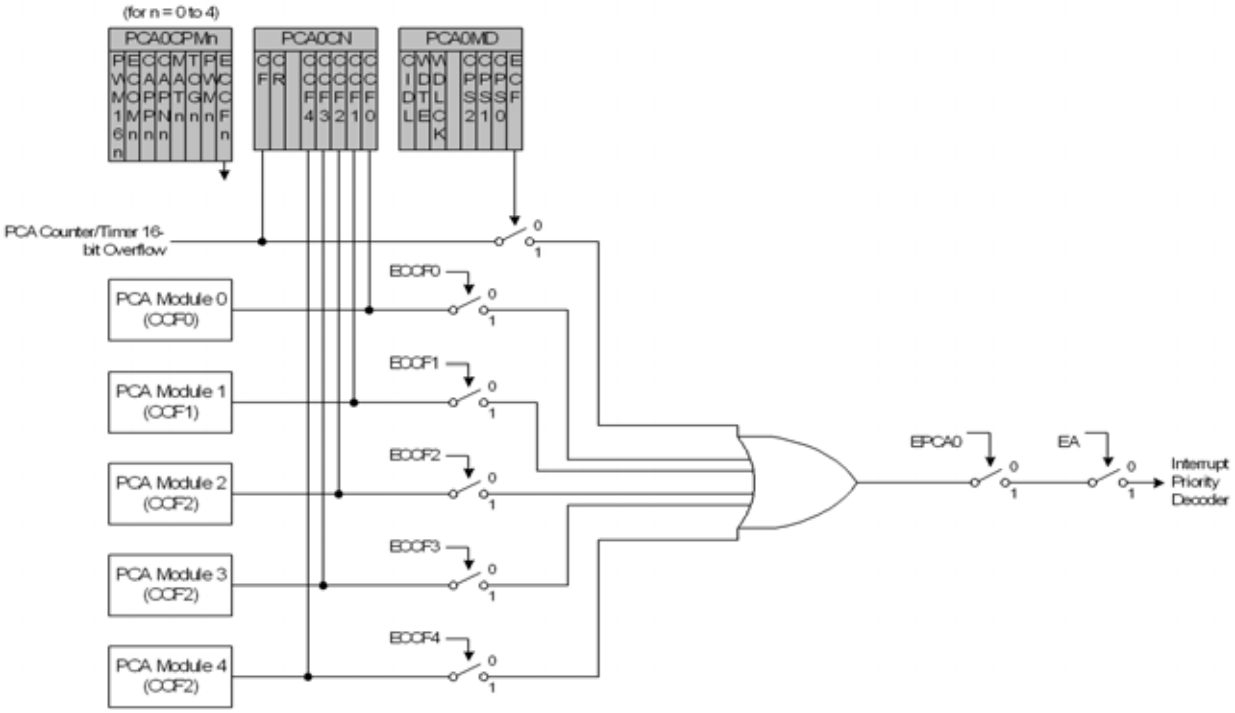

Figure 27.3. PCA Interrupt Block Diagram

SFR Definition 27.2. PCA0MD: PCA Mode

Bit	7	6	5	4	3	2	1	0
Name	CIDL	WDTE	WDLCK		CPS[2:0]			ECF
Type	R/W	R/W	R/W	R	R/W			R/W
Reset	0	1	0	0	0	0	0	0

SFR Address = 0xD9; SFR Page = All Pages

Bit	Name	Function
7	CIDL	**PCA Counter/Timer Idle Control.** Specifies PCA behavior when CPU is in Idle Mode. 0: PCA continues to function normally while the system controller is in Idle Mode. 1: PCA operation is suspended while the system controller is in Idle Mode.
6	WDTE	**Watchdog Timer Enable.** If this bit is set, PCA Module 4 is used as the watchdog timer. 0: Watchdog Timer disabled. 1: PCA Module 4 enabled as Watchdog Timer.
5	WDLCK	**Watchdog Timer Lock.** This bit locks/unlocks the Watchdog Timer Enable. When WDLCK is set, the Watchdog Timer may not be disabled until the next system reset. 0: Watchdog Timer Enable unlocked. 1: Watchdog Timer Enable locked.
4	Unused	Read = 0b, Write = Don't care.
3:1	CPS[2:0]	**PCA Counter/Timer Pulse Select.** These bits select the timebase source for the PCA counter 000: System clock divided by 12 001: System clock divided by 4 010: Timer 0 overflow 011: High-to-low transitions on ECI (max rate = system clock divided by 4) 100: System clock 101: External clock divided by 8 (synchronized with the system clock) 11x: Reserved
0	ECF	**PCA Counter/Timer Overflow Interrupt Enable.** This bit sets the masking of the PCA Counter/Timer Overflow (CF) interrupt. 0: Disable the CF interrupt. 1: Enable a PCA Counter/Timer Overflow interrupt request when CF (PCA0CN.7) is set.
Note: When the WDTE bit is set to 1, the other bits in the PCA0MD register cannot be modified. To change the contents of the PCA0MD register, the Watchdog Timer must first be disabled.		