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Details

Product Status	Not For New Designs
Core Processor	8051
Core Size	8-Bit
Speed	48MHz
Connectivity	SMBus (2-Wire/I ² C), SPI, UART/USART, USB
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	25
Program Memory Size	64KB (64K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	4.25K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 5.25V
Data Converters	-
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/c8051f34d-gqr

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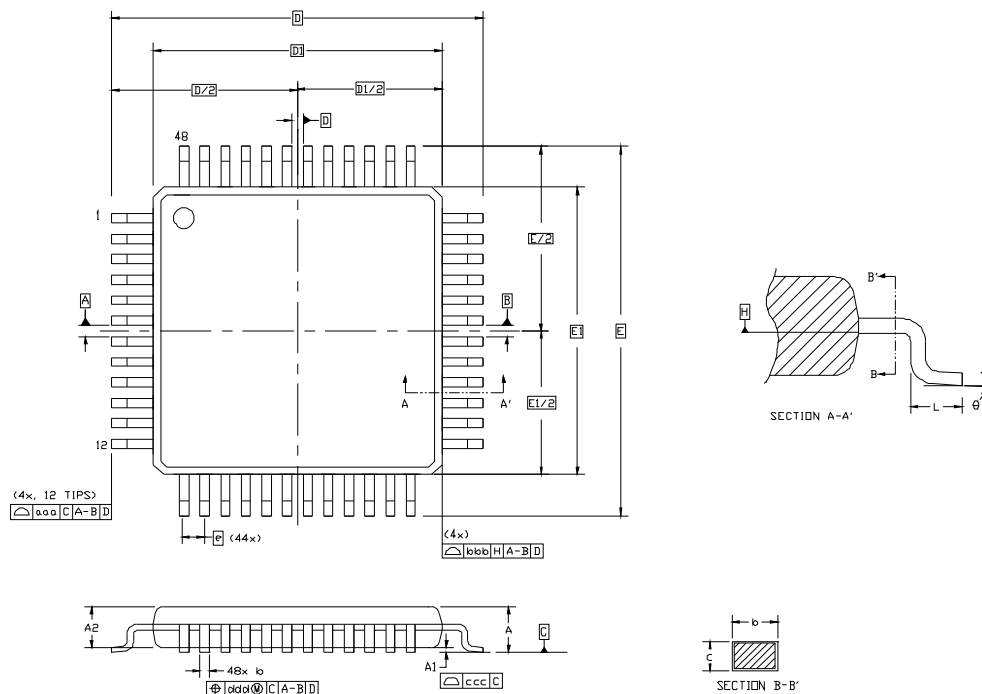


Figure 4.2. TQFP-48 Package Diagram

Table 4.2. TQFP-48 Package Dimensions

Dimension	Min	Nom	Max
A	—	—	1.20
A1	0.05	—	0.15
A2	0.95	1.00	1.05
b	0.17	0.22	0.27
c	0.09	—	0.20
D	9.00 BSC		
D1	7.00 BSC		
e	0.50 BSC		
E	9.00 BSC		
E1	7.00 BSC		
L	0.45	0.60	0.75
aaa	0.20		
bbb	0.20		
ccc	0.08		
ddd	0.08		
θ	0°	3.5°	7°

Notes:

1. All dimensions shown are in millimeters (mm) unless otherwise noted.
2. Dimensioning and Tolerancing per ANSI Y14.5M-1994.
3. This drawing conforms to JEDEC outline MS-026, variation ABC.
4. The recommended card reflow profile is per the JEDEC/IPC J-STD-020 specification for Small Body Components.

SFR Definition 5.9. ADC0LTH: ADC0 Less-Than Data High Byte

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xC6

Bits7–0: High byte of ADC0 Less-Than Data Word.

SFR Definition 5.10. ADC0LTL: ADC0 Less-Than Data Low Byte

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xC5

Bits7–0: Low byte of ADC0 Less-Than Data Word.

SFR Definition 7.3. CPT0MD: Comparator0 Mode Selection

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
-	-	CP0RIE	CP0FIE	-	-	CP0MD1	CP0MD0	00000010
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0x9D

Bits7–6: UNUSED. Read = 00b. Write = don't care.

Bit5: CP0RIE: Comparator0 Rising-Edge Interrupt Enable.

0: Comparator0 rising-edge interrupt disabled.

1: Comparator0 rising-edge interrupt enabled.

Bit4: CP0FIE: Comparator0 Falling-Edge Interrupt Enable.

0: Comparator0 falling-edge interrupt disabled.

1: Comparator0 falling-edge interrupt enabled.

Bits3–2: UNUSED. Read = 00b. Write = don't care.

Bits1–0: CP0MD1–CP0MD0: Comparator0 Mode Select

These bits select the response time for Comparator0.

Mode	CP0MD1	CP0MD0	CP0 Response Time*
0	0	0	Fastest Response
1	0	1	
2	1	0	
3	1	1	Lowest Power

* See Table 7.1 for response time parameters.

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Table 9.1. CIP-51 Instruction Set Summary (Continued)

Mnemonic	Description	Bytes	Clock Cycles
Boolean Manipulation			
CLR C	Clear Carry	1	1
CLR bit	Clear direct bit	2	2
SETB C	Set Carry	1	1
SETB bit	Set direct bit	2	2
CPL C	Complement Carry	1	1
CPL bit	Complement direct bit	2	2
ANL C, bit	AND direct bit to Carry	2	2
ANL C, /bit	AND complement of direct bit to Carry	2	2
ORL C, bit	OR direct bit to carry	2	2
ORL C, /bit	OR complement of direct bit to Carry	2	2
MOV C, bit	Move direct bit to Carry	2	2
MOV bit, C	Move Carry to direct bit	2	2
JC rel	Jump if Carry is set	2	2/4
JNC rel	Jump if Carry is not set	2	2/4
JB bit, rel	Jump if direct bit is set	3	3/5
JNB bit, rel	Jump if direct bit is not set	3	3/5
JBC bit, rel	Jump if direct bit is set and clear bit	3	3/5
Program Branching			
ACALL addr11	Absolute subroutine call	2	4
LCALL addr16	Long subroutine call	3	5
RET	Return from subroutine	1	6
RETI	Return from interrupt	1	6
AJMP addr11	Absolute jump	2	4
LJMP addr16	Long jump	3	5
SJMP rel	Short jump (relative address)	2	4
JMP @A+DPTR	Jump indirect relative to DPTR	1	4
JZ rel	Jump if A equals zero	2	2/4
JNZ rel	Jump if A does not equal zero	2	2/4
CJNE A, direct, rel	Compare direct byte to A and jump if not equal	3	3/5
CJNE A, #data, rel	Compare immediate to A and jump if not equal	3	3/5
CJNE Rn, #data, rel	Compare immediate to Register and jump if not equal	3	3/5
CJNE @Ri, #data, rel	Compare immediate to indirect and jump if not equal	3	4/6
DJNZ Rn, rel	Decrement Register and jump if not zero	2	2/4
DJNZ direct, rel	Decrement direct byte and jump if not zero	3	3/5
NOP	No operation	1	1

10. Prefetch Engine

The 48 MHz versions of the C8051F34x family of devices incorporate a 2-byte prefetch engine. Because the access time of the FLASH memory is 40 ns, and the minimum instruction time is roughly 20 ns, the prefetch engine is necessary for full-speed code execution. Instructions are read from FLASH memory two bytes at a time by the prefetch engine, and given to the CIP-51 processor core to execute. When running linear code (code without any jumps or branches), the prefetch engine allows instructions to be executed at full speed. When a code branch occurs, the processor may be stalled for up to two clock cycles while the next set of code bytes is retrieved from FLASH memory. The FLRT bit (FLSCL.4) determines how many clock cycles are used to read each set of two code bytes from FLASH. When operating from a system clock of 25 MHz or less, the FLRT bit should be set to '0' so that the prefetch engine takes only one clock cycle for each read. When operating with a system clock of greater than 25 MHz (up to 48 MHz), the FLRT bit should be set to '1', so that each prefetch code read lasts for two clock cycles.

SFR Definition 10.1. PFE0CN: Prefetch Engine Control

R	R	R/W	R	R	R	R	R/W	Reset Value
		PFEN					FLBWE	00100000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	

SFR Address: 0xAF

Bits 7–6: Unused. Read = 00b; Write = Don't Care

Bit 5: PFEN: Prefetch Enable.
This bit enables the prefetch engine.
0: Prefetch engine is disabled.
1: Prefetch engine is enabled.

Bits 4–1: Unused. Read = 0000b; Write = Don't Care

Bit 0: FLBWE: FLASH Block Write Enable.
This bit allows block writes to FLASH memory from software.
0: Each byte of a software FLASH write is written individually.
1: FLASH bytes are written in groups of two.

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SFR Definition 12.1. PSCTL: Program Store R/W Control

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
-	-	-	-	-	Reserved	PSEE	PSWE	00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0x8F

Bits7–3: Unused: Read = 00000b. Write = don't care.

Bit2: Reserved. Read = 0b. Must Write = 0b.

Bit1: PSEE: Program Store Erase Enable

Setting this bit (in combination with PSWE) allows an entire page of Flash program memory to be erased. If this bit is logic 1 and Flash writes are enabled (PSWE is logic 1), a write to Flash memory using the MOVX instruction will erase the entire page that contains the location addressed by the MOVX instruction. The value of the data byte written does not matter.

0: Flash program memory erasure disabled.

1: Flash program memory erasure enabled.

Bit0: PSWE: Program Store Write Enable

Setting this bit allows writing a byte of data to the Flash program memory using the MOVX write instruction. The Flash location should be erased before writing data.

0: Writes to Flash program memory disabled.

1: Writes to Flash program memory enabled; the MOVX write instruction targets Flash memory.

SFR Definition 12.2. FLKEY: Flash Lock and Key

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xB7

Bits–0: FLKEY: Flash Lock and Key Register

Write:

This register must be written to before Flash writes or erases can be performed. Flash remains locked until this register is written to with the following key codes: 0xA5, 0xF1. The timing of the writes does not matter, as long as the codes are written in order. The key codes must be written for each Flash write or erase operation. Flash will be locked until the next system reset if the wrong codes are written or if a Flash operation is attempted before the codes have been written correctly.

Read:

When read, bits 1-0 indicate the current Flash lock state.

00: Flash is write/erase locked.

01: The first key code has been written (0xA5).

10: Flash is unlocked (writes/erases allowed).

11: Flash writes/erases disabled until the next reset.

SFR Definition 14.2. OSCICL: Internal H-F Oscillator Calibration

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
-	-	-	OSCCAL					Variable
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xB3

Bits4–0: OSCCAL: Oscillator Calibration Value
 These bits determine the internal H-F oscillator period. When set to 00000b, the oscillator operates at its fastest setting. When set to 11111b, the oscillator operates at its slowest setting. The contents of this register are factory calibrated to produce a 12 MHz internal oscillator frequency.

Note: The contents of this register are undefined when Clock Recovery is enabled. See Section “16.4. USB Clock Configuration” on page 166 for details on Clock Recovery.

14.2. Programmable Internal Low-Frequency (L-F) Oscillator

The C8051F340/1/2/3/4/5/8/9/C/D devices include a programmable internal oscillator which operates at a nominal frequency of 80 kHz. The low-frequency oscillator circuit includes a divider that can be changed to divide the clock by 1, 2, 4, or 8, using the OSCLD bits in the OSCLCN register (see SFR Definition 14.3). Additionally, the OSCLF bits (OSCLCN5:2) can be used to adjust the oscillator's output frequency.

14.2.1. Calibrating the Internal L-F Oscillator

Timers 2 and 3 include capture functions that can be used to capture the oscillator frequency, when running from a known time base. When either Timer 2 or Timer 3 is configured for L-F Oscillator Capture Mode, a falling edge (Timer 2) or rising edge (Timer 3) of the low-frequency oscillator's output will cause a capture event on the corresponding timer. As a capture event occurs, the current timer value (TMRnH:TMRnL) is copied into the timer reload registers (TMRnRLH:TMRnRLL). By recording the difference between two successive timer capture values, the low-frequency oscillator's period can be calculated. The OSCLF bits can then be adjusted to produce the desired oscillator period.

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SFR Definition 15.2. XBR1: Port I/O Crossbar Register 1

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
WEAKPUD	XBARE	T1E	T0E	ECIE	PCA0ME			00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xE2
<p>Bit7: WEAKPUD: Port I/O Weak Pull-up Disable. 0: Weak Pull-ups enabled (except for Ports whose I/O are configured as analog input or push-pull output). 1: Weak Pull-ups disabled.</p> <p>Bit6: XBARE: Crossbar Enable. 0: Crossbar disabled; all Port drivers disabled. 1: Crossbar enabled.</p> <p>Bit5: T1E: T1 Enable 0: T1 unavailable at Port pin. 1: T1 routed to Port pin.</p> <p>Bit4: T0E: T0 Enable 0: T0 unavailable at Port pin. 1: T0 routed to Port pin.</p> <p>Bit3: ECIE: PCA0 External Counter Input Enable 0: ECI unavailable at Port pin. 1: ECI routed to Port pin.</p> <p>Bits2–0: PCA0ME: PCA Module I/O Enable Bits. 000: All PCA I/O unavailable at Port pins. 001: CEX0 routed to Port pin. 010: CEX0, CEX1 routed to Port pins. 011: CEX0, CEX1, CEX2 routed to Port pins. 100: CEX0, CEX1, CEX2, CEX3 routed to Port pins. 101: CEX0, CEX1, CEX2, CEX3, CEX4 routed to Port pins. 110: Reserved. 111: Reserved.</p>								

SFR Definition 15.3. XBR2: Port I/O Crossbar Register 2

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
							URT1E	00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xE3
<p>Bits7–1: RESERVED: Always write to 0000000b</p> <p>Bit0: URT1E: UART1 I/O Output Enable (C8051F340/1/4/5/8/A/B Only) 0: UART1 I/O unavailable at Port pins. 1: UART1 TX1, RX1 routed to Port pins.</p>								

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SFR Definition 15.11. P1SKIP: Port1 Skip

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xD5

Bits7–0: P1SKIP[7:0]: Port1 Crossbar Skip Enable Bits.
These bits select Port pins to be skipped by the Crossbar Decoder. Port pins used as analog inputs (for ADC or Comparator) or used as special functions (VREF input, external oscillator circuit, CNVSTR input) should be skipped by the Crossbar.
0: Corresponding P1.n pin is not skipped by the Crossbar.
1: Corresponding P1.n pin is skipped by the Crossbar.

SFR Definition 15.12. P2: Port2 Latch

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
P2.7	P2.6	P2.5	P2.4	P2.3	P2.2	P2.1	P2.0	11111111
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: (bit addressable) 0xA0

Bits7–0: P2.[7:0]
Write - Output appears on I/O pins per Crossbar Registers (when XBARE = '1').
0: Logic Low Output.
1: Logic High Output (high impedance if corresponding P2MDOUT.n bit = 0).
Read - Always reads '0' if selected as analog input in register P2MDIN. Directly reads Port pin when configured as digital input.
0: P2.n pin is logic low.
1: P2.n pin is logic high.

SFR Definition 15.13. P2MDIN: Port2 Input Mode

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								11111111
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xF3

Bits7-0: Analog Input Configuration Bits for P2.7-P2.0 (respectively).
Port pins configured as analog inputs have their weak pull-up, digital driver, and digital receiver disabled.
0: Corresponding P2.n pin is configured as an analog input.
1: Corresponding P2.n pin is not configured as an analog input.

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by reads/writes of the USB0DAT register. See Figure 16.2.

Endpoint control/status registers are accessed by first writing the USB register INDEX with the target endpoint number. Once the target endpoint number is written to the INDEX register, the control/status registers associated with the target endpoint may be accessed. See the “Indexed Registers” section of Table 16.2 for a list of endpoint control/status registers.

Important Note: The USB clock must be active when accessing USB registers.

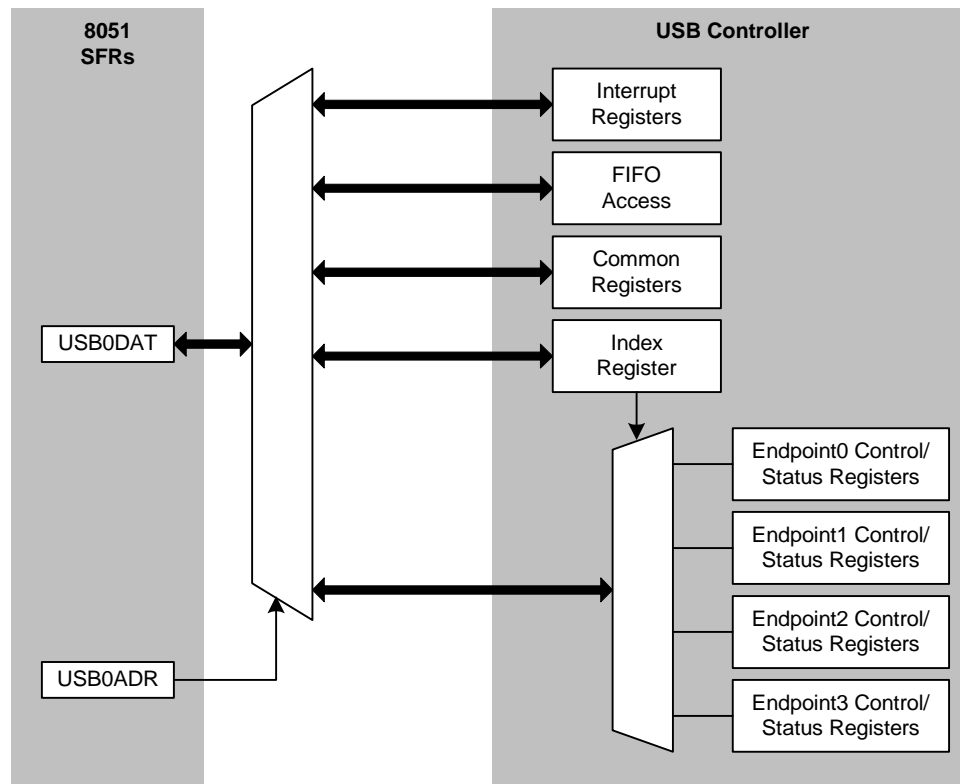


Figure 16.2. USB0 Register Access Scheme

The E0CNT register (USB Register Definition 16.18) holds the number of received data bytes in the Endpoint0 FIFO.

Hardware will automatically detect protocol errors and send a STALL condition in response. Firmware may force a STALL condition to abort the current transfer. When a STALL condition is generated, the STSTL bit will be set to '1' and an interrupt generated. The following conditions will cause hardware to generate a STALL condition:

1. The host sends an OUT token during a OUT data phase after the DATAEND bit has been set to '1'.
2. The host sends an IN token during an IN data phase after the DATAEND bit has been set to '1'.
3. The host sends a packet that exceeds the maximum packet size for Endpoint0.
4. The host sends a non-zero length DATA1 packet during the status phase of an IN transaction.
5. Firmware sets the SDSTL bit (E0CSR.5) to '1'.

16.10.1.Endpoint0 SETUP Transactions

All control transfers must begin with a SETUP packet. SETUP packets are similar to OUT packets, containing an 8-byte data field sent by the host. Any SETUP packet containing a command field of anything other than 8 bytes will be automatically rejected by USB0. An Endpoint0 interrupt is generated when the data from a SETUP packet is loaded into the Endpoint0 FIFO. Software should unload the command from the Endpoint0 FIFO, decode the command, perform any necessary tasks, and set the SOPRDY bit to indicate that it has serviced the OUT packet.

16.10.2.Endpoint0 IN Transactions

When a SETUP request is received that requires USB0 to transmit data to the host, one or more IN requests will be sent by the host. For the first IN transaction, firmware should load an IN packet into the Endpoint0 FIFO, and set the INPRDY bit (E0CSR.1). An interrupt will be generated when an IN packet is transmitted successfully. Note that no interrupt will be generated if an IN request is received before firmware has loaded a packet into the Endpoint0 FIFO. If the requested data exceeds the maximum packet size for Endpoint0 (as reported to the host), the data should be split into multiple packets; each packet should be of the maximum packet size excluding the last (residual) packet. If the requested data is an integer multiple of the maximum packet size for Endpoint0, the last data packet should be a zero-length packet signaling the end of the transfer. Firmware should set the DATAEND bit to '1' after loading into the Endpoint0 FIFO the last data packet for a transfer.

Upon reception of the first IN token for a particular control transfer, Endpoint0 is said to be in Transmit Mode. In this mode, only IN tokens should be sent by the host to Endpoint0. The SUEND bit (E0CSR.4) is set to '1' if a SETUP or OUT token is received while Endpoint0 is in Transmit Mode.

Endpoint0 will remain in Transmit Mode until any of the following occur:

1. USB0 receives an Endpoint0 SETUP or OUT token.
2. Firmware sends a packet less than the maximum Endpoint0 packet size.
3. Firmware sends a zero-length packet.

Firmware should set the DATAEND bit (E0CSR.3) to '1' when performing (2) and (3) above.

The SIE will transmit a NAK in response to an IN token if there is no packet ready in the IN FIFO (INPRDY = '0').

Writing '1' to INPRDY without writing any data to the endpoint FIFO will cause a zero-length packet to be transmitted upon reception of the next IN token.

A Bulk or Interrupt pipe can be shut down (or Halted) by writing '1' to the SDSTL bit (EINCSRL.4). While SDSTL = '1', hardware will respond to all IN requests with a STALL condition. Each time hardware generates a STALL condition, an interrupt will be generated and the STSTL bit (EINCSRL.5) set to '1'. The STSTL bit must be reset to '0' by firmware.

Hardware will automatically reset INPRDY to '0' when a packet slot is open in the endpoint FIFO. Note that if double buffering is enabled for the target endpoint, it is possible for firmware to load two packets into the IN FIFO at a time. In this case, hardware will reset INPRDY to '0' immediately after firmware loads the first packet into the FIFO and sets INPRDY to '1'. An interrupt will not be generated in this case; an interrupt will only be generated when a data packet is transmitted.

When firmware writes '1' to the FCDT bit (EINCSRH.3), the data toggle for each IN packet will be toggled continuously, regardless of the handshake received from the host. This feature is typically used by Interrupt endpoints functioning as rate feedback communication for Isochronous endpoints. When FCDT = '0', the data toggle bit will only be toggled when an ACK is sent from the host in response to an IN packet.

16.12.2.Endpoints1-3 IN Isochronous Mode

When the ISO bit (EINCSRH.6) is set to '1', the target endpoint operates in Isochronous (ISO) mode. Once an endpoint has been configured for ISO IN mode, the host will send one IN token (data request) per frame; the location of data within each frame may vary. Because of this, it is recommended that double buffering be enabled for ISO IN endpoints.

Hardware will automatically reset INPRDY (EINCSRL.0) to '0' when a packet slot is open in the endpoint FIFO. Note that if double buffering is enabled for the target endpoint, it is possible for firmware to load two packets into the IN FIFO at a time. In this case, hardware will reset INPRDY to '0' immediately after firmware loads the first packet into the FIFO and sets INPRDY to '1'. An interrupt will not be generated in this case; an interrupt will only be generated when a data packet is transmitted.

If there is not a data packet ready in the endpoint FIFO when USB0 receives an IN token from the host, USB0 will transmit a zero-length data packet and set the UNDRUN bit (EINCSRL.2) to '1'.

The ISO Update feature (see **Section 16.7**) can be useful in starting a double buffered ISO IN endpoint. If the host has already set up the ISO IN pipe (has begun transmitting IN tokens) when firmware writes the first data packet to the endpoint FIFO, the next IN token may arrive and the first data packet sent before firmware has written the second (double buffered) data packet to the FIFO. The ISO Update feature ensures that any data packet written to the endpoint FIFO will not be transmitted during the current frame; the packet will only be sent after a SOF signal has been received.

17.3.2. Clock Low Extension

SMBus provides a clock synchronization mechanism, similar to I2C, which allows devices with different speed capabilities to coexist on the bus. A clock-low extension is used during a transfer in order to allow slower slave devices to communicate with faster masters. The slave may temporarily hold the SCL line LOW to extend the clock low period, effectively decreasing the serial clock frequency.

17.3.3. SCL Low Timeout

If the SCL line is held low by a slave device on the bus, no further communication is possible. Furthermore, the master cannot force the SCL line high to correct the error condition. To solve this problem, the SMBus protocol specifies that devices participating in a transfer must detect any clock cycle held low longer than 25 ms as a “timeout” condition. Devices that have detected the timeout condition must reset the communication no later than 10 ms after detecting the timeout condition.

When the SMBTOE bit in SMB0CF is set, Timer 3 is used to detect SCL low timeouts. Timer 3 is forced to reload when SCL is high, and allowed to count when SCL is low. With Timer 3 enabled and configured to overflow after 25 ms (and SMBTOE set), the Timer 3 interrupt service routine can be used to reset (disable and re-enable) the SMBus in the event of an SCL low timeout.

17.3.4. SCL High (SMBus Free) Timeout

The SMBus specification stipulates that if the SCL and SDA lines remain high for more than 50 μ s, the bus is designated as free. When the SMBFTE bit in SMB0CF is set, the bus will be considered free if SCL and SDA remain high for more than 10 SMBus clock source periods. If the SMBus is waiting to generate a Master START, the START will be generated following this timeout. Note that a clock source is required for free timeout detection, even in a slave-only implementation.

17.4. Using the SMBus

The SMBus can operate in both Master and Slave modes. The interface provides timing and shifting control for serial transfers; higher level protocol is determined by user software. The SMBus interface provides the following application-independent features:

- Byte-wise serial data transfers
- Clock signal generation on SCL (Master Mode only) and SDA data synchronization
- Timeout/bus error recognition, as defined by the SMB0CF configuration register
- START/STOP timing, detection, and generation
- Bus arbitration
- Interrupt generation
- Status information

SMBus interrupts are generated for each data byte or slave address that is transferred. When transmitting, this interrupt is generated after the ACK cycle so that software may read the received ACK value; when receiving data, this interrupt is generated before the ACK cycle so that software may define the outgoing ACK value. See **Section “17.5. SMBus Transfer Modes” on page 198** for more details on transmission sequences.

Interrupts are also generated to indicate the beginning of a transfer when a master (START generated), or the end of a transfer when a slave (STOP detected). Software should read the SMB0CN (SMBus Control register) to find the cause of the SMBus interrupt. The SMB0CN register is described in **Section “17.4.2. SMB0CN Control Register” on page 195**; Table 17.4 provides a quick SMB0CN decoding reference.

20.3. SPI0 Slave Mode Operation

When SPI0 is enabled and not configured as a master, it will operate as a SPI slave. As a slave, bytes are shifted in through the MOSI pin and out through the MISO pin by a master device controlling the SCK signal. A bit counter in the SPI0 logic counts SCK edges. When 8 bits have been shifted through the shift register, the SPIF flag is set to logic 1, and the byte is copied into the receive buffer. Data is read from the receive buffer by reading SPI0DAT. A slave device cannot initiate transfers. Data to be transferred to the master device is pre-loaded into the shift register by writing to SPI0DAT. Writes to SPI0DAT are double-buffered, and are placed in the transmit buffer first. If the shift register is empty, the contents of the transmit buffer will immediately be transferred into the shift register. When the shift register already contains data, the SPI will load the shift register with the transmit buffer's contents after the last SCK edge of the next (or current) SPI transfer.

When configured as a slave, SPI0 can be configured for 4-wire or 3-wire operation. The default, 4-wire slave mode, is active when NSSMD1 (SPI0CN.3) = 0 and NSSMD0 (SPI0CN.2) = 1. In 4-wire mode, the NSS signal is routed to a port pin and configured as a digital input. SPI0 is enabled when NSS is logic 0, and disabled when NSS is logic 1. The bit counter is reset on a falling edge of NSS. Note that the NSS signal must be driven low at least 2 system clocks before the first active edge of SCK for each byte transfer. Figure 20.4 shows a connection diagram between two slave devices in 4-wire slave mode and a master device.

3-wire slave mode is active when NSSMD1 (SPI0CN.3) = 0 and NSSMD0 (SPI0CN.2) = 0. NSS is not used in this mode, and is not mapped to an external port pin through the crossbar. Since there is no way of uniquely addressing the device in 3-wire slave mode, SPI0 must be the only slave device present on the bus. It is important to note that in 3-wire slave mode there is no external means of resetting the bit counter that determines when a full byte has been received. The bit counter can only be reset by disabling and re-enabling SPI0 with the SPIEN bit. Figure 20.3 shows a connection diagram between a slave device in 3-wire slave mode and a master device.

20.4. SPI0 Interrupt Sources

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

Note that all of the following bits must be cleared by software.

1. 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.
2. 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.
3. 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.
4. 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.

20.5. Serial Clock Timing

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 20.5. For slave mode, the clock and data relationships are shown in Figure 20.6 and Figure 20.7.

The SPI0 Clock Rate Register (SPI0CKR) as shown in SFR Definition 20.3 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.

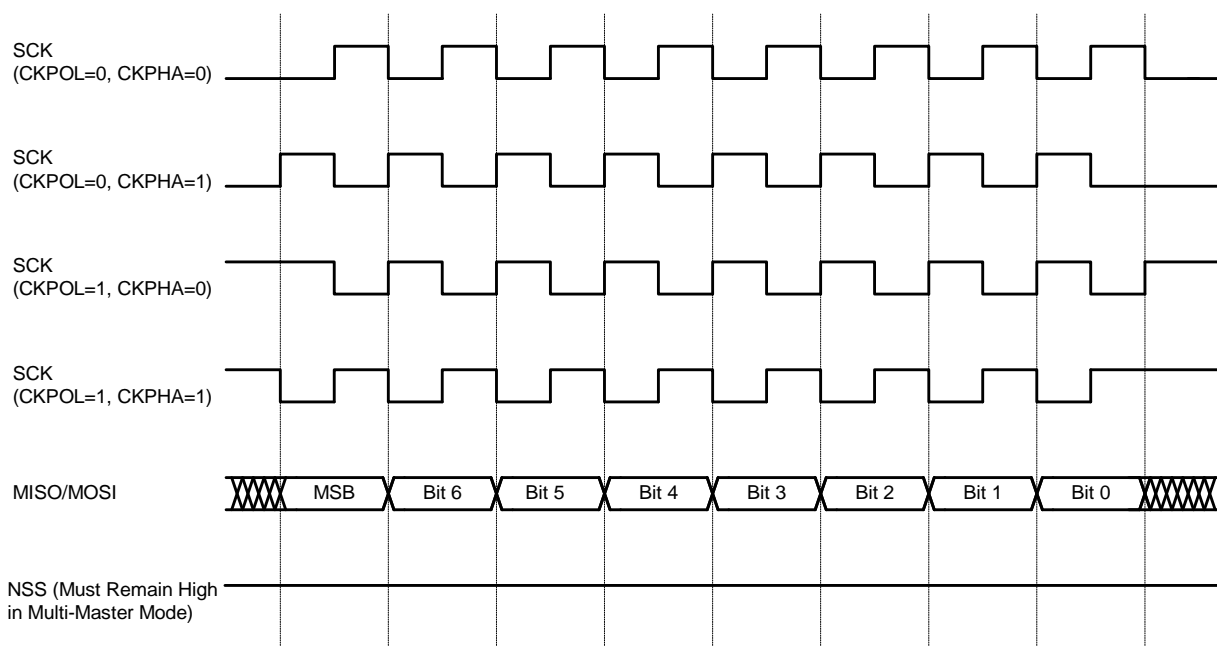


Figure 20.5. Master Mode Data/Clock Timing

SFR Definition 20.2. SPI0CN: SPI0 Control

R/W	R/W	R/W	R/W	R/W	R/W	R	R/W	Reset Value
SPIF	WCOL	MODF	RXOVRN	NSSMD1	NSSMD0	TXBMT	SPIEN	00000110
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Bit Addressable
SFR Address: 0xF8								
<p>Bit 7: SPIF: SPI0 Interrupt Flag. This bit is set to logic 1 by hardware at the end of a data transfer. If interrupts are enabled, setting this bit causes the CPU to vector to the SPI0 interrupt service routine. This bit is not automatically cleared by hardware. It must be cleared by software.</p> <p>Bit 6: WCOL: Write Collision Flag. This bit 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. It must be cleared by software.</p> <p>Bit 5: MODF: Mode Fault Flag. This bit is set to logic 1 by hardware (and generates a SPI0 interrupt) when a master mode collision is detected (NSS is low, MSTEN = 1, and NSSMD[1:0] = 01). This bit is not automatically cleared by hardware. It must be cleared by software.</p> <p>Bit 4: RXOVRN: Receive Overrun Flag (Slave Mode only). This bit is set to logic 1 by hardware (and generates a SPI0 interrupt) when the receive buffer still holds unread data from a previous transfer and the last bit of the current transfer is shifted into the SPI0 shift register. This bit is not automatically cleared by hardware. It must be cleared by software.</p> <p>Bits 3–2: NSSMD1–NSSMD0: Slave Select Mode. Selects between the following NSS operation modes: (See Section “20.2. SPI0 Master Mode Operation” on page 224 and Section “20.3. SPI0 Slave Mode Operation” on page 226). 00: 3-Wire Slave or 3-wire Master Mode. NSS signal is not routed to a port pin. 01: 4-Wire Slave or Multi-Master Mode (Default). NSS is always an input to the device. 1x: 4-Wire Single-Master Mode. NSS signal is mapped as an output from the device and will assume the value of NSSMD0.</p> <p>Bit 1: TXBMT: Transmit Buffer Empty. This bit will be set to logic 0 when new data has been written to the transmit buffer. When data in the transmit buffer is transferred to the SPI shift register, this bit will be set to logic 1, indicating that it is safe to write a new byte to the transmit buffer.</p> <p>Bit 0: SPIEN: SPI0 Enable. This bit enables/disables the SPI. 0: SPI disabled. 1: SPI enabled.</p>								

C8051F340/1/2/3/4/5/6/7/8/9/A/B/C/D

SFR Definition 21.9. TMR2RLL: Timer 2 Reload Register Low Byte

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xCA

Bits 7–0: TMR2RLL: Timer 2 Reload Register Low Byte.
TMR2RLL holds the low byte of the reload value for Timer 2 when operating in auto-reload mode, or the captured value of the TMR2L register in capture mode.

SFR Definition 21.10. TMR2RLH: Timer 2 Reload Register High Byte

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xCB

Bits 7–0: TMR2RLH: Timer 2 Reload Register High Byte.
The TMR2RLH holds the high byte of the reload value for Timer 2 when operating in auto-reload mode, or the captured value of the TMR2H register in capture mode.

SFR Definition 21.11. TMR2L: Timer 2 Low Byte

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xCC

Bits 7–0: TMR2L: Timer 2 Low Byte.
In 16-bit mode, the TMR2L register contains the low byte of the 16-bit Timer 2. In 8-bit mode, TMR2L contains the 8-bit low byte timer value.

SFR Definition 21.12. TMR2H Timer 2 High Byte

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
								00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xCD

Bits 7–0: TMR2H: Timer 2 High Byte.
In 16-bit mode, the TMR2H register contains the high byte of the 16-bit Timer 2. In 8-bit mode, TMR2H contains the 8-bit high byte timer value.

SFR Definition 22.3. PCA0CPMn: PCA Capture/Compare Mode

R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	Reset Value
PWM16n	ECOMn	CAPPn	CAPNn	MATn	TOGn	PWMn	ECCFn	00000000
Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	SFR Address: 0xDA, 0xDB, 0xDC, 0xDD, 0xDE
PCA0CPMn Address: PCA0CPM0 = 0xDA (n = 0), PCA0CPM1 = 0xDB (n = 1), PCA0CPM2 = 0xDC (n = 2), PCA0CPM3 = 0xDD (n = 3), PCA0CPM4 = 0xDE (n = 4)								
Bit7:	PWM16n: 16-bit Pulse Width Modulation Enable. This bit selects 16-bit mode when Pulse Width Modulation mode is enabled (PWMn = 1). 0: 8-bit PWM selected. 1: 16-bit PWM selected.							
Bit6:	ECOMn: Comparator Function Enable. This bit enables/disables the comparator function for PCA module n. 0: Disabled. 1: Enabled.							
Bit5:	CAPPn: Capture Positive Function Enable. This bit enables/disables the positive edge capture for PCA module n. 0: Disabled. 1: Enabled.							
Bit4:	CAPNn: Capture Negative Function Enable. This bit enables/disables the negative edge capture for PCA module n. 0: Disabled. 1: Enabled.							
Bit3:	MATn: Match Function Enable. This bit enables/disables the match function for PCA module n. When enabled, matches of the PCA counter with a module's capture/compare register cause the CCFn bit in PCA0MD register to be set to logic 1. 0: Disabled. 1: Enabled.							
Bit2:	TOGn: Toggle Function Enable. This bit enables/disables the toggle function for PCA module n. When enabled, matches of the PCA counter with a module's capture/compare register cause the logic level on the CEXn pin to toggle. If the PWMn bit is also set to logic 1, the module operates in Frequency Output Mode. 0: Disabled. 1: Enabled.							
Bit1:	PWMn: Pulse Width Modulation Mode Enable. This bit enables/disables the PWM function for PCA module n. When enabled, a pulse width modulated signal is output on the CEXn pin. 8-bit PWM is used if PWM16n is cleared; 16-bit mode is used if PWM16n is set to logic 1. If the TOGn bit is also set, the module operates in Frequency Output Mode. 0: Disabled. 1: Enabled.							
Bit0:	ECCFn: Capture/Compare Flag Interrupt Enable. This bit sets the masking of the Capture/Compare Flag (CCFn) interrupt. 0: Disable CCFn interrupts. 1: Enable a Capture/Compare Flag interrupt request when CCFn is set.							