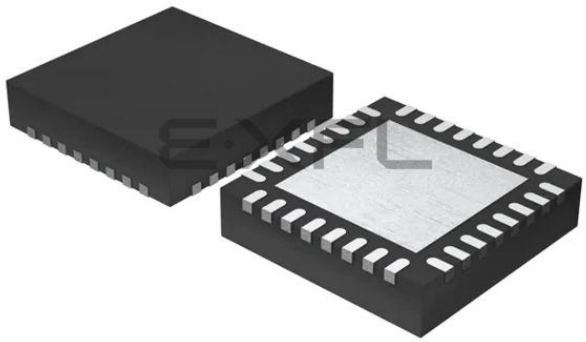

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	8051
Core Size	8-Bit
Speed	50MHz
Connectivity	SMBus (2-Wire/I²C), CANbus, LINbus, SPI, UART/USART
Peripherals	POR, PWM, Temp Sensor, WDT
Number of I/O	25
Program Memory Size	96KB (96K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8.25K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.25V
Data Converters	A/D 25x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	32-VFQFN Exposed Pad
Supplier Device Package	32-QFN (5x5)
Purchase URL	https://www.e-xfl.com/product-detail/silicon-labs/c8051f586-im

Table 5.11. Temperature Sensor Electrical Characteristics

VDDA = 1.8 to 2.75 V, –40 to +125 °C unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Units
Linearity		—	± 0.1	—	°C
Slope		—	3.33	—	mV/°C
Slope Error*		—	100	—	µV/°C
Offset	Temp = 0 °C	—	856	—	mV
Offset Error*	Temp = 0 °C	—	12	—	mV
Power Supply Current		—	22	—	µA
Tracking Time		12	—	—	µs
***Note:** Represents one standard deviation from the mean.					

Table 5.12. Voltage Reference Electrical Characteristics

VDDA = 1.8 to 2.75 V, –40 to +125 °C unless otherwise specified.

Parameter	Conditions	Min	Typ	Max	Units
Internal Reference (REFBE = 1)					
Output Voltage	25 °C ambient (REFLV = 0)	1.45	1.50	1.55	V
	25 °C ambient (REFLV = 1), V_{DD} = 2.6 V	2.15	2.20	2.25	
VREF Short-Circuit Current		—	5	10	mA
VREF Temperature Coefficient		—	22	—	ppm/°C
Power Consumption	Internal	—	30	50	µA
Load Regulation	Load = 0 to 200 µA to AGND	—	3	—	µV/µA
VREF Turn-on Time 1	4.7 µF and 0.1 µF bypass	—	1.5	—	ms
VREF Turn-on Time 2	0.1 µF bypass	—	46	—	µs
Power Supply Rejection		—	1.2	—	mV/V
External Reference (REFBE = 0)					
Input Voltage Range		1.5	—	V_{DDA}	V
Input Current	Sample Rate = 200 ksps; VREF = 1.5 V	—	2.5	—	µA
Power Specifications					
Reference Bias Generator	REFBE = 1 or TEMPE = 1	—	21	40	µA

6.5. ADC0 Analog Multiplexer

ADC0 includes an analog multiplexer to enable multiple analog input sources. Any of the following may be selected as an input: P0.0–P3.7, the on-chip temperature sensor, the core power supply (V_{DD}), or ground (GND). **ADC0 is single-ended and all signals measured are with respect to GND.** The ADC0 input channels are selected using the ADC0MX register as described in SFR Definition 6.13.

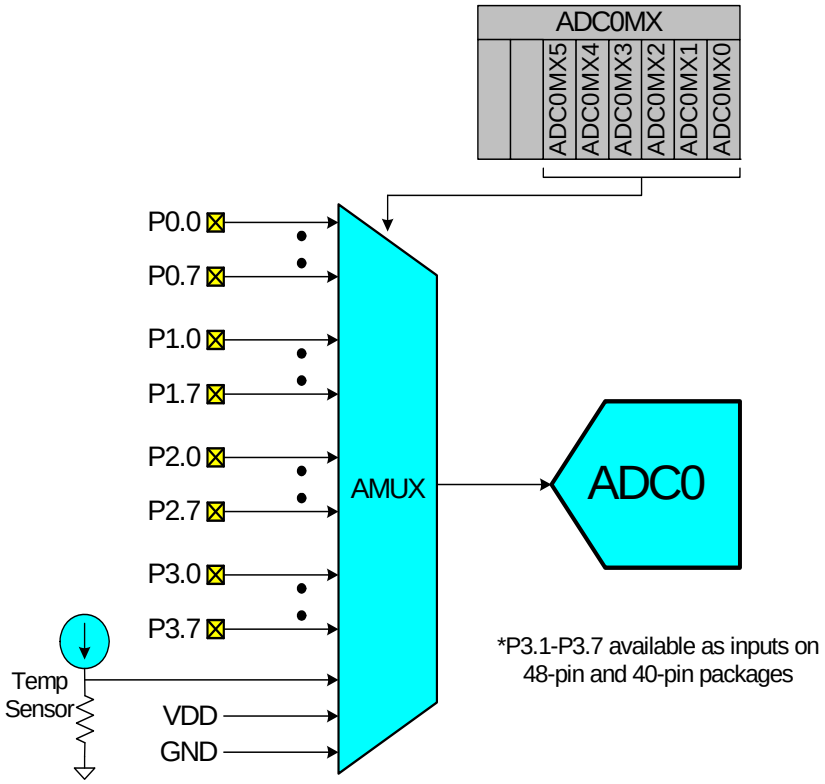

Figure 6.8. ADC0 Multiplexer Block Diagram

Important Note About ADC0 Input Configuration: Port pins selected as ADC0 inputs should be configured as analog inputs, and should be skipped by the Digital Crossbar. To configure a Port pin for analog input, set to 0 the corresponding bit in register PnMDIN. To force the Crossbar to skip a Port pin, set to 1 the corresponding bit in register PnSKIP. See Section “20. Port Input/Output” on page 188 for more Port I/O configuration details.

SFR Definition 6.13. ADC0MX: ADC0 Channel Select

Bit	7	6	5	4	3	2	1	0
Name			ADC0MX[5:0]					
Type	R	R	R/W					
Reset	0	0	1	1	1	1	1	1

SFR Address = 0xBB; SFR Page = 0x00;

Bit	Name	Function
7:6	Unused	Read = 00b; Write = Don't Care.
5:0	AMX0P[5:0]	**AMUX0 Positive Input Selection.** 000000: P0.0 000001: P0.1 000010: P0.2 000011: P0.3 000100: P0.4 000101: P0.5 000110: P0.6 000111: P0.7 001000: P1.0 001001: P1.1 001010: P1.2 001011: P1.3 001100: P1.4 001101: P1.5 001110: P1.6 001111: P1.7 010000: P2.0 010001: P2.1 010010: P2.2 010011: P2.3 010100: P2.4 010101: P2.5 010110: P2.6 010111: P2.7 011000: P3.0 011001: P3.1 (Available on 48-pin and 40-pin package devices) 011010: P3.2 (Available on 48-pin and 40-pin package devices) 011011: P3.3 (Available on 48-pin and 40-pin package devices) 011100: P3.4 (Available on 48-pin and 40-pin package devices) 011101: P3.5 (Available on 48-pin and 40-pin package devices) 011110: P3.6 (Available on 48-pin and 40-pin package devices) 011111: P3.7 (Available on 48-pin and 40-pin package devices) 100000–101111: Reserved 110000: Temp Sensor 110001: V_{DD} 110010–111111: GND

SFR Definition 12.1. PSBANK: Program Space Bank Select

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

SFR Address = 0xF5; SFR Page = All Pages

Bit	Name	Function
7:6	Reserved	Read = 00b, Must Write = 00b.
5:4	COBANK[1:0]	**Constant Operations Bank Select.** These bits select which Flash bank is targeted during constant operations (MOVC and Flash MOVX) involving address 0x8000 to 0xFFFF. 00: Constant Operations Target Bank 0 (note that Bank 0 is also mapped between 0x0000 to 0x7FFF). 01: Constant operations target Bank 1. 10: Constant operations target Bank 2. 11: Constant operations target Bank 3.
3:2	Reserved	Read = 00b, Must Write = 00b.
1:0	IFBANK[1:0]	**Instruction Fetch Operations Bank Select.** These bits select which Flash bank is used for instruction fetches involving address 0x8000 to 0xFFFF. These bits can only be changed from code in Bank 0. 00: Instructions fetch from Bank 0 (note that Bank 0 is also mapped between 0x0000 to 0x7FFF). 01: Instructions fetch from Bank 1. 10: Instructions fetch from Bank 2. 11: Instructions fetch from Bank 3.
Note: COBANK[1:0] and IFBANK[1:0] should not be set to select Bank 3 (11b) on the C8051F584/5/6/7-F590/1 devices.		

12.1.1. MOVX Instruction and Program Memory

The MOVX instruction in an 8051 device is typically used to access external data memory. On the C8051F58x/F59x devices, the MOVX instruction is normally used to read and write on-chip XRAM, but can be re-configured to write and erase on-chip Flash memory space. MOVC instructions are always used to read Flash memory, while MOVX write instructions are used to erase and write Flash. This Flash access feature provides a mechanism for the C8051F58x/F59x to update program code and use the program memory space for non-volatile data storage. Refer to Section “15. Flash Memory” on page 138 for further details.

12.2. Data Memory

The C8051F58x/F59x devices include 8448 bytes of RAM data memory. 256 bytes of this memory is mapped into the internal RAM space of the 8051. The other 8192 bytes of this memory is on-chip “external” memory. The data memory map is shown in Figure 12.1 for reference.

SFR Definition 14.2. IP: Interrupt Priority

Bit	7	6	5	4	3	2	1	0
Name		PSPI0	PT2	PS0	PT1	PX1	PT0	PX0
Type	R	R/W	R/W	R/W	R/W	R/W	R/W	R/W
Reset	1	0	0	0	0	0	0	0

SFR Address = 0xB8; Bit-Addressable; SFR Page = All Pages

Bit	Name	Function
7	Unused	Read = 1b, Write = Don't Care.
6	PSPI0	**Serial Peripheral Interface (SPI0) Interrupt Priority Control.** This bit sets the priority of the SPI0 interrupt. 0: SPI0 interrupt set to low priority level. 1: SPI0 interrupt set to high priority level.
5	PT2	**Timer 2 Interrupt Priority Control.** This bit sets the priority of the Timer 2 interrupt. 0: Timer 2 interrupt set to low priority level. 1: Timer 2 interrupt set to high priority level.
4	PS0	**UART0 Interrupt Priority Control.** This bit sets the priority of the UART0 interrupt. 0: UART0 interrupt set to low priority level. 1: UART0 interrupt set to high priority level.
3	PT1	**Timer 1 Interrupt Priority Control.** This bit sets the priority of the Timer 1 interrupt. 0: Timer 1 interrupt set to low priority level. 1: Timer 1 interrupt set to high priority level.
2	PX1	**External Interrupt 1 Priority Control.** This bit sets the priority of the External Interrupt 1 interrupt. 0: External Interrupt 1 set to low priority level. 1: External Interrupt 1 set to high priority level.
1	PT0	**Timer 0 Interrupt Priority Control.** This bit sets the priority of the Timer 0 interrupt. 0: Timer 0 interrupt set to low priority level. 1: Timer 0 interrupt set to high priority level.
0	PX0	**External Interrupt 0 Priority Control.** This bit sets the priority of the External Interrupt 0 interrupt. 0: External Interrupt 0 set to low priority level. 1: External Interrupt 0 set to high priority level.

18.6.1.3. 8-bit MOVX with Bank Select: EMI0CF[4:2] = 110

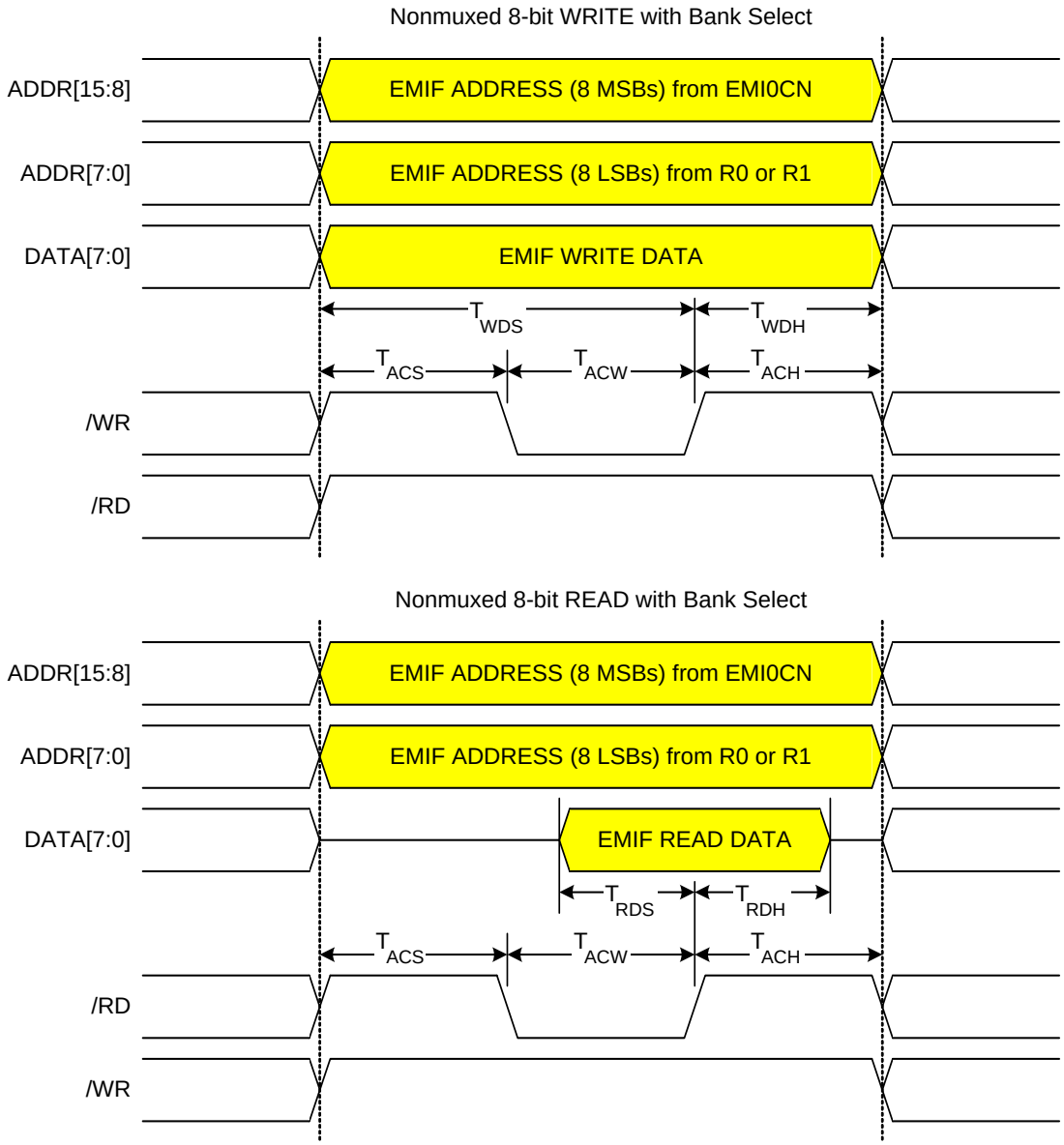

Figure 18.6. Non-multiplexed 8-bit MOVX with Bank Select Timing

SFR Definition 19.5. CLKMUL: Clock Multiplier

Bit	7	6	5	4	3	2	1	0
Name	MULEN	MULINIT	MULRDY	MULDIV[2:0]			MULSEL[1:0]	
Type	R/W	R/W	R	R/W			R/W	
Reset	0	0	0	0	0	0	0	0

SFR Address = 0x97; SFR Page = 0x0F;

Bit	Name	Function
7	MULEN	**Clock Multiplier Enable.** 0: Clock Multiplier disabled. 1: Clock Multiplier enabled.
6	MULINIT	**Clock Multiplier Initialize.** This bit is 0 when the Clock Multiplier is enabled. Once enabled, writing a 1 to this bit will initialize the Clock Multiplier. The MULRDY bit reads 1 when the Clock Multiplier is stabilized.
5	MULRDY	**Clock Multiplier Ready.** 0: Clock Multiplier is not ready. 1: Clock Multiplier is ready (PLL is locked).
4:2	MULDIV[2:0]	**Clock Multiplier Output Scaling Factor.** 000: Clock Multiplier Output scaled by a factor of 1. 001: Clock Multiplier Output scaled by a factor of 1. 010: Clock Multiplier Output scaled by a factor of 1. 011: Clock Multiplier Output scaled by a factor of 2/3*. 100: Clock Multiplier Output scaled by a factor of 2/4 (1/2). 101: Clock Multiplier Output scaled by a factor of 2/5*. 110: Clock Multiplier Output scaled by a factor of 2/6 (1/3). 111: Clock Multiplier Output scaled by a factor of 2/7*. ***Note:** The Clock Multiplier output duty cycle is not 50% for these settings.
1:0	MULSEL[1:0]	**Clock Multiplier Input Select.** These bits select the clock supplied to the Clock Multiplier

MULSEL[1:0]	Selected Input Clock	Clock Multiplier Output for MULDIV[2:0] = 000b
00	Internal Oscillator	Internal Oscillator x 2
01	External Oscillator	External Oscillator x 2
10	Internal Oscillator	Internal Oscillator x 4
11	External Oscillator	External Oscillator x 4

Notes: The maximum system clock is 50 MHz, and so the Clock Multiplier output should be scaled accordingly. If Internal Oscillator x 2 or External Oscillator x 2 is selected using the MULSEL bits, MULDIV[2:0] is ignored.

19.4. External Oscillator Drive Circuit

The external oscillator circuit may drive an external crystal, ceramic resonator, capacitor, or RC network. A CMOS clock may also provide a clock input. For a crystal or ceramic resonator configuration, the crystal/resonator must be wired across the XTAL1 and XTAL2 pins as shown in Option 1 of Figure 19.1. A 10 MΩ resistor also must be wired across the XTAL2 and XTAL1 pins for the crystal/resonator configuration. In RC, capacitor, or CMOS clock configuration, the clock source should be wired to the XTAL2 pin as shown in Option 2, 3, or 4 of Figure 19.1. The type of external oscillator must be selected in the OSCXCN register, and the frequency control bits (XFCN) must be selected appropriately (see SFR Definition 19.6).

Important Note on External Oscillator Usage: Port pins must be configured when using the external oscillator circuit. When the external oscillator drive circuit is enabled in crystal/resonator mode, Port pins P0.2 and P0.3 are used as XTAL1 and XTAL2 respectively. When the external oscillator drive circuit is enabled in capacitor, RC, or CMOS clock mode, Port pin P0.3 is used as XTAL2. The Port I/O Crossbar should be configured to skip the Port pins used by the oscillator circuit; see Section “20.3. Priority Crossbar Decoder” on page 192 for Crossbar configuration. Additionally, when using the external oscillator circuit in crystal/resonator, capacitor, or RC mode, the associated Port pins should be configured as **analog inputs**. In CMOS clock mode, the associated pin should be configured as a **digital input**. See Section “20.4. Port I/O Initialization” on page 195 for details on Port input mode selection.

19.4.1. External Crystal Example

If a crystal or ceramic resonator is used as an external oscillator source for the MCU, the circuit should be configured as shown in Figure 19.1, Option 1. The External Oscillator Frequency Control value (XFCN) should be chosen from the Crystal column of the table in SFR Definition 19.6 (OSCXCN register). For example, an 11.0592 MHz crystal requires an XFCN setting of 111b and a 32.768 kHz Watch Crystal requires an XFCN setting of 001b. After an external 32.768 kHz oscillator is stabilized, the XFCN setting can be switched to 000 to save power. It is recommended to enable the missing clock detector before switching the system clock to any external oscillator source.

Note: Small surface mount crystals can have maximum drive level specifications that are exceeded by the above XFCN recommendations. In these cases, a software-controlled startup sequence may be used to reliably start the crystal using a higher XFCN setting, and then lowering the XFCN setting once the oscillator has started to reduce the drive level and prevent damage or premature aging of the crystal. In all cases, the drive level should be measured to ensure that the crystal is being driven within its operational guidelines as part of robust oscillator system design. Contact technical support for additional details and recommendations if using surface mount crystals with these devices.

When the crystal oscillator is first enabled, the oscillator amplitude detection circuit requires a settling time to achieve proper bias. Introducing a delay of 1 ms between enabling the oscillator and checking the XTLVLD bit will prevent a premature switch to the external oscillator as the system clock. Switching to the external oscillator before the crystal oscillator has stabilized can result in unpredictable behavior. The recommended procedure is:

1. Force XTAL1 and XTAL2 to a high state. This involves enabling the Crossbar and writing 1 to the port pins associated with XTAL1 and XTAL2.
2. Configure XTAL1 and XTAL2 as analog inputs using.
3. Enable the external oscillator.
4. Wait at least 1 ms.
5. Poll for XTLVLD => 1.
6. Enable the Missing Clock Detector.
7. Switch the system clock to the external oscillator.

Important Note on External Crystals: Crystal oscillator circuits are quite sensitive to PCB layout. The crystal should be placed as close as possible to the XTAL pins on the device. The traces should be as short as possible and shielded with ground plane from any other traces which could introduce noise or interference.

The capacitors shown in the external crystal configuration provide the load capacitance required by the crystal for correct oscillation. These capacitors are "in series" as seen by the crystal and "in parallel" with the stray capacitance of the XTAL1 and XTAL2 pins.

Note: The desired load capacitance depends upon the crystal and the manufacturer. Refer to the crystal data sheet when completing these calculations.

For example, a tuning-fork crystal of 32.768 kHz with a recommended load capacitance of 12.5 pF should use the configuration shown in Figure 19.1, Option 1. The total value of the capacitors and the stray capacitance of the XTAL pins should equal 25 pF. With a stray capacitance of 3 pF per pin, the 22 pF capacitors yield an equivalent capacitance of 12.5 pF across the crystal, as shown in Figure 19.3.

SFR Definition 20.22. P2MDIN: Port 2 Input Mode

Bit	7	6	5	4	3	2	1	0
Name	P2MDIN[7:0]							
Type	R/W							
Reset	1	1	1	1	1	1	1	1

SFR Address = 0xF3; SFR Page = 0x0F

Bit	Name	Function
7:0	P2MDIN[7:0]	**Analog Configuration Bits for P2.7–P2.0 (respectively).** Port pins configured for analog mode have their weak pull-up and digital receiver disabled. For analog mode, the pin also needs to be configured for open-drain mode in the P2MDOUT register. 0: Corresponding P2.n pin is configured for analog mode. 1: Corresponding P2.n pin is not configured for analog mode.

SFR Definition 20.23. P2MDOUT: Port 2 Output Mode

Bit	7	6	5	4	3	2	1	0
Name	P2MDOUT[7:0]							
Type	R/W							
Reset	0	0	0	0	0	0	0	0

SFR Address = 0xA6; SFR Page = 0x0F

Bit	Name	Function
7:0	P2MDOUT[7:0]	**Output Configuration Bits for P2.7–P2.0 (respectively).** These bits are ignored if the corresponding bit in register P2MDIN is logic 0. 0: Corresponding P2.n Output is open-drain. 1: Corresponding P2.n Output is push-pull.

SFR Definition 20.30. P4MDOUT: Port 4 Output Mode

Bit	7	6	5	4	3	2	1	0
Name	P4MDOUT[7:0]							
Type	R/W							
Reset	0	0	0	0	0	0	0	0

SFR Address = 0xAF; SFR Page = 0x0F

Bit	Name	Function
7:0	P4MDOUT[7:0]	**Output Configuration Bits for P4.7–P4.0 (respectively).** 0: Corresponding P4.n Output is open-drain. 1: Corresponding P4.n Output is push-pull.

Note: Port 4.0 is only available on the 48-pin and 40-pin packages.; P4.1-P4.7 is only available on the 48-pin packages.

21. Local Interconnect Network (LIN0)

Important Note: This chapter assumes an understanding of the Local Interconnect Network (LIN) protocol. For more information about the LIN protocol, including specifications, please refer to the LIN consortium (http://www.lin-subbus.org).

LIN is an asynchronous, serial communications interface used primarily in automotive networks. The Silicon Laboratories LIN controller is compliant to the 2.1 Specification, implements a complete hardware LIN interface and includes the following features:

- Selectable Master and Slave modes.
- Automatic baud rate option in slave mode.
- The internal oscillator is accurate to within 0.5% of 24 MHz across the entire temperature range and for VDD voltages greater than or equal to the minimum output of the on-chip voltage regulator, so an external oscillator is not necessary for master mode operation for most systems.

Note: The minimum system clock (SYSCLK) required when using the LIN controller is 8 MHz.

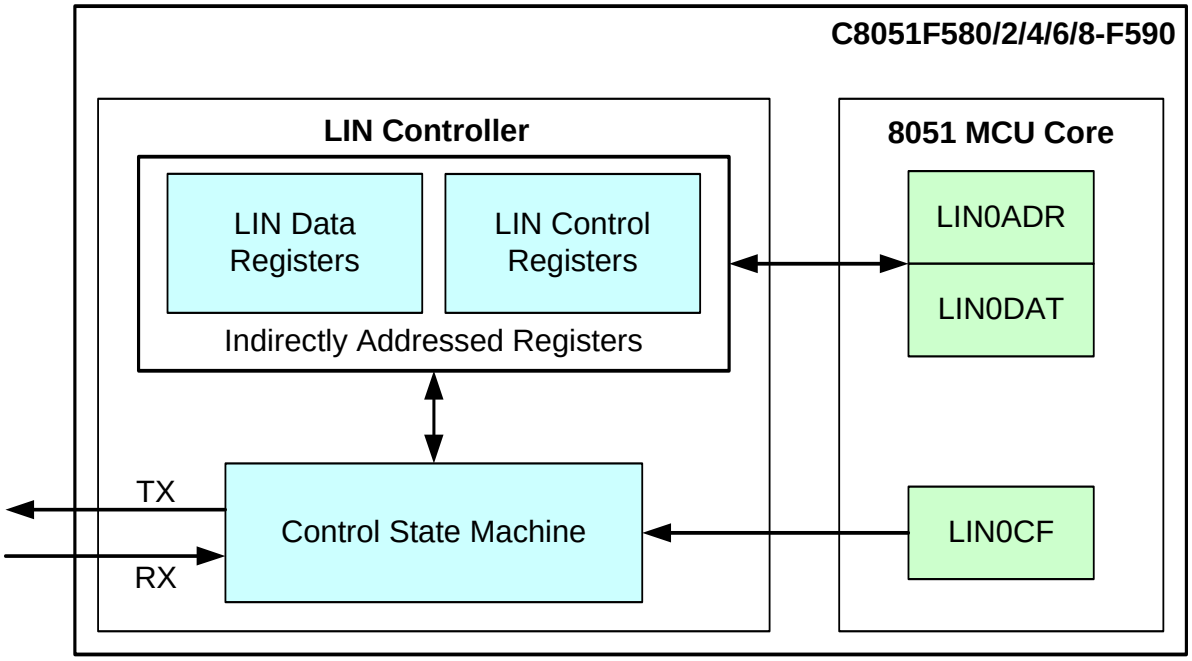

Figure 21.1. LIN Block Diagram

The LIN controller has four main components:

- LIN Access Registers—Provide the interface between the MCU core and the LIN controller.
- LIN Data Registers—Where transmitted and received message data bytes are stored.
- LIN Control Registers—Control the functionality of the LIN interface.
- Control State Machine and Bit Streaming Logic—Contains the hardware that serializes messages and controls the bus timing of the controller.

Table 21.2. Manual Baud Rate Parameters Examples

	Baud (bits/sec)														
	20 K			19.2 K			9.6 K			4.8 K			1 K		
SYSCLK (MHz)	Mult.	Pres.	Div.	Mult.	Pres.	Div.	Mult.	Pres.	Div.	Mult.	Pres.	Div.	Mult.	Pres.	Div.
25	0	1	312	0	1	325	1	1	325	3	1	325	19	1	312
24.5	0	1	306	0	1	319	1	1	319	3	1	319	19	1	306
24	0	1	300	0	1	312	1	1	312	3	1	312	19	1	300
22.1184	0	1	276	0	1	288	1	1	288	3	1	288	19	1	276
16	0	1	200	0	1	208	1	1	208	3	1	208	19	1	200
12.25	0	0	306	0	0	319	1	0	319	3	0	319	19	0	306
12	0	0	300	0	0	312	1	0	312	3	0	312	19	0	300
11.0592	0	0	276	0	0	288	1	0	288	3	0	288	19	0	276
8	0	0	200	0	0	208	1	0	208	3	0	208	19	0	200

21.2.4. Baud Rate Calculations—Automatic Mode

If the LIN controller is configured for slave mode, only the prescaler and divider need to be calculated:

$$\text{prescaler} = \ln\left[\frac{\text{SYSCLK}}{4000000}\right] \times \frac{1}{\ln 2} - 1$$

$$\text{divider} = \frac{\text{SYSCLK}}{2^{(\text{prescaler}+1)} \times 20000}$$

The following example calculates the values of these variables for a 24 MHz system clock:

$$\text{prescaler} = \ln\left[\frac{24000000}{4000000}\right] \times \frac{1}{\ln 2} - 1 = 1.585 \cong 1$$

$$\text{divider} = \frac{24000000}{2^{(1+1)} \times 20000} = 300$$

Table 21.3 presents some typical values of system clock and baud rate along with their factors.

24. UART0

UART0 is an asynchronous, full duplex serial port offering a variety of data formatting options. A dedicated baud rate generator with a 16-bit timer and selectable prescaler is included, which can generate a wide range of baud rates (details in Section “24.1. Baud Rate Generator” on page 256). A received data FIFO allows UART0 to receive up to three data bytes before data is lost and an overflow occurs.

UART0 has six associated SFRs. Three are used for the Baud Rate Generator (SBCON0, SBRLH0, and SBRLL0), two are used for data formatting, control, and status functions (SCON0, SMOD0), and one is used to send and receive data (SBUF0). The single SBUF0 location provides access to both transmit and receive registers. **Writes to SBUF0 always access the Transmit register. Reads of SBUF0 always access the buffered Receive register; it is not possible to read data from the Transmit register.**

With UART0 interrupts enabled, an interrupt is generated each time a transmit is completed (TI0 is set in SCON0), or a data byte has been received (RI0 is set in SCON0). The UART0 interrupt flags are not cleared by hardware when the CPU vectors to the interrupt service routine. They must be cleared manually by software, allowing software to determine the cause of the UART0 interrupt (transmit complete or receive complete). If additional bytes are available in the Receive FIFO, the RI0 bit cannot be cleared by software.

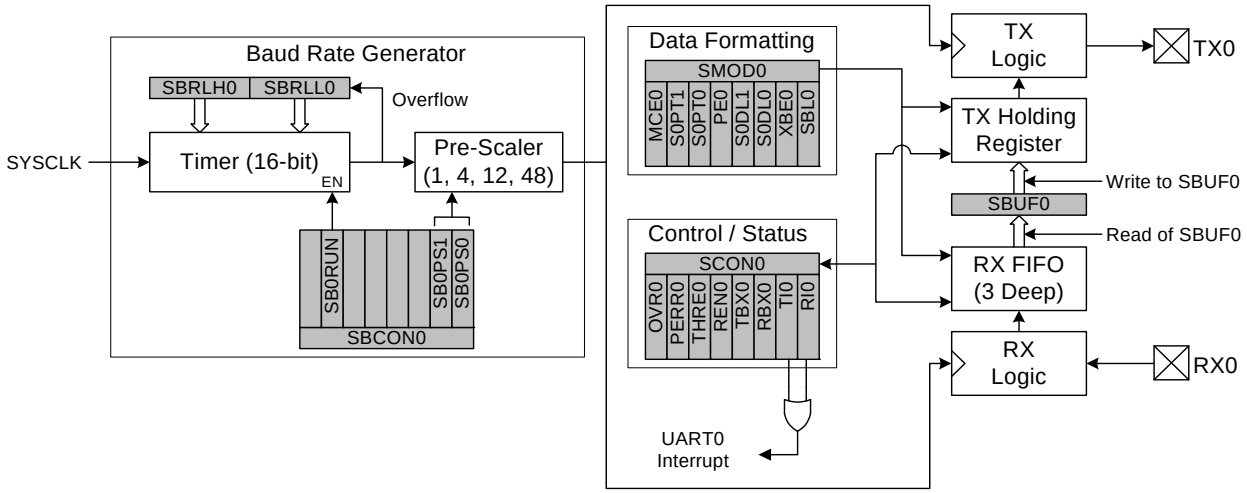

Figure 24.1. UART0 Block Diagram

24.1. Baud Rate Generator

The UART0 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 clock frequencies.

The baud rate generator is configured using three registers: SBCON0, SBRLH0, and SBRLL0. The UART0 Baud Rate Generator Control Register (SBCON0, SFR Definition 24.4) enables or disables the baud rate generator, selects the clock source for the baud rate generator, and selects the prescaler value for the timer. The baud rate generator must be enabled for UART0 to function. Registers SBRLH0 and SBRLL0 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. The baud rate for UART0 is defined in Equation 24.1, where “BRG Clock” is the baud rate generator’s selected clock source. For reliable UART operation, it is recommended that the UART baud rate is not configured for baud rates faster than SYSCLK/16.

Table 25.1. Timer Settings for Standard Baud Rates Using The Internal 24 MHz Oscillator

	Frequency: 24 MHz						
	Target Baud Rate (bps)	Baud Rate % Error	Oscillator Divide Factor	Timer Clock Source	SCA1–SCA0 (pre-scale select)[1]	T1M[1]	Timer 1 Reload Value (hex)
SYSCLK from Internal Osc.	230400	0.16%	104	SYSCLK	XX[2]	1	0xCC
	115200	0.16%	208	SYSCLK	XX	1	0x98
	57600	–0.08%	417	SYSCLK	XX	1	0x30
	28800	0.04%	833	SYSCLK/4	01	0	0x98
	14400	–0.02%	1667	SYSCLK/12	00	0	0x30
	9600	0.00%	2500	SYSCLK/12	00	0	0x98
	2400	0.00%	10000	SYSCLK/48	10	0	0x98
	1200	0.00%	20000	SYSCLK/48	10	0	0x30

Notes:

1. SCA1–SCA0 and T1M bit definitions can be found in Section 27.1.
2. X = Don't care.

SFR Definition 27.13. TMR3CN: Timer 3 Control

Bit	7	6	5	4	3	2	1	0
Name	TF3H	TF3L	TF3LEN	TF3CEN	T3SPLIT	TR3		T3XCLK
Type	R/W	R/W	R/W	R/W	R/W	R/W	R	R/W
Reset	0	0	0	0	0	0	0	0

SFR Address = 0x91; SFR Page = 0x00

Bit	Name	Function
7	TF3H	**Timer 3 High Byte Overflow Flag.** Set by hardware when the Timer 3 high byte overflows from 0xFF to 0x00. In 16 bit mode, this will occur when Timer 3 overflows from 0xFFFF to 0x0000. When the Timer 3 interrupt is enabled, setting this bit causes the CPU to vector to the Timer 3 interrupt service routine. This bit is not automatically cleared by hardware.
6	TF3L	**Timer 3 Low Byte Overflow Flag.** Set by hardware when the Timer 3 low byte overflows from 0xFF to 0x00. TF3L will be set when the low byte overflows regardless of the Timer 3 mode. This bit is not automatically cleared by hardware.
5	TF3LEN	**Timer 3 Low Byte Interrupt Enable.** When set to 1, this bit enables Timer 3 Low Byte interrupts. If Timer 3 interrupts are also enabled, an interrupt will be generated when the low byte of Timer 3 overflows.
4	TF3CEN	**Timer 3 Capture Mode Enable.** 0: Timer 3 Capture Mode is disabled. 1: Timer 3 Capture Mode is enabled.
3	T3SPLIT	**Timer 3 Split Mode Enable.** When this bit is set, Timer 3 operates as two 8-bit timers with auto-reload. 0: Timer 3 operates in 16-bit auto-reload mode. 1: Timer 3 operates as two 8-bit auto-reload timers.
2	TR3	**Timer 3 Run Control.** Timer 3 is enabled by setting this bit to 1. In 8-bit mode, this bit enables/disables TMR3H only; TMR3L is always enabled in split mode.
1	Unused	Read = 0b; Write = Don’t Care
0	T3XCLK	**Timer 3 External Clock Select.** This bit selects the external clock source for Timer 3. If Timer 3 is in 8-bit mode, this bit selects the external oscillator clock source for both timer bytes. However, the Timer 3 Clock Select bits (T3MH and T3ML in register CKCON) may still be used to select between the external clock and the system clock for either timer. 0: Timer 3 clock is the system clock divided by 12. 1: Timer 3 clock is the external clock divided by 8 (synchronized with SYSCLK).

SFR Definition 27.20. TMRnCAPL: Timer 4 and 5 Capture Register Low Byte

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

TMR4CAPL SFR Address = 0xCA; TMR5CAPL SFR Address = 0x92; SFR Page = 0x10

Bit	Name	Function
7:0	TMRnCAPL[7:0]	**Timer n Reload Register Low Byte.** TMRnCAPL captures the low byte of Timer 4 and 5 when Timer 4 and 5 are configured in capture mode. When Timer 4 and 5 are configured in auto-reload mode, it holds the low byte of the reload value.

SFR Definition 27.21. TMRnCAPH: Timer 4 and 5 Capture Register High Byte

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

TMR4CAPH SFR Address = 0xCB; TMR5CAPH SFR Address = 0x93; SFR Page = 0x10

Bit	Name	Function
7:0	TMRnCAPH[7:0]	**Timer n Reload Register High Byte.** TMRnCAPH captures the high byte of Timer 4 and 5 when Timer 4 and 5 are configured in capture mode. When Timer 4 and 5 are configured in auto-reload mode, it holds the high byte of the reload value.

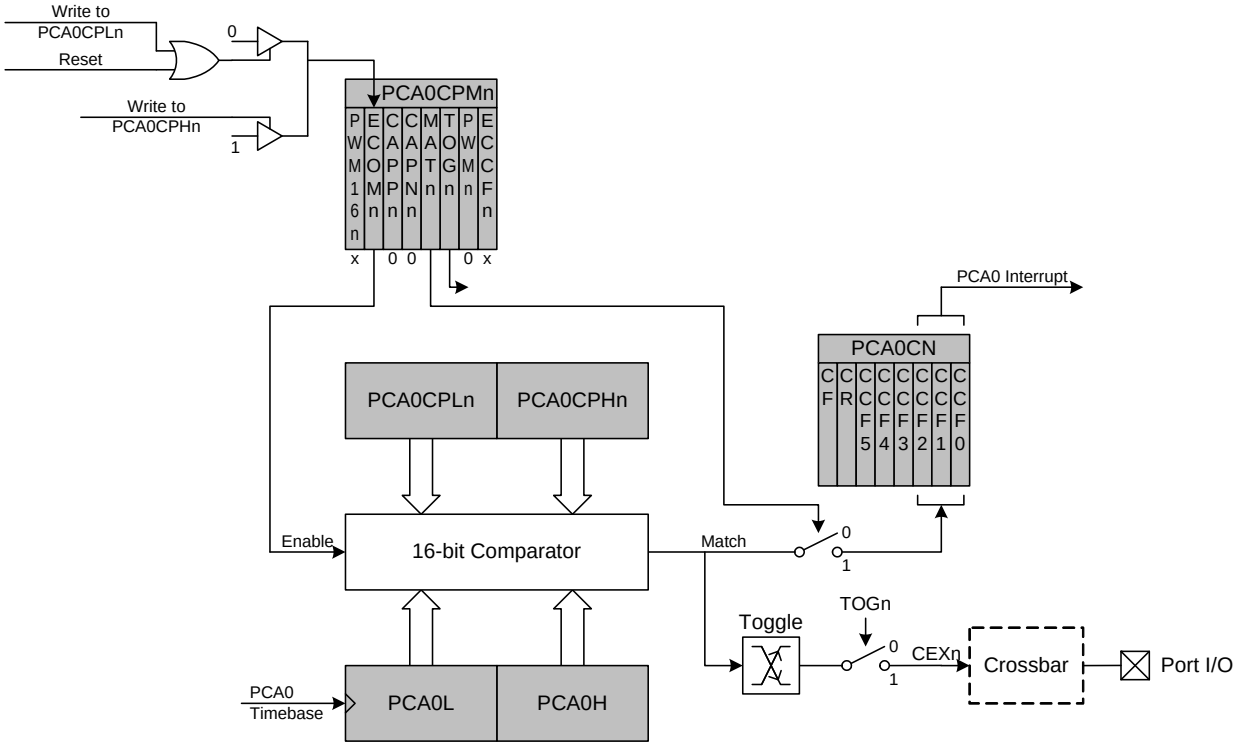

Figure 28.6. PCA0 High-Speed Output Mode Diagram

28.3.4. Frequency Output Mode

Frequency Output Mode produces a programmable-frequency square wave on the module's associated CEXn pin. The capture/compare module high byte holds the number of PCA0 clocks to count before the output is toggled. The frequency of the square wave is then defined by Equation 28.1.

$$F_{CEXn} = \frac{F_{PCA}}{2 \times PCA0CPHn}$$

Note: A value of 0x00 in the PCA0CPHn register is equal to 256 for this equation.

Equation 28.1. Square Wave Frequency Output

Where F_{PCA} is the frequency of the clock selected by the CPS2–0 bits in the PCA0 mode register, PCA0MD. The lower byte of the capture/compare module is compared to the PCA0 counter low byte; on a match, CEXn is toggled and the offset held in the high byte is added to the matched value in PCA0CPLn. Frequency Output Mode is enabled by setting the ECOMn, TOGn, and PWMn bits in the PCA0CPMn register. Note that the MATn bit should normally be set to 0 in this mode. If the MATn bit is set to 1, the CCFn flag for the channel will be set when the 16-bit PCA0 counter and the 16-bit capture/compare register for the channel are equal.

29.3.3. High-Speed Output Mode

In High-Speed Output mode, a module's associated CEXn pin is toggled each time a match occurs between the PCA1 Counter and the module's 16-bit capture/compare register (PCA1CPHn and PCA1CPLn). When a match occurs, the Capture/Compare Flag (CCFn) in PCA1CN is set to logic 1. An interrupt request is generated if the CCFn interrupt for that module is enabled. The CCFn bit is not automatically cleared by hardware when the CPU vectors to the interrupt service routine, and must be cleared by software. Setting the TOG1n, MAT1n, and ECOM1n bits in the PCA1CPMn register enables the High-Speed Output mode. If ECOM1n is cleared, the associated pin will retain its state, and not toggle on the next match event.

Important Note About Capture/Compare Registers: When writing a 16-bit value to the PCA1 Capture/Compare registers, the low byte should always be written first. Writing to PCA1CPLn clears the ECOM1n bit to 0; writing to PCA1CPHn sets ECOM1n to 1.

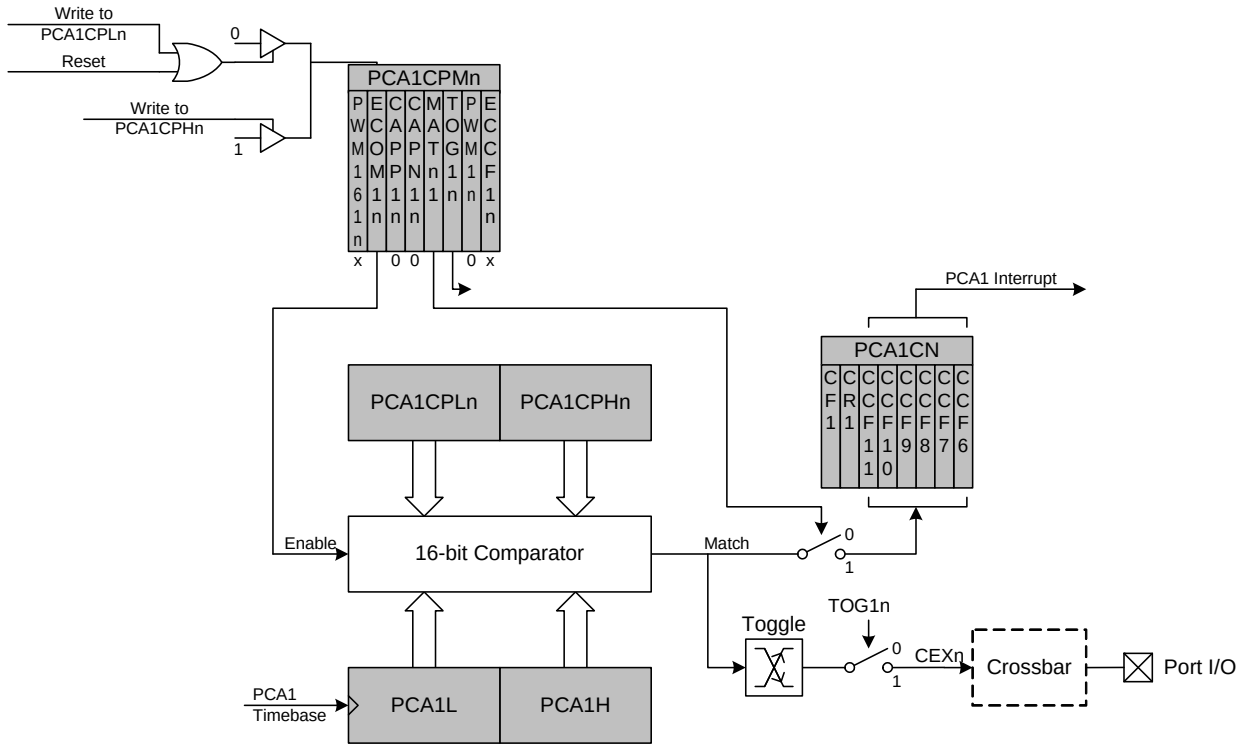

Figure 29.6. PCA1 High-Speed Output Mode Diagram