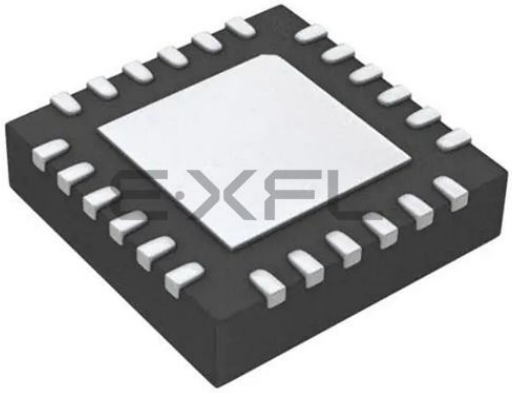

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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	8051
Core Size	8-Bit
Speed	50MHz
Connectivity	SMBus (2-Wire/I²C), SPI, UART/USART
Peripherals	POR, PWM, Temp Sensor, WDT
Number of I/O	18
Program Memory Size	32KB (32K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	2.25K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.25V
Data Converters	A/D 18x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	24-WFQFN Exposed Pad
Supplier Device Package	24-QFN (4x4)
Purchase URL	https://www.e-xfl.com/product-detail/silicon-labs/c8051f553-im

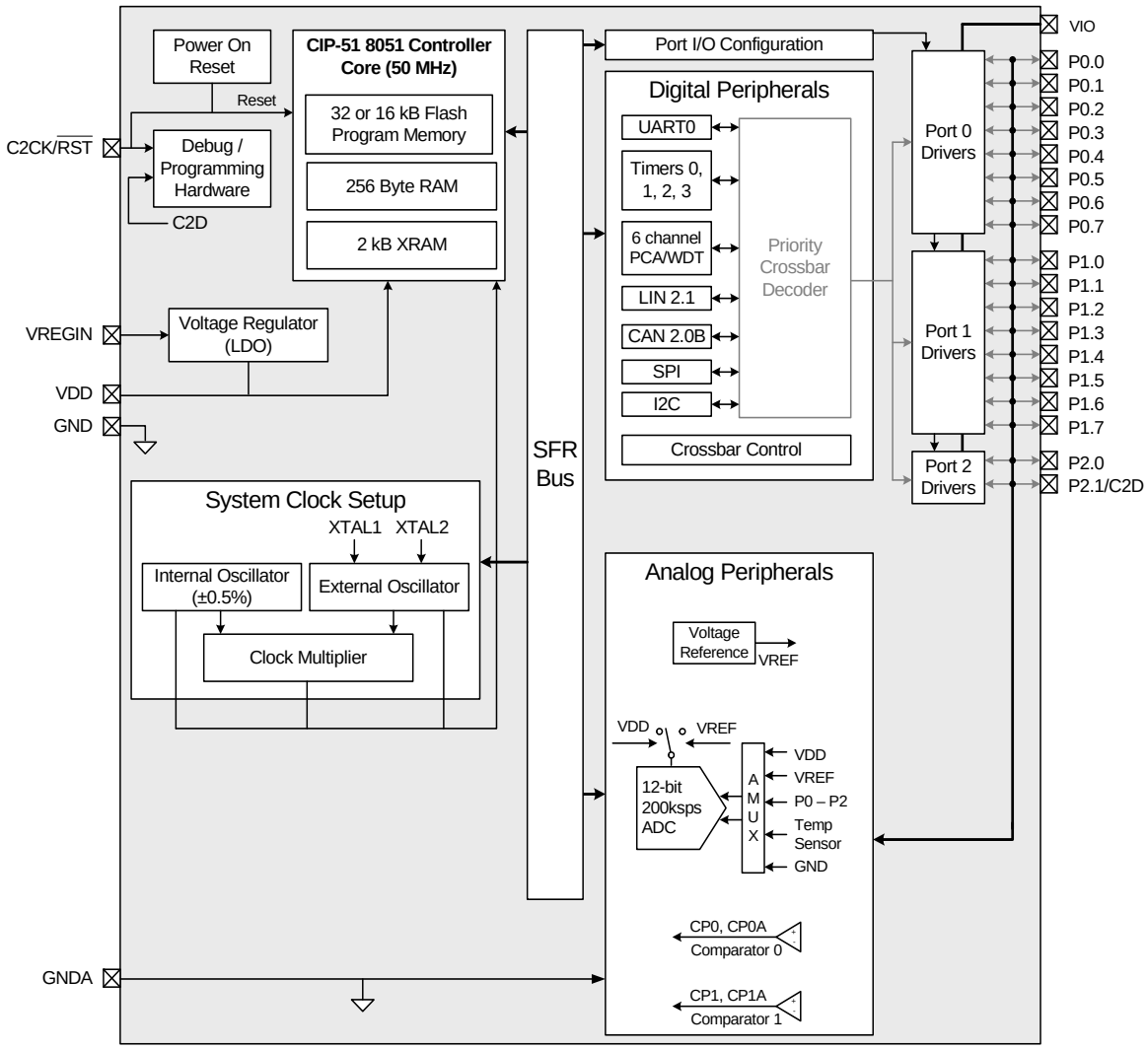

Figure 1.3. C8051F550-7 (24-pin) Block Diagram

Note that false rising edges and falling edges can be detected when the comparator is first powered on or if changes are made to the hysteresis or response time control bits. Therefore, it is recommended that the rising-edge and falling-edge flags be explicitly cleared to logic 0 a short time after the comparator is enabled or its mode bits have been changed.

SFR Definition 8.1. CPT0CN: Comparator0 Control

Bit	7	6	5	4	3	2	1	0
Name	CP0EN	CP0OUT	CP0RIF	CP0FIF	CP0HYP[1:0]		CP0HYN[1:0]	
Type	R/W	R	R/W	R/W	R/W		R/W	
Reset	0	0	0	0	0	0	0	0

SFR Address = 0x9A; SFR Page = 0x00

Bit	Name	Function
7	CP0EN	**Comparator0 Enable Bit.** 0: Comparator0 Disabled. 1: Comparator0 Enabled.
6	CP0OUT	**Comparator0 Output State Flag.** 0: Voltage on CP0+ < CP0–. 1: Voltage on CP0+ > CP0–.
5	CP0RIF	**Comparator0 Rising-Edge Flag. Must be cleared by software.** 0: No Comparator0 Rising Edge has occurred since this flag was last cleared. 1: Comparator0 Rising Edge has occurred.
4	CP0FIF	**Comparator0 Falling-Edge Flag. Must be cleared by software.** 0: No Comparator0 Falling-Edge has occurred since this flag was last cleared. 1: Comparator0 Falling-Edge has occurred.
3:2	CP0HYP[1:0]	**Comparator0 Positive Hysteresis Control Bits.** 00: Positive Hysteresis Disabled. 01: Positive Hysteresis = 5 mV. 10: Positive Hysteresis = 10 mV. 11: Positive Hysteresis = 20 mV.
1:0	CP0HYN[1:0]	**Comparator0 Negative Hysteresis Control Bits.** 00: Negative Hysteresis Disabled. 01: Negative Hysteresis = 5 mV. 10: Negative Hysteresis = 10 mV. 11: Negative Hysteresis = 20 mV.

10.4. Serial Number Special Function Registers (SFRs)

The C8051F55x/56x/57x devices include four SFRs, SN0 through SN3, that are pre-programmed during production with a unique, 32-bit serial number. The serial number provides a unique identification number for each device and can be read from the application firmware. If the serial number is not used in the application, these four registers can be used as general purpose SFRs.

SFR Definition 10.7. SNn: Serial Number n

Bit	7	6	5	4	3	2	1	0
Name	SERNUMn[7:0]							
Type	R/W							
Reset	Varies—Unique 32-bit value							

SFR Addresses: SN0 = 0xF9; SN1 = 0xFA; SN2 = 0xFB; SN3 = 0xFC; SFR Page = 0x0F;

Bit	Name	Function
7:0	SERNUMn[7:0]	**Serial Number Bits.** The four serial number registers form a 32-bit serial number, with SN3 as the most significant byte and SN0 as the least significant byte.

C8051F55x/56x/57x.

11.2.1.1. General Purpose Registers

The lower 32 bytes of data memory, locations 0x00 through 0x1F, may be addressed as four banks of general-purpose registers. Each bank consists of eight byte-wide registers designated R0 through R7. Only one of these banks may be enabled at a time. Two bits in the program status word, RS0 (PSW.3) and RS1 (PSW.4), select the active register bank (see description of the PSW in SFR Definition 10.6). This allows fast context switching when entering subroutines and interrupt service routines. Indirect addressing modes use registers R0 and R1 as index registers.

11.2.1.2. Bit Addressable Locations

In addition to direct access to data memory organized as bytes, the sixteen data memory locations at 0x20 through 0x2F are also accessible as 128 individually addressable bits. Each bit has a bit address from 0x00 to 0x7F. Bit 0 of the byte at 0x20 has bit address 0x00 while bit7 of the byte at 0x20 has bit address 0x07. Bit 7 of the byte at 0x2F has bit address 0x7F. A bit access is distinguished from a full byte access by the type of instruction used (bit source or destination operands as opposed to a byte source or destination).

The MCS-51™ assembly language allows an alternate notation for bit addressing of the form XX.B where XX is the byte address and B is the bit position within the byte. For example, the instruction:

```
MOV    C, 22.3h
```

moves the Boolean value at 0x13 (bit 3 of the byte at location 0x22) into the Carry flag.

11.2.1.3. Stack

A programmer's stack can be located anywhere in the 256-byte data memory. The stack area is designated using the Stack Pointer (SP) SFR. The SP will point to the last location used. The next value pushed on the stack is placed at SP+1 and then SP is incremented. A reset initializes the stack pointer to location 0x07. Therefore, the first value pushed on the stack is placed at location 0x08, which is also the first register (R0) of register bank 1. Thus, if more than one register bank is to be used, the SP should be initialized to a location in the data memory not being used for data storage. The stack depth can extend up to 256 bytes.

Table 12.1. Special Function Register (SFR) Memory Map for Pages 0x00 and 0x0F

Address	Page	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)
F8	0F	SPI0CN	PCA0L SN0	PCA0H SN1	PCA0CPL0 SN2	PCA0CPH0 SN3	PCACPL4	PCACPH4	VDM0CN
F0	0F	B (All Pages)	P0MAT P0MDIN	P0MASK P1MDIN	P1MAT P2MDIN	P1MASK P3MDIN		EIP1 EIP1	EIP2 EIP2
E8	0F	ADC0CN	PCA0CPL1	PCA0CPH1	PCA0CPL2	PCA0CPH2	PCA0CPL3	PCA0CPL3	RSTSRC
E0	0F	ACC (All Pages)	XBR0	XBR1	CCH0CN	IT01CF		EIE1 (All Pages)	EIE2 (All Pages)
D8	0F	PCA0CN	PCA0MD PCA0PWM	PCA0CPM0	PCA0CPM1	PCA0CPM2	PCA0CPM3	PCA0CPM4	PCA0CPM5
D0	0F	PSW (All Pages)	REF0CN	LIN0DATA	LIN0ADDR	P0SKIP	P1SKIP	P2SKIP	P3SKIP
C8	0F	TMR2CN	REG0CN LIN0CF	TMR2RLL	TMR2RLH	TMR2L	TMR2H	PCA0CPL5	PCA0CPH5
C0	0F	SMB0CN	SMB0CF	SMB0DAT	ADC0GTL	ADC0GTH	ADC0LTL	ADC0LTH	XBR2
B8	0F	IP (All Pages)		ADC0TK	ADC0MX	ADC0CF	ADC0L	ADC0H	
B0	0F	P3 (All Pages)	P2MAT	P2MASK EMI0CF			P4 (All Pages)	FLSCL (All Pages)	FLKEY (All Pages)
A8	0F	IE (All Pages)	SMOD0	EMI0CN EMI0TC	SBCON0	SBRLL0	SBRLH0	P3MAT P3MDOUT	P3MASK P4MDOUT
A0	0F	P2 (All Pages)	SPI0CFG OSCICN	SPI0CKR OSCICRS	SPI0DAT	P0MDOUT	P1MDOUT	P2MDOUT	SFRPAGE (All Pages)
98	0F	SCON0	SBUF0	CPT0CN	CPT0MD	CPT0MX	CPT1CN	CPT1MD OSCIFIN	CPT1MX OSCXCN
90	0F	P1 (All Pages)	TMR3CN	TMR3RLL	TMR3RLH	TMR3L	TMR3H		CLKMUL
88	0F	TCON (All Pages)	TMOD (All Pages)	TL0 (All Pages)	TL1 (All Pages)	TH0 (All Pages)	TH1 (All Pages)	CKCON (All Pages)	PSCTL CLKSEL
80	0F	P0 (All Pages)	SP (All Pages)	DPL (All Pages)	DPH (All Pages)	SFR0CN	SFRNEXT (All Pages)	SFRLAST (All Pages)	PCON (All Pages)
		0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)

(bit addressable)

Table 13.1. Interrupt Summary

Interrupt Source	Interrupt Vector	Priority Order	Pending Flag	Bit addressable?	Cleared by HW?	Enable Flag	Priority Control
Reset	0x0000	Top	None	N/A	N/A	Always Enabled	Always Highest
External Interrupt 0 (INT0)	0x0003	0	IE0 (TCON.1)	Y	Y	EX0 (IE.0)	PX0 (IP.0)
Timer 0 Overflow	0x000B	1	TF0 (TCON.5)	Y	Y	ET0 (IE.1)	PT0 (IP.1)
External Interrupt 1 (INT1)	0x0013	2	IE1 (TCON.3)	Y	Y	EX1 (IE.2)	PX1 (IP.2)
Timer 1 Overflow	0x001B	3	TF1 (TCON.7)	Y	Y	ET1 (IE.3)	PT1 (IP.3)
UART0	0x0023	4	RI0 (SCON0.0) TI0 (SCON0.1)	Y	N	ES0 (IE.4)	PS0 (IP.4)
Timer 2 Overflow	0x002B	5	TF2H (TMR2CN.7) TF2L (TMR2CN.6)	Y	N	ET2 (IE.5)	PT2 (IP.5)
SPI0	0x0033	6	SPIF (SPI0CN.7) WCOL (SPI0CN.6) MODF (SPI0CN.5) RXOVRN (SPI0CN.4)	Y	N	ESPI0 (IE.6)	PSPI0 (IP.6)
SMB0	0x003B	7	SI (SMB0CN.0)	Y	N	ESMB0 (EIE1.0)	PSMB0 (EIP1.0)
ADC0 Window Compare	0x0043	8	AD0WINT (ADC0CN.3)	Y	N	EWADC0 (EIE1.1)	PWADC0 (EIP1.1)
ADC0 Conversion Complete	0x004B	9	AD0INT (ADC0CN.5)	Y	N	EADC0 (EIE1.2)	PADC0 (EIP1.2)
Programmable Counter Array	0x0053	10	CF (PCA0CN.7) CCFn (PCA0CN.n) COVF (PCA0PWM.6)	Y	N	EPCA0 (EIE1.3)	PPCA0 (EIP1.3)
Comparator0	0x005B	11	CP0FIF (CPT0CN.4) CP0RIF (CPT0CN.5)	N	N	ECP0 (EIE1.4)	PCP0 (EIP1.4)
Comparator1	0x0063	12	CP1FIF (CPT1CN.4) CP1RIF (CPT1CN.5)	N	N	ECP1 (EIE1.5)	PCP1 (EIP1.5)
Timer 3 Overflow	0x006B	13	TF3H (TMR3CN.7) TF3L (TMR3CN.6)	N	N	ET3 (EIE1.6)	PT3 (EIP1.6)
LIN0	0x0073	14	LIN0INT (LINST.3)	N	N*	ELIN0 (EIE1.7)	PLIN0 (EIP1.7)
Voltage Regulator Dropout	0x007B	15	N/A	N/A	N/A	EREG0 (EIE2.0)	PREG0 (EIP2.0)
CAN0	0x0083	16	CAN0INT (CAN0CN.7)	N	Y	ECAN0 (EIE2.1)	PCAN0 (EIP2.1)
Port Match	0x008B	17	None	N/A	N/A	EMAT (EIE2.2)	PMAT (EIP2.2)

***Note:** The LIN0INT bit is cleared by setting RSTINT (LINCTRL.3)

SFR Definition 14.2. FLKEY: Flash Lock and Key

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

SFR Address = 0xB7; SFR Page = All Pages

Bit	Name	Function
7:0	FLKEY[7:0]	**Flash Lock and Key Register.** Write: This register provides a lock and key function for Flash erasures and writes. Flash writes and erases are enabled by writing 0xA5 followed by 0xF1 to the FLKEY register. Flash writes and erases are automatically disabled after the next write or erase is complete. If any writes to FLKEY are performed incorrectly, or if a Flash write or erase operation is attempted while these operations are disabled, the Flash will be permanently locked from writes or erasures until the next device reset. If an application never writes to Flash, it can intentionally lock the Flash by writing a non-0xA5 value to FLKEY from software. 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 16.2. RSTSRC: Reset Source

Bit	7	6	5	4	3	2	1	0
Name		FERROR	C0RSEF	SWRSF	WDTRSF	MCDRSF	PORSF	PINRSF
Type	R	R	R/W	R/W	R	R/W	R/W	R
Reset	0	Varies	Varies	Varies	Varies	Varies	Varies	Varies

SFR Address = 0xEF; SFR Page = 0x00

Bit	Name	Description	Write	Read
7	Unused	**Unused.**	Don't care.	0
6	FERROR	**Flash Error Reset Flag.**	N/A	Set to 1 if Flash read/write/erase error caused the last reset.
5	C0RSEF	**Comparator0 Reset Enable and Flag.**	Writing a 1 enables Comparator0 as a reset source (active-low).	Set to 1 if Comparator0 caused the last reset.
4	SWRSF	**Software Reset Force and Flag.**	Writing a 1 forces a system reset.	Set to 1 if last reset was caused by a write to SWRSF.
3	WDTRSF	**Watchdog Timer Reset Flag.**	N/A	Set to 1 if Watchdog Timer overflow caused the last reset.
2	MCDRSF	**Missing Clock Detector Enable and Flag.**	Writing a 1 enables the Missing Clock Detector. The MCD triggers a reset if a missing clock condition is detected.	Set to 1 if Missing Clock Detector timeout caused the last reset.
1	PORSF	**Power-On/V_{DD} Monitor Reset Flag, and V_{DD} monitor Reset Enable.**	Writing a 1 enables the V_{DD} monitor as a reset source. **Writing 1 to this bit before the V_{DD} monitor is enabled and stabilized may cause a system reset.**	Set to 1 anytime a power-on or V_{DD} monitor reset occurs. **When set to 1 all other RSTSRC flags are indeterminate.**
0	PINRSF	**HW Pin Reset Flag.**	N/A	Set to 1 if $\overline{\text{RST}}$ pin caused the last reset.

Note: Do not use read-modify-write operations on this register

SFR Definition 18.6. OSCXCN: External Oscillator Control

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

SFR Address = 0x9F; SFR Page = 0x0F

Bit	Name	Function
7	XTLVLD	**Crystal Oscillator Valid Flag.** (Read only when XOSCMD = 11x.) 0: Crystal Oscillator is unused or not yet stable. 1: Crystal 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. 101: Capacitor Oscillator Mode. 110: Crystal Oscillator Mode. 111: Crystal Oscillator Mode with divide by 2 stage.
3	Unused	Read = 0b; Write =0b
2:0	XFCN[2:0]	**External Oscillator Frequency Control Bits.** Set according to the desired frequency for Crystal or RC mode. Set according to the desired K Factor for C mode.

XFCN	Crystal Mode	RC Mode	C Mode
000	f ≤ 32 kHz	f ≤ 25 kHz	K Factor = 0.87
001	32 kHz < f ≤ 84 kHz	25 kHz < f ≤ 50 kHz	K Factor = 2.6
010	84 kHz < f ≤ 225 kHz	50 kHz < f ≤ 100 kHz	K Factor = 7.7
011	225 kHz < f ≤ 590 kHz	100 kHz < f ≤ 200 kHz	K Factor = 22
100	590 kHz < f ≤ 1.5 MHz	200 kHz < f ≤ 400 kHz	K Factor = 65
101	1.5 MHz < f ≤ 4 MHz	400 kHz < f ≤ 800 kHz	K Factor = 180
110	4 MHz < f ≤ 10 MHz	800 kHz < f ≤ 1.6 MHz	K Factor = 664
111	10 MHz < f ≤ 30 MHz	1.6 MHz < f ≤ 3.2 MHz	K Factor = 1590

When a digital I/O cell is placed in the high impedance state, a weak pull-up transistor pulls the Port pad to the VIO supply voltage to ensure the digital input is at a defined logic state. Weak pull-ups are disabled when the I/O cell is driven to GND to minimize power consumption and may be globally disabled by setting WEAKPUD to 1. The user should ensure that digital I/O are always internally or externally pulled or driven to a valid logic state to minimize power consumption. Port pins configured for digital I/O always read back the logic state of the Port pad, regardless of the output logic value of the Port pin.

19.1.3. Interfacing Port I/O in a Multi-Voltage System

All Port I/O are capable of interfacing to digital logic operating at a supply voltage higher than VDD and less than 5.25 V. Connect the VIO pin to the voltage source of the interface logic.

19.2. Assigning Port I/O Pins to Analog and Digital Functions

Port I/O pins P0.0–P3.7 can be assigned to various analog, digital, and external interrupt functions. P4.0 can be assigned to only digital functions. The Port pins assigned to analog functions should be configured for analog I/O, and Port pins assigned to digital or external interrupt functions should be configured for digital I/O.

19.2.1. Assigning Port I/O Pins to Analog Functions

Table 19.1 shows all available analog functions that require Port I/O assignments. **Port pins selected for these analog functions should have their corresponding bit in PnSKIP set to 1.** This reserves the pin for use by the analog function and does not allow it to be claimed by the Crossbar. Table 19.1 shows the potential mapping of Port I/O to each analog function.

Table 19.1. Port I/O Assignment for Analog Functions

Analog Function	Potentially Assignable Port Pins	SFR(s) used for Assignment
ADC Input	P0.0–P3.7[1]	ADC0MX, PnSKIP
Comparator0 or Compartor1 Input	P0.0–P2.7[1]	CPT0MX, CPT1MX, PnSKIP
Voltage Reference (VREF0)[2]	P0.0	REF0CN, PnSKIP
External Oscillator in Crystal Mode (XTAL1)	P0.2	OSCXCN, PnSKIP
External Oscillator in RC, C, or Crystal Mode (XTAL2)	P0.3	OSCXCN, PnSKIP

Notes:
1. P3.1–P3.7 are available on the 40-pin packages. P2.2-P3.0 are available 40-pin and 32-pin packages.
2. If VDD is selected as the voltage reference in the REF0CN register and the ADC is enabled in the ADC0CN register, the P0.0/VREF pin cannot operate as a general purpose I/O pin in open-drain mode. With the above settings, this pin can operate in push-pull output mode or as an analog input.

19.2.2. Assigning Port I/O Pins to Digital Functions

Any Port pins not assigned to analog functions may be assigned to digital functions or used as GPIO. Most digital functions rely on the Crossbar for pin assignment; however, some digital functions bypass the Crossbar in a manner similar to the analog functions listed above. **Port pins used by these digital functions and any Port pins selected for use as GPIO should have their corresponding bit in PnSKIP set to 1.** Table 19.2 shows all available digital functions and the potential mapping of Port I/O to each digital function.

SFR Definition 19.19. P1SKIP: Port 1 Skip

Bit	7	6	5	4	3	2	1	0
Name	P1SKIP[7:0]							
Type	R/W							
Reset	0	0	0	0	0	0	0	0

SFR Address = 0xD5; SFR Page = 0x0F

Bit	Name	Function
7:0	P1SKIP[7:0]	**Port 1 Crossbar Skip Enable Bits.** These bits select Port 1 pins to be skipped by the Crossbar Decoder. Port pins used for analog, special functions or GPIO 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 19.20. P2: Port 2

Bit	7	6	5	4	3	2	1	0
Name	P2[7:0]							
Type	R/W							
Reset	1	1	1	1	1	1	1	1

SFR Address = 0xA0; SFR Page = All Pages; Bit-Addressable

Bit	Name	Description	Write	Read
7:0	P2[7:0]	**Port 2Data.** 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: P2.n Port pin is logic LOW. 1: P2.n Port pin is logic HIGH.
Note: P2.2-P2.7 are available on 40-pin and 32-pin packages.				

21. Controller Area Network (CAN0)

Important Documentation Note: The Bosch CAN Controller is integrated in the C8051F550/1/4/5, ‘F560/1/4/5/8/9, and ‘F572/3 devices. This section of the data sheet gives a description of the CAN controller as an overview and offers a description of how the Silicon Labs CIP-51 MCU interfaces with the on-chip Bosch CAN controller. In order to use the CAN controller, refer to Bosch’s C_CAN User’s Manual as an accompanying manual to the Silicon Labs’ data sheet.

The C8051F550/1/4/5, ‘F560/1/4/5/8/9, and ‘F572/3 devices feature a Control Area Network (CAN) controller that enables serial communication using the CAN protocol. Silicon Labs CAN facilitates communication on a CAN network in accordance with the Bosch specification 2.0A (basic CAN) and 2.0B (full CAN). The CAN controller consists of a CAN Core, Message RAM (separate from the CIP-51 RAM), a message handler state machine, and control registers. Silicon Labs CAN is a protocol controller and does not provide physical layer drivers (i.e., transceivers). Figure 21.1 shows an example typical configuration on a CAN bus.

Silicon Labs’ CAN operates at bit rates of up to 1 Mbit/second, though this can be limited by the physical layer chosen to transmit data on the CAN bus. The CAN processor has 32 Message Objects that can be configured to transmit or receive data. Incoming data, message objects and their identifier masks are stored in the CAN message RAM. All protocol functions for transmission of data and acceptance filtering is performed by the CAN controller and not by the CIP-51 MCU. In this way, minimal CPU bandwidth is needed to use CAN communication. The CIP-51 configures the CAN controller, accesses received data, and passes data for transmission via Special Function Registers (SFRs) in the CIP-51.

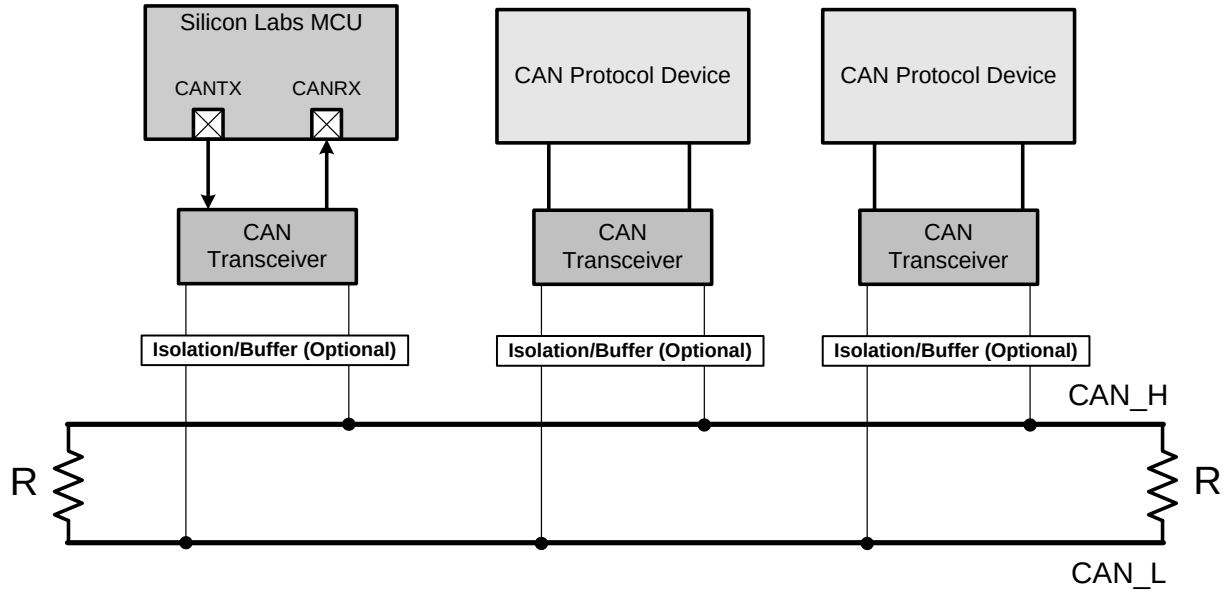

Figure 21.1. Typical CAN Bus Configuration

SFR Definition 22.2. SMB0CN: SMBus Control

Bit	7	6	5	4	3	2	1	0
Name	MASTER	TXMODE	STA	STO	ACKRQ	ARBLOST	ACK	SI
Type	R	R	R/W	R/W	R	R	R/W	R/W
Reset	0	0	0	0	0	0	0	0

SFR Address = 0xC0; Bit-Addressable; SFR Page =0x00

Bit	Name	Description	Read	Write
7	MASTER	**SMBus Master/Slave Indicator.** This read-only bit indicates when the SMBus is operating as a master.	0: SMBus operating in slave mode. 1: SMBus operating in master mode.	N/A
6	TXMODE	**SMBus Transmit Mode Indicator.** This read-only bit indicates when the SMBus is operating as a transmitter.	0: SMBus in Receiver Mode. 1: SMBus in Transmitter Mode.	N/A
5	STA	**SMBus Start Flag.**	0: No Start or repeated Start detected. 1: Start or repeated Start detected.	0: No Start generated. 1: When Configured as a Master, initiates a START or repeated START.
4	STO	**SMBus Stop Flag.**	0: No Stop condition detected. 1: Stop condition detected (if in Slave Mode) or pending (if in Master Mode).	0: No STOP condition is transmitted. 1: When configured as a Master, causes a STOP condition to be transmitted after the next ACK cycle. Cleared by Hardware.
3	ACKRQ	**SMBus Acknowledge Request.**	0: No Ack requested 1: ACK requested	N/A
2	ARBLOST	**SMBus Arbitration Lost Indicator.**	0: No arbitration error. 1: Arbitration Lost	N/A
1	ACK	**SMBus Acknowledge.**	0: NACK received. 1: ACK received.	0: Send NACK 1: Send ACK
0	SI	**SMBus Interrupt Flag.** This bit is set by hardware under the conditions listed in Table 15.3. SI must be cleared by software. While SI is set, SCL is held low and the SMBus is stalled.	0: No interrupt pending 1: Interrupt Pending	0: Clear interrupt, and initiate next state machine event. 1: Force interrupt.

Table 22.3. Sources for Hardware Changes to SMB0CN

Bit	Set by Hardware When:	Cleared by Hardware When:
MASTER	■ A START is generated.	■ A STOP is generated. ■ Arbitration is lost.
TXMODE	■ START is generated. ■ SMB0DAT is written before the start of an SMBus frame.	■ A START is detected. ■ Arbitration is lost. ■ SMB0DAT is not written before the start of an SMBus frame.
STA	■ A START followed by an address byte is received.	■ Must be cleared by software.
STO	■ A STOP is detected while addressed as a slave. ■ Arbitration is lost due to a detected STOP.	■ A pending STOP is generated.
ACKRQ	■ A byte has been received and an ACK response value is needed.	■ After each ACK cycle.
ARBLOST	■ A repeated START is detected as a MASTER when STA is low (unwanted repeated START). ■ SCL is sensed low while attempting to generate a STOP or repeated START condition. ■ SDA is sensed low while transmitting a 1 (excluding ACK bits).	■ Each time SI is cleared.
ACK	■ The incoming ACK value is low (ACKNOWLEDGE).	■ The incoming ACK value is high (NOT ACKNOWLEDGE).
SI	■ A START has been generated. ■ Lost arbitration. ■ A byte has been transmitted and an ACK/NACK received. ■ A byte has been received. ■ A START or repeated START followed by a slave address + R/W has been received. ■ A STOP has been received.	■ Must be cleared by software.

SFR Definition 24.3. SPI0CKR: SPI0 Clock Rate

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

SFR Address = 0xA2; SFR Page = 0x00

Bit	Name	Function
7:0	SCR[7:0]	**SPI0 Clock Rate.** These bits determine the frequency of the SCK output when the SPI0 module is configured for master mode operation. The SCK clock frequency is a divided version of the system clock, and is given in the following equation, where SYSCLK is the system clock frequency and SPI0CKR is the 8-bit value held in the SPI0CKR register. $f_{SCK} = \frac{SYSCLK}{2 \times (SPI0CKR[7:0] + 1)}$ for 0 <= SPI0CKR <= 255 Example: If SYSCLK = 2 MHz and SPI0CKR = 0x04, $f_{SCK} = \frac{2000000}{2 \times (4 + 1)}$ $f_{SCK} = 200\ kHz$

SFR Definition 24.4. SPI0DAT: SPI0 Data

Bit	7	6	5	4	3	2	1	0
Name	SPI0DAT[7:0]							
Type	R/W							
Reset	0	0	0	0	0	0	0	0

SFR Address = 0xA3; SFR Page = 0x00

Bit	Name	Function
7:0	SPI0DAT[7:0]	**SPI0 Transmit and Receive Data.** The SPI0DAT register is used to transmit and receive SPI0 data. Writing data to SPI0DAT places the data into the transmit buffer and initiates a transfer when in Master Mode. A read of SPI0DAT returns the contents of the receive buffer.

SFR Definition 25.14. 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 = 0x00

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 25.15. 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 = 0x00

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.

Table 26.2. PCA0CPM and PCA0PWM Bit Settings for PCA Capture/Compare Modules

Operational Mode	PCA0CPMn								PCA0PWM				
Bit Number	7	6	5	4	3	2	1	0	7	6	5	4–2	1–0
Capture triggered by positive edge on CEXn	X	X	1	0	0	0	0	A	0	X	B	XXX	XX
Capture triggered by negative edge on CEXn	X	X	0	1	0	0	0	A	0	X	B	XXX	XX
Capture triggered by any transition on CEXn	X	X	1	1	0	0	0	A	0	X	B	XXX	XX
Software Timer	X	C	0	0	1	0	0	A	0	X	B	XXX	XX
High Speed Output	X	C	0	0	1	1	0	A	0	X	B	XXX	XX
Frequency Output	X	C	0	0	0	1	1	A	0	X	B	XXX	XX
8-Bit Pulse Width Modulator (7)	0	C	0	0	E	0	1	A	0	X	B	XXX	00
9-Bit Pulse Width Modulator (7)	0	C	0	0	E	0	1	A	D	X	B	XXX	01
10-Bit Pulse Width Modulator (7)	0	C	0	0	E	0	1	A	D	X	B	XXX	10
11-Bit Pulse Width Modulator (7)	0	C	0	0	E	0	1	A	D	X	B	XXX	11
16-Bit Pulse Width Modulator	1	C	0	0	E	0	1	A	0	X	B	XXX	XX

Notes:
1. X = Don't Care (no functional difference for individual module if 1 or 0).
2. A = Enable interrupts for this module (PCA interrupt triggered on CCFn set to 1).
3. B = Enable 8th, 9th, 10th or 11th bit overflow interrupt (Depends on setting of CLSEL[1:0]).
4. C = When set to 0, the digital comparator is off. For high speed and frequency output modes, the associated pin will not toggle. In any of the PWM modes, this generates a 0% duty cycle (output = 0).
5. D = Selects whether the Capture/Compare register (0) or the Auto-Reload register (1) for the associated channel is accessed via addresses PCA0CPHn and PCA0CPLn.
6. E = When set, a match event will cause the CCFn flag for the associated channel to be set.
7. All modules set to 8, 9, 10 or 11-bit PWM mode use the same cycle length setting.

26.3.1. Edge-triggered Capture Mode

In this mode, a valid transition on the CEXn pin causes the PCA to capture the value of the PCA counter/timer and load it into the corresponding module's 16-bit capture/compare register (PCA0CPLn and PCA0CPHn). The CAPPn and CAPNn bits in the PCA0CPMn register are used to select the type of transition that triggers the capture: low-to-high transition (positive edge), high-to-low transition (negative edge), or either transition (positive or negative edge). When a capture occurs, the Capture/Compare Flag (CCFn) in PCA0CN 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. If both CAPPn and CAPNn bits are set to logic 1, then the state of the Port pin associated with CEXn can be read directly to determine whether a rising-edge or falling-edge caused the capture.

27.2. C2 Pin Sharing

The C2 protocol allows the C2 pins to be shared with user functions so that in-system debugging and Flash programming may be performed. This is possible because C2 communication is typically performed when the device is in the halt state, where all on-chip peripherals and user software are stalled. In this halted state, the C2 interface can safely ‘borrow’ the C2CK (RST) and C2D pins. In most applications, external resistors are required to isolate C2 interface traffic from the user application. A typical isolation configuration is shown in Figure 27.1.

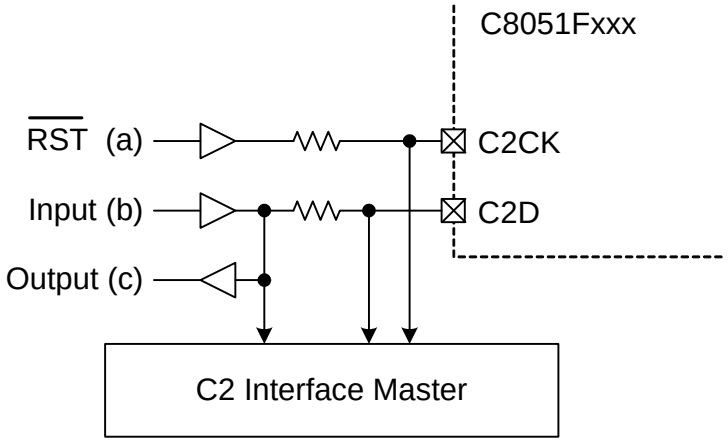

Figure 27.1. Typical C2 Pin Sharing

The configuration in Figure 27.1 assumes the following:

1. The user input (b) cannot change state while the target device is halted.
2. The RST pin on the target device is used as an input only.

Additional resistors may be necessary depending on the specific application.