PORTING CONSIDERATIONS FROM C8051F34X TO C8051F38X

1. Introduction

This application note highlights the differences between the C8051F34x and C8051F38x microcontrollers. These devices are designed to be code-compatible and pin-compatible, and thus require very minor changes when porting firmware and hardware between MCUs in these two families. The C8051F38x is the newest family and includes an enhanced feature set in addition to all of the peripherals of the C8051F34x. The C8051F38x devices should function as a drop-in replacement for the C8051F34x devices in most applications.

2. Relevant Documentation

Silicon Labs data sheets are available on the specific device landing page:

- **C8051F34x Data Sheet** — http://www.silabs.com/products/mcu/usb/Pages/C8051F32x-34x.aspx and click on the **Documentation** tab.
- **C8051F38x Data Sheet —** http://www.silabs.com/products/mcu/usb/Pages/C8051F38x.aspx and click on the **Documentation** tab.

3. Common Features

Some digital and analog peripherals are identical between the two families. If SFR paging is accounted for, firmware written for these peripherals will work on either device without any changes. The list of common digital and analog peripherals is:

- USB
- Comparator 0,1
- EMIF
- PCA
- SMBus 0
- SPI
- Timers 0, 1, 2, 3
- UART

Note that while these peripherals are common to both families, they might not be available on every part number of a product family. Refer to the Ordering Information sections of the applicable data sheets to determine the specific part number that includes the peripherals necessary for the system.

4. Pin-Compatibility

Corresponding package options in each product family are 100% pin-compatible; therefore, no PCB redesign is necessary when switching between these product families. Section “5. Distinguishing Factors” discusses additional porting considerations. Table 1 accounts for pin-compatibility but not memory size and available peripherals. A specific ’F38x part number is recommended for each ’F34x part number in “6. Recommended Part Numbers” .

Table 1. Pin-Compatible MCUs

Package	C8051F34x	C8051F38x
TQFP-48	C8051F341-GQ C8051F344-GQ C8051F345-GQ C8051F348-GQ C8051F34C-GQ	C8051F380-GQ C8051F382-GQ C8051F384-GQ C8051F386-GQ
LQFP-32	C8051F342-GQ C8051F343-GQ C8051F346-GQ C8051F347-GQ C8051F349-GQ C8051F34A-GQ C8051F34B-GQ C8051F34D-GQ	C8051F381-GQ C8051F383-GQ C8051F385-GQ C8051F387-GQ
QFN-32	C8051F342-GM C8051F343-GM C8051F346-GM C8051F347-GM C8051F349-GM C8051F34A-GM C8051F34B-GM	C8051F381-GM C8051F383-GM C8051F385-GM C8051F387-GM

5. Distinguishing Factors

Table 2 lists the primary differences between the C8051F34x and C8051F38x families, and this section discusses each of these differences in detail. Some peripherals and capabilities are unique to one of the families. When moving a design from one MCU family to another, ensure that the new MCU family includes the necessary features. Also, note that the features listed in the table might not be available in all devices in the product family. See the applicable data sheet to determine the part number that includes features necessary for the design.

The addition of features to the 'F38x family creates minor differences between some common components of the two families. When porting code between these families, it will be necessary to make minor firmware changes if these components are used. If these changes are accounted for, any firmware written can run directly on an MCU from either family.

Table 2. Feature Differences

Feature	C8051F34x	C8051F38x
Core		
SFR Paging	—	✓
Internal Oscillator	12 MHz	48 MHz
Analog		
Maximum ADC Throughput Rate	200 ksps	500 ksps
Digital		
Timers	4	6
SMBus/I^2C	1	2

5.1. Hardware Incompatibilities

While the C8051F38x family includes a number of new features not found on the C8051F34x family, there are some differences that should be considered for any design port.

- **Clock Multiplier** — The C8051F38x does not include the 4x clock multiplier from the C8051F34x device families. Instead, the internal oscillator is a 48 MHz oscillator that is divided down to the default oscillator frequency. This change only impacts systems which use the clock multiplier in conjunction with an external oscillator source.
- **External Oscillator C and RC Modes** — The C and RC modes of the oscillator have a divide-by-2 stage on the C8051F38x to aid with noise immunity. This was not present on the C8051F34x device family, and any clock generated with C or RC mode will change accordingly.
- **Fab Technology** — The C8051F38x is manufactured using a different technology process than the C8051F34x. As a result, many of the electrical performance parameters will have subtle differences. These differences should not affect most systems, but it is nonetheless important to review the electrical parameters for any peripherals that are used in the design and ensure they are compatible with the existing hardware.

5.2. Special Function Register Paging

The C8051F38x devices implement a paged special function register (SFR) scheme that greatly expands the number of available SFR addresses. This SFR address expansion provides support for more peripherals, such as:

- Second SMBus peripheral (SMBus1)
- Timer 4 and Timer 5

To correctly read or write to SFRs in a 'F38x device, the SFRPAGE register must be set to the correct SFR page. The SFRPAGE register itself is accessible from all SFR pages. For example, to access the SMBus1 Clock/ Configuration register SMB1CF, SFRPAGE must be set to 0x0F.

```
SFRPAGE = CONFIG_PAGE; // Switch SFR page to 0x0F

SMB1CF |= 0x80; // Enable SMBus1
```

CONFIG_PAGE is defined as **0x0F** in the **C8051F380_defs.h** header file. It is recommended to use the defined constants for SFRPAGE to enhance code readability and to reduce the porting effort for future platforms.

When porting code from a 'F34x device to a 'F38x device, modify the firmware to set the SFRPAGE before any SFR accesses. When porting code from a 'F38x device to a 'F34x device, remove all writes to SFRPAGE. In addition, code can define the same SFR Page defines on the 'F34x and set them all to 0x00 to promote back-and-forth compatibility between the two families. For example, **CONFIG_PAGE** is set to **0x0F** on the 'F38x, but can be defined as **0x00** for the 'F34x so no code modifications are needed.

5.3. ADC

The ADC peripheral is different between C8051F34x and C8051F38x. The C8051F34x features a 10-bit, 200 ksps SAR, while C8051F38x devices have a 10-bit, 500 ksps SAR. Table 3 details the list of differences that may affect the system and code design.

Table 3. ADC Differences

Feature	C8051F34x	C8051F38x
Resolution	10 bits	10 bits
Maximum Throughput Rate	200 ksps	500 ksps
Maximum SAR Conversion Clock	3 MHz	8.33 MHz
Power Supply Current (VDD supplied to ADC0)	400 µA (Operating Mode, 200 ksps)	750 µA (Operation Mode, 500 ksps)

5.4. Other Peripherals

All other peripherals and features not specifically discussed are functionally the same between the two device families. If SFR paging is accounted for, firmware written for these peripherals will operate the same way on both device families.

5.5. Special Function Registers

The SFR memory maps of the C8051F34x and C8051F38x families are very similar. However, there are a few differences related to functionality or features found on only one of the two device families. Fortunately, SFRs that exist on one family but not on the other can be safely written and read on the other device family without causing a problem. Likewise, certain registers have additional bits defined that are not present on both devices. In these cases, the default bit settings are safe to write, and the read values of those bits are defined in the data sheet.

Table 4 shows the combined SFR map of the two device families. The locations of SFRs that differ between the two families and those with only bitwise differences are highlighted.

Table 4. Special Function Register (SFR) Memory Map Comparison

	Address								Page
	0(8)	1(9)	2(A)	3(B)	4(C)	5(D)	6(E)	7(F)	
F8	SPI0CN	PCA0L	PCA0H	PCA0CPL0	PCA0CPH0	PCA0CPL4	PCA0CPH4	VDM0CN	
F0	B	P0MDIN	P1MDIN	P2MDIN	P3MDIN	P4MDIN	EIP1	EIP2	
E8	ADC0CN	PCA0CPL1	PCA0CPH1	PCA0CPL2	PCA0CPH2	PCA0CPL3	PCA0CPH3	RSTSRC	
E0	ACC	XBR0	XBR1	XBR2	IT01CF	SMOD1	EIE1	EIE2	0
					CKCON1				F
D8	PCA0CN	PCA0MD	PCA0CPM0	PCA0CPM1	PCA0CPM2	PCA0CPM3	PCA0CPM4	P3SKIP	
D0	PSW	REF0CN	SCON1	SBUF1	P0SKIP	P1SKIP	P2SKIP	USB0XCN	
C8	TMR2CN	REG01CN (REG0CN)	TMR2RLL	TMR2RLH	TMR2L	TMR2H	SMB0ADM	SMB0ADR	0
	TMR5CN		TMR5RLL	TMR5RLH	TMR5L	TMR5H	SMB1ADM	SMB1ADR	F
C0	SMB0CN	SMB0CF	SMB0DAT	ADC0GTL	ADC0GTH	ADC0LTL	ADC0LTH	P4	0
	SMB1CN	SMB1CF	SMB1DAT						F
B8	IP	CLKMUL	AMX0N	AMX0P	ADC0CF	ADC0L	ADC0H	SFRPAGE	0
		SMBTC							F
B0	P3	OSCXCN	OSCICN	OSCICL	SBRLL1	SBRLH1	FLSCL	FLKEY	
A8	IE	CLKSEL	EMI0CN	-	SBCON1	-	P4MDOUT	PFE0CN	
A0	P2	SPI0CFG	SPI0CKR	SPI0DAT	P0MDOUT	P1MDOUT	P2MDOUT	P3MDOUT	
98	SCON0	SBUF0	CPT1CN	CPT0CN	CPT1MD	CPT0MD	CTP1MX	CPT0MX	
90	P1	TMR3CN	TMR3RLL	TMR3RLH	TMR3L	TMR3H	USB0ADR	USB0DAT	0
		TMR4CN	TMR4RLL	TMR4RLH	TMR4L	TMR4H			F
88	TCON	TMOD	TL0	TL1	TH0	TH1	CKCON	PSCTL	
80	P0	SP	DPL	DPH	EMI0TC	EMI0CF	OSCLCN	PCON	

denotes SFRs on C8051F38x devices only

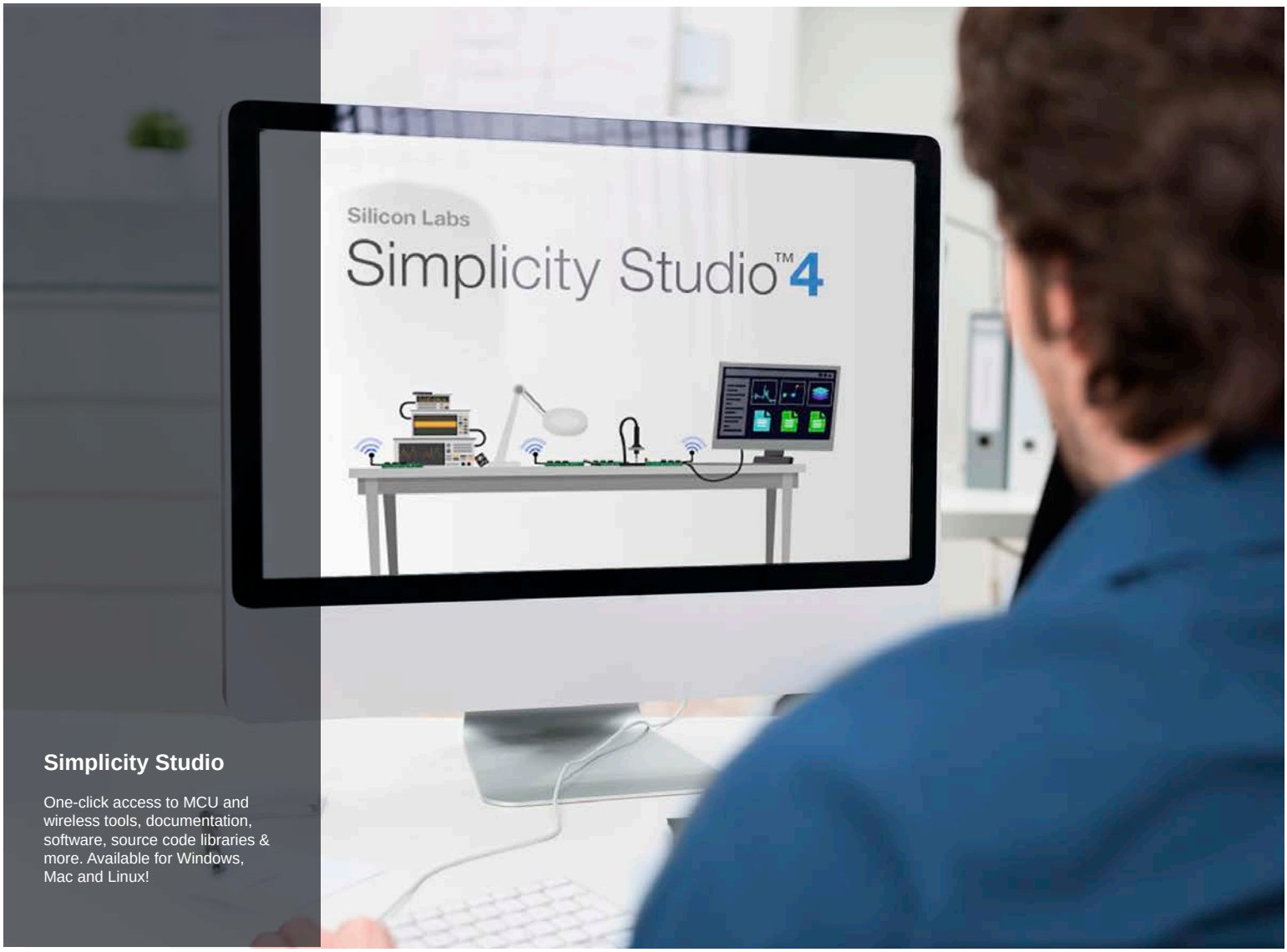
denotes bitwise differences across families

6. Recommended Part Numbers

The C8051F38x family is designed to be a pin- and code-compatible replacement for the C8051F34x device family. Table 5 lists recommended replacement part numbers for C8051F34x devices.

Table 5. C8051F38x Replacement Part Numbers

C8051F34x Part Number	C8051F38x Part Number
C8051F340-GQ	C8051F380-GQ
C8051F341-GQ	C8051F382-GQ
C8051F342-GQ	C8051F381-GQ
C8051F342-GM	C8051F381-GM
C8051F343-GQ	C8051F383-GQ
C8051F343-GM	C8051F383-GM
C8051F344-GQ	C8051F380-GQ
C8051F345-GQ	C8051F382-GQ
C8051F346-GQ	C8051F381-GQ
C8051F346-GM	C8051F381-GM
C8051F347-GQ	C8051F383-GQ
C8051F347-GM	C8051F383-GM
C8051F348-GQ	C8051F386-GQ
C8051F349-GQ	C8051F387-GQ
C8051F349-GM	C8051F387-GM
C8051F34A-GQ	C8051F381-GQ
C8051F34A-GM	C8051F381-GM
C8051F34B-GQ	C8051F383-GQ
C8051F34B-GM	C8051F383-GM
C8051F34C-GQ	C8051F384-GQ
C8051F34D-GQ	C8051F385-GQ



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