

## MCS®-51 INSTRUCTION SET

Table 10. 8051 Instruction Set Summary

Interrupt Response Time: Refer to Hardware Description Chapter.

**Instructions that Affect Flag Settings<sup>(1)</sup>**

Instruction	Flag			Instruction	Flag		
	C	OV	AC		C	OV	AC
ADD	X	X	X	CLR C	O		
ADDC	X	X	X	CPL C	X		
SUBB	X	X	X	ANL C,bit	X		
MUL	O	X		ANL C,/bit	X		
DIV	O	X		ORL C,bit	X		
DA	X			ORL C,bit	X		
RRC	X			MOV C,bit	X		
RLC	X			CJNE	X		
SETB C	1						

(1)Note that operations on SFR byte address 208 or bit addresses 209-215 (i.e., the PSW or bits in the PSW) will also affect flag settings.

**Note on instruction set and addressing modes:**

- Rn — Register R7–R0 of the currently selected Register Bank.
- direct — 8-bit internal data location's address. This could be an Internal Data RAM location (0–127) or a SFR [i.e., I/O port, control register, status register, etc. (128–255)].
- @Ri — 8-bit internal data RAM location (0–255) addressed indirectly through register R1 or R0.
- #data — 8-bit constant included in instruction.
- #data 16 — 16-bit constant included in instruction.
- addr 16 — 16-bit destination address. Used by LCALL & LJMP. A branch can be anywhere within the 64K-byte Program Memory address space.
- addr 11 — 11-bit destination address. Used by ACALL & AJMP. The branch will be within the same 2K-byte page of program memory as the first byte of the following instruction.
- rel — Signed (two's complement) 8-bit offset byte. Used by SJMP and all conditional jumps. Range is –128 to +127 bytes relative to first byte of the following instruction.
- bit — Direct Addressed bit in Internal Data RAM or Special Function Register.

Mnemonic	Description	Byte	Oscillator Period
<b>ARITHMETIC OPERATIONS</b>			
ADD	A,Rn	Add register to Accumulator	1 12
ADD	A,direct	Add direct byte to Accumulator	2 12
ADD	A,@Ri	Add indirect RAM to Accumulator	1 12
ADD	A,#data	Add immediate data to Accumulator	2 12
ADDC	A,Rn	Add register to Accumulator with Carry	1 12
ADDC	A,direct	Add direct byte to Accumulator with Carry	2 12
ADDC	A,@Ri	Add indirect RAM to Accumulator with Carry	1 12
ADDC	A,#data	Add immediate data to Acc with Carry	2 12
SUBB	A,Rn	Subtract Register from Acc with borrow	1 12
SUBB	A,direct	Subtract direct byte from Acc with borrow	2 12
SUBB	A,@Ri	Subtract indirect RAM from ACC with borrow	1 12
SUBB	A,#data	Subtract immediate data from Acc with borrow	2 12
INC	A	Increment Accumulator	1 12
INC	Rn	Increment register	1 12
INC	direct	Increment direct byte	2 12
INC	@Ri	Increment direct RAM	1 12
DEC	A	Decrement Accumulator	1 12
DEC	Rn	Decrement Register	1 12
DEC	direct	Decrement direct byte	2 12
DEC	@Ri	Decrement indirect RAM	1 12

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**Table 10. 8051 Instruction Set Summary (Continued)**

Mnemonic	Description	Byte	Oscillator Period
<b>ARITHMETIC OPERATIONS (Continued)</b>			
INC DPTR	Increment Data Pointer	1	24
MUL AB	Multiply A & B	1	48
DIV AB	Divide A by B	1	48
DA A	Decimal Adjust Accumulator	1	12
<b>LOGICAL OPERATIONS</b>			
ANL A,Rn	AND Register to Accumulator	1	12
ANL A,direct	AND direct byte to Accumulator	2	12
ANL A,@Ri	AND indirect RAM to Accumulator	1	12
ANL A,#data	AND immediate data to Accumulator	2	12
ANL direct,A	AND Accumulator to direct byte	2	12
ANL direct,#data	AND immediate data to direct byte	3	24
ORL A,Rn	OR register to Accumulator	1	12
ORL A,direct	OR direct byte to Accumulator	2	12
ORL A,@Ri	OR indirect RAM to Accumulator	1	12
ORL A,#data	OR immediate data to Accumulator	2	12
ORL direct,A	OR Accumulator to direct byte	2	12
ORL direct,#data	OR immediate data to direct byte	3	24
XRL A,Rn	Exclusive-OR register to Accumulator	1	12
XRL A,direct	Exclusive-OR direct byte to Accumulator	2	12
XRL A,@Ri	Exclusive-OR indirect RAM to Accumulator	1	12
XRL A,#data	Exclusive-OR immediate data to Accumulator	2	12
XRL direct,A	Exclusive-OR Accumulator to direct byte	2	12
XRL direct,#data	Exclusive-OR immediate data to direct byte	3	24
CLR A	Clear Accumulator	1	12
CPL A	Complement Accumulator	1	12
<b>LOGICAL OPERATIONS (Continued)</b>			
RL A	Rotate Accumulator Left	1	12
RLC A	Rotate Accumulator Left through the Carry	1	12
RR A	Rotate Accumulator Right	1	12
RRC A	Rotate Accumulator Right through the Carry	1	12
SWAP A	Swap nibbles within the Accumulator	1	12
<b>DATA TRANSFER</b>			
MOV A,Rn	Move register to Accumulator	1	12
MOV A,direct	Move direct byte to Accumulator	2	12
MOV A,@Ri	Move indirect RAM to Accumulator	1	12
MOV A,#data	Move immediate data to Accumulator	2	12
MOV Rn,A	Move Accumulator to register	1	12
MOV Rn,direct	Move direct byte to register	2	24
MOV Rn,#data	Move immediate data to register	2	12
MOV direct,A	Move Accumulator to direct byte	2	12
MOV direct,Rn	Move register to direct byte	2	24
MOV direct,direct	Move direct byte to direct byte	3	24
MOV direct,@Ri	Move indirect RAM to direct byte	2	24
MOV direct,#data	Move immediate data to direct byte	3	24
MOV @Ri,A	Move Accumulator to indirect RAM	1	12

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**Table 10. 8051 Instruction Set Summary (Continued)**

Mnemonic	Description	Byte	Oscillator Period	Mnemonic	Description	Byte	Oscillator Period
<b>DATA TRANSFER (Continued)</b>				<b>BOOLEAN VARIABLE MANIPULATION</b>			
MOV	@Ri,direct Move direct byte to indirect RAM	2	24	CLR	C Clear Carry	1	12
MOV	@Ri,#data Move immediate data to indirect RAM	2	12	CLR	bit Clear direct bit	2	12
MOV	DPTR,#data16 Load Data Pointer with a 16-bit constant	3	24	SETB	C Set Carry	1	12
MOVC	A,@A+DPTR Move Code byte relative to DPTR to Acc	1	24	SETB	bit Set direct bit	2	12
MOVC	A,@A+PC Move Code byte relative to PC to Acc	1	24	CPL	C Complement Carry	1	12
MOVX	A,@Ri Move External RAM (8-bit addr) to Acc	1	24	CPL	bit Complement direct bit	2	12
MOVX	A,@DPTR Move External RAM (16-bit addr) to Acc	1	24	ANL	C,bit AND direct bit to CARRY	2	24
MOVX	@Ri,A Move Acc to External RAM (8-bit addr)	1	24	ANL	C,/bit AND complement of direct bit to Carry	2	24
MOVX	@DPTR,A Move Acc to External RAM (16-bit addr)	1	24	ORL	C,bit OR direct bit to Carry	2	24
PUSH	direct Push direct byte onto stack	2	24	ORL	C,/bit OR complement of direct bit to Carry	2	24
POP	direct Pop direct byte from stack	2	24	MOV	C,bit Move direct bit to Carry	2	12
XCH	A,Rn Exchange register with Accumulator	1	12	MOV	bit,C Move Carry to direct bit	2	24
XCH	A,direct Exchange direct byte with Accumulator	2	12	JC	rel Jump if Carry is set	2	24
XCH	A,@Ri Exchange indirect RAM with Accumulator	1	12	JNC	rel Jump if Carry not set	2	24
XCHD	A,@Ri Exchange low-order Digit indirect RAM with Acc	1	12	JB	bit,rel Jump if direct Bit is set	3	24
				JNB	bit,rel Jump if direct Bit is Not set	3	24
				JBC	bit,rel Jump if direct Bit is set & clear bit	3	24
				<b>PROGRAM BRANCHING</b>			
				ACALL	addr11 Absolute Subroutine Call	2	24
				LCALL	addr16 Long Subroutine Call	3	24
				RET	 Return from Subroutine	1	24
				RETI	 Return from interrupt	1	24
				AJMP	addr11 Absolute Jump	2	24
				LJMP	addr16 Long Jump	3	24
				SJMP	rel Short Jump (relative addr)	2	24

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**Table 10. 8051 Instruction Set Summary (Continued)**

Mnemonic	Description	Byte	Oscillator Period
<b>PROGRAM BRANCHING (Continued)</b>			
JMP @A+DPTR	Jump indirect relative to the DPTR	1	24
JZ rel	Jump if Accumulator is Zero	2	24
JNZ rel	Jump if Accumulator is Not Zero	2	24
CJNE A,direct,rel	Compare direct byte to Acc and Jump if Not Equal	3	24
CJNE A,#data,rel	Compare immediate to Acc and Jump if Not Equal	3	24

Mnemonic	Description	Byte	Oscillator Period
<b>PROGRAM BRANCHING (Continued)</b>			
CJNE Rn,#data,rel	Compare immediate to register and Jump if Not Equal	3	24
CJNE @Ri,#data,rel	Compare immediate to indirect and Jump if Not Equal	3	24
DJNZ Rn,rel	Decrement register and Jump if Not Zero	2	24
DJNZ direct,rel	Decrement direct byte and Jump if Not Zero	3	24
NOP	No Operation	1	12

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