Instruction set of Microcontroller 8051

Prof. Atul Oak

Addressing modes of 8051 Microcontroller

- What is addressing mode?
- Register Addressing mode → MOV A, R1
- Immediate Addressing mode → MOV R1, #30H
- Direct Addressing mode → MOV A, 30H
- Indirect Addressing mode → MOV A, @R0
  → MOVX A, @DPTR
- Indexed Addressing mode → MOVC A, @A+DPTR

Data Transfer instructions

Mnemonic	Description	Byte	Oscillator period	Example
MOV A, Rn	Move register to accumulator	1	12	MOV A, R1
MOV A, direct	Move direct byte to accumulator	2	12	MOV A, 07H
MOV A, @Ri	Move indirect RAM address to accumulator	1	12	MOV A, @R1
MOV A, #data	Move immediate data to accumulator	2	12	MOV A, #25H
PUSH direct	Push direct byte onto the stack	2	24	PUSH 03H
POP direct	POP direct byte from the stack	2	24	POP 03H
XCH A, Rn	Exchange register with accumulator	1	12	XCH A, R1
XCH A, direct	Exchange direct byte with accumulator	2	12	XCH A, 3BH
XCH A, @Ri	Exchange indirect RAM address with accumulator	1	12	XCH A, @R0

Data Transfer instructions

Mnemonic	Description	Byte	Oscillator period	Example
MOV Rn, Direct	Move Direct byte to register	2	24	MOV R7,18H
MOV Rn, #Data	Move immediate data to register	2	12	MOV R6, #0FFH
MOV Direct, A	Move accumulator to direct byte	2	12	MOV 11H, A
MOV Direct, Rn	Move content of register to direct address	2	24	MOV 30H, R1
MOV Direct, @Ri	Move indirect RAM address to Direct address	2	24	MOV 30H, @R1
MOV Rn, A	Move content of accumulator to register	1	12	MOV R2,A
MOV direct, direct	Move direct byte to direct byte	3	24	MOV 30H, 40H

Data Transfer instructions

Mnemonic	Description	Byte	Oscillator period	Example
MOV direct, #data	Move immediate data to direct byte	3	24	MOV 40H, #20H
MOV @Ri, A	Move accumulator to indirect RAM	1	12	MOV @R0, A
MOV @Ri, direct	Move direct byte to indirect RAM	2	24	MOV @R0, 45H
MOV @Ri, #data	Move immediate data to indirect RAM	2	12	MOV @R0, #55H
MOV DPTR, #data 16	Load Data Pointer with 16 bit constant	3	24	MOV DPTR, #1000H

Arithmetic instructions

Mnemonic	Description	Byte	Oscillator period	Example
ADD A, Rn	Add register to accumulator	1	12	ADD A, R1
ADD A, direct	Add direct byte to accumulator	2	12	ADD A, 18H
ADD A, @Ri	Add indirect RAM address to accumulator	1	12	ADD A, @R1
ADD A, #data	Add immediate data to accumulator	2	12	ADD A, #25H
ADDC A, Rn	Add register to accumulator with carry	1	12	ADDC A, R1
ADDC A, direct	Add direct byte to accumulator with carry	2	12	ADDC A, 18H
ADDC A, @Ri	Add indirect RAM address to accumulator with carry	1	12	ADDC A, @R1
ADDC A, #data	Add immediate data to accumulator with carry	2	12	ADDC A, #25H

Arithmetic instructions

Mnemonic	Description	Byte	Oscillator period	Example
SUBB A, Rn	subtract register from accumulator with borrow	1	12	SUBB A, R1
SUBB A, direct	Subtract direct byte from accumulator with borrow	2	12	SUBB A, 18H
SUBB A, @Ri	subtract indirect RAM address from accumulator with borrow	1	12	SUBB A, @R1
SUBB A, #data	subtract immediate data from accumulator with borrow	2	12	SUBB A, #25H

Arithmetic instructions

Mnemonic	Description	Byte	Oscillator period	Example
MUL AB	Multiply registers content of A & B	1	48	MUL AB
DIV AB	Divide Register content of A by B	1	48	DIV AB
DA A	Decimal Adjust Accumulator	1	12	DA A

Arithmetic instructions

Mnemonic	Description	Byte	Oscillator period	Example
INC A	Increment Accumulator by 1	1	12	INC A
INC Rn	Increment register by 1	1	12	INC R2
INC Direct	Increment Direct byte by 1	2	12	INC F1H
INC @Ri	Increment content of RAM location by 1	1	12	INC @R0
INC DPTR	Increment data pointer by 1	1	24	INC DPTR
DEC A	Decrement Accumulator by 1	1	12	DEC A
DEC Rn	Decrement register by 1	1	12	DEC R2
DEC Direct	Decrement Direct byte by 1	2	12	DEC F1H
DEC @Ri	Decrement content of RAM location by 1	1	12	DEC @R0

Logic instructions

Mnemonic	Description	Byte	Oscillator period	Example
ANL A, Rn	Logical AND register Rn to accumulator	1	12	ANL A, R2
ANL A, direct	Logical AND direct byte to accumulator	2	12	ANL A, 20H
ANL A, @Ri	Logical AND indirect address with accumulator	1	12	ANL A, @R0
ANL A, #data	Logical AND immediate data to accumulator	2	12	ANL A, #44H
ORL A, Rn	Logical OR register Rn to accumulator	1	12	ORL A, R2
ORL A, direct	Logical OR direct byte to accumulator	2	12	ORL A, 20H
ORL A, @Ri	Logical OR indirect address with accumulator	1	12	ORL A, @R0
ORL A, #data	Logical OR immediate data to accumulator	2	12	ORL A, #44H

Logic instructions

Mnemonic	Description	Byte	Oscillator period	Example
XRL A, Rn	Logical EXOR register Rn to accumulator	1	12	XRL A, R2
XRL A, direct	Logical EXOR direct byte to accumulator	2	12	XRL A, 20H
XRL A, @Ri	Logical EXOR indirect address with accumulator	1	12	XRL A, @R0
XRL A, #data	Logical EXOR immediate data to accumulator	2	12	XRL A, #44H
CLR A	Clear Accumulator to zero	1	12	CLR A
CPL A	Complement accumulator	1	12	CPL A
NOP	This instruction performs no operation & execution continues with next instruction this instruction used in delay routines	1	24	NOP

Logic instructions

Mnemonic	Description	Byte	Oscillator period	Example
ANL Direct, A	Logical AND accumulator with direct byte	2	12	ANL 40H, A
ANL direct, #data	Logical AND immediate data to direct byte	3	24	ANL 40H, #50H
ORL Direct, A	Logical OR accumulator to direct byte	2	12	ORL 30H, A
ORL Direct , #data	Logical OR immediate data to direct byte	3	24	ORL 40H, #40H
XRL Direct, A	Logical EXOR accumulator to direct byte	2	12	XRL 40H, A
XRL Direct, #data	Logical EXOR immediate data with direct byte	3	24	XRL 40H, #40H

Logic instructions

Mnemonic	Description	Byte	Oscillator period	Example
RL A	Rotate accumulator left without carry	1	12	RL A
RLC A	Rotate accumulator left through carry	1	12	RLC A
RR A	Rotate accumulator right without carry	1	12	RR A
RRC A	Rotate accumulator right through carry	1	12	RRC A
SWAP A	Interchange lower 4 bits with higher 4 bits in accumulator	1	12	SWAP A

Program flow control instructions

Mnemonic	Description	Byte	Oscillator period	Example
CJNE A, direct,rel	Compare direct byte to accumulator & if not equal it jumps to target address	3	24	CJNE A, 32H,loop
CJNE A, #data, rel	Compare given data with content of accumulator & if not equal jumps to target address	3	24	CJNE A, #12H,loop
CJNE Rn, #data , rel	Compare immediate data with register & jump to target address if not equal	3	24	CJNE R2 ,#12H,loop
CJNE @Ri, #data, rel	Compare immediate data with indirect RAM & jump if not equal to target address	3	24	CJNE @R1, #11H,loop
DJNZ Rn ,rel	Decrement the register by 1 & jump to target address if not zero	2	24	DJNZ R3 , loop
DJNZ direct , rel	Decrement content of address by 1 & jump to target if not zero	3	24	DJNZ 11H , loop

Bit Manipulation instructions

Mnemonic	Description	Byte	Oscillator period	Example
SETB C	Set bit carry flag	1	12	SETB C
SETB bit	Set direct bit	2	12	SETB ACC.5
CPL C	Complement carry	1	12	CPL C
CPL bit	Complement direct bit	2	12	CPL P2.5
SJMP rel	Jump to target address	2	24	SJMP loop
LCALL rel	Long subroutine call , subroutine can be anywhere in 64KB of program memory	3	24	LCALL loop
JMP @A + DPTR	Jump to target with content of accumulator & data pointer loaded in PC	1	24	JMP @A+DPTR

Program flow control instructions

Mnemonic	Description	Byte	Oscillator period	Example
JC rel	Jump if carry to relative address	2	24	JC loop
JNC rel	Jump if no carry to relative address	2	24	JNC loop
JB bit, rel	Jump if direct bit is set to relative address	3	24	JB ACC.0, loop
JNB bit, rel	Jump if direct bit is reset to relative address	3	24	JNB ACC.0, loop
JBC bit, rel	Jump if direct bit is set to relative address and clear	3	24	JBC ACC.4, loop
JZ rel	Jump if accumulator is zero to relative address	2	24	JZ loop
JNZ rel	Jump if accumulator is not zero to relative address	2	24	JNZ loop

Bit Manipulation instructions

Mnemonic	Description	Byte	Oscillator period	Example
ANL C, bit	Logical AND direct bit to carry flag	2	24	ANL C, P2.1
ANL C, /bit	Logical AND complement of direct bit to carry flag	2	24	ANL C,/P2.5
ORL C, bit	Logical OR direct bit to carry	2	24	ORL C, P2.4
ORL C, /bit	Logical OR complement of direct bit to carry flag	2	24	ORL C,/P2.4
MOV C, bit	Move direct bit to carry	2	12	MOV C, P2.5
MOV bit, C	Move carry flag to direct bit	2	12	MOV P2.4,C
CLR C	Clear carry flag	1	12	CLR C
CLR bit	Clear direct bit	2	12	CLR ACC.5

Data transfer instructions

Mnemonic	Description	Byte	Oscillator period	Example
MOVC A, @A+PC	Moves byte of data located in code area to accumulator. The address of byte is addition of PC with content of acc	1	24	MOVC A, @A + PC
MOVX A, @Ri	This instruction moves a byte from external memory whose 8 bit address is pointed by R0 or R1 to accumulator	1	24	MOVX A, @R1
MOVX A, @DPTR	This instruction moves a byte from external memory whose 16 bit address is pointed by DPTR into accumulator	1	24	MOVX A, @DPTR
MOVX @Ri , A	This instruction moves the byte from the accumulator to an external memory location whose address is pointed by R1 or R0	1	24	MOVX @R0 , A
MOVX @DPTR, A	This instruction is used to move content of accumulator to location in external memory pointed by DPTR	1	24	MOVX @DPTR , A

Data transfer instructions

Mnemonic	Description	Byte	Oscillator period	Example
LCALL rel	Long subroutine call , subroutine can be anywhere in 64KB of program memory	3	24	LCALL loop
LJMP	Long jump used to jump to any location In 64KB address space, control do not return unlike LCALL	3	24	LJMP loop
RET	Return from subroutine previously called by CALL instruction. The top two bytes of stack are popped into PC and program execution continues at new address. SP is decremented by 2	1	24	RET
RETI	Return from interrupt used at end of ISR. The top two bytes are popped into PC and program continues at this new address. SP is decremented by 2	1	24	RETI