CSE-3103: Microprocessor and Microcontroller

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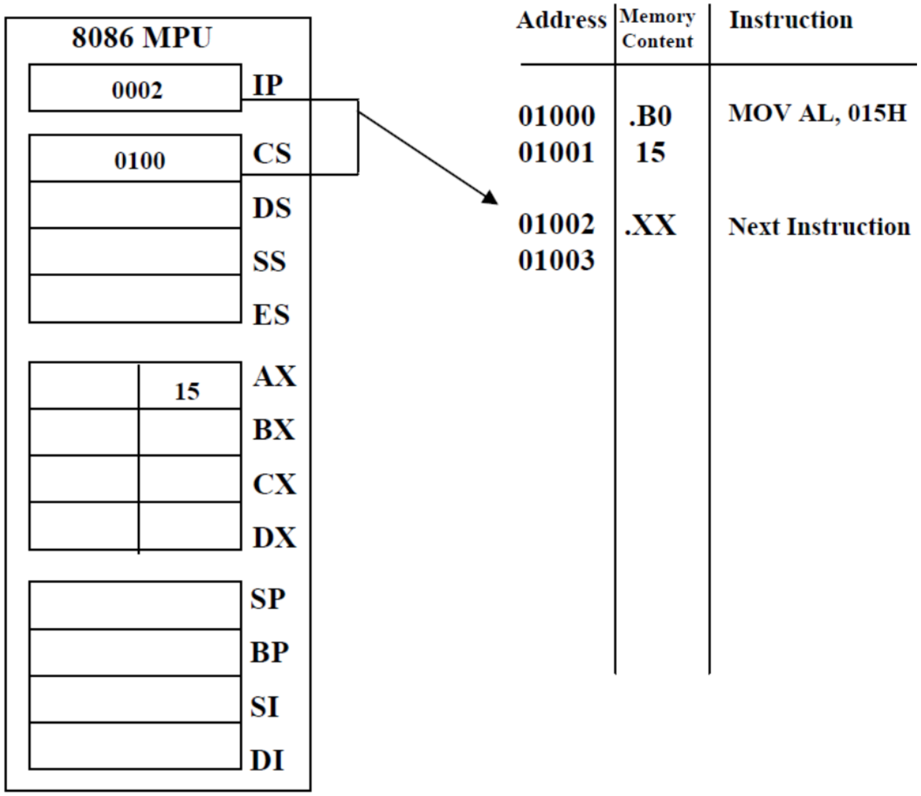
Immediate Addressing Mode

Operands are specified within instructions.

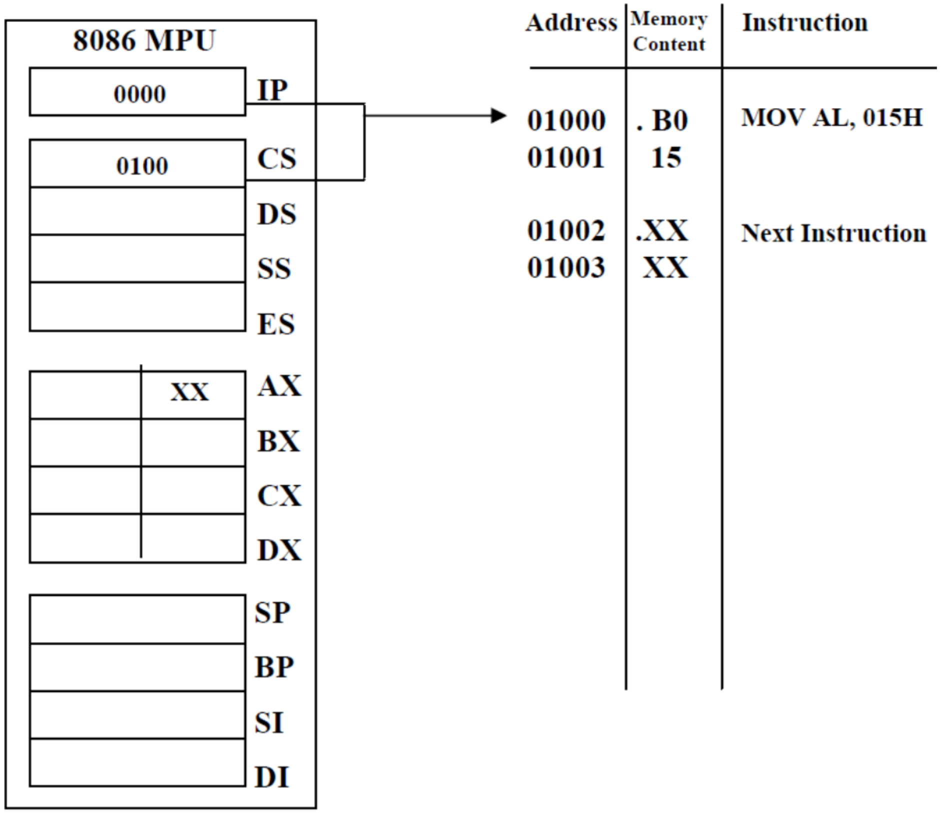
Example →

MOV AL, 15H

ADD AX, 0B14H



Address	Memory Content	Instruction
01000	.B0	MOV AL, 015H
01001	15	
01002	.XX	Next Instruction
01003		



Address	Memory Content	Instruction
01000	. B0	MOV AL, 015H
01001	15	
01002	.XX	Next Instruction
01003	XX	

Register Addressing Mode

Operands are stored within any of internal registers.

Example →

MOV AX, BX
ADD AL, BL

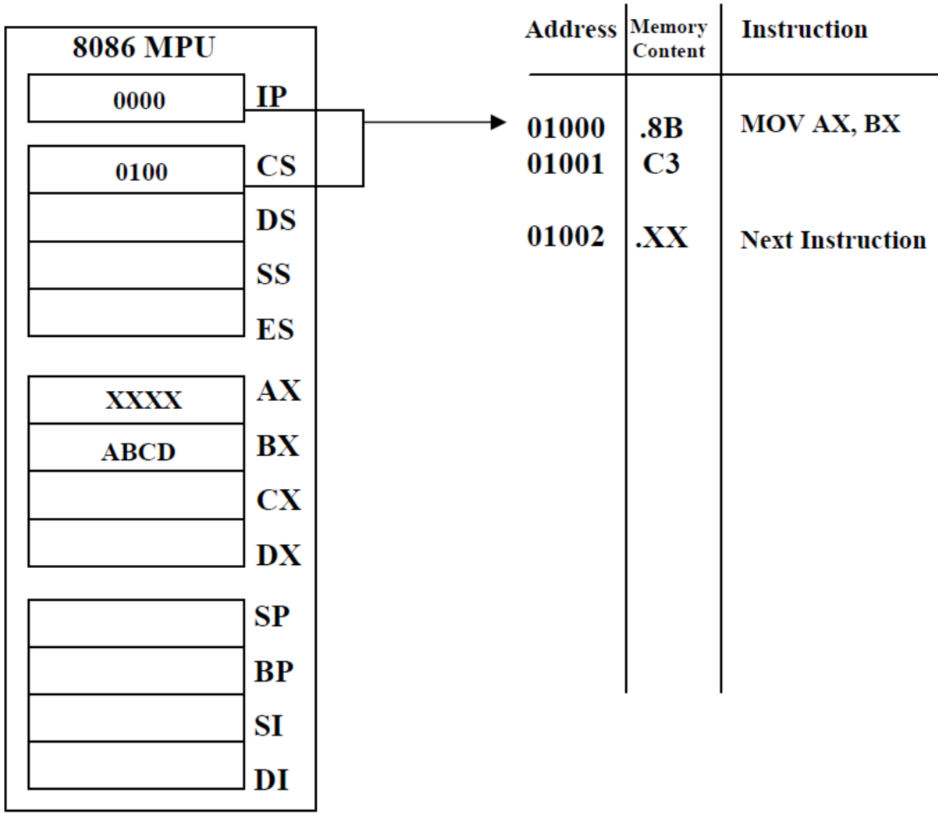
8-bit register →

AH, AL, BH, BL, CH, CL, DH, DL.

16-bit register →

AX, BX, CX, DX, SP, BP, SI, DI.

Instructions have to use same size registers.



Address	Memory Content	Instruction
01000	.8B	MOV AX, BX
01001	C3	
01002	.XX	Next Instruction

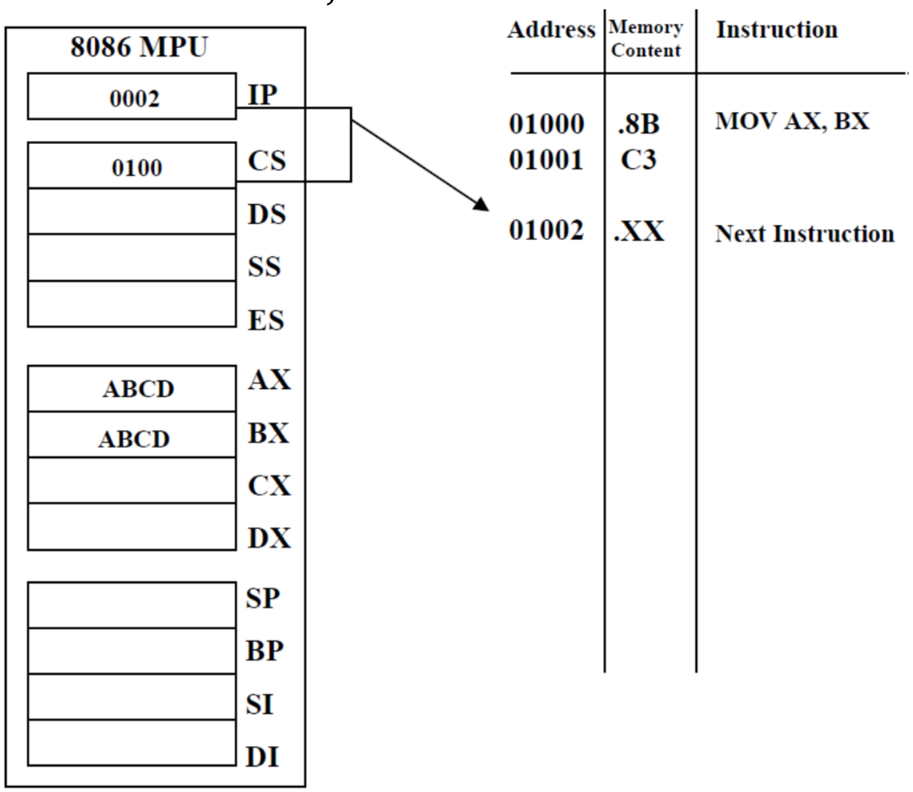
Register Addressing Mode

Operands are stored within any of internal registers.

Example →

MOV AX, BX

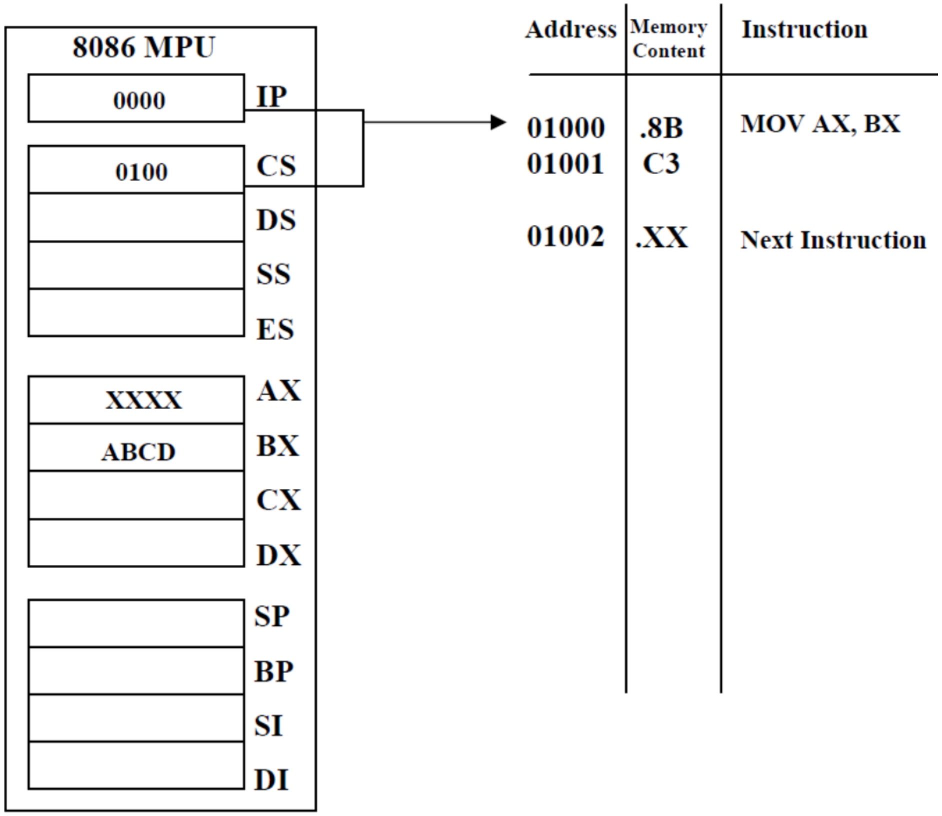
ADD AL, BL



8086 MPU

Register	Content
IP	0002
CS	0100
DS	
SS	
ES	
AX	ABCD
BX	ABCD
CX	
DX	
SP	
BP	
SI	
DI	

Address	Memory Content	Instruction
01000	.8B	MOV AX, BX
01001	C3	
01002	.XX	Next Instruction



8086 MPU

Register	Content
IP	0000
CS	0100
DS	
SS	
ES	
AX	XXXX
BX	ABCD
CX	
DX	
SP	
BP	
SI	
DI	

Address	Memory Content	Instruction
01000	.8B	MOV AX, BX
01001	C3	
01002	.XX	Next Instruction

Direct Addressing Mode

16-bit offset address is directly specified in instruction.

Example →

MOV CX, BETA

physical address = DS×10H + 1234H

= 0200×10H + 1234H

= 03234H

CL ← [03234H]

CH ← [03235H]

PA = Base segment : Direct address.

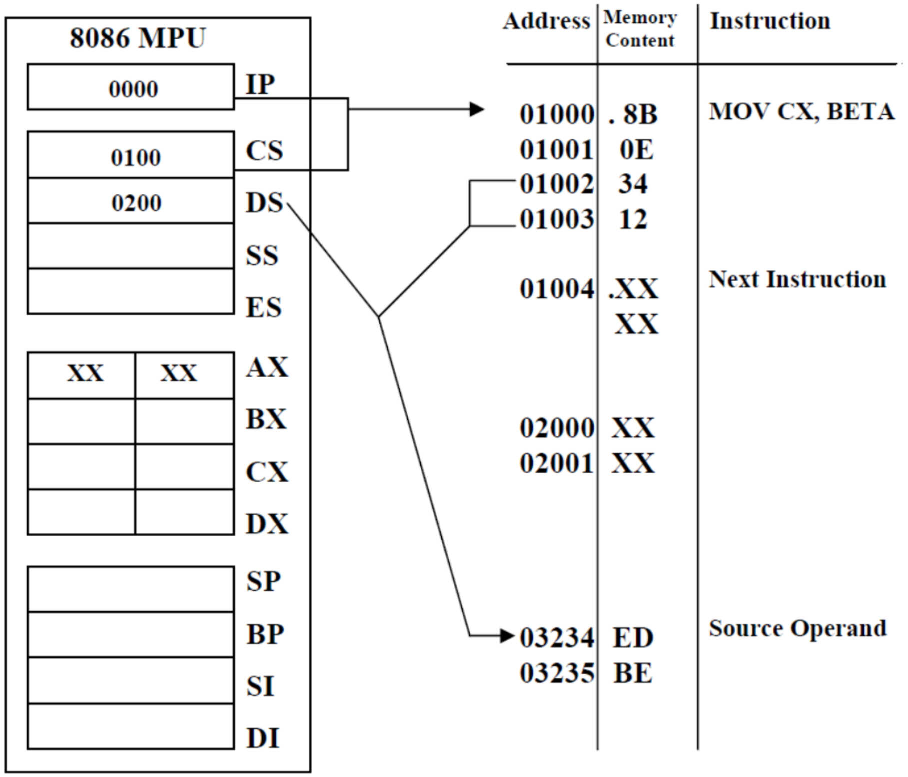
= DS/ES/SS : EA

Memory address →

default segment address = DS

alternate segment address = SEG (ES/SS).

SEG = segment override prefix.



8086 MPU

IP 0000

CS 0100

DS 0200

SS

ES

AX XX XX

BX

CX

DX

SP

BP

SI

DI

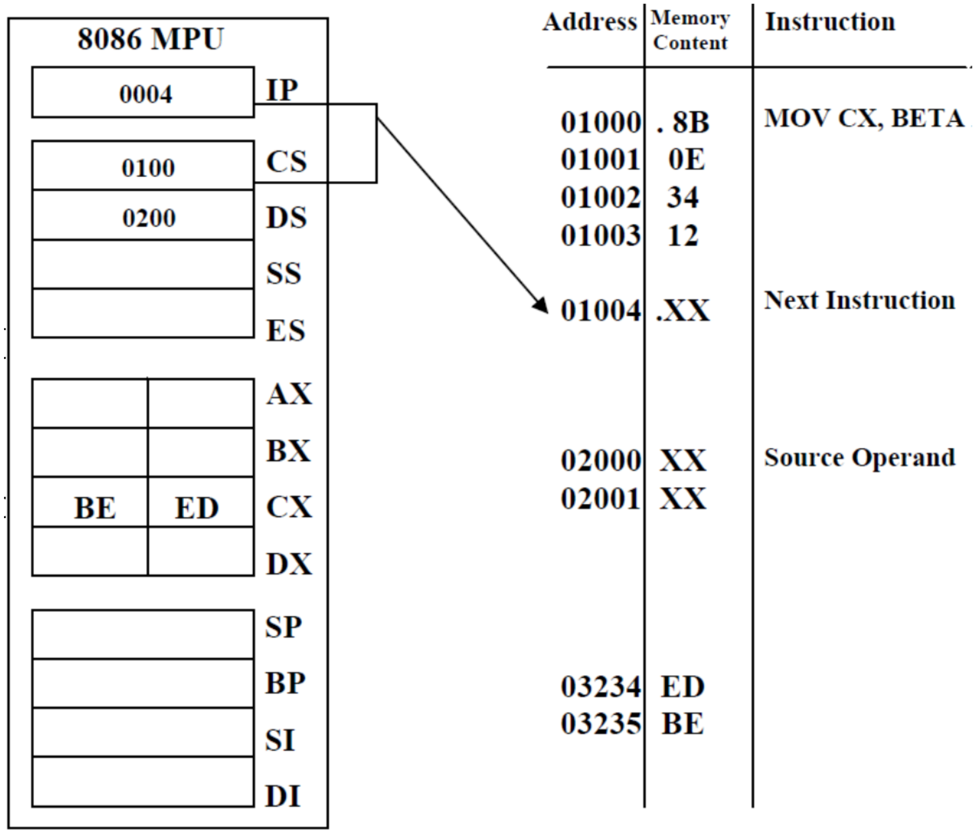
Address	Memory Content	Instruction
01000	. 8B	MOV CX, BETA
01001	0E	
01002	34	
01003	12	
01004	.XX	Next Instruction
	XX	
02000	XX	
02001	XX	
03234	ED	Source Operand
03235	BE	

Direct Addressing Mode

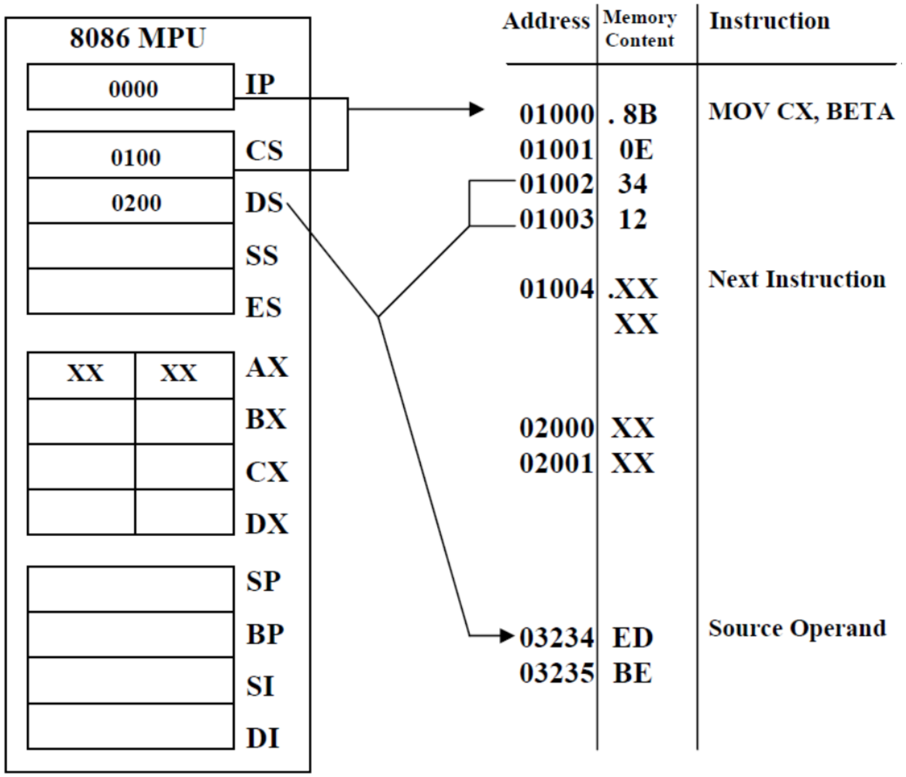
16-bit offset address is directly specified in instruction.

Example →

MOV CX, BETA



Address	Memory Content	Instruction
01000	. 8B	MOV CX, BETA
01001	0E	
01002	34	
01003	12	
01004	.XX	Next Instruction
02000	XX	Source Operand
02001	XX	
03234	ED	
03235	BE	



Address	Memory Content	Instruction
01000	. 8B	MOV CX, BETA
01001	0E	
01002	34	
01003	12	
01004	.XX	Next Instruction
	XX	
02000	XX	
02001	XX	
03234	ED	Source Operand
03235	BE	

Register Indirect Addressing Mode

Data is available at address →

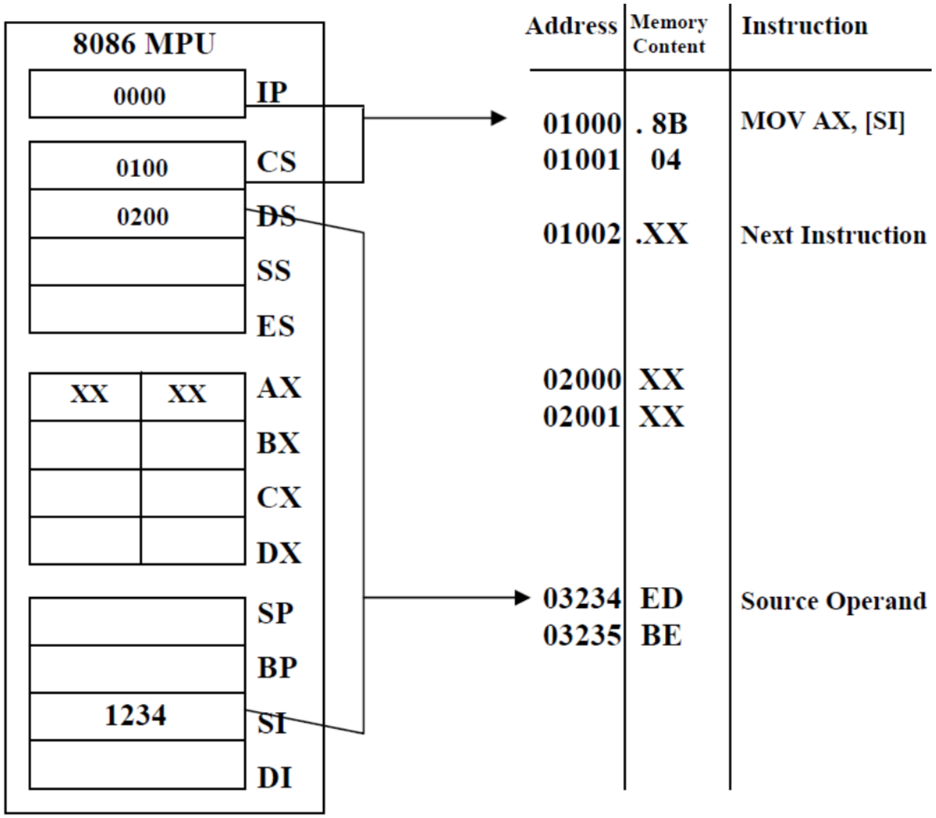
offset address → BX, SI or DI.
segment → DS (default) or ES.
another option → SS : BP

Difference →

direct addressing →
EA = constant
register indirect addressing →
EA = variable.

Example →

MOV AX, [SI]
physical address = DS×10H + SI
= 0200×10H + 1234H
= 03234H



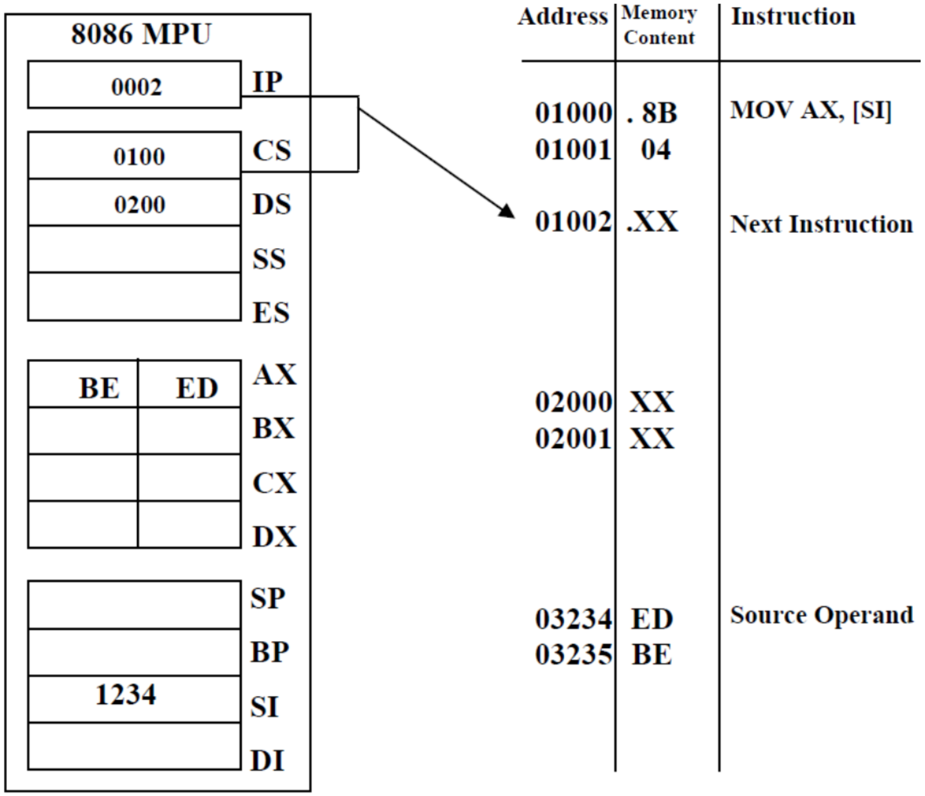
Address	Memory Content	Instruction
01000	. 8B	MOV AX, [SI]
01001	04	
01002	.XX	Next Instruction
02000	XX	
02001	XX	
03234	ED	Source Operand
03235	BE	

direct addressing:
MOV CX, [BETA]

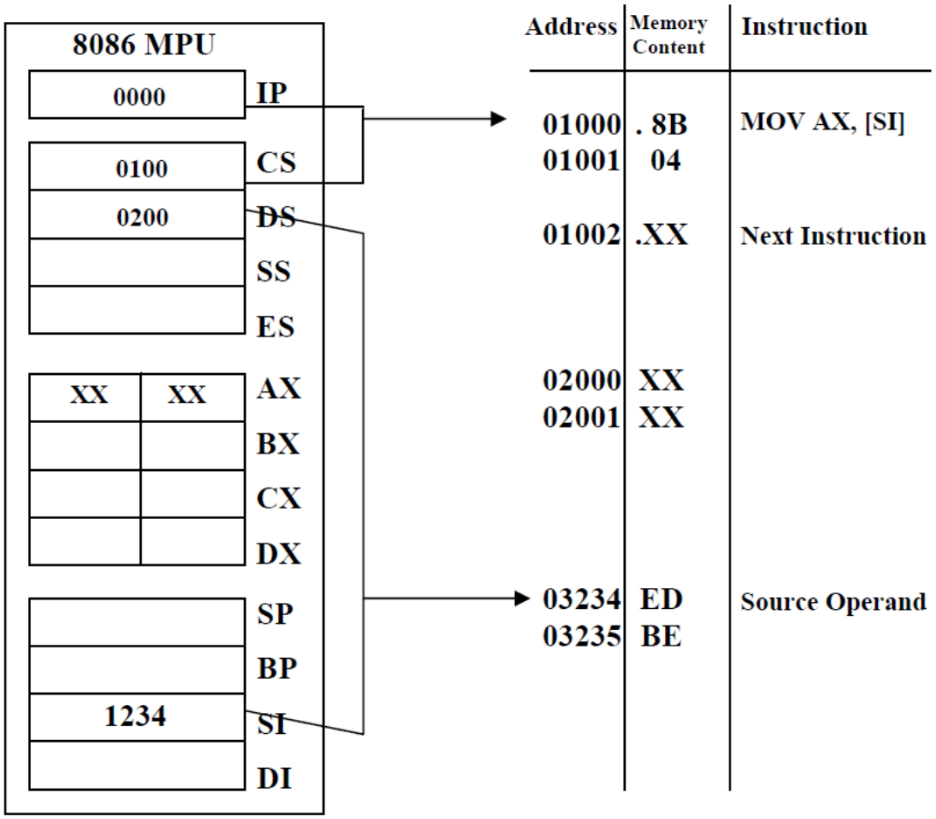
Register Indirect Addressing Mode

Example →

MOV AX, [SI]



Address	Memory Content	Instruction
01000	. 8B	MOV AX, [SI]
01001	04	
01002	.XX	Next Instruction
02000	XX	
02001	XX	
03234	ED	Source Operand
03235	BE	



Address	Memory Content	Instruction
01000	. 8B	MOV AX, [SI]
01001	04	
01002	.XX	Next Instruction
02000	XX	
02001	XX	
03234	ED	Source Operand
03235	BE	

Based Addressing Mode

Operand offset address →

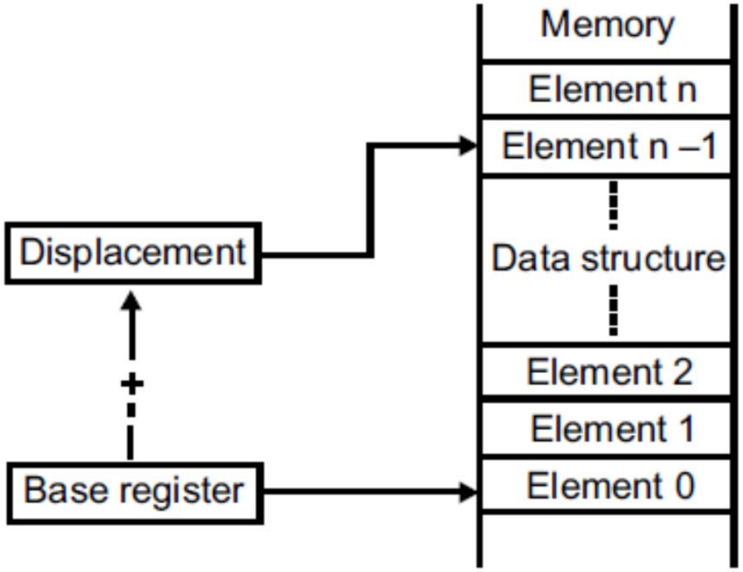
BX/BP registers + 8-bit/16-bit displacement.

Default segment address →

DS for BX.

SS for BP.

PA = Base segment : Base + Displacement



Change displacement value →

access different elements within same data structure.

Change base register value →

access same element in another data structure.

Example →

MOV [BX].BETA, AL

physical address = DS×10H + [BX] + BETA

= 0200×10H + 1000H + 1234H

= 04234H

Based Addressing Mode

Operand offset address →

BX/BP registers + 8-bit/16-bit displacement.

Default segment address →

DS for BX.

SS for BP.

PA = Base segment : Base + Displacement

Change displacement value →

access different elements within same data structure.

Change base register value →

access same element in another data structure.

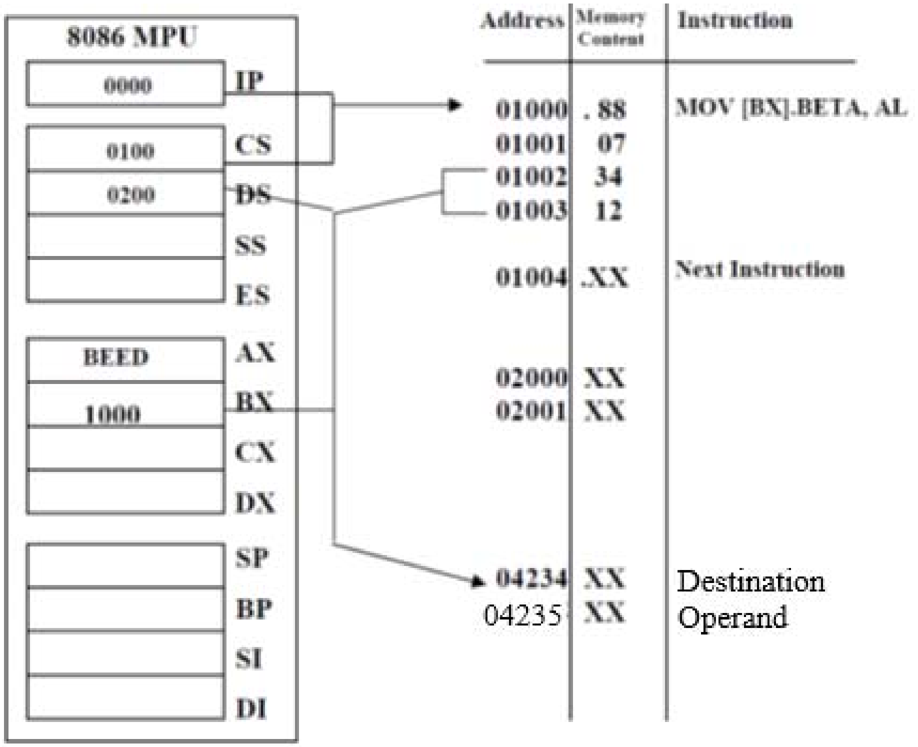
Example →

MOV [BX].BETA, AL

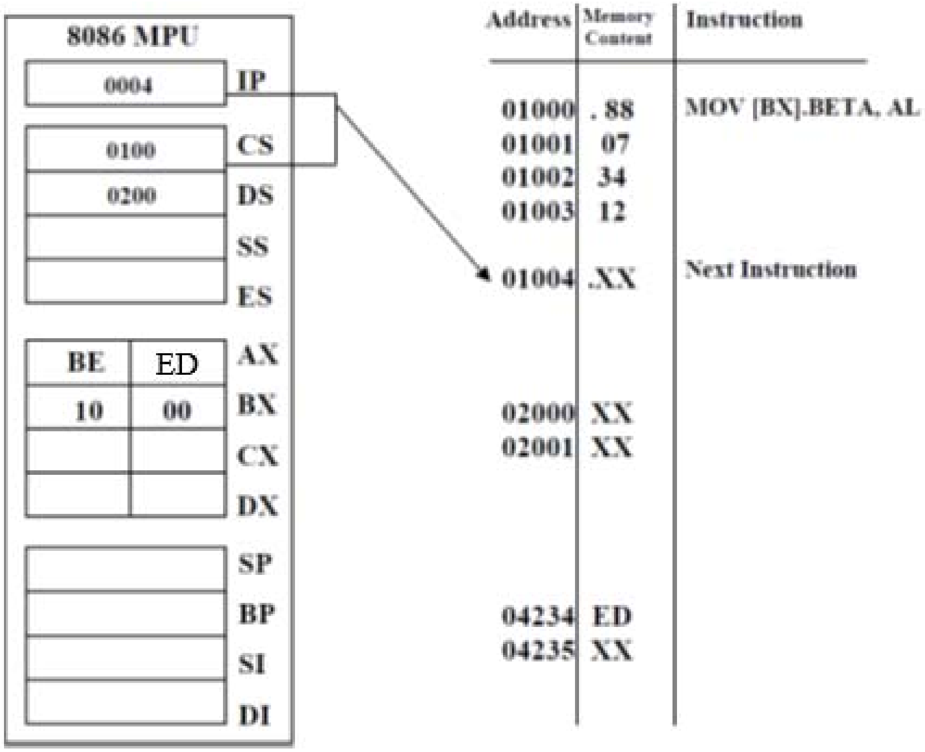
physical address = DS×10H + [BX] + BETA

= 0200×10H + 1000H + 1234H

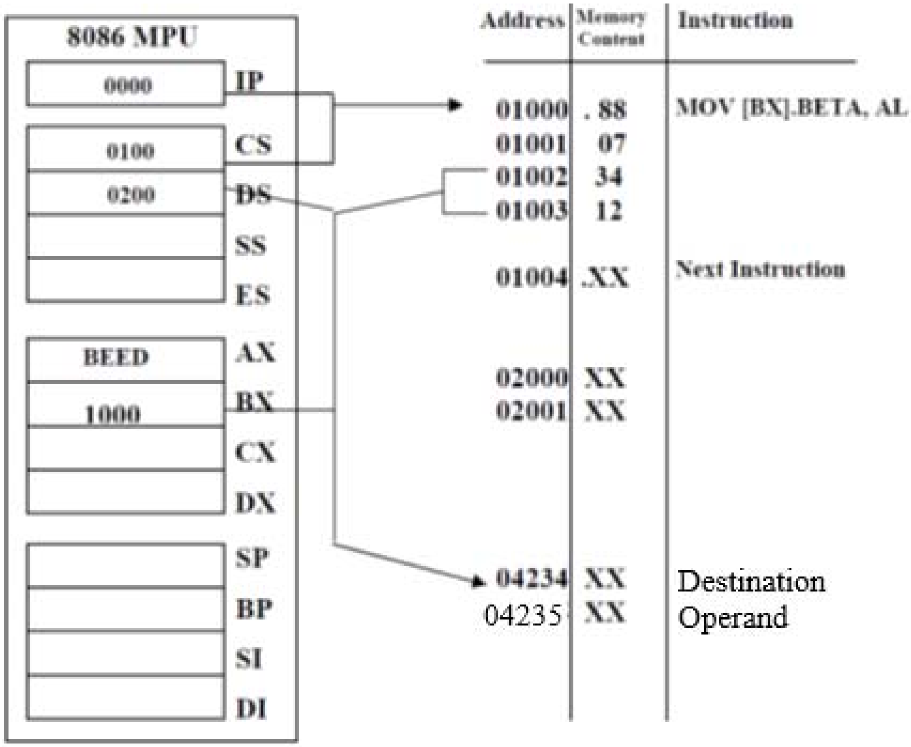
= 04234H



Based Addressing Mode



Address	Memory Content	Instruction
01000	. 88	MOV [BX].BETA, AL
01001	07	
01002	34	
01003	12	
01004	.XX	Next Instruction
02000	XX	
02001	XX	
04234	ED	
04235	XX	



Address	Memory Content	Instruction
01000	. 88	MOV [BX].BETA, AL
01001	07	
01002	34	
01003	12	
01004	.XX	Next Instruction
02000	XX	
02001	XX	
04234	XX	Destination Operand
04235	XX	

Example →

MOV [BX].BETA, AL

physical address = DS×10H + [BX] + BETA

= 0200×10H + 1000H + 1234H

= 04234H

Indexed Addressing Mode

Operand offset address →

SI or DI register + 8-bit/16-bit displacements.

Default segment address →

DS for SI.

ES for DI.

PA = Base segment : Index + Displacement

Change index register value →

access different elements within same data structure.

Change displacement value →

access same element in another data structure.

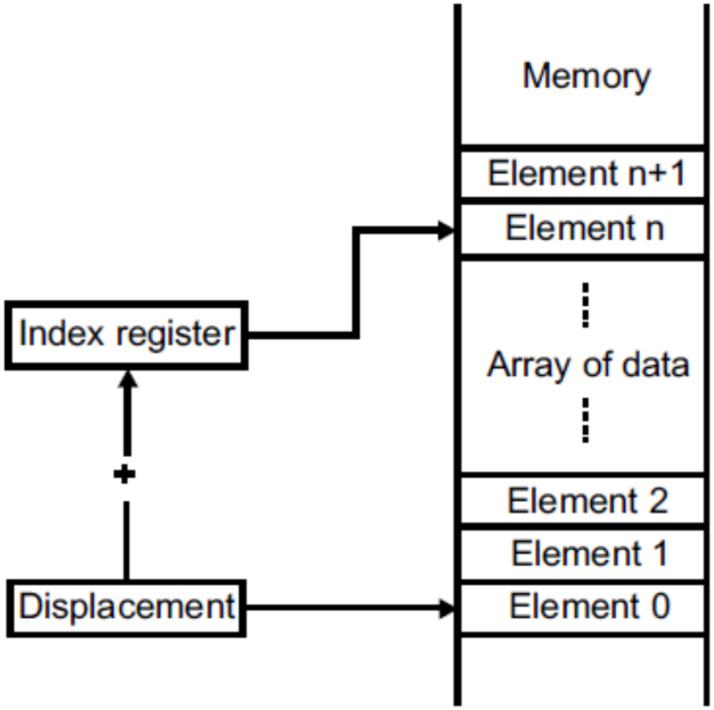
Example →

MOV AL, ARRAY[SI]

physical address = DS×10H + [SI] + ARRAY

= 0200×10H + 2000H + 1234H

= 05234H



Indexed Addressing Mode

Operand offset address →

SI or DI register + 8-bit/16-bit displacements.

Default segment address →

DS for SI.

ES for DI.

PA = Base segment : Index + Displacement

Change index register value →

access different elements within same data structure.

Change displacement value →

access same element in another data structure.

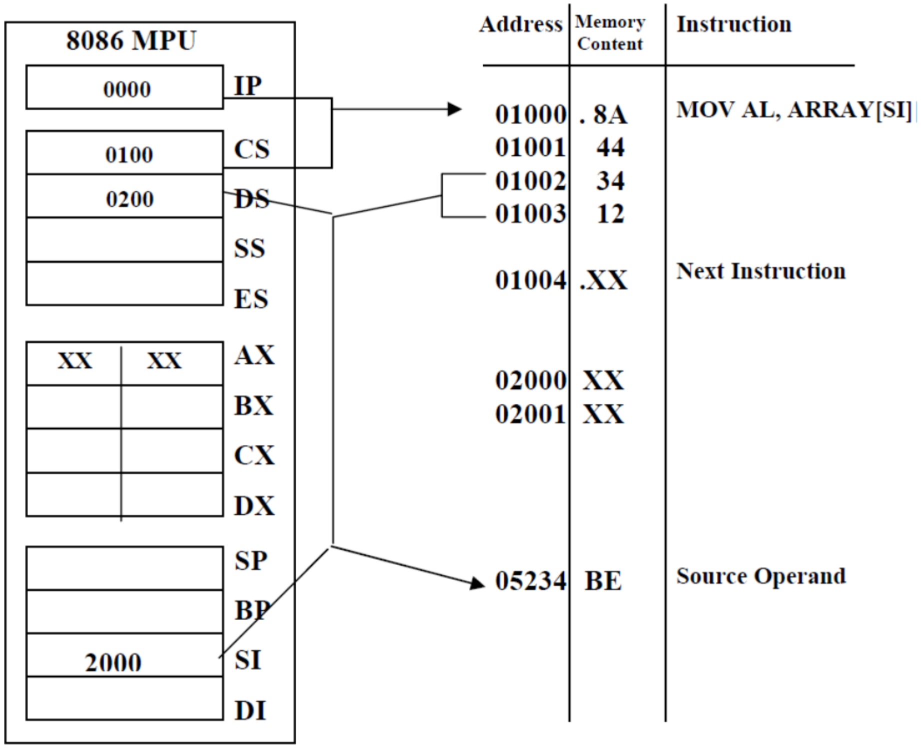
Example →

MOV AL, ARRAY[SI]

physical address = DS×10H + [SI] + ARRAY

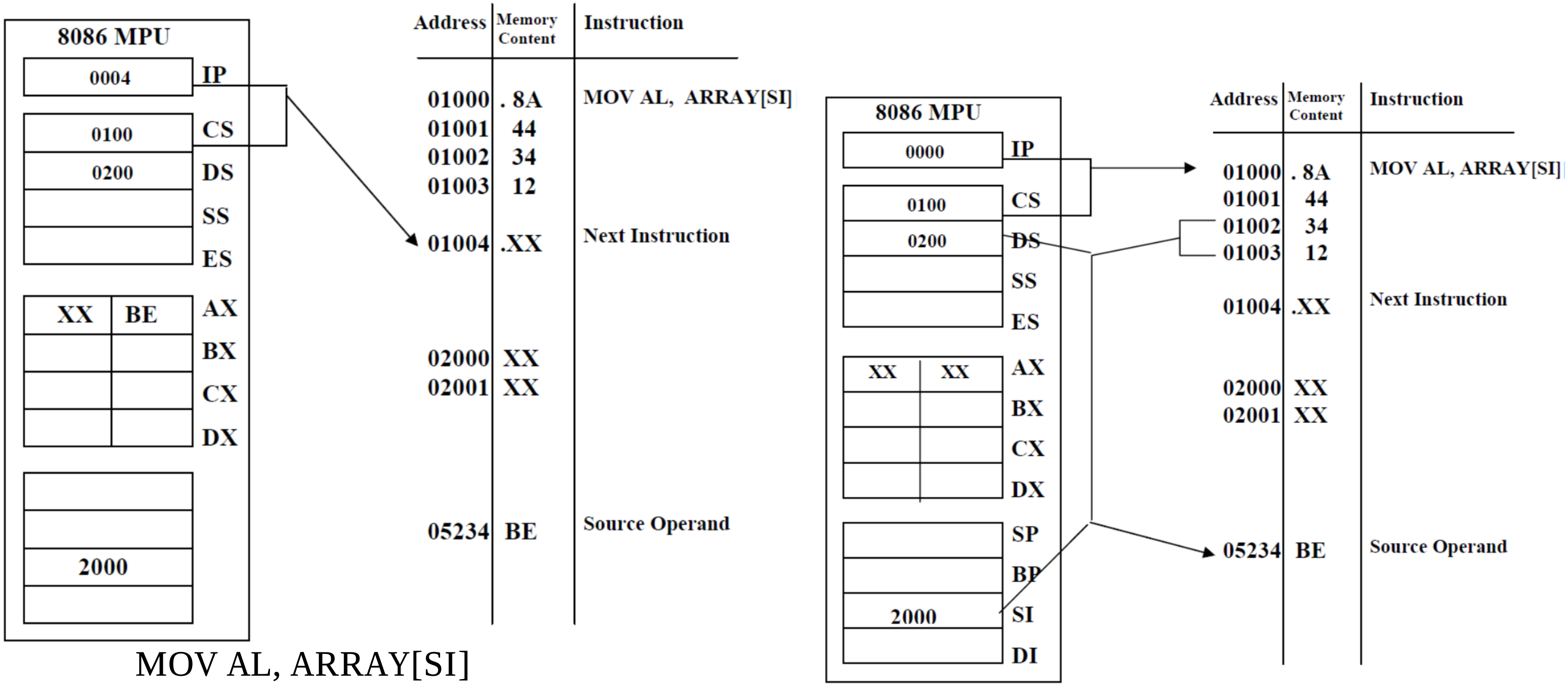
= 0200×10H + 2000H + 1234H

= 05234H



Address	Memory Content	Instruction
01000	. 8A	MOV AL, ARRAY[SI]
01001	44	
01002	34	
01003	12	
01004	.XX	Next Instruction
02000	XX	
02001	XX	
05234	BE	Source Operand

Indexed Addressing Mode



Address	Memory Content	Instruction
01000	. 8A	MOV AL, ARRAY[SI]
01001	44	
01002	34	
01003	12	
01004	.XX	Next Instruction
02000	XX	
02001	XX	
05234	BE	Source Operand

Address	Memory Content	Instruction
01000	. 8A	MOV AL, ARRAY[SI]
01001	44	
01002	34	
01003	12	
01004	.XX	Next Instruction
02000	XX	
02001	XX	
05234	BE	Source Operand

MOV AL, ARRAY[SI]

physical address = DS×10H + [SI] + ARRAY

= 0200×10H + 2000H + 1234H

= 05234H

Based Indexed Addressing Mode

Based indexed addressing = based addressing + indexed addressing.

Offset address →

Base register (BX or BP) + Index register (SI or DI).

Segment address →

DS or SS.

PA = Base segment : Base + Index
= DS : BX + SI or
= SS : BP + DI

Example →

MOV AL, [BX].[SI]

physical address = DS×10H + [BX] + [SI]
= 0300×10H + 1000H + 1234H
= 05234H

Relative Based Indexed Addressing

Offset address →

BX or BP + SI or DI
+ 8- or 16-bit displacement.

Segment address →

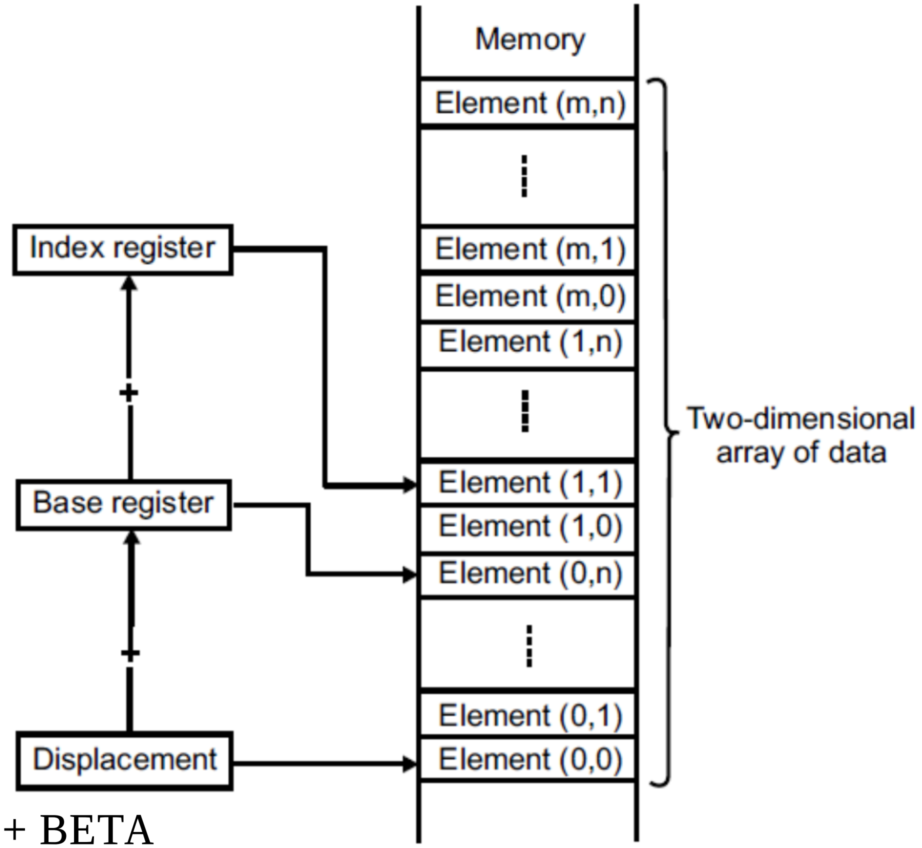
DS or SS.

PA = Base segment : Base + Index
+ Displacement

Used to access 2-D (m×n) array.
Displacement = starting position of array.
Base register = one coordinate (say m),
Index register = other coordinate (say n).

Example →

MOV AH, [BX] [SI] + BETA
physical address = DS×10H + [BX] + [SI] + BETA
= 0200×10H + 1000H + 2000H + 1234H
= 06234H



Relative Based Indexed Addressing

Offset address →

BX or BP + SI or DI

+ 8- or 16-bit displacement.

Segment address →

DS or SS.

PA = Base segment : Base + Index

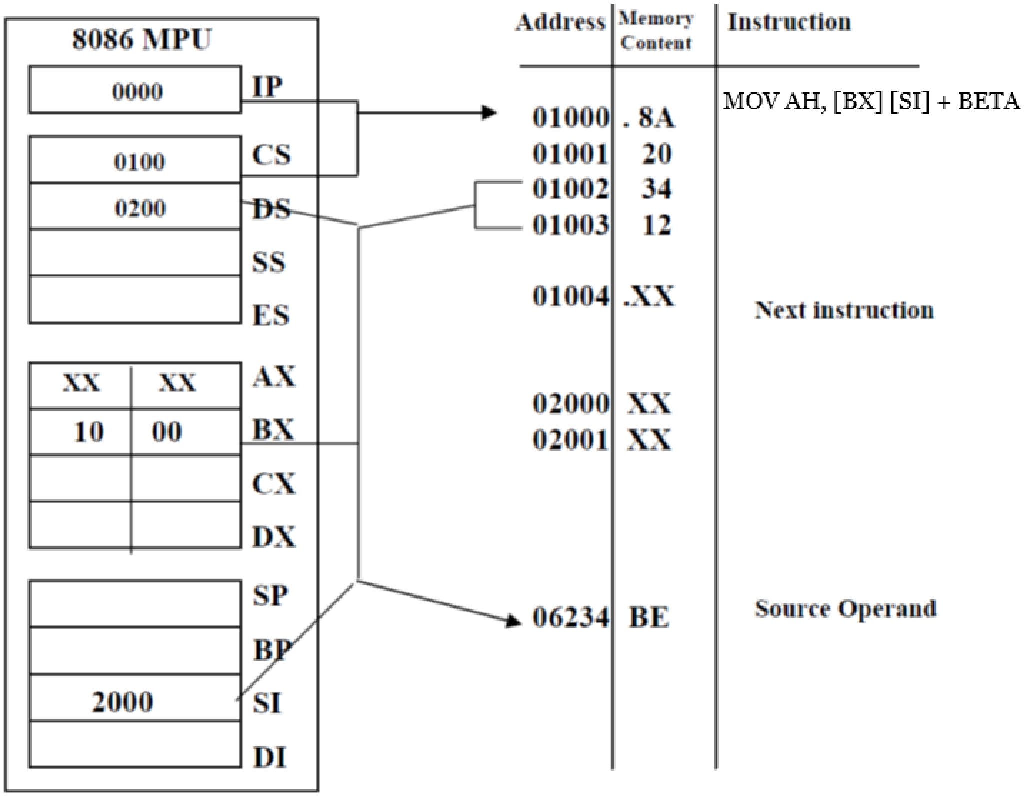
+ Displacement

Used to access 2-D (m×n) array.

Displacement = starting position of array.

Base register = one coordinate (say m),

Index register = other coordinate (say n).



Address	Memory Content	Instruction
01000	. 8A	MOV AH, [BX] [SI] + BETA
01001	20	
01002	34	
01003	12	
01004	.XX	Next instruction
02000	XX	
02001	XX	
06234	BE	Source Operand

Example →

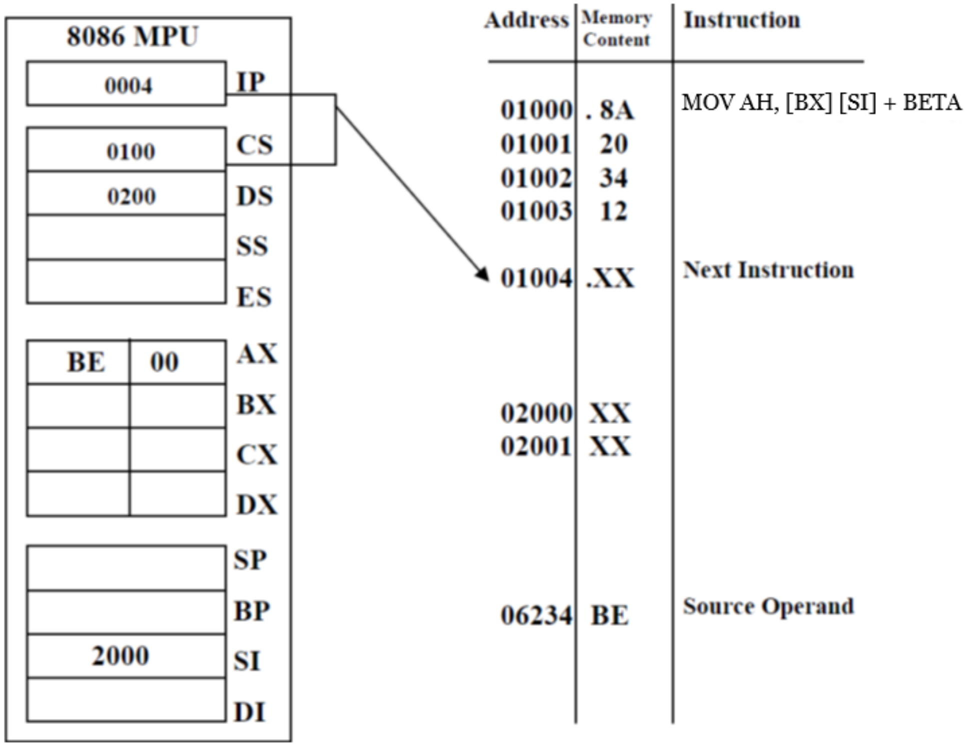
MOV AH, [BX] [SI] + BETA

physical address = DS×10H + [BX] + [SI] + BETA

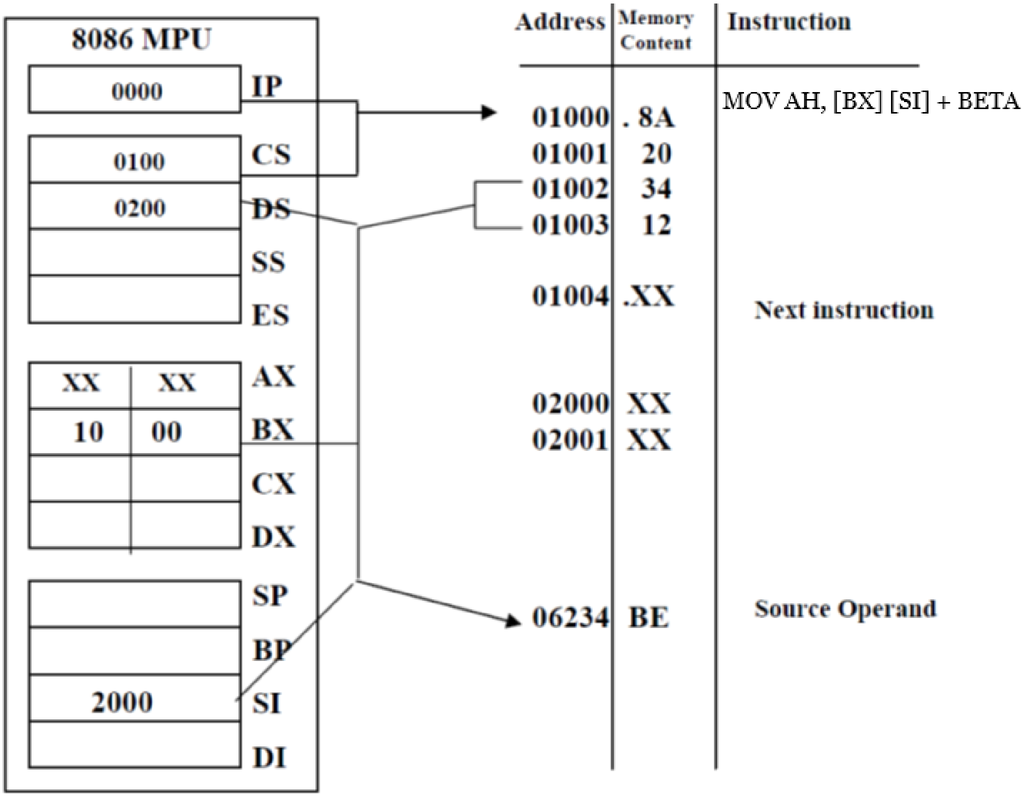
= 0200×10H + 1000H + 2000H + 1234H

= 06234H

Relative Based Indexed Addressing



Address	Memory Content	Instruction
01000	. 8A	MOV AH, [BX] [SI] + BETA
01001	20	
01002	34	
01003	12	
01004	.XX	Next Instruction
02000	XX	
02001	XX	
06234	BE	Source Operand



Address	Memory Content	Instruction
01000	. 8A	MOV AH, [BX] [SI] + BETA
01001	20	
01002	34	
01003	12	
01004	.XX	Next instruction
02000	XX	
02001	XX	
06234	BE	Source Operand

MOV AH, [BX] [SI] + BETA

physical address = DS×10H + [BX] + [SI] + BETA
= 0200×10H + 1000H + 2000H + 1234H
= 06234H