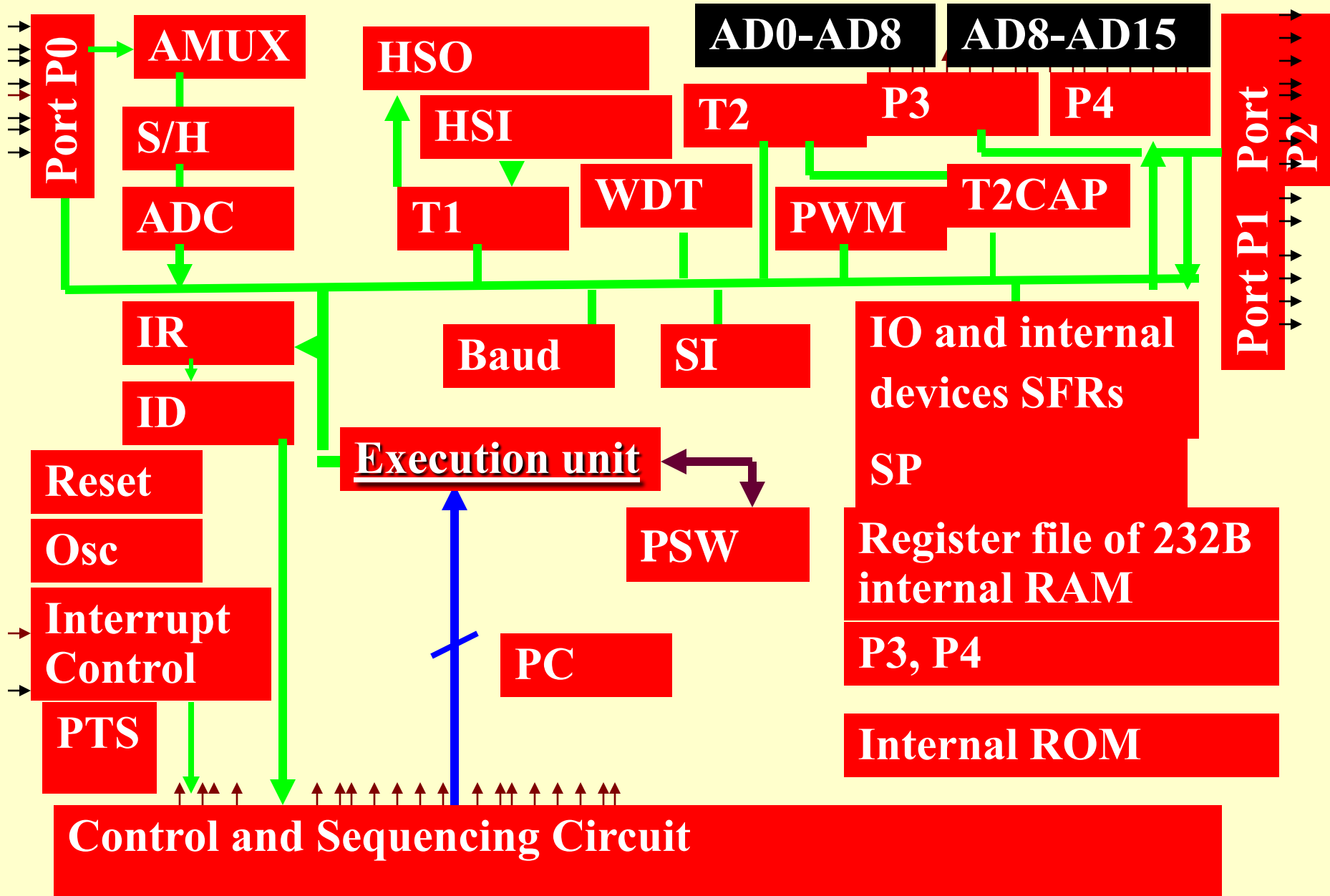


# Chapter 14

## 80x96 Family Microcontrollers



# Lesson 2

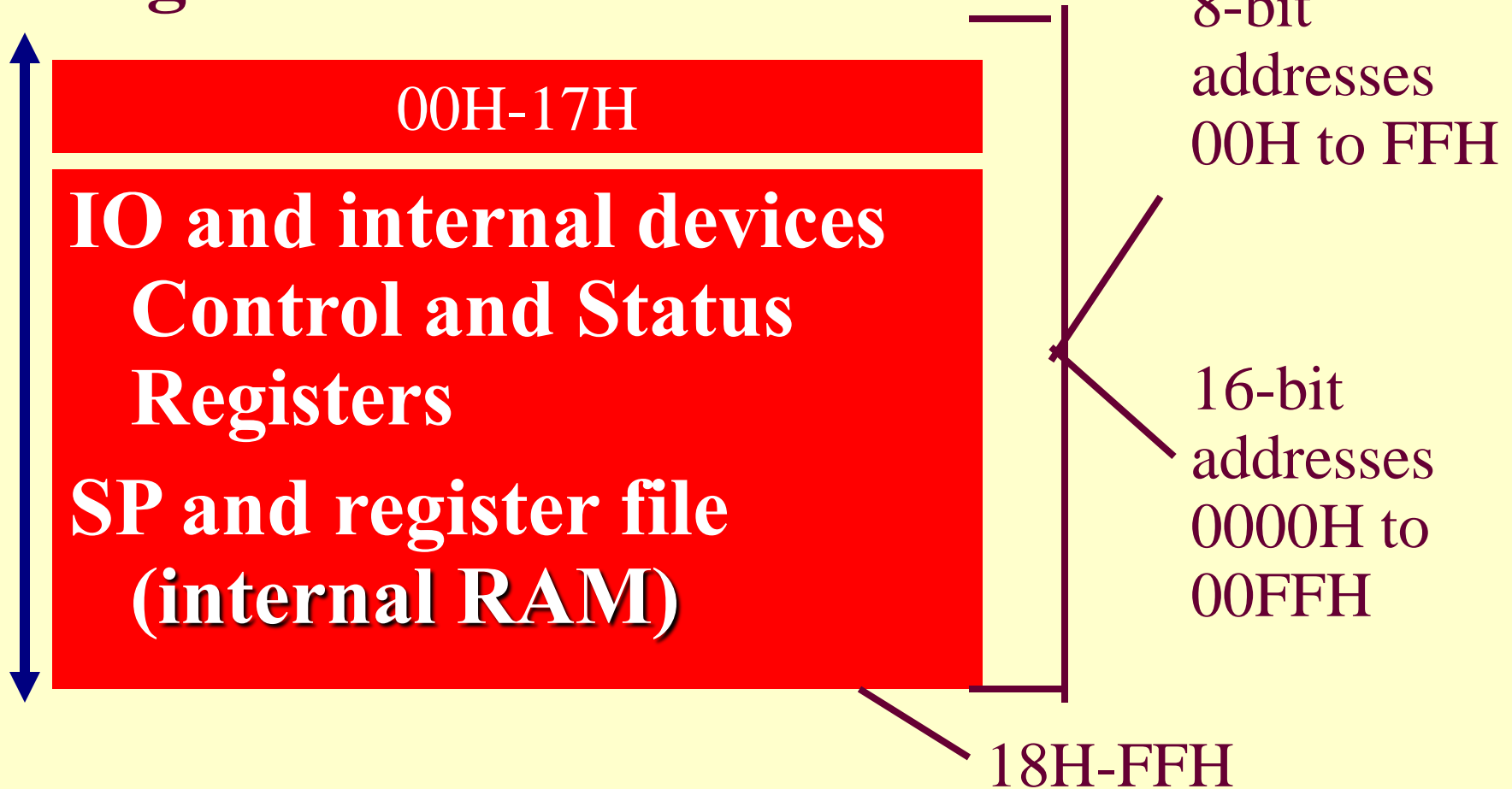
## 80x96 MCU H- and V-Windows

# Page

- 1 Page = 256 byte
- Page 0 256 bytes accessed by 256 addresses
- Page 1 256 bytes accessed by 256 addresses usng concept of V-windows
- Between 0x0000 and 0x00FF, there are Special Function Registers (SFRs), SP (at 0x18H–0x19) and a register file of 232 bytes at Internal RAM, and page 0 RAM

# Direct 8-bit addresses and 16 bit addresses

## Page 0 addresses



# Direct 8-bit addresses and 16 bit addresses

## Page 1 addresses



# 16 bit addresses

16-bit addresses 0100H to FFFFH



**Internal and External  
RAM and ROM**

# Horizontal Windows

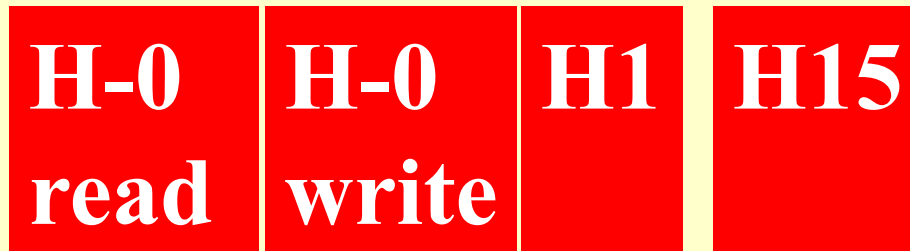
- Identical 8-bit address at page 0 used for a byte among more than 256 bytes using the concept of four horizontal windows



**Page 0 addresses between 00H and FFH  
can be 256 addresses**

A Page-0 8-bit address between 00H to FFH can be assigned to  $256 \text{ B} \times 4 = 1024$  internal bytes in 80x96, if page 0 is considered having four horizontal windows

## **80x96 Four Horizontal Windows**

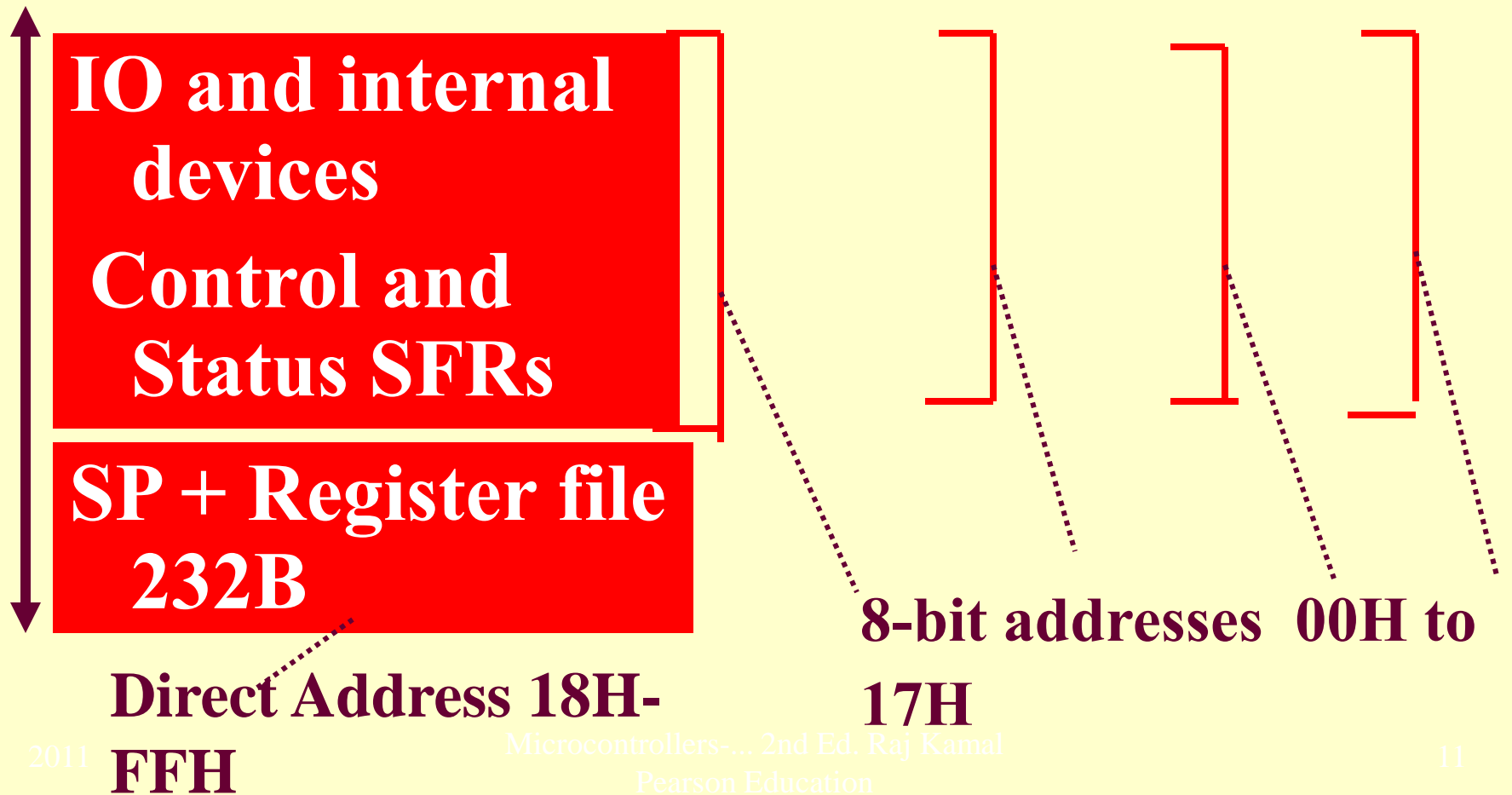


# Horizontal H0 Windows

- During write instruction, we consider using one H0-window
- During read operation, we consider using another H0-window

# Horizontal Windows

Page 0 Address



**Window select  
Register**

**When write 13H**



# Window Select Register (A special Function Register)

**16-bit address 0013H**  
**Write**

**Selects V and H-  
window**

**13H — When write**

**Direct Address**

**8-bit  
address  
13H**

**Lsb b0-b6**

**msb b7 - write control  
Bit for hold acknowledge**

**msb b7 - read  
hold pin status**

# Select an H-window write b6-b0

Write b6-b4= 000

0013H write

16-bit address

0013H

Write b3-b0



8-bit address

13H

Direct Address

Write b3-b0

0000- H0-read or H0-write byte

0001- H1-read or write byte

1111-H15-read or write byte

# Vertical Windows for 512 bytes

- Identical 8-bit or 7-bit or 6-bit or 5-bit address at pages 0 and 1 (512 bytes) can be used for accessing a byte by considering the 512 bytes present in vertical windows
- V-Windows four options
- Two or four or eight or sixteen vertical windows
- 256 or 128 or 64 or 32 bytes in one V-window accessed by just 8-bit or 7-bit or 6-bit or 5-bit address at pages 0 or 1

## Vertical Windows for 512 bytes

Pages 0  
addresses

**IO and internal devices Control and Status SFRs at Horizontal Window-0 read, -0 write, 1 and 15**

**Register file 232B (including internal RAM)**

**Additional 256 B RAM**

Page 1 addresses



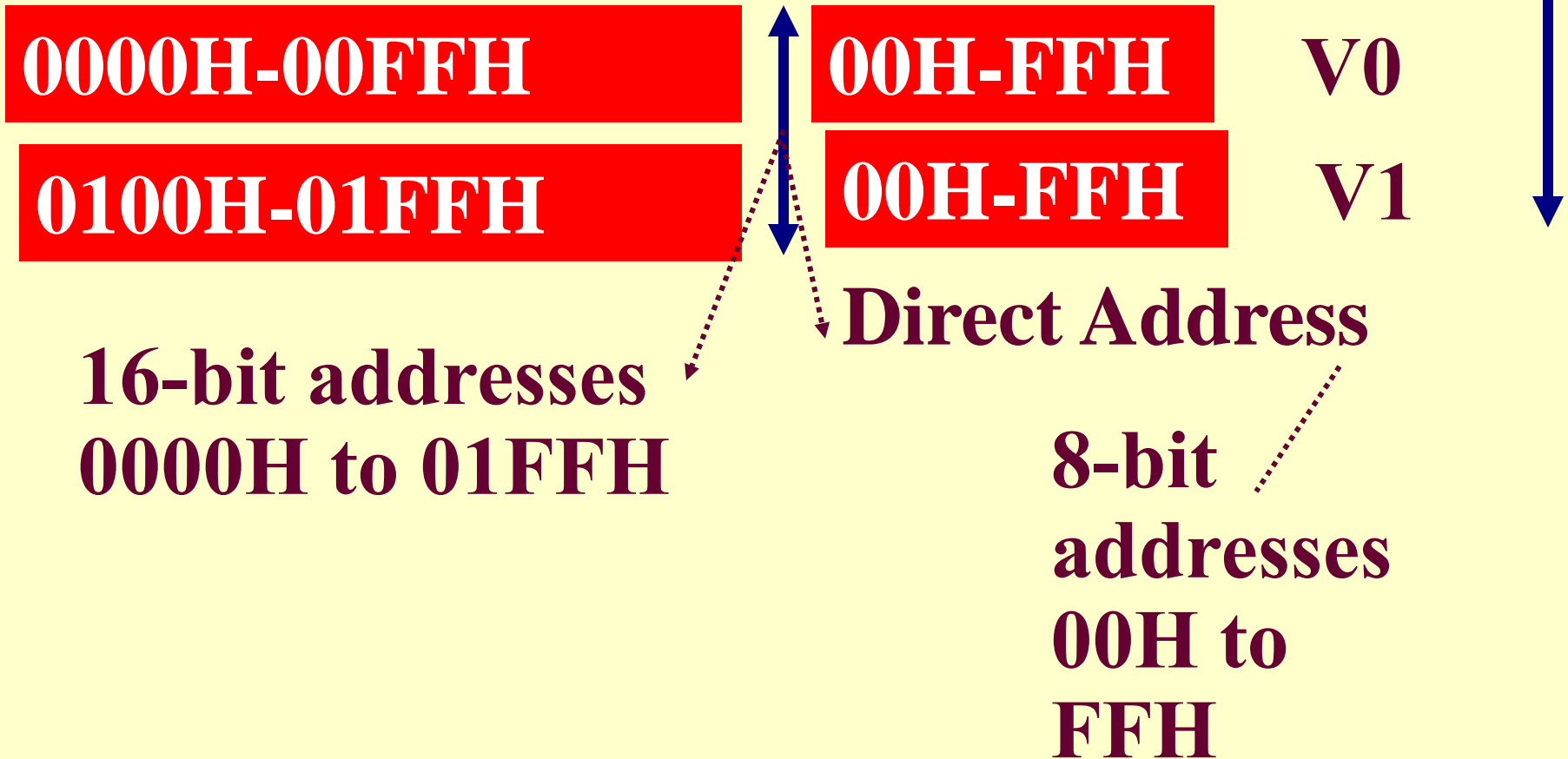
# Option 1

# 512 Bytes Page 0 and 1 addresses between 00H and FFH

- Page-0 and page-1, 8-bit address between 00H to FFH can be assigned to  $256 \text{ B} \times 2 = 512 \text{ B}$ , if pages 0 and 1 are assumed to be in two separate vertical windows V0 and V1 of 256 B each

# Pages 0-1 addresses

## 80x96 Vertical Windows, V0 and V1



# Select a V-window write b6-b0

0013H

16-bit address

0013H

13H — When write

Direct Address

8-bit  
address

13H



## Two V windows option 1

**V-window V0**

**V-Window V1**

Write b6-b2 = 00100

Write b1-b0 = 00 or 01

Write b1-b0 = 11 or 10

# **512 Bytes Page 0 and 1 addresses between 00H and FFH**

- Bit b0 in WSR is written = 0 for lower half of a V-window and =1 for upper half**

# **512 Bytes Page 0 and 1 addresses between 00H and FFH**

- A vertical window SFR or RAM can be associated with a distinct code block page and is addressed by 8-bit direct address in the a code-block of instructions**

# Option 2

## 7-bit addresses at Pages 0 and 1

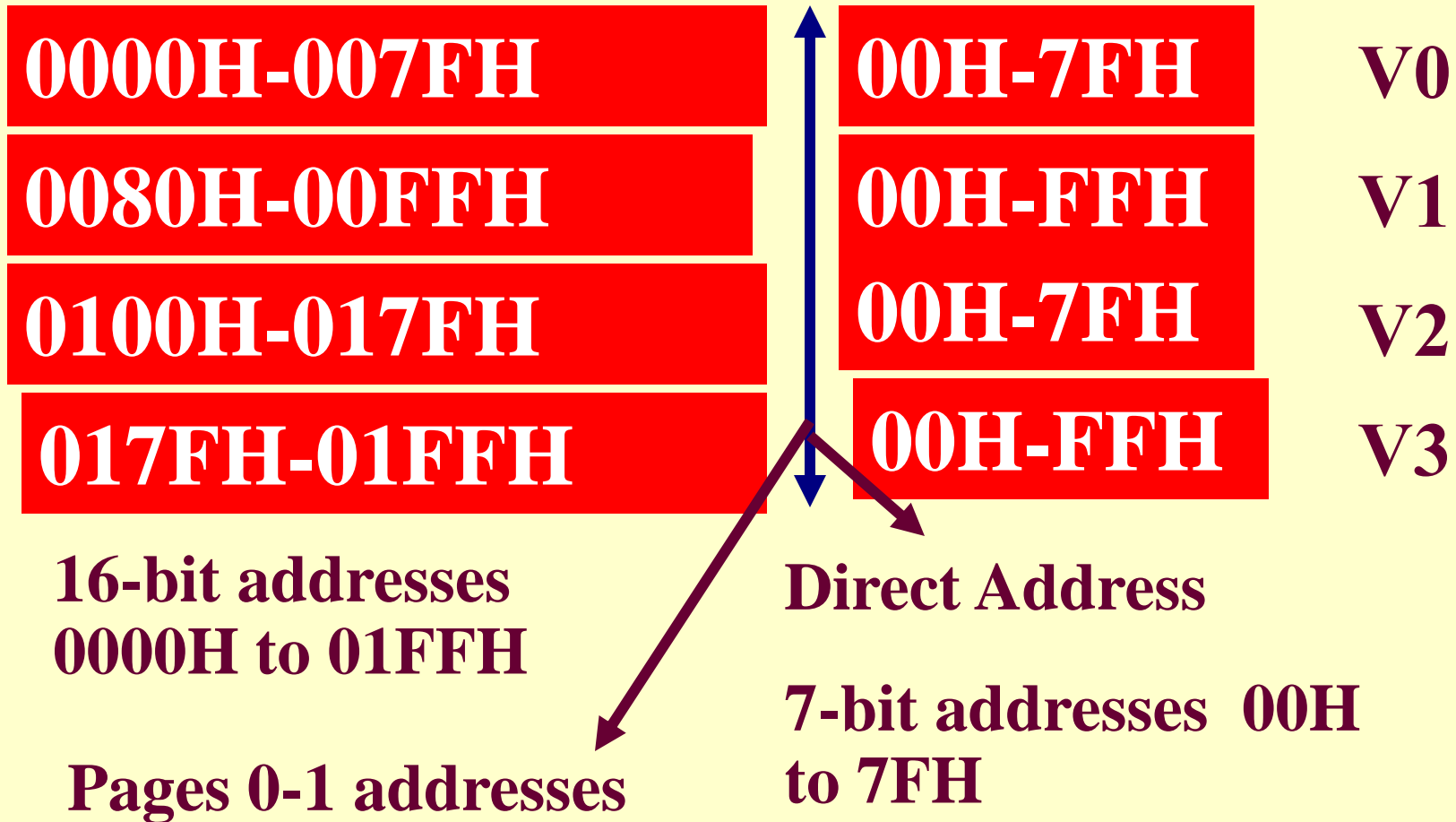
- Pages 0 and 1 of 256 bytes each between 00H and FFH divided in four V-windows
- Four vertical windows V0, V1, V2 and V3 of 128 B each
- Page 0 or 1 byte accessed by just 7-bit address between 00H to 7FH
- $128 \text{ B} \times 4 = 512 \text{ B}$  bytes at pages 0-1 are



# 7-bit addresses at Pages 0 and 1

- A vertical window V0, V1, V2 or V3 can be associated with a distinct code block among the four memory areas each be accessed by 7-bit address (msb of address =0)

# 80x96 Vertical Windows, V0, V1, V2 and V3



# Select a V-window write b6-b0

0013H

16-bit address

0013H

13H — When write

Direct Address

8-bit  
address

13H

## Four V windows option 2

**V-window V0**

**V-Window V1**

**V-window V2**

**V-Window V3**

Write b6-b2 = 00100

Write b1-b0 = 00 or 01

Write b1-b0 = 11 or 10

# 512 Bytes Page 0 and 1 addresses between 00H and FFH

- Bit b0 in WSR is written = 0 or 1 for lower half of a V-window and bit b1 = 0 or 1 for upper half

# Option 3

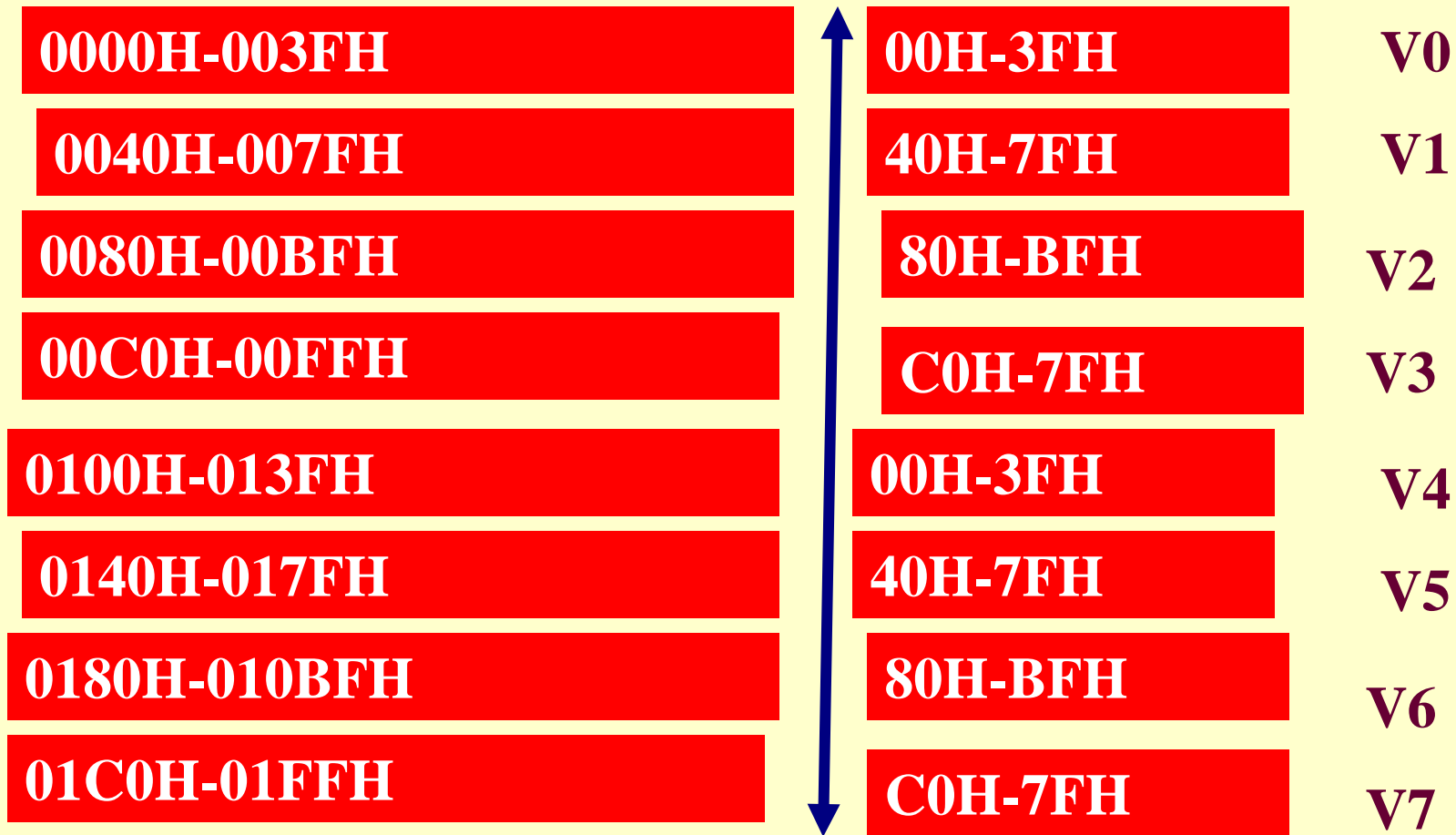
## 6-bit address at Pages 0 and 1 addresses

- A vertical window  $V0, \dots$  or  $V7$  can be associated with a distinct code block among the eight code blocks
- Each block having maximum 64 bytes

## 6-bit address at Pages 0 and 1 addresses

- Pages 0 and 1 addresses between 00H and FFH can be 256 B each in 8 Windows
- 6-bit address between 00H to 3FH can be assigned to  $64 \text{ B} \times 8 = 512 \text{ B}$  ,
- Pages 0-1 are assumed to be eight vertical windows V0,... V7 of 64 B each

# 80x96 Vertical Windows, V0 to V7



16-bit addresses  
0000H to 01FFH

Direct Address  
6-bit addresses 00H  
to 3FH



# Select a V-window write b6-b0

0013H

16-bit address

0013H

Write b6-b2 = 01000



13H — When write

Direct Address

8-bit address 13H

## Eight V windows option 3

V-window V0

V-window V2

V-window V4

V-window V6

V-Window V1

V-Window V3

V-Window V5

V-Window V7

Write b2-b0 = 000 or 001  
or 010 or 011

Write b2-b0 = 100 or  
101 or 110 or 111

# Option 4

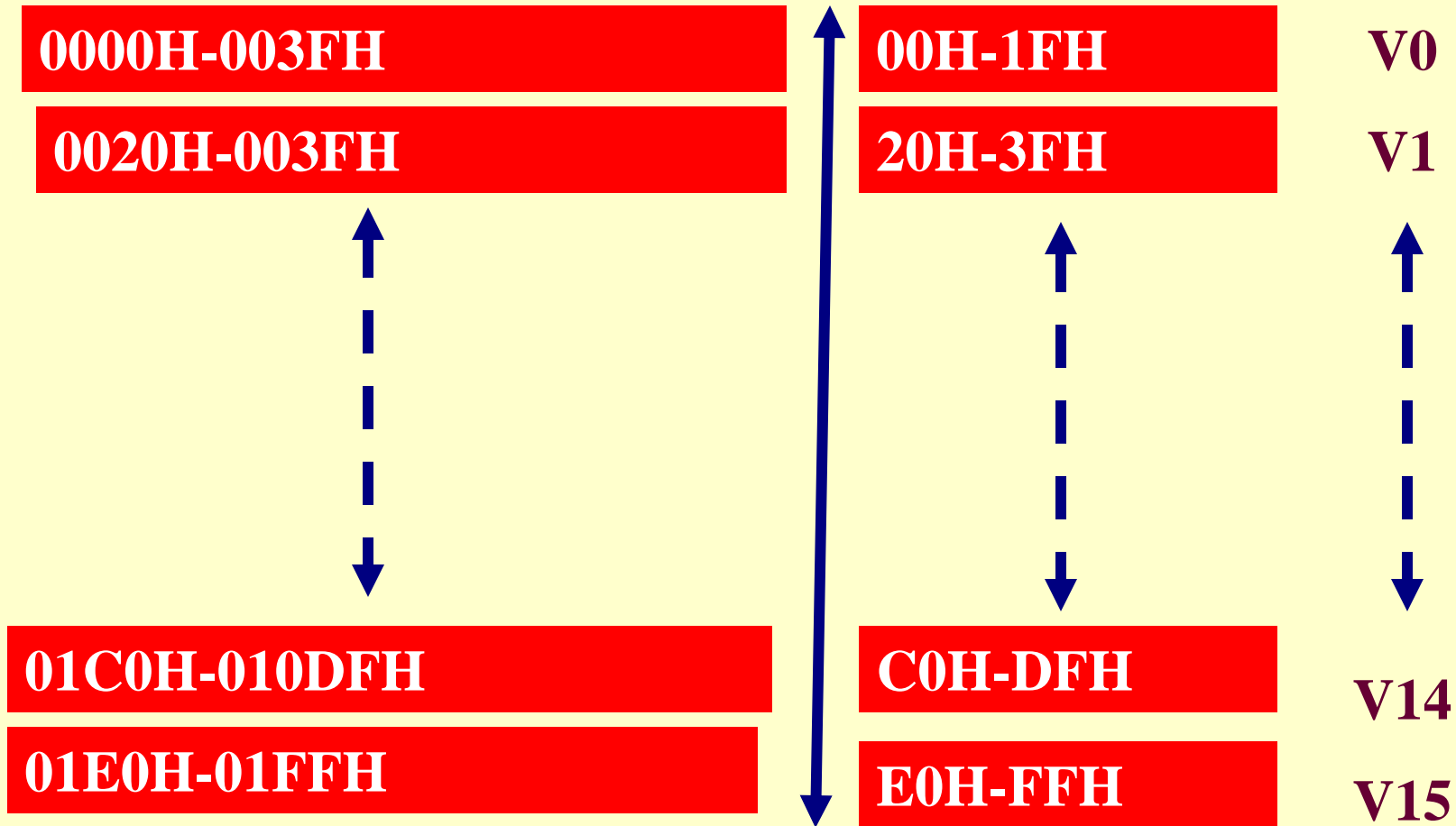
## 5-bit address at Pages 0 and 1 addresses

- Pages 0-1 8-bit address between 00H to FFH can be assigned to  $32 \text{ B} \times 8 = 512 \text{ B}$
- Pages 0-1 assumed to be eight vertical windows V0,... V15 of 32 B each

## 5-bit address at Pages 0 and 1 addresses

- A vertical window  $V_0, \dots$  or  $V_{15}$  can be associated with a distinct code block among the eight code or data blocks
- Each block having 32 bytes maximum

# 80x96 Vertical Windows, V0 to V15



**16-bit addresses**  
**0000H to 01FFH**

**Direct Address**  
**5-bit addresses 00H**  
**to 1FH**

# Select a V-window write b6-b0

0013H

16-bit address

0013H

Write b6-b2 = 10000

## Sixteen V windows option 4

**V-window V0**

**V-window V2**

**V-window V4**

**V-window V6**

Write b3-b0 = 0000

or 001.... 0111

**V-Window V1**

**V-Window V3**

**V-Window V5**

**V-Window V7**

Write b3-b0 = 1000

or 1001.... 1111

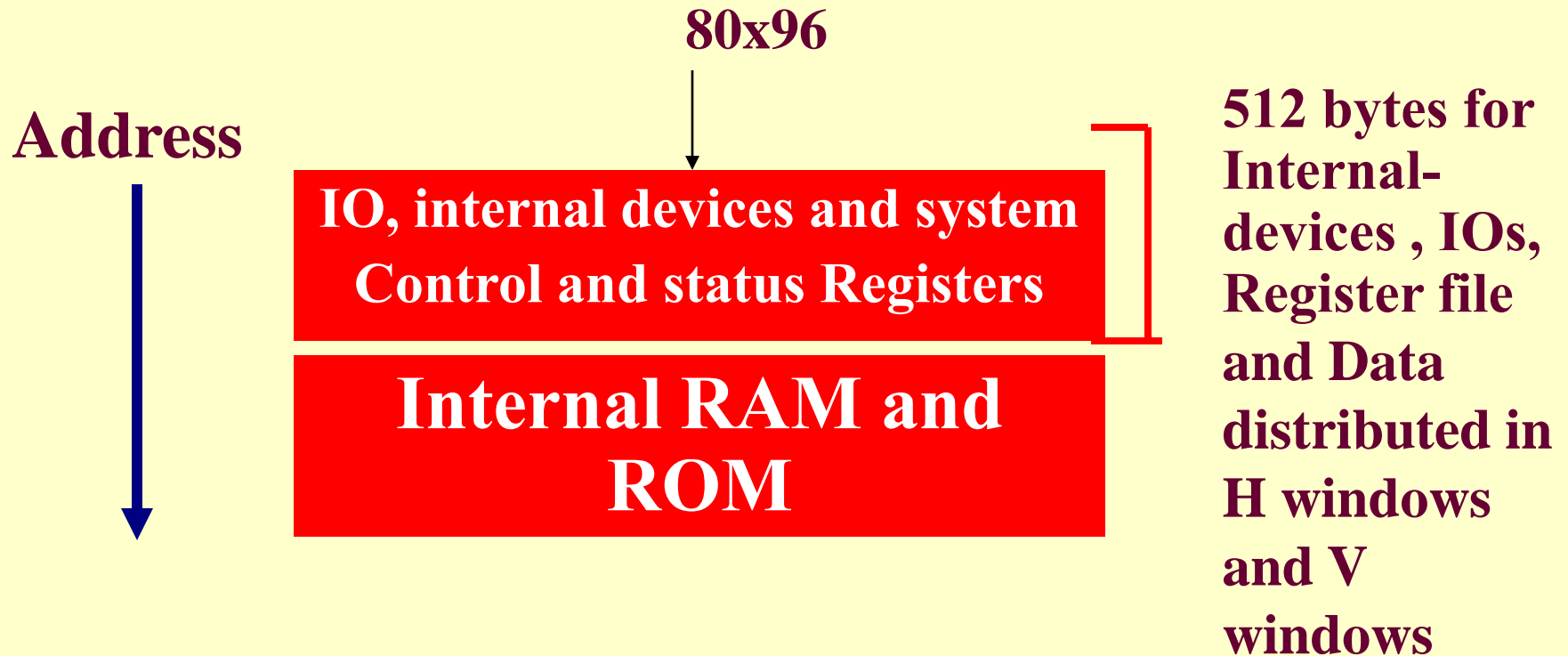
13H — **When write**

Direct Address

8-bit address 13H



# Addresses in 80x96



# Summary



# We learnt

- Page 0 256 bytes between 00H to FFH starting from 0000H
- Page 1 256 bytes between 00 to FFH starting from 0100H
- Window select register to select an H-Window
- Window select register to select a V-Window

# We learnt

- Four Horizontal Windows each accessed by 8-bit address
- H0-read
- H0-write
- H1 read and write
- H15

# We learnt

- Vertical Windows Four options— 2 or 4 or 8 or 16 V-windows
- Each address in a V-window accessed by 8, 7, 6 or 5-bit only when a V-window selected by write to WSR

# **End of Lesson 2 on H- and V- Windows**