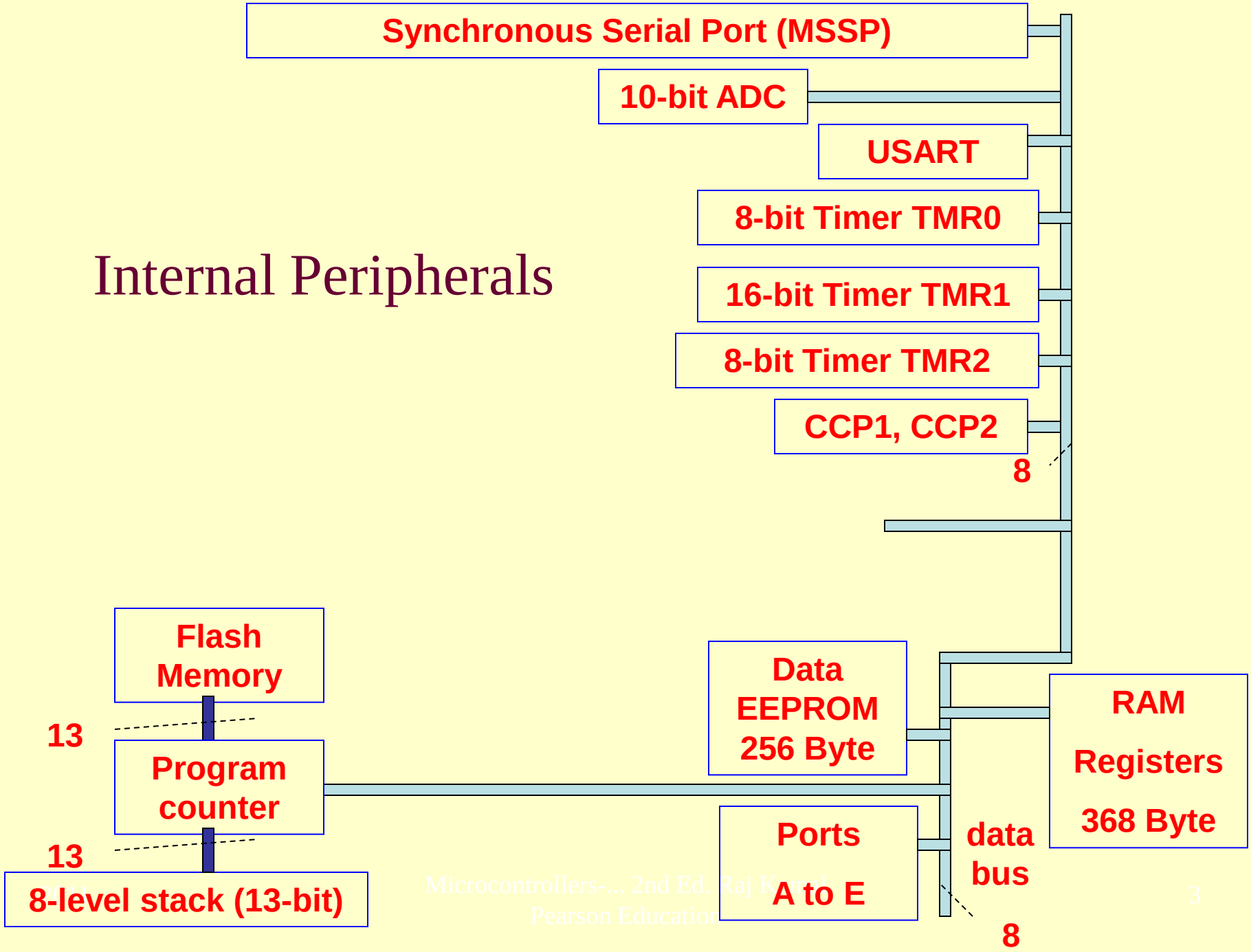
Chapter 13

PIC Family Microcontroller

Lesson 13

Analog to Digital Conversion (ADC)

Internal Peripherals



Analog to digital conversion in PIC16F877

- 8-input channel 10-bit ADC
- Analog inputs connect the internal ADC (Analog to Digital Converter) using Port A 6-bit port for the inputs/outputs

Example

- Assume 10-bit AD
- There are two reference inputs– V_{+ref} and $V_{–ref}$
- Analog voltage input AN ground potential = $V_{–ref}$
- The 10-bit output digital binary bits for AN = $(AN – V_{–ref}) \times (2^{10} – 1)/ (V_{+ref} – V_{–ref})$

Example

- If analog input AN = V_{-ref} then output converted bits = $(V_{+ref} - V_{-ref}) \times (2^{10} - 1) / (V_{+ref} - V_{-ref})$ = 0d0= 00 0000 0000
- If analog input AN= $(V_{+ref} - V_{-ref})$ then output converted bits = $(V_{+ref} - V_{-ref}) \times (2^{10} - 1) / (V_{+ref} - V_{-ref})$ = $(2^{10} - 1)$= 11 1111 1111

Example

- If analog input AN= $(V_{+ref} - V_{-ref})$ /2 then output converted bits = $(V_{+ref} - V_{-ref})/2 \times (2^{10} - 1)/ (V_{+ref} - V_{-ref}) = (2^{10} - 1)/2$ = 01 1111 1111.
- If analog input AN= $(V_{+ref} - V_{-ref})$ /4 then output converted bits = $(V_{+ref} - V_{-ref})/4 \times (2^{10} - 1)/ (V_{+ref} - V_{-ref}) = (2^{10} - 1)/4$ = 00 1111 1111.
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Example

- Assume V+ref = 2 V and V–ref = 0, then 2 V input at AN pin will generate converted bits after conversion = 11 1111 1111
- 1 V input — 01 1111 1111.
- 0.5 V input — 00 1111 1111,
- 0.0 V — 00 0000 0000

Analog to digital conversion inputs in PIC16F877

- PORTA multi-channel analog inputs, AN0, AN1, AN2, AN3 and AN4
- Port A RA2 pin also Vref–
- Port A RA3 pin also Vref+.
- Port A RA4 input has ST a input

Analog to digital conversion Registers

- 8-input channel 10-bit ADC in PIC16F877
- ADRESH (AD result higher) 2-bit at 0x011 Bank 0
- ADCON0 (AD control register 0) at 0x01F Bank 0
- ADRESL (AD result lower) 8-bits at 0x09E Bank 1
- ADCON1 (AD control register 1) at 0x09F Bank 1

Analog to digital conversion start in PIC16F877

- If b3-b2-b1-b0 in CCP2CON = 1011 then compare mode special event trigger mode activated and CCP2 device starts AD conversion if ADC device is activated

ADC control and ADC result register bits

- TABLE 13.11 explains ADC control and ADC result register bits

Summary

We learnt

- 8-input channel (including ref inputs) 10-bit ADC in PIC16F877
- ADRESH (AD result higher) 2-bit at 0x011 Bank 0
- ADCON0 (AD control register 0) at 0x01F Bank 0
- ADRESL (AD result lower) 8-bits at 0x09E Bank 1
- ADCON1 (AD control register 1) at 0x09F Bank 1

We learnt

- PORTA multi-channel analog inputs, AN0, AN1, AN2, AN3 and AN4
- Port A RA2 pin also Vref–
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- Port A RA4 input has ST a input

We learnt

- If b3-b2-b1-b0 in CCP2CON = 1011 then compare mode special event trigger mode activated and CCP2 device starts AD conversion if ADC device is activated

End of Lesson 13 on

Analog to Digital Conversion (ADC)