16.317: Microprocessor Systems Design I

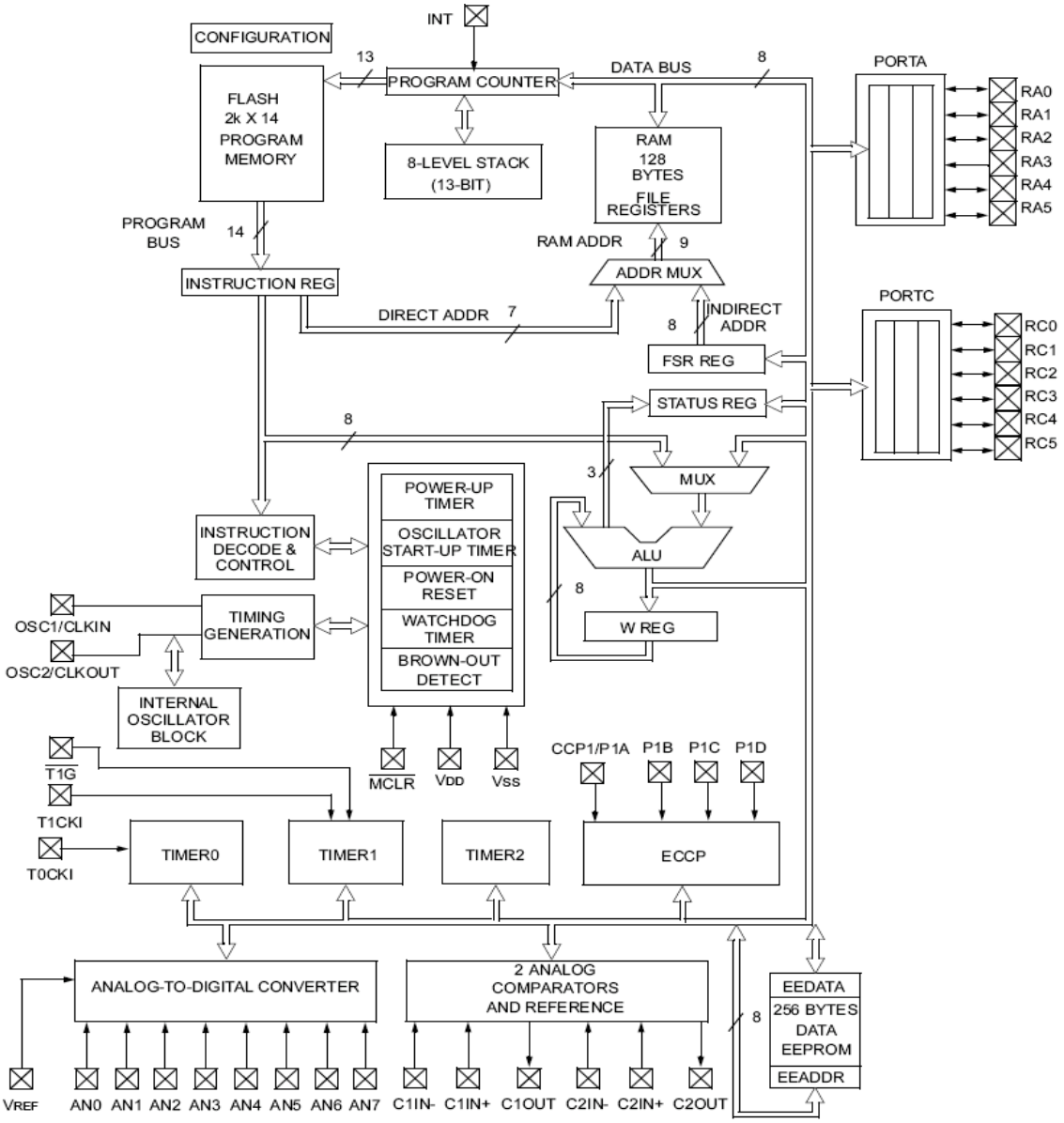
Fall 2013

Lecture 26: Key Questions
November 13, 2013

1. Explain the major differences between a microprocessor and a microcontroller, including the typical features of a microcontroller.

2. Explain the major benefits and limitations of using a microcontroller.

3. Explain the general components of the PIC 16F684 block diagram shown below.


INT
CONFIGURATION
13
PROGRAM COUNTER
DATA BUS
8
PORTA
RA0
RA1
RA2
RA3
RA4
RA5
FLASH
2k X 14
PROGRAM
MEMORY
8-LEVEL STACK
(13-BIT)
RAM
128
BYTES
FILE
REGISTERS
PROGRAM
BUS
14
RAM ADDR
9
ADDR MUX
INSTRUCTION REG
DIRECT ADDR
7
8
INDIRECT
ADDR
PORTC
RC0
RC1
RC2
RC3
RC4
RC5
FSR REG
STATUS REG
8
3
MUX
POWER-UP
TIMER
OSCILLATOR
START-UP TIMER
POWER-ON
RESET
WATCHDOG
TIMER
BROWN-OUT
DETECT
INSTRUCTION
DECODE &
CONTROL
ALU
8
W REG
OSC1/CLKIN
OSC2/CLKOUT
TIMING
GENERATION
INTERNAL
OSCILLATOR
BLOCK
T1G
T1CKI
T0CKI
MCLR
VDD
VSS
CCP1/P1A
P1B
P1C
P1D
TIMER0
TIMER1
TIMER2
ECCP
ANALOG-TO-DIGITAL CONVERTER
2 ANALOG
COMPARATORS
AND REFERENCE
EEDATA
256 BYTES
DATA
EEPROM
EEADDR
8
VREF
AN0
AN1
AN2
AN3
AN4
AN5
AN6
AN7
C1IN-
C1IN+
C1OUT
C2IN-
C2IN+
C2OUT

4. Briefly explain why the PIC 16F684 has so few pins and how they can be used to access all of the components shown above.

5. What is the difference between Harvard and von Neumann memory architectures?

6. Explain the basic organization of the PIC data memory.

7. Explain the purpose of the PCL and PCLATH registers.

8. Briefly describe the contents of the STATUS register.

9. Explain the basic organization of the PIC stack.

10. Explain how different memory banks are accessed in PIC microcontrollers, and what the general function of each bank is.

11. Explain direct addressing on the PIC microcontrollers.

12. <u>Example:</u> What address on the PIC16F684, which has 2 banks, is being accessed if:

- STATUS = 60h, instruction = 031Fh?

- STATUS = 40h, instruction = 1F02h?

- STATUS = 13h, instruction = 0793h?

- STATUS = EEh, instruction = 03F1h?

13. Explain indirect addressing on the PIC microcontrollers.

14. Explain how I/O ports are managed through special function registers. In the example below, what bits of PORTA are inputs? What bits are outputs?

```
bcf         STATUS, RP0   ; bank0
bcf         STATUS, RP1
clrf        PORTA         ; initializing PORTA by
                          ; clearing output data latches
 bsf        STATUS, RP0   ; select bank1
 movlw      0xCF          ; value used to initialize
                          ; data direction
 movwf      TRISA
```