

micro controllers

introduction

Areas of use

- You are used to chips like the Pentium and the Athlon, but in terms of installed machines these are a small portion of total computer use.
- Think how many computers you have at home
- Digital cameras, video cameras, TVs, mobile phones, calculators, micro-wave ovens etc all contain processors.

Numbers of machines

- You might have 1 or 2 Pentium class chips at home. (Each PC will also contain several embedded processors)
- You will have perhaps 10 to 20 other embedded computers in other devices.
- If you think of childrens toys, the numbers grow even higher.

Characteristics

- Embedded computers have to be very low cost, simple and reliable.
- They can not use any moving parts (disk drives) because:
 1. These are power hungry
 2. They are bulky
 3. They are expensive

Features

- Program in Read Only Memory – ROM
- Limited RAM storage – variables only not code
- Built in I/O devices
- Use very little power

Families

- Zilog Z8 series
- Intel 8051 series
- Arm 32 bit microcontrollers
- MicroChip – PIC microcontrollers

Zilog

- This company did more than any other to spread use of microprocessors in the 1970s and early 80s with their Z80 micro.
- This was the mainstay of early personal computers.

Current Z80e has

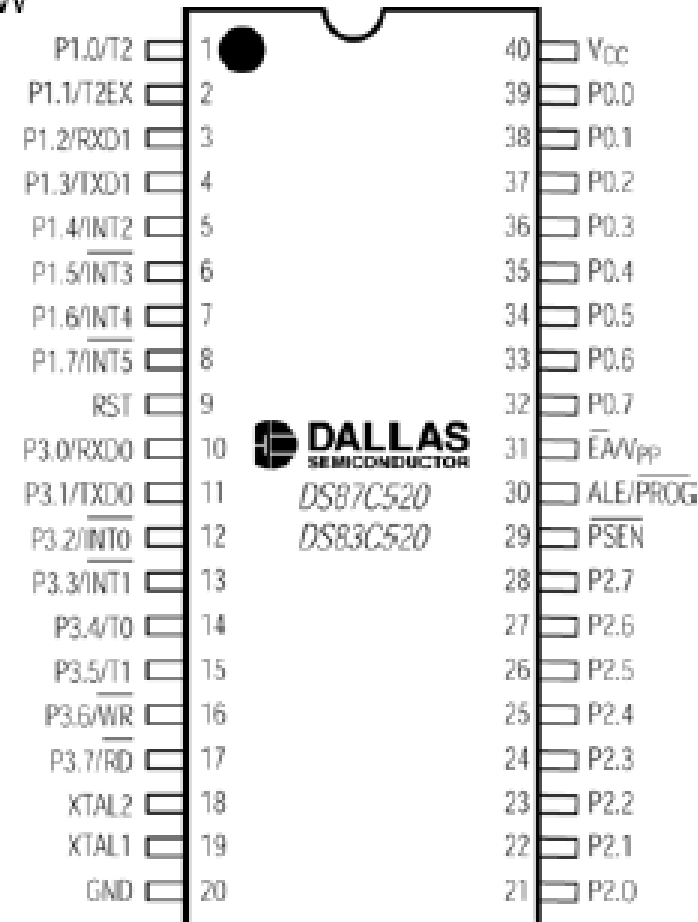
- eZ80® core operating at speeds up to 50MHz-Achieves high performance
- On-chip 10/100BaseT Ethernet MAC (eZ80F91 only) -Enables low-cost network applications
- Up to 256KB on-chip Flash memory
- Up to 16KB on-chip SRAM

This is a relatively high end micro controller

Intel 8051

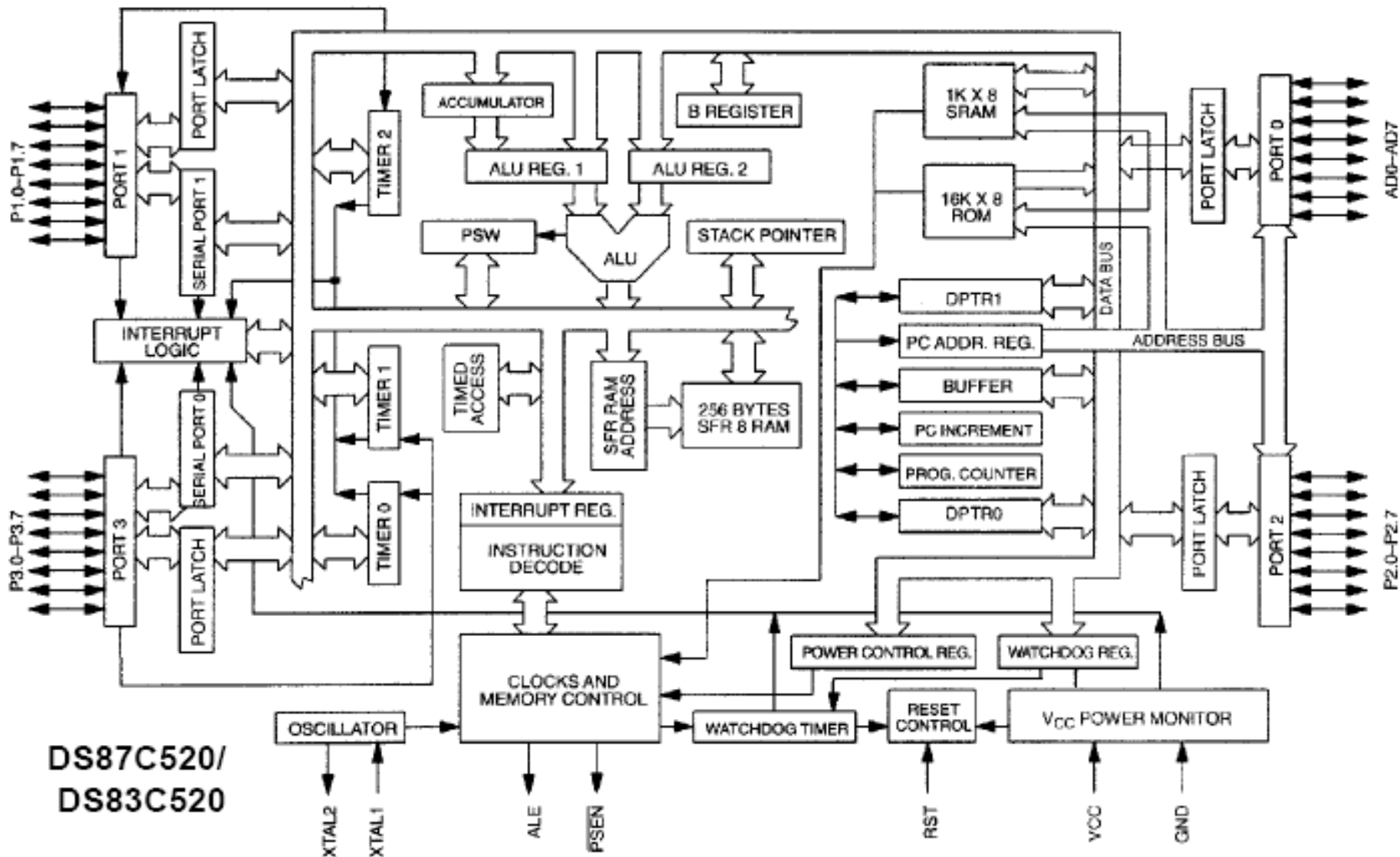
- This was one of the first microcontrollers to integrate ROM, RAM and I/O on one chip.
- Made by many other companies still, Amtel, Texas instruments etc.

TOP VIEW



40-PIN PDIP

DS87C520/DS83C520



ARM series

- One of the first RISC processors
- 32 Bit architecture
- Low transistor count compared to conventional processors
- Very low power consumption
- Used in digital Phones and PDAs.
- At the top end of the micro-controller performance spectrum.

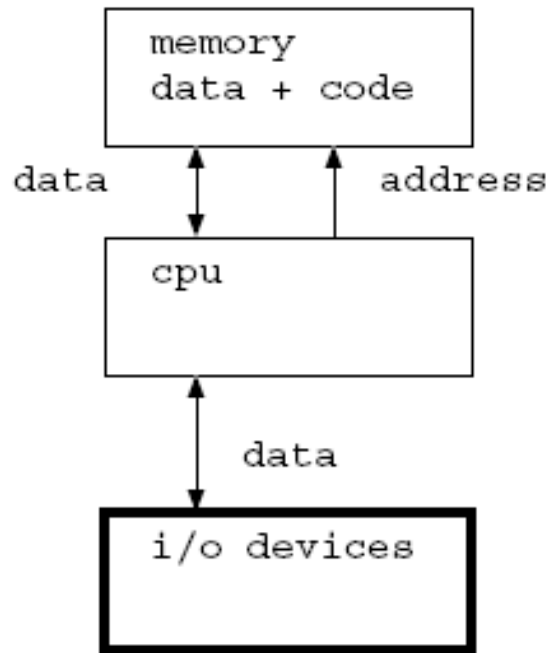
PIC

- Range of low end 8 bit microcontrollers.
- smallest have only 8 pins, largest 40 pins.
- Typical chip is an 18 pin one.
- Very cheap, you can pick them up at less than £1 each.
- Targeted at consumer products, burglar alarms etc.

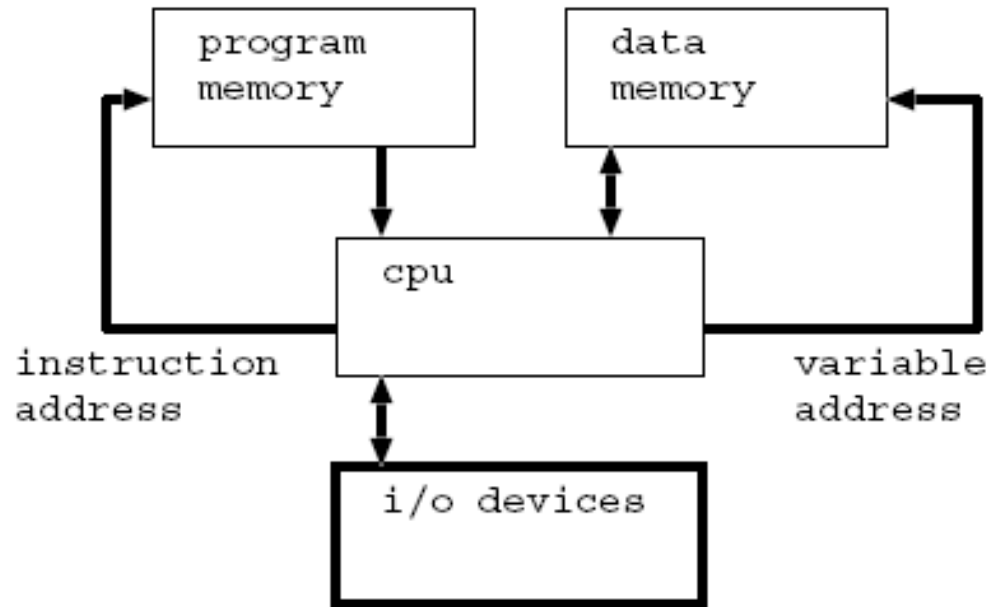
Harvard architecture

- Like many micros the PIC is a Harvard not a von-Neumann machine
- This is simpler and faster

comparison



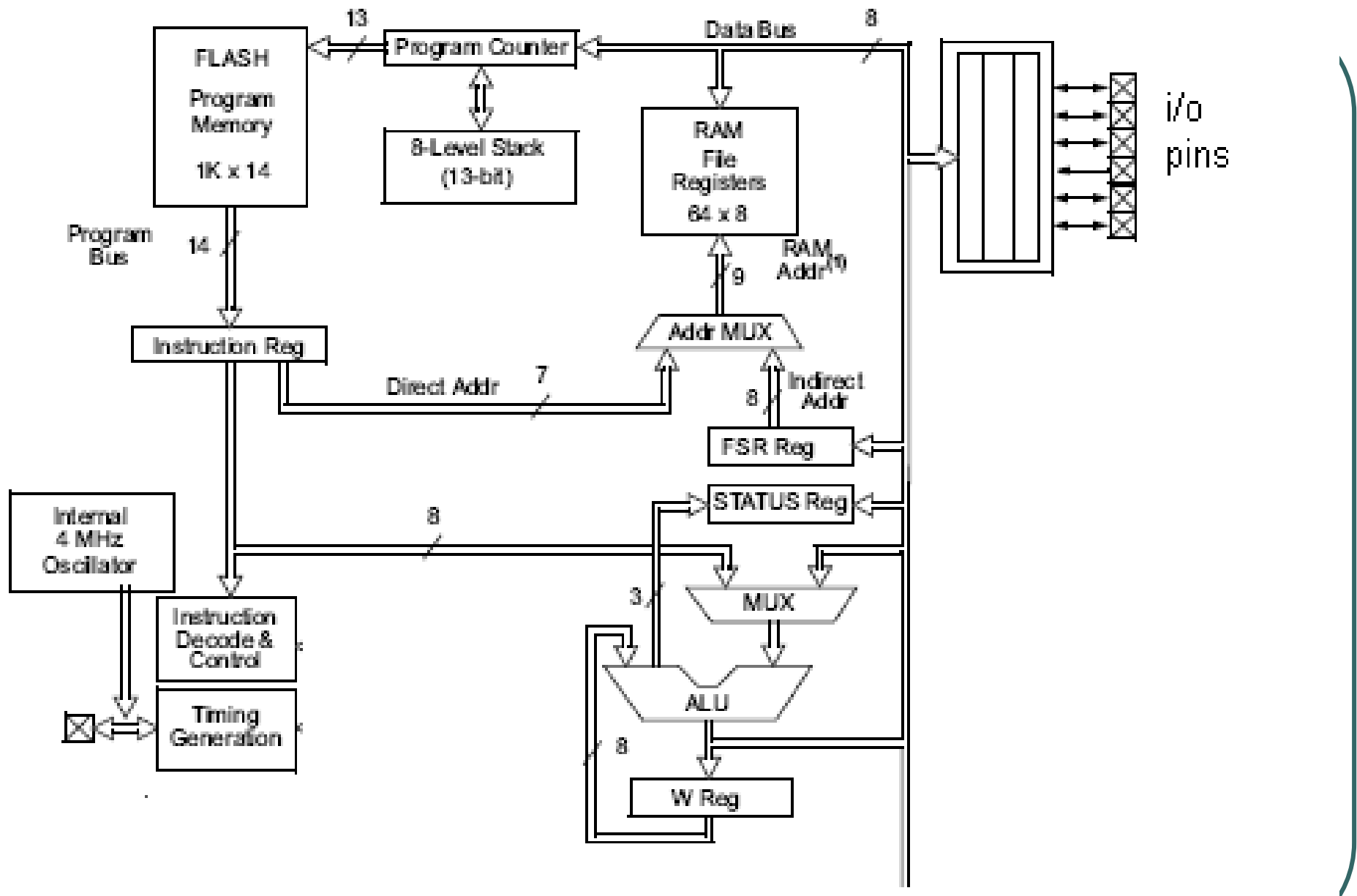
Von Neumann machine



Harvard Machine

Advantages of Harvard model

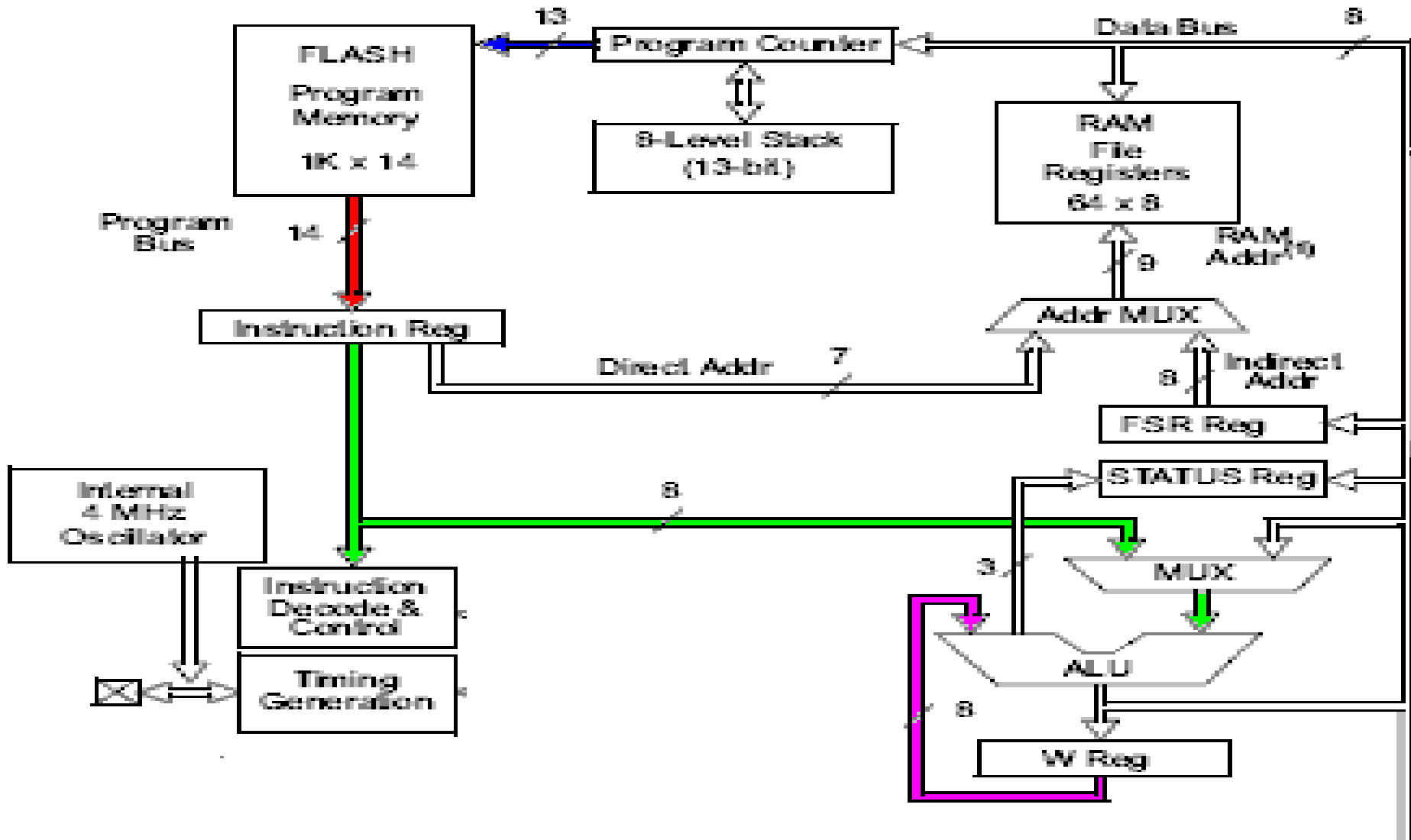
- An add operation of the form $a:=b+c$ must fetch 2 operands from memory and write 1 operand to memory. In addition it is likely to have to fetch 3 instructions from memory.
- With a single memory this will take 6 cycles. With 2 memories, we can fetch the instructions in parallel with the data and do it in 3 cycles.
- We have different word lengths for instructions and data – 8 bit data and perhaps 12 bit instructions.



Basic PIC architecture

to i/o registers

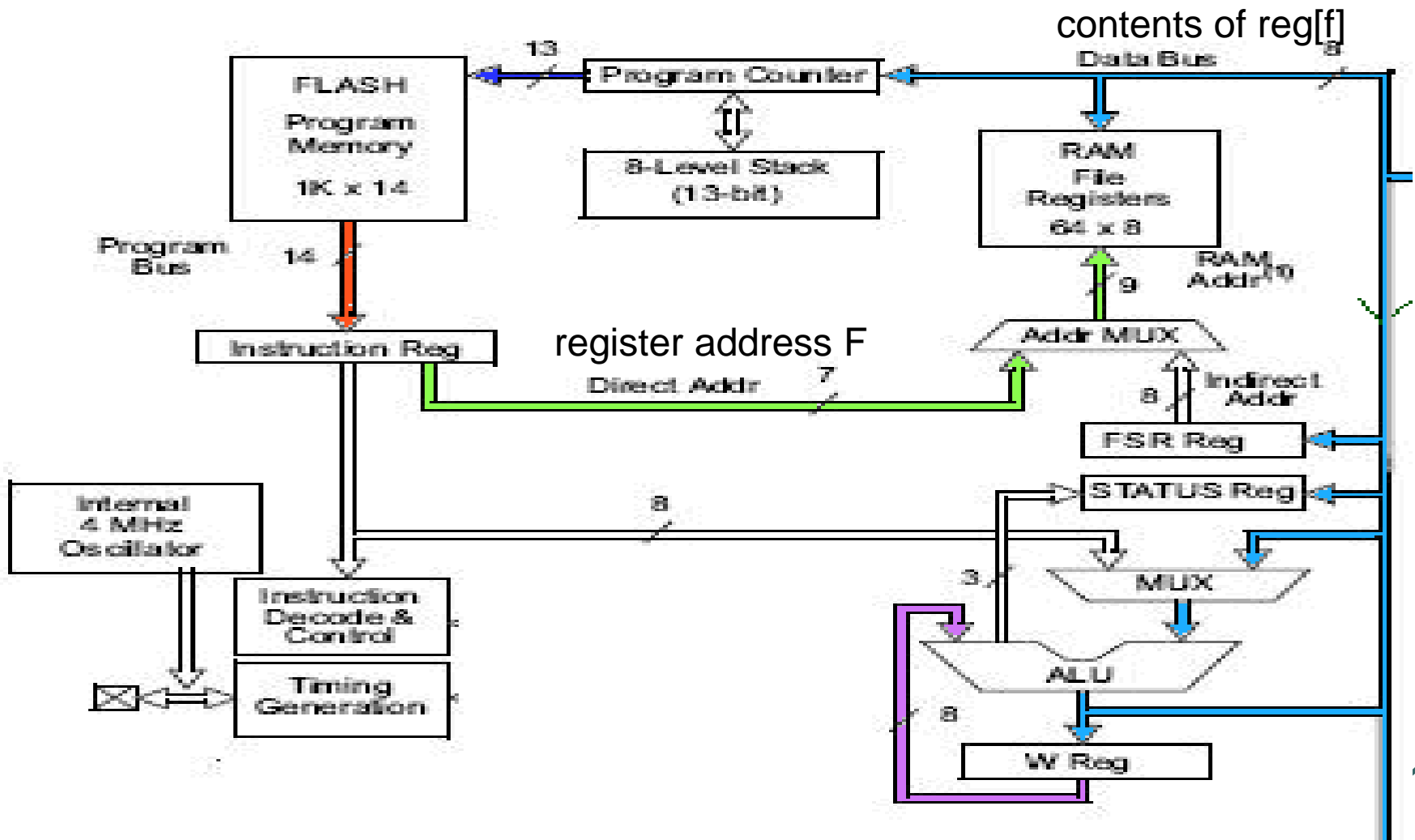
Add const to W path ϕ_1

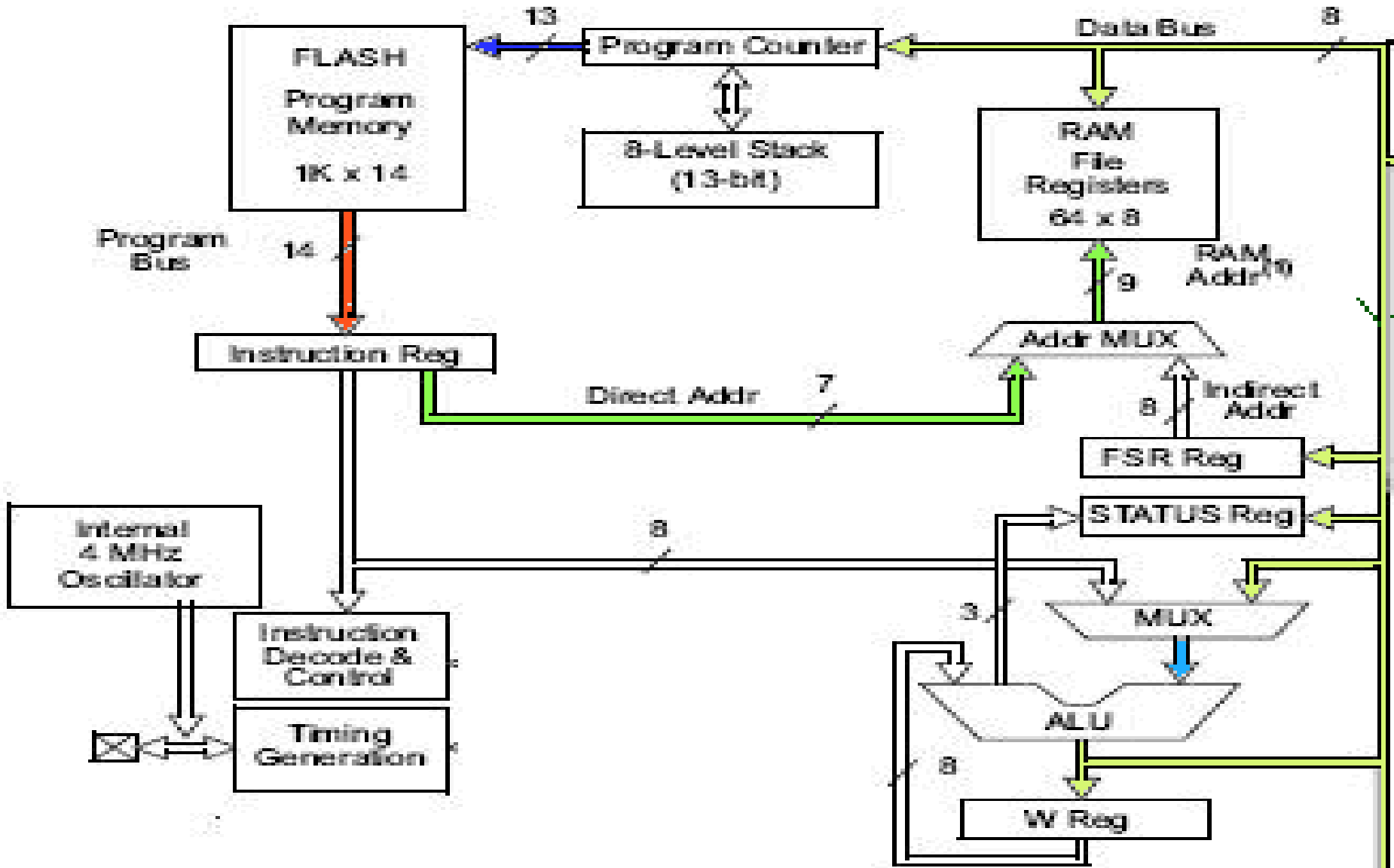


Add constants

- Constants can only be added to W reg since the same bits in the instruction are used to encode register addresses as are used to encode constants

phase1 $reg[f]=reg[f]+w$





Destinations

- Look at the output of the ALU, it can go either to `reg[f]` or to `W` register. Either can be the destination of a calculation.
- By understanding the bus structure of a CPU you can see what sort of instructions are possible.