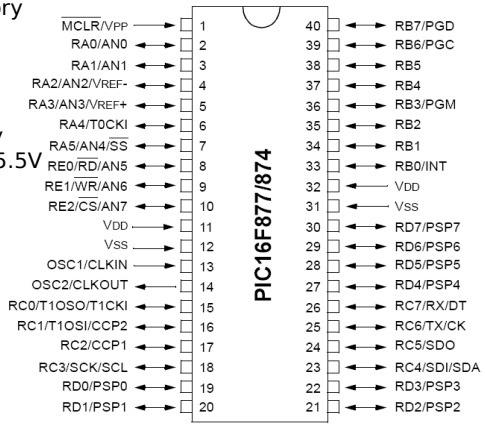
PIC 16F877

- High performance RISC CPU
- 35 single word instructions
- All single cycle instructions except for program branches
- Operating speed: DC - 20 MHz clock input
- 8K x 14 words of FLASH Program Memory
- 368 x 8 bytes of Data Memory (RAM)
- 256 x 8 bytes of EEPROM Data Memory
- Interrupt capability (up to 14 sources)
- Eight level deep hardware stack
- In-Circuit Serial Programming capability
- Wide operating voltage range: 2.0V to 5.5V
- High Sink/Source Current: 25 mA
- Low-power consumption



PIC 16F877

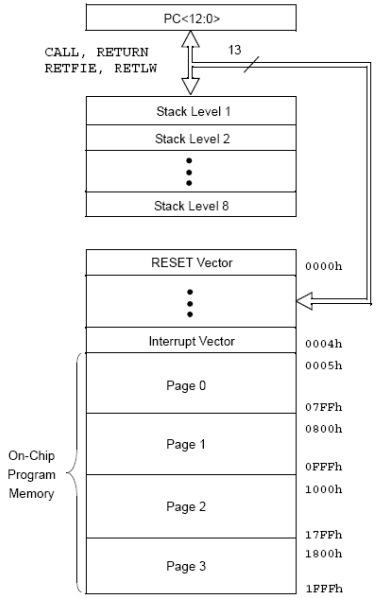
Peripheral Features:

- Timer0: 8-bit timer/counter with 8-bit prescaler
- Timer1: 16-bit timer/counter with prescaler,
- Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler
- Two Capture, Compare, PWM modules
  - Capture is 16-bit, max. resolution is 12.5 ns
  - Compare is 16-bit, max. resolution is 200 ns
  - PWM max. resolution is 10-bit
- 10-bit multi-channel Analog-to-Digital converter
- Synchronous Serial Port (SSP) with SPI (Master mode) and I2C (Master/Slave)
- Universal Synchronous Asynchronous Receiver Transmitter (USART/SCI)
- Parallel Slave Port (PSP) 8-bits wide
- Brown-out detection circuitry for Brown-out Reset (BOR)

PIC 16F877

Key Features PICmicro™ Mid-Range Reference Manual (DS33023)	PIC16F877
Operating Frequency	DC - 20 MHz
RESETS (and Delays)	POR, BOR (PWRT, OST)
FLASH Program Memory (14-bit words)	8K
Data Memory (bytes)	368
EEPROM Data Memory	256
Interrupts	14
I/O Ports	Ports A,B,C,D,E
Timers	3
Capture/Compare/PWM Modules	2
Serial Communications	MSSP, USART
Parallel Communications	PSP
10-bit Analog-to-Digital Module	8 input channels
Instruction Set	35 instructions

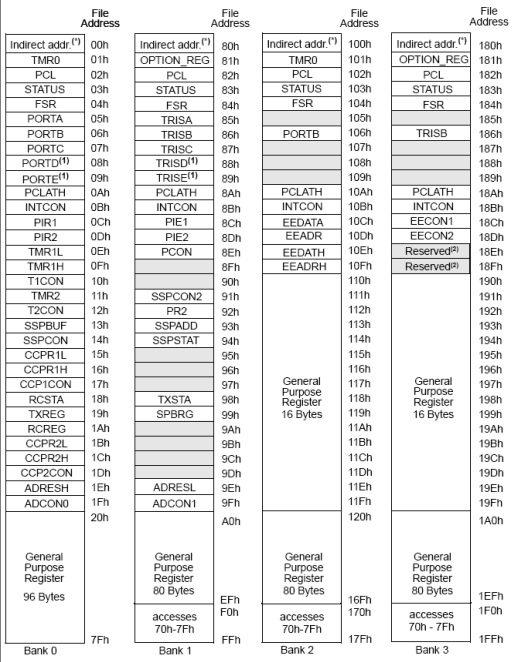
PIC 16F877



Program Memory Organization

- PIC16F877 has a 13-bit PC
- PIC16F877 has 8K x 14 words of FLASH program memory, and the
- Accessing a location above the physically implemented address will cause a wraparound.
- The RESET vector is at 0000h and the interrupt vector is at 0004h.

PIC 16F877



Data Memory Organization

- The data memory is partitioned into multiple banks which contain the General Purpose Registers and the Special Function Registers.
- Bits RP1 (STATUS<6>) and RP0 (STATUS<5>) are the bank select bits.

RP1:RP0	Bank
00	0
01	1
10	2
11	3

PIC 16F877: A/D Converter Module

- 10-bit resolution
- 8 inputs
- Successive approximation A/D converter
- Selectable voltage reference sources (VDD, VSS, RA2, RA3)
- The A/D module has four registers.
  - A/D Control Register0 (ADCON0) → Control operation
  - A/D Control Register1 (ADCON1) → Config port pins
  - A/D Result High Register (ADRESH) → Store result
  - A/D Result Low Register (ADRESL) → Store result

PIC 16F877: A/D Module

ADCON0 REGISTER (ADDRESS: 1Fh)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0
ADCS1	ADCS0	CHS2	CHS1	CHS0	GO/$\overline{\text{DONE}}$	—	ADON
bit 7							bit 0

- **ADCS1:ADCS0:** A/D Conversion Clock Select bits
  - 00 = FOSC/2
  - 01 = FOSC/8
  - 10 = FOSC/32
  - 11 = FRC (clock derived from the internal A/D module RC oscillator)
- **CHS2:CHS0**: Analog Channel Select bits
  - 000 = channel 0, (RA0/AN0)
  - 001 = channel 1, (RA1/AN1)
  - 010 = channel 2, (RA2/AN2)
  - 011 = channel 3, (RA3/AN3)
  - 100 = channel 4, (RA5/AN4)
  - 101 = channel 5, (RE0/AN5)**(1)**
  - 110 = channel 6, (RE1/AN6)**(1)**
  - 111 = channel 7, (RE2/AN7)**(1)**

PIC 16F877: A/D Module

ADCON0 REGISTER (ADDRESS: 1Fh)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0
ADCS1	ADCS0	CHS2	CHS1	CHS0	GO/$\overline{\text{DONE}}$	—	ADON
bit 7							bit 0

- **GO/DONE:** A/D Conversion Status bit
  If ADON = 1:
  - 1 = A/D conversion in progress (setting this bit starts the A/D conversion)
  - 0 = A/D conversion not in progress (this bit is automatically cleared by hardware when the A/D conversion is complete)
- **ADON**: A/D On bit
  - 1 = A/D converter module is operating
  - 0 = A/D converter module is shut-off and consumes no operating current

PIC 16F877: A/D Module

ADCON1 REGISTER (ADDRESS 9Fh)

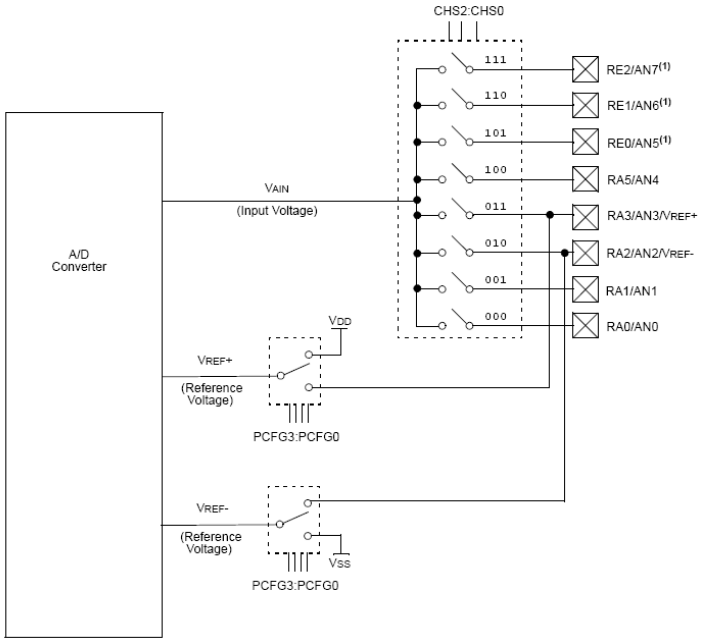
U-0	U-0	R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
ADFM	—	—	—	PCFG3	PCFG2	PCFG1	PCFG0
bit 7							bit 0

- **ADFM:** A/D Result Format Select bit
  1 = Right justified. 6 Most Significant bits of ADRESH are read as '0'.
  0 = Left justified. 6 Least Significant bits of ADRESL are read as '0'.
- **PCFG3:PCFG0**: A/D Port Configuration Control bits:

PCFG3: PCFG0	AN7(1) RE2	AN6(1) RE1	AN5(1) RE0	AN4 RA5	AN3 RA3	AN2 RA2	AN1 RA1	AN0 RA0	VREF+	VREF-	CHAN/ Refs(2)
0000	A	A	A	A	A	A	A	A	VDD	VSS	8/0
0001	A	A	A	A	VREF+	A	A	A	RA3	VSS	7/1
0010	D	D	D	A	A	A	A	A	VDD	VSS	5/0
0011	D	D	D	A	VREF+	A	A	A	RA3	VSS	4/1
0100	D	D	D	D	A	D	A	A	VDD	VSS	3/0
0101	D	D	D	D	VREF+	D	A	A	RA3	VSS	2/1
011x	D	D	D	D	D	D	D	D	VDD	VSS	0/0
1000	A	A	A	A	VREF+	VREF-	A	A	RA3	RA2	6/2
1001	D	D	A	A	A	A	A	A	VDD	VSS	6/0
1010	D	D	A	A	VREF+	A	A	A	RA3	VSS	5/1
1011	D	D	A	A	VREF+	VREF-	A	A	RA3	RA2	4/2
1100	D	D	D	A	VREF+	VREF-	A	A	RA3	RA2	3/2
1101	D	D	D	D	VREF+	VREF-	A	A	RA3	RA2	2/2
1110	D	D	D	D	D	D	D	A	VDD	VSS	1/0
1111	D	D	D	D	VREF+	VREF-	D	A	RA3	RA2	1/2

A = Analog input D = Digital I/O

PIC 16F877 : A/D Module



PIC 16F877 : A/D Module

- The ADRESH:ADRESL registers contain the 10-bit result of the A/D conversion.
- When the A/D conversion is complete, the result is loaded into this A/D result register pair.
- The GO/DONE bit (ADCON0<2>) is cleared
- The A/D interrupt flag bit ADIF is set.
- The analog input channels must have their corresponding TRIS bits set as inputs.

PIC 16F877 : A/D Module

Using A/D Module

1. **Configure the A/D module**:
   - Configure analog pins/voltage reference and digital I/O (ADCON1)
   - Select A/D input channel (ADCON0)
   - Select A/D conversion clock (ADCON0)
   - Turn on A/D module (ADCON0)
2. Configure A/D interrupt (if desired):
   - Clear ADIF bit
   - Set ADIE bit
   - Set PEIE bit
   - Set GIE bit
3. Wait the required acquisition time.
4. Start conversion:
   - Set GO/DONE bit (ADCON0)
5. Wait for A/D conversion to complete, by either:
   - Polling for the GO/DONE bit to be cleared (with interrupts enabled); OR
   - Waiting for the A/D interrupt
6. Read A/D result register pair (ADRESH:ADRESL), clear bit ADIF if required.
7. For the next conversion, go to step 1 or step 2, as required.

PIC 16F877 : A/D Module

Obtaining A/D results