

PIC Microprocessor Basics

© Create It Lab
BEG,RSTP,DH,CV

01-05-2014

Controller Design Options

Personal Computer

Tablet

Raspberry Pi

Arduino

TI-430

Beagle Bone

PIC

FPGA

Design / Development Considerations

Power

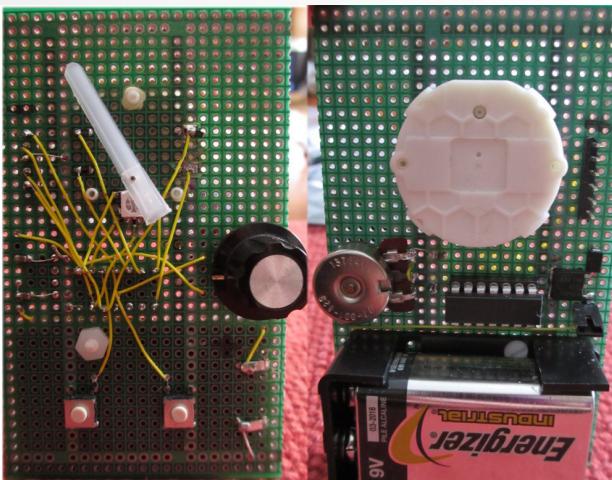
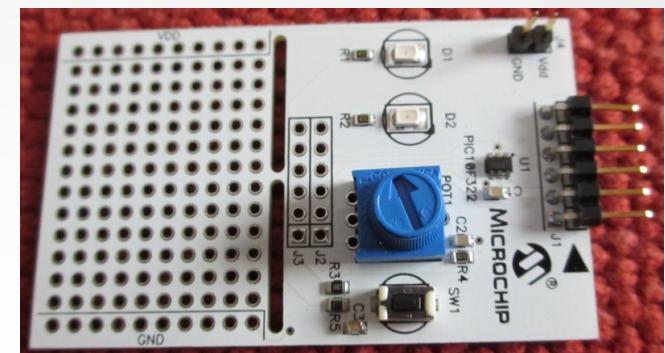
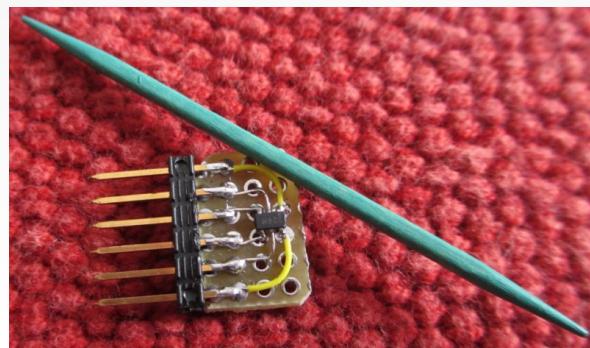
Cost

Size

External Components

Support

PIC Sightings



Coding Options

Assembler vs Compilier

Mnemonics vs Machine Code

Why Machine Code?

PIC 12F1822/16F1823 Instruction Set (49 Instructions)

BYTE-ORIENTED FILE REGISTER OPERATIONS

ADDWF
ADDWFC
ANDWF
ASRF
LSLF
LSRF
CLRF
CLRW
COMF
DECFSZ
INCF
IORWF
MOVF
MOVWF
RLF
RRF
SUBWF
SUBWFB
SWAPF
XORWF

BYTE ORIENTED SKIP OPERATIONS

DECFSZ
INCFSZ

BIT-ORIENTED FILE REGISTER OPERATIONS

BCF
BSF

INHERENT OPERATIONS

CLRWDAT
NOP
OPTION
RESET
SLEEP
TRIS

BIT-ORIENTED SKIP OPERATIONS

BTFS
BTFS

LITERAL OPERATIONS

ADDLW
ANDLW
IORLW
MOVLB
MOVLP
MOVLW
SUBLW
XORLW

CONTROL OPERATIONS

BRA
BRW
CALL
CALLW
GOTO
RETFIE
RETLW
RETURN

C-COMPILER OPTIMIZED

ADDSR
MOVIW
MOVWI

PIC 16F1823 Features

2K Words Program Memory

256 Data Bytes

128 8 bit Registers (SRAM)

12 I/O's

8 ADC Channels

8 CapSense Channels

2 Comparators

1 EUSART

1 MSSP (I2C/SPI)

1 Capture/Compare/PWM (ECCP) Full Bridge

Up to 32MHZ Clock

16 level stack

Watchdog Timer

Low Power

10 bit ADC, 8 channels

Analog Comparator

5 bit DAC

Fixed Voltage Reference

11 I/O and one Input Pin

25ma Source/Sink Capable

2-8 bit Timers

1-16 bit Enhanced Timer

MSSP with I2C, SPI, RS-232

Continous Wave Source

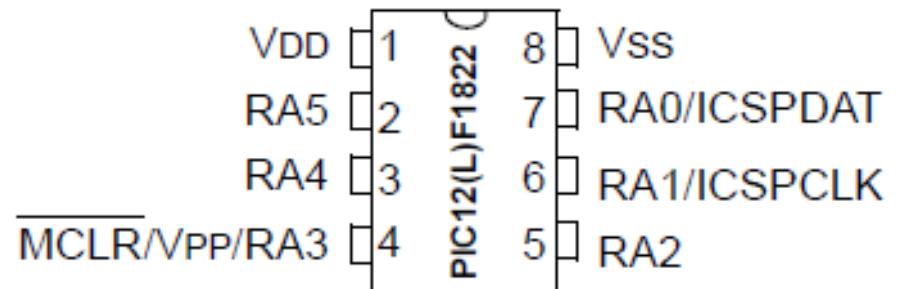
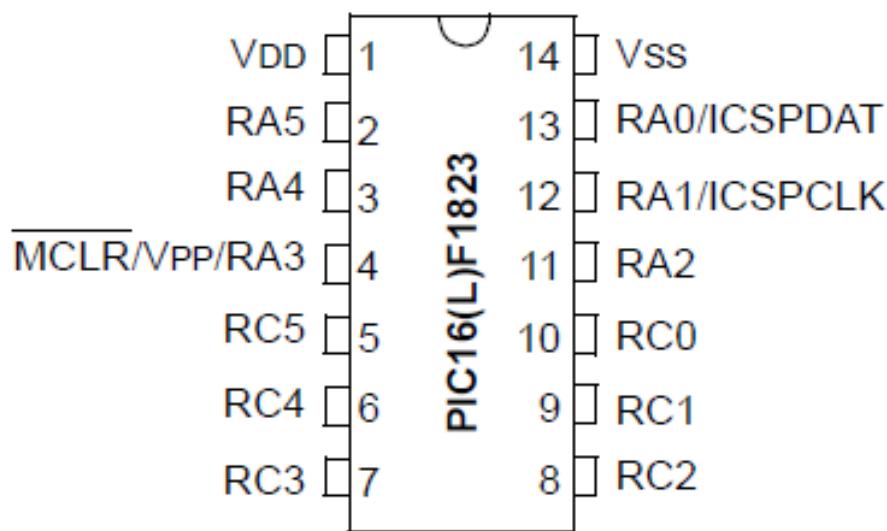
Hardware PWM

Capacitive Sense 8 channels

Programmable S-R Flip Flop

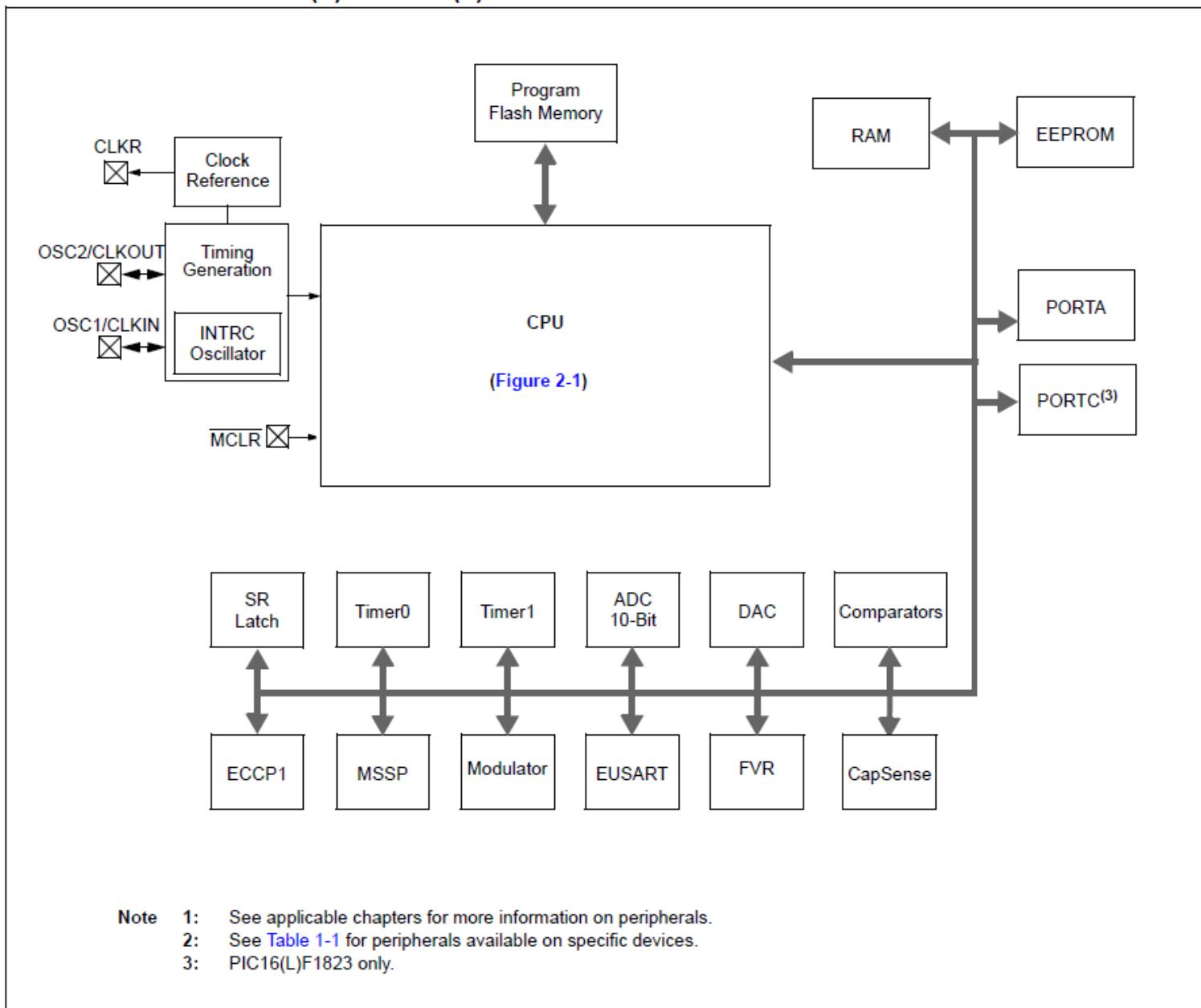
Note: 12F1822 has the same core CPU with less IO Pins

Package Examples



Block Diagram

FIGURE 1-1: PIC12(L)F1822/16(L)F1823 BLOCK DIAGRAM



Example Pin Function List

Name	Function	Input Type	Output Type	Description
RA0/AN0/CPS0/C1IN+/ DACOUT/TX ⁽¹⁾ /CK ⁽¹⁾ /SDO ⁽¹⁾ / SS ⁽¹⁾ /P1B ⁽¹⁾ /MDOUT/ICSPDAT/ ICDDAT	RA0	TTL	CMOS	General purpose I/O.
	AN0	AN	—	A/D Channel 0 input.
	CPS0	AN	—	Capacitive sensing input 0.
	C1IN+	AN	—	Comparator C1 positive input.
	DACOUT	—	AN	Digital-to-Analog Converter output.
	TX	—	CMOS	USART asynchronous transmit.
	CK	ST	CMOS	USART synchronous clock.
	SDO	—	CMOS	SPI data output.
	SS	ST	—	Slave Select input.
	P1B	—	CMOS	PWM output.
	MDOUT	—	CMOS	Modulator output.
	ICSPDAT	ST	CMOS	ICSP™ Data I/O.
RA1/AN1/CPS1/VREF+/C1IN0-/ SRI/RX ⁽¹⁾ /DT ⁽¹⁾ /SCL/SCK/ MDMIN/ICSPCLK/ICDCLK	RA1	TTL	CMOS	General purpose I/O.
	AN1	AN	—	A/D Channel 1 input.
	CPS1	AN	—	Capacitive sensing input 1.
	VREF+	AN	—	A/D and DAC Positive Voltage Reference input.
	C1IN0-	AN	—	Comparator C1 or C2 negative input.
	SRI	ST	—	SR latch input.
	RX	ST	—	USART asynchronous input.
	DT	ST	CMOS	USART synchronous data.
	SCL	I ² C™	OD	I ² C™ clock.
	SCK	ST	CMOS	SPI clock.
	MDMIN	ST	—	Modulator source input.
	ICSPCLK	ST	—	Serial Programming Clock.

Instruction Examples

Mnemonic, Operands	Description	Cycles	14-Bit Opcode				Status Affected	Notes
			MSb		Lsb			
BYTE-ORIENTED FILE REGISTER OPERATIONS								
ADDWF f, d	Add W and f	1	00	0111	dfff	ffff	C, DC, Z	2
ADDWFC f, d	Add with Carry W and f	1	11	1101	dfff	ffff	C, DC, Z	2
ANDWF f, d	AND W with f	1	00	0101	dfff	ffff	Z	2
ASRF f, d	Arithmetic Right Shift	1	11	0111	dfff	ffff	C, Z	2
LSLF f, d	Logical Left Shift	1	11	0101	dfff	ffff	C, Z	2
LSRF f, d	Logical Right Shift	1	11	0110	dfff	ffff	C, Z	2
CLRF f	Clear f	1	00	0001	1fff	ffff	Z	2
CLRW -	Clear W	1	00	0001	0000	00xx	Z	
COMF f, d	Complement f	1	00	1001	dfff	ffff	Z	2
DECF f, d	Decrement f	1	00	0011	dfff	ffff	Z	2
INCF f, d	Increment f	1	00	1010	dfff	ffff	Z	2
IORWF f, d	Inclusive OR W with f	1	00	0100	dfff	ffff	Z	2
MOVF f, d	Move f	1	00	1000	dfff	ffff	Z	2
MOVWF f	Move W to f	1	00	0000	1fff	ffff		2
RLF f, d	Rotate Left f through Carry	1	00	1101	dfff	ffff	C	2
RRF f, d	Rotate Right f through Carry	1	00	1100	dfff	ffff	C	2
SUBWF f, d	Subtract W from f	1	00	0010	dfff	ffff	C, DC, Z	2
SUBWFB f, d	Subtract with Borrow W from f	1	11	1011	dfff	ffff	C, DC, Z	2
SWAPF f, d	Swap nibbles in f	1	00	1110	dfff	ffff		2
XORWF f, d	Exclusive OR W with f	1	00	0110	dfff	ffff	Z	2
BYTE ORIENTED SKIP OPERATIONS								
DECFSZ f, d	Decrement f, Skip if 0	1(2)	00	1011	dfff	ffff		1, 2
INCFSZ f, d	Increment f, Skip if 0	1(2)	00	1111	dfff	ffff		1, 2
BIT-ORIENTED FILE REGISTER OPERATIONS								
BCF f, b	Bit Clear f	1	01	00bb	bfff	ffff		2
BSF f, b	Bit Set f	1	01	01bb	bfff	ffff		2
BIT-ORIENTED SKIP OPERATIONS								
BTFSC f, b	Bit Test f, Skip if Clear	1 (2)	01	10bb	bfff	ffff		1, 2
BTFSS f, b	Bit Test f, Skip if Set	1 (2)	01	11bb	bfff	ffff		1, 2

Number Basics

Binary, Hex, Octal, Decimal

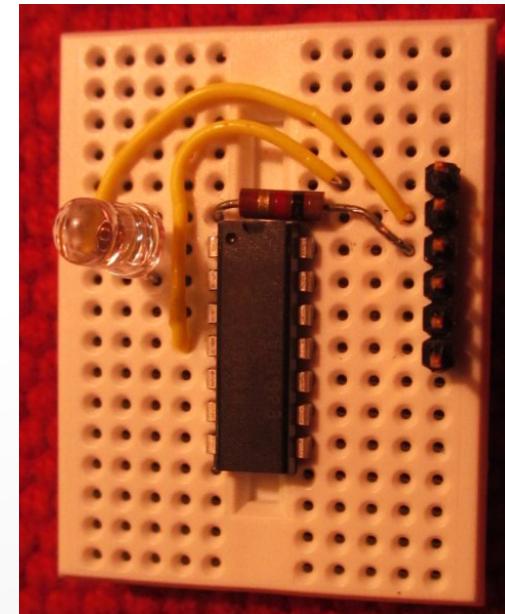
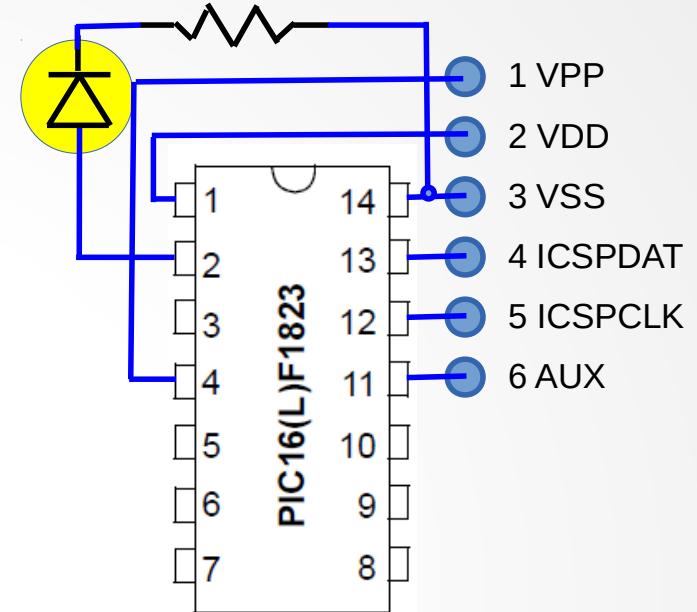
Decimal Numbers with no exact Binary Representation

Divide by 2,4,...

Simple PIC Assembler Program

LED Flasher

```
BANKSEL TRISA          ;  
;Set RA5 as output and set RA<4:0> as inputs  
MOVLW b'00011111'      ;  
    ;00----- reserved  
    ;--0---- TRISA5  
    ;--1---- TRISA4  
    ;--1--- TRISA3  
    ;----1-- TRISA2  
    ;----1- TRISA1  
    ;-----1 TRISA0  
  
MOVWF TRISA  
  
main_loop  
    BANKSEL PORTA          ;  
  
    BSF    PORTA,LED0  
    call   WAIT_200MS  
  
    BCF    PORTA,LED0  
    call   WAIT_200MS  
  
    goto  main_loop
```



PIC Programmer and CPU



Microchip PicKit 2 Clone with internal program memory.

PIC 16F1823 in a DIP 14

Digikey Partnumber PIC16F1823-I/P-ND

\$1.12 (25+)

Programimg Software

gpasm, gutils assembler

pk2cmd, Pic Programmer

Plain text editor (Like vi, emacs, wordpad)

Optional, MPLAB-X IDE

Acronyms and References

IDE - Integrated Development Environment

Microchip

<http://www.microchip.com/>

GPUTILS

<http://gutils.sourceforge.net/>

DigiKey

<http://www.digikey.com>

Random PIC Projects

<http://picprojects.org.uk/projects/picprojects.htm>