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PIC16F87/88

18/20/28-Pin Enhanced Flash MCUs with nanoWatt Technology

Low-Power Features:

- Power-Managed modes:
  - Primary Run: RC oscillator, 76 μA, 1 MHz, 2V
  - RC_RUN: 7 μA, 31.25 kHz, 2V
  - SEC_RUN: 9 μA, 32 kHz, 2V
  - Sleep: 0.1 μA, 2V
- Timer1 Oscillator: 1.8 μA, 32 kHz, 2V
- Watchdog Timer: 2.2 μA, 2V
- Two-Speed Oscillator Start-up

Oscillators:

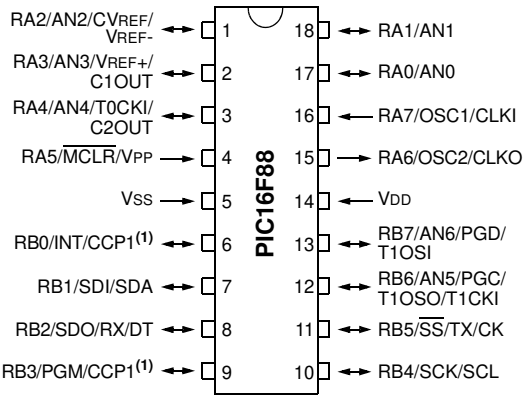
- Three Crystal modes:
  - LP, XT, HS: up to 20 MHz
- Two External RC modes
- One External Clock mode:
  - ECIO: up to 20 MHz
- Internal oscillator block:
  - 8 user selectable frequencies: 31 kHz, 125 kHz, 250 kHz, 500 kHz, 1 MHz, 2 MHz, 4 MHz, 8 MHz

Peripheral Features:

- Capture, Compare, PWM (CCP) module:
  - 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, 7-channel Analog-to-Digital Converter
- Synchronous Serial Port (SSP) with SPI (Master/Slave) and I^2C™ (Slave)
- Addressable Universal Synchronous Asynchronous Receiver Transmitter (AUSART/SCI) with 9-bit address detection:
  - RS-232 operation using internal oscillator (no external crystal required)
- Dual Analog Comparator module:
  - Programmable on-chip voltage reference
  - Programmable input multiplexing from device inputs and internal voltage reference
  - Comparator outputs are externally accessible

Pin Diagram

18-Pin PDIP, SOIC



Note 1: The CCP1 pin is determined by the CCPMX bit in Configuration Word 1 register.

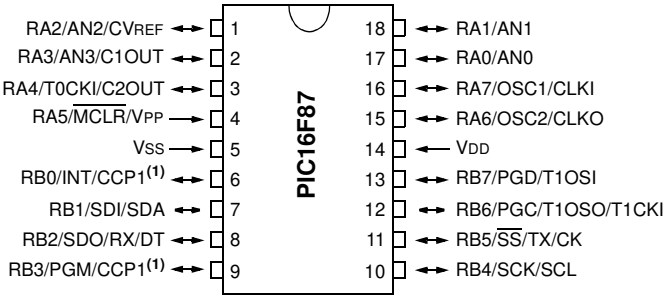
Special Microcontroller Features:

- 100,000 erase/write cycles Enhanced Flash program memory typical
- 1,000,000 typical erase/write cycles EEPROM data memory typical
- EEPROM Data Retention: > 40 years
- In-Circuit Serial Programming™ (ICSP™) via two pins
- Processor read/write access to program memory
- Low-Voltage Programming
- In-Circuit Debugging via two pins
- Extended Watchdog Timer (WDT):
  - Programmable period from 1 ms to 268s
- Wide operating voltage range: 2.0V to 5.5V

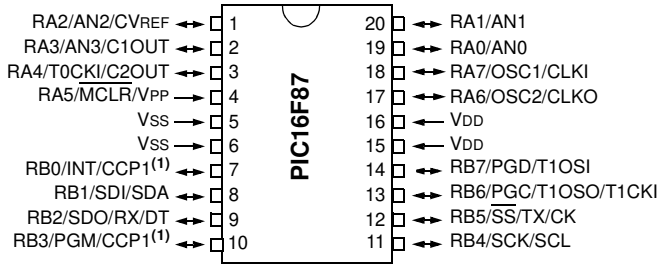
Device	Program Memory		Data Memory		I/O Pins	10-bit A/D (ch)	CCP (PWM)	AUSART	Comparators	SSP	Timers 8/16-bit
	Flash (bytes)	# Single-Word Instructions	SRAM (bytes)	EEPROM (bytes)							
PIC16F87	7168	4096	368	256	16	N/A	1	Y	2	Y	2/1
PIC16F88	7168	4096	368	256	16	1	1	Y	2	Y	2/1

Pin Diagrams

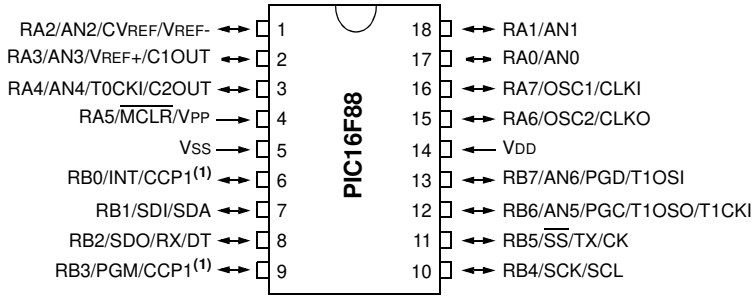
18-Pin PDIP, SOIC



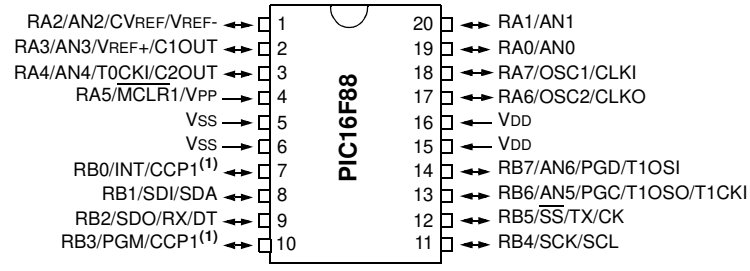
20-Pin SSOP



18-Pin PDIP, SOIC



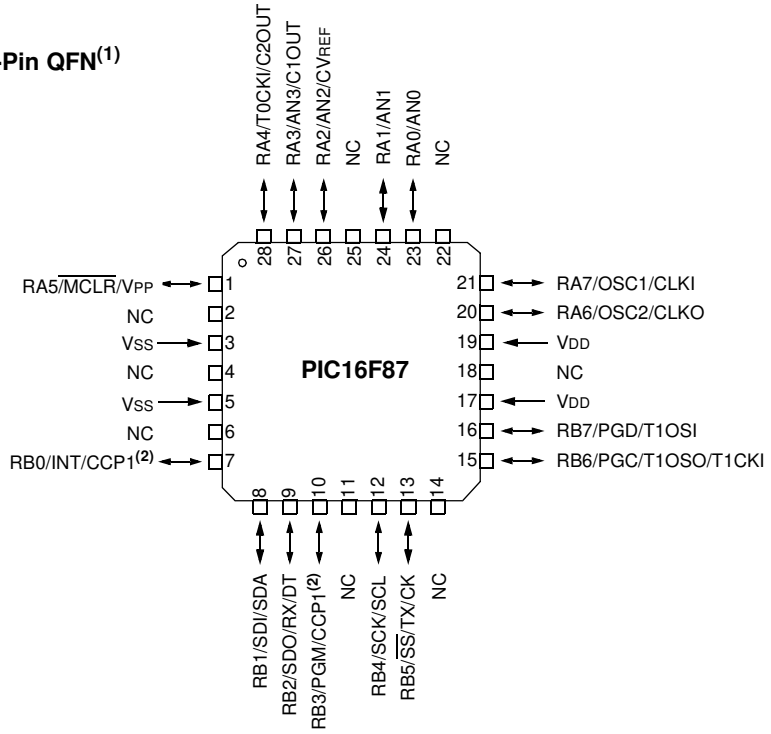
20-Pin SSOP



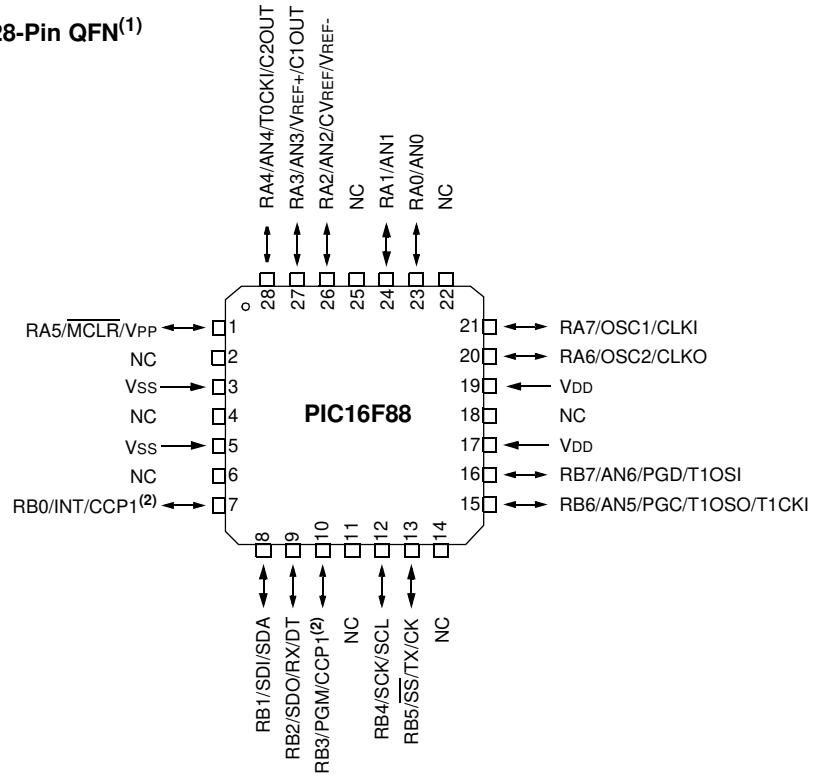
Note 1: The CCP1 pin is determined by the CCPMX bit in Configuration Word 1 register.

Pin Diagrams (Cont'd)

28-Pin QFN(1)



28-Pin QFN(1)



Note 1: For the QFN package, it is recommended that the bottom pad be connected to VSS.

2: The CCP1 pin is determined by the CCPMX bit in Configuration Word 1 register.

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1.0 DEVICE OVERVIEW

This document contains device specific information for the operation of the PIC16F87/88 devices. Additional information may be found in the "*PIC® Mid-Range MCU Family Reference Manual*" (DS33023) which may be downloaded from the Microchip web site. This Reference Manual should be considered a complementary document to this data sheet and is highly recommended reading for a better understanding of the device architecture and operation of the peripheral modules.

The PIC16F87/88 belongs to the Mid-Range family of the PIC® devices. Block diagrams of the devices are shown in Figure 1-1 and Figure 1-2. These devices contain features that are new to the PIC16 product line:

- Low-power modes: RC_RUN allows the core and peripherals to be clocked from the INTRC, while SEC_RUN allows the core and peripherals to be clocked from the low-power Timer1. Refer to **Section 4.7 "Power-Managed Modes"** for further details.
- Internal RC oscillator with eight selectable frequencies, including 31.25 kHz, 125 kHz, 250 kHz, 500 kHz, 1 MHz, 2 MHz, 4 MHz and 8 MHz. The INTRC can be configured as a primary or secondary clock source. Refer to **Section 4.5 "Internal Oscillator Block"** for further details.
- The Timer1 module current consumption has been greatly reduced from 20 μA (previous PIC16 devices) to 1.8 μA typical (32 kHz at 2V), which is ideal for real-time clock applications. Refer to **Section 7.0 "Timer1 Module"** for further details.
- Extended Watchdog Timer (WDT) that can have a programmable period from 1 ms to 268s. The WDT has its own 16-bit prescaler. Refer to **Section 15.12 "Watchdog Timer (WDT)"** for further details.
- Two-Speed Start-up: When the oscillator is configured for LP, XT or HS Oscillator mode, this feature will clock the device from the INTRC while the oscillator is warming up. This, in turn, will enable almost immediate code execution. Refer to **Section 15.12.3 "Two-Speed Clock Start-up Mode"** for further details.
- Fail-Safe Clock Monitor: This feature will allow the device to continue operation if the primary or secondary clock source fails by switching over to the INTRC.
- The A/D module has a new register for PIC16 devices named ANSEL. This register allows easier configuration of analog or digital I/O pins.

TABLE 1-1: AVAILABLE MEMORY IN PIC16F87/88 DEVICES

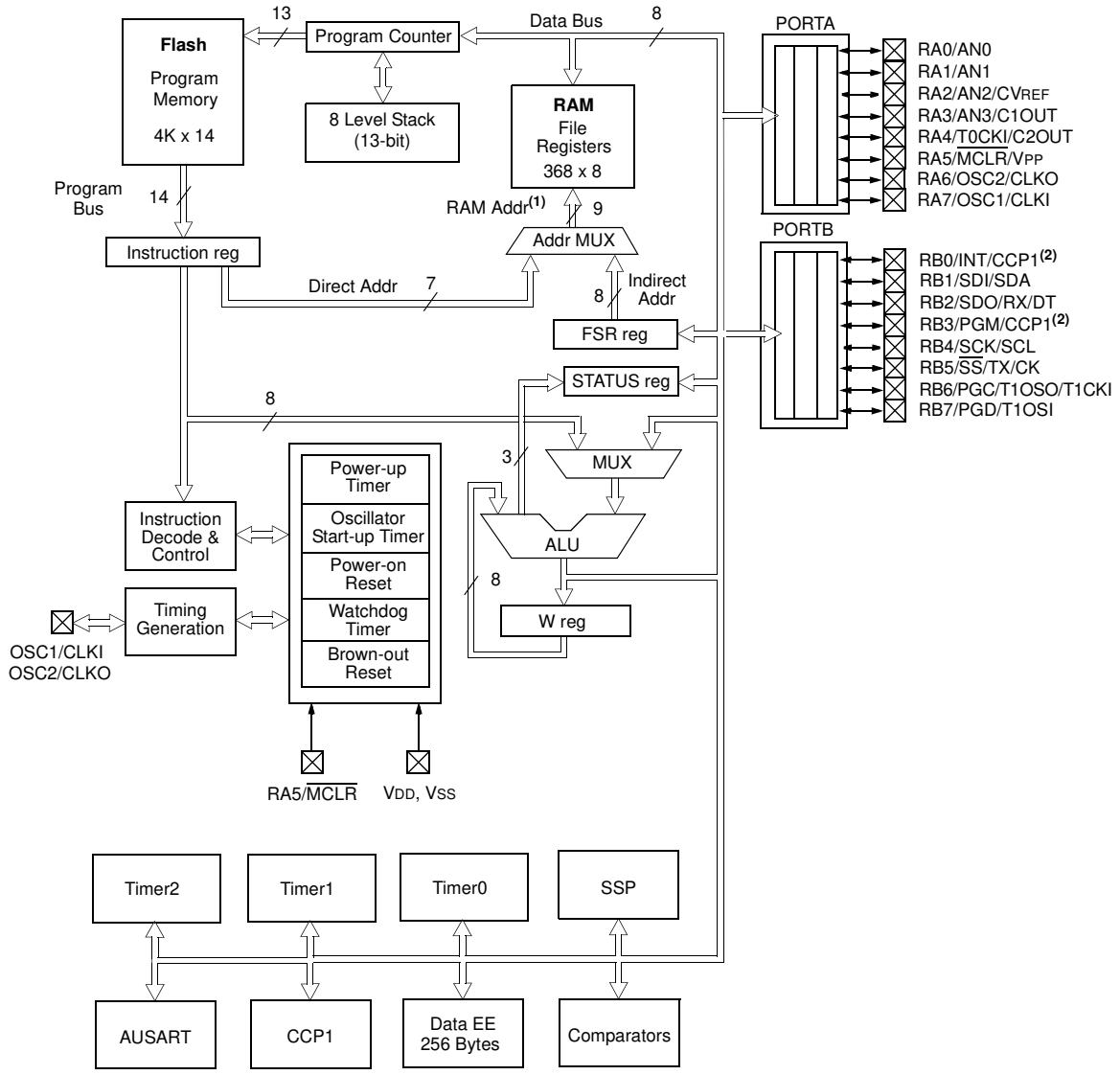
Device	Program Flash	Data Memory	Data EEPROM
PIC16F87/88	4K x 14	368 x 8	256 x 8

There are 16 I/O pins that are user configurable on a pin-to-pin basis. Some pins are multiplexed with other device functions. These functions include:

- External Interrupt
- Change on PORTB Interrupt
- Timer0 Clock Input
- Low-Power Timer1 Clock/Oscillator
- Capture/Compare/PWM
- 10-bit, 7-channel A/D Converter (PIC16F88 only)
- SPI/I^2C™
- Two Analog Comparators
- AUSART
- $\overline{MCLR}$ (RA5) can be configured as an input

Table 1-2 details the pinout of the devices with descriptions and details for each pin.

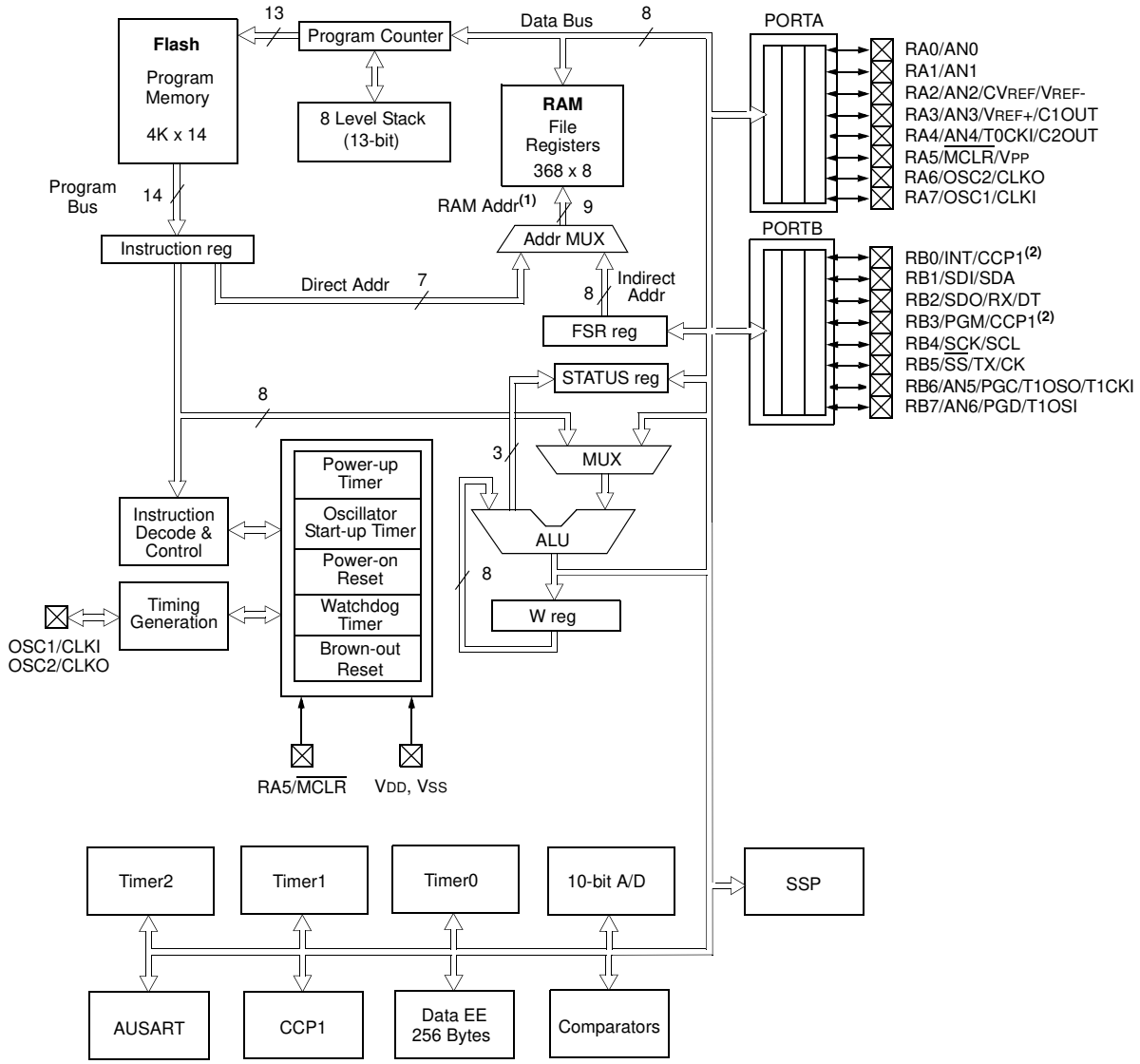
FIGURE 1-1: PIC16F87 DEVICE BLOCK DIAGRAM



Note 1: Higher order bits are from the STATUS register.

2: The CCP1 pin is determined by the CCPMX bit in Configuration Word 1 register.

FIGURE 1-2: PIC16F88 DEVICE BLOCK DIAGRAM



Note 1: Higher order bits are from the STATUS register.

2: The CCP1 pin is determined by the CCPMX bit in Configuration Word 1 register.

TABLE 1-2: PIC16F87/88 PINOUT DESCRIPTION

Pin Name	PDIP/ SOIC Pin#	SSOP Pin#	QFN Pin#	I/O/P Type	Buffer Type	Description
						PORTA is a bidirectional I/O port.
RA0/AN0	17	19	23			
RA0				I/O	TTL	Bidirectional I/O pin.
AN0				I	Analog	Analog input channel 0.
RA1/AN1	18	20	24			
RA1				I/O	TTL	Bidirectional I/O pin.
AN1				I	Analog	Analog input channel 1.
RA2/AN2/CVREF/VREF-	1	1	26			
RA2				I/O	TTL	Bidirectional I/O pin.
AN2				I	Analog	Analog input channel 2.
CVREF				O		Comparator VREF output.
VREF-(4)				I	Analog	A/D reference voltage (Low) input.
RA3/AN3/VREF+/C1OUT	2	2	27			
RA3				I/O	TTL	Bidirectional I/O pin.
AN3				I	Analog	Analog input channel 3.
VREF+(4)				I	Analog	A/D reference voltage (High) input.
C1OUT				O		Comparator 1 output.
RA4/AN4/T0CKI/C2OUT	3	3	28			
RA4				I/O	ST	Bidirectional I/O pin.
AN4(4)				I	Analog	Analog input channel 4.
T0CKI				I	ST	Clock input to the TMR0 timer/counter.
C2OUT				O		Comparator 2 output.
RA5/$\overline{\text{MCLR}}$/VPP	4	4	1			
RA5				I	ST	Input pin.
$\overline{\text{MCLR}}$				I	ST	Master Clear (Reset). Input/programming voltage input. This pin is an active-low Reset to the device.
VPP				P	–	Programming voltage input.
RA6/OSC2/CLKO	15	17	20			
RA6				I/O	ST	Bidirectional I/O pin.
OSC2				O	–	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode.
CLKO				O	–	In RC mode, this pin outputs CLKO signal which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate.
RA7/OSC1/CLKI	16	18	21			
RA7				I/O	ST	Bidirectional I/O pin.
OSC1				I	ST/CMOS(3)	Oscillator crystal input.
CLKI				I	–	External clock source input.

Legend: I = Input O = Output I/O = Input/Output P = Power
– = Not used TTL = TTL Input ST = Schmitt Trigger Input

Note 1: This buffer is a Schmitt Trigger input when configured as the external interrupt.
2: This buffer is a Schmitt Trigger input when used in Serial Programming mode.
3: This buffer is a Schmitt Trigger input when configured in RC Oscillator mode and a CMOS input otherwise.
4: PIC16F88 devices only.
5: The CCP1 pin is determined by the CCPMX bit in Configuration Word 1 register.

TABLE 1-2: PIC16F87/88 PINOUT DESCRIPTION (CONTINUED)

Pin Name	PDIP/ SOIC Pin#	SSOP Pin#	QFN Pin#	I/O/P Type	Buffer Type	Description
						PORTB is a bidirectional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.
RB0/INT/CCP1(5)	6	7	7			
RB0				I/O	TTL	Bidirectional I/O pin.
INT				I	ST(1)	External interrupt pin.
CCP1				I/O	ST	Capture input, Compare output, PWM output.
RB1/SDI/SDA	7	8	8			
RB1				I/O	TTL	Bidirectional I/O pin.
SDI				I	ST	SPI data in.
SDA				I/O	ST	I^2C™ data.
RB2/SDO/RX/DT	8	9	9			
RB2				I/O	TTL	Bidirectional I/O pin.
SDO				O	ST	SPI data out.
RX				I		AUSART asynchronous receive.
DT				I/O		AUSART synchronous detect.
RB3/PGM/CCP1(5)	9	10	10			
RB3				I/O	TTL	Bidirectional I/O pin.
PGM				I/O	ST	Low-Voltage ICSP™ Programming enable pin.
CCP1				I	ST	Capture input, Compare output, PWM output.
RB4/SCK/SCL	10	11	12			
RB4				I/O	TTL	Bidirectional I/O pin. Interrupt-on-change pin.
SCK				I/O	ST	Synchronous serial clock input/output for SPI.
SCL				I	ST	Synchronous serial clock Input for I^2C.
RB5/$\overline{SS}$/TX/CK	11	12	13			
RB5				I/O	TTL	Bidirectional I/O pin. Interrupt-on-change pin.
$\overline{SS}$				I	TTL	Slave select for SPI in Slave mode.
TX				O		AUSART asynchronous transmit.
CK				I/O		AUSART synchronous clock.
RB6/AN5/PGC/T1OSO/ T1CKI	12	13	15			
RB6				I/O	TTL	Bidirectional I/O pin. Interrupt-on-change pin.
AN5(4)				I		Analog input channel 5.
PGC				I/O	ST(2)	In-Circuit Debugger and programming clock pin.
T1OSO				O	ST	Timer1 oscillator output.
T1CKI				I	ST	Timer1 external clock input.
RB7/AN6/PGD/T1OSI	13	14	16			
RB7				I/O	TTL	Bidirectional I/O pin. Interrupt-on-change pin.
AN6(4)				I		Analog input channel 6.
PGD				I	ST(2)	In-Circuit Debugger and ICSP programming data pin.
T1OSI				I	ST	Timer1 oscillator input.
VSS	5	5, 6	3, 5	P	–	Ground reference for logic and I/O pins.
VDD	14	15, 16	17, 19	P	–	Positive supply for logic and I/O pins.

Legend: I = Input O = Output I/O = Input/Output P = Power
– = Not used TTL = TTL Input ST = Schmitt Trigger Input

Note 1: This buffer is a Schmitt Trigger input when configured as the external interrupt.
2: This buffer is a Schmitt Trigger input when used in Serial Programming mode.
3: This buffer is a Schmitt Trigger input when configured in RC Oscillator mode and a CMOS input otherwise.
4: PIC16F88 devices only.
5: The CCP1 pin is determined by the CCPMX bit in Configuration Word 1 register.

NOTES:

2.0 MEMORY ORGANIZATION

There are two memory blocks in the PIC16F87/88 devices. These are the program memory and the data memory. Each block has its own bus, so access to each block can occur during the same oscillator cycle.

The data memory can be further broken down into the general purpose RAM and the Special Function Registers (SFRs). The operation of the SFRs that control the "core" are described here. The SFRs used to control the peripheral modules are described in the section discussing each individual peripheral module.

The data memory area also contains the data EEPROM memory. This memory is not directly mapped into the data memory but is indirectly mapped. That is, an indirect address pointer specifies the address of the data EEPROM memory to read/write. The PIC16F87/88 device's 256 bytes of data EEPROM memory have the address range of 00h-FFh. More details on the EEPROM memory can be found in **Section 3.0 "Data EEPROM and Flash Program Memory"**.

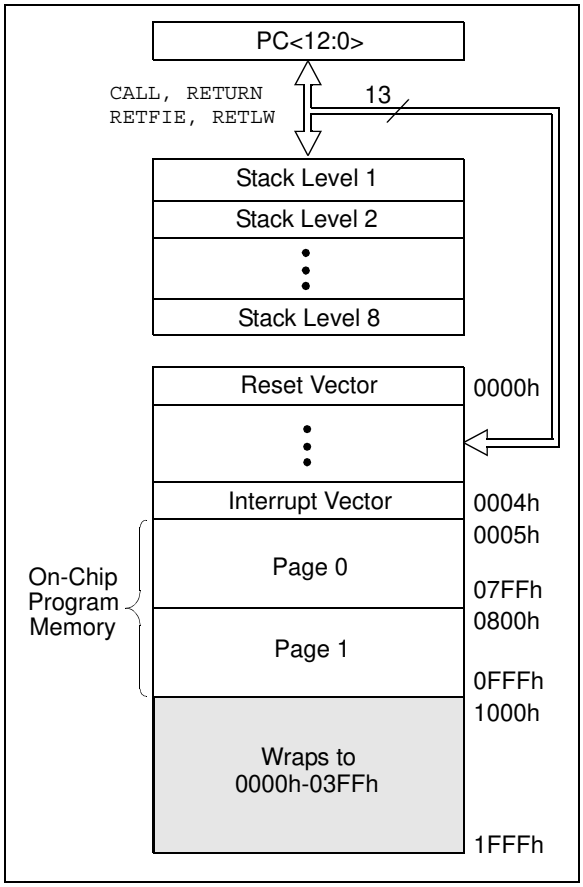
Additional information on device memory may be found in the "*PIC® Mid-Range MCU Family Reference Manual"* (DS33023).

2.1 Program Memory Organization

The PIC16F87/88 devices have a 13-bit program counter capable of addressing an 8K x 14 program memory space. For the PIC16F87/88, the first 4K x 14 (0000h-0FFFh) is physically implemented (see Figure 2-1). Accessing a location above the physically implemented address will cause a wraparound. For example, the same instruction will be accessed at locations 020h, 420h, 820h, C20h, 1020h, 1420h, 1820h and 1C20h.

The Reset vector is at 0000h and the interrupt vector is at 0004h.

FIGURE 2-1: PROGRAM MEMORY MAP AND STACK: PIC16F87/88



2.2 Data Memory Organization

The data memory is partitioned into multiple banks that 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

Each bank extends up to 7Fh (128 bytes). The lower locations of each bank are reserved for the Special Function Registers. Above the Special Function Registers are General Purpose Registers, implemented as static RAM. All implemented banks contain SFRs. Some "high use" SFRs from one bank may be mirrored in another bank for code reduction and quicker access (e.g., the STATUS register is in Banks 0-3).

Note:	EEPROM data memory description can be found in **Section 3.0 "Data EEPROM and Flash Program Memory"** of this data sheet.

2.2.1 GENERAL PURPOSE REGISTER FILE

The register file can be accessed either directly, or indirectly, through the File Select Register (FSR).

FIGURE 2-2: PIC16F87 REGISTER FILE MAP

File Address	Bank 0	File Address	Bank 1	File Address	Bank 2	File Address	Bank 3
00h	Indirect addr.(*)	80h	Indirect addr.(*)	100h	Indirect addr.(*)	180h	Indirect addr.(*)
01h	TMR0	81h	OPTION_REG	101h	TMR0	181h	OPTION_REG
02h	PCL	82h	PCL	102h	PCL	182h	PCL
03h	STATUS	83h	STATUS	103h	STATUS	183h	STATUS
04h	FSR	84h	FSR	104h	FSR	184h	FSR
05h	PORTA	85h	TRISA	105h	WDTCON	185h	
06h	PORTB	86h	TRISB	106h	PORTB	186h	TRISB
07h		87h		107h		187h	
08h		88h		108h		188h	
09h		89h		109h		189h	
0Ah	PCLATH	8Ah	PCLATH	10Ah	PCLATH	18Ah	PCLATH
0Bh	INTCON	8Bh	INTCON	10Bh	INTCON	18Bh	INTCON
0Ch	PIR1	8Ch	PIE1	10Ch	EEDATA	18Ch	EECON1
0Dh	PIR2	8Dh	PIE2	10Dh	EEADR	18Dh	EECON2
0Eh	TMR1L	8Eh	PCON	10Eh	EEDATH	18Eh	Reserved(1)
0Fh	TMR1H	8Fh	OSCCON	10Fh	EEADRH	18Fh	Reserved(1)
10h	T1CON	90h	OSCTUNE	110h		190h	
11h	TMR2	91h					
12h	T2CON	92h	PR2				
13h	SSPBUF	93h	SSPADD				
14h	SSPCON	94h	SSPSTAT				
15h	CCPR1L	95h					
16h	CCPR1H	96h					
17h	CCP1CON	97h					
18h	RCSTA	98h	TXSTA				
19h	TXREG	99h	SPBRG				
1Ah	RCREG	9Ah					
1Bh		9Bh					
1Ch		9Ch	CMCON				
1Dh		9Dh	CVRCON				
1Eh		9Eh					
1Fh		9Fh		11Fh		19Fh	
20h	General Purpose Register 96 Bytes	A0h	General Purpose Register 80 Bytes	120h	General Purpose Register 80 Bytes	1A0h	General Purpose Register 80 Bytes
		EFh		16Fh		1EFh	
		F0h	accesses 70h-7Fh	170h	accesses 70h-7Fh	1F0h	accesses 70h-7Fh
7Fh		FFh		17Fh		1FFh	

General Purpose Register 16 Bytes (Bank 2)

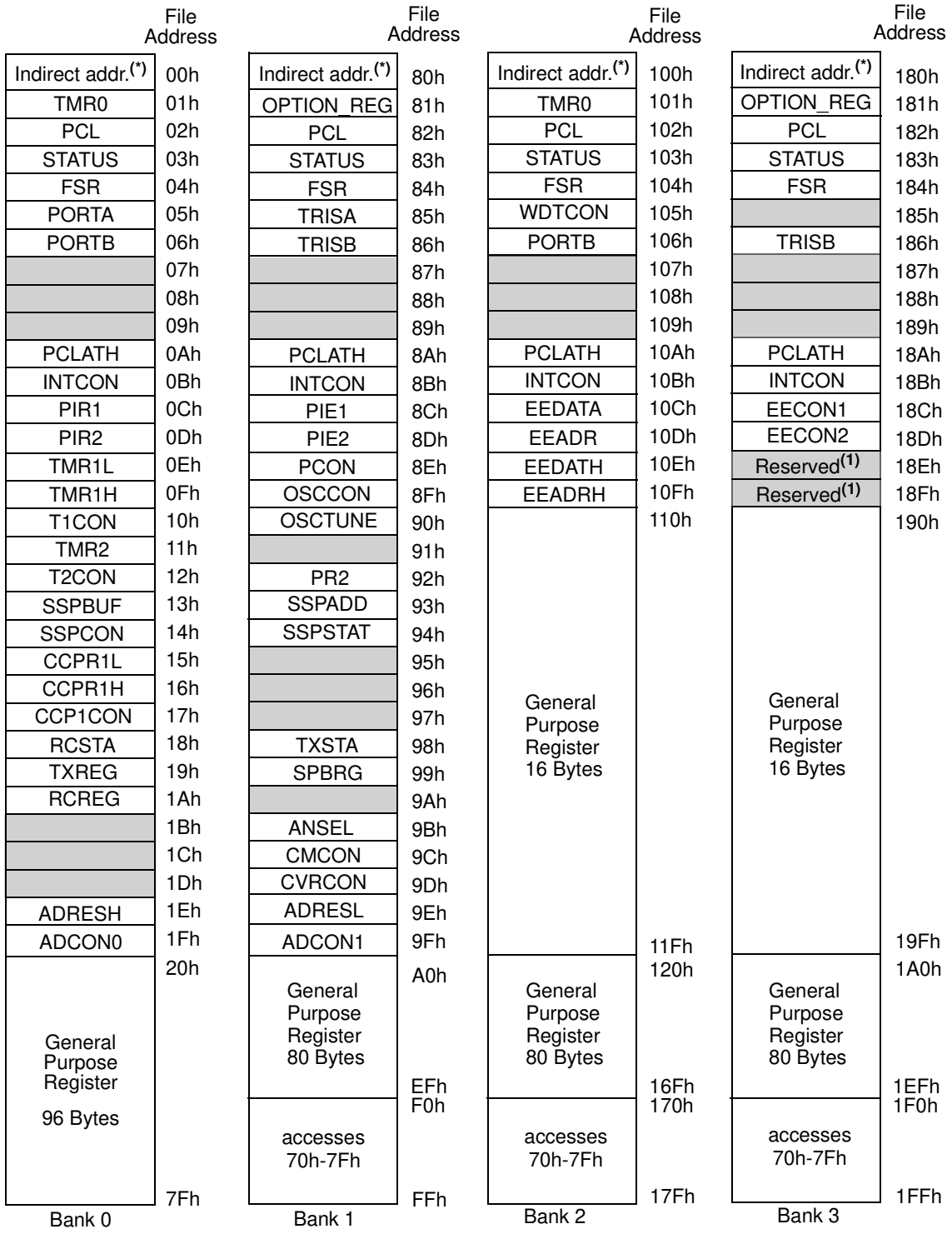
General Purpose Register 16 Bytes (Bank 3)

Unimplemented data memory locations, read as '0'.

* Not a physical register.

Note 1: This register is reserved, maintain this register clear.

FIGURE 2-3: PIC16F88 REGISTER FILE MAP



Unimplemented data memory locations, read as '0'.

* Not a physical register.

Note 1: This register is reserved, maintain this register clear.

2.2.2 SPECIAL FUNCTION REGISTERS

The Special Function Registers are registers used by the CPU and peripheral modules for controlling the desired operation of the device. These registers are implemented as static RAM. A list of these registers is given in Table 2-1.

The Special Function Registers can be classified into two sets: core (CPU) and peripheral. Those registers associated with the core functions are described in detail in this section. Those related to the operation of the peripheral features are described in detail in the peripheral feature section.

TABLE 2-1: SPECIAL FUNCTION REGISTER SUMMARY

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on: POR, BOR	Details on page
Bank 0											
00h(2)	INDF	Addressing this location uses contents of FSR to address data memory (not a physical register)								0000 0000	26, 135
01h	TMR0	Timer0 Module Register								xxxx xxxx	69
02h(2)	PCL	Program Counter (PC) Least Significant Byte								0000 0000	
03h(2)	STATUS	IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC	C	0001 1xxx	17
04h(2)	FSR	Indirect Data Memory Address Pointer								xxxx xxxx	135
05h	PORTA	PORTA Data Latch when written; PORTA pins when read (PIC16F87) PORTA Data Latch when written; PORTA pins when read (PIC16F88)								xxxx 0000 xxx0 0000	52
06h	PORTB	PORTB Data Latch when written; PORTB pins when read (PIC16F87) PORTB Data Latch when written; PORTB pins when read (PIC16F88)								xxxx xxxx 00xx xxxx	58
07h	—	Unimplemented								—	—
08h	—	Unimplemented								—	—
09h	—	Unimplemented								—	—
0Ah(1,2)	PCLATH	—	—	—	Write Buffer for the Upper 5 bits of the Program Counter					---0 0000	135
0Bh(2)	INTCON	GIE	PEIE	TMR0IE	INT0IE	RBIE	TMR0IF	INT0IF	RBIF	0000 000x	19, 69, 77
0Ch	PIR1	—	ADIF(4)	RCIF	TXIF	SSPIF	CCP1IF	TMR2IF	TMR1IF	-000 0000	21, 77
0Dh	PIR2	OSFIF	CMIF	—	EEIF	—	—	—	—	00-0 ----	23, 34
0Eh	TMR1L	Holding Register for the Least Significant Byte of the 16-bit TMR1 Register								xxxx xxxx	77, 83
0Fh	TMR1H	Holding Register for the Most Significant Byte of the 16-bit TMR1 Register								xxxx xxxx	77, 83
10h	T1CON	—	T1RUN	T1CKPS1	T1CKPS0	T1OSCEN	$\overline{T1SYNC}$	TMR1CS	TMR1ON	-000 0000	72, 83
11h	TMR2	Timer2 Module Register								0000 0000	80, 85
12h	T2CON	—	TOUTPS3	TOUTPS2	TOUTPS1	TOUTPS0	TMR2ON	T2CKPS1	T2CKPS0	-000 0000	80, 85
13h	SSPBUF	Synchronous Serial Port Receive Buffer/Transmit Register								xxxx xxxx	90, 95
14h	SSPCON	WCOL	SSPOV	SSPEN	CKP	SSPM3	SSPM2	SSPM1	SSPM0	0000 0000	89, 95
15h	CCPR1L	Capture/Compare/PWM Register 1 (LSB)								xxxx xxxx	83, 85
16h	CCPR1H	Capture/Compare/PWM Register 1 (MSB)								xxxx xxxx	83, 85
17h	CCP1CON	—	—	CCP1X	CCP1Y	CCP1M3	CCP1M2	CCP1M1	CCP1M0	--00 0000	81, 83
18h	RCSTA	SPEN	RX9	SREN	CREN	ADDEN	FERR	OERR	RX9D	0000 000x	98, 99
19h	TXREG	AUSART Transmit Data Register								0000 0000	103
1Ah	RCREG	AUSART Receive Data Register								0000 0000	105
1Bh	—	Unimplemented								—	—
1Ch	—	Unimplemented								—	—
1Dh	—	Unimplemented								—	—
1Eh	ADRESH(4)	A/D Result Register High Byte								xxxx xxxx	120
1Fh	ADCON0(4)	ADCS1	ADCS0	CHS2	CHS1	CHS0	GO/$\overline{DONE}$	—	ADON	0000 00-0	114, 120

Legend: x = unknown, u = unchanged, q = value depends on condition, - = unimplemented, read as '0', r = reserved. Shaded locations are unimplemented, read as '0'.

Note 1: The upper byte of the program counter is not directly accessible. PCLATH is a holding register for PC<12:8>, whose contents are transferred to the upper byte of the program counter.

2: These registers can be addressed from any bank.

3: RA5 is an input only; the state of the TRISA5 bit has no effect and will always read '1'.

4: PIC16F88 device only.

TABLE 2-1: SPECIAL FUNCTION REGISTER SUMMARY (CONTINUED)

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on: POR, BOR	Details on page
Bank 1											
80h(2)	INDF	Addressing this location uses contents of FSR to address data memory (not a physical register)								0000 0000	26, 135
81h	OPTION_REG	$\overline{RBPU}$	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0	1111 1111	18, 69
82h(2)	PCL	Program Counter (PC) Least Significant Byte								0000 0000	135
83h(2)	STATUS	IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC	C	0001 1xxx	17
84h(2)	FSR	Indirect Data Memory Address Pointer								xxxx xxxx	135
85h	TRISA	TRISA7	TRISA6	TRISA5(3)	PORTA Data Direction Register (TRISA<4:0>)					1111 1111	52, 126
86h	TRISB	PORTB Data Direction Register								1111 1111	58, 85
87h	—	Unimplemented								—	—
88h	—	Unimplemented								—	—
89h	—	Unimplemented								—	—
8Ah(1,2)	PCLATH	—	—	—	Write Buffer for the Upper 5 bits of the Program Counter					---0 0000	135
8Bh(2)	INTCON	GIE	PEIE	TMR0IE	INT0IE	RBIE	TMR0IF	INT0IF	RBIF	0000 000x	19, 69, 77
8Ch	PIE1	—	ADIE(4)	RCIE	TXIE	SSPIE	CCP1IE	TMR2IE	TMR1IE	-000 0000	20, 80
8Dh	PIE2	OSFIE	CMIE	—	EEIE	—	—	—	—	00-0 ----	22, 34
8Eh	PCON	—	—	—	—	—	—	$\overline{POR}$	$\overline{BOR}$	---- --0q	24
8Fh	OSCCON	—	IRCF2	IRCF1	IRCF0	OSTS	IOFS	SCS1	SCS0	-000 0000	40
90h	OSCTUNE	—	—	TUN5	TUN4	TUN3	TUN2	TUN1	TUN0	--00 0000	38
91h	—	Unimplemented								—	—
92h	PR2	Timer2 Period Register								1111 1111	80, 85
93h	SSPADD	Synchronous Serial Port (I^2C™ mode) Address Register								0000 0000	95
94h	SSPSTAT	SMP	CKE	D/$\overline{A}$	P	S	R/$\overline{W}$	UA	BF	0000 0000	88, 95
95h	—	Unimplemented								—	—
96h	—	Unimplemented								—	—
97h	—	Unimplemented								—	—
98h	TXSTA	CSRC	TX9	TXEN	SYNC	—	BRGH	TRMT	TX9D	0000 -010	97, 99
99h	SPBRG	Baud Rate Generator Register								0000 0000	99, 103
9Ah	—	Unimplemented								—	—
9Bh	ANSEL(4)	—	ANS6	ANS5	ANS4	ANS3	ANS2	ANS1	ANS0	-111 1111	120
9Ch	CMCON	C2OUT	C1OUT	C2INV	C1INV	CIS	CM2	CM1	CM0	0000 0111	121, 126, 128
9Dh	CVRCON	CVREN	CVROE	CVRR	—	CVR3	CVR2	CVR1	CVR0	000- 0000	126, 128
9Eh	ADRESL(4)	A/D Result Register Low Byte								xxxx xxxx	120
9Fh	ADCON1(4)	ADFM	ADCS2	VCFG1	VCFG0	—	—	—	—	0000 ----	52, 115, 120

Legend: x = unknown, u = unchanged, q = value depends on condition, - = unimplemented, read as '0', r = reserved. Shaded locations are unimplemented, read as '0'.

Note 1: The upper byte of the program counter is not directly accessible. PCLATH is a holding register for PC<12:8>, whose contents are transferred to the upper byte of the program counter.

2: These registers can be addressed from any bank.

3: RA5 is an input only; the state of the TRISA5 bit has no effect and will always read '1'.

4: PIC16F88 device only.

TABLE 2-1: SPECIAL FUNCTION REGISTER SUMMARY (CONTINUED)

Address	Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on: POR, BOR	Details on page
Bank 2											
100h(2)	INDF	Addressing this location uses contents of FSR to address data memory (not a physical register)								0000 0000	26, 135
101h	TMR0	Timer0 Module Register								xxxx xxxx	69
102h(2)	PCL	Program Counter's (PC) Least Significant Byte								0000 0000	135
103h(2)	STATUS	IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC	C	0001 1xxx	17
104h(2)	FSR	Indirect Data Memory Address Pointer								xxxx xxxx	135
105h	WDTCON	—	—	—	WDTPS3	WDTPS2	WDTPS1	WDTPS0	SWDTEN	---0 1000	142
106h	PORTB	PORTB Data Latch when written; PORTB pins when read (PIC16F87) PORTB Data Latch when written; PORTB pins when read (PIC16F88)								xxxx xxxx 00xx xxxx	58
107h	—	Unimplemented								—	—
108h	—	Unimplemented								—	—
109h	—	Unimplemented								—	—
10Ah(1,2)	PCLATH	—	—	—	Write Buffer for the Upper 5 bits of the Program Counter					---0 0000	135
10Bh(2)	INTCON	GIE	PEIE	TMR0IE	INT0IE	RBIE	TMR0IF	INT0IF	RBIF	0000 000x	19, 69, 77
10Ch	EEDATA	EEPROM/Flash Data Register Low Byte								xxxx xxxx	34
10Dh	EEADR	EEPROM/Flash Address Register Low Byte								xxxx xxxx	34
10Eh	EEDATH	—	—	EEPROM/Flash Data Register High Byte						--xx xxxx	34
10Fh	EEADRH	—	—	—	—	EEPROM/Flash Address Register High Byte				---- xxxx	34
Bank 3											
180h(2)	INDF	Addressing this location uses contents of FSR to address data memory (not a physical register)								0000 0000	135
181h	OPTION_REG	$\overline{RBPU}$	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0	1111 1111	18, 69
182h(2)	PCL	Program Counter (PC) Least Significant Byte								0000 0000	135
183h(2)	STATUS	IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC	C	0001 1xxx	17
184h(2)	FSR	Indirect Data Memory Address Pointer								xxxx xxxx	135
185h	—	Unimplemented								—	—
186h	TRISB	PORTB Data Direction Register								1111 1111	58, 83
187h	—	Unimplemented								—	—
188h	—	Unimplemented								—	—
189h	—	Unimplemented								—	—
18Ah(1,2)	PCLATH	—	—	—	Write Buffer for the Upper 5 bits of the Program Counter					---0 0000	135
18Bh(2)	INTCON	GIE	PEIE	TMR0IE	INT0IE	RBIE	TMR0IF	INT0IF	RBIF	0000 000x	19, 69, 77
18Ch	EECON1	EEPGD	—	—	FREE	WRERR	WREN	WR	RD	x--x x000	28, 34
18Dh	EECON2	EEPROM Control Register 2 (not a physical register)								---- ----	34
18Eh	—	Reserved, maintain clear								0000 0000	—
18Fh	—	Reserved, maintain clear								0000 0000	—

Legend: x = unknown, u = unchanged, q = value depends on condition, - = unimplemented, read as '0', r = reserved. Shaded locations are unimplemented, read as '0'.

Note 1: The upper byte of the program counter is not directly accessible. PCLATH is a holding register for PC<12:8>, whose contents are transferred to the upper byte of the program counter.

2: These registers can be addressed from any bank.

3: RA5 is an input only; the state of the TRISA5 bit has no effect and will always read '1'.

4: PIC16F88 device only.

2.2.2.1 STATUS Register

The STATUS register, shown in Register 2-1, contains the arithmetic status of the ALU, the Reset status and the bank select bits for data memory.

The STATUS register can be the destination for any instruction, as with any other register. If the STATUS register is the destination for an instruction that affects the Z, DC or C bits, then the write to these three bits is disabled. These bits are set or cleared according to the device logic. Furthermore, the $\overline{TO}$ and $\overline{PD}$ bits are not writable. Therefore, the result of an instruction with the STATUS register as destination may be different than intended.

For example, `CLRF STATUS` will clear the upper three bits and set the Z bit. This leaves the STATUS register as '`000u u1uu`' (where `u` = unchanged).

It is recommended, therefore, that only `BCF`, `BSF`, `SWAPF` and `MOVWF` instructions are used to alter the STATUS register because these instructions do not affect the Z, C or DC bits from the STATUS register. For other instructions not affecting any Status bits, see **Section 16.0 "Instruction Set Summary"**.

Note:	The C and DC bits operate as a $\overline{\text{borrow}}$ and $\overline{\text{digit borrow}}$ bit, respectively, in subtraction. See the `SUBLW` and `SUBWF` instructions for examples.

REGISTER 2-1: STATUS: ARITHMETIC STATUS REGISTER (ADDRESS 03h, 83h, 103h, 183h)

R/W-0	R/W-0	R/W-0	R-1	R-1	R/W-x	R/W-x	R/W-x
IRP	RP1	RP0	$\overline{TO}$	$\overline{PD}$	Z	DC	C
bit 7							bit 0

bit 7 **IRP:** Register Bank Select bit (used for indirect addressing)
`1` = Bank 2, 3 (100h-1FFh)
`0` = Bank 0, 1 (00h-FFh)

bit 6-5 **RP<1:0>:** Register Bank Select bits (used for direct addressing)
`11` = Bank 3 (180h-1FFh)
`10` = Bank 2 (100h-17Fh)
`01` = Bank 1 (80h-FFh)
`00` = Bank 0 (00h-7Fh)
Each bank is 128 bytes.

bit 4 **$\overline{TO}$:** Time-out bit
`1` = After power-up, `CLRWDT` instruction or `SLEEP` instruction
`0` = A WDT time-out occurred

bit 3 **$\overline{PD}$:** Power-Down bit
`1` = After power-up or by the `CLRWDT` instruction
`0` = By execution of the `SLEEP` instruction

bit 2 **Z:** Zero bit
`1` = The result of an arithmetic or logic operation is zero
`0` = The result of an arithmetic or logic operation is not zero

bit 1 **DC:** Digit carry/$\overline{\text{borrow}}$ bit (`ADDWF`, `ADDLW`, `SUBLW` and `SUBWF` instructions)**(1)**
`1` = A carry-out from the 4th low-order bit of the result occurred
`0` = No carry-out from the 4th low-order bit of the result

bit 0 **C:** Carry/$\overline{\text{borrow}}$ bit (`ADDWF`, `ADDLW`, `SUBLW` and `SUBWF` instructions)**(1,2)**
`1` = A carry-out from the Most Significant bit of the result occurred
`0` = No carry-out from the Most Significant bit of the result occurred

Note 1: For borrow, the polarity is reversed. A subtraction is executed by adding the two's complement of the second operand.
2: For rotate (`RRF`, `RLF`) instructions, this bit is loaded with either the high or low-order bit of the source register.

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

2.2.2.2 OPTION_REG Register

The OPTION_REG register is a readable and writable register that contains various control bits to configure the TMR0 prescaler/WDT postscaler (single assignable register known also as the prescaler), the external INT interrupt, TMR0 and the weak pull-ups on PORTB.

Note:	To achieve a 1:1 prescaler assignment for the TMR0 register, assign the prescaler to the Watchdog Timer. Although the prescaler can be assigned to either the WDT or Timer0, but not both, a new divide counter is implemented in the WDT circuit to give multiple WDT time-out selections. This allows TMR0 and WDT to each have their own scaler. Refer to **Section 15.12 "Watchdog Timer (WDT)"** for further details.

REGISTER 2-2: OPTION_REG: OPTION CONTROL REGISTER (ADDRESS 81h, 181h)

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
$\overline{\text{RBPU}}$	INTEDG	T0CS	T0SE	PSA	PS2	PS1	PS0
bit 7							bit 0

bit 7 **$\overline{\text{RBPU}}$**: PORTB Pull-up Enable bit
1 = PORTB pull-ups are disabled
0 = PORTB pull-ups are enabled by individual port latch values

bit 6 **INTEDG:** Interrupt Edge Select bit
1 = Interrupt on rising edge of RB0/INT pin
0 = Interrupt on falling edge of RB0/INT pin

bit 5 **T0CS:** TMR0 Clock Source Select bit
1 = Transition on RA4/T0CKI/C2OUT pin
0 = Internal instruction cycle clock (CLKO)

bit 4 **T0SE:** TMR0 Source Edge Select bit
1 = Increment on high-to-low transition on RA4/T0CKI/C2OUT pin
0 = Increment on low-to-high transition on RA4/T0CKI/C2OUT pin

bit 3 **PSA:** Prescaler Assignment bit
1 = Prescaler is assigned to the WDT
0 = Prescaler is assigned to the Timer0 module

bit 2-0 **PS<2:0>:** Prescaler Rate Select bits

Bit Value	TMR0 Rate	WDT Rate
000	1 : 2	1 : 1
001	1 : 4	1 : 2
010	1 : 8	1 : 4
011	1 : 16	1 : 8
100	1 : 32	1 : 16
101	1 : 64	1 : 32
110	1 : 128	1 : 64
111	1 : 256	1 : 128

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

2.2.2.3 INTCON Register

The INTCON register is a readable and writable register that contains various enable and flag bits for the TMR0 register overflow, RB Port change and External RB0/INT pin interrupts.

Note:	Interrupt flag bits get set when an interrupt condition occurs, regardless of the state of its corresponding enable bit or the global enable bit, GIE (INTCON<7>). User software should ensure the appropriate interrupt flag bits are clear prior to enabling an interrupt.

REGISTER 2-3: INTCON: INTERRUPT CONTROL REGISTER (ADDRESS 0Bh, 8Bh, 10Bh, 18Bh)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-x
GIE	PEIE	TMR0IE	INT0IE	RBIE	TMR0IF	INT0IF	RBIF
bit 7							bit 0

bit 7 **GIE:** Global Interrupt Enable bit
1 = Enables all unmasked interrupts
0 = Disables all interrupts

bit 6 **PEIE:** Peripheral Interrupt Enable bit
1 = Enables all unmasked peripheral interrupts
0 = Disables all peripheral interrupts

bit 5 **TMR0IE:** TMR0 Overflow Interrupt Enable bit
1 = Enables the TMR0 interrupt
0 = Disables the TMR0 interrupt

bit 4 **INT0IE:** RB0/INT External Interrupt Enable bit
1 = Enables the RB0/INT external interrupt
0 = Disables the RB0/INT external interrupt

bit 3 **RBIE:** RB Port Change Interrupt Enable bit
1 = Enables the RB port change interrupt
0 = Disables the RB port change interrupt

bit 2 **TMR0IF:** TMR0 Overflow Interrupt Flag bit
1 = TMR0 register has overflowed (must be cleared in software)
0 = TMR0 register did not overflow

bit 1 **INT0IF:** RB0/INT External Interrupt Flag bit
1 = The RB0/INT external interrupt occurred (must be cleared in software)
0 = The RB0/INT external interrupt did not occur

bit 0 **RBIF:** RB Port Change Interrupt Flag bit
A mismatch condition will continue to set flag bit RBIF. Reading PORTB will end the mismatch condition and allow flag bit RBIF to be cleared.
1 = At least one of the RB7:RB4 pins changed state (must be cleared in software)
0 = None of the RB7:RB4 pins have changed state

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

2.2.2.4 PIE1 Register

This register contains the individual enable bits for the peripheral interrupts.

Note:	Bit PEIE (INTCON<6>) must be set to enable any peripheral interrupt.

REGISTER 2-4: PIE1: PERIPHERAL INTERRUPT ENABLE REGISTER 1 (ADDRESS 8Ch)

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	ADIE(1)	RCIE	TXIE	SSPIE	CCP1IE	TMR2IE	TMR1IE
bit 7							bit 0

bit 7 **Unimplemented:** Read as '0'

bit 6 **ADIE:** A/D Converter Interrupt Enable bit(1)
1 = Enabled
0 = Disabled

Note 1: This bit is only implemented on the PIC16F88. The bit will read '0' on the PIC16F87.

bit 5 **RCIE:** AUSART Receive Interrupt Enable bit
1 = Enabled
0 = Disabled

bit 4 **TXIE:** AUSART Transmit Interrupt Enable bit
1 = Enabled
0 = Disabled

bit 3 **SSPIE:** Synchronous Serial Port (SSP) Interrupt Enable bit
1 = Enabled
0 = Disabled

bit 2 **CCP1IE:** CCP1 Interrupt Enable bit
1 = Enabled
0 = Disabled

bit 1 **TMR2IE:** TMR2 to PR2 Match Interrupt Enable bit
1 = Enabled
0 = Disabled

bit 0 **TMR1IE:** TMR1 Overflow Interrupt Enable bit
1 = Enabled
0 = Disabled

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

2.2.2.5 PIR1 Register

This register contains the individual flag bits for the peripheral interrupts.

Note:	Interrupt flag bits are set when an interrupt condition occurs, regardless of the state of its corresponding enable bit, or the global enable bit, GIE (INTCON<7>). User software should ensure the appropriate interrupt flag bits are clear prior to enabling an interrupt.

REGISTER 2-5: PIR1: PERIPHERAL INTERRUPT REQUEST (FLAG) REGISTER 1 (ADDRESS 0Ch)

U-0	R/W-0	R-0	R-0	R-0	R/W-0	R/W-0	R/W-0
—	ADIF(1)	RCIF	TXIF	SSPIF	CCP1IF	TMR2IF	TMR1IF
bit 7							bit 0

bit 7 **Unimplemented:** Read as '0'

bit 6 **ADIF:** A/D Converter Interrupt Flag bit(1)
1 = The A/D conversion completed (must be cleared in software)
0 = The A/D conversion is not complete

Note 1: This bit is only implemented on the PIC16F88. The bit will read '0' on the PIC16F87.

bit 5 **RCIF:** AUSART Receive Interrupt Flag bit
1 = The AUSART receive buffer is full (cleared by reading RCREG)
0 = The AUSART receive buffer is not full

bit 4 **TXIF:** AUSART Transmit Interrupt Flag bit
1 = The AUSART transmit buffer is empty (cleared by writing to TXREG)
0 = The AUSART transmit buffer is full

bit 3 **SSPIF:** Synchronous Serial Port (SSP) Interrupt Flag bit
1 = The transmission/reception is complete (must be cleared in software)
0 = Waiting to transmit/receive

bit 2 **CCP1IF:** CCP1 Interrupt Flag bit
Capture mode:
1 = A TMR1 register capture occurred (must be cleared in software)
0 = No TMR1 register capture occurred
Compare mode:
1 = A TMR1 register compare match occurred (must be cleared in software)
0 = No TMR1 register compare match occurred
PWM mode:
Unused in this mode.

bit 1 **TMR2IF:** TMR2 to PR2 Interrupt Flag bit
1 = A TMR2 to PR2 match occurred (must be cleared in software)
0 = No TMR2 to PR2 match occurred

bit 0 **TMR1IF:** TMR1 Overflow Interrupt Flag bit
1 = The TMR1 register overflowed (must be cleared in software)
0 = The TMR1 register did not overflow

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

2.2.2.6 PIE2 Register

The PIE2 register contains the individual enable bit for the EEPROM write operation interrupt.

REGISTER 2-6: PIE2: PERIPHERAL INTERRUPT ENABLE REGISTER 2 (ADDRESS 8Dh)

R/W-0	R/W-0	U-0	R/W-0	U-0	U-0	U-0	U-0
OSFIE	CMIE	—	EEIE	—	—	—	—
bit 7							bit 0

bit 7 **OSFIE:** Oscillator Fail Interrupt Enable bit
1 = Enabled
0 = Disabled

bit 6 **CMIE:** Comparator Interrupt Enable bit
1 = Enabled
0 = Disabled

bit 5 **Unimplemented:** Read as '0'

bit 4 **EEIE:** EEPROM Write Operation Interrupt Enable bit
1 = Enabled
0 = Disabled

bit 3-0 **Unimplemented:** Read as '0'

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

2.2.2.7 PIR2 Register

The PIR2 register contains the flag bit for the EEPROM write operation interrupt.

Note:	Interrupt flag bits are set when an interrupt condition occurs, regardless of the state of its corresponding enable bit, or the global enable bit, GIE (INTCON<7>). User software should ensure the appropriate interrupt flag bits are clear prior to enabling an interrupt.

REGISTER 2-7: PIR2: PERIPHERAL INTERRUPT REQUEST (FLAG) REGISTER 2 (ADDRESS 0Dh)

R/W-0	R/W-0	U-0	R/W-0	U-0	U-0	U-0	U-0
OSFIF	CMIF	—	EEIF	—	—	—	—
bit 7							bit 0

bit 7 **OSFIF:** Oscillator Fail Interrupt Flag bit
1 = System oscillator failed, clock input has changed to INTRC (must be cleared in software)
0 = System clock operating

bit 6 **CMIF:** Comparator Interrupt Flag bit
1 = Comparator input has changed (must be cleared in software)
0 = Comparator input has not changed

bit 5 **Unimplemented:** Read as '0'

bit 4 **EEIF:** EEPROM Write Operation Interrupt Flag bit
1 = The write operation completed (must be cleared in software)
0 = The write operation is not complete or has not been started

bit 3-0 **Unimplemented:** Read as '0'

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

2.2.2.8 PCON Register

Note:	Interrupt flag bits get set when an interrupt condition occurs, regardless of the state of its corresponding enable bit, or the global enable bit, GIE (INTCON<7>). User software should ensure the appropriate interrupt flag bits are clear prior to enabling an interrupt.

The Power Control (PCON) register contains a flag bit to allow differentiation between a Power-on Reset (POR), a Brown-out Reset, an external $\overline{MCLR}$ Reset and WDT Reset.

Note:	$\overline{BOR}$ is unknown on Power-on Reset. It must then be set by the user and checked on subsequent Resets to see if $\overline{BOR}$ is clear, indicating a brown-out has occurred. The $\overline{BOR}$ status bit is a 'don't care' and is not necessarily predictable if the brown-out circuit is disabled (by clearing the BOREN bit in the Configuration Word register).

REGISTER 2-8: PCON: POWER CONTROL REGISTER (ADDRESS 8Eh)

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	R/W-x
—	—	—	—	—	—	$\overline{POR}$	$\overline{BOR}$
bit 7							bit 0

bit 7-2 **Unimplemented:** Read as '0'

bit 1 **$\overline{POR}$:** Power-on Reset Status bit
1 = No Power-on Reset occurred
0 = A Power-on Reset occurred (must be set in software after a Power-on Reset occurs)

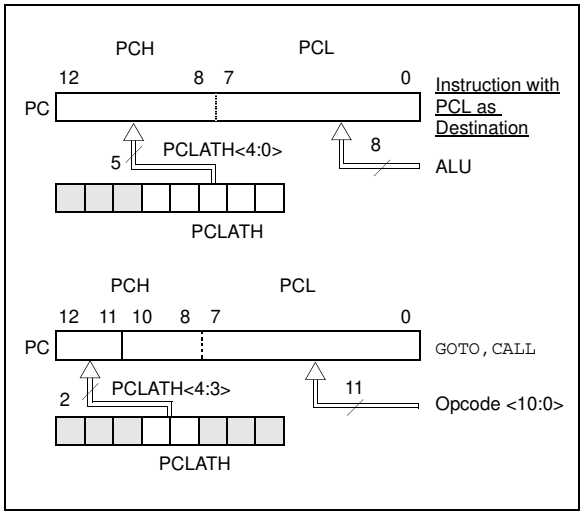
bit 0 **$\overline{BOR}$:** Brown-out Reset Status bit
1 = No Brown-out Reset occurred
0 = A Brown-out Reset occurred (must be set in software after a Brown-out Reset occurs)

Legend:			
R = Readable bit	W = Writable bit	U = Unimplemented bit, read as '0'	
-n = Value at POR	'1' = Bit is set	'0' = Bit is cleared	x = Bit is unknown

2.3 PCL and PCLATH

The Program Counter (PC) is 13 bits wide. The low byte comes from the PCL register which is a readable and writable register. The upper bits (PC<12:8>) are not readable but are indirectly writable through the PCLATH register. On any Reset, the upper bits of the PC will be cleared. Figure 2-4 shows the two situations for the loading of the PC. The upper example in the figure shows how the PC is loaded on a write to PCL (PCLATH<4:0> → PCH). The lower example in the figure shows how the PC is loaded during a CALL or GOTO instruction (PCLATH<4:3> → PCH).

FIGURE 2-4: LOADING OF PC IN DIFFERENT SITUATIONS



2.3.1 COMPUTED GOTO

A computed GOTO is accomplished by adding an offset to the program counter (ADDWF PCL). When doing a table read using a computed GOTO method, care should be exercised if the table location crosses a PCL memory boundary (each 256-byte block). Refer to the application note, *AN556, "Implementing a Table Read"*.

2.3.2 STACK

The PIC16F87/88 family has an 8-level deep x 13-bit wide hardware stack. The stack space is not part of either program or data space and the Stack Pointer is not readable or writable. The PC is PUSHed onto the stack when a CALL instruction is executed or an interrupt causes a branch. The stack is POPed in the event of a RETURN, RETLW or a RETFIE instruction execution. PCLATH is not affected by a PUSH or POP operation.

The stack operates as a circular buffer. This means that after the stack has been PUSHed eight times, the ninth push overwrites the value that was stored from the first push. The tenth push overwrites the second push (and so on).

Note 1:	There are no status bits to indicate stack overflow or stack underflow conditions.
2:	There are no instructions/mnemonics called PUSH or POP. These are actions that occur from the execution of the CALL, RETURN, RETLW and RETFIE instructions, or the vectoring to an interrupt address.

2.4 Program Memory Paging

All PIC16F87/88 devices are capable of addressing a continuous 8K word block of program memory. The CALL and GOTO instructions provide only 11 bits of address to allow branching within any 2K program memory page. When doing a CALL or GOTO instruction, the upper 2 bits of the address are provided by PCLATH<4:3>. When doing a CALL or GOTO instruction, the user must ensure that the page select bits are programmed so that the desired program memory page is addressed. If a return from a CALL instruction (or interrupt) is executed, the entire 13-bit PC is popped off the stack. Therefore, manipulation of the PCLATH<4:3> bits is not required for the RETURN instructions (which POPs the address from the stack).

Note:	The contents of the PCLATH register are unchanged after a RETURN or RETFIE instruction is executed. The user must rewrite the contents of the PCLATH register for any subsequent subroutine calls or GOTO instructions.

Example 2-1 shows the calling of a subroutine in page 1 of the program memory. This example assumes that PCLATH is saved and restored by the Interrupt Service Routine (if interrupts are used).

EXAMPLE 2-1: CALL OF A SUBROUTINE IN PAGE 1 FROM PAGE 0

```
        ORG 0x500
        BCF PCLATH, 4
        BSF PCLATH, 3 ;Select page 1
                      ;(800h-FFFh)
        CALL SUB1_P1  ;Call subroutine in
        :             ;page 1 (800h-FFFh)
        :
        ORG 0x900     ;page 1 (800h-FFFh)
SUB1_P1
        :             ;called subroutine
                      ;page 1 (800h-FFFh)
        :
        RETURN        ;return to
                      ;Call subroutine
                      ;in page 0
                      ;(000h-7FFh)
```