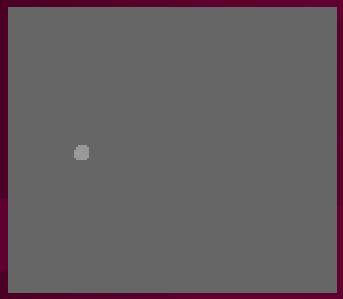
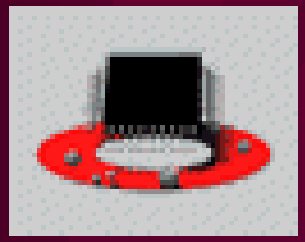
การใช้งาน CP-PIC877 V1.0



บริษัท อีทีที จำกัด



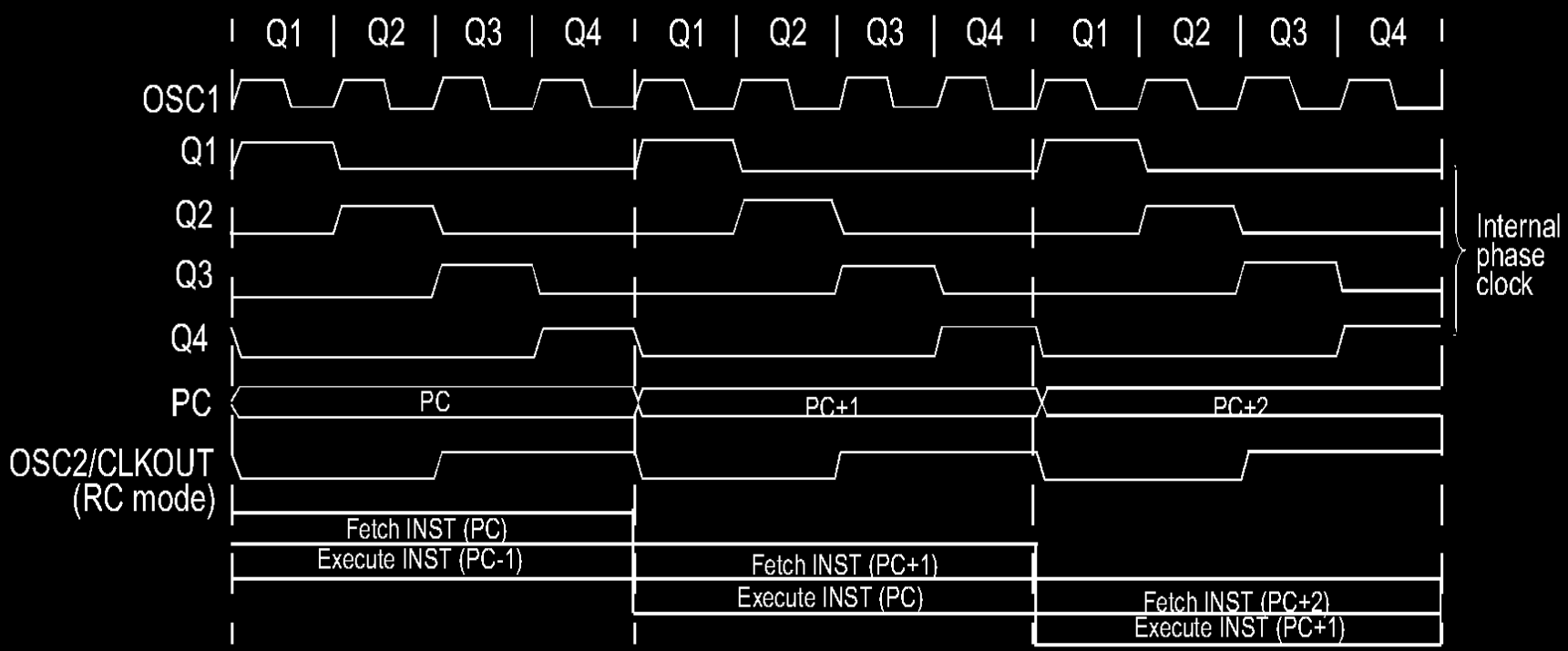
CP-PIC877 V1.0

คุณสมบัติทั่วไปของ CPU PIC 16F877

- 35 Instruction คำสั่ง
- ปฏิบัติคำสั่งทั่วไปใน Cycle เดียว และ 2 Cycle ในคำสั่งการกระโดด
- ทำงานที่ความถี่สูงสุด 20 MHz (16F877-20/P)
- หน่วยความจำโปรแกรม 8 K(14 Bit Words)
- หน่วยความจำข้อมูล (RAM) 368 Byte
- EEPROM 256 Byte
- สามารถตอบสนองอินเตอร์รัพท์ 14 แหล่ง
- STACK 8 ระดับ
- POR, BOR, PWRT , Oscillator Start-Up Timer และWatchdog Timer
- Code Protection

- Sleep Mode
- สามารถเลือกโหมดของสัญญาณนาฬิกาได้
- In-Circuit Serial Programming (ICSP)
- สามารถโปรแกรมได้ ด้วยแรงดัน +5V
- ทำงานได้ที่ไฟเลี้ยง 2.0 V- 5.5 V
- กระแสทั้งซิงก์ และ ซอร์สของพอร์ต คือ 25 mA
- Timer/Counter 3 ตัว Timer0,Timer1 และ Timer2
- โมดูล Capture/Compare/PWM จำนวน 2 ชุด
- USART
- Analog to Digital Converter 10Bit 8 Channel
- พอร์ต I/O จำนวน 5 พอร์ต A,B,C,D และ E รวมทั้งสิ้น 33 Bit

FIGURE 3-2: CLOCK/INSTRUCTION CYCLE

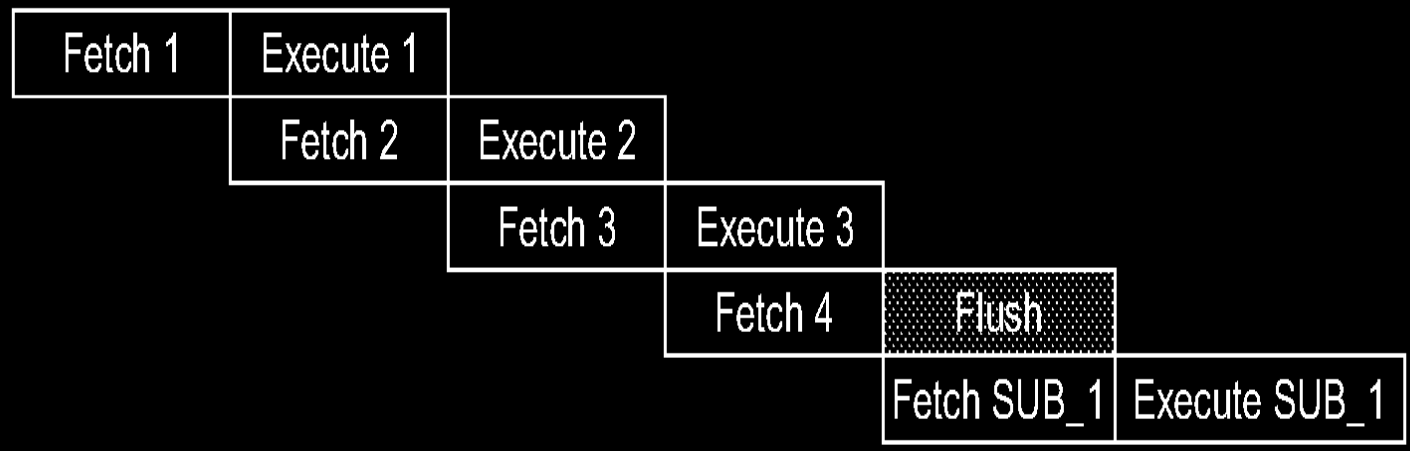


4Mhz / 4 =1Mhz

1/1Mhz = 1uS

EXAMPLE 3-1: INSTRUCTION PIPELINE FLOW

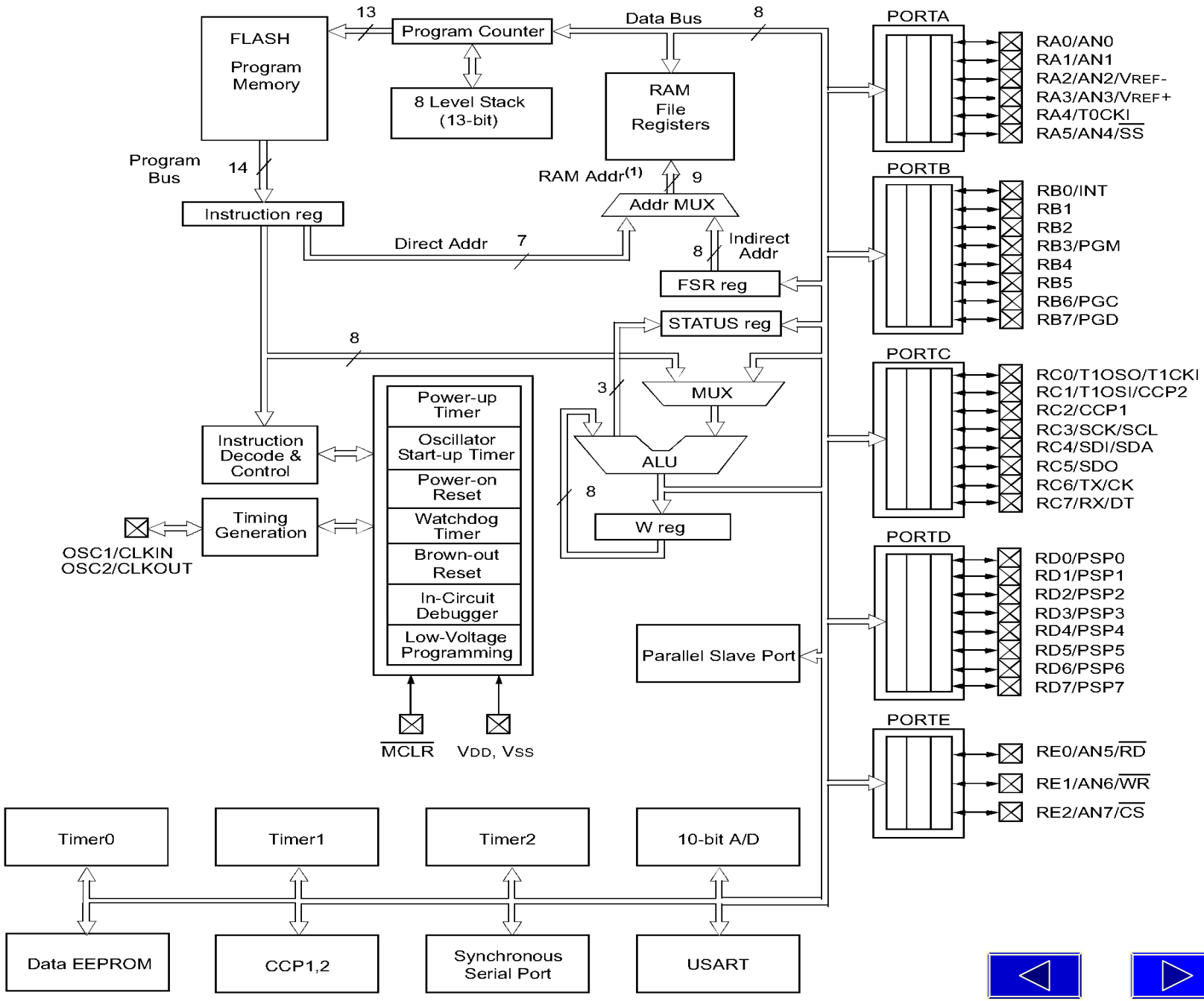
```
1. MOVLW 55h
2. MOVWF PORTB
3. CALL SUB_1
4. BSF   PORTA, BIT3
```



All instructions are single cycle, except for any program branches. These take two cycles since the fetch instruction is "flushed" from the pipeline while the new instruction is being fetched and then executed.


MCLR/VPP
RA0/AN0
RA1/AN1
RA2/AN2/VREF-
RA3/AN3/VREF+
RA4/T0CKI
RA5/SS/AN4
RE0/RD/AN5
RE1/WR/AN6
RE2/CS/AN7
VDD
VSS
OSC1/CLKIN
OSC2/CLKOUT
RC0/T1OSO/T1CKI
RC1/T1OSI/CCP2
RC2/CCP1
RC3/SCK/SCL
RD0/PSP0
RD1/PSP1
RB7/PGD
RB6/PGC
RB5
RB4
RB3/PGM
RB2
RB1
RB0/INT
VDD
VSS
RD7/PSP7
RD6/PSP6
RD5/PSP5
RD4/PSP4
RC7/RX/DT
RC6/TX/CK
RC5/SDO
RC4/SDI/SDA
RD3/PSP3
RD2/PSP2

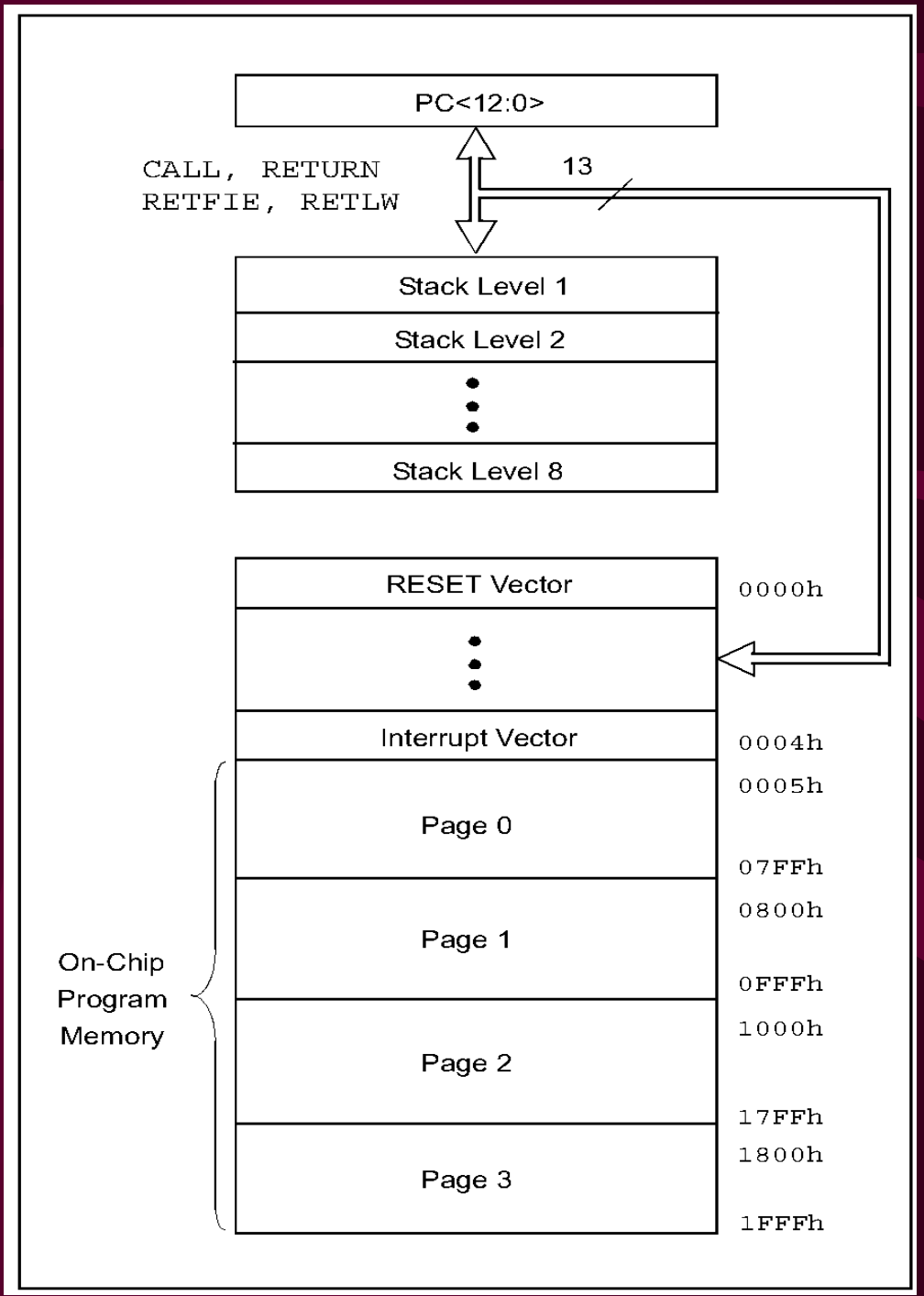
PIC16F877


FLASH
Program Memory
13
Program Counter
Data Bus
8
8 Level Stack (13-bit)
RAM File Registers
Program Bus
14
RAM Addr(1)
9
Addr MUX
Instruction reg
Direct Addr
7
8
Indirect Addr
FSR reg
STATUS reg
8
3
MUX
Power-up Timer
Oscillator Start-up Timer
Power-on Reset
Watchdog Timer
Brown-out Reset
In-Circuit Debugger
Low-Voltage Programming
Instruction Decode & Control
Timing Generation
ALU
8
W reg
OSC1/CLKIN
OSC2/CLKOUT
Parallel Slave Port
MCLR
VDD, VSS
PORTA
RA0/AN0
RA1/AN1
RA2/AN2/VREF-
RA3/AN3/VREF+
RA4/T0CKI
RA5/AN4/SS
PORTB
RB0/INT
RB1
RB2
RB3/PGM
RB4
RB5
RB6/PGC
RB7/PGD
PORTC
RC0/T1OSO/T1CKI
RC1/T1OSI/CCP2
RC2/CCP1
RC3/SCK/SCL
RC4/SDI/SDA
RC5/SDO
RC6/TX/CK
RC7/RX/DT
PORTD
RD0/PSP0
RD1/PSP1
RD2/PSP2
RD3/PSP3
RD4/PSP4
RD5/PSP5
RD6/PSP6
RD7/PSP7
PORTE
RE0/AN5/RD
RE1/AN6/WR
RE2/AN7/CS
Timer0
Timer1
Timer2
10-bit A/D
Data EEPROM
CCP1,2
Synchronous Serial Port
USART

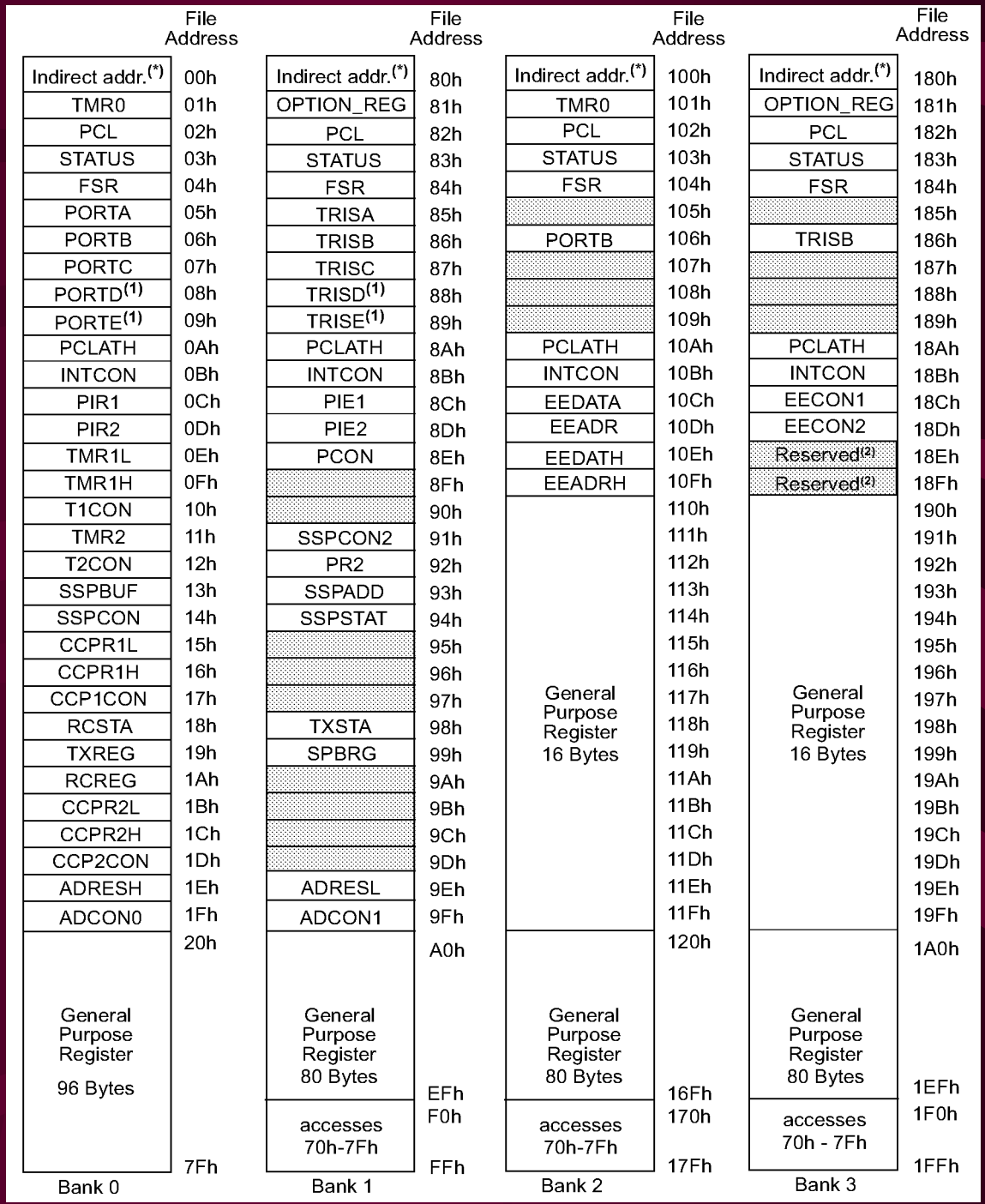
การจัดสรรพื้นที่หน่วยความจำ และ รีจิสเตอร์ต่างๆ

1. หน่วยความจำโปรแกรม 8 Kwords
2. หน่วยความจำข้อมูล RAM 368 Byte
3. หน่วยความจำข้อมูล EEPROM 256 Byte

หน่วยความจำโปรแกรม



หน่วยความจำข้อมูล



Bank 0	File Address	Bank 1	File Address	Bank 2	File Address	Bank 3	File Address
Indirect addr.(*)	00h	Indirect addr.(*)	80h	Indirect addr.(*)	100h	Indirect addr.(*)	180h
TMR0	01h	OPTION_REG	81h	TMR0	101h	OPTION_REG	181h
PCL	02h	PCL	82h	PCL	102h	PCL	182h
STATUS	03h	STATUS	83h	STATUS	103h	STATUS	183h
FSR	04h	FSR	84h	FSR	104h	FSR	184h
PORTA	05h	TRISA	85h		105h		185h
PORTB	06h	TRISB	86h	PORTB	106h	TRISB	186h
PORTC	07h	TRISC	87h		107h		187h
PORTD(1)	08h	TRISD(1)	88h		108h		188h
PORTE(1)	09h	TRISE(1)	89h		109h		189h
PCLATH	0Ah	PCLATH	8Ah	PCLATH	10Ah	PCLATH	18Ah
INTCON	0Bh	INTCON	8Bh	INTCON	10Bh	INTCON	18Bh
PIR1	0Ch	PIE1	8Ch	EEDATA	10Ch	EECON1	18Ch
PIR2	0Dh	PIE2	8Dh	EEADR	10Dh	EECON2	18Dh
TMR1L	0Eh	PCON	8Eh	EEDATH	10Eh	Reserved(2)	18Eh
TMR1H	0Fh		8Fh	EEADRH	10Fh	Reserved(2)	18Fh
T1CON	10h		90h		110h		190h
TMR2	11h	SSPCON2	91h		111h		191h
T2CON	12h	PR2	92h		112h		192h
SSPBUF	13h	SSPADD	93h		113h		193h
SSPCON	14h	SSPSTAT	94h		114h		194h
CCPR1L	15h		95h		115h		195h
CCPR1H	16h		96h		116h		196h
CCP1CON	17h		97h	General Purpose Register 16 Bytes	117h	General Purpose Register 16 Bytes	197h
RCSTA	18h	TXSTA	98h		118h		198h
TXREG	19h	SPBRG	99h		119h		199h
RCREG	1Ah		9Ah		11Ah		19Ah
CCPR2L	1Bh		9Bh		11Bh		19Bh
CCPR2H	1Ch		9Ch		11Ch		19Ch
CCP2CON	1Dh		9Dh		11Dh		19Dh
ADRESH	1Eh	ADRESL	9Eh		11Eh		19Eh
ADCON0	1Fh	ADCON1	9Fh		11Fh		19Fh
General Purpose Register 96 Bytes	20h	General Purpose Register 80 Bytes	A0h	General Purpose Register 80 Bytes	120h	General Purpose Register 80 Bytes	1A0h
	7Fh		EFh		16Fh		1EFh
		accesses 70h-7Fh	F0h	accesses 70h-7Fh	170h	accesses 70h - 7Fh	1F0h
			FFh		17Fh		1FFh

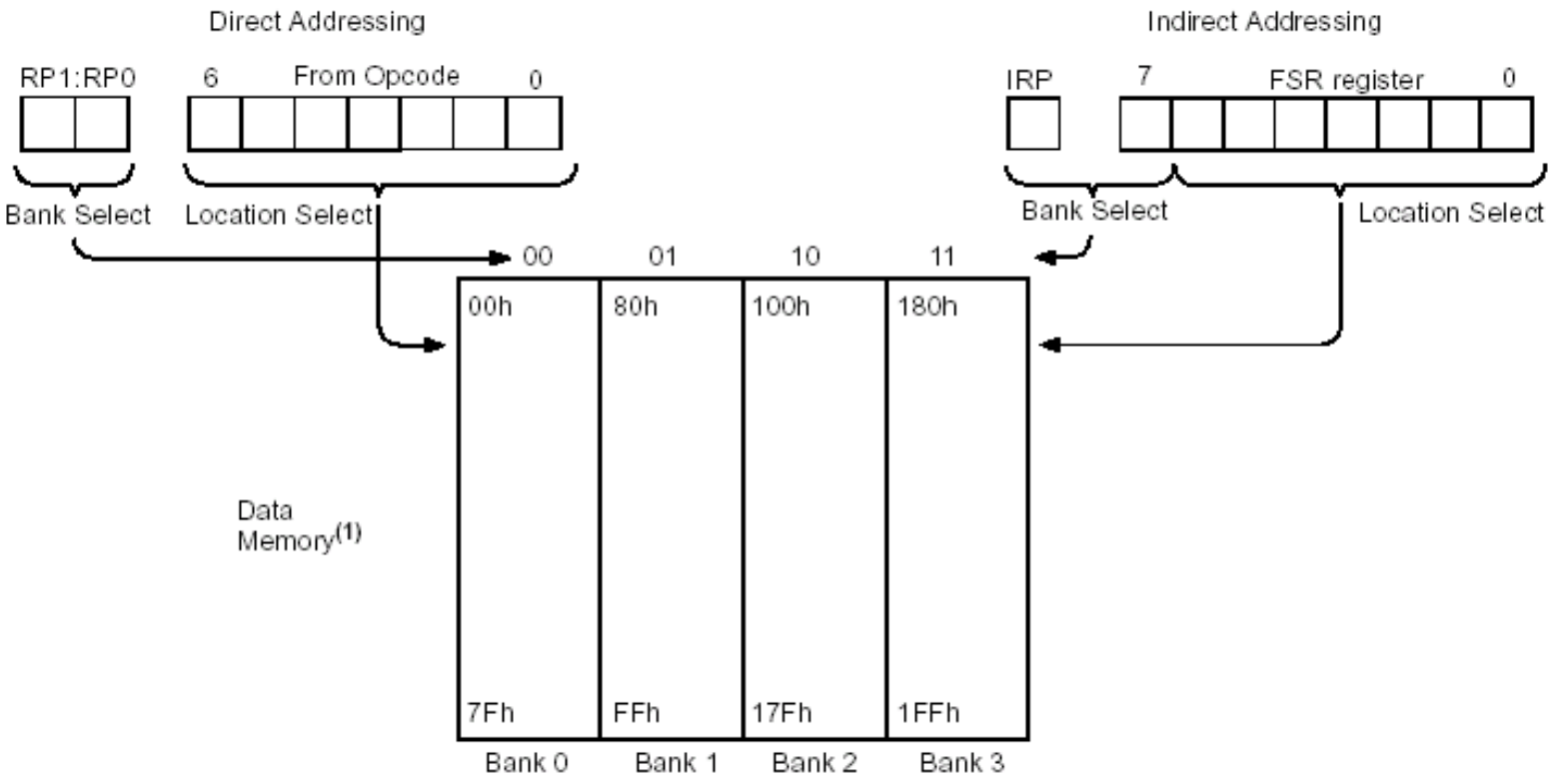
STATUS REGISTER (ADDRESS 03h, 83h, 103h, 183h)

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

RP1	RP0	Bank Select
0	0	Bank 0 : 00h - 7Fh
0	1	Bank 1 : 80h - FFh
1	0	Bank 2 : 100h - 17Fh
1	1	Bank 3 : 180h – 1FFh

DIRECT/INDIRECT ADDRESSING

FIGURE 2-6: DIRECT/INDIRECT ADDRESSING



Note 1: For register file map detail, see Figure 2-3.

```
        MOVLW   0X20    ; Initialize pointer
        MOVWF   FSR     ; to  RAM
NEXT    CLRF    INDF    ; clear INDF
        INCF    FSR,F   ; inc pointer
        BTFSS   FSR,4   ; all done?
        GOTO    NEXT    ; no clear next
CONTINUE
        :               ; Yes continue
```

3. หน่วยความจำข้อมูล EEPROM

มี จำนวน 256 ไบต์ สามารถอ่านและเขียนได้ โดยผ่าน
รีจิสเตอร์ฟังก์ชั่นพิเศษ 4 ตัวคือ

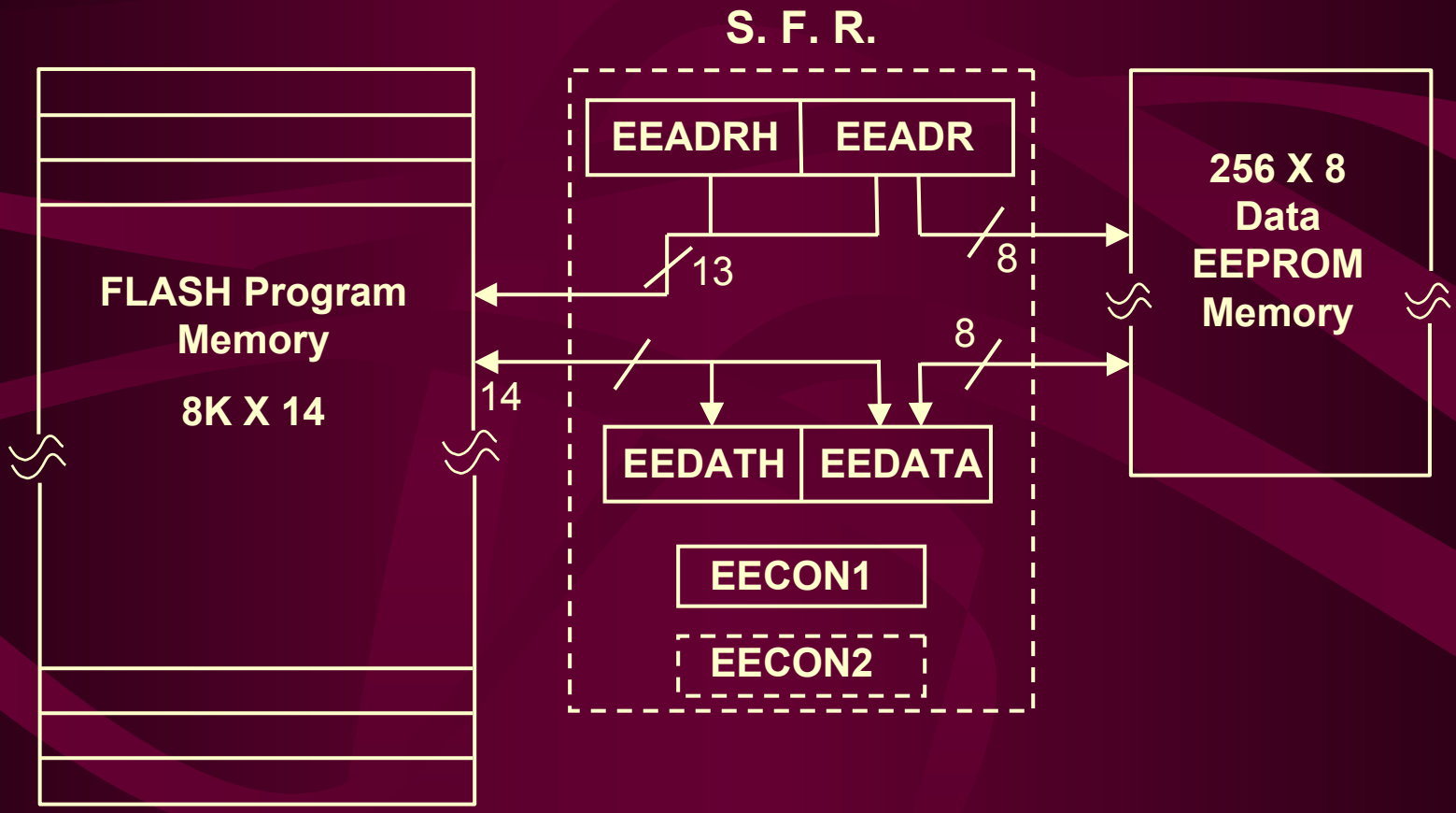
EECON1 : ควบคุมการเข้าถึงหน่วยความจำ

EECON2 : จัดลำดับการเขียนข้อมูล

EEDATA : เป็นบัฟเฟอร์ใช้เก็บข้อมูล 8 บิต สำหรับการอ่านและเขียน

EEADR : รีจิสเตอร์สำหรับเก็บแอดเดรส 00h – FFh (256 Byte)

FLASH Program and Data EEPROM Memory



FLASH Program & Data EEPROM: EECON1 Register

EEPGD	-	-	-	WRERR	WREN	WR	RD
bit7							bit0

EEPGD: Program / Data EEPROM Select Bit

1 = Accesses Program Memory

0 = Accesses Data Memory

WRERR: EEPROM Error Flag Bit

1 = A write operation is prematurely terminated

0 = The write operation completed

WREN: EEPROM Write Enable Bit

1 = Allows write cycles

0 = Inhibits write to the EEPROM

WR: Write Control Bit

1 = Initiates a write cycle (cleared by hardware only)

0 = Write cycle to the EEPROM is complete

RD: Read Control Bit

1 = Initiates a read cycle (cleared by hardware only)

0 = Read cycle from the EEPROM is complete

รีจิสเตอร์ STATUS

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 **RP1:RP0**: 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/$\overline{borrow}$ bit (`ADDWF`, `ADDLW`, `SUBLW`, `SUBWF` instructions)
(for $\overline{borrow}$, the polarity is reversed)
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/$\overline{borrow}$ bit (`ADDWF`, `ADDLW`, `SUBLW`, `SUBWF` instructions)
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: For $\overline{borrow}$, the polarity is reversed. A subtraction is executed by adding the two's complement of the second operand. For rotate (`RRF`, `RLF`) instructio is loaded with either the high, or low order bit of the source register.

รีจิสเตอร์ OPTION

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
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 pin
0 = Internal instruction cycle clock (CLKOUT)

bit 4 **T0SE**: TMR0 Source Edge Select bit
1 = Increment on high-to-low transition on RA4/T0CKI pin
0 = Increment on low-to-high transition on RA4/T0CKI 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 **PS2:PS0**: Prescaler Rate Select bits

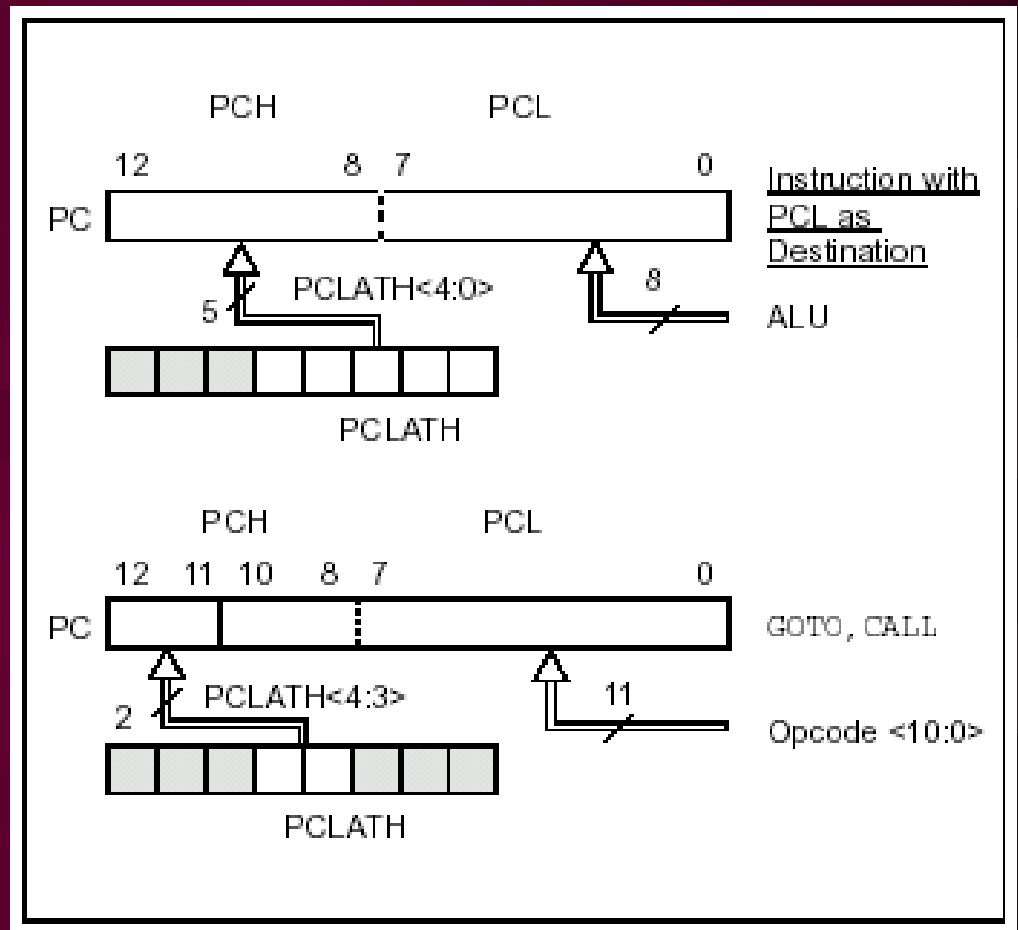
Bit Value	TMR0 Rate	WDT Rate
000	1 : 2	1 : 1
001	1 : 4	1 : 2
010	1 : 8	1 : 4
011	1 : 16	1 : 8
100	1 : 32	1 : 16
101	1 : 64	1 : 32
110	1 : 128	1 : 64
111	1 : 256	1 : 128

รีจิสเตอร์ W (Working Register)

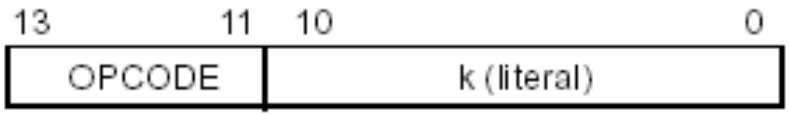
รีจิสเตอร์ PC (Program Counter)

2^{13} = 8192 (8KByte)

2^{11} = 2048 (2KByte)



CALL and GOTO instructions only

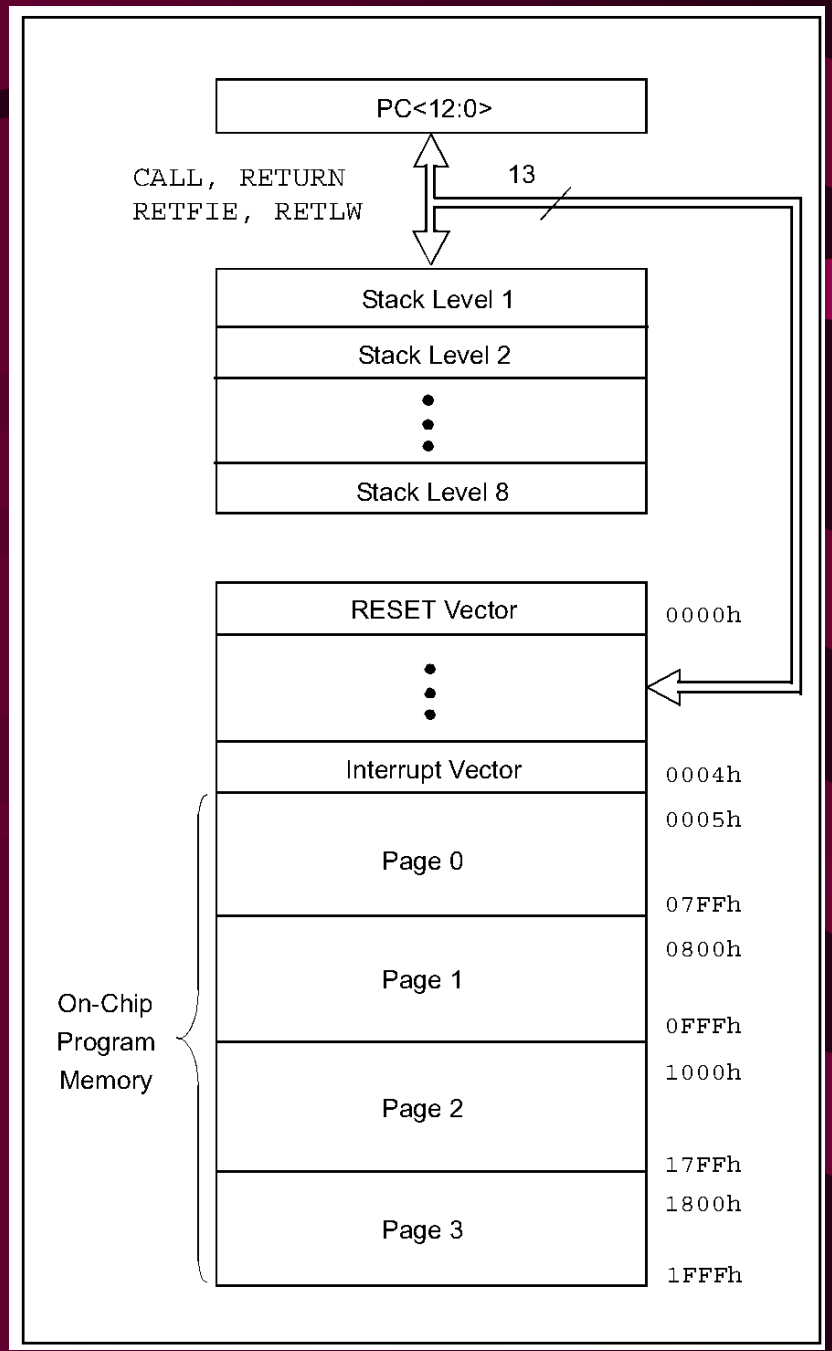


k = 11-bit immediate value

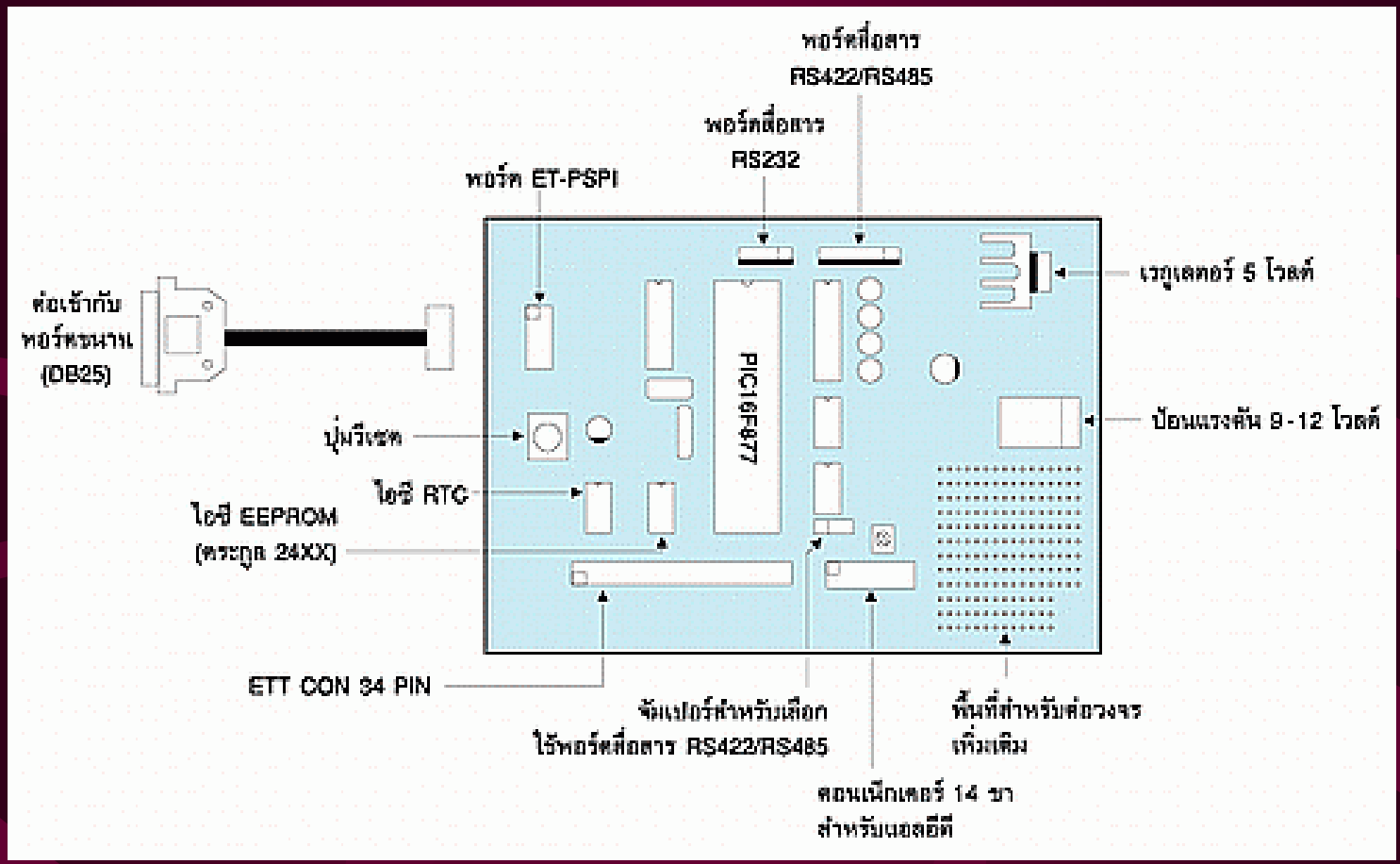
```
          ORG 0x500
          BCF PCLATH,4
          BSF PCLATH,3   ;Select page 1
                         ;(800h-FFFh)
          CALL SUB1_P1   ;Call subroutine in
          :              ;page 1 (800h-FFFh)
          :
          ORG 0x900      ;page 1 (800h-FFFh)
SUB1_P1
          :         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

Program Memory

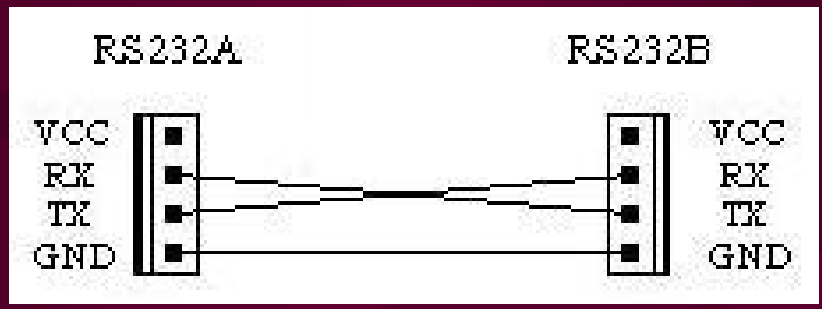
PCLATH<4>	PCLATH<3>	Page
0	0	Page 0
0	1	Page 1
1	0	Page 2
1	1	Page 3



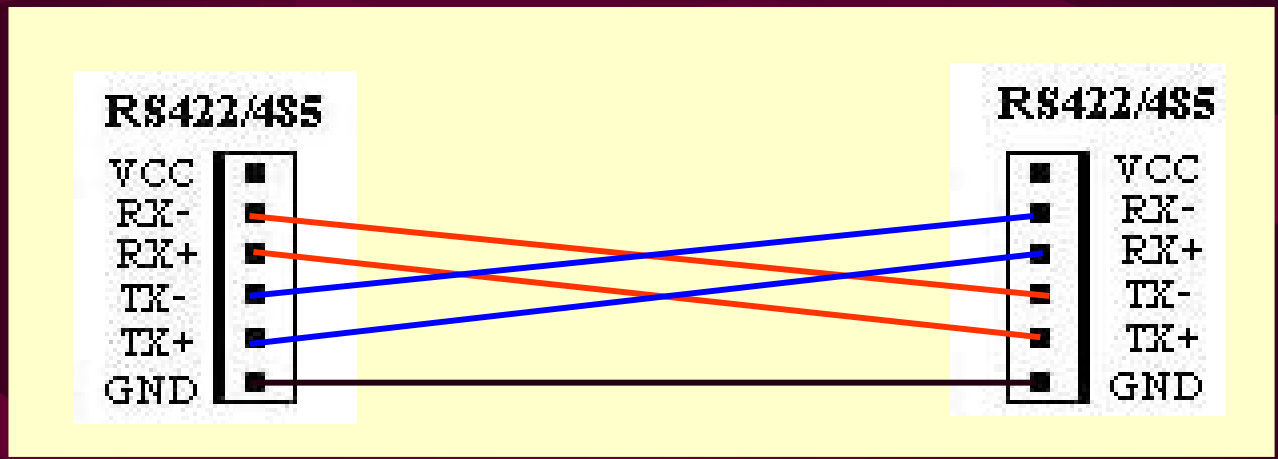
ส่วนประกอบและข้อจำกัดต่างๆ ของบอร์ด CP-PIC877 V1.0



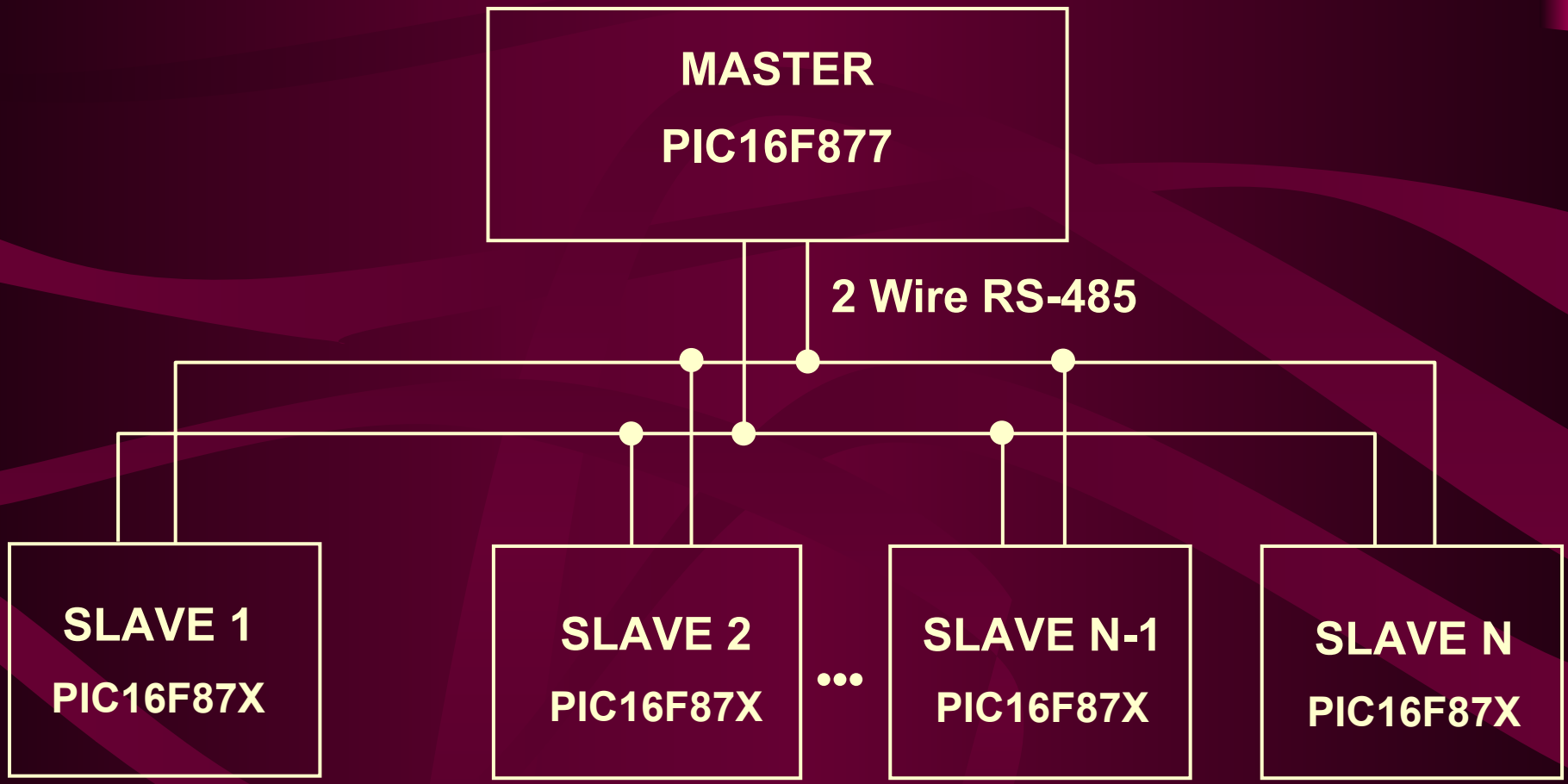
RS-232



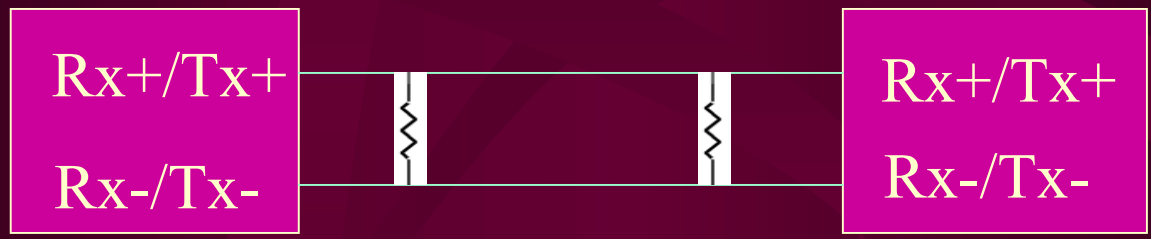
RS-422/RS-485



Addressable USART: Multi-Drop Serial Interface



การต่อ RS-422 แบบ Full Duplex

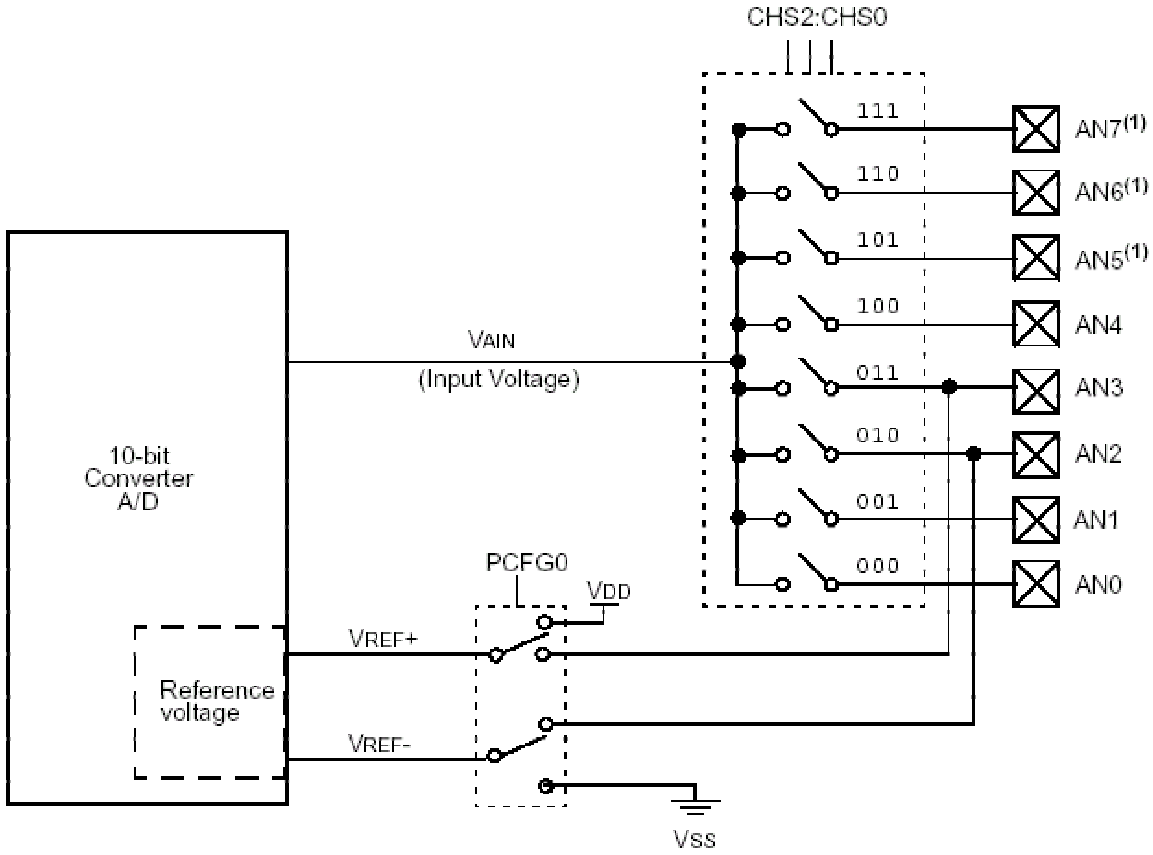


การต่อ RS-485 แบบ Half Duplex

10-Bit A/D Module:
Features

PIC16F87X devices have a 10-bit A/D (+/- 1 LSB)

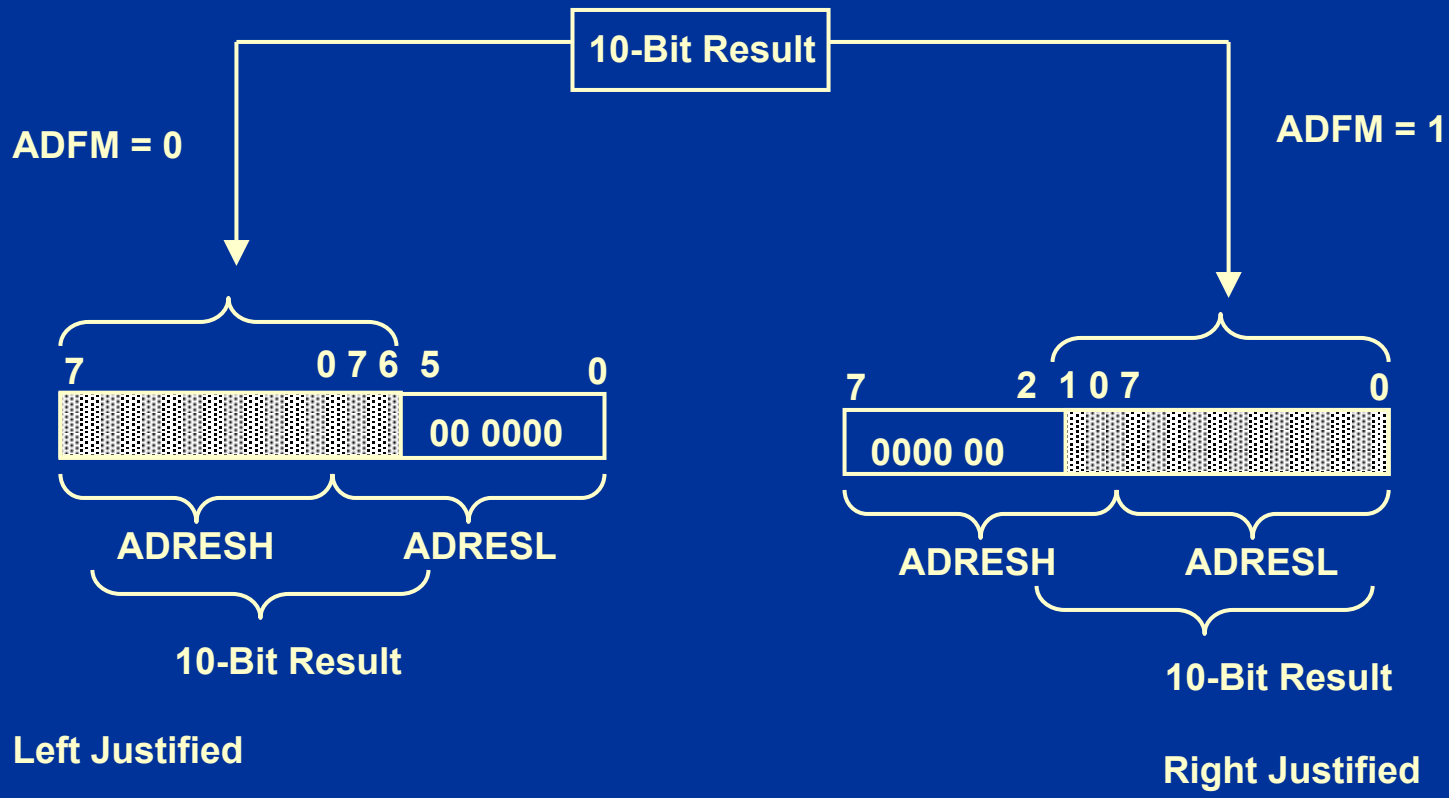
- A/D Result High Register (ADRESH)
- A/D Result Low Register (ADRESL)
- A/D Control Register0 (ADCON0)
- A/D Control Register1 (ADCON1)



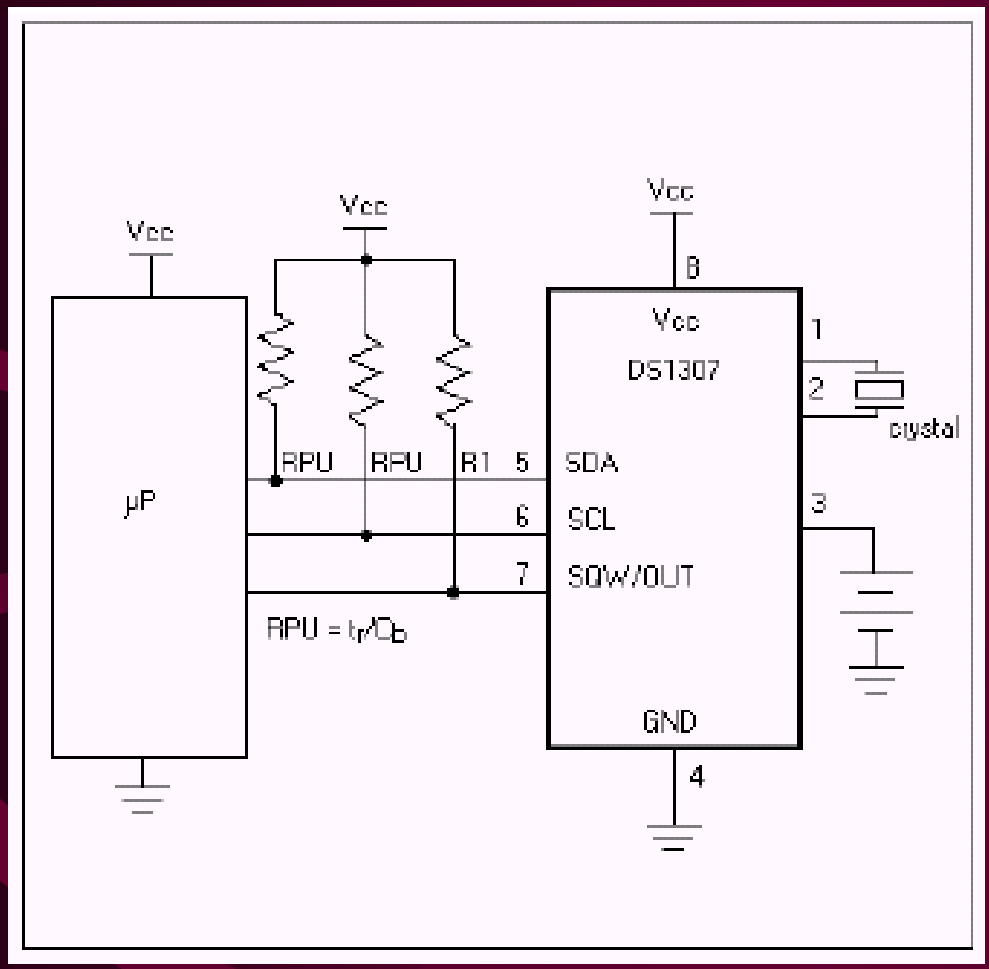
Note 1: Channels AN5 through AN7 are not available on PIC18F2X8 devices.

2: All I/O pins have diode protection to VDD and VSS.

10-Bit A/D Module:
Left/Right Justification of A/D Result

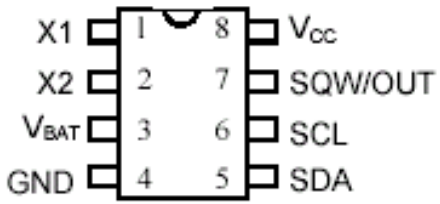


RTC (Real Time Clock) #DS1307

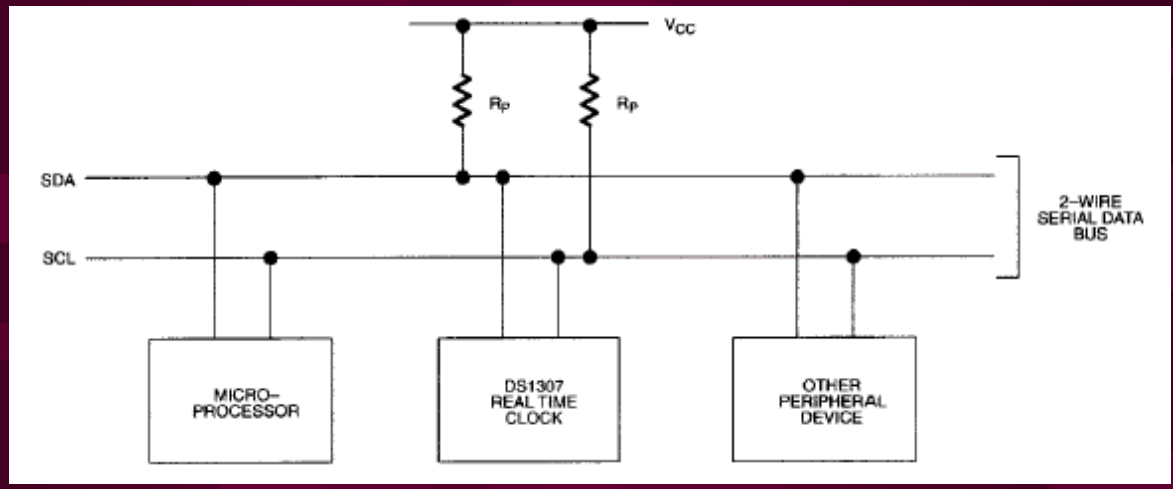


00H	SECONDS
	MINUTES
	HOURS
	DAY
	DATE
	MONTH
	YEAR
07H	CONTROL
08H 3FH	RAM 56 x 8

PIN ASSIGNMENT



DS1307 8-Pin DIP (300-mil)



<Slave Address>		<$\overline{R/W}$>		<Word Address (n)>		<Data(n)>		<Data (n+1)>		<Data (n+X)>		
S	1101000	0	A	XXXXXXXX	A	XXXXXXXX	A	XXXXXXXX	A	XXXXXXXX	A	P

DATA TRANSFERRED
(X+1 BYTES + ACKNOWLEDGE)

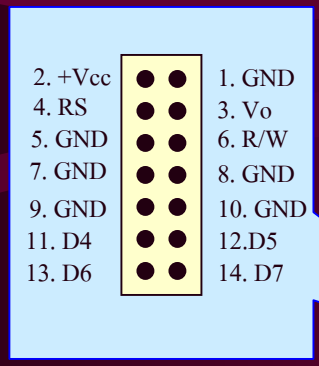
S – START
A – ACKNOWLEDGE
P – STOP
*$R/\overline{W}$ – READ/WRITE OR DIRECTION BIT.

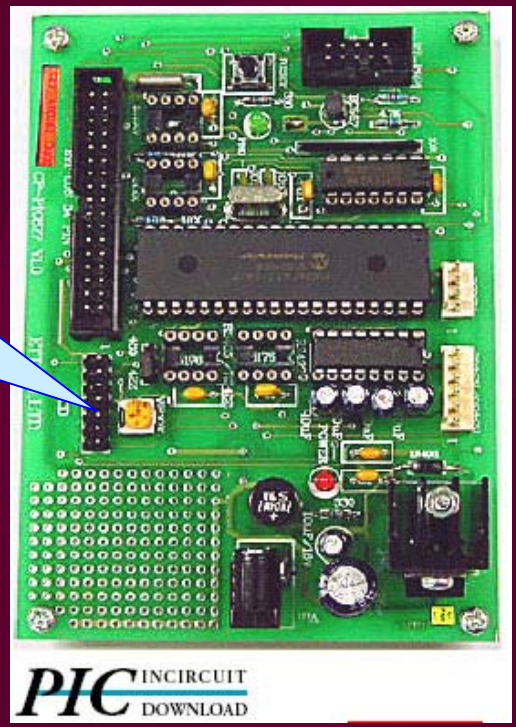
ADDRESS = D0h

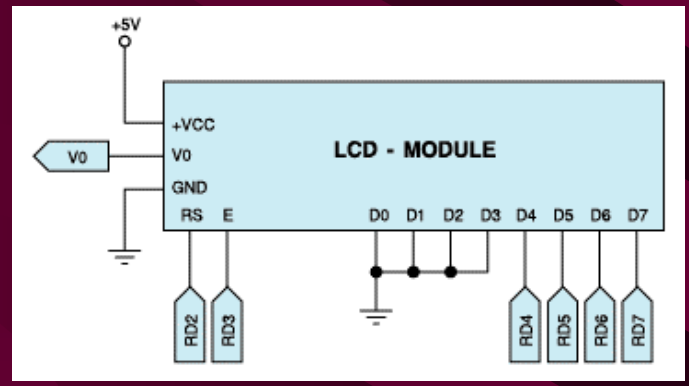
EEPROM 24XX

การต่อจะต่อผ่านระบบบัสของ I2CBUS เหมือนกับ RTC แต่การรับส่งข้อมูลจะไม่เกิดปัญหา เนื่องจาก อุปกรณ์ทั้งสองจะมีแอดเดรสต่างกัน

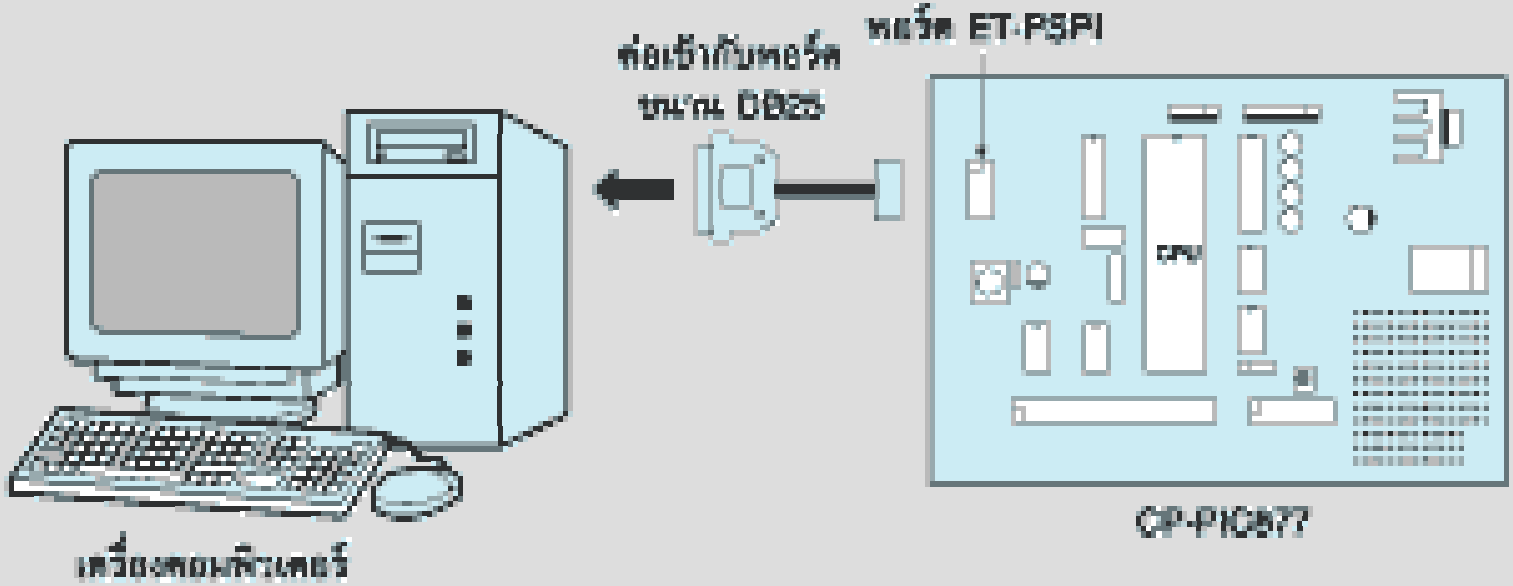
LCD 14 PIN

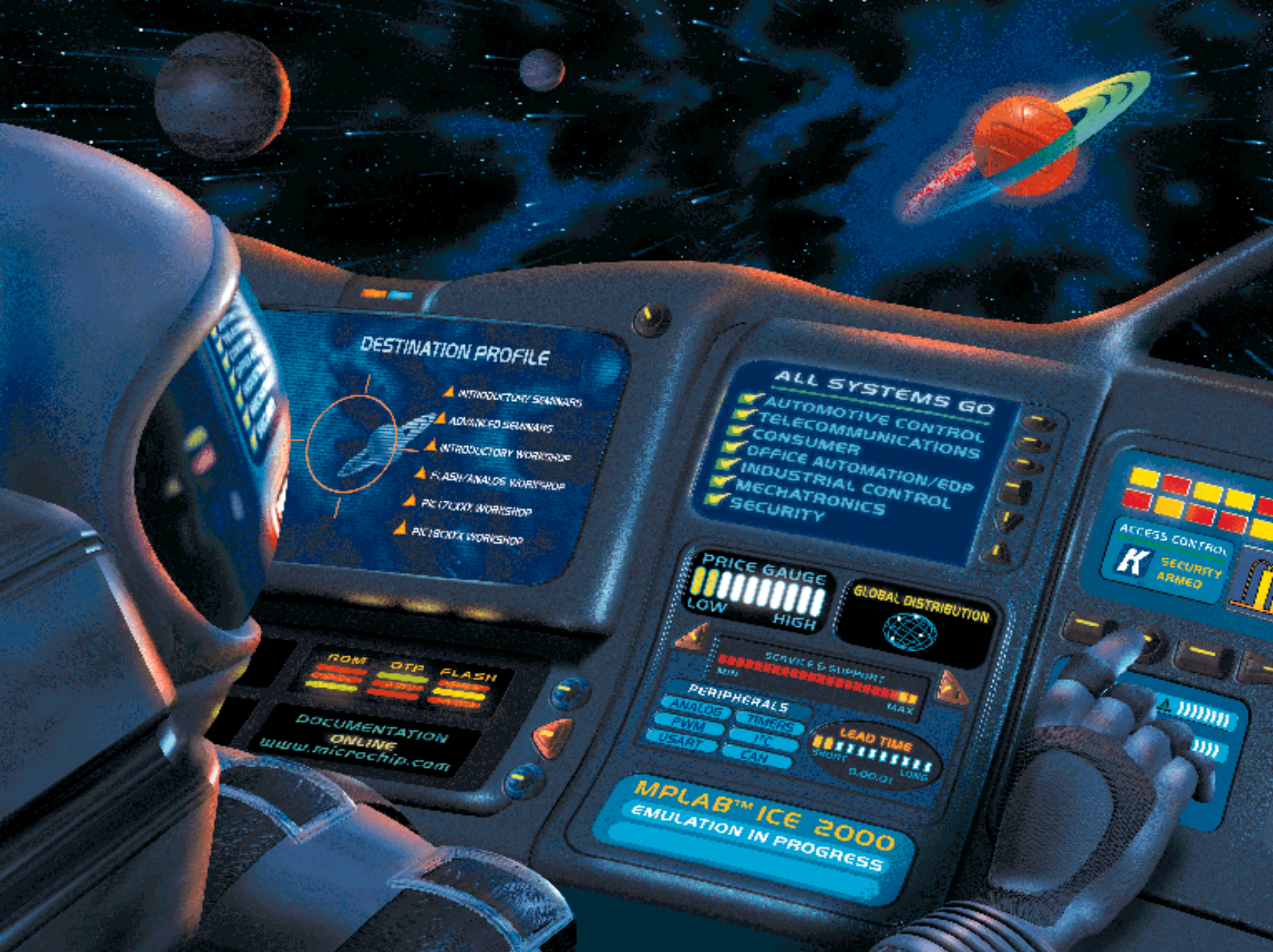


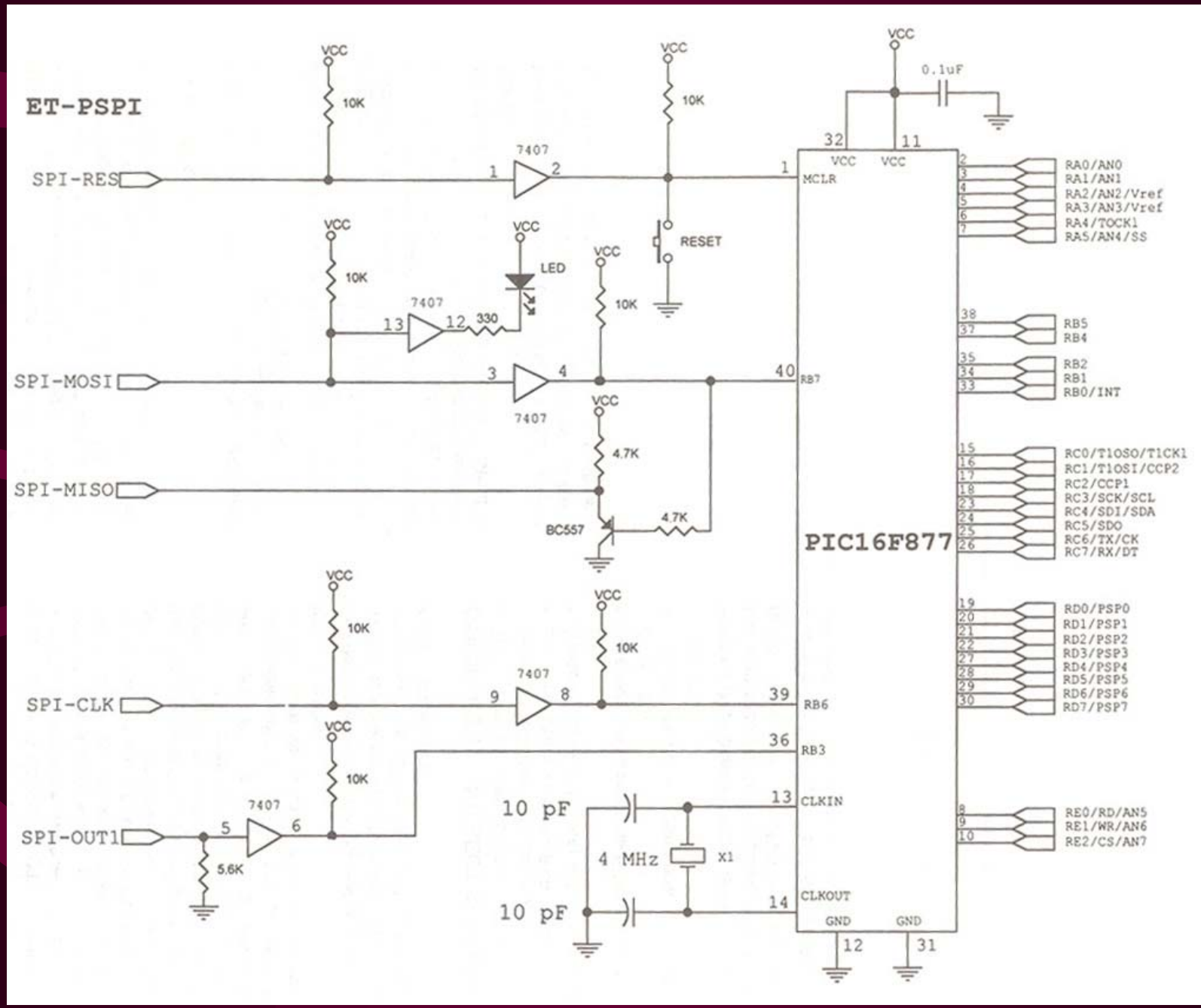


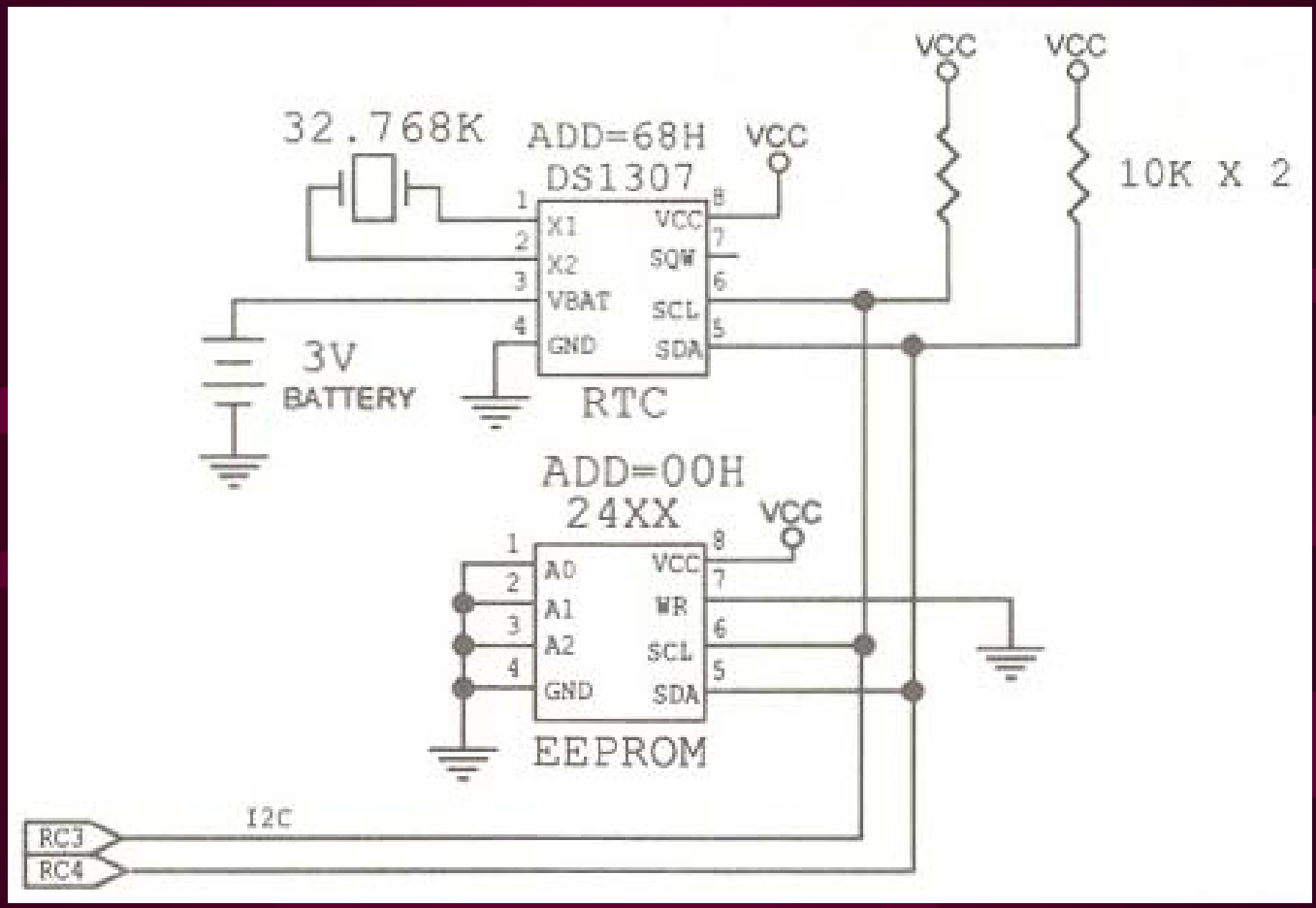


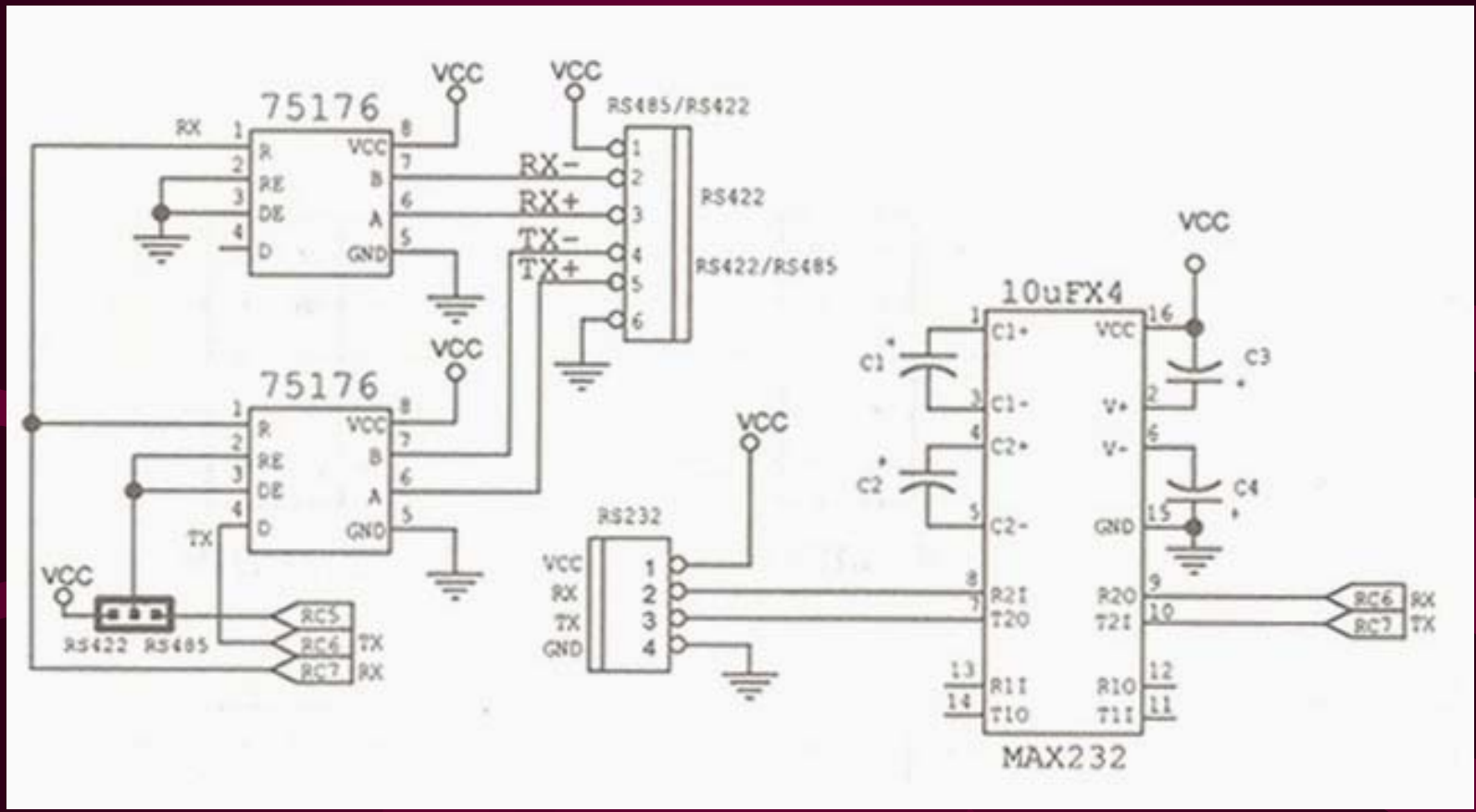
การดาวน์โหลดโปรแกรม




DESTINATION PROFILE
INTRODUCTORY SEMINARS
ADVANCED SEMINARS
INTRODUCTORY WORKSHOP
FLASH/ANALOG WORKSHOP
PIC17CXXX WORKSHOP
PIC18CXXX WORKSHOP
ALL SYSTEMS GO
AUTOMOTIVE CONTROL
TELECOMMUNICATIONS
CONSUMER
OFFICE AUTOMATION/EDP
INDUSTRIAL CONTROL
MECHATRONICS
SECURITY
PRICE GAUGE
LOW
HIGH
GLOBAL DISTRIBUTION
SERVICE & SUPPORT
MIN
MAX
PERIPHERALS
ANALOG
TIMERS
PWM
I²C
USART
CAN
LEAD TIME
SHORT
LONG
0.00.01
ROM
OTP
FLASH
DOCUMENTATION
ONLINE
www.microchip.com
MPLAB™ ICE 2000
EMULATION IN PROGRESS
ACCESS CONTROL
SECURITY
ARMED


ET-PSPI
SPI-RES
SPI-MOSI
SPI-MISO
SPI-CLK
SPI-OUT1
VCC
10K
7407
LED
330
RESET
4.7K
BC557
0.1uF
PIC16F877
MCLR
RB7
RB6
RB3
CLKIN
CLKOUT
10 pF
4 MHz
X1
5.6K
GND
RA0/AN0
RA1/AN1
RA2/AN2/Vref
RA3/AN3/Vref
RA4/TOCK1
RA5/AN4/SS
RB5
RB4
RB2
RB1
RB0/INT
RC0/T1OSO/T1CK1
RC1/T1OSI/CCP2
RC2/CCP1
RC3/SCK/SCL
RC4/SDI/SDA
RC5/SDO
RC6/TX/CK
RC7/RX/DT
RD0/PSP0
RD1/PSP1
RD2/PSP2
RD3/PSP3
RD4/PSP4
RD5/PSP5
RD6/PSP6
RD7/PSP7
RE0/RD/AN5
RE1/WR/AN6
RE2/CS/AN7


VCC
VCC
32.768K
ADD=68H
DS1307
VCC
10K X 2
1
2
3
4
X1
X2
VBAT
GND
8
7
6
5
VCC
SQW
SCL
SDA
3V
BATTERY
RTC
ADD=00H
24XX
VCC
1
2
3
4
A0
A1
A2
GND
8
7
6
5
VCC
WR
SCL
SDA
EEPROM
I2C
RC3
RC4


75176
RX
VCC
RS485/RS422
RX-
RX+
TX-
TX+
RS422
RS422/RS485
75176
TX
RS422 RS485
RC5
RC6
RC7
TX
RX
RS232
VCC
RX
TX
GND
10uFX4
C1+
C1-
C2+
C2-
V+
V-
GND
R2I
T2O
R1I
T1O
R2O
T2I
R1O
T1I
C1
C2
C3
C4
RC6
RC7
RX
TX
MAX232