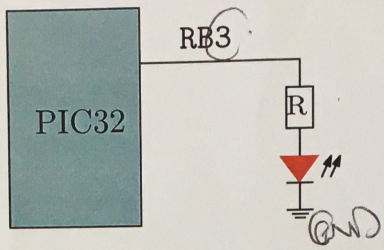
1. (4 punti) **GPIO**
   Su un PIC32MX3 il pin 3 della porta B (RB3) è collegato come in figura:



   Quale delle seguenti impostazioni permette l'accensione del LED?
   (Nell'ultima pagina i registri di PORTB)

   Segna tutte le risposte corrette:

   - ○ `ANSELBbits.ANSB3 = 1; TRISBbits.TRISB3 = 0; LATBbits.LATB3 = 1;`
   - ● `ANSELBbits.ANSB3 = 1; TRISBbits.TRISB3 = 1; LATBbits.LATB3 = 0;`
   - ○ `ANSELBbits.ANSB3 = 0; TRISBbits.TRISB3 = 1; LATBbits.LATB3 = 1;`
   - ○ `ANSELBbits.ANSB3 = 0; TRISBbits.TRISB3 = 0; LATBbits.LATB3 = 1;`
   - ○ `ANSELB = 0x0000; TRISB = 0xFAB7; LATBSET = 0xF8A8;`
   - ● `ANSELB = 0x000F; TRISB = 0xFAB7; LATBSET = 0xF8A8;`
   - ○ `ANSELBCLR = 0x000F; TRISBCLR = 0x0000; LATBSET = 0xFFFF;`

2. (3 punti) **GPIO**
   Specificare la linea di codice che permette di porre, contemporaneamente, PA5 e PA7 rispettivamente a '1' e '0'.

   `TRISA = 0x1010;`

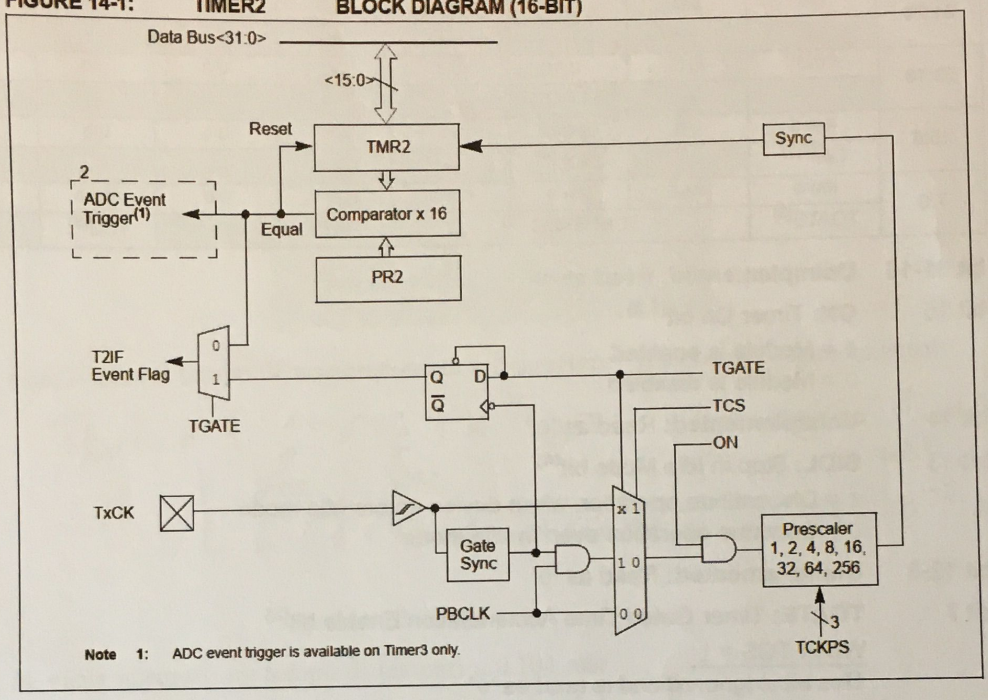
3. (4 punti) **GPIO**
   Si vuole ottenere, nella variabile **bit** lo stato logico ('1' o '0') del pin PC3.
   Quale delle seguenti istruzioni è corretta?

   Segna tutte le risposte corrette:

   - ● `int bit = PORTC & 0xF7;`
   - ● `int bit = PORTC & 0x8;`
   - ○ `int bit = PORTC & (1 << 3);`
   - ○ `int bit = (PORTC & 0x8) >> 3;`
   - ○ `int bit = PORTC | (1 << 3);`

4. (8 punti) **TIMER**
Nella figura seguente viene mostrato il *Timer2 block diagram* nel PIC32MX3xx.

FIGURE 14-1: TIMER2 BLOCK DIAGRAM (16-BIT)



Supponendo di avere:

$T_{CLK} = \frac{1}{10\,MHz} = 0.1 \cdot 10^{-3}\,ms$

- PBCLK = 10 MHz
- T2CON = 0x40 (**nella pagina seguente viene riportato il registro T2CON**)
- Timer2 Interrupt abilitato

(a) quanto deve valere PR2 affinché l'evento di interrupt arrivi ogni "Tempo richiesto"?

Tempo Richiesto	**PR2**
256 ms	
64 ms	
16 ms	
4 ms	

REGISTER 14-1: TxCON: TYPE B TIMER CONTROL REGISTER

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0
31:24	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
	—	—	—	—	—	—	—	—
23:16	U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
	—	—	—	—	—	—	—	—
15:8	R/W-0	U-0	R/W-0	U-0	U-0	U-0	U-0	U-0
	ON(1,3)	—	SIDL(4)	—	—	—	—	—
7:0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	R/W-0	U-0
	TGATE(3)	TCKPS<2:0>(3)			T32(2)	—	TCS(3)	—

bit 31-16 **Unimplemented:** Read as '0'

bit 15 **ON:** Timer On bit(1,3)
1 = Module is enabled
0 = Module is disabled

bit 14 **Unimplemented:** Read as '0'

bit 13 **SIDL:** Stop in Idle Mode bit(4)
1 = Discontinue operation when device enters Idle mode
0 = Continue operation even in Idle mode

bit 12-8 **Unimplemented:** Read as '0'

bit 7 **TGATE:** Timer Gated Time Accumulation Enable bit(3)
When TCS = 1:
This bit is ignored and is read as '0'.
When TCS = 0:
1 = Gated time accumulation is enabled
0 = Gated time accumulation is disabled

bit 6-4 **TCKPS<2:0>:** Timer Input Clock Prescale Select bits(3)
111 = 1:256 prescale value
110 = 1:64 prescale value
101 = 1:32 prescale value
100 = 1:16 prescale value
011 = 1:8 prescale value
010 = 1:4 prescale value
001 = 1:2 prescale value
000 = 1:1 prescale value

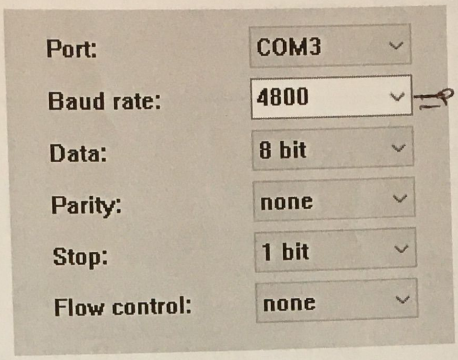
bit 3 **T32:** 32-Bit Timer Mode Select bit(2)
1 = Odd numbered and even numbered timers form a 32-bit timer
0 = Odd numbered and even numbered timers form a separate 16-bit timer

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

bit 1 **TCS:** Timer Clock Source Select bit(3)
1 = External clock from TxCK pin
0 = Internal peripheral clock

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

5. (4 punti) **UART**
Viene data una UART configurata come segue:



(a) quanto dura il tempo di trasmissione di un carattere? (mostare il ragionamento)

$T_{Byte} = (1 + 8 + 1) \times T_{BIT}$ (1 start, 8 data, 1 stop)

$T_{BIT} = \frac{1}{4800} = 2.08 \cdot 10^{-4}$

$= (1 + 8 + 1) \cdot 2.08 \cdot 10^{-4} = 2.08 \cdot 10^{-3}$ sec. ✓

Se viene misurato un tempo di bit pari a 0.104 ms:

(b) quanto vale il baudrate? (mostare il ragionamento)

6. (3 punti) **UART**
Due UART che comunicano...

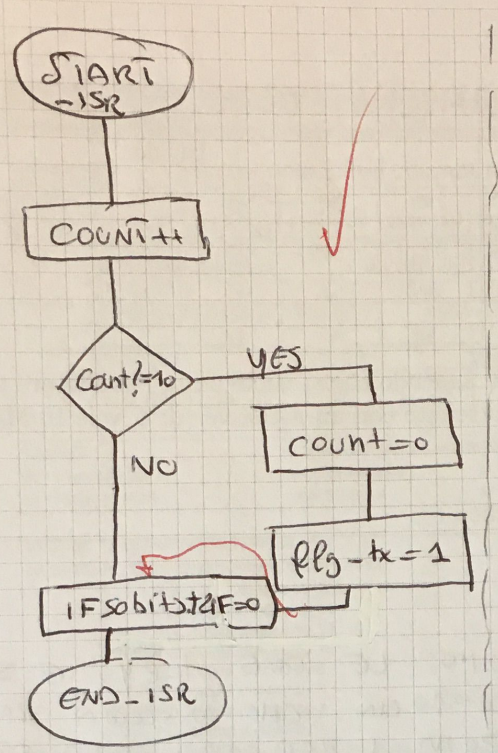
Segna tutte le risposte corrette:

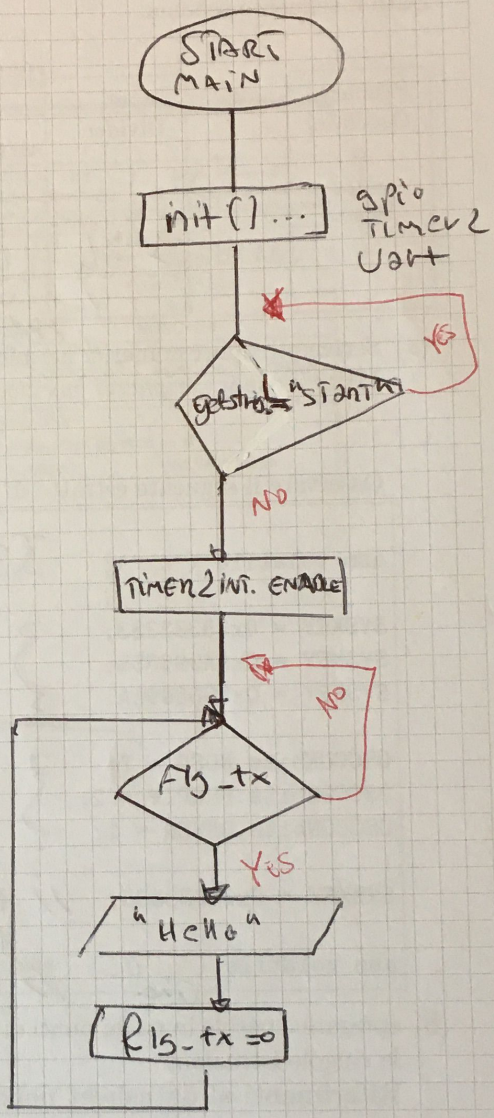
- [x] per sincronizzarsi usano il bit di start di ogni carattere, la velocità di comunicazione convenuta e il formato convenuto della trama
- [ ] usano una linea di clock per ogni direzione di comunicazione
- [ ] non si sincronizzano mai, come dice il loro nome "Universal **Asynchronous** Receiver Transmitter"
- [x] si sincronizzano ad ogni carattere, per la durata della trama di trasmissione del carattere

7. (8 punti) **Flowchart**

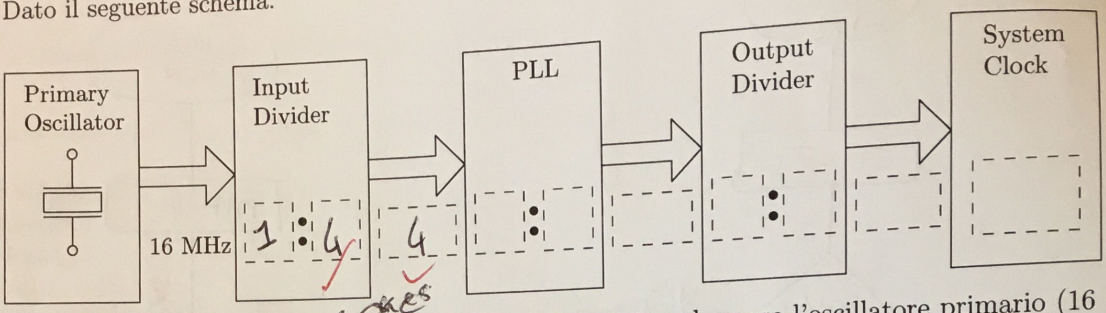
   (a) Disegnare il *flowchart* del seguente codice:

```
char flg_tx;
int count;


void main(void)
{
        gpioInit();     // general purpose I/O setting
                        // (all inputs and all outpus we need)
        Timer2Init();   // timer2 configuration
        UartInit();     // UART peripheral configuration and
                        // Receveing/Trasmitting functions

        while(getString() != "start");   // exec getString and wait
                                         // if cmd is not "start"
        Timer2InterruptEnable();         // Enable interrupt

        while(1)
        {
                if(flg_tx)    // check if custom flag is set by ISR
                {
                        putString("Hello");  // send a message
                        flg_tx = 0;          // reset custom flag
                }
        } //end while
} // end main


void __ISR(_TIMER_2_VECTOR, ipl2)
Timer2IntHandler(void)    // Interrupt Service Routine
{
        count ++;           // increment a variable
        if(count == 10)     // check if "count" reaches "10"
        {
                count = 0;      // reset "count"
                flg_tx = 1;     // set custom flag for endless while
        }

        IFS0bits.T2IF = 0; // Clear interrupt flag event
}
```


START
-ISR
COUNT++
Count!=10
YES
count=0
NO
flg_tx=1
IFSobitstatF=0
END_ISR


START
MAIN
init()...
gpio
TIMER2
Uart
YES
NO
TIMER2 INT. ENABLE
NO
Flg_tx
YES
"Hello"
flg_tx=0

8. (8 punti) **Clock**
Dato il seguente schema:



(a) Scrivere i valori numerici nei blocchi sapendo che si vuole usare l'oscillatore primario (16 MHz) e che il *peripheral bus clock*, ottenuto con un *postscaler* di 4, vale 10 MHz.

Osservare il seguente estratto di codice:

```
asm volatile ("di");

SYSKEY = 0x33333333;
SYSKEY = 0xAA996655;
SYSKEY = 0x556699AA;

OSCCONbits.NOSC = 7;
OSCCONbits.FRCDIV = 2;
OSCCONbits.OSWEN = 1;

SYSKEY = 0x33333333;

asm volatile ("ei");
```

(b) spiegare a parole in pochi punti di cosa si occupa ogni blocco di istruzioni. Non commentare le singole istruzioni.
Riferimenti al datasheet nelle pagine seguenti.

① CONFIGURAZIONE DEL BIT SETTING PER ~~ABILITARE~~ ABILITARE L'OSCILLATORE

disable interrupt

Configura il clock

REGISTER 8-1: OSCCON: OSCILLATOR CONTROL REGISTER

Bit Range	Bit 31/23/15/7	Bit 30/22/14/6	Bit 29/21/13/5	Bit 28/20/12/4	Bit 27/19/11/3	Bit 26/18/10/2	Bit 25/17/9/1	Bit 24/16/8/0
31:24	U-0	U-0	R/W-y	R/W-y	R/W-y	R/W-0	R/W-0	R/W-1
	—	—	PLLODIV<2:0>			FRCDIV<2:0>		
23:16	U-0	R-0	R-1	R/W-y	R/W-y	R/W-y	R/W-y	R/W-y
	—	SOSCRDY	PBDIVRDY	PBDIV<1:0>		PLLMULT<2:0>		
15:8	U-0	R-0	R-0	R-0	U-0	R/W-y	R/W-y	R/W-y
	—	COSC<2:0>			—	NOSC<2:0>		
7:0	R/W-0	R-0	R-0	R/W-0	R/W-0	R/W-0	R/W-y	R/W-0
	CLKLOCK	ULOCK(1)	SLOCK	SLPEN	CF	UFRCEN(1)	SOSCEN	OSWEN

Legend:	y = Value set from Configuration bits on POR	
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

bit 31-30 **Unimplemented:** Read as '0'

bit 29-27 **PLLODIV<2:0>:** Output Divider for PLL
- 111 = PLL output divided by 256
- 110 = PLL output divided by 64
- 101 = PLL output divided by 32
- 100 = PLL output divided by 16
- 011 = PLL output divided by 8
- 010 = PLL output divided by 4
- 001 = PLL output divided by 2
- 000 = PLL output divided by 1

bit 26-24 **FRCDIV<2:0>:** Internal Fast RC (FRC) Oscillator Clock Divider bits
- 111 = FRC divided by 256
- 110 = FRC divided by 64
- 101 = FRC divided by 32
- 100 = FRC divided by 16
- 011 = FRC divided by 8
- 010 = FRC divided by 4
- 001 = FRC divided by 2 (default setting)
- 000 = FRC divided by 1

bit 23 **Unimplemented:** Read as '0'

bit 22 **SOSCRDY:** Secondary Oscillator (SOSC) Ready Indicator bit
- 1 = Indicates that the Secondary Oscillator is running and is stable
- 0 = Secondary Oscillator is still warming up or is turned off

bit 21 **PBDIVRDY:** Peripheral Bus Clock (PBCLK) Divisor Ready bit
- 1 = PBDIV<1:0> bits can be written
- 0 = PBDIV<1:0> bits cannot be written

bit 20-19 **PBDIV<1:0>:** Peripheral Bus Clock (PBCLK) Divisor bits
- 11 = PBCLK is SYSCLK divided by 8 (default)
- 10 = PBCLK is SYSCLK divided by 4
- 01 = PBCLK is SYSCLK divided by 2
- 00 = PBCLK is SYSCLK divided by 1

Note 1: This bit is available on PIC32MX4XX devices only.

Note: Writes to this register require an unlock sequence. Refer to **Section 6. "Oscillator"** (DS60001112) in the *"PIC32 Family Reference Manual"* for details.

REGISTER 8-1: OSCCON: OSCILLATOR CONTROL REGISTER (CONTINUED)

bit 18-16 **PLLMULT<2:0>:** Phase-Locked Loop (PLL) Multiplier bits
- 111 = Clock is multiplied by 24
- 110 = Clock is multiplied by 21
- 101 = Clock is multiplied by 20
- 100 = Clock is multiplied by 19
- 011 = Clock is multiplied by 18
- 010 = Clock is multiplied by 17
- 001 = Clock is multiplied by 16
- 000 = Clock is multiplied by 15

bit 15 **Unimplemented:** Read as '0'

bit 14-12 **COSC<2:0>:** Current Oscillator Selection bits
- 111 = Internal Fast RC (FRC) Oscillator divided by OSCCON<FRCDIV> bits
- 110 = Internal Fast RC (FRC) Oscillator divided by 16
- 101 = Internal Low-Power RC (LPRC) Oscillator
- 100 = Secondary Oscillator (Sosc)
- 011 = Primary Oscillator (Posc) with PLL module (XTPLL, HSPLL or ECPLL)
- 010 = Primary Oscillator (Posc) (XT, HS or EC)
- 001 = Internal Fast RC Oscillator with PLL module via Postscaler (FRCPLL)
- 000 = Internal Fast RC (FRC) Oscillator

bit 11 **Unimplemented:** Read as '0'

bit 10-8 **NOSC<2:0>:** New Oscillator Selection bits
- 111 = Internal Fast RC Oscillator (FRC) divided by OSCCON<FRCDIV> bits
- 110 = Internal Fast RC Oscillator (FRC) divided by 16
- 101 = Internal Low-Power RC (LPRC) Oscillator
- 100 = Secondary Oscillator (Sosc)
- 011 = Primary Oscillator with PLL module (XTPLL, HSPLL or ECPLL)
- 010 = Primary Oscillator (XT, HS or EC)
- 001 = Internal Fast Internal RC Oscillator with PLL module via Postscaler (FRCPLL)
- 000 = Internal Fast Internal RC Oscillator (FRC)

On Reset, these bits are set to the value of the FNOSC Configuration bits (DEVCFG1<2:0>).

bit 7 **CLKLOCK:** Clock Selection Lock Enable bit

If clock switching and monitoring is disabled (FCKSM<1:0> = 1x):
- 1 = Clock and PLL selections are locked
- 0 = Clock and PLL selections are not locked and may be modified

If clock switching and monitoring is enabled (FCKSM<1:0> = 0x):
Clock and PLL selections are never locked and may be modified.

bit 6 **ULOCK:** USB PLL Lock Status bit(1)
- 1 = Indicates that the USB PLL module is in lock or USB PLL module start-up timer is satisfied
- 0 = Indicates that the USB PLL module is out of lock or USB PLL module start-up timer is in progress or USB PLL is disabled

bit 5 **SLOCK:** PLL Lock Status bit
- 1 = PLL module is in lock or PLL module start-up timer is satisfied
- 0 = PLL module is out of lock, PLL start-up timer is running or PLL is disabled

bit 4 **SLPEN:** Sleep Mode Enable bit
- 1 = Device will enter Sleep mode when a WAIT instruction is executed
- 0 = Device will enter Idle mode when a WAIT instruction is executed

bit 3 **CF:** Clock Fail Detect bit
- 1 = FSCM has detected a clock failure
- 0 = No clock failure has been detected

Note 1: This bit is available on PIC32MX4XX devices only.

Note: Writes to this register require an unlock sequence. Refer to **Section 6. "Oscillator"** (DS60001112) in the *"PIC32 Family Reference Manual"* for details.

PIC32MX330/350/370/430/450/470

REGISTER 8-1: OSCCON: OSCILLATOR CONTROL REGISTER (CONTINUED)

bit 2 **UFRCEN:** USB FRC Clock Enable bit(1)
- 1 = Enable FRC as the clock source for the USB clock source
- 0 = Use the Primary Oscillator or USB PLL as the USB clock source

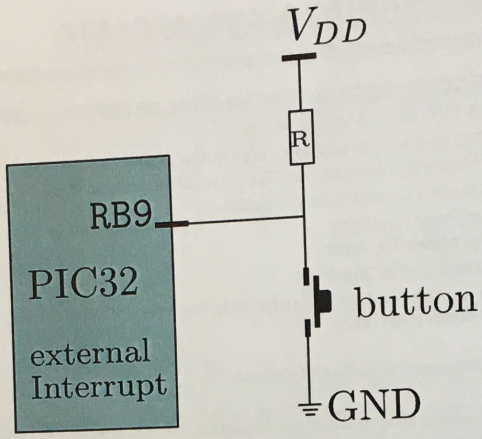
bit 1 **SOSCEN:** Secondary Oscillator (SOSC) Enable bit
- 1 = Enable Secondary Oscillator
- 0 = Disable Secondary Oscillator

bit 0 **OSWEN:** Oscillator Switch Enable bit
- 1 = Initiate an oscillator switch to selection specified by NOSC<2:0> bits
- 0 = Oscillator switch is complete

Note 1: This bit is available on PIC32MX4XX devices only.

Note: Writes to this register require an unlock sequence. Refer to **Section 6. "Oscillator"** (DS60001112) in the *"PIC32 Family Reference Manual"* for details.

9. (8 punti) **Interrupt**
Si supponga di avere il seguente sistema:



(a) scrivere la funzione di inizializzazione del pin a cui è associato un *External Interrupt*

(b) scrivere l'*Interrupt Service Routine* corrispondente

Se in difficoltà (non ricordate nomi di registri e/o funzioni), aiutatevi con pseudo-codice.

Nella pagina seguente trovate degli estratti dal *Datasheet*.

Prag~a interrupt Tine Interrupt Handler
obj void interHandle (void)
static

- incomplete ISR
- manca init_pin()

PIC32MX330/350/370/430/450/470

TABLE 7-1: INTERRUPT IRQ, VECTOR AND BIT LOCATION

Interrupt Source(1)	IRQ #	Vector #	Interrupt Bit Location				Persistent Interrupt
			Flag	Enable	Priority	Sub-priority	
Highest Natural Order Priority							
CT – Core Timer Interrupt	0	0	IFS0<0>	IEC0<0>	IPC0<4:2>	IPC0<1:0>	No
CS0 – Core Software Interrupt 0	1	1	IFS0<1>	IEC0<1>	IPC0<12:10>	IPC0<9:8>	No
CS1 – Core Software Interrupt 1	2	2	IFS0<2>	IEC0<2>	IPC0<20:18>	IPC0<17:16>	No
INT0 – External Interrupt	3	3	IFS0<3>	IEC0<3>	IPC0<28:26>	IPC0<25:24>	No
T1 – Timer1	4	4	IFS0<4>	IEC0<4>	IPC1<4:2>	IPC1<1:0>	No
IC1E – Input Capture 1 Error	5	5	IFS0<5>	IEC0<5>	IPC1<12:10>	IPC1<9:8>	Yes
IC1 – Input Capture 1	6	5	IFS0<6>	IEC0<6>	IPC1<12:10>	IPC1<9:8>	Yes
OC1 – Output Compare 1	7	6	IFS0<7>	IEC0<7>	IPC1<20:18>	IPC1<17:16>	No
INT1 – External Interrupt 1	8	7	IFS0<8>	IEC0<8>	IPC1<28:26>	IPC1<25:24>	No
T2 – Timer2	9	8	IFS0<9>	IEC0<9>	IPC2<4:2>	IPC2<1:0>	No
IC2E – Input Capture 2	10	9	IFS0<10>	IEC0<10>	IPC2<12:10>	IPC2<9:8>	Yes
IC2 – Input Capture 2	11	9	IFS0<11>	IEC0<11>	IPC2<12:10>	IPC2<9:8>	Yes
OC2 – Output Compare 2	12	10	IFS0<12>	IEC0<12>	IPC2<20:18>	IPC2<17:16>	No
INT2 – External Interrupt 2	13	11	IFS0<13>	IEC0<13>	IPC2<28:26>	IPC2<25:24>	No
T3 – Timer3	14	12	IFS0<14>	IEC0<14>	IPC3<4:2>	IPC3<1:0>	No
IC3E – Input Capture 3	15	13	IFS0<15>	IEC0<15>	IPC3<12:10>	IPC3<9:8>	Yes
IC3 – Input Capture 3	16	13	IFS0<16>	IEC0<16>	IPC3<12:10>	IPC3<9:8>	Yes
OC3 – Output Compare 3	17	14	IFS0<17>	IEC0<17>	IPC3<20:18>	IPC3<17:16>	No
INT3 – External Interrupt 3	18	15	IFS0<18>	IEC0<18>	IPC3<28:26>	IPC3<25:24>	No
T4 – Timer4	19	16	IFS0<19>	IEC0<19>	IPC4<4:2>	IPC4<1:0>	No
IC4E – Input Capture 4 Error	20	17	IFS0<20>	IEC0<20>	IPC4<12:10>	IPC4<9:8>	Yes
IC4 – Input Capture 4	21	17	IFS0<21>	IEC0<21>	IPC4<12:10>	IPC4<9:8>	Yes
OC4 – Output Compare 4	22	18	IFS0<22>	IEC0<22>	IPC4<20:18>	IPC4<17:16>	No
INT4 – External Interrupt 4	23	19	IFS0<23>	IEC0<23>	IPC4<28:26>	IPC4<25:24>	No
T5 – Timer5	24	20	IFS0<24>	IEC0<24>	IPC5<4:2>	IPC5<1:0>	No
IC5E – Input Capture 5 Error	25	21	IFS0<25>	IEC0<25>	IPC5<12:10>	IPC5<9:8>	Yes
IC5 – Input Capture 5	26	21	IFS0<26>	IEC0<26>	IPC5<12:10>	IPC5<9:8>	Yes
OC5 – Output Compare 5	27	22	IFS0<27>	IEC0<27>	IPC5<20:18>	IPC5<17:16>	No
AD1 – ADC1 Convert done	28	23	IFS0<28>	IEC0<28>	IPC5<28:26>	IPC5<25:24>	Yes
FSCM – Fail-Safe Clock Monitor	29	24	IFS0<29>	IEC0<29>	IPC6<4:2>	IPC6<1:0>	No
RTCC – Real-Time Clock and Calendar	30	25	IFS0<30>	IEC0<30>	IPC6<12:10>	IPC6<9:8>	No
FCE – Flash Control Event	31	26	IFS0<31>	IEC0<31>	IPC6<20:18>	IPC6<17:16>	No
CMP1 – Comparator Interrupt	32	27	IFS1<0>	IEC1<0>	IPC6<28:26>	IPC6<25:24>	No
CMP2 – Comparator Interrupt	33	28	IFS1<1>	IEC1<1>	IPC7<4:2>	IPC7<1:0>	No
USB – USB Interrupts	34	29	IFS1<2>	IEC1<2>	IPC7<12:10>	IPC7<9:8>	Yes
SPI1E – SPI1 Fault	35	30	IFS1<3>	IEC1<3>	IPC7<20:18>	IPC7<17:16>	Yes
SPI1RX – SPI1 Receive Done	36	30	IFS1<4>	IEC1<4>	IPC7<20:18>	IPC7<17:16>	Yes
SPI1TX – SPI1 Transfer Done	37	30	IFS1<5>	IEC1<5>	IPC7<20:18>	IPC7<17:16>	Yes
U1E – UART1 Fault	38	31	IFS1<6>	IEC1<6>	IPC7<28:26>	IPC7<25:24>	Yes
U1RX – UART1 Receive Done	39	31	IFS1<7>	IEC1<7>	IPC7<28:26>	IPC7<25:24>	Yes
U1TX – UART1 Transfer Done	40	31	IFS1<8>	IEC1<8>	IPC7<28:26>	IPC7<25:24>	Yes
I2C1B – I2C1 Bus Collision Event	41	32	IFS1<9>	IEC1<9>	IPC8<4:2>	IPC8<1:0>	Yes
I2C1S – I2C1 Slave Event	42	32	IFS1<10>	IEC1<10>	IPC8<4:2>	IPC8<1:0>	Yes
I2C1M – I2C1 Master Event	43	32	IFS1<11>	IEC1<11>	IPC8<4:2>	IPC8<1:0>	Yes
CNA – PORTA Input Change Interrupt	44	33	IFS1<12>	IEC1<12>	IPC8<12:10>	IPC8<9:8>	Yes

Note 1: Not all interrupt sources are available on all devices. See **TABLE 1: "PIC32MX330/350/370/430/450/470 Controller Family Features"** for the list of available peripherals.

TABLE 12-1: INPUT PIN SELECTION

Peripheral Pin	[*pin name*]R SFR	[*pin name*]R bits	[*pin name*]R Value to RPn Pin Selection
INT3	INT3R	INT3R<3:0>	0000 = RPD2 0001 = RPG8 0010 = RPF4 0011 = RPD10 0100 = RPF1 0101 = RPB9 0110 = RPB10 0111 = RPC14 1000 = RPB5 1001 = Reserved 1010 = RPC1(3) 1011 = RPD14(3) 1100 = RPG1(3) 1101 = RPA14(3) 1110 = Reserved 1111 = RPF2(1)
T2CK	T2CKR	T2CKR<3:0>	
IC3	IC3R	IC3R<3:0>	
U1RX	U1RXR	U1RXR<3:0>	
U2RX	U2RXR	U2RXR<3:0>	
$\overline{\text{U5CTS}}$	U5CTSR(3)	U5CTSR<3:0>	
REFCLKI	REFCLKIR	REFCLKIR<3:0>	
INT4	INT4R	INT4R<3:0>	0000 = RPD3 0001 = RPG7 0010 = RPF5 0011 = RPD11 0100 = RPF0 0101 = RPB1 0110 = RPE5 0111 = RPC13 1000 = RPB3 1001 = Reserved 1010 = RPC4(3) 1011 = RPD15(3) 1100 = RPG0(3) 1101 = RPA15(3) 1110 = RPF2(1) 1111 = RPF7(2)
T5CK	T5CKR	T5CKR<3:0>	
IC4	IC4R	IC4R<3:0>	
U3RX	U3RXR	U3RXR<3:0>	
$\overline{\text{U4CTS}}$	U4CTSR	U4CTSR<3:0>	
SDI1	SDI1R	SDI1R<3:0>	
SDI2	SDI2R	SDI2R<3:0>	
INT2	INT2R	INT2R<3:0>	0000 = RPD9 0001 = RPG6 0010 = RPB8 0011 = RPB15 0100 = RPD4 0101 = RPB0 0110 = RPE3 0111 = RPB7 1000 = Reserved 1001 = RPF12(3) 1010 = RPD12(3) 1011 = RPF8(3) 1100 = RPC3(3) 1101 = RPE9(3) 1110 = Reserved 1111 = RPB2
T4CK	T4CKR	T4CKR<3:0>	
IC2	IC2R	IC2R<3:0>	
IC5	IC5R	IC5R<3:0>	
$\overline{\text{U1CTS}}$	U1CTSR	U1CTSR<3:0>	
$\overline{\text{U2CTS}}$	U2CTSR	U2CTSR<3:0>	
$\overline{\text{SS1}}$	SS1R	SS1R<3:0>	

Note 1: This selection is not available on 64-pin USB devices.
2: This selection is only available on 100-pin General Purpose devices.
3: This selection is not available on 64-pin USB and General Purpose devices.
4: This selection is only available on General Purpose devices.

TABLE 12-4: PORTB REGISTER MAP

Virtual Address (BF88_#)	Register Name(1)	Bit Range	Bits																						All Resets
			31/15	30/14	29/13	28/12	27/11	26/10	25/9	24/8	23/7	22/6	21/5	20/4	19/3	18/2	17/1	16/0	
6100	ANSELB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	ANSELB15	ANSELB14	ANSELB13	ANSELB12	ANSELB11	ANSELB10	ANSELB9	ANSELB8	ANSELB7	ANSELB6	ANSELB5	ANSELB4	ANSELB3	ANSELB2	ANSELB1	ANSELB0	FFFF
6110	TRISB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	TRISB15	TRISB14	TRISB13	TRISB12	TRISB11	TRISB10	TRISB9	TRISB8	TRISB7	TRISB6	TRISB5	TRISB4	TRISB3	TRISB2	TRISB1	TRISB0	xxxx
6120	PORTB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	RB15	RB14	RB13	RB12	RB11	RB10	RB9	RB8	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0	xxxx
6130	LATB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	LATB15	LATB14	LATB13	LATB12	LATB11	LATB10	LATB9	LATB8	LATB7	LATB6	LATB5	LATB4	LATB3	LATB2	LATB1	LATB0	xxxx
6140	ODCB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	ODCB15	ODCB14	ODCB13	ODCB12	ODCB11	ODCB10	ODCB9	ODCB8	ODCB7	ODCB6	ODCB5	ODCB4	ODCB3	ODCB2	ODCB1	ODCB0	xxxx
6150	CNPUB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	CNPUB15	CNPUB14	CNPUB13	CNPUB12	CNPUB11	CNPUB10	CNPUB9	CNPUB8	CNPUB7	CNPUB6	CNPUB5	CNPUB4	CNPUB3	CNPUB2	CNPUB1	CNPUB0	xxxx
6160	CNPDB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	CNPDB15	CNPDB14	CNPDB13	CNPDB12	CNPDB11	CNPDB10	CNPDB9	CNPDB8	CNPDB7	CNPDB6	CNPDB5	CNPDB4	CNPDB3	CNPDB2	CNPDB1	CNPDB0	xxxx
6170	CNCONB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	ON	—	SIDL	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
6180	CNENB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	CNIEB15	CNIEB14	CNIEB13	CNIEB12	CNIEB11	CNIEB10	CNIEB9	CNIEB8	CNIEB7	CNIEB6	CNIEB5	CNIEB4	CNIEB3	CNIEB2	CNIEB1	CNIEB0	xxxx
6190	CNSTATB	31:16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0000
		15:0	CN STATB15	CN STATB14	CN STATB13	CN STATB12	CN STATB11	CN STATB10	CN STATB9	CN STATB8	CN STATB7	CN STATB6	CN STATB5	CN STATB4	CN STATB3	CN STATB2	CN STATB1	CN STATB0	xxxx

Legend: x = Unknown value on Reset; — = Unimplemented, read as '0'; Reset values are shown in hexadecimal.

Note 1: All registers in this table have corresponding CLR, SET and INV registers at its virtual address, plus an offset of 0x4, 0x8 and 0xC, respectively. See **Section 12.2 "CLR, SET, and INV Registers"** for more information.