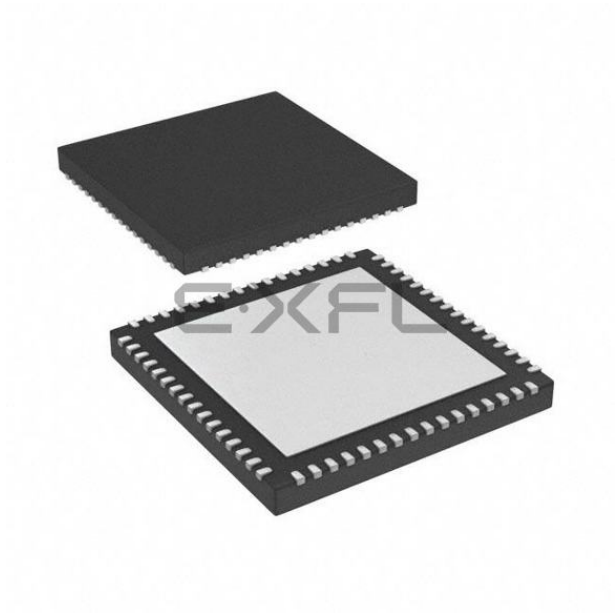
Microchip Technology - DSPIC33CH64MP506-E/MR Datasheet



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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	dsPIC
Core Size	16-Bit Dual-Core
Speed	180MHz, 200MHz
Connectivity	CANbus, I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, QEI, WDT
Number of I/O	53
Program Memory Size	88KB (88K x 8)
Program Memory Type	FLASH, PRAM
EEPROM Size	-
RAM Size	20K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 34x12b; D/A 4x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	64-QFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33ch64mp506-e-mr

TABLE 3-5: MASTER SFR BLOCK 100h

Register	Address	All Resets	Register	Address	All Resets	Register	Address	All Resets
Timers			INT1TMRH	15E	0000000000000000	MSI1MBX3D	1E0	0000000000000000
T1CON	100	0-0000000-00-00-	INT1HLDL	160	0000000000000000	MSI1MBX4D	1E2	0000000000000000
TMR1	104	0000000000000000	INT1HLDH	162	0000000000000000	MSI1MBX5D	1E4	0000000000000000
PR1	108	0000000000000000	INDX1CNTL	164	0000000000000000	MSI1MBX6D	1E6	0000000000000000
QEI			INDX1CNTH	166	0000000000000000	MSI1MBX7D	1E8	0000000000000000
QEI1CON	140	0000000000000000	INDX1HLDL	168	0000000000000000	MSI1MBX8D	1EA	0000000000000000
QEI1IOCL	144	0000000000000xxxx	INDX1HLDH	16A	0000000000000000	MSI1MBX9D	1EC	0000000000000000
QEI1IOCH	146	---------------0	QEI1GECL	16C	0000000000000000	MSI1MBX10D	1EE	0000000000000000
QEI1STAT	148	--00000000000000	QEI1GECH	16E	0000000000000000	MSI1MBX11D	1F0	0000000000000000
POS1CNTL	14C	0000000000000000	QEI1LECL	170	0000000000000000	MSI1MBX12D	1F2	0000000000000000
POS1CNTH	14E	0000000000000000	QEI1LECH	172	0000000000000000	MSI1MBX13D	1F4	0000000000000000
POS1HLDL	150	0000000000000000	MSI1CON	1D2	0---xx0000000000	MSI1MBX14D	1F6	0000000000000000
POS1HLDH	152	0000000000000000	MSI1STAT	1D4	0000000000000000	MSI1MBX15D	1F8	0000000000000000
VEL1CNTL	154	0000000000000000	MSI1KEY	1D6	--------00000000	MSI1FIFOCS	1FA	0---00000---0000
VEL1CNTH	156	0000000000000000	MSI1MBXS	1D8	--------00000000	MRSWFDATA	1FC	0000000000000000
VEL1HLDL	158	0000000000000000	MSI1MBX0D	1DA	0000000000000000	MWSRFDATA	1FE	0000000000000000
VEL1HLDH	15A	0000000000000000	MSI1MBX1D	1DC	0000000000000000			
INT1TMRL	15C	0000000000000000	MSI1MBX2D	1DE	0000000000000000			

Legend: x = unknown or indeterminate value; "-" = unimplemented bits. Address and Reset values are in hexadecimal and binary, respectively.

REGISTER 3-15: RCON: RESET CONTROL REGISTER(1) (CONTINUED)

bit 0 **POR:** Power-on Reset Flag bit
1 = A Power-on Reset has occurred
0 = A Power-on Reset has not occurred

Note 1: All of the Reset status bits can be set or cleared in software. Setting one of these bits in software does not cause a device Reset.

3.5 Master Interrupt Controller

Note 1: This data sheet summarizes the features of the dsPIC33CH128MP508 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **"Interrupts"** (DS70000600) in the *"dsPIC33/PIC24 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com).

The dsPIC33CH128MP508 family interrupt controller reduces the numerous peripheral interrupt request signals to a single interrupt request signal to the dsPIC33CH128MP508 family CPU.

The interrupt controller has the following features:

- Six Processor Exceptions and Software Traps
- Seven User-Selectable Priority Levels
- Interrupt Vector Table (IVT) with a Unique Vector for each Interrupt or Exception Source
- Fixed Priority within a Specified User Priority Level
- Fixed Interrupt Entry and Return Latencies
- Alternate Interrupt Vector Table (AIVT) for Debug Support

3.5.1 INTERRUPT VECTOR TABLE

The dsPIC33CH128MP508 family Interrupt Vector Table (IVT), shown in Figure 3-17, resides in program memory, starting at location, 000004h. The IVT contains six non-maskable trap vectors and up to 246 sources of interrupts. In general, each interrupt source has its own vector. Each interrupt vector contains a 24-bit wide address. The value programmed into each interrupt vector location is the starting address of the associated Interrupt Service Routine (ISR).

Interrupt vectors are prioritized in terms of their natural priority. This priority is linked to their position in the vector table. Lower addresses generally have a higher natural priority. For example, the interrupt associated with Vector 0 takes priority over interrupts at any other vector address.

3.5.1.1 Alternate Interrupt Vector Table

The Alternate Interrupt Vector Table (AIVT), shown in Figure 3-18, is available only when the Boot Segment (BS) is defined and the AIVT has been enabled. To enable the Alternate Interrupt Vector Table, the Configuration bit, AIVTDIS in the FSEC register, must be programmed and the AIVTEN bit must be set (INTCON2<8> = 1). When the AIVT is enabled, all interrupt and exception processes use the alternate vectors instead of the default vectors. The AIVT begins at the start of the last page of the Boot Segment, defined by BSLIM<12:0>. The second half of the page is no longer usable space. The Boot Segment must be at least two pages to enable the AIVT.

Note: Although the Boot Segment must be enabled in order to enable the AIVT, application code does not need to be present inside of the Boot Segment. The AIVT (and IVT) will inherit the Boot Segment code protection.

The AIVT supports debugging by providing a means to switch between an application and a support environment without requiring the interrupt vectors to be reprogrammed. This feature also enables switching between applications for evaluation of different software algorithms at run time.

3.5.2 RESET SEQUENCE

A device Reset is not a true exception because the interrupt controller is not involved in the Reset process. The dsPIC33CH128MP508 family devices clear their registers in response to a Reset, which forces the PC to zero. The device then begins program execution at location, 0x000000. A GOTO instruction at the Reset address can redirect program execution to the appropriate start-up routine.

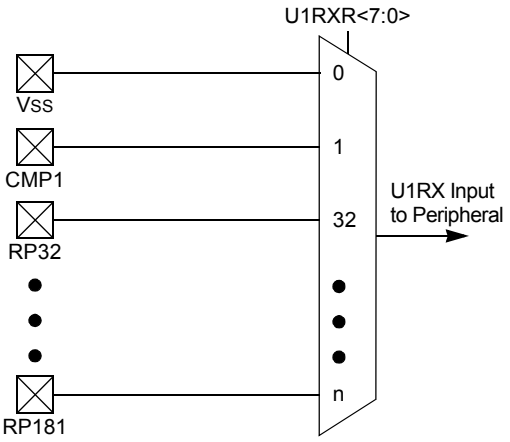
Note: Any unimplemented or unused vector locations in the IVT should be programmed with the address of a default interrupt handler routine that contains a RESET instruction.

TABLE 3-26: MASTER INTERRUPT PRIORITY REGISTERS

Register	Address	Bit 15	Bit14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
IPC0	840h	—	CNBIP2	CNBIP1	CNBIP0	—	CNAIP2	CNAIP1	CNAIP0	—	T1IP2	T1IP1	T1IP0	—	INT0IP2	INT0IP1	INT0IP0
IPC1	842h	—	CCT1IP2	CCT1IP1	CCT1IP0	—	CCP1IP2	CCP1IP1	CCP1IP0	—	—	—	—	—	DMA0IP2	DMA0IP1	DMA0IP0
IPC2	844h	—	U1RXIP2	U1RXIP1	U1RXIP0	—	SPI1TXIP2	SPI1TXIP1	SPI1TXIP0	—	SPI1RXIP2	SPI1RXIP1	SPI1RXIP0	—	DMA1IP2	DMA1IP1	DMA1IP0
IPC3	846h	—	INT1IP2	INT1IP1	INT1IP0	—	NVMIP2	NVMIP1	NVMIP0	—	ECCSBEIP2	ECCSBEIP1	ECCSBEIP0	—	U1TXIP2	U1TXIP1	U1TXIP0
IPC4	848h	—	CNCIP2	CNCIP1	CNCIP0	—	DMA2IP2	DMA2IP1	DMA2IP0	—	MI2C1IP2	MI2C1IP1	MI2C1IP0	—	SI2C1IP2	SI2C1IP1	SI2C1IP0
IPC5	84Ah	—	CCP2IP2	CCP2IP1	CCP2IP0	—	DMA4IP2	DMA4IP1	DMA4IP0	—	DMA3IP2	DMA3IP1	DMA3IP20	—	INT2IP2	INT2IP1	INT2IP0
IPC6	84Ch	—	U2RXIP2	U2RXIP1	U2RXIP0	—	INT3IP2	INT3IP1	INT3IP0	—	CAN1IP2	CAN1IP1	CAN1IP0	—	CCT2IP2	CCT2IP1	CCT2IP0
IPC7	84Eh	—	C1RXIP2	C1RXIP1	C1RXIP0	—	SPI2TXIP2	SPI2TXIP1	SPI2TXIP0	—	SPI2RXIP2	SPI2RXIP1	SPI2RXIP0	—	U2TXIP2	U2TXIP1	U2TXIP0
IPC8	850h	—	CCP3IP2	CCP3IP1	CCP3IP0	—	DMA5IP2	DMA5IP1	DMA5IP0	—	—	—	—	—	—	—	—
IPC9	852h	—	—	—	—	—	MI2C2IP2	MI2C2IP1	MI2C2IP0	—	SI2C2IP2	SI2C2IP1	SI2C2IP0	—	CCT3IP2	CCT3IP1	CCT3IP0
IPC10	854h	—	CCP5IP2	CCP5IP1	CCP5IP0	—	—	—	—	—	CCT4IP2	CCT4IP1	CCT4IP0	—	CCP4IP2	CCP4IP1	CCP4IP0
IPC11	856h	—	CCT6IP2	CCT6IP1	CCT6IP0	—	CCP6IP2	CCP6IP1	CCP6IP0	—	DMTIP2	DMTIP1	DMTIP0	—	CCT5IP2	CCT5IP1	CCT5IP0
IPC12	858h	—	CRCIP2	CRCIP1	CRCIP0	—	U2EIP2	U2EIP1	U2EIP0	—	U1EIP2	U1EIP1	U1EIP0	—	QEI1IP2	QEI1IP1	QEI1IP0
IPC13	85Ah	—	—	—	—	—	—	—	—	—	—	—	—	—	C1TXIP2	C1TXIP1	C1TXIP0
IPC14	85Ch	—	—	—	—	—	—	—	—	—	—	—	—	—			
IPC15	85Eh	—	PTGSTEPIP2	PTGSTEPIP1	PTGSTEPIP0	—	JTAGIP2	JTAGIP1	JTAGIP0	—	ICDIP2	ICDIP1	ICDIP0	—	—	—	—
IPC16	860h	—	PWM1IP2	PWM1IP1	PWM1IP0	—	—	—	—	—	I2C2BCIP2	I2C2BCIP1	I2C2BCIP0	—	I2C1BCIP2	I2C1BCIP1	I2C1BCIP0
IPC17	862h	—	—	—	—	—	PWM4IP2	PWM4IP1	PWM4IP0	—	PWM3IP2	PWM3IP1	PWM3IP0	—	PWM2IP2	PWM2IP1	PWM2IP0
IPC18	864h	—	CNDIP2	CNDIP1	CNDIP0	—	—	—	—	—	—	—	—	—	—	—	—
IPC19	866h	—	—	—	—	—	—	—	—	—	CMP1IP2	CMP1IP1	CMP1IP0	—	CNEIP2	CNEIP1	CNEIP0
IPC20	868h	—	PTG1IP2	PTG1IP1	PTG1IP0	—	PTG0IP2	PTG0IP1	PTG0IP0	—	PTGWDTIP2	PTGWDTIP1	PTGWDTIP0	—	—	—	—
IPC21	86Ah	—	SENT1EIP2	SENT1EIP1	SENT1EIP0	—	SENT1IP2	SENT1IP1	SENT1IP0	—	PTG3IP2	PTG3IP1	PTG3IP0	—	PTG2IP2	PTG2IP1	PTG2IP0
IPC22	86Ch	—	ADCAN0IP2	ADCAN0IP1	ADCAN0IP0	—	ADCIP2	ADCIP1	ADCIP0	—	SENT2EIP2	SENT2EIP1	SENT2EIP0	—	SENT2IP2	SENT2IP1	SENT2IP0
IPC23	86Eh	—	ADCAN4IP2	ADCAN4IP1	ADCAN4IP0	—	ADCAN3IP2	ADCAN3IP1	ADCAN3IP0	—	ADCAN2IP2	ADCAN2IP1	ADCAN2IP0	—	ADCAN1IP2	ADCAN1IP1	ADCAN1IP0
IPC24	870h	—	ADCAN8IP2	ADCAN8IP1	ADCAN8IP0	—	ADCAN7IP2	ADCAN7IP1	ADCAN7IP0	—	ADCAN6IP2	ADCAN6IP1	ADCAN6IP0	—	ADCAN5IP2	ADCAN5IP1	ADCAN5IP0
IPC25	872h	—	ADCAN12IP2	ADCAN12IP1	ADCAN12IP0	—	ADCAN11IP2	ADCAN11IP1	ADCAN11IP0	—	ADCAN10IP2	ADCAN10IP1	ADCAN10IP0	—	ADCAN9IP2	ADCAN9IP1	ADCAN9IP0
IPC26	874h	—	ADCAN16IP2	ADCAN16IP2	ADCAN16IP2	—	ADCAN15IP2	ADCAN15IP1	ADCAN15IP0	—	ADCAN14IP2	ADCAN14IP1	ADCAN14IP0	—	ADCAN13IP2	ADCAN13IP1	ADCAN13IP0
IPC27	876h	—	ADCAN20IP2	ADCAN20IP1	ADCAN20IP0	—	ADCAN19IP2	ADCAN19IP1	ADCAN19IP0	—	ADCAN18IP2	ADCAN18IP1	ADCAN18IP0	—	ADCAN17IP2	ADCAN17IP1	ADCAN17IP0
IPC28	878h	—	ADFLTIP2	ADFLTIP1	ADFLTIP0	—	—	—	—	—	—	—	—	—	—	—	—
IPC29	87Ah	—	ADCMP3IP2	ADCMP3IP1	ADCMP3IP0	—	ADCMP2IP2	ADCMP2IP1	ADCMP2IP0	—	ADCMP1IP2	ADCMP1IP1	ADCMP1IP0	—	ADCMP0IP2	ADCMP0IP1	ADCMP0IP0
IPC30	87Ch	—	ADFLTR3IP2	ADFLTR3IP1	ADFLTR3IP0	—	ADFLTR2IP2	ADFLTR2IP1	ADFLTR2IP0	—	ADFLTR1IP2	ADFLTR1IP1	ADFLTR1IP0	—	ADFLTR0IP2	ADFLTR0IP1	ADFLTR0IP0
IPC31	87Eh	—	SPI2GIP0	SPI2GIP1	SPI2GIP0	—	SPI1GIP2	SPI1GIP1	SPI1GIP0	—	CLC2PIP2	CLC2PIP1	CLC2PIP0	—	CLC1PIP2	CLC1PIP1	CLC1PIP0
IPC32	880h	—	MSIBIP2	MSIBIP1	MSIBIP0	—	MSIAIP2	MSIAIP1	MSIAIP0	—	MSIS1IP2	MSIS1IP1	MSIS1IP0	—	—	—	—
IPC33	882h	—	MSIFIP2	MSIFIP1	MSIFIP0	—	MSIEIP2	MSIEIP1	MSIEIP0	—	MSIDIP2	MSIDIP1	MSIDIP0	—	MSICIP2	MSICIP1	MSICIP0
IPC34	884h	—	MSIWFEIP2	MSIWFEIP1	MSIWFEIP0	—	MSIDTIP2	MSIDTIP1	MSIDTIP0	—	MSIHIP2	MSIHIP1	MSIHIP0	—	MSIGIP2	MSIGIP1	MSIGIP0

Legend: — = Unimplemented.

FIGURE 3-20: REMAPPABLE INPUT FOR U1RX



Note: For input only, Peripheral Pin Select functionality does not have priority over TRISx settings. Therefore, when configuring an RPn pin for input, the corresponding bit in the TRISx register must also be configured for input (set to '1'). Physical connection to a pin can be made through RP32 through RP71. There are internal signals and virtual pins that can be connected to an input. Table 3-30 shows the details of the input assignment.

Example 3-2 provides a configuration for bidirectional communication with flow control using UART1. The following input and output functions are used:

- Input Functions: U1RX, $\overline{\text{U1CTS}}$
- Output Functions: U1TX, $\overline{\text{U1RTS}}$

EXAMPLE 3-2: CONFIGURING UART1 INPUT AND OUTPUT FUNCTIONS

```
//
*****************************************
// Unlock Registers
//*****************************************
__builtin_write_RPCON(0x0000);
//*****************************************
// Configure Input Functions (See Table 3-31)
// Assign U1Rx To Pin RP35
//***************************
_U1RXR = 35;
// Assign U1CTS To Pin RP36
//***************************
_U1CTSR = 36;
//*****************************************
// Configure Output Functions (See Table 3-33)
//*****************************************
// Assign U1Tx To Pin RP37
//***************************
_RP37 = 1;
//***************************
// Assign U1RTS To Pin RP38
//***************************
_RP38 = 2;
//*****************************************
// Lock Registers
//*****************************************
__builtin_write_RPCON(0x0800);
```

REGISTER 3-47: RPINR11: PERIPHERAL PIN SELECT INPUT REGISTER 11

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
OCFBR7	OCFBR6	OCFBR5	OCFBR4	OCFBR3	OCFBR2	OCFBR1	OCFBR0
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
OCFAR7	OCFAR6	OCFAR5	OCFAR4	OCFAR3	OCFAR2	OCFAR1	OCFAR0
bit 7							bit 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

bit 15-8 **OCFBR<7:0>:** Assign SCCP Fault B (OCFB) Input to the Corresponding RPn Pin bits
See Table 3-30.

bit 7-0 **OCFAR<7:0>:** Assign SCCP Fault A (OCFA) Input to the Corresponding RPn Pin bits
See Table 3-30.

REGISTER 3-48: RPINR12: PERIPHERAL PIN SELECT INPUT REGISTER 12

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PCI9R7	PCI9R6	PCI9R5	PCI9R4	PCI9R3	PCI9R2	PCI9R1	PCI9R0
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PCI8R7	PCI8R6	PCI8R5	PCI8R4	PCI8R3	PCI8R2	PCI8R1	PCI8R0
bit 7							bit 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

bit 15-8 **PCI9R<7:0>:** Assign PWM Input 9 (PCI9) to the Corresponding RPn Pin bits
See Table 3-30.

bit 7-0 **PCI8R<7:0>:** Assign PWM Input 8 (PCI8) to the Corresponding RPn Pin bits
See Table 3-30.

REGISTER 3-135: C1FIFOSTAx: CAN FIFO STATUS REGISTER x (x = 1 TO 7) (CONTINUED)

bit 2 **TFERFFIF:** Transmit/Receive FIFO Empty/Full Interrupt Flag bit
TXEN = 1 (FIFO configured as a transmit FIFO):
Transmit FIFO Empty Interrupt Flag
1 = FIFO is empty
0 = FIFO is not empty, at least one message is queued to be transmitted
TXEN = 0 (FIFO configured as a receive FIFO):
Receive FIFO Full Interrupt Flag
1 = FIFO is full
0 = FIFO is not full

bit 1 **TFHRFHIF:** Transmit/Receive FIFO Half Empty/Half Full Interrupt Flag bit
TXEN = 1 (FIFO configured as a transmit FIFO):
Transmit FIFO Half Empty Interrupt Flag
1 = FIFO is ≤ half full
0 = FIFO is > half full
TXEN = 0 (FIFO configured as a receive FIFO):
Receive FIFO Half Full Interrupt Flag
1 = FIFO is ≥ half full
0 = FIFO is < half full

bit 0 **TFNRFNIF:** Transmit/Receive FIFO Not Full/Not Empty Interrupt Flag bit
TXEN = 1 (FIFO configured as a transmit FIFO):
Transmit FIFO Not Full Interrupt Flag
1 = FIFO is not full
0 = FIFO is full
TXEN = 0 (FIFO configured as a receive FIFO):
Receive FIFO Not Empty Interrupt Flag
1 = FIFO is not empty, has at least one message
0 = FIFO is empty

Note 1: FIFOCI<4:0> gives a zero-indexed value to the message in the FIFO. If the FIFO is four messages deep (FSIZE<4:0> = 3), FIFOCIx will take on a value of 0 to 3, depending on the state of the FIFO.
2: These bits are updated when a message completes (or aborts) or when the FIFO is reset.
3: This bit is reset on any read of this register or when the TXQ is reset. The bits are cleared when TXREQ is set or using an SPI write.

REGISTER 3-189: PTGT1LIM: PTG TIMER1 LIMIT REGISTER(1)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGT1LIM<15:8>							
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGT1LIM<7:0>							
bit 7							bit 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

bit 15-0 **PTGT1LIM<15:0>:** PTG Timer1 Limit Register bits
General Purpose Timer1 Limit register.

Note 1: These bits are read-only when the module is executing Step commands.

REGISTER 3-190: PTGSDLIM: PTG STEP DELAY LIMIT REGISTER(1)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGSDLIM<15:8>							
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PTGSDLIM<7:0>							
bit 7							bit 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

bit 15-0 **PTGSDLIM<15:0>:** PTG Step Delay Limit Register bits
This register holds a PTG Step delay value representing the number of additional PTG clocks between the start of a Step command and the completion of a Step command.

Note 1: These bits are read-only when the module is executing Step commands.

REGISTER 4-15: RCON: RESET CONTROL REGISTER(1) (CONTINUED)

bit 0 **POR:** Power-on Reset Flag bit
1 = A Power-on Reset has occurred
0 = A Power-on Reset has not occurred

Note 1: All of the Reset status bits can be set or cleared in software. Setting one of these bits in software does not cause a device Reset.

REGISTER 4-55: RPINR43: PERIPHERAL PIN SELECT INPUT REGISTER 43

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PCI15R7	PCI15R6	PCI15R5	PCI15R4	PCI15R3	PCI15R2	PCI15R1	PCI15R0
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PCI14R7	PCI14R6	PCI14R5	PCI14R4	PCI14R3	PCI14R2	PCI14R1	PCI14R0
bit 7							bit 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

bit 15-8 **PCI15R<7:0>:** Assign PWM Input 15 (S1PCI15) to the Corresponding S1RPn Pin bits
See Table 4-27.

bit 7-0 **PCI14R<7:0>:** Assign PWM Input 14 (S1PCI14) to the Corresponding S1RPn Pin bits
See Table 4-27.

REGISTER 4-56: RPINR44: PERIPHERAL PIN SELECT INPUT REGISTER 44

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
—	—	—	—	—	—	—	—
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
PCI16R7	PCI16R6	PCI16R5	PCI16R4	PCI16R3	PCI16R2	PCI16R1	PCI16R0
bit 7							bit 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

bit 15-8 **Unimplemented:** Read as ‘0’

bit 7-0 **PCI16<7:0>:** Assign PWM Input 16 (S1PCI16) to the Corresponding S1RPn Pin bits
See Table 4-27.

4.7 High-Speed, 12-Bit Analog-to-Digital Converter (Slave ADC)

Note 1: This data sheet summarizes the features of the dsPIC33CH128MP508 family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **"12-Bit High-Speed, Multiple SARs A/D Converter (ADC)**" (DS70005213) in the *"dsPIC33/PIC24 Family Reference Manual"*, which is available from the Microchip web site (www.microchip.com).

2: This section describes the Slave ADC.

dsPIC33CH128MP508S1 devices have a high-speed, 12-bit Analog-to-Digital Converter (ADC) that features a low conversion latency, high resolution and over-sampling capabilities to improve performance in AC/DC, DC/DC power converters. The Slave implements the ADC with three SAR cores, two dedicated and one shared.

4.7.1 SLAVE ADC FEATURES OVERVIEW

The High-Speed, 12-Bit Multiple SARs Analog-to-Digital Converter (ADC) includes the following features:

- Three ADC Cores: Two Dedicated Cores and One Shared (common) Core
- User-Configurable Resolution of up to 12 Bits for each Core
- Up to 3.5 Msps Conversion Rate per Channel at 12-Bit Resolution
- Low-Latency Conversion
- Up to 20 Analog Input Channels, with a Separate 16-Bit Conversion Result Register for each Input
- Conversion Result can be Formatted as Unsigned or Signed Data, on a per Channel Basis, for All Channels
- Simultaneous Sampling of up to Three Analog Inputs
- Channel Scan Capability
- Multiple Conversion Trigger Options for each Core, including:
  - PWM triggers from Master and Slave CPU cores
  - SCCP modules triggers
  - CLC modules triggers
  - External pin trigger event (ADTRG31)
  - Software trigger
- Four Integrated Digital Comparators with Dedicated Interrupts:
  - Multiple comparison options
  - Assignable to specific analog inputs
- Four Oversampling Filters with Dedicated Interrupts:
  - Provide increased resolution
  - Assignable to a specific analog input
- CVD Hardware for Capacitive Touch and Capacitance Measurement Applications

The module consists of three independent SAR ADC cores. Simplified block diagrams of the Multiple SARs 12-Bit ADC are shown in Figure 4-20 and Figure 4-21.

The analog inputs (channels) are connected through multiplexers and switches to the Sample-and-Hold (S&H) circuit of each ADC core. The core uses the channel information (the output format, the Measurement mode and the input number) to process the analog sample. When conversion is complete, the result is stored in the result buffer for the specific analog input, and passed to the digital filter and digital comparator if they were configured to use data from this particular channel.

The ADC module can sample up to three inputs at a time (two inputs from the dedicated SAR cores and one from the shared SAR core). If multiple ADC inputs request conversion on the shared core, the module will convert them in a sequential manner, starting with the lowest order input.

The ADC provides each analog input the ability to specify its own trigger source. This capability allows the ADC to sample and convert analog inputs that are associated with PWM generators operating on independent time bases.

REGISTER 4-86: ADCON2H: ADC CONTROL REGISTER 2 HIGH

HSC/R-0	HSC/R-0	U-0	r-0	r-0	r-0	R/W-0	R/W-0
REFRDY	REFERR	—	r	r	r	SHRSAMC9	SHRSAMC8
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
SHRSAMC7	SHRSAMC6	SHRSAMC5	SHRSAMC4	SHRSAMC3	SHRSAMC2	SHRSAMC1	SHRSAMC0
bit 7							bit 0

Legend:	r = Reserved bit	U = Unimplemented bit, read as ‘0’	
R = Readable bit	W = Writable bit	HSC = Hardware Settable/Clearable bit	
-n = Value at POR	‘1’ = Bit is set	‘0’ = Bit is cleared	x = Bit is unknown

bit 15 **REFRDY:** Band Gap and Reference Voltage Ready Flag bit
1 = Band gap is ready
0 = Band gap is not ready

bit 14 **REFERR:** Band Gap or Reference Voltage Error Flag bit
1 = Band gap was removed after the ADC module was enabled (ADON = 1)
0 = No band gap error was detected

bit 13 **Unimplemented:** Read as ‘0’

bit 12-10 **Reserved:** Maintain as ‘0’

bit 9-0 **SHRSAMC<9:0>:** Shared ADC Core Sample Time Selection bits
These bits specify the number of shared ADC Core Clock Periods (TADCORE) for the shared ADC core sample time.
1111111111 = 1025 TADCORE
...
0000000001 = 3 TADCORE
0000000000 = 2 TADCORE

REGISTER 6-2: CLKDIV: CLOCK DIVIDER REGISTER (MASTER) (CONTINUED)

bit 3-0 **PLLPRE<3:0>:** PLL Phase Detector Input Divider Select bits (also denoted as 'N1', PLL prescaler)(4)
11111 = Reserved
...
1001 = Reserved
1000 = Input divided by 8
0111 = Input divided by 7
0110 = Input divided by 6
0101 = Input divided by 5
0100 = Input divided by 4
0011 = Input divided by 3
0010 = Input divided by 2
0001 = Input divided by 1 (power-on default selection)
0000 = Reserved

Note 1: The DOZE<2:0> bits can only be written to when the DOZEN bit is clear. If DOZEN = 1, any writes to DOZE<2:0> are ignored.

2: This bit is cleared when the ROI bit is set and an interrupt occurs.

3: The DOZEN bit cannot be set if DOZE<2:0> = 000. If DOZE<2:0> = 000, any attempt by user software to set the DOZEN bit is ignored.

4: PLLPRE<3:0> may be updated while the PLL is operating, but the VCO may overshoot.

REGISTER 7-3: PMD2: MASTER PERIPHERAL MODULE DISABLE 2 CONTROL REGISTER HIGH

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-0
—	—	—	—	—	—	—	—
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
CCP8MD	CCP7MD	CCP6MD	CCP5MD	CCP4MD	CCP3MD	CCP2MD	CCP1MD
bit 7							bit 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

bit 15-8 **Unimplemented:** Read as ‘0’

bit 7 **CCP8MD:** SCCP8 Module Disable bit
1 = SCCP8 module is disabled
0 = SCCP8 module is enabled

bit 6 **CCP7MD:** SCCP7 Module Disable bit
1 = SCCP7 module is disabled
0 = SCCP7 module is enabled

bit 5 **CCP6MD:** SCCP6 Module Disable bit
1 = SCCP6 module is disabled
0 = SCCP6 module is enabled

bit 4 **CCP5MD:** SCCP5 Module Disable bit
1 = SCCP5 module is disabled
0 = SCCP5 module is enabled

bit 3 **CCP4MD:** SCCP4 Module Disable bit
1 = SCCP4 module is disabled
0 = SCCP4 module is enabled

bit 2 **CCP3MD:** SCCP3 Module Disable bit
1 = SCCP3 module is disabled
0 = SCCP3 module is enabled

bit 1 **CCP2MD:** SCCP2 Module Disable bit
1 = SCCP2 module is disabled
0 = SCCP2 module is enabled

bit 0 **CCP1MD:** SCCP1 Module Disable bit
1 = SCCP1 module is disabled
0 = SCCP1 module is enabled

REGISTER 9-10: PWMEVTy: PWM EVENT OUTPUT CONTROL REGISTER y(5) (CONTINUED)

bit 2-0 **EVTyPGS<2:0>:** PWM Event Source Selection bits(2)

111 = PG8
110 = PG7
101 = PG6
100 = PG5
011 = PG4
010 = PG3
001 = PG2
000 = PG1

Note 1: The event signal is stretched using the peripheral clock because different PGs may be operating from different clock sources. The leading edge of the event pulse is produced in the clock domain of the PWM Generator. The trailing edge of the stretched event pulse is produced in the peripheral clock domain.

2: No event will be produced if the selected PWM Generator is not present.

3: This is the PWM Generator output signal prior to output mode logic and any output override logic.

4: This signal should be the PGx_clk domain signal prior to any synchronization into the system clock domain.

5: 'y' denotes a common instance (A-F).

REGISTER 9-19: PGxEVTL: PWM GENERATOR x EVENT REGISTER LOW

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
ADTR1PS4	ADTR1PS3	ADTR1PS2	ADTR1PS1	ADTR1PS0	ADTR1EN3	ADTR1EN2	ADTR1EN1
bit 15							bit 8

U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	UPDTRG1	UPDTRG0	PGTRGSEL2(1)	PGTRGSEL1(1)	PGTRGSEL0(1)
bit 7							bit 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

bit 15-11 **ADTR1PS<4:0>:** ADC Trigger 1 Postscaler Selection bits
11111 = 1:32
...
00010 = 1:3
00001 = 1:2
00000 = 1:1

bit 10 **ADTR1EN3:** ADC Trigger 1 Source is PGxTRIGC Compare Event Enable bit
1 = PGxTRIGC register compare event is enabled as trigger source for ADC Trigger 1
0 = PGxTRIGC register compare event is disabled as trigger source for ADC Trigger 1

bit 9 **ADTR1EN2:** ADC Trigger 1 Source is PGxTRIGB Compare Event Enable bit
1 = PGxTRIGB register compare event is enabled as trigger source for ADC Trigger 1
0 = PGxTRIGB register compare event is disabled as trigger source for ADC Trigger 1

bit 8 **ADTR1EN1:** ADC Trigger 1 Source is PGxTRIGA Compare Event Enable bit
1 = PGxTRIGA register compare event is enabled as trigger source for ADC Trigger 1
0 = PGxTRIGA register compare event is disabled as trigger source for ADC Trigger 1

bit 7-5 **Unimplemented:** Read as '0'

bit 4-3 **UPDTRG<1:0>:** Update Trigger Select bits
11 = A write of the PGxTRIGA register automatically sets the UPDATE bit
10 = A write of the PGxPHASE register automatically sets the UPDATE bit
01 = A write of the PGxDC register automatically sets the UPDATE bit
00 = User must set the UPDATE bit (PGxSTAT<4>) manually

bit 2-0 **PGTRGSEL<2:0>:** PWM Generator Trigger Output Selection bits(1)
111 = Reserved
110 = Reserved
101 = Reserved
100 = Reserved
011 = PGxTRIGC compare event is the PWM Generator trigger
010 = PGxTRIGB compare event is the PWM Generator trigger
001 = PGxTRIGA compare event is the PWM Generator trigger
000 = EOC event is the PWM Generator trigger

Note 1: These events are derived from the internal PWM Generator time base comparison events.

Table 12-2 shows the truth table that describes how the Quadrature signals are decoded.

TABLE 12-2: TRUTH TABLE FOR QUADRATURE ENCODER

Current Quadrature State		Previous Quadrature State		Action
QA	QB	QA	QB	
1	1	1	1	No count or direction change
1	1	1	0	Count up
1	1	0	1	Count down
1	1	0	0	Invalid state change; ignore
1	0	1	1	Count down
1	0	1	0	No count or direction change
1	0	0	1	Invalid state change; ignore
1	0	0	0	Count up
0	1	1	1	Count up
0	1	1	0	Invalid state change; ignore
0	1	0	1	No count or direction change
0	1	0	0	Count down
0	0	1	1	Invalid state change; ignore
0	0	1	0	Count down
0	0	0	1	Count up
0	0	0	0	No count or direction change

Figure 12-2 illustrates the simplified block diagram of the QEI module. The QEI module consists of decoder logic to interpret the Phase A (QEAx) and Phase B (QEBx) signals, and an up/down counter to accumulate the count. The counter pulses are generated when the Quadrature state changes. The count direction information must be maintained in a register until a direction change is detected. The module also includes digital noise filters, which condition the input signal.

The QEI module consists of the following major features:

- Four Input Pins: Two Phase Signals, an Index Pulse and a Home Pulse
- Programmable Digital Noise Filters on Inputs
- Quadrature Decoder providing Counter Pulses and Count Direction
- Count Direction Status
- 4x Count Resolution
- Index (INDXx) Pulse to Reset the Position Counter
- General Purpose 32-Bit Timer/Counter mode
- Interrupts generated by QEI or Counter Events
- 32-Bit Velocity Counter
- 32-Bit Position Counter
- 32-Bit Index Pulse Counter
- 32-Bit Interval Timer
- 32-Bit Position Initialization/Capture Register
- 32-Bit Compare Less Than and Greater Than Registers
- External Up/Down Count mode
- External Gated Count mode
- External Gated Timer mode
- Interval Timer mode

NOTES:

REGISTER 14-7: SPIxIMSKH: SPIx INTERRUPT MASK REGISTER HIGH

R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
RXWIEN	—	RXMSK5(1)	RXMSK4(1,4)	RXMSK3(1,3)	RXMSK2(1,2)	RXMSK1(1)	RXMSK0(1)
bit 15							bit 8

R/W-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
TXWIEN	—	TXMSK5(1)	TXMSK4(1,4)	TXMSK3(1,3)	TXMSK2(1,2)	TXMSK1(1)	TXMSK0(1)
bit 7							bit 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

bit 15 **RXWIEN:** Receive Watermark Interrupt Enable bit
1 = Triggers receive buffer element watermark interrupt when RXMSK<5:0> ≤ RXELM<5:0>
0 = Disables receive buffer element watermark interrupt

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

bit 13-8 **RXMSK<5:0>:** RX Buffer Mask bits(1,2,3,4)
RX mask bits; used in conjunction with the RXWIEN bit.

bit 7 **TXWIEN:** Transmit Watermark Interrupt Enable bit
1 = Triggers transmit buffer element watermark interrupt when TXMSK<5:0> = TXELM<5:0>
0 = Disables transmit buffer element watermark interrupt

bit 6 **Unimplemented:** Read as '0'

bit 5-0 **TXMSK<5:0>:** TX Buffer Mask bits(1,2,3,4)
TX mask bits; used in conjunction with the TXWIEN bit.

Note 1: Mask values higher than FIFODEPTH are not valid. The module will not trigger a match for any value in this case.
2: RXMSK2 and TXMSK2 bits are only present when FIFODEPTH = 8 or higher.
3: RXMSK3 and TXMSK3 bits are only present when FIFODEPTH = 16 or higher.
4: RXMSK4 and TXMSK4 bits are only present when FIFODEPTH = 32.

TABLE 24-6: DC CHARACTERISTICS: OPERATING CURRENT (IDD) (MASTER SLEEP/SLAVE RUN)

DC CHARACTERISTICS	Master (Sleep) + Slave (Run)		Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended			
Parameter No.	**Typ.**	**Max.**	**Units**	**Conditions**		
Operating Current (IDD)(1)						
DC20a	7.2	9.0	mA	-40°C	3.3V	10 MIPS (N = 1, N2 = 5, N3 = 2, M = 50, FVCO = 400 MHz, FPLLO = 40 MHz)
	7.3	12.6	mA	+25°C		
	7.6	18.9	mA	+85°C		
	11.6	25.6	mA	+125°C		
DC21a	9.0	10.9	mA	-40°C	3.3V	20 MIPS (N = 1, N2 = 5, N3 = 1, M = 50, FVCO = 400 MHz, FPLLO = 80 MHz)
	9.2	14.6	mA	+25°C		
	9.4	20.8	mA	+85°C		
	13.4	27.5	mA	+125°C		
DC22a	13.1	15.2	mA	-40°C	3.3V	40 MIPS (N = 1, N2 = 3, N3 = 1, M = 60, FVCO = 480 MHz, FPLLO = 160 MHz)
	13.2	19.0	mA	+25°C		
	13.4	25.1	mA	+85°C		
	17.3	31.5	mA	+125°C		
DC23a	18.6	21.2	mA	-40°C	3.3V	70 MIPS (N = 1, N2 = 2, N3 = 1, M = 70, FVCO = 560 MHz, FPLLO = 280 MHz)
	18.8	25.0	mA	+25°C		
	18.8	31.1	mA	+85°C		
	22.8	37.0	mA	+125°C		
DC24a	23.0	26.1	mA	-40°C	3.3V	90 MIPS (N = 1, N2 = 2, N3 = 1, M = 90, FVCO = 720 MHz, FPLLO = 360 MHz)
	23.2	30.0	mA	+25°C		
	23.2	35.8	mA	+85°C		
	27.1	41.4	mA	+125°C		
DC25a	23.5	26.6	mA	-40°C	3.3V	100 MIPS (N = 1, N2 = 1, N3 = 1, M = 50, FVCO = 400 MHz, FPLLO = 400 MHz)
	23.7	30.4	mA	+25°C		
	23.7	36.4	mA	+85°C		
	27.6	41.9	mA	+125°C		

Note 1: IDD is primarily a function of the operating voltage and frequency. Other factors, such as I/O pin loading and switching rate, oscillator type, internal code execution pattern and temperature, also have an impact on the current consumption. The test conditions for all IDD measurements are as follows:

- Oscillator is switched to EC+PLL mode in software
- CLKO is configured as an I/O input pin in the Configuration Word
- All I/O pins are configured as output low
- $\overline{MCLR}$ = VDD, WDT and FSCM are disabled
- CPU, SRAM, program memory and data memory are operational
- No peripheral modules are operating or being clocked (all defined PMDx bits are set)
- CPU is executing `while(1)` statement
- JTAG is disabled