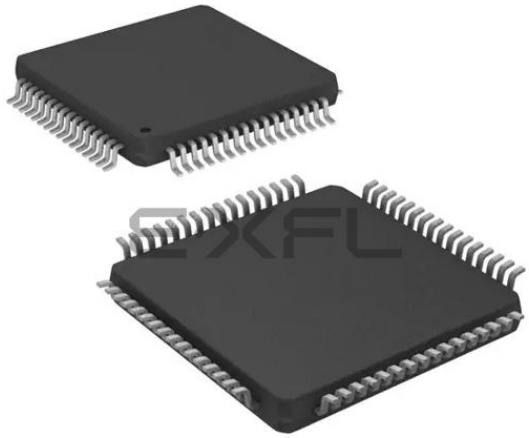
Microchip Technology - DSPIC33EP128MC506-H/PT Datasheet



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"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

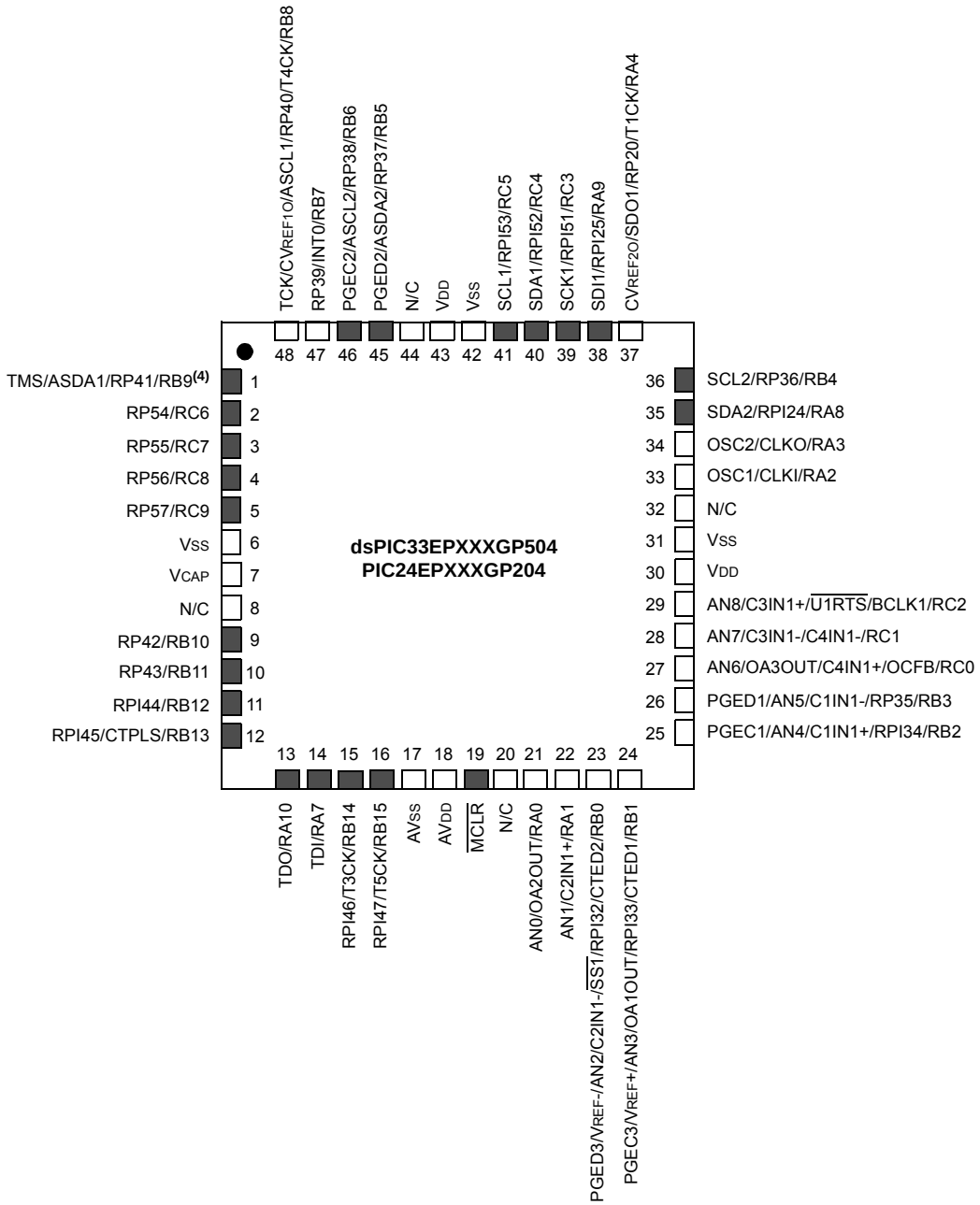
Applications of "Embedded - Microcontrollers"

Details	
Product Status	Obsolete
Core Processor	dsPIC
Core Size	16-Bit
Speed	60 MIPs
Connectivity	CANbus, I²C, IrDA, LINbus, QEI, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, DMA, Motor Control PWM, POR, PWM, WDT
Number of I/O	53
Program Memory Size	128KB (43K x 24)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	8K x 16
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 16x10b/12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 150°C (TA)
Mounting Type	Surface Mount
Package / Case	64-TQFP
Supplier Device Package	64-TQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33ep128mc506-h-pt

Pin Diagrams (Continued)

48-Pin UQFN(1,2,3)

■ = Pins are up to 5V tolerant



Note 1: The RPn/RPIn pins can be used by any remappable peripheral with some limitation. See **Section 11.4 "Peripheral Pin Select (PPS)"** for available peripherals and for information on limitations.

2: Every I/O port pin (RAx-RGx) can be used as a Change Notification pin (CNAx-CNGx). See **Section 11.0 "I/O Ports"** for more information.

3: The metal pad at the bottom of the device is not connected to any pins and is recommended to be connected to VSS externally.

4: There is an internal pull-up resistor connected to the TMS pin when the JTAG interface is active. See the JTAGEN bit field in Table 27-2.

REGISTER 3-2: CORCON: CORE CONTROL REGISTER

R/W-0	U-0	R/W-0	R/W-0	R/W-0	R-0	R-0	R-0
VAR	—	US1(1)	US0(1)	EDT(1,2)	DL2(1)	DL1(1)	DL0(1)
bit 15							bit 8

R/W-0	R/W-0	R/W-1	R/W-0	R/C-0	R-0	R/W-0	R/W-0
SATA(1)	SATB(1)	SATDW(1)	ACCSAT(1)	IPL3(3)	SFA	RND(1)	IF(1)
bit 7							bit 0

Legend:	C = Clearable bit		
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 **VAR:** Variable Exception Processing Latency Control bit
1 = Variable exception processing latency is enabled
0 = Fixed exception processing latency is enabled

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

bit 13-12 **US<1:0>:** DSP Multiply Unsigned/Signed Control bits(1)
11 = Reserved
10 = DSP engine multiplies are mixed-sign
01 = DSP engine multiplies are unsigned
00 = DSP engine multiplies are signed

bit 11 **EDT:** Early DO Loop Termination Control bit(1,2)
1 = Terminates executing DO loop at end of current loop iteration
0 = No effect

bit 10-8 **DL<2:0>:** DO Loop Nesting Level Status bits(1)
111 = 7 DO loops are active
•
•
•
001 = 1 DO loop is active
000 = 0 DO loops are active

bit 7 **SATA:** ACCA Saturation Enable bit(1)
1 = Accumulator A saturation is enabled
0 = Accumulator A saturation is disabled

bit 6 **SATB:** ACCB Saturation Enable bit(1)
1 = Accumulator B saturation is enabled
0 = Accumulator B saturation is disabled

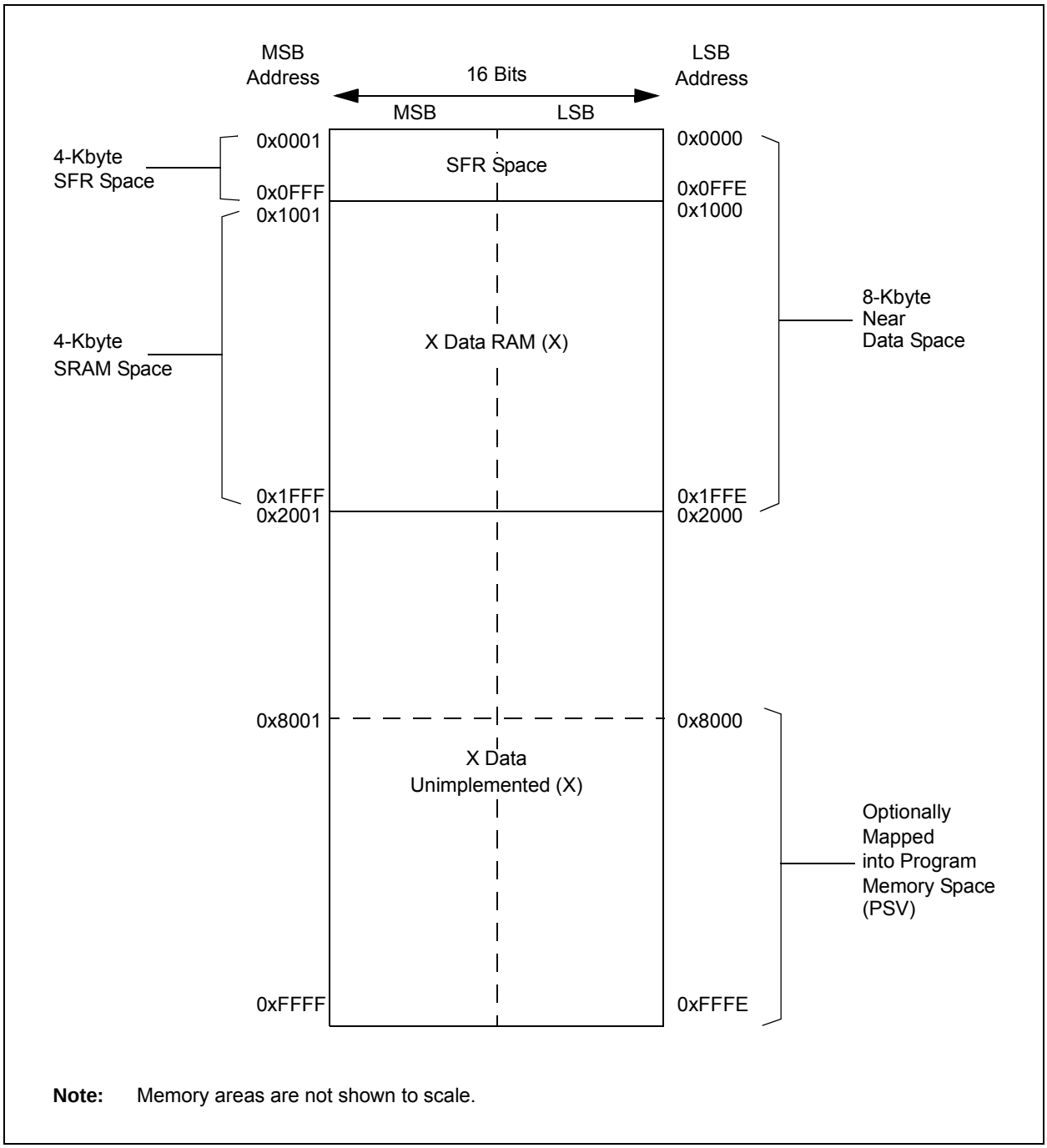
bit 5 **SATDW:** Data Space Write from DSP Engine Saturation Enable bit(1)
1 = Data Space write saturation is enabled
0 = Data Space write saturation is disabled

bit 4 **ACCSAT:** Accumulator Saturation Mode Select bit(1)
1 = 9.31 saturation (super saturation)
0 = 1.31 saturation (normal saturation)

bit 3 **IPL3:** CPU Interrupt Priority Level Status bit 3(3)
1 = CPU Interrupt Priority Level is greater than 7
0 = CPU Interrupt Priority Level is 7 or less

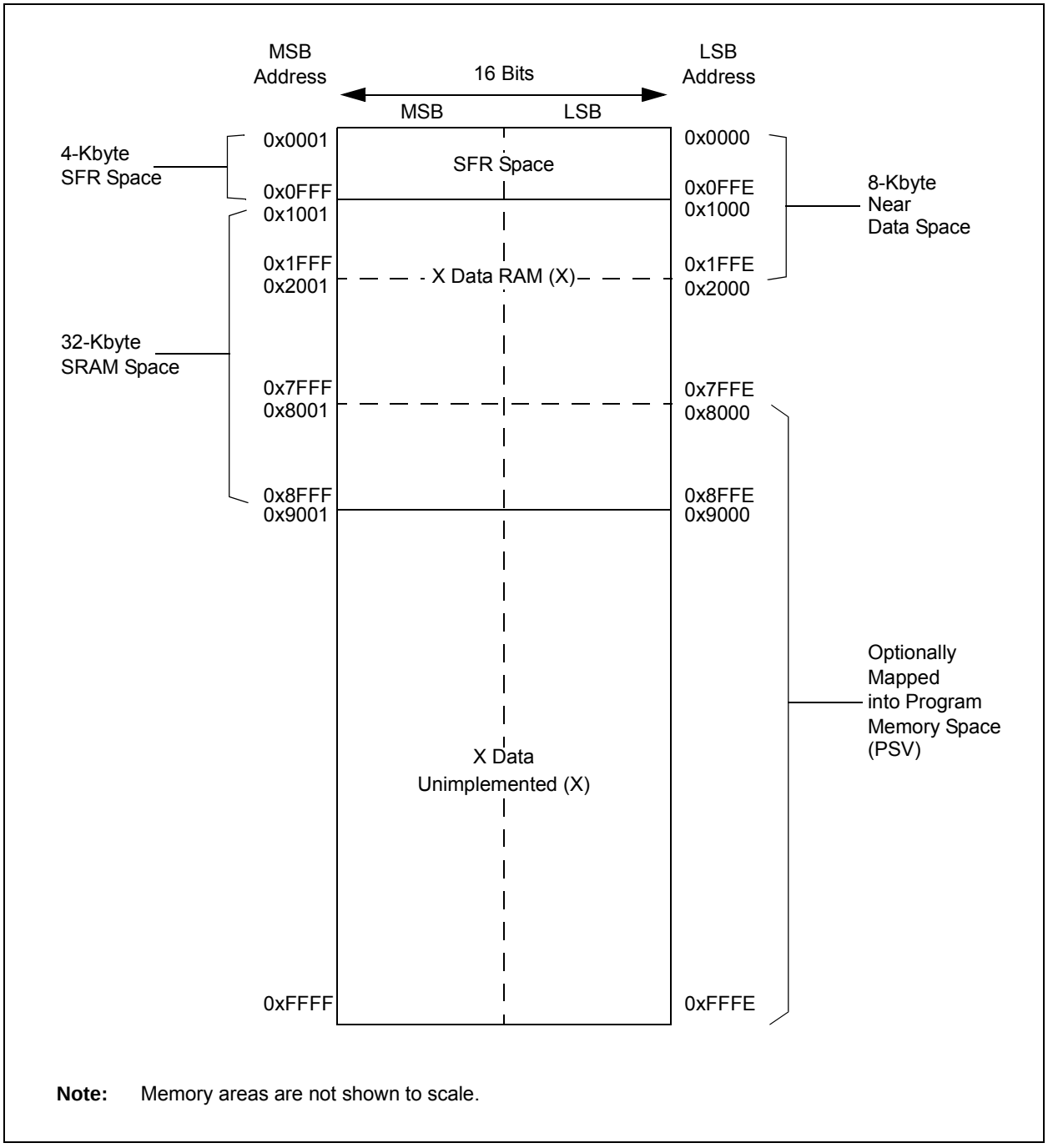
Note 1: This bit is available on dsPIC33EPXXXMC20X/50X and dsPIC33EPXXXGP50X devices only.
2: This bit is always read as '0'.
3: The IPL3 bit is concatenated with the IPL<2:0> bits (SR<7:5>) to form the CPU Interrupt Priority Level.

FIGURE 4-12: DATA MEMORY MAP FOR PIC24EP32GP/MC20X/50X DEVICES



Note: Memory areas are not shown to scale.

FIGURE 4-15: DATA MEMORY MAP FOR PIC24EP256GP/MC20X/50X DEVICES



Note: Memory areas are not shown to scale.

TABLE 4-27: PERIPHERAL PIN SELECT OUTPUT REGISTER MAP FOR dsPIC33EPXXXGP/MC204/504 AND PIC24EPXXXGP/MC204 DEVICES ONLY

File Name	Addr.	Bit 15	Bit 14	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	All Resets
RPOR0	0680	—	—	RP35R<5:0>						—	—	RP20R<5:0>						0000
RPOR1	0682	—	—	RP37R<5:0>						—	—	RP36R<5:0>						0000
RPOR2	0684	—	—	RP39R<5:0>						—	—	RP38R<5:0>						0000
RPOR3	0686	—	—	RP41R<5:0>						—	—	RP40R<5:0>						0000
RPOR4	0688	—	—	RP43R<5:0>						—	—	RP42R<5:0>						0000
RPOR5	068A	—	—	RP55R<5:0>						—	—	RP54R<5:0>						0000
RPOR6	068C	—	—	RP57R<5:0>						—	—	RP56R<5:0>						0000

Legend: — = unimplemented, read as '0'. Reset values are shown in hexadecimal.

TABLE 4-28: PERIPHERAL PIN SELECT OUTPUT REGISTER MAP FOR dsPIC33EPXXXGP/MC206/506 AND PIC24EPXXXGP/MC206 DEVICES ONLY

File Name	Addr.	Bit 15	Bit 14	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	All Resets
RPOR0	0680	—	—	RP35R<5:0>						—	—	RP20R<5:0>						0000
RPOR1	0682	—	—	RP37R<5:0>						—	—	RP36R<5:0>						0000
RPOR2	0684	—	—	RP39R<5:0>						—	—	RP38R<5:0>						0000
RPOR3	0686	—	—	RP41R<5:0>						—	—	RP40R<5:0>						0000
RPOR4	0688	—	—	RP43R<5:0>						—	—	RP42R<5:0>						0000
RPOR5	068A	—	—	RP55R<5:0>						—	—	RP54R<5:0>						0000
RPOR6	068C	—	—	RP57R<5:0>						—	—	RP56R<5:0>						0000
RPOR7	068E	—	—	RP97R<5:0>						—	—	—	—	—	—	—	—	0000
RPOR8	0690	—	—	RP118R<5:0>						—	—	—	—	—	—	—	—	0000
RPOR9	0692	—	—	—	—	—	—	—	—	—	—	RP120R<5:0>						0000

Legend: — = unimplemented, read as '0'. Reset values are shown in hexadecimal.

TABLE 4-33: PERIPHERAL PIN SELECT INPUT REGISTER MAP FOR dsPIC33EPXXXMC20X DEVICES ONLY

File Name	Addr.	Bit 15	Bit 14	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	All Resets
RPINR0	06A0	—	INT1R<6:0>							—	—	—	—	—	—	—	—	0000
RPINR1	06A2	—	—	—	—	—	—	—	—	—	INT2R<6:0>							0000
RPINR3	06A6	—	—	—	—	—	—	—	—	—	T2CKR<6:0>							0000
RPINR7	06AE	—	IC2R<6:0>							—	IC1R<6:0>							0000
RPINR8	06B0	—	IC4R<6:0>							—	IC3R<6:0>							0000
RPINR11	06B6	—	—	—	—	—	—	—	—	—	OCFAR<6:0>							0000
RPINR12	06B8	—	FLT2R<6:0>							—	FLT1R<6:0>							0000
RPINR14	06BC	—	QEB1R<6:0>							—	QEA1R<6:0>							0000
RPINR15	06BE	—	HOME1R<6:0>							—	INDX1R<6:0>							0000
RPINR18	06C4	—	—	—	—	—	—	—	—	—	U1RXR<6:0>							0000
RPINR19	06C6	—	—	—	—	—	—	—	—	—	U2RXR<6:0>							0000
RPINR22	06CC	—	SCK2INR<6:0>							—	SDI2R<6:0>							0000
RPINR23	06CE	—	—	—	—	—	—	—	—	—	SS2R<6:0>							0000
RPINR37	06EA	—	SYNCI1R<6:0>							—	—	—	—	—	—	—	—	0000
RPINR38	06EC	—	DTCMP1R<6:0>							—	—	—	—	—	—	—	—	0000
RPINR39	06EE	—	DTCMP3R<6:0>							—	DTCMP2R<6:0>							0000

Legend: — = unimplemented, read as '0'. Reset values are shown in hexadecimal.

REGISTER 7-3: INTCON1: INTERRUPT CONTROL 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
NSTDIS	OVAERR(1)	OVBERR(1)	COVAERR(1)	COVBERR(1)	OVATE(1)	OVBTE(1)	COVTE(1)
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	U-0
SFTACERR(1)	DIV0ERR	DMACERR	MATHERR	ADDRERR	STKERR	OSCFAIL	—
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 **NSTDIS:** Interrupt Nesting Disable bit
1 = Interrupt nesting is disabled
0 = Interrupt nesting is enabled

bit 14 **OVAERR:** Accumulator A Overflow Trap Flag bit(1)
1 = Trap was caused by overflow of Accumulator A
0 = Trap was not caused by overflow of Accumulator A

bit 13 **OVBERR:** Accumulator B Overflow Trap Flag bit(1)
1 = Trap was caused by overflow of Accumulator B
0 = Trap was not caused by overflow of Accumulator B

bit 12 **COVAERR:** Accumulator A Catastrophic Overflow Trap Flag bit(1)
1 = Trap was caused by catastrophic overflow of Accumulator A
0 = Trap was not caused by catastrophic overflow of Accumulator A

bit 11 **COVBERR:** Accumulator B Catastrophic Overflow Trap Flag bit(1)
1 = Trap was caused by catastrophic overflow of Accumulator B
0 = Trap was not caused by catastrophic overflow of Accumulator B

bit 10 **OVATE:** Accumulator A Overflow Trap Enable bit(1)
1 = Trap overflow of Accumulator A
0 = Trap is disabled

bit 9 **OVBTE:** Accumulator B Overflow Trap Enable bit(1)
1 = Trap overflow of Accumulator B
0 = Trap is disabled

bit 8 **COVTE:** Catastrophic Overflow Trap Enable bit(1)
1 = Trap on catastrophic overflow of Accumulator A or B is enabled
0 = Trap is disabled

bit 7 **SFTACERR:** Shift Accumulator Error Status bit(1)
1 = Math error trap was caused by an invalid accumulator shift
0 = Math error trap was not caused by an invalid accumulator shift

bit 6 **DIV0ERR:** Divide-by-Zero Error Status bit
1 = Math error trap was caused by a divide-by-zero
0 = Math error trap was not caused by a divide-by-zero

bit 5 **DMACERR:** DMAC Trap Flag bit
1 = DMAC trap has occurred
0 = DMAC trap has not occurred

Note 1: These bits are available on dsPIC33EPXXXMC20X/50X and dsPIC33EPXXXGP50X devices only.

REGISTER 11-15: RPINR37: PERIPHERAL PIN SELECT INPUT REGISTER 37 (dsPIC33EPXXXMC20X/50X AND PIC24EPXXXMC20X DEVICES ONLY)

U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	SYNCI1R<6:0>						
bit 15							bit 8

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-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 **Unimplemented:** Read as '0'

bit 14-8 **SYNCI1R<6:0>:** Assign PWM Synchronization Input 1 to the Corresponding RPn Pin bits (see Table 11-2 for input pin selection numbers)

1111001 = Input tied to RPI121
.
.
.
0000001 = Input tied to CMP1
0000000 = Input tied to Vss

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

REGISTER 11-22: RPOR4: PERIPHERAL PIN SELECT OUTPUT REGISTER 4

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP43R<5:0>					
bit 15							bit 8

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP42R<5:0>					
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 15-14 **Unimplemented:** Read as ‘0’

bit 13-8 **RP43R<5:0>:** Peripheral Output Function is Assigned to RP43 Output Pin bits (see Table 11-3 for peripheral function numbers)

bit 7-6 **Unimplemented:** Read as ‘0’

bit 5-0 **RP42R<5:0>:** Peripheral Output Function is Assigned to RP42 Output Pin bits (see Table 11-3 for peripheral function numbers)

REGISTER 11-23: RPOR5: PERIPHERAL PIN SELECT OUTPUT REGISTER 5

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP55R<5:0>					
bit 15							bit 8

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP54R<5:0>					
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 15-14 **Unimplemented:** Read as ‘0’

bit 13-8 **RP55R<5:0>:** Peripheral Output Function is Assigned to RP55 Output Pin bits (see Table 11-3 for peripheral function numbers)

bit 7-6 **Unimplemented:** Read as ‘0’

bit 5-0 **RP54R<5:0>:** Peripheral Output Function is Assigned to RP54 Output Pin bits (see Table 11-3 for peripheral function numbers)

REGISTER 18-1: SPIxSTAT: SPIx STATUS AND CONTROL REGISTER (CONTINUED)

bit 1 **SPITBF:** SPIx Transmit Buffer Full Status bit

1 = Transmit not yet started, SPIxTXB is full
0 = Transmit started, SPIxTXB is empty

Standard Buffer mode:
Automatically set in hardware when core writes to the SPIxBUF location, loading SPIxTXB. Automatically cleared in hardware when SPIx module transfers data from SPIxTXB to SPIxSR.

Enhanced Buffer mode:
Automatically set in hardware when the CPU writes to the SPIxBUF location, loading the last available buffer location. Automatically cleared in hardware when a buffer location is available for a CPU write operation.

bit 0 **SPIRBF:** SPIx Receive Buffer Full Status bit

1 = Receive is complete, SPIxRXB is full
0 = Receive is incomplete, SPIxRXB is empty

Standard Buffer mode:
Automatically set in hardware when SPIx transfers data from SPIxSR to SPIxRXB. Automatically cleared in hardware when the core reads the SPIxBUF location, reading SPIxRXB.

Enhanced Buffer mode:
Automatically set in hardware when SPIx transfers data from SPIxSR to the buffer, filling the last unread buffer location. Automatically cleared in hardware when a buffer location is available for a transfer from SPIxSR.

REGISTER 21-6: CxINTF: ECANx INTERRUPT FLAG REGISTER (CONTINUED)

bit 1 **RBIF:** RX Buffer Interrupt Flag bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

bit 0 **TBIF:** TX Buffer Interrupt Flag bit
1 = Interrupt request has occurred
0 = Interrupt request has not occurred

REGISTER 21-11: CxFEN1: ECANx ACCEPTANCE FILTER ENABLE REGISTER 1

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
FLTEN15	FLTEN14	FLTEN13	FLTEN12	FLTEN11	FLTEN10	FLTEN9	FLTEN8
bit 15							bit 8

R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1	R/W-1
FLTEN7	FLTEN6	FLTEN5	FLTEN4	FLTEN3	FLTEN2	FLTEN1	FLTEN0
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 **FLTEN<15:0>:** Enable Filter n to Accept Messages bits
1 = Enables Filter n
0 = Disables Filter n

REGISTER 21-12: CxBUFPNT1: ECANx FILTER 0-3 BUFFER POINTER 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
F3BP<3:0>				F2BP<3:0>			
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
F1BP<3:0>				F0BP<3:0>			
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 15-12 **F3BP<3:0>:** RX Buffer Mask for Filter 3 bits
1111 = Filter hits received in RX FIFO buffer
1110 = Filter hits received in RX Buffer 14
•
•
•
0001 = Filter hits received in RX Buffer 1
0000 = Filter hits received in RX Buffer 0

bit 11-8 **F2BP<3:0>:** RX Buffer Mask for Filter 2 bits (same values as bits<15:12>)

bit 7-4 **F1BP<3:0>:** RX Buffer Mask for Filter 1 bits (same values as bits<15:12>)

bit 3-0 **F0BP<3:0>:** RX Buffer Mask for Filter 0 bits (same values as bits<15:12>)

BUFFER 21-5: ECAN™ MESSAGE BUFFER WORD 4

R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
Byte 3							
bit 15							bit 8

R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
Byte 2							
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 **Byte 3<15:8>:** ECAN Message Byte 3 bits

bit 7-0 **Byte 2<7:0>:** ECAN Message Byte 2 bits

BUFFER 21-6: ECAN™ MESSAGE BUFFER WORD 5

R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
Byte 5							
bit 15							bit 8

R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x	R/W-x
Byte 4							
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 **Byte 5<15:8>:** ECAN Message Byte 5 bits

bit 7-0 **Byte 4<7:0>:** ECAN Message Byte 4 bits

NOTES:

TABLE 28-2: INSTRUCTION SET OVERVIEW (CONTINUED)

Base Instr #	Assembly Mnemonic	Assembly Syntax	Description	# of Words	# of Cycles(2)	Status Flags Affected
52	MUL	MUL.SS Wb,Ws,Wnd	{Wnd + 1, Wnd} = signed(Wb) * signed(Ws)	1	1	None
		MUL.SS Wb,Ws,Acc(1)	Accumulator = signed(Wb) * signed(Ws)	1	1	None
		MUL.SU Wb,Ws,Wnd	{Wnd + 1, Wnd} = signed(Wb) * unsigned(Ws)	1	1	None
		MUL.SU Wb,Ws,Acc(1)	Accumulator = signed(Wb) * unsigned(Ws)	1	1	None
		MUL.SU Wb,#lit5,Acc(1)	Accumulator = signed(Wb) * unsigned(lit5)	1	1	None
		MUL.US Wb,Ws,Wnd	{Wnd + 1, Wnd} = unsigned(Wb) * signed(Ws)	1	1	None
		MUL.US Wb,Ws,Acc(1)	Accumulator = unsigned(Wb) * signed(Ws)	1	1	None
		MUL.UU Wb,Ws,Wnd	{Wnd + 1, Wnd} = unsigned(Wb) * unsigned(Ws)	1	1	None
		MUL.UU Wb,#lit5,Acc(1)	Accumulator = unsigned(Wb) * unsigned(lit5)	1	1	None
		MUL.UU Wb,Ws,Acc(1)	Accumulator = unsigned(Wb) * unsigned(Ws)	1	1	None
		MULW.SS Wb,Ws,Wnd	Wnd = signed(Wb) * signed(Ws)	1	1	None
		MULW.SU Wb,Ws,Wnd	Wnd = signed(Wb) * unsigned(Ws)	1	1	None
		MULW.US Wb,Ws,Wnd	Wnd = unsigned(Wb) * signed(Ws)	1	1	None
		MULW.UU Wb,Ws,Wnd	Wnd = unsigned(Wb) * unsigned(Ws)	1	1	None
		MUL.SU Wb,#lit5,Wnd	{Wnd + 1, Wnd} = signed(Wb) * unsigned(lit5)	1	1	None
		MUL.SU Wb,#lit5,Wnd	Wnd = signed(Wb) * unsigned(lit5)	1	1	None
		MUL.UU Wb,#lit5,Wnd	{Wnd + 1, Wnd} = unsigned(Wb) * unsigned(lit5)	1	1	None
		MUL.UU Wb,#lit5,Wnd	Wnd = unsigned(Wb) * unsigned(lit5)	1	1	None
		MUL f	W3:W2 = f * WREG	1	1	None

Note 1: These instructions are available in dsPIC33EPXXXMC20X/50X and PIC24EPXXXMC20X devices only.
2: Read and Read-Modify-Write (e.g., bit operations and logical operations) on non-CPU SFRs incur an additional instruction cycle.

TABLE 30-7: DC CHARACTERISTICS: IDLE CURRENT (IIDLE)

DC CHARACTERISTICS			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**		
Idle Current (IIDLE)(1)						
DC40d	3	8	mA	-40°C	3.3V	10 MIPS
DC40a	3	8	mA	+25°C		
DC40b	3	8	mA	+85°C		
DC40c	3	8	mA	+125°C		
DC42d	6	12	mA	-40°C	3.3V	20 MIPS
DC42a	6	12	mA	+25°C		
DC42b	6	12	mA	+85°C		
DC42c	6	12	mA	+125°C		
DC44d	11	18	mA	-40°C	3.3V	40 MIPS
DC44a	11	18	mA	+25°C		
DC44b	11	18	mA	+85°C		
DC44c	11	18	mA	+125°C		
DC45d	17	27	mA	-40°C	3.3V	60 MIPS
DC45a	17	27	mA	+25°C		
DC45b	17	27	mA	+85°C		
DC45c	17	27	mA	+125°C		
DC46d	20	35	mA	-40°C	3.3V	70 MIPS
DC46a	20	35	mA	+25°C		
DC46b	20	35	mA	+85°C		

Note 1: Base Idle current (IIDLE) is measured as follows:

- CPU core is off, oscillator is configured in EC mode and external clock is active; OSC1 is driven with external square wave from rail-to-rail (EC clock overshoot/undershoot < 250 mV required)
- CLKO is configured as an I/O input pin in the Configuration Word
- All I/O pins are configured as inputs and pulled to VSS
- $\overline{\text{MCLR}}$ = VDD, WDT and FSCM are disabled
- No peripheral modules are operating; however, every peripheral is being clocked (all PMDx bits are zeroed)
- The NVMSIDL bit (NVMCON<12>) = 1 (i.e., Flash regulator is set to standby while the device is in Idle mode)
- The VREGSF bit (RCON<11>) = 0 (i.e., Flash regulator is set to standby while the device is in Sleep mode)
- JTAG is disabled

TABLE 30-53: OP AMP/COMPARATOR SPECIFICATIONS (CONTINUED)

DC CHARACTERISTICS			Standard Operating Conditions: 3.0V to 3.6V (unless otherwise stated)(1) Operating temperature -40°C ≤ TA ≤ +85°C for Industrial -40°C ≤ TA ≤ +125°C for Extended				
Param No.	**Symbol**	**Characteristic**	**Min.**	**Typ.(2)**	**Max.**	**Units**	**Conditions**
Op Amp DC Characteristics							
CM40	VCMR	Common-Mode Input Voltage Range	AVSS	—	AVDD	V	
CM41	CMRR	Common-Mode Rejection Ratio(3)	—	40	—	db	VCM = AVDD/2
CM42	VOFFSET	Op Amp Offset Voltage(3)	—	±5	—	mV	
CM43	VGAIN	Open-Loop Voltage Gain(3)	—	90	—	db	
CM44	IOS	Input Offset Current	—	—	—	—	See pad leakage currents in Table 30-11
CM45	IB	Input Bias Current	—	—	—	—	See pad leakage currents in Table 30-11
CM46	IOUT	Output Current	—	—	420	µA	With minimum value of RFEEDBACK (CM48)
CM48	RFEEDBACK	Feedback Resistance Value	8	—	—	kΩ	
CM49a	VOADC	Output Voltage Measured at OAx Using ADC(3,4)	AVSS + 0.077 AVSS + 0.037 AVSS + 0.018	— — —	AVDD – 0.077 AVDD – 0.037 AVDD – 0.018	V V V	IOUT = 420 µA IOUT = 200 µA IOUT = 100 µA
CM49b	VOUT	Output Voltage Measured at OAxOUT Pin(3,4,5)	AVSS + 0.210 AVSS + 0.100 AVSS + 0.050	— — —	AVDD – 0.210 AVDD – 0.100 AVDD – 0.050	V V V	IOUT = 420 µA IOUT = 200 µA IOUT = 100 µA
CM51	RINT1(6)	Internal Resistance 1 (Configuration A and B)(3,4,5)	198	264	317	Ω	Min = -40ºC Typ = +25ºC Max = +125ºC

Note 1: Device is functional at VBORMIN < VDD < VDDMIN, but will have degraded performance. Device functionality is tested, but not characterized. Analog modules (ADC, op amp/comparator and comparator voltage reference) may have degraded performance. Refer to Parameter BO10 in Table 30-13 for the minimum and maximum BOR values.

2: Data in "Typ" column is at 3.3V, +25°C unless otherwise stated.

3: Parameter is characterized but not tested in manufacturing.

4: See Figure 25-6 for configuration information.

5: See Figure 25-7 for configuration information.

6: Resistances can vary by ±10% between op amps.

Revision C (December 2011)

This revision includes typographical and formatting changes throughout the data sheet text.

In addition, where applicable, new sections were added to each peripheral chapter that provide information and links to related resources, as well as helpful tips. For examples, see **Section 20.1 "UART Helpful Tips"** and **Section 3.6 "CPU Resources"**.

All occurrences of TLA were updated to VTLA throughout the document, with the exception of the pin diagrams (updated diagrams were not available at time of publication).

A new chapter, **Section 31.0 "DC and AC Device Characteristics Graphs"**, was added.

All other major changes are referenced by their respective section in Table A-2.

TABLE A-2: MAJOR SECTION UPDATES

Section Name	Update Description
"16-bit Microcontrollers and Digital Signal Controllers (up to 256-Kbyte Flash and 32-Kbyte SRAM) with High-Speed PWM, Op amps, and Advanced Analog"	The content on the first page of this section was extensively reworked to provide the reader with the key features and functionality of this device family in an "at-a-glance" format.
Section 1.0 "Device Overview"	Updated the dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X, and PIC24EPXXXGP/MC20X Block Diagram (see Figure 1-1), which now contains a CPU block and a reference to the CPU diagram. Updated the description and Note references in the Pinout I/O Descriptions for these pins: C1IN2-, C2IN2-, C3IN2-, OA1OUT, OA2OUT, and OA3OUT (see Table 1-1).
Section 2.0 "Guidelines for Getting Started with 16-bit Digital Signal Controllers and Microcontrollers"	Updated the Recommended Minimum Connection diagram (see Figure 2-1).
Section 3.0 "CPU"	Updated the dsPIC33EPXXXGP50X, dsPIC33EPXXXMC20X/50X, and PIC24EPXXXGP/MC20X CPU Block Diagram (see Figure 3-1). Updated the Status register definition in the Programmer's Model (see Figure 3-2).
Section 4.0 "Memory Organization"	Updated the Data Memory Maps (see Figure 4-6 and Figure 4-11). Removed the DCB<1:0> bits from the OC1CON2, OC2CON2, OC3CON2, and OC4CON2 registers in the Output Compare 1 Through Output Compare 4 Register Map (see Table 4-10). Added the TRIG1 and TRGCON1 registers to the PWM Generator 1 Register Map (see Table 4-13). Added the TRIG2 and TRGCON2 registers to the PWM Generator 2 Register Map (see Table 4-14). Added the TRIG3 and TRGCON3 registers to the PWM Generator 3 Register Map (see Table 4-15). Updated the second note in **Section 4.7.1 "Bit-Reversed Addressing Implementation"**.
Section 8.0 "Direct Memory Access (DMA)"	Updated the DMA Controller diagram (see Figure 8-1).
Section 14.0 "Input Capture"	Updated the bit values for the ICx clock source of the ICTSEL<12:10> bits in the ICxCON1 register (see Register 14-1).
Section 15.0 "Output Compare"	Updated the bit values for the OCx clock source of the OCTSEL<2:0> bits in the OCxCON1 register (see Register 15-1). Removed the DCB<1:0> bits from the Output Compare x Control Register 2 (see Register 15-2).

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