Microchip Technology - DSPIC33EP16GS505T-E/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	Active
Core Processor	dsPIC
Core Size	16-Bit
Speed	60 MIPs
Connectivity	I²C, IrDA, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	35
Program Memory Size	16KB (16K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	2K x 8
Voltage - Supply (Vcc/Vdd)	3V ~ 3.6V
Data Converters	A/D 19x12b; D/A 1x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C
Mounting Type	Surface Mount
Package / Case	48-TQFP Exposed Pad
Supplier Device Package	48-TQFP-EP (7x7)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/dspic33ep16gs505t-e-pt

REGISTER 3-2: CORCON: CORE CONTROL REGISTER (CONTINUED)

bit 2 **SFA:** Stack Frame Active Status bit
1 = Stack frame is active; W14 and W15 address 0x0000 to 0xFFFF, regardless of DSRPAG
0 = Stack frame is not active; W14 and W15 address the base Data Space

bit 1 **RND:** Rounding Mode Select bit
1 = Biased (conventional) rounding is enabled
0 = Unbiased (convergent) rounding is enabled

bit 0 **IF:** Integer or Fractional Multiplier Mode Select bit
1 = Integer mode is enabled for DSP multiply
0 = Fractional mode is enabled for DSP multiply

Note 1: This bit is always read as '0'.
2: The IPL3 bit is concatenated with the IPL<2:0> bits (SR<7:5>) to form the CPU Interrupt Priority Level.

REGISTER 3-3: CTXTSTAT: CPU W REGISTER CONTEXT STATUS REGISTER

U-0	U-0	U-0	U-0	U-0	R-0	R-0	R-0
—	—	—	—	—	CCTXI2	CCTXI1	CCTXI0
bit 15							bit 8

U-0	U-0	U-0	U-0	U-0	R-0	R-0	R-0
—	—	—	—	—	MCTXI2	MCTXI1	MCTXI0
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 **Unimplemented:** Read as '0'

bit 10-8 **CCTXI<2:0>:** Current (W Register) Context Identifier bits
111 = Reserved
•
•
•
011 = Reserved
010 = Alternate Working Register Set 2 is currently in use
001 = Alternate Working Register Set 1 is currently in use
000 = Default register set is currently in use

bit 7-3 **Unimplemented:** Read as '0'

bit 2-0 **MCTXI<2:0>:** Manual (W Register) Context Identifier bits
111 = Reserved
•
•
•
011 = Reserved
010 = Alternate Working Register Set 2 was most recently manually selected
001 = Alternate Working Register Set 1 was most recently manually selected
000 = Default register set was most recently manually selected

TABLE 4-7: PWM REGISTER MAP

SFR 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
PTCON	0C00	PTEN	—	PTSIDL	SESTAT	SEIEN	EIPU	SYNCPOL	SYNCOEN	SYNCEN	SYNCSRC2	SYNCSRC1	SYNCSRC0	SEVTPS3	SEVTPS2	SEVTPS1	SEVTPS0	0000
PTCON2	0C02	—	—	—	—	—	—	—	—	—	—	—	—	—	PCLKDIV<2:0>			0000
PTPER	0C04	PWMx Primary Master Time Base Period Register (PTPER<15:0>)																FFF8
SEVTCMP	0C06	PWMx Special Event Compare Register (SEVTCMP12:0>)													—	—	—	0000
MDC	0C0A	PWMx Master Duty Cycle Register (MDC<15:0>)																0000
STCON	0C0E	—	—	—	SESTAT	SEIEN	EIPU	SYNCPOL	SYNCOEN	SYNCEN	SYNCSRC2	SYNCSRC1	SYNCSRC0	SEVTPS3	SEVTPS2	SEVTPS1	SEVTPS0	0000
STCON2	0C10	—	—	—	—	—	—	—	—	—	—	—	—	—	PCLKDIV<2:0>			0000
STPER	0C12	PWMx Secondary Master Time Base Period Register (STPER<15:0>)																FFF8
SSEVTCMP	0C14	PWMx Secondary Special Event Compare Register (SSEVTCMP<12:0>)													—	—	—	0000
CHOP	0C1A	CHPCLKEN	—	—	—	—	—	CHOPCLK6	CHOPCLK5	CHOPCLK4	CHOPCLK3	CHOPCLK2	CHOPCLK1	CHOPCLK0	—	—	—	0000
PWMKEY	0C1E	PWMx Protection Lock/Unlock Key Register (PWMKEY<15:0>)																0000

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

TABLE 4-8: PWM GENERATOR 1 REGISTER MAP

SFR 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
PWMCON1	0C20	FLTSTAT	CLSTAT	TRGSTAT	FLTIEN	CLIEN	TRGIEN	ITB	MDCS	DTC1	DTC0	—	—	MTBS	CAM	XPRES	IUE	0000
IOCON1	0C22	PENH	PENL	POLH	POLL	PMOD1	PMOD0	OVRENH	OVRENL	OVRDAT1	OVRDAT0	FLTDAT1	FLTDAT0	CLDAT1	CLDAT0	SWAP	OSYNC	C000
FCLCON1	0C24	IFLTMOD	CLSRC4	CLSRC3	CLSRC2	CLSRC1	CLSRC0	CLPOL	CLMOD	FLTSRC4	FLTSRC3	FLTSRC2	FLTSRC1	FLTSRC0	FLTPOL	FLTMOD1	FLTMOD0	00F8
PDC1	0C26	PWM1 Generator Duty Cycle Register (PDC1<15:0>)																0000
PHASE1	0C28	PWM1 Primary Phase-Shift or Independent Time Base Period Register (PHASE1<15:0>)																0000
DTR1	0C2A	—	—	PWM1 Dead-Time Register (DTR1<13:0>)														0000
ALTDTR1	0C2C	—	—	PWM1 Alternate Dead-Time Register (ALTDTR1<13:0>)														0000
SDC1	0C2E	PWM1 Secondary Duty Cycle Register (SDC1<15:0>)																0000
SPHASE1	0C30	PWM1 Secondary Phase-Shift Register (SPHASE1<15:0>)																0000
TRIG1	0C32	PWM1 Primary Trigger Compare Value Register (TRGCMP<12:0>)													—	—	—	0000
TRGCON1	0C34	TRGDIV3	TRGDIV2	TRGDIV1	TRGDIV0	—	—	—	—	DTM	—	TRGSTRT5	TRGSTRT4	TRGSTRT3	TRGSTRT2	TRGSTRT1	TRGSTRT0	0000
STRIG1	0C36	PWM1 Secondary Trigger Compare Value Register (STRGCMP<12:0>)													—	—	—	0000
PWMCAP1	0C38	PWM1 Primary Time Base Capture Register (PWMCAP<12:0>)													—	—	—	0000
LEBCON1	0C3A	PHR	PHF	PLR	PLF	FLTLEBEN	CLLEBEN	—	—	—	—	BCH	BCL	BPHH	BPHL	BPLH	BPLL	0000
LEBDLY1	0C3C	—	—	—	—	PWM1 Leading-Edge Blanking Delay Register (LEB<8:0>)									—	—	—	0000
AUXCON1	0C3E	HRPDIS	HRDDIS	—	—	BLANKSEL3	BLANKSEL2	BLANKSEL1	BLANKSEL0	—	—	CHOPSEL3	CHOPSEL2	CHOPSEL1	CHOPSEL0	CHOPHEN	CHOPLEN	0000

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

TABLE 4-26: ANALOG COMPARATOR REGISTER MAP

SFR 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
CMP1CON	0540	CMPON	—	CMPSIDL	HYSSEL1	HYSSEL0	FLTREN	FCLKSEL	DACOE	INSEL1	INSEL0	EXTREF	HYSPOL	CMPSTAT	ALTINP	CMPPOL	RANGE	0000
CMP1DAC	0542	—	—	—	—	CMREF<11:0>												0000
CMP2CON	0544	CMPON	—	CMPSIDL	HYSSEL1	HYSSEL0	FLTREN	FCLKSEL	DACOE	INSEL1	INSEL0	EXTREF	HYSPOL	CMPSTAT	ALTINP	CMPPOL	RANGE	0000
CMP2DAC	0546	—	—	—	—	CMREF<11:0>												0000
CMP3CON	0548	CMPON	—	CMPSIDL	HYSSEL1	HYSSEL0	FLTREN	FCLKSEL	DACOE	INSEL1	INSEL0	EXTREF	HYSPOL	CMPSTAT	ALTINP	CMPPOL	RANGE	0000
CMP3DAC	054A	—	—	—	—	CMREF<11:0>												0000
CMP4CON	054C	CMPON	—	CMPSIDL	HYSSEL1	HYSSEL0	FLTREN	FCLKSEL	DACOE	INSEL1	INSEL0	EXTREF	HYSPOL	CMPSTAT	ALTINP	CMPPOL	RANGE	0000
CMP4DAC	054E	—	—	—	—	CMREF<11:0>												0000

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

TABLE 4-27: JTAG INTERFACE REGISTER MAP

SFR 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
JDATAH	0FF0	—	—	—	—	JDATAH<11:0>												xxxx
JDATAL	0FF2	JDATAL<15:0>																0000

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

REGISTER 6-1: RCON: RESET CONTROL REGISTER(1)

R/W-0	R/W-0	U-0	U-0	R/W-0	U-0	R/W-0	R/W-0
TRAPR	IOPUWR	—	—	VREGSF	—	CM	VREGS
bit 15							bit 8

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-1	R/W-1
EXTR	SWR	SWDTEN(2)	WDTO	SLEEP	IDLE	BOR	POR
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 **TRAPR:** Trap Reset Flag bit
1 = A Trap Conflict Reset has occurred
0 = A Trap Conflict Reset has not occurred

bit 14 **IOPUWR:** Illegal Opcode or Uninitialized W Register Access Reset Flag bit
1 = An illegal opcode detection, an illegal address mode or Uninitialized W register used as an Address Pointer caused a Reset
0 = An illegal opcode or Uninitialized W register Reset has not occurred

bit 13-12 **Unimplemented:** Read as '0'

bit 11 **VREGSF:** Flash Voltage Regulator Standby During Sleep bit
1 = Flash voltage regulator is active during Sleep
0 = Flash voltage regulator goes into Standby mode during Sleep

bit 10 **Unimplemented:** Read as '0'

bit 9 **CM:** Configuration Mismatch Flag bit
1 = A Configuration Mismatch Reset has occurred.
0 = A Configuration Mismatch Reset has not occurred

bit 8 **VREGS:** Voltage Regulator Standby During Sleep bit
1 = Voltage regulator is active during Sleep
0 = Voltage regulator goes into Standby mode during Sleep

bit 7 **EXTR:** External Reset ($\overline{MCLR}$) Pin bit
1 = A Master Clear (pin) Reset has occurred
0 = A Master Clear (pin) Reset has not occurred

bit 6 **SWR:** Software RESET (Instruction) Flag bit
1 = A RESET instruction has been executed
0 = A RESET instruction has not been executed

bit 5 **SWDTEN:** Software Enable/Disable of WDT bit(2)
1 = WDT is enabled
0 = WDT is disabled

bit 4 **WDTO:** Watchdog Timer Time-out Flag bit
1 = WDT time-out has occurred
0 = WDT time-out 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.

2: If the WDTEN<1:0> Configuration bits are '11' (unprogrammed), the WDT is always enabled, regardless of the SWDTEN bit setting.

9.0 POWER-SAVING FEATURES

Note 1: This data sheet summarizes the features of the dsPIC33EPXXGS50X family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to **"Watchdog Timer and Power-Saving Modes"** (DS70615) in the "*dsPIC33/PIC24 Family Reference Manual*", which is available from the Microchip web site (www.microchip.com).

2: Some registers and associated bits described in this section may not be available on all devices. Refer to **Section 4.0 "Memory Organization"** in this data sheet for device-specific register and bit information.

The dsPIC33EPXXGS50X family devices provide the ability to manage power consumption by selectively managing clocking to the CPU and the peripherals. In general, a lower clock frequency and a reduction in the number of peripherals being clocked constitutes lower consumed power.

dsPIC33EPXXGS50X family devices can manage power consumption in four ways:

- Clock Frequency
- Instruction-Based Sleep and Idle modes
- Software-Controlled Doze mode
- Selective Peripheral Control in Software

Combinations of these methods can be used to selectively tailor an application's power consumption while still maintaining critical application features, such as timing-sensitive communications.

9.1 Clock Frequency and Clock Switching

The dsPIC33EPXXGS50X family devices allow a wide range of clock frequencies to be selected under application control. If the system clock configuration is not locked, users can choose low-power or high-precision oscillators by simply changing the NOSCx bits (OSCCON<10:8>). The process of changing a system clock during operation, as well as limitations to the process, are discussed in more detail in **Section 8.0 "Oscillator Configuration"**.

9.2 Instruction-Based Power-Saving Modes

The dsPIC33EPXXGS50X family devices have two special power-saving modes that are entered through the execution of a special PWRSAV instruction. Sleep mode stops clock operation and halts all code execution. Idle mode halts the CPU and code execution, but allows peripheral modules to continue operation. The assembler syntax of the PWRSAV instruction is shown in Example 9-1.

Note: SLEEP_MODE and IDLE_MODE are constants defined in the assembler include file for the selected device.

Sleep and Idle modes can be exited as a result of an enabled interrupt, WDT time-out or a device Reset. When the device exits these modes, it is said to "wake-up".

EXAMPLE 9-1: PWRSAV INSTRUCTION SYNTAX

```
PWRSAV  #SLEEP_MODE    ; Put the device into Sleep mode
PWRSAV  #IDLE_MODE     ; Put the device into Idle mode
```

REGISTER 9-2: PMD2: PERIPHERAL MODULE DISABLE CONTROL REGISTER 2

U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	—	IC4MD	IC3MD	IC2MD	IC1MD
bit 15							bit 8

U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	—	OC4MD	OC3MD	OC2MD	OC1MD
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 **Unimplemented:** Read as '0'

bit 11 **IC4MD:** Input Capture 4 Module Disable bit
1 = Input Capture 4 module is disabled
0 = Input Capture 4 module is enabled

bit 10 **IC3MD:** Input Capture 3 Module Disable bit
1 = Input Capture 3 module is disabled
0 = Input Capture 3 module is enabled

bit 9 **IC2MD:** Input Capture 2 Module Disable bit
1 = Input Capture 2 module is disabled
0 = Input Capture 2 module is enabled

bit 8 **IC1MD:** Input Capture 1 Module Disable bit
1 = Input Capture 1 module is disabled
0 = Input Capture 1 module is enabled

bit 7-4 **Unimplemented:** Read as '0'

bit 3 **OC4MD:** Output Compare 4 Module Disable bit
1 = Output Compare 4 module is disabled
0 = Output Compare 4 module is enabled

bit 2 **OC3MD:** Output Compare 3 Module Disable bit
1 = Output Compare 3 module is disabled
0 = Output Compare 3 module is enabled

bit 1 **OC2MD:** Output Compare 2 Module Disable bit
1 = Output Compare 2 module is disabled
0 = Output Compare 2 module is enabled

bit 0 **OC1MD:** Output Compare 1 Module Disable bit
1 = Output Compare 1 module is disabled
0 = Output Compare 1 module is enabled

REGISTER 9-6: PMD7: PERIPHERAL MODULE DISABLE CONTROL REGISTER 7

U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	—	CMP4MD	CMP3MD	CMP2MD	CMP1MD
bit 15							bit 8

U-0	U-0	U-0	U-0	U-0	U-0	R/W-0	U-0
—	—	—	—	—	—	PGA1MD	—
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 **Unimplemented:** Read as '0'

bit 11 **CMP4MD:** CMP4 Module Disable bit
1 = CMP4 module is disabled
0 = CMP4 module is enabled

bit 10 **CMP3MD:** CMP3 Module Disable bit
1 = CMP3 module is disabled
0 = CMP3 module is enabled

bit 9 **CMP2MD:** CMP2 Module Disable bit
1 = CMP2 module is disabled
0 = CMP2 module is enabled

bit 8 **CMP1MD:** CMP1 Module Disable bit
1 = CMP1 module is disabled
0 = CMP1 module is enabled

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

bit 1 **PGA1MD:** PGA1 Module Disable bit
1 = PGA1 module is disabled
0 = PGA1 module is enabled

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

REGISTER 10-34: RPOR14: PERIPHERAL PIN SELECT OUTPUT REGISTER 14

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP61R5	RP61R4	RP61R3	RP61R2	RP61R1	RP61R0
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
—	—	RP60R5	RP60R4	RP60R3	RP60R2	RP60R1	RP60R0
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 **RP61R<5:0>:** Peripheral Output Function is Assigned to RP61 Output Pin bits (see Table 10-2 for peripheral function numbers)

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

bit 5-0 **RP60R<5:0>:** Peripheral Output Function is Assigned to RP60 Output Pin bits (see Table 10-2 for peripheral function numbers)

REGISTER 10-35: RPOR15: PERIPHERAL PIN SELECT OUTPUT REGISTER 15

U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	RP63R5	RP63R4	RP63R3	RP63R2	RP63R1	RP63R0
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
—	—	RP62R5	RP62R4	RP62R3	RP62R2	RP62R1	RP62R0
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 **RP63R<5:0>:** Peripheral Output Function is Assigned to RP63 Output Pin bits (see Table 10-2 for peripheral function numbers)

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

bit 5-0 **RP62R<5:0>:** Peripheral Output Function is Assigned to RP62 Output Pin bits (see Table 10-2 for peripheral function numbers)

REGISTER 15-24: LEBCONx: PWMx LEADING-EDGE BLANKING (LEB) CONTROL REGISTER (x = 1 to 5)

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	U-0	U-0
PHR	PHF	PLR	PLF	FLTLEBEN	CLLEBEN	—	—
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
—	—	BCH(1)	BCL(1)	BPHH	BPHL	BPLH	BPLL
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 **PHR:** PWMxH Rising Edge Trigger Enable bit
1 = Rising edge of PWMxH will trigger the Leading-Edge Blanking counter
0 = Leading-Edge Blanking ignores the rising edge of PWMxH

bit 14 **PHF:** PWMxH Falling Edge Trigger Enable bit
1 = Falling edge of PWMxH will trigger the Leading-Edge Blanking counter
0 = Leading-Edge Blanking ignores the falling edge of PWMxH

bit 13 **PLR:** PWMxL Rising Edge Trigger Enable bit
1 = Rising edge of PWMxL will trigger the Leading-Edge Blanking counter
0 = Leading-Edge Blanking ignores the rising edge of PWMxL

bit 12 **PLF:** PWMxL Falling Edge Trigger Enable bit
1 = Falling edge of PWMxL will trigger the Leading-Edge Blanking counter
0 = Leading-Edge Blanking ignores the falling edge of PWMxL

bit 11 **FLTLEBEN:** Fault Input Leading-Edge Blanking Enable bit
1 = Leading-Edge Blanking is applied to the selected Fault input
0 = Leading-Edge Blanking is not applied to the selected Fault input

bit 10 **CLLEBEN:** Current-Limit Leading-Edge Blanking Enable bit
1 = Leading-Edge Blanking is applied to the selected current-limit input
0 = Leading-Edge Blanking is not applied to the selected current-limit input

bit 9-6 **Unimplemented:** Read as '0'

bit 5 **BCH:** Blanking in Selected Blanking Signal High Enable bit(1)
1 = State blanking (of current-limit and/or Fault input signals) when the selected blanking signal is high
0 = No blanking when the selected blanking signal is high

bit 4 **BCL:** Blanking in Selected Blanking Signal Low Enable bit(1)
1 = State blanking (of current-limit and/or Fault input signals) when the selected blanking signal is low
0 = No blanking when the selected blanking signal is low

bit 3 **BPHH:** Blanking in PWMxH High Enable bit
1 = State blanking (of current-limit and/or Fault input signals) when the PWMxH output is high
0 = No blanking when the PWMxH output is high

bit 2 **BPHL:** Blanking in PWMxH Low Enable bit
1 = State blanking (of current-limit and/or Fault input signals) when the PWMxH output is low
0 = No blanking when the PWMxH output is low

Note 1: The blanking signal is selected via the BLANKSEL<3:0> bits in the AUXCONx register.

REGISTER 19-8: ADCON4H: ADC CONTROL REGISTER 4 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
C3CHS1	C3CHS0	C2CHS1	C2CHS0	C1CHS1	C1CHS0	C0CHS1	C0CHS0
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 7-6 **C3CHS<1:0>:** Dedicated ADC Core 3 Input Channel Selection bits
1x = Reserved
01 = AN15 (differential negative input when DIFF3 (ADMOD0L<7>) = 1)
00 = AN3

bit 5-4 **C2CHS<1:0>:** Dedicated ADC Core 2 Input Channel Selection bits
11 = Reserved
10 = VREF Band Gap
01 = AN11 (differential negative input when DIFF2 (ADMOD0L<5>) = 1)
00 = AN2

bit 3-2 **C1CHS<1:0>:** Dedicated ADC Core 1 Input Channel Selection bits
11 = AN1ALT
10 = PGA2
01 = AN18 (differential negative input when DIFF1 (ADMOD0L<3>) = 1)
00 = AN1

bit 1-0 **C0CHS<1:0>:** Dedicated ADC Core 0 Input Channel Selection bits
11 = AN0ALT
10 = PGA1
01 = AN7 (differential negative input when DIFF0 (ADMOD0L<1>) = 1)
00 = AN0

REGISTER 19-9: ADCON5L: ADC CONTROL REGISTER 5 LOW

R-0, HSC	U-0	U-0	U-0	R-0, HSC	R-0, HSC	R-0, HSC	R-0, HSC
SHRRDY	—	—	—	C3RDY	C2RDY	C1RDY	C0RDY
bit 15							bit 8

R/W-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
SHRPWR	—	—	—	C3PWR	C2PWR	C1PWR	C0PWR
bit 7							bit 0

Legend:	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 **SHRRDY:** Shared ADC Core Ready Flag bit
1 = ADC core is powered and ready for operation
0 = ADC core is not ready for operation

bit 14-12 **Unimplemented:** Read as '0'

bit 11 **C3RDY:** Dedicated ADC Core 3 Ready Flag bit
1 = ADC core is powered and ready for operation
0 = ADC core is not ready for operation

bit 10 **C2RDY:** Dedicated ADC Core 2 Ready Flag bit
1 = ADC core is powered and ready for operation
0 = ADC core is not ready for operation

bit 9 **C1RDY:** Dedicated ADC Core 1 Ready Flag bit
1 = ADC core is powered and ready for operation
0 = ADC core is not ready for operation

bit 8 **C0RDY:** Dedicated ADC Core 0 Ready Flag bit
1 = ADC core is powered and ready for operation
0 = ADC core is not ready for operation

bit 7 **SHRPWR:** Shared ADC Core x Power Enable bit
1 = ADC Core x is powered
0 = ADC Core x is off

bit 6-4 **Unimplemented:** Read as '0'

bit 3 **C3PWR:** Dedicated ADC Core 3 Power Enable bit
1 = ADC core is powered
0 = ADC core is off

bit 2 **C2PWR:** Dedicated ADC Core 2 Power Enable bit
1 = ADC core is powered
0 = ADC core is off

bit 1 **C1PWR:** Dedicated ADC Core 1 Power Enable bit
1 = ADC core is powered
0 = ADC core is off

bit 0 **C0PWR:** Dedicated ADC Core 0 Power Enable bit
1 = ADC core is powered
0 = ADC core is off

REGISTER 19-10: ADCON5H: ADC CONTROL REGISTER 5 HIGH

U-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
—	—	—	—	WARMTIME3	WARMTIME2	WARMTIME1	WARMTIME0
bit 15							bit 8

R/W-0	U-0	U-0	U-0	R/W-0	R/W-0	R/W-0	R/W-0
SHRCIE	—	—	—	C3CIE	C2CIE	C1CIE	C0CIE
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 **Unimplemented:** Read as '0'

bit 11-8 **WARMTIME<3:0>:** ADC Dedicated Core x Power-up Delay bits

These bits determine the power-up delay in the number of the Core Source Clock Periods (TCORESRC) for all ADC cores.

1111 = 32768 Source Clock Periods
1110 = 16384 Source Clock Periods
1101 = 8192 Source Clock Periods
1100 = 4096 Source Clock Periods
1011 = 2048 Source Clock Periods
1010 = 1024 Source Clock Periods
1001 = 512 Source Clock Periods
1000 = 256 Source Clock Periods
0111 = 128 Source Clock Periods
0110 = 64 Source Clock Periods
0101 = 32 Source Clock Periods
0100 = 16 Source Clock Periods
00xx = 16 Source Clock Periods

bit 7 **SHRCIE:** Shared ADC Core Ready Common Interrupt Enable bit

1 = Common interrupt will be generated when ADC core is powered and ready for operation
0 = Common interrupt is disabled for an ADC core ready event

bit 6-4 **Unimplemented:** Read as '0'

bit 3 **C3CIE:** Dedicated ADC Core 3 Ready Common Interrupt Enable bit

1 = Common interrupt will be generated when ADC Core 3 is powered and ready for operation
0 = Common interrupt is disabled for an ADC Core 3 ready event

bit 2 **C2CIE:** Dedicated ADC Core 2 Ready Common Interrupt Enable bit

1 = Common interrupt will be generated when ADC Core 2 is powered and ready for operation
0 = Common interrupt is disabled for an ADC Core 2 ready event

bit 1 **C1CIE:** Dedicated ADC Core 1 Ready Common Interrupt Enable bit

1 = Common interrupt will be generated when ADC Core 1 is powered and ready for operation
0 = Common interrupt is disabled for an ADC Core 1 ready event

bit 0 **C0CIE:** Dedicated ADC Core 0 Ready Common Interrupt Enable bit

1 = Common interrupt will be generated when ADC Core 0 is powered and ready for operation
0 = Common interrupt is disabled for an ADC Core 0 ready event

REGISTER 19-17: ADEISTATL: ADC EARLY INTERRUPT STATUS 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
EISTAT<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
EISTAT<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 **EISTAT<15:0>:** Early Interrupt Status for Corresponding Analog Inputs bits
1 = Early interrupt was generated
0 = Early interrupt was not generated since the last ADCBUFx read

REGISTER 19-18: ADEISTATH: ADC EARLY INTERRUPT STATUS REGISTER HIGH

U-0	U-0	U-0	U-0	U-0	U-0	U-0	U-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
—	—	EISTAT<21:16>					
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 15-6 **Unimplemented:** Read as ‘0’

bit 5-0 **EISTAT<21:16>:** Early Interrupt Status for Corresponding Analog Inputs bits
1 = Early interrupt was generated
0 = Early interrupt was not generated since the last ADCBUFx read

23.0 SPECIAL FEATURES

Note: This data sheet summarizes the features of the dsPIC33EPXXGS50X family of devices. It is not intended to be a comprehensive reference source. To complement the information in this data sheet, refer to the related section of the *"dsPIC33/PIC24 Family Reference Manual*", which is available from the Microchip web site (www.microchip.com).

The dsPIC33EPXXGS50X family devices include several features intended to maximize application flexibility and reliability, and minimize cost through elimination of external components. These are:

- Flexible Configuration
- Watchdog Timer (WDT)
- Code Protection and CodeGuard™ Security
- JTAG Boundary Scan Interface
- In-Circuit Serial Programming™ (ICSP™)
- In-Circuit Emulation
- Brown-out Reset (BOR)

23.1 Configuration Bits

In dsPIC33EPXXGS50X family devices, the Configuration Words are implemented as volatile memory. This means that configuration data must be programmed each time the device is powered up. Configuration data is stored at the end of the on-chip program memory space, known as the Flash Configuration Words. Their specific locations are shown in Table 23-1 with detailed descriptions in Table 23-2. The configuration data is automatically loaded from the Flash Configuration Words to the proper Configuration Shadow registers during device Resets.

For devices operating in Dual Partition modes, the BSEQx bits (FBTSEQ<11:0>) determine which panel is the Active Partition at start-up and the Configuration Words from that panel are loaded into the Configuration Shadow registers.

Note: Configuration data is reloaded on all types of device Resets.

When creating applications for these devices, users should always specifically allocate the location of the Flash Configuration Words for configuration data in their code for the compiler. This is to make certain that program code is not stored in this address when the code is compiled. Program code executing out of configuration space will cause a device Reset.

Note: Performing a page erase operation on the last page of program memory clears the Flash Configuration Words.

TABLE 23-1: CONFIGURATION REGISTER MAP(3) (CONTINUED)

Name	Address	Device Memory Size (Kbytes)	Bits 23-16	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
FDEVOPT	002BAC	16	—	—	—	—	—	—	—	—	—	—	DBCC	—	ALTI2C2	ALTI2C1	Reserved(1)	—	PWMLOCK
	0057AC	32																	
	00AFAC	64																	
FALTREG	002BB0	16	—	—	—	—	—	—	—	—	—	—	CTXT2<2:0>			—	CTXT1<2:0>		
	0057B0	32																	
	00AFB0	64																	
FBTSEQ	002BFC	16	IBSEQ<11:0>					BSEQ<11:0>											
	0057FC	32																	
	00AFFC	64																	
FBOOT(4)	801000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	BTMODE<1:0>	

Note 1: These bits are reserved and must be programmed as '1'.
2: This bit is reserved and must be programmed as '0'.
3: When operating in Dual Partition mode, each partition will have dedicated Configuration registers. On a device Reset, the configuration values of the Active Partition are read at start-up, but during a soft swap condition, the configuration settings of the newly Active Partition are ignored.
4: FBOOT resides in configuration memory space.

TABLE 26-11: DC CHARACTERISTICS: I/O PIN INPUT SPECIFICATIONS (CONTINUED)

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				
Param No.	**Symbol**	**Characteristic**	**Min.**	**Typ.(1)**	**Max.**	**Units**	**Conditions**
DI60a	IICL	**Input Low Injection Current**	0	—	-5(5,8)	mA	All pins except VDD, VSS, AVDD, AVSS, MCLR, VCAP and RB7
DI60b	IICH	**Input High Injection Current**	0	—	+5(6,7,8)	mA	All pins except VDD, VSS, AVDD, AVSS, MCLR, VCAP, RB7 and all 5V tolerant pins(7)
DI60c	∑IICT	**Total Input Injection Current (sum of all I/O and control pins)**	-20(9)	—	+20(9)	mA	Absolute instantaneous sum of all ± input injection currents from all I/O pins (| IICL | + | IICH |) ≤ ∑IICT

Note 1: Data in "Typ." column is at 3.3V, +25°C unless otherwise stated.

2: The leakage current on the MCLR pin is strongly dependent on the applied voltage level. The specified levels represent normal operating conditions. Higher leakage current can be measured at different input voltages.

3: Negative current is defined as current sourced by the pin.

4: See the **"Pin Diagrams"** section for the 5V tolerant I/O pins.

5: VIL Source < (VSS – 0.3). Characterized but not tested.

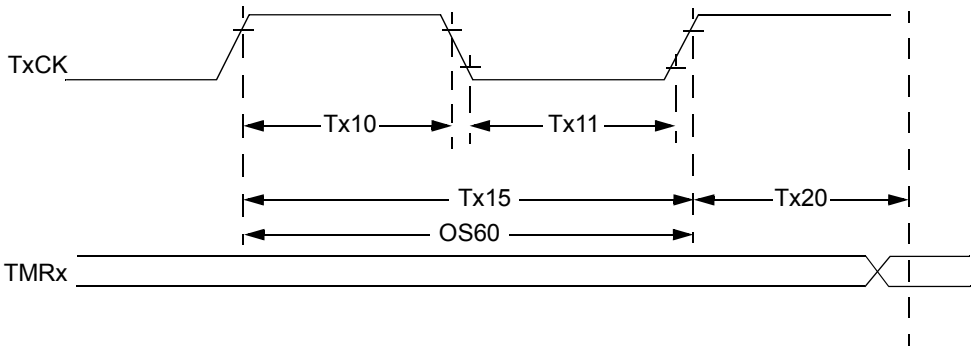
6: VIH Source > (VDD + 0.3) for pins that are not 5V tolerant only.

7: Digital 5V tolerant pins do not have internal high-side diodes to VDD and cannot tolerate any "positive" input injection current.

8: Injection Currents > | 0 | can affect the ADC results by approximately 4-6 counts.

9: Any number and/or combination of I/O pins not excluded under IICL or IICH conditions are permitted provided the mathematical "absolute instantaneous" sum of the input injection currents from all pins do not exceed the specified limit. Characterized but not tested.

FIGURE 26-5: TIMER1-TIMER5 EXTERNAL CLOCK TIMING CHARACTERISTICS



Note: Refer to Figure 26-1 for load conditions.

TABLE 26-24: TIMER1 EXTERNAL CLOCK TIMING REQUIREMENTS(1)

AC 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				
Param No.	**Symbol**	**Characteristic(2)**		**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
TA10	TTXH	T1CK High Time	Synchronous mode	Greater of: 20 or (TCY + 20)/N	—	—	ns	Must also meet Parameter TA15, N = Prescale Value (1, 8, 64, 256)
			Asynchronous	35	—	—	ns	
TA11	TTXL	T1CK Low Time	Synchronous mode	Greater of: 20 or (TCY + 20)/N	—	—	ns	Must also meet Parameter TA15, N = Prescale Value (1, 8, 64, 256)
			Asynchronous	10	—	—	ns	
TA15	TTXP	T1CK Input Period	Synchronous mode	Greater of: 40 or (2 TCY + 40)/N	—	—	ns	N = Prescale Value (1, 8, 64, 256)
OS60	Ft1	T1CK Oscillator Input Frequency Range (oscillator enabled by setting bit, TCS (T1CON<1>))		DC	—	50	kHz	
TA20	TCKEXTMRL	Delay from External T1CK Clock Edge to Timer Increment		0.75 TCY + 40	—	1.75 TCY + 40	ns	

Note 1: Timer1 is a Type A timer.

2: These parameters are characterized but not tested in manufacturing.

FIGURE 26-17: SPIx SLAVE MODE (FULL-DUPLEX, CKE = 0, CKP = 1, SMP = 0) TIMING CHARACTERISTICS

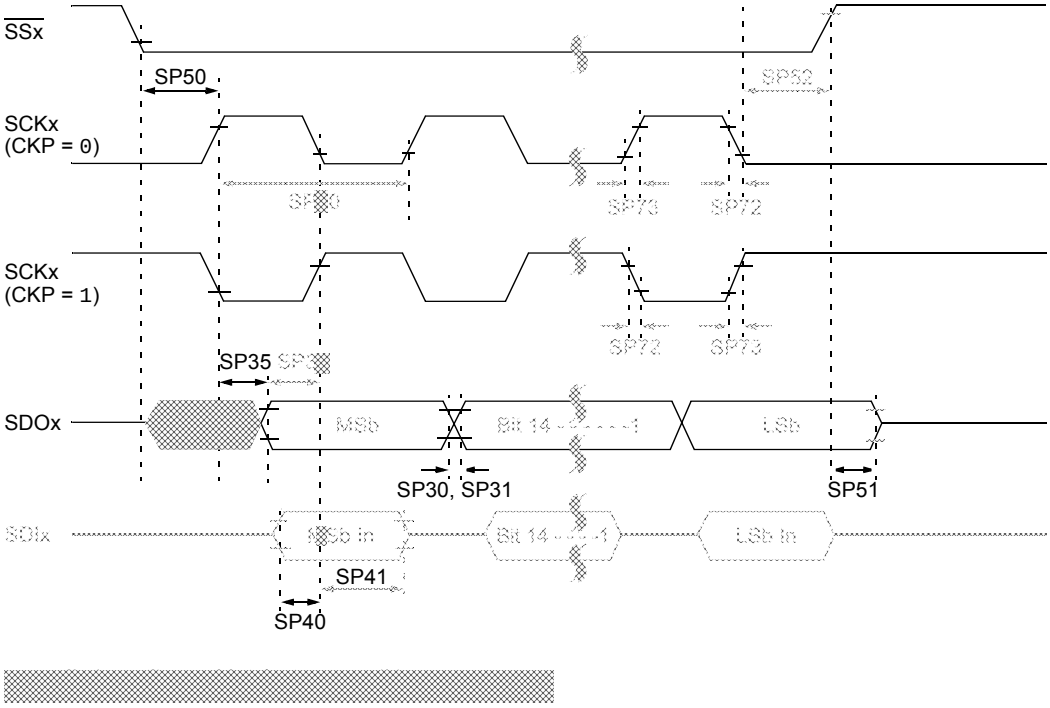


TABLE 26-48: PGAx MODULE SPECIFICATIONS

AC/DC CHARACTERISTICS(1)				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				
Param No.	**Symbol**	**Characteristic**		**Min.**	**Typ.**	**Max.**	**Units**	**Comments**
PA01	VIN	Input Voltage Range		AVSS – 0.3	—	AVDD + 0.3	V	
PA02	VCM	Common-Mode Input Voltage Range		AVSS	—	AVDD – 1.6	V	
PA03	VOS	Input Offset Voltage		-10	—	10	mV	
PA04	VOS	Input Offset Voltage Drift with Temperature		—	±15	—	µV/°C	
PA05	RIN+	Input Impedance of Positive Input		—	>1M || 7 pF	—	Ω|| pF	
PA06	RIN-	Input Impedance of Negative Input		—	10K || 7 pF	—	Ω|| pF	
PA07	GERR	Gain Error		-2	—	2	%	Gain = 4x, 8x
				-3	—	3	%	Gain = 16x
				-4	—	4	%	Gain = 32x, 64x
PA08	LERR	Gain Nonlinearity Error		—	—	0.5	%	% of full scale, Gain = 16x
PA09	IDD	Current Consumption		—	2.0	—	mA	Module is enabled with a 2-volt P-P output voltage swing
PA10a	BW	Small Signal Bandwidth (-3 dB)	G = 4x	—	10	—	MHz	
PA10b			G = 8x	—	5	—	MHz	
PA10c			G = 16x	—	2.5	—	MHz	
PA10d			G = 32x	—	1.25	—	MHz	
PA10e			G = 64x	—	0.625	—	MHz	
PA11	OST	Output Settling Time to 1% of Final Value		—	0.4	—	µs	Gain = 16x, 100 mV input step change
PA12	SR	Output Slew Rate		—	40	—	V/µs	Gain = 16x
PA13	TGSEL	Gain Selection Time		—	1	—	µs	
PA14	TON	Module Turn On/Setting Time		—	—	10	µs	

Note 1: The PGAx module is functional at VBORMIN < VDD < VDDMIN, but with degraded performance. Unless otherwise stated, module functionality is tested, but not characterized.

TABLE 26-49: CONSTANT-CURRENT SOURCE SPECIFICATIONS

DC CHARACTERISTICS(1)				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			
Param No.	**Symbol**	**Characteristic**	**Min.**	**Typ.**	**Max.**	**Units**	**Conditions**
CC01	IDD	Current Consumption	—	30	—	µA	
CC02	IREG	Regulation of Current with Voltage On	—	±3	—	%	
CC03	IOUT	Current Output at Terminal	—	10	—	µA	

Note 1: The constant-current source module is functional at VBORMIN < VDD < VDDMIN, but with degraded performance. Unless otherwise stated, module functionality is tested, but not characterized.

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