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Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	PIC
Core Size	8-Bit
Speed	20MHz
Connectivity	-
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	17
Program Memory Size	3.5KB (2K x 14)
Program Memory Type	FLASH
EEPROM Size	256 x 8
RAM Size	128 x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 5.5V
Data Converters	A/D 14x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	20-SSOP (0.209", 5.30mm Width)
Supplier Device Package	20-SSOP
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16f785-i-ss

3.4 Internal Clock Modes

The PIC16F785/HV785 has two independent, internal oscillators that can be configured or selected as the system clock source.

1. The **HFINTOSC** (High-frequency Internal Oscillator) is factory calibrated and operates at 8 MHz. The frequency of the HFINTOSC can be user adjusted ±12% via software using the OSCTUNE register (Register 3-1).
2. The **LFINTOSC** (Low-frequency Internal Oscillator) is uncalibrated and operates at approximately 31 kHz.

The system clock speed can be selected via software using the Internal Oscillator Frequency Select (IRCF) bits.

The system clock can be selected between external or internal clock sources via the System Clock Selection (SCS) bit (see **Section 3.5 "Clock Switching"**).

3.4.1 INTRC AND INTRCIO MODES

The INTRC and INTRCIO modes configure the internal oscillators as the system clock source when the device is programmed using the Oscillator Selection (FOSC) bits in the Configuration Word (Register 12-1).

In **INTRC** mode, the OSC1 pin is available for general purpose I/O. The OSC2/CLKOUT pin outputs the selected internal oscillator frequency divided by 4. The CLKOUT signal may be used to provide a clock for external circuitry, synchronization, calibration, test or other application requirements.

In **INTRCIO** mode, the OSC1 and OSC2 pins are available for general purpose I/O.

3.4.2 HFINTOSC

The High-frequency Internal Oscillator (HFINTOSC) is a factory calibrated 8 MHz internal clock source. The frequency of the HFINTOSC can be altered approximately ±12% via software using the OSCTUNE register (Register 3-1).

The output of the HFINTOSC connects to a postscaler and multiplexer (see Figure 3-1). One of seven frequencies can be selected via software using the IRCF bits (see **Section 3.4.4 "Frequency Select Bits (IRCF)"**).

The HFINTOSC is enabled by selecting any frequency between 8 MHz and 125 kHz (IRCF ≠ 000) as the system clock source (SCS = 1) or when Two-Speed Start-up is enabled (IESO = 1 and IRCF ≠ 000).

The HF Internal Oscillator (HTS) bit, in the OSCCON Register, indicates whether the HFINTOSC is stable or not.

3.4.2.1 Calibration Bits

The 8 MHz High-frequency Internal Oscillator (HFINTOSC) is factory calibrated. The HFINTOSC calibration bits are stored in the Calibration Word (CALIB) located in program memory location 2008h. The Calibration Word is not erased using the specified bulk erase sequence in the "*PIC16F785/HV785 Memory Programming Specification*" (DS41237) and does not require reprogramming. Reference the "*PIC16F785/HV785 Memory Programming Specification*" (DS41237) for more information on the Calibration Word register.

Note:	Address 2008h is beyond the user program memory space. It belongs to the special Configuration Memory space (2000h-3FFFh), which can be accessed only during programming. See "*PIC16F785/HV785 Memory Programming Specification*" (DS41237) for more information.

3.4.3 LFINTOSC

The Low-frequency Internal Oscillator (LFINTOSC) is an uncalibrated (approximate) 31 kHz internal clock source.

The output of the LFINTOSC connects to a postscaler and multiplexer (see Figure 3-1). 31 kHz can be selected via software using the IRCF bits (see **Section 3.4.4 "Frequency Select Bits (IRCF)"**). The LFINTOSC is also the frequency for the Power-up Timer (PWRT), Watchdog Timer (WDT) and Fail-Safe Clock Monitor (FSCM).

The LFINTOSC is enabled by selecting 31 kHz (IRCF = 000) as the system clock source (SCS = 1), or when any of the following are enabled:

- Two-Speed Start-up (IESO = 1 and IRCF = 000)
- Power-up Timer (PWRT)
- Watchdog Timer (WDT)
- Fail-Safe Clock Monitor (FSCM)

The LF Internal Oscillator (LTS) bit, in the OSCCON register, indicates whether the LFINTOSC is stable or not.

3.4.4 FREQUENCY SELECT BITS (IRCF)

The output of the 8 MHz HFINTOSC and 31 kHz LFINTOSC connect to a postscaler and multiplexer (see Figure 3-1). The Internal Oscillator Frequency select bits IRCF<2:0> in the OSCCON Register select the frequency output of the internal oscillators. One of eight frequencies can be selected via software:

- 8 MHz
- 4 MHz (Default after Reset)
- 2 MHz
- 1 MHz
- 500 kHz
- 250 kHz
- 125 kHz
- 31 kHz

Note:	Following any Reset, the IRCF bits are set to '110' and the frequency selection is forced to 4 MHz. The user can modify the IRCF bits to select a different frequency.

3.4.5 HF AND LF INTOSC CLOCK SWITCH TIMING

When switching between the LFINTOSC and the HFINTOSC, the new oscillator may already be shut down to save power. If this is the case, there is a 10 μs delay after the IRCF bits are modified before the frequency selection takes place. The LTS/HTS bits will reflect the current active status of the LFINTOSC and the HFINTOSC oscillators. The timing of a frequency selection is as follows:

1. IRCF bits are modified.
2. If the new clock is shut down, a 10 μs clock start-up delay is started.
3. Clock switch circuitry waits for a falling edge of the current clock.
4. CLKOUT is held low and the clock switch circuitry waits for a rising edge in the new clock.
5. CLKOUT is now connected with the new clock. HTS/LTS bits are updated as required.
6. Clock switch is complete.

If the internal oscillator speed selected is between 8 MHz and 125 kHz, there is no start-up delay before the new frequency is selected. This is because the old and the new frequencies are derived from the HFINTOSC via the postscaler and multiplexer.

Note:	Care must be taken to ensure an invalid voltage or frequency selection is not selected. An example of an invalid configuration is selecting 8 MHz when V_{DD} is 2.0V.

6.5 Timer1 Operation in Asynchronous Counter Mode

If control bit $\overline{\text{T1SYNC}}$ of the T1CON Register is set, the external clock input is not synchronized. The timer continues to increment asynchronous to the internal phase clocks. The timer will continue to run during Sleep and can generate an interrupt on overflow, which will wake-up the processor. However, special precautions in software are needed to read/write the timer (**Section 6.5.1 "Reading and Writing Timer1 in Asynchronous Counter Mode"**).

Note:	The ANSEL0 (91h) register must be initialized to configure an analog channel as a digital input. Pins configured as analog inputs will read '0'.

6.5.1 READING AND WRITING TIMER1 IN ASYNCHRONOUS COUNTER MODE

Reading TMR1H or TMR1L while the timer is running from an external asynchronous clock will ensure a valid read (taken care of in hardware). However, the user should keep in mind that reading the 16-bit timer in two 8-bit values itself, poses certain problems, since the timer may overflow between the reads.

For writes, it is recommended that the user simply stop the timer and write the desired values. A write contention may occur by writing to the timer registers, while the register is incrementing. This may produce an unpredictable value in the timer register.

6.6 Timer1 Oscillator

A crystal oscillator circuit is built-in between pins OSC1 (input) and OSC2 (amplifier output). It is enabled by setting control bit T1OSCEN of the T1CON Register. The oscillator is a low power oscillator rated for 32.768 kHz. It will continue to run during Sleep. It is primarily intended for a 32.768 kHz tuning fork crystal.

The Timer1 oscillator is shared with the system LP oscillator. Thus, Timer1 can use this mode only when the primary system clock is also the LP oscillator or is derived from the internal oscillator. As with the system LP oscillator, the user must provide a software time delay to ensure proper oscillator start-up.

Sleep mode will not disable the system clock when the system clock and Timer1 share the LP oscillator.

TRISA<5> and TRISA<4> bits are set when the Timer1 oscillator is enabled. RA5 and RA4 read as '0' and TRISA<5> and TRISA<4> bits read as '1'.

Note:	The oscillator requires a start-up and stabilization time before use. Thus, T1OSCEN should be set and a suitable delay observed prior to enabling Timer1.

6.7 Timer1 Operation During Sleep

Timer1 can only operate during Sleep when setup in Asynchronous Counter mode. In this mode, an external crystal or clock source can be used to increment the counter. To setup the timer to wake the device:

- Timer1 of the T1CON Register must be on
- TMR1IE bit of the PIE1 Register must be set
- PEIE bit of the INTCON Register must be set

The device will wake-up on an overflow. If the GIE bit of the INTCON Register is set, the device will wake-up and jump to the Interrupt Service Routine (0004h) on an overflow. If the GIE bit is clear, execution will continue with the next instruction.

TABLE 6-1: REGISTERS ASSOCIATED WITH TIMER1

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR, BOR	Value on all other Resets
ANSEL0	ANS7	ANS6	ANS5	ANS4	ANS3	ANS2	ANS1	ANS0	1111 1111	1111 1111
CM2CON1	MC1OUT	MC2OUT	—	—	—	—	T1GSS	C2SYNC	00-- --10	00-- --10
INTCON	GIE	PEIE	T0IE	INTE	RAIE	T0IF	INTF	RAIF	0000 0000	0000 0000
PIE1	EEIE	ADIE	CCP1IE	C2IE	C1IE	OSFIE	TMR2IE	TMR1IE	0000 0000	0000 0000
PIR1	EEIF	ADIF	CCP1IF	C2IF	C1IF	OSFIF	TMR2IF	TMR1IF	0000 0000	0000 0000
T1CON	T1GINV	TMR1GE	T1CKPS1	T1CKPS0	T1OSCEN	$\overline{\text{T1SYNC}}$	TMR1CS	TMR1ON	0000 0000	uuuu uuuu
TMR1L	Holding Register for the Least Significant Byte of the 16-bit TMR1 Register								xxxx xxxx	uuuu uuuu
TMR1H	Holding Register for the Most Significant Byte of the 16-bit TMR1 Register								xxxx xxxx	uuuu uuuu

Legend: – x = unknown, u = unchanged, – = unimplemented, read as '0'. Shaded cells are not used by the Timer1 module.

7.2 Timer2 Interrupt

The Timer2 module has an 8-bit period register, PR2. Timer2 increments from 00h until it matches PR2 and then resets to 00h on the next increment cycle. PR2 is a readable and writable register. The PR2 register is initialized to FFh upon Reset.

FIGURE 7-1: TIMER2 BLOCK DIAGRAM

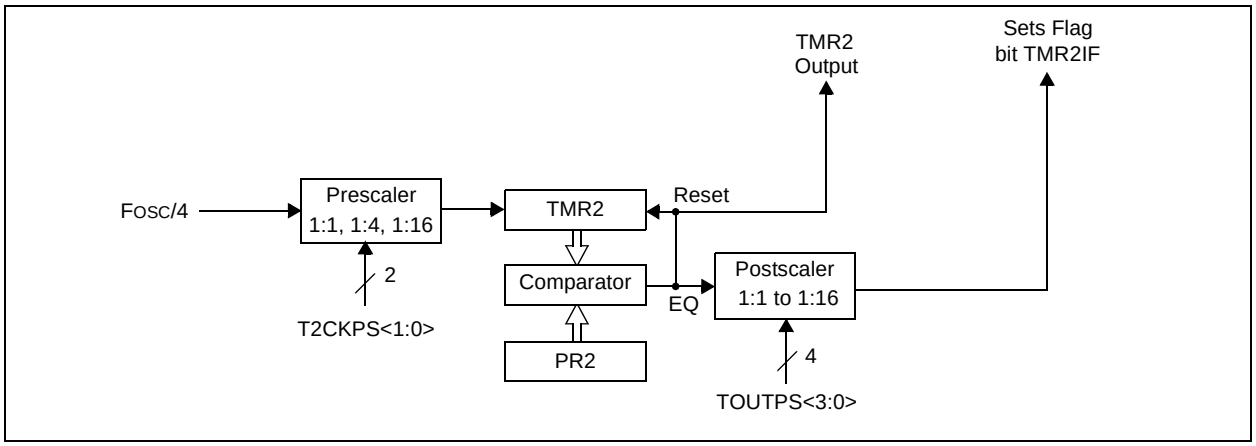


TABLE 7-1: REGISTERS ASSOCIATED WITH TIMER2

Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Value on POR, BOR	Value on all other Resets
INTCON	GIE	PEIE	T0IE	INTE	RAIE	T0IF	INTF	RAIF	0000 0000	0000 0000
PIE1	EEIE	ADIE	CCP1IE	C2IE	C1IE	OSFIE	TMR2IE	TMR1IE	0000 0000	0000 0000
PIR1	EEIF	ADIF	CCP1IF	C2IF	C1IF	OSFIF	TMR2IF	TMR1IF	0000 0000	0000 0000
PR2	Timer2 Module Period register								1111 1111	1111 1111
T2CON	—	TOUTPS3	TOUTPS2	TOUTPS1	TOUTPS0	TMR2ON	T2CKPS1	T2CKPS0	-000 0000	-000 0000
TMR2	Holding Register for the 8-bit TMR2 Register								0000 0000	0000 0000

Legend: – x = unknown, u = unchanged, – = unimplemented, read as '0'. Shaded cells are not used by the Timer2 module.

REGISTER 9-1: CM1CON0: COMPARATOR C1 CONTROL REGISTER 0

R/W-0	R-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
C1ON	C1OUT	C1OE	C1POL	C1SP	C1R	C1CH1	C1CH0
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 7 **C1ON:** Comparator C1 Enable bit
1 = C1 Comparator is enabled
0 = C1 Comparator is disabled

bit 6 **C1OUT:** Comparator C1 Output bit
If C1POL = 1 (inverted polarity):
C1OUT = 1, C1VP < C1VN
C1OUT = 0, C1VP > C1VN
If C1POL = 0 (non-inverted polarity):
C1OUT = 1, C1VP > C1VN
C1OUT = 0, C1VP < C1VN

bit 5 **C1OE:** Comparator C1 Output Enable bit
1 = C1OUT is present on the RA2/AN2/T0CKI/INT/C1OUT pin**(1)**
0 = C1OUT is internal only

bit 4 **C1POL:** Comparator C1 Output Polarity Select bit
1 = C1OUT logic is inverted
0 = C1OUT logic is not inverted

bit 3 **C1SP:** Comparator C1 Speed Select bit
1 = C1 operates in normal speed mode
0 = C1 operates in low-power, slow speed mode

bit 2 **C1R:** Comparator C1 Reference Select bit (non-inverting input)
1 = C1VP connects to C1V_{REF} output
0 = C1VP connects to RA0/AN0/C1IN+/ICSPDAT

bit 1-0 **C1CH<1:0>:** Comparator C1 Channel Select bits
00 = C1VN of C1 connects to RA1/AN1/C12IN0-/V_{REF}/ICSPCLK
01 = C1VN of C1 connects to RC1/AN5/C12IN1-/PH1
10 = C1VN of C1 connects to RC2/AN6/C12IN2-/OP2
11 = C1VN of C1 connects to RC3/AN7/C12IN3-/OP1

Note 1: C1OUT will only drive RA2/AN2/T0CKI/INT/C1OUT if: (C1OE = 1) and (C1ON = 1) and (TRISA<2> = 0).

9.1.2.2 Control Register CM2CON1

Comparator C2 has one additional feature: its output can be synchronized to the Timer1 clock input. Setting C2SYNC of the CM2CON1 Register synchronizes the output of Comparator 2 to the falling edge of the Timer1 clock input (see Figure 9-2 and Register 9-3).

The CM2CON1 register also contains mirror copies of both comparator outputs, MC1OUT and MC2OUT of the CM2CON1 Register. The ability to read both outputs simultaneously from a single register eliminates the timing skew of reading separate registers.

Note:	Obtaining the status of C1OUT or C2OUT by reading CM2CON1 does not affect the comparator interrupt mismatch registers.

REGISTER 9-3: CM2CON1: COMPARATOR C2 CONTROL REGISTER 1

R-0	R-0	U-0	U-0	U-0	U-0	R/W-1	R/W-0
MC1OUT	MC2OUT	—	—	—	—	T1GSS	C2SYNC
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 7 **MC1OUT**: Mirror Copy of C1OUT bit (CM1CON0<6>)

bit 6 **MC2OUT**: Mirror Copy of C2OUT bit (CM2CON0<6>)

bit 5-2 **Unimplemented:** Read as ‘0’

bit 1 **T1GSS**: Timer1 Gate Source Select bit
1 = Timer1 gate source is RA4/AN3/T1G/OSC2/CLKOUT
0 = Timer1 gate source is SYNCC2OUT.

bit 0 **C2SYNC**: C2 Output Synchronous Mode bit
1 = C2 output is synchronous to falling edge of TMR1 clock
0 = C2 output is asynchronous

NOTES:

12.1 A/D Configuration and Operation

There are four registers available to control the functionality of the A/D module:

1. ANSEL0 (Register 12-1)
2. ANSEL1 (Register 12-2)
3. ADCON0 (Register 12-3)
4. ADCON1 (Register 12-4)

12.1.1 ANALOG PORT PINS

The ANS<11:0> bits, of the ANSEL1 and ANSEL0 Registers, and the TRISA<4,2:0>, TRISB<5:4> and TRISC<7:6,3:0>> bits control the operation of the A/D port pins. Set the corresponding TRISx bits to '1' to set the pin output driver to its high-impedance state. Likewise, set the corresponding ANSx bit to disable the digital input buffer.

Note:	Analog voltages on any pin that is defined as a digital input may cause the input buffer to conduct excess current.

12.1.2 CHANNEL SELECTION

There are fourteen analog channels on the PIC16F785/HV785. The CHS<3:0> bits of the ADCON0 Register control which channel is connected to the sample and hold circuit.

12.1.3 VOLTAGE REFERENCE

There are two options for the voltage reference to the A/D converter: either V_{DD} is used or an analog voltage applied to V_{REF} is used. The VCFG bit of the ADCON0 Register controls the voltage reference selection. If VCFG is set, then the voltage on the V_{REF} pin is the reference; otherwise, V_{DD} is the reference.

12.1.4 CONVERSION CLOCK

The A/D conversion cycle requires 11 T_{AD}. The source of the conversion clock is software selectable via the ADCS bits of the ADCON1 Register. There are seven possible clock options:

- F_{OSC}/2
- F_{OSC}/4
- F_{OSC}/8
- F_{OSC}/16
- F_{OSC}/32
- F_{OSC}/64
- F_{RC} (dedicated internal oscillator)

For correct conversion, the A/D conversion clock (1/T_{AD}) must be selected to ensure a minimum T_{AD} of 1.6 μs. Table 12-1 shows a few T_{AD} calculations for selected frequencies.

TABLE 12-1: T_{AD} VS. DEVICE OPERATING FREQUENCIES

A/D Clock Source (T_{AD})		Device Frequency			
Operation	**ADCS2:ADCS0**	**20 MHz**	**5 MHz**	**4 MHz**	**1.25 MHz**
2 T_{OSC}	000	100 ns(2)	400 ns(2)	500 ns(2)	1.6 μs
4 T_{OSC}	100	200 ns(2)	800 ns(2)	1.0 μs(2)	3.2 μs
8 T_{OSC}	001	400 ns(2)	1.6 μs	2.0 μs	6.4 μs
16 T_{OSC}	101	800 ns(2)	3.2 μs	4.0 μs	12.8 μs(3)
32 T_{OSC}	010	1.6 μs	6.4 μs	8.0 μs(3)	25.6 μs(3)
64 T_{OSC}	110	3.2 μs	12.8 μs(3)	16.0 μs(3)	51.2 μs(3)
A/D RC	x11	2-6 μs(1), (4)	2-6 μs(1), (4)	2-6 μs(1), (4)	2-6 μs(1), (4)

Legend: Shaded cells are outside of recommended range.

Note 1: The A/D RC source has a typical T_{AD} time of 4 μs for V_{DD} > 3.0V.

2: These values violate the minimum required T_{AD} time.

3: For faster conversion times, the selection of another clock source is recommended.

4: When the device frequency is greater than 1 MHz, the A/D RC clock source is only recommended if the conversion will be performed during Sleep.

REGISTER 12-3: ADCON0: A/D CONTROL REGISTER

R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0
ADFM	VCFG	CHS3	CHS2	CHS1	CHS0	GO/$\overline{\text{DONE}}$	ADON
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 7 **ADFM:** A/D Result Formed Select bit
1 = Right justified
0 = Left justified

bit 6 **VCFG**: Voltage Reference bit
1 = V_{REF} pin
0 = V_{DD}

bit 5-2 **CHS<3:0>:** Analog Channel Select bits
0000 = Channel 00 (AN0)
0001 = Channel 01 (AN1)
0010 = Channel 02 (AN2)
0011 = Channel 03 (AN3)
0100 = Channel 04 (AN4)
0101 = Channel 05 (AN5)
0110 = Channel 06 (AN6)
0111 = Channel 07 (AN7)
1000 = Channel 08 (AN8)
1001 = Channel 09 (AN9)
1010 = Channel 10 (AN10)
1011 = Channel 11 (AN11)
1100 = CV_{REF}
1101 = VR
1110 = Reserved. Do not use.
1111 = Reserved. Do not use.

bit 1 **GO/$\overline{\text{DONE}}$:** A/D Conversion Status bit
1 = A/D conversion cycle in progress. Setting this bit starts an A/D conversion cycle.
This bit is automatically cleared by hardware when the A/D conversion has completed.
0 = A/D conversion completed/not in progress

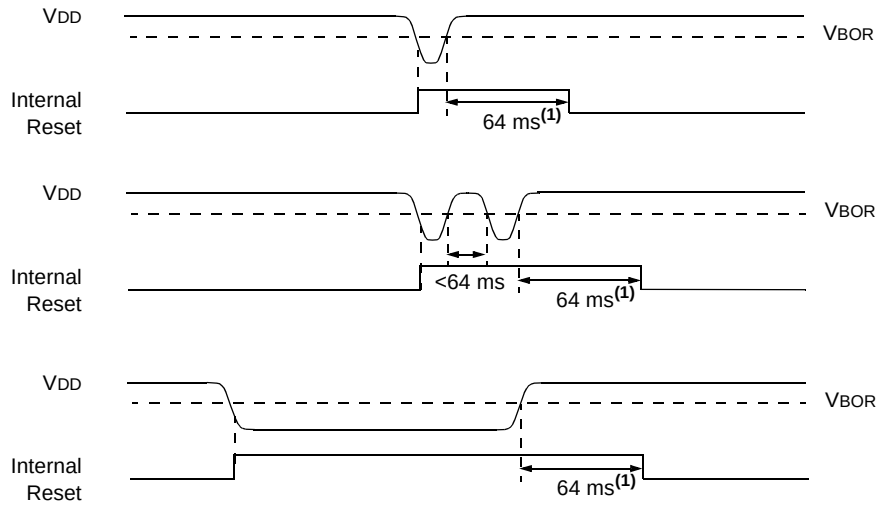
bit 0 **ADON:** A/D Enable bit
1 = A/D converter module is enabled
0 = A/D converter is shut-off and consumes no operating current

15.2.5 BOR CALIBRATION

The PIC16F785/HV785 stores the BOR calibration values in fuses located in the Calibration Word (2008h). The Calibration Word is not erased when using the specified bulk erase sequence in the "PIC16F785/HV785 *Memory Programming Specification*" (DS41237) and thus, does not require reprogramming.

Note:	Address 2008h is beyond the user program memory space. It belongs to the special configuration memory space (2000h-3FFFh), which can be accessed only during programming. See "*PIC16F785/HV785 Memory Programming Specification*" (DS41237) for more information.

FIGURE 15-3: BROWN-OUT SITUATIONS



Note 1: 64 ms delay only if $\overline{\text{PWRTE}}$ bit is programmed to '0'.

TABLE 19-3: PRECISION INTERNAL OSCILLATOR PARAMETERS

Param No.	Sym	Characteristic	Freq. Tolerance	Min	Typ†	Max	Units	Conditions
F10	FOSC	Internal Calibrated INTOSC Frequency(1)	±1%	7.92	8.00	8.08	MHz	VDD = 3.5V, 25°C
			±2%	7.84	8.00	8.16	MHz	2.5V ≤ VDD ≤ 5.5V 0°C ≤ TA ≤ +85°C
			±5%	7.60	8.00	8.40	MHz	2.0V ≤ VDD ≤ 5.5V -40°C ≤ TA ≤ +85°C (Ind.) -40°C ≤ TA ≤ +125°C (Ext.)
F14	TIOSCST	Oscillator wake-up from Sleep start-up time*	—	—	12	24	µs	VDD = 2.0V, -40°C to +85°C
			—	—	7	14	µs	VDD = 3.0V, -40°C to +85°C
			—	—	6	11	µs	VDD = 5.0V, -40°C to +85°C

* These parameters are characterized but not tested.

† Data in 'Typ' column is at 5.0V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

Note 1: To ensure these oscillator frequency tolerances, VDD and VSS must be capacitively decoupled as close to the device as possible. 0.1 uF and 0.01 uF values in parallel are recommended.

FIGURE 19-5: RESET, WATCHDOG TIMER, OSCILLATOR START-UP TIMER AND POWER-UP TIMER TIMING

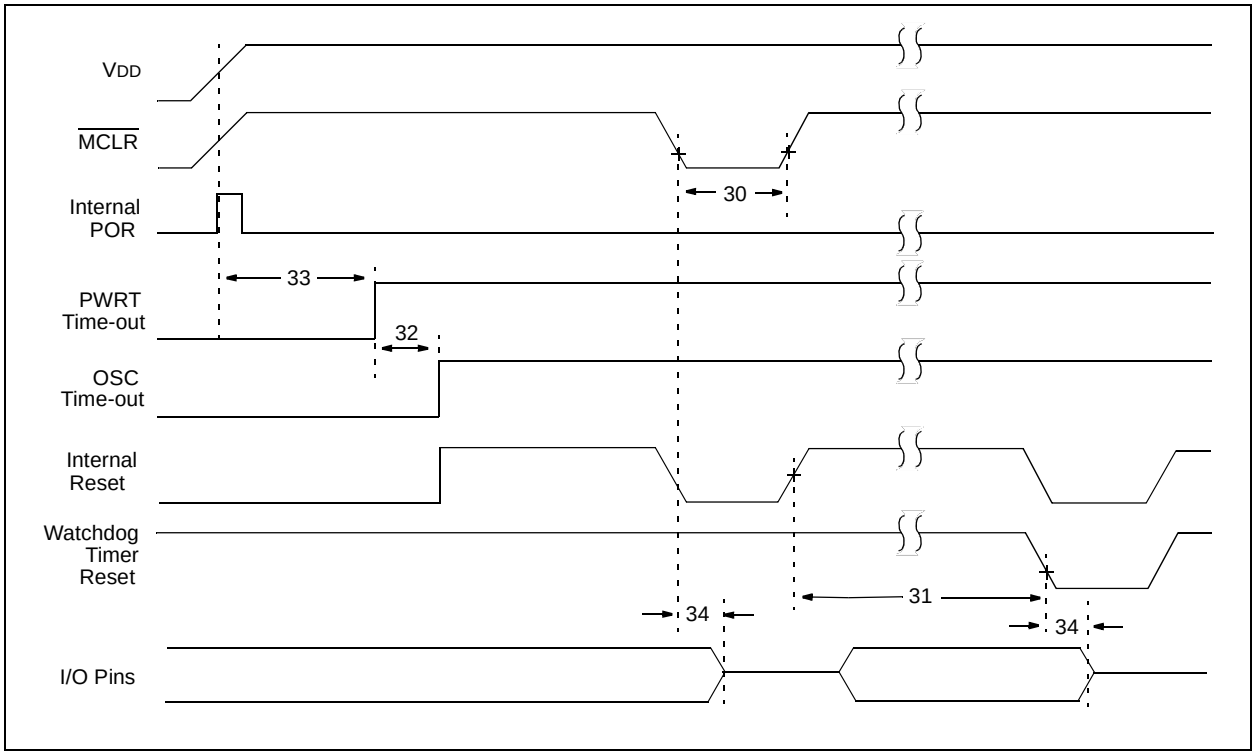


FIGURE 20-6: MAXIMUM IDD vs. VDD OVER FOSC (XT MODE)

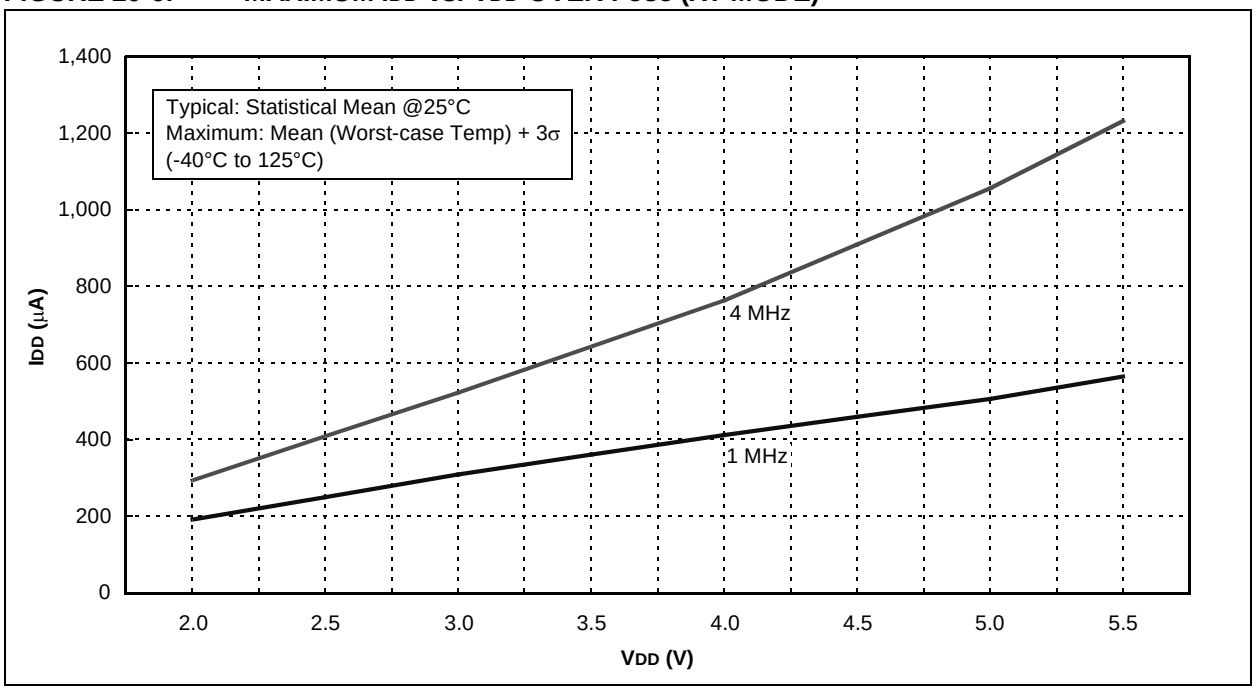


FIGURE 20-7: IDD vs. VDD (LP MODE)

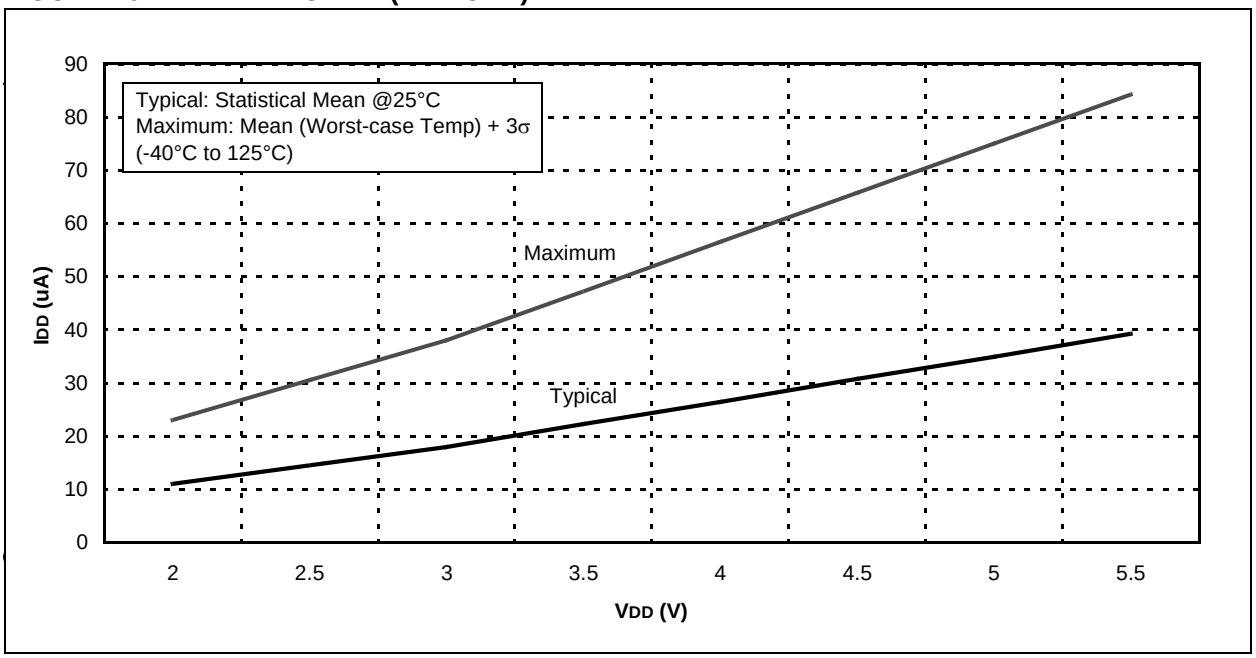


FIGURE 20-10: IDD vs. VDD OVER FOSC (LFINTOSC MODE, 31 kHz)

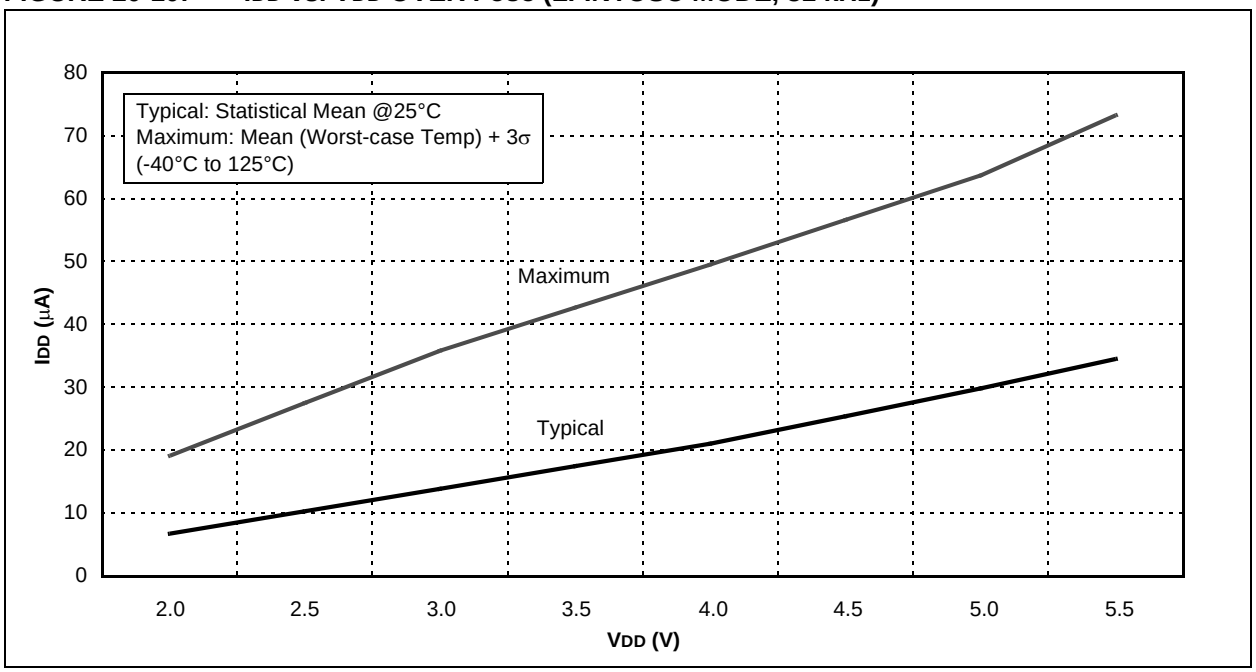


FIGURE 20-11: TYPICAL IDD vs. FOSC OVER VDD (HFINTOSC MODE)

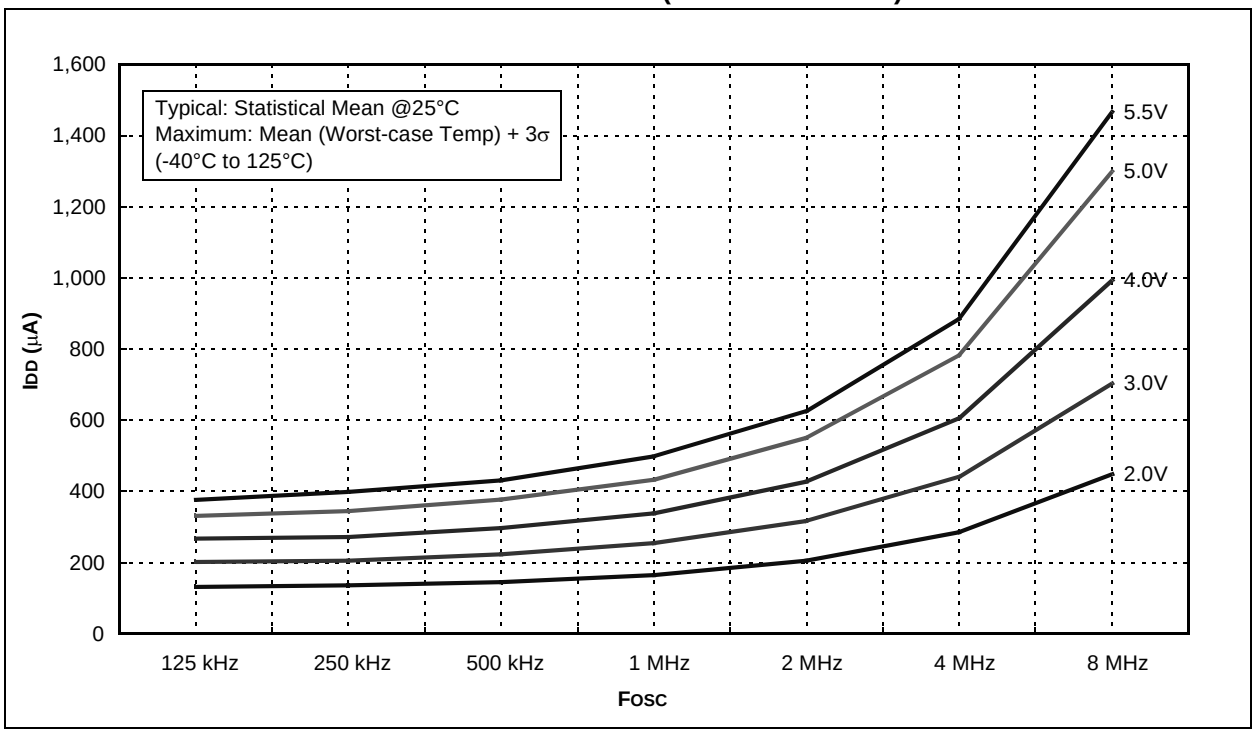


FIGURE 20-14: MAXIMUM IPD VS. VDD (SLEEP MODE, ALL PERIPHERALS DISABLED)

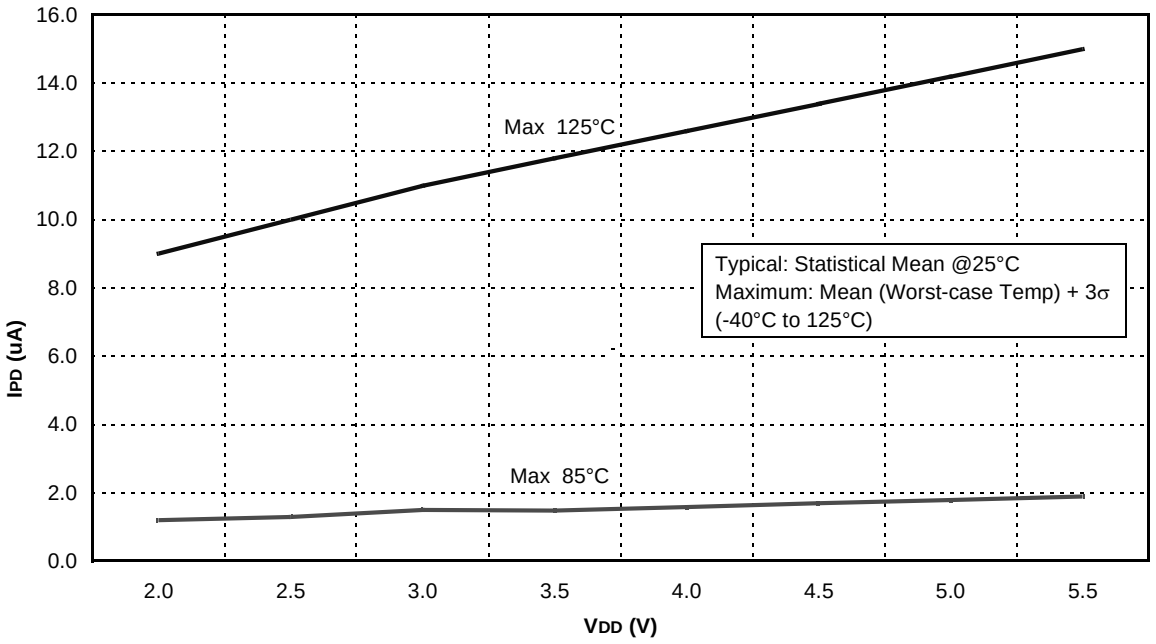


FIGURE 20-15: COMPARATOR IPD VS. VDD (BOTH COMPARATORS ENABLED)

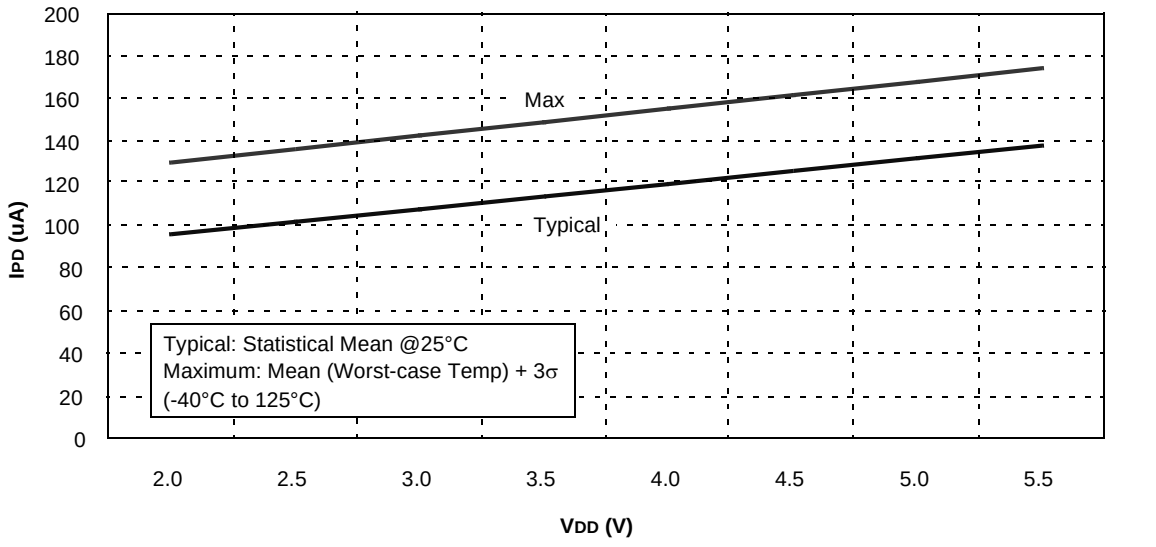


FIGURE 20-24: VOL VS. IOL OVER TEMPERATURE (VDD = 5.0V)

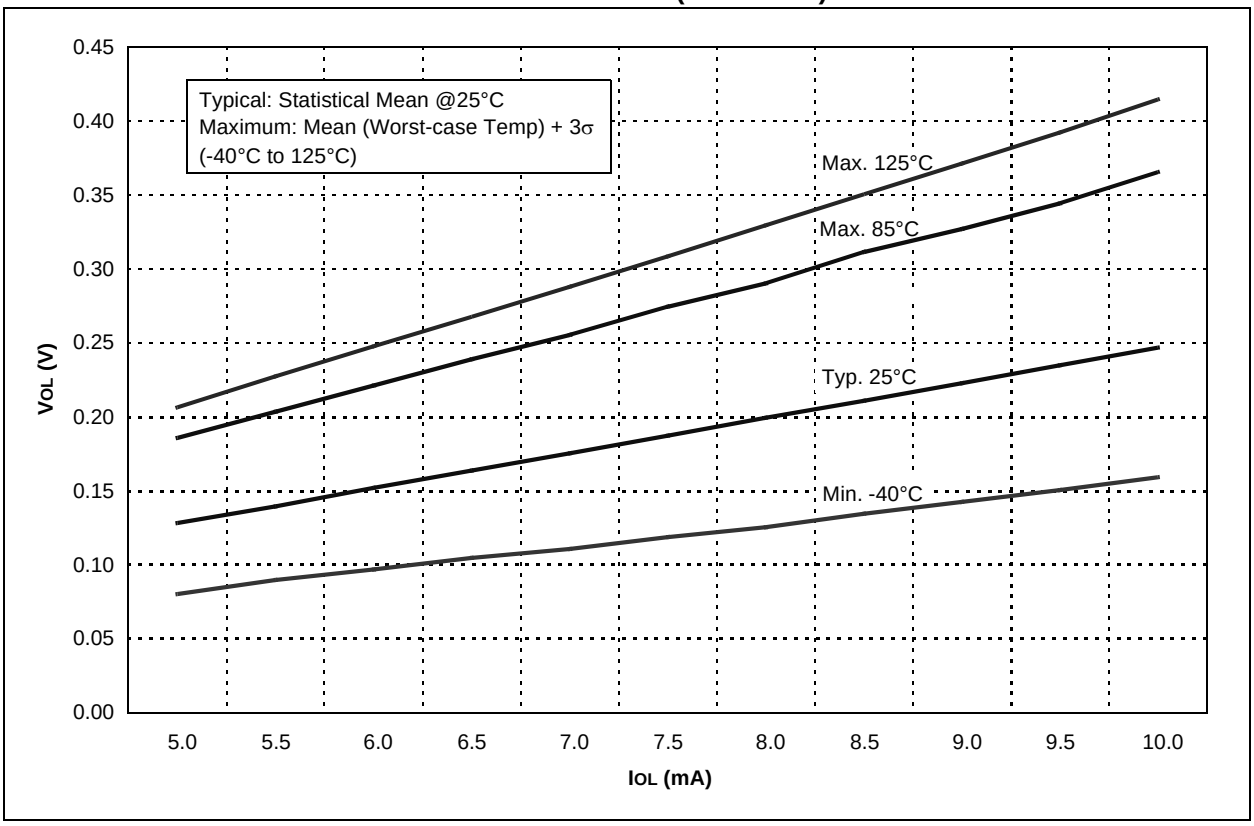
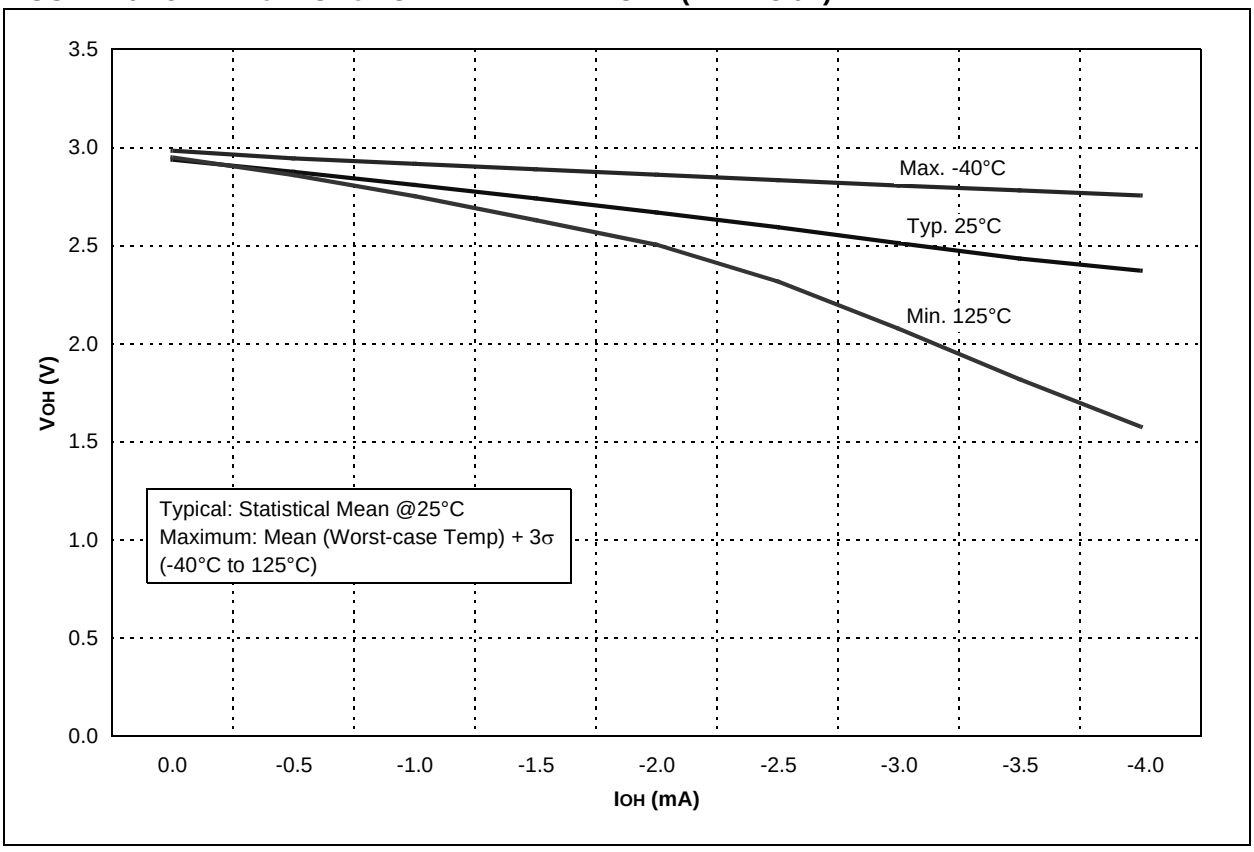
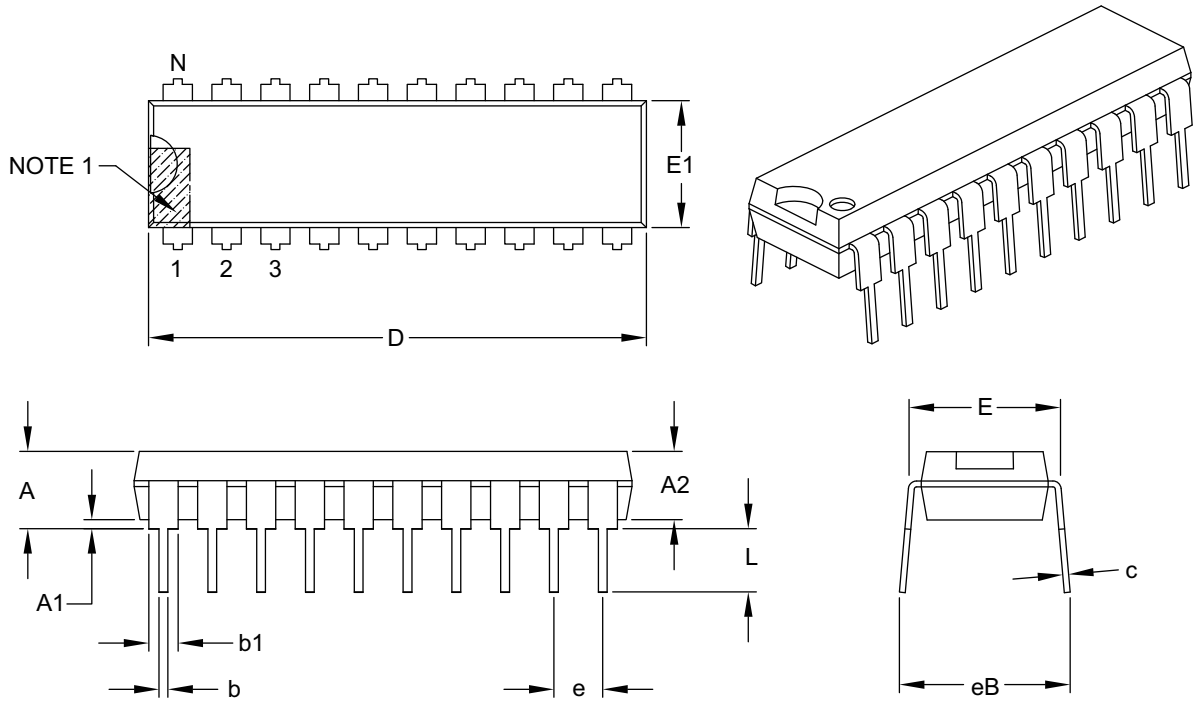


FIGURE 20-25: VOH VS. IOH OVER TEMPERATURE (VDD = 3.0V)



20-Lead Plastic Dual In-Line (P) – 300 mil Body [PDIP]

Note: For the most current package drawings, please see the Microchip Packaging Specification located at http://www.microchip.com/packaging



Units		INCHES		
Dimension Limits		MIN	NOM	MAX
Number of Pins	N		20	
Pitch	e		.100 BSC	
Top to Seating Plane	A	–	–	.210
Molded Package Thickness	A2	.115	.130	.195
Base to Seating Plane	A1	.015	–	–
Shoulder to Shoulder Width	E	.300	.310	.325
Molded Package Width	E1	.240	.250	.280
Overall Length	D	.980	1.030	1.060
Tip to Seating Plane	L	.115	.130	.150
Lead Thickness	c	.008	.010	.015
Upper Lead Width	b1	.045	.060	.070
Lower Lead Width	b	.014	.018	.022
Overall Row Spacing §	eB	–	–	.430

Notes:

1. Pin 1 visual index feature may vary, but must be located within the hatched area.
2. § Significant Characteristic.
3. Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .010" per side.
4. Dimensioning and tolerancing per ASME Y14.5M.

BSC: Basic Dimension. Theoretically exact value shown without tolerances.

Microchip Technology Drawing C04-019B

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PART NO.	X	/XX	XXX
Device	Temperature Range	Package	Pattern

Device:	PIC16F785[(1)], PIC16HV785[(1)], PIC16F785T[(2)], PIC16HV785T[(2)]; VDD range 4.2V to 5.5V PIC16F785[(1)], PIC16HV785[(1)], PIC16F785T[(2)], PIC16HV785T[(2)]; VDD range 2.0V to 5.5V
Temperature Range:	I = -40°C to +85°C Industrial) E = -40°C to +125°C Extended)
Package:	ML = QFN P = PDIP SO = SOIC SS = SSOP
Pattern:	QTP, SQTP, Code or Special Requirements (blank otherwise)

Examples:

a) PIC16F785 - E/SO 301 = Extended temp., SOIC package.

b) PIC16F785 - I/ML = Industrial temp., QFN package.

Note 1: F = Standard Voltage Range
LF = Wide Voltage Range

2: T = in tape and reel PLCC, and TQFP packages only.