

dsPIC30F5011/5013 Family Silicon Errata and Data Sheet Clarification

The dsPIC30F5011/5013 family devices that you have received conform functionally to the current Device Data Sheet (DS70116J), except for the anomalies described in this document.

The silicon issues discussed in the following pages are for silicon revisions with the Device and Revision IDs listed in [Table 1](#). The silicon issues are summarized in [Table 2](#).

The errata described in this document will be addressed in future revisions of the dsPIC30F5011/5013 silicon.

Note: This document summarizes all silicon errata issues from all revisions of silicon, previous as well as current. Only the issues indicated in the last column of [Table 2](#) apply to the current silicon revision (**A5**).

Data Sheet clarifications and corrections start on [page 20](#), following the discussion of silicon issues.

The silicon revision level can be identified using the current version of MPLAB® IDE and Microchip's programmers, debuggers and emulation tools, which are available at the Microchip corporate web site (www.microchip.com).

For example, to identify the silicon revision level using MPLAB IDE in conjunction with MPLAB ICD 3 or PICKit™ 3:

1. Using the appropriate interface, connect the device to the MPLAB ICD 3 programmer/debugger or PICKit 3.
2. From the main menu in MPLAB IDE, select *Configure>Select Device*, and then select the target part number in the dialog box.
3. Select the MPLAB hardware tool (*Debugger>Select Tool*).
4. Perform a "Connect" operation to the device (*Debugger>Connect*). Depending on the development tool used, the part number *and* Device Revision ID value appear in the **Output** window.

Note: If you are unable to extract the silicon revision level, please contact your local Microchip sales office for assistance.

The Device and Revision ID values for the various dsPIC30F5011/5013 silicon revisions are shown in [Table 1](#).

TABLE 1: SILICON DEVREV VALUES

Part Number	Device ID ⁽¹⁾	Revision ID for Silicon Revision ⁽²⁾				
		A1	A2	A3 ⁽³⁾	A4 ⁽³⁾	A5
dsPIC30F5011	0x0080	0x1001	0x1002	0x1003	0x1003	0x1005
dsPIC30F5013	0x0081					

- Note 1:** The Device and Revision IDs (DEVID and DEVREV) are located at the last two implemented addresses in program memory.
- 2:** Refer to the "*dsPIC30F Flash Programming Specification*" (DS70102) for detailed information on Device and Revision IDs for your specific device.
- 3:** Contact Microchip Technical Support (<http://microchip.com/support>) for assistance in differentiating silicon revisions A3 and A4.

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TABLE 2: SILICON ISSUE SUMMARY

Module	Feature	Item Number	Issue Summary	Affected Revisions ⁽¹⁾				
				A1	A2	A3	A4	A5
CPU	MAC Class Instructions with ± 4 Address Modification	1.	Sequential MAC instructions, which prefetch data from Y data space using ± 4 address modification, will cause an address error trap.	X	X	X	X	X
CPU	DAW.b Instruction	2.	The Decimal Adjust instruction, DAW.b, may improperly clear the Carry bit, C (SR<0>).	X	X	X	X	X
PSV Operations	—	3.	In certain instructions, fetching one of the operands from program memory using Program Space Visibility (PSV) will corrupt specific bits in the STATUS Register, SR.	X	X	X	X	X
CPU	Nested DO Loops	4.	When using two DO loops in a nested fashion, terminating the inner level DO loop by setting the EDT bit (CORCON<11>) will produce unexpected results.	X	X	X	X	X
I ² C	Read Operations on I2CCON SFR	5.	Read operations performed on the I2CCON Special Function Register (SFR) may yield incorrect results at operation over 20 MIPS.	X	X	X	X	X
I ² C	Write Operations on I2CTRN SFR	6.	Write operations performed on the I2CTRN SFR may yield incorrect results at operation over 20 MIPS.	X	X	X	X	X
UART	Write Operations on U1MODE and U2MODE SFRs	7.	Write operations performed on the U1MODE and U2MODE SFRs may yield incorrect results at operation over 20 MIPS.	X	X	X	X	X
DCI	Idle Mode	8.	The DCI module should not be stopped when the device enters Idle mode.	X	X	X	X	X
PLL	4x Mode	9.	The 4x PLL mode of operation may not function correctly for certain input frequencies.	X	X	X	X	X
Interrupt Controller	—	10.	An interrupt occurring immediately after modifying the CPU IPL, interrupt IPL, interrupt enable or interrupt flag may cause an address error trap.	X	X	X	X	X
CPU	DISI Instruction	11.	The DISI instruction will not disable interrupts if a DISI instruction is executed in the same instruction cycle that the DISI counter decrements to zero.	X	X	X	X	X
Output Compare	PWM Mode	12.	Output compare will produce a glitch when loading 0% duty cycle in PWM mode. It will also miss the next compare after the glitch.	X	X	X	X	X
Output Compare	—	13.	The output compare module will produce a glitch on the output when an I/O pin is initially set high and the module is configured to drive the pin low at a specified time.	X	X	X	X	X
ADC	Sleep Mode	14.	ADC event triggers from the INT0 pin will not wake-up the device from Sleep mode if the SMP1<3:0> bits are non-zero.	X	X	X	X	X
PLL	8x Mode	15.	If 8x PLL mode is used, the input frequency range is 5 MHz-10 MHz instead of 4 MHz-10 MHz.	X	X	X	X	X
Sleep Mode	—	16.	Execution of the SLEEP instruction (PWRSAV #0) may cause incorrect program operation after the device wakes up from Sleep. The current consumption during Sleep may also increase beyond the specifications listed in the device data sheet.	X	X	X		

Note 1: Only those issues indicated in the last column apply to the current silicon revision.

TABLE 2: SILICON ISSUE SUMMARY (CONTINUED)

Module	Feature	Item Number	Issue Summary	Affected Revisions ⁽¹⁾				
				A1	A2	A3	A4	A5
I ² C	Slave Mode	17.	The I ² C module loses incoming data bytes when operating as an I ² C slave.	X	X	X	X	X
I/O	Port Pin Multiplexed with IC1	18.	The Port I/O pin multiplexed with the Input Capture 1 (IC1) function cannot be used as a digital input pin when the UART auto-baud feature is enabled.	X	X	X	X	X
I ² C	10-Bit Addressing	19.	When the I ² C module is configured for 10-Bit Addressing using the same address bits (A10 and A9) as other I ² C devices, the A10 and A9 bits may not work as expected.	X	X	X	X	X
Timer	Sleep Mode	20.	Clock switching prevents the device from waking up from Sleep.	X	X	X	X	X
PLL	Lock Status bit	21.	The PLL LOCK status bit (OSCCON<5>) can occasionally get cleared and generate an oscillator failure trap even when the PLL is still locked and functioning correctly.	X	X	X	X	X
PSV Operations	—	22.	An address error trap occurs in certain addressing modes when accessing the first four bytes of any PSV page.	X	X	X	X	X
I ² C	10-Bit Addressing	23.	The 10-bit slave does not set the RBF flag or load the I2CRCV register on address match if the Least Significant bits (LSbs) of the address are the same as the 7-bit reserved addresses.	X	X	X	X	X
I ² C	10-Bit Addressing	24.	When the I ² C module is configured as a 10-bit slave with an address of 0x102, the I2CRCV register content for the lower address byte is 0x01, rather than 0x02.	X	X	X	X	X
I ² C	Bus Collision	25.	When the I ² C module is enabled, the dsPIC [®] DSC device generates a glitch on the SDA and SCL pins, causing a false communication start in a single master configuration or a bus collision in a multi-master configuration.	X	X	X	X	X
Data EEPROM	—	26.	The Most Significant bit (MSb) of every fourth byte in data EEPROM may be corrupted.	X	X			
Flash Memory	IDD Current	27.	This release of silicon exhibits a current draw (IDD) of approximately 190 mA during a row erase operation performed on program Flash memory.	X	X			
I/O	RC15 Pin for Digital I/O	28.	For this revision of silicon, if the RC15 pin is required for digital input/output, the FPR<3:0> bits in the FOSC Configuration register may not be set up for FRC w/PLL 4x/8x/16x modes.	X	X			
CAN	RX Filters 3, 4 and 5	29.	CAN Receive Filters 3, 4 and 5 may not work for a given combination of instruction cycle speed and CAN bit time quanta.	X	X	X	X	X
ADC	Current Consumption in Sleep Mode	30.	If the ADC module is in an enabled state when the device enters Sleep mode, the Power-Down Current (IPD) of the device may exceed the device data sheet specifications.	X	X	X	X	X
CAN	Transmit Buffers	31.	Data may not be transmitted correctly if the number of transmit buffers is greater than 1.	X	X	X	X	X

Note 1: Only those issues indicated in the last column apply to the current silicon revision.

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Silicon Errata Issues

Note: This document summarizes all silicon errata issues from all revisions of silicon, previous as well as current. Only the issues indicated by the shaded column in the following tables apply to the current silicon revision (**A5**).

1. Module: CPU

Sequential MAC class instructions, which prefetch data from Y data space using ± 4 address modification, will cause an address error trap. The trap occurs only when all of the following conditions are true:

1. Two sequential MAC class instructions (or a MAC class instruction executed in a REPEAT or DO loop) that prefetch from Y data space.
2. Both instructions prefetch data from Y data space using the $+ = 4$ or $- = 4$ address modification.
3. Neither of the instructions uses an accumulator write-back.

Work around

The problem described above can be avoided by using any of the following methods:

1. Inserting any other instruction between the two MAC class instructions.
2. Adding an accumulator write-back (a dummy write-back if needed) to either of the MAC class instructions.
3. Do not use the $+ = 4$ or $- = 4$ address modification.
4. Do not prefetch data from Y data space.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

2. Module: CPU

The Decimal Adjust instruction, DAW.b, may improperly clear the Carry bit, C (SR<0>), when executed.

Work around

Check the state of the Carry bit prior to executing the DAW.b instruction. If the Carry bit is set, set the Carry bit again after executing the DAW.b instruction. [Example 1](#) shows how the application should process the Carry bit during a BCD addition operation.

EXAMPLE 1: CHECK CARRY BIT BEFORE DAW.b

```
.include "p30f5013.inc"
.....
MOV.b #0x80, w0 ;First BCD number
MOV.b #0x80, w1 ;Second BCD number
ADD.b w0, w1, w2 ;Perform addition
BRA NC, L0 ;If C set go to L0
DAW.b w2 ;If not, do DAW and
BSET.b SR, #C ;set the carry bit
BRA L1 ;and exit
L0:DAW.b w2
L1: ....
```

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

3. Module: PSV Operations

When one of the operands of instructions shown in [Table 3](#) is fetched from program memory using Program Space Visibility (PSV), the STATUS Register, SR, and/or the results may be corrupted.

These instructions are identified in [Table 3](#). [Example 2](#) demonstrates one scenario where this occurs.

Also, always use Work around 2 if the C compiler is used to generate code for dsPIC30F5011/5013 devices.

TABLE 3: AFFECTED INSTRUCTIONS

Instruction ⁽¹⁾	Examples of Incorrect Operation ⁽²⁾	Data Corruption IN
ADDC	ADDC W0, [W1++], W2 ;	SR<1:0> bits ⁽³⁾ , Result in W2
SUBB	SUBB.b W0, [++W1], W3 ;	SR<1:0> bits ⁽³⁾ , Result in W3
SUBBR	SUBBR.b W0, [++W1], W3 ;	SR<1:0> bits ⁽³⁾ , Result in W3
CPB	CPB W0, [W1++], W4 ;	SR<1:0> bits ⁽³⁾
RLC	RLC [W1], W4 ;	SR<1:0> bits ⁽³⁾ , Result in W4
RRC	RRC [W1], W2 ;	SR<1:0> bits ⁽³⁾ , Result in W2
ADD (Accumulator-based)	ADD [W1++], A ;	SR<1:0> bits ⁽³⁾
LAC	LAC [W1], A ;	SR<15:10> bits ⁽⁴⁾

- Note 1:** Refer to the “16-bit MCU and DSC Programmer’s Reference Manual” (DS70157) for details on the dsPIC30F instruction set.
- 2:** The errata only affects these instructions when a PSV access is performed to fetch one of the source operands in the instruction. A PSV access is performed when the Effective Address (EA) of the source operand is greater than 0x8000 and the PSV bit (CORCON<2>) is set to ‘1’. In the examples shown, the data access from program memory is made via the W1 register.
- 3:** SR<1:0> bits represent Sticky Zero and Carry Status bits, respectively.
- 4:** SR<15:10> bits represent Accumulator Overflow and Saturation Status bits.

EXAMPLE 2: INCORRECT RESULTS

```
.include "p30fxxxx.inc"
.....
MOV.B #0x00, W0 ;Load PSVPAG register
MOV.B WREG, PSVPAG
BSET CORCON, #PSV ;Enable PSV
....
MOV #0x8200, W1 ;Set up W1 for
;indirect PSV access
;from 0x000200
ADD W3, [W1++], W5 ;This instruction
;works ok
ADDC W4, [W1++], W6 ;Carry flag and W5
;gets corrupted here!
```

Work arounds

Work around 1: For Assembly Language Source Code

To work around the erratum in the MPLAB® ASM30 assembler, the application may perform a PSV access to move the source operand from program memory to RAM, or a W register, prior to performing the operations listed in [Table 3](#). The work around for [Example 2](#) is demonstrated in [Example 3](#).

EXAMPLE 3: CORRECT RESULTS

```
.include "p30fxxxx.inc"
.....
MOV.B #0x00, w0 ;Load PSVPAG register
MOV.B WREG, PSVPAG
BSET CORCON, #PSV ;Enable PSV
....
MOV #0x8200, W1 ;Set up W1 for
;indirect PSV access
;from 0x000200
ADD W3, [W1++], W5 ;This instruction
;works ok
MOV [W1++], W2 ;Load W2 with data
;from program memory
ADDC W4, W2, W6 ;Carry flag and W4
;results are ok!
```

Work around 2: For C Language Source Code

For applications using C language, MPLAB C30 Versions 1.20.04 or higher provide the following command-line switch that implements a work around for the erratum.

```
-merrata=psv
```

Refer to the `readme.txt` file in the MPLAB C30 v1.20.04 toolsuite for further details.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

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4. Module: CPU

When using two DO loops in a nested fashion, terminating the inner-level DO loop by setting the EDT bit (CORCON<11>) will produce unexpected results. Specifically, the device may continue executing code within the outer DO loop forever. This erratum does not affect the operation of the MPLAB C30 compiler.

Work around

The application should save the DCOUNT Special Function Register (SFR) prior to entering the inner DO loop and restore it upon exiting the inner DO loop. This work around is shown in [Example 4](#).

EXAMPLE 4: SAVE AND RESTORE DCOUNT

```
.include "p30fxxxx.inc"
.....
DO    #CNT1, LOOP0    ;Outer loop start
....
PUSH  DCOUNT        ;Save DCOUNT
DO    #CNT2, LOOP1    ;Inner loop
....
BTSS  Flag, #0
BSET  CORCON, #EDT    ;Terminate inner
....
                      ;DO-loop early
....
LOOP1: MOV    W1, W5    ;Inner loop ends
      POP    DCOUNT    ;Restore DCOUNT
      ...
LOOP0: MOV    W5, W8    ;Outer loop ends
```

Note: For details on the functionality of the EDT bit, see 2.9.2.4 “Early Termination of the DO Loop” in Section 2. “CPU” (DS70049) of the “dsPIC30F Family Reference Manual”.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

5. Module: I²C

Data read from the I2CCON Special Function Register may not be correct at device operation greater than 20 MIPS for VDD in the range of 4.5V to 5.5V (or 10 MIPS VDD in the range of 3V to 3.6V).

If the dsPIC[®] DSC device needs to operate at a throughput higher than 20 MIPS, the user should incorporate the suggested work around while reading the I2CCON SFR.

Applications that use I²C software functions from Microchip’s dsPIC30F Peripheral Library should operate the device at 20 MIPS or less.

Work arounds

Work around 1: For Assembly Language Source Code

When reading the I2CCON SFR, perform two consecutive read operations of the same SFR. The work around is demonstrated in [Example 5](#). In this example, a Memory Direct Addressing mode is used to read the SFR. The application may use any addressing mode to perform the read operation. Note that interrupts must be temporarily disabled, as shown, so that the two consecutive reads do not get interrupted.

EXAMPLE 5: CONSECUTIVE READS

```
.include "p30fxxxx.inc"
.....
PUSH  SR
BSET  SR, #IPL2
BSET  SR, #IPL1
BSET  SR, #IPL0
MOV   I2CCON, W0    ; first SFR read
MOV   I2CCON, W0    ; second SFR read
POP   SR
```

Work around 2: For C Language Source Code

For C programmers, the MPLAB C30 v1.20.02 toolsuite provides a built-in function that may be incorporated in the application source code. This function may be used to read the I2CCON SFR. Some examples of usage are shown in the `readme.txt` file provided with the MPLAB C30 v1.20.02 toolsuite. The function has the following prototype:

```
unsigned __builtin_read sfr(volatile void *);
```

The special argument is the address of a 16-bit SFR (I2CCON in this case). This function should only be used to read the I2CCON Special Function Register. For example, the I2CCON register can be read using a function call:

```
reg_value = __builtin_read sfr(&I2CCON);
```

where `reg_value` is the 16-bit value read from the SFR.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

6. Module: I²C

Data writes to the I2CTRN Special Function Register may not be correct at device operation greater than 20 MIPS for V_{DD} in the range of 4.5V to 5.5V (or 10 MIPS V_{DD} in the range of 3V to 3.6V).

If the dsPIC[®] DSC device needs to operate at a throughput higher than 20 MIPS, the user should incorporate the suggested work around while writing to the I2CTRN SFR.

Applications that use I²C software functions from Microchip's dsPIC30F Peripheral Library should operate the device at 20 MIPS or less.

Work arounds

Work around 1: For Assembly Language Source Code

When writing to the I2CTRN SFR, the user must follow the write sequence shown in [Example 6](#). In this example, a Memory Direct Addressing mode is used to write to the SFR. The application may use any addressing mode to perform the write operation. Note that interrupts must be temporarily disabled, as shown, so that this write sequence does not get interrupted.

EXAMPLE 6: SPECIAL WRITE SEQUENCE

```

.include "p30fxxxx.inc"
.....
MOV    #reg_value, W1 ;I2CTRN value
PUSH  SR
BSET  SR, #IPL2
BSET  SR, #IPL1
BSET  SR, #IPL0
MOV   #I2CTRN, W0    ;write I2CTRN
                        ;address to W0
MOV   W0, W0         ;perform a direct
                        ;write to W0
MOV   W1, I2CTRN    ;write to I2CTRN
POP   SR
    
```

Work around 2: For C Language Source Code

For C programmers, the MPLAB C30 v1.30 toolsuite provides a built-in function that may be incorporated in the application source code. This function may be used to write to the I2CTRN SFR. Some examples of usage are shown in the `readme.txt` file provided with the MPLAB C30 v1.30 toolsuite. The function has the following prototype:

```
void __builtin_writesfr(volatile void *,
                        unsigned int);
```

The special argument is the address of a 16-bit SFR (I2CTRN in this case). For example, the I2CTRN register can be written using a function call:

```
__builtin_writesfr(&I2CTRN, reg_value);
```

where `reg_value` is the 16-bit value to be written to the SFR.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

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7. Module: UART

Data writes to the U1MODE and U2MODE Special Function Registers may not be correct at device operation greater than 20 MIPS for VDD in the range of 4.5V to 5.5V (or 10 MIPS VDD in the range of 3V to 3.6V).

If the dsPIC DSC device needs to operate at a throughput higher than 20 MIPS, the user should incorporate the suggested work around while writing to the U1MODE or U2MODE SFR.

Applications that use UART software functions from Microchip's dsPIC30F Peripheral Library should operate the device at 20 MIPS or less.

Work arounds

Work around 1: For Assembly Language Source Code

When writing to the U1MODE (or U2MODE) SFR, the user must follow the write sequence shown in [Example 7](#). In this example, a Memory Direct Addressing mode is used to write to the SFR. The application may use any addressing mode to perform the write operation. Note that interrupts must be temporarily disabled, as shown, so that this write sequence does not get interrupted.

EXAMPLE 7: SPECIAL WRITE SEQUENCE

```
.include "p30fxxxx.inc"
.....
MOV    #reg_value, W1 ;U1MODE value
PUSH  SR
BSET  SR, #IPL2
BSET  SR, #IPL1
BSET  SR, #IPL0
MOV    #U1MODE, W0    ;write U1MODE
                        ;address to W0
MOV    W0, W0         ;perform a direct
                        ;write to W0
MOV    W1, U1MODE     ;write to U1MODE
POP   SR
```

Work around 2: For C Language Source Code

For C programmers, the MPLAB C30 v1.30 toolsuite provides a built-in function that may be incorporated in the application source code. This function may be used to write to the U1MODE and U2MODE SFRs. Some examples of usage are shown in the `readme.txt` file provided with the MPLAB C30 v1.30 toolsuite. The function has the following prototype:

```
void __builtin_writesfr(volatile void *,
                        unsigned int);
```

The special argument is the address of a 16-bit SFR (U1MODE or U2MODE in this case). For example, the U1MODE register can be written using a function call:

```
__builtin_writesfr(&U1MODE, reg_value);
```

where `reg_value` is the 16-bit value to be written to the SFR.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

8. Module: DCI

For this release of silicon, the DCI module should not be stopped when the device enters Idle mode.

Work around

Do not set the DCISIDL bit (DCICON1<13>). This will ensure the DCI module continues to run when the device enters Idle mode.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

9. Module: PLL

When the 4x PLL mode of operation is selected, the specified input frequency range of 4 MHz-10 MHz is not fully supported.

When device VDD is 2.5V-3.0V, the 4x PLL input frequency must be in the range of 4 MHz-5 MHz. When device VDD is 3.0V-3.6V, the 4x PLL input frequency must be in the range of 4 MHz-6 MHz for both industrial and extended temperature ranges.

Work around

1. Use 8x PLL or 16x PLL mode of operation and set the final device clock speed using the POST<1:0> oscillator postscaler control bits (OSCCON<7:6>).
2. Use the EC without PLL Clock mode with a suitable clock frequency to obtain the equivalent 4x PLL clock rate.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

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10. Module: Interrupt Controller

The following sequence of events will lead to an address error trap. The generic term, "Interrupt 1", is used to represent any enabled dsPIC30F interrupt.

1. User software performs one of the following operations:
 - CPU IPL is raised to Interrupt 1 IPL level or higher, or
 - Interrupt 1 IPL is lowered to CPU IPL level or lower, or
 - Interrupt 1 is disabled (Interrupt 1 IE bit set to '0'), or
 - Interrupt 1 flag is cleared
2. Interrupt 1 occurs between 2 and 4 instruction cycles after any of the operations listed above.

Work arounds

Work around 1: For Assembly Language Source Code

The user may disable interrupt nesting, disable interrupts before modifying the Interrupt 1 setting, or execute a DISI instruction before modifying the CPU IPL or Interrupt 1. A minimum DISI value of 4 is required if the DISI instruction is executed immediately before the CPU IPL or Interrupt 1 is modified, as shown in [Example 8](#). It is necessary to have DISI active for four cycles after the CPU IPL or Interrupt 1 is modified.

EXAMPLE 8: USING DISI

```
.include "p30fxxxx.inc"
...
DISI #4          ; protect the disable
; of INT1
BCLR IE1, #INT1IE ; disable interrupt 1
... ; next instruction
;protected by DISI
```

EXAMPLE 10: USING SET_AND_SAVE_CPU_IPL AND RESTORE_CPU_IPL MACROS

```
// Note: Macros defined in device include files
#define SET_AND_SAVE_CPU_IPL (save_to, ipl){ \
save_to = SRbits.IPL; \
SET_CPU_IPL (ipl); } (void) 0;

#define RESTORE_CPU_IPL (saved_to) SET_CPU_IPL (saved_to)

#include "p30fxxxx.h"
...
int save_to;
SET_AND_SAVE_CPU_IPL (save_to, 3)
...
RESTORE_CPU_IPL (save_to)
```

Work around 2: For C Language Source Code

Applications using the C language, MPLAB C30 Versions 1.32 and higher, provide several macros for modifying the CPU IPL. The SET_CPU_IPL macro provides the ability to safely modify the CPU IPL, as shown in [Example 9](#).

EXAMPLE 9: USING SET_CPU_IPL MACRO

```
// Note: Macro defined in device include
// files
#define SET_CPU_IPL (ipl){          \
int DISI_save;                    \
\
DISI_save = DISICNT;              \
asm volatile ("disi #0x3FFF"); \
SRbits.IPL = ipl;                 \
__builtin_nop();                  \
__builtin_nop();                  \
DISICNT = DISI_save; } (void) 0;

#include "p30fxxxx.h"
...
SET_CPU_IPL (3)
...
```

There is one level of DISI, so this macro saves and restores the DISI state. For temporarily modifying and restoring the CPU IPL, the macros, SET_AND_SAVE_CPU_IPL and RESTORE_CPU_IPL, can be used, as shown in [Example 10](#). These macros also make use of the macro, SET_CPU_IPL.

For modification of the Interrupt 1 setting, the INTERRUPT_PROTECT macro can be used. This macro disables interrupts before executing the desired expression, as shown in Example 11. This macro is not distributed with the compiler.

EXAMPLE 11: USING INTERRUPT_PROTECT MACRO

```
#define INTERRUPT_PROTECT (x) { \
int    save_sr; \
SET_AND_SAVE_CPU_IPL (save_sr, 7); \
x; \
RESTORE_CPU_IPL      (save_sr); } (void) 0;
. . .
INTERRUPT_PROTECT    (IEC0bits.U1TXIE=0);
```

Note: If you are using a MPLAB C30 compiler version earlier than Version 1.32, you may still use the macros by adding them to your application.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

11. Module: CPU

When a user executes a DISI #7, for example, this will disable interrupts for 7 + 1 cycles (7 + the DISI instruction itself). In this case, the DISI instruction uses a counter, which counts down from 7 to 0. The counter is loaded with 7 at the end of the DISI instruction.

If the user code executes another DISI on the instruction cycle where the DISI counter has become zero, the new DISI count is loaded, but the DISI state machine does not properly re-engage and continue to disable interrupts. At this point, all interrupts are enabled. The next time the user code executes a DISI instruction, the feature will act normally and block interrupts.

In summary, it is only when a DISI execution is coincident with the current DISI count = 0 that the issue occurs. Execute a DISI instruction before the DISI counter is loaded with the new value and leave interrupts disabled until the counter becomes zero.

Work around

When executing multiple DISI instructions within the source code, make sure that subsequent DISI instructions have at least one instruction cycle between the time that the DISI counter decrements to zero and the next DISI instruction. Alternatively, make sure that the subsequent DISI instructions are called before the DISI counter decrements to zero.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

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12. Module: Output Compare

If the desired duty cycle is '0' (OCxRS = 0), the module will generate a high-level glitch of 1 Tcy. The second problem is that on the next cycle after the glitch, the OC pin does not go high, or in other words, it misses the next compare for any value written on OCxRS.

Work arounds

There are two possible solutions to this problem:

1. Load a value greater than '0' to the OCxRS register when operating in PWM mode. In this case, no 0% duty cycle is achievable.
2. If the application requires 0% duty cycles, the output compare module can be disabled for 0% duty cycles and re-enabled for non-zero percent duty cycles.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

13. Module: Output Compare

A glitch will be produced on an output compare pin under the following conditions:

- The user software initially drives the I/O pin high using the output compare module or a write to the associated PORT register
- The output compare module is configured and enabled to drive the pin low at some point in later time (OCxCON = 0x0002 or OCxCON = 0x0003)

When these events occur, the output compare module will drive the pin low for one instruction cycle (Tcy) after the module is enabled.

Work around

None.

However, the user may use a timer interrupt and write to the associated PORT register to control the pin manually.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

14. Module: ADC

ADC event triggers from the INT0 pin will not wake-up the device from Sleep mode if the SMP1x bits are non-zero. This means that if the ADC is configured to generate an interrupt after a certain number of INT0 triggered conversions, the ADC conversions will not be triggered and the device will remain in Sleep. The ADC will perform conversions and wake-up the device only if it is configured to generate an interrupt after each INT0 triggered conversion (SMPI<3:0> = 0000).

Work around

None.

If an ADC event trigger from the INT0 pin is required, initialize SMPI<3:0> to '0000' (interrupt on every conversion).

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

15. Module: PLL

If 8x PLL mode is used, the input frequency range is 5 MHz-10 MHz instead of 4 MHz-10 MHz.

Work around

None.

If 8x PLL is used, make sure the input crystal or clock frequency is 5 MHz or greater.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

16. Module: Sleep Mode

Execution of the SLEEP instruction (PWRSAV #0) may cause incorrect program operation after the device wakes up from Sleep. The current consumption during Sleep may also increase beyond the specifications listed in the device data sheet.

Work arounds

To avoid this issue, implement any of the following three work arounds, depending on the application requirements.

Work around 1:

Ensure that the PWRSAV #0 instruction is located at the end of the last row of program Flash memory available on the target device and fill the remainder of the row with NOP instructions.

This can be accomplished by replacing all occurrences of the PWRSAV #0 instruction with a function call to a suitably aligned subroutine. The address() attribute provided by the MPLAB ASM30 assembler can be utilized to correctly align the instructions in the subroutine. For an application written in C, the function call would be GotoSleep(), while for an assembly language application, the function call would be CALL _GotoSleep.

The address error Trap Service Routine (TSR) software can then replace the invalid return address saved on the stack with the address of the instruction immediately following the _GotoSleep or GotoSleep() function call. This ensures that the device continues executing the correct code sequence after waking up from Sleep mode.

[Example 12](#) demonstrates the work around described above.

EXAMPLE 12:

```

; -----
.global __reset
.global _main
.global _GotoSleep
.global __AddressError
.global __INT1Interrupt
; -----
.section *, code
_main:
    BSET    INTCON2, #INT1EP        ; Set up INT pins to detect falling edge
    BCLR    IFS1, #INT1IF         ; Clear interrupt pin interrupt flag bits
    BSET    IE1, #INT1IE         ; Enable ISR processing for INT pins
    CALL    _GotoSleep            ; Call function to enter SLEEP mode
_continue:
    BRA     _continue
; -----
; Address Error Trap
__AddressError:
    BCLR    INTCON1, #ADDRERR
    ; Set program memory return address to _continue
    POP.D   W0
    MOV.B   #tblpage (_continue), W1
    MOV     #tbloffset (_continue), W0
    PUSH.D  W0
    RETFIE
; -----
__INT1Interrupt:
    BCLR    IFS1, #INT1IF        ; Ensure flag is reset
    RETFIE                       ; Return from Interrupt Service Routine
; -----
.section *, code, address (0x1FC0)
_GotoSleep:
; fill remainders of the last row with NOP instructions
    .rept 31
        NOP
    .endr
; Place SLEEP instruction in the last word of program memory
    PWRSAV #0

```

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Work around 2:

Instead of executing a `PWRSVAV #0` instruction to put the device into Sleep mode, perform a clock switch to the 512 kHz Low-Power RC (LPRC) Oscillator with a 64:1 Postscaler mode. This enables the device to operate at 0.002 MIPS, thereby significantly reducing the current consumption of the device. Similarly, instead of using an interrupt to wake-up the device from Sleep mode, perform another clock switch back to the original oscillator source to resume normal operation. Depending on the device, refer to **Section 7. “Oscillator”** (DS70054) or **Section 29. “Oscillator”** (DS70268) in the “*dsPIC30F Family Reference Manual*” for more details on performing a clock switch operation.

Note: The above work around is recommended for users for whom application hardware changes are not possible.

Work around 3:

Instead of executing a `PWRSVAV #0` instruction to put the device into Sleep mode, perform a clock switch to the 32 kHz Low-Power (LP) Oscillator with a 64:1 Postscaler mode. This enables the device to operate at 0.000125 MIPS, thereby significantly reducing the current consumption of the device. Similarly, instead of using an interrupt to wake-up the device from Sleep mode, perform another clock switch back to the original oscillator source to resume normal operation. Depending on the device, refer to **Section 7. “Oscillator”** (DS70054) or **Section 29. “Oscillator”** (DS70268) in the “*dsPIC30F Family Reference Manual*” for more details on performing a clock switch operation.

Note: The above work around is recommended for users for whom application hardware changes are possible, and also for users whose application hardware already includes a 32 kHz LP Oscillator crystal.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X					

17. Module: I²C

When the I²C module is configured as a slave, either in Single Master or Multi-Master mode, the I²C receiver buffer is filled whether a valid slave address is detected or not. Therefore, an I²C receiver overflow condition occurs and this condition is indicated by the I2COV flag in the I2CSTAT register.

This overflow condition inhibits the ability to set the I²C receive interrupt flag (SI2CIF) when the last valid data byte is received. Therefore, the I²C slave Interrupt Service Routine (ISR) is not called and the I²C receiver buffer is not read prior to receiving the next data byte.

Work arounds

To avoid this issue, either of the following two work arounds can be implemented, depending on the application requirements.

Work around 1:

For applications in which the I²C receiver interrupt is not required, the following procedure can be used to receive valid data bytes:

1. Wait until the RBF flag is set.
2. Poll the I²C receiver interrupt SI2CIF flag.
3. If SI2CIF is not set in the corresponding Interrupt Flag Status register (IFSx), a valid address or data byte has not been received for the current slave. Execute a dummy read of the I²C Receiver Buffer, I2CRCV; this will clear the RBF flag. Go back to Step 1 until SI2CIF is set and then continue to Step 4.
4. If the SI2CIF bit is set in the corresponding Interrupt Flag Status register (IFSx), valid data has been received. Check the D_A flag to verify that an address or a data byte has been received.
5. Read the I2CRCV buffer to recover valid data bytes; this will also clear the RBF flag.
6. Clear the I²C receiver interrupt flag, SI2CIF.
7. Go back to Step 1 to continue receiving incoming data bytes.

Work around 2:

Use this work around for applications in which the I²C receiver interrupt is required. Assuming that the RBF and the I2COV flags in the I2CSTAT register are set due to previous data transfers in the I²C bus (i.e., between master and other slaves), the following procedure can be used to receive valid data bytes:

1. When a valid slave address byte is detected, the SI2CIF bit is set and the I²C slave Interrupt Service Routine is called; however, the RBF and I2COV bits are already set due to data transfers between other I²C nodes.
2. Check the status of the D_A flag and the I2COV flag in the I2CSTAT register when executing the I²C slave service routine.
3. If the D_A flag is cleared and the I2COV flag is set, an invalid data byte was received but a valid address byte was received. The overflow condition occurred because the I²C receive buffer was overflowing with previous I²C data transfers between other I²C nodes. This condition only occurs after a valid slave address was detected.
4. Clear the I2COV flag and perform a dummy read of the I²C Receiver Buffer, I2CRCV, to clear the RBF bit and recover the valid address byte. This action will also avoid the loss of the next data byte due to an overflow condition.
5. Verify that the recovered address byte matches the current slave address byte. If they match, the next data to be received is a valid data byte.
6. If the D_A flag and the I2COV flag are both set, a valid data byte was received and a previous valid data byte was lost. It will be necessary to code for handling this overflow condition.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

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18. Module: I/O

If the user application enables the auto-baud feature in the UART module, the I/O pin multiplexed with the IC1 (Input Capture 1) pin cannot be used as a digital input. However, the external interrupt function (INT1) can be used.

Work around

None.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

19. Module: I²C

If there are two I²C devices on the bus, one of them is acting as the master receiver and the other as the slave transmitter. If both devices are configured for 10-Bit Addressing mode, and have the same value in the A10 and A9 bits of their addresses, then when the slave select address is sent from the master, both the master and slave Acknowledge it. When the master sends out the read operation, both the master and the slave enter into Read mode and both of them transmit the data. The resultant data will be the ANDing of the two transmissions.

Work around

In all I²C devices, the addresses, as well as bits A10 and A9, should be different.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

20. Module: Timer

When the timer is being operated in Asynchronous mode using the Secondary Oscillator (32.768 kHz) and the device is put into Sleep mode, a clock switch to any other oscillator mode before putting the device to Sleep prevents the timer from waking the device from Sleep.

Work around

Do not clock switch to any other oscillator mode if the timer is being used in Asynchronous mode using the Secondary Oscillator (32.768 kHz).

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

21. Module: PLL

The PLL LOCK status bit (OSCCON<5>) can occasionally get cleared and generate an oscillator failure trap, even when the PLL is still locked and functioning correctly.

Work around

The user application must include an oscillator failure Trap Service Routine. In the Trap Service Routine, first inspect the status of the Clock Failure status bit (OSCCON<3>). If this bit is clear, return from the Trap Service Routine immediately and continue program execution.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

22. Module: PSV Operations

An address error trap occurs in certain addressing modes when accessing the first four bytes of a PSV page. This only occurs when using the following addressing modes:

- MOV.D
- Register Indirect Addressing (Word or Byte mode) with pre/post-decrement

Work around

Do not perform PSV accesses to any of the first four bytes using the above addressing modes. For applications using the C language, MPLAB C30 Version 3.11 or higher, provides the following command-line switch that implements a work around for the erratum.

```
-merrata=psv_trap
```

Refer to the `readme.txt` file in the MPLAB C30 v3.11 toolsuite for further details.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

23. Module: I²C

In 10-Bit Addressing mode, some address matches do not set the RBF flag or load the I²C Receive register, I2CRCV, if the lower address byte matches the reserved addresses. In particular, these include all addresses with the form, xx0000xxxx and xx1111xxxx, with the following exceptions:

- 001111000x
- 011111001x
- 101111010x
- 111111011x

Work around

Ensure that the lower address byte in 10-Bit Addressing mode does not match any 7-bit reserved addresses.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

24. Module: I²C

When the I²C module is configured as a 10-bit slave with an address of 0x102, the I2CRCV register content for the lower address byte is 0x01 rather than 0x02; however, the module Acknowledges both address bytes.

Work around

None.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

25. Module: I²C

When the I²C module is enabled by setting the I2CEN bit in the I2CCON register, the dsPIC DSC device generates a glitch on the SDA and SCL pins. This glitch falsely indicates a Communication Start to all devices on the I²C bus, and can cause a bus collision in a multi-master configuration.

Additionally, when the I2CEN bit is set, the S and P bits of the I²C module are set to the values, '1' and '0', respectively, which indicates a Communication Start condition.

Work arounds

To avoid this issue, either of the following two work arounds can be implemented, depending on the application requirements.

Work around 1:

In a single master environment, add a delay between enabling the I²C module and the first data transmission. The delay should be equal to or greater than the time it takes to transmit two data bits.

In the multi-master configuration, in addition to the delay, all other I²C masters should be synchronized and wait for the I²C module to be initialized before initiating any kind of communication.

Work around 2:

In dsPIC[®] DSC devices in which the I²C module is multiplexed with other modules that have precedence in the use of the pin, it is possible to avoid this glitch by enabling the higher priority module before enabling the I²C module.

Use the following procedure to implement this work around:

1. Enable the higher priority peripheral module that is multiplexed on the same pins as the I²C module.
2. Set up and enable the I²C module.

Disable the higher priority peripheral module that was enabled in Step 1.

Note: Work around 2 works only for devices that share the SDA and SCL pins with another peripheral that has a higher precedence over the port latch, such as the UART. The priority is shown in the pin diagram located in the data sheet. For example, if the SDA and SCL pins are shared with the UART and SPI pins, then the UART has higher precedence on the port latch pin.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

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26. Module: Data EEPROM

The Most Significant bit (MSb) of every fourth byte in data EEPROM may be corrupted on any write operation. This write corruption may occur while using either MPLAB ICD 2 or Run-Time Self-Programming (RTSP).

Figure 1 shows the first twelve bytes in data EEPROM and indicates the affected bits.

Work arounds

Work around 1:

Use program Flash memory instead of data EEPROM to store constant data.

Work around 2:

Use less than 16 bits in each word in the available data EEPROM, excluding the Most Significant bit.

Work around 3:

Avoid using every fourth byte. Example 13 shows how the ASM30 assembler can be used to allocate data in the EEPROM under this constraint.

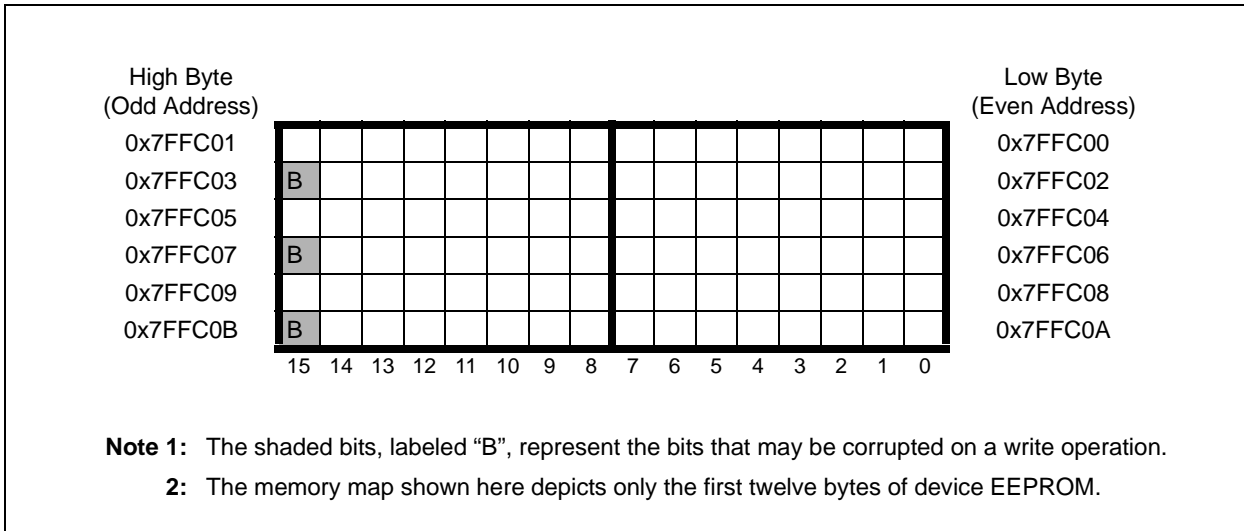
EXAMPLE 13:

```
.include "p30f5013.inc"
.section .eedata, "r"
.align 4
.hword 0xF345
.byte 0x23
.byte 0xFF ;Unused byte
.hword 0x1234
.byte 0x23
.byte 0xFF ;Unused byte"
```

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X						

FIGURE 1: dsPIC30F5011/5013 DATA EEPROM



27. Module: Flash Memory

This release of silicon draws a current (IDD) of approximately 190 mA during any row erase operation performed on program Flash memory.

Work arounds

Work around 1:

Supply the VDD pin using a voltage regulator capable of sourcing a minimum of 190 mA of current.

Work around 2:

When using a voltage regulator capable of driving 150 mA current, and if Brown-out Reset (BOR) is enabled for a VDD greater than or equal to 4.2V, then connect a 1000 μ F electrolytic capacitor across the VDD pin and ground.

If the row erase operation is performed as part of a RTSP operation, the user should ensure that the device is operating at less than 10 MIPS prior to the erase operation. To ensure the device is operating at less than 10 MIPS, the application may postscale the system clock or switch to the internal FRC Oscillator.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X						

28. Module: I/O

The port pin, RC15, is multiplexed with the Primary Oscillator pin, OSC2. When the RC15 pin is required for digital input/output, specific bits in the Oscillator Configuration register, FOSC, may be set up as follows:

- FOS<1:0> bits (FOSC<9:8>) configured for LP, LPRC, FRC, ECIO, ERCIO or ECIO w/PLL 4x/8x/16x
- FPR<3:0> bits (FOSC<3:0>) may be configured for ECIO w/PLL 4x/8x/16x

For this revision of silicon, if the RC15 digital I/O port function is desired, the FPR<3:0> bits in the FOSC Configuration register may not be set up for FRC w/PLL 4x/8x/16x modes.

Work around

None. In future revisions of silicon, port pin RC15 may also be configured for digital I/O when the FPR<3:0> bits in the FOSC Configuration register are set up for FRC w/PLL 4x/8x/16x modes.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X						

29. Module: CAN

CAN Receive Filters 3, 4 and 5 may not work for a given combination of instruction cycle speed and CAN bit time quanta.

Work around

Do not use CAN RX Filters 3, 4 and 5; instead, use Filters 0, 1 and 2.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

30. Module: ADC

If the ADC module is in an enabled state when the device enters Sleep mode as a result of executing a PWRSAV #0 instruction, the device Power-Down Current (IPD) may exceed the specifications listed in the device data sheet. This may happen even if the ADC module is disabled by clearing the ADON bit prior to entering Sleep mode.

Work around

In order to remain within the IPD specifications listed in the device data sheet, the user software must completely disable the ADC module by setting the ADC module disable bit in the corresponding Peripheral Module Disable register (PMDx) prior to executing a PWRSAV #0 instruction.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

31. Module: CAN

When 2 or 3 CAN transmit buffers are enabled, the module reports successful transmissions (TXREQ bit (C1TXxCON<3>) is cleared), even though the messages did not transmit.

Work around

The user should only enable a single transmission buffer for CAN messages.

Affected Silicon Revisions

A1	A2	A3	A4	A5			
X	X	X	X	X			

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Data Sheet Clarifications

The following typographic corrections and clarifications are to be noted for the latest version of the device data sheet (DS70116J):

Note: Corrections are shown in **bold**. Where possible, the original bold text formatting has been removed for clarity.

1. Module: DC Characteristics: Power-Down Current (IPD)

The Maximum values for Power-Down Current (IPD) Parameters DC60c and DC60g, in Table 23-7 of the current data sheet, have changed to 150 μ A and 200 μ A, respectively, as shown in the following table.

TABLE 4: DC CHARACTERISTICS: POWER-DOWN CURRENT (IPD)

DC CHARACTERISTICS			Standard Operating Conditions: 2.5V to 5.5V (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for Industrial $-40^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$ for Extended			
Parameter No.	Typical ⁽¹⁾	Maximum	Units	Conditions		
Power-Down Current (IPD) ⁽²⁾						
DC60a	5	25	μ A	25 $^{\circ}$ C	3.3V	Base Power Down Current ⁽³⁾
DC60b	8	40	μ A	85 $^{\circ}$ C		
DC60c	14	150	μ A	125 $^{\circ}$ C		
DC60e	8	40	μ A	25 $^{\circ}$ C	5V	
DC60f	12	55	μ A	85 $^{\circ}$ C		
DC60g	20	200	μ A	125 $^{\circ}$ C		

- Note 1:** Data in the Typical column is at 5V, 25 $^{\circ}$ C unless otherwise stated. Parameters are for design guidance only and are not tested.
- 2:** Base IPD is measured with all peripherals and clocks shut down. All I/Os are configured as inputs and pulled high. LVD, BOR, WDT, etc. are all switched off.
- 3:** The Δ current is the additional current consumed when the module is enabled. This current should be added to the base IPD current.

APPENDIX A: REVISION HISTORY

Rev A Document (4/2009)

Initial release of this document; issued for revision A1, A2, A3 and A4 silicon

Includes silicon issues 1-2 (CPU), 3 (PSV Operations), 4 (CPU), 5-6 (I²C), 7 (UART), 8 (DCI), 9 (PLL), 10 (Interrupt Controller), 11 (CPU), 12-13 (Output Compare), 14 (ADC), 15 (PLL), 16 (Sleep Mode), 17 (I²C), 18 (I/O), 19 (I²C), 20 (Timer), 21 (PLL), 22 (PSV Operations), 23-25 (I²C), 26 (Data EEPROM), 27 (Flash Memory), 28 (I/O) and 29 (CAN).

This document replaces the following errata documents:

- DS80201, “dsPIC30F5011/5013 Rev. A1 Silicon Errata”
- DS80210, “dsPIC30F5011/5013 Rev. A1/A2 Silicon Errata”
- DS80223, “dsPIC30F5011/5013 Rev. A3 Silicon Errata”
- DS80399, “dsPIC30F5011/5013 Rev. A4 Silicon Errata”

Rev B Document (8/2009)

Updated silicon issue 10 (Interrupt Controller).

Rev C Document (2/2010)

Updated silicon issue 10 (Interrupt Controller).

Rev D Document (6/2010)

Added silicon issue 30 (ADC) and data sheet clarification 1 (The following typographic corrections and clarifications are to be noted for the latest version of the device data sheet (DS70116J)).

Rev E Document (9/2010)

Updated the revision ID for A4 silicon in [Table 1](#).

Rev F Document (5/2011)

Updated the current silicon revision to A5 throughout the document.

Removed data sheet clarification 1.

Rev G Document (9/2011)

Added data sheet clarification 1 (DC Characteristics: Power-Down Current (I_{PD})).

Rev H Document (11/2015)

Added silicon issue 31 (CAN).

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NOTES:

Note the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
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