# PIC16(L)F1826/1827 Family Silicon Errata and Data Sheet Clarification

The PIC16(L)F1826/1827 family devices that you have received conform functionally to the current Device Data Sheet (DS41391**D**), 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 PIC16(L)F1826/1827 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 9, 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 2 or PICkit™ 3:

1. Using the appropriate interface, connect the device to the MPLAB ICD 2 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 DEVREV values for the various PIC16(L)F1826/ 1827 silicon revisions are shown in Table 1.

**TABLE 1: SILICON DEVREV VALUES**

| Part Number | Device ID(1) | Revision ID for Silicon Revision(2) | | | |
|---|---|---|---|---|---|
| | | A2 | A3 | A4 | A5 |
| PIC16F1826 | 10 0111 100x xxxx | 2 | 3 | 4 | 5 |
| PIC16LF1826 | 10 1000 100x xxxx | 2 | 3 | 4 | 5 |
| PIC16F1827 | 10 0111 101x xxxx | 2 | 3 | 4 | 5 |
| PIC16LF1827 | 10 1000 101x xxxx | 2 | 3 | 4 | 5 |

**Note 1:** The Device ID is located in the last configuration memory space.

**2:** Refer to the *"PIC16F/LF182X/PIC12F/LF1822 Memory Programming Specification"* (DS41390) for detailed information on Device and Revision IDs for your specific device.

**TABLE 2: SILICON ISSUE SUMMARY**

| Module | Feature | Item Number | Issue Summary | Affected Revisions(1) | | | |
|---|---|---|---|---|---|---|---|
| | | | | A2 | A3 | A4 | A5 |
| Data EE Memory | Memory Endurance | 1.1 | Erase/Write endurance limited. | X | X | | |
| Program Flash Memory (PFM) | Endurance | 2.1 | Erase/Write endurance limited. | X | X | | |
| Timer1 | Timer0 Gate Source | 3.1 | Toggle mode works improperly. | X | X | | |
| Oscillator | HS mode | 4.1 | Frequency/Voltage range. | X | X | X | X |
| ADC | ADC Conversion | 5.1 | ADC Conversion may not complete. | X | X | | |
| Enhanced Capture Compare PWM (ECCP) | Enhanced PWM | 6.1 | PWM 0% duty cycle direction change. | X | X | | |
| Enhanced Capture Compare PWM (ECCP) | Enhanced PWM | 6.2 | PWM 0% duty cycle port steering. | X | X | | |
| Resets | Power-on Reset (POR) | 7.1 | Reset under low-power conditions. | | X | | |
| Timer1 | T1 Gate Toggle mode | 8.1 | T1 gate flip-flop does not clear. | X | X | | |
| BOR | Wake-up from Sleep | 9.1 | Device resets on wake-up from Sleep (LF devices only). | X | X | X | |

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

## 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: Data EE Memory

#### 1.1 Data EE Memory Endurance

The typical write/erase endurance of the Data EE Memory is limited to 10k cycles.

**Work around**

Use error correction method that stores data in multiple locations.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | | | | | | |

### 2. Module: Program Flash Memory (PFM)

#### 2.1 Program Flash Memory Endurance

The typical write/erase endurance of the PFM is limited to 1k cycles when $V_{DD}$ is above 3.0 volts.

**Work around**

Use an error correction method that stores data in multiple locations.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | | | | | | |

### 3. Module: Timer1

#### 3.1 Timer1 Gate Toggle Mode with Timer0 as Gate Source

Timer1 Gate Toggle mode provides unexpected results when Timer0 overflow is selected as the Timer1 gate source. We do not recommend using Timer0 overflow as the Timer1 gate source while in Timer1 Gate Toggle mode or when Toggle mode is used in conjunction with Timer1 Gate Single-Pulse mode.

**Work around**

None.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | | | | | | |

## 4. Module: Oscillator

### 4.1 HS Oscillator Frequency

The Standard Operating Conditions for the HS Oscillator are as follows:

| Characteristic | Min. | Typ† | Max. | Units | Conditions | Operating Temperature |
|---|---|---|---|---|---|---|
| Oscillator Frequency | 1 | — | 20 | MHz | HS Oscillator mode, $V_{DD}$ > 2.3V | -40°C ≤ $T_A$ ≤ +85°C |
| Oscillator Frequency | 1 | — | 20 | MHz | HS Oscillator mode, $V_{DD}$ ≥ 2.8V | -40°C ≤ $T_A$ ≤ +125°C |

**Work around**

None.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | X | X | | | | |

## 5. Module: ADC

### 5.1 Analog-to-Digital Conversion

An ADC conversion may not complete under these conditions:

1. When FOSC is greater than 8 MHz and it is the clock source used for the ADC converter.
2. The ADC is operating from its dedicated internal FRC oscillator and the device is not in Sleep mode (any FOSC frequency).

   When this occurs, the ADC Interrupt Flag (ADIF) does not get set, the GO/DONE bit does not get cleared, and the conversion result does not get loaded into the ADRESH and ADRESL result registers.

   **Work around**

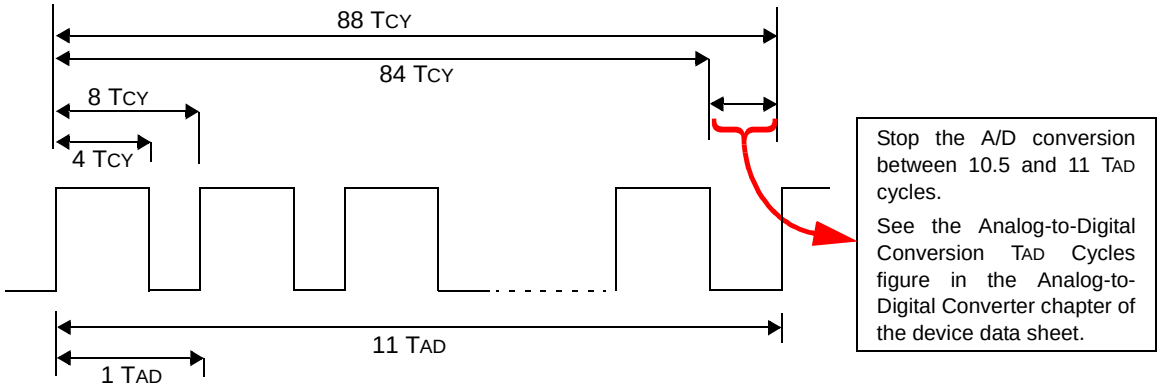
   Method 1: Select the system clock, FOSC, as the ADC clock source and reduce the FOSC frequency to 8 MHz or less when performing ADC conversions.

   Method 2: Select the dedicated FRC oscillator as the ADC conversion clock source and perform all conversions with the device in Sleep.

   Method 3: This method is provided if the application cannot use Sleep mode and requires continuous operation at frequencies above 8 MHz. This method requires early termination of an ADC conversion. Provide a fixed time delay in software to stop the A-to-D conversion manually, after all 10 bits are converted, but before the conversion would complete automatically. The conversion is stopped by clearing the GO/DONE bit in software. The GO/DONE bit must be cleared during the last ½ TAD cycle, before the conversion would have completed automatically. Refer to Figure 1 for details.

**FIGURE 1: INSTRUCTION CYCLE DELAY CALCULATION EXAMPLE**

FOSC = 32 MHz
TCY = 4/32 MHz = 125 nsec
TAD = 1 µsec, ADCS = FOSC/32




See the ADC Clock Period (TAD) vs. Device Operating Frequencies table, in the Analog-to-Digital Converter section of the device data sheet.

In Figure 1, 88 instruction cycles (TCY) will be required to complete the full conversion. Each TAD cycle consists of 8 TCY periods. A fixed delay is provided to stop the A/D conversion after 86 instruction cycles and terminate the conversion at the correct time as shown in the figure above.

**Note:** The exact delay time will depend on the TAD divisor (ADCS) selection. The TCY counts shown in the timing diagram above apply to this example only. Refer to Table 3 for the required delay counts for other configurations.

**EXAMPLE 1: CODE EXAMPLE OF INSTRUCTION CYCLE DELAY**

```
BSF    ADCON0, ADGO   ; Start ADC conversion
                      ; Provide 86
                        instruction cycle
                        delay here
BCF    ADCON0, ADGO   ; Terminate the
                        conversion manually
MOVF   ADRESH, W      ; Read conversion
                        result
```

For other combinations of FOSC, TAD values and Instruction cycle delay counts, refer to Table 3.

**TABLE 3: INSTRUCTION CYCLE DELAY COUNTS BY TAD SELECTION**

| TAD | Instruction Cycle Delay Counts |
|---|---|
| FOSC/64 | 172 |
| FOSC/32 | 86 |
| FOSC/16 | 43 |

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | | | | | | |

## 6. Module: Enhanced Capture Compare PWM (ECCP)

### 6.1 Enhanced PWM

When the PWM is configured for Full-Bridge mode and the duty cycle is set to 0%, writing the PxM<1:0> bits to change the direction has no effect on PxA and PxC outputs.

**Work around**

Increase the duty cycle to a value greater than 0% before changing directions.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | | | | | | |

### 6.2 Enhanced PWM

In PWM mode, when the duty cycle is set to 0% and the STRxSYNC bit is set, writing the STRxA, STRxB, STRxC and the STRxD bits to enable/disable steering to port pins has no effect on the outputs.

**Work around**

Increase the duty cycle to a value greater than 0% before enabling/disabling steering to port pins.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | | | | | | |

## 7. Module: Resets

### 7.1 Reset under Low-Power Conditions

This issue pertains only to the F product version, PIC16F1826/1827. The LF product version, PIC16LF1826/1827, is not affected by this issue in any way.

When employing any one of the low-power oscillators (ECL mode, LP mode, LFINTOSC, or Timer1 Oscillator as alternate system clock source) at temperatures of -20°C or colder while, at the same time, the source voltage supplied to the VDD pin drops below 2.7 volts, the device may experience a Power-on Reset (POR). Also, when the source voltage supplied to the VDD pin is below 2.7 volts, at temperatures of -20°C or colder, and a SLEEP instruction is executed, the device may experience a Power-on Reset (POR) upon entering Sleep mode, regardless of the type of clock source being used or which power-managed mode is being employed.

**Work around**

There are three separate work-arounds and one recommendation available to avoid this Reset condition. Employing any one of these will avoid this reset condition.

1. Enabling the Brown-out Reset (BOR) circuitry.
2. Enabling the Fixed Voltage Reference (FVR) module.
3. Maintaining a source voltage (VDD) to the device above 2.7 volts when operating at temperatures of -20°C or colder.
4. Use the LF product version (PIC16LF1826/1827) when the VDD required is between 1.8V and 3.6V.

The ‘Affected Silicon Revisions’ below refers only to the F product version, PIC16F1826/1827.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| | X | | | | | | |

## 8. Module: Timer1

### 8.1 Timer1 Gate Toggle mode

When Timer1 Gate Toggle mode is enabled, it is possible to measure the full-cycle length of a Timer1 gate signal. To perform this function, the Timer1 gate source is routed through a flip-flop that changes state on every incrementing edge of the gate signal. Timer1 Gate Toggle mode is enabled by setting the T1GTM bit of the T1GCON register. When working properly, clearing either the T1GTM bit or the TMR1ON bit would also clear the output value of this flip-flop, and hold it clear. This is done in order to control which edge is being measured. The issue that exists is that clearing the TMR1ON bit does not clear the output value of the flip-flop and hold it clear.

**Work around**

Clear the T1GTM bit in the T1GCON register to clear and hold clear the output value of the flip-flop.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | | | | | | |

## 9. Module: BOR

### 9.1 BOR Reset

This issue affects only the PIC16LF1826/1827 devices. The device may undergo a BOR Reset when waking-up from Sleep and BOR is re-enabled. A BOR Reset may also occur the moment the software BOR is enabled.

Under certain voltage and temperature conditions and when either SBODEN or BOR_NSLEEP is selected, the devices may occasionally reset when waking-up from Sleep or BOR is enabled.

**Work around**

Method 1: In applications where BOR use is not critical, turn off the BOR in the Configuration Word.

Method 2: Set the FVREN bit of the FVRCON register. Maintain this bit on at all times.

Method 3: When BOR module is needed only during run-time, use the software-enabled BOR by setting the SBODEN option on the Configuration Word. BOR should be turned off by software before Sleep, then follow the below sequence for turning BOR on after Wake-up:

a. Wake-up event occurs;

b. Turn on FVR (FVREN bit of the FVRCON register);

c. Wait until FVRRDY bit is set;

d. Wait 15 µs after the FVR Ready bit is set;

e. Manually turn on the BOR.

Method 4: Use the software-enabled BOR as described in Method 3, but use the following sequence:

a. Switch to internal 32 kHz oscillator immediately before Sleep;

b. Upon wake-up, turn on FVR (FVREN bit of the FVRCON register);

c. Manually turn on the BOR;

d. Switch the clock back to the preferred clock source.

**Note:** When using the software BOR follow the steps in Methods 3 or 4 above when enabling BOR for the first time during program execution.

**Affected Silicon Revisions**

| A2 | A3 | A4 | A5 | | | | |
|---|---|---|---|---|---|---|---|
| X | X | X | | | | | |

## Data Sheet Clarifications

The following typographic corrections and clarifications are to be noted for the latest version of the device data sheet (DS41391**D**):

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

### 1. Module: Temperature Indicator

In Register 14-1: FVRCON: Fixed Voltage Reference Control Register, the TSEN and TSRNG bits that enable and select the range for the temperature indicator module are missing. The corrected register table is shown below.

**REGISTER 14-1: FVRCON: FIXED VOLTAGE REFERENCE CONTROL REGISTER**

| R/W-0/0 | R-q/q | R/W-0/0 | R/W-0/0 | R/W-0/0 | R/W-0/0 | R/W-0/0 | R/W-0/0 |
|---|---|---|---|---|---|---|---|
| FVREN | FVRRDY(1) | **TSEN** | **TSRNG** | CDAFVR<1:0> | | ADFVR<1:0> | |
| bit 7 | | | | | | | bit 0 |

| **Legend:** | | |
|---|---|---|
| R = Readable bit | W = Writable bit | U = Unimplemented bit, read as ‘0’ |
| u = Bit is unchanged | x = Bit is unknown | -n/n = Value at POR and BOR/Value at all other Resets |
| ‘1’ = Bit is set | ‘0’ = Bit is cleared | q = Value depends on condition |

bit 7 **FVREN:** Fixed Voltage Reference Enable bit
0 = Fixed Voltage Reference is disabled
1 = Fixed Voltage Reference is enabled

bit 6 **FVRRDY:** Fixed Voltage Reference Ready Flag bit(1)
0 = Fixed Voltage Reference output is not ready or not enabled
1 = Fixed Voltage Reference output is ready for use

**bit 5 TSEN: Temperature Indicator Enable bit(3)**
**0 = Temperature Indicator is disabled**
**1 = Temperature Indicator is enabled**

**bit 4 TSRNG: Temperature Indicator Range Selection bit(3)**
**0 = VOUT = VDD - 2VT (Low Range)**
**1 = VOUT = VDD - 4VT (High Range)**

bit 3-2 **CDAFVR<1:0>:** Comparator and DAC Fixed Voltage Reference Selection bit
00 = Comparator and DAC Fixed Voltage Reference Peripheral output is off.
01 = Comparator and DAC Fixed Voltage Reference Peripheral output is 1x (1.024V)
10 = Comparator and DAC Fixed Voltage Reference Peripheral output is 2x (2.048V)(2)
11 = Comparator and DAC Fixed Voltage Reference Peripheral output is 4x (4.096V)(2)

bit 1-0 **ADFVR<1:0>:** ADC Fixed Voltage Reference Selection bit
00 = ADC Fixed Voltage Reference Peripheral output is off.
01 = ADC Fixed Voltage Reference Peripheral output is 1x (1.024V)
10 = ADC Fixed Voltage Reference Peripheral output is 2x (2.048V)(2)
11 = ADC Fixed Voltage Reference Peripheral output is 4x (4.096V)(2)

**Note 1:** FVRRDY is always ‘1’ on devices with LDO (PIC16F1826/27).
**2:** Fixed Voltage Reference output cannot exceed VDD.
**3: See Section 15.0, “Temperature Indicator Module”, for additional information.**

## APPENDIX A: DOCUMENT REVISION HISTORY

### Rev A Document (10/2009)

Initial release of this document.

### Rev B Document (02/2010)

Added PIC16F1826 and PIC16F1827 to this errata; Added Rev. A3 for PIC16F/LF1826/1827.

Data Sheet Clarifications: Added Modules 1 thru 5.

### Rev C Document (05/2010)

Added Modules 5, 6 and 7.

### Rev D Document (06/2010)

Removed Module 6 (Oscillator); Added Modules 7 (Resets) and 8 (Timer1).

Data Sheet Clarifications: Removed Modules 1 to 5.

### Rev E Document (07/2010)

Revised Module 5.1; Other minor corrections.

### Rev F Document (09/2010)

Added Silicon Revision A4.

### Rev G Document (02/2011)

Added Module 9.

### Rev H Document (05/2011)

Added Silicon Revision A5.

Data Sheet Clarifications: Added Module 1.

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