

PIC16F716 Rev. A Silicon/Data Sheet Errata

The PIC16F716 parts you have received conform functionally to the Device Data Sheet (DS41206B) and the Programming Specification (DS40245B), except for the anomalies described below.

All problems listed here will be addressed in future revisions of the **PIC16F716** silicon.

1. Module: Silicon (Rev. A4) – Programming

The oscillator circuitry may prevent proper initialization of the Programming mode when the part is programmed in-circuit.

Work around

Tie the OSC1/EXTCLK pin (pin 16 of 18-pin package or pin 18 of 20-pin package) to ground to disable the oscillator during In-circuit Serial Programming™.

2. Module: ECCP

The ECCP module will override pin data of the RB3/CCP1 pin when operating in Software Interrupt mode (CCP1M = 0xA) or Special Event Trigger mode (CCP1M = 0xB). The RB3/CCP1 pin can be used as a general purpose input by setting the TRISB3 bit. However, if the pin is configured as an output, the ECCP module will always drive the pin low.

This affects all released versions of silicon.

Work around

None.

Clarifications/Corrections to the Data Sheet:

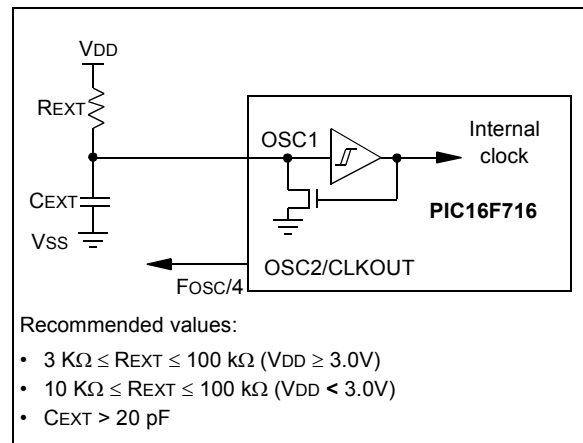
In the Device Data Sheet (DS41206B), the following clarifications and corrections should be noted.

1. Module: Oscillator Configuration

In Figure 9-3, revise the second line of recommended values as follows:

$$10 \text{ k}\Omega \leq R_{EXT} \leq 100 \text{ k}\Omega \text{ (VDD < 3.0V)}$$

FIGURE 9-3: RC OSCILLATOR MODE



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2. Module: Electrical Characteristics

In Section 12.4, “DC Characteristics: PIC16F716 (Industrial, Extended)”, changes to parameter numbers D033A and D042B are shown in bold and italics below.

12.4 DC Characteristics: PIC16F716 (Industrial, Extended)

DC CHARACTERISTICS		Standard Operating Conditions (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 Operating voltage V_{DD} range as described in DC specification Section 12.1 “DC Characteristics: PIC16F716 (Industrial, Extended)” and Section 12.4 “DC Characteristics: PIC16F716 (Industrial, Extended)”					
Param No.	Sym	Characteristic	Min	Typ†	Max	Units	Conditions
D030 D030A D031 D032 D033 D033A	V _{IL}	Input Low Voltage					
		I/O ports					
		with TTL buffer	V _{SS}	—	0.8V	V	4.5V ≤ V _{DD} ≤ 5.5V
		with Schmitt Trigger buffer	V _{SS}	—	0.15V _{DD}	V	otherwise
		MCLR, OSC1 (in RC mode)	V _{SS}	—	0.2V _{DD}	V	
		OSC1 (in HS mode)	V _{SS}	—	0.3V _{DD}	V	(Note 1)
D040 D040A D041 D042 D042A D042B D043	V _{IH}	Input High Voltage					
		I/O ports					
		with TTL buffer	2.0	—	V _{DD}	V	4.5V ≤ V _{DD} ≤ 5.5V
			0.25 V _{DD} + 0.8V	—	V _{DD}	V	otherwise
		with Schmitt Trigger buffer	0.8 V _{DD}	—	V _{DD}	V	For entire V _{DD} range
		MCLR	0.8 V _{DD}	—	V _{DD}	V	
D060 D061 D063	I _{IL}	Input Leakage Current ^{(2), (3)}					
		I/O ports	—	—	±1	μA	V _{SS} ≤ V _{PIN} ≤ V _{DD} , Pin at high-impedance
		MCLR, RA4/T0CKI	—	—	±5	μA	V _{SS} ≤ V _{PIN} ≤ V _{DD}
		OSC1/CLKIN	—	—	±5	μA	V _{SS} ≤ V _{PIN} ≤ V _{DD} , XT, HS and LP Oscillator modes
D070	I _{PURB}	PORTB weak pull-up current	TBD	250	TBD	μA	V _{DD} = 5V, V _{PIN} = V _{SS}
D080 D083	V _{OL}	Output Low Voltage					
		I/O ports	—	—	0.6	V	I _{OL} = 8.5 mA, V _{DD} = 4.5V, -40°C to +85°C
			—	—	0.6	V	I _{OL} = 7.0 mA, V _{DD} = 4.5V, -40°C to +125°C
D090 D092	V _{OH}	Output High Voltage					
		I/O ports ⁽³⁾	V _{DD} - 0.7	—	—	V	I _{OH} = -3.0 mA, V _{DD} = 4.5V, -40°C to +85°C
			V _{DD} - 0.7	—	—	V	I _{OH} = -2.5 mA, V _{DD} = 4.5V, -40°C to +125°C
		OSC2/CLKOUT (RC Oscillator mode)	V _{DD} - 0.7	—	—	V	I _{OH} = -1.3 mA, V _{DD} = 4.5V, -40°C to +85°C
D150* D100 D101	V _{OD}	Open-Drain High Voltage	—	—	8.5	V	RA4 pin
		Capacitive Loading Specs on Output Pins					
D100	C _{OSC2}	OSC2/CLKOUT pin	—	—	15	pF	In XT, HS and LP modes when external clock is used to drive OSC1.
D101	C _{IO}	All I/O pins and OSC2 (in RC mode)	—	—	50	pF	

* These parameters are characterized but not tested.

† Data in “Typ” column is at 5V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

- Note**
- 1: In RC Oscillator mode, the OSC1/CLKIN pin is a Schmitt Trigger input. It is not recommended that the PIC[®] microcontroller be driven with external clock in RC mode.
 - 2: The leakage current on the MCLR/VPP pin is strongly dependent on the applied voltage level. The specified levels represent normal operating conditions. Higher leakage current may be measured at different input voltages.
 - 3: Negative current is defined as current sourced by the pin.

3. Module: Interrupts

The IOCB register is not used on this device. The interrupt-on-change feature will automatically be enabled for any RB<7:4> configured as an input.

See **Section 3.2 “PORTB and the TRISB Register”** in the data sheet (DS41206B) for more information.

REGISTER 2-3: INTCON: INTERRUPT 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-x
GIE	PEIE	T0IE	INTE	RBIE	T0IF ⁽¹⁾	INTF	RBIF
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 | GIE: Global Interrupt Enable bit
1 = Enables all unmasked interrupts
0 = Disables all interrupts |
| bit 6 | PEIE: Peripheral Interrupt Enable bit
1 = Enables all unmasked peripheral interrupts
0 = Disables all peripheral interrupts |
| bit 5 | T0IE: Timer0 Overflow Interrupt Enable bit
1 = Enables the Timer0 interrupt
0 = Disables the Timer0 interrupt |
| bit 4 | INTE: RB0/INT External Interrupt Enable bit
1 = Enables the RB0/INT external interrupt
0 = Disables the RB0/INT external interrupt |
| bit 3 | RBIE: PORTB Change Interrupt Enable bit
1 = Enables the PORTB change interrupt
0 = Disables the PORTB change interrupt |
| bit 2 | T0IF: Timer0 Overflow Interrupt Flag bit ⁽¹⁾
1 = TMR0 register has overflowed (must be cleared in software)
0 = TMR0 register did not overflow |
| bit 1 | INTF: RB0/INT External Interrupt Flag bit
1 = The RB0/INT external interrupt occurred (must be cleared in software)
0 = The RB0/INT external interrupt did not occur |
| bit 0 | RBIF: PORTB Change Interrupt Flag bit
1 = When at least one of the PORTB general purpose I/O pins changed state (must be cleared in software)
0 = None of the PORTB general purpose I/O pins have changed state |

Note 1: T0IF bit is set when Timer0 rolls over. Timer0 is unchanged on Reset and should be initialized before clearing T0IF bit.

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4. Module: ADC

Corrected values for the acquisition time example for the 8-bit ADC used by this device are shown below.

EQUATION 7-1: ACQUISITION TIME EXAMPLE

Assumptions: Temperature = 50°C and external impedance of 10kΩ 5.0V VDD

$$\begin{aligned}T_{ACQ} &= \text{Amplifier Settling Time} + \text{Hold Capacitor Charging Time} + \text{Temperature Coefficient} \\&= T_{AMP} + T_C + T_{COFF} \\&= 5\mu s + T_C + [(Temperature - 25^\circ C)(0.05\mu s/^\circ C)]\end{aligned}$$

The value for T_C can be approximated with the following equations:

$$V_{APPLIED}\left(1 - \frac{1}{511}\right) = V_{CHOLD} \quad ;[1] V_{CHOLD} \text{ charged to within } 1/2 \text{ lsb}$$

$$V_{APPLIED}\left(1 - e^{\frac{-T_C}{RC}}\right) = V_{CHOLD} \quad ;[2] V_{CHOLD} \text{ charge response to } V_{APPLIED}$$

$$V_{APPLIED}\left(1 - e^{\frac{-T_C}{RC}}\right) = V_{APPLIED}\left(1 - \frac{1}{511}\right) \quad ;\text{combining [1] and [2]}$$

Solving for T_C :

$$\begin{aligned}T_C &= -CHOLD(RIC + RSS + RS) \ln(1/511) \\&= -10pF(1k\Omega + 7k\Omega + 10k\Omega) \ln(0.0019569) \\&= 1.12\mu s\end{aligned}$$

Therefore:

$$\begin{aligned}T_{ACQ} &= 5MS + 1.12MS + [(50^\circ C - 25^\circ C)(0.05MS/^\circ C)] \\&= 7.37\mu s\end{aligned}$$

5. Module: Electrical Characteristics

In Section 12.0, "Electrical Characteristics",
change (in bold):

From: Voltage on RA4 with respect to Vss
.....0V to +8.5V

To: Voltage on RA4 with respect to Vss
.....**-0.3V** to +8.5V

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APPENDIX A: REVISION HISTORY

Rev. A Document (2/19/04)

First revision of this document.

Rev. B Document (7/12/04)

Changes made to parameter numbers D033A and D042B in Section 12.4, "DC Characteristics: PIC16F716 (Industrial, Extended)".

Rev. C Document (3/28/07)

Changes made to the data sheet revision referenced (DS41206B), emphasis added in Figure 9-3, "RC Oscillator Mode", to the second recommended value, removed note 1 in register 2-3, "INTCON: Interrupt Control Register", and adjusted values in Equation 7-1 "Acquisition Time Example".

Rev. D Document (8/22/07)

Added Module 5: Electrical Characteristics (add -0.3V to "Voltage on RA4").

Rev. E Document (4/02/08)

Added Module 2: ECCP on first page.

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