PIC16F716

PIC16F716 Rev. A Silicon/Data Sheet Errata

The PIC16F716 parts you have received conform functionally to the Device Data Sheet (DS41206**B**) and the Programming Specification (DS40245**B**), 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™.

Clarifications/Corrections to the Data Sheet:

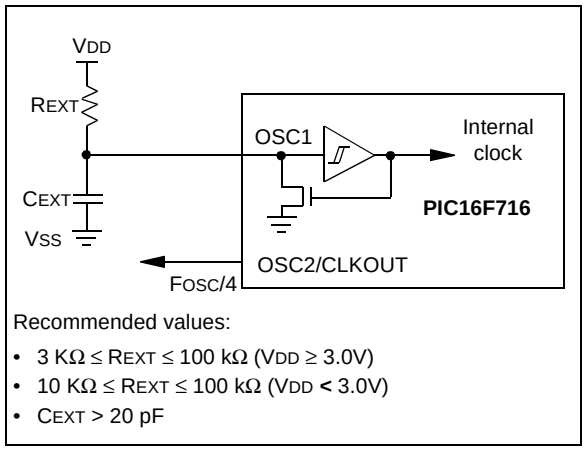
In the Device Data Sheet (DS41206**B**), the following clarifications and corrections should be noted.

1. Module: Oscillator Configuration

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

10 kΩ ≤ REXT ≤ 100 kΩ (VDD < 3.0V)

FIGURE 9-3: RC OSCILLATOR MODE



Recommended values:

- 3 KΩ ≤ REXT ≤ 100 kΩ (VDD ≥ 3.0V)
- 10 KΩ ≤ REXT ≤ 100 kΩ (VDD < 3.0V)
- CEXT > 20 pF

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°C ≤ TA ≤ +85°C for industrial -40°C ≤ TA ≤ +125°C for extended Operating voltage VDD 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**
	VIL	**Input Low Voltage**					
		I/O ports					
D030		with TTL buffer	VSS	—	0.8V	V	4.5V ≤ VDD ≤ 5.5V
D030A			VSS	—	0.15VDD	V	otherwise
D031		with Schmitt Trigger buffer	VSS	—	0.2VDD	V	
D032		MCLR, OSC1 (in RC mode)	VSS	—	0.2VDD	V	
D033		OSC1 (in HS mode)	VSS	—	0.3VDD	V	**(Note 1)**
D033A		OSC1 (in XT and LP modes)	VSS	—	***0.3***	V	
	VIH	**Input High Voltage**					
		I/O ports		—			
D040		with TTL buffer	2.0	—	VDD	V	4.5V ≤ VDD ≤ 5.5V
D040A			0.25 VDD + 0.8V	—	VDD	V	otherwise
D041		with Schmitt Trigger buffer	0.8 VDD	—	VDD	V	For entire VDD range
D042		MCLR	0.8 VDD	—	VDD	V	
D042A		OSC1 (HS)	0.7 VDD	—	VDD	V	**(Note 1)**
D042B		***OSC1 (XT and LP modes)***	***1.6***	**—**	***VDD***	***V***	
D043		OSC1 (in RC mode)	0.9 VDD	—	VDD	V	
	IIL	**Input Leakage Current(2), (3)**					
D060		I/O ports	—	—	±1	µA	VSS ≤ VPIN ≤ VDD, Pin at high-impedance
D061		MCLR, RA4/T0CKI	—	—	±5	µA	VSS ≤ VPIN ≤ VDD
D063		OSC1/CLKIN	—	—	±5	µA	VSS ≤ VPIN ≤ VDD, XT, HS and LP Oscillator modes
D070	IPURB	**PORTB weak pull-up current**	TBD	250	TBD	µA	VDD = 5V, VPIN = VSS
	VOL	**Output Low Voltage**					
D080		I/O ports	—	—	0.6	V	IOL = 8.5 mA, VDD = 4.5V, -40°C to +85°C
			—	—	0.6	V	IOL = 7.0 mA, VDD = 4.5V, -40°C to +125°C
D083		OSC2/CLKOUT (RC Oscillator mode)	—	—	0.6	V	IOL = 1.6 mA, VDD = 4.5V, -40°C to +85°C
			—	—	0.6	V	IOL = 1.2 mA, VDD = 4.5V, -40°C to +125°C
	VOH	**Output High Voltage**					
D090		I/O ports(3)	VDD – 0.7	—	—	V	IOH = -3.0 mA, VDD = 4.5V, -40°C to +85°C
			VDD – 0.7	—	—	V	IOH = -2.5 mA, VDD = 4.5V, -40°C to +125°C
D092		OSC2/CLKOUT (RC Oscillator mode)	VDD – 0.7	—	—	V	IOH = -1.3 mA, VDD = 4.5V, -40°C to +85°C
			VDD – 0.7	—	—	V	IOH = -1.0 mA, VDD = 4.5V, -40°C to +125°C
D150*	VOD	**Open-Drain High Voltage**	—	—	8.5	V	RA4 pin
		Capacitive Loading Specs on Output Pins					
D100	COSC2	OSC2/CLKOUT pin	—	—	15	pF	In XT, HS and LP modes when external clock is used to drive OSC1.
D101	CIO	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.

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 V_{DD}*

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

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

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

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

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

Solving for T_C:

$$T_C = -C_{HOLD}(R_{IC} + R_{SS} + R_S)\ ln(1/511)$$
$$= -10pF(1k\Omega + 7k\Omega + 10k\Omega)\ ln(0.0019569)$$
$$= 1.12\mu s$$

Therefore:

$$T_{ACQ} = 5\mu s + 1.12\mu s + [(50°C - 25°C)(0.05\mu s/°C)]$$
$$= 7.37\mu s$$

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”.

NOTES:

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