

## PIC18C658/858 Rev. B2 Silicon/Data Sheet Errata

The PIC18C658/858 parts you have received conform functionally to the Device Data Sheet (DS30475A), except for the anomalies described below.

All the problems listed here will be addressed in future revisions of the PIC18C658/858 silicon.

### 1. Module: CAN

The CAN module may send a passive error flag earlier than expected. This will occur at the transition point of error active to error passive, TEC (Transmit Error Count), or REC (Receive Error Count)  $\geq 128$ .

#### Work around

None for current silicon revision. Use the latest silicon revision when it becomes available.

### 2. Module: CAN

The CAN module may not synchronize correctly if there is a phase error between nodes that is equal to the Synchronization Jump Width (SJW). As a result, the module may request retransmission of messages from the transmitting node.

#### Work around

1. Use the longest SJW possible that will work with the application.
2. Use the latest silicon revision when it becomes available.

Date Codes that pertain to this issue:

**ALL**

**Note:** When the manufacture date of a newer version of silicon is in production, the last date where this issue may occur will be specified.

### 3. Module: LVD

The minimum and maximum LVD voltage levels (parameter D420) have changed. The new values are shown in Table 1.

#### Work around

None

Date Codes that pertain to this issue:

**ALL**

**Note:** When the manufacture date of a newer version of silicon is in production, the last date where this issue may occur will be specified.

**TABLE 1: LVD MINIMUM VOLTAGES**

Param No.	Symbol	Characteristic		Min.	Max.	Units
D420	VLVD	LVD Voltage	LVDL<3:0> = 0100	2.35	2.80	V
			LVDL<3:0> = 0101	2.55	3.02	V
			LVDL<3:0> = 0110	2.64	3.14	V
			LVDL<3:0> = 0111	2.83	3.37	V
			LVDL<3:0> = 1000	3.11	3.71	V
			LVDL<3:0> = 1001	3.29	3.93	V
			LVDL<3:0> = 1010	3.39	4.04	V
			LVDL<3:0> = 1011	3.58	4.26	V
			LVDL<3:0> = 1100	3.77	4.49	V
			LVDL<3:0> = 1101	3.95	4.71	V
		LVDL<3:0> = 1110	4.23	5.05	V	

# PIC18C658/858

## 4. Module: BOR

The minimum and maximum BOR Voltage levels (parameter D005) have changed. The new values are shown in Table 2 (below).

### Work around

None.

Date Codes that pertain to this issue:

**ALL**

**Note:** When the manufacture date of a newer version of silicon is in production, the last date where this issue may occur will be specified.

## 5. Module: Watchdog Timer

After the WDT is allowed to time-out, all subsequent WDT periods following the very first, may double in duration. This can occur if the CLRWDT instruction is not executed prior to the timer timing out.

### Work around

Always execute the CLRWDT instruction prior to entering a potential WDT time-out condition.

## 6. Module: CAN

Two of the Receive Buffer modes defined by bits RXM1 and RXM0 of the RXB0CON register (RXB0CON<6:5>), are currently reversed from their description in the original Device Data Sheet (DS30475A). The actual values for these bits are shown in the excerpt from Register 17-12 (below) (changes from the original data sheet in **bold**).

This anomaly is particular to this silicon revision. Future revisions will restore the operation of these bits to their original description in the Device Data Sheet (DS30475A).

### Work around

1. Always configure the mode for Receive Buffer 0 as 'Receive All Valid Messages' (bits RXM1:RXM0 = 00). In addition, use the EXIDEN bit of the RXF0SIDL register (RXF0SIDL<3>) to set the filter for standard or extended ID messages. Set EXIDEN (= 1) for extended ID messages, and clear EXIDEN for standard ID messages.
2. Use the latest silicon revision when it becomes available.

**TABLE 2: BOR MAXIMUM VOLTAGES**

Param No.	Symbol	Characteristic		Min.	Max.	Units
D005	VBOR	BOR Voltage	BORV<1:0> = 11	2.35	2.80	V
			BORV<1:0> = 10	2.55	3.02	V
			BORV<1:0> = 01	3.95	4.71	V
			BORV<1:0> = 00	4.23	5.05	V

## REGISTER 17-12: RXB0CON - RECEIVE BUFFER 0 CONTROL REGISTER

bit 6-5	<p><b>RXM1:RXM0:</b> Receive Buffer Mode bits</p> <p>11 = Receive all messages (including those with errors)</p> <p>10 = <b>Receive only valid messages with standard identifier</b></p> <p>01 = <b>Receive only valid messages with extended identifier</b></p> <p>00 = Receive all valid messages</p>
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## 7. Module: WDT

When the device is configured for either EC or RC oscillator modes, with the Power-up Timer enabled, bit  $\overline{TO}$  of the RCON register (RCON<3>) may default to '0', even though no WDT time-out has occurred.

The  $\overline{TO}$  bit functions normally in all other configurations.

### Work around

1. Use bit  $\overline{TO}$  in conjunction with bit  $\overline{POR}$  (RCON<1>), to determine if a RESET condition has occurred.
2. Use the latest silicon revision when it becomes available.

## 8. Module: I/O (Parallel Slave Port)

The Input Buffer Status bit of the PSPCON register (PSPCON<7>) may be inadvertently cleared, even when the PORTD input buffer has not been read. This will occur only when the following two conditions occur simultaneously:

- The four Least Significant bits of the BSR register are equal to 0Fh (BSR<3:0> = 1111), and
- Any instruction that contains 83h in its 8 Least Significant bits (i.e., register file addresses, literal data, address offsets, etc.) is executed.

### Work around

All work arounds will involve setting the contents of BSR<3:0> to some value other than 0Fh. In addition to those proposed below, other solutions may exist.

1. When developing or modifying code, keep these guidelines in mind:
  - Assign 12-bit addresses to all variables. This allows the assembler to know when Access Banking can be used.
  - Do not set the BSR to point to Bank 15 (BSR = 0Fh).
  - Allow the assembler to manipulate the Access bit present in most instructions. Accessing the SFRs in Bank 15 will be done through the Access Bank. Continue to use the BSR to select Banks 1 through 5 and the upper half of Bank 0.
2. If accessing a part of Bank 15 is required and the use of Access Banking is not possible, consider using indirect addressing.
3. If pointing the BSR to Bank 15 is unavoidable, review the absolute file listing. Verify that no instructions contains 83h in the 8 Least Significant bits while the BSR points to Bank 15 (BSR = 0Fh).

## 9. Module: Interrupts

High priority interrupts may become improperly enabled, while low priority interrupts become improperly disabled at the same time. This may occur when low priority interrupts are in an enabled state and the following conditions occur simultaneously:

- High priority interrupts are being changed from an enabled to a disabled state; and
- One or more low priority interrupts occur.

### Work around

1. Always disable low priority interrupts before disabling high priority interrupts. Re-enable the low priority interrupts afterwards, if necessary.
2. Use the latest silicon revision when it becomes available.

# PIC18C658/858

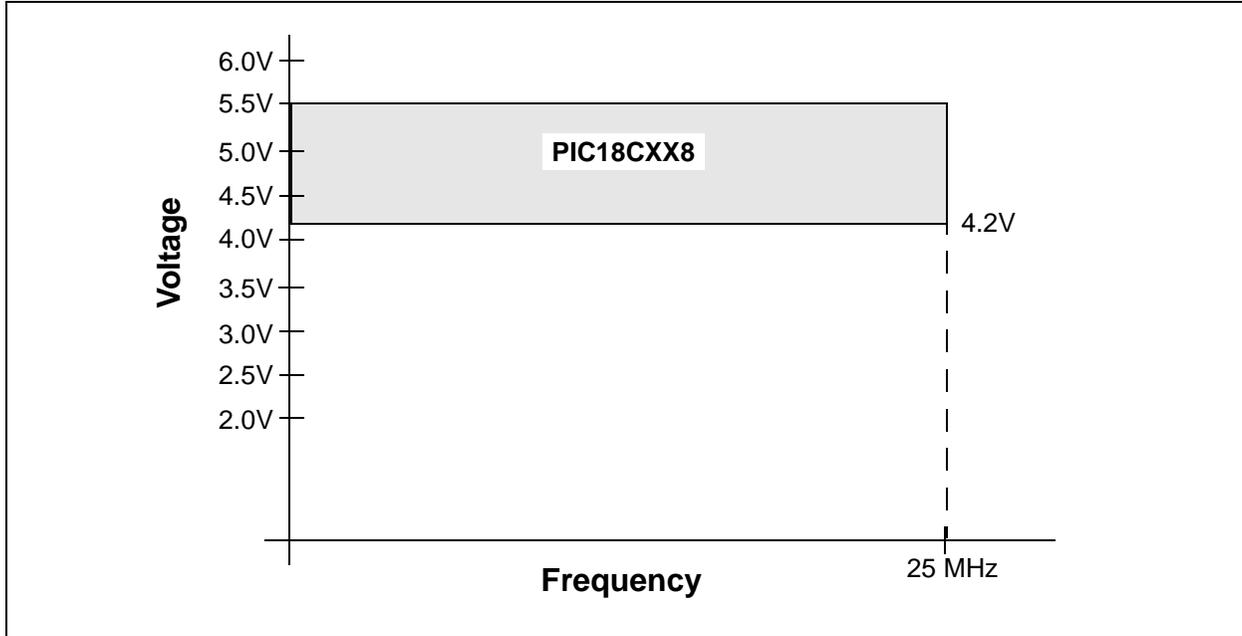
## 10. Module: Core (Voltage vs. Frequency)

The device may not operate properly at frequencies exceeding 25 MHz. The graphs in Figures 1 and 2 (page 4) show the expected voltage vs. frequency operating range for standard voltage range and extended voltage range devices, respectively.

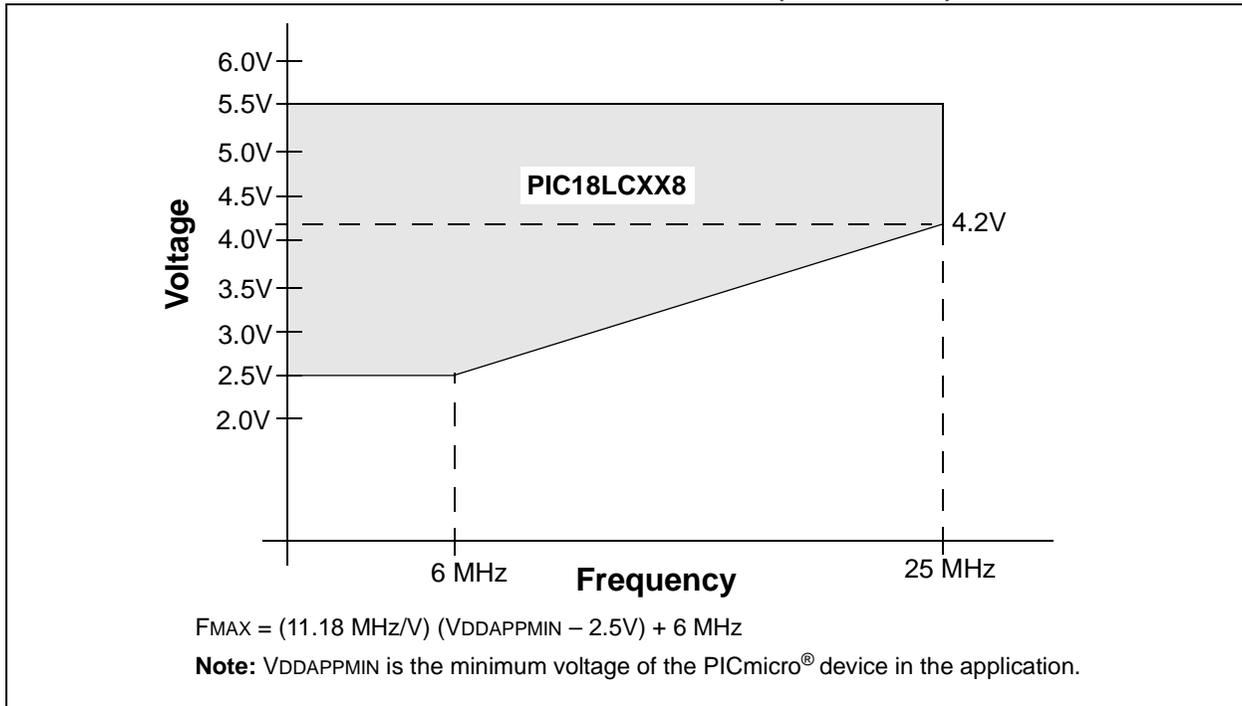
### Work around

None. This issue is expected to be resolved in a future silicon revision. Please contact a Microchip sales office for additional information on availability.

**FIGURE 1: PIC18CXX8 VOLTAGE-FREQUENCY GRAPH (INDUSTRIAL, EXTENDED)**



**FIGURE 2: PIC18LCXX8 VOLTAGE-FREQUENCY GRAPH (INDUSTRIAL)**



## 11. Module: I/O (PORTB Interrupt-on-Change)

The RB Port Change Flag bit of the INTCON register (RBIF, INTCON<0>) may be inadvertently cleared, even when the PORTB<7:4> pins have not been read. This will occur only when the following two conditions occur simultaneously:

- The four Least Significant bits of the BSR register are equal to 0Fh (BSR<3:0> = 1111), and
- Any instruction that contains 81h in its 8 Least Significant bits (i.e., register file addresses, literal data, address offsets, etc.) is executed.

### Work around

All work arounds will involve setting the contents of BSR<3:0> to some value other than 0Fh. In addition to those proposed below, other solutions may exist.

1. When developing or modifying code, keep these guidelines in mind:
  - Assign 12-bit addresses to all variables. This allows the assembler to know when Access Banking can be used.
  - Do not set the BSR to point to Bank 15 (BSR = 0Fh).
  - Allow the assembler to manipulate the Access bit present in most instructions. Accessing the SFRs in Bank 15 will be done through the Access Bank. Continue to use the BSR to select Banks 1 through 5, and the upper half of Bank 0.
2. If accessing a part of Bank 15 is required and the use of Access Banking is not possible, consider using indirect addressing.
3. If pointing the BSR to Bank 15 is unavoidable, review the absolute file listing. Verify that no instructions contain 81h in the 8 Least Significant bits, while the BSR points to Bank 15 (BSR = 0Fh).

## 12. Module: Interrupts

When an interrupt occurs simultaneously with the clearing of one or more interrupt enable flags in the INTCON, PIE1 or PIE2 registers, the instruction immediately following the interrupted instruction may be executed before vectoring to the Interrupt Service Routine (ISR). If that instruction is a control operation, the ISR may not execute as intended.

In the case of conditional branch instructions, the first instruction of the ISR may be skipped if the tested condition would have resulted in a branch.

In the case of GOTO, CALL, or BRA instructions, program execution may vector to the address encoded in the instruction; the ISR will not be executed at all. The GIE bit will still be cleared, disabling all interrupts.

Additionally, on return from the interrupt (by executing RETFIE), the instruction following the interrupted instruction may be executed again.

There may be other interrupt related symptoms.

### Work around

Three possible solutions are presented here. Other solutions may exist. None of these require special attention when setting interrupt enable bits.

1. All instructions that clear interrupt enable bits should be followed by a NOP instruction.
2. Prior to disabling any interrupt source, disable all interrupts by clearing the GIE bit (INTCON<7>). After disabling the desired interrupts, re-enable all interrupts by setting GIE.
3. If interrupt priority is being used:
  - a) clear both GIEL and GIEH (in order) bits (INTCON<7:6>) to disable all peripheral interrupts
  - b) clear the desired interrupt enable bits
  - c) set both GIEH and GIEL, in order to re-enable peripheral interrupts

## 13. Module: CAN Module

Under certain circumstances, the module may transmit unexpected messages. This will only happen when all of the following conditions occur simultaneously:

1. The identifier registers for Transmit buffer TXB0 are never used or written to;
2. Either of the transmit buffers, TXB1 or TXB2, are in use; and
3. The CAN module attempts to retransmit a message that has lost one or more previous arbitrations.

### Work around

Clear the TXB0SIDL and TXB0SIDH registers as part of the CAN initialization routine.

## 14. Module: A/D (External Voltage Reference) and Comparator Voltage Reference

When the external voltage reference,  $V_{REF-}$ , is selected for use with either the A/D or comparator voltage reference,  $AV_{SS}$  is connected to  $V_{REF-}$  in the comparator module. If  $V_{REF-}$  is a voltage other than  $AV_{SS}$  (which must be tied externally to  $V_{SS}$ ), excessive current will flow into the  $V_{REF-}$  pin.

### **Work around**

If external  $V_{REF-}$  is used with a voltage other than 0V, enable the comparator voltage reference by setting the  $CVREN$  bit in the  $CVRCON$  register. This disconnects  $V_{REF-}$  and  $AV_{SS}$  within the comparator module.

## Clarifications/Corrections to the Data Sheet:

In the Device Data Sheet (DS30475A), the following clarifications and corrections should be noted.

### 1. Module: Timer1

Section 11.1 (Timer1 Operation) is amended with the following clarification:

When Timer1 is configured to operate as an asynchronous counter, care must be taken that there is no incoming pulse while the module is being turned off. If an incoming pulse arrives while Timer1 is being turned off, the value of register TMR1 may become unpredictable.

If an application requires that Timer1 be turned off and if it is possible that Timer1 may receive an incoming pulse while being turned off, synchronize the external clock first, by clearing the T1SYNC bit of register T1CON. Please note that this may cause Timer1 to miss up to one count.

### 2. Module: LVD

Table 25-1 of the Device Data Sheet is amended to include parameters D421, D422, D423 and D425, related to the performance of the Low Voltage Detect module.

In addition, the minimum and maximum LVD voltage levels (specification D420) are also amended (see Issue 3 of this Errata), and typical voltage levels are provided.

Table 25-1 should read as follows (changes and additions in **bold**):

**TABLE 25-1: LOW VOLTAGE DETECT CHARACTERISTICS**

				<b>Standard Operating Conditions (unless otherwise stated)</b>				
				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				
<b>Param No.</b>	<b>Symbol</b>	<b>Characteristic</b>		<b>Min.</b>	<b>Typ</b>	<b>Max.</b>	<b>Units</b>	<b>Conditions</b>
D420	VLVD	LVD Voltage	LVDL<3:0> = 0100	<b>2.35</b>	<b>2.58</b>	2.80	V	
			LVDL<3:0> = 0101	<b>2.55</b>	<b>2.78</b>	3.02	V	
			LVDL<3:0> = 0110	<b>2.64</b>	<b>2.89</b>	3.14	V	
			LVDL<3:0> = 0111	<b>2.83</b>	<b>3.1</b>	3.37	V	
			LVDL<3:0> = 1000	<b>3.11</b>	<b>3.41</b>	3.71	V	
			LVDL<3:0> = 1001	<b>3.29</b>	<b>3.61</b>	3.93	V	
			LVDL<3:0> = 1010	<b>3.39</b>	<b>3.72</b>	4.04	V	
			LVDL<3:0> = 1011	<b>3.58</b>	<b>3.92</b>	4.26	V	
			LVDL<3:0> = 1100	<b>3.77</b>	<b>4.13</b>	4.49	V	
			LVDL<3:0> = 1101	<b>3.95</b>	<b>4.33</b>	4.71	V	
			LVDL<3:0> = 1110	<b>4.23</b>	<b>4.64</b>	5.05	V	
D421	$\Delta$ ILVD	<b>Supply Current</b>		—	<b>35</b>	<b>50</b>	$\mu\text{A}$	
D425	VBG	<b>Internally Generated Reference Voltage</b>		TBD	<b>1.22</b>	TBD	V	

# PIC18C658/858

## 3. Module: BOR

The minimum and maximum specified values for parameter D005, as listed in Section 25.1 of the Device Data Sheet, are amended as noted (see also Issue 4 of this Errata).

Also, the typical and maximum values for parameter D022A are amended, as noted (see Issue 4 of this Errata).

Section 25.1 in part should read as follows (changes and additions in **bold**):

## 25.1 DC Characteristics

PIC18LCXX8 (Industrial)		Standard Operating Conditions (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial						
PIC18CXX8 (Industrial, Extended)		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						
Param No.	Symbol	Characteristic/ Device	Min	Typ	Max	Units	Conditions	
D005	VBOR	<b>Brown-out Reset Voltage</b>						
		PIC18LCXX8	BORV1:BORV0 = 11	<b>2.35</b>	—	<b>2.80</b>	V	
			BORV1:BORV0 = 10	<b>2.55</b>	—	<b>3.02</b>	V	
			BORV1:BORV0 = 01	<b>3.95</b>	—	<b>4.71</b>	V	
	BORV1:BORV0 = 00	<b>4.23</b>	—	<b>5.05</b>	V			
D005		PIC18CXX8	BORV1:BORV0 = 1x	N.A.	N.A.	N.A.	V	Not in operating voltage range of device
			BORV1:BORV0 = 01	3.95	—	<b>4.71</b>	V	
			BORV1:BORV0 = 00	4.23	—	<b>5.05</b>	V	
D022A	$\Delta$ BOR	PIC18LCXX8	Brown-out Reset	—	<b>10</b>	TBD	$\mu\text{A}$	$V_{DD} = 5.5\text{V}$
			Brown-out Reset	—	<b>10</b>	TBD	$\mu\text{A}$	$V_{DD} = 2.5\text{V}, 25^{\circ}\text{C}$
D022A		PIC18CXX8	Brown-out Reset	—	<b>10</b>	TBD	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C} \text{ to } +85^{\circ}\text{C}$
			Brown-out Reset	—	<b>10</b>	TBD	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C} \text{ to } +125^{\circ}\text{C}$
			Brown-out Reset	—	<b>10</b>	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, 25^{\circ}\text{C}$

Legend: Shading added to differentiate characteristics for "LC" devices. Characteristics are assumed to be common for "C" and "LC" devices unless otherwise noted.

\* These parameters are characterized but not tested.

## 4. Module: Comparator

Section 25.1 of the Device Data Sheet is amended to add parameter D023 related to the Analog Comparator module.

In addition, a new table is added to describe the Analog Comparator specifications.

Section 25.1 in part should read as follows (changes and additions in **bold**):

### 25.1 DC Characteristics (cont'd)

PIC18LCXX8 (Industrial)		Standard Operating Conditions (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial					
PIC18CXX8 (Industrial, Extended)		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					
Param No.	Symbol	Characteristic/ Device	Min	Typ	Max	Units	Conditions
D020	IPD	<b>Power-down Current<sup>(3)</sup></b>					
		PIC18LCXX8	—	<2.5	5	$\mu\text{A}$	$V_{DD} = 2.5\text{V}, -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
			—	—	36	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
—	—	TBD	$\mu\text{A}$	$V_{DD} = 2.5\text{V}, 25^{\circ}\text{C}$			
D020		PIC18CXX8	—	<1	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
D020A			—	—	36	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
D021B			—	—	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, 25^{\circ}\text{C}$
D021B			—	TBD	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
		—	—	42	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	
D022	$\Delta I_{WDT}$	<b>Module Differential Current</b>					
		PIC18LCXX8 Watchdog Timer	—	—	12	$\mu\text{A}$	$V_{DD} = 2.5\text{V}$
			—	—	25	$\mu\text{A}$	$V_{DD} = 5.5\text{V}$
—	—	TBD	$\mu\text{A}$	$V_{DD} = 2.5\text{V}, 25^{\circ}\text{C}$			
D022		PIC18CXX8 Watchdog Timer	—	—	25	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
			—	—	TBD	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
			—	—	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, 25^{\circ}\text{C}$
D022A	$\Delta I_{BOR}$	PIC18LCXX8 Brown-out Reset	—	—	50	$\mu\text{A}$	$V_{DD} = 5.5\text{V}$
			—	—	TBD	$\mu\text{A}$	$V_{DD} = 2.5\text{V}, 25^{\circ}\text{C}$
D022A		PIC18CXX8 Brown-out Reset	—	—	50	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
			—	—	TBD	$\mu\text{A}$	$V_{DD} = 5.5\text{V}, -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
			—	—	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, 25^{\circ}\text{C}$
D022B	$\Delta I_{LVD}$	PIC18LCXX8 Low Voltage Detect	—	—	50	$\mu\text{A}$	$V_{DD} = 2.5\text{V}$
			—	—	TBD	$\mu\text{A}$	$V_{DD} = 2.5\text{V}, 25^{\circ}\text{C}$
D022B		PIC18CXX8 Low Voltage Detect	—	—	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$
			—	—	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$
		—	—	TBD	$\mu\text{A}$	$V_{DD} = 4.2\text{V}, 25^{\circ}\text{C}$	

Legend: Rows are shaded for improved readability.

**Note 1:** This is the limit to which  $V_{DD}$  can be lowered in SLEEP mode, or during a device RESET, without losing RAM data.

**2:** The supply current is mainly a function of the operating voltage and frequency. Other factors, such as I/O pin loading and switching rate, oscillator type, internal code execution pattern, and temperature also have an impact on the current consumption.

The test conditions for all IDD measurements in active operation mode are:

OSC1 = external square wave, from rail-to-rail; all I/O pins tri-stated, pulled to  $V_{DD}$

MCLR =  $V_{DD}$ ; WDT enabled/disabled as specified.

**3:** The power-down current in SLEEP mode does not depend on the oscillator type. Power-down current is measured with the part in SLEEP mode, with all I/O pins in hi-impedance state and tied to  $V_{DD}$  and  $V_{SS}$ , and all features that add delta current disabled (such as WDT, Timer1 Oscillator, BOR, ...).

**4:** For RC osc configuration, current through REXT is not included. The current through the resistor can be estimated by the formula  $I_r = V_{DD}/2R_{EXT}$  (mA) with  $R_{EXT}$  in kOhm.

# PIC18C658/858

## 25.1 DC Characteristics (cont'd)

<b>PIC18LCXX8</b> (Industrial)		<b>Standard Operating Conditions (unless otherwise stated)</b> Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +85^{\circ}\text{C}$ for industrial					
<b>PIC18CXX8</b> (Industrial, Extended)		<b>Standard Operating Conditions (unless otherwise stated)</b> 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					
Param No.	Symbol	Characteristic/ Device	Min	Typ	Max	Units	Conditions
D023	$\Delta I_{\text{COMP}}$	PIC18LCXX8 Comparator	—	—	100	$\mu\text{A}$	$V_{\text{DD}} = 2.5\text{V}$
D023		PIC18CXX8 Comparator	—	—	100	$\mu\text{A}$	$V_{\text{DD}} = 4.2\text{V}$
D023A	$\Delta I_{\text{VREF}}$	PIC18LCXX8 Voltage Reference	—	—	300	$\mu\text{A}$	$V_{\text{DD}} = 2.5\text{V}$
D023A		PIC18CXX8 Voltage Reference	—	—	300	$\mu\text{A}$	$V_{\text{DD}} = 4.2\text{V}$
D025	$\Delta I_{\text{OSCB}}$	PIC18LCXX8 Timer1 Oscillator	—	—	3 TBD	$\mu\text{A}$ $\mu\text{A}$	$V_{\text{DD}} = 2.5\text{V}$ $V_{\text{DD}} = 2.5\text{V}, 25^{\circ}\text{C}$
D025		PIC18CXX8 Timer1 Oscillator	—	—	TBD TBD TBD	$\mu\text{A}$ $\mu\text{A}$ $\mu\text{A}$	$V_{\text{DD}} = 4.2\text{V}, -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$ $V_{\text{DD}} = 4.2\text{V}, -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ $V_{\text{DD}} = 4.2\text{V}, 25^{\circ}\text{C}$

Legend: Rows are shaded for improved readability.

**Note 1:** This is the limit to which  $V_{\text{DD}}$  can be lowered in SLEEP mode, or during a device RESET, without losing RAM data.

**2:** The supply current is mainly a function of the operating voltage and frequency. Other factors, such as I/O pin loading and switching rate, oscillator type, internal code execution pattern, and temperature also have an impact on the current consumption.

The test conditions for all  $I_{\text{DD}}$  measurements in active operation mode are:

$\text{OSC1}$  = external square wave, from rail-to-rail; all I/O pins tri-stated, pulled to  $V_{\text{DD}}$

$\text{MCLR}$  =  $V_{\text{DD}}$ ; WDT enabled/disabled as specified.

**3:** The power-down current in SLEEP mode does not depend on the oscillator type. Power-down current is measured with the part in SLEEP mode, with all I/O pins in hi-impedance state and tied to  $V_{\text{DD}}$  and  $V_{\text{SS}}$ , and all features that add delta current disabled (such as WDT, Timer1 Oscillator, BOR, ...).

**4:** For RC osc configuration, current through  $\text{REXT}$  is not included. The current through the resistor can be estimated by the formula  $I_r = V_{\text{DD}}/2\text{REXT}$  (mA) with  $\text{REXT}$  in kOhm.

**TABLE 1: COMPARATOR SPECIFICATIONS**

	Operating conditions: $V_{\text{DD}}$ range as described in Table 1 Operating temperature $-40^{\circ}\text{C} < T_A < +125^{\circ}\text{C}$ Current consumption is specified in Table 1				
Characteristics	Min.	Typ	Max	Units	Comments
Input Offset Voltage		$\pm 5.0$	$\pm 10$	mV	
Input Common Mode Voltage	0		$V_{\text{DD}} - 1.5$	V	
CMRR	+55			db	
Response Time <sup>(1)</sup>		150	400 600	ns ns	PIC18CXX8 PIC18LCXX8
Comparator Mode Change to Output Valid			10	$\mu\text{s}$	

**Note 1:** Response time measured with one comparator at  $(V_{\text{DD}} - 1.5)/2$ , while the other input transitions from  $V_{\text{SS}}$  to  $V_{\text{DD}}$ .

## 5. Module: Electrical Specifications

The operating frequency range for extended temperature devices has been changed.

The maximum external clock frequency (EC and ECIO modes) and oscillator frequency (HS mode) for extended temperature devices has been changed to 25 MHz. When the PLL is used (HS+PLL mode), the maximum clock and oscillator frequency has been changed to 6.25 MHz. Other values of related parameters have changed accordingly.

The title of Figure 25-1 is amended to read:

**“PIC18CXX8 Voltage-Frequency Graph (Industrial, Extended)”**

Table 25-4, Parameters 1 and 1A of the Device Data Sheet are amended in part, as follows (changes and additions in **bold**):

**TABLE 1-1: EXTERNAL CLOCK TIMING REQUIREMENTS**

Param. No.	Symbol	Characteristic	Min	Max	Units	Conditions
1A	Fosc	External CLKIN Frequency	<b>DC</b> <b>DC</b> <b>4</b> <b>DC</b> <b>DC</b>	<b>25</b> <b>25</b> <b>6.25</b> <b>4</b> <b>25</b>	<b>MHz</b> <b>MHz</b> <b>MHz</b> <b>MHz</b> <b>MHz</b>	<b>XT osc (Industrial, Extended)</b> <b>HS osc (Industrial, Extended)</b> <b>HS + PLL osc (Industrial, Extended)</b> <b>LP osc (Industrial, Extended)</b> <b>EC, ECIO (Industrial, Extended)</b>
		Oscillator Frequency	<b>DC</b> <b>0.1</b> <b>4</b> <b>4</b> <b>5</b>	<b>4</b> <b>4</b> <b>25</b> <b>6.25</b> <b>200</b>	<b>MHz</b> <b>MHz</b> <b>MHz</b> <b>MHz</b> <b>kHz</b>	<b>RC osc (Industrial, Extended)</b> <b>XT osc (Industrial, Extended)</b> <b>HS osc (Industrial, Extended)</b> <b>HS + PLL osc (Industrial, Extended)</b> <b>LP osc mode (Industrial, Extended)</b>
1	Tosc	External CLKIN Period	<b>40</b> <b>40</b> <b>160</b> <b>250</b> <b>40</b>	<b>—</b> <b>—</b> <b>250</b> <b>—</b> <b>—</b>	<b>ns</b> <b>ns</b> <b>ns</b> <b>ns</b> <b>ns</b>	<b>XT osc (Industrial, Extended)</b> <b>HS osc (Industrial, Extended)</b> <b>HS + PLL osc (Industrial, Extended)</b> <b>LP osc (Industrial, Extended)</b> <b>EC, ECIO (Industrial, Extended)</b>
		Oscillator Period	<b>250</b> <b>250</b> <b>40</b> <b>160</b> <b>5</b>	<b>—</b> <b>—</b> <b>—</b> <b>250</b> <b>—</b>	<b>ns</b> <b>ns</b> <b>ns</b> <b>ns</b> <b>μs</b>	<b>RC osc (Industrial, Extended)</b> <b>XT osc (Industrial, Extended)</b> <b>HS osc (Industrial, Extended)</b> <b>HS + PLL osc (Industrial, Extended)</b> <b>LP osc (Industrial)</b>

**Note:** Footnotes in original table omitted for the sake of brevity.

# PIC18C658/858

## 6. Module: Interrupts

The operation of the GIE/GIEH bit (INTCON<7>) is clarified as follows: when the bit is cleared, all interrupts are disabled. This is regardless of the state of the IPEN bit (RCON<7>), the priority of the interrupt, or whether or not the interrupt is unmasked. This varies from the original description, in which clearing the bit when IPEN = 1 would only disable high priority interrupts.

The seventh paragraph in Section 7.0 of the Device Data Sheet (beginning “When an interrupt is responded to...”) is amended by adding the following sentence to the end:

“It is important to note, however, that clearing the GIE/GIEH bit, regardless of the state of the IPEN bit, will disable **all** interrupts.”

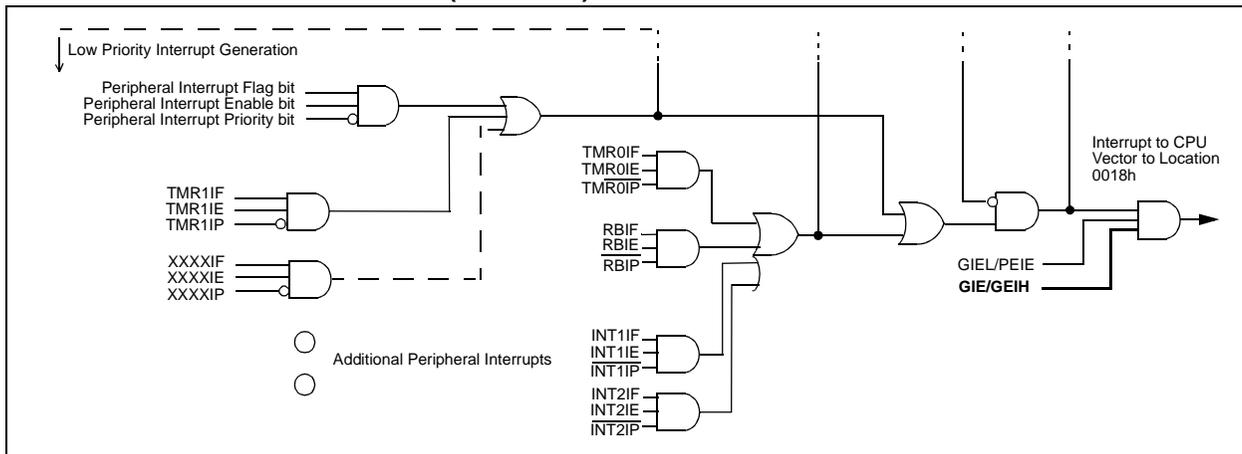
The changes to the bit descriptions in Register 7-1 in the Device Data Sheet are shown in the excerpt below (changes in **bold**).

Also, the interrupt logic funnel shown in Figure 7-1 of the Device Data Sheet is amended with the addition of a GIE/GIEH control line, as shown in Figure 1 (new material in **bold line**).

### REGISTER 7-1: INTCON REGISTER (EXCERPT)

bit 7	<p><b>GIE/GIEH:</b> Global Interrupt Enable bit</p> <p><u>When IPEN (RCON&lt;7&gt;) = 0:</u></p> <p>1 = Enables all unmasked interrupts</p> <p>0 = Disables all interrupts</p> <p><u>When IPEN (RCON&lt;7&gt;) = 1:</u></p> <p>1 = Enables all high priority interrupts</p> <p>0 = <b>Disables all interrupts</b></p>
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### FIGURE 1: INTERRUPT LOGIC (EXCERPT)



## 7. Module: USART

The operation of the USART Transmit Interrupt flag bit TXIF (PIR1<4>) is clarified as follows:

TXIF is not cleared immediately upon loading data into the transmit buffer TXREG. The flag bit becomes valid in the second instruction cycle following the load instruction (see Example 1). Polling TXIF immediately following a load of TXREG will give invalid results (Example 2).

This clarification applies to **all** USART transmission modes (master or slave, synchronous or asynchronous, 8-bit or 9-bit).

### EXAMPLE 1: CORRECTLY POLLING THE TXIF BIT

```
movwf  TXREG    ;load the register
nop           ;first instruction--
            ;just a placeholder, it
            ;could be any instruction
btfss  PIR1,TXIF ;second instruction--
            ;now TXIF is valid
```

### EXAMPLE 2: POLLING THE TXIF BIT IMMEDIATELY AFTER LOADING THE TRANSMIT BUFFER

```
movwf  TXREG    ;load the register
btfss  PIR1,TXIF ;first instruction--
            ;reading TXIF now will
            ;give invalid results
```

## 8. Module: A/D (VREF+ and VREF- References)

The operation of the module is clarified by the addition of the following note to the end of Section 18.1 ("A/D Acquisition Requirements"):

**Note:** When using external voltage references with the A/D converter, the source impedance of the external voltage references must be less than 20Ω to obtain the specified A/D resolution. Higher reference source impedances will increase both offset and gain errors. Resistive voltage dividers will not provide a sufficiently low source impedance.

To maintain the best possible performance in A/D conversions, external VREF inputs should be buffered with an operational amplifier or other low output impedance circuit.

# PIC18C658/858

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## APPENDIX A: REVISION HISTORY

### Rev A Document (6/2001)

First revision of this document. Includes issues 1 through 8 (pages 1 through 3) and clarifications 1 through 4 (pages 4 through 7).

### Rev B Document (6/2001)

Added issue 9 (Interrupts). Updated issue 8 (I/O module – Parallel Slave Port) to include the latest information.

### Rev C Document (8/2001)

Added issue 10 (Core).

### Rev D Document (10/2001)

Added issue 11 (I/O module - PORTB Interrupt-on-Change).

### Rev E Document (11/2001)

Added silicon issue 12 (Interrupts) and Data Sheet Clarification issue 5 (Electrical Characteristics).

### Rev F Document (2/2002)

Added Data Sheet Clarification issue 6 (Interrupts) and issue 7 (USART).

### Rev G Document (3/2002)

Updated issue 10 (Core).

### Rev H Document (4/2002)

Added silicon issue 13 (CAN module).

### Rev J Document (3/2003)

Added silicon issue 14 (A/D (External Voltage Reference) and Comparator Voltage Reference), and data sheet clarification issue 8 (A/D - VREF+ and VREF-References).

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Tel: 765-864-8360 Fax: 765-864-8387

#### Los Angeles

18201 Von Karman, Suite 1090  
Irvine, CA 92612  
Tel: 949-263-1888 Fax: 949-263-1338

#### San Jose

Microchip Technology Inc.  
2107 North First Street, Suite 590  
San Jose, CA 95131  
Tel: 408-436-7950 Fax: 408-436-7955

#### Toronto

6285 Northam Drive, Suite 108  
Mississauga, Ontario L4V 1X5, Canada  
Tel: 905-673-0699 Fax: 905-673-6509

### ASIA/PACIFIC

#### Australia

Microchip Technology Australia Pty Ltd  
Marketing Support Division  
Suite 22, 41 Rawson Street  
Epping 2121, NSW  
Australia  
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

#### China - Beijing

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Beijing Liaison Office  
Unit 915  
Bei Hai Wan Tai Bldg.  
No. 6 Chaoyangmen Beidajie  
Beijing, 100027, No. China  
Tel: 86-10-85282100 Fax: 86-10-85282104

#### China - Chengdu

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Chengdu Liaison Office  
Rm. 2401-2402, 24th Floor,  
Ming Xing Financial Tower  
No. 88 TIDU Street  
Chengdu 610016, China  
Tel: 86-28-86766200 Fax: 86-28-86766599

#### China - Fuzhou

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Fuzhou Liaison Office  
Unit 28F, World Trade Plaza  
No. 71 Wusi Road  
Fuzhou 350001, China  
Tel: 86-591-7503506 Fax: 86-591-7503521

#### China - Hong Kong SAR

Microchip Technology Hongkong Ltd.  
Unit 901-6, Tower 2, Metroplaza  
223 Hing Fong Road  
Kwai Fong, N.T., Hong Kong  
Tel: 852-2401-1200 Fax: 852-2401-3431

#### China - Shanghai

Microchip Technology Consulting (Shanghai)  
Co., Ltd.  
Room 701, Bldg. B  
Far East International Plaza  
No. 317 Xian Xia Road  
Shanghai, 200051  
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

#### China - Shenzhen

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Shenzhen Liaison Office  
Rm. 1812, 18/F, Building A, United Plaza  
No. 5022 Binhe Road, Futian District  
Shenzhen 518033, China  
Tel: 86-755-82901380 Fax: 86-755-82966626

#### China - Qingdao

Rm. B505A, Fullhope Plaza,  
No. 12 Hong Kong Central Rd.  
Qingdao 266071, China  
Tel: 86-532-5027355 Fax: 86-532-5027205

#### India

Microchip Technology Inc.  
India Liaison Office  
Marketing Support Division  
Divyasree Chambers  
1 Floor, Wing A (A3/A4)  
No. 11, O'Shaughnessy Road  
Bangalore, 560 025, India  
Tel: 91-80-2290061 Fax: 91-80-2290062

### Japan

Microchip Technology Japan K.K.  
Benex S-1 6F  
3-18-20, Shinyokohama  
Kohoku-Ku, Yokohama-shi  
Kanagawa, 222-0033, Japan  
Tel: 81-45-471-6166 Fax: 81-45-471-6122

### Korea

Microchip Technology Korea  
168-1, Youngbo Bldg. 3 Floor  
Samsung-Dong, Kangnam-Ku  
Seoul, Korea 135-882  
Tel: 82-2-554-7200 Fax: 82-2-558-5934

### Singapore

Microchip Technology Singapore Pte Ltd.  
200 Middle Road  
#07-02 Prime Centre  
Singapore, 188980  
Tel: 65-6334-8870 Fax: 65-6334-8850

### Taiwan

Microchip Technology (Barbados) Inc.,  
Taiwan Branch  
11F-3, No. 207  
Tung Hua North Road  
Taipei, 105, Taiwan  
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

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#### Austria

Microchip Technology Austria GmbH  
Durisolstrasse 2  
A-4600 Wels  
Austria  
Tel: 43-7242-2244-399  
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Microchip Technology Nordic ApS  
Regus Business Centre  
Lautrup høj 1-3  
Ballerup DK-2750 Denmark  
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Microchip Technology SARL  
Parc d'Activite du Moulin de Massy  
43 Rue du Saule Trapu  
Batiment A - 1er Etage  
91300 Massy, France  
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

#### Germany

Microchip Technology GmbH  
Steinheilstrasse 10  
D-85737 Ismaning, Germany  
Tel: 49-089-627-144-100  
Fax: 49-089-627-144-44

#### Italy

Microchip Technology SRL  
Via Quasimodo, 12  
20025 Legnano (MI)  
Milan, Italy  
Tel: 39-0331-742611 Fax: 39-0331-466781

#### United Kingdom

Microchip Ltd.  
505 Eskdale Road  
Winnersh Triangle  
Wokingham  
Berkshire, England RG41 5TU  
Tel: 44 118 921 5869 Fax: 44-118 921-5820

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