PIC18F87J11 Family
Silicon Errata and Data Sheet Clarification

The PIC18F87J11 family devices that you have received conform functionally to the current Device Data Sheet (DS39778**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 PIC18F87J11 family 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 (**A6**) or (**C2**), respectively.

Data Sheet clarifications and corrections start on page 5, 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 PIC18F87J11 family 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	A4	A5	A6	C1	C2
PIC18F66J11	444h	1h	2h	4h	5h	6h	10h	13h
PIC18F66J16	446h							
PIC18F67J11	448h							
PIC18F86J11	44Eh							
PIC18F86J16	450h							
PIC18F87J11	452h							

Note 1: The Device IDs (DEVID and DEVREV) are located at the last two implemented addresses of configuration memory space. They are shown in hexadecimal in the format "DEVID DEVREV".

2: Refer to the *"PIC18F6XJXX/8XJXX Flash Microcontroller Programming Specification"* (DS39644) for detailed information on Device and Revision IDs for your specific device.

TABLE 2: SILICON ISSUE SUMMARY

Module	Feature	Item Num	Issue Summary	Affected Revisions[1]						
				A1	A2	A4	A5	A6	C1	C2
MSSPx	I^2C™ Slave Reception	1.	When configured for I^2C slave reception, the MSSPx module may not receive the correct data if the SSPxBUF register is not read within a window after an SSPxIF interrupt occurs.	X	X	X	X	X	X	X
Oscillator Configuration	PLL	2.	When Phase Lock Loop (PLL) is enabled, if the PLL input frequency is higher than 8 MHz, there may be problems accessing the RAM.	X	X					
Voltage Regulator	V_{DDCORE}	3.	If V_{DDCORE} drops below approximately 2.45V, while the on-chip core voltage regulator is enabled and operating in Voltage Tracking mode, the REGSLP bit (WDTCON <7>) will be automatically cleared.	X						
SRAM	Read/Write	4.	Any read or write access to SRAM will increase the current consumption of the device – varying with how often the SRAM is accessed.	X						
Low-Voltage Detect	LVDSTAT	5.	The LVDSTAT V_{DDCORE} status bit is not implemented in the cited revision of silicon.	X						
MSSPx	I^2C™ Master mode	6.	In Master mode, the first clock may become narrower than the configuration width if the slave performs a clock stretch and release.	X	X	X	X	X	X	
EUSART	Synchronous Mode	7.	The TRMT bit may not indicate when the TSR register is empty.	X	X	X	X	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 (**A6**) or (**C2**), respectively.

1. Module: Master Synchronous Serial Port (MSSPx)

When configured for I^2C™ slave reception, the MSSPx module may not receive the correct data, in extremely rare cases. This occurs only if the Serial Receive/Transmit Buffer Register (SSPxBUF) is not read within a window after the SSPxIF interrupt (PIRx<3>) has occurred.

Work around

The issue can be resolved in either of these ways:

- Prior to the I^2C slave reception, enable the clock stretching feature.

  This is done by setting the SEN bit (SSPxCON2<0>).
- Each time the SSPxIF is set, read the SSPxBUF before the first rising clock edge of the next byte being received.

Affected Silicon Revisions

A1	A2	A4	A5	A6	C1	C2	
X	X	X	X	X	X	X	

2. Module: Oscillator Configurations (PLL)

When Phase Lock Loop (PLL) is enabled, if the PLL input frequency is higher than 8 MHz, there may be problems accessing the RAM.

Work around

Limit the PLL input frequency from 4 MHz to 8 MHz. This will cause the system clock to operate from 16 MHz to 32 MHz.

If it is necessary to run the device above 32 MHz, do not enable PLL and use the EC mode.

Affected Silicon Revisions

A1	A2	A4	A5	A6	C1	C2	
X	X						

3. Module: Voltage Regulator

If V_{DDCORE} drops below approximately 2.45V while the on-chip core voltage regulator is enabled, and operating in Voltage Tracking mode, the REGSLP bit (WDTCON <7>) will be automatically cleared. The REGSLP bit cannot be set again by firmware until V_{DDCORE} rises back above the 2.45V approximate threshold.

Additionally, the REGSLP bit retains its previous state upon all Resets except POR.

Work around

None.

Affected Silicon Revisions

A1	A2	A4	A5	A6	C1	C2	
X							

4. Module: SRAM

Any access to SRAM, either in the form of read or write operations, will increase the current consumption of the device, depending on how often the SRAM is accessed. A small current increase is normal, but in this cited silicon revision, the difference may be significant and of particular concern for low-power applications.

For further details, see Table 3.

TABLE 3: TYPICAL CURRENT CONSUMPTION

Case 1:			
Voltage Regulator Enabled Temperature = +25°C SEC_RUN mode using 32 kHz Timer1 Crystal			
Condition	**IDD (μA)**	**VDD (V)**	
No RAM access(1)	59	3.3	
Typ RAM access(2)	201	3.3	
Extreme RAM access(3)	906	3.3	
Case 2:			
Voltage Regulator Disabled VDDCORE is tied to VDD Temperature = +25°C SEC_RUN mode using 32 kHz Timer1 Crystal			
Condition	**IDD (μA)**	**VDD (V)**	**VDDCORE (V)**
No RAM access(1)	20	2.5	2.5
Typ RAM access(2)	132	2.5	2.5
Extreme RAM access(3)	723	2.5	2.5

Note 1: Code execution patterns where no instructions access SRAM.
2: Code execution that accesses SRAM, once every seven instruction cycles.
3: Code execution where every instruction cycle executes an instruction that accesses SRAM.

Work around

None.

Affected Silicon Revisions

A1	A2	A4	A5	A6	C1	C2	
X							

5. Module: Low-Voltage Detect

The LVDSTAT, VDDCORE status bit (WDTCON<6>), is not implemented in this revision of silicon.

Work around

None.

Affected Silicon Revisions

A1	A2	A4	A5	A6	C1	C2	
X							

6. Module: MSSPx (I²C™ Master)

If the module is in I²C Master mode, and the slave performs clock stretching, the first clock pulse after the slave releases the SCLx line may be narrower than the configured clock width. This may result in the slave missing the first clock in the next transmission/reception.

Work around

If the module is in I²C Master mode, do not allow the slave to perform clock stretching. Alternately, the master can slow down the SCLx clock frequency to a level where the slave can detect the narrowed clock pulse.

Affected Silicon Revisions

A1	A2	A4	A5	A6	C1	C2	
X	X	X	X	X	X		

7. Module: Enhanced Universal Synchronous Asynchronous Receiver Transmitter (EUSART)

In Synchronous Slave Transmission mode, the TRMT bit (TXSTA<1>) may not indicate when the TSR register is empty.

Work around

Instead of polling the TRMT bit to determine the status of the EUSART, poll the TXIF flag (PIR1<4>) to determine when new data can be written to the TXREG register.

Affected Silicon Revisions

A1	A2	A4	A5	A6	C1	C2	
X	X	X	X	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 (DS39778**D**):

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

1. Module: Table 27-1: Memory Programming Requirements

On page 398, the parameter, D132, which provides the minimum and maximum voltage levels of the Self-Timed Erase or Write for VDD and VDDCORE, are included. A new parameter (D133B) is added. The TWE parameter number and conditions column are changed. The changed/appended values are indicated in bold text in the following table:

TABLE 27-1: MEMORY PROGRAMMING REQUIREMENTS

DC CHARACTERISTICS			**Standard Operating Conditions (unless otherwise stated)** Operating temperature -40°C ≤ TA ≤ +85°C for industrial				
Param No.	**Sym**	**Characteristic**	**Min**	**Typ†**	**Max**	**Units**	**Conditions**
		Program Flash Memory					
D130	EP	Cell Endurance	10K	—	—	E/W	-40°C to +85°C
D131	VPR	VDD for Read	VMIN	—	3.6	V	VMIN = Minimum operating voltage
D132B	VPEW	**Voltage for Self-Timed Erase or Write**					
		VDD	**2.35**	—	**3.6**	V	**ENVREG tied to VDD**
		VDDCORE	**2.25**	—	**2.7**	V	**ENVREG tied to VSS**
D133A	TIW	Self-Timed Write Cycle Time	—	2.8	—	ms	
D133B	**TIE**	**Self-Timed Page Erase Cycle Time**	**—**	**33.0**	**—**	**ms**	
D134	TRETD	Characteristic Retention	20	—	—	Year	Provided no other specifications are violated
D135	IDDP	Supply Current during Programming	—	3	14	mA	
D140	TWE	Writes per Erase Cycle	—	—	1	—	**For each physical address**

† Data in "Typ" column is at 3.3V, 25°C unless otherwise stated. These parameters are for design guidance only and are not tested.

2. Module: Table 27-2: Comparator Specifications

On page 399, the maximum Input Offset Voltage (Parameter No. D300) is changed to ±25 mV.

The parameter numbers for TRESP and TMC2OV are changed to D303 and D304, respectively.

A new parameter, D305, for VIRV is added.

The changed/appended values are indicated in bold text in the following table:

TABLE 27-2: COMPARATOR SPECIFICATIONS

Operating Conditions: 3.0V < VDD < 3.6V, -40°C < TA < +85°C (unless otherwise stated)							
Param No.	**Sym**	**Characteristics**	**Min**	**Typ**	**Max**	**Units**	**Comments**
D300	VIOFF	Input Offset Voltage	—	±5.0	**±25**	mV	
D301	VICM	Input Common Mode Voltage	0	—	AVDD – 1.5	V	
D302	CMRR	Common Mode Rejection Ratio	55	—	—	dB	
D303	TRESP	Response Time**(1)**	—	150	400	ns	
D304	TMC2OV	Comparator Mode Change to Output Valid	—	—	10	µs	
D305	**VIRV**	**Internal Reference Voltage**	**—**	**1.2**	**—**	**V**	

Note 1: Response time measured with one comparator input at (VDD – 1.5)/2, while the other input transitions from VSS to VDD.

3. Module: Table 27-4: Internal Voltage Regulator Specifications

On page 399, the comments column for the CF is changed. The note, which states “These parameters are characterized but not tested”, is removed. The changed content is indicated in bold text in the following table:

TABLE 27-4: INTERNAL VOLTAGE REGULATOR SPECIFICATIONS

Operating Conditions: -40°C < TA < +85°C (unless otherwise stated)							
Param No.	**Sym**	**Characteristics**	**Min**	**Typ**	**Max**	**Units**	**Comments**
	VRGOUT	Regulator Output Voltage*	—	2.5	—	V	
	CF	External Filter Capacitor Value*	4.7	10	—	µF	**Capacitor must be low series resistance (<5 Ohms)**

4. Module: Section 27.3 “DC Characteristics: PIC18F87J11 Family (Industrial)”

On page 396, the characteristics and conditions of the Input Leakage Current are updated for the Analog (D060) and included for the Digital (D060A) I/O ports. The changed values are indicated in bold text in the following table:

DC CHARACTERISTICS			**Standard Operating Conditions (unless otherwise stated)** Operating temperature -40°C ≤ TA ≤ +85°C for industrial			
Param No.	**Symbol**	**Characteristic**	**Min**	**Max**	**Units**	**Conditions**
	VIL	**Input Low Voltage**				
		All I/O Ports:				
D030		with TTL Buffer	VSS	0.15 VDD	V	VDD < 3.3V
D030A			—	0.8	V	3.3V ≤ VDD ≤ 3.6V
D031		with Schmitt Trigger Buffer	VSS	0.2 VDD	V	
D032		$\overline{MCLR}$	VSS	0.2 VDD	V	
D033		OSC1	VSS	0.3 VDD	V	HS, HSPLL modes
D033A		OSC1	VSS	0.2 VDD	V	EC, ECPLL modes
D034		T1CKI	VSS	0.3	V	
	VIH	**Input High Voltage**				
		I/O Ports with Non 5.5V Tolerance:(2)				
D040		with TTL Buffer	0.25 VDD + 0.8V	VDD	V	VDD < 3.3V
D040A			2.0	VDD	V	3.3V ≤ VDD ≤ 3.6V
D041		with Schmitt Trigger Buffer	0.8 VDD	VDD	V	
		I/O Ports with 5.5V Tolerance:(2)				
Dxxx		with TTL Buffer	0.25 VDD + 0.8V	5.5	V	VDD < 3.3V
DxxxA			2.0	5.5	V	3.3V ≤ VDD ≤ 3.6V
Dxxx		with Schmitt Trigger Buffer	0.8 VDD	5.5	V	
D042		$\overline{MCLR}$	0.8 VDD	VDD	V	
D043		OSC1	0.7 VDD	VDD	V	HS, HSPLL modes
D043A		OSC1	0.8 VDD	VDD	V	EC, ECPLL modes
D044		T1CKI	1.6	VDD	V	
	IIL	**Input Leakage Current(1)**				
D060		**I/O Ports with Non 5.5V Tolerance(2)**	—	±1	µA	VSS ≤ VPIN ≤ VDD, Pin at high-impedance
D060A		**I/O Ports with 5.5V Tolerance(2)**	**—**	**±1**	**µA**	**VSS ≤ VPIN ≤ 5.5V, Pin at high-impedance**
D061		$\overline{MCLR}$	—	±1	µA	VSS ≤ VPIN ≤ VDD
D063		OSC1	—	±5	µA	VSS ≤ VPIN ≤ VDD

Note 1: Negative current is defined as current sourced by the pin.

2: Refer to Table 10-1 for the pins that have corresponding tolerance limits.

5. Module: Example 6-2: Erasing a Flash Program Memory Row

On page 94, an instruction to enable the write process to memory for erasing the Flash programming memory row is missing in the example. The changed content is indicated in bold text in the following example:

EXAMPLE 6-2: ERASING A FLASH PROGRAM MEMORY ROW

```
                MOVLW CODE_ADDR_UPPER          ; load TBLPTR with the base
                MOVWF TBLPTRU                  ; address of the memory block
                MOVLW CODE_ADDR_HIGH
                MOVWF TBLPTRH
                MOVLW CODE_ADDR_LOW
                MOVWF TBLPTRL
          ERASE_ROW
                BSF EECON1, WREN               ; enable write to memory
                BSF EECON1, FREE               ; enable Row Erase operation
                BCF INTCON, GIE                ; disable interrupts
      Required  MOVLW 55h
      Sequence  MOVWF EECON2                   ; write 55h
                MOVLW 0AAh
                MOVWF EECON2                   ; write 0AAh
                BSF EECON1, WR                 ; start erase (CPU stall)
                BSF INTCON, GIE                ; re-enable interrupts
```

6. Module: Section 19.3 “SPI Mode” and Section 19.4 “I²C™ Mode”

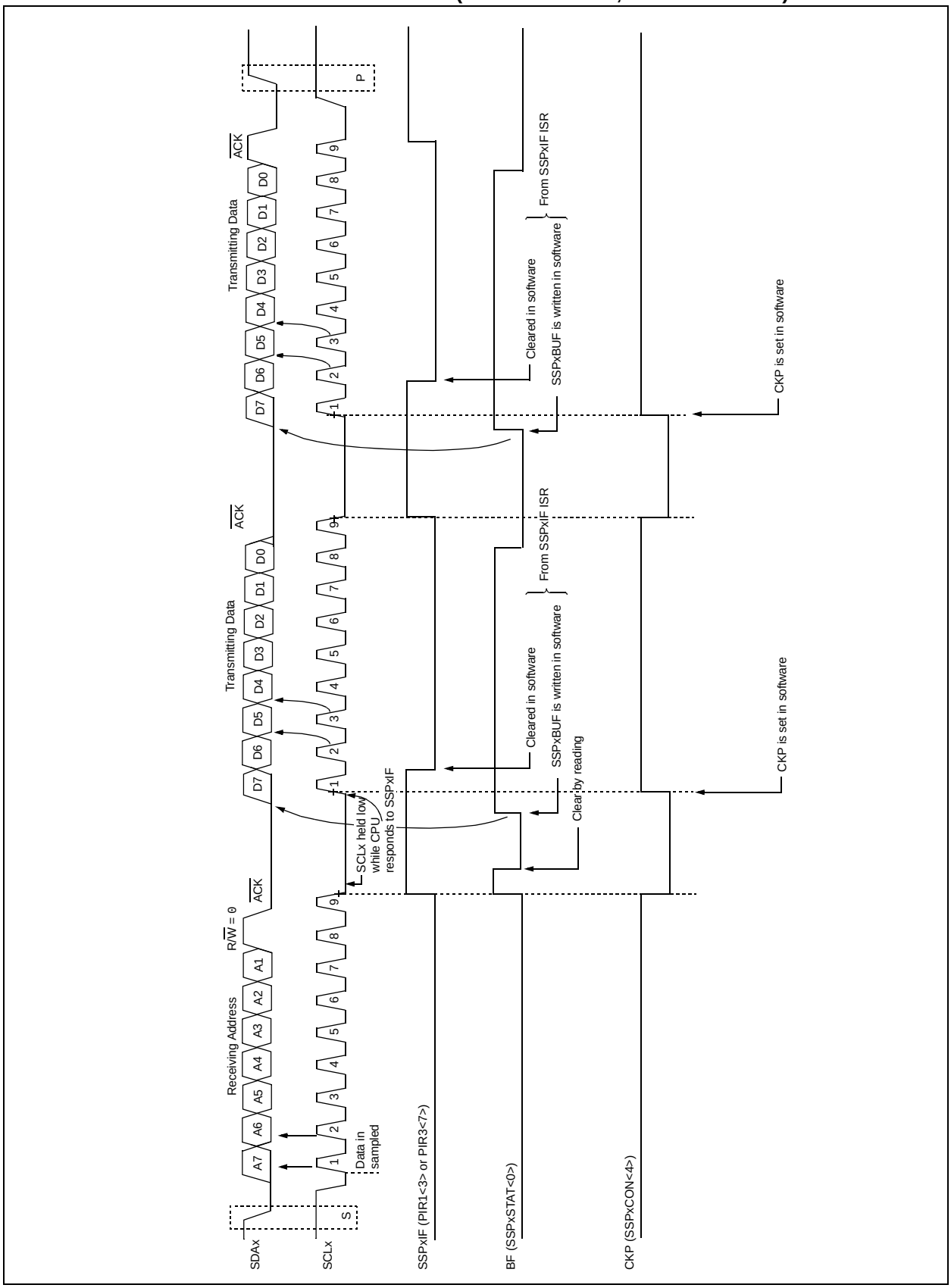
In **Section 19.3 “SPI Mode”**, on page 223, and **Section 19.4 “I²C™ Mode”**, on page 233, the following new note is included to describe the procedure to disable the MSSPx module:

Note:	Disabling the MSSPx module by clearing the SSPEN (SSPxCON1<5>) bit may not reset the module. It is recommended to clear the SSPxSTAT, SSPxCON1 and SSPxCON2 registers and select the mode prior to setting the SSPEN bit to enable the MSSPx module.

7. Module: Figure 19-10: I²C™ Slave Mode Timing (Transmission, 7-Bit Address)

On page 244, the figure is replaced with the new timing diagram provided in Figure 19-10.

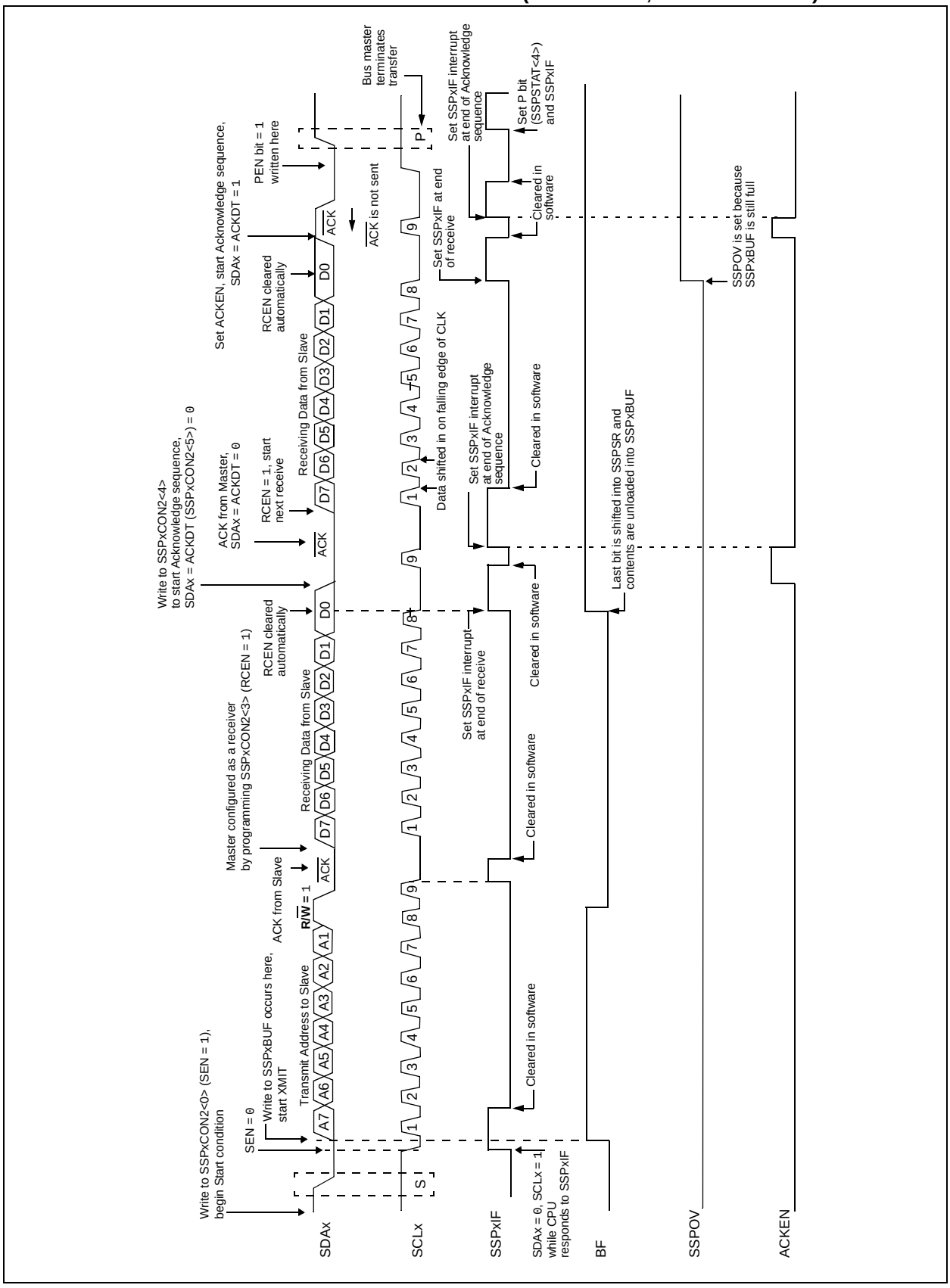
FIGURE 19-10: I²C™ SLAVE MODE TIMING (TRANSMISSION, 7-BIT ADDRESS)



8. Module: Figure 19-24: I²C™ Master Mode Waveform (Reception, 7-Bit Address)

On page 261, the condition (R/$\overline{W}$) when the Acknowledge signal (ACK) is received from the slave, after transmitting the address to the slave, is changed to ‘1’. The changed value is indicated in bold text in Figure 19-24.

FIGURE 19-24: I²C™ MASTER MODE WAVEFORM (RECEPTION, 7-BIT ADDRESS)



9. Module: Table 1-3: PIC18F6XJ1X Pinout I/O Descriptions

On page 20, the pin type for the RF3, RF4 and RF5 pins is changed from I (Input) to I/O (Input/Output). The changed content is indicated in bold text in the following table.

Pin Name	Pin Number	Pin Type	Buffer Type	Description
	64-TQFP			
				PORTF is a bidirectional I/O port.
RF1/AN6/C2OUT	17			
RF1		I/O	ST	Digital I/O.
AN6		I	Analog	Analog input 6.
C2OUT		O	—	Comparator 2 output.
RF2/PMA5/AN7/C1OUT	16			
RF2		I/O	ST	Digital I/O.
PMA5		O	—	Parallel Master Port address.
AN7		I	Analog	Analog input 7.
C1OUT		O	—	Comparator 1 output.
RF3/AN8/C2INB	15			
RF3		**I/O**	ST	Digital **I/O**.
AN8		I	Analog	Analog input 8.
C2INB		I	Analog	Comparator 2 input B.
RF4/AN9/C2INA	14			
RF4		**I/O**	ST	Digital **I/O**.
AN9		I	Analog	Analog input 8.
C2INA		I	Analog	Comparator 2 input A.
RF5/AN10/C1INB/CV_{REF}	13			
RF5		**I/O**	ST	Digital **I/O**.
AN10		I	Analog	Analog input 10.
C1INB		I	Analog	Comparator 1 input B.
CV_{REF}		O	Analog	Comparator reference voltage output.
RF6/AN11/C1INA	12			
RF6		I/O	ST	Digital I/O.
AN11		I	Analog	Analog input 11.
C1INA		I	Analog	Comparator 1 input A.
RF7/$\overline{SS1}$	11			
RF7		I/O	ST	Digital I/O.
$\overline{SS1}$		I	TTL	SPI slave select input.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; OD = Open-Drain (no P diode to V_{DD})

Note 1: Default assignment for ECCP2/P2A when Configuration bit, CCP2MX, is set.

2: Alternate assignment for ECCP2/P2A when Configuration bit, CCP2MX, is cleared.

10. Module: Memory Organization

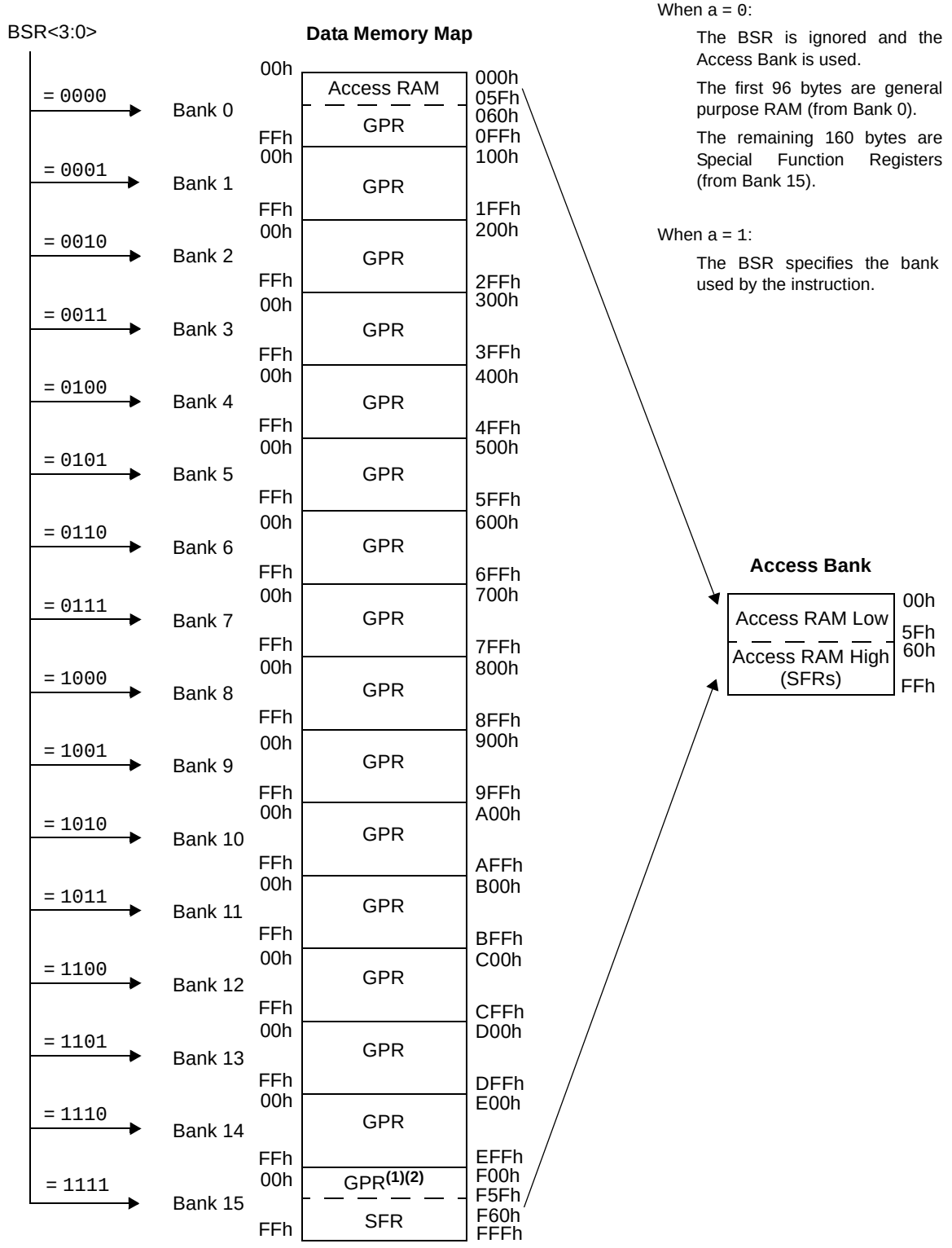
On page 75, the note at the end of **Section 5.3.4** "**Special Function Registers"** has been amended. The new information is indicated in bold text.

Note:	Addresses, F5Ah through F5Fh, are not part of the Access Bank. These registers must always be accessed using the Bank Select Register. **Addresses, F40h to F59h, are not implemented and not accessible to the user.**

11. Module: Memory Organization

On page 73, in Figure 5-7, Note 2 has been added. The additional note is indicated in bold text in Figure 5-7.

FIGURE 5-7: DATA MEMORY MAP FOR PIC18F87J11 FAMILY DEVICES



Note 1: Addresses, F5Ah through F5Fh, are also used by SFRs, but are not part of the Access RAM. Users must always use the complete address, or load the proper BSR value, to access these registers.

2: Addresses, F40h to F59h, are not implemented and are not accessible to the user.

12. Module: Electrical Specification

Changes have been made to the V_{BOR} specification, Parameter Number D005 in Table 27.1, as shown in bold text in the updated table below.

27.1 DC Characteristics: Supply Voltage PIC18F87J11 Family (Industrial)

PIC18F87J11 Family (Industrial)			Standard Operating Conditions (unless otherwise stated) Operating temperature -40°C ≤ T_A ≤ +85°C for industrial				
Param No.	Symbol	Characteristic	Min	Typ	Max	Units	Conditions
D001	V_{DD}	Supply Voltage	V_{DDCORE} 2.0	— —	3.6 3.6	V V	ENVREG tied to V_{SS} ENVREG tied to V_{DD}
D001B	V_{DDCORE}	External Supply for Microcontroller Core	2.0	—	2.70	V	ENVREG tied to V_{SS}
D001C	AV_{DD}	Analog Supply Voltage	V_{DD} – 0.3	—	V_{DD} + 0.3	V	
D001D	AV_{SS}	Analog Ground Potential	V_{SS} – 0.3	—	V_{SS} + 0.3	V	
D002	V_{DR}	RAM Data Retention Voltage(1)	1.5	—	—	V	
D003	V_{POR}	V_{DD} Start Voltage to Ensure Internal Power-on Reset Signal	—	—	0.7	V	See Section 5.3 “Power-on Reset (POR)” for details
D004	S_{VDD}	V_{DD} Rise Rate to Ensure Internal Power-on Reset Signal	0.05	—	—	V/ms	See Section 5.3 “Power-on Reset (POR)” for details
D005	V_{BOR}	Brown-out Reset Voltage	**1.75(2)**	2.0	**2.4**	V	

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: When the BOR is enabled, the part will continue to operate until the BOR occurs. This is valid, although V_{DD} may be below the minimum V_{DD} voltage.

DOCUMENT REVISION HISTORY

Rev A Document (2/2010)

Combined existing silicon and data sheet errata documents into the new, single document format. Added the A6 silicon revision, but no issues or clarifications.

This document replaces these errata documents:

- DS80418A, *"PIC18F87J11 Family Rev. A5 Silicon Errata"*
- DS80417A, *"PIC18F87J11 Family Rev. A4 Silicon Errata"*
- DS80344A, *"PIC18F87J11 Family Rev. A2 Silicon Errata"*
- DS80305B, *"PIC18F87J11 Family Rev. A1 Silicon Errata"*
- DS80408B, *"PIC18F87J11 Family Data Sheet Errata"*

Rev B Document (7/2010)

Added silicon issue 6 (MSSPx I^2C™ Master).

Added data sheet clarifications 10 and 11 (Memory Organization).

Rev C Document (8/2010)

Added silicon revision B0; includes existing silicon issues 1 (Master Synchronous Serial Port – MSSPx) and 6 (MSSPx – I^2C Master).

No new data sheet clarifications added.

Rev D Document (2/2011)

Replaced silicon revision B0 with revision C1 for lower pin count devices. Added silicon issue 12 (Enhanced Universal Synchronous Asynchronous Receiver Transmitter (EUSART). Removed data sheet clarification 12 (Electrical Characteristics).

Rev E Document (9/2011)

Removed data sheet clarification 12 (Guidelines for Getting Started). Added new data sheet clarification 12 (Electrical Specification). Added new silicon revision (**C2**).

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.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Trademarks

ISBN: 978-1-61341-638-9

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
ISO/TS 16949:2009

Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://www.microchip.com/support
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Indianapolis
Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario, Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8569-7000
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Chongqing
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

China - Hangzhou
Tel: 86-571-2819-3187
Fax: 86-571-2819-3189

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-5778-366
Fax: 886-3-5770-955

Taiwan - Kaohsiung
Tel: 886-7-536-4818
Fax: 886-7-330-9305

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

08/02/11