

## 28/40/44/64-Pin, High-Temperature, Enhanced Flash Microcontrollers with ECAN™ and nanoWatt XLP Technology

### High-Temperature Features:

- Ambient Temperature Range of -40°C to +150°C

### Power-Managed Modes:

- Run: CPU on, Peripherals on
- Idle: CPU off, Peripherals on
- Sleep: CPU off, Peripherals off
- Two-Speed Oscillator Start-up
- Fail-Safe Clock Monitor (FSCM)
- Power-Saving Peripheral Module Disable (PMD)
- Ultra Low-Power Wake-up
- Fast Wake-up, 1 μs, Typical
- Low-Power WDT, 300 nA, Typical
- Run mode Currents Down to Very Low 3.8 μA, Typical
- Idle mode Currents Down to Very Low 880 nA, Typical
- Sleep mode Currents Down to Very Low 13 nA, Typical

### ECAN Bus Module Features:

- Conforms to CAN 2.0B Active Specification
- Three Operating modes:
  - Legacy mode (full backward compatibility with existing PIC18CXX8/FXX8 CAN modules)
  - Enhanced mode
  - FIFO mode or programmable TX/RX buffers
- Message Bit Rates up to 1 Mbps
- DeviceNet™ Data Byte Filter Support

### ECAN Bus Module Features (Continued):

- Six Programmable Receive/Transmit Buffers
- Three Dedicated Transmit Buffers with Prioritization
- Two Dedicated Receive Buffers
- 16 Full, 29-Bit Acceptance Filters with Dynamic Association
- Three Full, 29-Bit Acceptance Masks
- Automatic Remote Frame Handling
- Advanced Error Management Features

### Special Microcontroller Features:

- On-Chip 3.3V Regulator
- Operating Speed up to 64 MHz
- 3.6 Kbytes of General Purpose Registers (SRAM)
- Three Internal Oscillators:
  - LF-INTOSC (31 kHz)
  - MF-INTOSC (500 kHz)
  - HF-INTOSC (16 MHz)
- Priority Levels for Interrupts
- 8 x 8 Single-Cycle Hardware Multiplier
- Extended Watchdog Timer (WDT):
  - Programmable period from 4 ms to 4,194s
- In-Circuit Serial Programming™ (ICSP™) via Two Pins
- In-Circuit Debug via Two Pins
- Programmable BOR
- Programmable LVD

**TABLE 1: DEVICE COMPARISON**

Device	Program Memory	Data Memory (Bytes)	Data EE (Bytes)	Pins	I/O	CTMU	12-Bit A/D Channels	CCP/ECCP	Timers 8-Bit/16-Bit	EUSART	Comparators	ECAN™	MSSP	BORM/LVD	DSM
PIC18F25K80	32 Bytes	3,648	1,024	28	24	1	8-ch	4/1	2/3	2	2	1	1	Yes	No
PIC18F26K80	64 Bytes	3,648	1,024	28	24	1	8-ch	4/1	2/3	2	2	1	1	Yes	No
PIC18F45K80	32 Bytes	3,648	1,024	40/44	35	1	11-ch	4/1	2/3	2	2	1	1	Yes	No
PIC18F46K80	64 Bytes	3,648	1,024	40/44	35	1	11-ch	4/1	2/3	2	2	1	1	Yes	No
PIC18F65K80	32 Bytes	3,648	1,024	64	54	1	11-ch	4/1	2/3	2	2	1	1	Yes	Yes
PIC18F66K80	64 Bytes	3,648	1,024	64	54	1	11-ch	4/1	2/3	2	2	1	1	Yes	Yes

# PIC18F66K80 FAMILY

---

## Peripheral Highlights:

- Five CCP/ECCP modules:
  - Four Capture/Compare/PWM (CCP) modules
  - One Enhanced Capture/Compare/PWM (ECCP) module
- Five 8/16-Bit Timer/Counter modules:
  - Timer0: 8/16-bit timer/counter with 8-bit programmable prescaler
  - Timer1, Timer3: 16-bit timer/counter
  - Timer2, Timer4: 8-bit timer/counter
- Two Analog Comparators
- Configurable Reference Clock Output
- Charge Time Measurement Unit (CTMU):
  - Capacitance measurement
  - Time measurement with 1 ns typical resolution
  - Integrated voltage reference
- Up to Four External Interrupts
- One Master Synchronous Serial Port (MSSP) module:
  - 3/4-wire SPI (supports all four SPI modes)
  - I<sup>2</sup>C™ Master and Slave modes
- Two Enhanced Addressable USART modules:
  - LIN/J2602 support
  - Auto-Baud Detect (ABD)
- 12-Bit A/D Converter with up to 11 Channels:
  - Auto-acquisition and Sleep operation
  - Differential Input mode of operation
- Data Signal Modulator module:
  - Select modulator and carrier sources from various module outputs
- Integrated Voltage Reference

# PIC18F66K80 FAMILY

---

## Table of Contents

- 1.0 Device Overview ..... 5
- 2.0 Special Features of the CPU ..... 7
- 3.0 Electrical Characteristics ..... 9
- Appendix A: Revision History ..... 13
- The Microchip Web Site ..... 15
- Customer Change Notification Service ..... 15
- Customer Support ..... 15
- Reader Response ..... 16
- Product Identification System ..... 17

# PIC18F66K80 FAMILY

---

---

## TO OUR VALUED CUSTOMERS

It is our intention to provide our valued customers with the best documentation possible to ensure successful use of your Microchip products. To this end, we will continue to improve our publications to better suit your needs. Our publications will be refined and enhanced as new volumes and updates are introduced.

If you have any questions or comments regarding this publication, please contact the Marketing Communications Department via E-mail at [docerrors@microchip.com](mailto:docerrors@microchip.com) or fax the **Reader Response Form** in the back of this data sheet to (480) 792-4150. We welcome your feedback.

### Most Current Data Sheet

To obtain the most up-to-date version of this data sheet, please register at our Worldwide Web site at:

<http://www.microchip.com>

You can determine the version of a data sheet by examining its literature number found on the bottom outside corner of any page. The last character of the literature number is the version number, (e.g., DS30000A is version A of document DS30000).

### Errata

An errata sheet, describing minor operational differences from the data sheet and recommended workarounds, may exist for current devices. As device/documentation issues become known to us, we will publish an errata sheet. The errata will specify the revision of silicon and revision of document to which it applies.

To determine if an errata sheet exists for a particular device, please check with one of the following:

- Microchip's Worldwide Web site; <http://www.microchip.com>
- Your local Microchip sales office (see last page)

When contacting a sales office, please specify which device, revision of silicon and data sheet (include literature number) you are using.

### Customer Notification System

Register on our web site at [www.microchip.com](http://www.microchip.com) to receive the most current information on all of our products.

# PIC18F66K80 FAMILY

---

## 1.0 DEVICE OVERVIEW

This document contains device-specific information for the following devices, operating in an ambient temperature range between -40°C and +150°C:

- PIC18F25K80
- PIC18F26K80
- PIC18F45K80
- PIC18F46K80
- PIC18F65K80
- PIC18F66K80

**Note:** This data sheet documents only the devices' features and specifications that are in addition to the features and specifications of the non-specialty PIC18F66K80 devices. For information on the features and specifications shared by this document's high-temperature devices and the non-specialty devices, see the "PIC18F66K80 Family Data Sheet" (DS39977).

This family of devices offers the advantages of all PIC18 microcontrollers; namely, high computational performance at an economical price. In addition to these features, the PIC18F66K80 family introduces design enhancements that make these microcontrollers a logical choice for many high-performance, power-sensitive applications.

The primary differentiating features and specifications of the high-temperature PIC18F66K80 family devices are:

- Above +125°C, writes are not allowed for Flash program memory
- All AC timing specifications are increased by 15%  
This derating factor includes parameters, such as TPWRT
- Maximum HS frequency of operation is 64 MHz

**Note:** The test duration for AEC-Q100 reliability testing for devices operating at +150°C is 1,000 hours. Any design operating at +125°C to +150°C for longer than that period is not warranted without prior written approval from Microchip Technology Inc.

# PIC18F66K80 FAMILY

---

NOTES:

# PIC18F66K80 FAMILY

## 2.0 SPECIAL FEATURES OF THE CPU

**Note:** For additional details on the Configuration bits, refer to **Section 28.1 “Configuration Bits”** in the “*PIC18F66K80 Family Data Sheet*” (DS39977). Device ID information presented in this section is for the high-temperature PIC18F66K80 family devices only.

## 2.1 Device ID Registers

The Device ID registers are read-only registers. They identify the device type and revision for device programmers and can be read by firmware using table reads.

**TABLE 2-1: DEVICE IDs**

File Name	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Default/ Unprogrammed Value	
3FFFFEh	DEVID1 <sup>(1)</sup>	DEV2	DEV1	DEV0	REV4	REV3	REV2	REV1	REV0	xxxx xxxx
3FFFFFh	DEVID2 <sup>(1)</sup>	DEV10	DEV9	DEV8	DEV7	DEV6	DEV5	DEV4	DEV3	xxxx xxxx

**Legend:** x = unknown; u = unchanged; — = unimplemented.

**Note 1:** See [Register 2-1](#) and [Register 2-2](#) for DEVIDx values. DEVIDx registers are read-only and cannot be programmed by the user.

**REGISTER 2-1: DEVID1: DEVICE ID REGISTER 1**

R	R	R	R	R	R	R	R
DEV2 <sup>(1)</sup>	DEV1 <sup>(1)</sup>	DEV0 <sup>(1)</sup>	REV4	REV3	REV2	REV1	REV0
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 7-5 **DEV<2:0>:** Device ID bits<sup>(1)</sup>

111 = PIC18F66K80

100 = PIC18F25K80

011 = PIC18F45K80

010 = PIC18F65K80

001 = PIC18F26K80

000 = PIC18F46K80

bit 4-0 **REV<4:0>:** Revision ID bits

These bits are used to indicate the device revision.

**Note 1:** These DEV<2:0> values may be shared with other devices. The specific device is always identified by using the entire DEV<10:0> bit sequence.

# PIC18F66K80 FAMILY

---

## REGISTER 2-2: DEVID2: DEVICE ID REGISTER 2

R	R	R	R	R	R	R	R
DEV10 <sup>(1)</sup>	DEV9 <sup>(1)</sup>	DEV8 <sup>(1)</sup>	DEV7 <sup>(1)</sup>	DEV6 <sup>(1)</sup>	DEV5 <sup>(1)</sup>	DEV4 <sup>(1)</sup>	DEV3 <sup>(1)</sup>
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 7-0      **DEV<10:3>**: Device ID bits<sup>(1)</sup>

0110 0000 = PIC18F66K80

0110 0001 = PIC18F46K80, PIC18F26K80, PIC18F65K80, PIC18F45K80, PIC18F25K80

**Note 1:** These DEV<10:3> values may be shared with other devices. The specific device is always identified by using the entire DEV<10:0> bit sequence.



# PIC18F66K80 FAMILY

## 3.0 ELECTRICAL CHARACTERISTICS

**Note:** Other than some basic data, this section documents only the high-temperature PIC18F66K80 family devices' specifications that differ from those of the non-specialty PIC18F66K80 family devices. For detailed information on the electrical specifications shared by the high-temperature and non-specialty devices, see the "PIC18F66K80 Family Data Sheet" (DS3977).

Unless otherwise noted, this section's parameters assume a minimum voltage of 4.0V.

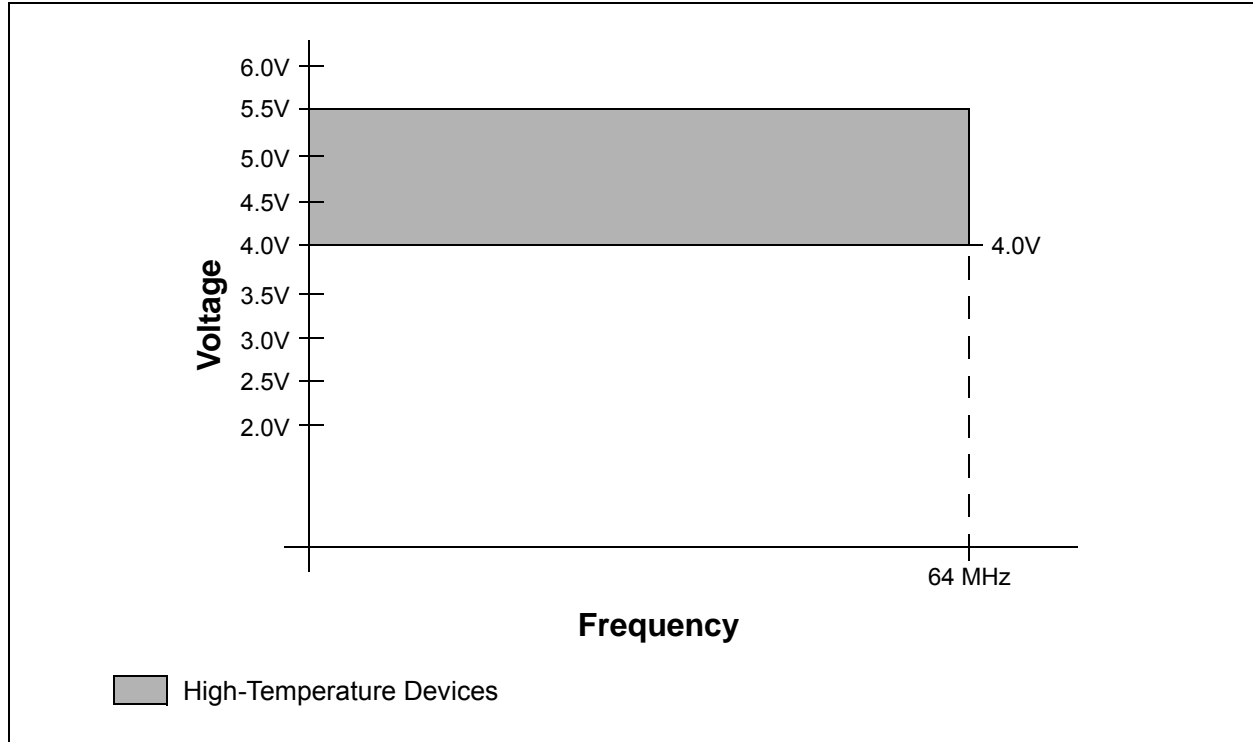
### 3.1 Absolute Maximum Ratings<sup>(†)</sup>

Ambient temperature under bias.....	+150°C
Maximum current out of V <sub>SS</sub> pin .....	60 mA
Maximum current into V <sub>DD</sub> pin .....	60 mA
Maximum output current sunk by any I/O pin <sup>(1)</sup> .....	1 mA
Maximum output current sourced by any I/O pin <sup>(1)</sup> .....	1 mA
Maximum current sunk by all ports combined <sup>(1)</sup> .....	10 mA
Maximum current sourced by all ports combined <sup>(1)</sup> .....	10 mA

**Note 1:** Maximum allowable current is a function of device maximum power dissipation (see **Section 31.0 "Electrical Characteristics"** in the "PIC18F66K80 Family Data Sheet").

† **NOTICE:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

**FIGURE 3-1: PIC18F66K80 VOLTAGE-FREQUENCY GRAPH (HIGH TEMPERATURE)**



# PIC18F66K80 FAMILY

## 3.2 DC Characteristics: Supply Voltage (High Temperature)

PIC18F66K80 Family (High Temperature)		Standard Operating Conditions (unless otherwise stated) Operating temperature $+125^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$ for high temperature					
Param No.	Symbol	Characteristic	Min	Typ	Max	Units	Conditions
D001	VDD	Supply Voltage	4.0	—	5.5	V	For F devices

## 3.3 DC Characteristics: Power Down and Supply Current (High Temperature)

PIC18F66K80 Family (High Temperature)		Standard Operating Conditions (unless otherwise stated) Operating temperature $+125^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$ for high temperature				
Param No.	Device	Typ	Max	Units	Conditions	
	PIC18FXXK80	<b>Power-Down Current (IPD)<sup>(1)</sup></b>				
		10	28	μA	+150°C	VDD = 5V, Sleep mode
		<b>Module Differential Currents</b>				
		12	29	μA	+150°C	VDD = 5V, Watchdog Timer Current: ΔI <sub>WDT</sub>
		12	28	μA	+150°C	VDD = 5V, A/D Current: ΔI <sub>AD</sub>
		12	28	μA	+150°C	VDD = 5V, High/Low-Voltage Detect: ΔI <sub>HVLD</sub>
		<b>Supply Current (IDD)<sup>(2,3)</sup></b>				
		10	32	mA	+150°C	VDD = 5V, FOSC = 64 MHz (PRI_RUN mode)
		—	8	mA	+150°C	VDD = 5V, FOSC = 4 MHz (PRI_RUN mode)
		—	3	mA	+150°C	VDD = 5V, FOSC = 1 MHz (PRI_RUN mode)
		—	8	mA	+150°C	VDD = 5V, FOSC = 64 MHz (PRI_IDLE mode)
		—	1.8	mA	+150°C	VDD = 5V, FOSC = 4 MHz (PRI_IDLE mode)
		—	1	mA	+150°C	VDD = 5V, FOSC = 1 MHz (PRI_IDLE mode)
		—	28	mA	+150°C	VDD = 5V, FOSC = 64 MHz (PRI_RUN mode, 16 MHz w/PLL)
—	8	mA	+150°C	VDD = 5V, FOSC = 16 MHz (PRI_RUN mode, 4 MHz w/PLL)		

**Note 1:** 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 a high-impedance state and tied to VDD or VSS, and all features that add delta current are disabled (such as WDT, secondary oscillator, BOR, etc.).

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

**3:** 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 VDD;

MCLR = VDD; WDT is enabled/disabled as specified.

# PIC18F66K80 FAMILY

## 3.4 DC Characteristics: PIC18F66K80 Family (High Temperature)

PIC18F66K80 Family (High Temperature)			Standard Operating Conditions (unless otherwise stated) Operating temperature $+125^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$ for high temperature				
Param No.	Symbol	Characteristic	Min	Typ	Max	Units	Conditions
D031	V <sub>IL</sub>	I/O Ports with Schmitt Trigger Buffer	V <sub>SS</sub>	—	0.25 V <sub>DD</sub>	V	V <sub>DD</sub> = 5.0V
D032	V <sub>IL</sub>	$\overline{\text{MCLR}}$	V <sub>SS</sub>	—	0.25 V <sub>DD</sub>	V	V <sub>DD</sub> = 5.0V
D041	V <sub>IH</sub>	I/O Ports with Schmitt Trigger Buffer	0.85 V <sub>DD</sub>	—	V <sub>DD</sub>	V	V <sub>DD</sub> = 5.0V
D042	V <sub>IH</sub>	$\overline{\text{MCLR}}$ , OSC1 (EC mode)	0.85 V <sub>DD</sub>	—	V <sub>DD</sub>	V	V <sub>DD</sub> = 5.0V
D060	I <sub>IL</sub>	Input Leakage Current I/O Ports	—	—	±2	μA	V <sub>SS</sub> ≤ V <sub>PIN</sub> ≤ V <sub>DD</sub> , Pin at high-impedance

## 3.5 DC Characteristics: Memory Programming Requirements

PIC18F66K80 Family (High Temperature)			Standard Operating Conditions (unless otherwise stated) Operating temperature $+125^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$ for high temperature				
Param No.	Symbol	Characteristic	Min	Typ	Max	Units	Conditions
D120	ED	Data EEPROM Memory Byte Endurance	50K	—	—	E/W	+125°C to +150°C
D121	V <sub>DRW</sub>	V <sub>DD</sub> for Read/Write	4.0	—	5.5	V	Using EECON to read/write PIC18FXXKXX devices
D123	V <sub>RETD</sub>	Characteristic Retention	1	—	—	Year	Provided no other specifications are violated

# PIC18F66K80 FAMILY

## 3.6 AC Characteristics Internal RC Accuracy (INTOSC)

PIC18F66K80 Family (High Temperature)		Standard Operating Conditions (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$			
Param No.	Min	Typ	Max	Units	Conditions
INTOSC Accuracy @ Freq = 16 MHz, 8 MHz, 4 MHz, 2 MHz, 1 MHz, 500 kHz, 250 kHz <sup>(1)</sup>					
OA1	-20	—	$\pm 20$	%	+125°C to +150°C, V <sub>DD</sub> = 4.0-5.5V
OA2 LF_INTOSC Accuracy @ 31 kHz					
OA2	-25	—	$\pm 25$	%	V <sub>DD</sub> = 4.0-5.5V

**Note 1:** Frequency is calibrated at +25°C. The OSCTUNE register can be used to compensate for temperature drift.

**TABLE 3-1: DC CHARACTERISTICS: HIGH/LOW-VOLTAGE DETECT CHARACTERISTICS**

PIC18F66K80 Family (High Temperature)		Standard Operating Conditions (unless otherwise stated) Operating temperature $-40^{\circ}\text{C} \leq T_A \leq +150^{\circ}\text{C}$				
Param No.	Characteristic	Min	Typ	Max	Units	
D420	HLVD Voltage on V <sub>DD</sub> , Transition High-to-Low	HLVDL<3:0> = 1101	4.00	4.44	4.88	V
		HLVDL<3:0> = 1110	4.28	4.75	5.23	V

## APPENDIX A: REVISION HISTORY

### Revision A (February 2012)

Original mini data sheet for the high-temperature devices in the PIC18F66K80 family.

# PIC18F66K80

---

NOTES:

## THE MICROCHIP WEB SITE

Microchip provides online support via our WWW site at [www.microchip.com](http://www.microchip.com). This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

## CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at [www.microchip.com](http://www.microchip.com). Under "Support", click on "Customer Change Notification" and follow the registration instructions.

## CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support
- Development Systems Information Line

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

**Technical support is available through the web site at: <http://microchip.com/support>**

# PIC18F66K80 FAMILY

---

---

## READER RESPONSE

It is our intention to provide you with the best documentation possible to ensure successful use of your Microchip product. If you wish to provide your comments on organization, clarity, subject matter, and ways in which our documentation can better serve you, please FAX your comments to the Technical Publications Manager at (480) 792-4150.

Please list the following information, and use this outline to provide us with your comments about this document.

TO: Technical Publications Manager Total Pages Sent \_\_\_\_\_

RE: Reader Response

From: Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City / State / ZIP / Country \_\_\_\_\_

Telephone: (\_\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_ FAX: (\_\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_

Application (optional):

Would you like a reply?  Y  N

Device: PIC18F66K80 Family

Literature Number: DS30509A

Questions:

1. What are the best features of this document?

\_\_\_\_\_  
\_\_\_\_\_

2. How does this document meet your hardware and software development needs?

\_\_\_\_\_  
\_\_\_\_\_

3. Do you find the organization of this document easy to follow? If not, why?

\_\_\_\_\_  
\_\_\_\_\_

4. What additions to the document do you think would enhance the structure and subject?

\_\_\_\_\_  
\_\_\_\_\_

5. What deletions from the document could be made without affecting the overall usefulness?

\_\_\_\_\_  
\_\_\_\_\_

6. Is there any incorrect or misleading information (what and where)?

\_\_\_\_\_  
\_\_\_\_\_

7. How would you improve this document?

\_\_\_\_\_  
\_\_\_\_\_



# PIC18F66K80 FAMILY

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	<u>X</u>	<u>/XX</u>	<u>XXX</u>
Device	Temperature Range	Package	Pattern
Device <sup>(1,2)</sup>	PIC18F25K80/26K80, PIC18F45K80/46K80, PIC18F65K80/66K80, PIC18F25K80/26K80T, PIC18F45K80/46K80T, PIC18F65K80/66K80T V <sub>DD</sub> range 4.0V to 5.5V		
Temperature Range	I = -40°C to +85°C (Industrial) E = -40°C to +125°C (Extended) H = -40°C to +150°C (High Temperature)		
Package	PT = TQFP Thin Quad Flatpack MR = QFN Plastic Quad Flat, No Lead Package SS = SSOP Plastic Shrink Small Outline MM = QFN Plastic Quad Flat, No Lead Package ML = QFN Plastic Quad Flat, No Lead Package		
Pattern	QTP, SQTP, Code or Special Requirements (blank otherwise)		

**Examples:**

a) PIC18F46K80T-H/PT = High Temperature, TQFP package in tape and reel configuration

**Note 1:** F = Standard Voltage Range  
**2:** LF = Wide Voltage Range  
**3:** T = In Tape and Reel PLCC, and TQFP packages only

# PIC18F66K80 FAMILY

---

NOTES:

---

**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.

---

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights.

**Trademarks**

The Microchip name and logo, the Microchip logo, dsPIC, KEELOQ, KEELOQ logo, MPLAB, PIC, PICmicro, PICSTART, PIC<sup>32</sup> logo, rPIC and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.


FilterLab, Hampshire, HI-TECH C, Linear Active Thermistor, MXDEV, MXLAB, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Application Maestro, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, HI-TIDE, In-Circuit Serial Programming, ICSP, Mindi, MiWi, MPASM, MPLAB Certified logo, MPLIB, MPLINK, mTouch, Omniscient Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICKit, PICtail, REAL ICE, rLAB, Select Mode, Total Endurance, TSHARC, UniWinDriver, WiperLock and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2012, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

ISBN: 978-1-62076-016-1

**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<sup>®</sup> MCUs and dsPIC<sup>®</sup> DSCs, KEELOQ<sup>®</sup> 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.*



# MICROCHIP

## 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](http://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 - Osaka**  
Tel: 81-66-152-7160  
Fax: 81-66-152-9310

**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

11/29/11