



Welcome to [E-XFL.COM](https://www.e-xfl.com)

What is "[Embedded - Microcontrollers](#)"?

"[Embedded - Microcontrollers](#)" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "[Embedded - Microcontrollers](#)"

Details

Product Status	Active
Core Processor	PIC
Core Size	8-Bit
Speed	64MHz
Connectivity	ECANbus, I ² C, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, LVD, POR, PWM, WDT
Number of I/O	54
Program Memory Size	64KB (32K x 16)
Program Memory Type	FLASH
EEPROM Size	1K x 8
RAM Size	3.6K x 8
Voltage - Supply (Vcc/Vdd)	1.8V ~ 5.5V
Data Converters	A/D 11x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 125°C (TA)
Mounting Type	Surface Mount
Package / Case	64-VFQFN Exposed Pad
Supplier Device Package	64-VQFN (9x9)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic18f66k80-e-mr

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)
 - I²C™ 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 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 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 ⁽¹⁾	DEV2	DEV1	DEV0	REV4	REV3	REV2	REV1	REV0	xxxx xxxx
3FFFFFh DEVID2 ⁽¹⁾	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 ⁽¹⁾	DEV1 ⁽¹⁾	DEV0 ⁽¹⁾	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⁽¹⁾

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 ⁽¹⁾	DEV9 ⁽¹⁾	DEV8 ⁽¹⁾	DEV7 ⁽¹⁾	DEV6 ⁽¹⁾	DEV5 ⁽¹⁾	DEV4 ⁽¹⁾	DEV3 ⁽¹⁾
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⁽¹⁾
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" (DS39977).

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

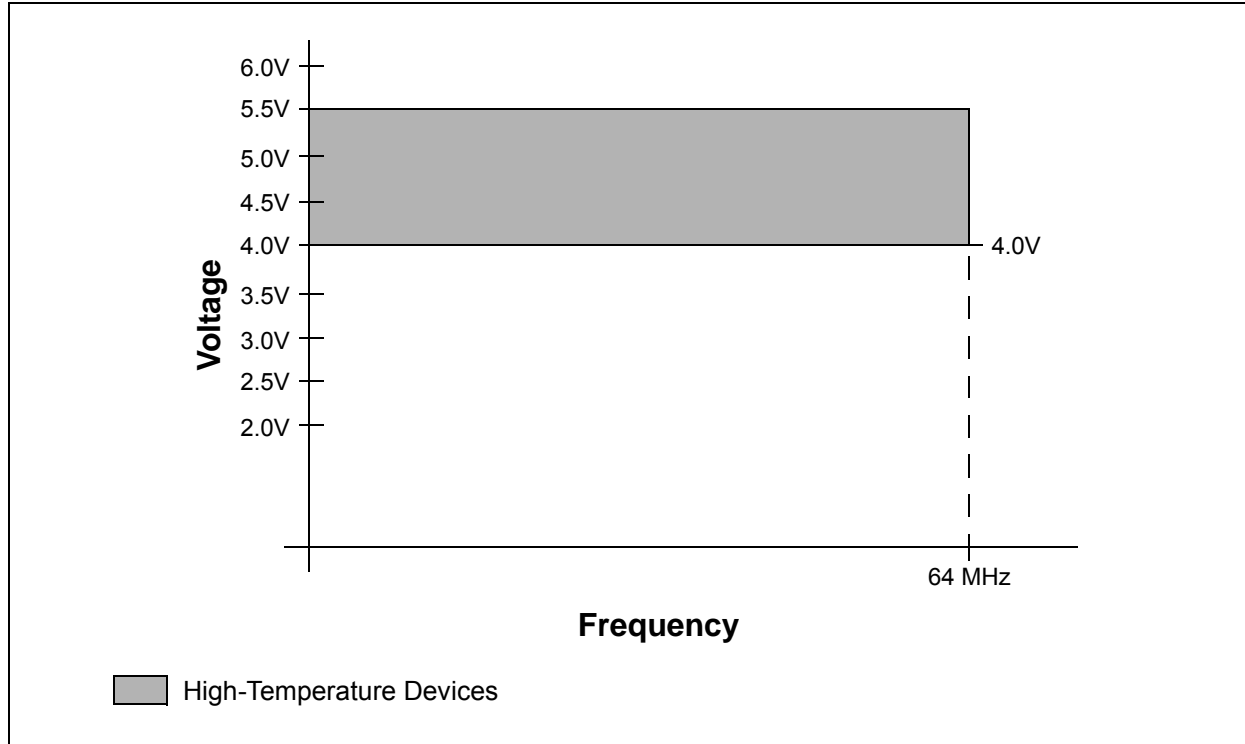
3.1 Absolute Maximum Ratings^(†)

Ambient temperature under bias	+150°C
Maximum current out of V _{SS} pin	60 mA
Maximum current into V _{DD} pin	60 mA
Maximum output current sunk by any I/O pin ⁽¹⁾	1 mA
Maximum output current sourced by any I/O pin ⁽¹⁾	1 mA
Maximum current sunk by all ports combined ⁽¹⁾	10 mA
Maximum current sourced by all ports combined ⁽¹⁾	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	Power-Down Current (IPD) ⁽¹⁾					
		10	28	μA	+150°C	VDD = 5V, Sleep mode	
		Module Differential Currents					
		12	29	μA	+150°C	VDD = 5V, Watchdog Timer Current: ΔI _{WDT}	
		12	28	μA	+150°C	VDD = 5V, A/D Current: ΔI _{AD}	
		12	28	μA	+150°C	VDD = 5V, High/Low-Voltage Detect: ΔI _{HLVD}	
		Supply Current (IDD) ^(2,3)					
		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 _{IL}	I/O Ports with Schmitt Trigger Buffer	V _{SS}	—	0.25 V _{DD}	V	V _{DD} = 5.0V
D032	V _{IL}	$\overline{\text{MCLR}}$	V _{SS}	—	0.25 V _{DD}	V	V _{DD} = 5.0V
D041	V _{IH}	I/O Ports with Schmitt Trigger Buffer	0.85 V _{DD}	—	V _{DD}	V	V _{DD} = 5.0V
D042	V _{IH}	$\overline{\text{MCLR}}$, OSC1 (EC mode)	0.85 V _{DD}	—	V _{DD}	V	V _{DD} = 5.0V
D060	I _{IL}	Input Leakage Current I/O Ports	—	—	±2	μA	V _{SS} ≤ V _{PIN} ≤ V _{DD} , 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 _{DRW}	V _{DD} for Read/Write	4.0	—	5.5	V	Using EECON to read/write PIC18FXXXKXX devices
D123	V _{RETD}	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 ⁽¹⁾					
OA1	-20	—	± 20	%	+125°C to +150°C, V _{DD} = 4.0-5.5V
OA2 LF_INTOSC Accuracy @ 31 kHz					
OA2	-25	—	± 25	%	V _{DD} = 4.0-5.5V

Note 1: Frequency is calibrated at +25°C. The OSC_{TUNE} 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°C ≤ TA ≤ +150°C				
Param No.	Characteristic		Min	Typ	Max	Units
D420	HLVD Voltage on VDD, 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. 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. 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 ^(1,2)	PIC18F25K80/26K80, PIC18F45K80/46K80, PIC18F65K80/66K80, PIC18F25K80/26K80T, PIC18F45K80/46K80T, PIC18F65K80/66K80T VDD 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, PIC³² logo, rfPIC 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, Omniscent Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICKit, PICtail, REAL ICE, rfLAB, 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® 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 - 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