

## 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  $\mu$ s, Typical
- Low-Power WDT, 300 nA, Typical
- Run mode Currents Down to Very Low 3.8  $\mu$ A, 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

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## 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



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# 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.



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NOTES:



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## 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/<br>Unprogrammed<br>Value |
|------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-----------------------------------|
| 3FFFEh DEVID1 <sup>(1)</sup> | DEV2  | DEV1  | DEV0  | REV4  | REV3  | REV2  | REV1  | REV0  | xxxx xxxx                         |
| 3FFFFh 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.

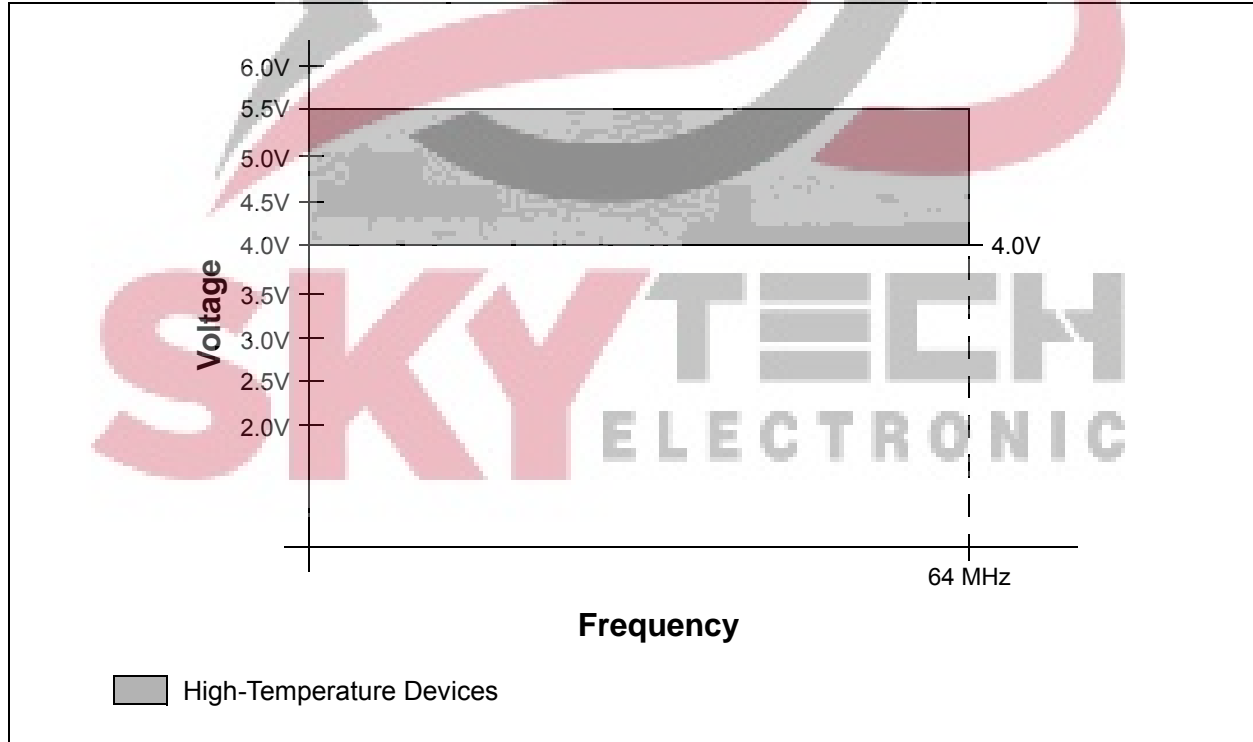
### 3.1 Absolute Maximum Ratings<sup>(†)</sup>

|  |        |
|--|--------|
| 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<br>(High Temperature) |        | Standard Operating Conditions (unless otherwise stated)<br>Operating temperature +125°C ≤ TA ≤ +150°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<br>(High Temperature) |            | Standard Operating Conditions (unless otherwise stated)<br>Operating temperature +125°C ≤ TA ≤ +150°C for high temperature |        |   |            |  |
|--|------------|--|--------|---|------------|--|
| Param No.                                | Device     | Typ  | Max    | Units   | Conditions |  |
|  | PIC18FXK80 | <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,<br>Watchdog Timer Current: ΔIWD    |
|  |            | 12   | 28     | μA  | +150°C     | VDD = 5V, A/D Current: ΔIAD                  |
|  |            | 12   | 28     | μA  | +150°C     | VDD = 5V,<br>High/Low-Voltage Detect: ΔIHLVD |
|  |            | <b>Supply Current (IDD)<sup>(2,3)</sup></b>  |        |   |            |  |
|  |            | 10   | 32     | mA  | +150°C     | VDD = 5V, FOSC = 64 MHz<br>(PRI_RUN mode)    |
|  |            | —  | 8      | mA  | +150°C     | VDD = 5V, FOSC = 4 MHz<br>(PRI_RUN mode)     |
|  |            | —  | 3      | mA  | +150°C     | VDD = 5V, FOSC = 1 MHz<br>(PRI_RUN mode)     |
|  |            | —  | 8      | mA  | +150°C     | VDD = 5V, FOSC = 64 MHz<br>(PRI_IDLE mode)   |
|  |            | —  | 1.8    | mA  | +150°C     | VDD = 5V, FOSC = 4 MHz<br>(PRI_IDLE mode)    |
|  |            | —  | 1      | mA  | +150°C     | VDD = 5V, FOSC = 1 MHz<br>(PRI_IDLE mode)    |
| —  | 28         | mA   | +150°C | VDD = 5V, FOSC = 64 MHz<br>(PRI_RUN mode, 16 MHz w/PLL) |            |  |
| —  | 8          | mA   | +150°C | VDD = 5V, FOSC = 16 MHz<br>(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.

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

| PIC18F66K80 Family<br>(High Temperature) |                 |   | Standard Operating Conditions (unless otherwise stated)<br>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<br>I/O Ports        | —   | —   | ±2                   | μA    | V <sub>SS</sub> ≤ V <sub>PIN</sub> ≤ V <sub>DD</sub> ,<br>Pin at high-impedance |

## 3.5 DC Characteristics: Memory Programming Requirements

| PIC18F66K80 Family<br>(High Temperature) |                   |                                      | Standard Operating Conditions (unless otherwise stated)<br>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<br>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<br>PIC18FXXKXX devices |
| D123                                     | V <sub>RETD</sub> | Characteristic Retention             | 1   | —   | —   | Year  | Provided no other specifications<br>are violated |

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## 3.6 AC Characteristics Internal RC Accuracy (INTOSC)

| PIC18F66K80 Family<br>(High Temperature)   |     | Standard Operating Conditions (unless otherwise stated)<br>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,<br>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<br>(High Temperature) |   | Standard Operating Conditions (unless otherwise stated)<br>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> ,<br>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 |

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## APPENDIX A: REVISION HISTORY

### Revision A (February 2012)

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



# PIC18F66K80

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## 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> | <b>Examples:</b>  |
|-------------------------|---|------------|------------|---|
| Device                  | Temperature Range   | Package    | Pattern    | a) PIC18F46K80T-H/PT = High Temperature, TQFP package in tape and reel configuration  |
| Device <sup>(1,2)</sup> | PIC18F25K80/26K80, PIC18F45K80/46K80, PIC18F65K80/66K80, PIC18F25K80/26K80T, PIC18F45K80/46K80T, PIC18F65K80/66K80T<br>VDD range 4.0V to 5.5V   |            |            |   |
| Temperature Range       | I = -40°C to +85°C (Industrial)<br>E = -40°C to +125°C (Extended)<br>H = -40°C to +150°C (High Temperature)   |            |            |   |
| Package                 | PT = TQFP Thin Quad Flatpack<br>MR = QFN Plastic Quad Flat, No Lead Package<br>SS = SSOP Plastic Shrink Small Outline<br>MM = QFN Plastic Quad Flat, No Lead Package<br>ML = QFN Plastic Quad Flat, No Lead Package |            |            | <b>Note 1:</b> F = Standard Voltage Range<br><b>2:</b> LF = Wide Voltage Range<br><b>3:</b> T = In Tape and Reel PLCC, and TQFP packages only |
| Pattern                 | QTP, SQTP, Code or Special Requirements (blank otherwise)   |            |            |   |



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# PIC18F66K80 FAMILY

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NOTES:



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