
14/20-Pin, 8-Bit Flash USB Microcontroller Product Brief

High-Performance RISC CPU:

- C Compiler Optimized Architecture
- Only 49 Instructions
- 14 Kbytes Linear Program Memory Addressing
- 1024 bytes Linear Data Memory Addressing
- Operating Speed:
 - DC – 48 MHz clock input
 - DC – 83 ns instruction cycle
 - Selectable 3x or 4x PLL for specific frequencies
- Interrupt Capability with Automatic Context Saving
- 16-Level Deep Hardware Stack with Optional Overflow/Underflow Reset
- Direct, Indirect and Relative Addressing modes:
 - Two full 16-bit File Select Registers (FSRs) capable of accessing both data or program memory
 - FSRs can read program and data memory

Special Microcontroller Features:

- Operating Voltage Range:
 - 1.8V to 3.6V (PIC16LF145X)
 - 2.3V to 5.5V (PIC16F145X)
- Self-Programmable under Software Control
- Power-on Reset (POR)
- Power-up Timer (PWRT)
- Programmable Brown-Out Reset (BOR)
- Low-Power BOR (LPBOR)
- Extended Watchdog Timer (WDT):
 - Programmable period from 1 ms to 256s
- Programmable Code Protection
- In-Circuit Serial Programming™ (ICSP™) via Two Pins
- Enhanced Low-Voltage Programming (LVP)
- Power-Saving Sleep mode

Universal Serial Bus (USB) Features:

- Self-tuning from USB host (eliminates need for external crystal)
- USB V2.0 Compliant SIE
- Low Speed (1.5 Mb/s) and Full Speed (12 Mb/s)
- Supports Control, Interrupt, Isochronous and Bulk Transfers
- Supports up to 8 Bidirectional Endpoints
- 512-Byte Dual Access RAM for USB
- Interrupt-on-Change (IOC) on D+/D- for USB Host Detection
- Configurable Internal Pull-up Resistors for use with USB

Low-Power Features**PIC16LF145X with XLP:**

- Standby Current:
 - 20 nA @ 1.8V, typical
- Watchdog Timer Current:
 - 300 nA @ 1.8V, typical
- Operating Current:
 - 30 μ A/MHz @ 1.8V, typical
- Timer1 Oscillator:
 - 600 nA @ 32 kHz, 1.8V, typical

Flexible Oscillator Structure:

- 16 MHz Internal Oscillator Block:
 - Factory calibrated to $\pm 0.25\%$, typical
 - Software selectable frequency range from 16 MHz to 31 kHz
 - Tunable to 0.25% across temperature range
 - 48 MHz with 3x PLL
- 31 kHz Low-Power Internal Oscillator
- Clock Switching with run from:
 - Primary Oscillator
 - Secondary Oscillator (SOSC)
 - Internal Oscillator
- Clock Reference Output:
 - Clock Prescaler
 - CLKOUT

Analog Features⁽¹⁾:

- Analog-to-Digital Converter (ADC):
 - 10-bit resolution
 - Up to 9 external channels
 - Two internal channels:
 - Fixed Voltage Reference channel
 - DAC output channel
 - Auto acquisition capability
 - Conversion available during Sleep
- Two Comparators:
 - Rail-to-rail inputs
 - Power mode control
 - Software controllable hysteresis
- Voltage Reference module:
 - Fixed Voltage Reference (FVR) with 1.024V, 2.048V and 4.096V output levels
- Up to one rail-to-rail resistive 5-bit DAC with positive reference selection

Note 1: Analog features are not available on PIC16(L)F1454 devices.
--

PIC16(L)F145X

Peripheral Features:

- Up to 14 I/O Pins and three Input-only Pins:
 - High current sink/source 25 mA/25 mA
 - Individually programmable weak pull-ups
 - Individually programmable Interrupt-On-Change (IOC) pins
- Timer0: 8-Bit Timer/Counter with 8-Bit Programmable Prescaler
- Enhanced Timer1:
 - 16-bit timer/counter with prescaler
 - External Gate Input mode
- Timer2: 8-Bit Timer/Counter with 8-Bit Period Register, Prescaler and Postscaler
- Two 10-bit PWM modules
- Complementary Waveform Generator (CWG)⁽¹⁾:
 - Up to four selectable signal sources
 - Selectable falling and rising edge dead-band control
 - Polarity control
 - Up to four auto-shutdown sources
 - Multiple input sources: PWM, Comparators
- Master Synchronous Serial Port (MSSP) with SPI and I²C™ with:
 - 7-bit address masking
 - SMBus/PMBus™ compatibility
- Enhanced Universal Synchronous Asynchronous Receiver Transmitter (EUSART):
 - RS-232, RS-485 and LIN compatible
 - Auto-baud detect
 - Auto-wake-up on Start

Note 1: Not available on PIC16(L)F1454 devices.

PIC16(L)F145X Family Types

Device	Data Sheet Index	Program Memory Flash (words)	Data SRAM (bytes)	I/O's ⁽²⁾	10-bit ADC (ch)	Comparators	DAC	Timers (8/16-bit)	PWM	EUSART	MSSP (I ² C™/SPI)	CWG	USB	Clock Reference	Debug ⁽¹⁾	XLP
PIC16(L)F1454	(1)	8192	1024	11	—	—	—	2/1	2	1	1	—	1	1	I/H	Y
PIC16(L)F1455	(1)	8192	1024	11	5	2	1	2/1	2	1	1	1	1	1	I/H	Y
PIC16(L)F1459	(1)	8192	1024	17	9	2	1	2/1	2	1	1	1	1	1	I/H	Y

Note 1: I - Debugging, Integrated on Chip; H - Debugging, Available using Debug Header;
E - Emulation, Available using Emulation Header.

2: Three pins are input-only.

Data Sheet Index:

1: Future Product [PIC16\(L\)F1454/1455/1459 Data Sheet, 14/20-Pin Flash, 8-Bit USB Microcontrollers](#).

FIGURE 1: 14-PIN PDIP, SOIC, TSSOP DIAGRAM FOR PIC16(L)F1454/1455

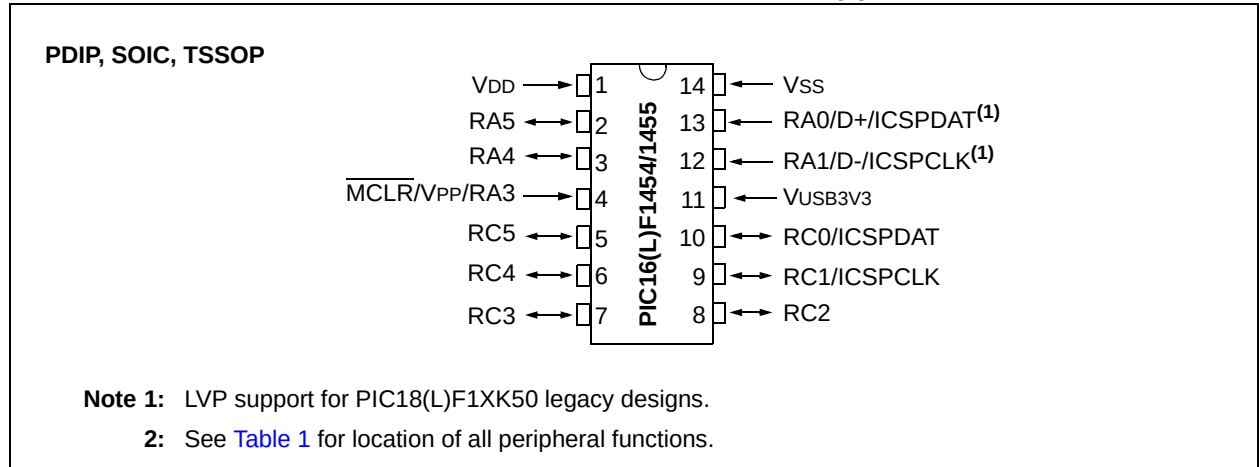
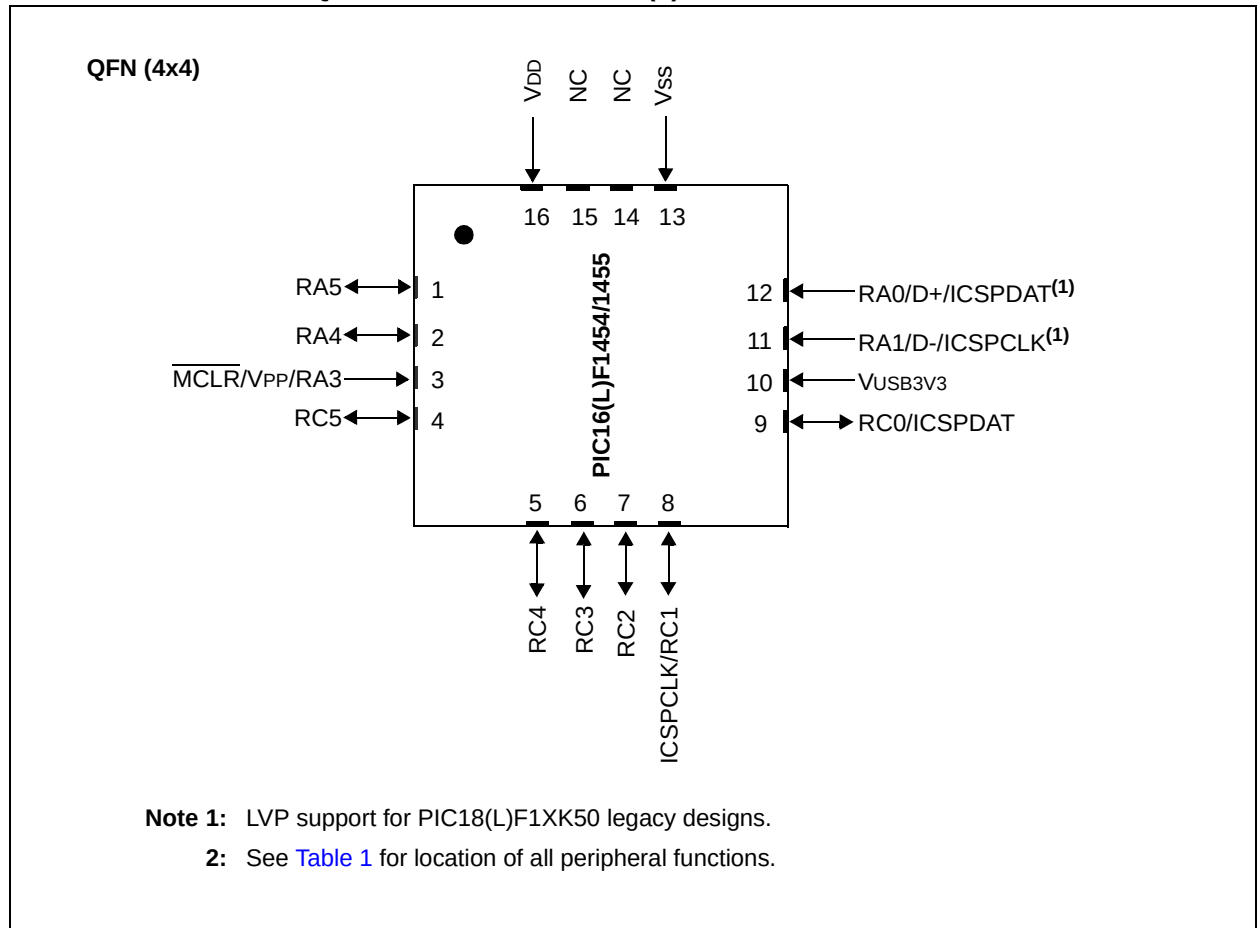


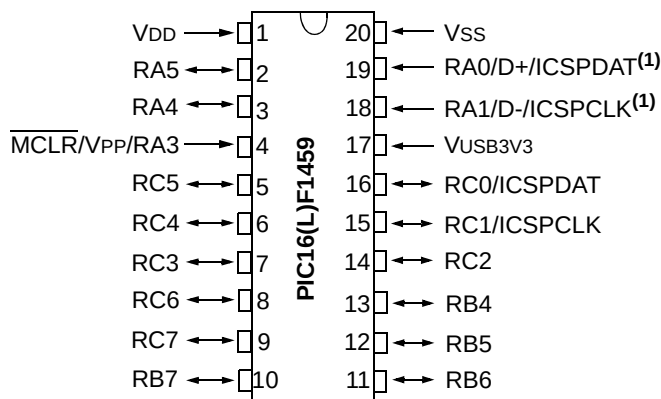
FIGURE 2: 16-PIN QFN DIAGRAM FOR PIC16(L)F1454/1455



PIC16(L)F145X

FIGURE 3: 20-PIN PDIP, SOIC, SSOP DIAGRAM FOR PIC16(L)F1459

PDIP, SOIC, SSOP

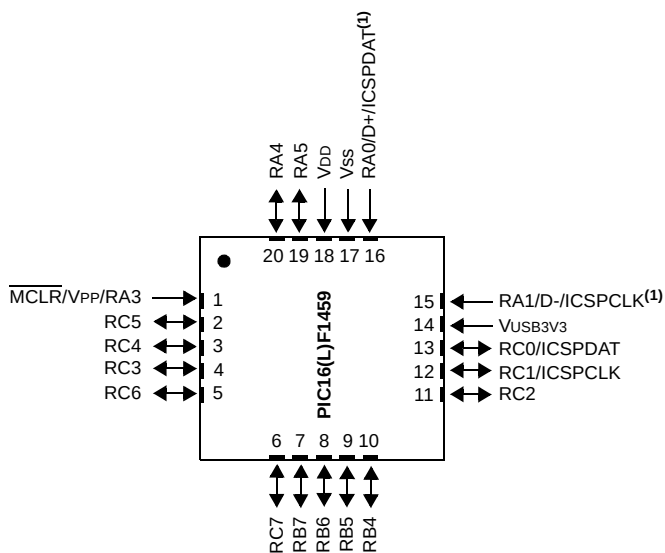


Note 1: LVP support for PIC18(L)F1XK50 legacy designs.

2: See [Table 1](#) for location of all peripheral functions.

FIGURE 4: 20-PIN QFN DIAGRAM FOR PIC16(L)F1459

QFN (5x5)



Note 1: LVP support for PIC18(L)F1XK50 legacy designs.

2: See [Table 1](#) for location of all peripheral functions.

PIC16(L)F145X

TABLE 1: 14-PIN ALLOCATION TABLE (PIC16(L)F1454)

I/O	14-Pin PDIP/SOIC/TSSOP	16-Pin QFN	ADC	Reference	Comparator	Timer	CWG	USB	EUSART	PWM	MSSP	Interrupt	Basic
RA0	13	12	—	—	—	—	—	D+	—	—	—	IOC	ICSPDAT ⁽³⁾
RA1	12	11	—	—	—	—	—	D-	—	—	—	IOC	ICSPCLK ⁽³⁾
RA2	—	—	—	—	—	—	—	—	—	—	—	—	—
RA3	4	3	—	—	—	T1G ⁽²⁾	—	—	—	—	SS ⁽²⁾	IOC	MCLR V _{PP}
RA4	3	2	—	—	—	SOSCO T1G ⁽¹⁾	—	—	—	—	SDO ⁽²⁾	IOC	CLKOUT OSC2 CLKR ⁽¹⁾
RA5	2	1	—	—	—	SOSCI T1CKI	—	—	—	PWM2 ⁽²⁾	—	IOC	CLKIN OSC1
RC0	10	9	—	—	—	—	—	—	—	—	SCL SCK	—	ICSPDAT
RC1	9	8	—	—	—	—	—	—	—	—	SDA SDI	INT	ICSPCLK
RC2	8	7	—	—	—	—	—	—	—	—	SDO ⁽¹⁾	—	—
RC3	7	6	—	—	—	—	—	—	—	PWM2 ⁽¹⁾	SS ⁽¹⁾	—	CLKR ⁽²⁾
RC4	6	5	—	—	—	—	—	—	TK CK	—	—	—	—
RC5	5	4	—	—	—	T0CKI	—	—	RX DT	PWM1	—	—	—
V _{DD}	1	16	—	—	—	—	—	—	—	—	—	—	V _{DD}
V _{SS}	14	13	—	—	—	—	—	—	—	—	—	—	V _{SS}
V _{USB3V3}	11	10	—	—	—	—	—	V _{USB3V3}	—	—	—	—	—

- Note**
- 1: Default location for peripheral pin function. Alternate location can be selected using the APFCON register.
 - 2: Alternate location for peripheral pin function selected by the APFCON register.
 - 3: LVP support for PIC18(L)F1XK50 legacy designs.

PIC16(L)F145X

TABLE 2: 14-PIN ALLOCATION TABLE (PIC16(L)F1455)

I/O	14-Pin PDIP/SOIC/TSSOP	16-Pin QFN	ADC	Reference	Comparator	Timer	CWG	USB	EUSART	PWM	MSSP	Interrupt	Basic
RA0	13	12	—	—	—	—	—	D+	—	—	—	IOC	ICSPDAT ⁽³⁾
RA1	12	11	—	—	—	—	—	D-	—	—	—	IOC	ICSPCLK ⁽³⁾
RA2	—	—	—	—	—	—	—	—	—	—	—	—	—
RA3	4	3	—	—	—	T1G ⁽²⁾	—	—	—	—	SS ⁽²⁾	IOC	MCLR V _{PP}
RA4	3	2	AN3	—	—	SOSCO T1G ⁽¹⁾	—	—	—	—	SDO ⁽²⁾	IOC	CLKOUT OSC2 CLKR ⁽¹⁾
RA5	2	1	—	—	—	SOSCI T1CKI	—	—	—	PWM2 ⁽²⁾	—	IOC	CLKIN OSC1
RC0	10	9	AN4	VREF+	C1IN+ C2IN+	—	—	—	—	—	SCL SCK	—	ICSPDAT
RC1	9	8	AN5	—	C1IN1- C2IN1-	—	CWGFLT	—	—	—	SDA SDI	INT	ICSPCLK
RC2	8	7	AN6	DACOUT1	C1IN2- C2IN2-	—	—	—	—	—	SDO ⁽¹⁾	—	—
RC3	7	6	AN7	DACOUT2	C1IN3- C2IN3-	—	—	—	—	PWM2 ⁽¹⁾	SS ⁽¹⁾	—	CLKR ⁽²⁾
RC4	6	5	—	—	C1OUT C2OUT	—	CWG1B	—	TK CK	—	—	—	—
RC5	5	4	—	—	—	T0CKI	CWG1A	—	RX DT	PWM1	—	—	—
VDD	1	16	—	—	—	—	—	—	—	—	—	—	VDD
VSS	14	13	—	—	—	—	—	—	—	—	—	—	VSS
VUSB3V3	11	10	—	—	—	—	—	VUSB3V3	—	—	—	—	—

- Note**
- 1: Default location for peripheral pin function. Alternate location can be selected using the APFCON register.
 - 2: Alternate location for peripheral pin function selected by the APFCON register.
 - 3: LVP support for PIC18(L)F1XK50 legacy designs.

PIC16(L)F145X

TABLE 3: 20-PIN ALLOCATION TABLE (PIC16(L)F1459)

I/O	20-Pin PDIP/SSOP	20-Pin QFN	ADC	Reference	Comparator	Timer	CWG	USB	EUSART	PWM	MSSP	Interrupt	Basic
RA0	19	16	—	—	—	—	—	D+	—	—	—	IOC	ICSPDAT ⁽³⁾
RA1	18	15	—	—	—	—	—	D-	—	—	—	IOC	ICSPCLK ⁽³⁾
RA2	—	—	—	—	—	—	—	—	—	—	—	—	—
RA3	4	1	—	—	—	T1G ⁽²⁾	—	—	—	—	SS ⁽²⁾	IOC	MCLR VPP
RA4	3	20	AN3	—	—	SOSCO T1G ⁽¹⁾	—	—	—	—	—	IOC	OSC2 CLKOUT CLKR ⁽¹⁾
RA5	2	19	—	—	—	SOSCI T1CKI	—	—	—	—	—	IOC	OSC1 CLKIN
RB4	13	10	AN10	—	—	—	—	—	—	—	SDA SDI	IOC	—
RB5	12	9	AN11	—	—	—	—	—	RX DX	—	—	IOC	—
RB6	11	8	—	—	—	—	—	—	—	—	SCL SCK	IOC	—
RB7	10	7	—	—	—	—	—	—	TX CK	—	—	IOC	—
RC0	16	13	AN4	VREF+	C1IN+ C2IN+	—	—	—	—	—	—	—	ICSPDAT
RC1	15	12	AN5	—	C1IN1- C2IN1-	—	CWGFLT	—	—	—	—	INT	ICSPCLK
RC2	14	11	AN6	DACOUT1	C1IN2- C2IN2-	—	—	—	—	—	—	—	—
RC3	7	4	AN7	DACOUT2	C1IN3- C2IN3-	—	—	—	—	—	—	—	CLKR ⁽²⁾
RC4	6	3	—	—	C1OUT C2OUT	—	CWG1B	—	—	—	—	—	—
RC5	5	2	—	—	—	T0CKI	CWG1A	—	—	PWM1	—	—	—
RC6	8	5	AN8	—	—	—	—	—	—	PWM2	SS ⁽¹⁾	—	—
RC7	9	6	AN9	—	—	—	—	—	—	—	SDO	—	—
VDD	1	18	—	—	—	—	—	—	—	—	—	—	VDD
VSS	20	17	—	—	—	—	—	—	—	—	—	—	VSS
VUSB3V3	17	14	—	—	—	—	—	VUSB3V3	—	—	—	—	—

- Note**
- 1: Default location for peripheral pin function. Alternate location can be selected using the APFCON register.
 - 2: Alternate location for peripheral pin function selected by the APFCON register.
 - 3: LVP support for PIC18(L)F1XK50 legacy designs.

PIC16(L)F145X

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.

© 2011-2012, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

ISBN: 9781620762202

QUALITY MANAGEMENT SYSTEM
CERTIFIED BY DNV
= ISO/TS 16949 =

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