

1.8V to 3.3V Single IC XO with Frequency Tuning (10 MHz to 130 MHz)

Features

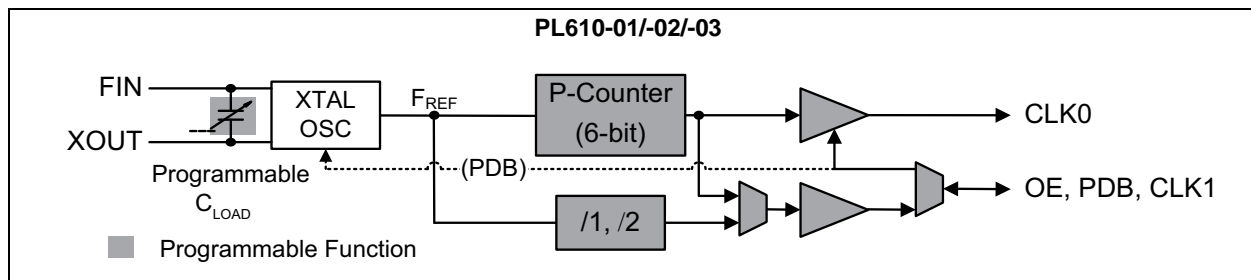
- Single Die, Wide Frequency Coverage, Programmable Advanced Oscillator Design
- Single IC to Cover up to 130 MHz Output Frequency.
- Direct Oscillation Operation with Optional Programmable Features:
 - ± 50 ppm Frequency Tuning
 - Output Drive Setting (4 mA, 8 mA, or 16 mA)
 - 6-Bit Odd/Even Output Divider ($\leq \pm 63$)
- Fundamental Crystal Input Frequency:
 - 10 MHz to 60 MHz (Default)
 - 60 MHz to 130 MHz (Programming Option)
- Output Frequency: LVCMOS
 - 80 kHz to 130 MHz
- Wire Bond and Flip Chip Options to Choose from
- Very Low Jitter and Phase Noise
- Low Current Consumption
- Single 1.8V, 2.5V, or 3.3V $\pm 10\%$ Power Supply
- Operating Temperature Range from -40°C to $+85^{\circ}\text{C}$

General Description

The PL610 is a high performance general purpose clock that uses a single die to cover outputs up to 130 MHz, eliminating the need for multiple ICs to cover a wide frequency range. Designed to fit in a small 2.0 mm x 1.6 mm, or larger substrates, the PL610 offers the best phase noise and jitter performance, smallest die size, and lowest power consumption of any comparable IC.

The optional 'frequency fine tuning' feature of PL610 allows for frequency adjustment after encapsulation of the module, up to ± 50 ppm. In addition, there is a '6' bit optional programmable Odd/Even divider (default = ± 1), and three programmable output drive strengths (4 mA, 8 mA (default), 16 mA) to choose from. The full feature set of PL610 makes it the most versatile XO for any application.

Block Diagram



PL610-01/-02/-03

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{DD})	-0.5V to +7.0V
Input Voltage (V_{IN}).....	-0.5V to $V_{DD} + 0.5V$
Output Voltage (V_{OUT}).....	-0.5V to $V_{DD} + 0.5V$

† **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 operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability. Parts are tested to commercial grade only.

TABLE 1-1: AC ELECTRICAL CHARACTERISTICS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Crystal Input Frequency (XIN)	—	10	—	60	MHz	Fundamental Crystal, Low Frequency
		60	—	130		Fundamental Crystal, High Frequency
Output Frequency	—	.080	—	130	MHz	@ V _{DD} = 1.8V to 3.3V, ±10%
V _{DD} Sensitivity	—	-2	—	+2	ppm	Frequency vs. V _{DD} ±10%
Output Rise Time (see Figure 3-1)	—	—	1	1.2	ns	15 pF Load, 10/90% V _{DD} , High Drive, 3.3V
Output Fall Time (see Figure 3-1)	—	—	1	1.2	ns	15 pF Load, 10/90% V _{DD} , High Drive, 3.3V
Duty Cycle (Note 1, see Figure 3-1)	—	45	50	55	%	—

Note 1: For 1.8V operation, the 50% ±5% duty cycle is guaranteed for frequencies ≤40 MHz.

TABLE 1-2: DC ELECTRICAL CHARACTERISTICS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Supply Current, Dynamic, with Loaded LVCMOS Output	I _{DD}	—	3.7	—	mA	V _{DD} = 3.3V, 40 MHz, Load = 15 pF
		—	2.75	—		V _{DD} = 2.5V, 40 MHz, Load = 15 pF
		—	2.0	—		V _{DD} = 1.8V, 40 MHz, Load = 15 pF
		—	2.5	—		V _{DD} = 3.3V, 26 MHz, Load = 15 pF
		—	1.8	—		V _{DD} = 2.5V, 26 MHz, Load = 15 pF
		—	1.3	—		V _{DD} = 1.8V, 26 MHz, Load = 15 pF
Supply Current, Dynamic, with Unloaded LVCMOS Output	—	—	1.65	—	mA	V _{DD} = 3.3V, 40 MHz, No Load
		—	1.2	—		V _{DD} = 2.5V, 40 MHz, No Load
		—	0.9	—		V _{DD} = 1.8V, 40 MHz, No Load
		—	1.2	—		V _{DD} = 3.3V, 26 MHz, No Load
		—	0.8	—		V _{DD} = 2.5V, 26 MHz, No Load
		—	0.58	—		V _{DD} = 1.8V, 26 MHz, No Load
Operating Voltage	V _{DD}	1.62	—	3.63	V	—
Power Supply Ramp	t _{PU}	0.001	—	100	ms	Time for V _{DD} to reach 90% V _{DD} . Power ramp must be monotonic.
Output Low Voltage	V _{OL}	—	—	0.1	V	I _{OL} = +4 mA Standard Drive
Output High Voltage	V _{OH}	V _{DD} - 0.4	—	—	V	I _{OH} = -4 mA Standard Drive

PL610-01/-02/-03

TABLE 1-2: DC ELECTRICAL CHARACTERISTICS (CONTINUED)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Output Current, Low Drive (See Figure 3-2)	I _{OLD}	±4	—	—	mA	V _{OL} = 0.4V, V _{OH} = 2.4V
Output Current, Standard Drive (See Figure 3-2)	I _{OSD}	±8	—	—	mA	V _{OL} = 0.4V, V _{OH} = 2.4V
Output Current, High Drive (See Figure 3-2)	I _{OHD}	±16	—	—	mA	V _{OL} = 0.4V, V _{OH} = 2.4V

TABLE 1-3: CRYSTAL SPECIFICATIONS (10 MHZ TO 60 MHZ)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Fundamental Crystal Resonator Frequency	F _{XIN}	10	—	60	MHz	—
Crystal Loading Rating (The IC can be programmed for any value in this range.)	C _{L(XTAL)}	8	—	12	pF	—
Maximum Sustainable Drive Level	—	—	—	100	μW	—
Operating Drive Level	—	—	25	—	μW	—
Crystal Shunt Capacitance	C ₀	—	—	3	pF	—
Effective Series Resistance, Fundamental, (See Figure 3-4)	ESR	—	—	50	Ω	—

TABLE 1-4: CRYSTAL SPECIFICATIONS (60 MHZ TO 130 MHZ)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Fundamental Crystal Resonator Frequency	F _{XIN}	60	—	130	MHz	—
Crystal Loading Rating (The IC can be programmed for any value in this range.)	C _{L(XTAL)}	5	—	8	pF	—
Maximum Sustainable Drive Level	—	—	—	100	μW	—
Operating Drive Level	—	—	25	—	μW	—
Crystal Shunt Capacitance	C ₀	—	—	2.5	pF	—
Effective Series Resistance, Fundamental, (See Figure 3-4)	ESR	—	—	30	Ω	—

TABLE 1-5: PHASE NOISE SPECIFICATIONS (SEE MTC-3)

Parameters	Freq.	@1 Hz	@10 Hz	@100 Hz	@1 kHz	@10 kHz	@100 kHz	@1 MHz	Units
Phase noise relative to carrier (typ.)	40 MHz	-67	-98	-127	-142	-151	-155	-155	dBc/Hz
	26 MHz	-65	-96	-124	-145	-150	-155	-155	

TABLE 1-6: KEY PROGRAMMING PARAMETERS (OPTIONAL)

CLK[0:1] Output Frequency	Crystal Load	Output Drive Strength	Output Dividers
CLK0 = F_{REF} , $F_{REF}/2$ or F_{REF}/P Where P = 6-bit Optional: CLK1 = F_{REF} , $F_{REF}/2$ or CLK0	Optional 'Frequency Tuning' after encapsulation, up to: ±50 ppm Tuning Range Single-bit C_L adjustment for high/low frequency input	Three optional drive strengths to choose from: <ul style="list-style-type: none"> • Low: 4 mA • Std: 8 mA (default) • High: 16 mA 	Optional 6-bit odd/even output divider: <ul style="list-style-type: none"> • ÷1 (default) to ÷63

PL610-01/-02/-03

TEMPERATURE SPECIFICATIONS (Note 1)

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
Temperature Ranges						
Storage Temperature Range	T _S	-65	—	+150	°C	—
Ambient Operating Temperature	T _A	-40	—	+85	°C	—

Note 1: Exposure of the device under conditions beyond the limits specified by the maximum ratings for extended periods may cause permanent damage to the device and affect product reliability. These conditions represent a stress rating only, and functional operations of the device at these or any other conditions above the operational limits noted in this specification is not implied. Operating temperature is guaranteed by design. Parts are tested to commercial grade only.

2.0 PAD DESCRIPTIONS

The descriptions of the pads are listed in [Table 2-2](#).

Pad Configurations

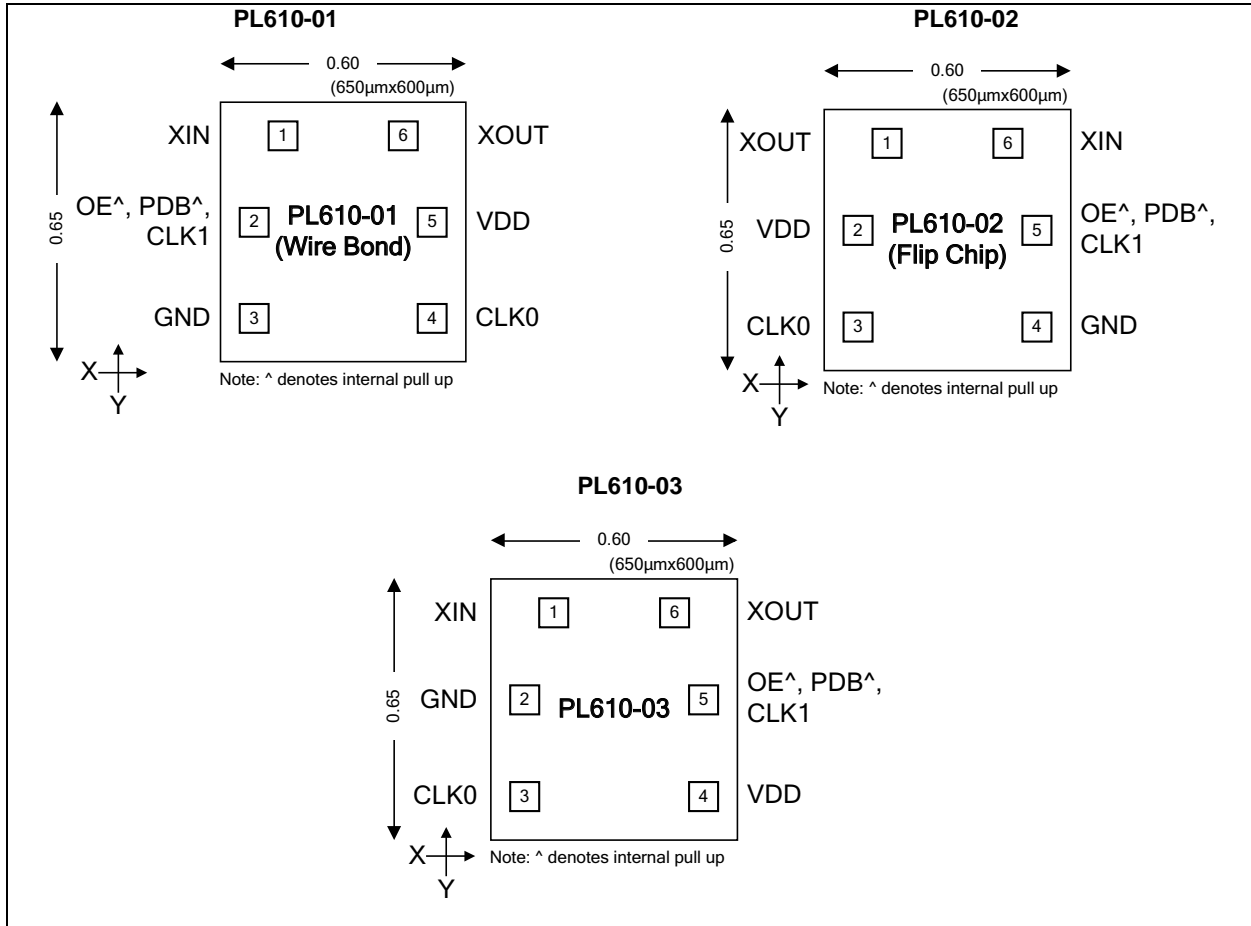


TABLE 2-1: DIE SPECIFICATION

Chip Size	Chip Thickness	Pad Size	Chip Base
0.65 mm x 0.60 mm	Optional	90 μm	GND Level

TABLE 2-2: PAD FUNCTION TABLE

Pad Number	Pad Center		Pad Name PL610-01	Pad Name PL610-02	Pad Name PL610-03
	X	Y			
1	-177	231	XIN	XOUT	XIN
2	-215	41	OE, PDB, CLK1	VDD	GND
3	-215	-186	GND	CLK0	CLK0
4	215	-186	CLK0	GND	VDD
5	215	41	VDD	OE, PDB, CLK1	OE, PDB, CLK1
6	177	213	XOUT	XIN	XOUT

PL610-01/-02/-03

TABLE 2-3: PAD FUNCTION DESCRIPTIONS

Pad Name	Description
CLK0	Programmable clock output
GND	GND connection
OE [^] , PDB [^] , CLK1	Programmable as: Output Enable (OE) – Enables/Disables CLK0 output buffer Power Down (PDB) – Enables/Disables CLK0 output buffer and crystal oscillator circuitry CLK1 – Second clock output
V _{DD}	V _{DD} connection
XIN	Crystal input pad
XOUT	Crystal output pad

3.0 MEASUREMENT TEST CIRCUITS (MTC)

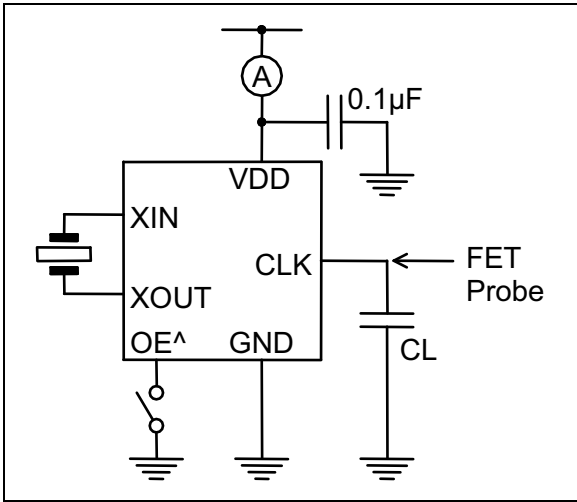


FIGURE 3-1: MTC-1: Rise Time, Fall Time, Duty Cycle, V_{OL} , V_{OH} , I_{DD} , Power Down Current, Output Enable/Disable.

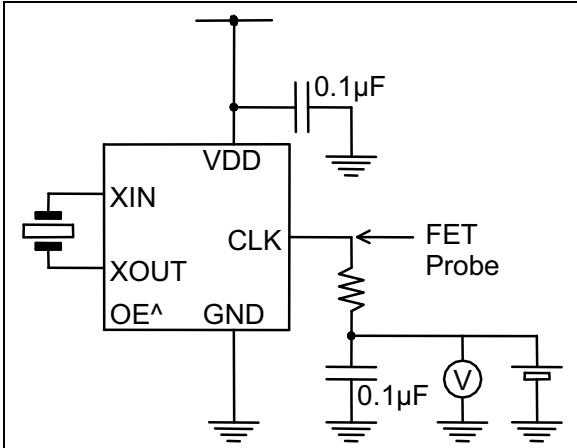


FIGURE 3-2: MTC-2: Output Drive Current and Output Impedance.

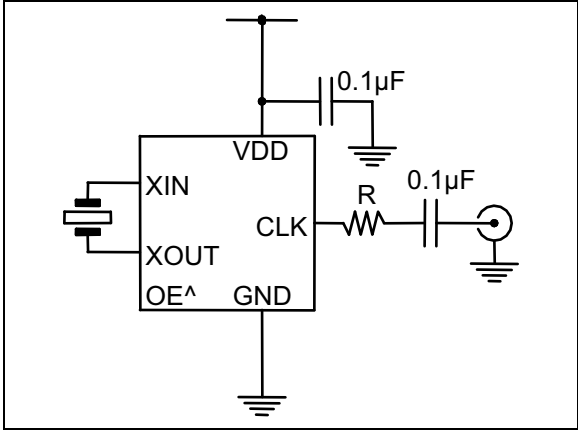


FIGURE 3-3: MTC-3: Jitter and Phase Noise.

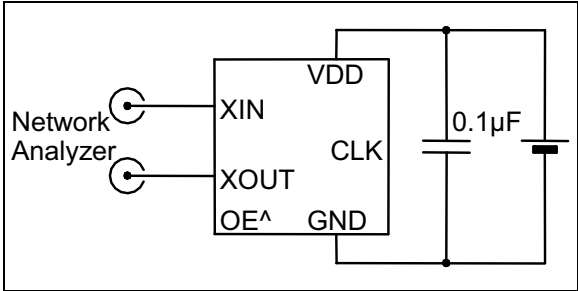


FIGURE 3-4: MTC-4: Negative Resistance.

PL610-01/-02/-03

4.0 WAVEFORM SWITCHING CHARACTERISTICS

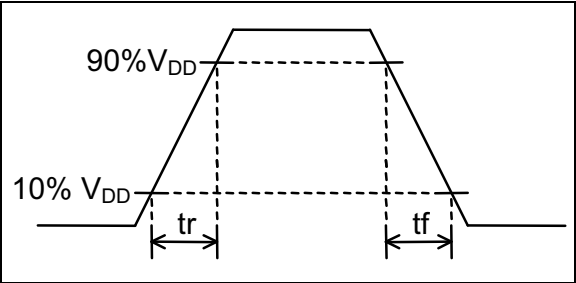


FIGURE 4-1: Rise and Fall Times.

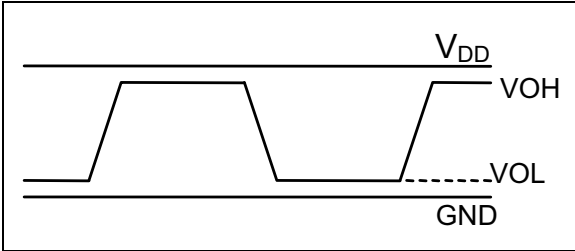


FIGURE 4-2: V_{OH} , V_{OL} .

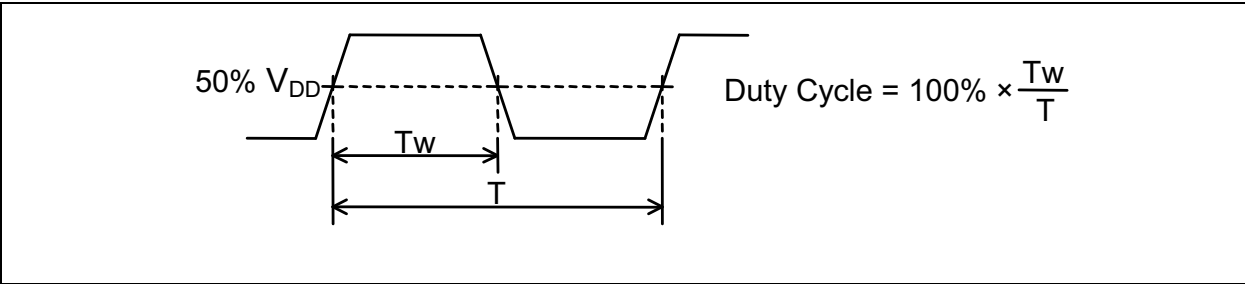


FIGURE 4-3: Duty Cycle.

APPENDIX A: REVISION HISTORY

Revision A (August 2016)

- Converted Micrel document PL610-01/-02/-03 to Microchip data sheet DS20005616A.
- Minor text changes throughout.

NOTES:

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

<u>PART NO.</u>	<u>X</u>	<u>X</u>	<u>X</u>	<u>X</u>
Device	Package	Thickness	Temperature	Media Type
<p>Device:</p> <p>PL610-01: 1.8V to 3.3V Single IC XO with Frequency Tuning (10 MHz to 130 MHz)</p> <p>PL610-02: 1.8V to 3.3V Single IC XO with Frequency Tuning (10 MHz to 130 MHz)</p> <p>PL610-03: 1.8V to 3.3V Single IC XO with Frequency Tuning (10 MHz to 130 MHz)</p> <p>Package:</p> <p>D = Die</p> <p>E = Die (with non-conductive backcoating)</p> <p>V = Wafer (with non-conductive backcoating)</p> <p>W = Wafer</p> <p>Thickness:</p> <p>6 = 6 mm (Die Only)</p> <p>8 = 8 mm</p> <p>A = 10 mm</p> <p>none = 12 mm</p> <p>Temperature:</p> <p>C = 0°C to +70°C (Commercial)</p> <p>Media Type:</p> <p>none = Tray</p>	<p>Examples:</p> <p>a) PL610-01D6C: 1.8V to 3.3V Single IC XO with Frequency Tuning, Die, 6 mm Thickness, Commercial Temp. Range, Tray</p> <p>b) PL610-02E8C: 1.8V to 3.3V Single IC XO with Frequency Tuning, Die (non-conductive back), 8 mm Thickness, Commercial Temp. Range, Tray</p> <p>c) PL610-03VAC: 1.8V to 3.3V Single IC XO with Frequency Tuning, Wafer (non-conductive back), 10 mm Thickness, Commercial Temp. Range, Tray</p> <p>d) PL610-01WC: 1.8V to 3.3V Single IC XO with Frequency Tuning, Wafer, 12 mm Thickness, Commercial Temp. Range, Tray</p> <p>e) PL610-02W8C: 1.8V to 3.3V Single IC XO with Frequency Tuning, Wafer, 8 mm Thickness, Commercial Temp. Range, Tray</p> <p>f) PL610-03DAC: 1.8V to 3.3V Single IC XO with Frequency Tuning, Die, 10 mm Thickness, Commercial Temp. Range, Tray</p> <p>g) PL610-02E6C: 1.8V to 3.3V Single IC XO with Frequency Tuning, Die (non-conductive back), 6 mm Thickness, Commercial Temp. Range, Tray</p> <p>h) PL610-01VC: 1.8V to 3.3V Single IC XO with Frequency Tuning, Wafer (non-conductive back), 12 mm Thickness, Commercial Temp. Range, Tray</p>			

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 unless otherwise stated.

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, KEELoc® 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.

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

Trademarks

The Microchip name and logo, the Microchip logo, AnyRate, dsPIC, FlashFlex, flexPWR, Heldo, JukeBlox, KeeLoq, KeeLoq logo, Klear, LANCheck, LINK MD, MediaLB, MOST, MOST logo, MPLAB, OptoLyzer, PIC, PICSTART, PIC32 logo, RightTouch, SpyNIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

ClockWorks, The Embedded Control Solutions Company, ETHERSYNCH, Hyper Speed Control, HyperLight Load, IntelliMOS, mTouch, Precision Edge, and QUIET-WIRE are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, MiWi, motorBench, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PureSilicon, RightTouch logo, REAL ICE, Ripple Blocker, Serial Quad I/O, SQL, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, 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.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

GestIC is a registered trademarks of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

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

© 2016, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

ISBN: 978-1-5224-0877-2



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

Atlanta

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

Austin, TX

Tel: 512-257-3370

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

Novi, MI
Tel: 248-848-4000

Houston, TX

Tel: 281-894-5983

Indianapolis

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

Los Angeles

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

New York, NY

Tel: 631-435-6000

San Jose, CA

Tel: 408-735-9110

Canada - Toronto

Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Asia Pacific Office

Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon

Hong Kong

Tel: 852-2943-5100
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 - Dongguan

Tel: 86-769-8702-9880

China - Guangzhou

Tel: 86-20-8755-8029

China - Hangzhou

Tel: 86-571-8792-8115
Fax: 86-571-8792-8116

China - Hong Kong SAR

Tel: 852-2943-5100
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: 86-755-8864-2200
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

ASIA/PACIFIC

China - Xiamen

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

China - Zhuhai

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

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: 91-20-3019-1500

Japan - Osaka

Tel: 81-6-6152-7160
Fax: 81-6-6152-9310

Japan - Tokyo

Tel: 81-3-6880-3770
Fax: 81-3-6880-3771

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: 886-7-213-7828

Taiwan - Taipei

Tel: 886-2-2508-8600
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 - Dusseldorf

Tel: 49-2129-3766400

Germany - Karlsruhe

Tel: 49-721-625370

Germany - Munich

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

Italy - Milan

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

Italy - Venice

Tel: 39-049-7625286

Netherlands - Drunen

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

Poland - Warsaw

Tel: 48-22-3325737

Spain - Madrid

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

Sweden - Stockholm

Tel: 46-8-5090-4654

UK - Wokingham

Tel: 44-118-921-5800
Fax: 44-118-921-5820

06/23/16