

## Low-Power, 1.62V to 3.63V, 1:2 Inverting Fanout Buffer IC

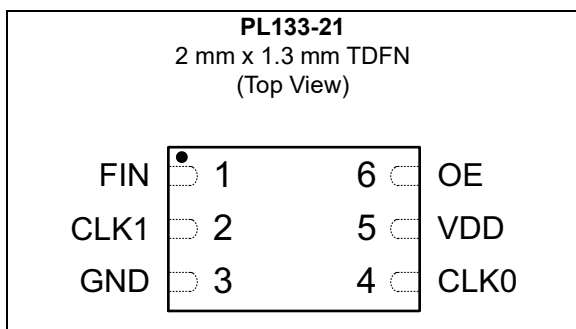
### Features

- Two LVCMOS Outputs
- Input/Output Frequency: 1 MHz to 150 MHz
- Supports LVCMOS or Sine-Wave Input Clock
- Output Enable (OE) only Controls CLK0. CLK1 is Always On.
- Extremely Low Additive Jitter
- 8 mA Output Drive Strength
- Low Current Consumption
- Single 1.8V, 2.5V, or 3.3V  $\pm 10\%$  Power Supply
- Operating Temperature Range:
  - 0° to +70°C (Commercial)
  - -40° to +85°C (Industrial)
- Available in TDFN-6L Green/RoHS-Compliant Package

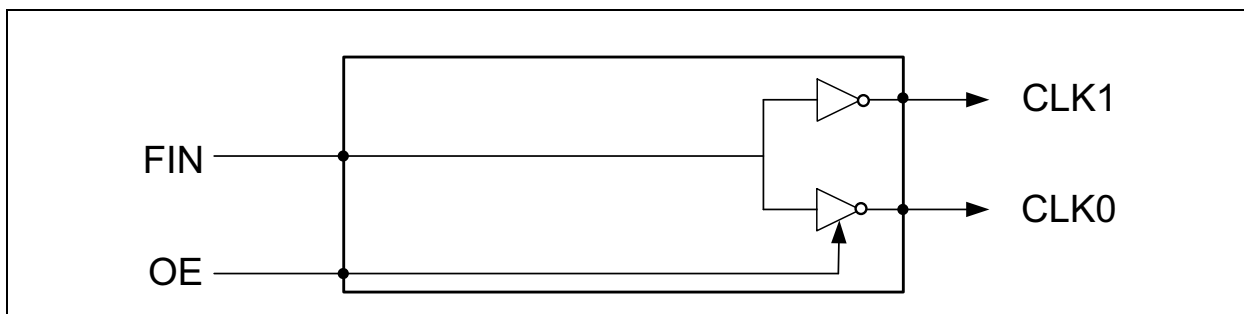
### General Description

The PL133-21 is an advanced inverting fanout buffer design for high performance, low-power, small form-factor applications. The PL133-21 accepts a reference clock input of 1 MHz to 150 MHz and produces two outputs of the same frequency. Reference clock inputs may be LVCMOS or sine-wave signals (the inputs are internally AC-coupled). PL133-21 is designed to fit in a small 2 mm x 1.3 mm x 0.6 mm TDFN package and offers the best phase noise, jitter performance, and lowest power consumption of any comparable IC.

### Package Type



### Functional Block Diagram



# PL133-21

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Supply Voltage Range ( $V_{DD}$ ).....	-0.5V to +4.6V
Input Voltage Range ( $V_{IN}$ ).....	-0.5V to $V_{DD}+0.5V$
Output Voltage Range ( $V_{OUT}$ ).....	-0.5V to $V_{DD}+0.5V$

† **Notice:** Exposure of the device under conditions beyond the limits specified by 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. Parts are tested to commercial grade only.

### AC ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Input Frequency	$f_{IN}$	1	—	150	MHz	@ $V_{DD} = 2.5V$ and $3.3V$
		1	—	65		@ $V_{DD} = 1.8V$
Input Signal Amplitude		0.8	—	$V_{DD}$	$V_{PP}$	Internally AC-coupled
Output Rise Time	$t_r$	—	2	3	ns	15 pF Load, 10/90% $V_{DD}$ , 3.3V
Output Fall Time	$t_f$	—	2	3	ns	15 pF Load, 90/10% $V_{DD}$ , 3.3V
Output-to-Output Skew		—	—	500	ps	—
Duty Cycle		45	50	55	%	Input duty cycle is 50%

### DC ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Units	Condition
Supply Current, Dynamic	$I_{DD}$	—	1.8	—	mA	$V_{DD} = 3.3V$ , 25 MHz, No Load
		—	1.3	—		$V_{DD} = 2.5V$ , 25 MHz, No Load
		—	0.8	—		$V_{DD} = 1.8V$ , 25 MHz, No Load
Operating Voltage	$V_{DD}$	1.62	—	3.63	V	—
Output Low Voltage	$V_{OL}$	—	—	0.4	V	$I_{OL} = +4$ mA, $V_{DD} = 3.3V$
Output High Voltage	$V_{OH}$	2.4	—	—	V	$I_{OL} = -4$ mA, $V_{DD} = 3.3V$
Output Current	$I_{OSD}$	8	—	—	mA	$V_{OL} = 0.4V$ , $V_{OH} = 2.4V$ , $V_{DD} = 3.3V$

### TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
<b>Temperature Ranges</b>						
Ambient Operating Temperature	$T_A$	-40	—	+85	°C	—
Storage Temperature	$T_S$	-65	—	+150	°C	—

2.0 NOISE CHARACTERISTICS

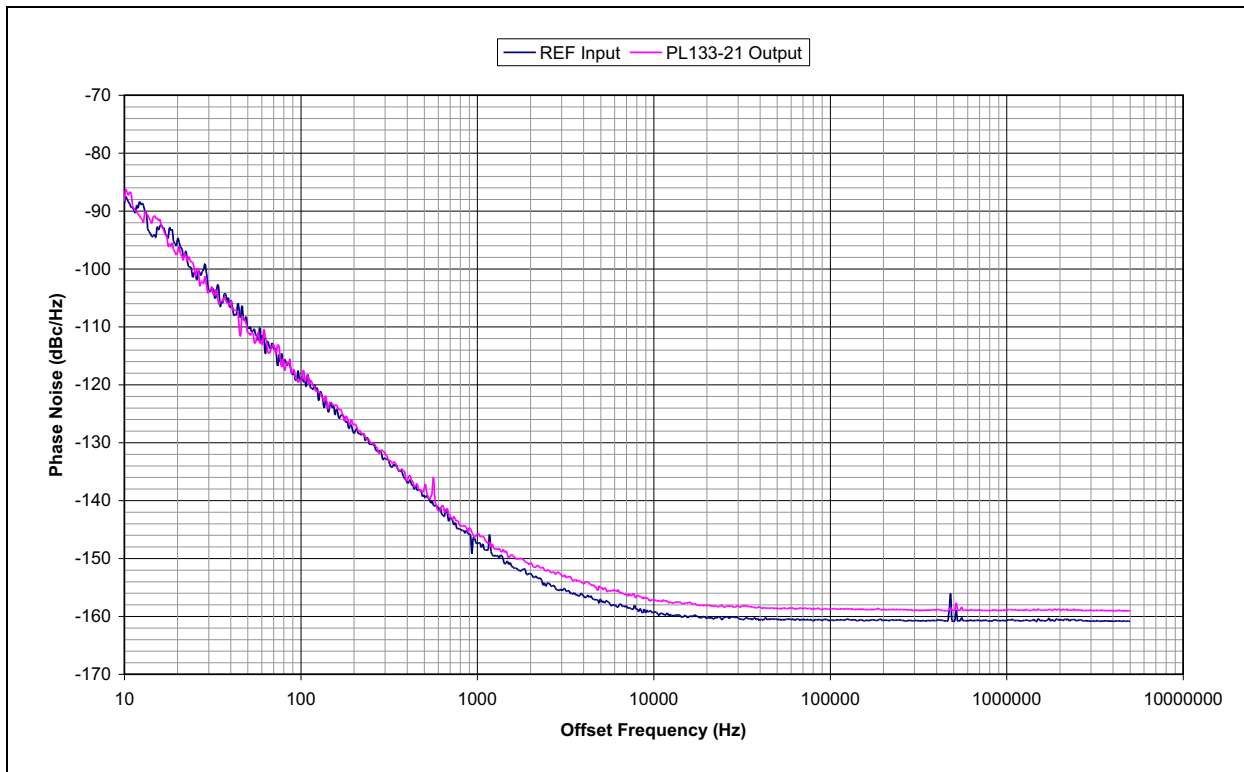


FIGURE 2-1: PL133-21 Additive Phase Jitter.  $V_{DD} = 3.3V$ ,  $CLK = 26\text{ MHz}$ , Integration Range: 12 kHz to 5 MHz, 0.127 ps Typical.

TABLE 2-1: NOISE CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Additive Phase Jitter		—	130	—	fs	$V_{DD} = 3.3V$ , Frequency = 26 MHz Offset = 12 kHz ~ 5 MHz
		—	150	—		$V_{DD} = 3.3V$ , Frequency = 100 MHz Offset = 12 kHz ~ 20 MHz

When a buffer is used to pass a signal then the buffer will add a little bit of its own noise. The phase noise on the output of the buffer will be a little bit more than the phase noise in the input signal. To quantify the noise addition in the buffer we compare the Phase Jitter numbers from the input and the output. The difference is called Additive Phase Jitter. The formula for the Additive Phase Jitter is as follows:

EQUATION 2-1:

$$\text{Additive Phase Jitter} = \sqrt{\text{Output Phase Jitter}^2 - \text{Input Phase Jitter}^2}$$

## 3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 3-1](#).

**TABLE 3-1: PIN FUNCTION TABLE**

Pin Number	Pin Name	Pin Type	Description
1	FIN	I	Reference clock input.
2	CLK1	O	Clock output (inverted).
3	GND	P	Ground connection.
4	CLK0	O	Clock output (inverted).
5	VDD	P	V <sub>DD</sub> connection.
6	OE	I	Output enable input.

### 3.1 Layout Recommendations

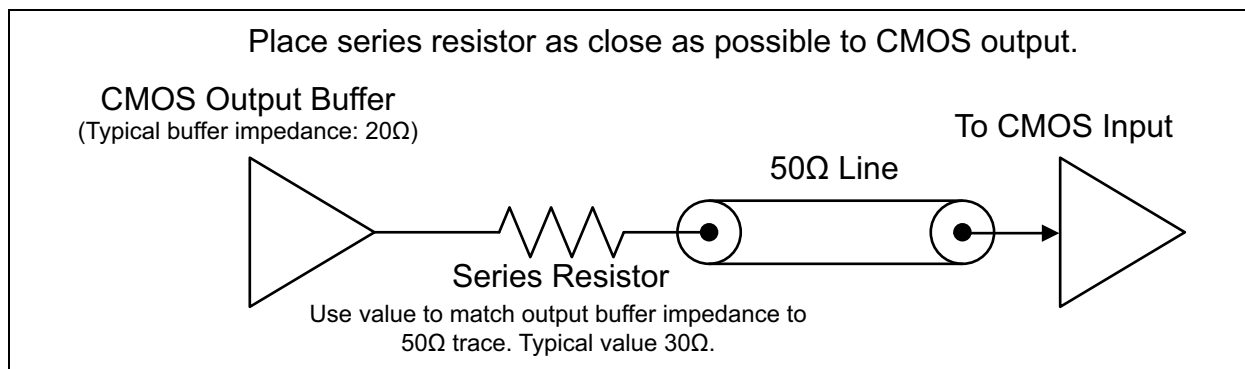
The following guidelines are to assist you with a performance-optimized PCB design.

#### 3.1.1 SIGNAL INTEGRITY AND TERMINATION CONSIDERATIONS

- Keep traces short.
- Trace = Inductor. With a capacitive load this equals ringing.
- Long trace = Transmission Line. Without proper termination this will cause reflections (looks like ringing).
- Design long traces as “striplines” or “microstrips” with defined impedance.
- Match trace at one side to avoid reflections bouncing back and forth.

#### 3.1.2 DECOUPLING AND POWER SUPPLY CONSIDERATIONS

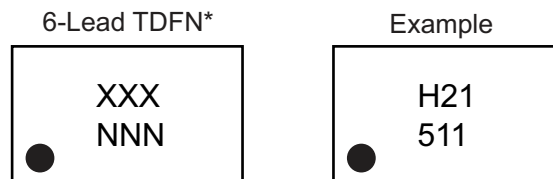
- Place decoupling capacitors as close as possible to the VDD pin to limit noise from the power supply.
- Multiple VDD pins should be decoupled separately for best performance.
- The addition of a ferrite bead in series with VDD can help prevent noise from other board sources.
- The value of decoupling capacitor is frequency dependent. Typical values to use are 0.1  $\mu\text{F}$  for designs using crystals <50 MHz and 0.01  $\mu\text{F}$  for designs using crystals >50 MHz.



**FIGURE 3-1:** Typical CMOS Termination.

## 4.0 PACKAGING INFORMATION

### 4.1 Package Marking Information



**Legend:**

- XX...X Product code or customer-specific information
- Y Year code (last digit of calendar year)
- YY Year code (last 2 digits of calendar year)
- WW Week code (week of January 1 is week '01')
- NNN Alphanumeric traceability code
- Ⓔ3 Pb-free JEDEC<sup>®</sup> designator for Matte Tin (Sn)
- \* This package is Pb-free. The Pb-free JEDEC designator (Ⓔ3) can be found on the outer packaging for this package.
- , ▲, ▼ Pin one index is identified by a dot, delta up, or delta down (triangle mark).

**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information. Package may or may not include the corporate logo.

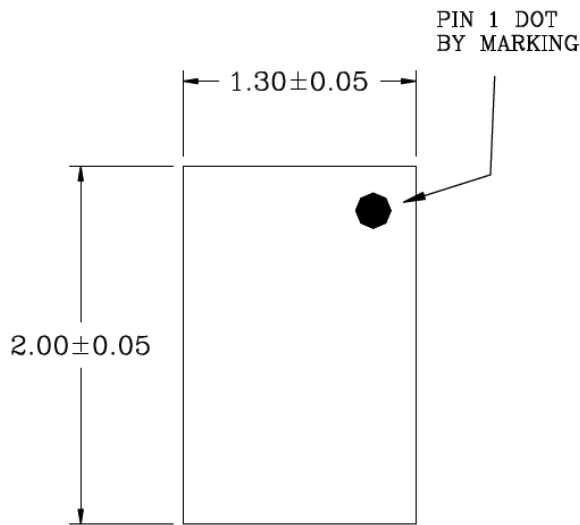
Underbar ( \_ ) and/or Overbar ( ¯ ) symbol may not be to scale.

# PL133-21

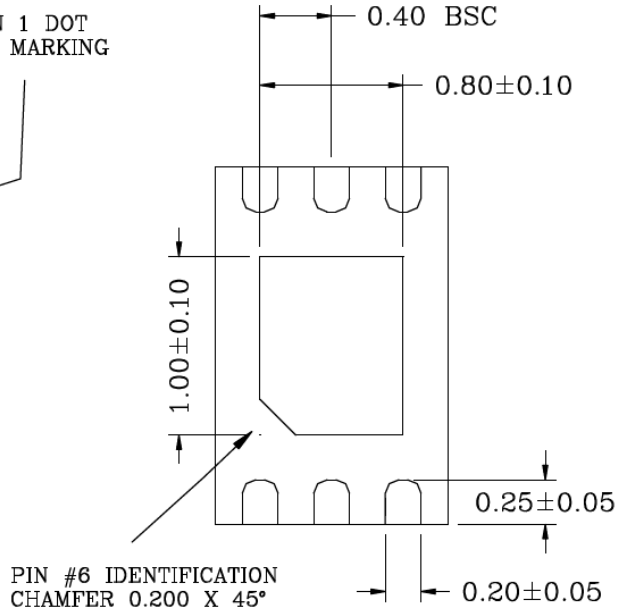
**TITLE**

6 LEAD TDFN 2.0x1.3 mm PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

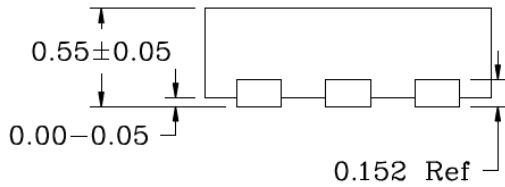
<b>DRAWING #</b>	TDFN2013-6LD-PL-1	<b>UNIT</b>	MM
<b>Lead Frame</b>	NiPdAu	<b>Lead Finish</b>	NiPdAu



TOP VIEW  
NOTE: 1, 2



BOTTOM VIEW  
NOTE: 1, 2



SIDE VIEW  
NOTE: 1, 2

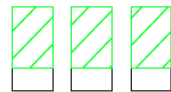
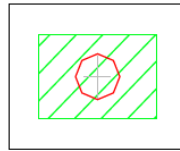
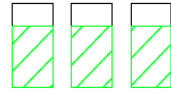
**NOTES**

1. MAX PACKAGE WARPAGE IS 0.05mm.
2. MAX ALLOWABLE BURR IS 0.076mm IN ALL DIRECTIONS.
3. PIN #1 IS ON TOP WILL BE LASER MARKED.
4. UNIT IN mm.
5. SHADED AREA IS SOLDER STENCIL OPENING.
6. RECOMMENDED VIA SIZE IS 0.30-0.35mm.

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

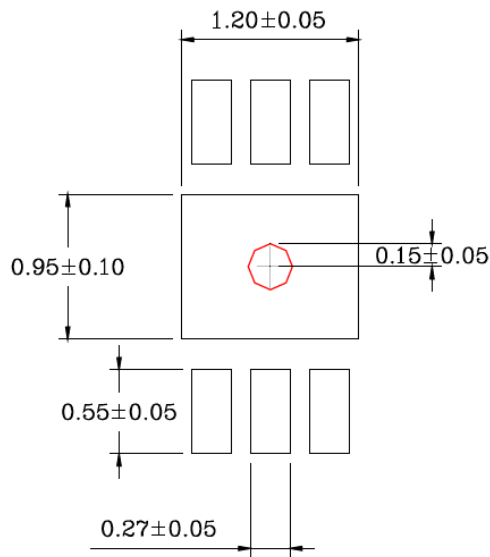
POD-Land Pattern TDFN2013-6LD-PL-1

## RECOMMENDED LAND PATTERN



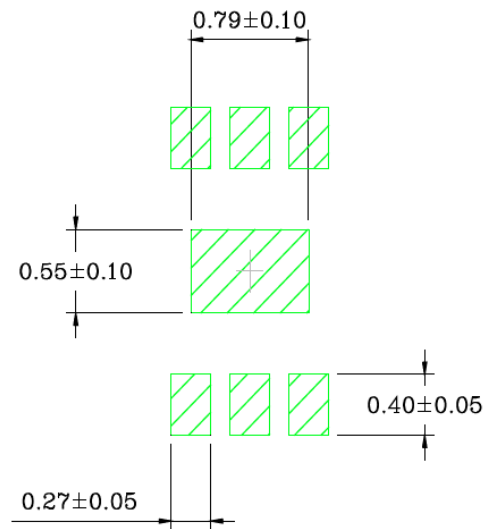
### STACKED-UP

NOTE: 4, 5, 6



### EXPOSED METAL TRACE

NOTE: 4, 6



### SOLDER STENCIL OPENING

NOTE: 4, 5

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

NOTES:



## APPENDIX A: REVISION HISTORY

### Revision A (February 2020)

- Converted Micrel document PL133-21 to Microchip data sheet DS20006309A.
- Minor text changes throughout.

### Revision B (October 2020)

- Added the word Inverting in the data sheet title and updated [Functional Block Diagram](#).

# PL133-21

---

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>
Device	Package	Temp. Range	Packing
<b>Device:</b>	PL133-21:	Low-Power, 1.62V to 3.63V, 1:2 Fanout Buffer IC	
<b>Package:</b>	G	=	6-Lead 2 mm x 1.3 mm TDFN
<b>Temperature Range:</b>	C	=	0°C to +70°C (NiPdAu Lead-Free)
<b>Tape and Reel:</b>	<blank>=	20/Bag	
	R	=	3,000/Reel

**Examples:**

a) PL133-21GC:  
 PL133-21,  
 6-Lead TDFN, 0°C to +70°C Temperature Range,  
 20/Bag

b) PL133-21GC-R:  
 PL133-21,  
 6-Lead TDFN, 0°C to +70°C Temperature Range,  
 3,000/Reel

**Note 1:** Tape and Reel identifier only appears in the catalog part number description. This identifier is used for ordering purposes and is not printed on the device package. Check with your Microchip Sales Office for package availability with the Tape and Reel option.

NOTES:

---

**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is secure when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods being used in attempts to breach the code protection features of the Microchip devices. We believe that these methods require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Attempts to breach these code protection features, most likely, cannot be accomplished without violating Microchip's intellectual property rights.
- Microchip is willing to work with any customer who is concerned about the integrity of its code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is "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 is provided for the sole purpose of designing with and using Microchip products. Information 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.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". 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 ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL OR CONSEQUENTIAL LOSS, DAMAGE, COST OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION. 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.

### Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, HELDO, IGLoo, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PackeTime, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TempTrackr, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, FlashTec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, Vite, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, INICnet, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, memBrain, MIndi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQR, 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.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark 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.

© 2020, Microchip Technology Incorporated, All Rights Reserved.

ISBN: 978-1-5224-6893-6

For information regarding Microchip's Quality Management Systems, please visit [www.microchip.com/quality](http://www.microchip.com/quality).



# 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](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

#### 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

#### 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

Tel: 317-536-2380

#### Los Angeles

Mission Viejo, CA

Tel: 949-462-9523

Fax: 949-462-9608

Tel: 951-273-7800

#### Raleigh, NC

Tel: 919-844-7510

#### New York, NY

Tel: 631-435-6000

#### San Jose, CA

Tel: 408-735-9110

Tel: 408-436-4270

#### Canada - Toronto

Tel: 905-695-1980

Fax: 905-695-2078

### ASIA/PACIFIC

#### Australia - Sydney

Tel: 61-2-9868-6733

#### China - Beijing

Tel: 86-10-8569-7000

#### China - Chengdu

Tel: 86-28-8665-5511

#### China - Chongqing

Tel: 86-23-8980-9588

#### China - Dongguan

Tel: 86-769-8702-9880

#### China - Guangzhou

Tel: 86-20-8755-8029

#### China - Hangzhou

Tel: 86-571-8792-8115

#### China - Hong Kong SAR

Tel: 852-2943-5100

#### China - Nanjing

Tel: 86-25-8473-2460

#### China - Qingdao

Tel: 86-532-8502-7355

#### China - Shanghai

Tel: 86-21-3326-8000

#### China - Shenyang

Tel: 86-24-2334-2829

#### China - Shenzhen

Tel: 86-755-8864-2200

#### China - Suzhou

Tel: 86-186-6233-1526

#### China - Wuhan

Tel: 86-27-5980-5300

#### China - Xian

Tel: 86-29-8833-7252

#### China - Xiamen

Tel: 86-592-2388138

#### China - Zhuhai

Tel: 86-756-3210040

### ASIA/PACIFIC

#### India - Bangalore

Tel: 91-80-3090-4444

#### India - New Delhi

Tel: 91-11-4160-8631

#### India - Pune

Tel: 91-20-4121-0141

#### Japan - Osaka

Tel: 81-6-6152-7160

#### Japan - Tokyo

Tel: 81-3-6880-3770

#### Korea - Daegu

Tel: 82-53-744-4301

#### Korea - Seoul

Tel: 82-2-554-7200

#### Malaysia - Kuala Lumpur

Tel: 60-3-7651-7906

#### Malaysia - Penang

Tel: 60-4-227-8870

#### Philippines - Manila

Tel: 63-2-634-9065

#### Singapore

Tel: 65-6334-8870

#### Taiwan - Hsin Chu

Tel: 886-3-577-8366

#### Taiwan - Kaohsiung

Tel: 886-7-213-7830

#### Taiwan - Taipei

Tel: 886-2-2508-8600

#### Thailand - Bangkok

Tel: 66-2-694-1351

#### Vietnam - Ho Chi Minh

Tel: 84-28-5448-2100

### EUROPE

#### Austria - Wels

Tel: 43-7242-2244-39

Fax: 43-7242-2244-393

#### Denmark - Copenhagen

Tel: 45-4485-5910

Fax: 45-4485-2829

#### Finland - Espoo

Tel: 358-9-4520-820

#### France - Paris

Tel: 33-1-69-53-63-20

Fax: 33-1-69-30-90-79

#### Germany - Garching

Tel: 49-8931-9700

#### Germany - Haan

Tel: 49-2129-3766400

#### Germany - Heilbronn

Tel: 49-7131-72400

#### Germany - Karlsruhe

Tel: 49-721-625370

#### Germany - Munich

Tel: 49-89-627-144-0

Fax: 49-89-627-144-44

#### Germany - Rosenheim

Tel: 49-8031-354-560

#### Israel - Ra'anana

Tel: 972-9-744-7705

#### Italy - Milan

Tel: 39-0331-742611

Fax: 39-0331-466781

#### Italy - Padova

Tel: 39-049-7625286

#### Netherlands - Drunen

Tel: 31-416-690399

Fax: 31-416-690340

#### Norway - Trondheim

Tel: 47-7288-4388

#### Poland - Warsaw

Tel: 48-22-3325737

#### Romania - Bucharest

Tel: 40-21-407-87-50

#### Spain - Madrid

Tel: 34-91-708-08-90

Fax: 34-91-708-08-91

#### Sweden - Gothenberg

Tel: 46-31-704-60-40

#### Sweden - Stockholm

Tel: 46-8-5090-4654

#### UK - Wokingham

Tel: 44-118-921-5800

Fax: 44-118-921-5820