

Low-Power, 1.62V to 3.63V, 1 MHz to 150 MHz, Inverting 1:3 Fanout Buffer IC

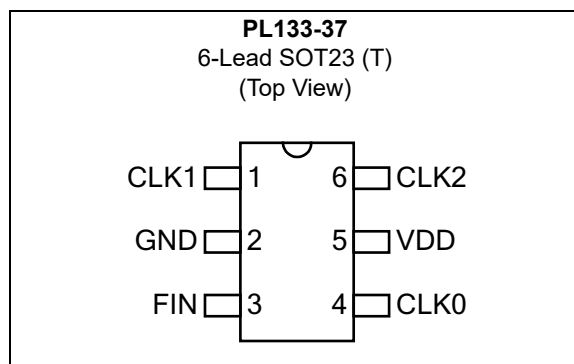
Features

- 3 LVCMOS Inverted Outputs
- 12 mA Output Drive Strength
- Input/Output Frequency:
 - Reference Clock: 1 MHz to 150 MHz
- Supports LVCMOS or Sine Wave Input Clock
- Very Low Jitter and Phase Noise
- Low Current Consumption
- Single 1.8V, 2.5V, or 3.3V $\pm 10\%$ Power Supply
- Operating Temperature Range
 - 0°C to +70°C (Commercial)
 - -40°C to +85°C (Industrial)
- Available in 6-Lead SOT23
GREEN/RoHS-Compliant Package

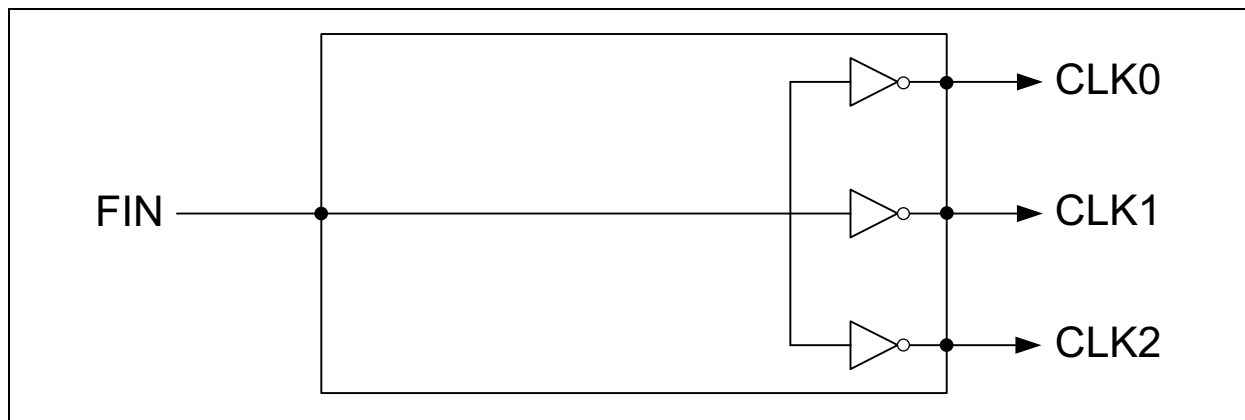
General Description

The PL133-37 is an advanced fanout buffer design for high performance, low-power, small form-factor applications. The PL133-37 accepts a reference clock input of 1 MHz to 150 MHz and produced three inverted outputs of the same frequency. Reference clock inputs may be LVCMOS or sine-wave signals (the inputs are internally AC-coupled). Offered in a small 3 mm x 3 mm 6-lead SOT23, the PL133-37 offers the best phase noise, jitter performance, and lowest power consumption of any comparable IC.

Package Type



Block Diagram



PL133-37

1.0 ELECTRICAL CHARACTERISTICS

Absolute Maximum Ratings †

Supply Voltage (V_{DD})	.....	-0.5V to +4.6V
DC Input Voltage (V_I)	.....	-0.5V to $V_{DD} + 0.5V$
DC Output Voltage (V_O)	.....	-0.5V to $V_{DD} + 0.5V$
Storage Temperature (T_S)	.....	-65°C to +150°C
Ambient Operating Temperature (Note 1)	.....	-40°C to +85°C

† **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.

Note 1: Operating temperature is guaranteed by design. Parts are tested to commercial grade only.

AC SPECIFICATIONS

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Input Frequency	f_{IN}	1	—	150	MHz	2.5V and 3.3V operation
		1	—	100	MHz	1.8V operation
Input Signal Amplitude	f_{IN}	0.8	—	V_{DD}	V_{PP}	Internally AC-coupled, ≤ 150 MHz, $V_{DD} = 2.5V$ and $3.3V$
		0.5	—	V_{DD}	V_{PP}	Internally AC-coupled, ≤ 100 MHz, All V_{DD} s
		0.1	—	V_{DD}	V_{PP}	Internally AC-coupled, $3.3V \leq 50$ MHz, $2.5V \leq 40$ MHz, $1.8V \leq 15$ MHz,
Output Enable Time	t_{EN}	—	—	10	ns	OE function, $T_A = +25^\circ C$, 15 pF load
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, 10/90% V_{DD} , 3.3V
Duty Cycle	—	45	50	55	%	Input duty cycle is 50%
Output-to-Output Skew	t_{OOSK}	—	—	250	ps	All outputs equally loaded

DC SPECIFICATIONS

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply Current, Dynamic	I_{DD}	—	1.2	—	mA	$V_{DD} = 3.3V$, 25 MHz, no load
		—	0.9	—	mA	$V_{DD} = 2.5V$, 25 MHz, no load
		—	0.6	—	mA	$V_{DD} = 1.8V$, 25 MHz, no load
Supply Current, Standby	$I_{DD\ SB}$	—	0.3	—	mA	OE pin pulled low, $V_{DD} = 3.3V$
Operating Voltage	V_{DD}	1.62	—	3.63	V	—
Output Low Voltage	V_{OL}	—	—	0.4	V	$I_{OL} = 12$ mA, $V_{DD} = 3.3V$
Output High Voltage	V_{OH}	2.4	—	—	V	$I_{OL} = -12$ mA, $V_{DD} = 3.3V$
Output Current	I_{OSD}	12	—	—	ma	$V_{OL} = 0.4V$, $V_{OH} = 2.4V$, $V_{DD} = 3.3V$

NOISE CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Additive Phase Jitter	t_{JITTER}	—	70	—	fs	$V_{\text{DD}} = 3.3\text{V}$, Frequency = 26 MHz, Offset = 12 kHz ~ 5 MHz
		—	80	—	fs	$V_{\text{DD}} = 3.3\text{V}$, Frequency = 100 MHz, Offset = 12 kHz ~ 20 MHz

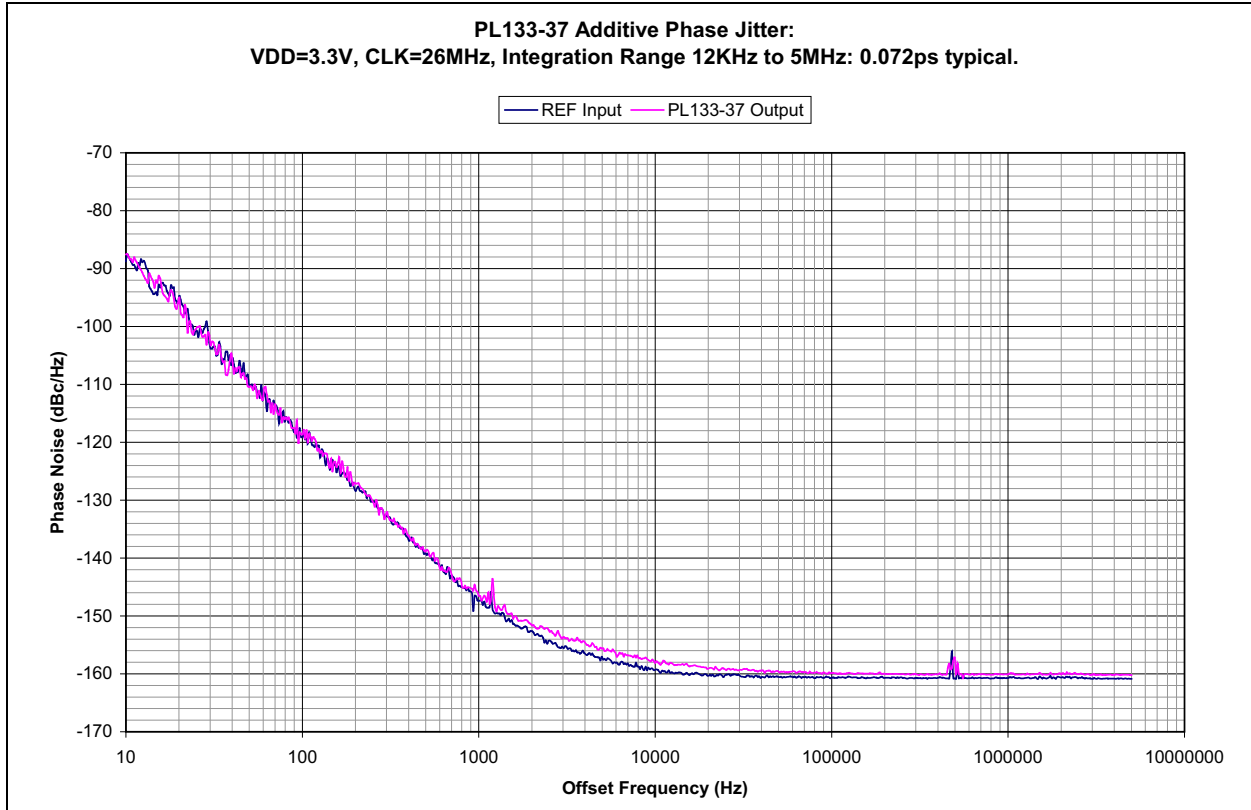


FIGURE 1-1: *PL133-37 Additive Phase Jitter.*

When a buffer is used to pass a signal, the buffer adds 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 additive phase jitter is as follows:

EQUATION 1-1:

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

PL133-37

2.0 PIN DESCRIPTION

The descriptions of the pins are listed in [Table 2-1](#).

TABLE 2-1: PIN FUNCTION TABLE

Pin Number	Pin Name	Pin Type	Description
1	CLK1	O	Output clock (inverted).
2	GND	P	Ground connection.
3	FIN	I	Reference clock input.
4	CLK0	O	Output clock (inverted).
5	VDD	P	Power supply.
6	CLK2	O	Output clock (inverted).

LAYOUT RECOMMENDATIONS

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

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 that look like ringing.
- Design long traces as striplines or microstrips with defined impedance.
- Match trace at one side to avoid reflections bouncing back and forth.

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 the decoupling capacitor is frequency dependent. The typical value to use is 0.1 μF .

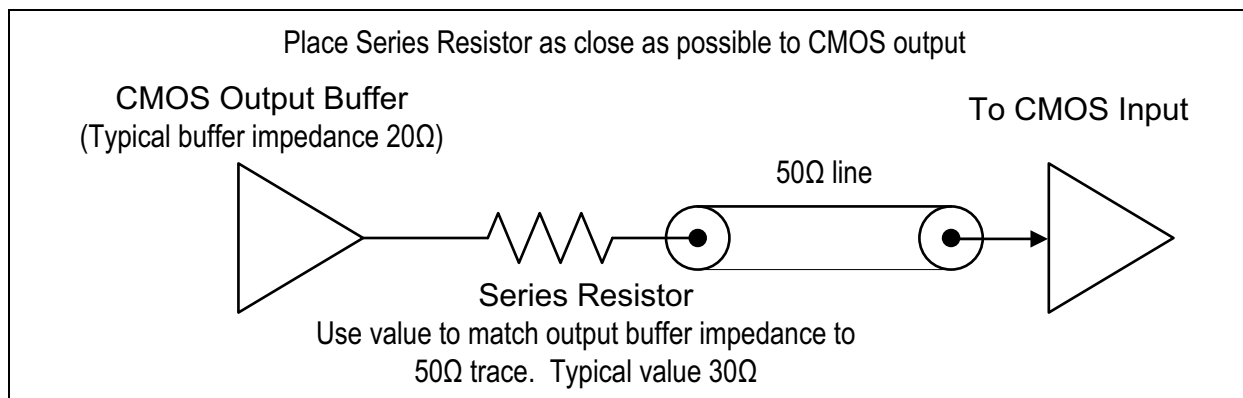


FIGURE 2-1: Typical CMOS Termination.

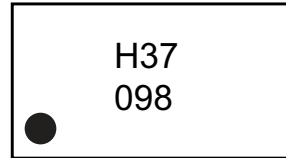
3.0 PACKAGING INFORMATION

3.1 Package Marking Information

6-Lead SOT23*



Example



Note: Industrial temperature versions of this part contain a capital letter “I” after the alphanumeric traceability code.

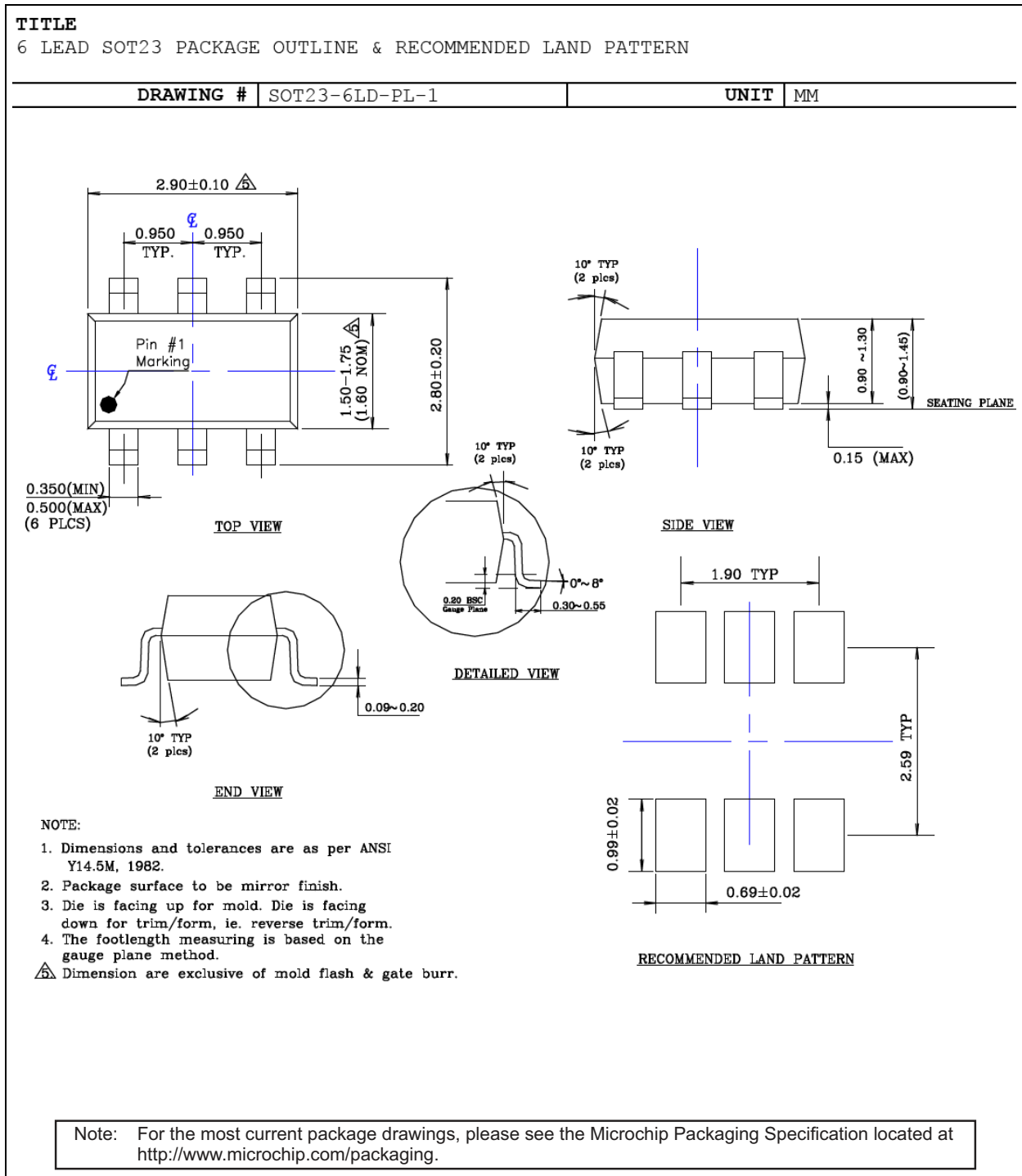
Legend:	XX...X	Product code
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
		Pb-free JEDEC® designator for Matte Tin (Sn)
	ⓔ3	This package is Pb-free. The Pb-free JEDEC designator (ⓔ) can be found on the outer packaging for this package. ⓔ3
	●, ▲, ▼	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.

PL133-37

6-Lead SOT23 Package Outline and Recommended Land Pattern



APPENDIX A: REVISION HISTORY

Revision A (September 2020)

- Converted Micrel document PL133-37 to Microchip data sheet template DS20006403A.
- Minor grammatical 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>	Examples:
Device	Package	Temperature Range	Media Type	
Device:	PL133-37:	Low-Power, 1.62V to 3.63V, 1 MHz to 150 MHz, Inverting 1:3 Fanout Buffer IC		a) PL133-37TC: PL133-37, 6-Lead SOT23, 0°C to +70°C Temperature Range, 20/Bag
Package:	T	=	6-Lead 3 mm x 3 mm SOT23	b) PL133-37TC-R: PL133-37, 6-Lead SOT23, 0°C to +70°C Temperature Range, 3,000/Reel
Temperature Range:	C	=	0°C to +70°C	c) PL133-37TI: PL133-37, 6-Lead SOT23, -40°C to +85°C Temperature Range, 20/Bag
	I	=	-40°C to +85°C	d) PL133-37TI-R: PL133-37, 6-Lead SOT23, -40°C to +85°C Temperature Range, 3,000/Reel
Media Type:	(blank)	=	20/Bag	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.
	R	=	3,000/Reel	

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, TempTracker, 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., SQI, 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: 978-1-5224-6699-4

For information regarding Microchip's Quality Management Systems, please visit 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>
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

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