

## 32-Channel Serial-to-Parallel Converter with Open-Drain Outputs

### Features

- 100 mA Minimum Sink Current
- 16 MHz Shift Register Speed
- Polarity and Blanking Inputs
- CMOS-Compatible Inputs

### Applications

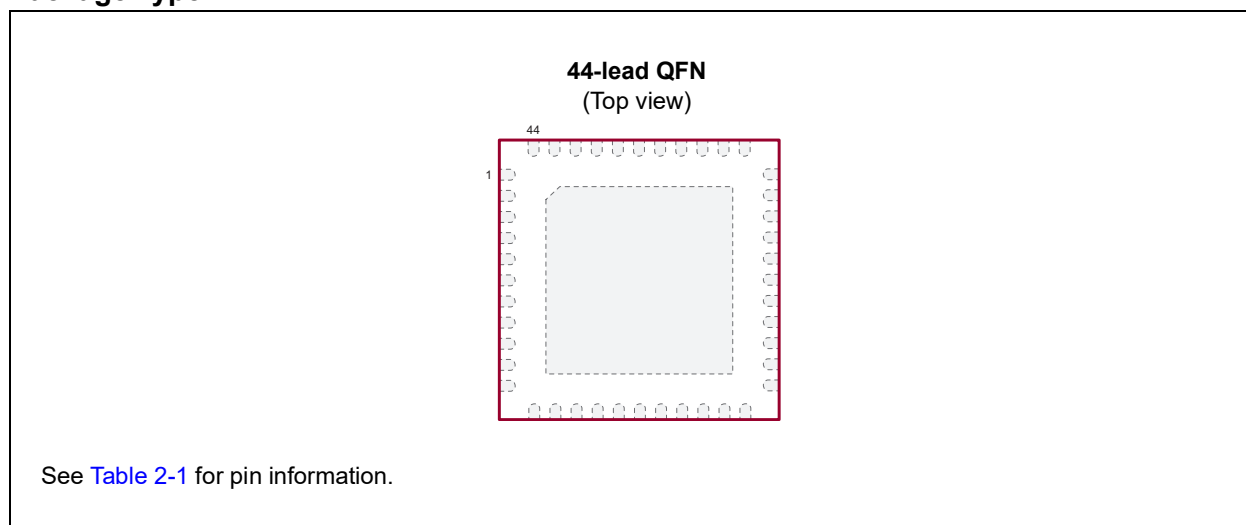
- Inkjet and Electrostatic Print Heads
- AC-Electroluminescent Displays
- Microelectromechanical Systems (MEMS) Applications

### General Description

The HV5623 is a low-voltage serial to high-voltage parallel converter with open-drain outputs. This device is designed as a driver for AC-electroluminescent displays. It can also be used in any application requiring multiple-output high-voltage current sinking capabilities, such as driving inkjet and electrostatic print heads, plasma panels, vacuum fluorescent or large matrix LCD displays.

This device consists of a 32-bit Shift register, 32 latches and control logic to perform the polarity selection and blanking of the outputs. Data is shifted through the Shift register on the high-to-low transition of the clock. The HV5623 shifts clockwise when viewed from the top of the package. A data output buffer is provided for cascading devices. This output reflects the current status of the last bit of the Shift register. Operation of the Shift register is not affected by the  $\overline{LE}$  (latch enable),  $\overline{BL}$  (blanking) and the POL (polarity) inputs. Transfer of data from the Shift register to the latch occurs when the  $\overline{LE}$  (latch enable) input is high. The data in the latch is stored when  $\overline{LE}$  is low.

### Package Type





## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

Supply Voltage, $V_{DD}$ (Note 1)	–0.5V to +7V
Output Voltage, $HV_{OUT}$ (Note 1)	–0.5V to +230V
Logic Input Levels (Note 1)	–0.5V to $V_{DD} + 0.5V$
Ground Current (Note 2)	1.5A
Maximum Junction Temperature, $T_{J(MAX)}$	+125°C
Storage Temperature, $T_S$	–65°C to +150°C
Continuous Total Power Dissipation:	
44-lead QFN (Note 3)	3.4W

† **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:** All voltages are referenced to  $V_{SS}$ .  
**Note 2:** Duty cycle is limited by the total power dissipated in the package.  
**Note 3:** 1 oz 4-layer 3" x 4" PCB

### RECOMMENDED OPERATING CONDITIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Logic Supply Voltage	$V_{DD}$	4.5	—	5.5	V	
High-Voltage Output	$HV_{OUT}$	–0.3	—	+220	V	
High-Level Input Voltage	$V_{IH}$	0.8 $V_{DD}$	—	$V_{DD}$	V	
Low-Level Input Voltage	$V_{IL}$	0	—	0.2 $V_{DD}$	V	
Clock Frequency	$f_{CLK}$	—	—	16	MHz	
Operating Ambient Temperature	$T_A$	–40	—	+85	°C	

### DC ELECTRICAL CHARACTERISTICS

Electrical Specifications: Over recommended operating conditions unless otherwise noted.							
Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions	
$V_{DD}$ Supply Current	$I_{DD}$	—	—	25	mA	$f_{CLK} = 16$ MHz, $f_{DATA} = 8$ MHz	
Quiescent $V_{DD}$ Supply Current	$I_{DDQ}$	—	—	100	µA	$D_{IN} = 0V$ , all input logic pins = 0V, all outputs off	
Off-State Output Current	$I_{O(OFF)}$	—	—	10	µA	All outputs high, all switches parallel	
High-Level Logic Input Current	$I_{IH}$	—	—	1	µA	$V_{IH} = V_{DD}$	
Low-Level Logic Input Current	$I_{IL}$	—	—	–1	µA	$V_{IL} = 0V$	
High-Level Output Data Out	$V_{OH}$	$V_{DD} - 1V$	—	—	V	$I_{DOUT} = -10$ mA	
Low-Level Output Voltage	$HV_{OUT}$	$V_{OL}$	—	—	15	V	$I_{HV_{OUT}} = +100$ mA
	Data Out		—	—	1	V	$I_{DOUT} = +10$ mA
$HV_{OUT}$ Clamp Voltage	$V_{OC}$	—	—	–1.5	V	$I_{OL} = -100$ mA	

# HV5623

## AC ELECTRICAL CHARACTERISTICS

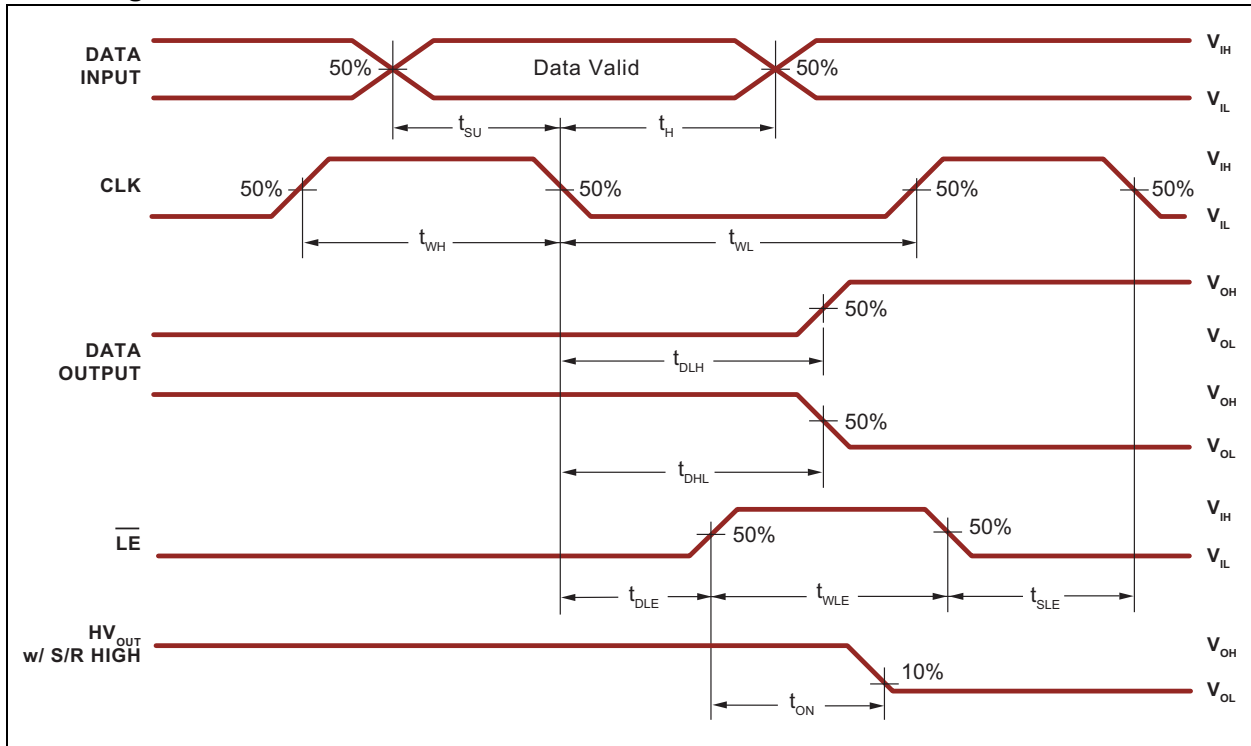
Electrical Specifications: $V_{DD} = 5V$ , $T_J = 25^\circ C$						
Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Clock Frequency	$f_{CLK}$	—	—	16	MHz	
Clock Pulse Width, High or Low	$t_{WL}, t_{WH}$	31	—	—	ns	
Data Setup Time before CLK Falls	$t_{SU}$	25	—	—	ns	
Data Hold Time after CLK Falls	$t_H$	10	—	—	ns	
Turn-On Time, $HV_{OUT}$ from Enable	$t_{ON}$	—	—	400	ns	$R_L = 2\text{ k}\Omega$ to $V_{PP}$ maximum
Delay Time Clock to Data High to Low	$t_{DHL}$	—	—	35	ns	$C_L = 15\text{ pF}$
Delay Time Clock to Data Low to High	$t_{DLH}$	—	—	35	ns	$C_L = 15\text{ pF}$
Delay Time Clock to $\overline{LE}$ Low to High	$t_{DLE}$	20	—	—	ns	
Width of $\overline{LE}$ Pulse	$t_{WLE}$	20	—	—	ns	
$\overline{LE}$ Setup Time before Clock Falls	$t_{SLE}$	20	—	—	ns	
Digital Logic Input Capacitance	$C_{IN}$	—	—	15	pF	

## TEMPERATURE SPECIFICATIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
<b>TEMPERATURE RANGE</b>						
Operating Ambient Temperature	$T_A$	-40	—	+85	$^\circ C$	
Maximum Junction Temperature	$T_{J(MAX)}$	—	—	+125	$^\circ C$	
Storage Temperature	$T_S$	-65	—	+150	$^\circ C$	
<b>PACKAGE THERMAL RESISTANCE</b>						
44-lead QFN	$\theta_{JA}$	—	19	—	$^\circ C/W$	<a href="#">Note 1</a>

**Note 1:** 1 oz 4-layer 3" x 4" PCB

## Switching Waveforms



# HV5623

## 2.0 PIN DESCRIPTION

The details on the pins of HV5623 are listed in [Table 2-1](#). Refer to [Package Type](#) for the location of pins.

**TABLE 2-1: 44-LEAD QFN PIN FUNCTION TABLE**

Pin Number	Pin Name	Description
1	HV <sub>OUT22</sub>	High-voltage output
2	HV <sub>OUT21</sub>	High-voltage output
3	HV <sub>OUT20</sub>	High-voltage output
4	HV <sub>OUT19</sub>	High-voltage output
5	HV <sub>OUT18</sub>	High-voltage output
6	HV <sub>OUT17</sub>	High-voltage output
7	HV <sub>OUT16</sub>	High-voltage output
8	HV <sub>OUT15</sub>	High-voltage output
9	HV <sub>OUT14</sub>	High-voltage output
10	HV <sub>OUT13</sub>	High-voltage output
11	HV <sub>OUT12</sub>	High-voltage output
12	HV <sub>OUT11</sub>	High-voltage output
13	HV <sub>OUT10</sub>	High-voltage output
14	HV <sub>OUT9</sub>	High-voltage output
15	HV <sub>OUT8</sub>	High-voltage output
16	HV <sub>OUT7</sub>	High-voltage output
17	HV <sub>OUT6</sub>	High-voltage output
18	HV <sub>OUT5</sub>	High-voltage output
19	HV <sub>OUT4</sub>	High-voltage output
20	HV <sub>OUT3</sub>	High-voltage output
21	HV <sub>OUT2</sub>	High-voltage output
22	HV <sub>OUT1</sub>	High-voltage output
23	DATA OUT	Data output pin
24	NC	No internal connection
25	NC	No internal connection
26	NC	No internal connection
27	$\overline{\text{POL}}$	Inverts the polarity of the HV <sub>OUT</sub> pins
28	CLK	Clock pin, Shift registers shift data on falling edge of input clock.
29	VSS	Reference voltage, usually ground
30	VDD	Logic supply voltage
31	$\overline{\text{LE}}$	Latch enable pin, data is shifted from Shift register to latches on logic input high.
32	DATA IN	Data input pin
33	$\overline{\text{BL}}$	Blanking pin sets all HV <sub>OUT</sub> pins on or off depending upon state of polarity. See <a href="#">Table 3-2</a> .
34	N/C	No internal connection
35	HV <sub>OUT32</sub>	High-voltage output

**TABLE 2-1: 44-LEAD QFN PIN FUNCTION TABLE (CONTINUED)**

Pin Number	Pin Name	Description
36	HV <sub>OUT</sub> 31	High-voltage output
37	HV <sub>OUT</sub> 30	High-voltage output
38	HV <sub>OUT</sub> 29	High-voltage output
39	HV <sub>OUT</sub> 28	High-voltage output
40	HV <sub>OUT</sub> 27	High-voltage output
41	HV <sub>OUT</sub> 26	High-voltage output
42	HV <sub>OUT</sub> 25	High-voltage output
43	HV <sub>OUT</sub> 24	High-voltage output
44	HV <sub>OUT</sub> 23	High-voltage output
Center Tab		Connect to VSS.

# HV5623

## 3.0 FUNCTIONAL DESCRIPTION

Follow the steps in [Table 3-1](#) to power up and power down the HV5623.

**TABLE 3-1: POWER-UP AND POWER-DOWN SEQUENCE**

Power-Up		Power-Down	
Step	Description	Step	Description
1	Connect ground.	1	Remove all inputs.
2	Apply V <sub>DD</sub> .	2	Remove V <sub>DD</sub> .
3	Set all inputs to a known state.	3	Disconnect ground.

**TABLE 3-2: FUNCTION TABLE**

Function	Inputs <sup>1</sup>					Outputs				
	Data	CLK	$\overline{LE}$	$\overline{BL}$	$\overline{POL}$	Shift Register		High-Voltage Output		Data Out
						1	2...32	1	2...32	
All On	X	X	X	L	L	Note 2	Note 2	On	On	Note 2
All Off	X	X	X	L	H	Note 2	Note 2	Off	Off	Note 2
Invert Mode	X	X	L	H	L	Note 2	Note 2	$\overline{\text{Note 2}}$	$\overline{\text{Note 2}}$	Note 2
Load S/R	H or L	↓	L	H	H	H or L	Note 2	Note 2	Note 2	Note 2
Load Latches	X	H or L	↑	H	H	Note 2	Note 2	Note 2	Note 2	Note 2
	X	H or L	↑	H	L	Note 2	Note 2	$\overline{\text{Note 2}}$	$\overline{\text{Note 2}}$	Note 2
Transparent Latch Mode	L	↓	H	H	H	L	Note 2	Off	Note 2	Note 2
	H	↓	H	H	H	H	Note 2	On	Note 2	Note 2

**Note 1:** H = High logic level

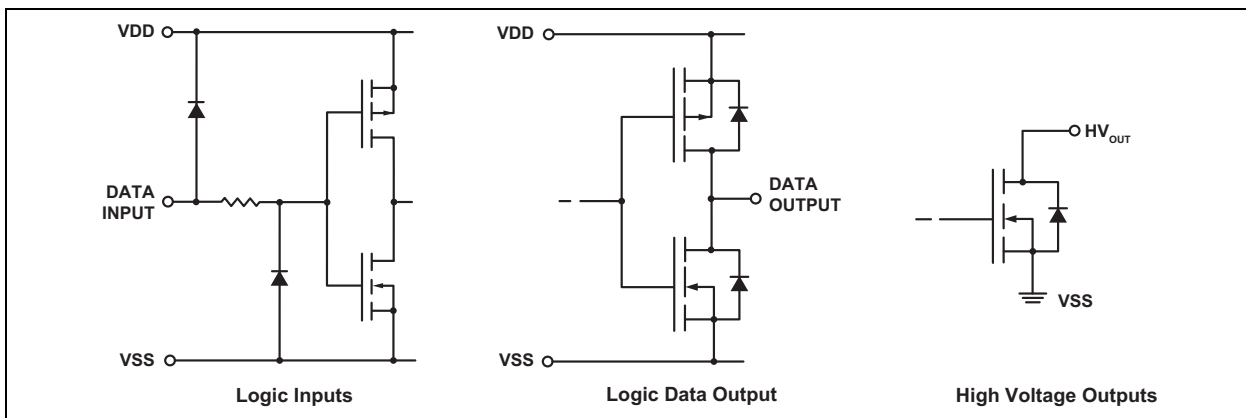
L = Low logic level

X = Don't care

↓ = High-to-low transition

↑ = Low-to-high transition

**2:** Dependent on previous stage's state before the last CLK ↓ or last  $\overline{LE}$  high



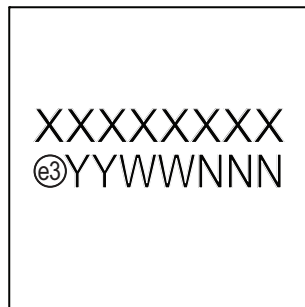
**FIGURE 3-1:** Input and Output Equivalent Circuits.



## 4.0 PACKAGE MARKING INFORMATION

### 4.1 Packaging Information

44-lead QFN

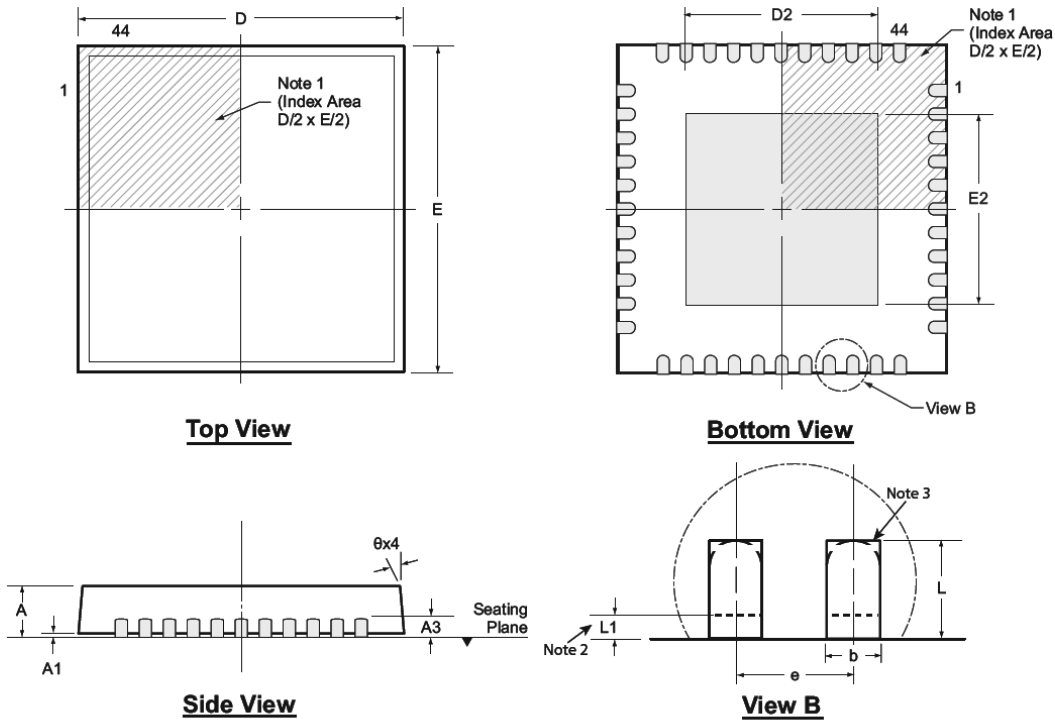


Example



<b>Legend:</b>	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
	(e3)	Pb-free JEDEC® designator for Matte Tin (Sn)
	*	This package is Pb-free. The Pb-free JEDEC designator (e3) can be found on the outer packaging for this package.
<b>Note:</b>	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 product code or customer-specific information. Package may or not include the corporate logo.	

## 44-Lead QFN Package Outline (K7) 7.00x7.00mm body, 0.80mm height (max), 0.50mm pitch



Note: For the most current package drawings, see the Microchip Packaging Specification at [www.microchip.com/packaging](http://www.microchip.com/packaging).

**Notes:**

1. A Pin 1 identifier must be located in the index area indicated. The Pin 1 identifier can be: a molded mark/identifier; an embedded metal marker; or a printed indicator.
2. Depending on the method of manufacturing, a maximum of 0.15mm pullback (L1) may be present.
3. The inner tip of the lead may be either rounded or square.

Symbol	A	A1	A3	b	D	D2	E	E2	e	L	L1	θ	
Dimension (mm)	MIN	0.70	0.00	0.20 REF	0.18	6.85*	5.00†	6.85*	5.00†	0.50 BSC	0.45†	0.00	0°
	NOM	0.75	0.02		0.25	7.00	5.15†	7.00	5.15†		0.55†	-	-
	MAX	0.80	0.05		0.30	7.15*	5.25†	7.15*	5.25†		0.65†	0.15	14°

JEDEC Registration MO-220, Variation WKKD-3, Issue K, June 2006

\* This dimension is not specified in the JEDEC drawing.

† This dimension differs from the JEDEC drawing.

Drawings not to scale.

## APPENDIX A: REVISION HISTORY

### Revision A (July 2019)

- Converted Supertex Doc# DSFP-PIC18FXXXX to Microchip DS20005702A
- Changed the quantity of the 44-lead QFN K7 package from 280/Tray to 260/Tray
- Changed the quantity of the K7 M933 media type from 2000/Reel to 3000/Reel
- Removed the HVCMOS<sup>®</sup> Technology from the Features section
- Made minor text changes throughout the document

# HV5623

## 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>				
Device	Package Options	-	Environmental	-
				Media Type
Device:	HV5623	=	32-Channel Serial-to-Parallel Converter with Open-Drain Outputs	
Package:	K7	=	44-lead (7x7) WQFN	
Environmental:	G	=	Lead (Pb)-free/RoHS-compliant Package	
Media Type:	(blank)	=	260/Tray for a K7 Package	
	M933	=	3000/Reel for a K7 Package	

<b>Examples:</b>	
a) HV5623K7-G:	32-Channel Serial-to-Parallel Converter with Open-Drain Outputs, 44-lead (7x7) WQFN, 260/Tray
b) HV5623K7-G-M933:	32-Channel Serial-to-Parallel Converter with Open-Drain Outputs, 44-lead (7x7) WQFN, 3000/Reel

---

---

**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.

### 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.

© 2019, Microchip Technology Incorporated, All Rights Reserved.

ISBN: 978-1-5224-4791-7

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>  
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: 45-4450-2828  
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