

---

## P-Channel Enhancement-Mode Vertical DMOS FET

---

### Features

- High Input Impedance and High Gain
- Low Power Drive Requirement
- Ease of Paralleling
- Low  $C_{ISS}$  and Fast Switching Speeds
- Excellent Thermal Stability
- Integral Source-Drain Diode
- Free from Secondary Breakdown

### Applications

- Logic-Level Interfaces (Ideal for TTL and CMOS)
- Solid-State Relays
- Analog Switches
- Power Management
- Telecommunication Switches

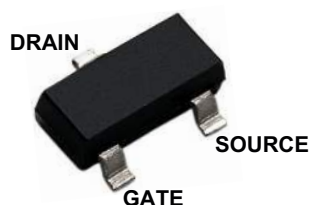
### General Description

The TP5335 is a low-threshold, Enhancement-mode (normally-off) transistor that utilizes an advanced vertical DMOS structure and a well-proven silicon gate manufacturing process. This combination produces a device with the power handling capabilities of bipolar transistors and the high input impedance and positive temperature coefficient inherent in MOS devices. Characteristic of all MOS structures, this device is free from thermal runaway and thermally induced secondary breakdown.

Microchip's vertical DMOS FETs are ideally suited to a wide range of switching and amplifying applications where high breakdown voltage, high input impedance, low input capacitance, and fast switching speeds are desired.

### Package Type

**3-lead SOT-23**  
(Top view)



See [Table 2-1](#) for pin information.

# TP5335

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings<sup>(†)</sup>

Drain-to-Source Voltage.....	$BV_{DSS}$
Drain-to-Gate Voltage .....	$BV_{DGS}$
Gate-to-Source Voltage.....	$\pm 20V$
Junction Temperature, $T_J$ .....	$-55^{\circ}C$ to $+150^{\circ}C$
Storage Temperature, $T_S$ .....	$-55^{\circ}C$ to $+150^{\circ}C$

† **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.

### DC ELECTRICAL CHARACTERISTICS – COMMERCIAL

**Electrical Specifications:**  $T_A = T_J = 25^{\circ}C$  unless otherwise specified. All DC parameters are 100% tested at  $25^{\circ}C$  unless otherwise stated. (Pulse test: 300  $\mu s$  pulse, 2% duty cycle.)

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Drain-to-Source Breakdown Voltage	$BV_{DSS}$	-350	—	—	V	$V_{GS} = 0V, I_D = -100 \mu A$
Gate Threshold Voltage	$V_{GS(th)}$	-1	—	-2.4	V	$V_{DS} = V_{GS}, I_D = -1 mA$
Change in $V_{GS(th)}$ with Temperature	$\Delta V_{GS(th)}$	—	—	4.5	mV/ $^{\circ}C$	$V_{DS} = V_{GS}, I_D = -1 mA$ (Note 1)
Gate Body Leakage	$I_{GSS}$	—	—	-100	nA	$V_{GS} = \pm 20V, V_{DS} = 0V$
Zero-Gate Voltage Drain Current	$I_{DSS}$	—	—	-10	$\mu A$	$V_{DS} = \text{Maximum rating}, V_{GS} = 0V$
		—	—	-1	mA	$V_{DS} = \text{Maximum rating}, V_{GS} = 0V, T_A = 125^{\circ}C$ (Note 1)
On-State Drain Current	$I_{D(ON)}$	-200	—	—	mA	$V_{GS} = -4.5V, V_{DS} = -25V$
		-400	—	—	mA	$V_{GS} = -10V, V_{DS} = -25V$
Static Drain-to-Source On-State Resistance	$R_{DS(ON)}$	—	—	75	$\Omega$	$V_{GS} = -4.5V, I_D = -150 mA$
		—	—	30	$\Omega$	$V_{GS} = -10V, I_D = -200 mA$
Change in $R_{DS(ON)}$ with Temperature	$\Delta R_{DS(ON)}$	—	—	1.7	%/ $^{\circ}C$	$V_{GS} = -10V, I_D = -200 mA$ (Note 1)

**Note 1:** Specification is obtained by characterization and is not 100% tested.

### DC ELECTRICAL CHARACTERISTICS – AUTOMOTIVE

**Electrical Specifications:** **Boldface** specification limits apply over the full operating temperature range of  $T_A = T_J = -55^{\circ}C, 25^{\circ}C,$  and  $150^{\circ}C$  unless otherwise specified. Non-boldfaced specification limits apply only to  $T_A = T_J = 25^{\circ}C$  unless otherwise specified. All DC parameters are 100% tested at all three temperatures unless otherwise specified. (Pulse test: 300  $\mu s$  pulse, 2% duty cycle.)

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Drain-to-Source Breakdown Voltage	$BV_{DSS}$	<b>-350</b>	—	—	V	$V_{GS} = 0V, I_D = -100 \mu A$
Gate Threshold Voltage	$V_{GS(th)}$	-1	—	<b>-2.4</b>	V	$V_{DS} = V_{GS}, I_D = -1 mA$
Change in $V_{GS(th)}$ with Temperature	$\Delta V_{GS(th)}$	—	3.3	—	mV/ $^{\circ}C$	$V_{DS} = V_{GS}, I_D = -1 mA$ (Note 1)
Gate Body Leakage	$I_{GSS}$	—	—	-100	nA	$V_{GS} = \pm 20V, V_{DS} = 0V$
		—	—	<b>-220</b>	nA	$V_{GS} = \pm 20V, V_{DS} = 0V$

**Note 1:** Specification is obtained by characterization and is not 100% tested.

## DC ELECTRICAL CHARACTERISTICS – AUTOMOTIVE (CONTINUED)

**Electrical Specifications:** Boldface specification limits apply over the full operating temperature range of  $T_A = T_J = -55^\circ\text{C}$ ,  $25^\circ\text{C}$ , and  $150^\circ\text{C}$  unless otherwise specified. Non-boldfaced specification limits apply only to  $T_A = T_J = 25^\circ\text{C}$  unless otherwise specified. All DC parameters are 100% tested at all three temperatures unless otherwise specified. (Pulse test: 300  $\mu\text{s}$  pulse, 2% duty cycle.)

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Zero-Gate Voltage Drain Current	$I_{DSS}$	—	—	-10	$\mu\text{A}$	$V_{DS} = \text{Maximum rating}$ , $V_{GS} = 0\text{V}$
		—	—	<b>-1</b>	<b>mA</b>	$V_{DS} = \text{Maximum rating}$ , $V_{GS} = 0\text{V}$
On-State Drain Current	$I_{D(ON)}$	<b>-200</b>	—	—	<b>mA</b>	$V_{GS} = -4.5\text{V}$ , $V_{DS} = -25\text{V}$
		-400	—	—	<b>mA</b>	$V_{GS} = -10\text{V}$ , $V_{DS} = -25\text{V}$
		<b>-375</b>	—	—	<b>mA</b>	$V_{GS} = -10\text{V}$ , $V_{DS} = -25\text{V}$
Static Drain-to-Source On-State Resistance	$R_{DS(ON)}$	—	—	<b>75</b>	$\Omega$	$V_{GS} = -4.5\text{V}$ , $I_D = -150\text{ mA}$
		—	—	30	$\Omega$	$V_{GS} = -10\text{V}$ , $I_D = -200\text{ mA}$
		—	—	<b>70</b>	$\Omega$	$V_{GS} = -10\text{V}$ , $I_D = -200\text{ mA}$
Change in $R_{DS(ON)}$ with Temperature	$\Delta R_{DS(ON)}$	—	1	—	$\% / ^\circ\text{C}$	$V_{GS} = -10\text{V}$ , $I_D = -200\text{ mA}$ ( <b>Note 1</b> )

**Note 1:** Specification is obtained by characterization and is not 100% tested.

## AC ELECTRICAL CHARACTERISTICS – COMMERCIAL

**Electrical Specifications:**  $T_A = T_J = 25^\circ\text{C}$  unless otherwise specified. Specification is obtained by characterization and is not 100% tested.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Forward Transconductance	$G_{FS}$	125	—	—	mmho	$V_{DS} = -25\text{V}$ , $I_D = -200\text{ mA}$
Input Capacitance	$C_{ISS}$	—	—	110	pF	$V_{GS} = 0\text{V}$ , $V_{DS} = -25\text{V}$ , $f = 1\text{ MHz}$
Common Source Output Capacitance	$C_{OSS}$	—	—	60	pF	
Reverse Transfer Capacitance	$C_{RSS}$	—	—	22	pF	
Turn-On Delay Time	$t_{d(ON)}$	—	—	20	ns	$V_{DD} = -25\text{V}$ , $I_D = -150\text{ mA}$ , $R_{GEN} = 25\Omega$
Rise Time	$t_r$	—	—	15	ns	
Turn-Off Delay Time	$t_{d(OFF)}$	—	—	25	ns	
Fall Time	$t_f$	—	—	25	ns	
<b>DIODE PARAMETER</b>						
Diode Forward Voltage Drop	$V_{SD}$	—	—	-1.8	V	$V_{GS} = 0\text{V}$ , $I_{SD} = -200\text{ mA}$ ( <b>Note 1</b> )
Reverse Recovery Time	$t_{rr}$	—	800	—	ns	$V_{GS} = 0\text{V}$ , $I_{SD} = -200\text{ mA}$

**Note 1:** All DC parameters are 100% tested at  $25^\circ\text{C}$  unless otherwise stated. (Pulse test: 300  $\mu\text{s}$  pulse, 2% duty cycle.)

# TP5335

## AC ELECTRICAL CHARACTERISTICS – AUTOMOTIVE

**Electrical Specifications:**  $T_A = T_J = 25^\circ\text{C}$  unless otherwise specified. Specification is obtained by characterization and is not 100% tested.

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Forward Transconductance	$G_{FS}$	—	285	—	mmho	$V_{DS} = -25\text{V}$ , $I_D = -200\text{ mA}$
Input Capacitance	$C_{ISS}$	—	80	—	pF	$V_{GS} = 0\text{V}$ , $V_{DS} = -25\text{V}$ , $f = 1\text{ MHz}$
Common Source Output Capacitance	$C_{OSS}$	—	12	—	pF	
Reverse Transfer Capacitance	$C_{RSS}$	—	2	—	pF	
Turn-On Delay Time	$t_{d(ON)}$	—	7.6	—	ns	$V_{DD} = -25\text{V}$ , $I_D = -150\text{ mA}$ , $R_{GEN} = 25\Omega$
Rise Time	$t_r$	—	3	—	ns	
Turn-Off Delay Time	$t_{d(OFF)}$	—	19	—	ns	
Fall Time	$t_f$	—	10	—	ns	
<b>DIODE PARAMETER</b>						
Diode Forward Voltage Drop	$V_{SD}$	—	—	-1.8	V	$V_{GS} = 0\text{V}$ , $I_{SD} = -200\text{ mA}$ ( <b>Note 1</b> )
Reverse Recovery Time	$t_{rr}$	—	450	—	ns	$V_{GS} = 0\text{V}$ , $I_{SD} = -200\text{ mA}$

**Note 1:** 100% Production Tested at  $T_A = T_J = (-55^\circ\text{C}, 25^\circ\text{C}, \text{ and } 150^\circ\text{C})$ .

## TEMPERATURE SPECIFICATIONS

Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
<b>TEMPERATURE RANGE</b>						
Operating Junction Temperature	$T_J$	-55	—	+150	$^\circ\text{C}$	
Storage Temperature	$T_S$	-55	—	+150	$^\circ\text{C}$	
<b>PACKAGE THERMAL RESISTANCE</b>						
3-lead SOT-23	$\theta_{JA}$	—	203	—	$^\circ\text{C/W}$	

## THERMAL CHARACTERISTICS

Package	$I_D$ ( <b>Note 1</b> ) (Continuous) (mA)	$I_D$ (Pulsed) (mA)	Power Dissipation at $T_A = 25^\circ\text{C}$ (W)	$I_{DR}$ ( <b>Note 1</b> ) (mA)	$I_{DRM}$ (mA)
3-lead SOT-23	-85	-400	0.36	-85	-400

**Note 1:**  $I_D$  (continuous) is limited by maximum  $T_J$ .

## 2.0 PIN DESCRIPTION

Table 2-1 shows the description of pins in TP5335 SOT-23. Refer to [Package Type](#) for the location of pins.

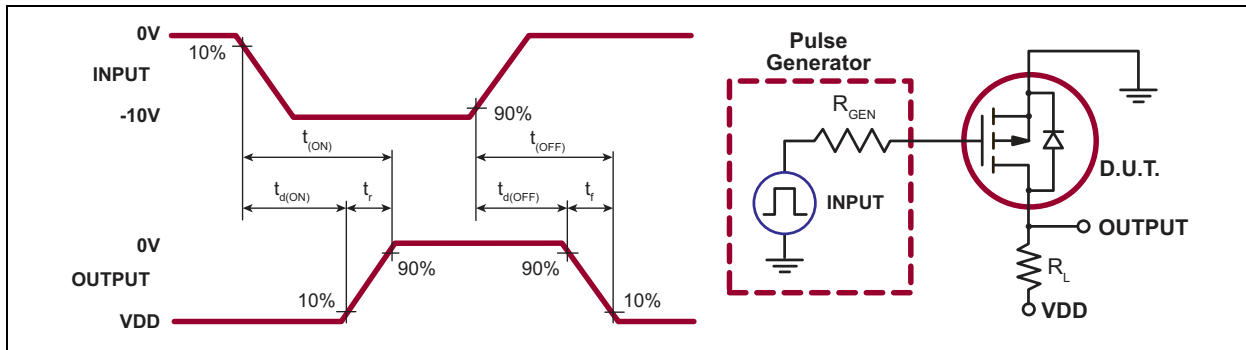
**TABLE 2-1: PIN FUNCTION TABLE**

Pin Number	Pin Name	Description
1	Gate	Gate
2	Source	Source
3	Drain	Drain

# TP5335

## 3.0 FUNCTIONAL DESCRIPTION

Figure 3-1 illustrates the switching waveforms and test circuit for TP5335.



**FIGURE 3-1:** Switching Waveforms and Test Circuit.

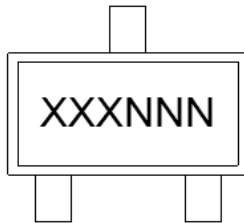
**TABLE 3-1: PRODUCT SUMMARY**

$BV_{DSS}/BV_{DGS}$ (V)	$R_{DS(ON)}$ (Maximum) ( $\Omega$ )	$V_{GS(th)}$ (Maximum) (V)
-350	30	-2.4

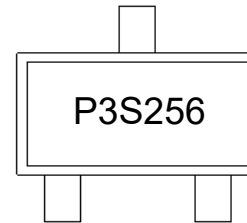
## 4.0 PACKAGING INFORMATION

### 4.1 Package Marking Information

3-Lead SOT-23  
(2.90 mm X 1.30 mm)



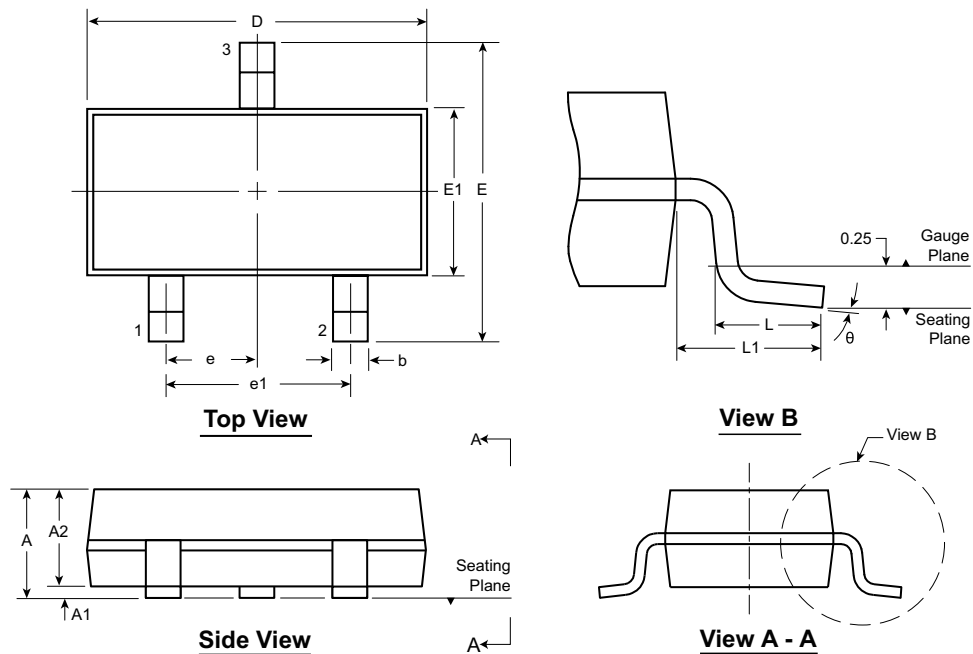
Example



<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.

**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 not include the corporate logo.

## 3-Lead TO-236AB (SOT-23) Package Outline (K1/T) 2.90x1.30mm body, 1.12mm height (max), 1.90mm pitch



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

Symbol	A	A1	A2	b	D	E	E1	e	e1	L	L1	$\theta$
Dimension (mm)	MIN	0.89	0.01	0.88	0.30	2.80	2.10	1.20		0.20 <sup>†</sup>	0.54	0°
	NOM	-	-	0.95	-	2.90	-	1.30	0.95 BSC	1.90 BSC	REF	-
	MAX	1.12	0.10	1.02	0.50	3.04	2.64	1.40		0.60		8°

JEDEC Registration TO-236, Variation AB, Issue H, Jan. 1999.

<sup>†</sup> This dimension differs from the JEDEC drawing.

**Drawings not to scale.**



## APPENDIX A: REVISION HISTORY

### Revision D (March 2022)

- Updated tables [DC Electrical Characteristics – Automotive](#) and [AC Electrical Characteristics – Automotive](#).
- Updated [Section 4.1 “Package Marking Information”](#).
- Updated [Product Identification System](#) format.
- Updated legal and contact information.

### Revision C (June 2020)

- Added automotive specifications to the Electrical Characteristics section.
- Added automotive specifications to the Product Identification System section.
- Made minor text changes throughout the document.

### Revision B (February 2020)

- Revised the order of pins in the Pin Function Table.
- Revised the Electrical Specifications and included notes in the DC Electrical Characteristics and AC Electrical Characteristics tables.
- Made minor text changes throughout the document.

### Revision A (December 2018)

- Converted Supertex Doc# DSFP-TP5335 to Microchip DS20005704A.
- Made minor text changes throughout the document.

# 2N7000

---

NOTES:

# TP5335

## 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>XX</u>	<u>-X</u>	<u>-XXX</u>
Device	Package	Environmental	Qualification
<b>Device:</b>	TP5335:	P-Channel Enhancement-Mode Vertical DMOS FET	
<b>Package:</b>	K1	= 3-lead SOT-23	
<b>Environmental:</b>	G	= Lead (Pb)-free/RoHS-compliant Package	
<b>Media Type:</b>	(Blank)	= 3000/Reel for a K1 Package	
<b>Qualification:</b>	(Blank) VAO	= Standard Part = Automotive AEC-Q100 Qualified	

**Examples:**

a) TP5335K1-G: P-Channel Enhancement-Mode Vertical DMOS FET, 3-lead SOT-23, 3000/Reel

b) TP5335K1-G-VAO: P-Channel Enhancement-Mode Vertical DMOS FET, Automotive Grade, 3-lead SOT-23, 3000/Reel, Automotive Grade

NOTES:

---

---

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

- 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, within operating specifications, and under normal conditions.
- Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
- 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. Microchip is committed to continuously improving the code protection features of our products.

---

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications 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. Contact your local Microchip sales office for additional support or, obtain additional support at <https://www.microchip.com/en-us/support/design-help/client-support-services>.

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.

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

**Trademarks**

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

AgileSwitch, 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, QuietWire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, 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, Augmented Switching, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, NVM Express, NVMe, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQL, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, 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, Symmcom, and Trusted Time 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.

© 2018-2022, Microchip Technology Incorporated and its subsidiaries.

All Rights Reserved.

ISBN: 978-1-6683-0092-3



# 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: 45-4485-5910  
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