

## High-Input Voltage, Adjustable 3-Terminal Linear Regulator

### Features

- 13.2V to 100V Input Voltage Range
- Stable with a 100 nF Output Capacitor
- Adjustable 1.20V to 88V Output Regulation
- 5% Reference Voltage Tolerance
- 50 mA Minimum Output Current Limiting
- 10  $\mu$ A Typical ADJ Current
- Overtemperature Protection
- Available in Three Different Packages

### Applications

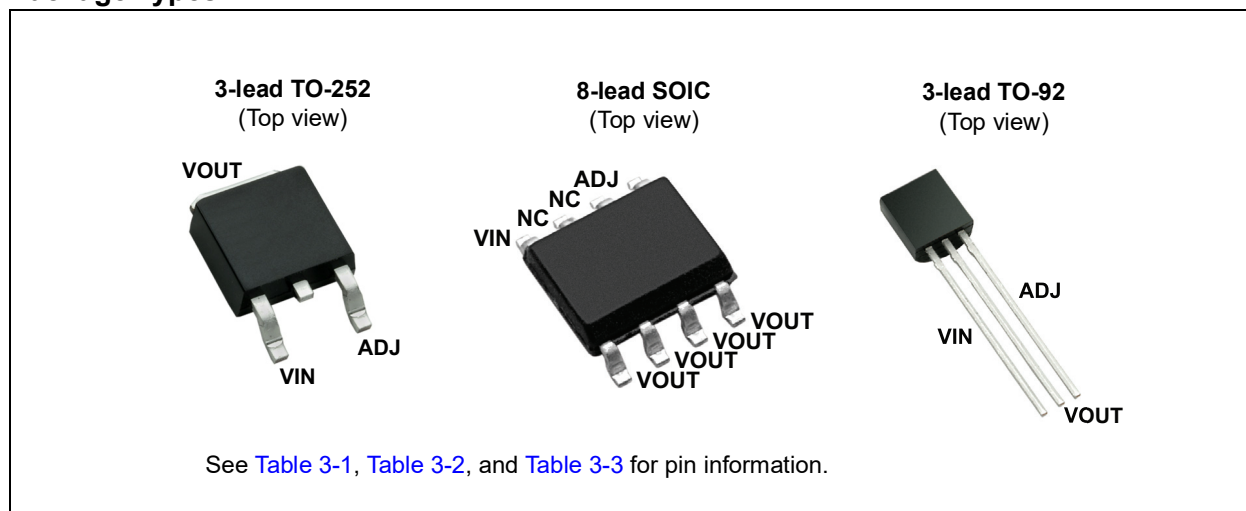
- DC/DC SMPS Startup Circuits
- Adjustable High-voltage Constant-current Sources
- Industrial Controls
- Motor Controls
- Battery-powered Systems
- Power Supplies
- Telecommunications Applications
- LED Drivers
- Automotive Applications

### General Description

The LR12 is a high-voltage, low-output current and adjustable linear regulator. It has a wide operating input voltage range of 13.2V to 100V. The output voltage can be adjusted between 1.2V and 88V, provided that the input voltage is at least 12V greater than the output voltage. The output voltage can be adjusted by means of two external resistors,  $R_1$  and  $R_2$ , as shown in the [Typical Application Circuit](#) diagrams. The LR12 regulates the voltage difference between  $V_{OUT}$  and ADJ pins to a nominal value of 1.2V, which is amplified by the external resistor ratio,  $R_1$  and  $R_2$ . A typical internal constant bias current of 10  $\mu$ A is connected to the ADJ pin. This increases  $V_{OUT}$  by a constant voltage of 10  $\mu$ A times  $R_2$ .

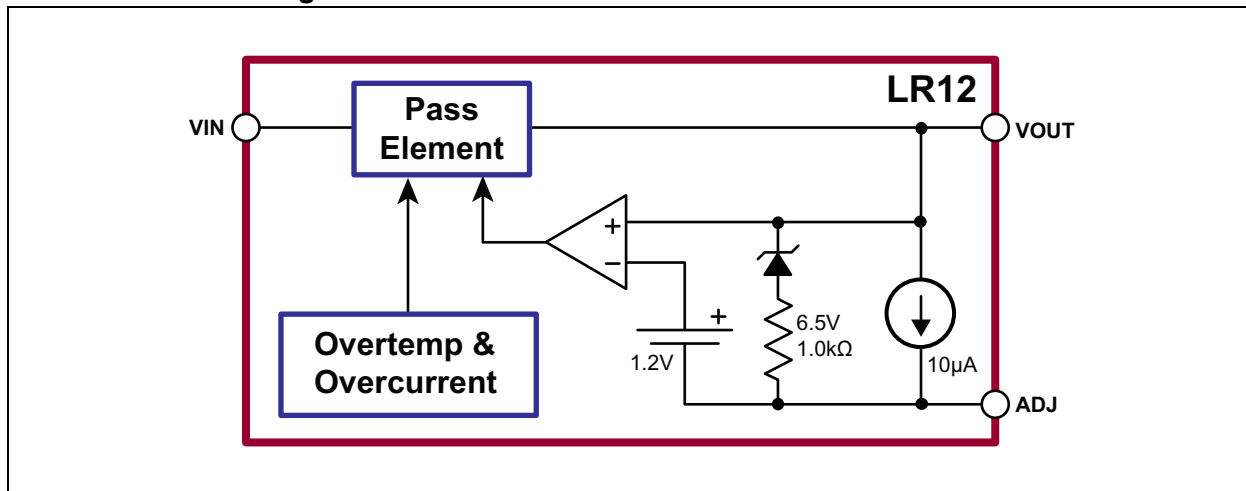
The LR12 is current limiting and temperature limiting. The output current limit is 100 mA maximum, and the minimum temperature limit is 125°C. An output short-circuit current will therefore be limited to 100 mA maximum. When the junction temperature reaches its temperature limit, the output current and/or output voltage will decrease to keep the junction temperature from exceeding the limit. For SMPS startup circuit applications, the LR12 turns off when an external voltage greater than the output voltage of the LR12 is applied to  $V_{OUT}$  of the LR12. To maintain stability, a bypass capacitor of 100 nF or larger and a minimum DC output current of 500  $\mu$ A are required.

### Package Types

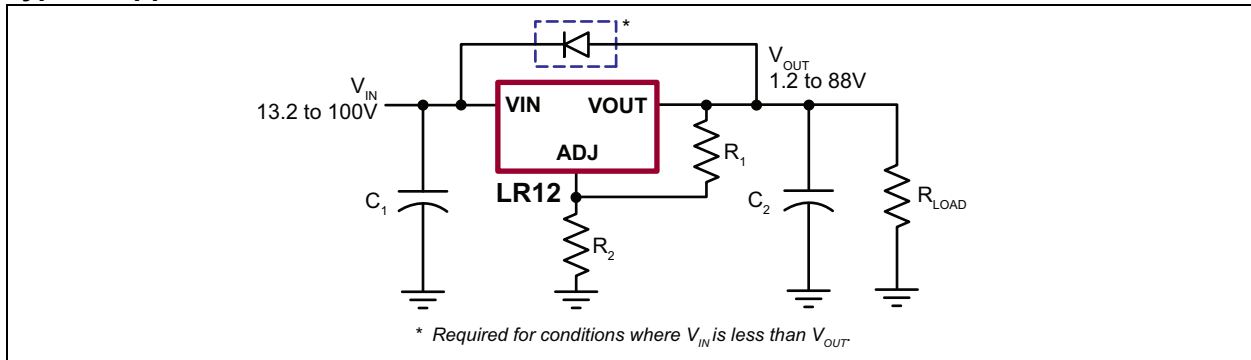


# LR12

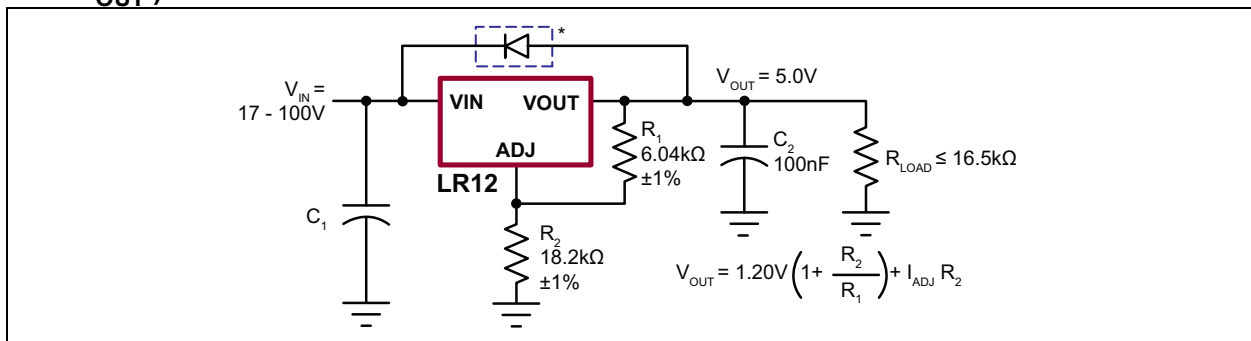
## Functional Block Diagram



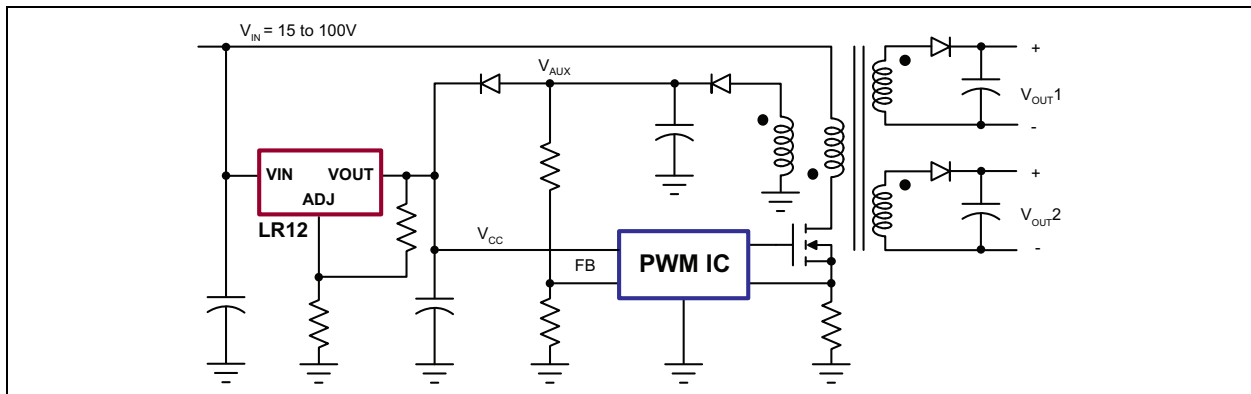
## Typical Application Circuit



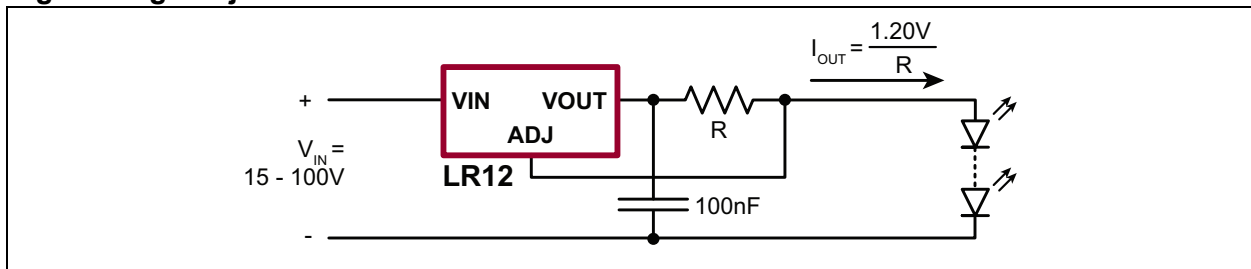
## High-input Voltage, 5V Output Linear Regulator (Required for conditions where $V_{IN}$ is less than $V_{OUT}$ ).



## SMPS Startup Circuit



## High-voltage Adjustable Constant Current Source



# LR12

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings†

$V_{IN-ADJ}$ .....	–0.5V to +120V
$V_{OUT-ADJ}$ .....	–10V to +10V
$V_{IN-V_{OUT}}$ .....	–0.5V to +120V
Operating Ambient Temperature, $T_A$ .....	–40°C to +85°C
Operating Junction Temperature, $T_J$ .....	–40°C to +125°C
Storage Temperature, $T_S$ .....	–65°C to +150°C
Power Dissipation at $T_A = 25^\circ\text{C}$ :	
3-lead TO-252 (DPAK).....	2W
8-lead SOIC.....	1.8W3-la
3-lead TO-92.....	0.6W

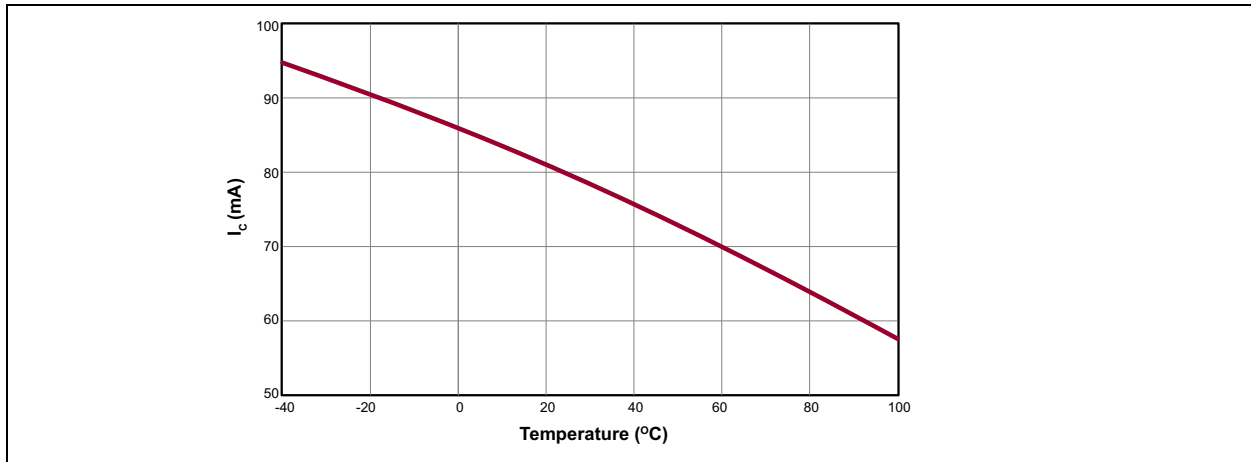
† **Notice:** Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

Electrical Specifications: Test conditions unless otherwise specified: $-40^\circ\text{C} < T_A < +85^\circ\text{C}$						
Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
Input-to-output Voltage Difference	$V_{IN-V_{OUT}}$	12	—	98.8	V	
Overall Output Voltage Regulation	$V_{OUT}$	1.14	1.2	1.26	V	$13.2\text{V} < V_{IN} < 100\text{V}$ , $R_1 = 2.4\text{ k}\Omega$ , $R_2 = 0$
Line Regulation	$\Delta V_{OUT}$	—	0.003	0.03	%/V	$15\text{V} < V_{IN} < 100\text{V}$ , $V_{OUT} = 5\text{V}$ , $I_{OUT} = 0.5\text{A}$
Load Regulation		—	1.4	3	%	$V_{IN} = 15\text{V}$ , $V_{OUT} = 5\text{V}$ , $0.5\text{ mA} < I_{OUT} < 50\text{ mA}$
Temperature Regulation		–1	—	+1	%	$V_{IN} = 15\text{V}$ , $V_{OUT} = 5\text{V}$ , $I_{OUT} = 10\text{ mA}$ , $-40^\circ\text{C} < T_A < 85^\circ\text{C}$
Output Current Limit	$I_{OUT}$	50	—	100	mA	$T_J < 85^\circ\text{C}$ , $V_{IN-V_{OUT}} < 12\text{V}$
Minimum Output Current		—	—	–0.5		$T_J < 125^\circ\text{C}$ , $V_{IN-V_{OUT}} < 100\text{V}$
Adjust Output Current	$I_{ADJ}$	5	10	15	$\mu\text{A}$	Includes $R_1$ and load current
Minimum Output Load Capacitance	C2	100	—	—	nF	
Ripple Rejection Ratio	$DV_{OUT}/DV_{IN}$	50	60	—	dB	120 Hz, $V_{OUT} = 5\text{V}$

## TEMPERATURE SPECIFICATIONS

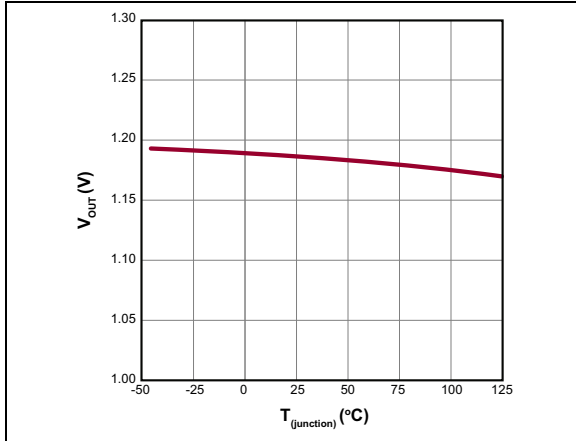
Parameter	Sym.	Min.	Typ.	Max.	Unit	Conditions
<b>TEMPERATURE RANGE</b>						
Operating Ambient Temperature	$T_A$	–40	—	+85	$^\circ\text{C}$	
Operating Junction Temperature	$T_J$	–40	—	+125	$^\circ\text{C}$	
Storage Temperature	$T_S$	–65	—	+150	$^\circ\text{C}$	
<b>PACKAGE THERMAL RESISTANCE</b>						
3-lead TO-252 (DPAK)	$\theta_{JA}$	—	81	—	$^\circ\text{C/W}$	
8-lead SOIC	$\theta_{JA}$	—	101	—	$^\circ\text{C/W}$	
3-lead TO-92	$\theta_{JA}$	—	132	—	$^\circ\text{C/W}$	



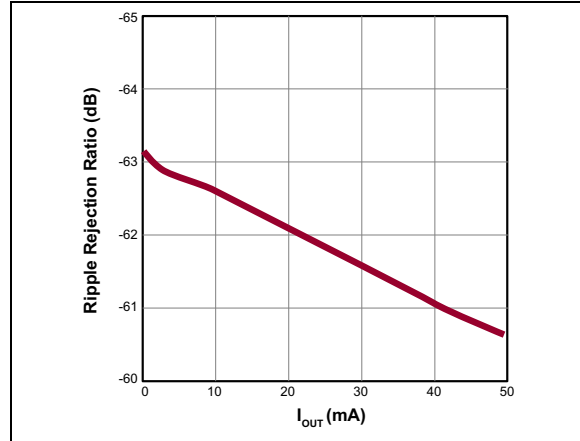
**FIGURE 1-1:** *Current Limit.*

## 2.0 TYPICAL PERFORMANCE CURVES

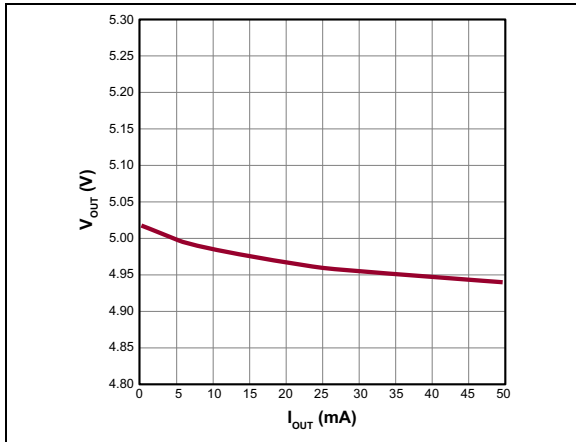
**Note:** The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g. outside specified power supply range) and therefore outside the warranted range.



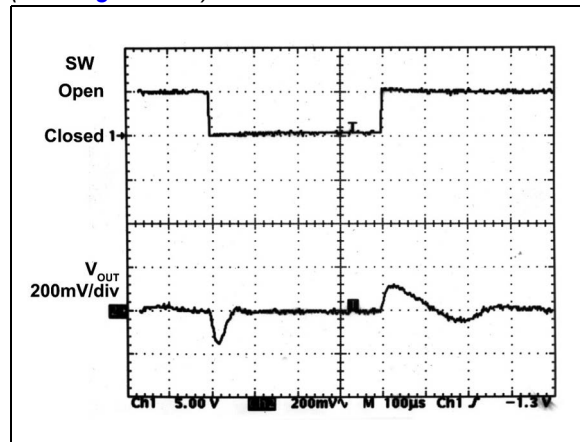
**FIGURE 2-1:** Temperature Variation  
(See Figure 4-1.).



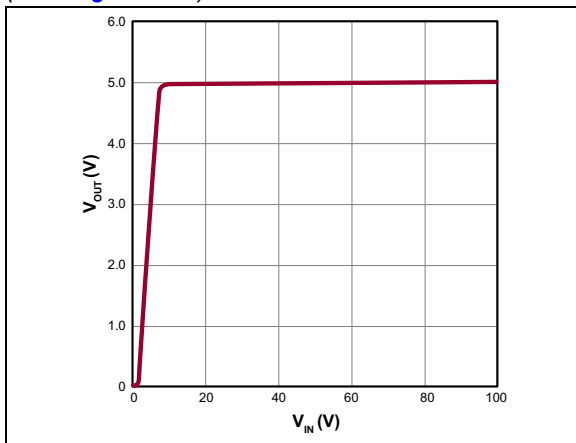
**FIGURE 2-4:** Ripple Rejection  
(See Figure 4-4.).



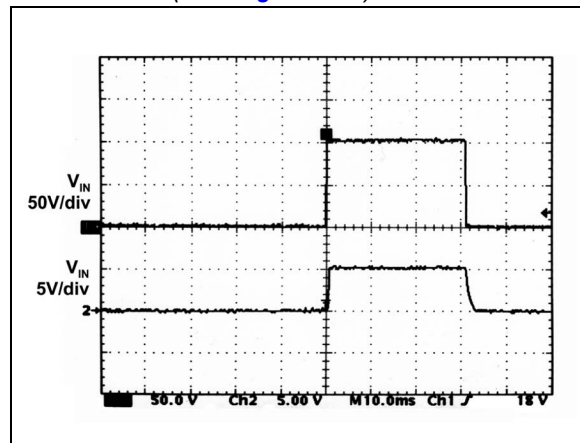
**FIGURE 2-2:** Load Regulation  
(See Figure 4-2.).



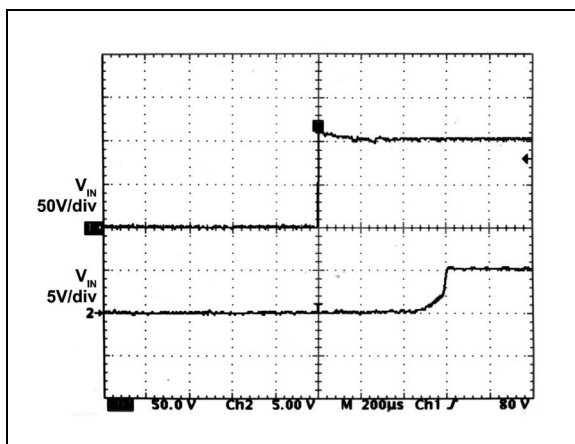
**FIGURE 2-5:** Load Transient Response,  
Load = 509Ω (See Figure 4-5.).



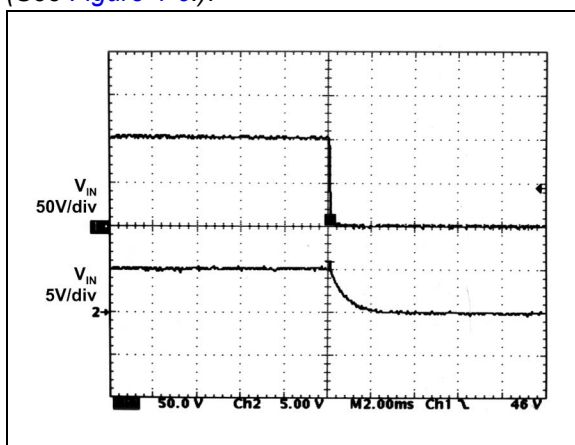
**FIGURE 2-3:**  $V_{OUT}$  vs.  $V_{IN}$   
(See Figure 4-3.).



**FIGURE 2-6:** Line Turn-on/off Response  
(See Figure 4-6.).



**FIGURE 2-7:** Line Power-up Transient  
(See [Figure 4-6](#)).



**FIGURE 2-8:** Line Power-down Transient  
(See [Figure 4-6](#)).

# LR12

## 3.0 PIN DESCRIPTION

The details on the pins of LR12 3-lead TO-252 (DPAK), 8-lead SOIC, and 3-lead TO-92 packages are listed in [Table 3-1](#), [Table 3-2](#), and [Table 3-3](#), respectively. Refer to [Package Types](#) for the location of pins.

**TABLE 3-1: 3-LEAD TO-252 (DPAK) PIN FUNCTION TABLE**

Pin Number	Pin Name	Description
1	VIN	Regulator Input Voltage
2	VOOUT	Regulator Output Voltage
3	ADJ	Adjustment pin
4	VOOUT	Regulator Output Voltage

**TABLE 3-2: 8-LEAD SOIC PIN FUNCTION TABLE**

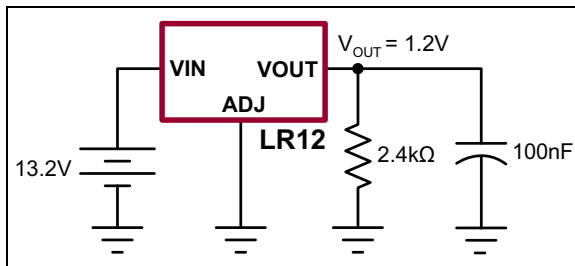
Pin Number	Pin Name	Description
1	VOOUT	Regulator Output Voltage
2	VOOUT	Regulator Output Voltage
3	VOOUT	Regulator Output Voltage
4	VOOUT	Regulator Output Voltage
5	ADJ	Adjustment pin
6	NC	No connection
7	NC	No connection
8	VIN	Regulator Input Voltage

**TABLE 3-3: 3-LEAD TO-92 PIN FUNCTION TABLE**

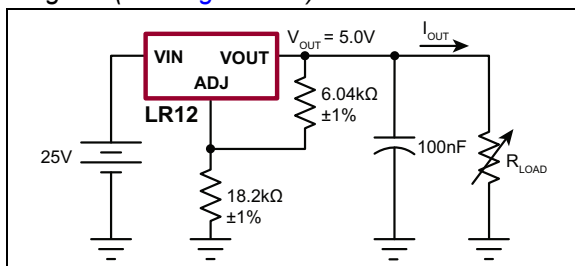
Pin Number	Pin Name	Description
1	VIN	Regulator Input Voltage
2	VOOUT	Regulator Output Voltage
3	ADJ	Adjustment pin

## 4.0 APPLICATION INFORMATION

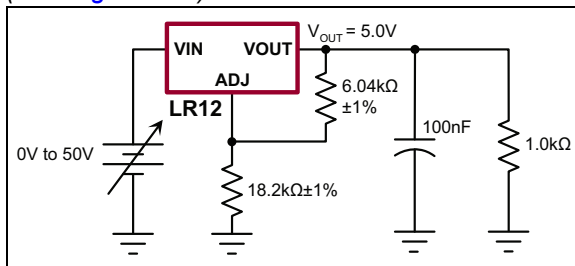
### 4.1 Measurement Circuits



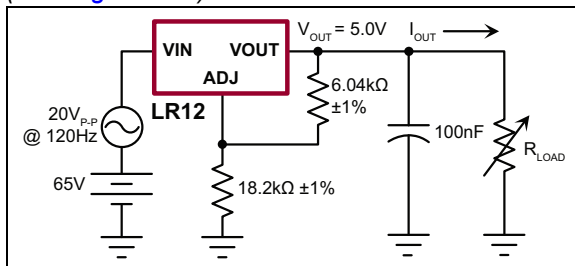
**FIGURE 4-1:** Temperature Variation Diagram (See Figure 2-1.).



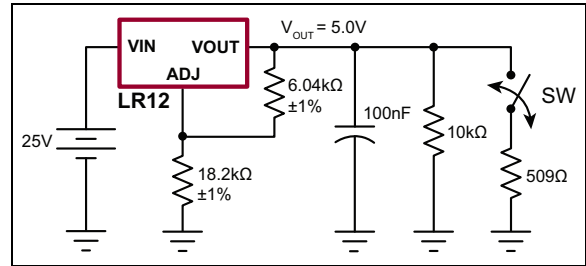
**FIGURE 4-2:** Load Regulation Diagram (See Figure 2-2.).



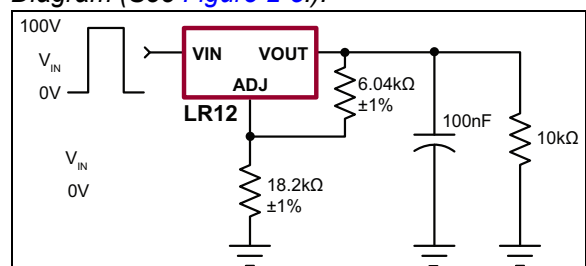
**FIGURE 4-3:**  $V_{OUT}$  vs.  $V_{IN}$  Diagram (See Figure 2-3.).



**FIGURE 4-4:** Ripple Rejection Diagram (See Figure 2-4.).



**FIGURE 4-5:** Load Transient Response Diagram (See Figure 2-5.).

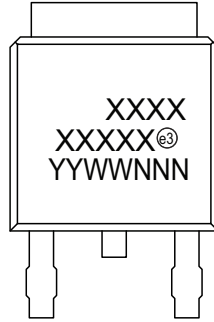


**FIGURE 4-6:** Line Transient Response (See Figure 2-6, Figure 2-7, and Figure 2-8.).

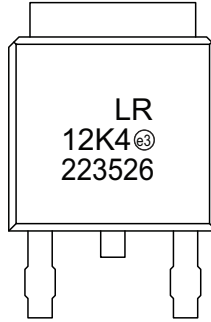
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

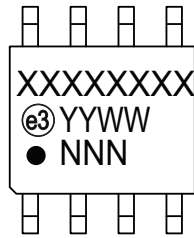
TO-252 (D-PAK)



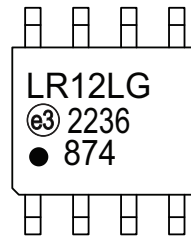
Example



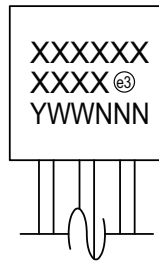
8-lead SOIC



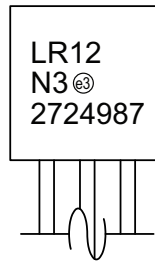
Example



3-lead TO-92



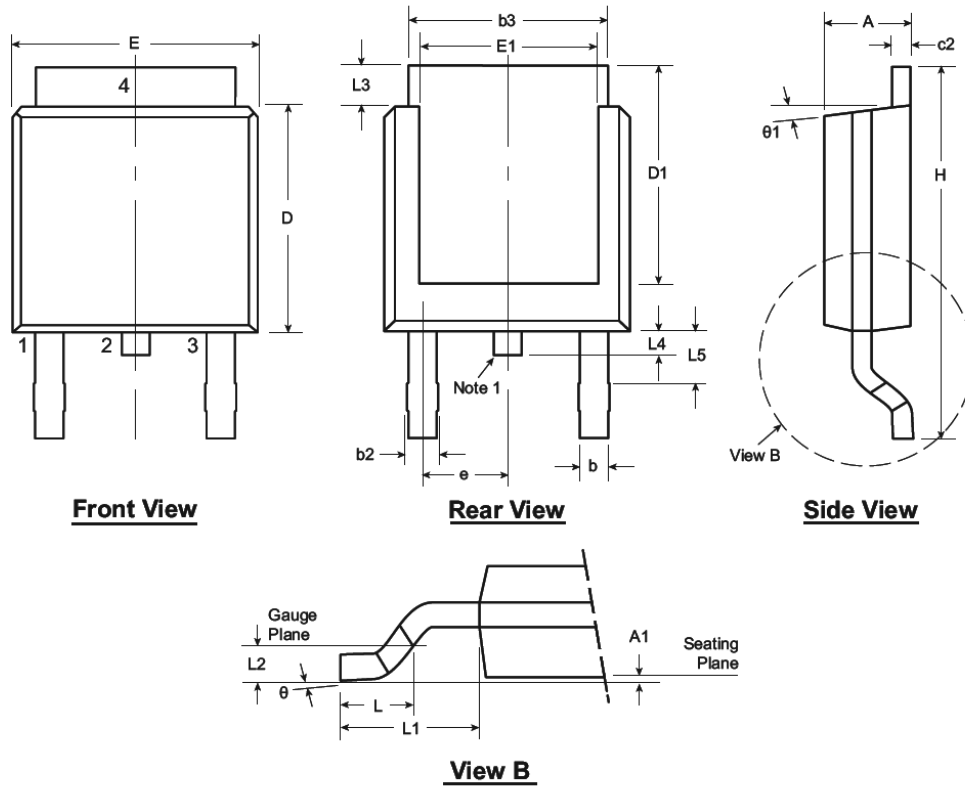
Example



<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 product code or customer-specific information. Package may or may not include the corporate logo.

## 3-Lead TO-252 (D-PAK) Package Outline (K4)



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

**Note:**

1. Although 4 terminal locations are shown, only 3 are functional. Lead number 2 was removed.

Symbol	A	A1	b	b2	b3	c2	D	D1	E	E1	e	H	L	L1	L2	L3	L4	L5	θ	θ1
Dimension (inches)	MIN	.086	.000*	.025	.030	.195	.018	.235	.205	.250	.170	.370	.055	.108	.020	.035	.025*	.035†	0°	0°
	NOM	-	-	-	-	-	.240	-	-	-	.090	-	.060	REF	BSC	-	-	-	-	-
	MAX	.094	.005	.035	.045	.215	.035	.245	.217*	.265	.200*	.410	.070			.050	.040	.060	10°	15°

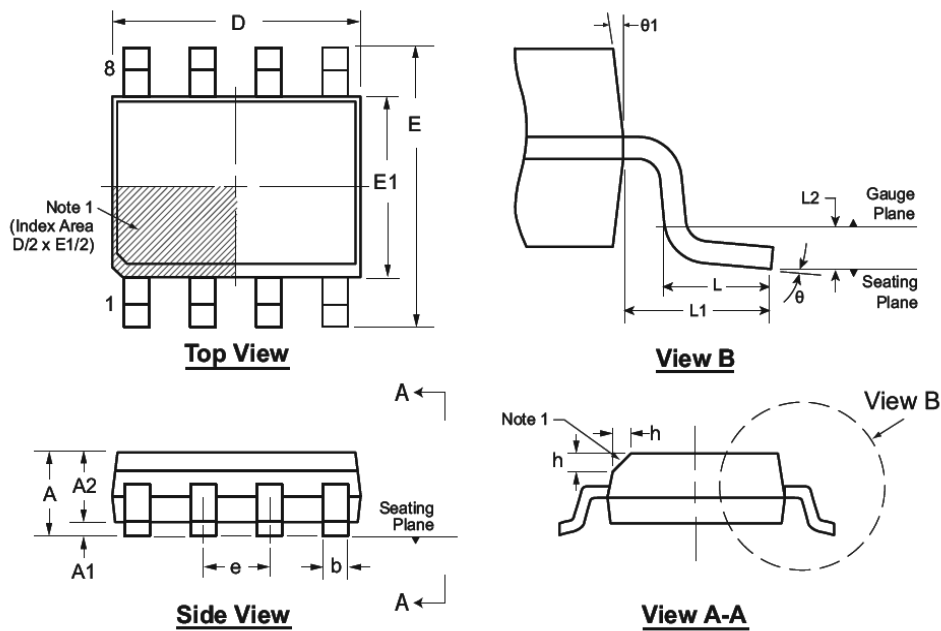
JEDEC Registration TO-252, Variation AA, Issue E, June 2004.

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

† This dimension differs from the JEDEC drawing.

**Drawings not to scale.**

## 8-Lead SOIC (Narrow Body) Package Outline (LG/TG) 4.90x3.90mm body, 1.75mm height (max), 1.27mm pitch



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

**Note:**

1. This chamfer feature is optional. 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.

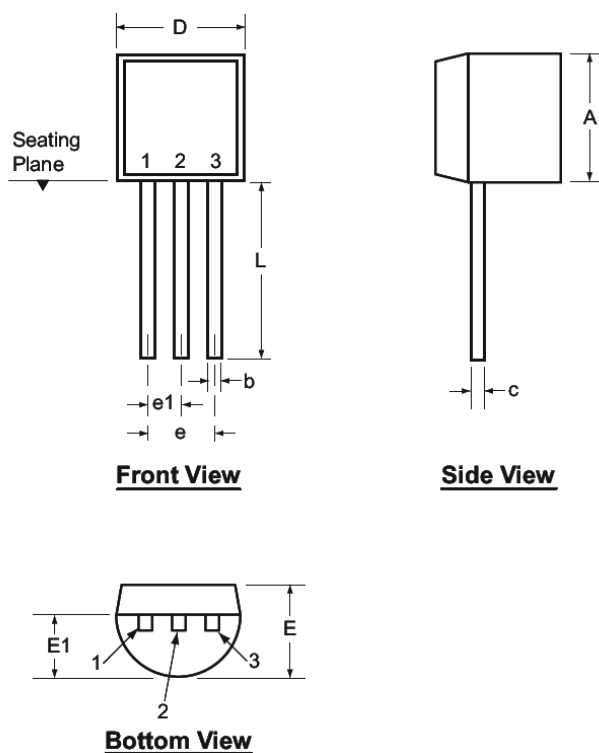
Symbol		A	A1	A2	b	D	E	E1	e	h	L	L1	L2	θ	θ1
Dimension (mm)	MIN	1.35*	0.10	1.25	0.31	4.80*	5.80*	3.80*	1.27 BSC	0.25	0.40	1.04 REF	0.25 BSC	0°	5°
	NOM	-	-	-	-	4.90	6.00	3.90		-	-			-	-
	MAX	1.75	0.25	1.65*	0.51	5.00*	6.20*	4.00*		0.50	1.27			8°	15°

JEDEC Registration MS-012, Variation AA, Issue E, Sept. 2005.

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

Drawings are not to scale.

## 3-Lead TO-92 Package Outline (L/LL/N3)



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

Symbol		A	b	c	D	E	E1	e	e1	L
Dimensions (inches)	MIN	.170	.014 <sup>†</sup>	.014 <sup>†</sup>	.175	.125	.080	.095	.045	.500
	NOM	-	-	-	-	-	-	-	-	-
	MAX	.210	.022 <sup>†</sup>	.022 <sup>†</sup>	.205	.165	.105	.105	.055	.610*

JEDEC Registration TO-92.

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

† This dimension differs from the JEDEC drawing.

Drawings not to scale.

# LR12

---

NOTES:

## APPENDIX A: REVISION HISTORY

### Revision A (August 2022)

- Converted Supertex Doc# DSFP-LR12 to Microchip DS20005735A
- Updated package marking format
- Changed the quantity of the 8-lead SOIC LG package from 2500/Reel to 3300/Reel to align packaging specifications with the actual BQM
- Removed the TO-92 N3 P002,P003,P005, P013, and P014 media types to align packaging specifications with the actual BQM
- Made minor text changes throughout the document

PRODUCT IDENTIFICATION SYSTEM

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

PART NO.		XX	-	X	-	X
Device		Package Options		Environmental		Media Type
<div><div>Device:LR12 = High-Input Voltage, Adjustable 3-Terminal Linear Regulator</div><div>Packages:K4 = 3-lead DPAK LG = 8-lead SOIC N3 3-lead TO-92</div><div>Environmental:G = Lead (Pb)-free/RoHS-compliant Package</div><div>Media Types:(blank) = 2000/Reel for a K4 Package = 3300/Reel for an LG Package = 1000/Bag for an N3 Package</div></div>						
<div>Examples:<div>a) LR12K4-G:High-Input Voltage, Adjustable 3-Terminal Linear Regulator, 3-lead DPAK, 2000/Reel</div><div>b) LR12LG-G:High-Input Voltage, Adjustable 3-Terminal Linear Regulator, 8-lead SOIC, 3300/Reel</div><div>c) LR12N3-G:High-Input Voltage, Adjustable 3-Terminal Linear Regulator, 3-lead TO-92, 1000/Bag</div></div>						

---

**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, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Klear, 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, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, 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, Clockstudio, 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, IntelliMOS, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, KoD, maxCrypto, maxView, 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, RTAX, RTG4, SAM-ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, Trusted Time, 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, 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.

© 2022, Microchip Technology Incorporated and its subsidiaries.

All Rights Reserved.

ISBN: 978-1-6683-1089-2

## 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