

## Precision Temperature-to-Voltage Converter

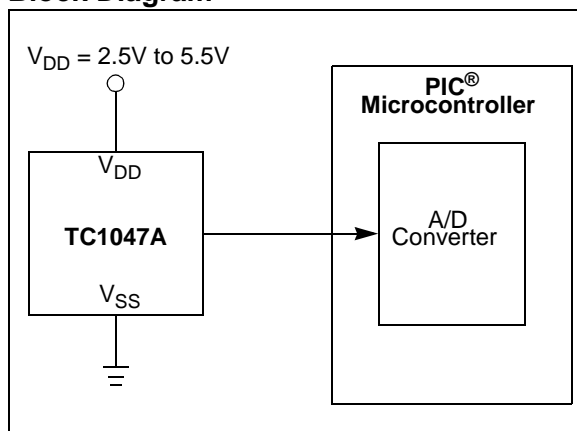
### Features

- Supply Voltage Range:
  - **TC1047:** 2.7V to 4.4V
  - **TC1047A:** 2.5V to 5.5V
- Wide Temperature Measurement Range:
  - -40°C to +125°C
- High Temperature Converter Accuracy:
  - $\pm 2^\circ\text{C}$ , Max, at 25°C
- Linear Temperature Slope: 10 mV/°C (typ.)
- Available in 3-Pin SOT-23B Package
- Very Low Supply Current:
  - 35  $\mu\text{A}$  Typical

### Applications

- Cellular Phones
- Power Supply Thermal Shutdown
- Temperature-Controlled Fans
- Temperature Measurement/Instrumentation
- Temperature Regulators
- Consumer Electronics
- Portable Battery-Powered Equipment

### Block Diagram

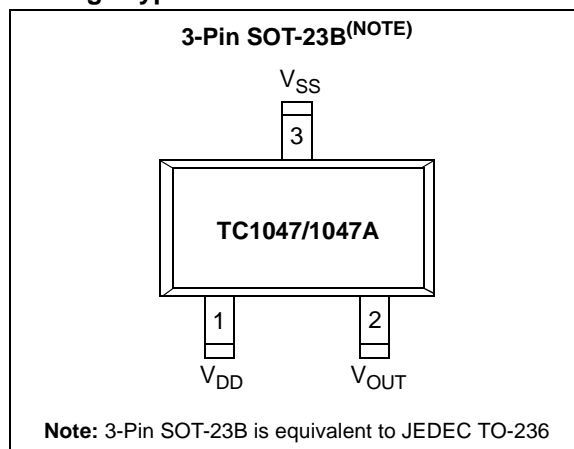


### General Description

The TC1047 and TC1047A are linear voltage output temperature sensors whose output voltage is directly proportional to the measured temperature. The TC1047 and TC1047A can accurately measure temperature from -40°C to +125°C. With the TC1047, the supply voltage can vary between 2.7V and 4.4V. The power supply range of the TC1047A is from 2.5V to 5.5V.

The output voltage range for these devices is typically 100 mV at -40°C, 500 mV at 0°C, 750 mV at +25°C and 1.75V at +125°C. A 10 mV/°C voltage slope output response allows for a predictable temperature measurement over a wide temperature range. The TC1047 and TC1047A are packaged in 3-pin SOT-23B packages, making them ideal for space-critical applications.

### Package Type



# TC1047/TC1047A

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings\*

Supply Voltage .....+7V  
 Voltage on Any Pin with Respect to Supplies:  
 ..... $V_{SS} - 0.3$  to  $V_{DD} + 0.3V$   
 Operating Temperature .....-40°C to +125°C  
 Storage Temperature Range .....-55°C to +150°C

\*Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

### ELECTRICAL CHARACTERISTICS

**Electrical Specifications:** Unless otherwise indicated, these specifications apply for the entire supply voltage range and for  $T_A = -40^\circ\text{C}$  to  $+125^\circ\text{C}$ .

Parameters	Sym	Min	Typ	Max	Units	Conditions
Supply Voltage	$V_{DD}$	2.7	—	4.4	V	TC1047
		2.5	—	5.5	V	TC1047A
Supply Current, Operating	$I_Q$	—	35	60	$\mu\text{A}$	
Average Slope of Output Voltage	$A_V$	—	10	—	$\text{mV}/^\circ\text{C}$	
Temperature Accuracy	$\text{TMP}_{\text{ACY}}$	-2	$\pm 0.5$	+2	$^\circ\text{C}$	$T_A = 25^\circ\text{C}$
		-3	$\pm 0.5$	+3	$^\circ\text{C}$	$T_A = +125^\circ\text{C}$
		—	1.0	—	$^\circ\text{C}$	$T_A = -40^\circ\text{C}$
Output Voltage	$V_{\text{OUT}}$	—	100	—	mV	$T_A = -40^\circ\text{C}$
		730	750	770	mV	$T_A = 25^\circ\text{C}$
		1720	1750	1780	mV	$T_A = +125^\circ\text{C}$
Output Source and Sink Current	$I_{\text{OUT}}$	100	—	—	$\mu\text{A}$	

### TEMPERATURE CHARACTERISTICS

**Electrical Specifications:** Unless otherwise indicated,  $V_{DD} = +2.3V$  to  $+5.5V$  and  $V_{SS} = \text{GND}$ .

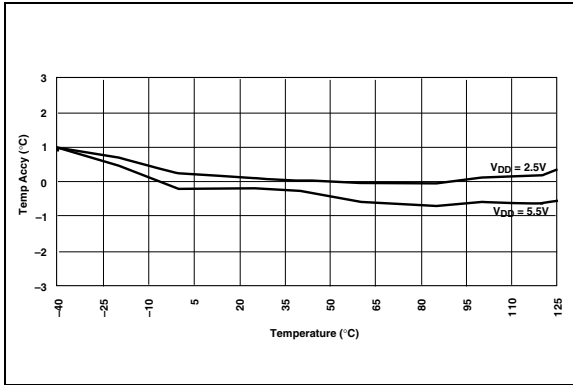
Parameters	Sym	Min	Typ	Max	Units	Conditions
<b>Temperature Ranges</b>						
Specified Temperature Range	$T_A$	-40	—	+85	$^\circ\text{C}$	
Operating Temperature Range	$T_A$	-40	—	+125	$^\circ\text{C}$	<b>Note 1</b>
Storage Temperature Range	$T_A$	-65	—	+150	$^\circ\text{C}$	
<b>Thermal Package Resistances</b>						
Thermal Resistance, 3L-SOT-23B	$\theta_{JA}$	—	336	—	$^\circ\text{C}/\text{W}$	

**Note 1:** The TC1047/TC1047A operate over this extended temperature range, but with reduced performance. In any case, the Junction Temperature ( $T_J$ ) must not exceed the Absolute Maximum specification of  $+150^\circ\text{C}$ .

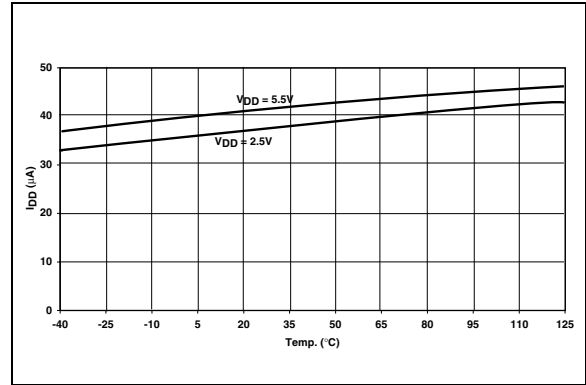
## 2.0 TYPICAL PERFORMANCE CURVES

**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.

**Note:** Unless otherwise indicated,  $V_{DD} = 2.7V$  thru  $4.4V$  and  $T_A = -40^{\circ}C$  to  $+125^{\circ}C$ .



**FIGURE 2-1:** Temperature Accuracy vs. Temperature.



**FIGURE 2-2:** Supply Current vs. Temperature.

# TC1047/TC1047A

## 3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

TABLE 3-1: PIN FUNCTION TABLE

Pin No.	Symbol	Description
1	V <sub>DD</sub>	Input Supply Voltage
2	V <sub>OUT</sub>	Temperature Sensor Output Terminal
3	V <sub>SS</sub>	Ground Terminal

## 4.0 DETAILED DESCRIPTION

The TC1047 and TC1047A have an output voltage that varies linearly with temperature in degrees Celsius. Figure 4-1 shows a plot of the output voltage versus temperature for the TC1047 and TC1047A. The temperature slope is fixed at 10 mV/°C and the output voltage at 0°C is 500 mV.

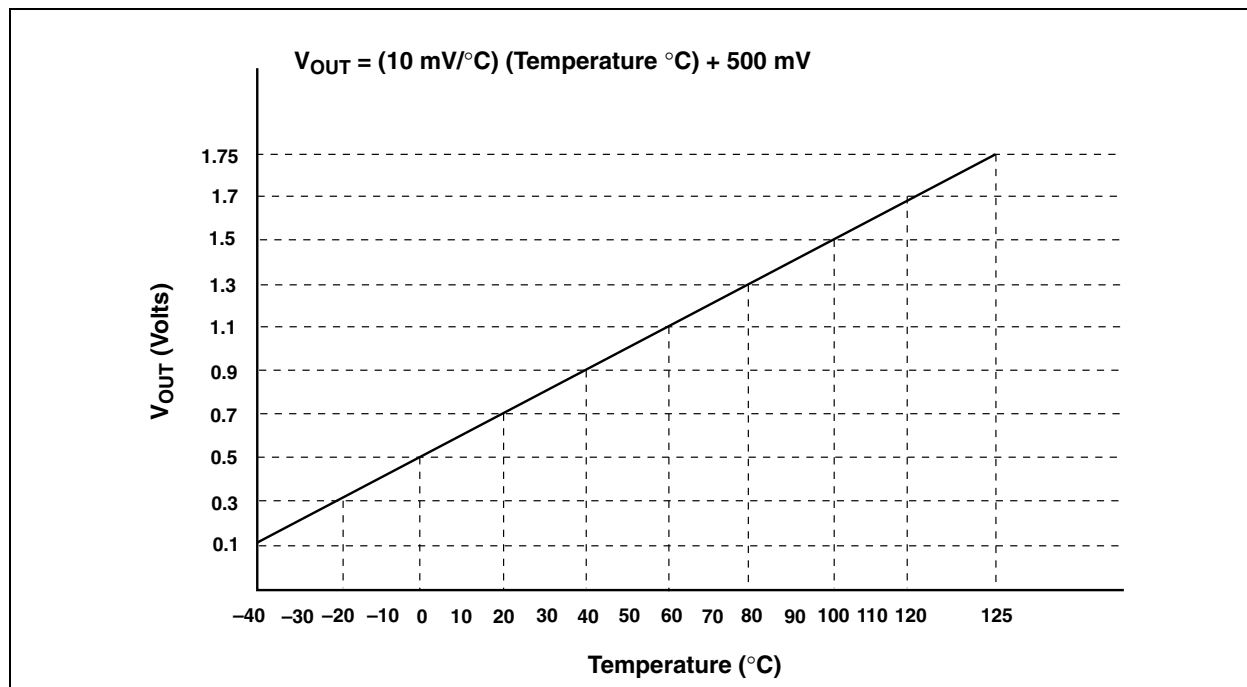
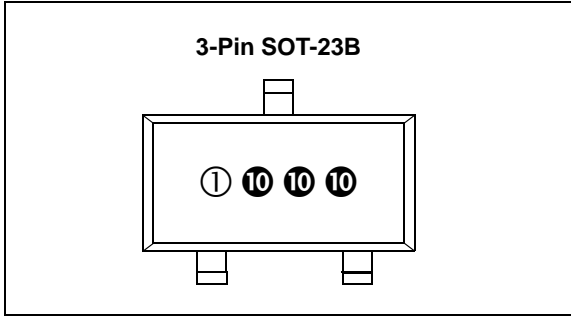


FIGURE 4-1: Output Voltage vs. Temperature.

## 5.0 PACKAGE INFORMATION

### 5.1 Package Marking Information



1 & 2 = part number code + temperature range and voltage

Part Number	Code
TC1047	AL
TC1047A	BL

3 = year and quarter code

4 = lot ID number

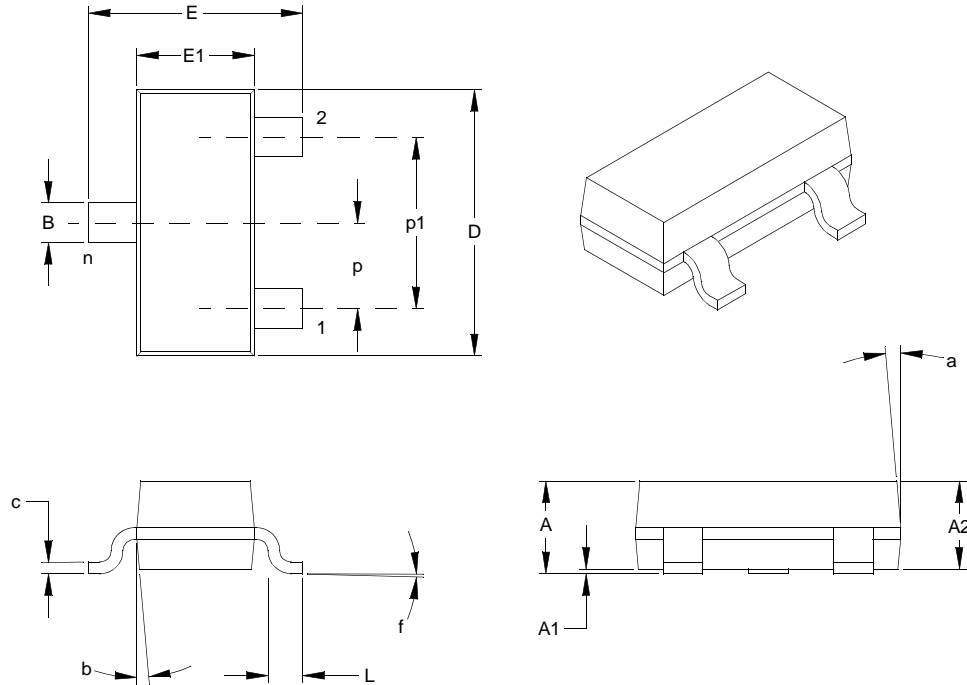
<b>Legend:</b>	XX...X	Customer-specific information*
	Y	Year code (last digit of calendar year)
	YY	Year code (last 2 digits of calendar year)
	WW	Week code (week of January 1 is week '01')
	NNN	Alphanumeric traceability code
	(e3)	Pb-free JEDEC designator for Matte Tin (Sn)
	*	This package is Pb-free. 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.

# TC1047/TC1047A

## 3-Lead Plastic Small Outline Transistor (TT) (SOT-23)

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



Dimension Limits	Units	INCHES*			MILLIMETERS		
		MIN	NOM	MAX	MIN	NOM	MAX
Number of Pins	n		3			3	
Pitch	p		.038			0.96	
Outside lead pitch (basic)	p1		.076			1.92	
Overall Height	A	.035	.040	.044	0.89	1.01	1.12
Molded Package Thickness	A2	.035	.037	.040	0.88	0.95	1.02
Standoff	A1	.000	.002	.004	0.01	0.06	0.10
Overall Width	E	.083	.093	.104	2.10	2.37	2.64
Molded Package Width	E1	.047	.051	.055	1.20	1.30	1.40
Overall Length	D	.110	.115	.120	2.80	2.92	3.04
Foot Length	L	.014	.018	.022	0.35	0.45	0.55
Foot Angle	f	0	5	10	0	5	10
Lead Thickness	c	.004	.006	.007	0.09	0.14	0.18
Lead Width	B	.015	.017	.020	0.37	0.44	0.51
Mold Draft Angle Top	a	0	5	10	0	5	10
Mold Draft Angle Bottom	b	0	5	10	0	5	10

\*Controlling Parameter

Notes:

Dimensions D and E1 do not include mold flash or protrusions. Mold flash or protrusions shall not exceed .005" (0.127mm) per side.

JEDEC Equivalent: TO-236

Drawing No. C04-104

Revised 03-11-05

## **APPENDIX A: REVISION HISTORY**

### **Revision D (December 2012)**

Added a note to each package outline drawing.

### **Revision C (May 2005)**

The following is the list of modifications:

1. Added Appendix A: Revision History.

### **Revision B (May 2002)**

### **Revision A (March 2001)**

- Original Release of this Document.

# TC1047/TC1047A

---

NOTES:



## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

<u>PART NO.</u>	X	XX
Device	Temperature Range	Package
Device:	TC1047: Precision Temp-to-Voltage Converter TC1047XTR: Precision Temp-to-Voltage Converter (Tape and Reel)	
Temperature Range:	V = -40°C to +125°C	
Package:	NB = Plastic Small Outline Transistor, SOT-23B, 3-lead	

**Examples:**

- a) TC1047VNBTR: Precision Temp-to-Voltage Converter
- b) TC1047AVNBTR: Precision Temp-to-Voltage Converter

# TC1047/TC1047A

---

NOTES:

---

**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.

**Trademarks**

The Microchip name and logo, the Microchip logo, dsPIC, FlashFlex, KEELOQ, KEELOQ logo, MPLAB, PIC, PICmicro, PICSTART, PIC<sup>32</sup> logo, rPIC, SST, SST Logo, SuperFlash and UNI/O are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

FilterLab, Hampshire, HI-TECH C, Linear Active Thermistor, MTP, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Silicon Storage Technology is a registered trademark of Microchip Technology Inc. in other countries.

Analog-for-the-Digital Age, Application Maestro, BodyCom, chipKIT, chipKIT logo, CodeGuard, dsPICDEM, dsPICDEM.net, dsPICworks, dsSPEAK, ECAN, ECONOMONITOR, FanSense, HI-TIDE, In-Circuit Serial Programming, ICSP, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, mTouch, Omniscent Code Generation, PICC, PICC-18, PICDEM, PICDEM.net, PICkit, PICtail, REAL ICE, rLAB, Select Mode, SQI, Serial Quad I/O, Total Endurance, TSHARC, UniWinDriver, WiperLock, ZENA and Z-Scale 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.

GestIC and ULPP are registered trademarks 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.

© 2001-2012, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.

ISBN: 9781620768839

**QUALITY MANAGEMENT SYSTEM**  
**CERTIFIED BY DNV**  
**== ISO/TS 16949 ==**

*Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC<sup>®</sup> MCUs and dsPIC<sup>®</sup> DSCs, KEELOQ<sup>®</sup> code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.*



# 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

**Boston**  
Westborough, MA  
Tel: 774-760-0087  
Fax: 774-760-0088

**Chicago**  
Itasca, IL  
Tel: 630-285-0071  
Fax: 630-285-0075

**Cleveland**  
Independence, OH  
Tel: 216-447-0464  
Fax: 216-447-0643

**Dallas**  
Addison, TX  
Tel: 972-818-7423  
Fax: 972-818-2924

**Detroit**  
Farmington Hills, MI  
Tel: 248-538-2250  
Fax: 248-538-2260

**Indianapolis**  
Noblesville, IN  
Tel: 317-773-8323  
Fax: 317-773-5453

**Los Angeles**  
Mission Viejo, CA  
Tel: 949-462-9523  
Fax: 949-462-9608

**Santa Clara**  
Santa Clara, CA  
Tel: 408-961-6444  
Fax: 408-961-6445

**Toronto**  
Mississauga, Ontario,  
Canada  
Tel: 905-673-0699  
Fax: 905-673-6509

### ASIA/PACIFIC

**Asia Pacific Office**  
Suites 3707-14, 37th Floor  
Tower 6, The Gateway  
Harbour City, Kowloon  
Hong Kong  
Tel: 852-2401-1200  
Fax: 852-2401-3431

**Australia - Sydney**  
Tel: 61-2-9868-6733  
Fax: 61-2-9868-6755

**China - Beijing**  
Tel: 86-10-8569-7000  
Fax: 86-10-8528-2104

**China - Chengdu**  
Tel: 86-28-8665-5511  
Fax: 86-28-8665-7889

**China - Chongqing**  
Tel: 86-23-8980-9588  
Fax: 86-23-8980-9500

**China - Hangzhou**  
Tel: 86-571-2819-3187  
Fax: 86-571-2819-3189

**China - Hong Kong SAR**  
Tel: 852-2943-5100  
Fax: 852-2401-3431

**China - Nanjing**  
Tel: 86-25-8473-2460  
Fax: 86-25-8473-2470

**China - Qingdao**  
Tel: 86-532-8502-7355  
Fax: 86-532-8502-7205

**China - Shanghai**  
Tel: 86-21-5407-5533  
Fax: 86-21-5407-5066

**China - Shenyang**  
Tel: 86-24-2334-2829  
Fax: 86-24-2334-2393

**China - Shenzhen**  
Tel: 86-755-8864-2200  
Fax: 86-755-8203-1760

**China - Wuhan**  
Tel: 86-27-5980-5300  
Fax: 86-27-5980-5118

**China - Xian**  
Tel: 86-29-8833-7252  
Fax: 86-29-8833-7256

**China - Xiamen**  
Tel: 86-592-2388138  
Fax: 86-592-2388130

**China - Zhuhai**  
Tel: 86-756-3210040  
Fax: 86-756-3210049

### ASIA/PACIFIC

**India - Bangalore**  
Tel: 91-80-3090-4444  
Fax: 91-80-3090-4123

**India - New Delhi**  
Tel: 91-11-4160-8631  
Fax: 91-11-4160-8632

**India - Pune**  
Tel: 91-20-2566-1512  
Fax: 91-20-2566-1513

**Japan - Osaka**  
Tel: 81-6-6152-7160  
Fax: 81-6-6152-9310

**Japan - Tokyo**  
Tel: 81-3-6880-3770  
Fax: 81-3-6880-3771

**Korea - Daegu**  
Tel: 82-53-744-4301  
Fax: 82-53-744-4302

**Korea - Seoul**  
Tel: 82-2-554-7200  
Fax: 82-2-558-5932 or  
82-2-558-5934

**Malaysia - Kuala Lumpur**  
Tel: 60-3-6201-9857  
Fax: 60-3-6201-9859

**Malaysia - Penang**  
Tel: 60-4-227-8870  
Fax: 60-4-227-4068

**Philippines - Manila**  
Tel: 63-2-634-9065  
Fax: 63-2-634-9069

**Singapore**  
Tel: 65-6334-8870  
Fax: 65-6334-8850

**Taiwan - Hsin Chu**  
Tel: 886-3-5778-366  
Fax: 886-3-5770-955

**Taiwan - Kaohsiung**  
Tel: 886-7-213-7828  
Fax: 886-7-330-9305

**Taiwan - Taipei**  
Tel: 886-2-2508-8600  
Fax: 886-2-2508-0102

**Thailand - Bangkok**  
Tel: 66-2-694-1351  
Fax: 66-2-694-1350

### EUROPE

**Austria - Wels**  
Tel: 43-7242-2244-39  
Fax: 43-7242-2244-393

**Denmark - Copenhagen**  
Tel: 45-4450-2828  
Fax: 45-4485-2829

**France - Paris**  
Tel: 33-1-69-53-63-20  
Fax: 33-1-69-30-90-79

**Germany - Munich**  
Tel: 49-89-627-144-0  
Fax: 49-89-627-144-44

**Italy - Milan**  
Tel: 39-0331-742611  
Fax: 39-0331-466781

**Netherlands - Drunen**  
Tel: 31-416-690399  
Fax: 31-416-690340

**Spain - Madrid**  
Tel: 34-91-708-08-90  
Fax: 34-91-708-08-91

**UK - Wokingham**  
Tel: 44-118-921-5869  
Fax: 44-118-921-5820

11/29/12

## X-ON Electronics

Largest Supplier of Electrical and Electronic Components

*Click to view similar products for [Temperature Sensor Development Tools](#) category:*

*Click to view products by [Microchip](#) manufacturer:*

Other Similar products are found below :

[EVAL-ADT75EBZ](#) [T20321SS2B](#) [T2016P2CRRXC4S2](#) [DC2507A](#) [MAX1617AEVKIT](#) [BB-WSK-REF-2](#) [MCP9800DM-TS1](#) [TMPSNSRD-RTD2](#) [MIKROE-2273](#) [MIKROE-2539](#) [MIKROE-2554](#) [DPP201Z000](#) [DPP901Z000](#) [1899](#) [EV-BUNCH-WSN-2Z](#) [DPP904R000](#) [KIT0021](#) [SEN0206](#) [SEN0227](#) [MIKROE-2769](#) [SEN-13314](#) [SEN0137](#) [3328](#) [DC1785B](#) [MHUM-01](#) [3538](#) [DPP201G000](#) [DFR0066](#) [WPP100B009](#) [393](#) [SDT310LTC100A3850](#) [SI7005EVB-UDP-M3L1](#) [2857](#) [1782](#) [2652](#) [269](#) [3245](#) [3622](#) [3648](#) [3721](#) [4089](#) [4101](#) [4369](#) [4566](#) [4636](#) [4808](#) [4821](#) [AS6200C-WL\\_EK\\_AB](#) [AS6200-WL\\_DK\\_ST](#) [AS6200-WL\\_EK\\_AB](#)