

## High Current Charge Pump DC-to-DC Converter

### Features

- Pin Compatible With TC7662/ICL7662/SI7661
- High Output Current 80mA
- No External Diodes Required
- Wide Operating Range 3V to 18V
- Low Output Impedance 28Ω Typ.
- No Low Voltage Terminal Required
- Application Zener On-Chip
- OSC Frequency Doubling Pin Option for Smaller Output Capacitors

### Applications

- Laptop Computers
- Disk Drives
- Process Instrumentation
- μP-Based Controllers

### Device Selection Table

Part Number	Package	Operating Temp. Range
TC962COE	16-Pin SOIC Wide	0°C to +70°C
TC962CPA	8-Pin Plastic DIP	0°C to +70°C
TC962EPA	8-Pin Plastic DIP	-40°C to +85°C
TC962IJA	8-Pin CERDIP	-25°C to +85°C
TC962MJA	8-Pin CERDIP	-55°C to +125°C

### General Description

The TC962 is an advanced version of the industry standard TC7662 high voltage DC-to-DC converter. Using improved design techniques and CMOS construction, the TC962 can source as much as 80mA versus the 7662's 20mA capability.

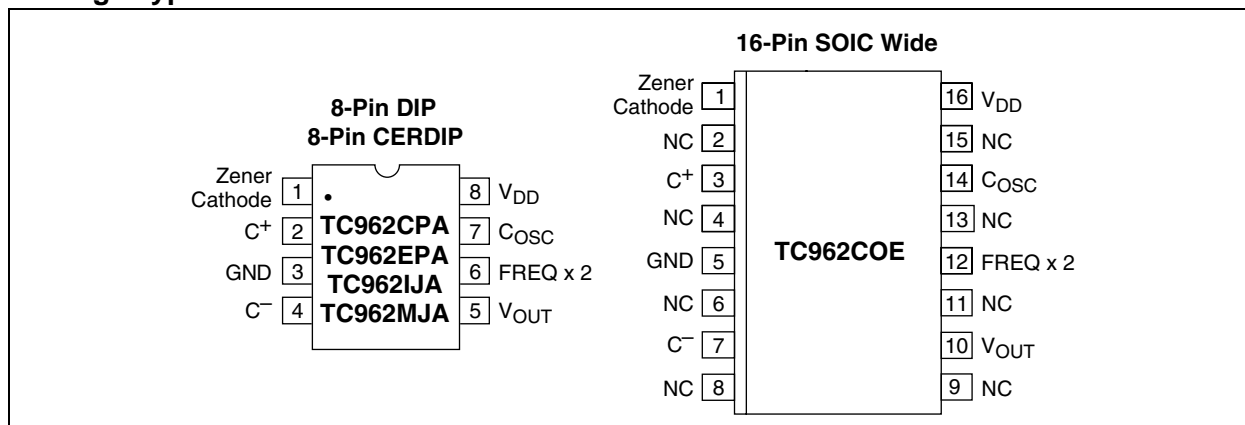
As an inverter, the TC962 can put out voltages as high as 18V and as low as 3V without the need for external diodes. The output impedance of the device is a low 28Ω (with the proper capacitors), voltage conversion efficiency is 99.9%, and power conversion efficiency is 97%.

The low voltage terminal (pin 6) required in some TC7662 applications has been eliminated. Grounding this terminal will double the oscillator frequency from 12kHz to 24kHz. This will allow the use of smaller capacitors for the same output current and ripple, in most applications. Only two external capacitors are required for inverter applications. In the event an external clock is needed to drive the TC962 (such as paralleling), driving this pin directly will cause the internal oscillator to sync to the external clock.

Pin 1, which is used as a test pin on the 7662, is a voltage reference zener on the TC962. This zener (6.4V at 5mA) has a dynamic impedance of 12Ω and is intended for use where the TC962 is supplying current to external regulator circuitry and a reference is needed for the regulator circuit. (See *Section 3.0 Applications Information*).

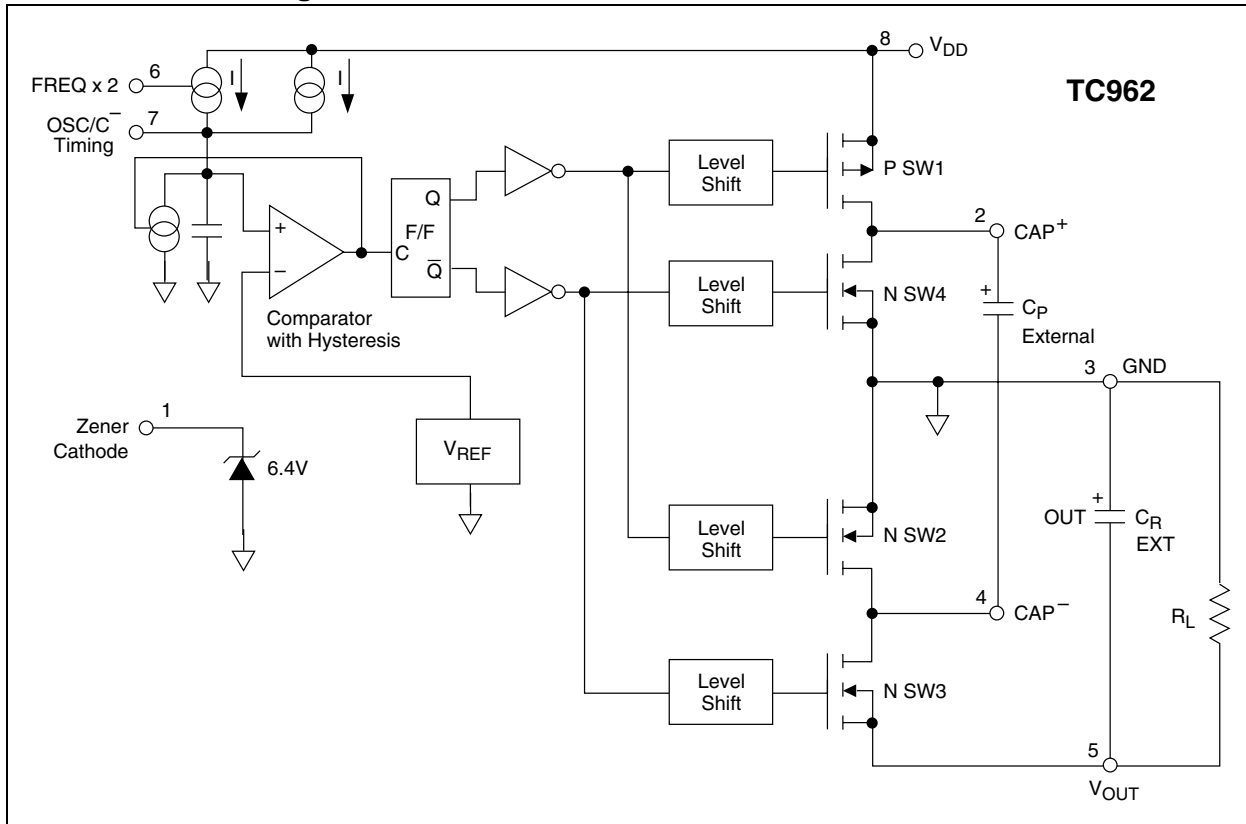
The TC962 is compatible with the LTC1044, SI7661 and ICL7662. It should be used in designs that require greater power and/or less input to output voltage drop. It offers superior performance over the ICL7660S.

### Package Type



# TC962

## Functional Block Diagram



## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings\*

Supply Voltage ( $V_{DD}$ to GND) .....	+18V
Input Voltage Any Pin .....	
..... ( $V_{DD} + 0.3$ ) to ( $V_{SS} - 0.3$ ) (Note 1)	
Current Into Any Pin.....	10mA
ESD Protection .....	$\pm 2000V$
Output Short Circuit .....	Continuous (at 5.5V Input)
Package Power Dissipation ( $T_A \leq 70^\circ C$ )	
SOIC .....	760 mW
PDIP .....	730 mW
CERDIP .....	800 mW
Package Thermal Resistance	
CERDIP, $R_{\theta J-A}$ .....	$90^\circ C/W$
PDIP, $R_{\theta J-A}$ .....	$140^\circ C/W$
Operating Temperature Range	
CPA, COE .....	$0^\circ C$ to $+70^\circ C$
IJA .....	$-25^\circ C$ to $+85^\circ C$
EPA .....	$-40^\circ C$ to $+85^\circ C$
MJA .....	$-55^\circ C$ to $+125^\circ C$
Storage Temperature Range .....	$-65^\circ C$ to $+150^\circ C$

\*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.

### TC962 ELECTRICAL SPECIFICATIONS

Electrical Characteristics: $V_{DD} = 15V$ , $T_A = 25^\circ C$ (See Figure 3-1) unless otherwise noted.						
Symbol	Parameter	Min	Typ	Max	Units	Test Conditions
$V_{DD}$	Supply Voltage	3	—	18	V	
$I_S$	Supply Current $V_{DD} = 15V$	—	—	—	$\mu A$	$R_L = \infty$ $T_A = +25^\circ C$ $0 \leq T_A \leq +70^\circ C$ $-55^\circ C \leq T_A \leq +125^\circ C$
		—	510	700		
		—	560	—		
	$V_{DD} = 5V$	—	650	—		
		—	190	—		
		—	210	—		
$R_O$	Output Source Resistance	—	32	37	$\Omega$	$I_L = 20mA$ , $V_{DD} = 15V$ $I_L = 80mA$ , $V_{DD} = 15V$ $I_L = 3mA$ , $V_{DD} = 5V$
		—	35	40		
		—	—	50		
$F_{OSC}$	Oscillator Frequency	—	12	—	kHz	Pin 6 Open Pin 6 GND
		—	24	—		
$P_{EFF}$	Power Efficiency	93	97	—	%	$R_L = 2k\Omega$
		—	—	—		
$V_{DEF}$	Voltage Efficiency	99	99.9	—	%	$R_L = \infty$ Over temperature range
		—	—	—		
		96	—	—		
$V_Z$	Zener Voltage	6.0	6.2	6.4	V	$I_Z = 5mA$
$Z_{ZT}$	Zener Impedance	—	12	—	$\Omega$	$I_L = 2.5mA$ to $7.5mA$

**Note 1:** Connecting any input terminal to voltages greater than  $V^+$  or less than GND may cause destructive latch-up. It is recommended that no inputs from sources operating from external supplies be applied prior to "power up" of the TC962.

# TC962

## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

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

Pin No. (8-Pin DIP) (8-Pin CERDIP)	Symbol	Description
1	Zener Cathode	Cathode of internal zener diode.
2	C <sup>+</sup>	Positive side of external CP capacitor (pump cap).
3	GND	Ground terminal.
4	C <sup>-</sup>	Negative side of external CP capacitor (pump cap).
5	V <sub>OUT</sub>	Output voltage.
6	FREQ x 2	If grounded, frequency doubles.
7	C <sub>OSC</sub>	Capacitor to GND will decrease frequency.
8	V <sub>DD</sub>	Input voltage.

Pin No. (16-Pin SOIC)	Symbol	Description
1	Zener Cathode	Cathode of internal zener diode.
2	NC	No connect.
3	C <sup>+</sup>	Positive side of external CP capacitor (pump cap).
4	NC	No connect.
5	GND	Ground terminal.
6	NC	No connect.
7	C <sup>-</sup>	Negative side of external CP capacitor (pump cap).
8	NC	No connect.
9	NC	No connect.
10	V <sub>OUT</sub>	Output voltage.
11	NC	No connect.
12	FREQ x 2	If grounded, frequency doubles.
13	NC	No connect.
14	C <sub>OSC</sub>	Capacitor to GND will decrease frequency.
15	NC	No connect.
16	V <sub>DD</sub>	Input voltage.

## 3.0 APPLICATIONS INFORMATION

### 3.1 Theory of Operation

The TC962 is a capacitive pump (sometimes called a switched capacitor circuit), where four MOSFET switches control the charge and discharge of a capacitor.

The functional block diagram shows how the switching action works. SW1 and SW2 are turned on simultaneously, charging  $C_P$  to the supply voltage,  $V_{IN}$ . This assumes that the on resistance of the MOSFETs in series with the capacitor results in a charging time (3 time constants) that is less than the on time provided by the oscillator frequency as shown:

$$3 (R_{DS(ON)} C_P) < C_P / (0.5 f_{OSC})$$

In the next cycle, SW1 and SW2 are turned off and after a very short interval of all switches being off (this prevents large currents from occurring due to cross conduction), SW3 and SW4 are turned on. The charge in  $C_P$  is then transferred to  $C_R$ , but with the polarity inverted. In this way, a negative voltage is now derived.

An oscillator supplies pulses to a flip-flop that is then fed to a set of level shifters. These level shifters then drive each set of switches at one-half the oscillator frequency.

The oscillator has two pins that control the frequency of oscillation. Pin 7 can have a capacitor added that is returned to ground. This will lower the frequency of the oscillator by adding capacitance to the timing capacitor

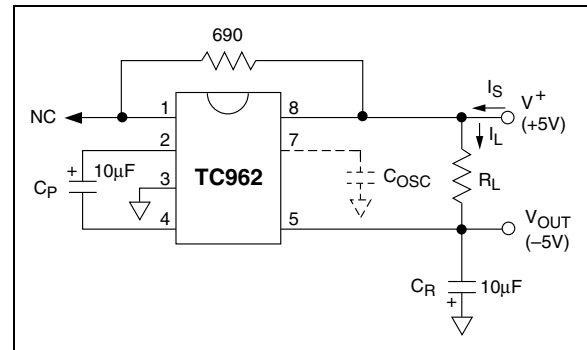
internal to the TC962. Grounding pin 6 will turn on a current source and double the frequency. This will double the charge current going into the internal capacitor, as well as any capacitor added to pin 7.

A zener diode has been added to the TC962 for use as a reference in building external regulators. This zener runs from pin 1 to ground.

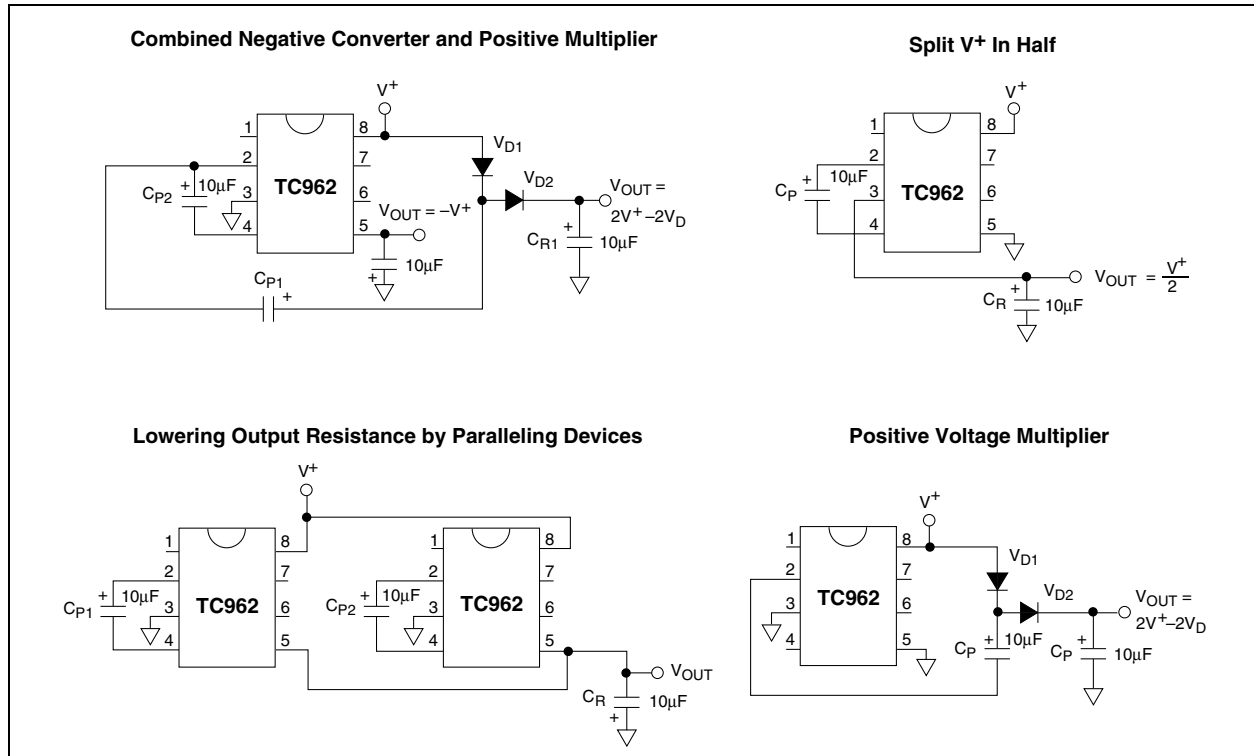
### 3.2 Latch Up

All CMOS structures contain a parasitic SCR. Care must be taken to prevent any input from going above or below the supply rail, or latch up will occur. The result of latch up is an effective short between  $V_{DD}$  and  $V_{SS}$ . Unless the power supply input has a current limit, this latch up phenomena will result in damage to the device. (See AN763 Latch-up Protection of CMOS ICs.)

**FIGURE 3-1: TEST CIRCUIT**



**FIGURE 3-2: TYPICAL APPLICATIONS**

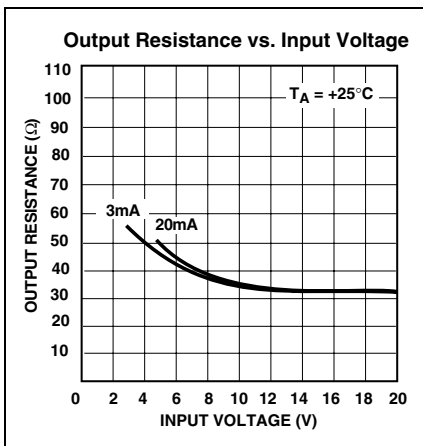
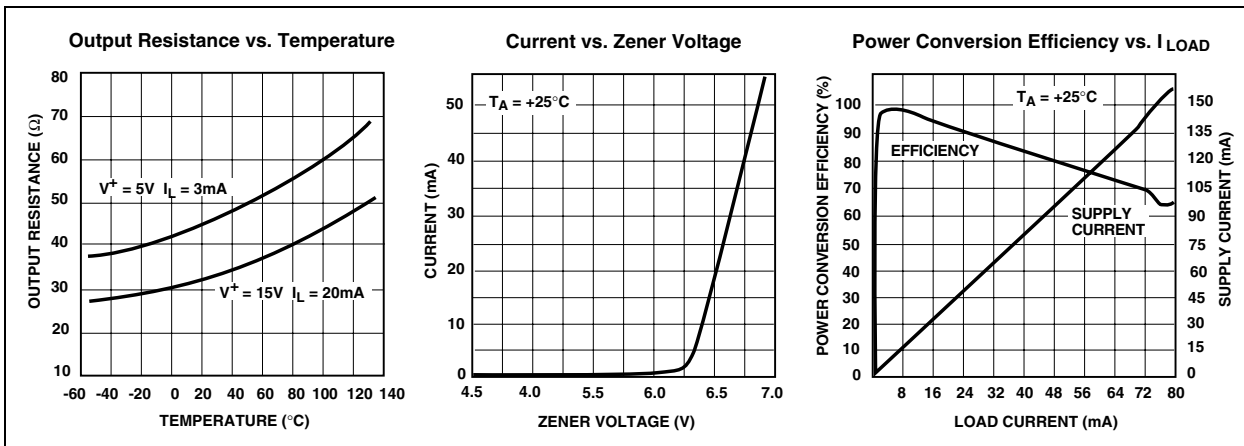
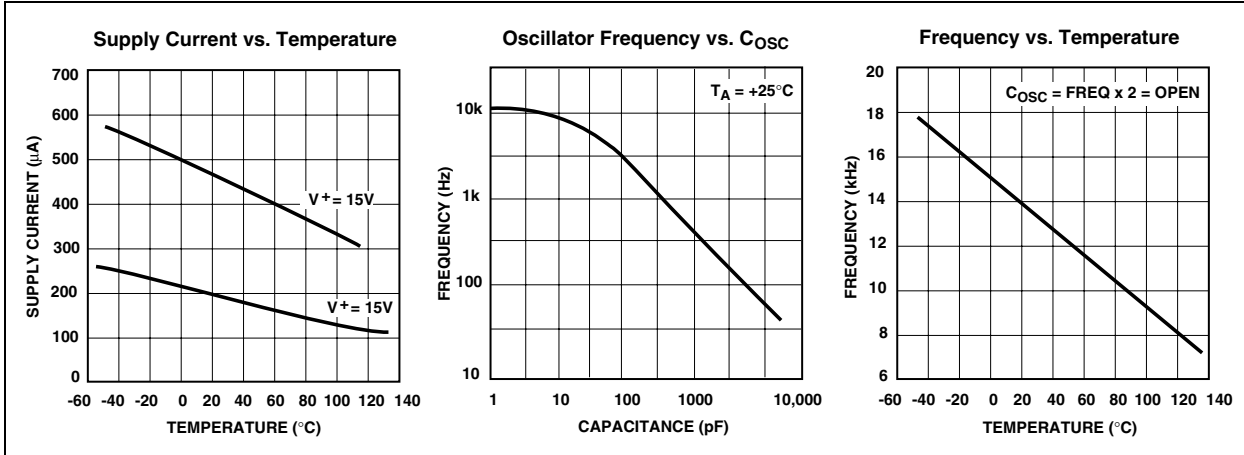


# TC962

## 4.0 TYPICAL CHARACTERISTICS

**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.

Circuit of Figure 3-1,  $C_P = C_R = 10\mu\text{F}$ ,  $C_{PESR} \approx C_{RESR} \approx 1\Omega$ .

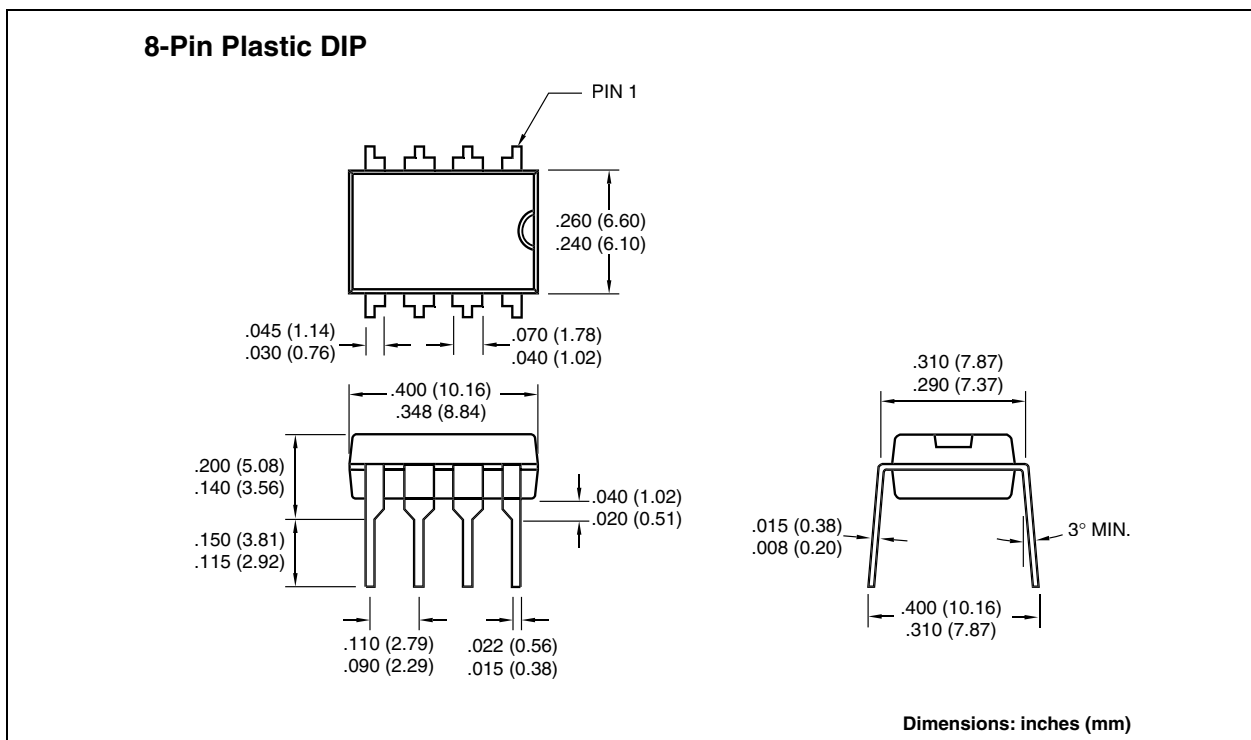
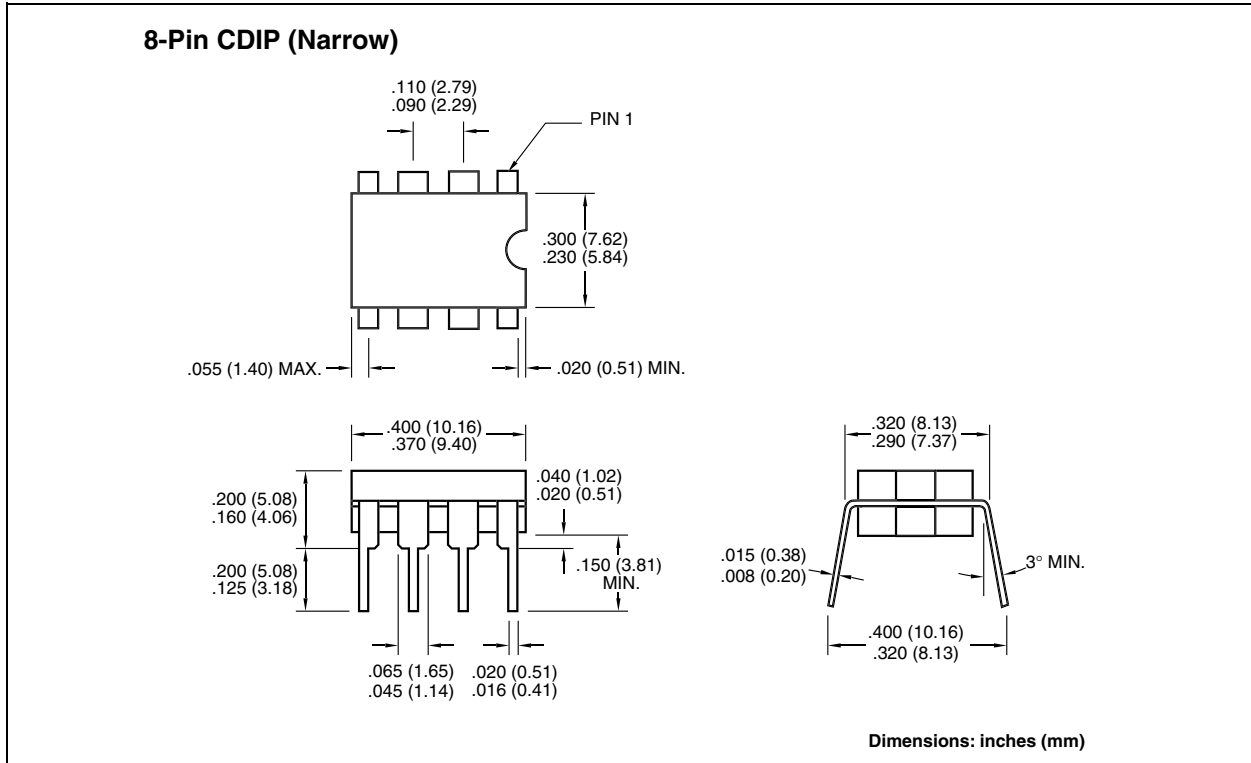


## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

Package marking data not available at this time.

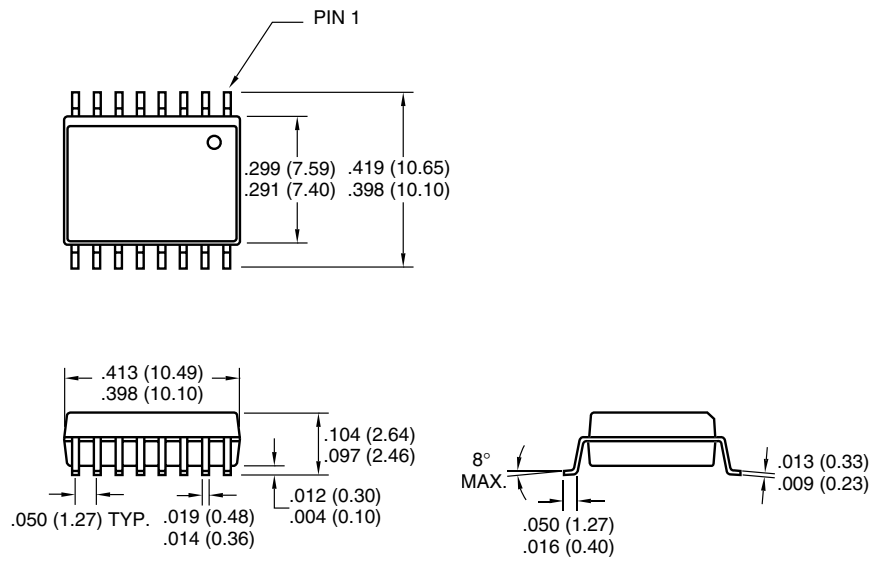
### 5.2 Package Dimensions



# TC962

## Package Dimensions (Continued)

### 16-Pin SOIC (Wide)



Dimensions: inches (mm)

## **Sales and Support**

### **Data Sheets**

Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Corporate Literature Center U.S. FAX: (480) 792-7277
3. The Microchip Worldwide Site ([www.microchip.com](http://www.microchip.com))

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

### **New Customer Notification System**

Register on our web site ([www.microchip.com/cn](http://www.microchip.com/cn)) to receive the most current information on our products.

# TC962

---

---

NOTES:

Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights.

## Trademarks


The Microchip name and logo, the Microchip logo, FilterLab, KEELOQ, microID, MPLAB, PIC, PICmicro, PICMASTER, PICSTART, PRO MATE, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

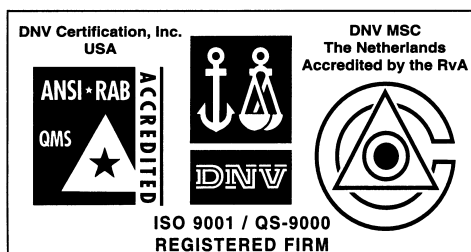
dsPIC, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, microPort, Migratable Memory, MPASM, MPLIB, MPLINK, MPSIM, MXDEV, PICC, PICDEM, PICDEM.net, rfPIC, Select Mode and Total Endurance are trademarks of Microchip Technology Incorporated in the U.S.A.

Serialized Quick Turn Programming (SQTP) is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2002, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.



*Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 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: 480-792-7627  
Web Address: <http://www.microchip.com>

#### Rocky Mountain

2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7966 Fax: 480-792-7456

#### Atlanta

500 Sugar Mill Road, Suite 200B  
Atlanta, GA 30350  
Tel: 770-640-0034 Fax: 770-640-0307

#### Boston

2 Lan Drive, Suite 120  
Westford, MA 01886  
Tel: 978-692-3848 Fax: 978-692-3821

#### Chicago

333 Pierce Road, Suite 180  
Itasca, IL 60143  
Tel: 630-285-0071 Fax: 630-285-0075

#### Dallas

4570 Westgrove Drive, Suite 160  
Addison, TX 75001  
Tel: 972-818-7423 Fax: 972-818-2924

#### Detroit

Tri-Atria Office Building  
32255 Northwestern Highway, Suite 190  
Farmington Hills, MI 48334  
Tel: 248-538-2250 Fax: 248-538-2260

#### Kokomo

2767 S. Albright Road  
Kokomo, Indiana 46902  
Tel: 765-864-8360 Fax: 765-864-8387

#### Los Angeles

18201 Von Karman, Suite 1090  
Irvine, CA 92612  
Tel: 949-263-1888 Fax: 949-263-1338

#### New York

150 Motor Parkway, Suite 202  
Hauppauge, NY 11788  
Tel: 631-273-5305 Fax: 631-273-5335

#### San Jose

Microchip Technology Inc.  
2107 North First Street, Suite 590  
San Jose, CA 95131  
Tel: 408-436-7950 Fax: 408-436-7955

#### Toronto

6285 Northam Drive, Suite 108  
Mississauga, Ontario L4V 1X5, Canada  
Tel: 905-673-0699 Fax: 905-673-6509

### ASIA/PACIFIC

#### Australia

Microchip Technology Australia Pty Ltd  
Suite 22, 41 Rawson Street  
Epping 2121, NSW  
Australia  
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

#### China - Beijing

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Beijing Liaison Office  
Unit 915  
Bei Hai Wan Tai Bldg.  
No. 6 Chaoyangmen Beidajie  
Beijing, 100027, No. China  
Tel: 86-10-85282100 Fax: 86-10-85282104

#### China - Chengdu

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Chengdu Liaison Office  
Rm. 2401, 24th Floor,  
Ming Xing Financial Tower  
No. 88 TIDU Street  
Chengdu 610016, China  
Tel: 86-28-6766200 Fax: 86-28-6766599

#### China - Fuzhou

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Fuzhou Liaison Office  
Unit 28F, World Trade Plaza  
No. 71 Wusi Road  
Fuzhou 350001, China  
Tel: 86-591-7503506 Fax: 86-591-7503521

#### China - Shanghai

Microchip Technology Consulting (Shanghai)  
Co., Ltd.  
Room 701, Bldg. B  
Far East International Plaza  
No. 317 Xian Xia Road  
Shanghai, 200051  
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

#### China - Shenzhen

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Shenzhen Liaison Office  
Rm. 1315, 13/F, Shenzhen Kerry Centre,  
Renminnan Lu  
Shenzhen 518001, China  
Tel: 86-755-2350361 Fax: 86-755-2366086

#### Hong Kong

Microchip Technology Hongkong Ltd.  
Unit 901-6, Tower 2, Metroplaza  
223 Hing Fong Road  
Kwai Fong, N.T., Hong Kong  
Tel: 852-2401-1200 Fax: 852-2401-3431

#### India

Microchip Technology Inc.  
India Liaison Office  
Divyasree Chambers  
1 Floor, Wing A (A3/A4)  
No. 11, O'Shaugnessey Road  
Bangalore, 560 025, India  
Tel: 91-80-2290061 Fax: 91-80-2290062

### Japan

Microchip Technology Japan K.K.  
Benex S-1 6F  
3-18-20, Shinyokohama  
Kohoku-Ku, Yokohama-shi  
Kanagawa, 222-0033, Japan  
Tel: 81-45-471- 6166 Fax: 81-45-471-6122

### Korea

Microchip Technology Korea  
168-1, Youngbo Bldg. 3 Floor  
Samsung-Dong, Kangnam-Ku  
Seoul, Korea 135-882  
Tel: 82-2-554-7200 Fax: 82-2-558-5934

### Singapore

Microchip Technology Singapore Pte Ltd.  
200 Middle Road  
#07-02 Prime Centre  
Singapore, 188980  
Tel: 65-6334-8870 Fax: 65-6334-8850

### Taiwan

Microchip Technology Taiwan  
11F-3, No. 207  
Tung Hua North Road  
Taipei, 105, Taiwan  
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

### EUROPE

#### Denmark

Microchip Technology Nordic ApS  
Regus Business Centre  
Lautrup høj 1-3  
Ballerup DK-2750 Denmark  
Tel: 45 4420 9895 Fax: 45 4420 9910

#### France

Microchip Technology SARL  
Parc d'Activite du Moulin de Massy  
43 Rue du Saule Trapu  
Batiment A - 1er Etage  
91300 Massy, France  
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

#### Germany

Microchip Technology GmbH  
Gustav-Heinemann Ring 125  
D-81739 Munich, Germany  
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

#### Italy

Microchip Technology SRL  
Centro Direzionale Colleoni  
Palazzo Taurus 1 V. Le Colleoni 1  
20041 Agrate Brianza  
Milan, Italy  
Tel: 39-039-65791-1 Fax: 39-039-6899883

#### United Kingdom

Arizona Microchip Technology Ltd.  
505 Eskdale Road  
Winnersh Triangle  
Wokingham  
Berkshire, England RG41 5TU  
Tel: 44 118 921 5869 Fax: 44-118 921-5820

03/01/02



This datasheet has been download from:

[www.datasheetcatalog.com](http://www.datasheetcatalog.com)

Datasheets for electronics components.