

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
- μ P-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.

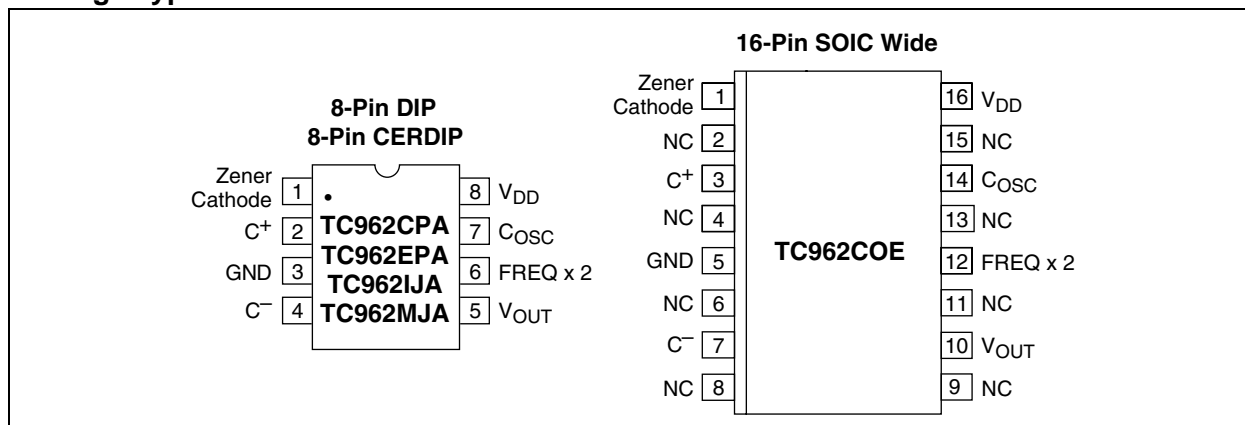
As an inverter, the TC962 can put out voltages as high as 18V and as low as 3V without the need for external diodes. The output impedance of the device is a low 28Ω (with the proper capacitors), voltage conversion efficiency is 99.9%, and power conversion efficiency is 97%.

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*).

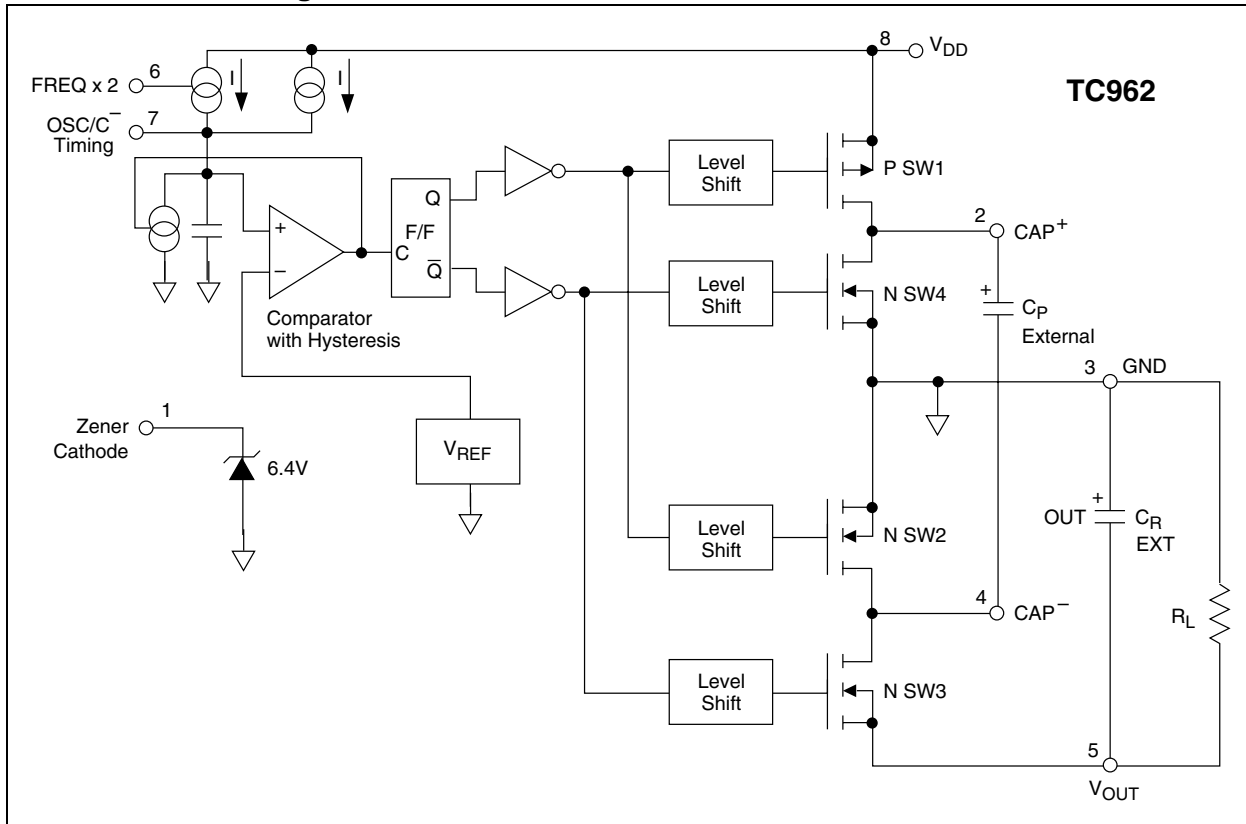
The TC962 is compatible with the LTC1044, SI7661 and ICL7662. It should be used in designs that require greater power and/or less input to output voltage drop. It offers superior performance over the ICL7660S.

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 $V_{DD} = 15V$	—	—	—	μA	$R_L = \infty$ $T_A = +25^\circ C$ $0 \leq T_A \leq +70^\circ C$ $-55^\circ C \leq T_A \leq +125^\circ C$	
		—	510	700			
		—	560	—			
	$V_{DD} = 5V$	—	650	—			$T_A = +25^\circ C$ $0 \leq T_A \leq +70^\circ C$ $-55^\circ C \leq T_A \leq +125^\circ C$
		—	190	—			
		—	210	—			
R_O	Output Source Resistance	—	32	37	Ω	$I_L = 20mA$, $V_{DD} = 15V$ $I_L = 80mA$, $V_{DD} = 15V$ $I_L = 3mA$, $V_{DD} = 5V$	
		—	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	—	Ω	$I_L = 2.5mA$ 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 ⁺	Positive side of external CP capacitor (pump cap).
3	GND	Ground terminal.
4	C ⁻	Negative side of external CP capacitor (pump cap).
5	V _{OUT}	Output voltage.
6	FREQ x 2	If grounded, frequency doubles.
7	C _{OSC}	Capacitor to GND will decrease frequency.
8	V _{DD}	Input voltage.

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

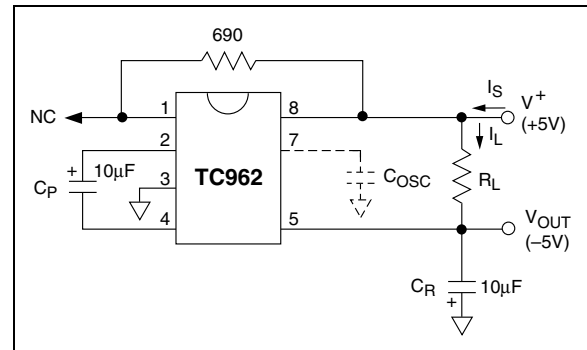
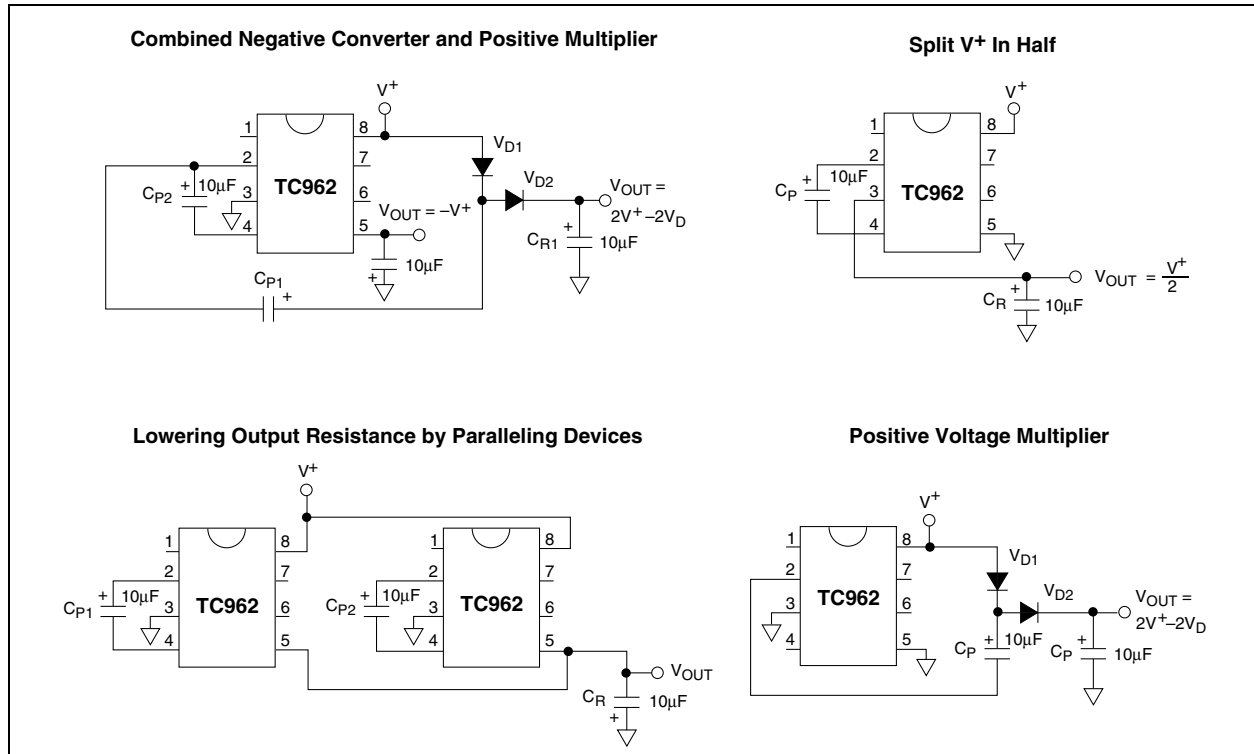


FIGURE 3-2: TYPICAL APPLICATIONS

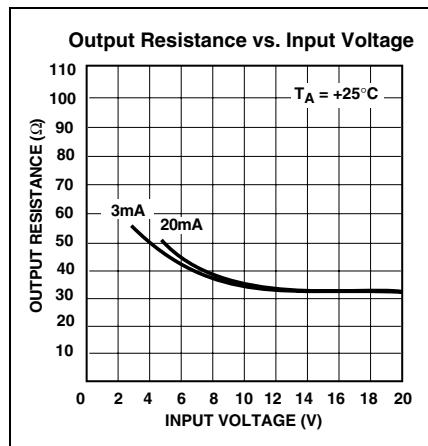
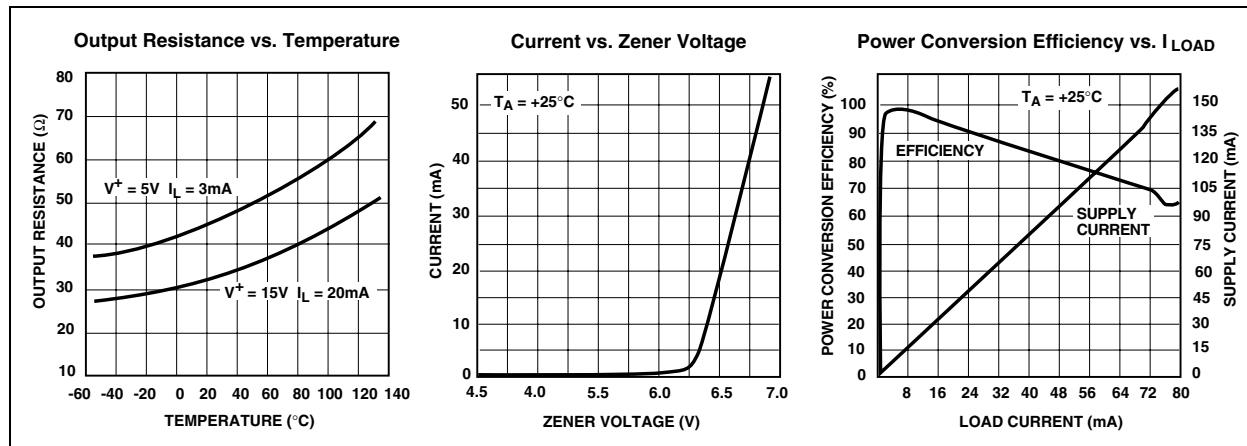
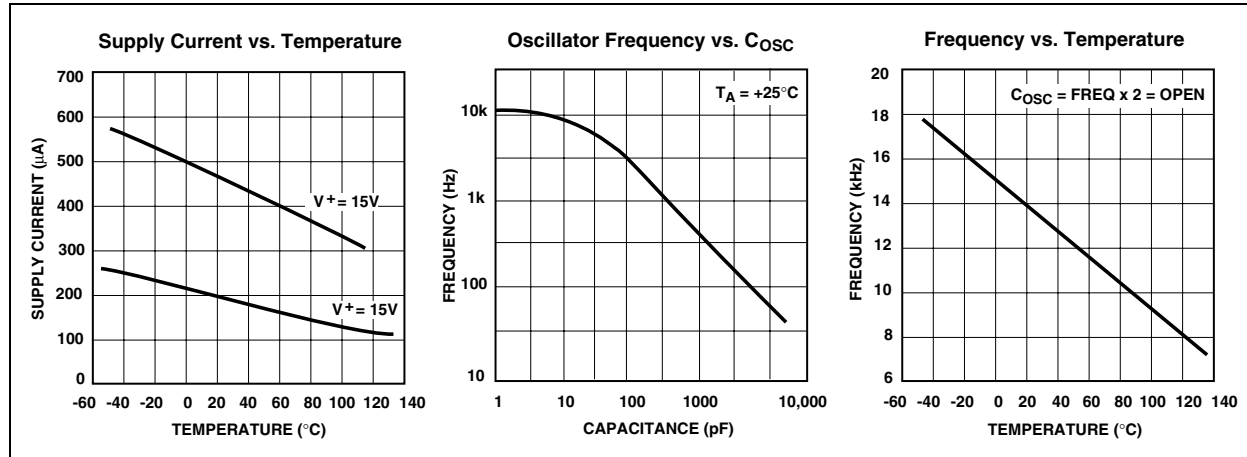


TC962

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, $C_P = C_R = 10\mu\text{F}$, $C_{PESR} \approx C_{RESR} \approx 1\Omega$.

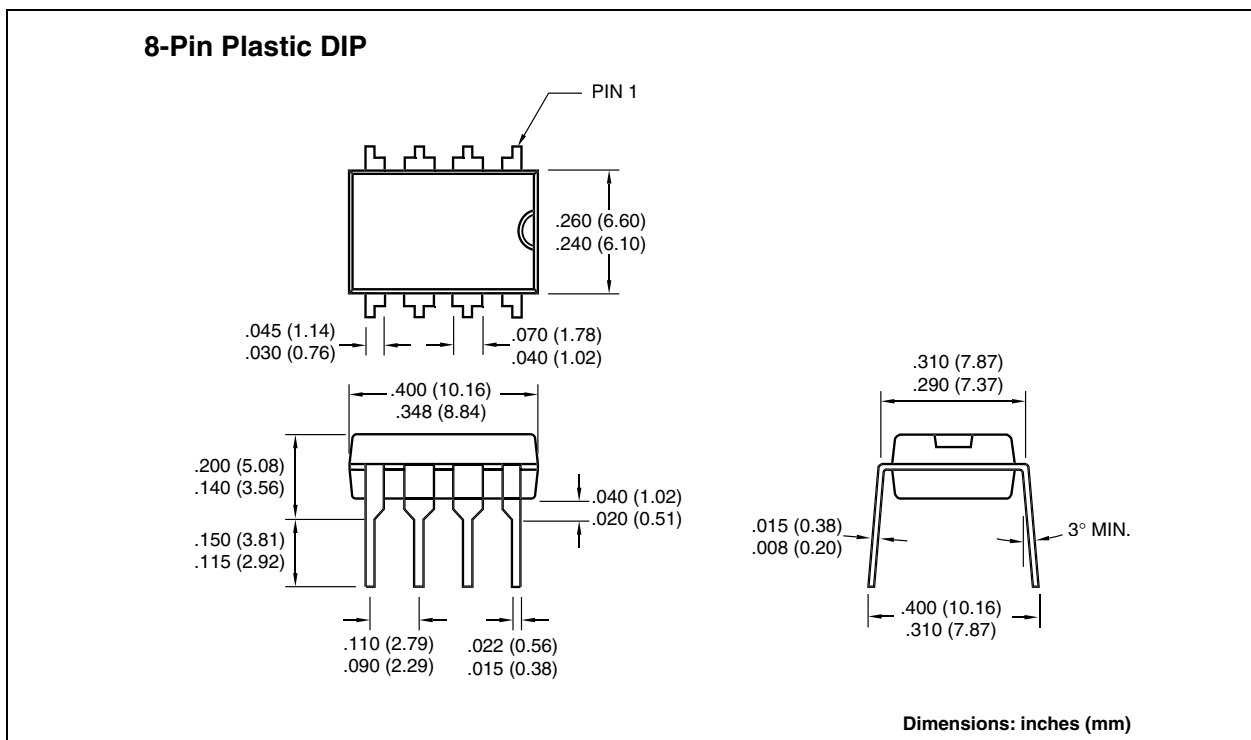
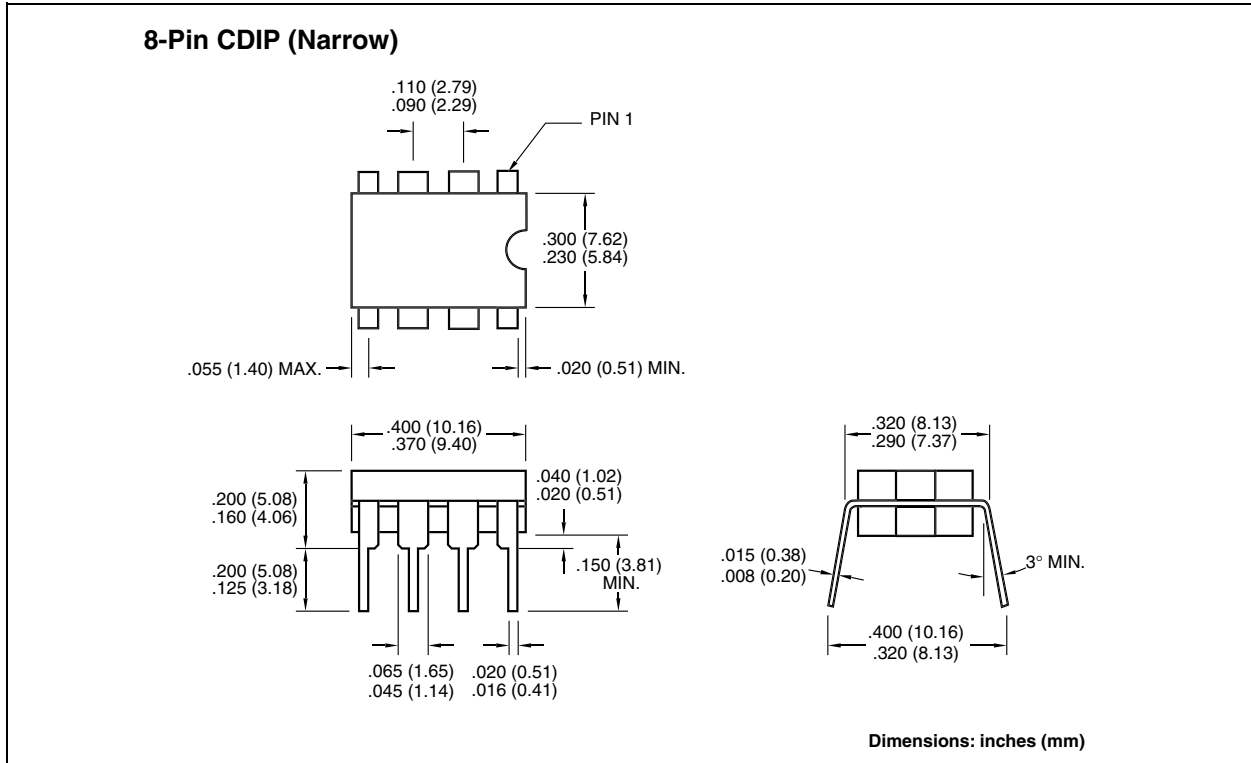


5.0 PACKAGING INFORMATION

5.1 Package Marking Information

Package marking data not available at this time.

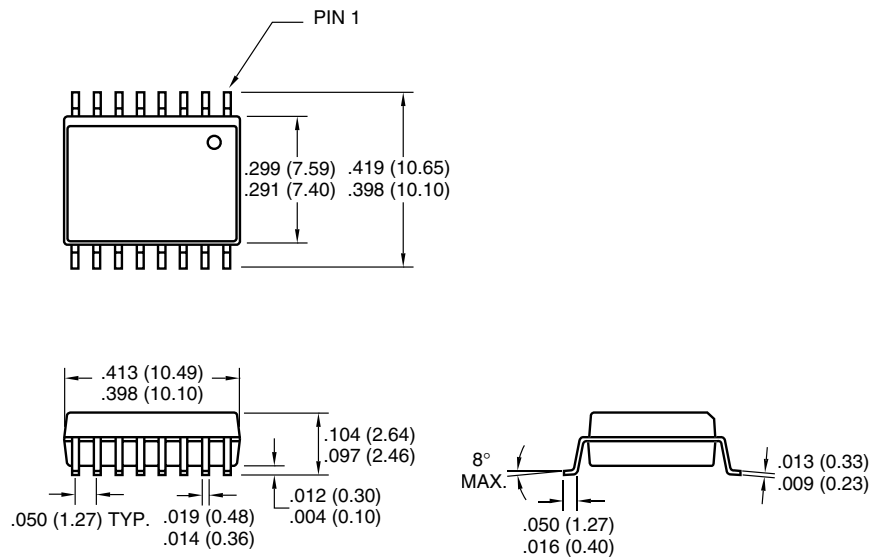
5.2 Package Dimensions



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)

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) 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.

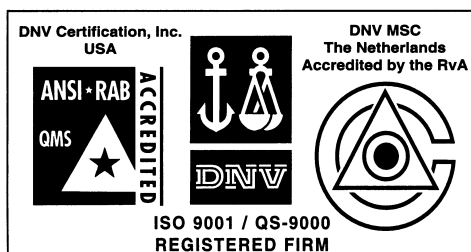
dsPIC, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, microPort, Migratable Memory, MPASM, MPLIB, MPLINK, MPSIM, MXDEV, PICC, PICDEM, PICDEM.net, rfPIC, Select Mode and Total Endurance are trademarks of Microchip Technology Incorporated in the U.S.A.

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

