

1.5A DUAL OPEN-DRAIN MOSFET DRIVERS

FEATURES

- Independently-Programmable Rise and Fall Times
- Low Output Impedance 7Ω Typ.
- High Speed t_R, t_F <30nsec with 1000pF Load
- Short Delay Times < 30nsec
- Wide Operating Range 4.5V to 18V
- Latch-Up Protected Will Withstand > 500mA Reverse Current (Either Polarity)
- Input Withstands Negative Swings Up to - 5V

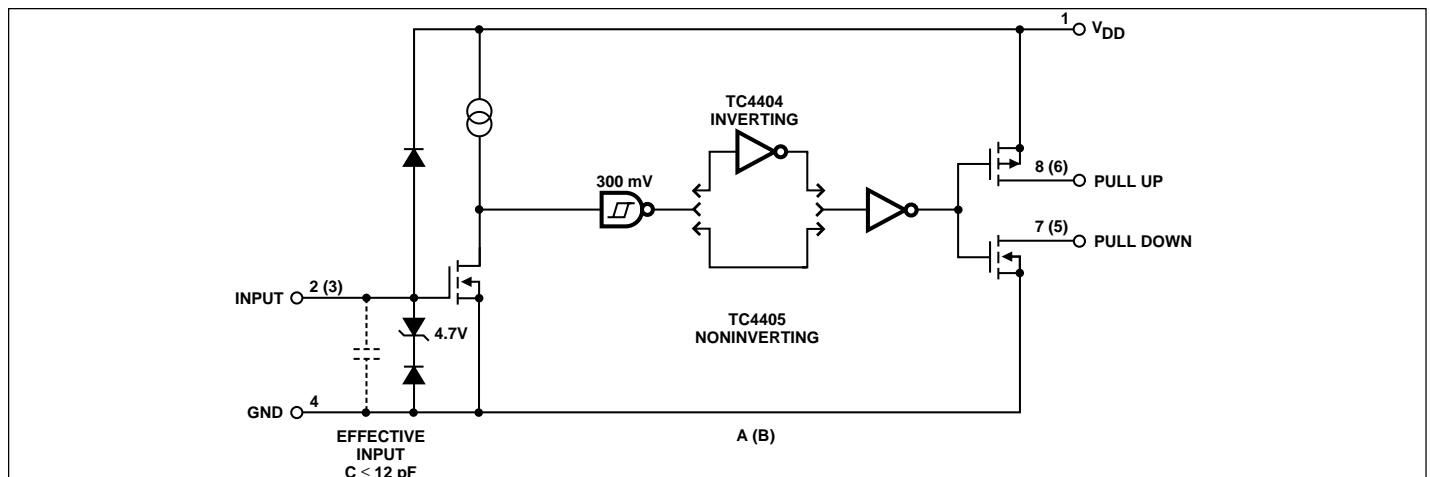
APPLICATIONS

- Motor Controls
- Driving Bipolar Transistors
- Driver for Non-overlapping Totem Poles
- Reach-Up/Reach-Down Driver

ORDERING INFORMATION

Part No.	Package	Temp. Range
TC4404COA	8-Pin SOIC	0°C to +70°C
TC4404CPA	8-Pin PDIP	0°C to +70°C
TC4404EOA	8-Pin SOIC	- 40°C to +85°C
TC4404EPA	8-Pin PDIP	- 40°C to +85°C
TC4404MJA	8-Pin CerDIP	- 55°C to +125°C
TC4405COA	8-Pin SOIC	0°C to +70°C
TC4405CPA	8-Pin PDIP	0°C to +70°C
TC4405EOA	8-Pin SOIC	- 40°C to +85°C
TC4405EPA	8-Pin PDIP	- 40°C to +85°C
TC4405MJA	8-Pin CerDIP	- 55°C to +125°C

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The TC4404 and TC4405 are CMOS buffer-drivers constructed with complementary MOS outputs, where the drains of the totem-pole output have been left separated so that individual connections can be made to the pull-up and pull-down sections of the output. This allows the insertion of drain-current-limiting resistors in the pull-up and/or pull-down sections, allowing the user to define the rates of rise and fall for a capacitive load; or a reduced output swing, if driving a resistive load, or to limit base current, when driving a bipolar transistor. Minimum rise and fall times, with no resistors, will be less than 30nsec for a 1000pF load. There is no upper limit.

For driving MOSFETs in motor-control applications, where slow-ON/fast-OFF operation is desired, these devices are superior to the previously-used technique of adding a diode-resistor combination between the driver output and the MOSFET, because they allow accurate control of turn-ON, while maintaining fast turn-OFF and maximum noise immunity for an OFF device.

When used to drive bipolar transistors, these drivers maintain the high speeds common to other TelCom drivers. They allow insertion of a base current-limiting resistor, while providing a separate half-output for fast turn-OFF. By proper positioning of the resistor, either npn or pnp transistors can be driven.

For driving many loads in low-power regimes, these drivers, because they eliminate shoot-through currents in the output stage, require significantly less power at higher frequencies, and can be helpful in meeting low-power budgets.

Because neither drain in an output is dependent on the other, these devices can also be used as open-drain buffer/drivers where both drains are available in one device,

1.5A DUAL OPEN-DRAIN MOSFET DRIVERS

TC4404 TC4405

thus minimizing chip count. Unused open drains should be returned to the supply rail that their device sources are connected to (pull-downs to ground, pull-ups to V_{DD}), to prevent static damage. In addition, in situations where timing resistors or other means of limiting crossover currents are used, like drains may be paralleled for greater current carrying capacity.

These devices are built to operate in the most demanding electrical environments. They will not latch up under any conditions within their power and voltage ratings; they are not subject to damage when up to 5V of noise spiking of either polarity occurs on their ground pin; and they can accept, without damage or logic upset, up to 1/2 amp of reverse current (of either polarity) being forced back into their outputs. All terminals are fully protected against up to 2 kV of electrostatic discharge.

ABSOLUTE MAXIMUM RATINGS*

Supply Voltage	+22V
Maximum Chip Temperature	+150°C
Storage Temperature Range	- 65°C to +150°C
Lead Temperature (Soldering, 10 sec)	+300°C

Package Thermal Resistance

CerDIP $R_{\theta J-A}$	150°C/W
CerDIP $R_{\theta J-C}$	55°C/W
PDIP $R_{\theta J-A}$	125°C/W
PDIP $R_{\theta J-C}$	45°C/W
SOIC $R_{\theta J-A}$	155°C/W
SOIC $R_{\theta J-C}$	45°C/W

Operating Temperature Range

C Version	0°C to +70°C
E Version	- 40°C to +85°C
M Version	- 55°C to +125°C

Package Power Dissipation ($T_A \leq 70^\circ\text{C}$)

Plastic	730mW
CerDP	800mW
SOIC	470mW

*Static-sensitive device. Unused devices must be stored in conductive material. Protect devices from static discharge and static fields. 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 operational sections of the specifications is not implied. Exposure to Absolute Maximum Rating Conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS: Specifications measured at $T_A = +25^\circ\text{C}$ with $4.5\text{V} \leq V_{DD} \leq 18\text{V}$, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Input						
V_{IH}	Logic 1 High Input Voltage		2.4	—	—	V
V_{IL}	Logic 0 Low Input Voltage		—	—	0.8	V
I_{IN}	Input Current	$-0\text{V} \leq V_{IN} \leq V_{DD}$	- 1	—	1	μA
Output						
V_{OH}	High Output Voltage		$V_{DD} - 0.025$	—	—	V
V_{OL}	Low Output Voltage		—	—	0.025	V
R_O	Output Resistance	$I_{OUT} = 10\text{ mA}$, $V_{DD} = 18\text{V}$; Any Drain	—	7	10	Ω
I_{PK}	Peak Output Current (Any Drain)	Duty cycle < 2%, $t \leq 300\mu\text{sec}$	—	1.5	—	A
I_{DC}	Continuous Output Current (Any Drain)		—	—	100	mA
I_R	Latch-Up Protection (Any Drain) Withstand Reverse Current	Duty cycle < 2%, $t \leq 300\mu\text{sec}$	> 500	—	—	mA
Switching Time (Note 1)						
t_R	Rise Time	Figure 1, $C_L = 1000\text{pF}$	—	25	30	nsec
t_F	Fall Time	Figure 1, $C_L = 1000\text{pF}$	—	25	30	nsec
t_{D1}	Delay Time	Figure 1, $C_L = 1000\text{pF}$	—	15	30	nsec
t_{D2}	Delay Time	Figure 1, $C_L = 1000\text{pF}$	—	32	50	nsec
Power Supply						
I_S	Power Supply Current	$V_{IN} = 3\text{V}$ (Both Inputs)	—	—	4.5	mA
		$V_{IN} = 0\text{V}$ (Both Inputs)	—	0.4	—	mA

NOTE: 1. Switching times guaranteed by design.

1.5A DUAL OPEN-DRAIN MOSFET DRIVERS

TC4404
TC4405

ELECTRICAL CHARACTERISTICS: Specifications measured over operating temperature range with $4.5V \leq V_{DD} \leq 18V$, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Input						
V_{IH}	Logic 1 High Input Voltage		2.4	—	—	V
V_{IL}	Logic 0 Low Input Voltage		—	—	0.8	V
I_{IN}	Input Current	$-0V \leq V_{IN} \leq V_{DD}$	-10	—	10	μA
Output						
V_{OH}	High Output Voltage		$V_{DD} - 0.025$	—	—	V
V_{OL}	Low Output Voltage		—	—	0.025	V
R_O	Output Resistance	$I_{OUT} = 10\text{ mA}$, $V_{DD} = 18V$; Any Drain	—	9	12	Ω
I_{PK}	Peak Output Current (Any Drain)	Duty cycle <2%, $t \leq 300\mu\text{sec}$	—	1.5	—	A
I_{DC}	Continuous Output Current (Any Drain)		—	—	100	mA
I_R	Latch-Up Protection (Any Drain) Withstand Reverse Current	Duty cycle <2%, $t \leq 300\mu\text{sec}$	> 500	—	—	mA
Switching Time (Note 1)						
t_R	Rise Time	Figure 1, $C_L = 1000\text{pF}$	—	—	40	nsec
t_F	Fall Time	Figure 1, $C_L = 1000\text{pF}$	—	—	40	nsec
t_{D1}	Delay Time	Figure 1, $C_L = 1000\text{pF}$	—	—	40	nsec
t_{D2}	Delay Time	Figure 1, $C_L = 1000\text{pF}$	—	—	60	nsec
Power Supply						
I_S	Power Supply Current	$V_{IN} = 3V$ (Both Inputs)	—	—	8	mA
		$V_{IN} = 0V$ (Both Inputs)	—	—	0.6	mA

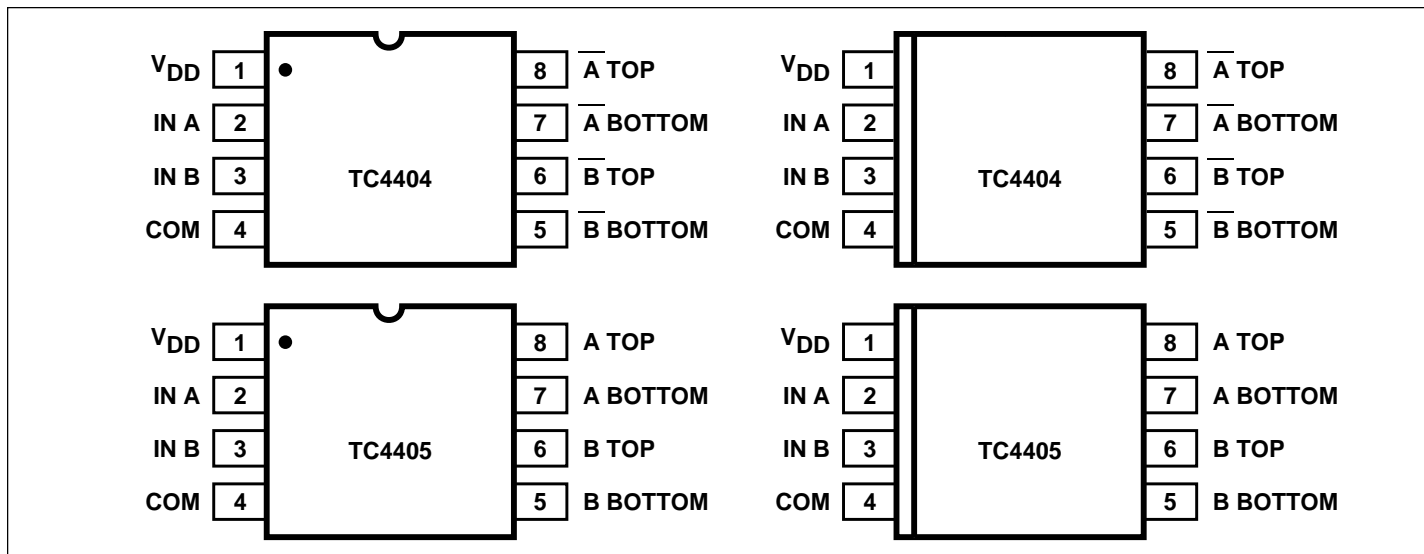
NOTE 1. Switching times guaranteed by design.

Circuit Layout Guidelines

Avoid long power supply and ground traces (added inductance causes unwanted voltage transients). Use power and ground planes wherever possible. In addition, it is advisable that low ESR bypass capacitors (4.7 μF or 10 μF

tantalum) be placed as close to the driver as possible. The driver should be physically located as close to the device it is driving as possible to minimize the length of the output trace.

PIN CONFIGURATIONS (DIP and SOIC)



1.5A DUAL OPEN-DRAIN MOSFET DRIVERS

TC4404
TC4405

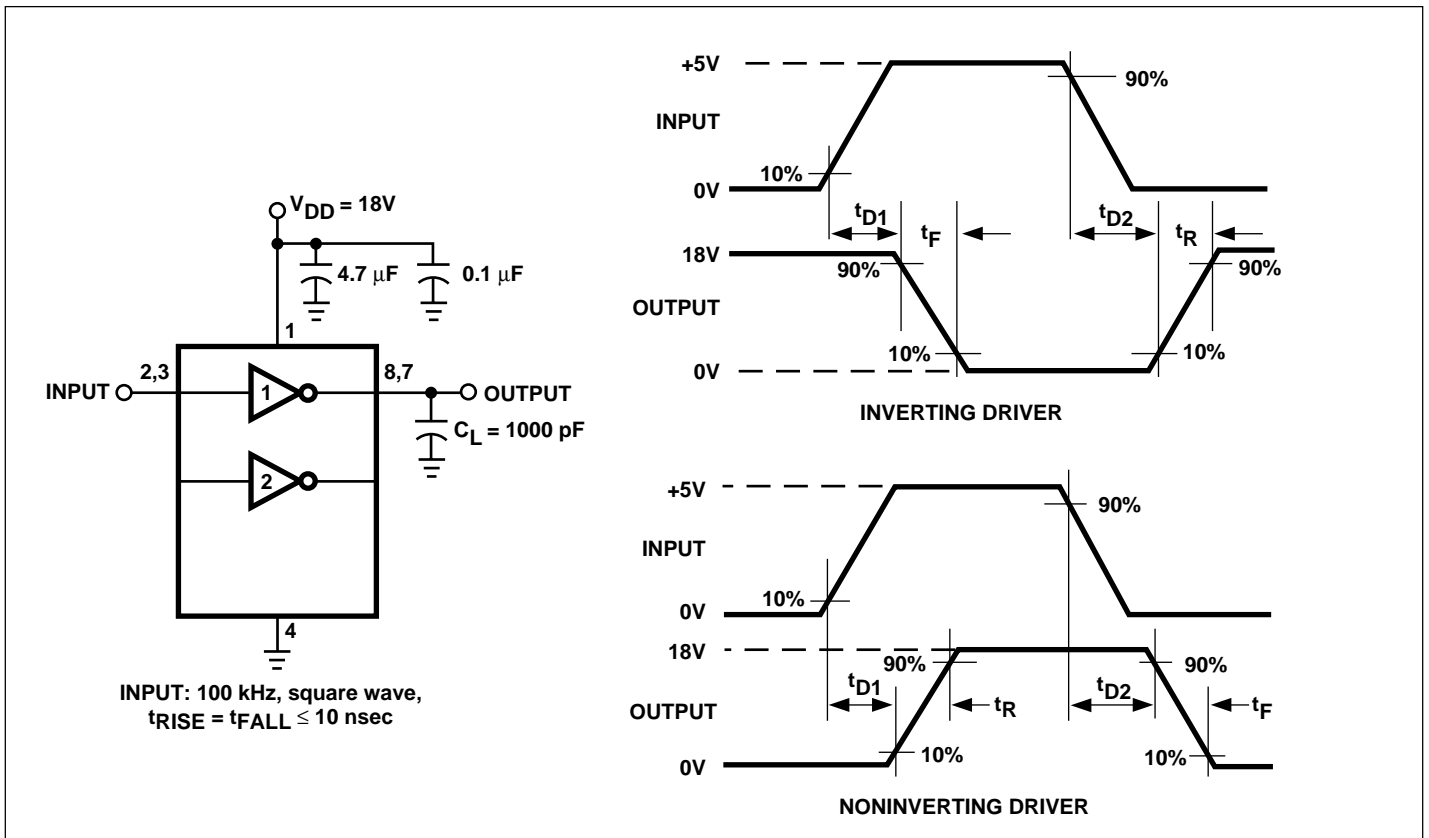
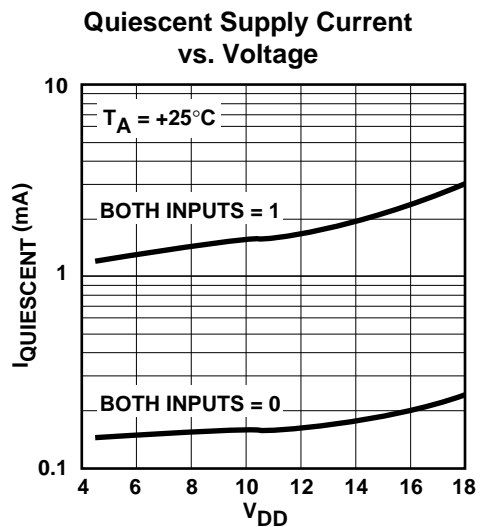
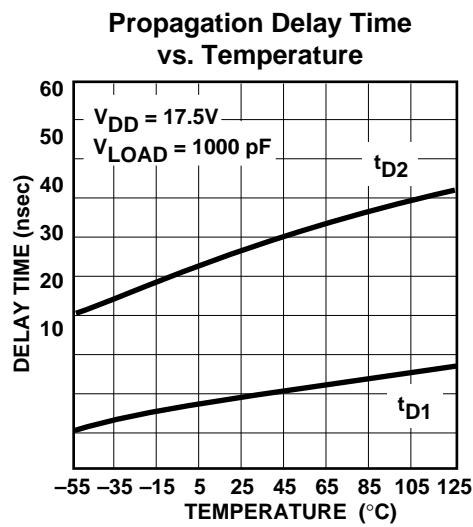
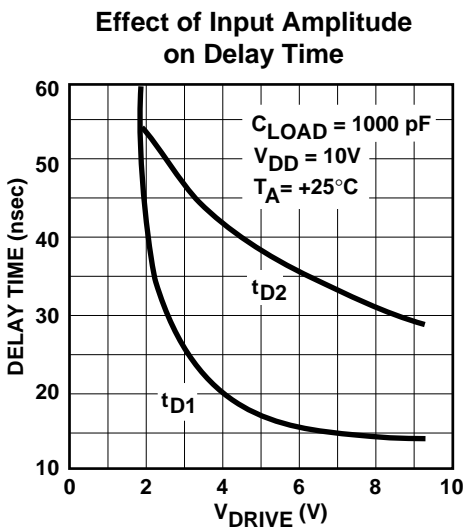
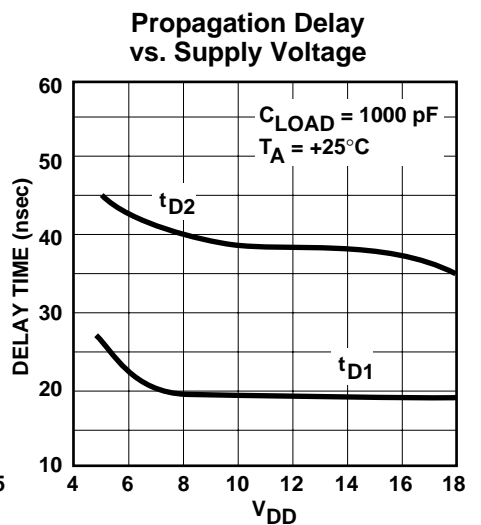
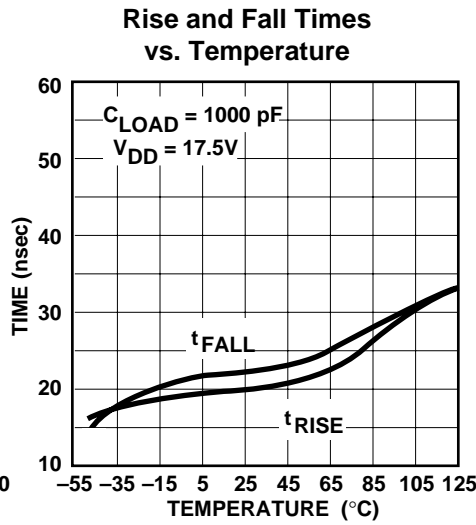
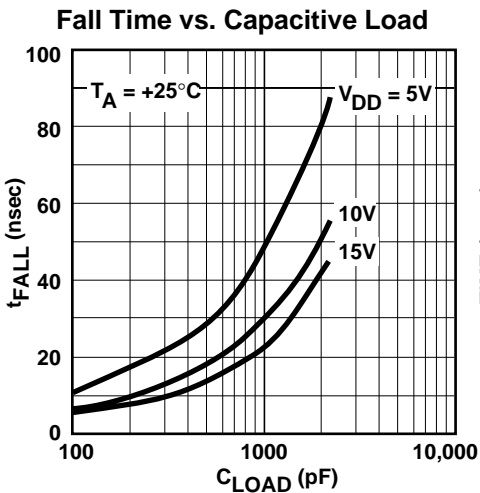
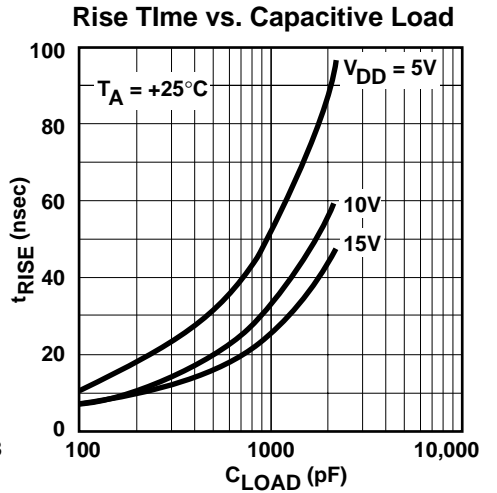
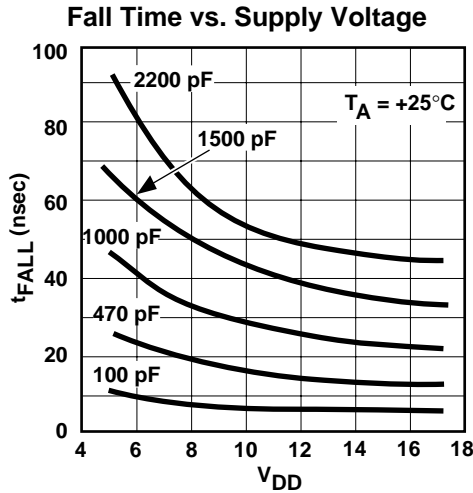
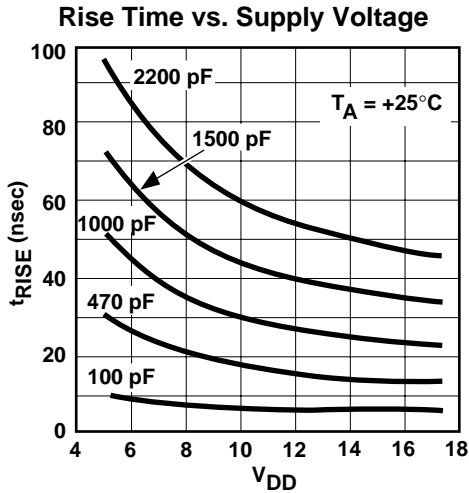


Figure 1. Switching Time Test Circuit

1.5A DUAL OPEN-DRAIN MOSFET DRIVERS

TC4404
TC4405

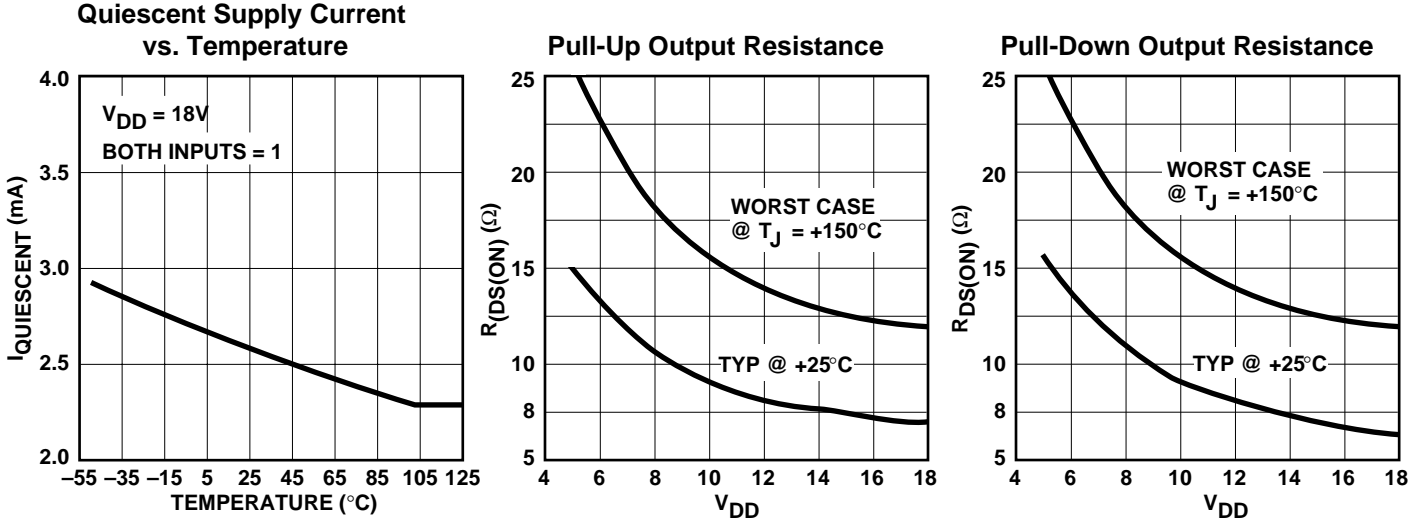
TYPICAL CHARACTERISTICS



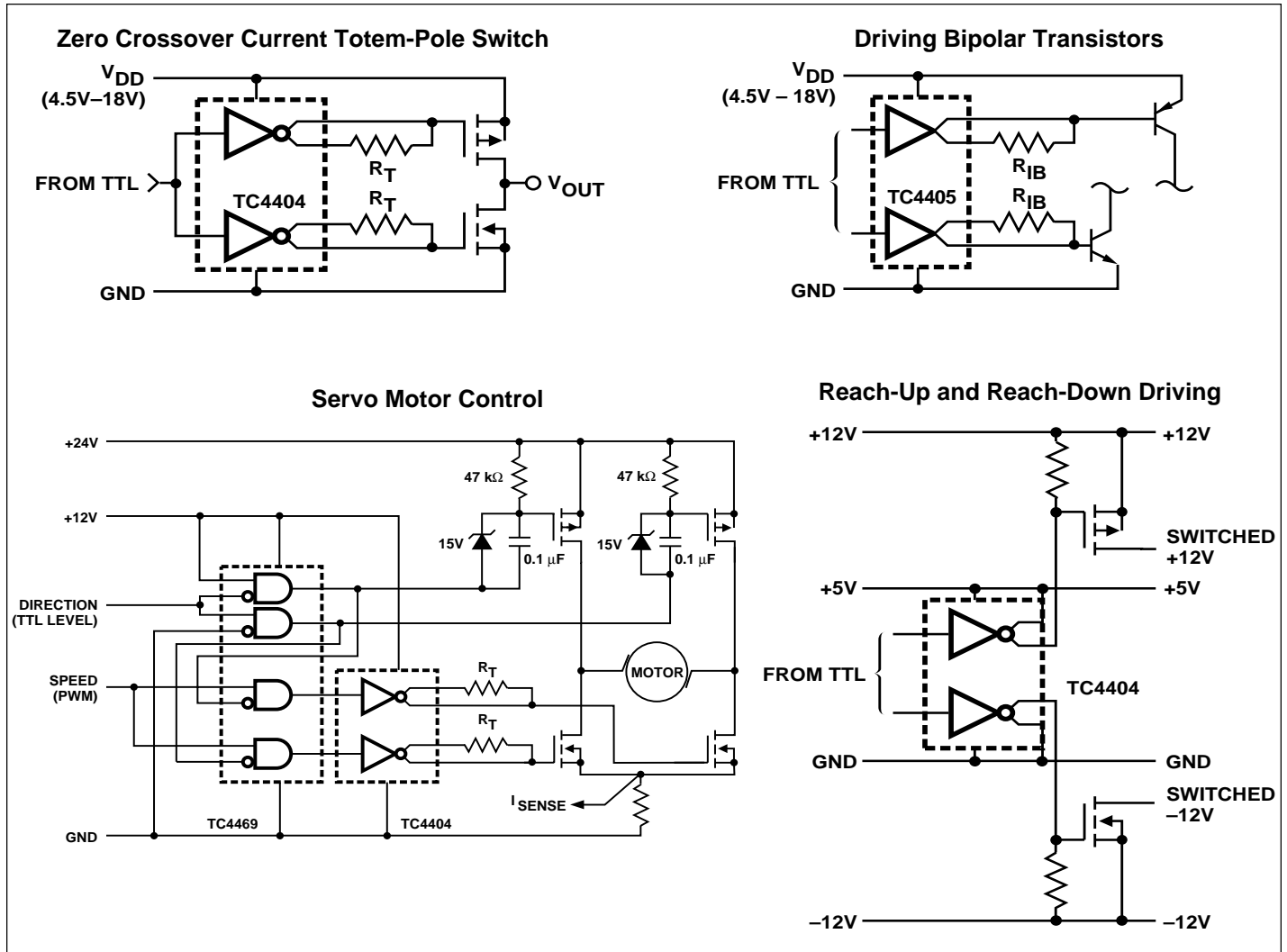
1.5A DUAL OPEN-DRAIN MOSFET DRIVERS

TC4404 TC4405

TYPICAL CHARACTERISTICS (Cont.)



TYPICAL APPLICATIONS

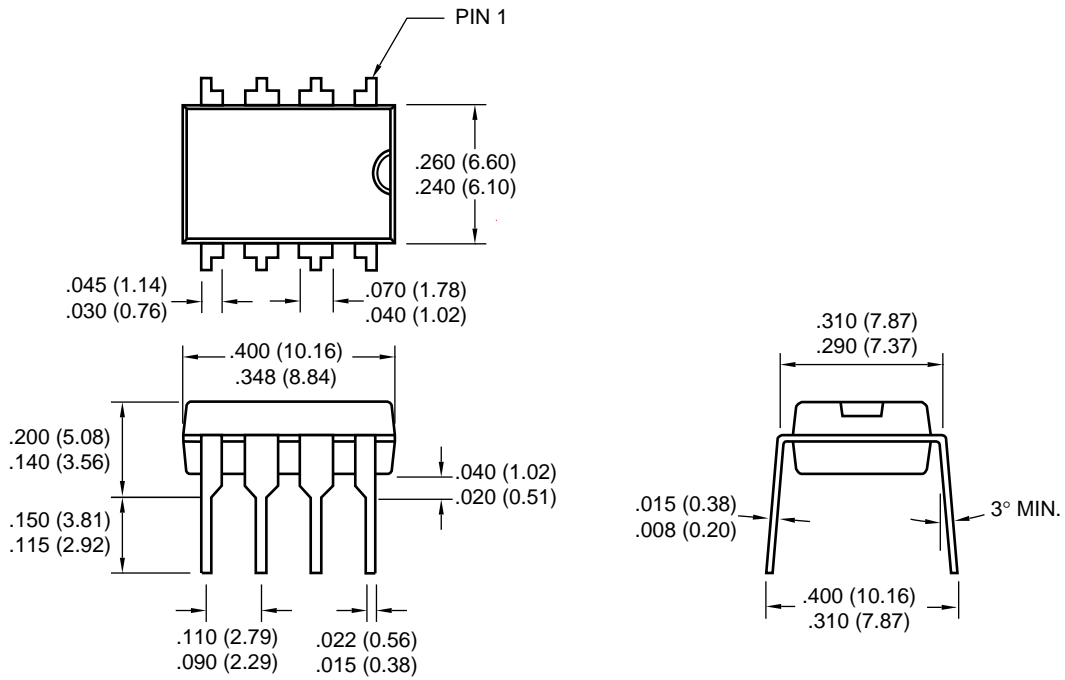


1.5A DUAL OPEN-DRAIN MOSFET DRIVERS

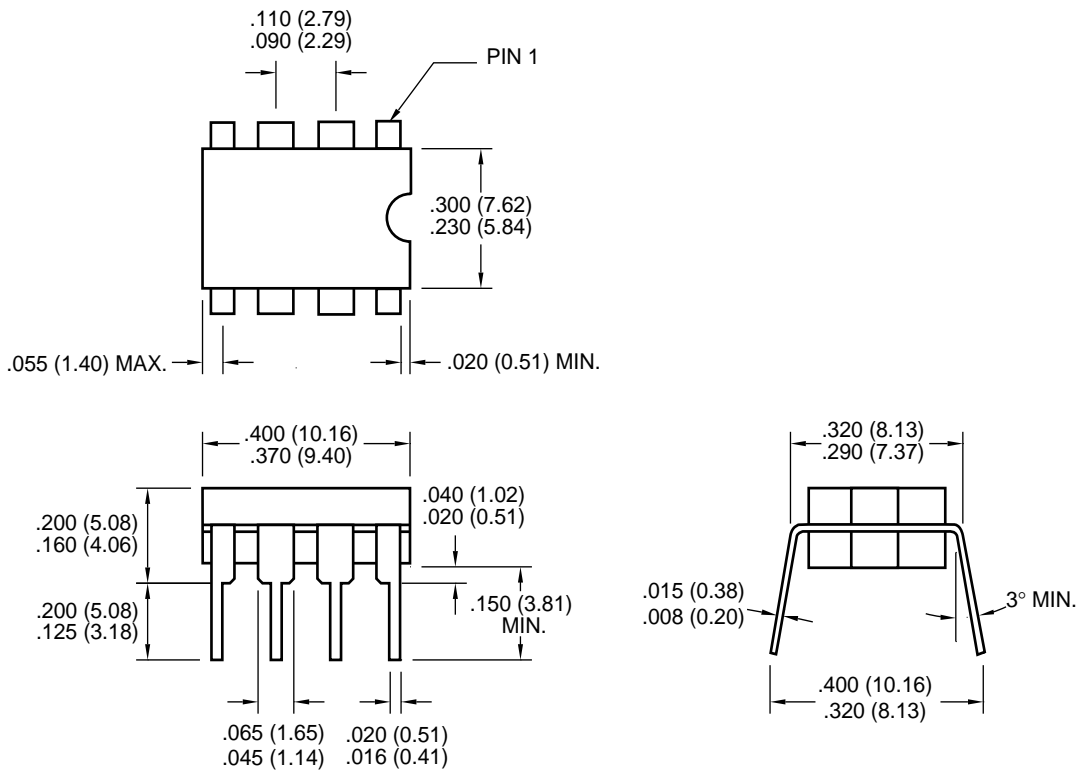
TC4404
TC4405

PACKAGE DIMENSIONS

8-Pin Plastic DIP



8-Pin CerDIP

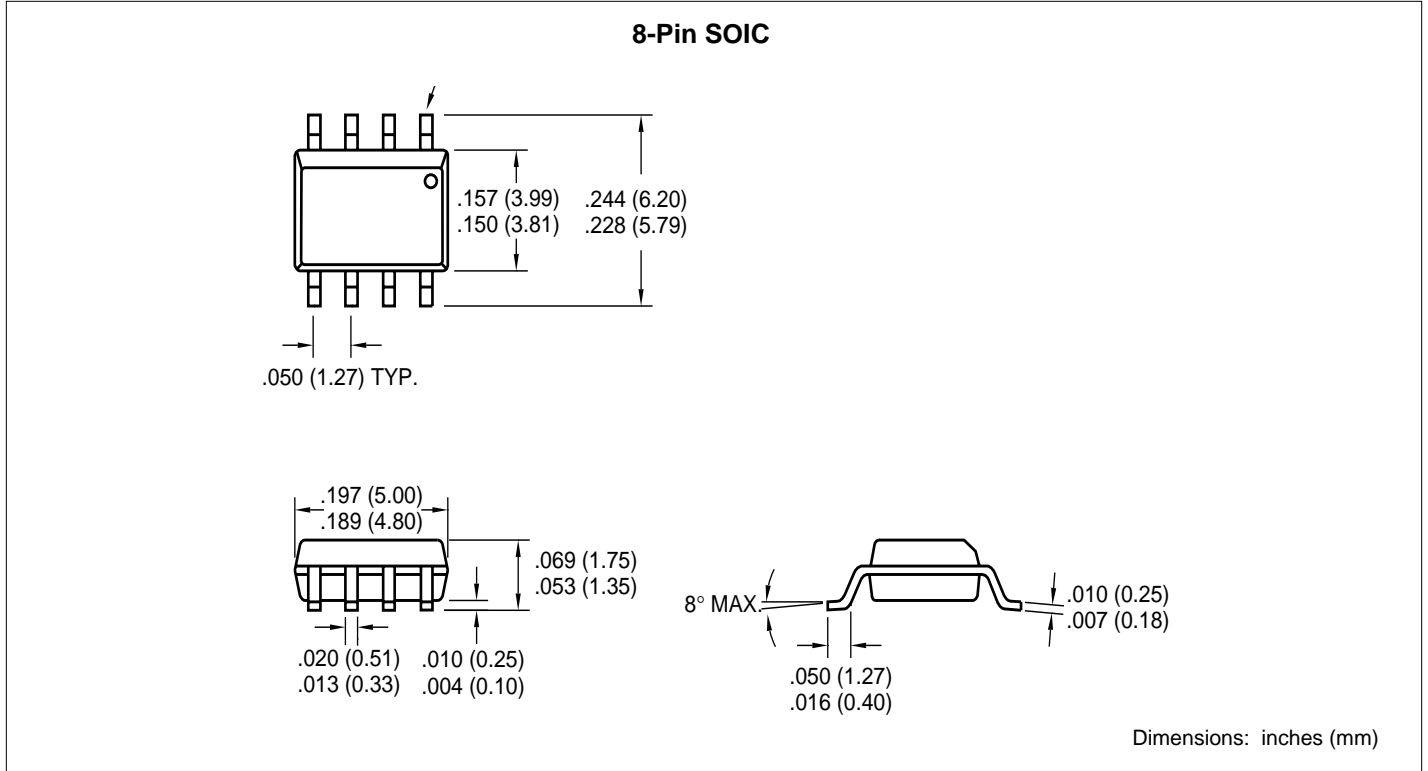


Dimensions: inches (mm)

1.5A DUAL OPEN-DRAIN MOSFET DRIVERS

TC4404
TC4405

PACKAGE DIMENSIONS





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

Austin

Analog Product Sales
8303 MoPac Expressway North
Suite A-201
Austin, TX 78759
Tel: 512-345-2030 Fax: 512-345-6085

Boston

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

Boston

Analog Product Sales
Unit A-8-1 Millbrook Tarry Condominium
97 Lowell Road
Concord, MA 01742
Tel: 978-371-6400 Fax: 978-371-0050

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

Dayton

Two Prestige Place, Suite 130
Miamisburg, OH 45342
Tel: 937-291-1654 Fax: 937-291-9175

Detroit

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

Los Angeles

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

Mountain View

Analog Product Sales
1300 Terra Bella Avenue
Mountain View, CA 94043-1836
Tel: 650-968-9241 Fax: 650-967-1590

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

China - Beijing

Microchip Technology Beijing Office
Unit 915
New China Hong Kong Manhattan Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Shanghai

Microchip Technology Shanghai Office
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

Hong Kong

Microchip Asia Pacific
RM 2101, 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, OisShaughnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Microchip Technology Intl. Inc.
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
Tel: 82-2-554-7200 Fax: 82-2-558-5934

ASIA/PACIFIC (continued)

Singapore

Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-334-8870 Fax: 65-334-8850

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

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

Denmark

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

France

Arizona 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

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

Germany


Analog Product Sales
Lochamer Strasse 13
D-82152 Martinsried, Germany
Tel: 49-89-895650-0 Fax: 49-89-895650-22

Italy

Arizona 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

All rights reserved. © 2001 Microchip Technology Incorporated. Printed in the USA. 1/01  Printed on recycled paper.

01/09/01

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, except as maybe explicitly expressed herein, under any intellectual property rights. The Microchip logo and name are registered trademarks of Microchip Technology Inc. in the U.S.A. and other countries. All rights reserved. All other trademarks mentioned herein are the property of their respective companies.